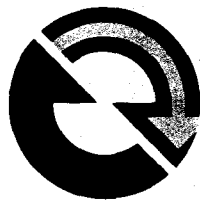


**Allison**

**Transmissions**

**5600-5800 Series  
Service Manual**



**Detroit Diesel  
Allison**

## **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 MODELS

CT, CBT 5640, 5840, 5860

CLT, CLBT 5640, 5660, 5840, 5860

CLBT 5865

VCLT 5860

VCLBT 5860

REVISED 1 DECEMBER 1975



**Detroit Diesel Allison**

Division of General Motors Corporation  
Indianapolis, Indiana 46206

**NOTE:**

*Additional copies of this service manual may be purchased from Detroit Diesel Allison Distributors. See your yellow pages—under Engines, Diesel.*

## FOREWORD

This manual contains a supplement for transmissions equipped with an electrically controlled valve body. The supplement, located at the back of this manual, consists of Sections 1 through 5 and contains the service and test procedures for the electric-shift control system. The basic manual consists of Sections 1 through 8 and contains complete service information for the 5600 and 5800 Series transmissions equipped with a mechanically controlled valve body.

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## FOLDOUTS

### Cross-Section Views

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## SUPPLEMENT

- Electric Valve Body
- Control Systems ..... (back of manual)

## Section 1. GENERAL INFORMATION

### 1-1. SCOPE, ARRANGEMENT OF MANUAL

**a. Models Covered.** This Service Manual covers the 5640, 5660, 5840 and 5860 model transmissions (fig. 1-1 through 1-4). The 5640 and 5660 series are designed for heavy-duty operation with engines up to 350 horsepower. The 5840 and 5860 series transmissions are designed for heavy-duty operation with engines up to 475 horsepower. The various features and options, such as the hydraulic retarder, power takeoff and others are also included and are discussed in paragraph 1-5, below.

**b. Section Content.** Arrangement is as follows. Section 1 contains general information; Section 2 describes the transmission and its function; Section 3 covers maintenance instruction; Section 4 lists information required for general overhaul of the transmission; Section 5 covers disassembly of the transmission; Section 6 outlines the rebuild of subassemblies; Section 7 covers assembly of the transmission; Section 8 is a tabulation of wear limits and spring information. A supplement (at the back of this manual) contains service information for the electric control systems used with the 5660 and 5860 series transmissions.

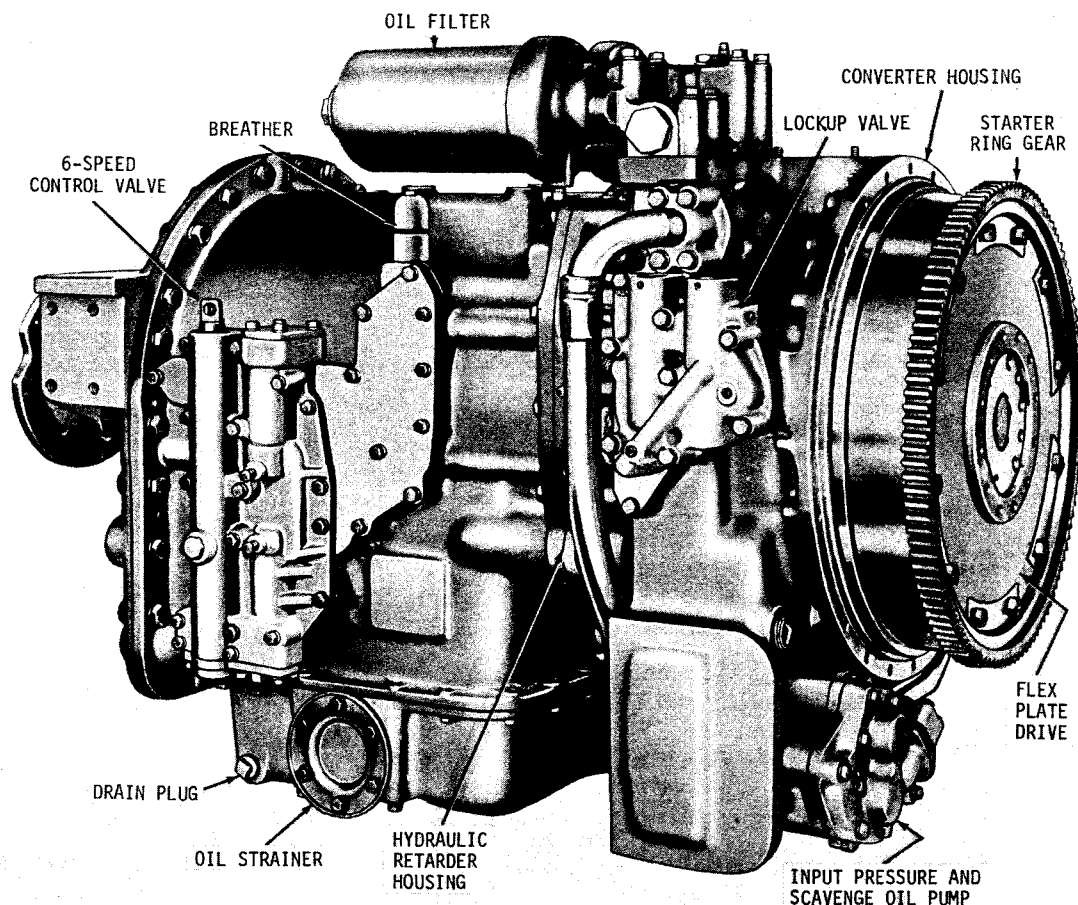
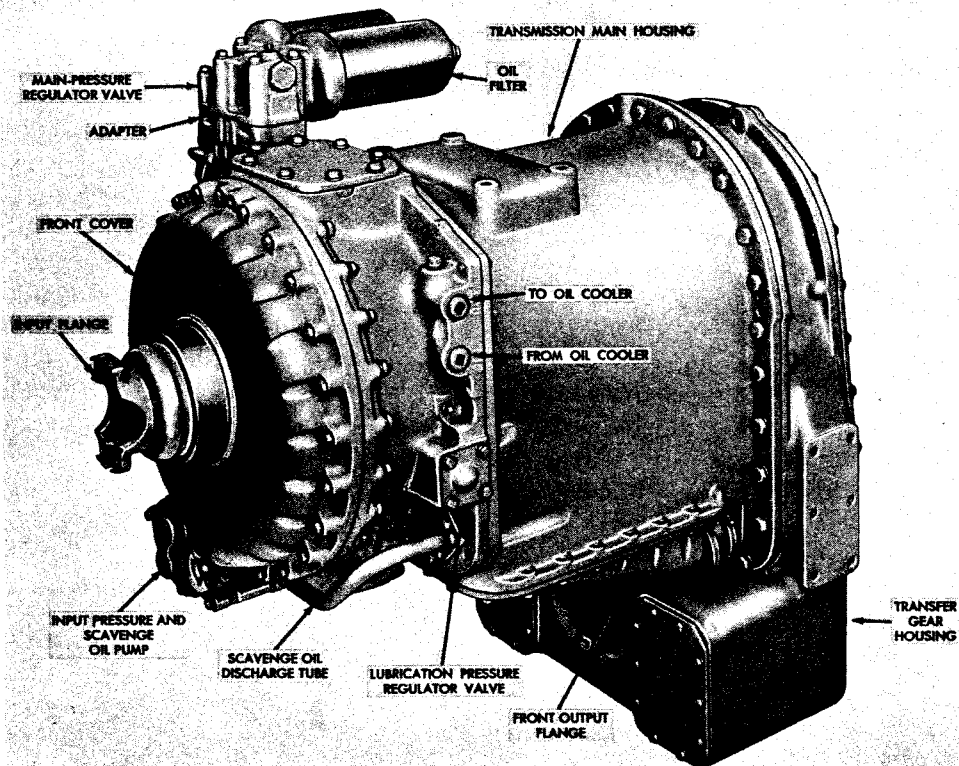


Fig. 1-1. Model CLBT 5660 (or 5860) transmission, direct mount—right-front view

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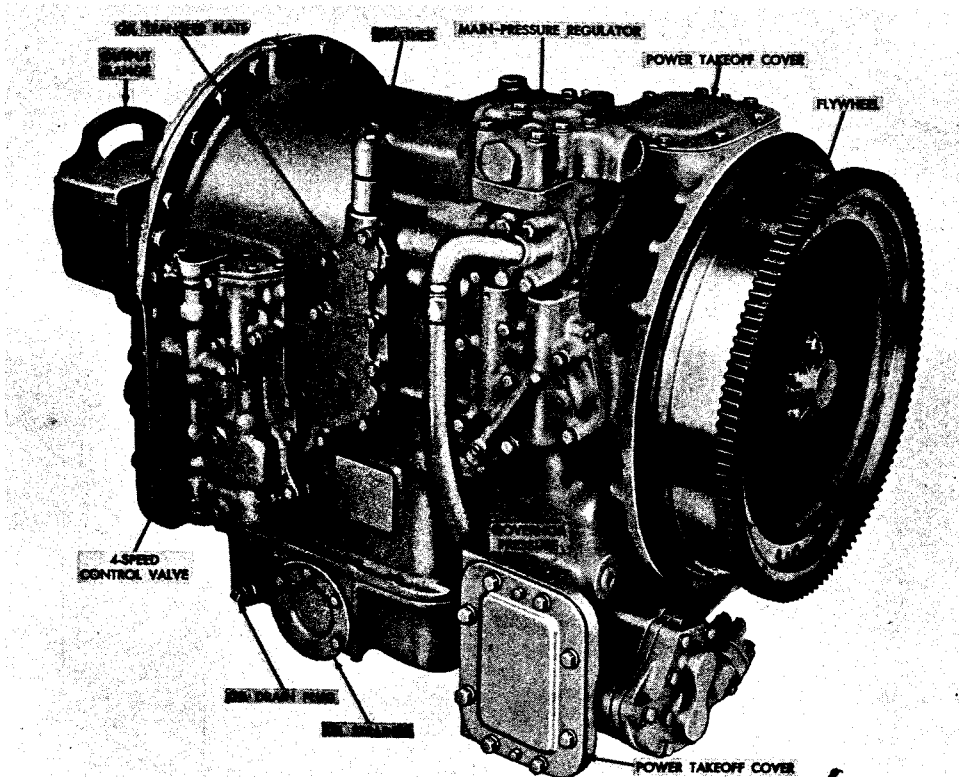
## 5640-5860 TRANSMISSIONS

Para 1-1



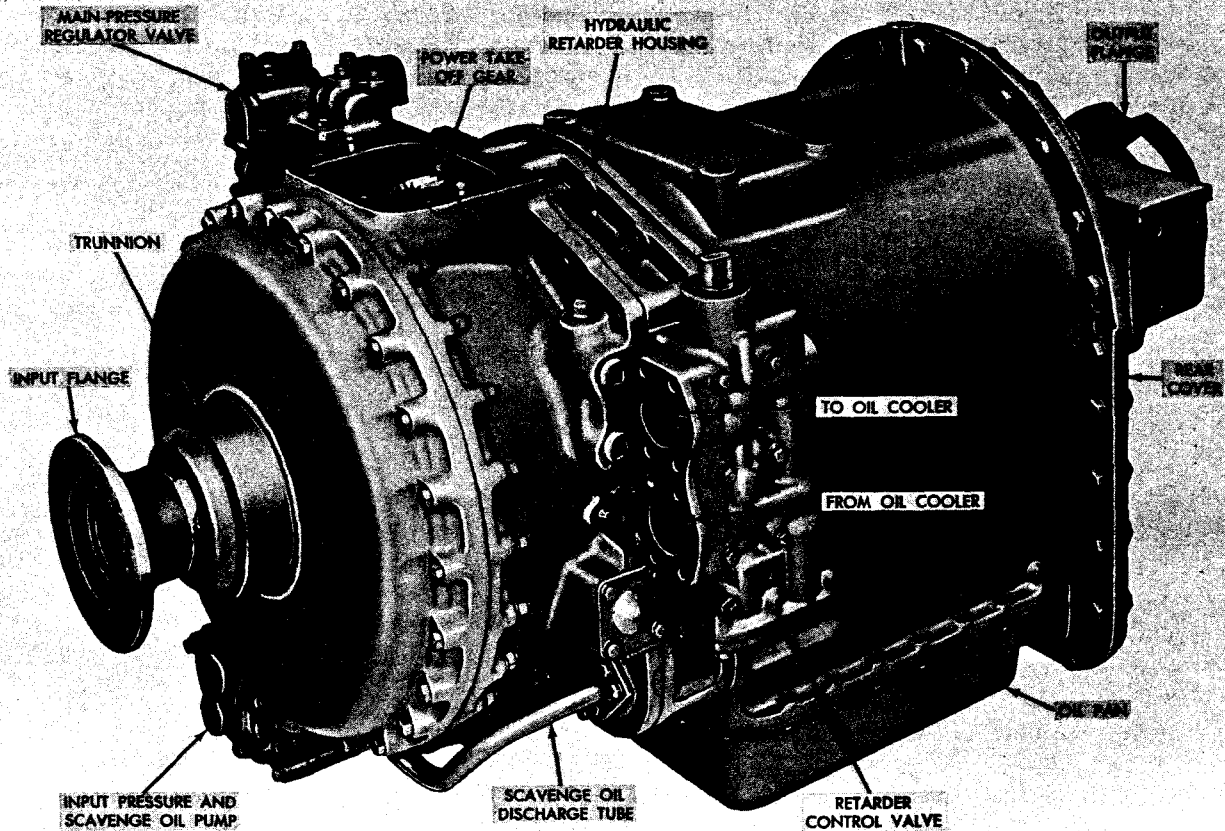
S1510

Fig. 1-2. Model CLT 5660 (or 5860) transmission, remote mount and transfer housing—left-front view



S1511

Fig. 1-3. Model CLT 5640 (or 5840) transmission, direct mount—right-front view



S1512

Fig. 1-4. Model CLBT 5640 (or 5840) transmission, remote mount—left-front view

c. **Illustrations.** Illustrations include photographs, line drawings, cross sections, and exploded views. Transmission features and overhaul procedures are illustrated mainly by photographs. Line drawings illustrate special tools and the hydraulic system. Cross sections show transmission construction and illustrate the torque paths through the transmission. Exploded views show, in detail, the relationship of all parts.

d. **Foldouts.** Cross sections, hydraulic schematic, and a series of parts exploded views are in foldouts at the back of the manual and supplement. These can be opened and used simultaneously for reference with any section of the manual.

e. **How Instructions Apply to Specific Models.** Because of basic similarities of all models covered, instructions apply generally to all models. Where procedures vary between models, notes within the basic instructions identify procedures with specific models.

## 1-2. SUPPLEMENTARY INFORMATION TO BE ISSUED

When new models and/or assemblies are introduced, which have features not covered in this Service Manual, supplementary information will be issued. Contact your dealer or distributor for latest service information. Such inquiries should include model, assembly number, and serial number from the transmission nameplate (refer to paragraph 1-3, below).

## 1-3. MODEL DESIGNATION

a. **Meaning of Letters, Numbers.** Each letter and number in the model designation (refer to fig. 1-5) of the transmission has a particular meaning in describing the transmission, as follows:

- V—Variable capacity (Converter)
- C—Converter
- L—Lockup clutch

## Para 1-3/1-5

- B—Hydraulic retarder
- T—Transmission
- 5—Type of converter (Series 500)
- 6 or 8—Transmission capacity (350 or 475 ghp)
- 4 or 6—Number of forward speeds
- 0—Model change

b. **Assembly Number Suffix.** Certain transmission assemblies may have letters following the transmission assembly number. These letters indicate changes made after the original build of the assembly and are as follows:

- S — Conversion from 4-speed to split-range control valve body
- SS— Conversion from 4-speed to 6-speed control valve body
- V — Conversion to wide-spaced rear output shaft bearings (below S/N 20549).

**NOTE**

Service information for the split-range valve body is not covered in this Service Manual. Refer to 5640-5840 series (split-range valve body) Supplement, publication number SA 1112.

**1-4. ORDERING PARTS**

a. **See Nameplate.** Because of the difference in models and the various options and arrangements of optional equipment, each transmission has a part number (assembly number), serial number and model number. When ordering parts, always include these numbers (see transmission nameplate, fig. 1-5) in addition to the part numbers of the repair parts needed.

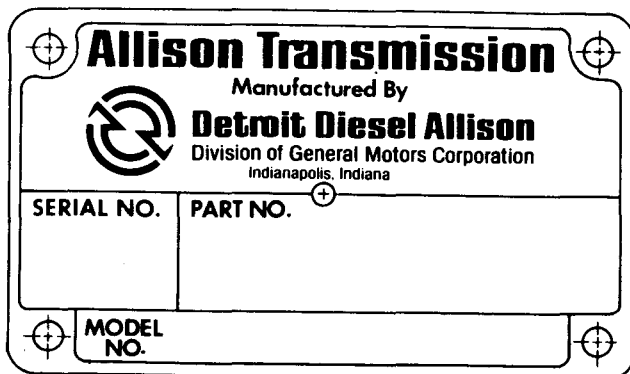


Fig. 1-5. Transmission nameplate

b. **Refer to Catalog.** Refer to the current issue of Series 5640, 5660, 5840 and 5860 Parts Catalog (SA 1077) when ordering parts. Do not use exploded view reference numbers in this Service Manual when ordering parts.

c. **Address Your Dealer.** All parts orders and requests for information should be directed to your dealer. Refer to paragraph 4-5.

**1-5. CONSTRUCTION FEATURES AND OPTIONS**

a. **Basic Unit.** The CT version of each transmission model, with direct-mount and straight-through output (output drive in line with input) is the basic unit. The 5640 and 5840 transmissions have 4 forward speeds and reverse (2 reverse speeds prior to transmission S/N 23851). Speeds are manually selected. The basic features of the 5660 and 5860 transmissions are the same except they are equipped with a 6-speed control valve body providing 6 forward speeds and 1 reverse speed.

b. **Packaged Design.** The Torqmatic converter, planetary gearing, clutches, hydraulic retarder, oil supply and hydraulic control system all are contained in one compact package. This arrangement saves space, provides strength and longer life, simplifies mounting and requires less maintenance.

**c. Torque Converter**

(1) Three types of torque converters all of which are shown in a composite picture (fig. 1-6). The types are as follows:

- (a) 4-element (fixed capacity)
- (b) 3-element (fixed capacity)
- (c) 3-element (variable capacity)

(2) The 4-element converter is a single-stage, polyphase, unit, consisting of a converter pump, first and second stator, and turbine (fig. 1-6).

(3) The 3-element converter is the same as in (2), above, except it includes only one stator (fig. 1-6).

(4) The variable-capacity converter is the same as in (2), above, except for a single stator with piston controlled vanes (fig. 1-6).

d. **Planetary Gearing.** The planetary gear train consists of four constant mesh, straight spur gear planetary sets. The forward set is called the

splitter planetary. The three rear planetary sets are intermediate, low and reverse ranges. From these planetaries, in combination with six clutches (e, below), the 5660 and 5860 transmissions provide 6 speeds forward and 1 reverse. The 5640 and 5840 transmissions provide 4 speeds forward and reverse (2 reverse speeds prior to transmission S/N 23851). The number of speed ranges is determined by the control valve used.

**e. Range Clutches.** Six multiplate friction clutches direct torque through the transmission in accordance with the gear selected by the operator. All clutches are hydraulically applied, spring released, and oil cooled. The friction surfaces are resin-graphite (sintered bronze in earlier models) against polished steel, and normal wear is automatically compensated.

**f. Lockup Clutch (CLT, CLBT models).** A lockup clutch is available on all 5640, 5660, 5840 and 5860 transmission models. The clutch consists

of a single friction clutch plate, hydraulically engaged and released at predetermined vehicle output speeds. The lockup clutch provides a mechanical 1:1 drive ratio from the engine directly to the transmission gearing. Refer to C, foldout 5.

**g. Hydraulic System.** A single, integral hydraulic system serves the converter, the transmission, and the retarder. Oil for all hydraulic operations comes from the same sump and is supplied by the same pumps. The rear oil pump (not included in all assemblies), although helping to supply oil for all other functions, primarily supplies the oil required when push or tow starting the vehicle. Refer to paragraphs 2-11 through 2-30 for a complete explanation of the hydraulic system. Refer to foldouts 3 and 4.

**h. Four-Speed Control Valve Body (5640, 5840 models).** This valve body is indicated in the model designation by the third digit (4) in model

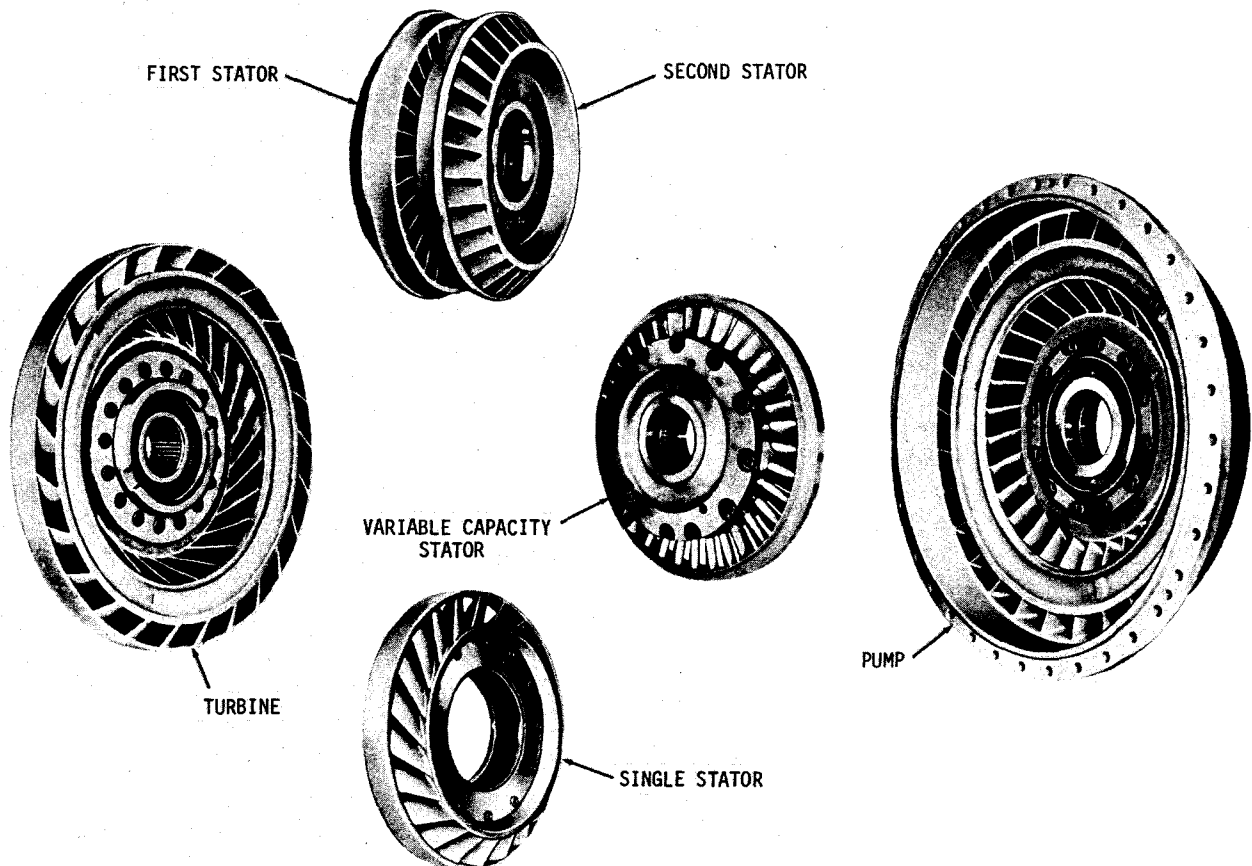


Fig. 1-6. Three- and four-element torque converter elements

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## Para 1-5/1-6

designations, such as CLBT 5640 or CLBT 5840. The valve body provides 4 speeds forward and 1 in reverse (2 reverse speeds prior to transmission S/N 23851). Refer to specifications and data (paragraph 1-7, below).

**i. Six-Speed Valve Body (5660, 5860 models).** This valve body may be mechanically or electrically actuated to provide 6 forward speeds and 1 reverse speed. The driving speed is manually or automatically selected, wherein the control valve body hydraulically applies the clutches necessary for operation in the speed selected.

**j. Remote Mounting.** A remote-type input is available for all transmission models. An input flange is provided on remote-mounted installations. Refer to A and B, foldout 5.

**k. Hydraulic Retarder (CBT, CLBT models).** The hydraulic retarder is a device which, when charged with oil, helps to check the speed of the vehicle. The retarder allows continuous downhill retarding in any forward range. The maximum retarding force (absorption capacity) developed by the retarder is 1500 pound feet torque (1200 pound feet — earlier models) at 2100 rotor rpm. Refer to A, foldout 11.

**l. Transfer Gears.** Two types of transfer gear housings are available, each having a drive gear ratio of 1:1. The dropbox transfer gear housing (refer to B, foldout 18) has the output drive 18-1/2 inches lower than the transmission input centerline. The transmission oil sump is integral with the dropbox housing. The angular transfer gear housing (refer to A, foldout 19) has the output drive 5-1/4 inches below, and 17-3/4 inches to the left (viewing from output end), of the transmission input drive centerline. The transmission oil sump for the angular transfer housing is separate from the housing, located on the transmission proper. Each gear housing has output locations at both the front and rear; however, both are not always fitted with output flanges.

**m. Parking Brake.** A 12 x 5-inch, drum-type parking brake is available for all transmission models. The parking brake is used only on straight-through models and the rear output on transfer gear model transmissions.

**n. Speedometer Drive.** An SAE, heavy-duty speedometer drive is available on all models. The speedometer drives on the straight-through and angular transfer gear model transmissions rotate at half transmission output speed, while on the vertical transfer gear (dropbox) transmission, the

speedometer drive rotates at transmission output speed. Refer to A, foldout 17; B, foldout 18; and A, foldout 19.

**o. Power Takeoff.** Each model may be equipped with a heavy-duty, SAE power takeoff at either the top or lower right side of the converter housing (viewed from the output end of the transmission). Refer to figure 1-3. The top takeoff operates at a ratio of 1.21 x engine speed, while the side is 1.00 x engine speed. Refer to item 7 (B, foldout 7) and item 3 (A, foldout 8).

**p. Converter Lockup Control (CLT, CLBT models).** Optional lockup control valve bodies are available on all CLT and CLBT model transmissions. These valve bodies permit automatic lockup to occur in all gears and neutral, or all gears and neutral except first and reverse (5660, 5860), or all gears except first, reverse and neutral (5640, 5840). Refer to figure 3-8.

**q. Control Valve.** Four optional control valves have been supplied for the 5000 series transmissions. The first two were a "split-range" valve body and an early type manual-electric valve body. These are obsolete assemblies, and information is available only from Detroit Diesel Allison Transmission Service Department. Third, is the present manual-electric valve body. Fourth, is the automatic-electric valve body. Service information for these two valve bodies is found in the supplement at the back of this manual.

**r. Input and Output Flanges.** Transmissions may be equipped with Spicer or Mechanics flanges at the input and/or output locations of all models.

**s. Electric-Shift Control Systems.** Two electric-shift control systems are available — automatic electric and manual electric. The automatic-electric system automatically selects the gear ratio for the most efficient operation of the vehicle; the manual-electric system allows the operator to select the desired ratio. For additional information, refer to the supplement at the back of this manual.

## 1-6. DRIVING INSTRUCTIONS

## CAUTION

Shift the transmission to neutral before starting the engine, or when the vehicle is parked and the engine is running. Also, when vehicle is moving in either forward or reverse direction, stop the vehicle and release the throttle before shifting to the opposite direction.

## GENERAL INFORMATION

### Para 1-6/1-7

a. **Tips.** These transmissions are designed for full-power shifting. It is possible to upshift or downshift the transmission at full-throttle, regardless of load. However, a downshift must not be made if the vehicle speed exceeds the maximum speed attainable in the next lower gear. Downshifting at excessive speeds will overspeed the transmission, engine, and power train components. To move the vehicle, idle the engine and shift the manual selector control to the speed desired and depress the accelerator. All upshifts should be made with the accelerator depressed.

#### NOTE

For operating characteristics of the electric-shift control systems, refer to the supplement at the back of this manual.

#### b. Temperatures, Pressures

(1) Watch for any deviation from normal readings. If the converter-out oil temperature exceeds 250°F, under normal operating conditions, stop the vehicle immediately and determine the cause. If no external cause is visible, shift the transmission to neutral and run the engine at 1000 to 1200 rpm. The temperature should drop rapidly to the engine water temperature in 2 or 3 minutes. If the temperature does not drop, trouble is indicated. The cause of the trouble should be determined before further operation of the vehicle. Refer to the trouble-shooting chart at the end of Section 3. Refer to specifications and data (paragraph 1-7, below) for normal pressure limits.

(2) If operating under load on an up-grade, and the converter-out oil temperature rises above 250°F, downshift the transmission. If the high temperature persists, operate the vehicle in the lower gear until the transmission can be checked.

c. **Hydraulic Retarder Operation.** The hydraulic retarder may be applied, and will function in any gear. Shifting (up or down) is now acceptable while the hydraulic retarder is applied, when necessary. No adverse effect on transmission life

will be experienced by downshifting with the retarder applied, provided the transmission is **out of lockup**.

#### IMPORTANT

When in lockup, even with non-retarder model transmission, downshifting should not be practiced **under any condition**, due to the overspeed effect on engine and drive-line components.

Upshifting, if required, can be accomplished during lockup operation with the retarder applied.

#### d. Tow, Push Starts

##### NOTE

Not all transmissions are equipped with a rear (output) pump. Push or tow starting cannot be accomplished when there is no rear pump.

(1) To tow or push start the vehicle, shift the manual selector control to neutral. Then tow or push the vehicle until main pressure is obtained. Shift to first or second gear and continue towing or pushing the vehicle until sufficient speed is attained to start the vehicle.

##### CAUTION

During tow or push starting, to prevent engine overspeeding, do not exceed the maximum speed of the gear selected.

(2) During the towing or pushing, the rear pump, driven by the output shaft, is supplying the oil necessary to charge the converter and apply the clutches. When the clutches are applied, the transmission output shaft drives the converter turbine. The turbine transmits torque to the converter pump hydraulically, driving the converter pump. The rotation of the pump starts the engine.

### 1-7. SPECIFICATIONS, DATA

The following specifications and data refer to all models of the 5640, 5660, 5840 and 5860 series transmissions unless otherwise specified.

### SPECIFICATIONS, DATA

#### Mounting:

Direct .....

Remote .....

#### Input rating:

Speed .....

Torque .....

Flywheel housing—SAE 1, wet (24-bolt circle);  
2 mounting pads at rear  
Trunnion mounting at front; 2 mounting pads at rear

5640, 5660	5840	5860
2500 rpm max	2500 rpm max	2500 rpm max
850 lb ft max	1000 lb ft max	1195 lb ft max

# 5640-5860 TRANSMISSIONS

Para 1-7

## SPECIFICATIONS, DATA—Continued

HP range:							
Series 5640, 5660	Up to 350 hp						
Series 5840	Up to 400 hp						
Series 5860	Up to 475 hp						
Rotation (viewed from input end):							
Input	Clockwise						
Output	Clockwise						
Torqmatic converter:		TC 500 series, single-stage, polyphase, 3-element or 4-element					
		5640, 5660 and 5840, 5860 Stall torque ratios					
Model	530 540 550 560 570 580 590						
Ratios (4-element)	3.5 2.7 3.4 2.5 3.1 2.7 2.5						
Ratios (3-element)	3.5 2.9 3.7 2.7 3.1 2.6 2.5						
		VTC 500 Series, 3-element					
		VTC 550		VTC 570			
Ratios	Open	3.3		2.2			
	Closed	3.3		2.1			
Gear data:							
Range gearing	Constant mesh planetary						
Transfer gearing	Constant mesh in-line						
Gears	Straight spur-type						
Gear ratio:		Range	Six speed	Four speed			
		1st	4.00:1	4.00:1			
		2nd	2.68:1	2.01:1			
		3rd	2.01:1	1.00:1			
		4th	1.35:1	0.67:1			
		5th	1.00:1				
		6th	0.67:1				
		Reverse (or reverse 1*)	5.12:1	5.12:1			
		Reverse 2		3.44:1*			
		Transfer gear	1.00:1	1.00:1			
Clutches:							
Type	Multidisk, hydraulic-actuated, spring-released, oil-cooled, automatic compensation for wear						
Material	Friction plates—resin graphite on steel; reaction plates—polished steel						
Sump	Integral on both straight-through and transfer gear housing models						
Pumps:							
Input pressure and scavenge	Positive displacement, spur gear type						
Output (rear)	Positive displacement, internal-external gear type						

\*Not applicable after transmission S/N 23850

## SPECIFICATIONS, DATA—Continued

Oil capacity:			
Straight-through models .....	Approx 18 1/2 gal, plus cooling circuit		
Transfer gear models .....	Approx 13 gal, plus cooling circuit		
Oil filter .....	Two parallel, full-flow, cartridge-type mounted on transmission (remote-mount optional)		
Oil type:			
Above -10°F .....	Hydraulic transmission fluid type C-2		
Below -10°F .....	Hydraulic transmission fluid type C-2 (Auxiliary preheat required to raise temperature in sump and external circuit)		
Converter-out oil pressure .....	30 to 65 psi at full throttle normal operating speed		
Lubrication pressure (CLT models only):			
Output stalled .....	20 psi min at 1500 rpm input		
Normal operating speed .....	30 psi max at full throttle		
Main pressure (min and max psi values at 180 to 200°F operating temperature, 1500 rpm input, output stalled):			<b>AFTER S/N 38793</b>
First gear and reverse .....	5640, 5840	5660, 5860	5660, 5860
Second through fourth gears .....	170 to 230	170 to 230	170 to 185
Second through sixth gears .....	140 to 185	140 to 185	170 to 185
Lockup, splitter and range clutch pressures .....	Same as main pressure		
Converter-out temperature .....	250°F max		
Parking brake .....	12 x 5 drum-type		
Flanges:			
Mechanics .....	Input (remote)—7C or 8C; output—8C or 9C		
Spicer .....	Input (remote)—1650, 1700 or 1800; output—1800 or 1850		
Speedometer drive:			
Type .....	SAE heavy-duty, regular		
Ratio to output .....	Straight-through models—0.50:1; transfer gear housing models—1.00:1		
Controls:			
Range shift .....	Manual and electric**		
Hydraulic retarder .....	Manual		
Weight (dry) .....	Approx 2600 lb (lockup clutch and hydraulic retarder included) depending on options		
Hydraulic retarder absorption capacity (CBT and CLBT models) .....	1500 lb ft torque at 2100 rpm (earlier models — 1200 lb ft) <sup>†</sup>		
Power takeoff mounting (optional top or right side mounting, viewed from output end) ....	SAE, heavy duty		
Power takeoff gear backlash .....	Follow the recommendation of the PTO manufacturer; in the absence of recommendation, backlash should be 0.005 min to 0.025 max		

\*\* Specifications and data for the electric shift control systems are presented in the supplement at the back of this manual.

<sup>†</sup> A kit containing the necessary parts and rework information is available to increase the capacity of the earlier models to equal the capacity of the later models. Refer to the Parts Catalog for kit identification.

## Section 2. DESCRIPTION AND OPERATION

### 2-1. SCOPE OF SECTION 2

This section describes and explains the function of transmission components. It includes a full description of the hydraulic system and explains hydraulic action. Torque paths through the transmission are illustrated.

#### NOTE

The hydraulic schematic diagrams, in color, are on foldouts 3 and 4 at the back of this manual. Fold them out to follow the layout as the text is read.

### 2-2. TRANSMISSION—GENERAL DESCRIPTION

The 5640, 5660, 5840 and 5860 series transmissions are hydraulic-operated, torque converter transmissions with planetary gearing. For cross-section views, refer to foldouts 1 and 2 at the back of this manual. The combination of torque converter and planetary gearing makes available infinitely variable torque ratios, within the design limits of the transmission.

### 2-3. MOUNTING, INPUT DRIVE

a. **Engine Mount** (foldout 1). The transmission is mounted directly to the engine through laminated steel flexible disks 1 bolted to flywheel 3. The flex disk drive is connected to the engine crankshaft flange by bolts. The front flange of converter housing 34 bolts to the engine flywheel housing. The rear of the transmission is supported at side mounting pads, each having four (six in transfer case models) 5/8-11 tapped holes.

b. **Remote Mount** (foldout 2). The front of the transmission is supported at the trunnion on converter housing front cover 2. Input shaft 38 is bolted to converter drive cover 3 and extends through the converter housing front cover. Input flange 1 is splined to the shaft. The transmission is coupled to the engine through a drive shaft and universal joints. The rear of the transmission is supported at side mounting pads, each having four (six in transfer case models) 5/8-11 tapped holes.

### 2-4. TORQUE CONVERTER, LOCKUP CLUTCH

#### a. Three Types of Converters

(1) Earlier transmissions used a fixed-capacity, 4-element converter. Later models have either fixed- or variable-capacity, 3-element converters.

(2) Torque converters differ as to torque multiplying capacity. Different vane design provides different ratios within each type. This difference in vane design does not affect service procedures in any way. Because of the difference in ratios, the elements in the two types of converters should not be interchanged.

#### b. Four-Element Converter (fixed capacity)

(1) The 4-element converter consists of a pump 34 (A, foldout 6), turbine 6 or 8, first-stator assembly 12 and second-stator assembly 17.

(2) Pump 34 is the input element and is driven by the engine. Vanes of the pump direct oil against the vanes of turbine 6 or 8.

(3) Turbine 6 or 8 is the output element and is connected directly to the transmission gearing. Oil from converter pump 34, striking the turbine vanes, drives turbine 6 or 8.

(4) Stator assemblies 12 and 17 are the reaction members necessary for torque multiplication. The first stator 12, and second stator 17, redirect the oil flow from the turbine and return it to the pump in the same direction the pump is rotating. As the pump turns faster in relation to the turbine, the velocity of the oil flow within the converter increases and so does torque multiplication. Thus, torque multiplication is greatest when the pump is at full speed and the turbine is stalled.

(5) When the turbine speed approaches pump speed, the stators freewheel in the same direction as the pump and turbine, and the converter functions as a fluid coupling.

## Para 2-4

## c. Three-Element Converter (fixed capacity)

(1) The 3-element converter consists of a pump 34 (A, foldout 6), turbine 6 or 8, and a single stator 4 (B, foldout 6).

(2) Functions of the converter pump and turbine are explained in b(2) and b(3), above.

(3) Torque multiplication is accomplished with a single stator in a 3-element converter. As the reaction member, stator 4 (B, foldout 6) re-directs the oil flow from the turbine to the pump in the same direction the pump is rotating. With increased pump rotation in relation to the turbine, the velocity of the oil flow within the converter increases as does the torque multiplication, which is greatest at turbine stall. When turbine speed approaches pump speed, the stator freewheels in the same direction as the pump and turbine. The torque converter then functions as a fluid coupling.

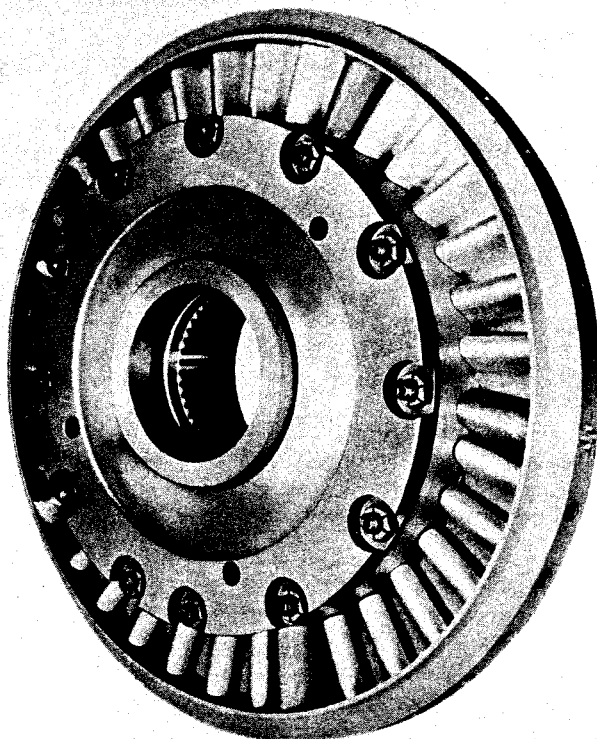
## d. Three-Element Converter (variable capacity) (fig. 2-1)

(1) Components and operation of the fixed-capacity, 3-element converter is the same

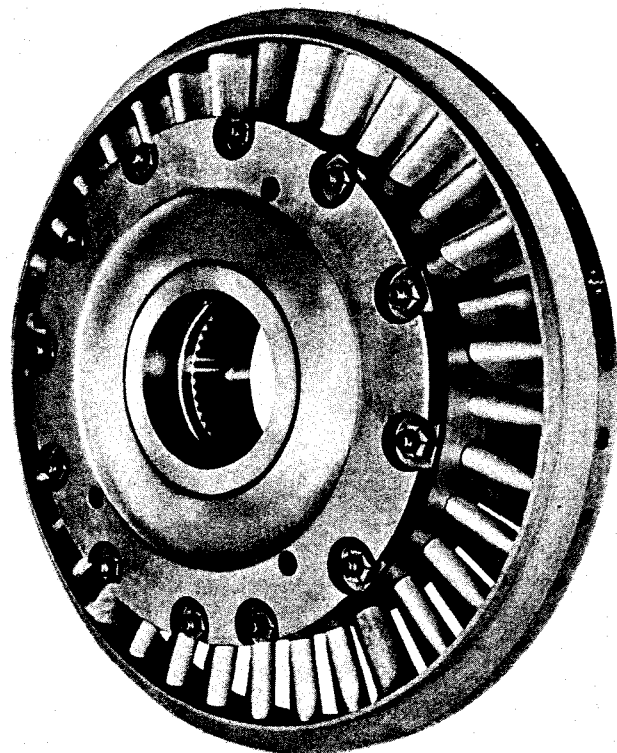
except for the stator. Variable-capacity torque converter stator 6 assembly (A, foldout 7) operates in either the closed or the open position. Stator vanes 12, of the converter are mounted on cranks. The cranks fit in a groove of stator piston 14, which is located in the stator hub. Thus, movement of the piston changes the angle of the stator vanes.

(2) Converter pressure, acting continually against the front of the stator piston, keeps the piston pushed rearward. In this position, the stator vanes are held open and full torque from the engine is directed through the transmission.

(3) When more power is desired at the vehicle-furnished power takeoff (between engine and transmission), a regulated pressure higher than converter pressure is applied to the rear of the stator piston. This pushes the piston forward, rotating the stator vanes to a practically closed position. This action reduces the torque absorbing capacity of the converter, and makes more engine power available for the power takeoff.



VANES CLOSED



VANES OPEN

Fig. 2-1. Variable-capacity converter stator—front view

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## e. Stator Control Valve Assembly (fig. 2-2)

(1) The function of the stator control valve is to control the position of the stator blades. The valve is actuated by a vehicle-furnished air cylinder. When air pressure is directed to the air cylinder, the air cylinder stem moves the spring-loaded ball valve off its seat. Spring pressure at the bottom of the stator control valve pushes the valve upward, allowing transmission main hydraulic pressure to surround the valve stem and flow through a diagonal passage to an area above the largest top land of the valve. The pressure in this area pushes the valve downward and compresses the spring. When hydraulic and spring pressures are in balance, stator control pressure is regulated. The apply circuit directs the regulated pressure to the cavity behind the stator piston, moving the piston forward against its stop, closing the stator vanes.

(2) When the air is exhausted from the air cylinder, the spring-loaded ball valve returns to its seat and closes an exhaust circuit. The oil

flowing through the orifice is then trapped and the resulting pressure increase acts upon the top of the control valve. The valve moves downward against its spring and a stop. In the downward position, apply pressure is blocked at the valve and pressure at the stator piston is exhausted through its apply circuit. Converter pressure returns the piston rearward against its stop. This movement rotates the stator vanes to the open position and full torque from the engine is directed through the transmission.

f. Lockup Clutch (foldout 1). The lockup clutch consists of a single plate of clutch 4 and a piston located in flywheel 3. At high turbine shaft speeds, main oil pressure applies the clutch, locking the converter pump and turbine together. With the pump and turbine locked together, they rotate as a unit, at the same speed as the engine. During converter operation, at low-turbine shaft speeds (low vehicle speeds), oil pressure within the converter releases the clutch. Refer to paragraph 2-16 for explanation of the lockup shift valve.

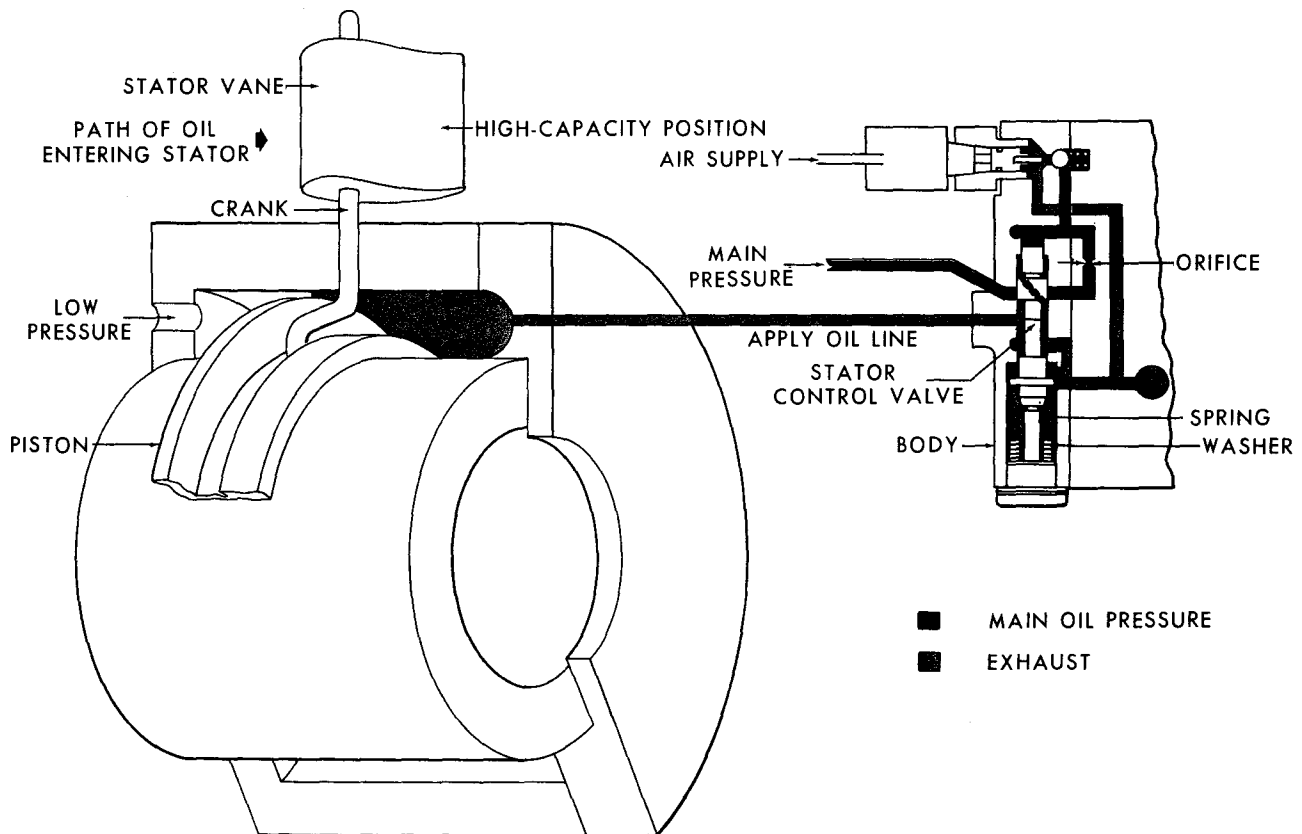


Fig. 2-2. Variable-capacity stator vane angle control—schematic view

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## Para 2-4/2-8

g. **Oil Flow to, from Converter** (foldout 1). Oil from the input-driven pump flows through internal passageways in converter housing 34 and through ground sleeve 31. It then enters the converter elements between stator 6, and converter pump 7. The oil leaves the converter elements between stator 6 and turbine 5, flows inside the ground sleeve along turbine output shaft 40, and out through a passageway in the ground sleeve and converter housing to the oil cooler. From the oil cooler, the oil flows back to the sump.

## 2-5. INPUT DRIVEN PRESSURE, SCAVENGE OIL PUMP

a. A combination oil pressure and scavenge pump 36 and 37 (foldout 1) is located at the lower front of the transmission. It is a conventional gear-type pump, having two separate pairs of gears with a common housing, and driven by a common shaft. The pump is driven by the torque converter pump element through a simple spur gear train of 1 to 1 ratio. This results in the pump always turning at the same speed as the engine. The larger pair of gears comprises input pressure pump 36 and provides oil to the hydraulic circuit under pressure. It draws oil from the sump. The smaller pair of gears comprises scavenge pump 37. The pressure pump provides charging pressure to the converter and cooling flow for the converter and transmission. The pump also supplies oil pressure to the lubrication circuit, and pressure for the hydraulic control of all clutches.

b. The function of scavenge pump 37 is to draw excessive oil from the converter housing, in which the converter and pump gear train operate, and return it to the sump.

## 2-6. REAR OIL PUMP

a. **Earlier Models** (foldout 2). In transmissions prior to S/N 47641, rear oil pump 21, is located at the rear, either in the transfer housing cover or in the output drive housing. The pump is an internal-external gear type. Driven by the transmission output shaft, it supplies oil to the hydraulic circuit at any time the output shaft turns in a forward direction. Its volume is smaller than the volume of the input pump but its flow is channeled to the same circuit through a check valve (foldouts 3 or 4). This check valve prevents loss of oil from the hydraulic circuit during reverse operation. In addition to supplying a portion of the volume of oil to the circuit, it has a different

primary function—that of supplying the system when push-starting of the vehicle is required.

b. **Later Models.** Effective with S/N 47641, the rear oil pump assembly (push-start pump) was eliminated from all 5000 series models. The new output drive housing assembly (which houses the pump) can be used on any 5000 straight-through model, prior to S/N 47641 back to S/N 20549, but the push-start pump is replaced by a spacer and a snapping.

## 2-7. HYDRAULIC RETARDER

a. **Simple Construction** (foldout 1). The hydraulic retarder consists of only one moving part — a rotor 10, which is splined to turbine output shaft 40. The control valve, retarder valve body, and retarder housing 32, make up the other parts. The retarder housing (with cast reaction vanes) encloses the rotor. Refer to paragraph 2-21 for explanation of the hydraulic retarder valve.

b. **Torque Absorption.** When the hydraulic retarder is applied, it absorbs the torque being developed by the driving wheels. This energy is converted to heat in the retarder and harmlessly dissipated through the oil cooler.

## 2-8. PLANETARY GEARING

a. **Ratio and Direction** (foldout 1). The hydraulic transmissions use four planetary gear sets. These gear sets consist of splitter planetary 13, low-range 18, intermediate-range 16 and reverse-range planetary 21. The gear sets are used in combination with six clutches (paragraph 2-9, below) to obtain the desired speed ratios and rotational direction.

### b. Splitter Planetary (foldout 1)

(1) The splitter planetary gear set operates at two speeds (ratios) called low splitter (direct drive, gears locked together by low-splitter clutch 11) and high splitter (overdrive). Torque from the turbine output shaft always goes to the splitter planetary carrier. Low splitter (direct drive) occurs in neutral, first, second, third and reverse (reverse-1 prior to S/N 23851) gears on the 5640, 5840 model transmissions and in neutral, reverse, first, third and fifth on the 5660, 5860 transmissions. High splitter (overdrive) occurs in fourth gear (and reverse 2 prior to S/N 23851) on the 5640, 5840 transmissions and in second, fourth and sixth gears on the 5660 and 5860 model transmissions.



(2) Low-splitter operation occurs when low-splitter (direct drive) clutch 11 (foldout 1) is applied. This causes splitter planetary 13 to rotate as a unit; because one member of the low-splitter clutch is attached to the turbine output shaft, and the other member is attached to the high-splitter planetary sun gear. When any two members of a planetary unit are locked together, that planetary system must rotate as a unit, thus providing direct drive through the planetary. Refer to paragraph 2-31.

(3) High-splitter occurs when high-splitter (overdrive) clutch is applied, holding the splitter planetary sun gear stationary. One member of the high-splitter clutch is attached to the splitter planetary sun gear; the other is "grounded" to the transmission housing. The carrier pinions, rotating around the stationary sun gear, overdrive the ring gear in the same direction the carrier is rotating. This is high-splitter drive to the range gearing (paragraph 2-31d(1)).

**c. Range Planetary Gearing (foldout 1)**

(1) The range planetary gearing consists of three planetaries: low 18, intermediate 16, and reverse 21. Out of these three planetaries, in combination with the splitter planetary, are obtained 6 speeds forward and 1 reverse in the 5660, 5860 model transmissions. A combination, in the 5640, 5840 model transmissions, provides 4 speeds forward and 1 reverse (2 reverse speeds prior to S/N 23851).

(2) The range planetaries are interconnected in such a way that their combined action, or the action of only one, produces the desired ratio, speed and direction of rotation. Combined action is called compound gearing. It eliminates the necessity of separate planetary sets for every gear ratio desired.

(3) Referring to foldout 1, note that retarder rotor 10 and the splitter planetary carrier are both connected to turbine output shaft 40. The splitter ring gear is connected to splitter output shaft 29, which is splined to the intermediate-range sun gear and has an integral low-range sun gear. The intermediate-range planetary carrier is connected with the low-range ring gear. The low-range planetary carrier is connected to the reverse-range sun gear. The transmission output shaft is connected to the reverse-range and low-range carriers. Two clutches (a splitter clutch and a range clutch) must be engaged for engine torque to pass through the transmission to the

output. Paragraph 2-31, below, explains how the various torque paths through the transmission are obtained.

## 2-9. SPLITTER AND RANGE CLUTCHES

**a. Multiplate Clutches (foldout 1).** The splitter and range clutches are all multiplate. They are hydraulic-applied, spring-released, oil-cooled, friction-type clutches. No adjustment is necessary since the design of the clutch permits fully effective operation throughout the life of the clutch plates. The friction plates are steel with faces of resin graphite (sintered bronze on earlier models). The reaction plates are steel.

**b. Actuated by Hydraulic Pressure.** Each clutch is applied by the movement of a piston, actuated by hydraulic pressure. Each clutch is released by springs when the hydraulic pressure is exhausted. In some clutches, the release springs are a series of small, compression-type springs arranged in a circle, and between the clutch and clutch back plate. In others, the clutch piston is moved to release position by a Belleville (disk-type) spring.

## 2-10. FUNCTION OF HYDRAULIC SYSTEM, COMPONENTS

The hydraulic system (foldouts 3 or 4) comprises the valves, pumps, lines, clutch application components, filters, cooler, flow passages and controls. The function of the hydraulic system is to provide and control the oil flow and oil pressure necessary for all hydraulic operations. The following paragraphs describe the components of the hydraulic system. Paragraphs 2-29 and 2-30 explain the operation of the hydraulic system. Refer to foldout 3 or 4 while following the explanation of the hydraulic components and operation. If the transmission is equipped with an electric-shift control system, refer to the supplement at the back of this manual.

## 2-11. OIL FILTER (A, foldout 9; B, foldout 9; A, foldout 10)

**a.** The oil passes through two disposable cartridge-type oil filter elements 20 (A, foldout 9), in parallel. The filters are arranged for full-flow operation, which means that all of the oil flowing in the circuit must pass through them.

**b.** On some filters, a signal switch 19 (A, foldout 9), located in the filter base assembly,

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warns the vehicle operator that the oil filters are becoming clogged. This switch is activated by differential oil pressure in the filter base. When oil pressure going into the filter elements exceeds the pressure coming out by 15 psi, electrical contact is made to a signaling device located in the vehicle operator's compartment.

**2-12. FILTER BYPASS (A, Foldout 9)**

When the filter elements are badly clogged, and the differential oil pressure in the filter base is 20 psi, a filter bypass valve 12 opens and allows the oil to bypass the filter elements.

**2-13. MAIN-PRESSURE REGULATOR VALVE (foldout 3 or 4)**

Main pressure in the hydraulic circuit is regulated by the movement of a spring-loaded, spool-type valve 40 (A, foldout 9), located in main-pressure regulator valve body 41. Its movement opens or closes ports through which the oil may flow. The degree of such openings or closings determines the volume of flow and thereby the pressures. Prior to S/N 30084, pitot pressure acted at the right end of the valve and modulated the main pressure. Function and movement are fully automatic. The pressure is regulated to the required value for various requirements of pressure and flow. Earlier models have a movable regulator plug 36; later models have a plug which cannot move. The movable plug varies the compression of spring 38 and influences main pressure. Refer to paragraph 2-15, below.

**2-14. MANUAL SELECTOR VALVE**

**a. Spool-type Valve.** Manual selector valve 31 (C, foldout 13) or 36 (A, foldout 14) on both the 5640 and 5840, and 5660 and 5860 transmissions is a spool-type valve located in the control valve body at the right side of the transmission. The selector valve is operated manually, through linkage by a control near the operator. Its movement determines the gear in which the vehicle operates. Each gear position, at the operator's control, positions the selector valve and directs oil to the clutches requiring engagement for that particular gear, and exhausts all other clutches. Spring-loaded steel balls locate the selector valve accurately in each shift position and restrain its movement until manually shifted.

**b. 5660, 5860 Models.** This selector valve has eight positions which are manually selected by the operator, providing neutral, 6 forward speeds and 1 reverse speed. Aside from directing oil to the range

clutches, the valve directs oil to the booster signal circuit, neutral and intermediate trimmer valves and, on some models, to the lockup shift valve. The actions of these components are explained in paragraphs 2-15, 2-16, 2-18, 2-23, below. The selector valve is not used with electric-shift control systems.

**c. 5640, 5840 Models.** This selector valve has six positions (seven prior to S/N 23851) which are manually selected by the operator, providing 4 speeds forward and 1 reverse (2 reverse speeds prior to S/N 23851). Aside from directing oil to the range clutches, the valve directs oil to the booster signal circuit, lockup shift valve and the reverse relay valve. The actions of these components are explained in paragraphs 2-15, 2-16, 2-20, below.

**2-15. MAIN-PRESSURE REGULATOR BOOSTER PLUG**

**a. Location Varies.** All 5640, 5660, 5840 and 5860 model transmissions include the main-pressure regulator booster plug. However, the location of it varies with the type oil filter used. In transmissions which use the filter arrangement including signal switch 19 (A, foldout 9), or which use a remote-mounted filter (refer to 4 in B, foldout 8), the booster plug (36 in A, foldout 9; or 13 in B, foldout 8) is located in the main-pressure regulator valve body. In transmissions which have a transmission-mounted oil filter, without the signal switch (refer to 5 in B, foldout 9), booster plug 17 is located in oil filter adapter 11. The type of booster plug used determines the main oil pressure schedule applicable to the transmission.

**b. Earlier Models**

(1) Earlier models have a booster plug which moves lengthwise in its bore (refer to foldouts 3 and 4). This type booster plug is pushed, by booster signal pressure, against the main-pressure regulator valve spring. Thus, main pressure is increased during operation in first gear, neutral and reverse in 5640 and 5840 models, and in first gear and reverse operation of 5660 and 5860 models. This type booster plug is identified by a bore depth of 0.590 or 0.720 inch at the spring end.

(2) Another feature in earlier model hydraulic systems is a check valve connecting the pitot pressure and main pressure oil lines. The function of this valve is explained in paragraph 2-28, below. All transmissions prior to S/N 30084 include this valve.

(3) Both the booster plug and check valve, described in (1) and (2), above, affect the transmission main-pressure schedule, as does another difference in the hydraulic circuit in earlier models (prior to S/N 30084). Prior to removal of the check valve between the pitot and main-pressure lines, pitot pressure was applied to the right end of the main-pressure regulator valve (refer to foldout 3, inset of this area). Pitot pressure exerted a leftward force on the regulator valve, against spring pressure. Thus, main pressure was reduced as pitot pressure increased.

(4) This modulation caused main pressure to decrease as splitter output shaft speed increased. Thus, earlier models had two distinct pressure levels caused by the action of the booster plug and, in addition, modulation of those two levels by the action of pitot pressure against the main-pressure regulator valve.

#### c. Later Models

(1) Later model 5640, 5660, 5840 and 5860 transmissions have a booster plug that is longer and, by reason of its length, cannot move lengthwise in its bore. Thus, booster signal pressure in first gear and reverse (and neutral in 5640, 5840 models) cannot influence main pressure. This booster plug is identified by a bore depth of 0.740 inch at the spring end.

(2) Another feature in later model transmissions which affect main pressure is the elimination of a check valve between the pitot and main-pressure lines (refer to b(2), above).

(3) In addition to the booster plug change, and elimination of the check valve, pitot pressure no longer acts against the right end of the main-pressure regulator valve (refer to b(3) and (4), above).

(4) Thus, with elimination of the features which produced two pressure levels according to the operating gear, and which modulated those pressure levels, along with the establishment of a new pressure range, late model transmissions have a different pressure schedule. Refer to paragraph 3-3 for pressure schedules.

### 2-16. LOCKUP SHIFT VALVE

a. **Function** (foldout 3 or 4). Flow of oil to and from the lockup clutch piston cavity is controlled by the lockup shift valve. The shift valve is a spool-type valve. Movement of the valve in

its bore opens or closes ports and determines whether the lockup clutch is engaged or disengaged. This valve is located in lockup valve body 2 (B, foldout 10).

b. **Controlled Lockup Operation.** Automatic lockup operation occurs as a result of pitot oil pressure acting upon the lockup shift valve at high turbine output speeds. Transmissions are available with lockup operation occurring in all selector positions (refer to foldout 4), or in all positions except first, reverse, and neutral, or all positions except first and reverse. This is accomplished by using different lockup valve bodies. To prevent lockup, booster signal pressure is directed to the end of the lockup shift valve that is normally exhausted (refer to fig. 3-8 and fold-out 3). Booster signal pressure prevents the lockup shift valve from moving to lockup position.

### 2-17. FLOW VALVE

Working in conjunction with the lockup shift valve (paragraph 2-16, above) is the spool-type flow valve, located in the lockup valve body. This valve momentarily interrupts the flow of main pressure to the lockup clutch when shifts occur from one gear to another. When the manual selector valve is moved (except to neutral), a rapid flow of oil is required to engage different clutches. This oil must pass through the flow valve bore. During the initial part of this flow, the valve moves to the left, cutting off main pressure to the lockup clutch and exhausting the lockup clutch line. When the on-coming clutch is filled, the valve returns to the right and restores pressure to the lockup clutch. Thus, full-power shifts are cushioned by the torque converter.

### 2-18. INTERMEDIATE-RANGE TRIMMER VALVE (5660, 5860 MODELS ONLY)

The intermediate-range trimmer valve is located in the same body as the selector valve (A, foldout 14). It consists of a valve 20, plug 17, and three springs 16, 18 and 19 in a common bore. Its function has to do only with the application of the intermediate-range clutch and provides an initial reduction of pressure to that clutch, followed by a rise in pressure to equal main pressure. Thus, the valve provides a smooth and gradual application of the range clutch.

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**2-19. INTERMEDIATE-RANGE CLUTCH ACCUMULATOR VALVE (5640, 5840 MODELS ONLY)**

The intermediate-range clutch accumulator valve (C, foldout 13) consists of a valve 15, spring 16, a plug 19 and a check valve 18. The function of this valve is the same as the trimmer valve explained in paragraph 2-18, above. Only the terminology and the design method used is different, which accomplishes the same result—smooth and gradual application of the intermediate-range clutch.

**2-20. REVERSE RELAY VALVE (5640, 5840 MODELS)**

a. The reverse relay valve (foldout 3) is a spool-type valve fitted to a bore in control valve body assembly 10 (C, foldout 13). Its primary function in transmissions prior to S/N 23851 is to direct oil to the low-splitter clutch during operation in reverse 1, and to the high-splitter clutch during operation in reverse 2. Its secondary function is to direct oil to the low-splitter clutch during operation in first-, second- and third-gear operation.

b. In transmission assemblies prior to S/N 23851, valve 36 (C, foldout 13) could move lengthwise in its bore and function as in a, above. In those transmissions, pin 37 was shorter and was concentric with a spring.

c. In transmissions beginning with S/N 23851, the spring was omitted and pin 37 (C, foldout 13) was made longer. The longer pin prevented valve 36 from moving leftward (foldout 2). When the valve is blocked in its rightward position, pressure cannot reach the high-splitter clutch during reverse operation. Thus, reverse 2 ratio was eliminated from the shift schedule.

**2-21. HYDRAULIC RETARDER VALVE**

a. **Location.** Located at the left-front side of the transmission is the hydraulic retarder valve (B, foldout 11). It is a spool-type valve, mounted in a vertical position. It is connected by linkage with a hand lever or foot pedal operated by the driver of the vehicle. Two types are used—one has the oil cooler openings at the front; the other at the rear.

b. **Function.** The retarder is applied when the valve is pushed downward in the body and released in its upward position (foldouts 3 or 4).

Oil supply for the retarder, having passed through the torque converter to the oil cooler (heat exchanger), is directed to the retarder, when retarder operation is desired. Oil flow from the retarder is directed through the oil cooler (heat exchanger).

**2-22. TORQUE LIMITER VALVE**

The torque limiter valve (used only in earlier models) is incorporated in the retarder valve body (paragraph 2-21, above). This is a spring-loaded bypass valve which opens when pressure in the line carrying oil from the retarder exceeds 50 psi, at which time the oil flows directly to sump (exhaust), bypassing the oil cooler (heat exchanger). The valve limits the amount of oil in the retarder, so that it will not absorb more than 1200 pound feet torque. The torque limiter valve and related components are not required on later models.

**2-23. NEUTRAL TRIMMER VALVE (5660, 5860 MODELS)**

a. The neutral trimmer valve assembly (foldout 4) consists of trimmer valve 37 (A, foldout 14), valve plug 40 and springs 38, 39, and 41 located in a common bore. Its purpose is to reduce clutch apply pressure for a predetermined length of time. The neutral trimmer valve reduces clutch apply pressure momentarily, when shifting from neutral to low or reverse gears, insuring a smooth and positive clutch apply.

b. Main oil pressure is present at the trimmer valve in all selector positions (foldout 4). Neutral signal oil pressure is present at the valve plug in neutral only. Therefore, when a shift is made from neutral, neutral signal oil pressure is exhausted, allowing main pressure to move the trimmer valve and exhaust part of the clutch apply oil to sump. Thus, pressure is reduced for range clutch application.

c. At the same time, clutch apply oil pressure is escaping to sump, it also flows through an orifice in the trimmer valve to the area between the valve and valve plug, moving the plug rightward. The trimmer valve is now hydraulically stable; however, when the trimmer valve plug reaches the stop, the trimmer springs then move the trimmer valve back, closing the exhaust port, allowing pressure to return to maximum. This valve also functions in this manner when shifting from neutral to the other selector positions.

**2-24. PRIMARY-CONVERTER PRESSURE REGULATOR VALVE (RETARDER-EQUIPPED MODELS ONLY)** (foldout 3 or 4)

This valve is an umbrella-type valve located in the retarder housing. The purpose of the valve is to maintain a minimum of 10 psi oil pressure within the torque converter. Maintaining this oil pressure in the converter assures a continuous hydraulic torque transmitting medium between the vehicle engine and transmission output at all times. Since the application of the hydraulic retarder requires a large initial volume of oil, the valve prevents the exhausting of the torque converter to fill the retarder. The valve also prevents oil from the retarder from entering the oil line to the torque converter.

**2-25. SECONDARY-CONVERTER PRESSURE REGULATOR VALVE (RETARDER-EQUIPPED MODELS ONLY)** (foldout 3 or 4)

This valve is an umbrella-type valve located in the retarder valve body. The function of the valve is to provide 22.5 psi oil pressure at the retarder valve. This oil pressure assures rapid filling of the hydraulic retarder housing when a retarder application is made. The valve maintains 22.5 psi in the torque converter when the retarder is not applied.

**2-26. CONVERTER PRESSURE RELIEF VALVE** (foldout 3 or 4)

This valve is an umbrella-type valve located in the transmission housing. The function of this valve is to limit converter-in oil pressure to 80 psi. The valve protects the torque converter from excessive oil pressure, such as during cold starts, by dumping the excess oil directly to sump.

**2-27. LUBRICATION PRESSURE REGULATOR VALVE (CT, CLT MODELS ONLY)** (foldout 4)

This valve is located in the converter housing and is used only in the CT, CLT model transmissions. The valve regulates lubrication pressure at 20 to 25 psi, allowing excess oil to flow to sump. Transmissions that use the primary- and secondary- converter pressure regulator valves (paragraphs 2-24 and 2-25, above) do not use this valve.

**2-28. CHECK VALVES**

**a. Pitot to Main-Pressure Lines** (foldout 3 or 4)

(1) Prior to transmission S/N 30084, all 5640, 5660, 5840, and 5860 transmissions included a check valve connecting the pitot pressure line to the main pressure line. In the same transmissions, the pitot pressure line was connected to the right end of the main-pressure regulator valve (refer to paragraph 2-15b(2), (3) and (4), above).

(2) The purpose of the check valve is to allow pitot pressure to bleed off into the main-pressure line at any time main-pressure falls below pitot pressure. This is necessary to prevent a high pitot pressure from over-modulating main pressure (to a lower pressure) when main pressure is low. Such a condition might arise during use of the hydraulic retarder, or at any time there is a heavy flow demand on the main oil system. Elimination of the pitot pressure connection to the main-pressure regulator valve made the check valve unnecessary.

**b. At Flow Valve** (foldout 3 or 4). All CLT and CLBT transmissions include a check valve with an orifice, located in the lockup valve body. The purpose of this valve is to permit the rapid exhaust of oil from the left end of the flow valve during shifts, and a gradual return (through the orifice) of the oil. Refer to paragraph 2-17, above, for explanation of the flow valve.

**2-29. 5640, 5840 HYDRAULIC SYSTEM IN ACTION**

**a. Neutral Hydraulic Action**

**NOTE**

The hydraulic schematic for the 5640, 5840 transmission is shown in color on foldout 3 at the end of this manual. Fold it out to follow the action as the text is read.

(1) The manual selector valve is in the neutral position, the vehicle engine is idling, and normal operating temperature (180° to 200°F) is indicated. The input oil pump, driven when the engine is operating, picks up oil from the sump and forces it into the hydraulic system.

(2) The oil flows through the transmission oil filters to the main-pressure regulator valve. From the regulator valve, the oil flows to the lock-

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up shift valve and flow valve (CLT and CLBT models). At the lockup shift valve, the oil is stopped at the valve. At the flow valve, oil must flow through an orifice. If the circuit beyond the valve requires oil, the oil moves the valve, bypassing the orifice and flows unrestricted through the valve. Any oil present at the opposite end of the flow valve unseats the check valve, and is forced into the main circuit beyond the flow valve. In CT and CBT models, main pressure flows directly from the main-pressure regulator to the manual selector valve.

(3) Continuing to the manual selector valve, the oil flows into the drilled center passage of the valve.

(4) In neutral, the manual selector valve directs oil to the low-splitter clutch by way of the reverse relay valve, and to the lockup shift valve, (CLT, CLBT models which exclude lockup in neutral, first and reverse) and the main-pressure regulator valve by way of the booster signal line.

(5) As oil pressure increases in the circuit, several actions occur simultaneously. The low-splitter clutch is applied. Pressure equalizes in the main line at both sides of the flow valve and seats the check valve at the flow valve (CLT and CLBT models). Oil begins flowing through the orifice in the check valve. This flow, acting on the larger diameter end of the flow valve, moves the valve in the direction of the smaller diameter end. The valve moves the limit of its travel in that direction. The valve remains in this position until a range shift is made and a volume of oil is required for the filling of another clutch piston cavity for clutch application. Refer to paragraph 2-17, above.

(6) Booster signal pressure, at the main-pressure regulator valve, moves the booster plug (on early model transmissions—see paragraph 2-15, above) against spring pressure and main pressure at the pressure regulator valve. Pressure in the main circuit increases until it balances spring pressure acting against the regulator valve. Oil flowing into a lateral drilled passage of the regulator valve unseats a spring-loaded ball check valve, and flows through a second passage to an area between the valve and the valve body housing. Pressure at this point builds up and moves the main-pressure regulator valve toward the booster signal plug, against spring pressure at the booster plug. When it moves sufficiently to uncover the port that supplies oil to the converter, any oil in excess of main oil line demand will flow to the converter, charging it.

(7) Oil flowing to the torque converter will be limited to a maximum of 80 psi by the converter pressure relief valve. Some models will be limited to a maximum of 65 psi. The lubrication and pitot governor oil is also supplied by means of orifices in the converter-in oil line on hydraulic retarder model transmissions. On non-hydraulic retarder models, the governor and lubrication circuits are supplied from the converter-out oil line. The governor is supplied by an orifice. The lubrication circuit is supplied from the lubrication pressure regulator valve in the oil cooler return line. Oil in excess of 20 to 25 psi at the valve is exhausted to sump.

(8) On hydraulic retarder model transmissions, converter-out oil flows through the primary-converter pressure regulator valve to the oil cooler. From the oil cooler, the oil flows to the secondary-converter pressure regulator valve. At the secondary-regulator valve, any oil in excess of 22.5 psi is exhausted to sump. The secondary valve maintains 22.5 psi oil pressure at the hydraulic retarder valve for the rapid filling of the retarder cavity, when the retarder is operated. Refer to paragraph 2-25, above.

(9) In neutral, there will be a pressure in the pitot tube line proportional to the speed of the governor collector ring which is attached to the low-splitter clutch drum. At idle, this pressure will exert only a negligible force at the right ends of the main-pressure regulator valve (on earlier models—refer to paragraph 2-15b(2), (3) and (4)) and the lockup shift valve (on CLT, CLBT models). When engine speed is increased (on models prior to S/N 30084), pitot pressure increases and reacts against the main-pressure regulator valve, which in turn reduces main pressure (by allowing more oil to escape into the converter oil circuit). Pitot pressure can rise, and main pressure fall, until pitot pressure exceeds main by 0.75 psi. At this point, pitot pressure will escape into the main circuit (at check valve) and afterward, for all practical purposes, main and pitot pressures will remain balanced.

(10) Pitot oil pressure, at the lockup shift valve, has no effect (in transmissions that exclude lockup in neutral, first and reverse) since it is opposed at the other end of the valve by booster signal pressure plus spring pressure. Therefore, lockup cannot occur in neutral. Refer to paragraph 2-16, above.

(11) On transmissions equipped with a lockup valve body that permits lockup operation in first, reverse and neutral, the pitot oil pressure at the lockup shift valve will move the valve. Refer to paragraph 2-16, above. Movement of the valve allows main oil pressure to flow through the flow valve bore to the lockup clutch, applying the clutch. The transmission is now operating in low-splitter lockup.

(12) During operation in lockup in any gear, when a shift is made, either up or down, the transmission automatically comes out of lockup until the shift is made. The lockup clutch again engages after the shift is made, due to the action of the flow valve. Refer to paragraph 2-17, above.

#### **b. First-Gear Hydraulic Action**

(1) In first gear, the hydraulic action is the same as described for neutral (a, above), except as follows: the low-range clutch is applied. All clutch cavities except the low splitter and low range are exhausted to sump.

(2) As in neutral, with an increase in turbine speed, the lockup clutch is applied (CLT, CLBT models) and the transmission is operating in first-gear lockup.

(3) If the special control lockup valve body is being used, lockup will not occur in first gear. Refer to paragraph 2-16.

#### **c. Second-Gear Hydraulic Action.**

(1) In second gear, the hydraulic action is the same as described in neutral (a, above), except as follows: the intermediate-range clutch is applied and the booster signal oil line is not charged. All other clutch cavities are exhausted to sump.

(2) With the absence of booster signal oil at the main-pressure regulator booster plug, main oil pressure is reduced (earlier models). Refer to paragraph 2-15, above.

(3) As in neutral, with an increase in pitot pressure, the lockup clutch is applied (CLT, CLBT models). Thus, the transmission is operating in second-gear lockup.

(4) As in first gear, when operating in lockup, a shift to another gear momentarily disengages the lockup clutch until the shift is made. Refer to paragraph 2-17, above.

(5) When the shift is made to second gear, the intermediate clutch accumulator valve functions. When the shift is made, intermediate clutch apply oil flows to one end of the clutch accumulator plug and, through an orifice of a check valve, to the accumulator valve. Oil pressure at the plug moves it against spring pressure, allowing some of the oil to exhaust to sump. This escape of oil to exhaust reduces the initial apply pressure at the intermediate-range clutch, permitting a gradual clutch application. Oil flow to the accumulator valve is restricted by the orifice. The valve gradually moves against spring pressure, thereby moving the plug and closing the exhaust port at the plug. With the exhaust port closed, clutch pressure rises to maximum. The plug remains in this position while operating in second gear.

(6) When a shift is made from second gear, oil at the accumulator plug is exhausted. Oil at the accumulator valve also exhausts, unseating the check valve, permitting the valve to move to its original position (away from the accumulator plug).

#### **d. Third Gear, Hydraulic Action**

(1) In third gear, hydraulic action is the same as described in neutral (a, above), except the high-range clutch is applied and the booster signal oil line is not charged. As in neutral, the low-splitter clutch is applied. All other clutch cavities are exhausted to sump.

(2) As in neutral, with an increase in pitot pressure, the lockup clutch is applied (CLT, CLBT models). Thus, the transmission is operating in third-gear lockup.

(3) As in all gears, when operating in lockup, a shift to another gear momentarily disengages the lockup clutch until the shift is made. Refer to paragraph 2-17, above.

#### **e. Fourth Gear, Hydraulic Action**

(1) In fourth gear, the high-range clutch and high-splitter clutch are engaged. All other clutch cavities are exhausted to sump. The hydraulic action at the flow valve, lockup shift valve and the remainder of the converter system is the same as described for neutral (a, above).

(2) As in neutral, with an increase in pitot pressure, the lockup clutch is applied (CLT, CLBT models).

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(3) As in all other gears, when a shift is made to another gear during lockup operation, the clutch disengages until the shift has been made, due to the action of the flow valve. Refer to paragraph 2-17, above.

**f. Reverse, Hydraulic Action (effective with S/N 23851)**

(1) In reverse, the hydraulic action is the same as neutral, except the reverse clutch is applied. All other clutch cavities are exhausted to sump.

(2) The booster signal oil line is charged, thus preventing lockup in reverse. Refer to paragraph 2-16, above.

**g. Reverse, Hydraulic Action (prior to S/N 23851)**

(1) Two reverse speeds are provided prior to transmission S/N 23851. Reverse 1 is equivalent to reverse on later transmissions. Reverse 2 is a higher ratio, obtained by engaging the high-splitter and reverse clutches.

(2) Reverse 1 functions as explained in f, above.

(3) Reverse 2 occurs when the manual selector valve directs an R2 signal (foldout 3) to the right end of the reverse relay valve. This moves the valve leftward against a stop pin (shorter in earlier models—see inset). In its leftward position, the relay valve directs pressure (C2 feed) to the high-splitter clutch.

(4) The low-splitter clutch exhausts through the selector valve bore.

## 2-30. MODEL 5660, 5860 HYDRAULIC SYSTEM IN ACTION

### a. Neutral, Hydraulic Action

#### NOTE

The hydraulic schematic for the 5660, 5860 transmission is shown in color on foldout 4 at the end of this manual. Fold it out to follow the action as the text is read. However, if the transmission is equipped with an electric valve body, refer to the supplement at the back of this manual.

(1) The manual selector valve is in the neutral position, vehicle engine idling—normal oil temperature (180° to 200°) indicated. The input oil pump, driven when the engine is operating, picks up oil from the sump and forces it into the hydraulic system.

(2) The oil flows through the transmission oil filters to the main-pressure regulator valve. From the regulator valve, the oil flows to the lockup shift valve and the flow valve (CLT and CLBT models). Oil at the lockup shift valve is stopped at the valve. At the flow valve, oil must flow through an orifice. If the circuit beyond the valve requires oil, then the oil moves the valve, bypassing the orifice and flows unrestricted through the valve bore. When the valve moves, then, any oil at the larger diameter end of the valve will unseat the check valve and enter the main oil circuit beyond the flow valve.

#### NOTE

In CT and CBT models, main-pressure flows directly from the main-pressure regulator to the manual selector valve.

(3) Continuing to the manual selector valve, the oil fills the upper drilled passage of the valve and the lateral passages connected thereto.

(4) In neutral, the manual selector valve directs oil to three places: the neutral trimmer valve (left end), neutral trimmer valve plug (right end) and the low-splitter clutch cavity. Main oil at the trimmer valve flows through the orifice in the trimmer valve to the area between the valve and valve plug.

(5) As oil pressure increases in the circuit, several actions occur simultaneously. The low-splitter clutch is applied. Pressure equalizes in the main line at both sides of the flow valve and seats the check valve at the larger diameter end (CLT and CLBT models). Oil begins flowing through the orifice in the check valve. This flow, acting on the larger diameter end of the flow valve, moves the valve in the direction of the small diameter end. The valve moves the limit of its travel in that direction and remains in that position until a shift is made to another gear, and oil must flow to another clutch piston cavity.

(6) The action of the flow valve, as described in (5), above, occurs every time there is a significant flow past it. However, the flow valve has no purpose except to disengage the lockup clutch when a shift is made. At such time, the movement of the flow valve opens ports which exhaust the lockup clutch apply pressure and shuts off its oil supply. Therefore, the primary purpose of the flow valve is to automatically place the transmission in converter operation during a shift, either up or down.



(7) No action of the neutral trimmer valve or valve plug has occurred as a result of the increase in oil pressure in the main circuit.

(8) When the main oil circuit is charged, pressure builds up until the main-pressure regulator valve moves to regulate the pressure. Oil flows into a lateral drilled passage of the main-pressure regulator valve and into a central passage, unseats a spring-loaded steel ball check valve, and flows out of the valve through a second lateral passage. The point at which oil leaves the valve is between a land on the valve and the valve body. Pressure, building up at this point, moves the regulator valve toward the booster plug against spring pressure. When it moves sufficiently to uncover the port that supplies the converter with oil, all oil in excess of other demands will flow to the converter, charging it. Oil flowing to the converter will be limited to a maximum of 80 psi by the converter pressure relief valve.

(9) On transmissions equipped with a hydraulic retarder, the circuit which supplies oil to the converter also supplies oil, through an orifice, to the lubrication circuit and, through another orifice, to the fluid velocity governor. On non-hydraulic retarder model transmissions, the governor and lubrication circuits are supplied from the converter-out oil line. The governor is supplied through an orifice. The lubrication system is supplied from the lubrication regulator valve in the oil cooler return line. Any oil in excess of 20 to 25 psi at the lubrication valve is exhausted to the sump.

(10) On transmissions equipped with a hydraulic retarder, converter-out oil flows through the primary-converter pressure regulator valve, through the oil cooler to the secondary-converter pressure regulator valve. As stated in paragraph 2-24, above, the primary valve maintains a minimum of 10 psi oil pressure in the torque converter. The secondary-regulator valve maintains 22.5 psi oil pressure for the function of the hydraulic retarder, as mentioned in paragraph 2-25, above.

(11) In neutral, there will be a pressure in the pitot tube line proportional to the speed of the governor collector ring which is attached to the splitter direct clutch housing. At idle, this pressure will exert only a negligible force at the end of the lockup shift valve (and at the right end of the main-pressure regulator valve in transmissions having a modulated main pressure. Refer to paragraph 2-15b(2), (3) and (4), above).

(12) As turbine speed increases, pitot pressure directed to the lockup shift valve increases (CLT, CLBT models). The increase of pitot pressure at the lockup valve moves the valve against spring pressure at the opposite end. Movement of the valve allows main oil pressure to flow to the flow valve, through the flow valve to the lockup clutch, applying the clutch. The transmission is now operating in low-splitter lockup.

(13) During operation in lockup in any gear, when a shift is made, either up or down, the transmission automatically comes out of lockup until the shift is made. Then the clutch again engages after the shift is made, due to the action of the flow valve (paragraph 2-17, above).

#### **b. First Gear, Hydraulic Action**

(1) In first gear, the hydraulic action is the same as described for neutral (a, above) except as follows: the low-range clutch is applied and the booster signal pressure line is charged. The oil in the neutral signal line is exhausted to sump.

(2) On earlier model transmissions, when main oil pressure enters the booster signal line, its action on the main-pressure regulator valve increases the main oil pressure schedule while operating in first range. Refer to paragraph 2-15, above.

(3) When the shift was made from neutral to first gear, the neutral signal line which was charged with main oil pressure was exhausted to sump. The absence of this oil at the neutral trimmer valve plug allows the neutral trimmer valve to function, thus assuring a smooth and gradual application of the low-range clutch. Refer to paragraph 2-23, above.

(4) As in neutral, with an increase in turbine speed, the lockup clutch is applied (CLT, CLBT models) and the transmission is operating in first-gear lockup. Refer to paragraph 2-16b, above.

(5) If the special control lockup valve body is being used, lockup will not occur in first gear. Refer to paragraph 2-16b, above.

#### **c. Second Gear, Hydraulic Action**

(1) In second gear, the hydraulic action is the same as described in neutral (a, above), except as follows: the low-range clutch is applied, the high-splitter clutch is applied and the neutral signal oil line is not charged. All other clutch cavities are exhausted to sump.

## Para 2-30

(2) As in neutral, with an increase in turbine speed, the lockup clutch is applied, allowing the transmission to operate in second-gear lockup.

(3) If a downshift is made from second to first gear, the booster signal line is charged, increasing main oil pressure (on early model transmissions) during first-gear operation. Refer to paragraph 2-15, above. If an upshift is made to third gear, the intermediate-range trimmer valve functions for the application of the intermediate-range clutch. Refer to paragraph 2-18, above. If the transmission is operating in lockup when an upshift or downshift is made, the lockup clutch is momentarily disengaged until the shift is made, due to the action of the flow valve. Refer to paragraph 2-17, above. The low-range clutch is applied when operating in first or second gear. The difference in ratio is obtained by using the low- or high-splitter in combination with the low-range planetary for first or second gear, respectively.

#### d. Third Gear, Hydraulic Action

(1) In third gear, the hydraulic action is the same as described for neutral (a, above), except the intermediate-range clutch is applied and the neutral signal line is exhausted to sump. As in neutral, the low-splitter clutch is applied. All other clutch cavities are exhausted to sump.

(2) When an upshift is made to third gear or a downshift made to fourth gear, the intermediate-range trimmer valve functions for the application of the intermediate-range clutch. Refer to paragraph 2-18, above. The orifice in the intermediate-range clutch apply line prevents the intermediate-range clutch from disengaging quickly. Thus, when a shift is made to a gear other than third or fourth, that range clutch is partially applied before the intermediate-range clutch is fully disengaged, reducing shift shock and maintaining continuous torque output during a shift.

(3) As in neutral, with an increase in pitot pressure, the lockup clutch is applied (CLT, CLBT models). Thus, the transmission is operating in third-gear lockup.

(4) As in first and second gears, when operating in lockup, a shift to another range disengages the lockup clutch, momentarily, until the shift is made. Refer to paragraph 2-17, above.

#### e. Fourth Gear, Hydraulic Action

(1) In fourth gear, the hydraulic action is the same as in neutral (a, above), except as follows: the intermediate-range and high-splitter

clutches are applied and the neutral signal line is exhausted to sump. All other clutch cavities are exhausted to sump.

(2) When a shift is made from third gear to fourth gear, or fourth to third, the only hydraulic action occurring at the selector valve is the directing of oil to the high- or low-splitter clutch. The intermediate-range clutch is applied when operating in either gear.

(3) As in neutral, with an increase in pitot pressure, the lockup clutch is applied (CLT, CLBT models). The transmission is now operating in fourth gear lockup.

#### f. Fifth Gear, Hydraulic Action

(1) In fifth gear, the hydraulic action is the same as neutral (a, above), except as follows: the high-range clutch is applied and the neutral signal line is exhausted to sump. As in neutral, the low-splitter clutch is applied. All other clutch cavities are exhausted to sump.

(2) As in neutral, with an increase in pitot pressure, the lockup clutch is applied (CLT, CLBT models). The transmission is now operating in fifth-gear lockup.

#### g. Sixth Gear, Hydraulic Action

(1) In sixth gear, the hydraulic action is the same as neutral (a, above), except the high-range clutch and high-splitter clutch are applied and the neutral signal line is exhausted to sump. All other clutch cavities are exhausted to sump.

(2) When a shift is made from sixth to fifth gears, or from fifth to sixth gears, the only hydraulic action which occurs at the selector valve is the directing of oil to the high- or low-splitter clutch, since the high-range clutch is engaged when operating in either of these gears.

(3) As in neutral, with an increase in pitot oil pressure, the lockup clutch is applied (CLT, CLBT models). The transmission is now operating in sixth-gear lockup.

#### h. Reverse Gear, Hydraulic Action

(1) In reverse gear, the hydraulic action is the same as in neutral (a, above), except as follows: the reverse clutch is applied, the booster signal line is charged and the neutral signal oil line is exhausted to sump. All other clutch cavities are exhausted to sump.

(2) When the booster signal oil line is charged (on earlier models), the main-pressure regulator valve increases the main oil pressure schedule while operating in reverse. Refer to paragraph 2-15, above.

(3) When the shift was made from neutral to reverse, the neutral signal line which was charged with main oil pressure is exhausted to sump. The absence of this oil at the neutral trimmer valve plug allows the neutral trimmer valve to function, thus assuring a smooth and gradual application of the reverse clutch. Refer to paragraph 2-23, above.

(4) As in neutral (a, above), with an increase in turbine speed, the lockup clutch is applied (CLT, CLBT models). The transmission is now operating in reverse-gear lockup.

(5) If the special control lockup valve body is being used, lockup will not occur in reverse gear. Refer to paragraph 2-16, above.

## 2-31. TORQUE PATHS

### a. Torque Path Diagrams

(1) Figures 2-3 through 2-12 show the paths by which torque is transmitted through the transmission under various conditions. Because 4- and 6-speed manual selector positions do not, in all gears, coincide with the same applied clutch-

es, some torque path diagrams will cover two gear conditions. One of these will apply to 4-speed (5640, 5840) models, and the other to 6-speed (5660, 5860) models. Other diagrams will represent only one of these types because there is no corresponding condition for the other type. Also, some of the diagrams represent identical conditions for both 4- and 6-speed transmissions.

(2) In all the torque path explanations, it is assumed that the engine is operating at a normal driving speed. This assumption is made because torque cannot be transmitted beyond the torque converter at idling speed, even though two driving clutches are engaged. The direction of rotation is determined by viewing the transmission from the front (input) end.

(3) Some of the torque path diagrams show converter operation and others show lockup. Converter operation is applicable to all transmissions in all gears, whether equipped with a lockup clutch or not. Lockup operation is applicable only to those models equipped with a lockup clutch, and in the gears not specifically excepted in the explanation of the lockup shift valve (paragraph 2-16, above).

(4) A better overall understanding of the transmission can be gained if the hydraulic system is reviewed along with study of the torque paths. Refer to paragraphs 2-29 and 2-30, above.

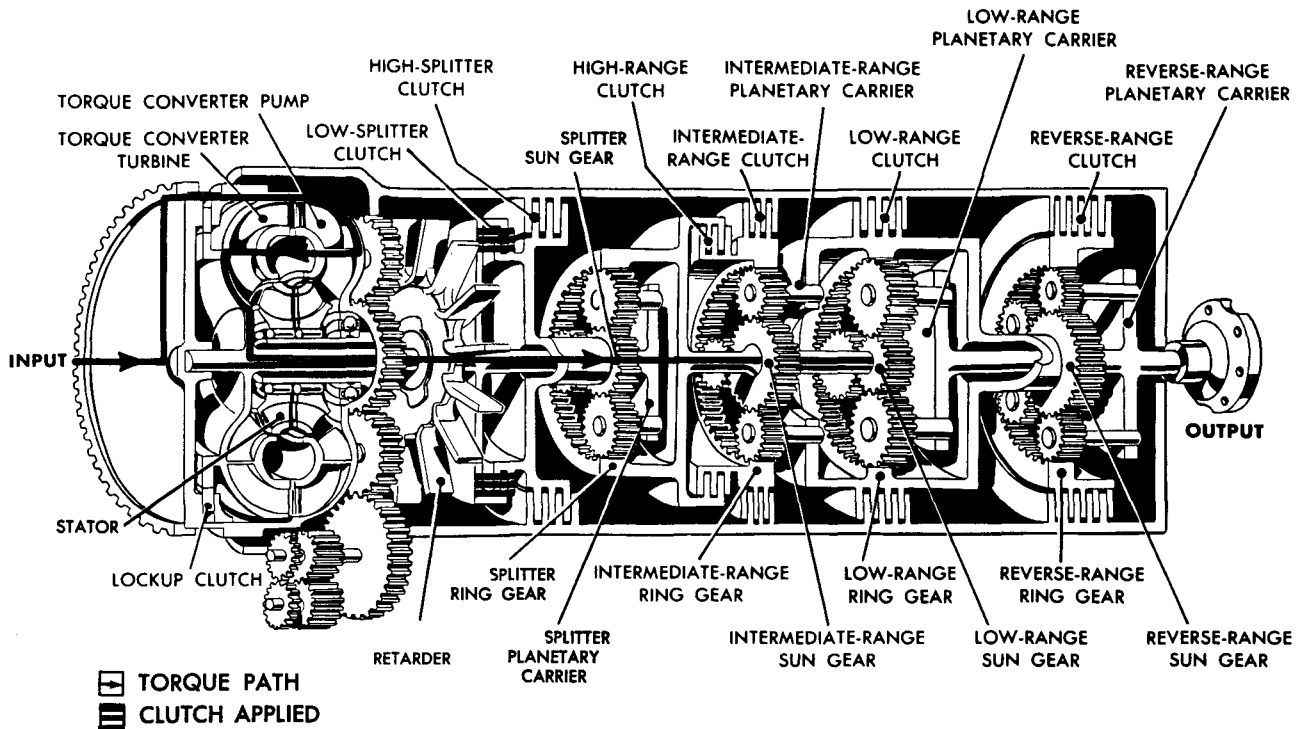


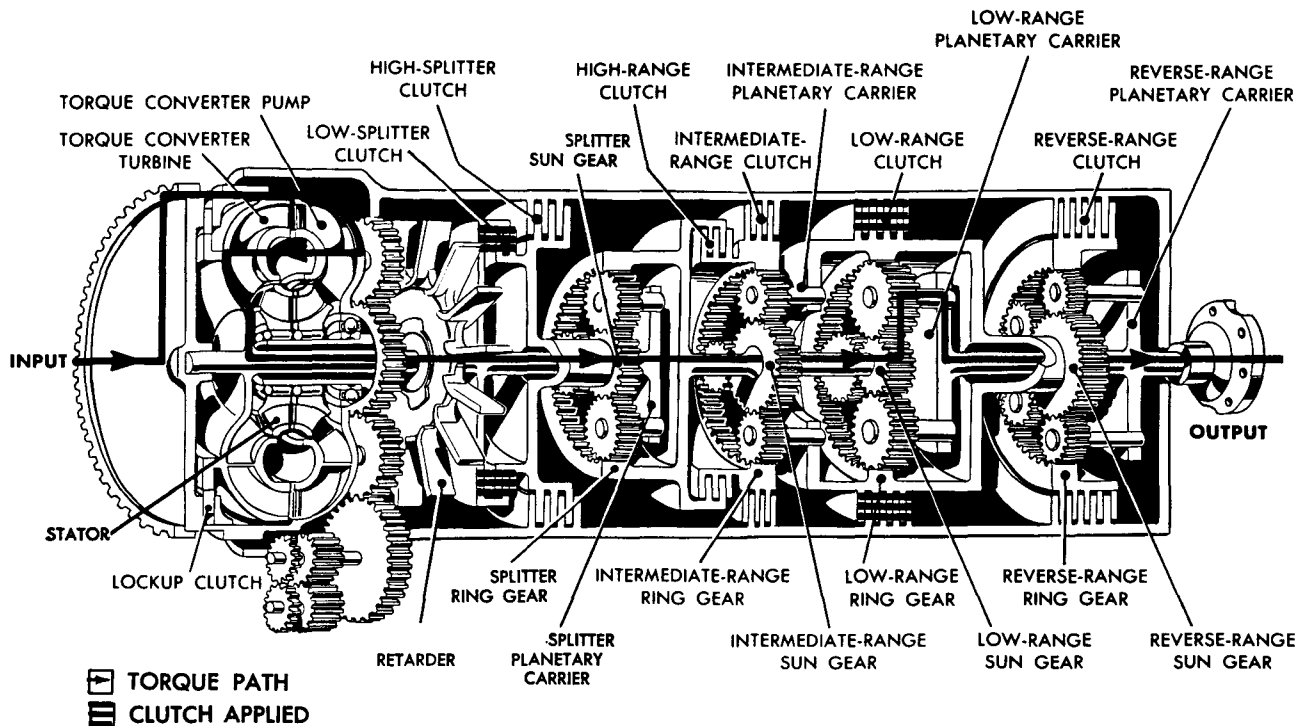
Fig. 2-3. Neutral (all models), low splitter, converter—torque path

S1515

b. Neutral (all models)—Torque Path (fig. 2-3).

(1) The manual selector valve is in neutral (N) position. The torque from the engine passes, by hydraulic action, through the converter to the low-splitter clutch and the splitter planetary carrier. The low-splitter clutch is applied, transmitting torque to the splitter sun gear. All other clutches are released.

(2) With two elements (sun gear and carrier) of the splitter planetary thus locked together, the third member (ring gear) must rotate when the other two rotate. The intermediate- and low-range sun gears are attached to the splitter ring gear and rotate with it. Torque is not transmitted to the transmission output because the other clutches are released and allow free rotation of all range planetary gears.



S1516

Fig. 2-4. First gear (all models), low splitter, low range, converter—torque path

**c. First Gear (all models)—Torque Path (fig. 2-4)**

(1) The manual selector valve is in first-gear (1) position. The torque from the engine passes, by hydraulic action, through the converter to the low-splitter clutch and the splitter planetary carrier. The low-splitter clutch is applied. Thus, rotation and torque is transmitted to the intermediate- and low-range sun gears (refer to b(2), above).

(2) In addition to the low-splitter clutch, the low-range clutch is applied. This holds the low-

range ring gear stationary. The rotating low-range sun gear forces the pinions on the low-range planetary carrier to rotate within the stationary ring gear. Rotation of the pinions causes the carrier to rotate in the same direction as the sun gear. The low-range planetary carrier, being attached to the transmission output shaft, causes it to rotate.

(3) The transmission output shaft rotates in a clockwise direction. A speed reduction ratio of 4.00 to 1 is obtained, entirely within the low-range planetary.

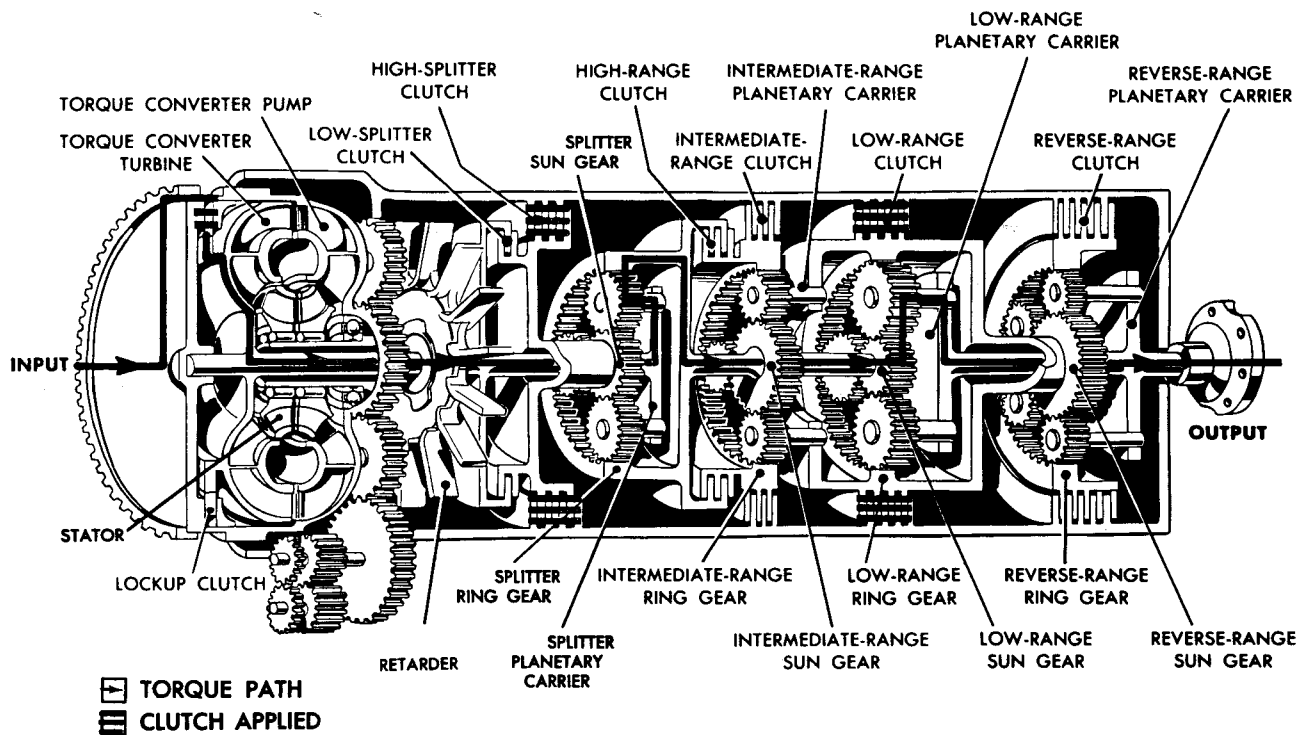


Fig. 2-5. Second gear (5660, 5860), high splitter, low range, lockup—torque path

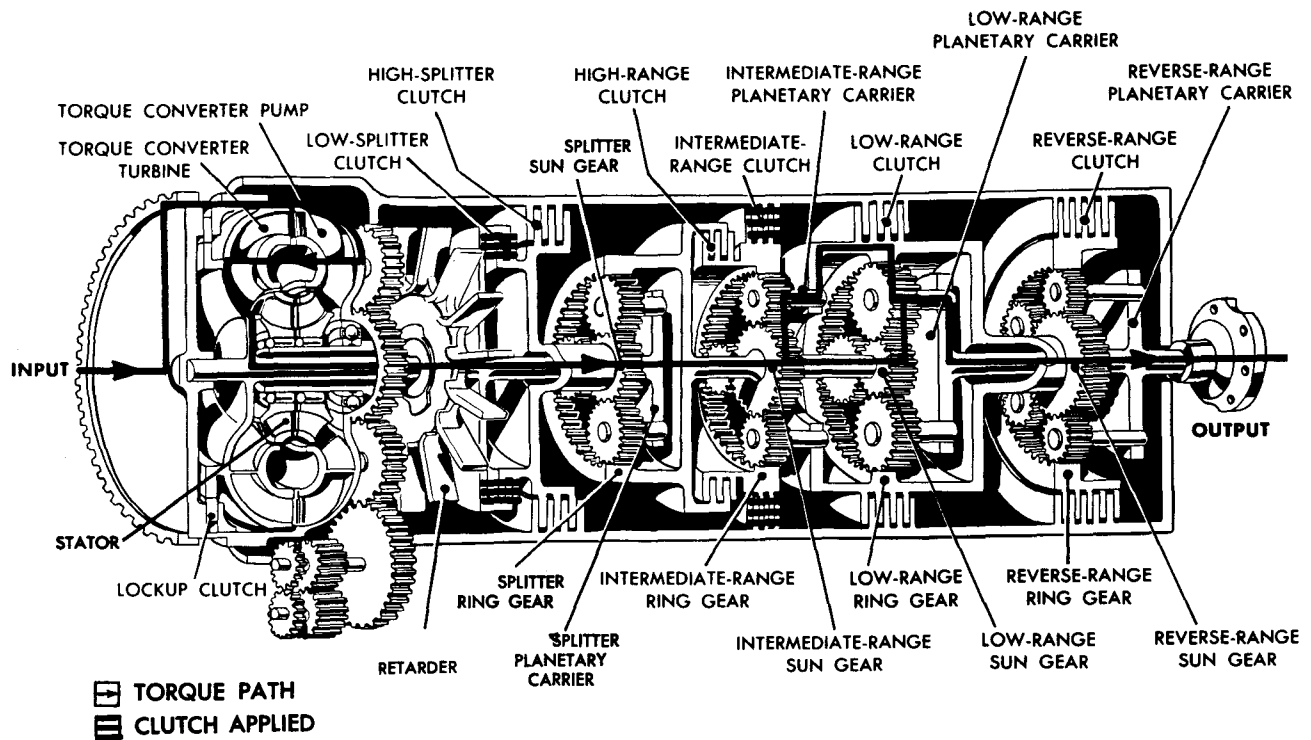
S1517

d. Second Gear (5660, 5860)—Torque Path (fig. 2-5)

(1) The manual selector valve is in second-gear (2) position. The torque from the engine passes, through the applied lockup clutch, to the low-splitter clutch and splitter planetary carrier. The high-splitter clutch is applied. This holds the splitter sun gear stationary. This forces the pinions on the splitter planetary carrier to rotate around the stationary sun gear. The pinions overdrive the splitter ring gear, to which is attached the intermediate- and low-range sun gears.

(2) In addition to the high-splitter clutch, the low-range clutch is engaged. Refer to c(2), above, for explanation of power flow from the low-range sun gear to the transmission output shaft.

(3) The transmission output shaft rotates in a clockwise direction. A speed increase ratio of 0.67 to 1 in high splitter, coupled with a speed reduction ratio of 4.00 to 1 in the low-range planetary, gives an overall speed reduction of 2.68 to 1.



S1518

Fig. 2-6. Second gear (5640, 5840), third gear (5660, 5860), low splitter, intermediate range, converter—torque path

**e. Second Gear (5640, 5840); Third Gear (5660, 5860)—Torque Path (fig. 2-6)**

(1) The manual selector valve is in the second-gear (2) position on 5640 and 5840 transmissions. It is in the third-gear (3) position on 5660 and 5860 transmissions. The torque from the engine passes, by hydraulic action, through the converter to the low-splitter clutch. The low-splitter clutch is applied. Thus, torque and rotation is transmitted to the intermediate-range and low-range sun gears (refer to b(2), above).

(2) In addition to the low-splitter clutch, the intermediate-range clutch is applied. This holds the intermediate-range ring gear stationary. The rotating, intermediate-range sun gear forces the pinions on the intermediate-range planetary carrier to rotate within the stationary-ring gear. This causes the carrier and the low-range ring

gear, to which it is attached, to rotate. Thus, both the sun gear and ring gear of the low-range planetary are rotating in the same direction, but at different speeds. The ring gear has the slower rotation.

(3) The low-range pinions, being meshed with both the sun gear and ring gear, rotate at another speed and drive the low-range planetary carrier. The carrier, attached to the output shaft, drives it. This arrangement of two planetaries, interconnected, is called compounding.

(4) The transmission output rotates in a clockwise direction at an overall speed reduction ratio of 2.01 to 1. This ratio is the result of 1.00 to 1 ratio in the splitter, and a 2.01 to 1 ratio in the intermediate- and low-range planetaries compounded.

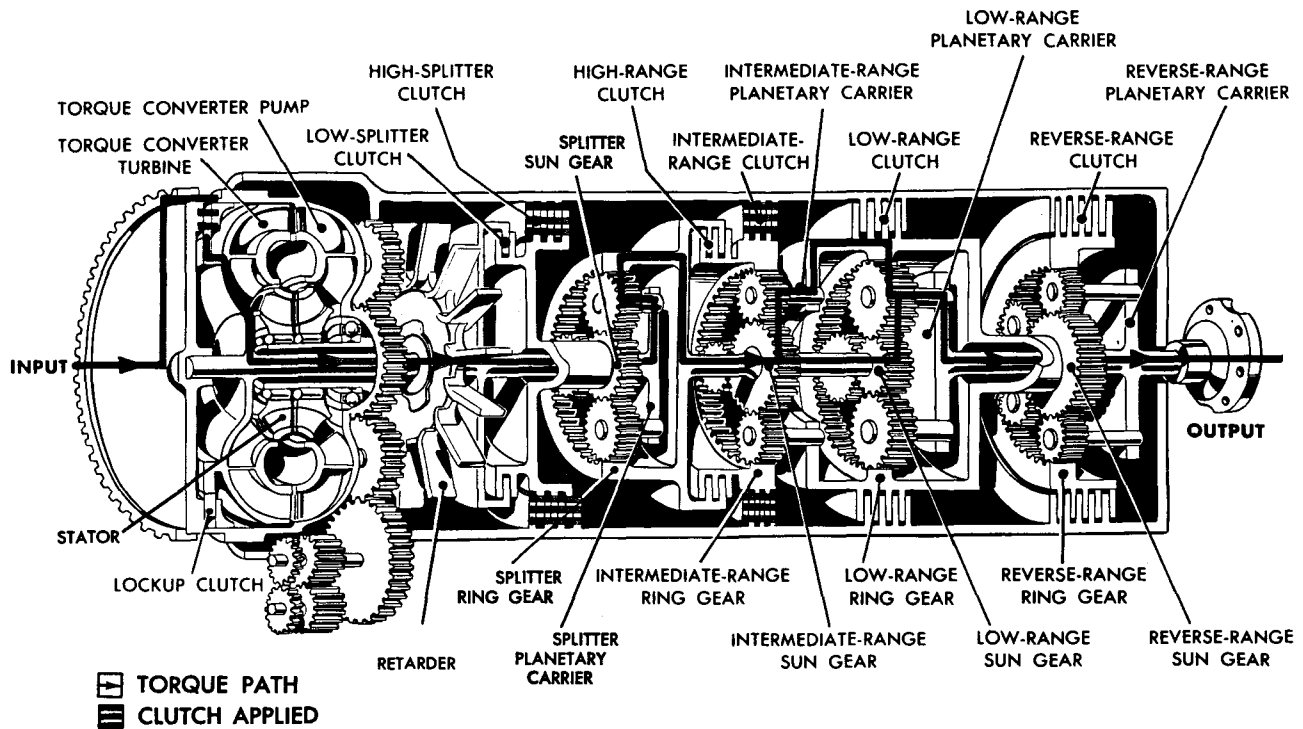


Fig. 2-7. Fourth gear (5660, 5860), high splitter, intermediate range, lockup—torque path

S1519

**f. Fourth Gear (5660, 5860)—Torque Path**  
(fig. 2-7)

(1) The manual selector valve is at the fourth-gear (4) position. The torque from the engine passes, through the applied lockup clutch, to the low-splitter clutch and the splitter planetary carrier. The high-splitter clutch is applied. Refer to d(1), above, for explanation of delivery of power to the low- and intermediate-range sun gears.

(2) In addition to the high-splitter clutch, the intermediate-range clutch is applied. Refer to e(2) and (3), above, for explanation of action in the intermediate- and low-range planetaries.

(3) The transmission output rotates in a clockwise direction at an overall speed reduction of 1.35 to 1. This is a result of the 0.67 to 1 overdrive in the high-splitter planetary, coupled with the 2.01 to 1 speed reduction in the compounded low- and intermediate-range planetaries.



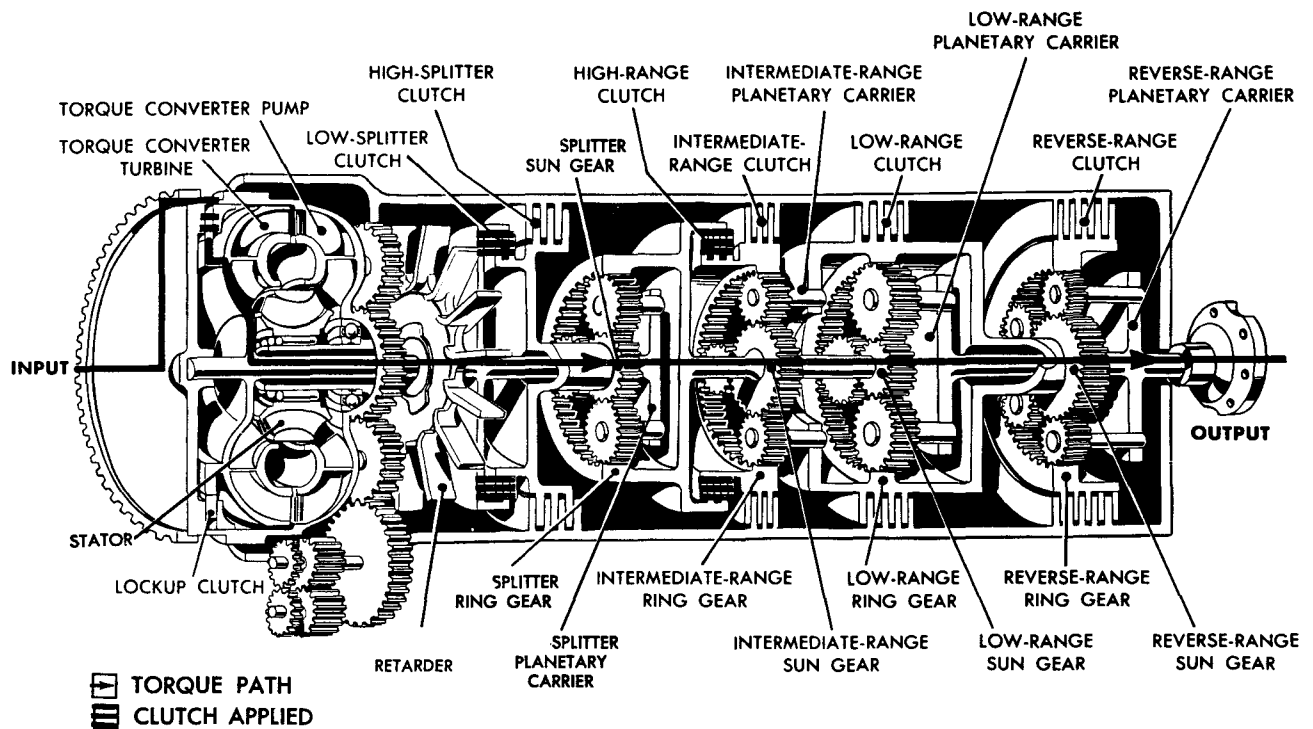


Fig. 2-8. Third gear (5640, 5840), fifth gear (5660, 5860), low splitter, high range, lockup—torque path

S1520

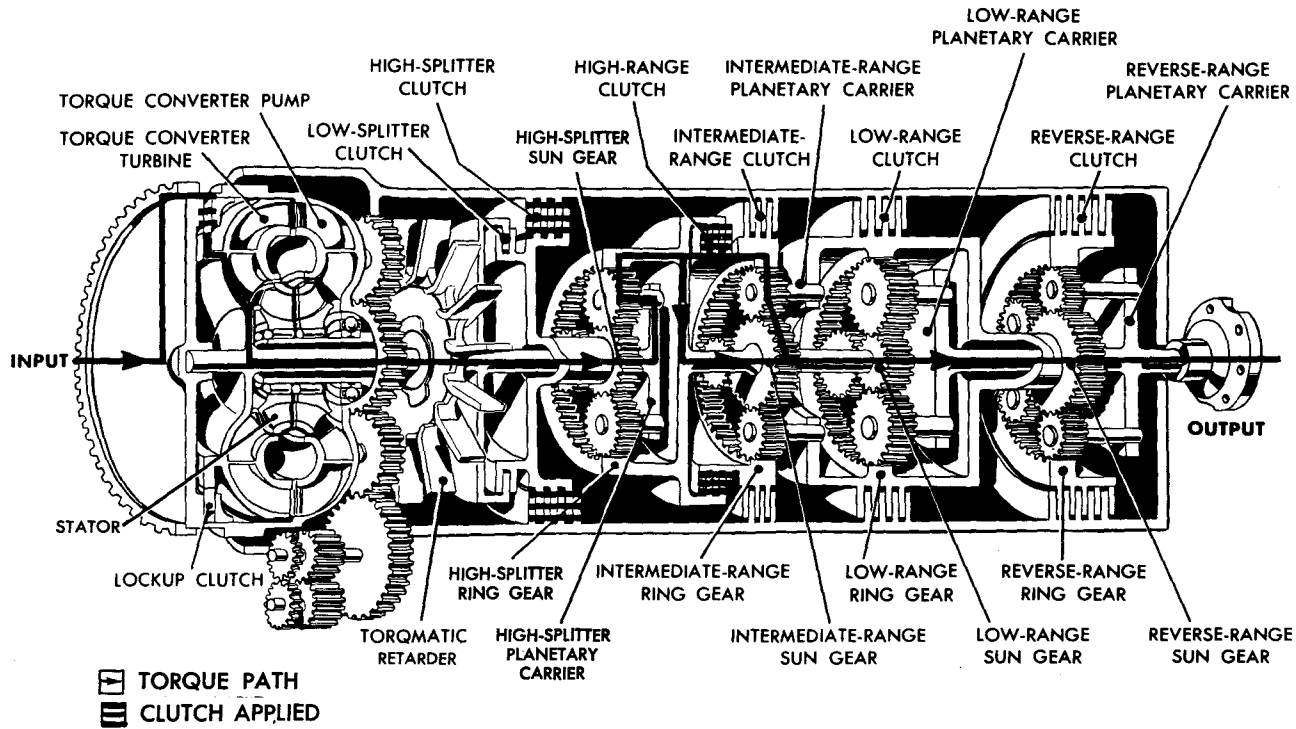
**g. Third Gear (5640, 5840); Fifth Gear (5660, 5860)—Torque Path (fig. 2-8)**

(1) The manual selector valve is in third-gear (3) position on 5640 and 5840 transmissions. It is in fifth-gear (5) position on 5660 and 5860 transmissions. The torque from the engine passes through the applied lockup clutch, to the low-splitter clutch and to the splitter planetary carrier. The low-splitter clutch is applied. Refer to b(2), above, for explanation of delivery of power to the low- and intermediate-range sun gears.

(2) In addition to the low-splitter clutch, the high-range clutch is applied. This causes the intermediate-range ring gear to rotate at the same

speed as the intermediate-range sun gear. Thus, the intermediate-range planetary carrier must rotate at the same speed as the sun and ring gears. In turn, the low-range ring gear, being connected to the intermediate-range planetary carrier, also rotates at the same speed. The low-range sun gear is rotating also at the same speed. The result is that the entire range planetary group is locked together and rotating at the same speed as the turbine output shaft.

(3) The transmission output rotates in a clockwise direction at 1.00 to 1 ratio. This is a result of direct drive in the low-splitter clutch, and direct drive through the locked planetary sets. There is no relative rotation of any planetary gears. They are rotating as a unit.



S1521

Fig. 2-9. Fourth gear (5640, 5840), sixth gear (5660, 5860), high splitter, high range, lockup—torque path

**h. Fourth Gear (5640, 5840); Sixth Gear (5660, 5860)—Torque Path (fig. 2-9)**

(1) The manual selector valve is in the fourth-gear (4) position on 5640 and 5840 transmissions. It is in the sixth-gear (6) position on 5660 and 5860 transmissions. The torque from the engine passes through the applied lockup clutch, to the low-splitter clutch and to the splitter planetary carrier. The high-splitter clutch is applied. Refer to d(1), above, for explanation of the delivery of power to the intermediate- and low-range sun gears.

(2) In addition to the high-splitter clutch, the high-range clutch is applied. Refer to g(2), above, for explanation of delivery of power to the transmission output.

(3) The transmission output rotates in a clockwise direction at a speed increase of 0.67 to 1. This is a result of the overdrive ratio of 0.67 to 1 in the splitter planetary, coupled with the locked up range planetary group, rotating as a unit.

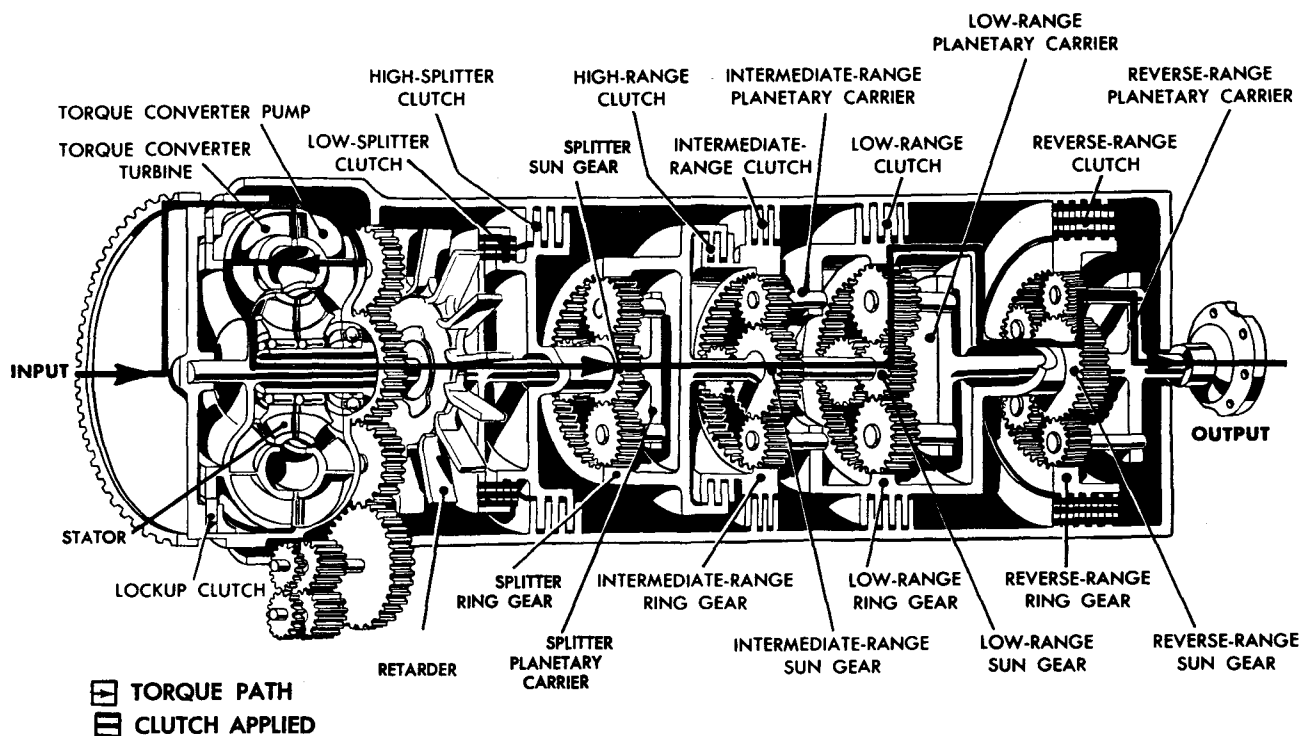


Fig. 2-10. Reverse 1 (5640, 5840 prior to S/N 23851), reverse (all other), low splitter, reverse range, converter-torque path

S1522

**i. Reverse 1 (5640, 5840 prior to S/N 23851); Reverse (all other models)—Torque Path (fig. 2-10)**

(1) The manual selector valve is in the reverse 1 (R1) position on 5640 and 5840 transmissions prior to S/N 23851. It is in the reverse (R) position on 5640 and 5840 transmissions beginning with S/N 23851, and on all 5660 and 5860 transmissions. The torque from the engine passes, by hydraulic action, through the converter to the low-splitter clutch and to the splitter planetary carrier. The low-splitter clutch is applied. Refer to b(2), above, for explanation of the flow of power to the low- and intermediate-range sun gears.

(2) In addition to the low-splitter clutch, the reverse-range clutch is applied. This holds the reverse-range ring gear stationary. The reverse-range planetary is coupled with the low-range planetary (compounded) to obtain opposite rotation and the desired ratio. The two planetaries are so interconnected that rotation is reversed in

the low-range planetary, and further speed reduction is obtained in the reverse-range planetary.

(3) The low-range sun gear rotates clockwise, driving the low-range planetary pinions counterclockwise. The low-range ring gear is driven counterclockwise by the pinions. The reverse-range sun gear, being connected to the low-range ring gear, also rotates counterclockwise. The sun gear forces the reverse-range planetary pinions to rotate clockwise within the stationary ring gear, driving the reverse-range carrier counterclockwise.

(4) The low-range planetary carrier, being connected to the reverse-range planetary carrier, thus acts as a reaction member although it is moving slowly (output shaft speed). The overall speed reduction ratio is 5.12 to 1. This is the result of direct drive (1.00 to 1 ratio) in the low-splitter clutch and a 5.12 to 1 speed reduction ratio in the compounded low- and reverse-range planetaries.

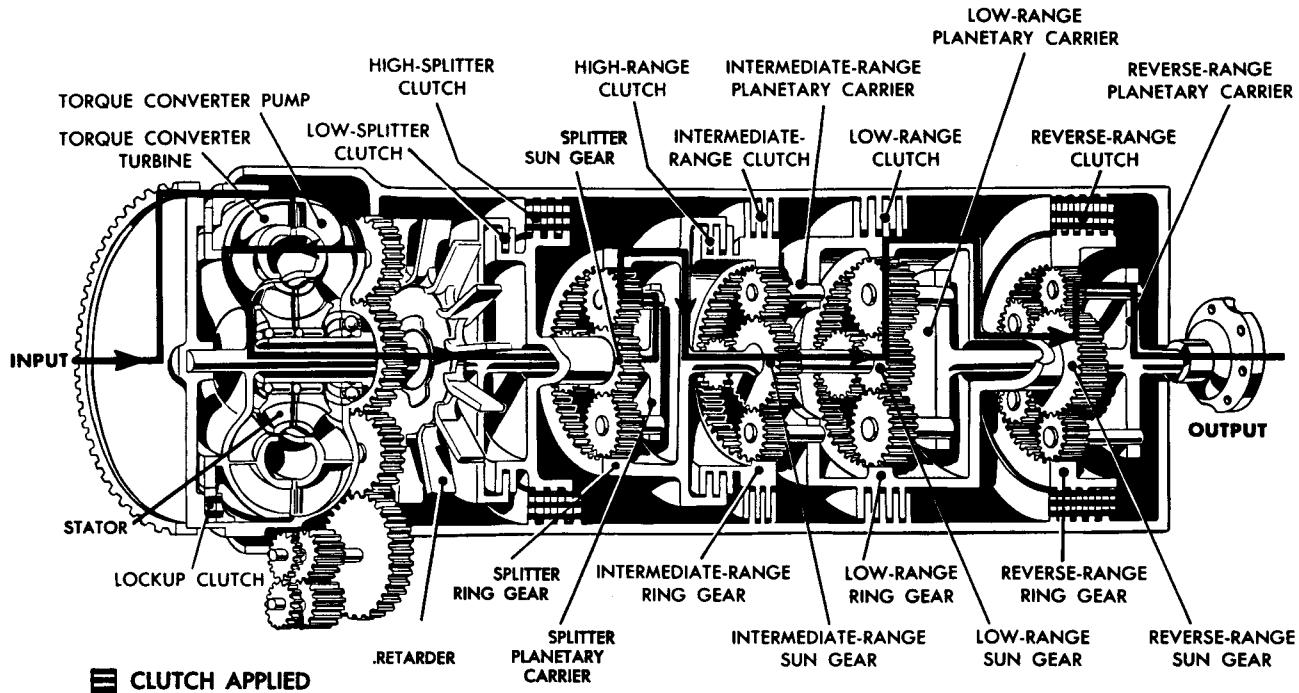


Fig. 2-11. Reverse 2 (5640, 5840 prior to S/N 23851), high splitter, reverse range, converter—torque path

S1523

j. Reverse 2 (5640, 5840 prior to S/N 23851)  
—Torque Path (fig. 2-11)

(1) The manual selector valve is in the reverse 2 (R2) position. The torque from the engine passes, by hydraulic action, through the converter to the low-splitter clutch and to the splitter planetary carrier. The high-splitter clutch is applied. Refer to d(1), above, for explanation of the flow of power to the low- and intermediate-range sun gears.

(2) In addition to the high-splitter clutch, the reverse-range clutch is applied. Refer to i(2) and (3), above, for explanation of the flow of power to the transmission output.

(3) The output rotates counterclockwise at an overall speed reduction ratio of 3.44 to 1. This results from combining the splitter overdrive ratio of 0.67 to 1 with the 5.12 to 1 ratio of the compounded low- and reverse-range planetary carriers.

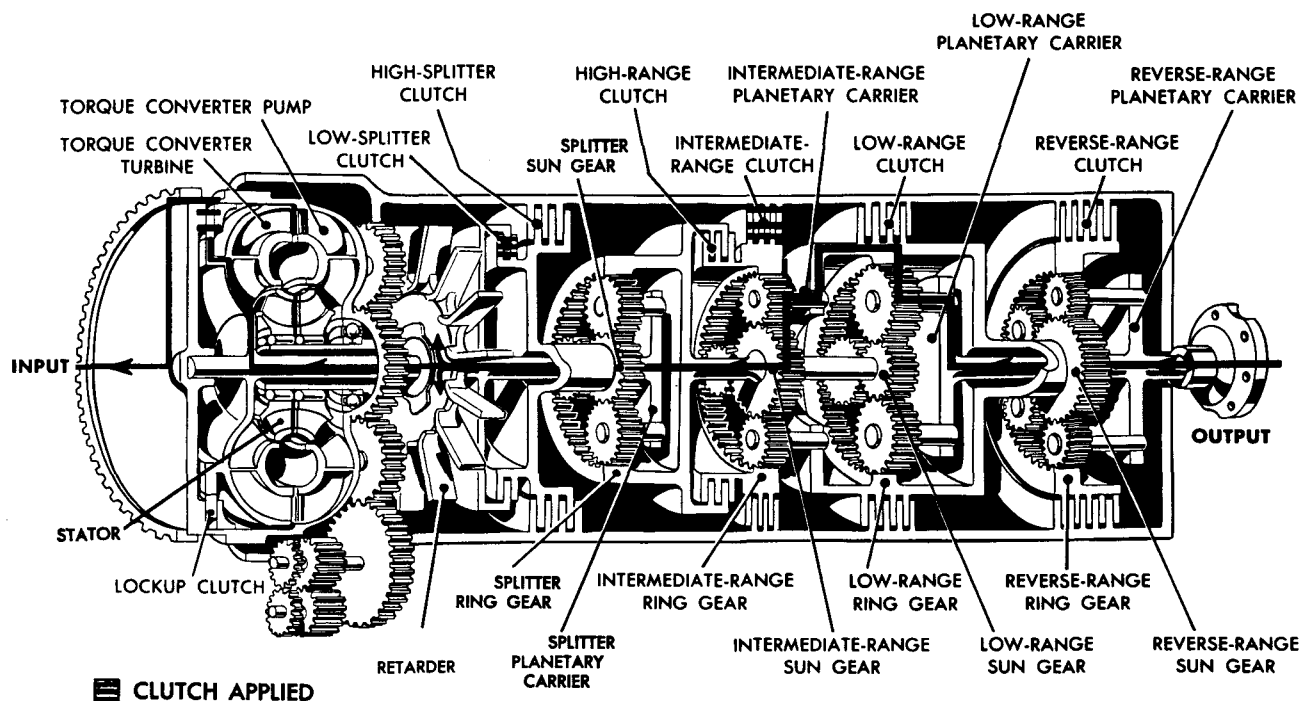


Fig. 2-12. Hydraulic retarder operation, second gear (5640, 5840), third gear (5660, 5860)—torque path

S1524

**k. Hydraulic Retarder Operation, Second Gear (5640, 5840); Third Gear (5660, 5860)—Torque Path (fig. 2-12)**

(1) During operation of the hydraulic retarder, the flow of torque through the transmission is reversed. The driving gear in which the retarder is applied depends upon vehicle speed and the degree of retarding desired. Figure 2-12 illustrates the torque path in second gear (5640, 5840) or third gear (5660, 5860).

(2) Torque enters the transmission at the rear (normally the output). It is transmitted through the applied range clutch and planetary gearing, and through the splitter clutch. Because torque is transmitted in the opposite direction, through a clutch and gear system which normally reduces speed and increases torque, torque is reduced while speed is increased. Thus, the hy-

draulic rotor is rotating faster than the transmission output and has a proportionately lower torque.

(3) Thus, any retarding action on the retarder rotor will be multiplied at the transmission output (by the ratio of the gear in operation). In this case, the multiplication is 2.01. To apply the retarder, oil is directed into the cavity surrounding the retarder rotor. The oil impedes the rotation of the retarder rotor. A torque limiting valve in the retarder control valve limits the torque absorption of the retarder to 1200 pound feet, by limiting the retarder-out oil pressure.

(4) The hydraulic retarder is designed with a capacity which enables it to absorb several times the torque which can be absorbed by engine braking alone. Of course, normal engine braking assists the retarder. Emptying the retarder cavity of oil releases the retarder. When the cavity is empty, the rotor can rotate freely.

## Section 3. PREVENTIVE MAINTENANCE

### 3-1. SCOPE OF SECTION 3

This section contains the tests, adjustments and maintenance information pertinent to all models of the 5640, 5660, 5840 and 5860 transmissions. A troubleshooting chart at the end of this section is included for assisting in the location of the probable cause of a transmission malfunction.

### 3-2. MINIMUM MAINTENANCE

There is a minimum of maintenance necessary on hydraulic transmissions. If the instructions are followed as outlined, and at regular intervals, the service life of the transmission will be extended. A good maintenance program results in an on-schedule work program, with a minimum amount of downtime.

### 3-3. TRANSMISSION GAGE READINGS

**a. Temperature.** Normal operating temperature is 180° to 200° F. This is the temperature of the oil leaving the torque converter. The vehicle should be shifted to neutral and the engine operated at 1200 to 1500 rpm for a few minutes if the temperature reaches 250°. The temperature should never be allowed to exceed 250°. Refer to the troubleshooting chart at the end of this section if the oil consistently tends to overheat.

#### **b. Main Pressure**

(1) If the vehicle is equipped with a main oil pressure gage, it will continuously register the pressure in the main-pressure circuit and the applied clutches. To properly evaluate the pressures shown, it is necessary to know the pressure schedules applicable to various models, and the features which determine the different pressure schedules.

Two changes in the hydraulic system cause the pressure schedules of later models to be different from those of earlier models.

(2) The first of these changes is the elimination of pressure modulation. Refer to paragraphs 2-13 and 2-28. With pressure modulation, main pressure decreases as pitot pressure rises. The elimination of the modulation feature occurred at transmission S/N 30084.

(3) The second of these changes is the introduction of a longer main-pressure regulator booster plug which prevents a step-up in main pressure for low gear and reverse operation (refer to para 2-15). In addition, the spring loading of the regulator valve is different when the new booster plug is used. The net effects of the new booster plug is reduced pressure in low gear and reverse, and increased pressure in other gears. The result is the same pressure in all gears.

(4) The new booster plug was introduced after the elimination of pressure modulation. This change was not pinpointed by serial number because the feature also was made available for earlier models. The effect of installing the new booster plug into earlier transmissions with pressure modulation is not shown in the pressure schedules, below. However, the pressure schedule is changed when that is done.

(5) The pressure schedules, below, cover the earlier models (prior to S/N 30084) before any change in the pressure regulation components, and the later models (beginning with S/N 30084) showing the effects of the elimination of pressure modulation alone and coupled with the use of the new booster plug.

**c. If No Gages.** If the vehicle does not have gages on the instrument panel, refer to paragraphs 3-12 and 3-13, below.

## 5640-5860 TRANSMISSIONS

Para 3-3/3-5

### SCHEDULE 1 (prior to S/N 30084)

#### Before elimination of pressure modulation, original booster plug

Selector position	5640, 5840	5660, 5860
6	*	140 to 155
5	*	140 to 155
4	140 to 155	140 to 155
3	140 to 155	140 to 155
2	140 to 155	140 to 155
1	190 to 230	190 to 230
N	*	*
R	190 to 230 (S/N 23851 to 30084)	190 to 230
R-1	190 to 230 (prior to S/N 23851)	*
R-2	190 to 230 (prior to S/N 23851)	*

The pressures above are taken with the engine running at 1500 rpm, normal (180° to 200°F) temperature, and the output stalled. The high limits, tabulated above, may increase by 15 psi at full throttle. The 140 psi pressures will decrease to approximately 110 psi; and the 190 psi pressures to approximately 170 psi as vehicle speed increases.

\*Not applicable

### SCHEDULE 2 (beginning with S/N 30084)

#### After elimination of pressure modulation

Selector position	5640, 5840		5660, 5860	
	Old booster	New booster	Old booster	New booster
6	*	*	140 to 155	170 to 185
5	*	*	140 to 155	170 to 185
4	140 to 155	170 to 185	140 to 155	170 to 185
3	140 to 155	170 to 185	140 to 155	170 to 185
2	140 to 155	170 to 185	140 to 155	170 to 185
1	190 to 230	170 to 185	190 to 230	170 to 185
N	*	*	*	*
R	190 to 230	170 to 185	190 to 230	170 to 185

The pressures above are taken with the engine running at 1500 rpm, normal (180° to 200°F) temperature, and the output stalled. The high limits, tabulated above, may increase by 15 psi (with old booster plug) or 25 psi (with new booster plug) at full throttle.

\*Not applicable

### 3-4. MAINTENANCE INTERVALS

The type of service and operating conditions will determine the maintenance intervals. However, it is well to check daily on the hydraulic system oil level, or check it at the end of each shift. At the same time, look for oil leaks.

### 3-5. KEEPING OIL CLEAN

a. **Dirt Harmful.** Because the hydraulic system is the "heart" of your transmission, it is especially important that the oil be kept clean. The area around the oil filler hole must be kept clean, and oil containers must be kept free from water, dirt, mud or other harmful matter.

**b. Metal Contamination of Oil.** If the oil in the hydraulic system becomes contaminated with metal particles, all of the components of the hydraulic system—the transmission oil lines and passages, sump, filter, strainer, cooler, valve bodies and oil pumps—must be disassembled and thoroughly cleaned. Metal particles (other than minute particles ordinarily trapped by the oil filter) in the oil are evidence of failure of some part.

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

#### NOTE

If engine coolant leaks into 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.

### 3-6. KEEPING TRANSMISSION BREATHER CLEAN

The breather for the transmission should be kept clean at all times. It should be checked and cleaned regularly and as frequently as is necessary, depending on the operating conditions. Badly corroded or plugged breather screens restrict proper breathing, causing a buildup of condensation and subsequent oil deterioration.

### 3-7. OIL CAPACITIES

**a. Straight-through Models.** This model transmission requires approximately 18 gallons of oil, plus the cooling and filter circuits, on an initial fill. After draining oil during a regular oil change, approximately 14-1/2 gallons of oil are needed for refill.

**b. Transfer Gear (dropbox) Models.** For initial fill on the transfer gear model, approximately

13 gallons, plus the cooling and filter circuits, are required. When making a regular oil change, approximately 10 gallons of oil are required for refill.

### 3-8. HOW TO CHECK OIL

**a. Cold Check.** The cold check (engine not running) is to be made only to make sure that there is sufficient oil in the hydraulic system to safely start the engine—especially if the equipment has been idle for a long period. The oil level must reach the full-level check plug (fig. 3-1 or 3-2).

#### b. Hot Check

(1) Oil level should be checked with the engine running at 1000 rpm, transmission in neutral, and with the transmission at normal operating temperature (180° to 200°F). The hydraulic retarder control must be in the Off position.

(2) For straight-through drive, check the oil level at the two plugs at the right rear of the rear cover assembly (fig. 3-1). The lower plug is at the low oil level mark and the upper plug is at the full level. Oil level should be maintained between the Full and Add check plugs. Approximately 1-1/2 gallons are required to bring the oil level from the Add mark to the Full mark. Oil is added through an opening above and to the right of the oil level plugs (fig. 3-1).

(3) Exact location of filler pipe opening may vary between different vehicles. In some installations, this opening is plugged by a 1-1/4-inch pipe plug; and a short filler tube assembly, located on the top-right side of the transmission housing, is used.

(4) Transmissions equipped with transfer gear housings have the same oil level check plug arrangement (fig. 3-2). These transmissions are filled through an oil filler tube at the top and on the right side of the transfer gear housing. This opening is fitted with a combination breather and oil filler cap.

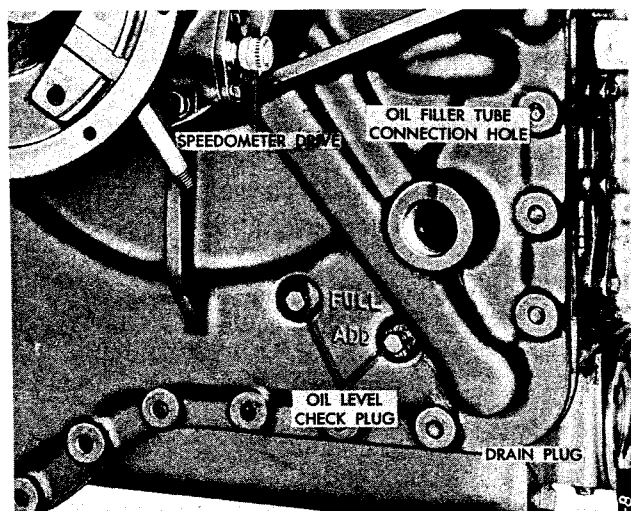
**c. Sight Gage Check.** Later straight-through models are equipped with an oil sight gage (fig. 3-1). The oil levels as indicated on the sight gage, are defined in the illustration.

### 3-9. WHEN TO CHANGE OIL, FILTERS

**a. Oil.** Oil should be changed in the transmission every 1000 hours of operation, or oftener, depending upon operating conditions. Also, the oil must be changed whenever there are traces of dirt or evidence of high operating temperatures,



## Para 3-8/3-10



## SIGHT GAGE

## OIL CHECK PROCEDURE

1. OIL—TYPE C-2
2. TRANSMISSION AT NORMAL OPERATING TEMP. (180 TO 200°F)
3. NEUTRAL—ENGINE IDLE

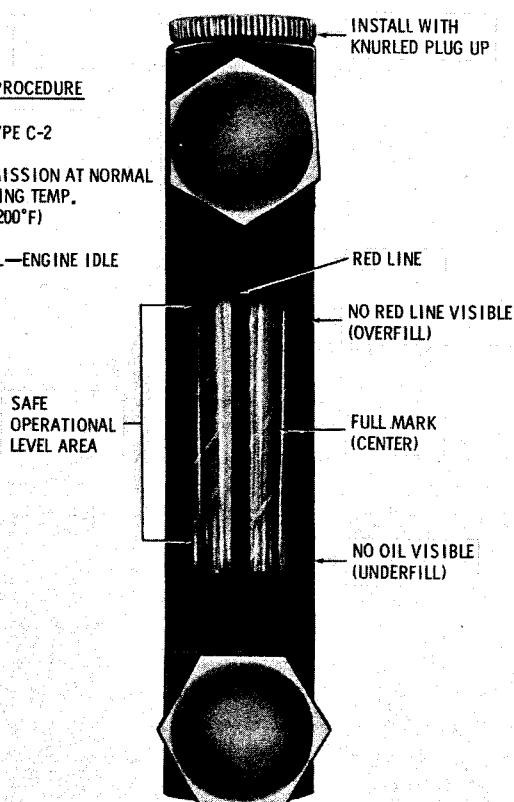
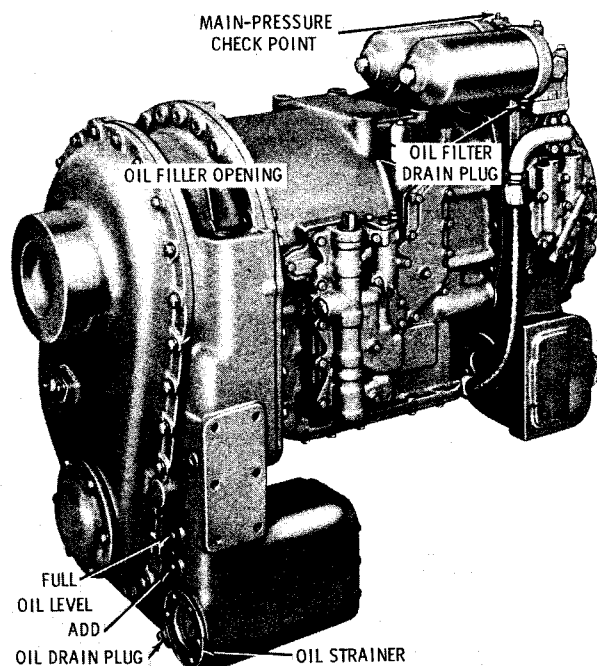


Fig. 3-1. Fill, drain, and oil level locations (straight-through model)

such as discoloration or strong odor. If the oil shows metal contamination, the system must be thoroughly drained and cleaned. See paragraph 3-5, above.

**b. Filters.** The oil filter elements should be changed when the oil is changed and at 200-hour



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Fig. 3-2. Oil system check points (dropbox model) —right-rear view

intervals between oil changes. The strainer in the oil sump should be removed and thoroughly cleaned at each oil change. Refer also to paragraph 2-11.

### 3-10. HOW TO CHANGE OIL

**a. Inspection Prior to Oil Change.** Examine the transmission breather cap for dirt or corrosion and clean if necessary. Examine the oil for metal contamination and evidence of operation at excessively high temperature (refer to para 3-5b, above).

#### b. Draining Transmission

(1) The oil should be warm when the transmission is drained. Remove the drain plug from the right side of the oil pan on straight-through drive models (fig. 3-1), or from the rear of the transfer gear housing on transfer gear housing models (fig. 3-2).

(2) Remove the oil strainer (fig. 3-2 or 3-3), and clean the strainer with mineral spirits, using a soft-bristle brush.

(3) Remove the oil filter drain plug (fig. 3-3), then remove the filter shell center bolt and shell. Remove and discard the filter element and the filter shell gasket. Install a new element and new gasket. Install the filter shell. Repeat this procedure for the other filter element.

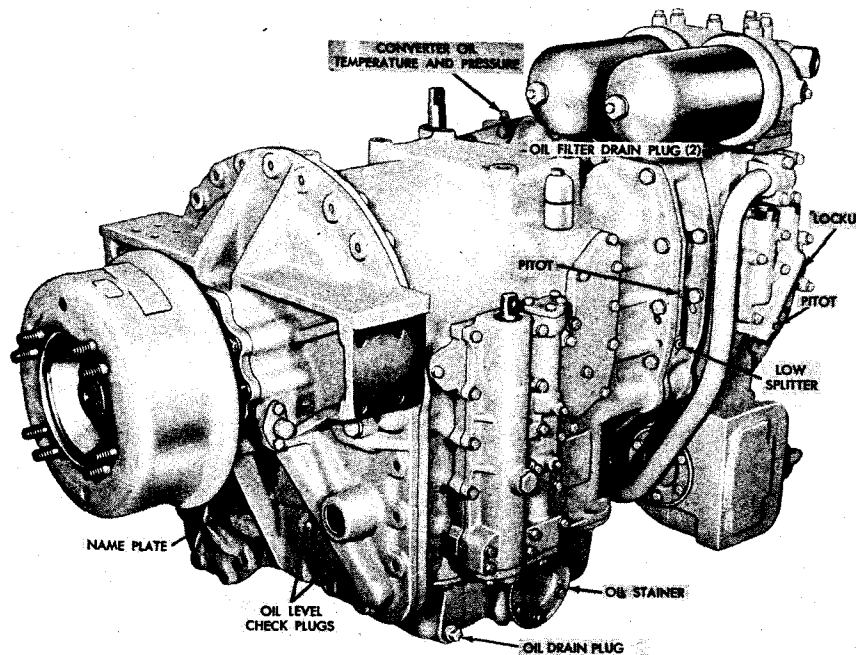


Fig. 3-3. Oil system check points (straight-through model)—right-rear view

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**c. Filling Transmission, Hydraulic System**

- (1) Install the drain plug in the sump.
- (2) Install the strainer in the sump.
- (3) Install the filter drain plug.
- (4) Before starting the engine, pour 9-1/2 gallons of hydraulic transmission fluid type C2 into the filler opening (see fig. 3-1 or 3-2).
- (5) Start the engine and, with the transmission in neutral, run at idle speed for 2 minutes. This will charge the system and will lower the sump level. With engine still running at 1000 rpm, add enough oil to bring the level up to the Add (lower) oil level plug (fig. 3-1 or 3-2). Recheck the oil level after normal operating temperature (180° to 200°F) is reached and add oil, as necessary, to bring the oil level to the Full (upper) oil level plug.

**3-11. BRAKE, LINKAGE ADJUSTMENTS AND INSPECTION**

**a. Brake Adjustment**

- (1) Adjust the brake shoes for proper drum clearance by inserting a screwdriver or brake adjusting tool into the adjusting slot in the brake drum. Rotate the adjusting screw star wheel between the lower ends of the brake shoes. (Reference figure 7-111). The brake linkage should be disconnected during this adjustment. Insert a 0.020-inch feeler gage near the center of the shoe

and adjust the star wheel until the gage is snug between the shoe and drum. Remove the feeler gage.

- (2) Adjust the vehicle brake linkage by releasing the hand lever fully, and adjusting the connecting linkage so that it can be freely connected to the apply lever on the brake. All slack should be taken out of the brake, without actually moving the brake shoes, when the linkage adjustment is made.

**b. Manual Selector Valve**

- (1) Clean any accumulation of dirt away from the linkage and lubricate all points of movement. Move the selector control through all shift positions. The selector should move freely but with a definite "detent" feel at each shift position.
- (2) The linkage is correctly adjusted when the detent point coincides with the marking on the shift control for each speed. Inspect the linkage for binding, and for worn, cracked or bent parts; check the condition of the cotter pins. Replace any defective parts.

- (3) The manual selector valve and related linkage are not required for electric-shift control systems.

**c. Hydraulic Retarder Valve**

- (1) Clean and lubricate all linkage. The retarder is applied when the valve moves down

## Para 3-11/3-13

(into the valve body). Therefore, it is important, for normal operation with retarder Off, that the linkage be adjusted so that the valve returns to the upward position. If the linkage allows the retarder to be partially applied at all times, loss of lubrication pressure or excessive drag will result and fuel consumption will be excessive.

(2) Overheating could result if the retarder is constantly in operation while pulling. When the retarder is fully applied, make sure that the retarder valve is all the way down (into the body). If the valve does not have full travel in both directions, maximum performance of the retarder cannot be obtained.

(3) Inspect the linkage for binding, wear, cracks, breaks, and defective cotter pins. Replace all defective parts.

### 3-12. CHECKING OIL PRESSURES

Pressure schedules 1 and 2 in paragraph 3-3, above, make it easier to locate transmission troubles. A study of the hydraulic system, as discussed in Section 2, will explain the normal operation of various hydraulic components and will make the pressure checks easier to understand. The diagnosis, location and correction of hydraulic troubles can be made with a minimum of effort and time by the use of pressure checks, a study of the hydraulic system, and the use of the troubleshooting chart at the end of this section.

### 3-13. CHECKS WITH NO GAGES

#### NOTE

Pressures should be checked with the engine running at 1500 rpm and the transmission oil temperature at 180° to 200°F. Apply the service and parking brakes securely to prevent the vehicle from moving during stalled output testing.

#### a. Checking Main Pressure

(1) The location of the main-pressure check point depends upon the transmission model and filter equipment. On transmissions equipped with main-pressure regulator valve body assembly 33 (A, foldout 9), whether the filter is integral or remote, the main-pressure check point is at the front of regulator body 41. This is indicated by plug 44.

(2) On transmissions equipped with oil filter adapter assembly 5 (B, foldout 9), the main-pressure check point is at the top of adapter 11. This opening is tapped for plug 12. Figure 3-2 illustrates this check point.

(3) On transmissions equipped with valve body assembly 4 (B, foldout 8), the main-pressure tap is at the top of body 8. This opening is tapped for plug 5. Figure 3-4 illustrates this check point.

(4) To check main pressure, attach an 0 to 300 psi pressure gage to the main-pressure check point while the engine is stopped. Refer to paragraph 3-3, above, for pressure schedules, and the prescribed conditions for obtaining pressures.

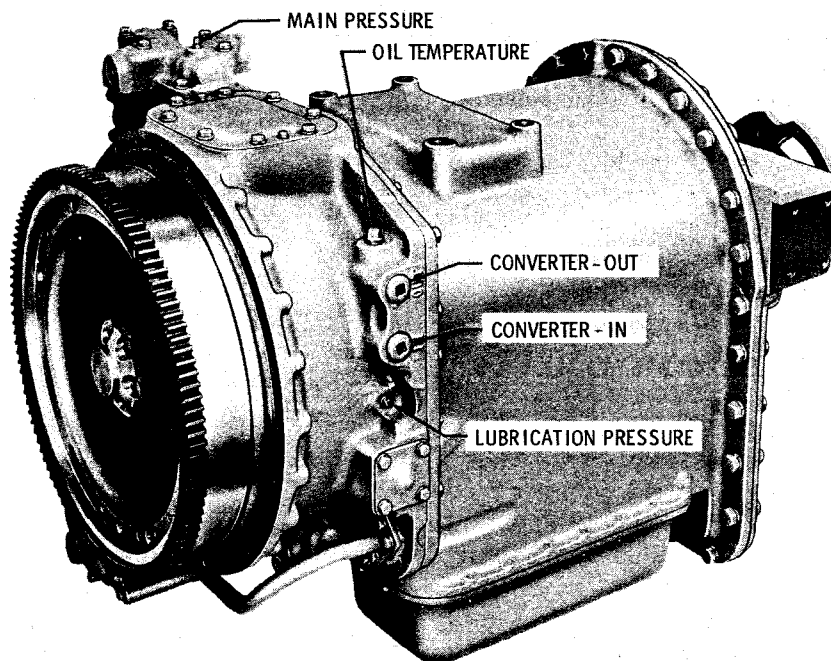


Fig. 3-4. Oil system check points—left-front view

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**b. Checking Lubrication Oil Pressure (CLT models only).** Install a pressure gage at the lubrication oil pressure check point (fig. 3-4). With the engine running at 1500 rpm, output stalled, the pressure should be 20 psi. With the engine operating at full throttle, output stalled, the pressure should be 30 psi. If it is necessary to adjust the pressure, refer to paragraph 3-15, below.

**c. Checking Fluid Velocity Governor (pitot) Pressure**

(1) Install a pressure gage at one of the pitot pressure check points (shown in fig. 3-3). Governor pressure depends upon the speed of rotation of the low-splitter (direct drive) clutch drum. Therefore, no reading can be had with the vehicle standing except when the shift control is in neutral position. In neutral, with engine running at 1000 rpm, the reading will be proportional to the speed of the turbine output shaft and will vary from 0 to approximately 30 psi.

(2) With the vehicle in motion, readings in each range will be proportional to the speed of the vehicle in that range. While the vehicle is being driven, there will be a momentary sudden drop in governor pressure as shifts are made from one range to another.

(3) When upshifting, the pressure will quickly return after the shift is made, but the pressure will be somewhat lower than before shifting. It will climb as the vehicle speed increases. In downshifting, the pressure will return and be somewhat higher than before shifting. It will fall as the vehicle speed decreases. Under certain operating conditions, governor pressure will vary from 0 to 120 psi.

**d. Checking Converter-out Pressure.** Install the pressure gage at the check point (shown in fig. 3-4). This reading will vary from 30 psi to 65 psi at full throttle, normal operating output speed range, depending upon the operational functions.

**e. Checking Stator Control Pressure (VCLT, VCLBT)**

(1) Stator control pressure should be 150 to 170 psi in first gear with the output stalled and the engine operating at 1500 rpm (main pressure should not vary more than 5% of 170 to 185 psi). Replace spring 28 (A, foldout 10) if variation is more than 5%.

(2) The stator control pressure is taken at the top of the stator control valve. With the transmission in neutral, normal oil temperature,

engine speed at 1500 rpm, the pressure should read 0 to 20 psi. Actuate the vehicle manufacture-supplied stator shift control mechanism. The pressure gage should read 140 to 170 psi **maximum**. When the stator control is released, oil pressure at the gage must drop to 0 to 20 psi.

**3-14. ADJUSTING MAIN PRESSURE**

Normal main oil pressures are listed in paragraph 3-3b, above. If the operating pressures do not fall within those limits, main pressure requires adjustment. If it is necessary to adjust the pressure, it can be raised or lowered by adding or removing shims at the booster signal plug end of the main-pressure regulator valve spring. To add or remove shims, remove the main-pressure regulator valve plug, gasket, and booster plug. These are items 34, 35 and 36 (A, foldout 9); or items 19, 18 and 17 (B, foldout 9); or items 15, 14 and 13 (B, foldout 8). The shims are located in the bore of the booster plug. Shims are available in two thicknesses (0.0289 and 0.0528). Each of the thinner shims affect pressure approximately 6 psi. Each of the thicker shims affect the pressure approximately 10 psi. Add or remove shims to obtain the proper main oil pressure readings.

**3-15. ADJUSTING LUBRICATION OIL PRESSURE (CLT MODELS ONLY)**

**a.** The purpose of setting lubrication oil pressure at 30 psi, full throttle, with the output stalled—is to limit converter-out oil pressure to 65 psi maximum. This is necessary to assure adequate lockup clutch capacity. Converter-out pressure is a function of lubrication oil pressure and cooler restrictions. If converter-out pressure exceeds 65 psi after the lubrication valve has been adjusted, larger lines are required in the cooler circuit.

**b.** Lubrication oil pressure should not be less than 20 psi in all drive ranges and neutral, at 1500 rpm with the output stalled. It should not exceed 30 psi in neutral range, at full throttle—output stalled. If the lubrication pressure needs to be adjusted, add or subtract shims (103341) between the lubrication regulator valve and the spring. Refer to item 33 (A, foldout 8). Each added shim will increase the pressure approximately 2 psi.

**CAUTION**

Do not use more than 10 shims to adjust the lubrication oil pressure. Replace the spring or check for additional causes of pressure loss.

## Para 3-15/3-19

c. After adjusting the lubrication pressure, check the converter-out oil pressure at full throttle normal operating output speed range. The converter-out pressure should be 30 to 65 psi in all ranges, including neutral. If the oil pressure exceeds 65 psi, larger cooler circuit oil lines are required. If high-speed operation of the vehicle is not possible, disconnect the driveline.

## 3-16. LOCKUP SPEED ADJUSTMENT

a. Lockup speed should be checked with the transmission in fifth gear (third gear in the 5640 and 5840 models), at the point of lockup disengagement (release). The lockup pressure check point is shown in figure 3-3. The "out-of-lockup" rpm should be as close as possible to the vehicle manufacturer's recommendation.

b. Attach a tachometer of known accuracy to the engine. Increase the vehicle speed until it is operating in lockup. At this point, apply the hydraulic retarder (or drive the vehicle up an incline if it is a CLT model transmission) until the lockup clutch releases and the transmission operates in converter operation. Note the engine speed at the moment the lockup clutch releases and compare it to the lockup release speed recommended by the vehicle manufacturer for the transmission.

**NOTE**

Although transmissions may have the same model designation, the engine speed at which the lockup clutch release occurs may vary between them due to the vehicle application and the engine governed speed. Therefore, be sure that the lockup release speed is the one specifically recommended for the vehicle and transmission being checked and adjusted.

c. If the lockup release rpm requires adjustment, the speed can be changed by adding or removing shims 4 (B, foldout 10). These shims are located between lockup shift valve 3 and lockup valve spring 7. Adding a shim will raise the lockup speed approximately 20 rpm; removing a shim will lower the lockup speed the same amount.

**NOTE**

On some assemblies, shim 4 will be under washer 5 (when a second spring 6 is included).

## 3-17. CHECKING OIL TEMPERATURE

Install a temperature indicator at the check point indicated in figure 3-4. The maximum oil

temperature should not exceed 250°F. Above-normal temperatures indicate trouble and should be immediately investigated and corrected. Refer to the troubleshooting chart at the end of this section.

## 3-18. LOCKED STATOR CHECK

a. **Basis of Check.** Closely associated with the oil temperature check is the locked stator check which determines if the stator in the torque converter is locked to the freewheel roller race and unable to freewheel. The check is based upon the cooling rate of the converter oil after the oil is brought to a temperature higher than normal.

b. **Test**

(1) Install the temperature indicator at the check point identified in figure 3-4.

(2) Apply the vehicle brakes securely.

(3) Start the engine and let it run at idle speed until the engine and transmission are warm.

(4) Shift the selector lever to sixth gear (fourth gear on 5640 and 5840 models) and increase the engine speed to full throttle.

(5) In stalled condition, the oil in the transmission will heat rapidly. When an oil temperature of 230°F is reached, throttle the engine momentarily and shift to neutral. Increase the engine speed to full throttle again and immediately check the rate of temperature drop. The oil temperature, after 2 minutes, should drop rapidly to normal. A slow drop rate, or failure to drop to normal, indicates that the stator may be locked. A rapid drop to normal temperature indicates proper functioning of the stator. If a locked stator is indicated, refer to the troubleshooting chart, at the end of this section, for corrective action.

## 3-19. TRANSMISSION STALL TEST

a. **Definition, Purpose.** The converter stall test is a test of the engine and transmission as a unit, wherein the transmission output is stalled while the engine is operated at full throttle. This test will indicate, by the speed which the engine reaches, if the engine and transmission are performing satisfactorily under full load. A lower or higher speed than that established as normal for the specific engine-transmission combination is an indication of either engine or transmission malfunction.

**NOTE**

To conduct a stall test, it will be necessary to know the established normal stall speed of the specific engine and transmission combination. This information may be obtained from your equipment dealer or distributor.

**b. Procedures.** The test is usually made while the engine and transmission are installed in the vehicle. The vehicle wheels must be blocked securely to prevent vehicle movement. The brakes should be applied. Conduct the test as outlined below.

(1) Start the engine and bring the transmission to normal (180 to 200°F) operating temperature.

(2) On transmission with manual-hydraulic shift or manual-electric shift, move the selector control to the highest gear.

(3) If the transmission is equipped with an automatic-electric shift, install Harness Adapter J 24712 (para 4-4) between the cab wiring harness and the shift tower. This provides a fifth-gear hold when the range selector is in any forward gear, regardless of the throttle setting.

(4) Increase the engine speed to full throttle.

**NOTE**

Do not allow converter-out temperature to exceed 250°F. Do not maintain full-stall condition longer than 30 seconds.

(5) Record the engine speed attained at full-throttle operation.

**c. Results.** The only reading derived from the stall test is engine speed. The difference between established normal speed and the actual speed recorded is significant only if it exceeds 150 rpm (higher or lower). Refer to the troubleshooting chart in paragraph 3-22, for malfunctions which may be indicated by excessively high- or low-speed readings derived in a stall test.

**NOTE**

A tachometer of known accuracy must be used.

**3-20 PRESERVATION, STORAGE**

**a. Preservative Selection.** When transmissions are to be stored or remain inactive for extended periods of time, specific preservation

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 the factory and can be safely stored for 6 weeks without further treatment. Before placing the unit in service, drain the preservative oil and fill the unit with Hydraulic transmission fluid type C-2.

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

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

(2) Drain the oil as described in paragraph 3-10.

(3) Install the drain plug.

(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. If the transmission is equipped with an automatic-electric shift control, shift to sixth gear and operate the equipment at sufficient speed to cause sixth gear operation to occur. Then stop the equipment and stall the converter to raise the oil temperature to 225°F.

**CAUTION**

Do not allow temperature to exceed 275°F. If the unit does not have a temperature gage, do not stall for more than 90 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 ferrous 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 3-10.

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

## Para 3-20/3-21

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

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

**NOTE**

Motorstor is a preservative additive manufactured by the 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).

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

**e. Storage, 1 Year—With Oil**

(1) Drain the oil as described in paragraph 3-10.

(2) Install the drain plug.

(3) Fill the transmission to operating level with a mixture of 30 parts hydraulic transmission fluid type C-2 to 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. If the transmission is equipped with an automatic-electric shift control, shift to sixth gear and operate the equipment at sufficient speed to cause sixth gear operation to occur. Then stop the equipment and stall the converter to raise the oil temperature to 225°F.

**CAUTION**

Do not allow temperature to exceed 275°F. If the unit does not have a temperature gage, do not stall for more than 90 seconds.

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

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

(7) If additional storage time is required, just add the prescribed amount (30 to 1) of Motorstor, or equivalent, and repeat steps (4), (5) and (6). It is not necessary to drain the transmission each year.

**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 openings and breathers.

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

(4) Install new filters.

(5) Add hydraulic transmission fluid type C-2 to proper level.

**NOTE**

It is not necessary to drain the transmission fluid-Motorstor mixture from the transmission.

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

(7) Remove the tape from openings and breathers.

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

(9) Drain oil as described in paragraph 3-10.

(10) Install a new external oil filter element(s).

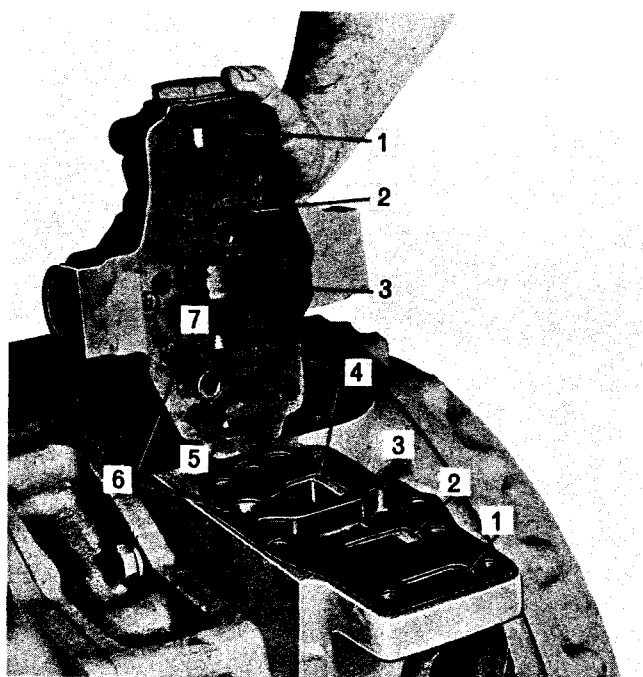
(11) Refill transmission with hydraulic transmission fluid type C-2 to proper level.

**3-21. HYDRAULIC SCHEMATIC AND OIL PASSAGE IDENTIFICATIONS**

**a. Oil Flow Paths.** A thorough study of the hydraulic system and hydraulic action (para 2-29 and 2-30) and of the hydraulic system schematics (foldouts 3 and 4) will help in learning how the hydraulic system operates. The hydraulic schematics apply specifically to the CLBT models, and include a partial schematic of the CLT model, where the two differ.

**b. Study Components.** A thorough knowledge of all hydraulic components and the function of each, and their relation to each other, will simplify the location and correction of troubles. Refer

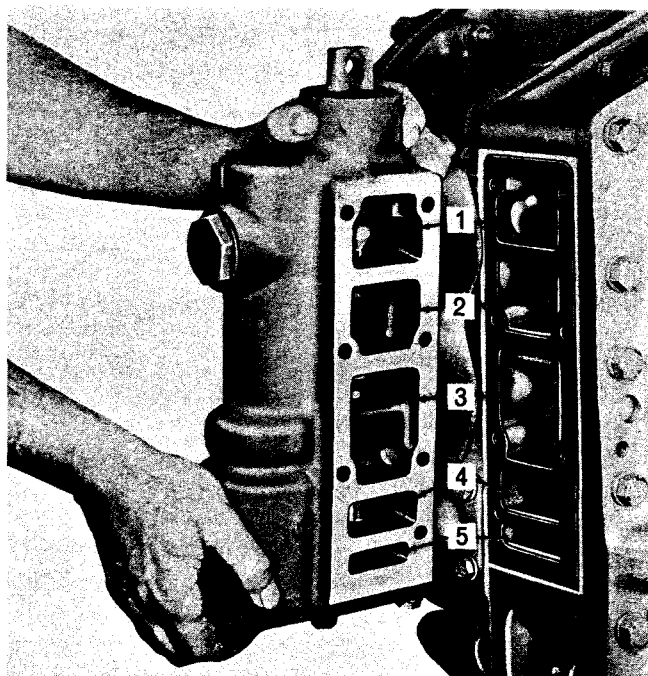
to figures 3-5 through 3-16 and to foldouts 3 and 4 to aid in tracing oil flow through the transmission. Use these aids in conjunction with the troubleshooting chart, at the end of this section.



S1529

- 1 - Booster signal
- 2 - Exhaust
- 3 - Oil pump supply
- 4 - Converter-in
- 5 - Governor (pitot)
- 6 - Main oil
- 7 - Pitot relief valve

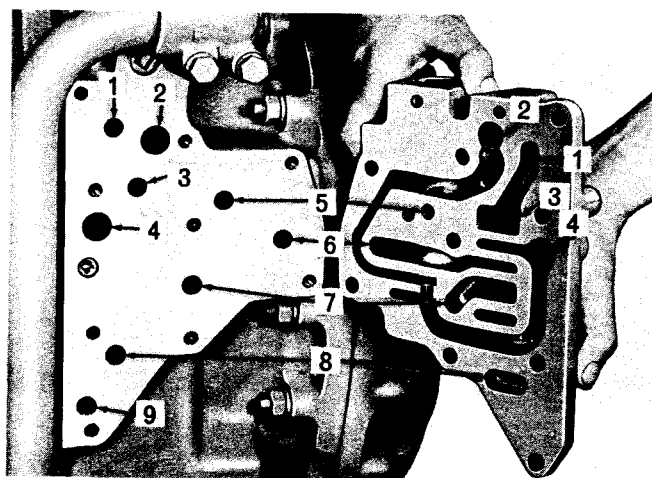
Fig. 3-5. Main-pressure regulator valve and mounting pad-oil passages



S1530

- 1 - Retarder-out
- 2 - Oil to cooler
- 3 - Retarder-in
- 4 - Exhaust to sump
- 5 - Exhaust to sump

Fig. 3-6. Retarder control valve and mounting pad-oil passages



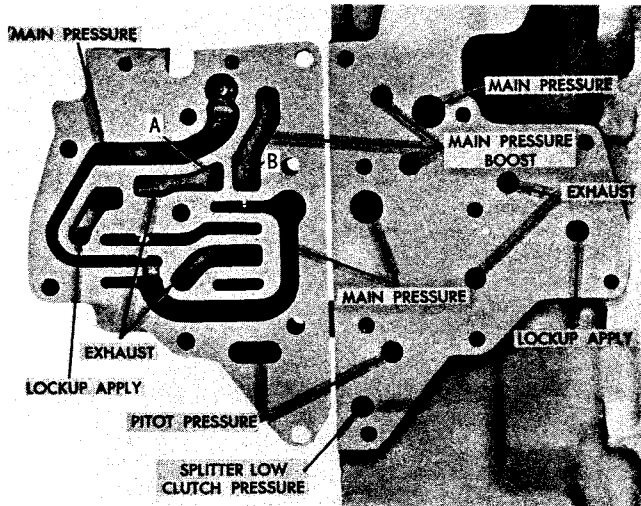
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- 1 - Main-pressure booster
- 2 - Selector valve
- 3 - Range selector booster
- 4 - Main pressure
- 5 - Flow valve exhaust
- 6 - Lockup clutch
- 7 - Lockup shift valve
- 8 - Governor (pitot)
- 9 - Low splitter

Fig. 3-7. Lockup valve assembly and mounting pad-oil passages



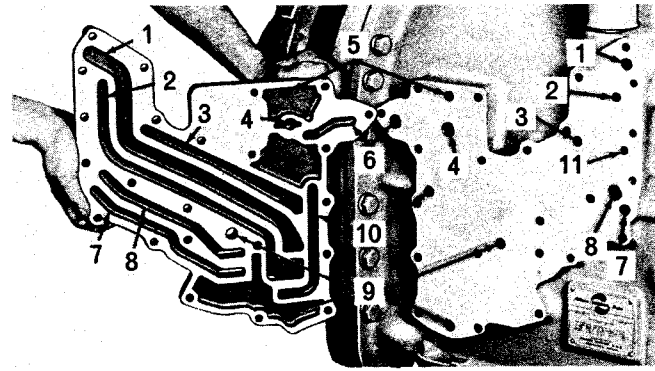
## Para 3-21



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When hole is at A, lockup can occur in all gears and neutral. When hole is at B, lockup can occur in all gears except first, reverse and neutral (5640, 5840), or in all gears and neutral except first and reverse (5660, 5860). When there are holes at both locations (A and B) lockup can occur in all gears and neutral except first and reverse (5660, 5860).

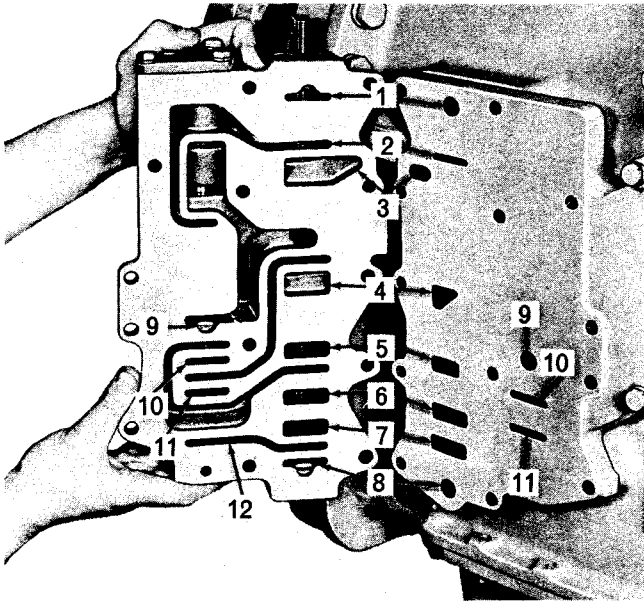
Fig. 3-8. Torque converter housing and lockup shift valve—oil passages



S1534

- 1 - Main oil
- 2 - Booster signal
- 3 - High range
- 4 - Intermediate range
- 5 - Exhaust
- 6 - Low range
- 7 - Low splitter
- 8 - High splitter
- 9 - Exhaust
- 10 - Reverse range
- 11 - Pitot

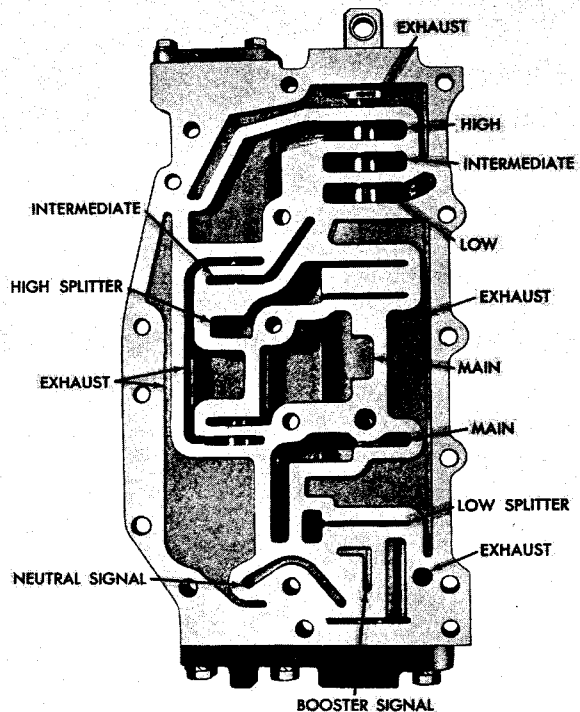
Fig. 3-10. Inner side of oil transfer plate and transmission housing (5640, 5840)—oil passages



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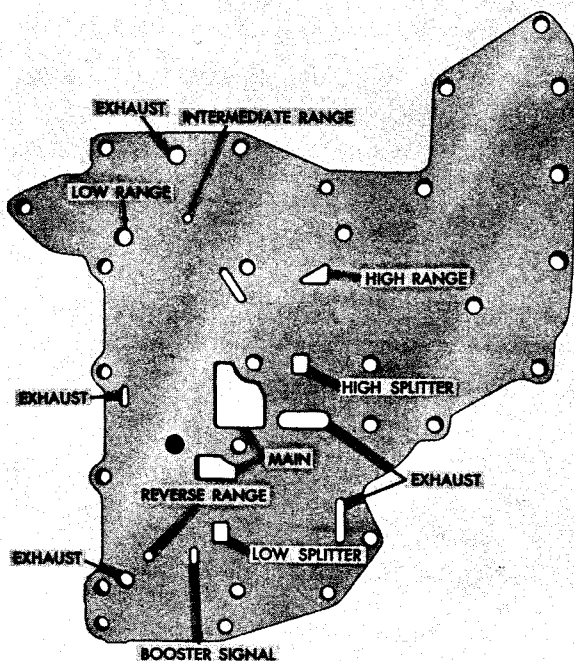
- 1 - Exhaust to sump
- 2 - Intermediate range
- 3 - Low range
- 4 - High range
- 4 - Main oil
- 6 - Booster signal pressure
- 7 - Reverse range
- 8 - Exhaust to sump
- 9 - Exhaust to sump
- 10 - High Splitter
- 11 - Low splitter
- 12 - Reverse relay feed

Fig. 3-9. Control valve body and outer side of oil transfer plate (5640, 5840)—oil passages



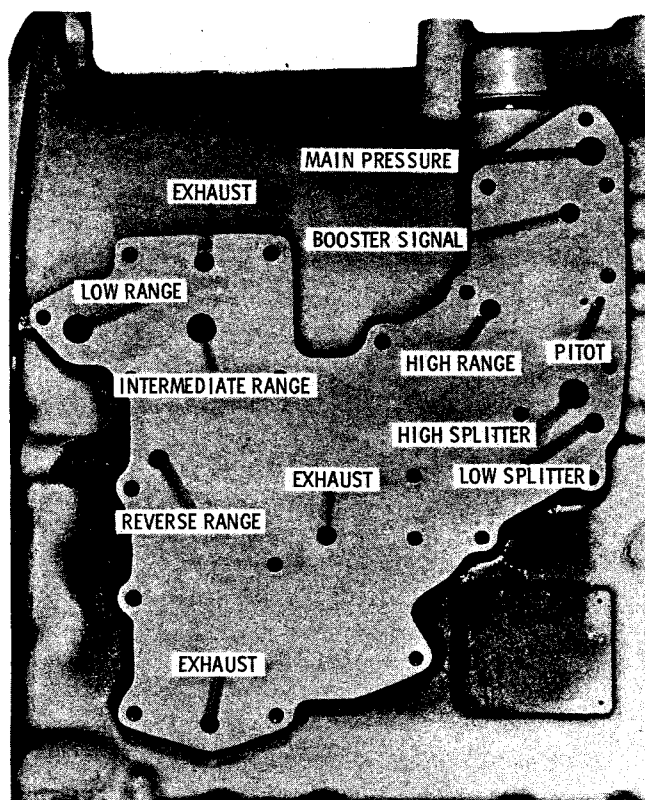
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Fig. 3-11. Control valve body (5660, 5860)—oil passages



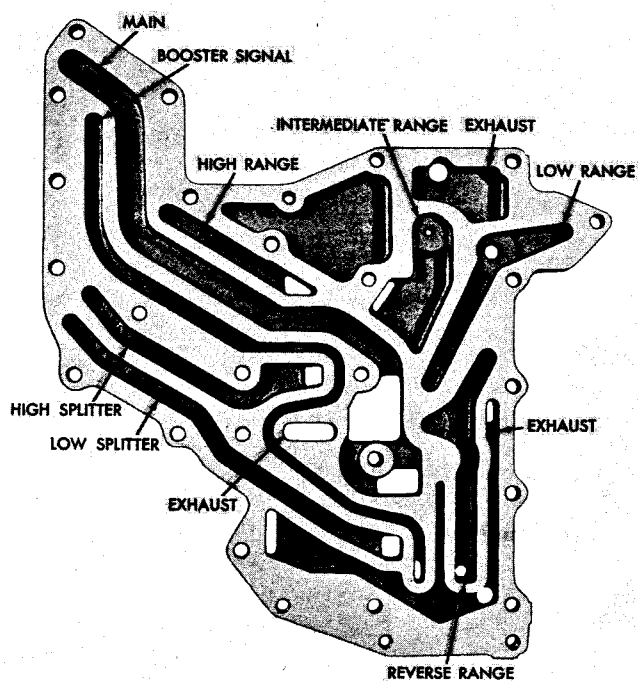
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Fig. 3-12. Outer side of oil transfer plate (5660, 5860)—oil passages



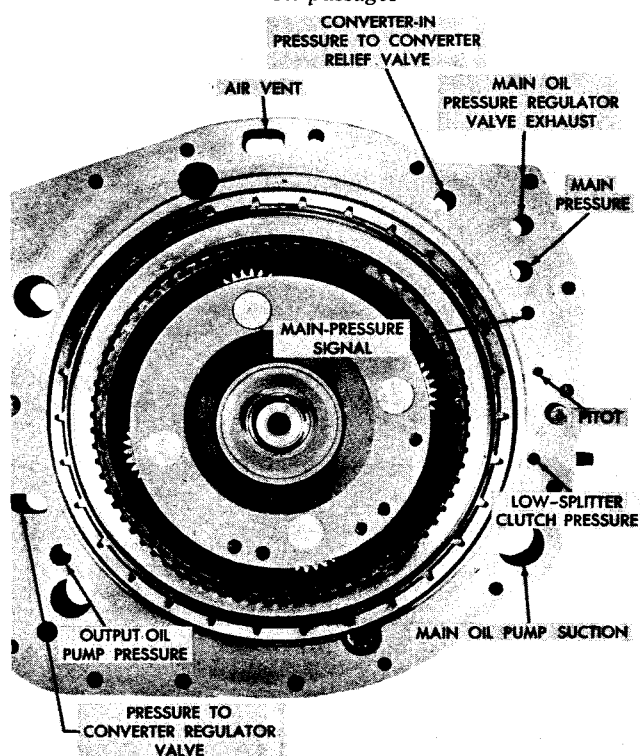
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Fig. 3-14. Transmission housing (5660, 5860)—oil passages



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Fig. 3-13. Inner side of oil transfer plate (5660, 5860)—oil passages



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Fig. 3-15. Rear of retarder housing (CBT, CLBT, VCLBT)—oil passages

## Para 3-22

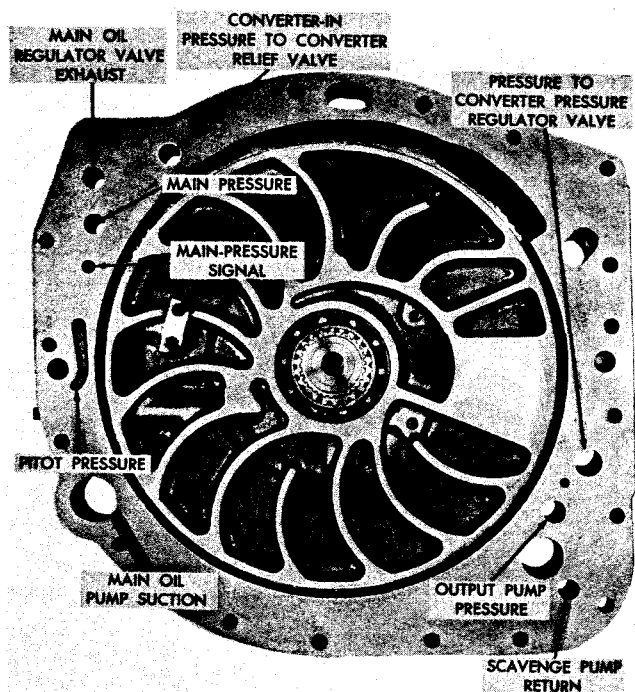


Fig. 3-16. Front of retarder housing (CBT, CLBT, VCLBT)—oil passages

## 3-22. TROUBLESHOOTING

a. **Preliminary Checks.** When any transmission malfunction occurs, the procedures, outlined below, should be performed first. All data should be written down for accurate evaluation. The results of the checks listed below, used in conjunction with the troubleshooting chart (b, below) will help locate the cause of trouble.

(1) Observe all safety rules such as blocking the vehicle while making checks.

(2) Use accurate instrument equipment—gages, tachometer, etc.

(3) Check oil level. Refer to paragraph 3-8, above.

(4) Check all control linkage. Refer to paragraph 3-11, above.

(5) Inspect engine and transmission mountings and mounting bolts.

(6) Perform vehicle stall check (if required). Refer to paragraph 3-19, above.

(7) Check transmission oil pressures and temperatures. Refer to paragraphs 3-12 through 3-17, above.

## b. Troubleshooting Chart

(1) The troubleshooting chart, which follows, will assist in locating sources of transmission troubles. It covers malfunctions of both the engine and transmission as they affect transmission performance. For details concerning engine troubles, refer to the engine service manual. A study of Section 2 of this manual will help locate troubles when using the troubleshooting chart.

(2) Items A through J, below, apply to the 5640, 5660, 5840 and 5860 model transmissions. Item K, below, applies only to the 5660 and 5860 transmissions. Item L, below, applies only to the 5640 and 5840 transmissions.

## TROUBLESHOOTING CHART

Cause	Remedy
<b>(A) LOW CONVERTER-OUT PRESSURE</b>	
1. Low oil level	1. Add oil (para 3-8)
2. Oil line leakage (remote-mounted cooler or filter)	2. Check for oil leaks—correct leaks
3. Plugged oil strainer	3. Clean strainer (para 4-6b)
4. Defective oil pump	4. Rebuild or replace oil pump assembly (para 6-17)
5. High oil temperature	5. Refer to B, Below
6. Foaming oil	6. Refer to E6, below
7. Secondary converter pressure regulator valve, stuck open	7. Remove hydraulic retarder valve body and repair valve (para 6-10)

TROUBLESHOOTING CHART—Continued

Cause	Remedy
<b>ⓑ HIGH OIL TEMPERATURE</b>	
1. Low oil level	1. Add oil (para 3-8)
2. High oil level	2. Drain to proper level; drain oil to Full mark (para 3-8)
3. Low water level in cooling system	3. Add water; check for leaks
4. Low main pressure	4. Refer to G, below
5. Low converter-out pressure	5. Refer to A, above
6. Clogged or dirty oil cooler	6. Clean or replace as necessary
7. One or both stators, locked	7. Refer to para 3-18 for checking and to D3, below, for corrective action
8. Operating too slow in the gear selected	8. Downshift at a higher speed
9. Stators interchanged	9. Refer to D3, below
10. Stator(s) installed without rollers	10. Refer to D4, below
11. Vehicle brakes dragging	11. Check parking and service brakes
12. Clutch slipping	12. Refer to C4, below
13. Restricted oil lines (remote filter or cooler)	13. Clean or replace lines as necessary
<b>ⓒ HIGH ENGINE SPEED AT CONVERTER STALL</b> (refer to para 3-19 for stall test information)	
1. Low oil level	1. Add oil (para 3-10c)
2. Low converter-out pressure	2. Refer to A, above
3. High oil temperature (above 250°F)	3. Refer to B, above
4. Clutch slipping—main-pressure normal	4. Replace clutch piston seal rings or clutch plates
5. Foaming oil	5. Refer to E6, below
<b>ⓓ LOW ENGINE SPEED AT CONVERTER STALL</b> (Refer to para 3-19 for stall test information)	
1. Low engine output torque	1. Tune engine and check output
2. Converter element interference	2. Check for noise at stall; overhaul converter if necessary (Sect. 5, 6 and 7)
3. Stators interchanged	3. Assemble stators correctly (para 6-15)
4. Stators installed without rollers	4. Install rollers (para 6-15)
5. Transmission oil not up to operating temperature	5. Warm up transmission to 160° to 200°F

(Continued on next page)

## TROUBLESHOOTING CHART—Continued

Cause	Remedy
<b>(E) LOSS OF POWER</b>	
1. Low engine speed at converter stall	1. Refer to D, above
2. High engine speed at converter stall	2. Refer to C, above
3. Manual selector valve not positioned properly	3. Check linkage (para 3-11a)
4. Hydraulic retarder partially applied	4. Check linkage (para 3-11b)
5. Vehicle brakes dragging	5. Check parking and service brakes
6. Foaming oil	6. a. Check for low oil level; add oil (para 3-8) b. Check for worn input oil pump; rebuild or replace pump assembly (para 6-17) c. Check for air leaks at input oil pump; correct leaks d. Check for water in oil; correct cause; clean system e. Check for high oil level; drain to proper level (para 3-8)
<b>(F) NO POWER TRANSMITTED IN ANY RANGE</b>	
1. Driveline failure	1. Check input and output of transmission
2. Manual selector valve not positioned properly	2. Check linkage; correct defects (para 3-11a)
3. Low oil level	3. Add oil (para 3-8)
4. Low main pressure	4. Refer to G, below
5. Failed piston seals	5. Overhaul transmission (Sect. 5, 6, 7)
6. Broken transmission shaft	6. Overhaul transmission (Sect. 5, 6, 7)
<b>(G) LOW MAIN PRESSURE</b>	
1. Low oil level	1. Fill to proper level (para 3-8)
2. Leaks in hydraulic system	2. Check all external points for leaks; check each range for localizing internal leaks
3. Failure in pressure regulator	3. Overhaul valve assembly (para 6-5)
4. Worn input oil pump assembly	4. Rebuild or replace pump assembly (para 6-17)
5. Clogged oil strainer	5. Clean strainer (para 4-6b)
6. Air leaks at suction side of input pump	6. Check input pump; correct leaks
<b>(H) NO POWER TRANSMITTED IN ONE RANGE</b>	
1. Manual selector linkage out of adjustment	1. Adjust linkage (para 3-11a)
2. Low main pressure in one range	2. Check for worn piston seals or broken housing (Sect. 5, 6, 7)
3. Clutch slipping	3. Replace clutch piston seal rings or clutch plates (Sect. 5, 6, 7)
<b>(I) SLOW CLUTCH ENGAGEMENT</b>	
1. Low oil level	1. Fill to proper level (para 3-8)
2. Foaming oil	2. Refer to E6, above
3. Worn piston seals	3. Overhaul transmission (Sect. 5, 6, 7)
4. Low main pressure	4. Refer to G, above

TROUBLESHOOTING CHART—Continued

Cause	Remedy
<b>(J) FAILURE TO PUSH START</b>	
1. Engine does not turn when vehicle is pushed	1. a. Low oil level; fill to proper level (para 3-8) b. Manual selector valve in neutral; shift to second gear (para 1-6d) c. Check to determine if engine is locked d. Check for clogged hydraulic passages e. Check for worn output oil pump (para 6-17) f. Check for driveline failure; determine if transmission output flange turns during pushing operation g. Check for slippage of either the direct drive or intermediate-range clutch by shifting to the highest gear (fourth or sixth) h. Check for slippage of intermediate-range clutch only by shifting to first gear
<p style="text-align: center;"><b>NOTE</b></p> <p>Beginning with transmission S/N 47641, a push-start pump is not included. Thus the vehicle cannot be push started.</p>	
<b>(K) MODELS 5660 AND 5860 TRANSMISSION</b>	
1. TRANSMISSION LOCKED IN ALL GEARS	
Indicates failed transmission parts and overhaul is required (refer to Sect. 5 through 8).	
2. VEHICLE DRIVES IN FIRST AND SECOND GEARS AND MOVES FORWARD IN NEUTRAL WHEN ENGINE IS ACCELERATED, BUT STALLS IN EVERY OTHER GEAR WHEN ENGINE IS ACCELERATED	
Low-range clutch has failed (won't release) and transmission must be overhauled (refer to Sect. 5 through 8).	
3. VEHICLE DRIVES IN THIRD AND FOURTH GEARS AND MOVES FORWARD IN NEUTRAL WHEN ENGINE IS ACCELERATED, BUT STALLS IN EVERY OTHER GEAR WHEN ENGINE IS ACCELERATED	
Intermediate-range clutch has failed and transmission must be overhauled (refer to Sect. 5 through 8).	
4. VEHICLE DRIVES IN FIFTH AND SIXTH GEARS AND MOVES FORWARD IN NEUTRAL WHEN ENGINE IS ACCELERATED, BUT STALLS IN ALL OTHER GEARS WHEN ENGINE IS ACCELERATED	
High-range clutch has failed and transmission must be overhauled (refer to Sect. 5 through 8).	
5. VEHICLE DRIVES IN REVERSE AND MOVES BACKWARD IN NEUTRAL WHEN ENGINE IS ACCELERATED, BUT STALLS IN ALL OTHER GEARS WHEN ENGINE IS ACCELERATED	
Reverse clutch has failed and transmission must be overhauled (refer to Sect. 5 through 8).	
6. VEHICLE WILL OPERATE IN SECOND, FOURTH AND SIXTH GEARS BUT WILL NOT OPERATE IN ALL OTHER GEARS	
High-splitter clutch has failed and transmission must be overhauled (refer to Sect. 5 through 8).	

**NOTE**

"Failed," in respect to clutches, as used in 2 through 6, above, does not indicate slippage. It indicates that the clutches are not releasing—that they are locked in some way.

(Continued on next page)

## TROUBLESHOOTING CHART—Continued

7. VEHICLE WILL OPERATE IN FIRST, THIRD AND FIFTH GEARS BUT WILL NOT OPERATE IN ALL OTHER GEARS

Low-splitter clutch will not release or there is oil leakage of high-splitter clutch piston seals; overhaul transmission (refer to sect. 5 through 8).

(L) MODELS 5640 AND 5840 TRANSMISSIONS

1. TRANSMISSION LOCKED IN ALL GEARS

Indicates failed transmission parts and overhaul is required (refer to Sect. 5 through 8).

2. VEHICLE DRIVES IN FIRST GEAR AND MOVES FORWARD IN NEUTRAL WHEN ENGINE IS ACCELERATED, BUT STALLS IN EVERY OTHER GEAR WHEN ENGINE IS ACCELERATED

Low-range clutch has failed (won't release) and transmission must be overhauled (refer to Sect. 5 through 8).

3. VEHICLE DRIVES IN SECOND GEAR AND MOVES FORWARD IN NEUTRAL WHEN ENGINE IS ACCELERATED, BUT STALLS IN EVERY OTHER GEAR WHEN ENGINE IS ACCELERATED

Intermediate-range clutch has failed and transmission must be overhauled (refer to Sect. 5 through 8).

4. VEHICLE DRIVES IN THIRD AND FOURTH GEARS AND MOVES FORWARD IN NEUTRAL WHEN ENGINE IS ACCELERATED, BUT STALLS IN ALL OTHER GEARS WHEN ENGINE IS ACCELERATED

High-range clutch has failed and the transmission must be overhauled (refer to Sect. 5 through 8).

5. VEHICLE DRIVES IN REVERSE GEAR AND MOVES BACKWARD IN NEUTRAL WHEN ENGINE IS ACCELERATED, BUT STALLS IN ALL OTHER GEARS WHEN ENGINE IS ACCELERATED

Reverse-range clutch has failed and transmission must be overhauled (refer to Sect. 5 through 8).

6. VEHICLE DRIVES IN FIRST, SECOND, THIRD AND REVERSE GEARS, BUT STALLS IN FOURTH GEAR WHILE MOVING OR WHEN ATTEMPTING TO MOVE THE VEHICLE; ACTION IN NEUTRAL IS NORMAL

Low-splitter (direct drive) clutch has failed and transmission must be overhauled (refer to Sect. 5 through 8).

7. VEHICLE DRIVES IN FOURTH GEAR, BUT STALLS IN NEUTRAL AND ALL OTHER GEARS WHILE MOVING OR WHEN ATTEMPTING TO MOVE THE VEHICLE

High-splitter (overdrive) clutch has failed and transmission must be overhauled (refer to Sect. 5 through 8).

(M) ELECTRIC SHIFT PROBLEMS

1. Improper shifting

1. Refer to supplement at the back of the manual.

NOTE

"Failed," in respect to clutches, as used in 2 through 7, above, does not indicate slippage. It indicates that the clutches are not releasing—that they are locked in some way.

## Section 4. GENERAL OVERHAUL INFORMATION

### 4-1. SCOPE OF SECTION 4

This section covers items and information necessary to effectively overhaul the transmission. Changed, or new procedures, required for models not covered in this manual are discussed. Removal of the transmission is covered in the vehicle service manual. Tools and equipment required for overhaul are listed, and special tools illustrated. Instructions for ordering parts are included. Cleaning, inspection and wear limits are discussed. Removal and installation of interference-fit flanges, and shimming of output flanges are covered. PTO backlash measurement is outlined. Standard torque specifications are tabulated.

### 4-2. PROCEDURES SUBJECT TO CHANGE

Because of the release of new models, and changes in current models, instructions in this manual are subject to change. Major changes are made available in supplemental information form at your dealer or distributor. Always check with your dealer for this type of information. When requesting service information, be sure to include the part number, serial number and model number of your transmission, found on the transmission nameplate (fig. 1-5).

### 4-3. REMOVAL OF TRANSMISSION FROM VEHICLE

Refer to the vehicle manufacturer's service manual for the removal and installation of the transmission.

### 4-4. TOOLS, EQUIPMENT

**a. Tools.** A minimum number of special and improvised tools are required for overhaul procedures (fig. 4-1 through 4-5). Tools having numbers with a J prefix may be ordered from Service Tool Division, Kent-Moore Corp., Warren, Michigan. If spanner wrench J 6534-02 is fabricated, refer to figure 4-2 for specifications. Refer to the special tools chart at the end of this section for a list of tools and references to their uses. The special tools and

test equipment required to service the electric-shift control systems are defined in the supplement at the back of this manual.

**b. Equipment Needed.** Before overhaul is started, proper equipment should be available—a suitable hoist (2-ton capacity), proper hand tools, receptacles for small parts, an arbor press, and a transmission work table (fig. 4-6).

**c. Careful Handling.** Handle the transmission parts with care. Nicks, dents, or scratches caused by careless handling of parts can cause subsequent transmission failure.

### 4-5. PARTS REPLACEMENT

Replace all gaskets and sealrings. If the transmission has been overheated, replace all springs. Handle all sealrings with care to avoid damage. Refer to paragraph 1-4 for ordering parts.

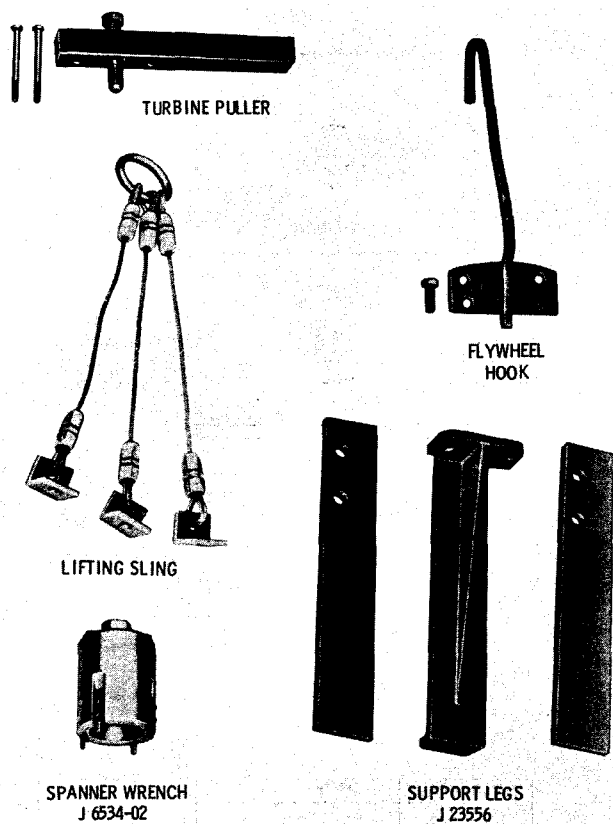


Fig. 4-1. Special tool group

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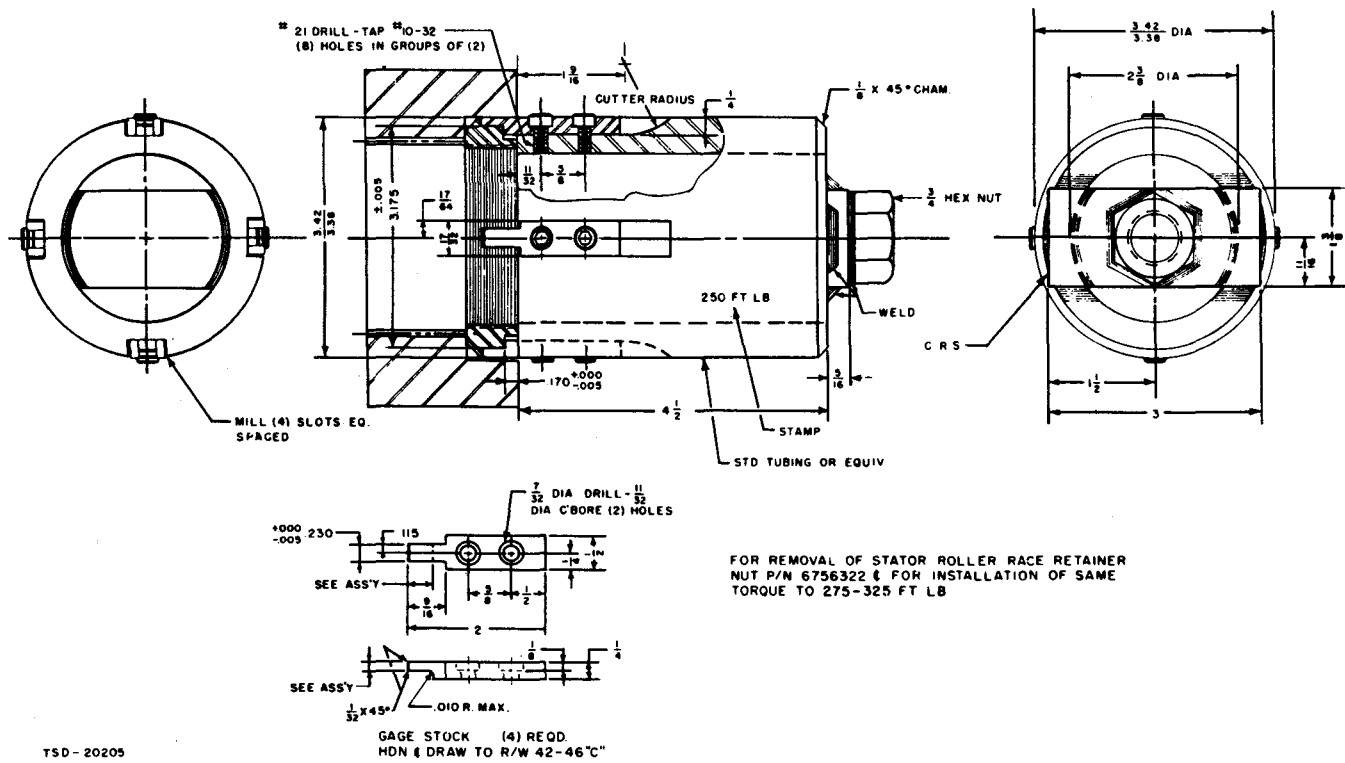
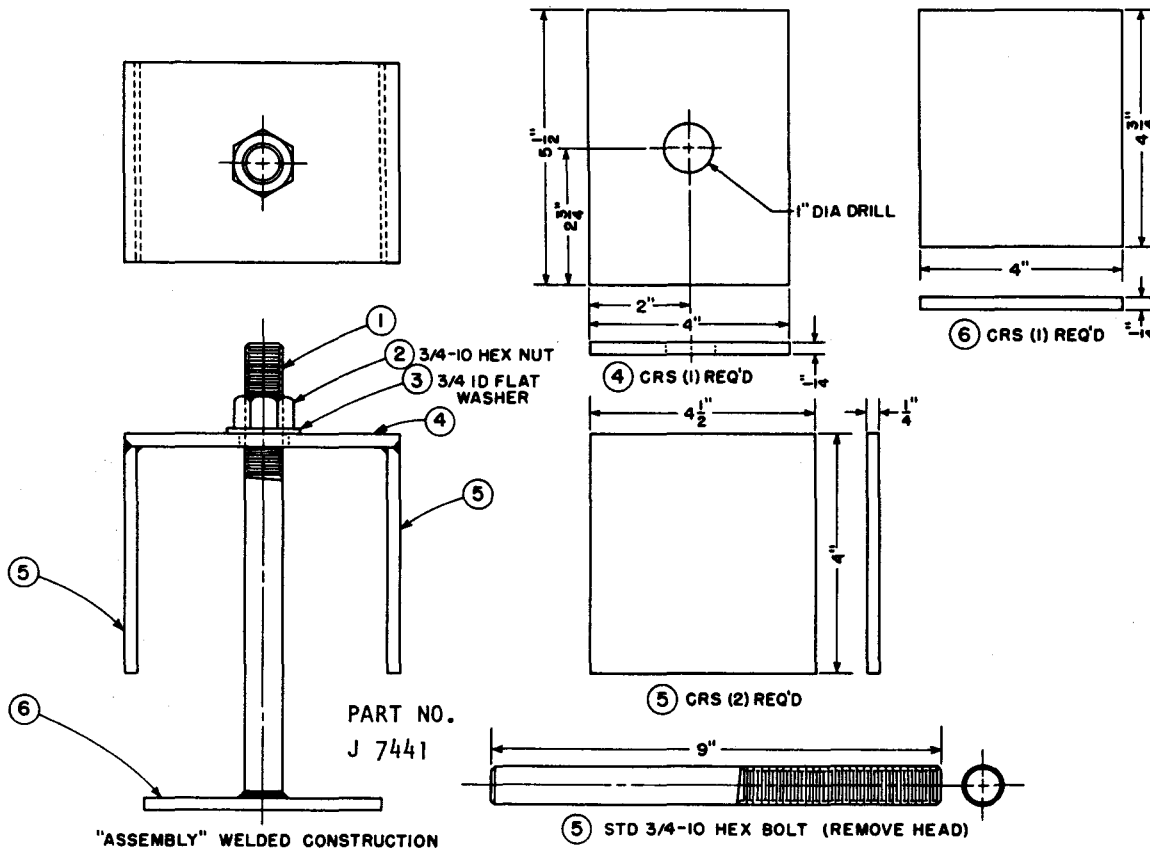


Fig. 4-2. Spanner wrench for roller race retaining nut

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## GENERAL OVERHAUL INFORMATION

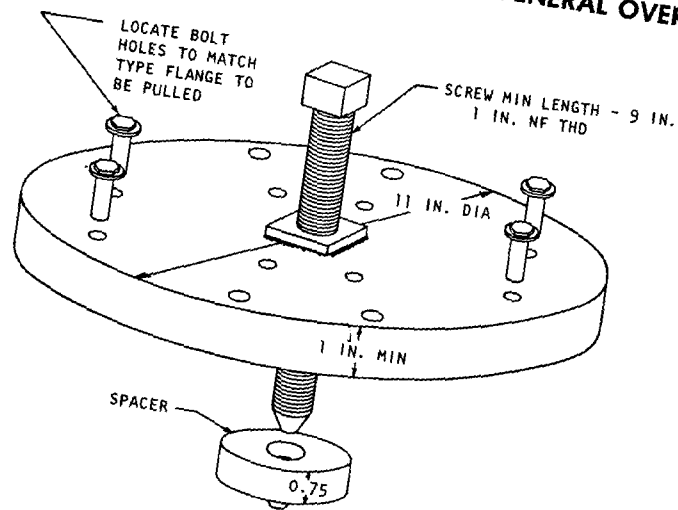


Fig. 4-4. Puller for interference-fit flanges

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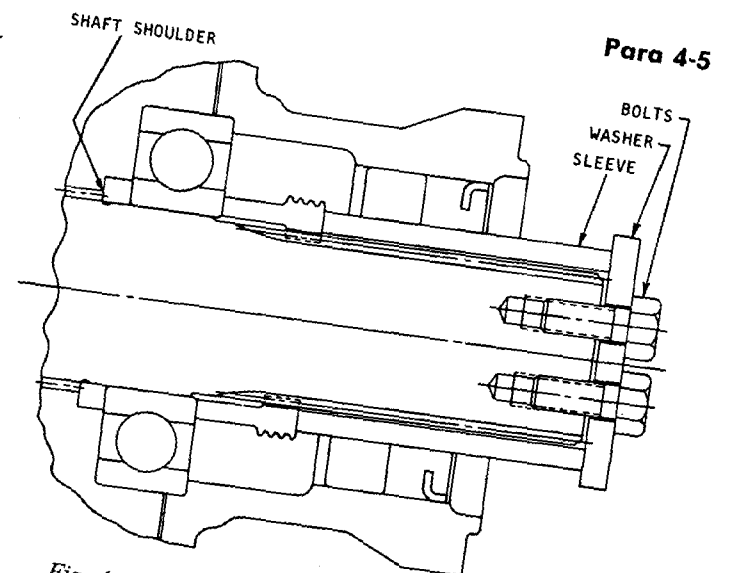


Fig. 4-5. Sleeve for positioning parts against shaft shoulder

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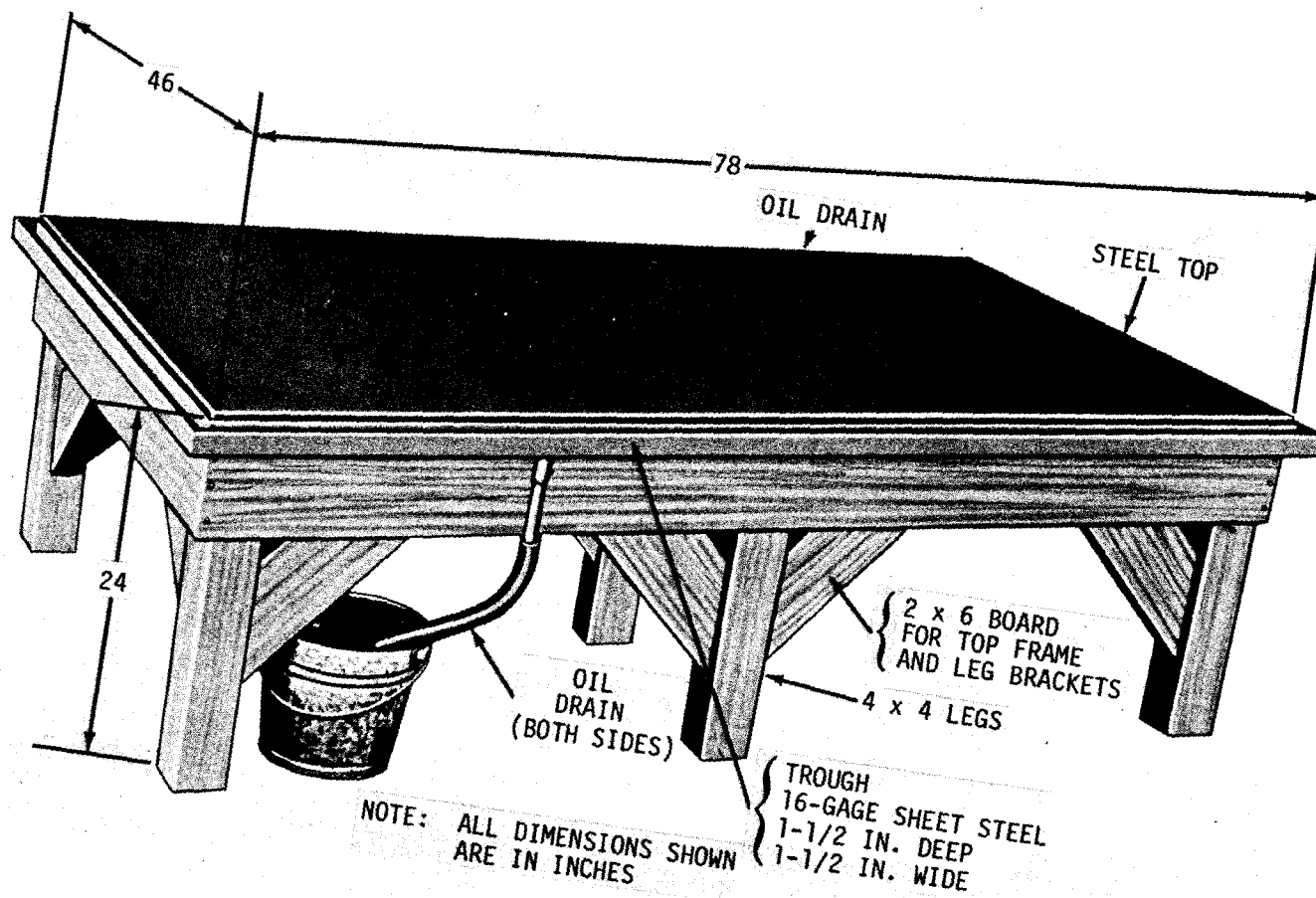


Fig. 4-6. Transmission disassembly and assembly table

## Para 4-6

**4-6. CLEANING, INSPECTION**

**a. Dirt, Abrasives Harmful.** Whenever the transmission contains dirt or other abrasive matter, unnecessary wear will result. At disassembly, check all parts for presence of abrasive material. Metallic contamination of oil is evidence of the failure of some part. If metal particles (other than minute particles normally trapped in the oil filter) are found, both the transmission and torque converter assembly must be thoroughly cleaned. Refer to paragraph 3-5.

**b. Cleaning Parts**

(1) All metallic parts of the transmission should be cleaned thoroughly with dry-cleaning solvent, volatile mineral spirits, paint thinner, or (except bearings) by the live steam-cleaning method. Do not use caustic soda solution for steam cleaning.

(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 wire back and forth through the passages and flushing them with cleaning solvent or paint thinner. Dry the passages with compressed air.

(4) Examine parts, especially oil passages, after cleaning to make certain they are entirely clean and reclean them if necessary.

**c. Cleaning Bearings**

(1) Thoroughly wash bearings (that have been in service) in dry-cleaning solvent, volatile mineral spirits, or paint thinner.

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

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

**NOTE**

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

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

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

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

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

(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.

**e. Inspecting Cast Parts, Machined Surfaces**

(1) Inspect bores for wear, grooves, scratches, 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 wire back and forth through the passage and flushing it with cleaning solvent.

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

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

(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 the defective parts.

**f. 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 a defective bearing's housing and shaft for grooved, burred or galled conditions that would indicate that 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 300°F if suitable facilities, such as an electric oven, are available. Coat the mating surfaces with white lead and use the proper size installation sleeve and an arbor press to seat the bearing.

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

#### g. Inspecting Bushings, Thrust Washers

(1) Inspect bushings for scores, burs, roundness, 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.

#### 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. It is much less expensive to replace such parts than to replace converter elements or transmission gearing, which can fail due to defective bearings, bushings, or thrust washers.

#### h. Inspecting Seals, Gaskets

(1) Inspect sealrings for scoring, cuts and hardness. If these defects are found, replace sealrings.

(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 circumference of the seal to help prevent oil leaks.

(3) Replace all composition gaskets.

(4) Inspect hook-type sealrings for wear or broken hooks.

(5) If a hook-type sealring shows any signs of wear on the outside diameter, replace the sealring.

(6) The sides of the sealring should be smooth (0.005-inch maximum side wear). The sides of the shaft groove (or the bore) in which the

sealring fits should be smooth (50 microinches equivalent), and square (within 0.002 inch) with the axis of rotation. If the sides of the ring grooves have to be reworked, install a new sealring. A new sealring should be installed if shaft grooves are reworked, or sealring outside diameter wear causes possibility of closing the gap between the sealring hooks when the ring is installed.

#### i. Inspecting Gears

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

j. **Inspecting Splined Parts.** Inspect splined parts for stripped, twisted, chipped, or burred splines. Remove burs with a soft stone. If other defects are found, replace the part. Spline wear is not considered detrimental except where it affects tightness of an assembly, such as driveline flanges.

k. **Inspecting Threaded Parts.** Inspect parts for burred or damaged threads. Remove burs with a soft stone or fine file. Replace damaged parts.

l. **Inspecting Snaprings.** Inspect all snaprings for nicks, distortion, and excessive wear. Replace the part if one of these defects is found. The snapring must snap tight in its groove for proper functioning.

m. **Inspecting Springs.** Inspect springs for signs of overheating, permanent set or wear due to rubbing of adjacent parts. Replace the spring if any one of these defects is found. Refer to the spring chart (para 8-4) for spring specifications.

### 4-7. WEAR LIMITS

Refer to Section 8 for general and specific information covering parts fits and clearances.

### 4-8. REMOVAL AND INSTALLATION PROCEDURES FOR TIGHT-FIT FLANGES

The following procedures are recommended for units using tight-fit flanges.

## Para 4-8

## a. Removal

(1) Install a suitable heavy-duty puller to the face of the flange. A typical puller is illustrated in figure 4-4.

**CAUTION**

A puller that pulls directly against the outside diameter of the flange may deform the pilot diameter and mounting face.

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

(3) Provide a means for preventing flange rotation.

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

**CAUTION**

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

## b. Installation

(1) Make sure that the input shaft is in its most outward position and the bearing between the shaft shoulder and the flange is tight against the shaft shoulder. A typical method is to insert a sleeve over the shaft and pull tight with bolts and washers as illustrated in figure 4-5. Although figure 4-5 illustrates installation of an output flange, the procedure is the same for all flanges.

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

(3) Heat the flange to a minimum of 250°F prior to assembly. Two methods for heating are suggested as follows:

(a) Heat in a controlled temperature furnace for a minimum period of 30 minutes.

(b) Submerge the flange in a container of oil and heat the oil (if acetylene torch is used, heat the container of oil for 15 minutes).

(4) Immediately upon removing the flange from the heat source, install the flange on the shaft, making sure that the flange is tight against its locating shoulder. The flange should slide freely to its assembled position.

**CAUTION**

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

(5) Install the flange retaining nut, or washer and bolts to draw the flange down into final position. If bolts are used, remove them and install the lockstrip (and shims, if used). The shim pack thickness can be determined as illustrated in figure 4-7.

(6) Shims are available in two thicknesses (0.005 and 0.025). Use the proper combination of shims to allow 0.008 to 0.012 inch between face A (fig. 4-7) and surface of the shim pack.

(7) After the assembly has cooled, it is good practice to check the bolt torque and, if necessary, retorque to 96 to 115 pound feet. If the flange is retained by a nut, check it for 700 to 1000 pound feet torque.

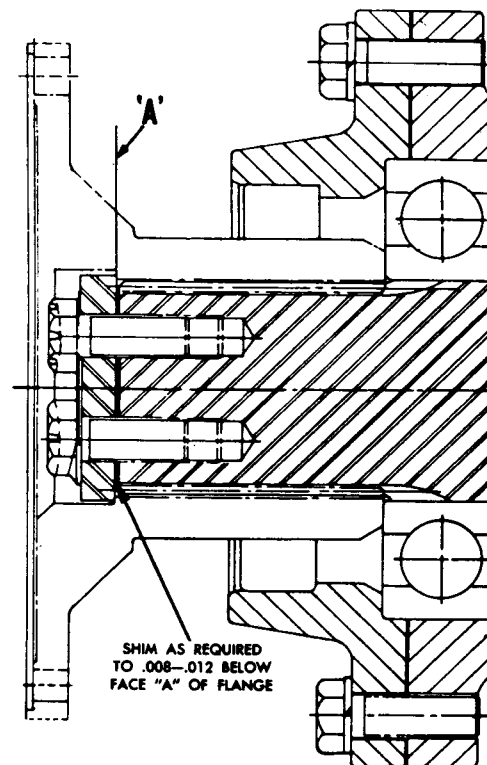


Fig. 4-7. Measurement to determine flange shim thickness

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**4-9. DETERMINING PTO BACKLASH LIMITS**

a. **Proper Backlash Important.** Upon installation of a power takeoff (PTO) assembly, it is important that the proper backlash between the assembly and transmission drive gear is provided. Either excessive or insufficient backlash in the PTO gear train can result in damage to the transmission and PTO assembly.

b. **How to Determine.** Where proper instructions are not available from the vehicle manufacturer, the following method is suggested.

(1) Determine the backlash between the drive gear and the driven gear in the transmission. Call this quantity A.

(2) Determine the backlash between the drive gear and the driven gear in the PTO assembly. Call this quantity B.

(3) Install PTO on the transmission and determine the total backlash in the gear train. Call this quantity C.


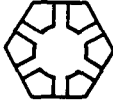
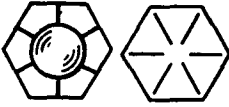
(4) Add quantity A to quantity B, then subtract the sum from quantity C. The remainder will be the backlash between the transmission gear and the PTO gear. Call this quantity D. For safe operation, the value of D should be 0.005 to 0.025. The formula is stated:  $D = C - (A + B)$ .

**4-10. TORQUE SPECIFICATIONS**

Unless otherwise specified, the torque specifications listed in the following chart will apply to all assembly procedures. Refer to figure 6-24 for a cross-section view of the transmission, indicating the torque values for all bolts shown.

**GENERAL TORQUE SPECIFICATIONS—BOLTS, SCREWS AND NUTS**

(All torque values are given in pounds feet)

Size	Threads per inch	Standard heat-treated bolts and screws	Special heat-treated bolts, screws, Allen-head screws, and self-locking capscrews	Standard nuts on bolts
			 	
1/4	20	6-8	9-11	
	28	8-10	10-12	
5/16	18	13-16	17-20	
	24	14-18	19-23	
3/8	16	26-32	36-43	
	24	33-40	41-49	
7/16	14	42-50	54-65	42-50
	20	50-60	64-77	25-30
1/2	13	67-80	81-97	
	20	83-100	96-115	
9/16	12	85-100	103-123	
	18	100-120	122-146	
5/8	11	117-140	164-192	
	18	134-160	193-225	134-160
3/4	10	180-210	284-325	
	16	215-250	337-385	