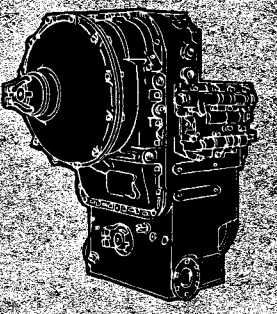
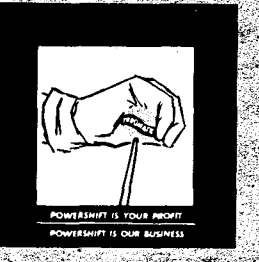
SERVICE MANUAL



SERIES "T" 725

Allison

TORQMATIC
Hydro POWERSHIFT
TRANSMISSIONS



SERVICE MANUAL

SERIES TT 2220

Allison

TORQMATIC
Hydro POWERSHIFT
TRANSMISSIONS

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by

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Section I GENERAL INFORMATION

1. SCOPE OF MANUAL

a. Coverage. This service manual covers the description, operation, maintenance and overhaul of Series TT 2220 Allison Torqmatic Hydro POWERSHIFT transmission assemblies. In addition to general description and data, each functional component group is described and its operation explained. Hydraulic systems and the flow of torque through the transmission are explained (sect. II, para 14 through 26). Helpful tips on operation and maintenance are given. Disassembly, rebuild and assembly procedures are covered. Wear limits information and torque specifications are covered in tabular form (sect. VIII).

b. Arrangement

(1) Eight sections. Eight sections, in which pages and illustrations (figures) are numbered beginning with "1" in each section make up the text of the manual. Page and illustration numbers are prefixed with the applicable section Roman numeral.

(2) Section content. Sect. I contains general information, specifications and tabulated data. Sect. II describes components and explains their operation. Sect. III outlines preventive maintenance procedures. Sect. IV gives information preliminary to overhaul procedures. Sect. V covers disassembly of the transmission into subassemblies. Sect. VI outlines the rebuild of subassemblies. Sect. VII covers the assembly of the transmission from subassemblies. Sect. VIII contains wear limits information as well as a tabulated list.

(3) Foldout illustrations. Seven foldout illustrations at the back of the manual include a cross-section view of the transmission and exploded views showing all parts in their assembly relation to each other.

2. ASSEMBLY DIFFERENCES

The model TT 2220-1 transmission (fig. I-1 and I-2) is available with a variety of optional features. The choice of these optional features determines the transmission assembly number. This manual covers the basic transmission assembly as well as all options (para 7, below) available at the time of the manual's preparation.

3. SUPPLEMENTARY INFORMATION

When new models and/or assemblies are offered, which have features not covered in this manual, or when design changes are introduced, supplementary information will be issued.

4. MODEL DESIGNATION

a. Importance of Model Designation. Transmission configurations may be identified by the model designation on the name plate,

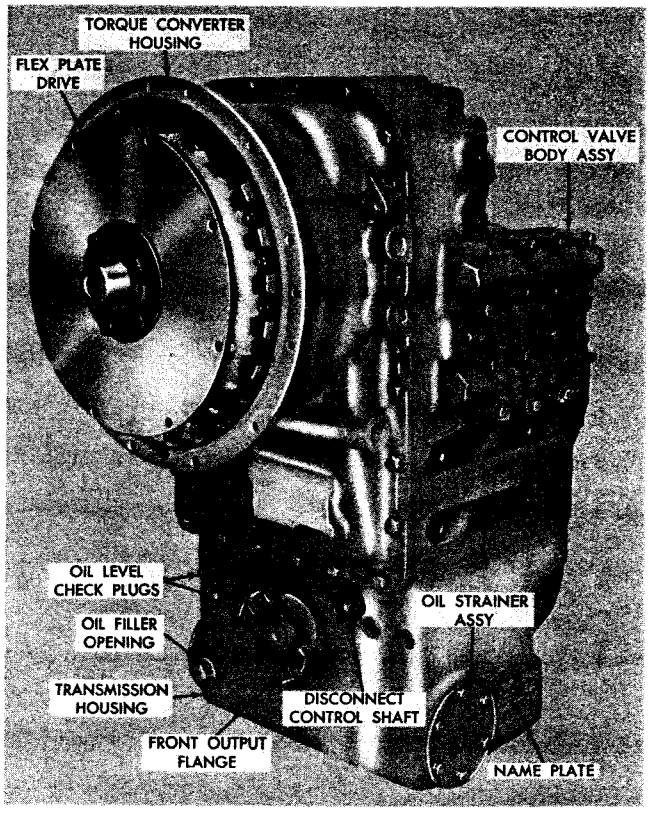

Fig. I-1. Model TT 2220-1 transmission, direct mount—left-front view

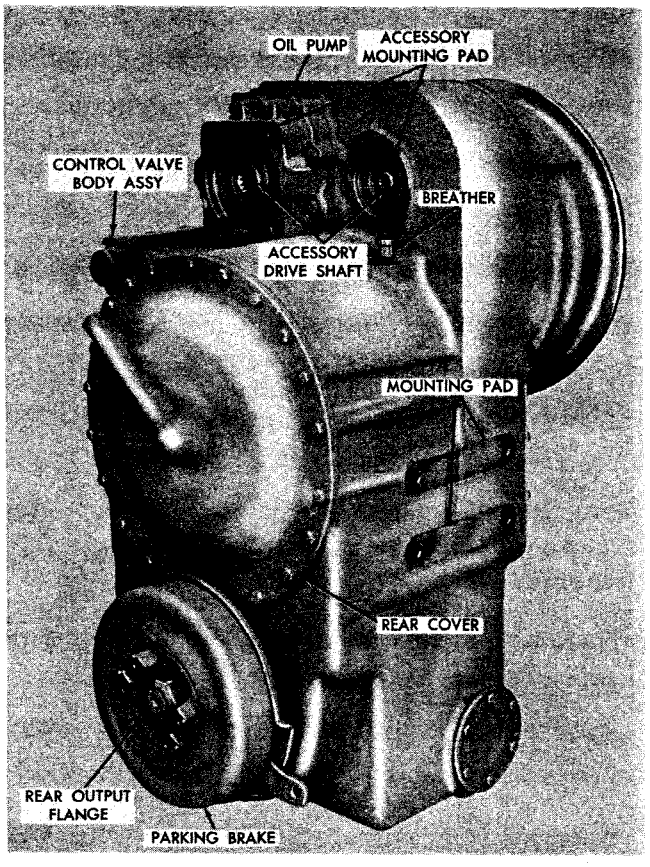

Fig. I-2. Model TT 2220-1 transmission, direct mount—right-rear view

located at the lower-left side of the transmission housing (fig. I-1). This model designation, the transmission assembly number, and the serial number must be given when communicating with the dealer concerning the transmission. Refer to para 5, below, and to fig. I-3.

b. Meaning of Letters, Numbers. In the model designation TT 2220-1, the letters and numbers indicate the following:

TT – two turbines
First 2 – 2000 series transmission
Second 2 – 200 series torque converter
Third 2 – number of forward ranges
0 – model change (none)
-1 – drop box model (includes output transfer gears)

Note: Any TT 2220 series transmission for which the model is other than TT 2220-1 will require some supplementary information to this manual.

5. ORDERING PARTS

a. Parts Catalog. All replacement parts should be ordered from your Torqmatic dealer. Parts catalog SA 1133 lists replacement parts. Do not order parts by illustration item identification in this manual.

b. Service Kits. Repair and overhaul parts kits are available for some subassemblies. The kits also are listed in catalog SA 1133 and should be ordered from your Torqmatic dealer.

c. Name Plate. As mentioned in para 4a, above, the name plate (fig. I-3) gives the transmission model number, serial number and part number. To insure that the correct parts for your transmission will be supplied, furnish all three of these numbers when ordering.

6. CONSTRUCTION FEATURES

a. General. The TT 2220 series transmissions have a 4-element torque converter (foldout 1) geared to the range gearing. Two converter transfer gear sets 8, 22, 25 and 26 connect turbines 2 and 3 to range gear input shaft 23 (second-turbine driven gear). Lower ratio gear set 8 and 22 is connected by turbine freewheel clutch 24. Thus, two gear ratios are available between the converter and range gearing. The gear ratio which transmits torque is determined automatically by speed and load demands.

Fig. I-3. Transmission name plate

b. Mounting and Input Drive. The transmission may be remote-mounted (foldout 1) and connected to the engine by a shaft from the engine to input drive flange 1. Or, the transmission may be bolted directly to the engine and coupled to the engine flywheel by flexible drive disks 3 and 4 (B, foldout 2).

c. Torque Converter and Gearing. There are four elements in the torque converter – pump, first turbine, second turbine, and stator. The first turbine, assisted by the second turbine as output speed increases, drives the range gearing when speeds are low and load demand is high. The second turbine automatically takes over and transmits all of the drive to the range gearing when speed increases and load demand lessens. The first turbine freewheels when the second turbine transmits all of the drive to the range gearing. Gears 8 and 22 (foldout 1) and turbine freewheel clutch 24 transmit torque from the first turbine to the range gearing. Gears 25 and 26 transmit torque from the second turbine to the range gearing.

d. Range Gearing and Clutches. The output from both of the two torque converter turbines is transmitted to the range-gear section which consists of reverse-range planetary 10 (foldout 1) and clutch 9; forward-range planetary 12 and clutch 11; and high-range clutch 13. The engagement of a clutch will produce reverse-, forward-1 or forward-2 range.

e. Transfer Gearing and Housing. Two gears 14 and 15 (foldout 1), between high-range clutch 13 and output shaft 17 transmit torque to output drive flanges 16 and 20. The transmission housing extends downward to enclose these gears, output shafts 17 and 19, and the manual disconnect components.

f. Outputs and Front Disconnect. Output transfer gear 15 (foldout 1) drives rear-output shaft 17 and rear-output drive flange 16. A splined collar 18 transmits torque from rear-output shaft 17 to front-output shaft 19 and front-output drive flange 20. A manual control is linked to shifter shaft 21. Moving shaft 21 forward slides collar 18 out of engagement with the rear output shaft and interrupts power to front-output drive flange 20.

g. Oil Pump. An oil pump assembly 7 (foldout 1), which operates when the engine runs, supplies oil flow and pressure for converter operation, lubrication, cooling, clutch application, and control.

7. TORQMATIC OPTIONS

a. Torque Converter Elements. Optional torque converter elements are offered which give different torque multiplication ratios and capacities. Such elements differ only in the blading and do not affect service procedures.

b. Engine-driven Power Takeoff. Parts are available which provide an engine-driven power takeoff drive. These include shaft assembly 10 (B, foldout 3), bearings 8 and 13, gear 1, oil seal 10 (A, foldout 4), and snap ring 9 (B, foldout 3). On the basic transmission, plate 12 (A, foldout 4) is bolted over an opening when the power takeoff drive is not furnished.

c. Oil Pump Mounting Pad. Basic transmissions have a 4-bolt, SAE size C mounting pad and spline at the rear of oil pump assembly 7 (foldout 1). A 2-bolt, SAE size B mounting pad and spline is optional.

d. Control Valves

(1) Two types of control valve body assemblies are available. The basic transmission is equipped with the type which includes a clutch cutoff control actuated by hydraulic pressure from the brake system. An attachment is available which adapts this valve to actuation by air-brake pressure, supplied with an air cylinder and push rod. The clutch cutoff control completely releases any driving clutch when vehicle brakes are applied.

(2) The other type of control valve body assembly includes an inching control. It is manually actuated and permits slipping or releasing the operating range clutch at any desired time. It is recommended that the inching control be used only in forward-1 or reverse. During clutch slippage or release, additional oil for cooling and lubrication is directed to the clutches. The inching control permits precise maneuvering of a vehicle such as a loader or fork lift.

e. Remote or Direct Mounting. The transmission may be remote mounted and driven by a shaft from the engine, or direct mounted and driven by a laminated flex disk between the engine flywheel and the transmission. Remote-mounted models have a cover which encloses the torque converter. Direct-mounted models are bolted directly to the engine flywheel housing. Provision is made in direct-mounted models to isolate the accessory drive gears from the flywheel cavity to retain lubrication for the gears and to keep the flywheel housing dry.

f. Parking Brake. An internal, expanding shoe-type parking brake is available as an option. When used, the brake assembly is mounted at the rear output flange. The brake is mechanical and is manually applied.

g. Input and Output Flanges. All popular makes and sizes of drive flanges are offered for input and output shafts. Each flange is retained by a flat washer, and a nut which has a nylon insert.

8. OPERATING INSTRUCTIONS

a. Range Selection

(1) When a shift is made from neutral to any operating range, the engine should be at idle speed. Shifts from forward-1 to forward-2 may be made at full load and speed. Downshifts from forward-2 to forward-1 may be made under full load, at full throttle, but not at a speed higher than maximum speed of forward-1 range.

(2) Shifts from reverse to forward, or from forward to reverse cannot be made at full load and speed. It is necessary to release the throttle and bring the vehicle to a stop before making such shifts.

b. Inching Control. Applying the inching control will release whatever operating clutch is applied. It is recommended that the inching control be used only in forward-1 or reverse. Full application will completely release the clutch. Partial application will slip the clutch. Very slight or slow movements of the vehicle can be made with this control. Additional cooling and lubricating oil is supplied to the clutches to prevent failure when extensive use of the inching feature is required.

c. Clutch Cutoff Control. When the transmission control valve is equipped with this feature, the operating range clutch is completely released when the brakes are applied. Hydraulic or air pressure actuates the clutch cutoff. Thus, without having to shift the transmission to neutral, vehicles equipped with power takeoff-driven devices or accessory pumps may be operated at full throttle while standing.

d. Output Disconnect. The transmission front output may be disconnected by actuating the control which moves the disconnect shaft at the front of the transmission drop box. Forward movement of the shaft disconnects the front drive; rearward movement connects it. Two spring-loaded ball detents retain the shaft in either position. The control should never be shifted while the vehicle is moving.

e. Temperatures, Pressures

(1) When a transmission is equipped with a temperature gage, the bulb or sending unit is mounted in the converter-out oil stream (fig. III-1). Temperature should never be permitted to exceed 250° F. Overly severe operating conditions may cause the temperature to reach this maximum. If so, the transmission should be shifted to neutral and the engine should be operated at approximately 1000 to 1500 rpm for several minutes until the normal temperature (180° to 200° F) is restored. If the temperature reaches maximum during normal operation of the transmission, stop the engine and locate the trouble. Refer to sect. III, para 7 and 11.

(2) When a transmission is equipped with a clutch pressure gage, it is connected to the front of the control valve body assembly (fig. III-1). The pressure shown is that which is effective in the operating range clutch. Shifting, use of the inching control, or use of the clutch cutoff control will cause fluctuations and variations in the pressure indicated. If abnormal pressures are evident, refer to sect. III, para 7 and 11.

9. SPECIFICATIONS, DATA

The following specifications and data apply to the TT 2220-1 model.

SPECIFICATIONS, DATA – TT 2220-1

Item	Description
Transmission type	Torque converter and planetary gear
Rating:	
max input speed	3000 rpm
max net input torque	250 lb ft
max input hp, gross	150
Rotation, viewed from input end:	
input	Clockwise
outputs, forward operation	Clockwise
Mounting, drive:	
side, all models	Four 5/8-11 tapped holes in side pads, each side
front, direct mounted	SAE 3 flange on converter housing bolts to engine flywheel housing, flex-plate drive
front, remote mounted	Front unmounted, converter enclosed input flange for shaft and universal joint coupling
Gear ranges, selector positions	Reverse, neutral, forward-1, forward-2
Size:	
length overall	
direct mount, less flanges and brake	29.04 in. (approx)
remote mount, less flanges and brake	31.84 in. (approx)
width	19.36 in.
height	34.70 in.
Weight, dry: remote mount	800 lb (approx)
direct mount	760 lb (approx)
Torque converter:	
torque	2-stage, 2-phase, 4-element
elements	Pump, 2 turbines, fixed stator
torque multiplication ratios	TT 240 – 5.1:1 TT 260 – 4.8:1
Gear data:	
turbine transfer gearing	6-pitch, straight spur
range gearing	10-pitch, straight spur planetary
output transfer gearing	4-pitch, straight spur
accessory gearing	6-pitch, straight spur

(Continued on next page)

SPECIFICATIONS, DATA - Continued

Item		Description
Clutch data:	type	Multidisk, hydraulic-actuated, spring-released, oil-cooled, automatic compensation for wear
	material	Reaction plates – steel Friction plates–sintered bronze on steel
Parking brake:	size, type	10 x 1 1/2, expanding shoe, mechanical
	rating	30,000 lb in. at 1500 lb apply force
Flanges:	input	Mechanics 4C, 5C; Rockwell 5N; Spicer 1480
	front, rear outputs	Mechanics 4C, 5C, 6C; Rockwell 5N; Spicer 1480
Oil system:		
	oil pump	Input driven, gear type, positive displacement
	sump	Integral, single
	oil type: above -10° F	Hydraulic transmission fluid type C-1
	below -10° F	Hydraulic transmission fluid type C-1. Auxiliary preheat required to raise temperature in sump and external circuit compatible with ambient temperature recommendations. Automatic transmission fluid type A, suffix A identification optional when hydraulic transmission fluid type C-1 is not available.
	oil capacity	8 1/2 US gal
	oil filter	Remote, furnished by customer
	converter-out oil temperature	250° F max
	main pressure, at full throttle	140 to 160 psi
	lube, at full throttle	15-30 psi
	converter-out pressure, at full throttle stall	25 psi min
	converter-out pressure, at full throttle no load	65 psi max
Control valve body:	basic	Clutch cutoff, hydraulic actuated (air actuator optional)
	optional	Inching control, manual
Power takeoff:		
	basic	None, opening covered
	optional	Engine driven, 0.909 x engine speed
	mounting pad, right rear	SAE size A, 2-bolt
	intermittent rating, hp	20 at 2600 engine rpm

(Continued on next page)

SPECIFICATIONS, DATA - Continued

Item		Description	
Implement pump drive (pad at rear of input pump):			
basic		SAE size C, 4-bolt	
optional		SAE size B, 2-bolt	
ratio		0.909 x engine speed	
rating:	intermittent, hp	80 at 2600 engine rpm	
	continuous, hp	50 at 2600 engine rpm	
Gear ratios:			
forward-1 range – overall		2.663:1	includes 0.846:1 transfer gear ratio
forward-2 range – overall		0.659:1	
reverse-range – overall		1.964:1	
oil pump drive gears		1.100:1	
power takeoff gears		1.100:1	

Overall transmission torque ratios, max at output stall:	Converter – TT 240	TT 260
forward-1	13.58:1	12.78:1
forward-2	3.56:1	3.36:1
reverse	10.00:1	9.42:1

Section II DESCRIPTION AND OPERATION

1. SCOPE

Included in this section is a general description of the TT 2220-1 Torqmatic Hydro POWERSHIFT transmission and detailed descriptions of components and their operation. The action of the hydraulic system in neutral and each operating range is explained and illustrated in colored, individual hydraulic schematics. The torque paths through the transmission in neutral and each operating phase are explained and illustrated in colored, individual cross-section views.

2. GENERAL DESCRIPTION

a. The Model TT 2220-1 transmission is a torque converter, planetary gear type (foldout 1). A 2-turbine torque converter is coupled by gears to a forward planetary gear set, a reverse gear set, and a direct-drive clutch. The driven elements of these three units are connected to output transfer gears which drive output shafts extending forward and rearward from a transfer case. The transfer case is the lower section of the transmission housing.

b. During operation, one or both turbines drive the range gearing. At high load demand and low speed, the first turbine, assisted by the second turbine as the output speed increases, drives the gearing. When the first turbine is driving, a freewheeling clutch in the reduction gears between the first turbine and range gearing is engaged. At low output speed the second turbine is rotating at a slow speed and not contributing a significant amount of torque. As the output speed increases, the torque transmitted by the second turbine increases and combines with the torque transmitted by the first turbine to drive the range gearing.

c. When a sufficient output speed is reached, all torque is transmitted by the second turbine to the range gearing, causing the second turbine to overrun the first turbine. The first turbine then freewheels. Thus, there is automatic phasing between the two turbines, caused by speed and load variations. The two turbines extend the torque multiplication range of the converter sufficiently, in each gear range, to equal the range available with a conventional torque converter and two planetary gear ratios.

d. Ranges are selected by a single, manual control which has selector positions at neutral (N), forward-1 (F-1), forward-2 (F-2), and reverse (R). Forward-1 engages forward-range clutch 11 (foldout 1); forward-2 engages the direct-drive, or high-range clutch 13; reverse engages the reverse-range clutch 9.

e. Para 3 through 13, below, describe the major component groups and explain their operation.

3. MOUNTING AND INPUT DRIVE

a. Two methods of coupling the engine to the transmission are available. The remote-mounted transmissions have an input shaft 11 (A, foldout 2) which is bolted to input drive cover 13. The shaft extends through transmission front cover 6 and is supported by bearing 8. The input shaft is splined for flange 3. Nut 1 and washer 2 retain the flange.

b. When the transmission is mounted directly to the engine, no front cover is used. Laminated, steel flex disks 3 and 4 (B, foldout 2) are bolted to drive cover 7 by the inner-bolt circle. The outer-bolt circle engages bolts installed in the engine flywheel. The front flange of the torque converter housing bolts to the engine flywheel housing. When a dry flywheel housing is desired, a pressed steel diaphragm 11, seal 10, seal ring 9, and plug 8 are installed. These parts prevent oil entering the flywheel housing but permit the oil which lubricates the accessory gears to return to the sump.

4. TWO-TURBINE TORQUE CONVERTER

a. The torque converter (foldout 1) consists mainly of pump 5, first turbine 2, second

turbine 3, and stator 4. The bladed elements are cast aluminum. Pump 5 is the drive element; turbines 2 and 3 are the driven elements; stator 4 is the reaction element.

b. Two pairs of gears transmit the rotation of the turbines to the range gear section. Gears 8 and 22 (foldout 1) reduce the speed from first turbine 2 and transmits it through freewheel clutch 24 to gear 25, and finally to range gear input shaft 23. Freewheel clutch 24 engages when the speed of gear 22 reaches the speed of gear 25. When gear 25 rotates faster, the freewheel clutch releases. Gears 25 and 26 transmit rotation, with an increase in speed, from second turbine 3 to the range gears.

5. FORWARD, REVERSE GEARING AND CLUTCHES

a. There are only two planetary gear sets (12 and 10, foldout 1) in the model TT 2220-1 transmission. One is for forward drive at low speed and the other is for reverse drive. These planetary sets and their clutches are described together because of their interconnection and their use of common parts.

b. The forward- and reverse-range planetary gear sets each have 10-pitch gears with the same number of teeth on corresponding gears. Ring gears have 59 teeth; pinions have 19 teeth; integral sun gears have 21 teeth. Each carrier supports four pinions on needle roller bearings. The sun gear is the driving member in each planetary. The carrier is the reaction member in the reverse-range planetary, and the ring gear is the reaction member in the forward-range planetary. The ring gear is the driven member in the reverse-range planetary, and the carrier is the driven member in the forward-range planetary.

c. The reverse-range clutch has five external-tanged plates 7 (A, foldout 5) and five internal-splined plates 8. The external-tanged plates engage pins 18 in anchor assembly 16. The internal-splined plates engage a splined hub 11 which is attached to the reverse-range planetary carrier assembly 10. The forward-range clutch has plates 10 and 9 (B, foldout 5) which are identical to those in the reverse-range clutch but only three of each are used. The external-tanged plates engage the opposite ends of the same pins as do the reverse-range clutch plates. Anchor assembly 16 (A, foldout 5) is common to both clutches. Internal-splined plates 9 (B, foldout 5) engage forward planetary ring gear 11. Piston 1 (A, foldout 5) applies the reverse-range clutch. Piston 16 (B, foldout 5) applies the forward-range clutch.

d. The position of the selector valve determines which clutch is engaged. When the reverse-range clutch is engaged, the carrier is held stationary. The sun gear drives the carrier pinions which, in turn, drive the ring gear in reverse. The ring gear is attached to the forward-range carrier which transmits drive to the output transfer drive gear. When the forward-range clutch is engaged, the ring gear is held stationary. The sun gear drives the carrier pinions which rotate within the stationary ring gear. This causes the carrier to rotate in the same direction as the sun gear but at a slower speed. The carrier is attached to the output transfer drive gear.

6. HIGH-RANGE CLUTCH

a. There is no gearing in high range. A 3-plate clutch transmits torque at 1 to 1 ratio. Plates are identical to those used in the other clutches. One external-tanged plate 9 (A, foldout 6) and two internal-splined plates 10 are used. The external-tanged plate engages pins 4 in transfer drive gear 3. The internal-splined plates 10 engages hub 7 which is splined to forward and reverse sun gear 6 (A, foldout 5). High-range piston housing 17 (A, foldout 6) is bolted to drive gear 3 and contains piston 13. Clutch pressure is received through a drilled hub of piston housing 17 from a passage in rear cover 24.

b. When the high-range clutch is engaged, hub 7 is locked into rotation with transfer drive gear 3. This causes torque to be transmitted from second turbine driven gear 3 (B, foldout 4), through sun gear 6 (A, foldout 5) and to high-range clutch hub 7 (A, foldout 6). All components of the reverse- and forward-range planetary gear sets rotate as a unit with the

high-range clutch during high-range operation. There is no relative movement among any of these parts during high-range operation.

7. OUTPUT TRANSFER GEARS, SHAFTS

a. Gears. There are two output transfer gears. The drive gear 3 (A, foldout 6) is a 4-pitch, 52-tooth straight spur gear. It serves also as a reaction plate for the high-range clutch. The driven gear 16 (B, foldout 6) is a 4-pitch, 44-tooth straight spur gear. The driven gear, located vertically below the drive gear, is splined to rear-output shaft 19.

b. Output Shafts, Front Disconnect

(1) Rear-output shaft 19 is supported in the lower part of the transmission on ball bearings 14 and 21. It is splined at the rear for the rear output flange; at the front for the front-output disconnect. The front-output shaft 7 is supported at the rear by bushing 18 in rear-output shaft 19 (B, foldout 6).

(2) At the front, ball bearing 6 supports the front-output shaft in the transmission housing. A splined, sliding disconnect coupling 10 may be shifted by forward and rearward movement of shifter fork shaft 11 and fork 13. In the forward position, internal splines in coupling 10 engage only the splines on shaft 7. In the rearward position splines on both shaft 7 and shaft 19 are engaged in coupling 10. Spring-loaded detent balls 8 position the coupling in the forward (released) or rearward (engaged) position.

c. Output Flanges. Several optional types and sizes of output flanges 3 are available for the front- or rear-output shafts. The flanges are splined to the shafts and retained by a single nut at each flange. The nuts have nylon annular inserts which provide a vibration-proof means of locking the nut to the threaded ends of the output shafts. Rear-output flanges 34 are available which have provisions for mounting a parking brake.

8. PARKING BRAKE

An internal, expanding shoe-type brake is available for mounting at the rear output of the transmission (fig. I-2). The shoe assembly back plate is bolted to bosses at the rear of the transmission housing. The drum is bolted to the rear-output flange. The brake is manually applied.

9. POWER TAKEOFF, ACCESSORY PUMP MOUNT

a. Engine-driven Power Takeoff

(1) At the rear of the transmission, at the upper-right side, is a 2-bolt SAE mounting pad. On transmissions which do not include a power takeoff, drive components are deleted and this pad is covered by accessory drive cover 12 (A, foldout 4). On transmissions which include a power takeoff, an internal-splined shaft is located concentric with the mounting pad.

(2) The power takeoff includes gear 1 (B, foldout 3), bearing 8, shaft assembly 10 and some minor parts. Gear 1 meshes with input accessory drive gear 18 (A, foldout 3). The gear is supported by bearing 8 (B, foldout 3) and is splined to shaft 12. Shaft 12 is supported by bearing 13. Oil seal 10 (A, foldout 4) prevents oil leakage at the mounting pad. The power takeoff rotates at 0.909 times engine speed and in a clockwise direction, as viewed from the rear.

b. Accessory Oil Pump Mounting. On the rear surface of input-driven oil pump assembly 6 (A, foldout 7) is an SAE mounting pad. Two sizes of pads are available. Basic equipment is a 4-bolt, SAE size C mounting pad. Optional is a 2-bolt SAE size B pad. When the smaller (size B) pad is used, drive coupling 18 is required for B size spline. Accessory oil pumps for either of the pads are driven by an internal spline in accessory driven gear 43 (B, foldout 3). The accessory shaft rotates at 0.909 times the engine speed and clockwise as viewed from the rear.

10. OIL PUMP

a. Engine Driven, Accessible. Oil pump 6 (A, foldout 7) furnishes the entire oil flow

and oil pressure for all transmission operations. It is driven by the input accessory gear 18 (A, foldout 3) and rotates at any time the engine rotates. Pump assembly 6 (A, foldout 7) includes two spur gears 12 and 15, body assembly 8 and cover 17. Oil is picked up from the transmission sump by suction tube 2 (A, foldout 4). Oil is delivered to passages in the transmission housing for distribution to the control valve body and other locations. The oil pump assembly is mounted outside of the transmission and is conveniently accessible without removing other major components.

b. Strainer, Optional Filter. All models of this transmission have a wire mesh strainer assembly 24 (A, foldout 4) which fits into the sump and over the lower end of suction tube 2. The strainer assembly is easily removable for cleaning or replacement. A full-flow oil filter must be connected into the oil system. Two 1 1/16-12 tapped openings are provided to connect the filter lines immediately above the control valve mounting pad on the left side of transmission housing (fig. III-1). An external circuit must be connected between these openings prior to operating the transmissions.

11. VALVE BODY ASSEMBLIES

a. Optional Types. There are three types of control valve body assemblies available for the TT 2220 model transmissions. The basic transmission is equipped with the clutch cutoff-type valve, in which hydraulic pressure from the vehicle brake system releases the operating clutch. A variation of this type of control valve system is operated through an air cylinder and push rod by air from an air brake system. The third type of valve system is the inching control, in which a manually-operated valve permits slipping or full release of the forward-1 or reverse clutch. Refer to sect. I, para 7d and 8b and c for further information on these controls.

b. Main-pressure Regulator, Selector Valves

(1) Regardless of which control valve body assembly is used, the major functions — those of main-pressure regulation, and range selection — are the same in all three valve body configurations. The control valve body of each type includes the main-pressure regulator valve components in the upper bore of the body; the optional valve in the middle bore; and the selector valve components in the lower bore. The main-pressure regulator valve group includes items 6, 7, 8, 14 and 15 (B, foldout 7). The selector valve group includes items 28 through 35.

(2) The main-pressure regulator valve is spring loaded and regulates the pressure for clutch application. A trimmer is included in the main-pressure regulator valve bore to control the rate of clutch application. The selector valve is a spool-type valve which is manually moved lengthwise to the various range positions. Spring-loaded ball detents position the valve in each range.

c. Clutch Cutoff Valve

(1) Clutch cutoff valve 21 (B, foldout 7) is located between the main-pressure regulator valve and the selector valve. It is a spool-type valve which is moved rearward by spring 20 pressure, and forward by plug 22 when brake hydraulic pressure acts on the plug.

(2) In the variation which is actuated by brake air pressure, a miniature air cylinder is mounted at the rear of the valve body. A stem of the air cylinder moves valve 21 forward.

(3) In normal operation, valve 21 is rearward. This allows main pressure to flow to the selector valve. When the vehicle brakes (hydraulic or air) are applied, valve 21 moves against spring 20. This interrupts the flow of main pressure to the selector valve and exhausts clutch apply pressure, releasing whatever clutch has been applied.

d. Inching Control Valve

(1) The inching control valve, like the clutch cutoff valve, is located between the main-pressure regulator and the selector valve. It is a spool-type valve which moves lengthwise in its bore. Main pressure and spring 43 (B, foldout 7) holds the valve forward during normal operation. The rear stem

of the valve is linked to a manual control by which the valve can be moved rearward. When manual effort is relaxed, the valve returns to its forward position. In its forward position, the valve permits full main pressure to flow to the selector valve.

(2) When the inching control valve is moved rearward manually, main pressure exerted on the operating range clutch is bled off through a passage which leads to the reverse and forward clutch plate area. This reduces main pressure available to apply the clutch, allowing it to slip. At the same time, the oil being bled off cools and lubricates the slipping clutch. The degree of rearward movement of the inching valve determines the degree of slippage, from full apply to full release. An inching regulator valve 39 (B, foldout 7) and spring 38 maintains a uniform clutch apply pressure at any given position of the inching valve.

12. LUBRICATION, CONVERTER REGULATOR VALVES

Both of these valves are spring-loaded, disk-type valves located inside the transmission at the rear of the torque converter housing. The lubrication regulator valve 26 (B, foldout 3) is in the oil cooler return circuit. Its spring will hold the valve closed until lubrication pressure reaches 20 psi. All oil in excess of that required for lubrication returns to the sump. The converter pressure regulator valve 23 is in the circuit which carries oil from the main-pressure regulator valve to the torque converter. Its spring will permit a maximum of 80 psi in the converter-in line. All excess oil returns to the sump.

13. HOUSINGS, COVERS

a. Torque Converter Housing. The torque converter housing 40 (B, foldout 3) is cast aluminum. It covers the large front opening of the transmission housing. It supports and encloses the torque converter components. It is the front supporting member for the accessory driven gears and the converter driven gears. In direct-mounted transmissions the front of the converter housing bolts to the engine flywheel housing. In remote-mounted transmissions, it supports front cover 6 (A, foldout 2).

b. Transmission Housing

(1) Transmission housing 8 (A, foldout 4) is cast iron and is the main structural member of the transmission assembly. It supports and encloses the rear end of the accessory driven gears and converter driven gears. It supports and encloses the range gearing and clutches, output transfer gears, output shafts and front-disconnect components. It provides an external-mounting surface for the transmission oil pump and accessory pump. It includes various passages, within the casting, for oil circuits.

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

c. Front Cover. The transmission front cover 6 (A, foldout 2), used on remote-mounted assemblies, is cast iron. It is bolted to the front flange of the torque converter housing. It supports the input shaft. It forms an oil-tight enclosure for the torque converter and accessory gear area.

d. Rear Cover. The transmission rear cover 24 (A, foldout 6) is cast iron, and closes the large circular opening at the rear of the transmission housing. It supports the rear end of the high-range clutch and output transfer drive gear. The rear cover includes an oil passage which connects the control valve body and high-range clutch.

14. HYDRAULIC ACTION – GENERAL

a. System Components. The hydraulic system includes every component which generates, directs, controls, or uses oil flow or oil pressure. By this definition, practically every part of the transmission can be considered a part of the hydraulic system (fig. II-1). However, in the following explanation, only those components which have a primary

function in the hydraulic system are described and their function explained. All components have been physically described in preceding paragraphs 4 through 13.

b. Hydraulic Fluid. The hydraulic fluid used in the transmission is an oil especially processed for automatic transmissions (refer to sect. I, para 9). It lubricates, cools and controls the transmission and is the power transmitting medium in the torque converter. Its flow lubricates and cools the transmission, its pressure applies clutches, and its velocity and impact transmits power in the torque converter. The oil is pumped from and returns to a single reservoir – the sump in the lower part of the transmission housing.

c. Flow in Oil Filter, Cooler. Neither of these items are an integral part of the transmission. These units, and their lines and fittings are furnished and connected by the transmission customer. Oil picked up by the pump, through a wire mesh strainer, is pumped through a full-flow oil filter and returned to the system. Oil leaving the torque converter flows to a heat exchanger (cooler) and returns to the system. Oil returning from the cooler takes two paths in the transmission. Part of it flows into the lubrication system. All oil not required for lubrication returns to the sump.

d. Hydraulic Action in Torque Converter

(1) The torque converter is continuously filled with oil during transmission operation. The oil is pressure fed to the converter and then circulates to the oil cooler and back to the transmission. The converter pump element is driven by the engine. When the engine is accelerated, the pump blades throw oil outward and forward into the blades of the first turbine. The impact of the oil causes the first turbine to rotate and deliver power through reduction gearing to the range gearing. At the same time, the second turbine is rotating, but at a lower speed.

(2) As output speed increases, the angle of oil flow from pump to turbines changes. When this occurs, oil strikes the blades of the second turbine with sufficient impact to cause the second turbine to assume part of the drive load and assist the first turbine. At a higher output speed, the angle of oil flow from pump to turbines is such that the second turbine is transmitting all of the torque to the gearing. Power from the second turbine is delivered to the range gearing by overdrive gears.

(3) From the turbines, oil flows inward and rearward, between the blades of the stator. The stator blades deflect the oil in the direction of pump rotation and into the pump blades. The unexpended energy in the oil assists the pump. This return of energy to the converter pump is the key to the converter's ability to multiply torque.

e. Schematic Hydraulic Action Diagrams

(1) In the explanations of hydraulic action under various given conditions in para 15 through 18, below, the oil circuits are colored as indicated in each diagram (fig. II-1 through II-5). The valves are shown in the positions they are in normally for those conditions.

(2) Some of the diagrams illustrate the clutch cutoff valve and others illustrate the inching control valve. The action of either of these valves is the same regardless of the operating range. It is recommended that the inching control valve be used only in forward-1 or reverse ranges. The hydraulic explanations are referenced to the corresponding mechanical actions (torque paths). In all forward- and reverse-range hydraulic actions there are two corresponding torque paths (first and second turbine torque paths).

15. HYDRAULIC ACTION – NEUTRAL

a. Fig. II-1 illustrates the hydraulic system's action when the range selector control is in neutral position while the vehicle engine is running. The oil pump draws oil from the sump and pumps it to the main-pressure regulator valve (through the oil filter, if the transmission is so equipped). Pressure on the left end of the valve pushes the valve toward the right, against its spring. When hydraulic pressure balances spring force, main pressure is regulated. All oil not required to maintain main pressure flows to the torque converter, to charge it continually.

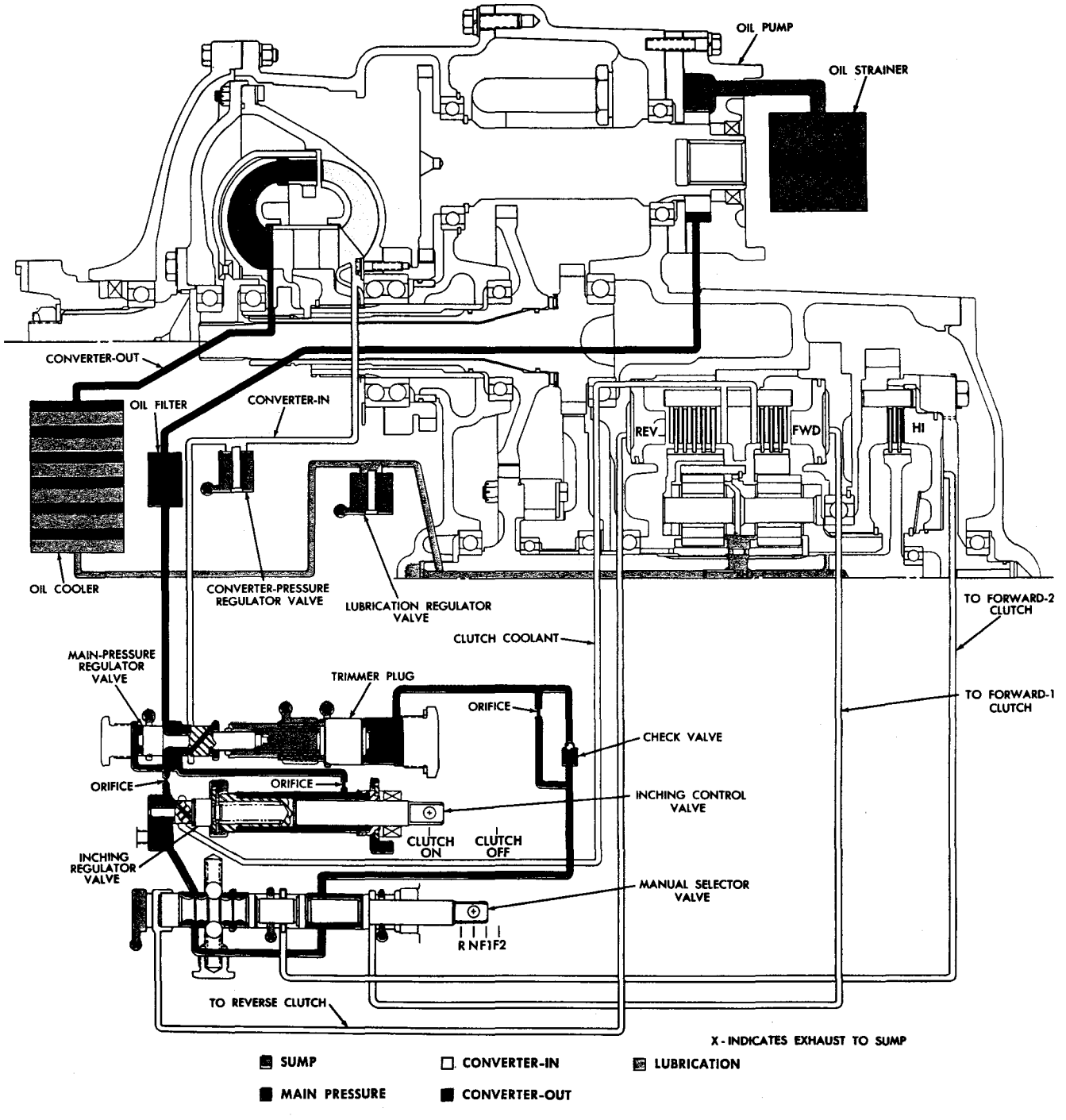

Fig. II-1. Hydraulic action in neutral, inching control valve released—schematic diagram

b. Pressure in the converter-in line cannot exceed 80 psi because the converter regulator valve opens at this pressure. Oil which escapes from the open valve returns to the sump. Oil flows through the torque converter, leaving it through the converter-out line. Oil from the converter flows to the oil cooler and returns to the transmission at the lubrication-pressure regulator valve. The lubrication-pressure regulator valve opens at 20 psi

and returns all oil not required for lubrication to the sump. Oil at 20 psi flows into the lubrication system.

c. In the control valve body which includes the inching control valve, oil flows from the main-pressure regulator valve by two paths. One passage directs pressure to the right-end of the inching control valve. This pressure provides a positive retracting force on the valve to overcome the tendency of pressure at the valve's other end to extend it (rightward). A spring also pushes the valve toward the left to keep it retracted when the engine is not operating. The second path by which oil leaves the main-pressure regulator valve is through an orifice and a passage to the left end of the inching regulator valve.

d. Main pressure pushes the inching regulator valve toward the right against a spring which seats in the left end of the inching control valve. When the inching control valve is released (retracted), main pressure and spring force at its right end is sufficient to hold it leftward. This exerts sufficient force on the regulator spring to hold the inching regulator valve leftward far enough to prevent oil escaping to the clutch coolant passage. Thus, main pressure is retained at the left end of the inching regulator valve.

e. Main pressure continues to the range selector valve and surrounds the valve in the detent area. A passage leading from the bottom of the selector valve bore directs main pressure toward the right and into the valve bore again. Main pressure surrounds this area of the valve and leaves the bore at the top. This passage directs main pressure to a ball check valve and an orifice which are in parallel passages leading to the trimmer valve. Oil flowing upward at this point seats the check valve and is blocked. Oil can flow through, but is restricted by, the orifice.

f. Above the check valve and orifice, main pressure is directed to the right end of the trimmer valve plug. Here, main pressure pushes the trimmer valve plug toward the left. This compresses the trimmer spring and main-pressure regulator valve spring. The compressed regulator valve spring exerts a leftward force on the main-pressure regulator valve, pushing the valve leftward. This restricts oil flowing to the converter-in line and raises main pressure. The purpose of the trimmer valve is the reduction of clutch apply pressure when a clutch begins to fill and the restoration of full clutch apply pressure to the clutch when it is completely filled. This action occurs each time the range selector valve is moved from neutral to any range, or from any range to another.

g. The clutch apply pressure is low initially and restored to full value when the clutch is filled because the oil required to fill a clutch must flow through the orifice just below the main-pressure regulator valve. Pressure is reduced by the orifice. This lower pressure, in turn, allows the trimmer valve plug to return toward the right. Oil displaced by the rightward movement of the trimmer plug can return rapidly to the selector valve by opening the ball check valve – this insures rapid reduction of main pressure. When the clutch fills, oil flow through the orifice, at the left end of the main-pressure regulator, stops. Clutch pressure then becomes equal to the reduced main pressure, and begins to push the trimmer valve plug leftward again. The check valve closes and the rate of leftward movement of the trimmer valve plug is controlled by the flow of oil through the orifice at the left of the check valve. When the trimmer valve plug is fully leftward against its stop, full main pressure is restored and acts upon the applied range clutch.

h. In neutral, pressure cannot reach any range clutch. Refer to fig. II-6 and para 20 for an explanation of the power flow through the transmission in neutral. Hydraulic action in neutral for transmissions equipped with the clutch cutoff type of control valve body assembly is the same as that described in this paragraph, above, except for c and d, pertaining to the inching control valve. Refer to fig. II-3 and para 17a, below, for an explanation of the clutch cutoff valve action.

16. HYDRAULIC ACTION – FORWARD-1 RANGE

a. Fig. II-2 illustrates the hydraulic system's action when the range selector control is in forward-1 position. Oil flow in the sys-

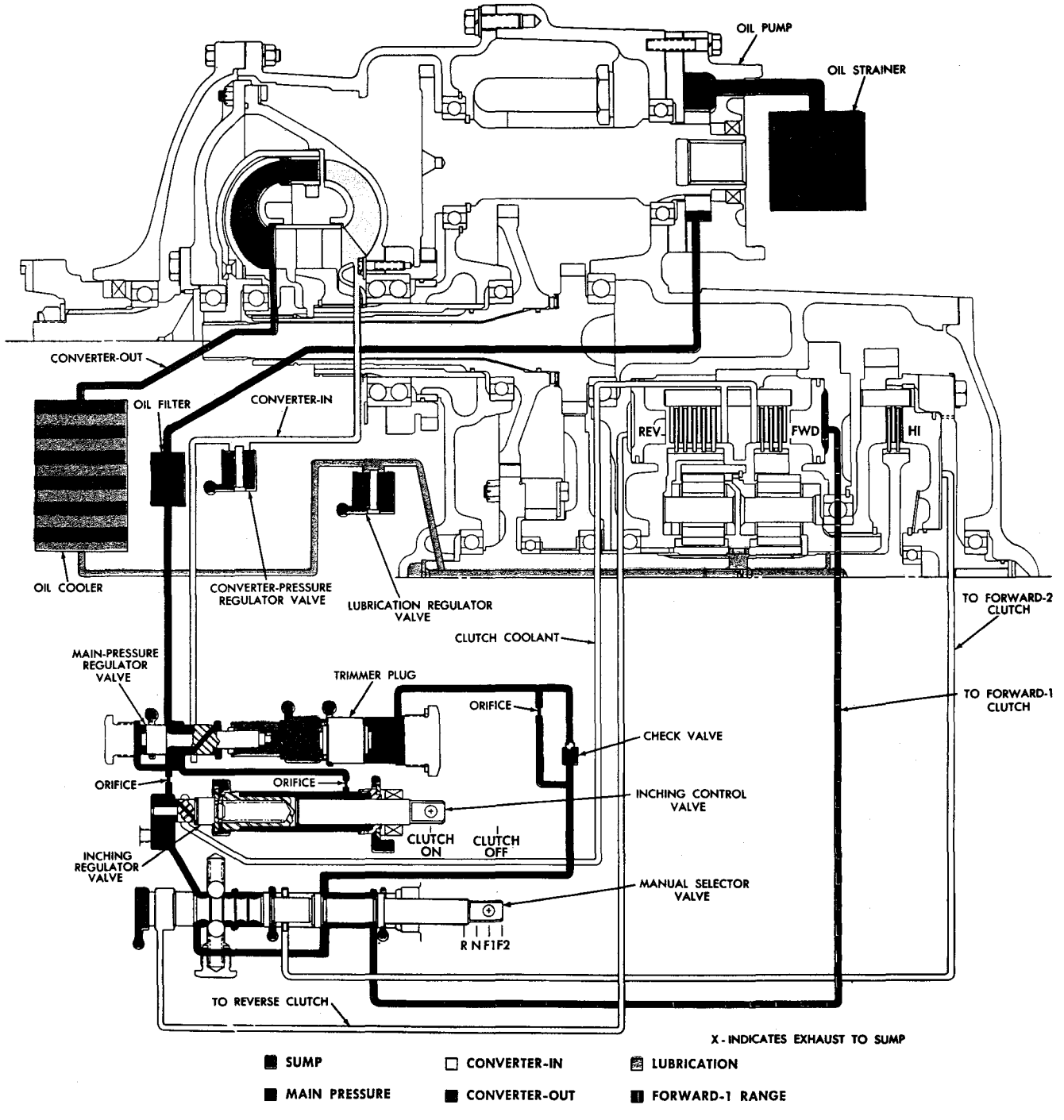

Fig. II-2. Hydraulic action in forward-1 range, inching control valve released—schematic diagram

tem, except flow to the range clutch, is as described in para 15a through g, above.

b. In forward-1, pressure is directed to the forward-range clutch, applying it. The reverse- and high-range clutches exhaust to the sump. Para 21 and 22, below, and fig. II-7 and II-8 cover the power flows through the transmission which correspond to the hydraulic conditions in this paragraph.

c. When the transmission is equipped with the clutch cutoff-type control valve body assembly, the hydraulic action is different only for the clutch cutoff valve. Refer to para 17a, below, and fig. II-3, for an explanation of the action of the clutch cutoff valve.

17. HYDRAULIC ACTION – FORWARD-2 RANGE

a. Fig. II-3 illustrates the hydraulic system's action in forward-2 range when the system includes the clutch cutoff type control valve body assembly. The hydraulic action is the same as described in para 15a through g, above, except for c and d describing the inching control valve, and flow to the range clutch.

b. When the transmission is equipped with the clutch cutoff control, brake apply pressure operates the valve. Fig. II-3 illustrates the use of brake hydraulic pressure. However, for vehicles equipped with air brakes, a small air cylinder is attached to the control valve body and its movement mechanically operates the cutoff valve when air pressure is applied to the air cylinder. Except for the type of brake system furnishing pressure, the operation of the clutch cutoff valve is the same for either system.

c. When the vehicle brakes are applied, brake pressure moves the clutch cutoff plug and valve to the left. The valve's movement cuts off the flow of oil to the range selector valve and exhausts the pressure directed to the applied clutch which, in this case, is the high-range clutch. In addition, pressure is exhausted from the right end of the trimmer valve plug. This allows the trimmer valve plug to move to the right, reducing main pressure to its lowest value.

d. When the clutch cutoff valve is applied (vehicle brakes applied), the vehicle stops, but the engine can be accelerated to provide power for accessory pumps or other vocational equipment while the vehicle is standing. Such a stop does not require shifting to neutral and again to a travel range when travel is resumed. When the brakes are released, a spring pushes the clutch cutoff valve and plug to the right and range-clutch pressure is restored. The trimmer valve then acts as described in para 15e, f and g, above.

e. Refer to para 23 and 24, below, and fig. II-9 and II-10 for corresponding transmission torque paths.

18. HYDRAULIC ACTION – REVERSE RANGE

a. Inching Control Valve Applied

(1) Fig. II-4 illustrates the hydraulic system's action in reverse, with the inching control valve applied. The hydraulic system acts as described in para 15a through g, above, except for oil flow to the reverse-range clutch.

(2) The range selector valve is in reverse-range position. This directs oil to the reverse-range clutch, applying the clutch.

(3) When the inching control valve is applied (manually moved toward the right), the force of the inching regulator valve spring is reduced. Main pressure against the left-end of the regulator valve moves it rightward. This movement uncovers a port which allows oil to flow into the clutch coolant passage. The amount of oil escaping into the coolant passage is determined by the position of the inching control valve. When the inching control valve is fully rightward, the coolant passage is completely uncovered; when partially rightward, the passage is partially uncovered. When the passage is partially uncovered, the inching regulator valve assumes a position that results in a balance between clutch apply pressure and inching regulator valve spring force.

(4) When the clutch coolant passage is completely uncovered, sufficient oil can flow through it to reduce clutch apply pressure to a negligible value. Clutch apply pressure falls because main pressure is restricted by the orifice below and at the left of main pressure regulator valve. When clutch apply pressure falls, the trimmer valve plug moves rightward and main pressure decreases. Thus, depending upon the position of the inching control valve, clutch apply pressure can range from very low to maximum.

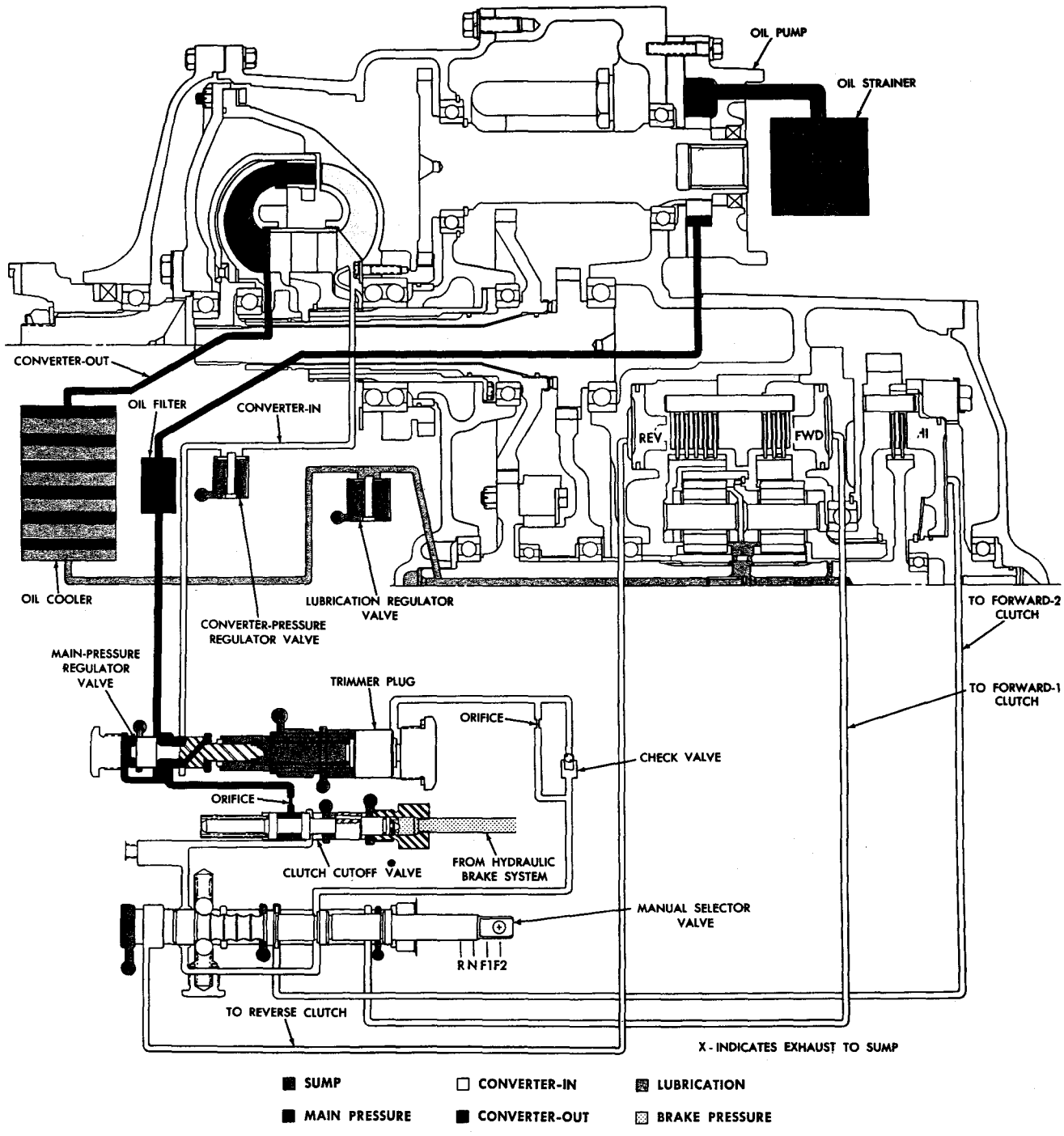

Fig. II-3. Hydraulic action in forward-2 range, clutch cutoff valve applied—schematic diagram

(5) When the inching control valve is returned to released (full leftward) position, full clutch apply pressure is restored after the trimmer valve acts as explained in para 15e, f and g, above.

(6) Refer to para 25 and 26, below, and fig. II-11 and II-12 for corresponding transmission torque paths.

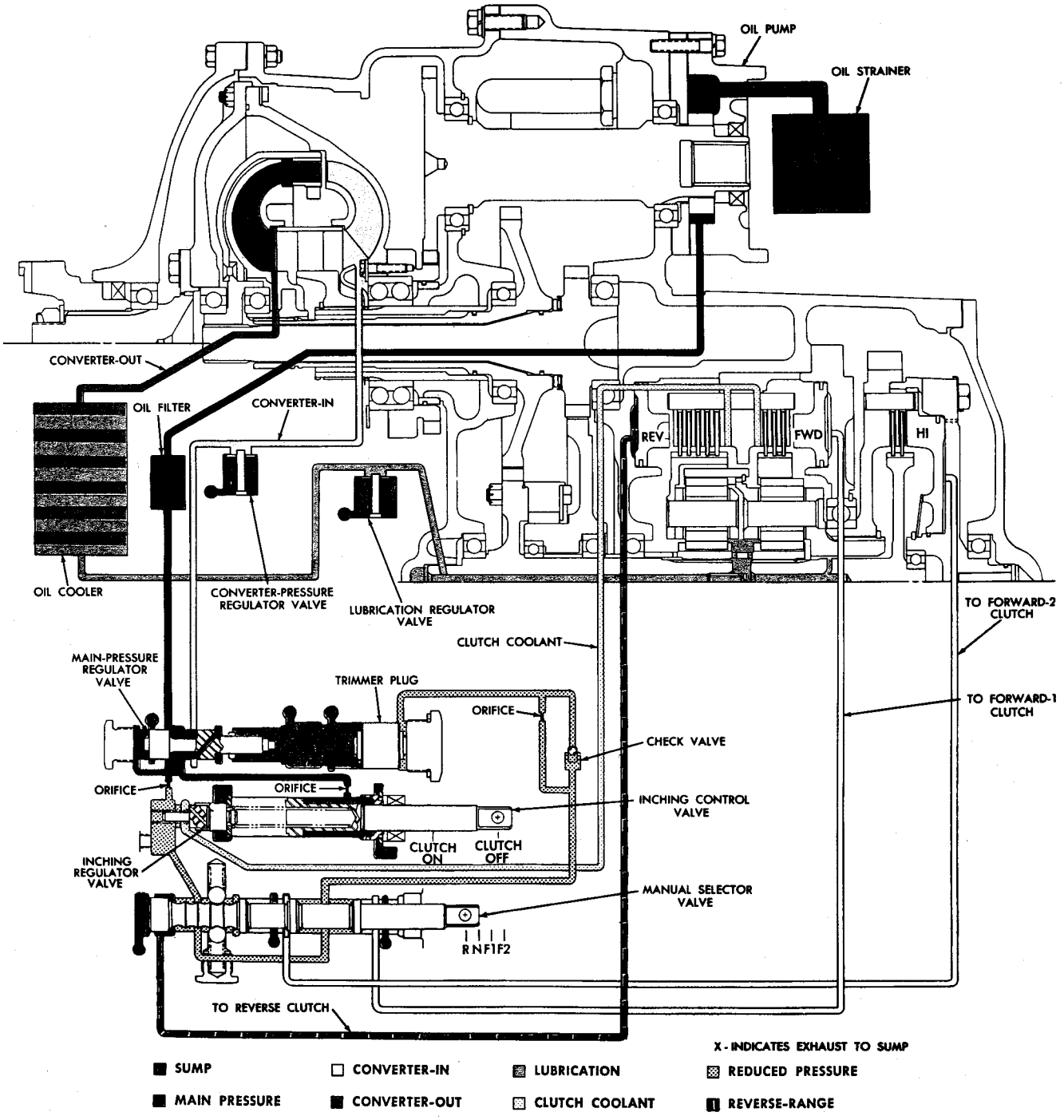

Fig. II-4. Hydraulic action in reverse range, inching control valve applied—schematic diagram

b. Clutch Cutoff Valve Released

(1) Fig. II-5 illustrates the hydraulic system's action in reverse range when the clutch cutoff valve is included in the system. It is shown in released position. In released position, main pressure passes through the bore and around the valve, to the range selector valve. Hydraulic action in the system is as described in para 15a through g, above,

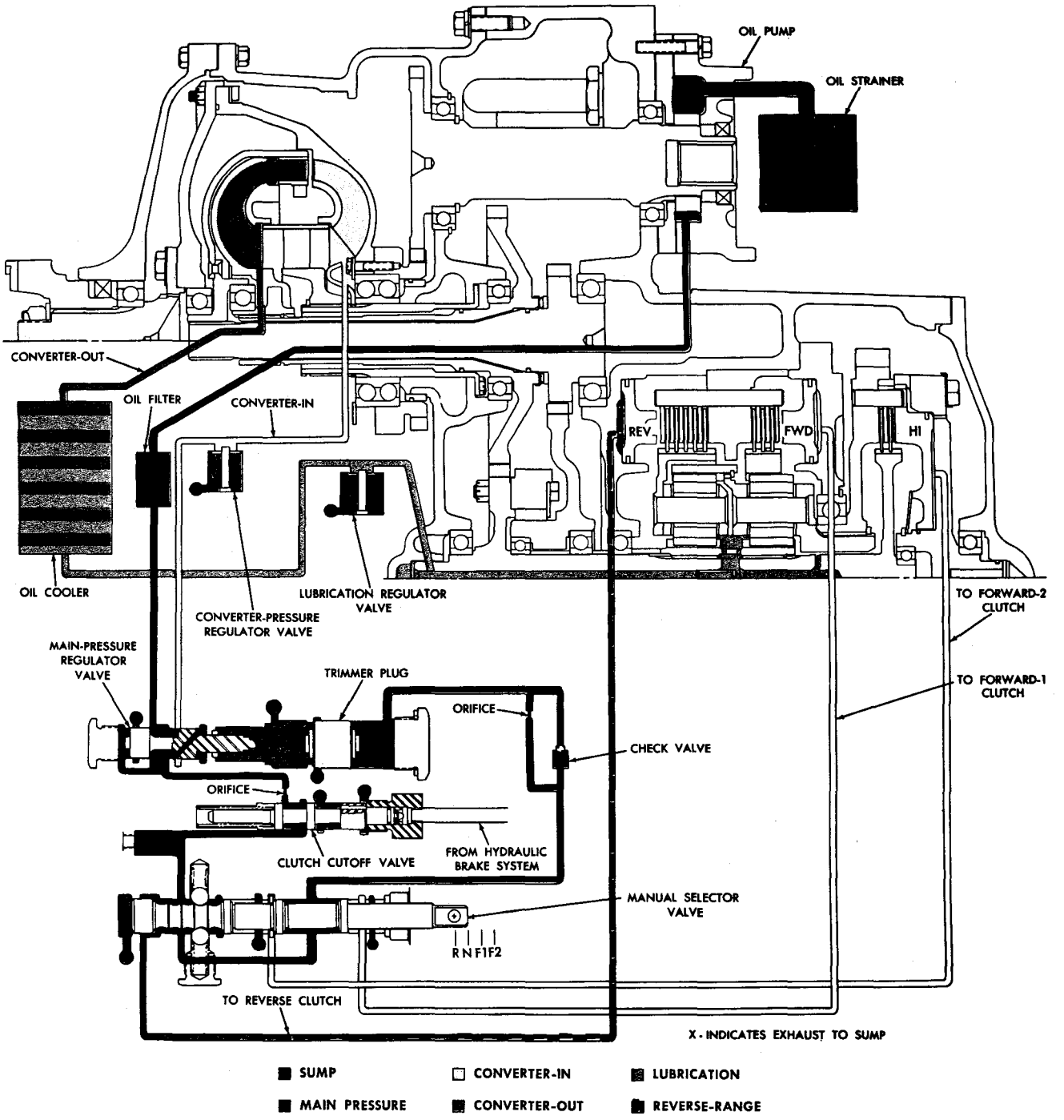

Fig. II-5. Hydraulic action in reverse range, clutch cut off control released—schematic diagram

except for 15c and d which describes the inching control valve. In addition, the range selector valve is in reverse-range position. This permits pressure to reach the reverse-range clutch and apply it.

(2) Refer to para 17a, above, for explanation of the clutch cutoff valve when applied.

(3) Refer to para 25 and 26, below, and fig. II-11 and II-12 for corresponding transmission torque paths.

19. TORQUE PATHS THROUGH TRANSMISSION – GENERAL

a. Para 20 through 26, below, and fig. II-6 through II-12 illustrate the paths by which power flows from the engine to the transmission output shafts. The cross-section views each have a continuous red line from input to output to indicate the components through which power flows. Engagement of the turbine freewheel clutch is indicated by vertical, parallel bars of color. Clutches which are applied in the various gear ranges are indicated by horizontal, parallel bars of color on the clutch plates. Rotations are indicated by black arrows on components.

b. Speed and load determine whether the transmission torque flows through the first and second or second only converter turbine. The transition of the torque path from one turbine to the other is automatic and involves only hydraulic action within the torque converter (refer to para 14d, above). Thus, there is no difference in the valve hydraulic action representing first or second turbine conditions for each given range. For example, para 16, above, and fig. II-2, which cover hydraulic action for forward-1 range, apply equally to para 21 and 22, below, and fig. II-7 and II-8.

Note: Fig. II-6 through II-12 illustrate the front-output disconnect in the engaged position. If the disconnect coupling were moved forward or toward the left in the illustrations, the front output shaft would not rotate.

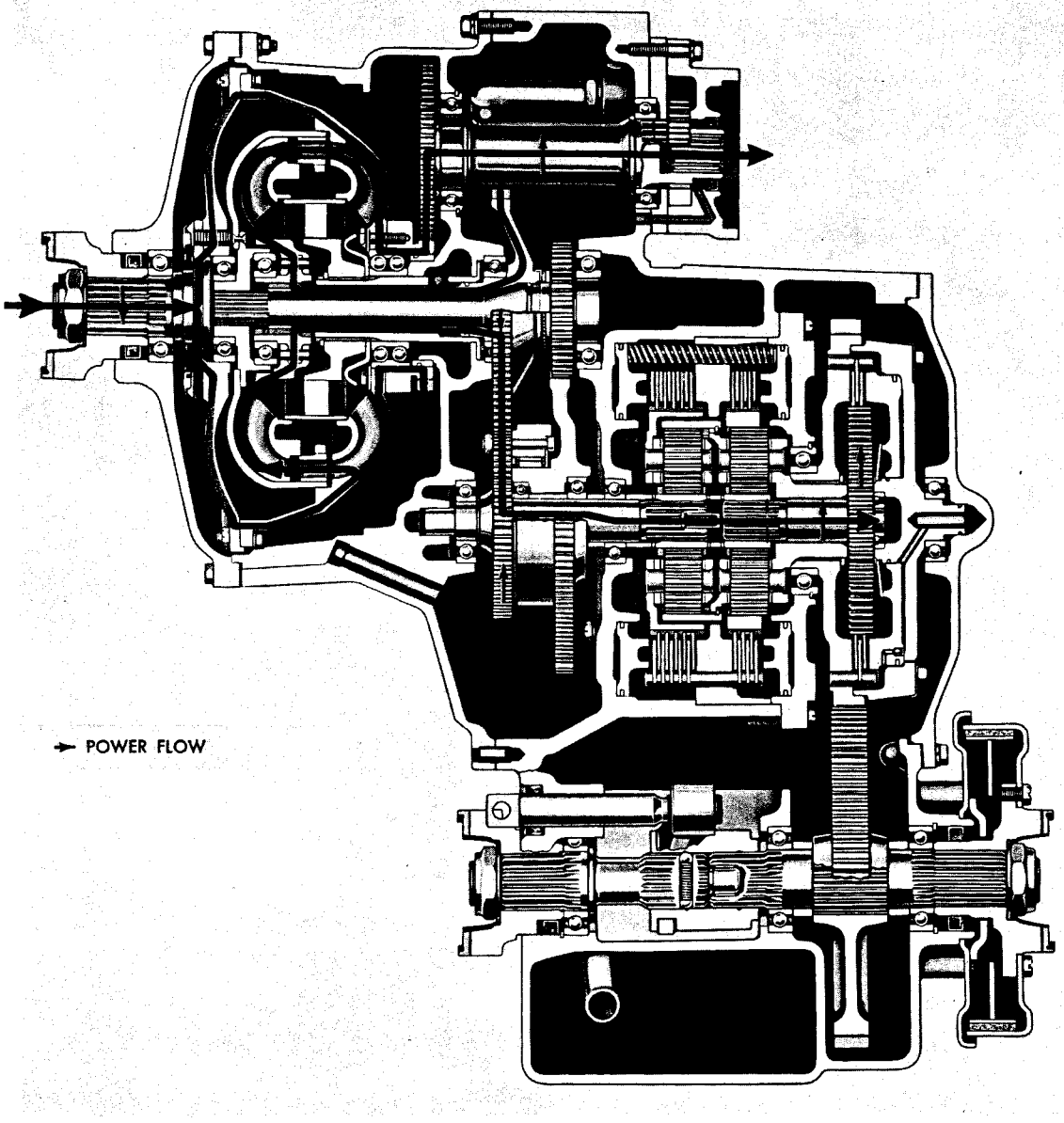

Fig. II-6. Neutral and PTO—torque path

20. NEUTRAL AND PTO – TORQUE PATH

a. Fig. II-6 illustrates the torque path through the transmission and power takeoff drive gear. No range clutches are applied. Thus, there is no load on the turbine. Under no-load condition, the second turbine will assume the drive to the range gearing. Torque cannot flow beyond the high-range clutch hub.

b. Torque from the engine flows through the converter pump to the accessory drive gear and into the oil pump drive gear and is available for an accessory pump or other vocational equipment at the oil pump gear shaft internal splines. On transmissions which are equipped with a power takeoff, a second gear and shaft is located directly behind the oil pump drive gear and shaft illustrated. The flow of torque in the power takeoff drive is identical to that illustrated for the oil pump drive gear and shaft shown.

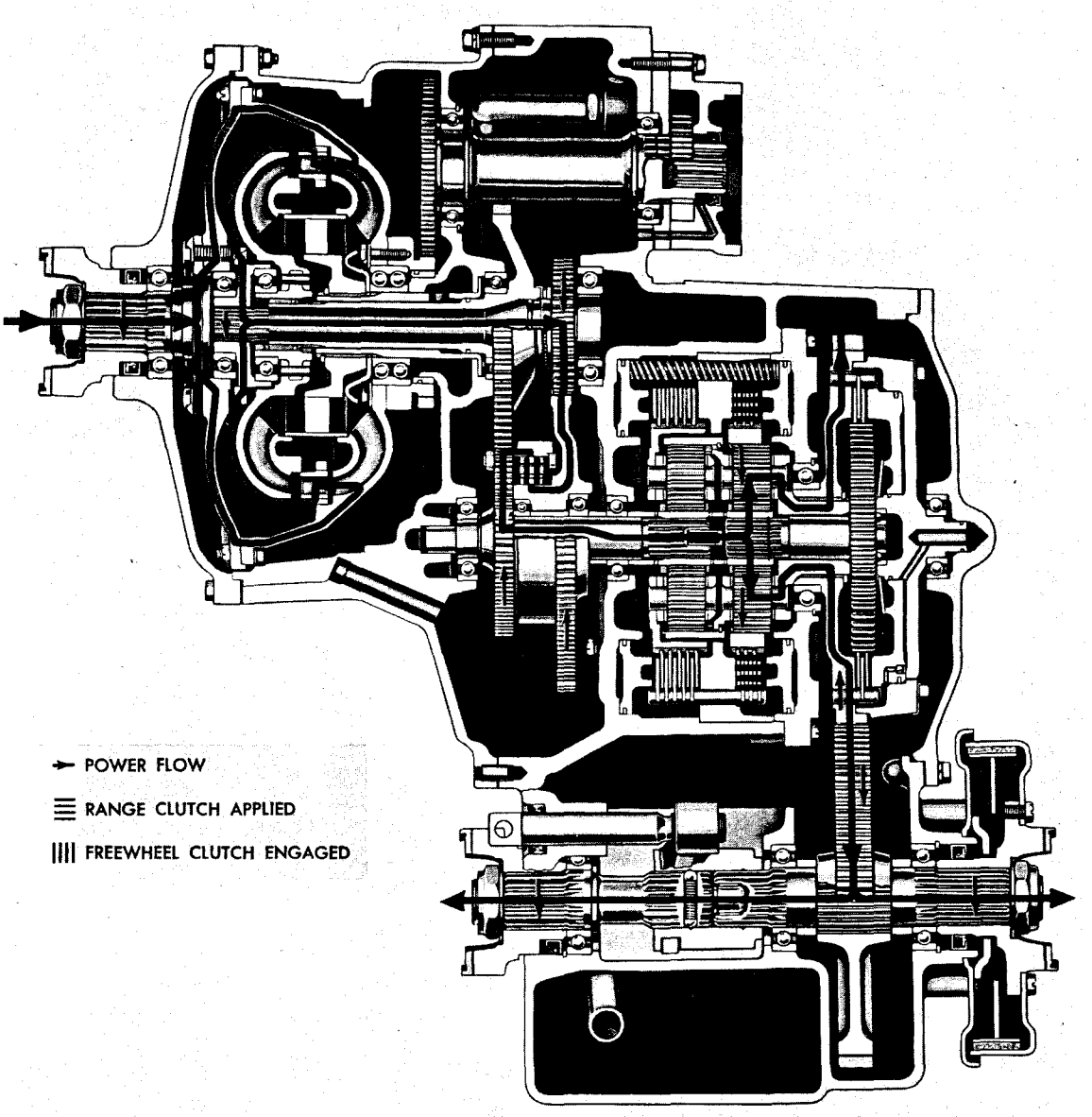

Fig. II-7. Forward-1, first turbine—torque path

21. FORWARD-1, FIRST TURBINE – TORQUE PATH

a. Fig. II-7 illustrates the torque path through the transmission in forward-1 range when load demand is high. Refer also to fold-out 1 for identification of components. Torque is transmitted hydraulically from the converter pump to the first turbine at stall. From the first turbine, torque flows through reduction gears and the engaged freewheel clutch to the second-turbine driven gear. As output speed increases, part of the torque is transmitted by the second turbine to the second turbine driven gear.

b. In the range gear section, the forward-range clutch is applied, holding the ring gear stationary. The forward-range sun gear drives the forward-range planetary pinions, which are forced to rotate within the stationary ring gear. The carrier, to which the pinions are mounted, is splined to and drives the output transfer drive gear. The drive gear meshes with the driven gear which, in turn, drives the front- and rear-output shafts.

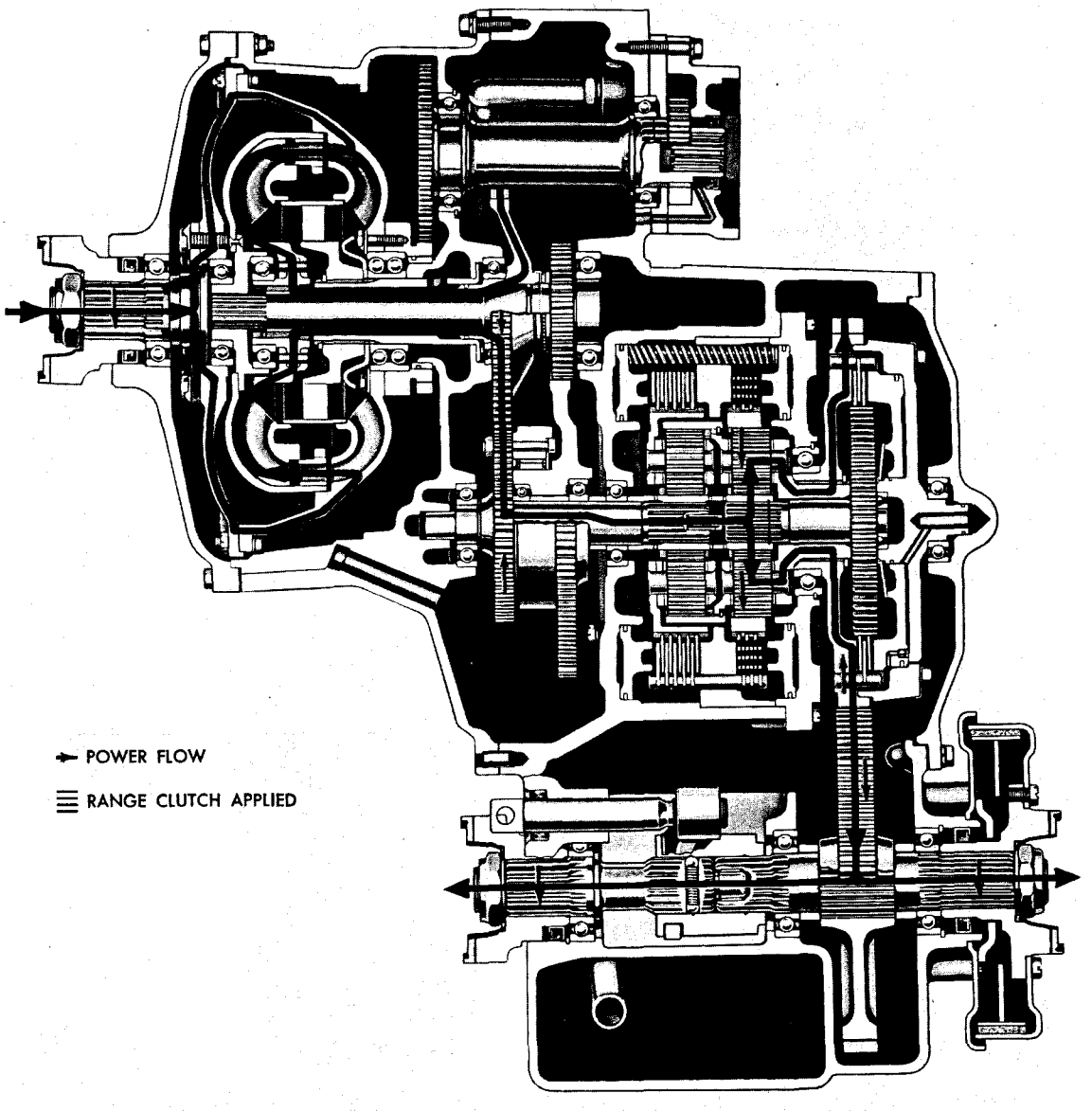

Fig. II-8. Forward-1, second turbine—torque path

22. FORWARD-1, SECOND TURBINE — TORQUE PATH

a. Fig. II-8 illustrates the torque path through the transmission, under lighter load or higher speed conditions, in forward-1 range. Refer also to foldout 1 for identification of components. Under these conditions, oil from the converter pump blades is thrown against the second-turbine blades because there is no significant difference between the pump and first-turbine speeds. From the second turbine, torque is transmitted by an overdrive gear set to the range gearing. The turbine freewheel clutch is now disengaged because the second-turbine driven gear overruns the first-turbine driven gear.

b. The forward-1 range clutch is applied. The torque path from the range gear section of the transmission to the front and rear outputs is identical to that described in para 21b, above.

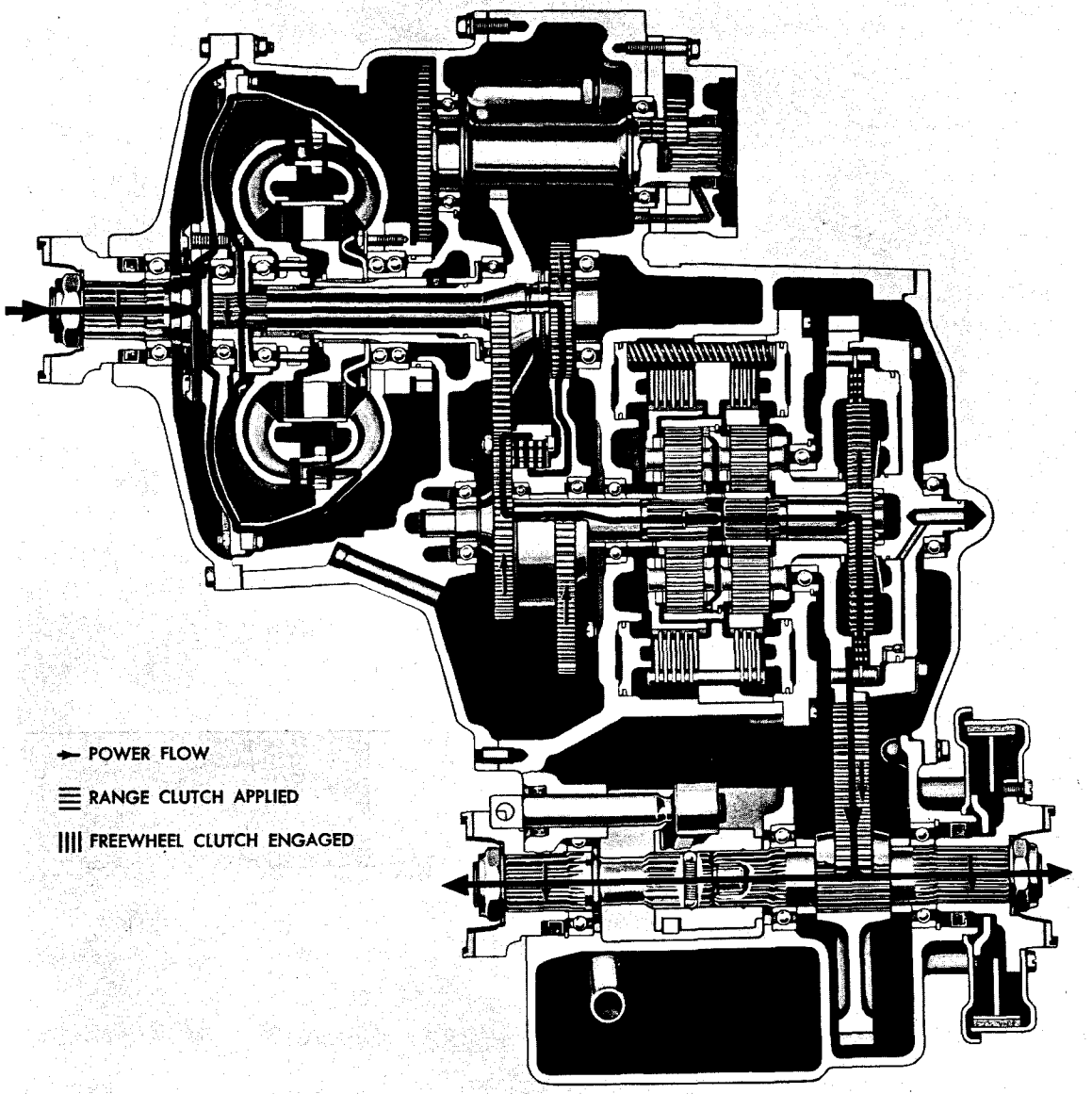

Fig. II-9. Forward-2, first turbine—torque path

23. FORWARD-2, FIRST TURBINE – TORQUE PATH

a. Fig. II-9 illustrates the torque path through the transmission in forward-2 range when load demand is high. The engine torque is transmitted to the range gears in the manner described in 21a, above.

b. From the second-turbine driven gear, torque is transmitted through the sun gear splines to the high-range clutch hub. The high-range clutch is applied, locking the hub to the output transfer drive gear. The torque path from this point to the transmission outputs is as described previously – through the output transfer driven gear and output shafts.

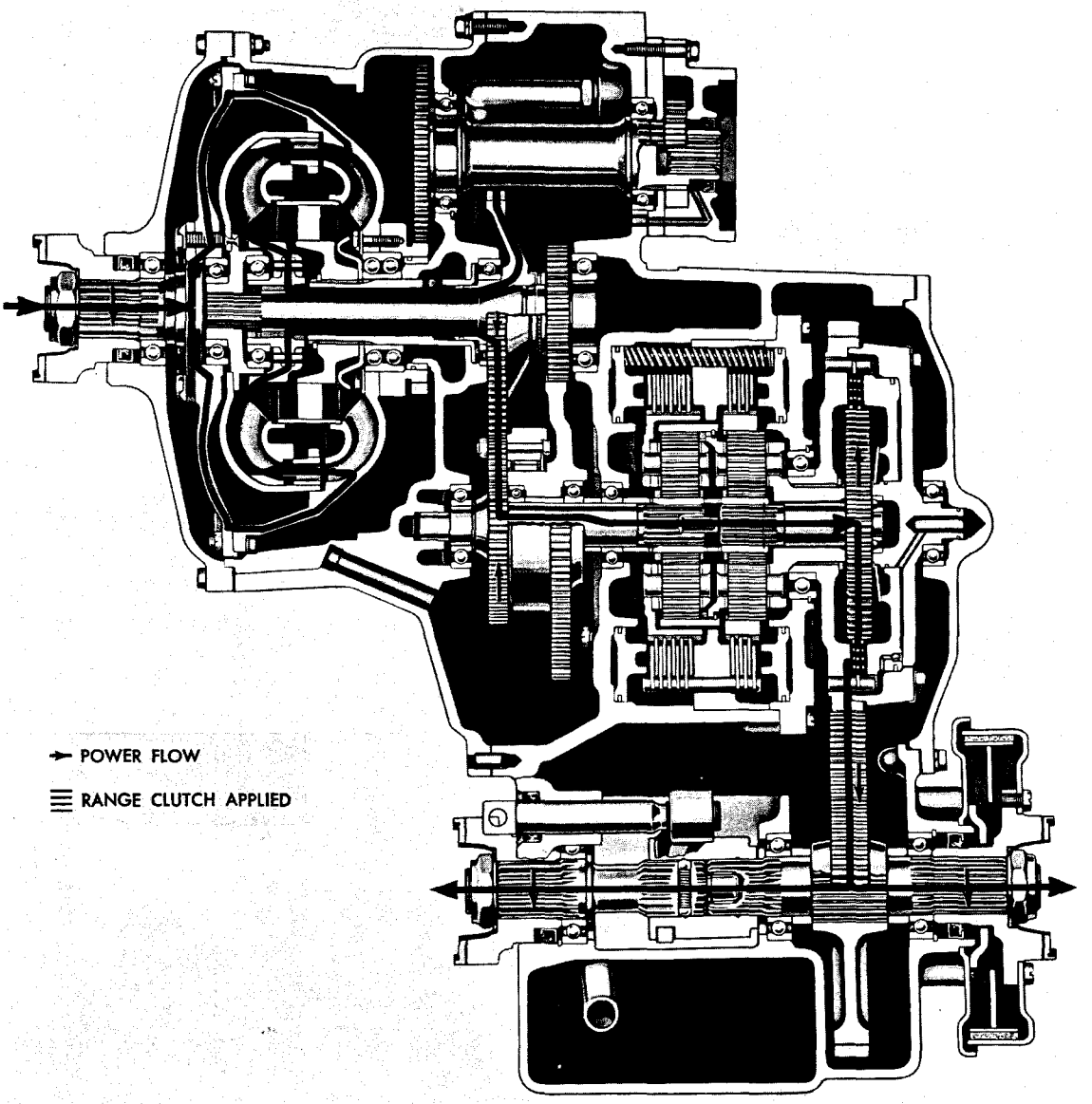

Fig. II-10. Forward-2, second turbine—torque path

24. FORWARD-2, SECOND TURBINE – TORQUE PATH

a. Fig. II-10 illustrates the torque path through the transmission in forward-2 range under lighter load or higher speed conditions. The transmission of torque from the engine to the range gear section of the transmission is as described in 22a, above.

b. From the second-turbine driven gear to the transmission outputs, torque is transmitted in the identical manner as described in 23b, above.

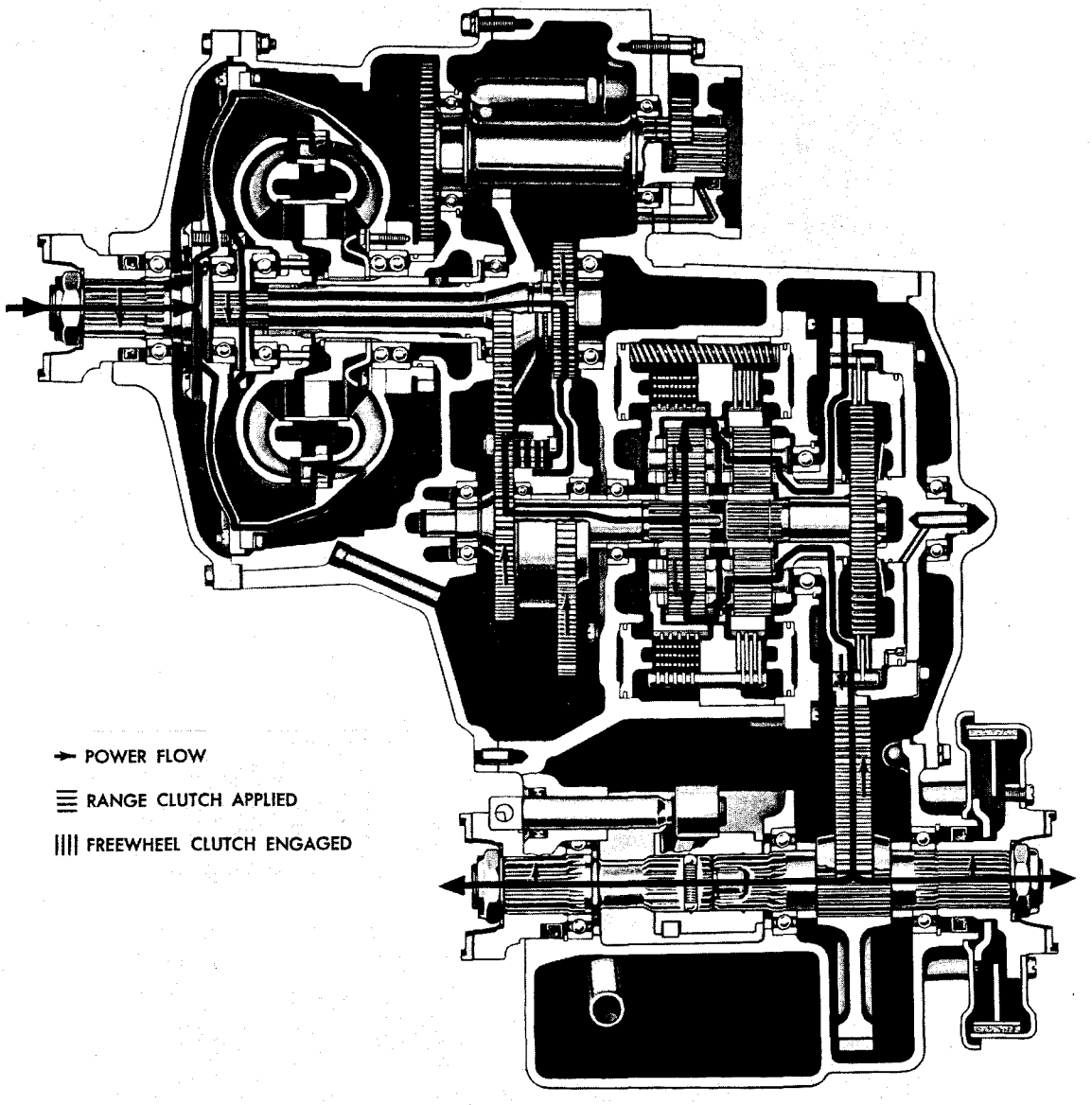

Fig. II-11. Reverse, first turbine—torque path

25. REVERSE, FIRST TURBINE – TORQUE PATH

a. Fig. II-11 illustrates the torque path through the transmission in reverse range when load demand is high. The engine torque is transmitted to the range gears in the manner described in 21a, above.

b. In the range gear section of the transmission, the reverse-range clutch is applied. This holds the reverse-range planetary carrier stationary. The second-turbine driven gear drives the reverse-range sun gear which, in turn, drives the reverse-range planetary pinions. The pinions mesh with the reverse-range ring gear and drive it in a direction opposite that of the sun gear. The ring gear is attached to the forward-planetary carrier. Thus, torque is transmitted from the reverse-range ring gear, through the forward-range carrier, to the output transfer drive gear. The remainder of the torque path is identical to that previously described except that rotations are reversed.

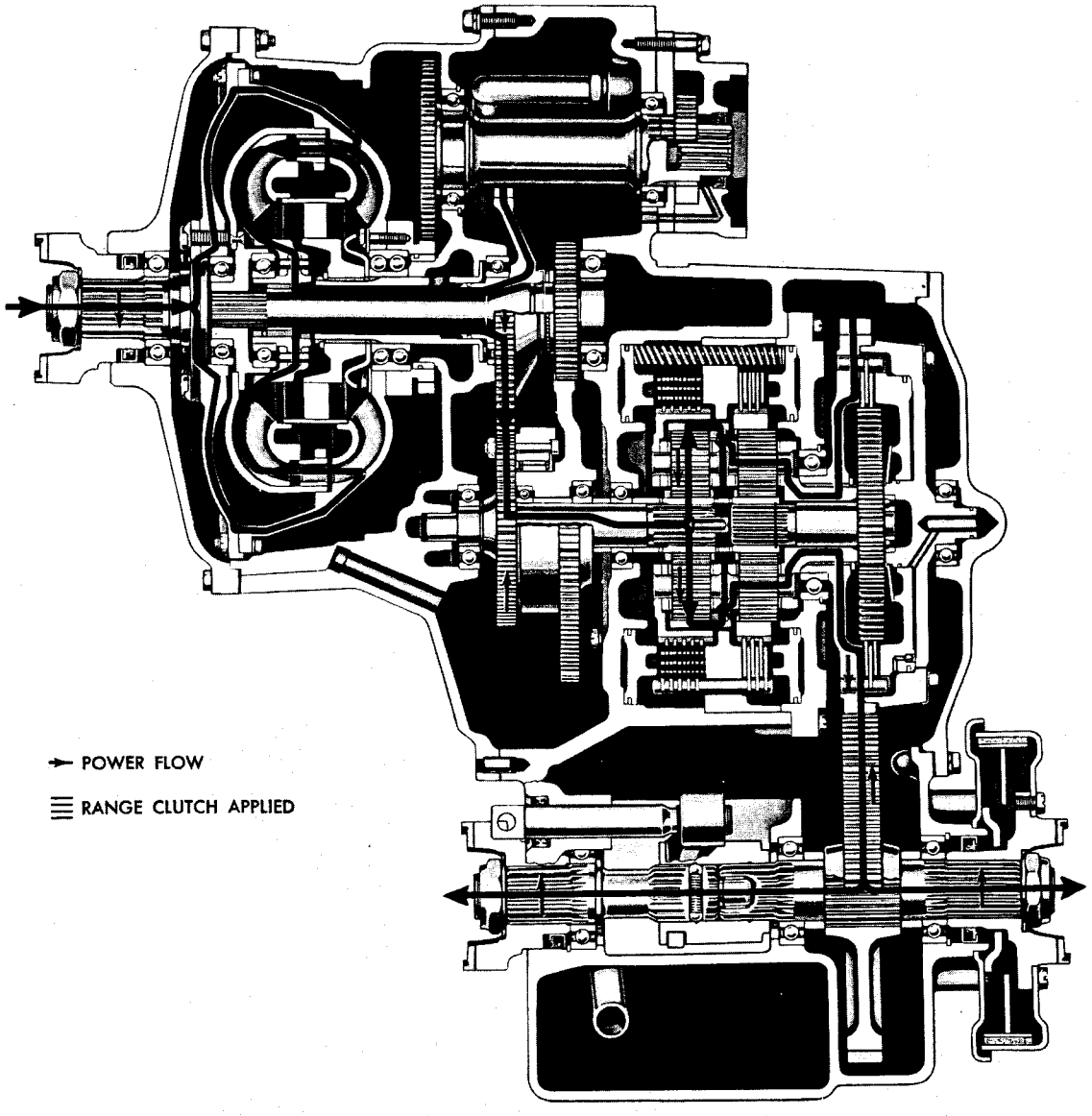

Fig. II-12. Reverse, second turbine—torque path

26. REVERSE, SECOND TURBINE — TORQUE PATH

a. Fig. II-12 illustrates the transmission torque path in reverse range under lighter loads or at higher speeds. The transmission of torque from the engine to the transmission range gearing is as described in 22a, above.

b. From the second-turbine driven gear to the transmission outputs, torque is transmitted as described in 25a, above.

Section III PREVENTIVE MAINTENANCE

1. SCOPE

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

2. PERIODIC INSPECTIONS, CLEANING

a. Inspecting Exterior. The exterior of the transmission should be cleaned and inspected at regular intervals. The severity of service and operating environment will determine the frequency of such procedures. The transmission should be inspected for loose bolts, oil leaks, linkage troubles, and bent or damaged oil lines. Oil leaks which cannot be stopped by tightening the parts require immediate attention. Linkage must be kept clean and well lubricated.

b. Cleaning Breather. The prevalence of dust and dirt will determine the frequency at which the breather requires cleaning. Clean the area around the breather (fig. I-2) before removing it. Wash the breather thoroughly by agitating it in mineral spirits or gasoline. Dry it thoroughly with compressed air, after cleaning. Always use a wrench of the proper size to remove or replace the breather. Pliers or a pipe wrench will crush or damage it, and produce metal chips which may enter the transmission.

c. Cleaning Oil Strainer. At each oil change, the strainer assembly at the lower-left side of the transmission housing should be removed and cleaned. Note that the strainer is offset toward the bottom of the transmission and must be reinstalled in that position. A new gasket should be used. The interior end of the strainer must slip over the oil pickup tube in the sump. Examine the strainer flange carefully, for oil leakage, after the oil sump is filled.

d. 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 sides. Oil in the water side (radiator) is another sign of leakage. This, however, may indicate leakage from the engine oil system. Any accumulation of sludge or soft dirt in the sump should be removed with "flushing oil."

e. Metal Particles in Oil. Metal particles except the usual minute particles normally removed by the oil filter) in the oil indicate damage to transmission parts. When this condition is found, the transmission should be disassembled and closely inspected to find the source. Metal contamination will require complete disassembly and cleaning of lines, cooler, filter and all areas where such particles may lodge.

3. CHECKING OIL LEVEL

a. Cold Check

(1) Two oil level check plugs are located at the lower-right front of the transmission housing (fig. I-1). Before starting the engine, remove the upper (Full) plug. Oil flowing from this plug opening indicates sufficient oil in the system to permit starting the engine. Add oil to this level if none flows when the plug is removed. Replace the plug.

(2) Start the engine and operate at 1000-1500 rpm with the transmission in neutral range. Operate for approximately 1 minute to charge the hydraulic system.

(3) Add oil as required to establish the oil level at the lower (Add) plug.

Note: – an oil check made at a lower engine rpm may result in low oil level at operating speeds and temperature.
– Thermal expansion will raise the oil level to approximately Full level as the transmission attains operating temperature.

b. Hot Check. Start the engine and run it at 1000 to 1500 rpm until the transmission reaches normal operating temperature (approximately 180° F). Then idle the engine and shift through all range positions slowly. This will insure that all parts of the system are filled with oil. Shift to neutral and set the engine speed at approximately 1500 to 2000 rpm. Remove the upper (Full) oil level check plug. Oil should be at the level of the plug opening. Add or drain oil to bring it to this level.

Note: A false oil level may be indicated by foaming or spurting. A true level is indicated by a solid oil stream flowing from the check plug.

Note: The transmission may be operated safely as long as the oil is above the level of the lower (Add) oil check plug.

4. MAINTENANCE INTERVALS

a. Use Determines Frequency. The severity of service and the environment in which the transmission operates will determine the frequency of some maintenance operations. Under very dusty or dirty operating conditions, the transmission oil should be changed more often. Oil should be changed immediately if it has been subjected to overheating – indicated by discoloration and a strong odor. The oil strainer should be cleaned at every oil change. The breather will require more frequent cleaning when dirt and dust conditions are severe. Inspection of the breather will usually reveal whether cleaning is required (refer to 2b, above).

b. When to Change Oil. Generally, the oil should be changed after each 1000 hours of operation. For severe service, refer to a, above. Refer also to para 2, above, before changing oil.

5. CHANGING OIL, FILTERS

a. Draining Oil. The transmission should be at operating temperature (180° F) when the oil is changed. Remove the plug at the left rear of the transmission housing. Remove the oil filter element from the remote-mounted filter. Remove, clean and reinstall the strainer assembly (fig. I-1), as outlined in para 2c, above. Let the oil drain for 30 minutes, if time permits. Install a new oil filter element and gasket. Install the oil drain plug.

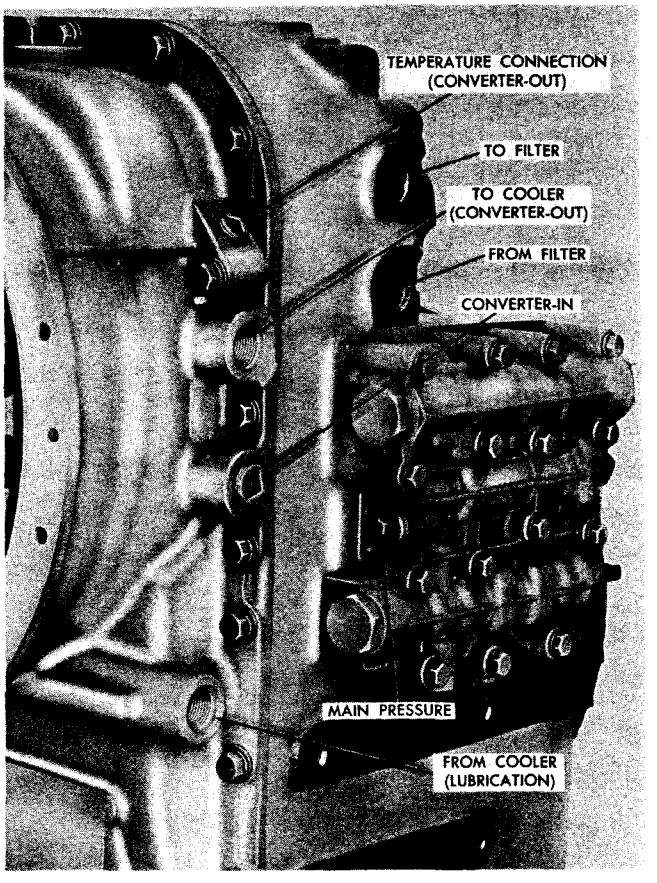

Fig. III-1. Pressure and temperature check points

b. Filling Oil System. Add 7 1/2 gallons (initial fill), or 6 1/2 gallons after oil change, of the specified oil to the transmission. Refer to sect. I, para 9. Then proceed as outlined in para 3b, above, adding oil as required to establish the correct oil level for operation.

6. OIL CAPACITY

The TT 2220-1 transmission requires approximately 8 1/2 US gallons of oil – exclusive of the external cooler and filter circuits. However, some oil will be trapped and will not drain. Thus, refilling at oil changes will not require as much oil as a transmission which is dry after rebuild.

7. PRESSURES, TEMPERATURES

Fig. III-1 illustrates the points where the transmission temperature and pressures may be measured. The vehicle may be equipped with a temperature gage and a pressure gage. If so, the temperature gage is connected to register the converter-out (to cooler) temperature, and the pressure gage registers clutch pressure. Clutch pressure during normal operation in any gear or in neutral is approximately equal to main pressure and may be regarded as main pressure. However, while either the clutch cutoff control, or inching control is being used, clutch pressure may fall to practically zero. This does not indicate that main pressure has decreased. Therefore, when checking main pressure, neither of these controls must be activated.

8. CHECKING, ADJUSTING LINKAGE

a. See Vehicle Manual Instructions. The specific design of control linkages for range selection, front output disconnect and inching control (when used) depends upon the installation. Control linkages are provided by the vehicle manufacturer. Therefore, only general instructions for linkage adjustments can be provided in this manual.

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

c. Front-output Disconnect. The front-output disconnect shaft position must be adjusted by disconnecting the linkage and rotating the shaft. Push the shaft inward (toward the rear) to its engaged position. A spring-loaded detent will indicate engaged position. When the disconnect is engaged, adjust the shaft (by rotating it) until the measurement from the center of the linkage pin hole to the front face of the transmission housing (split line) is 0.170 to 0.210 inch.

9. TRANSMISSION STALL TEST

a. Definition, Purpose

(1) A stall check determines condition while the output shaft is prevented from turning and the engine is running at wide-open throttle. The stall test indicates whether or not the engine and transmission-converter are performing satisfactorily as a unit.

(2) It will be necessary to refer to the engine-converter matched performance curve to determine the recommended engine speed at stall. This data is available from your dealer, or from Allison Division, GMC. Stall tests may be made in any range, if necessary. However, such tests in the lower range must be made with extreme caution because of the high torque delivered at the transmission output shaft. For this reason, stall tests should be made only in the high range, unless conditions warrant tests in other ranges.

b. Procedure. With the transmission at normal operating temperature of at least 180 degrees F, connect a tachometer to the engine, apply the vehicle brakes securely and shift the selector control to high range. Accelerate the engine to wide-open throttle. Record the engine speed at wide-open throttle, after reaching a stabilized engine rpm, and converter temperature reaches 225 degrees F minimum. Do not let converter-out oil temperature exceed 250 degrees F.

> Caution: Because of the rapid rise in oil temperature, the stall condition should never be maintained for more than 30 seconds at one time. Approximately 2 minutes should be allowed between tests for cooling and to prevent overheating. During this 2-minute period, the selector control should be moved to neutral and engine speed maintained. Momentarily throttle the engine back when shifting to neutral.

c. Results. Under stall test conditions, a comparison of the actual engine speed with the established normal speed for such conditions will indicate whether the engine or transmission is malfunctioning. To determine the desired engine speed at stall, refer to the engine-converter matched performance curve for the particular installation. Refer to the TROUBLESHOOTING CHART, end of this section, for possible causes of stall test deviations from normal.

Note: Because of effects of ambient temperature, altitude, engine accessory loss variations, etc., on power input to the converter, the actual engine stall speed may vary ± 150 rpm from the estimated value shown on the engine-converter match chart for normal installation.

10. STORAGE

a. Period of Storage. The preparations to be made for storage of a transmission will depend upon the conditions under which it is to be stored and the period of time involved. Under severe storage conditions, preservative measures should be used if the idle period is to exceed one week. The following procedures will give protection for twelve months. Repeat the process if the storage procedure exceeds this period.

b. Preservatives and Procedures. Protective oil must meet government specification USA 2-126 grade 1. Grease must meet specification ANC 124d. Moistureproof tape is required. Drain the oil while the transmission is at operating temperature (approximately 180° F). Refill the system with preservative oil and raise the transmission temperature to approximately 225° F. Shift the transmission slowly through all selector positions to thoroughly distribute the oil.

Note: Do not operate the vehicle to raise the temperature. Rather, lock the vehicle brakes, shift to forward-2 selector position and run the engine at approximately 1000 rpm. On vehicles equipped with clutch cutoff control, do not apply the brakes but block the vehicle against forward movement.

Stop the engine and allow the transmission to cool until the heat of the sump can be tolerated by hand. Tape all openings, and tape or grease all exposed metal surfaces. When outside storage is necessary, provide a ventilated, rainproof covering.

c. Return to Service. Remove the moistureproof tape and grease. Start the engine and run it at idle speed until the oil temperature reaches 150° F. Drain the oil and refill as outlined in para 4 through 6, above.

Note: Do not operate the vehicle while using preservative oil except for minimum necessary time and distance.

11. TROUBLESHOOTING

a. General. Troubleshooting is the systematic search for and location of malfunctions in the engine or transmission which affect transmission performance. A thorough study of the description and operation of components and the hydraulic system in sect. II will be helpful in troubleshooting. The engine and transmission must be regarded as a single package during troubleshooting.

b. Troubleshooting Chart. The following chart outlines the possible causes and remedies for transmission troubles. Capital letters indicate the symptom; numerals following the symptom indicate several possible causes; numerals in the right column indicate remedies for the correspondingly numbered causes in the left column.

TROUBLESHOOTING CHART

Cause	Remedy
A. LOW MAIN PRESSURE	
1. Low oil level	1. Add oil to correct level (sect. III, para 3)
2. Clogged oil strainer	2. Clean strainer (sect. III, para 2c)
3. Clogged oil filter	3. Replace filter element (sect. III, para 5)
4. Weak or broken main-pressure regulator valve spring	4. Replace spring (sect. VI, para 9)
5. Inching control adjustment not fully retracted	5. Adjust linkage (sect. III, para 8)
6. Oil pump worn	6. Rebuild oil pump (sect. VI, para 8)
7. Air leak at intake side of oil pump	7. Check pump mounting bolts. Check oil pickup tube and nut (sect. VI, para 3)
8. Internal oil leakage	8. Disassemble transmission, rebuild subassemblies as required
9. Brake hydraulic (or air) pressure applying clutch cutoff valve	9. Check brake residual pressure (brakes released). Check brakes for full release
10. External oil leakage	10. Tighten bolts or replace gaskets
B. OVERHEATING	
1. High oil level	1. Restore proper oil level (sect. III, para 3)
2. Clutch failed	2. Rebuild transmission (sect. IV thru VIII)
3. Vehicle overloaded	3. Reduce load
4. Low main pressure	4. Refer to A, above
5. Engine water overheated	5. Correct engine overheating
6. Cooler oil or water line kinked or clogged	6. Clean or replace line
C. LOW CLUTCH APPLY PRESSURE	
1. Low main pressure	1. Refer to A, above
2. Clutch piston seal rings failed	2. Overhaul transmission
3. Clutch cutoff valve sticking	3. Rebuild control valve body assembly (sect. VI, para 9)
4. Inching control valve sticking	4. Rebuild control valve body assembly (sect. VI, para 9)
5. Internal oil leakage	5. Overhaul transmission

(Continued on next page)

TROUBLESHOOTING CHART - Continued

Cause	Remedy
D. AERATED OIL (foaming)	
1. Incorrect type oil used	1. Change oil, use proper type (sect. III, para 5)
2. High oil level	2. Restore proper oil level (sect. III, para 3)
3. Low oil level	3. Restore proper oil level (sect. III, para 3)
4. Air entering suction side of oil pump	4. Check oil pump bolts and gasket. Check oil pickup tube and nut.
E. VEHICLE WILL NOT TRAVEL	
1. Low main pressure	1. Refer to A, above
2. Low clutch apply pressure	2. Refer to C, above
3. Selector linkage broken or disconnected	3. Repair or connect linkage (sect. III, para 8)
4. Internal mechanical failure	4. Overhaul transmission
F. CLUTCH CUTOFF VALVE INEFFECTIVE	
1. Valve or plug sticking in bore	1. Rebuild control valve body assembly (sect. VI, para 9)
2. Brake apply hydraulic pressure not reaching control valve	2. Check pressure at control valve (full release at 300 psi)
3. Brake apply air pressure not reaching air cylinder	3. Check at air cylinder for brake-apply pressure
4. Plunger sticking in air cylinder	4. Check operation of air cylinder
G. VEHICLE TRAVELS IN NEUTRAL WHEN ENGINE IS ACCELERATED	
1. Selector linkage out of adjustment	1. Adjust linkage (sect. III, para 8)
2. Clutch failed (won't release)	2. Overhaul transmission
H. VEHICLE LACKS POWER AND ACCELERATION AT LOW SPEED	
1. Low main pressure	1. Refer to A, above
2. Low clutch apply pressure	2. Refer to C, above
3. Turbine freewheel clutch failed	3. Overhaul transmission
4. Engine malfunction	4. Check engine – refer to engine service manual

Section IV GENERAL OVERHAUL

1. SCOPE

This section provides preliminary information in preparing for the overhaul of a transmission. Tools and equipment needed are discussed. Replacement parts and service kits are covered. The importance of careful handling and cleanliness is stressed. Helpful information on inspection of parts is given. General information on the removal and installation of the transmission is included. Standard torque specifications for bolts and nuts are tabulated. An explanation of wear limits is made.

2. CHANGES IN MODEL, PROCEDURES

The release of new assemblies and/or product improvements may require new or different overhaul procedures. Major changes will be covered in supplementary information to this manual. Consult your dealer or distributor for the latest information. Give the model, assembly part number and serial number stamped on the transmission name plate (refer to sect. I, para 4).

3. TOOLS, EQUIPMENT NEEDED

a. In addition to ordinary mechanic's hand tools, the following items should be available.

(1) Chain hoist (at least 1/2 ton capacity).

(2) Suitable disassembly and assembly table.

(3) Press (for removal, installation of press-fit parts).

(4) Supply of wood blocks.

(5) Clean wiping cloths (do not use linty waste).

(6) Parts receptacles.

(7) Cleaning equipment (brushes, solvent, etc.)

(8) Torque wrenches.

(9) Oil-soluble grease.

(10) Dry ice (for cooling press-fit spindles, etc.)

(11) Hot plate or heating equipment to provide oil at 200° F (for heating bearings before installation).

b. A puller kit or improvised puller is required for removing the torque converter pump, bearing and accessory drive gear from the ground sleeve. If a puller kit is not available, an improvised puller similar to that illustrated in fig. IV-1 may be fabricated. The principal dimensions are given in the illustration.

c. When interference-fit input and output flanges are supplied with the transmission, a puller is required for their removal. The variety of flanges available will determine the specific puller required to remove them (refer to para 8, below).

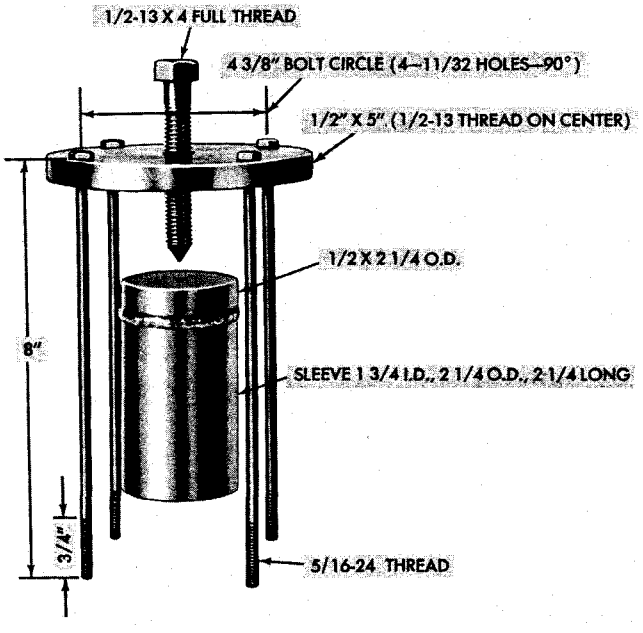

Fig. IV-1. Improvised puller for converter pump assembly

4. REPLACEMENT PARTS

a. Ordering Information. Refer to sect. I, para 5, for information on ordering parts or service kits.

b. Parts Normally Replaced. The following parts are normally replaced at each transmission rebuild.

(1) Gaskets.

(2) Cotter pins.

(3) Lock strips.

(4) Washers or snap rings damaged by removal.

(5) Oil seals (when removed).

Caution: Do not burn discarded Teflon seals in a closed area, since toxic gases could result.

c. Service Kits. Make use of the repair and overhaul kits which are available for certain transmissions and subassemblies. See sect. I, para 5 on how to order.

5. CAREFUL HANDLING

During all rebuild procedures, parts and subassemblies must be handled carefully to prevent nicking, scratching and denting. Parts which fit together closely but with operating clearance will stick if damaged only slightly. Parts which depend upon smooth surfaces for sealing may leak if scratched. Such parts should be carefully handled and protected during removal, cleaning, inspection and installation.

6. CLEANING, INSPECTION

a. General. All parts must be clean to permit effective inspection. At assembly it is very important that no dirt or foreign matter be allowed to enter the transmission. Even minute particles can cause the malfunction of close fitting parts such as valves.

b. Cleaning Parts

(1) All metallic parts of the transmission except bearings should be cleaned thoroughly with volatile mineral spirits, or by the 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 with spirits. Dry the passages with compressed air.

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

c. Cleaning Bearings

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

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

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

Note: Never dry bearings with compressed air. Do not 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.

(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 wire back and forth through the passage and flushing it out with cleaning solvent.

(3) Inspect mounting faces for burs, scratches, nicks, 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 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 200° F on an electric hot plate or in an oil bath. Coat the mating surfaces with white lead and use the proper size installation sleeve and an arbor press to seat the bearing.

(5) If a bearing must be removed or installed without 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 roundness, scores, burs, sharp edges, and evidence of overheating. Remove scores with crocus cloth. Remove burs and sharp edges with a scraper or knife blade. If the bushing is out-of-round, deeply scored, or excessively worn, replace it, using the proper size replacer.

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 Oil Seals, Gaskets

(1) Inspect seal rings for cuts and hardness. Replace seal rings if these defects are found.

(2) When replacing lip-type seal rings, make sure the spring-loaded side is toward the oil to be sealed in (toward the inside of the unit). Use a nonhardening sealing compound on the outside diameter of the seal to help prevent oil leaks.

(3) Replace all composition gaskets.

(4) Inspect hook-type seal rings for wear, broken hooks, and distortion.

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

(6) The sides of the seal ring should be smooth (0.005-inch maximum side wear). The sides of the shaft groove (or the bore) in which the seal ring fits should be smooth (50 micro inches equivalent) and square with the axis of rotation within 0.002 inch. If the sides of the ring grooves have to be reworked (0.020-inch maximum side wear), install a new seal ring.

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. Replace the part if other defects are found. Spline wear is not considered detrimental except where it affects tightness of fit of the splined parts.

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 Snap Rings. Inspect all snap rings for nicks, distortion, and excessive wear. Replace the part if one of these defects is found. The snap ring must snap tight in its groove for proper functioning.

m. Inspecting Springs. Inspect all the springs for signs of overheating, permanent set or wear due to rubbing adjacent parts. Replace the spring if any one of these defects is found.

7. REMOVING, INSTALLING TRANSMISSION

Drain the oil from the transmission. If possible, it should be allowed to drain overnight, and while the transmission is warm. Replace the drain plug. Consult the vehicle service manual for specific instructions for removal and installation, since applications will differ. Be sure all linkages, controls, cooler and filter lines, temperature and pressure connections, input and output couplings, and mounting bolts are disconnected before the transmission is removed and reconnected after the transmission is installed. Two 3/4-10 tapped openings are provided at the top of the transmission housing for lifting the assembly. Bolts or eyebolts may be installed into these openings. Clean the exterior of the transmission. Steam cleaning should be followed immediately by disassembly since condensation should not be allowed to remain in the transmission to cause rust.

8. REMOVING, INSTALLING DRIVE FLANGES

a. Removing. When interference-fit drive flanges are used, they should be removed before further disassembly is started. A heavy-duty puller kit is required. The transmission drive flanges must be prevented from rotating while the puller is used. A heavy steel plate may be bolted to the ears of the flange to provide a grip for the puller jaws. Drill the center of the plate to let the puller screw pass through to the transmission shaft. Use bolts to fasten the plate at all bolt locations on the flange. Such a plate will prevent distortion of the flange during the pulling process. The plate should be at least 1 inch thick. It may be tapped for a puller screw in the center if a puller kit is not available. The puller screw should be at least 1 inch in diameter, should be heat treated and have a fine thread (1-14). A typical improvised puller is illustrated in fig. IV-2.

b. Installing. Be sure that spacers or other parts are in place on the shaft which receives the flange. Inspect the shaft and flange splines for dirt, paint, rust, burs and rough spots. Remove any of these. Coat the shaft

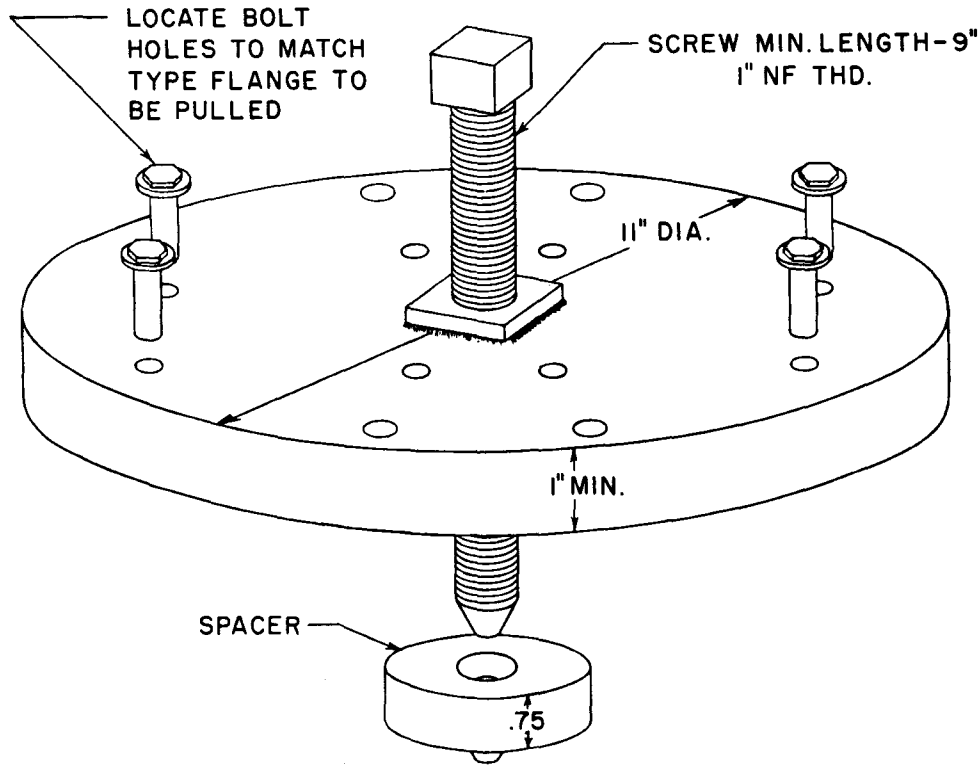

Fig. IV-2. Improvised puller for interference-fit flanges

splines with light bearing grease. Grease the oil seal lip. Heat the flange to approximately 300° F. While it is hot, quickly install it on the shaft. Seat it immediately and install the nut which retains it. Tighten the nut before the flange cools. Recheck the nut for tightness after the flange cools.

9. WEAR LIMITS

Refer to sect. VIII for general and specific information covering parts fits, clearances and wear limits.

10. TORQUE SPECIFICATIONS

Unless otherwise specified in the text of sect. V through VII or in fig. IV-3, the torque specifications in the following chart will apply to all assembly procedures. Refer to fig. IV-3 for convenient reference to the torque required to tighten all threaded items visible in the transmission cross section.

(Torque Specification Chart follows on next page)

STANDARD TORQUE SPECIFICATIONS

(All torque values are given in pound feet)

Size	Threads per inch	Standard heat-treated bolts and screws	Special heat-treated bolts, screws, Allen-head screws and self-locking capscrews	Nuts
				
1/4	20	9-11	9-11	
	28	10-12	10-12	
5/16	18	13-16	17-20	
	24	14-18	19-23	14-18
3/8	16	26-32	36-43	
	24	33-40	41-49	33-40
7/16	14	42-50	54-65	
	20	50-60	64-77	
1/2	13	67-80	81-97	
	20	83-100	96-115	
5/8	11	117-140	164-192	
	18	134-160	193-225	134-160

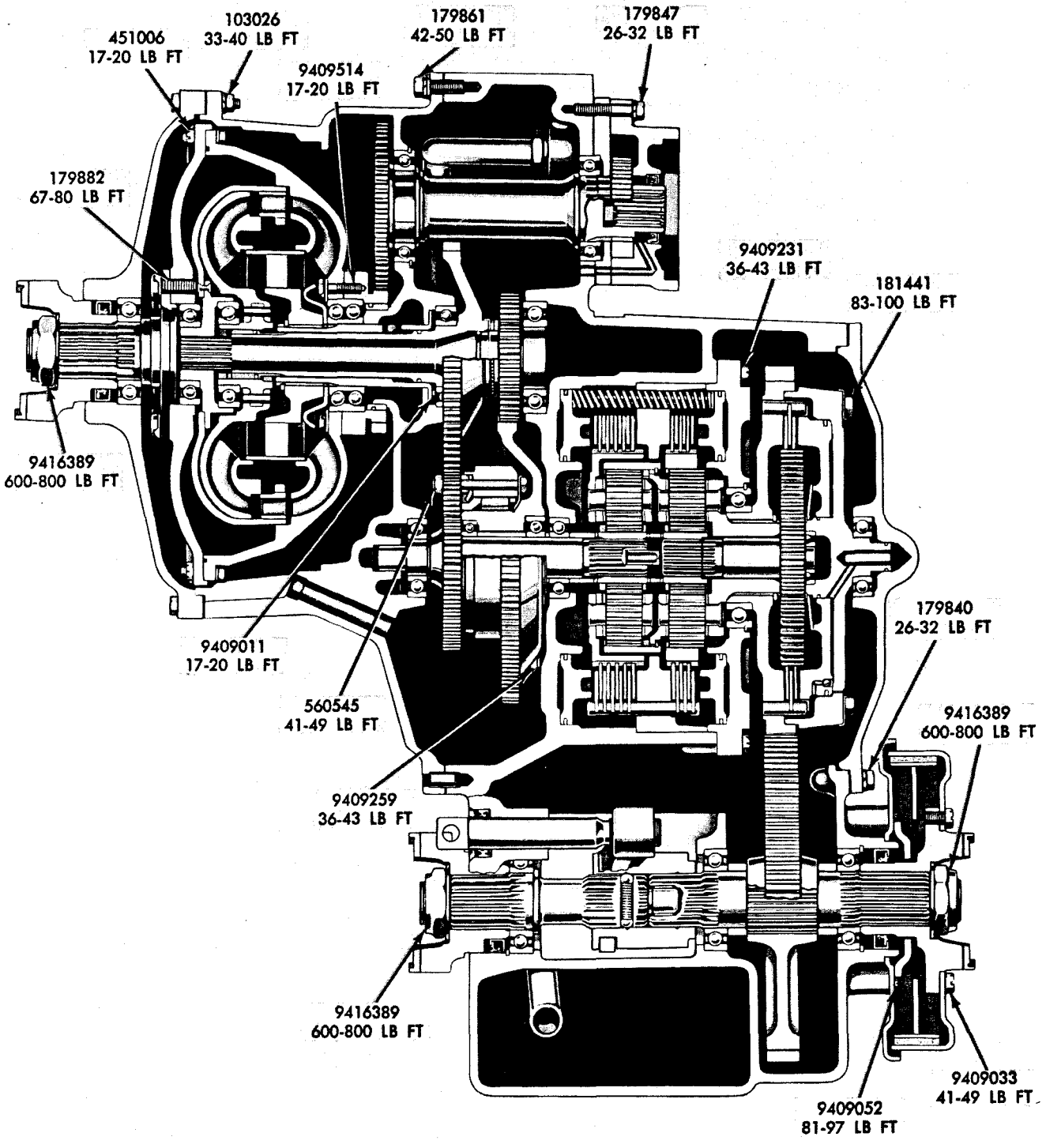

Fig. IV-3. Cross-section view of TT 2220-1 transmission, showing torque specifications

Section V DISASSEMBLY OF TRANSMISSION INTO SUBASSEMBLIES

1. GENERAL

a. Scope

(1) The disassembly procedures in this section describe the disassembly of the transmission into its subassemblies. Rebuild of the subassemblies is described in sect. VI. Assembly of the transmission from subassemblies is described in sect. VII.

(2) Para 2, below, describes disassembly of the engine mount model, while para 3, outlines disassembly of the remote mount model. Para 4, below, explains the possibility of removing the high-range clutch, the forward-range clutch and planetary and the reverse-range clutch and planetary, while the transmission is installed in the vehicle.

(3) Refer to cross-section drawing (foldout 1) for functional location of parts. Refer to disassembly and assembly pictures and exploded views (foldouts 2 through 7) for parts identification.

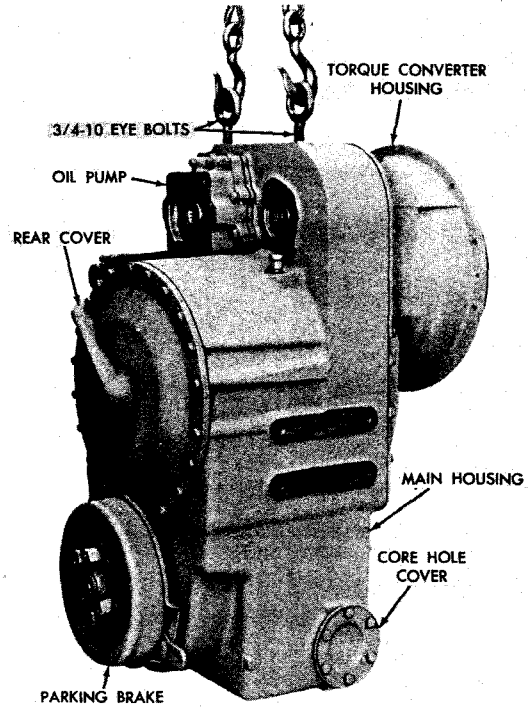

Fig. V-1. Lifting transmission

b. Preparation for Disassembly

(1) Drain the transmission if it was not drained before removing from drive line.

(2) Refer to sect. IV, para 3 on tools and equipment before beginning disassembly.

2. DISASSEMBLY OF ENGINE MOUNT MODEL

a. Removal of Minor Assemblies

(1) Install the eyebolts in holes provided, attach hoist hooks and set the transmission on a table in the vertical position (fig. V-1).

(2) Remove the oil drain plug and drain oil and reinstall (fig. V-2).

(3) Remove six bolts and six lock washers. Remove the oil strainer assembly and gasket (fig. V-2).

(4) Remove six bolts and lock washers from the core hole cover and remove cover and gasket (fig. V-1).

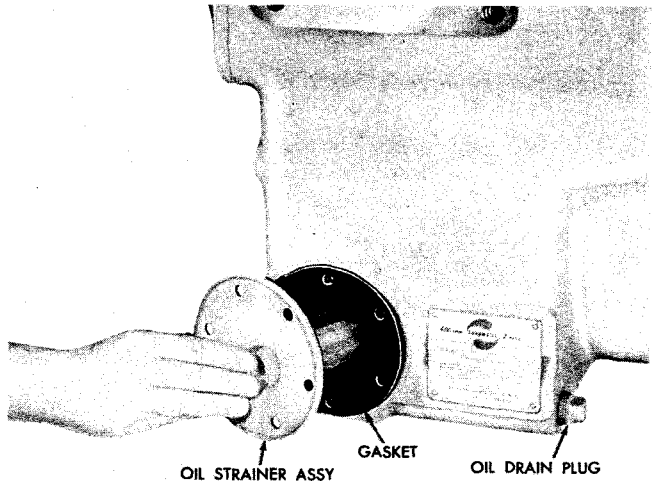

Fig. V-2. Removing oil strainer and gasket

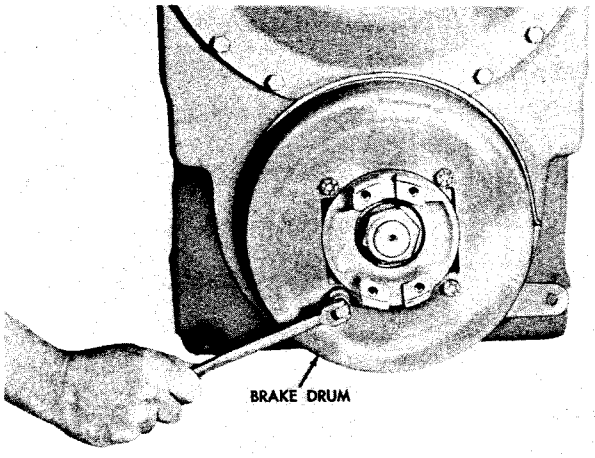

Fig. V-3. Removing (or installing) brake drum

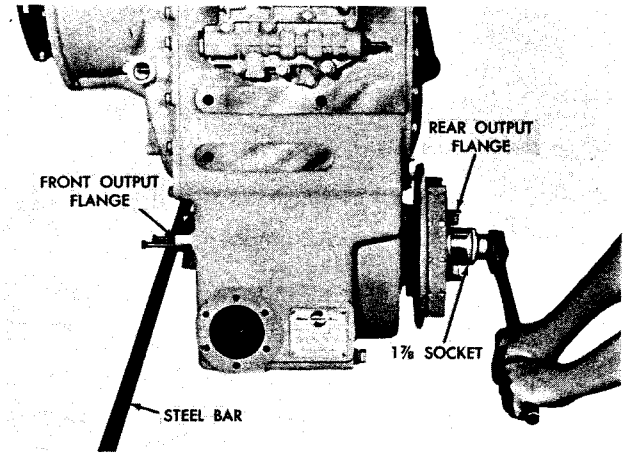

Fig. V-4. Removing rear output flange nut

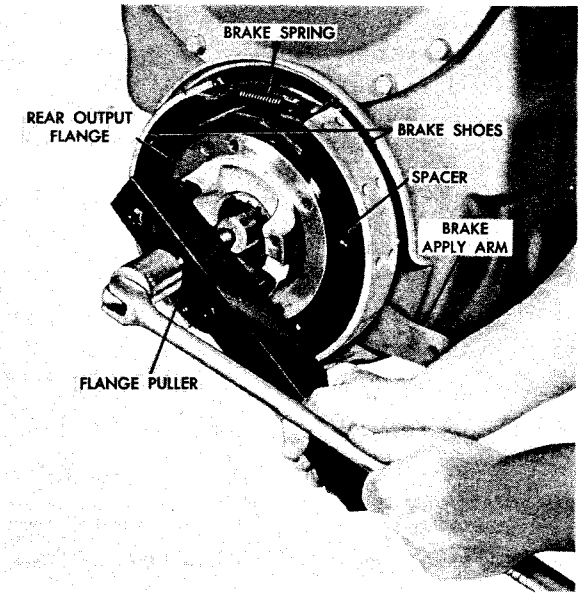

Fig. V-5. Removing (or installing) rear output flange

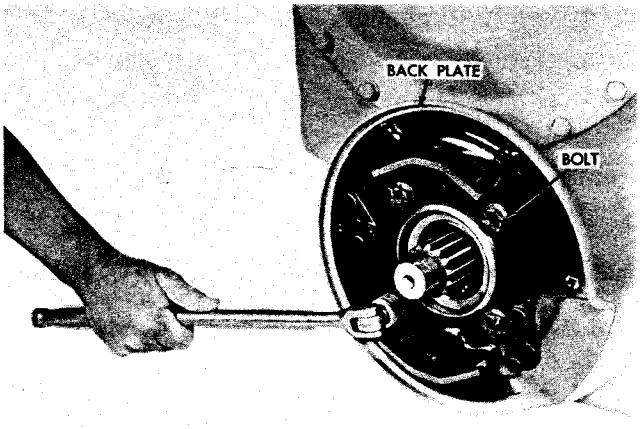

Fig. V-6. Removing (or installing) brake back plate

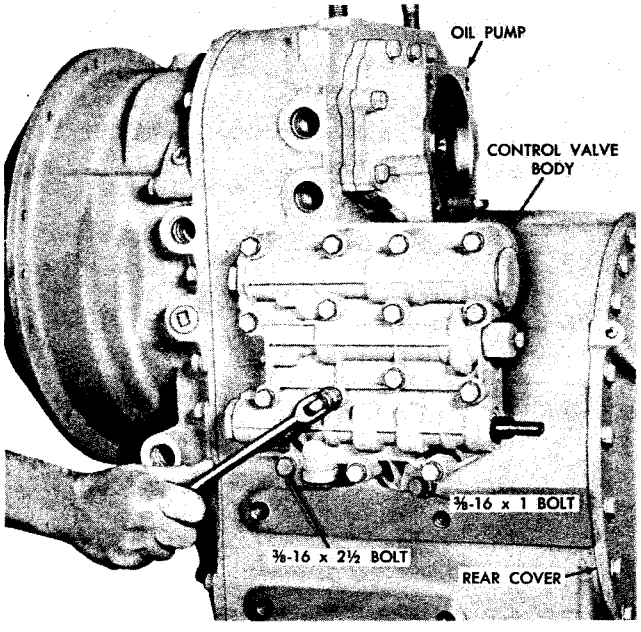

Fig. V-7. Removing (or installing) valve body bolts

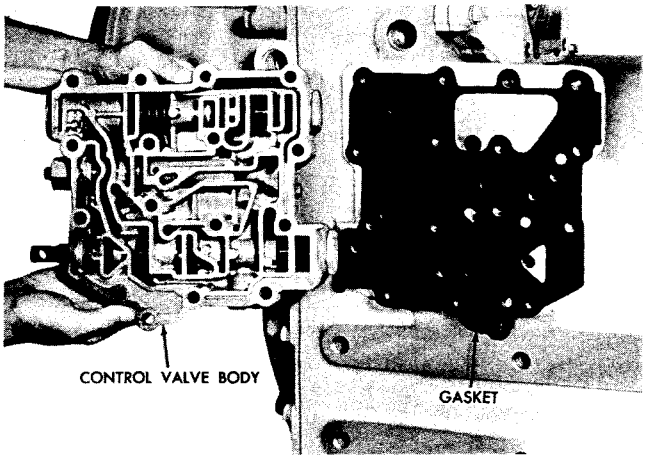

Fig. V-8. Removing valve body and gasket

(5) Remove four bolts and remove the brake drum (fig. V-3).

b. Removal of Output Flanges

(1) Using a 1 7/8-inch socket, remove the rear output flange nut and washer. To keep the flange from rotating, install two bolts into the front output flange and place one end of a bar between the bolts and rest the other end against the assembly table (fig. V-4).

(2) Remove front output flange nut and washer, using the same procedure.

(3) Using a flange puller, remove the front and rear output flanges (fig. V-5).

c. Removal of Brake Assembly

(1) Remove two springs, spacer, two brake shoes and brake apply arm (fig. V-5).

(2) Remove four bolts and brake back plate (fig. V-6).

d. Removal of Valve Body Assembly

(1) Remove 16 bolts and 16 lock washers from the valve body assembly (fig. V-7).

(2) Remove the valve body assembly and gasket (fig. V-8).

e. Removal of Flex Disks and Torque Converter Cover Assembly

(1) Position the transmission on the back side. Do not allow the transmission to rest on the rear output shaft.

(2) Remove six bolts, a plate, three flex disks and one flex disk assembly (fig. V-9).

(3) Remove 24 nuts from converter pump cover (fig. V-10).

(4) Install two bolts in the cover holes 180° apart and using these as pullers, remove the cover and ball bearing (fig. V-11). Do not remove the ball bearing unless necessary for replacement. If necessary to replace, drive on the outer race to remove.

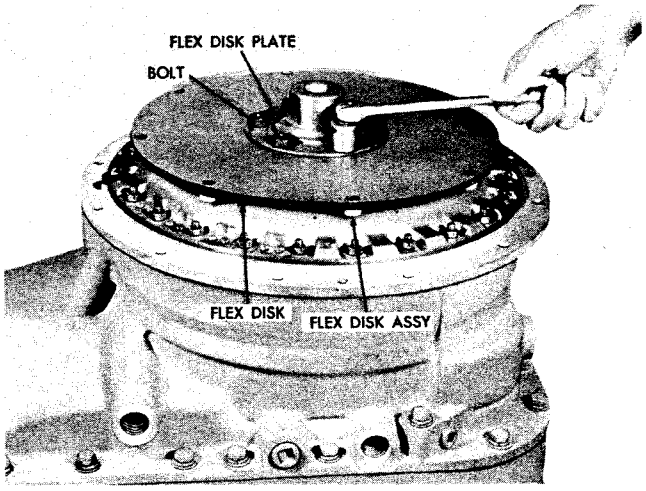

Fig. V-9. Removing (or installing) flex disk assembly

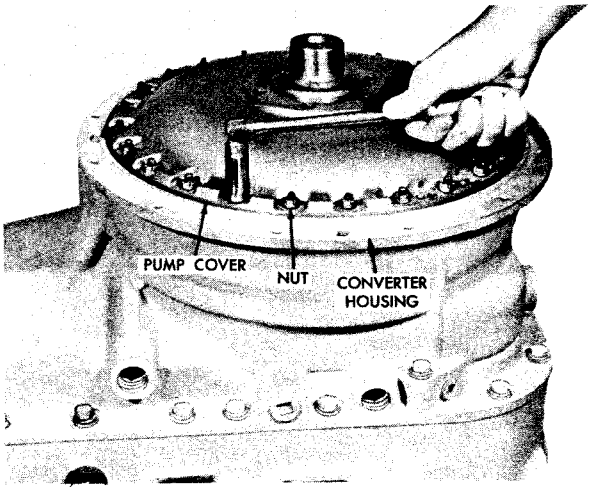

Fig. V-10. Removing (or installing) torque converter cover bolts

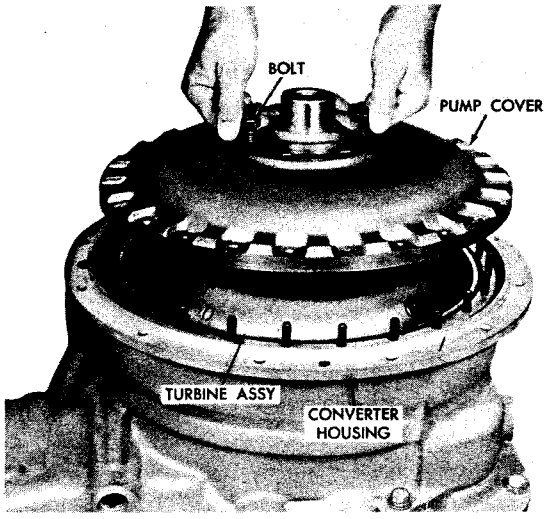

Fig. V-11. Removing torque converter cover

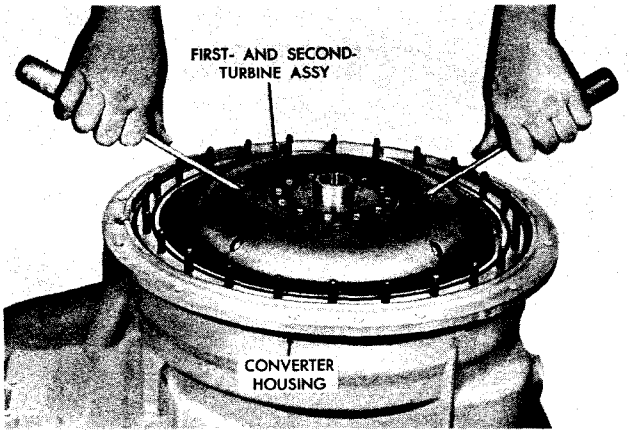

Fig. V-12. Removing first- and second-turbine assembly

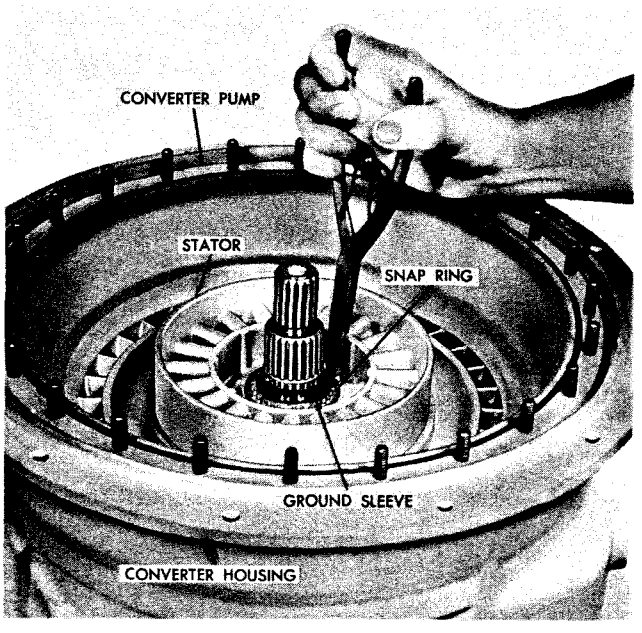

Fig. V-13. Removing external-snap ring from converter ground sleeve, and removing stator

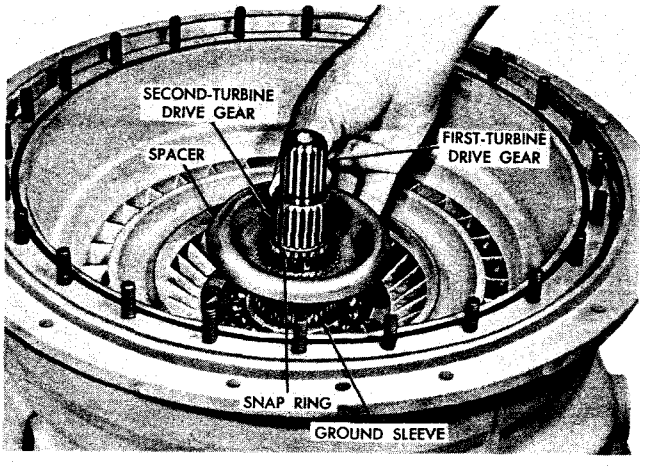

Fig. V-14. Removing spacer

f. Removal of Torque Converter Elements

(1) Using two screwdrivers, remove first and second turbine assembly (fig. V-12).

(2) Using snap ring pliers, remove external-snap ring from converter ground sleeve. Remove stator (fig. V-13).

(3) Remove the spacer that fits between the stator and pump (fig. V-14).

(4) Bend down the lock strips and remove four of the 12 bolts that secure the converter pump to the input accessory drive gear (fig. V-15). Using a puller in the four holes, remove the converter pump, bearing, accessory drive gear, retainer and gasket as an assembly (fig. V-15 and IV-1).

g. Removal of Torque Converter Housing

(1) Remove 24 bolts and 24 lock washers from the converter housing (fig. V-15).

(2) Attach a suitable sling to the engine mounting face and use a hoist to remove the

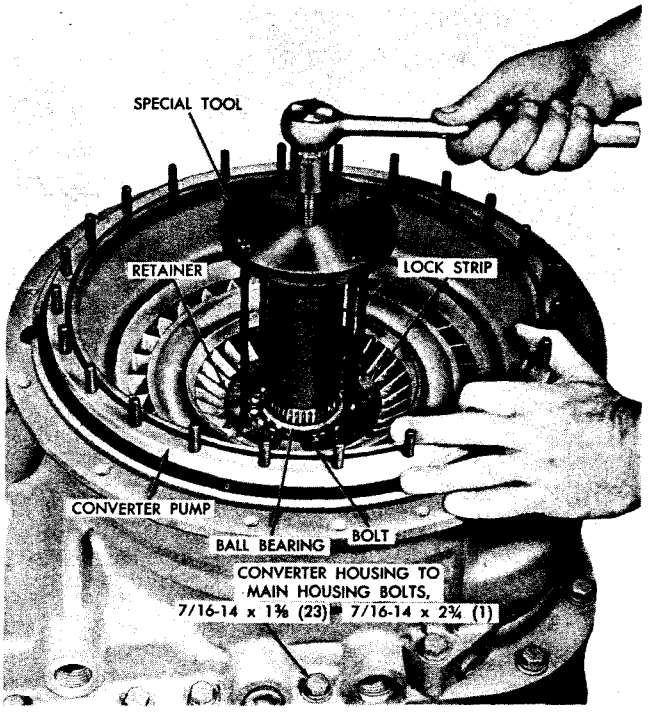

Fig. V-15. Removing converter pump, input accessory drive gear and bearing

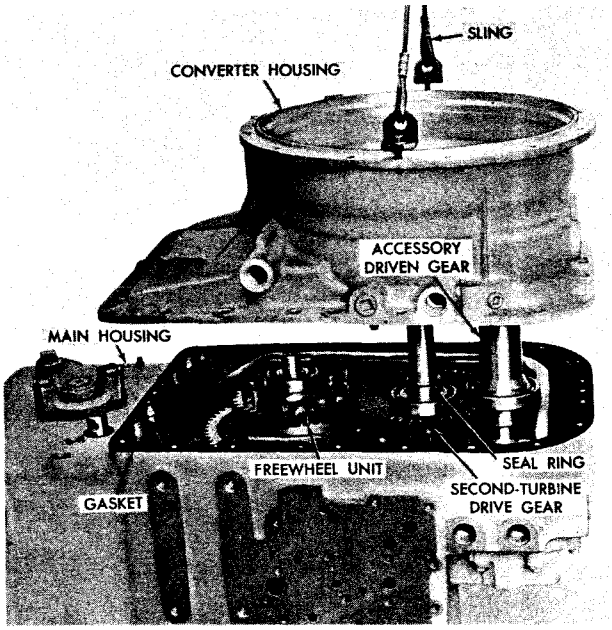

Fig. V-16. Removing (or installing) torque converter housing assembly from main housing

housing. Remove the gasket (fig. V-16). The accessory drive and driven gear will come with the housing as well as the diaphragm and oil seal.

h. Removal of Input Gears and Freewheel Unit

(1) Remove the second-turbine drive gear, seal ring, snap ring, and ball bearing (fig. V-17).

(2) Remove the turbine freewheel unit, first-turbine driven gear and second-turbine driven gear as an assembly (fig. V-17).

(3) Remove the forward and reverse sun gear (fig. V-18).

(4) Remove the roller bearing and two thrust races (fig. V-18).

(5) Remove the first-turbine drive gear and seal ring (fig. V-18).

(6) Remove the accessory drive shaft assembly and bearing (fig. V-19). Do not remove the plug from the shaft. Do not remove the bearing from the shaft unless necessary. If necessary, drive the bearing from shaft. It may be necessary to tap the assembly lightly with a soft hammer from the mounting pad side.

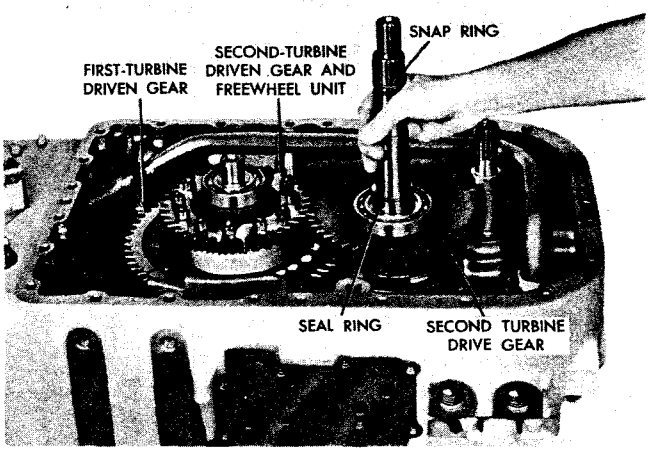

Fig. V-17. Removing (or installing) second-turbine gear, turbine driven gears and freewheel unit

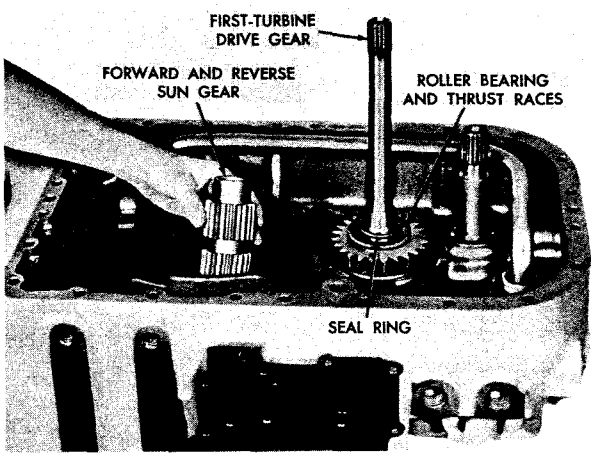

Fig. V-18. Removing (or installing) forward- and reverse-range sun gear

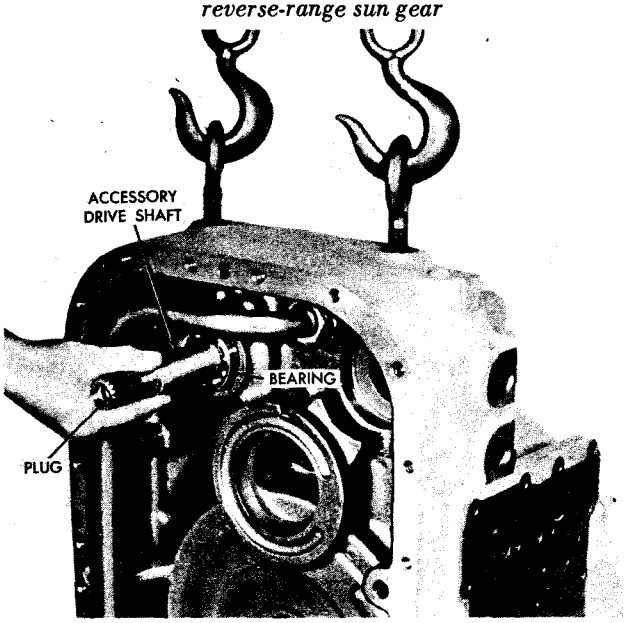

Fig. V-19. Removing accessory drive shaft assembly and bearing

i. Removal of Rear Cover and High-range Clutch Assembly

(1) Position the transmission on blocks on the front split line. Remove 21 bolts and 21 lock washers from rear cover (fig. V-20).

(2) Using two of the bolts removed in the holes provided, push the cover off the main housing. Remove the rear cover and gasket (fig. V-20).

(3) Bend the corners of six lock tabs away from six bolt heads. Remove six bolts and lock tabs from high-range piston housing (fig. V-21).

(4) Using two screwdrivers, pry up and remove the high clutch piston housing, piston and high-range clutch hub (fig. V-22).

(5) Remove the high-range clutch plates (fig. V-23).

(6) Remove the snap ring which holds the transfer drive gear assembly to the forward planetary carrier assembly (fig. V-23).

(7) Remove the transfer drive gear assembly and ball bearing (fig. V-23 and VII-3). Do not remove the pins from the transfer drive gear unless replacement is necessary. If necessary to remove, press the pins from the gear. Do not remove the ball bearing unless necessary for replacement. If necessary to remove, pull the bearing from the gear hub.

j. Removal of Forward Clutch and Planetary

(1) Remove 10 bolts from the forward piston housing. Remove the forward piston housing and piston. The housing is under spring tension and it will be necessary to release the tension evenly around the housing (fig. V-24).

(2) Remove 12 clutch spring pins and 12 springs (fig. V-25).

(3) Remove one internal- and one external-clutch plate (fig. V-25).

(4) Remove the forward ring gear (fig. V-25).

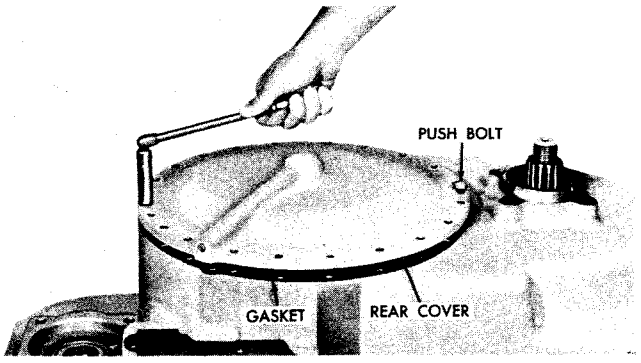

Fig. V-20. Removing main housing rear cover and gasket

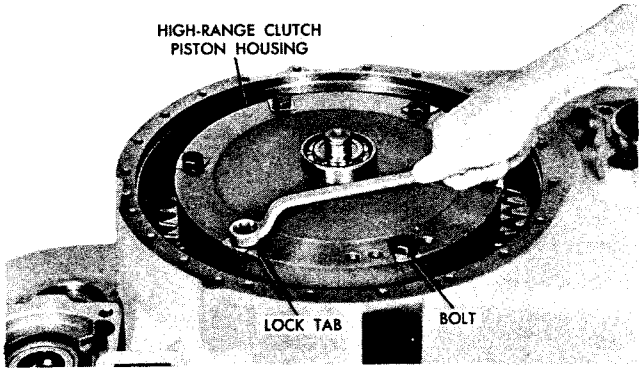

Fig. V-21. Removing high-range piston housing bolts

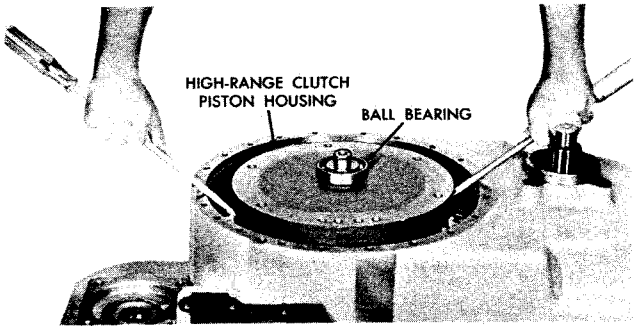

Fig. V-22. Removing high-range piston housing, piston and high-range clutch hub

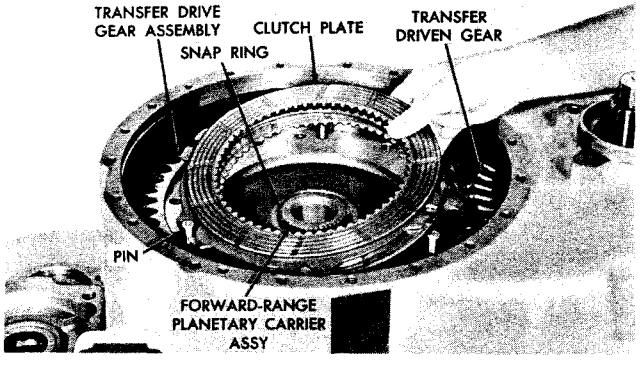

Fig. V-23. Removing high-range clutch plates

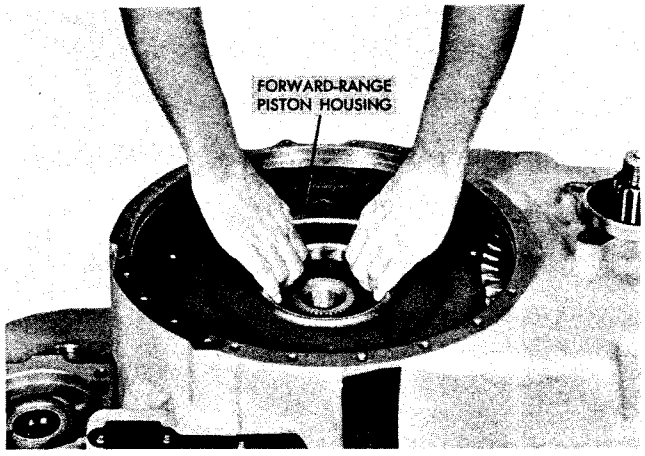

Fig. V-24. Removing (or installing) forward-range piston housing and piston

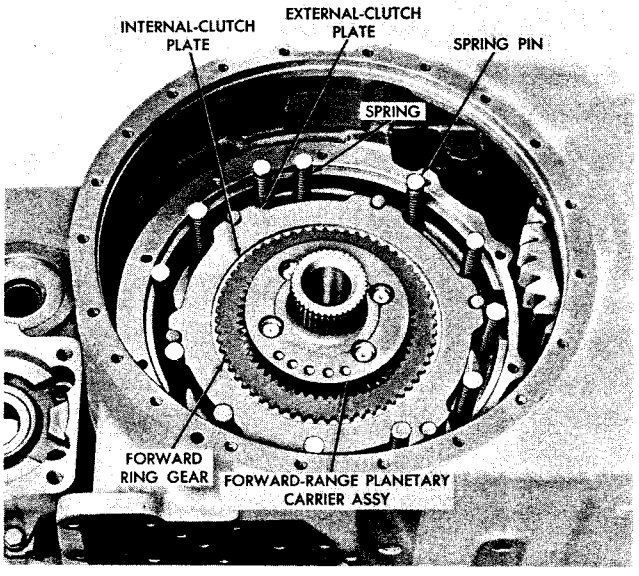

Fig. V-25. Removing clutch springs and pins

(5) Remove forward carrier and reverse ring gear (fig. V-25). The reverse ring gear is attached to the carrier with a snap ring and is removed with the carrier.

(6) Remove two internal- and two external-clutch plates (fig. V-26).

k. Removal of Forward and Reverse Clutch Anchor and Reverse Clutch and Planetary

(1) Remove the forward and reverse clutch anchor assembly (fig. V-27).

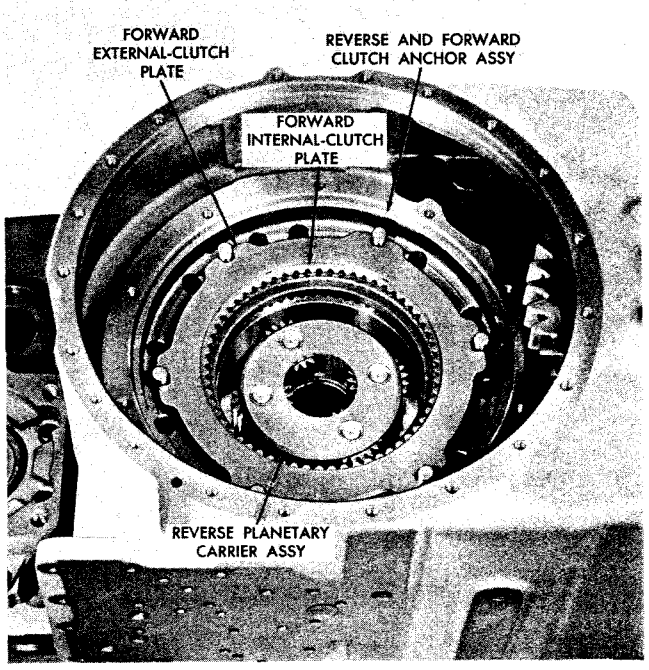

Fig. V-26. Removing remainder of forward-range clutch plates

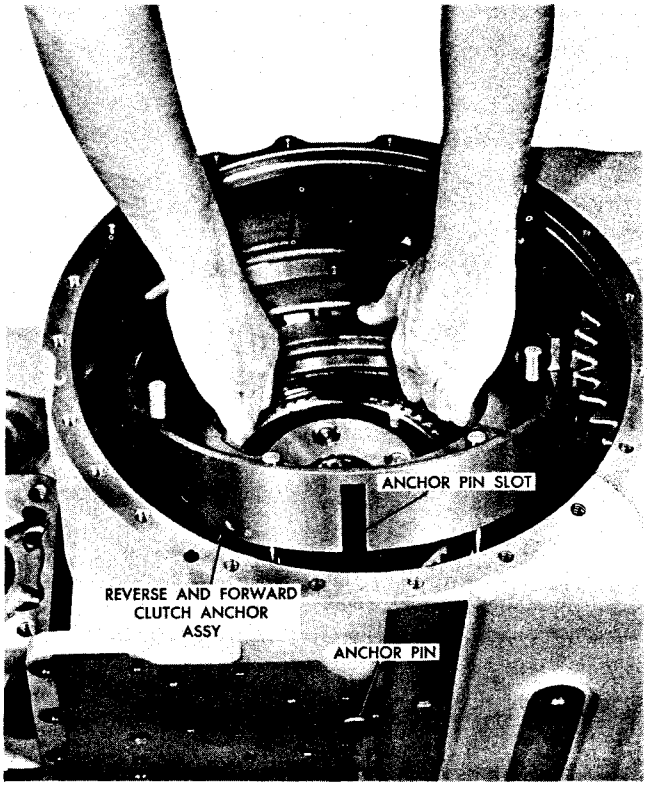

Fig. V-27. Removing (or installing) forward- and reverse-range clutch anchor assembly and anchor pin

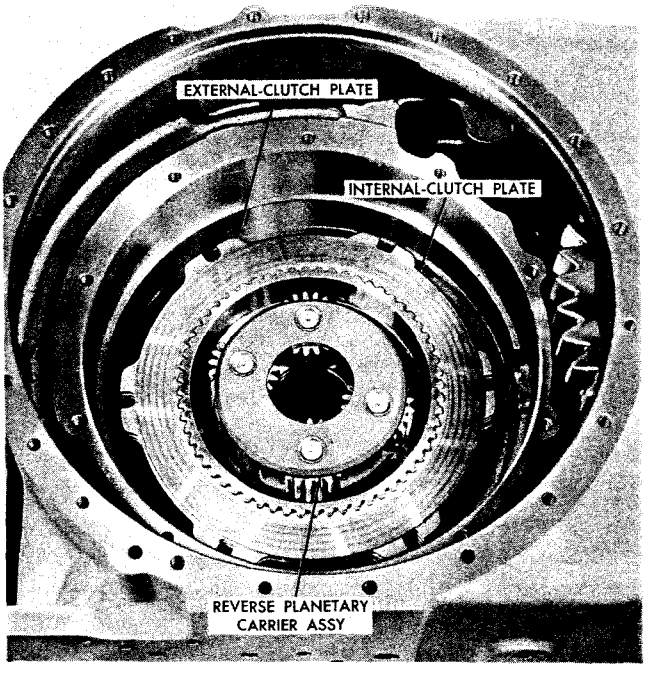

Fig. V-28. Removing reverse-range planetary carrier assembly and clutch plates

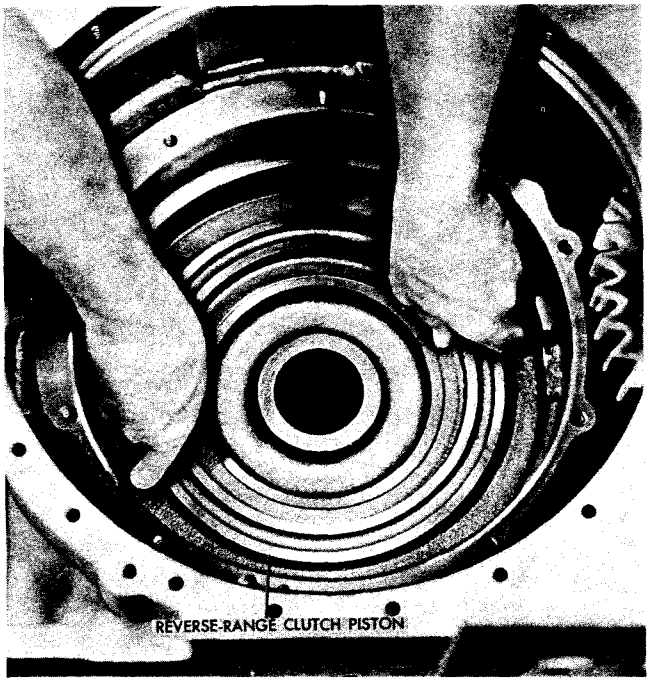

Fig. V-29. Removing (or installing) reverse-range piston

(2) Remove the reverse planetary carrier assembly and the reverse clutch plates (fig. V-28).

(3) Remove the reverse clutch piston and seal rings (fig. V-29).

1. Removal of Charging Oil Pump Assembly

(1) Remove nine bolts and nine lock washers from the oil pump assembly (fig. V-30).

(2) Remove the oil pump assembly and gasket.

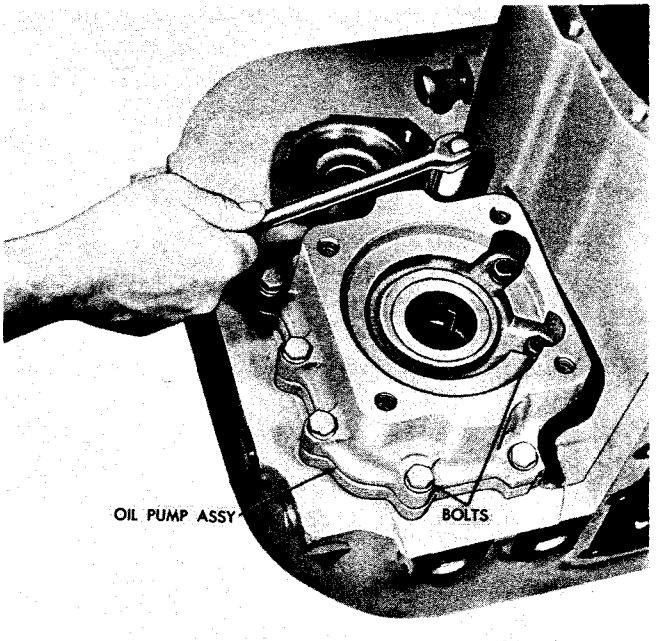

Fig. V-30. Removing oil pump assembly

3. DISASSEMBLY OF REMOTE MOUNT MODEL

a. General. The disassembly procedures described in para 2, above, also apply to the remote mount model, except for the removal of the transmission front cover, converter drive and related parts. Subparagraph b, below, describes the disassembly of the transmission front cover, converter drive and related parts.

b. Disassembly (A, foldout 2)

(1) Follow the same general procedures as described in para 2a through 2d, above.

(2) After completing the disassembly procedures referred to in (1), above, continue with (3) through (9), below.

(3) Position the transmission on the back side. Do not allow the transmission to rest on the rear output shaft.

(4) Remove the input flange nut 1 and washer 2.

(5) Using a flange puller, remove input flange 3.

(6) Remove twelve bolts 5, nuts 15 and lock washers 14 from transmission front cover 6. Remove the cover and oil seal 4 as an assembly and gasket 7. Do not remove the oil seal from the cover unless necessary. If necessary, drive the seal from the bore.

(7) Bend three lock strips 10 away from six bolts 9 and remove six bolts from input shaft 11. Remove input shaft and ball bearing 8 as an assembly. Do not remove the ball bearing unless necessary. If necessary, drive on the inner race to remove.

(8) Remove twenty-four nuts 12 from converter pump cover 13.

(9) Install two bolts in the cover holes 180° apart and, using these as pullers, remove the cover.

(10) Resume the disassembly of the transmission by following the procedures described in para 2f through 2l, above.

4. DISASSEMBLY OF HIGH-RANGE CLUTCH, FORWARD-RANGE CLUTCH AND PLANETARY, AND REVERSE-RANGE CLUTCH AND PLANETARY – WITH TRANSMISSION IN VEHICLE

a. Condition. It is possible to remove the high-range clutch, the forward-range clutch and planetary and the reverse-range clutch and planetary while the transmission is installed in the vehicle. This is to facilitate servicing in the field.

b. Disassembly. The removal of parts is the same as described in para 2i to k, above. On earlier production models so equipped, it will be necessary also to remove the brake assembly. A quick inspection of the unit will determine if this is necessary. The brake assembly removal is described in para 2a(5) and 2c, above.

Section VI REBUILD OF SUBASSEMBLIES

1. TORQUE CONVERTER HOUSING – REBUILD

a. Disassembly (fig. VI-1 and -2)

Note: Only the engine mount model will have the diaphragm oil seal and plug described in (1), below.

(1) Do not remove the diaphragm 11 (B, foldout 2) and oil seal 10 from the housing unless necessary. If it is necessary to remove the diaphragm and oil seal they will be scrapped. Drive or pull the diaphragm from the housing. Do not remove plug 12 from the housing unless necessary. If necessary, drive the plug from the housing.

(2) Do not remove lube regulator valve assembly 26 (B, foldout 3) from the housing unless necessary. If necessary, pull or drive pin 28 from the housing and remove spring 27 and valve 26.

(3) Do not remove the converter regulator valve assembly from the housing unless necessary. If necessary, pull or drive pin 25 from the housing and remove spring 24 and valve 23.

(4) Remove four bolts 18 from the converter ground sleeve and remove the ground sleeve by tapping with a soft hammer.

Note: Some transmissions will not have the power takeoff option and, therefore, will not contain the parts described in (5) and (6), below.

(5) Remove the snap ring from outer race of ball bearing 8 (B, foldout 3) and remove accessory drive gear 1, ball bearing 8 and snap ring 9 as an assembly.

(6) Remove snap ring 9 from accessory drive gear 1 and remove ball bearing 8.

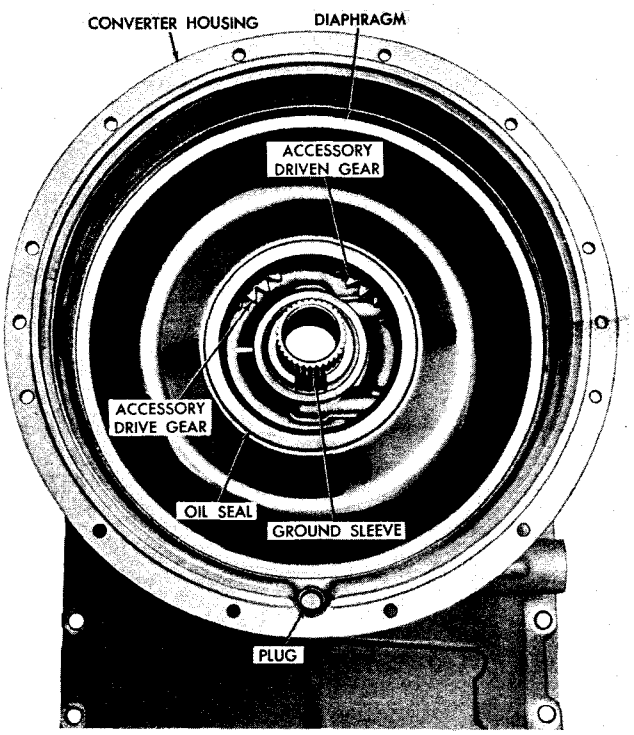

Fig. VI-1. Torque converter housing—front view

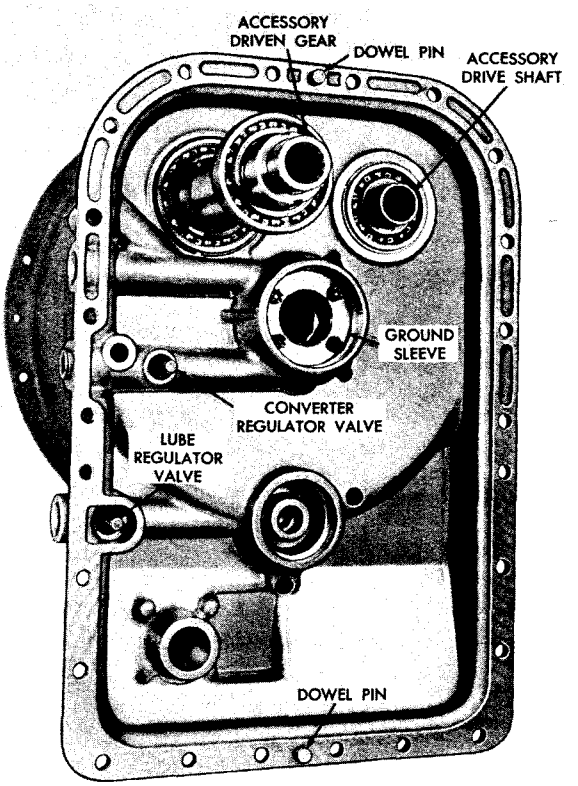

Fig. VI-2. Torque converter housing—rear view

(7) Remove the snap ring from outer race of ball bearing 14 on accessory driven gear 43. Remove accessory driven gear 43, ball bearing 14, snap ring 15 and ball bearing 16 as an assembly.

(8) Remove ball bearing 16 from accessory driven gear by tapping on inner race. Remove snap ring 15 and ball bearing 14 by prying on the bearing.

(9) Remove seal ring 42 from converter housing sleeve 39. Do not remove converter housing sleeve 39 from the housing unless necessary. If necessary, drive or pull the sleeve from the housing.

(10) Do not remove two plugs 41, two dowel pins 36 or pipe plugs 37 and 38 from the housing. If necessary, remove by unscrewing or driving out.

b. Cleaning, Inspection, Wear Limits. Refer to sect. IV, para 6, for cleaning and inspection. Refer to sect. VIII for wear limits.

c. Assembly (fig. VI-1 and VI-2)

(1) If two plugs 41 (B, foldout 3) were removed, install in housing by pressing in 0.030 min. below surface until plug is tight (20 lb force approx). If two dowel pins 36 were removed, install in dowel holes by pressing in until the end projects 0.440 inches from split line face. If the two pipe plugs 37 and 38 were removed, install by screwing in until tight.

(2) If converter housing sleeve 39 was removed, install by driving the sleeve evenly around the circumference until firmly seated on the shoulder. Heat the ring if necessary for easier installation. Install seal ring 42 on the sleeve.

(3) Install ball bearing 14 on accessory driven gear 43. Install snap ring 15. Install ball bearing 16.

(4) Install accessory driven gear 43, ball bearing 14, snap ring 15 and ball bearing 16 into the housing bore as an assembly. Install the snap ring on the outer race of ball bearing 14.

(5) Install ball bearing 8 and snap ring 9 on accessory drive gear 1.

(6) Install accessory drive gear 1, ball bearing 8 and snap ring 9 into the housing bore as an assembly. Install the snap ring on the outer race of ball bearing 8.

(7) Install ground sleeve 17 into housing bore, making certain that all four bolt holes are properly alined. The holes are unevenly spaced to prevent improper installation. Install four 5/16-18 x 3/4 bolts 18, and torque to 17 to 20 pound feet.

(8) If the converter regulator valve assembly was removed, install valve 23, spring 24 and pin 25. Drive the pin into the housing until it projects 1.19 inches above the surface of housing.

(9) If the lube regulator valve assembly was removed, install valve 26, spring 27 and pin 28. Drive the pin into the housing until it is flush to 0.010 inch below the surface of the housing.

(10) If diaphragm 11 (B, foldout 2) and oil seal 10 were removed, install the oil seal in the diaphragm and install the diaphragm assembly into the housing. Make certain it is seated against the housing shoulder. If the plug 12 was removed, install the plug in the housing bore.

2. TORQUE CONVERTER – REBUILD

a. Disassembly (A, foldout 3)

Note: There is a V groove on the rim of the turbine and support which will insure proper alinement in assembly (fig. VI-3). Make sure that the groove is clearly legible. If not, use a 3-corner file to make it 0.040 inch maximum depth.

(1) On the outside diameter of first-turbine support 3 (A, foldout 3), drive six pins 7 that hold first turbine 6 to the support until they clear the support and allow the turbine to be removed. The pins should remain in the first turbine.

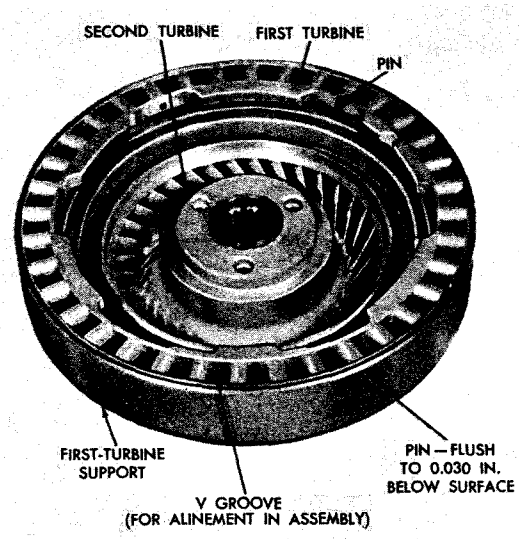

Fig. VI-3. First- and second-turbine assembly

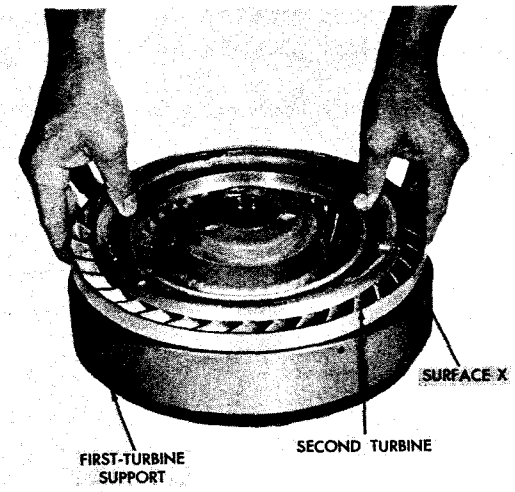

Fig. VI-4. Removing (or installing) second turbine from first-turbine support

(2) Remove second turbine 5 and ball bearing 4 as an assembly (fig. VI-4). Do not remove the ball bearing from the turbine unless necessary. If necessary, pull or drive the bearing from the turbine.

(3) Do not remove ball bearing 1 (A, foldout 3) from first-turbine support unless necessary. If necessary, pull or drive the bearing from the support.

(4) Remove remaining eight bolts 11 from converter pump assembly 14. This will allow six strips 12, pump retainer 13, pump gasket 16, double-row ball bearing 17 and the input accessory drive gear 18 to be removed as individual pieces.

b. Cleaning, Inspection. Refer to sect. IV, para 6, for cleaning and inspection.

c. Assembly (A, foldout 3)

(1) Install ball bearing 17 into accessory drive gear 18 and aline the holes in gasket 16 with holes in the accessory drive gear. Install the bearing in the bore in the pump and seat the accessory drive gear and gasket against the pump, alining the bolt holes in the gear, gasket and pump.

Note: Bearing must be assembled with loader notch toward front of transmission.

(2) Install pump retainer 13, six lock strips 12 and twelve 5/16-24 x 1 bolts 11. Bend the lock strips against the bolt heads.

(3) If ball bearing 1 was removed from first-turbine support 3, install the bearing.

(4) If ball bearing 4 was removed from second turbine 5, install the bearing. Install the second-turbine assembly into the first-turbine support.

(5) Install first turbine 6 into first-turbine support 3, flush to 0.010 inch below surface "X", making certain the V groove alinement mark is properly matched (positioned). Secure the first turbine to the support by driving six pins 7 into the support so that they are flush to 0.030 inch below the surface of the outside diameter of the support.

3. TRANSMISSION HOUSING, FRONT OUTPUT DISCONNECT CLUTCH AND REAR OUTPUT SHAFT – REBUILD

a. Disassembly

(1) Remove self-locking bolt 1 (A, foldout 4), from suction tube 2 bracket. Remove male nut 3 from housing 8 and remove suction tube 2, male nut 3 and seal ring 4.

(2) Remove six bolts 18 and lock wash-

ers 17 from core hole cover 16. Remove core hole cover 16 and gasket 15.

(3) Remove breather 9.

(4) Do not remove four pipe plugs 19, 27, 28, and 29 unless necessary. If necessary, remove the plugs.

(5) Do not remove four drive screws 21 and name plate 20.

Note: Some models will not contain the accessory power takeoff drive but instead will have a cover plate and gasket covering the drive hole.

(6) Remove two bolts 14 and lock washers 13 from accessory drive cover plate 12. Remove cover plate 12 and gasket 11. Do not remove oil seal 10 unless necessary. If necessary, drive out oil seal.

(7) Unscrew shifter fork shaft 11 (B, foldout 6) from shifter fork 13. Reach into the rear of the housing to remove the shifter fork. Do not remove oil seal 12 unless necessary. If necessary, pull out oil seal.

(8) Remove front output shaft oil seal 4 by collapsing.

(9) Remove snap ring 5 that retains ball bearing 6 in the housing. Remove ball bearing 6, shaft 7, two balls 8, spring 9 and disconnect coupling 10 as an assembly through the front housing hole.

(10) Remove disconnect coupling 10 from shaft 7 and contain two balls 8 and spring 9 by wrapping a cloth around the sleeve and shaft to prevent loss of parts when spring 9 tension is released. Do not remove ball bearing 6 unless necessary. If necessary, drive off bearing.

(11) Remove the rear output shaft or seal 23 by collapsing.

(12) Remove snap ring 22 that retains ball bearing 21 in the housing. Remove ball bearing 21, shaft assembly 17, two spacers 15 and 20 and transfer driven gear 16. The driven gear should be held while the shaft is tapped with a soft hammer on the front end inside the housing and driven out of the driven gear and housing.

(13) Do not remove bushing 18 from shaft 19 unless necessary. If necessary, pry the bushing out of the shaft bore. Do not remove ball bearing 21 from shaft 19 unless necessary. If necessary, drive off the bearing and remove spacer 20.

(14) Do not remove ball bearing 14 from housing 8 (A, foldout 4) unless necessary. If necessary, drive the ball bearing from the housing bore.

b. Cleaning, Inspection, Wear Limits. Refer to sect. IV, para 6, for cleaning and inspection. Refer to sect. VIII for wear limits.

c. Assembly

(1) If ball bearing 14 (B, foldout 6) was removed, install the bearing in the housing bore. If ball bearing 21 was removed from shaft 19, install spacer 20 and ball bearing on shaft.

(2) If bushing 18 was removed from shaft 19, install a new bushing in the shaft by pressing in until the end of the bushing is 0.160 to 0.200 inch from the end of the shaft. The bushing is prebored to give correct diameter after assembly.

(3) Hold transfer driven gear 16 and spacer 15 in place in the housing and install rear output shaft assembly 17, spacer 20 and ball bearing 21 as an assembly into the rear output shaft hole, bushing end first. Engage the output shaft splines in the driven gear and carefully guide the shaft into bearing 14. Tap the outer end of the shaft with a soft hammer to seat the ball bearings, spacers and shaft assembly.

(4) Install snap ring 22 in the housing. Press in new oil seal 23 until it is securely seated in the housing bore.

(5) If ball bearing 6 was removed from shaft, install the ball bearing.

(6) Install two balls 8 and spring 9 in

the front output shaft and slide disconnect coupling 10, groove end first, onto front output shaft until the detent balls are felt to seat in the ball groove.

(7) Install front output shaft, coupling and bearing into the front output housing hole, coupling end first. Engage the coupling splines with the rear output shaft splines and use care when the front output shaft enters the rear output shaft bushing so as not to burr the bushing.

(8) Install snap ring 5 in the housing. Press in new oil seal 4 until it is securely seated in the housing bore.

(9) If oil seal 12 was removed, install new oil seal. Install shifter fork shaft 11 in the housing. Hold shifter fork 13 in place in the groove in disconnect coupling 10 and screw shifter fork shaft 11 into shifter fork 13. Adjust the shaft so that the center of the hole in the shaft is 0.170 to 0.210 inch below the front split line face of the main housing.

(10) If oil seal 10 (A, foldout 4) was removed, install a new seal. Install gasket 11 and cover plate 12 and tighten with two 3/8-16 x 1 bolts 14 and two lock washers 13.

(11) If four pipe plugs 19, 27, 28 and 29 were removed, install the plugs.

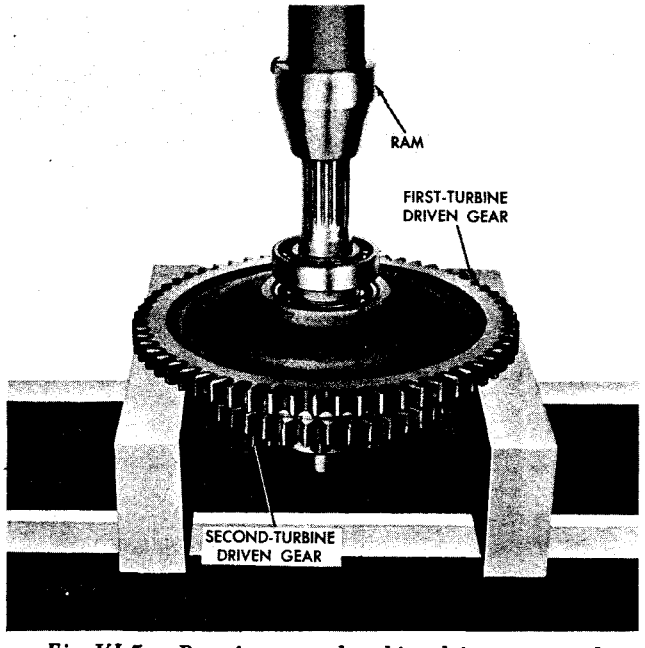

Fig. VI-5. Pressing second-turbine driven gear and freewheel unit out of first-turbine driven gear

(12) Install breather 9.

(13) Install gasket 15 and core hole cover 16 and tighten with six 3/8-16 x 7/8 bolts 18 and lock washers 17.

(14) Install suction tube 2 by screwing male nut 3 securely against seal ring 4. Install one self-locking 3/8-16 x 5/8 bolt 1 in the tube bracket hole and housing.

4. TURBINE DRIVEN GEARS AND FREEWHEEL UNIT – REBUILD

a. Disassembly (S/N 101 thru 151) (B, foldout 4)

(1) Press second-turbine driven gear assembly 3 out of first turbine driven gear 16 (fig. VI-5). Ball bearing 20 (B, foldout 4) and spacers 19 and 17 will come out as loose pieces.

(2) Remove ball bearing 18 from gear 16 for greater ease in assembly.

(3) Remove twelve nuts 2 from twelve bolts 8.

(4) Using a screwdriver, pry freewheel cam 5 from second-turbine driven gear 3.

(5) Remove twelve bolts 8 and freewheel cam washer 7 from freewheel cam.

(6) Remove roller clutch assembly 6 from freewheel cam 5. The end bearing and spring may come off of one side of the clutch assembly (fig. VI-6). Do not separate the end bearing and spring. One of the end bearings and springs will not come off.

(7) Do not remove ball bearings 1 (B, foldout 4) and 4 from second-turbine driven gear 3 unless necessary. If necessary, drive or pull off the bearings.

Note: Transmissions from S/N 101 through S/N 136 have an orifice tube installed in second-turbine driven gear 3. Starting with S/N 137, the orifice tube is not used.

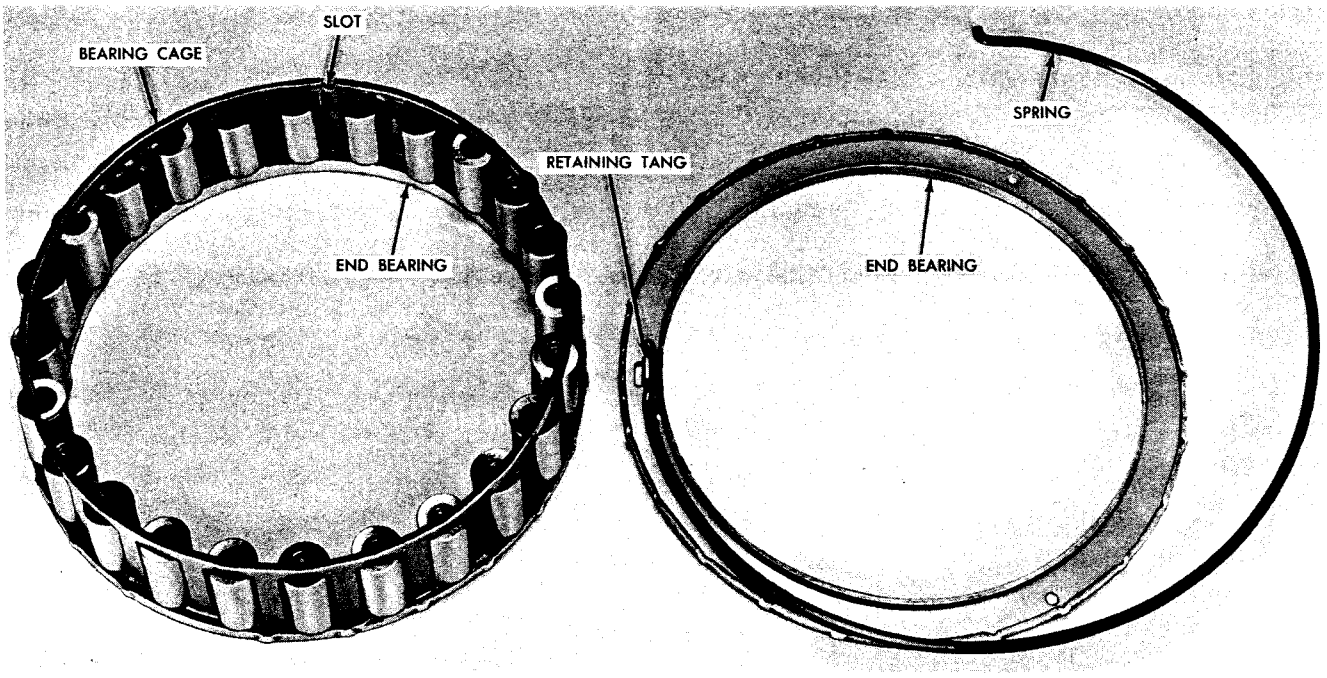

Fig. VI-6. Freewheel clutch bearing cage and end bearing

(8) If the transmission has an orifice tube installed in second-turbine driven gear 3, do not remove it unless necessary. If necessary, pull out the orifice tube.

b. Disassembly (S/N 152 and after) (B, foldout 4)

(1) Press the second-turbine driven gear assembly out of the first-turbine driven gear (fig. VI-5). Ball bearing 20 (B, foldout 4) and spacers 19 and 17 will come out as loose pieces. Also rollers 12 will fall out of roller cage 11. Care should be taken so none will be lost.

(2) Remove ball bearing 18 from gear 16 for greater ease in assembly.

(3) Remove twelve nuts 2 from twelve bolts 15.

(4) Using a screwdriver, pry freewheel cam 13 loose from the second-turbine driven gear 3.

(5) Remove spring plate 10 (B, foldout 4), roller cage 11, twelve bolts 15 and oil collector 14 from freewheel cam 13.

(6) Do not remove ball bearings 1 and 4 from second-turbine driven gear 3 unless necessary. If necessary, drive or pull off bearings.

c. Cleaning, Inspection, Wear Limits. Refer to sect. IV, para 6, for cleaning and inspection. Refer to sect. VIII for wear limits.

d. Assembly (S/N 101 thru 151) (B, foldout 4)

(1) If the transmission had an orifice tube installed in second-turbine driven gear 3 and it was removed, install the tube in the gear. Press in until it extends 0.380 to 0.420 inch from the end of the gear.

(2) If ball bearings 1 and 4 were removed from second-turbine driven gear 3, install the bearings.

(3) If the roller clutch assembly was disassembled, make certain the spring is still retained in the end bearing by the tang (fig. VI-6). Insert the hook of the opposite end of the spring in the slot in the roller cage (fig. VI-7).

(4) Hold the end bearing and roller cage assembly in one hand and roll the other end bearing counterclockwise so that the spring

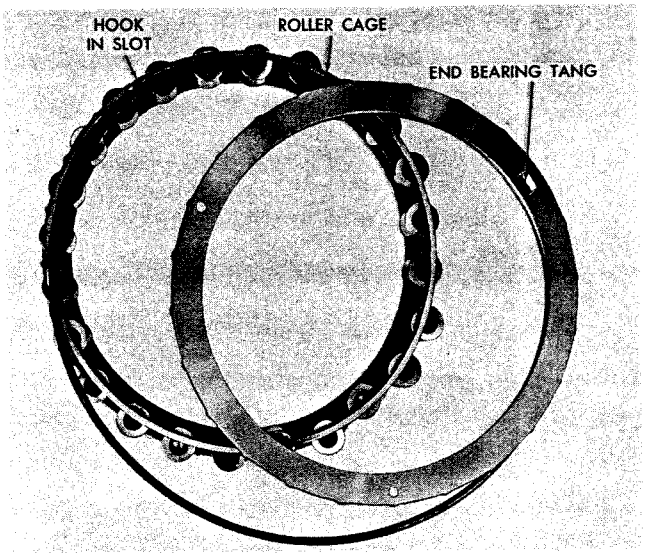

Fig. VI-7. Starting spring and end bearing on roller cage (in units with S/N 101 through 151)

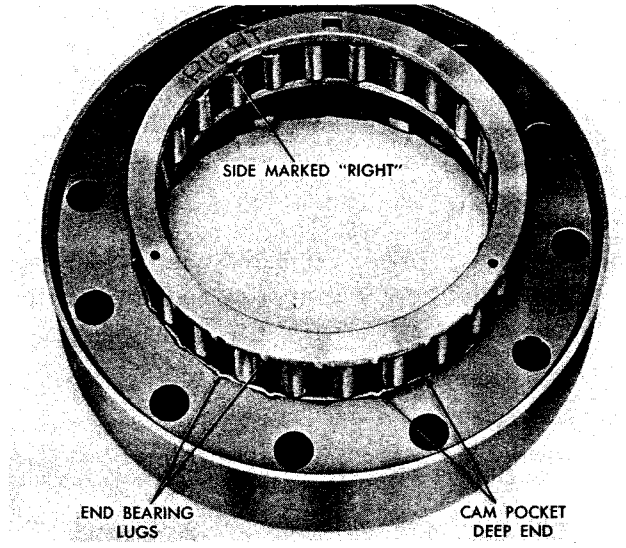

Fig. VI-8. Installing roller cage and end bearings into cam (in units with S/N 101 through 151)

will fit down in the roller cage and allow the end bearing to seat properly on the roller cage.

(5) Install roller clutch assembly 6 (B, foldout 4) into the freewheel cam 5 with the side marked with the word RIGHT facing to the rear of the transmission (fig. VI-8 and VI-9). Be sure to install the assembly with the end bearing lugs in the deep end of the cam pockets.

(6) After the lugs on the one end bearing are properly started in the cam pockets, rotate the end bearing marked RIGHT counterclockwise enough to locate the lugs on it in the

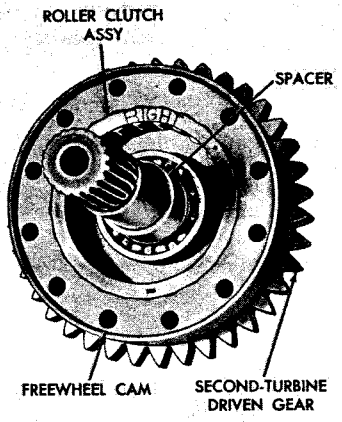

Fig. VI-9. Second-turbine driven gear and freewheel unit

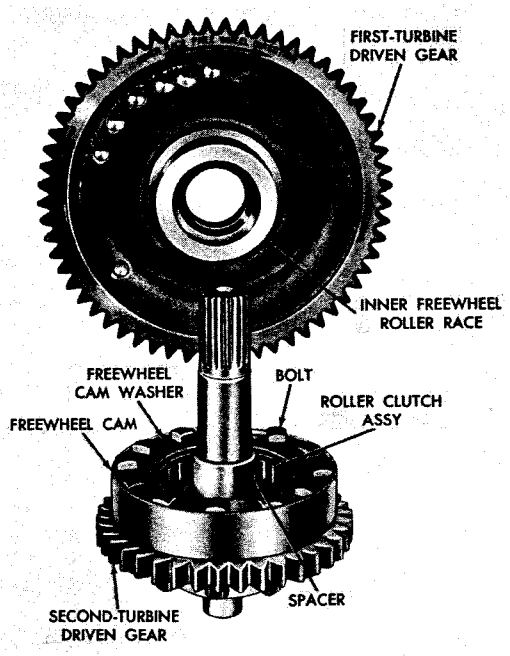

Fig. VI-10. Second-turbine driven gear and freewheel unit removed from first-turbine driven gear

deep end of the cam pocket. This action will create the proper spring tension on the roller cage and rollers.

(7) Install the freewheel cam with roller clutch assembly on second turbine driven gear 3 (B, foldout 4), making sure to aline the twelve bolt holes (fig. VI-9).

(8) Install freewheel cam washer 7 (B, foldout 4) and twelve 3/8-24 x 2 1/4 bolts 8 into freewheel cam 5 and second-turbine driven gear 3. Tighten twelve nuts 2 to 41 to

49 pound feet. Be sure that all twelve bolt heads are seated on the flat surface of the cam washer.

(9) Install first-turbine driven gear 16 with integral inner freewheel race (fig. VI-10) on second-turbine driven gear 3 (B, foldout 4) and freewheel unit assembly. Rotate the first-turbine driven gear in the direction marked on the gear face to aid in picking up the freewheel rollers (fig. VI-10).

(10) Install wide spacer 17 (B, foldout 4) on second-turbine driven gear 3.

(11) Install ball bearing 18 on second-turbine driven gear 3 and press in place in first-turbine driven gear 16.

(12) Install narrow spacer 19 and press in place ball bearing 20 on second-turbine driven gear 3.

e. Assembly (S/N 152 and after) (B, foldout 4)

(1) Install ball bearing 1 onto second-turbine driven gear 3 and press the bearing against the shoulder on the gear.

(2) Install ball bearing 4 onto second-turbine driven gear and press the bearing against the shoulder on the gear.

(3) Install the collector on the freewheel cam (fig. VI-11). Install twelve bolts into the collector and cam, making sure all bolts are seated against the flat surface of the collector.

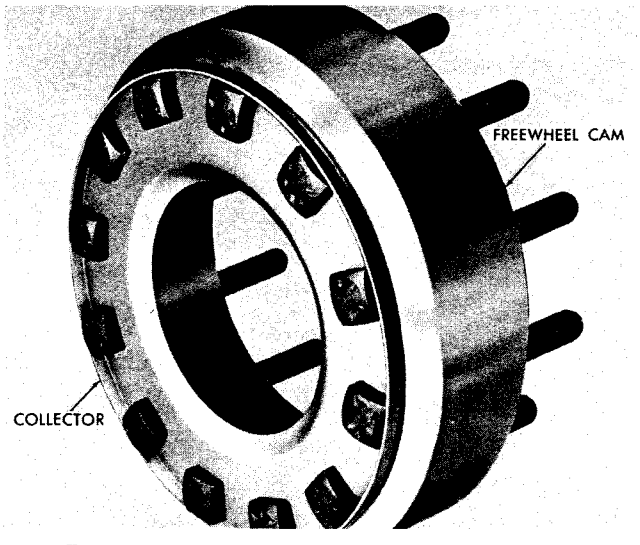

Fig. VI-11. Collector installed on freewheel cam (in units with S/N 152 and above)

(4) Place a rubber band around the bolts to help hold them in place and position the cam with the threaded end of the bolts facing up (fig. VI-12).

(5) Install freewheel roller cage (fig. VI-12). Grease the pockets in the freewheel roller cage and cam with an oil soluble grease and install fifteen rollers into the cam pockets (fig. VI-12).

(6) Install the freewheel cam with rollers in place onto the first-turbine driven gear (fig. VI-13). Make sure all bolt heads are in place within the lip on the collector by checking to see that the bolts cannot be rotated.

(7) Remove the rubber band used to retain the bolts and install the spring plate and three springs, alining the index marks and positioning the plate as shown in fig. VI-13.

(8) Install second-turbine driven gear 3 (B, foldout 4) onto freewheel cam 13 and aline the bolt holes. Press second-turbine driven gear 3 into first-turbine driven gear 16 to seat bearing 4 in the bore of the first-turbine driven gear.

(9) Make sure the bolts are still in place so they will not rotate and install twelve nuts 2. Tighten the nuts evenly to position second-turbine driven gear 3 against spring plate 10.

(10) Turn the assembly over and install spacer 17 onto the second-turbine driven gear shaft. Press ball bearing 18 onto second-turbine driven gear 3 and into first-turbine driven gear 16.

(11) Install spacer 19 and press ball bearing 20 onto the second-turbine driven gear shaft.

5. REVERSE CLUTCH AND PLANETARY – REBUILD

a. Disassembly (A, foldout 5)

(1) Do not remove Teflon seal ring 3

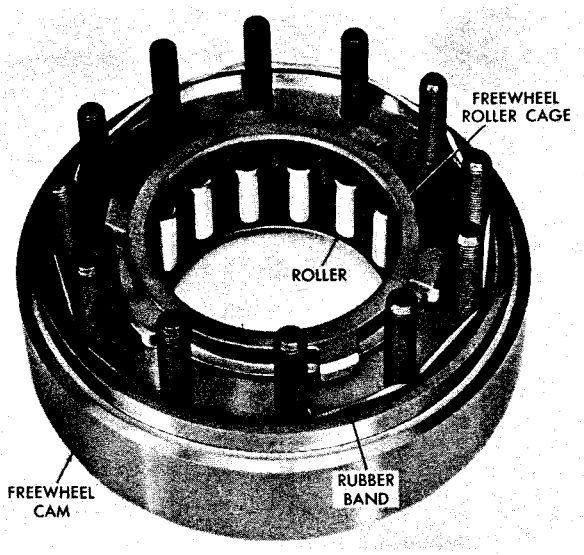

Fig. VI-12. Roller cage and rollers installed in cam (in units with S/N 152 and above)

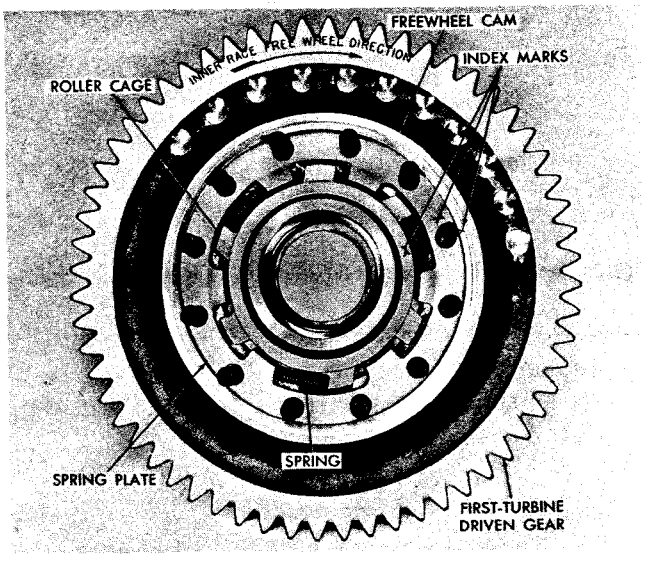

Fig. VI-13. Freewheel clutch installed in first-turbine driven gear (in units with S/N 152 and above)

and expander 2 unless necessary for replacement. If necessary, pry out the seal ring and expander.

(2) Do not remove Teflon seal ring 5 and expander 4 unless necessary for replacement. If necessary, pry out the seal ring and expander.

(3) Disassemble reverse-range planetary carrier assembly 9 only if there is evidence of undue wear or damage. The failure of one pinion requires the replacement of all pinions in the carrier assembly. Place carrier assembly 9 in a press, hub side down, and press out four spindles 15.

(4) Remove two thrust washers 12, pinion 13 and twenty-two pinion rollers 14.

(5) Repeat step (4), above, for the remaining three pinions.

(6) Separate hub 11 and reverse-range carrier 10.

(7) Do not remove six pins 18 from reverse- and forward-range clutch anchor assembly 16 unless necessary for replacement. If necessary, drive pins out of anchor 17.

b. Cleaning, Inspection, Wear Limits. Refer to sect. IV, para 6, for cleaning and inspection. Refer to sect. VIII for wear limits.

c. Assembly (A, foldout 5)

(1) If pins 18 were removed from anchor 17, install the pins. Press in until the reverse-range clutch end of the pin extends 1.550 inch from the flat surface of the anchor.

(2) If facilities are available, chill four new spindles 15 for one hour.

(3) Install thrust washer 12 on a pin alining tool.

Note: An alining tool can be made by grinding a spindle to 0.005 inch undersize.

(4) Coat the bore of pinion 13 with oil-soluble grease and install it on the alining tool.

(5) Install twenty-two pinion rollers 14 into the space between the alining tool and the pinion bore.

(6) Install thrust washer 12 onto the alining tool.

(7) Remove the alining tool and install the assembly into reverse-range planetary carrier 10 with the chamfered end of the carrier spindle bores up (fig. VI-14).

(8) Insert the alining tool to center the pinion assembly with the pin bore in carrier 10 (A, foldout 5).

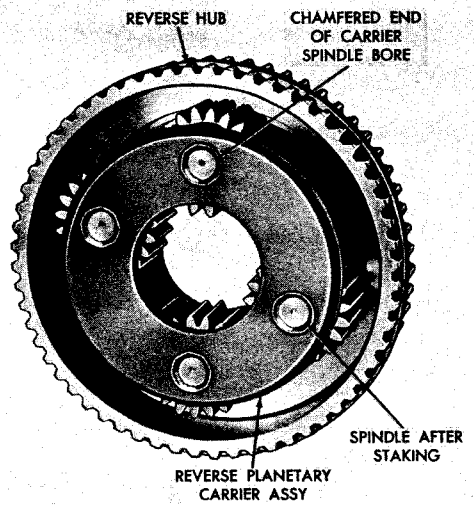

Fig. VI-14. Reverse-range planetary carrier and hub assembly

(9) Repeat steps (3) through (8), above, for the remaining three pinions.

(10) Place the carrier with pinion and associated parts in hub 11. Insert the alining tool into a pinion and aline the carrier spindle bore with the hub spindle bore.

(11) Start a chilled pin into the spindle bore and press the pin into the bore to the dimension shown in inset (fig. VI-15), allowing the alining tool to be pushed out of the bore.

(12) Repeat steps (10) and (11), above, for the installation of the remaining three spindles.

(13) Support one of the pins and stake securely with an octagon punch on both ends (fig. VI-14). The pinion must rotate freely after assembly.

(14) Stake the remaining three spindles in the same manner.

(15) If Teflon seal ring 5 (A, foldout 5) and expander 4 were removed, install a new ring and expander into the reverse-range piston groove.

(16) If Teflon seal ring 3 and expander 2 were removed, install a new ring and expander into the reverse-range piston groove.

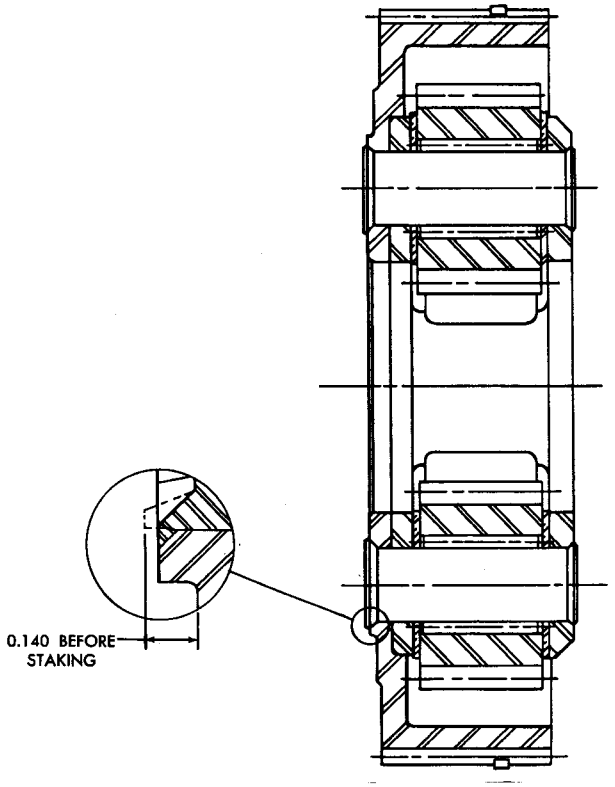

Fig. VI-15. Reverse-range planetary carrier assembly—cross section, showing pin dimensions

6. FORWARD CLUTCH AND PLANETARY – REBUILD

a. Disassembly (B, foldout 5)

(1) Remove snap ring 8 from reverse-range ring gear 1. Separate ring gear 1 and forward-range planetary carrier assembly 2.

(2) Disassemble forward-range planetary carrier assembly 2 only if there is evidence of undue wear or damage. The failure of one pinion requires the replacement of all pinions in the carrier assembly. Place carrier assembly 2 in a press and press out four spindles 4.

(3) Remove two thrust washers 5, pinion 7, and twenty-two pinion rollers 6 from planetary carrier 3.

(4) Repeat step (3), above, for the remaining three pinions.

(5) Remove forward-range piston 16 from piston housing 17.

(6) Do not remove Teflon seal ring 12 and expander 13 from forward-range piston 16 unless necessary for replacement. If necessary, pry out seal ring and expander.

(7) Do not remove Teflon seal ring 14 and expander 15 from forward-range piston 16 unless necessary for replacement. If necessary, pry out the seal ring and expander.

b. Cleaning, Inspection, Wear Limits. Refer to sect. IV, para 6, for cleaning and inspection. Refer to sect. VIII for wear limits.

c. Assembly (B, foldout 5)

(1) If Teflon seal ring 14 and expander 15 were removed, install a new seal ring and expander.

(2) If Teflon seal ring 12 and expander 13 were removed, install a new seal ring and expander.

(3) Install the forward-range piston with seal rings into forward-range piston housing 17.

(4) If facilities are available, chill four new spindles 4 for one hour.

(5) Install thrust washer 5 on a spindle alining tool.

Note: An alining tool can be made by grinding a spindle to 0.005 inch undersize.

(6) Coat the bore of pinion 7 with oil-soluble grease and install it on the alining tool.

(7) Install twenty-two pinion rollers into the space between the alining tool and the pinion bore.

(8) Install thrust washer 5 onto the alining tool.

(9) Remove the alining tool and install the assembly into forward-range planetary carrier assembly 3.

(10) Insert the alining tool to center the pinion assembly with the pin bore in carrier 3.

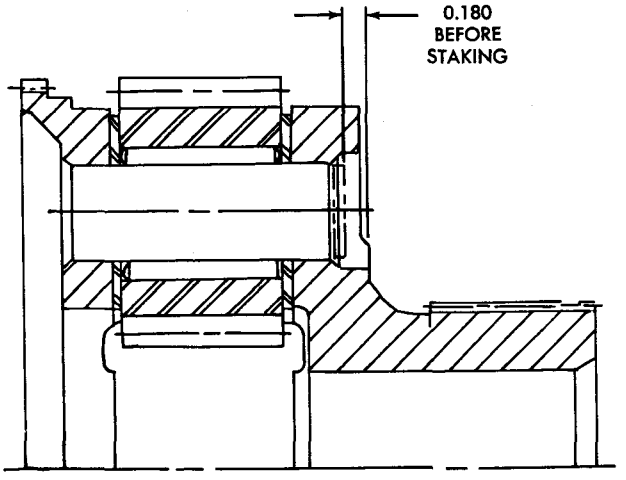

Fig. VI-16. Forward-range planetary carrier assembly—cross section, showing pin dimensions

(11) Place the carrier assembly into a press, remove the alining tool and start a chilled spindle 4 into the spindle bore.

(12) Press the spindle into the bore to the dimension shown in inset, fig. VI-16.

(13) Support the spindle and stake securely with an octagon punch on both ends. The pinion must rotate freely after assembly.

(14) Install the remaining three pinion assemblies in the same manner.

7. HIGH-RANGE CLUTCH – REBUILD

a. Disassembly (A, foldout 6)

(1) Do not remove ball bearing 1 from transfer drive gear 3 unless necessary for replacement. If necessary, remove the bearing from the gear.

(2) Do not remove six pins 4 from transfer drive gear 3 unless necessary for replacement. If necessary, drive the pins out of the gear.

(3) Do not remove snap ring 6 from high-range clutch hub 7 unless necessary to replace. If necessary, remove snap ring 6 from the hub.

(4) Do not remove ball bearing 8 from high-range clutch hub 7, unless necessary to

replace. If necessary, remove the bearing from the hub.

(5) Remove snap ring 11 from the hub of high-range piston housing 17. It will release the tension of piston return spring 12. Remove piston return spring 12.

(6) Remove high-range clutch piston 13 from high-range clutch housing 17. Do not remove Teflon seal ring 15 and expander 14 from the piston unless necessary to replace. If necessary, remove the seal ring and expander.

(7) Do not remove seal ring 16 from high-range piston housing 17 unless necessary to replace. If necessary, remove the seal ring from the housing.

(8) Do not remove ball bearing 20 from high-range piston housing 17 unless necessary to replace. If necessary, remove the bearing from the housing.

(9) Do not remove seal ring 21 from high-range piston housing 17 unless necessary to replace. If necessary, remove the seal ring from the housing.

b. Cleaning, Inspection, Wear Limits. Refer to sect. IV, para 6, for cleaning and inspection. Refer to sect. VIII for wear limits.

c. Assembly (A, foldout 6)

(1) If seal ring 21 was removed from high-range piston housing 17, install the seal ring.

(2) If ball bearing 20 was removed from high-range piston housing 17, install the ball bearing.

(3) If seal ring 16 was removed from high-range piston housing 17, install the seal ring.

(4) If Teflon seal ring 15 and expander 14 were removed from high-range clutch piston 13, install a new Teflon seal ring and expander. Install the high-range clutch piston and seal ring in high-range piston housing 17.

(5) Install piston return spring 12 with the concave side toward piston 13. Install snap ring 11 on hub of high-range piston housing 17. It will be necessary to depress the return spring to install the snap ring.

(6) If ball bearing 8 was removed from high-range clutch hub 7, install ball bearing.

(7) If snap ring 6 was removed from high-range clutch hub 7, install the snap ring.

(8) If any or all of six pins 4 were removed from transfer drive gear 3, install the pin or pins so that one end of the pin extends 0.750 inch from the clutch plate surface of the gear.

(9) If ball bearing 1 was removed from transfer drive gear 3, install the ball bearing.

8. CHARGING OIL PUMP – REBUILD

a. Disassembly (A, foldout 7) (fig. VI-17)

(1) Tap on pump body 9 (A, foldout 7) to loosen pump cover 17. Remove pump cover and gasket 16.

(2) Remove drive gear 12.

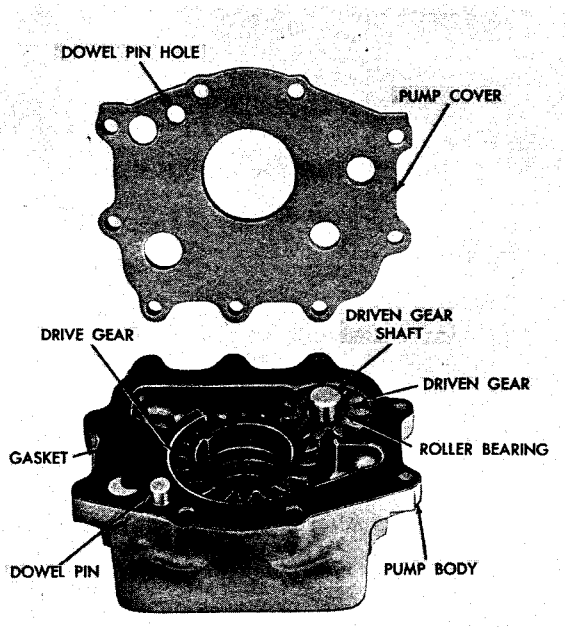

Fig. VI-17. Charging oil pump

(3) Remove driven gear assembly 13. Do not remove roller bearing 14 from driven gear 15 unless necessary for replacement. If necessary, remove the roller bearing.

(4) Do not remove driven gear shaft 11 unless replacement is necessary. If necessary, remove the shaft.

(5) Do not remove oil seal 7 unless necessary for replacement. If necessary, remove the seal.

(6) Do not remove dowel pin 10 unless necessary for replacement. If necessary, remove the pin.

b. Cleaning, Inspection, Wear Limits. Refer to sect. IV, para 6, for cleaning and inspection. Refer to sect. VIII for wear limits.

c. Assembly (A, foldout 7) (fig. VI-17)

(1) If dowel pin 10 (A, foldout 7) was removed, install the dowel pin so that the end extends 0.420 above the cover split line surface of body 9.

(2) If oil seal 7 was removed, install a new seal.

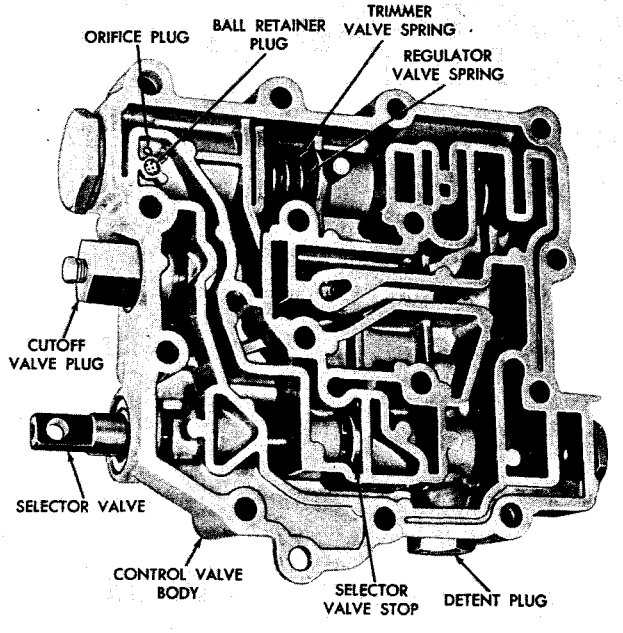

Fig. VI-18. Control valve body

(3) If driven gear shaft 11 was removed, install the shaft so that the end extends 0.480 inch above cover split line surface of body 9.

(4) If roller bearing 14 was removed from gear 15, install a new roller bearing so that the end of the bearing is 0.060 inch below the face of the gear. Install the bearing with the driver against the numbered end of bearing cage. Install driven gear assembly 13 onto shaft 11.

(5) Install drive gear 12.

(6) Install gasket 16 and pump cover 17, making certain to properly aline the holes in cover, gasket and body.

9. CONTROL VALVE BODY – REBUILD

a. Disassembly (clutch cutoff model) (B, foldout 7) (fig. VI-18)

(1) Remove plug 31, gasket 32, spring 33 and detent ball 30 from valve body 9.

(2) Remove plug 35 and gasket 34 from valve body 9.

(3) Remove valve stop 13 from selector valve 29.

(4) Remove selector valve 29 by tapping on the plug end of the valve and drive oil seal 28 out of the body with the valve.

(5) Remove detent ball 30 and spring 33.

(6) Remove cutoff valve plug 26 and gasket 24. Clutch cutoff valve plug 22, seal ring 23 and cup 25 will come out with plug 26. Remove plug 22, seal ring 23 and cup 25 from plug 26. Remove seal ring 23 from plug 22.

(7) Remove cutoff valve 21 and spring 20.

(8) Remove plug 6 and gasket 7 from regulator valve 8 end of the valve body.

(9) Remove regulator valve 8.

(10) Remove plug 19 and gasket 18 from trimmer valve plug 17 end of the valve body.

(11) Remove trimmer valve plug 17, spring 16, spring 15 and spring retainer 14.

(12) Do not remove orifice plug 10, ball 11 or ball retainer plug 12 unless necessary for replacement. If necessary, remove plugs and ball.

b. Disassembly (inching control model) (B, foldout 7)

(1) Follow steps (1) through (5), in a, above.

(2) Remove stop 37 from plug 45.

(3) Remove oil seal 46 by collapsing.

(4) Remove inching valve 42 by pulling from the bore which will remove at the same time spring 43, plug 45 and seal ring 44. Remove seal ring 44 from plug 45.

(5) Spring 41 may come out with the valve. If not, remove the spring.

(6) Remove stop 40 from the end of inching regulator valve 39.

(7) Remove valve 39 and spring 38 from bore.

(8) Complete the disassembly by following steps (8) through (12) in a, above.

c. Cleaning, Inspection, Wear Limits. Refer to sect. IV, para 6, for cleaning and inspection. Refer to sect. VIII for wear limits.

d. Assembly (clutch cutoff model) (B, foldout 7) (fig. VI-18)

(1) If orifice plug 10 (B, foldout 7) was removed, press in flush to 0.010 inch below surface. If ball 11 and retainer plug 12 were removed, install ball 11 and press in retainer plug 12 flush to 0.010 inch below surface.

(2) At assembly, all valves must move freely by their own weight.

(3) Install spring retainer 14 on one end of inner spring 15 and install retainer, inner spring and outer spring 16 in the valve body bore.

(4) Install trimmer valve plug 17 and gasket 18 and plug 19. Tighten the plug securely against the gasket.

(5) Install regulator valve 8 and make certain that the small end of the valve is properly seated in spring retainer 14.

(6) Install plug 6 and gasket 7. Tighten the plug securely against the gasket.

(7) Install cutoff valve spring 20 and cutoff valve 21.

(8) Install seal ring 23 onto plug 22. Install plug 22, seal ring 23 and cup 25 into cutoff valve plug 26. Install cutoff valve plug 26 and gasket 24. Install plug 27 in plug 26. Tighten the plug securely against the gasket.

(9) Install one detent spring 33 and one detent ball 30.

(10) Depress ball 30 against spring 33 and install selector valve 29, engaging the ball in the detent slot.

(11) Install valve stop 13.

(12) Install detent ball 30, spring 33, gasket 32 and plug 31. Tighten the plug securely against the gasket.

(13) Install valve plug gasket 34 and plug 35. Tighten the plug securely against the gasket.

(14) Install new oil seal 28. Press in flush to 0.030 inch below the surface.

e. Assembly (inching control model) (B, foldout 7)

(1) Follow steps (1) through (6) in d, above.

(2) Install spring 38 onto the stem of inching regulator valve 39 and install both into the valve bore.

(3) Install stop 40 on end of valve 39.

(4) Install spring 41 into inching valve 42, and install both into the valve bore. Make certain that spring 41 fits over end of valve 39.

(5) Install spring 43 over valve 42.

(6) Install seal ring 44 onto plug 45 and install both in plug bore.

(7) Install stop 37 on plug 45. Press on plug with a screwdriver to compress spring 43 to allow installation.

(8) Install new oil seal 46. Press in flush to 0.030 inch below the surface.

(9) Complete the assembly by following the steps in (8) through (14) in d, above.