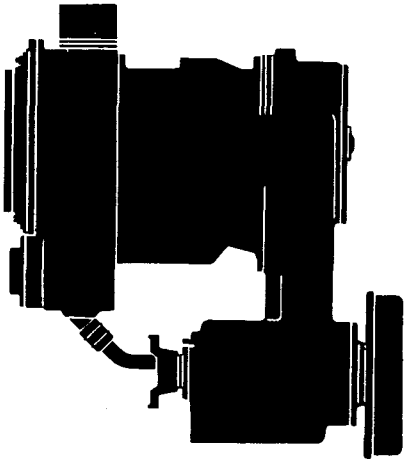
Allison

TORQMATIC TRANSMISSIONS

MODEL CRT-3330

TORQMATIC

SERVICE MANUAL



SERVICE MANUAL

Allison TORQMATIC DRIVES

MODELS

CRT-3330-1
CRT-3330-3

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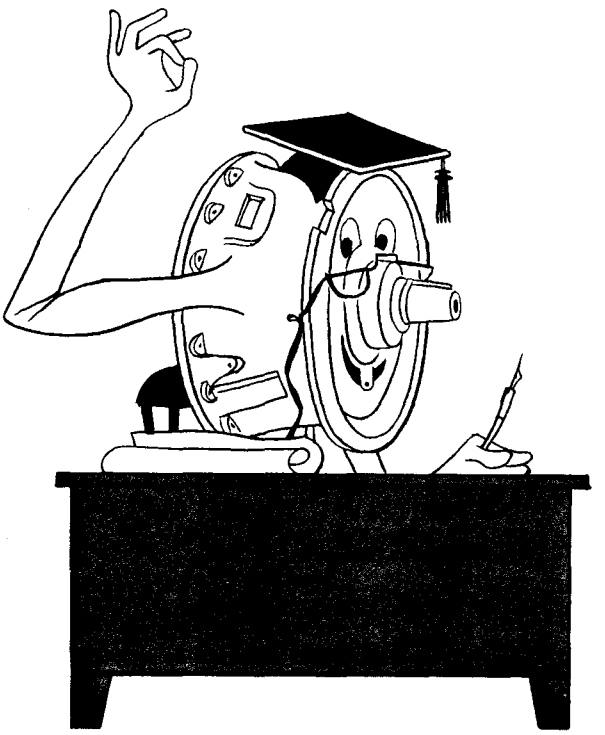

This manual is dedicated
to you operators and mechanics
who want to get the most
out of your equipment.
In this book you will find
service pictures and service information
that will help you to keep your
Torqmatic "torqing" a long time.
Also included are extra sheets
for service notes you may want
to record for future reference.
If we can be of further help to you,
just drop a line to our
Service Manager.

"Doc" Torquee

TORQMATIC

TRANSMISSIONS OPERATIONS
ALLISON DIVISION
General Motors Corporation
Indianapolis 6, Indiana

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SECTION I GENERAL INFORMATION

1. SCOPE

a. MODELS COVERED

(1) This Service Manual covers Model CRT-3330-1 and Model CRT-3330-3 Torqmatic transmissions. Figures I-1 through I-4 illustrate these models.

(2) The Model CRT-3330-1 transmission includes transfer gears which provide output drive 20 inches lower than input. There are both front and rear outputs. The oil sump is part of the transfer gear housing assembly.

(3) The Model CRT-3330-3 is a straight-through drive model with an oil sump adapter and an oil sump in place of the transfer gear housing assembly. There is no front output shaft on this model.

b. KEEPING MANUAL CURRENT. For your convenience, this manual is loose leaf and sectionalized so that new or replacement pages can be inserted as new models are released or changes occur which affect your particular model.

2. TRANSMISSION CHARACTERISTICS

a. HORSEPOWER RANGE. The CRT-3330 Torqmatic transmission is designed for heavy-duty operation with either Diesel or gasoline engines in the 70 to 130 horsepower range depending upon the installation and the type of service.

b. TORQUE MULTIPLIER, FLUID COUPLING AND PLANETARY GEARING. The CRT-3330 Torqmatic transmission combines all the desirable characteristics of a hydraulic torque multiplier and a fluid coupling to transmit engine power to automotive equipment. The Torqmatic converter automatically adjusts the output torque to the load demand. The advantages of hydraulic torque multiplication are further extended by

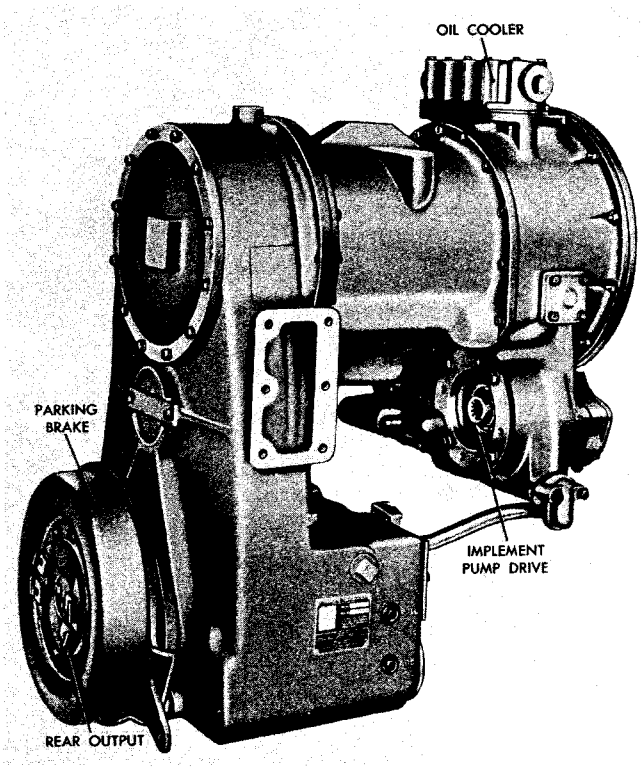


Fig I-1. Model CRT-3330-1 Torqmatic transmission with transfer gear housing assembly parking brake, and integral oil cooler, right rear view

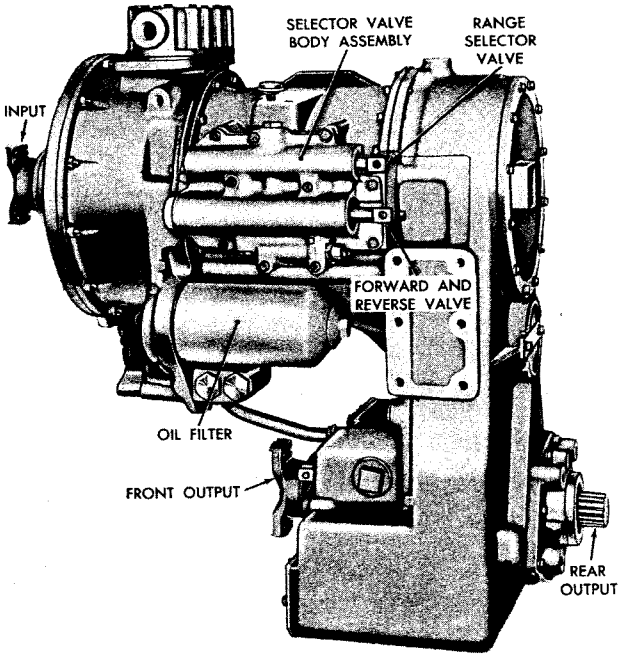


Fig I-2. Model CRT-3330-1 Torqmatic transmission with transfer gear housing assembly and integral oil cooler, left rear view

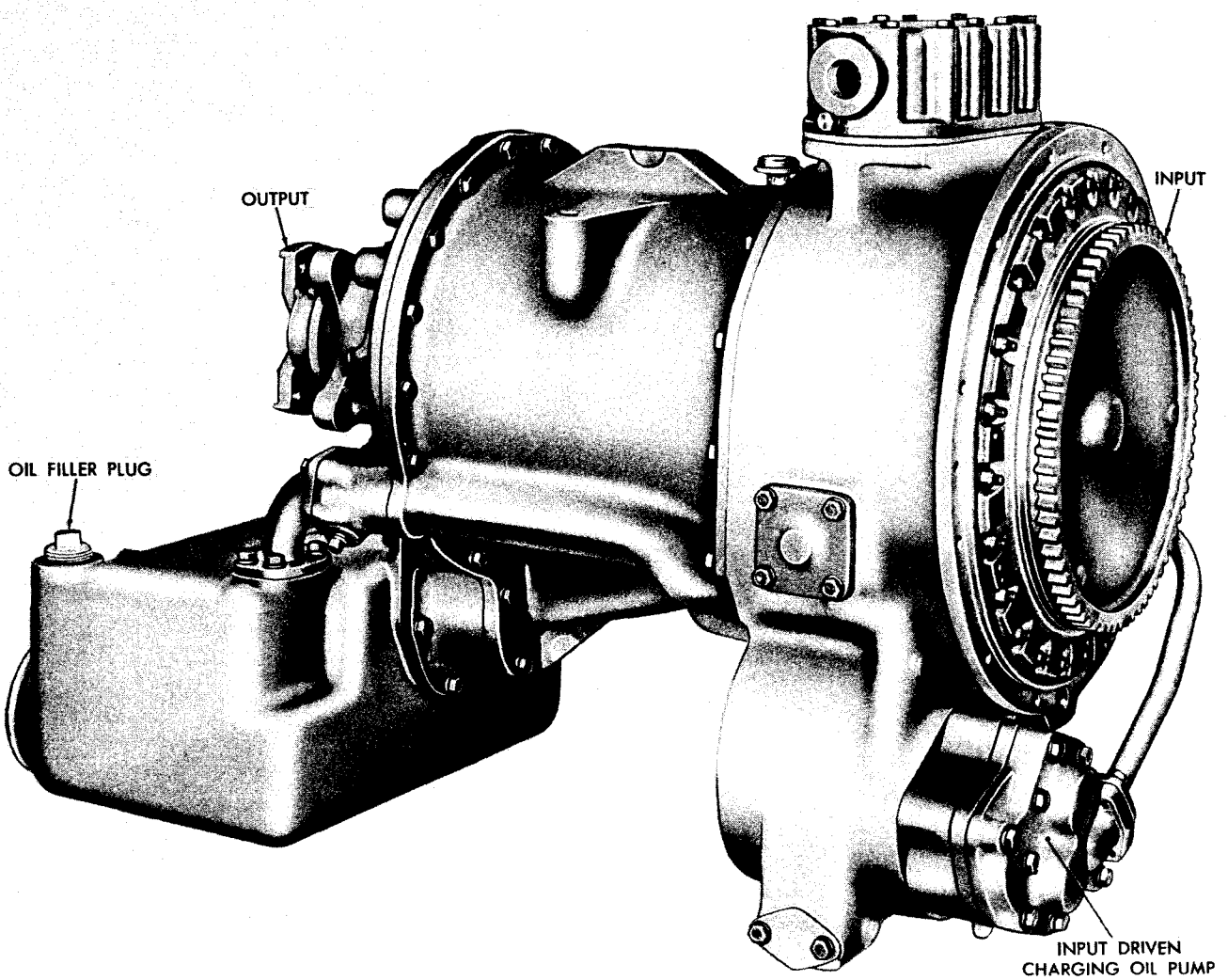


Fig I-3. Model CRT-3330-3 Torqmatic transmission with bearing retainer, adapter, and oil sump, right front view

constant mesh planetary gearing. This combination makes available an "infinite" range of speed ratios (within the design limits of the converter and transmission) with three forward speeds and three reverse speeds — and eliminates the need for a conventional clutch. Section II explains how the transmission works.

c. CONVERTER TYPE. The Torqmatic converter transmission employs the rotating principle. It is a four element, single stage, polyphase type of converter. How the converter works is fully explained in Section II, Principles of Operation. Detailed specifications are contained in the specifications and data chart elsewhere in this section.

d. TORQMATIC DRIVE ADVANTAGES

(1) The Torqmatic converter protects the engine from damaging shock loads and harmful engine lugging and stalling, thereby increasing the life of engine and equipment — and their service availability. Because torque is multiplied hydraulically and automatically, engine power is fitted to the load more efficiently. This eliminates gearshift-guess and reduces driver fatigue.

(2) The compact, constant-mesh, planetary gearing is designed to supplement the advantages of the Allison Torqmatic converter. The CRT-3330 Torqmatic transmission quick-shifts under full load at wide open throttle without interrupting the power flow

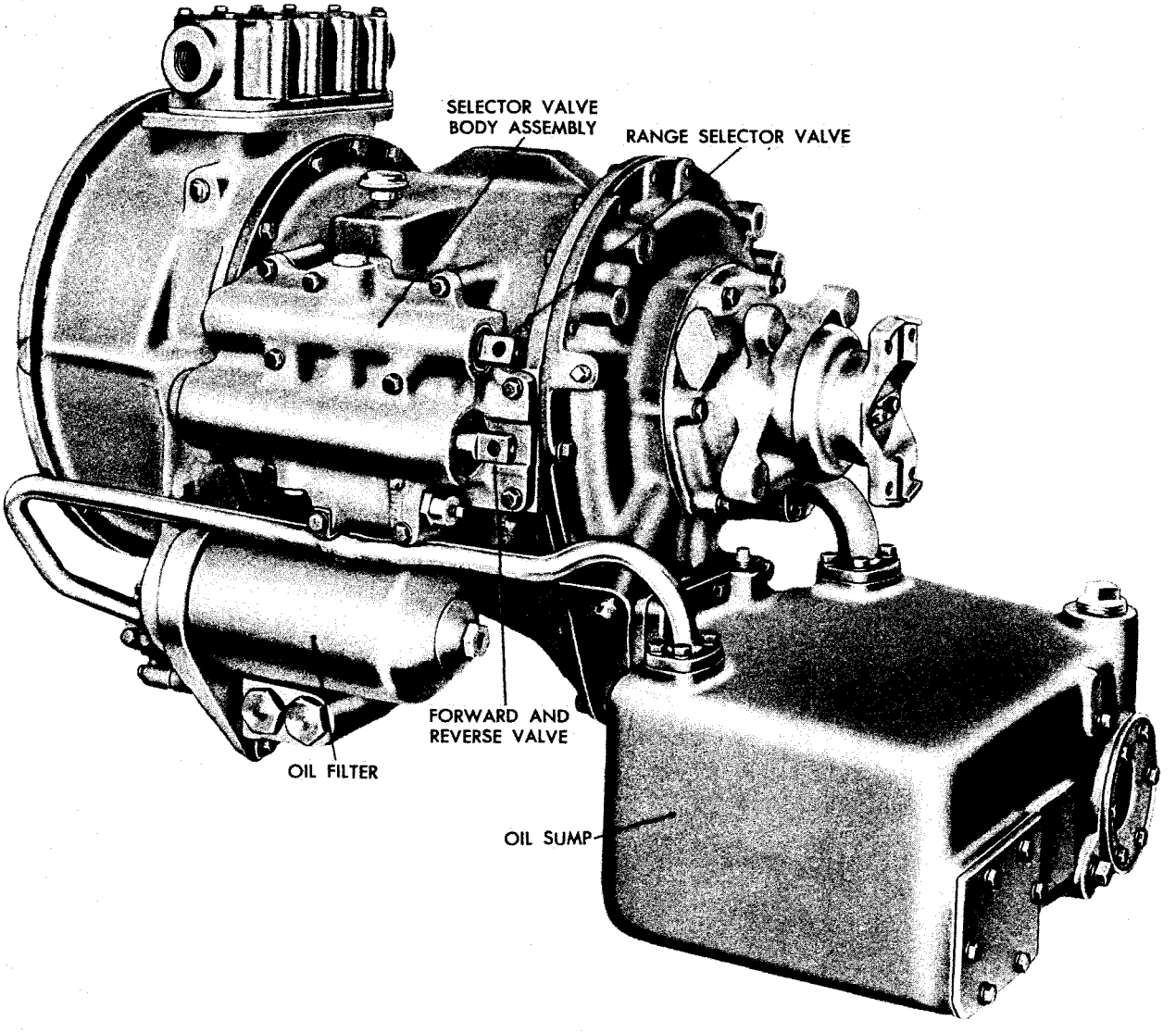


Fig I-4. Model CRT-3330-3 Torqmatic transmission with bearing retainer, adapter, and oil sump, left rear view

from the engine to the load. With Torqmatic Drive, only three range speeds are necessary for maximum vehicle performance because the converter provides "infinite" speed ratios in each speed range. The conventional clutch is eliminated.

3. DESIGN FEATURES

a. COMPACT DESIGN. The CRT-3330 Torqmatic transmission has been designed for space saving in any installation. The transmission can be either remote engine mounted or direct engine mounted. See paragraph n below.

b. PLANETARY SYSTEM. The transmission planetary gearing is a compound planetary gear train in constant mesh. Its gears and multiple disk clutches are so compactly arranged that three ranges in both forward and reverse are contained in a "small package".

c. RANGE CLUTCHES. Controlling the gear train are five multiple-disk, oil cooled, friction clutches. These clutches are hydraulically applied and spring released. The friction plates have sintered bronze facings and the reaction plates are steel. Because the clutches are hydraulically controlled, there is automatic compensation for normal

wear — no adjustment is necessary.

d. TRANSFER GEARING RATIO. In the CRT-3330-1 model, the transfer gearings (figs VI-3 and VI-4) transfers the drive from the planetary gearing to the lower output shaft. A 1 to 1 ratio is standard but 1.62 to 1 and 0.659 to 1 ratios are optional.

e. OUTPUT OIL PUMP ASSEMBLY. An output oil pump assembly, mounted on the rear output shaft, provides the hydraulic pressures to engage the range clutch, the forward and reverse clutch, and to charge the converter during push-starting. This pump supplements the converter charging oil pump during forward operation only — does not function in reverse operation. See paragraphs 8c below and 16i in section II.

f. CONVERTER PUMP RATIOS. The 320 Series converter pump has a 3.5 to 1 ratio, and is standard. The 370 Series converter pump has a 2.5 to 1 ratio, and is optional.

g. IMPLEMENT PUMP DRIVE RATIO. A 1.27 to 1 ratio is standard for the implement pump drive but 1 to 1 ratio is optional.

h. REMOTE OIL FILTER ADAPTER. The CRT-3330 Torqmatic transmission can be equipped with a full flow oil filter mounted on the converter housing. A remote oil filter adapter is available so that the oil filter can be mounted elsewhere.

i. DISCONNECT FOR FRONT OUTPUT SHAFT. For installations that require the front output shaft to be disconnected occasionally, a manual disconnect is available for Model CRT-3330-1 transmission.

j. PARKING BRAKE. The transmission is available with or without the parking brake on the rear output shaft (figs I-1 and VI-3).

k. GOVERNOR DRIVE. The CRT-3330-1 model has provision for mounting a governor on the rear of the transfer gear housing. Since the governor drive shaft assembly is turbine driven, the governor tends to keep the output speed constant in the speed range selected.

l. SPEEDOMETER DRIVE. The CRT-3330-3 model has provision for mounting a speedometer on the rear output shaft bearing retainer. The speedometer drive is output shaft driven by a worm gear and pinion.

m. OIL COOLER. The oil cooler can be mounted on the transmission, or it can be remotely mounted. For remote mounting, oil line connections are provided on the oil cooler mounting pad.

n. TRANSMISSION MOUNTING

(1) If the transmission is direct-mounted, the torque converter housing of the transmission is bolted directly to the flywheel housing of the engine. In such case, the converter pump cover assembly has an integral drive ring that meshes with an internal gear on the flywheel of the engine. A "wet" or "dry" converter housing can be obtained for this configuration.

(2) A "wet" converter housing permits lubricating oil supplied to the input oil pump drive gear and accessory drive and idler gears to splash off the spinning gears and pass by the torque converter into the flywheel compartment.

(3) For engines where the splashing of oil would not be desirable, there is a dry converter housing configuration which closes off the passage of oil to the engine flywheel compartment around the converter elements.

(4) For remote mounting the converter pump cover assembly does not have an integral drive ring. The converter pump cover assembly is bolted to the converter input drive shaft. The transmission front cover encloses the front of the transmission. An output flange is included with this configuration.

4. ORDERING PARTS

Because of the many models and varied applications and types of installations of the Torqmatic quick-shift transmission, each transmission is given a part number besides its serial number. Therefore, when ordering parts or requesting information for your transmission, always include this transmission part number found on your transmission name plate; see figure I-5. All parts orders or requests for information should be directed

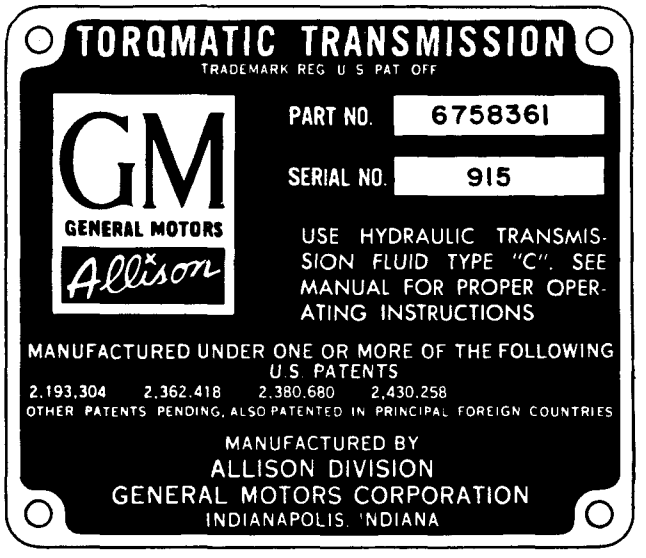


Fig I-5. Torqmatic transmission name plate

to your dealer. Refer to section IV, paragraph 4.

5. HYDRAULIC SYSTEM

a. OIL RESERVOIR. The bottom of the transfer gear housing on the CRT-3330-1 model serves as the oil sump, or reservoir. The CRT-3330-3 model has a special housing which serves as the oil sump, since there is no transfer gear housing.

b. HYDRAULIC SYSTEM OIL FLOW. The flow of oil in the hydraulic system is from the oil reservoir through the input oil pump to the oil filter. From there the oil under pressure goes to both the main pressure regulator valve and the forward and reverse direction selector valve. Hydraulic pressure is available at the forward-reverse selector valve for applying the clutches when needed, but from the main pressure regulator valve the oil goes to both the torque converter and the clutch cutoff valve. From the clutch cutoff valve the oil goes to the range selector valve where it is available to the range clutches as needed. From the torque converter the oil goes to the transmission oil cooler, then to the lubrication oil pressure regulator valve and thence to lube and sump. In forward direction the output oil pump oil flow augments the input oil pump oil flow before it reaches the pressure regulator valve. In reverse direction the output oil pump does not function. Refer to section II, paragraph 16.

c. CLUTCH CUTOFF VALVE. The clutch cutoff valve normally passes oil from the main pressure regulator valve to the range selector valve, but in certain installations it is desirable that all the engine power be directed to the implement pump for furnishing high oil pressure to the mechanism being driven by the implement pump. In these instances hydraulic pressure from the vehicle hydraulic brakes is applied to the end of the clutch cutoff valve, moving the valve against spring pressure. Thus the valve cuts off oil pressure to the range clutch and interrupts the power flow through range gearing to the output shaft. Therefore, as long as the vehicle brakes are applied, all engine power is available to the implement pump. Upon release of the brake, the cutoff valve again directs oil pressure to the range selector valve.

d. SENSE-FEEL OPERATION

(1) The forward and reverse valve has a built-in sense-feel feature that is unique in design and operates as follows: When the valve is moved to select either forward or reverse direction, oil is admitted into the valve cavity which allows oil to go both to the clutch piston cavity and to the clutch plate area of the clutch being applied.

(2) The oil going to the clutch plates also exerts pressure on a piston that is attached in the center of the control valve. The clutch piston movement is started by the clutch apply line oil and the oil going to the clutch plate area lubricates the plates as they are being applied. At the beginning of the application, the valve piston allows a free flow of lube oil to the plates plus a low apply pressure to the clutch piston.

(3) As the selector valve is moved further to the full apply position, the valve piston moves over the lube line hole creating a restriction and causing two things to occur. The clutch apply pressure to the piston increases, compressing the plates together, and the lube pressure in the valve cavity, due to restriction, also increases.

(4) The increasing lube pressure acting upon the piston on the selector valve, opposes the movement of the valve to the full apply position. This makes it increasingly harder

to move the selector valve to the full apply detent position, and thus a "feel" of actually applying the clutch is obtained through the manual apply lever used to move the selector valve. This is called "sense-feel" operation and is the same in both forward and reverse directions.

(5) In the full apply position the lube flow to the clutch plates is shut off completely, making full line pressure available to the clutch apply piston. This "sense-feel" feature allows the operator to slip the clutches as he may desire to pick up the load and thus "feel" the load pick-up.

6. MODEL DESIGNATION

The letters "CRT" show the arrangement of the transmission components and the type of transmission. The digits (3330) indicate the size of converter used, the transmission capacity, the transmission basic speed ranges, and the auxiliary gear speed ranges. The example below illustrates the meaning of the letters and numbers.

C — Converter
RT — Transmission with 3 speeds forward, 3 speeds reverse
3 — Converter size
3 — Transmission capacity
3 — Transmission basic speed ranges
0 — Auxiliary gear speed ranges
-1 — Transfer gearing, front and rear outputs
-3 — Straight-through drive, rear output only

"CRT" means a transmission with a converter placed first and a transmission with three speeds forward and three speeds reverse connected to the converter. The first digit (3) indicates the converter size, Series 300. The second digit (3) indicates the approximate transmission torque capacity. The third number (3) means the transmission has three basic speed ranges. The fourth number (0) indicates there is no auxiliary gear speed range. The suffix (-1) indicates that the unit has transfer gearing with both front and rear outputs. The suffix (-3) indicates straight-through drive with a rear output only.

7. SPECIFICATIONS AND DATA

The specifications and data and the mounting dimensions are subject to change. Be sure you have the latest data which applies to new or old installations. The specifications and data chart is included in this section.

8. DRIVING INSTRUCTIONS

a. DRIVING TIPS. The CRT-3330 Torqmatic transmission is full power shifting. It is possible to upshift or downshift the transmission at wide-open throttle regardless of load. However, a downshift should not be made, if the vehicle speed exceeds the maximum speed normally attained in the next lower range. Downshifting at excessive speeds will overspeed the engine.

CAUTION

Shift the transmission to neutral before starting the engine or when the vehicle is parked and the engine is running.

To move the vehicle, select the speed range desired and then engage the directional clutch — forward or reverse. Both a range clutch and a direction clutch must be engaged to transmit power to the drive line.

b. TEMPERATURES AND PRESSURES. If the converter oil "OUT" temperature rises above 250° F., stop the vehicle immediately. Shift the transmission to neutral and run the engine at 1000 to 1300 rpm. The temperature should drop rapidly to the engine water temperature in two or three minutes. If the temperature does not drop, trouble is indicated. The cause of the trouble should be determined before further operation of the vehicle. Refer to the Trouble Shooting Chart in section III. Refer to Specifications and Data, paragraph 7 above for hydraulic pressure limits.

c. TOW OR PUSH START. To tow or push start a vehicle, place the transmission range selector valve lever in low-range position and the direction selector valve in forward position. (Refer also to section II, paragraph 16i, Tow Start.) Then push or tow the vehicle until sufficient speed is reached to crank the engine. During the towing or push-

ing, the output pump, driven by the output shaft, is supplying the oil at the pressure required to charge the converter and apply the clutches. When the oil pressure applies the clutches, the transmission output shaft drives the converter and cranks the engine.

SPECIFICATIONS AND DATA
MODEL CRT-3330-1 AND -3

ITEM	DESCRIPTION
Input rotation	Right hand
Output rotation	Same as input
Torque multiplication ratio at stall-converter only	320 Series — 3.5 to 1 370 Series — 2.5 to 1
Converter "OUT" oil pressure	20 — 65 psi
Maximum converter "OUT" oil temperature	250° F.
Range gearing	Constant mesh planetary. All ranges operate in both forward and reverse
Transfer gearing (CRT-3330-1)	Constant mesh, in line
Gears	Spur type
Transfer gear ratio	1.00 to 1, 1.62 to 1 or 0.659 to 1 (optional)
Range gear ratios (CRT-3330-1)	0.659 to 1 Transfer gear

	Low	Intermediate	High
Forward	5.27 to 1	1.91 to 1	0.659 to 1
Reverse	5.11 to 1	1.85 to 1	0.639 to 1

1.0 to 1 Transfer gear

	Low	Intermediate	High
Forward	8.00 to 1	2.90 to 1	1.00 to 1
Reverse	7.75 to 1	2.81 to 1	0.97 to 1

1.62 to 1 Transfer gear

	Low	Intermediate	High
Forward	12.96 to 1	4.70 to 1	1.62 to 1
Reverse	12.55 to 1	4.55 to 1	1.57 to 1

Range gear ratios (CRT-3330-3)

	Low	Intermediate	High
Forward	8.00 to 1	2.90 to 1	1.00 to 1
Reverse	7.75 to 1	2.81 to 1	0.97 to 1

Oil sump	Integral
Input driven charging oil pump (CRT-3330-1)	Positive displacement, gear type (1.00 to 1 or 1.27 to 1 optional ratios)

SPECIFICATIONS AND DATA - Continued

ITEM	DESCRIPTION
Input pressure and scavenge oil pump (CRT-3330-3)	Positive displacement, gear type (1.00 to 1 or 1.27 to 1 optional ratios)
Push start oil pump	Internal-external type
Oil capacity (CRT-3330-1)	7.5 gal (U.S.) initial fill 5.75 gal (U.S.) refill
Oil capacity (CRT-3330-3)	8.25 gal (U.S.) initial fill 7.0 gal (U.S.) refill
Oil filter	Full flow, transmission mounted (remote mounted optional), also strainer in sump
Oil cooler	Transmission mounted (remote mounted optional)
Type of oil	Hydraulic transmission fluid Type "C"
Maximum input speed	2600 rpm
Maximum input torque	270 lb-ft
Controls	Range shift control, and forward-and-reverse shift control — both manually operated
Control valve body	Incorporates two new features to provide for (a) SENSE-FEEL hydraulic control clutches for inching the load; (b) quick cutoff valve to disengage transmission, making full engine power available for implement pump operation
Clutch type	Multiple disk, hydraulically actuated, spring released, oil cooled, with automatic wear compensation
Clutch friction plates	Sintered bronze
Clutch reaction plates	Steel
Clutch pressure	90-125 psi
Flanges	Mechanics, Input — 6C Front output (CRT-3330-1 only) — 7C Rear output — 7C or 8C
Weight (dry)	CRT-3330-1 — 1170-1260 lbs depending on options CRT-3330-3 — 900-1000 lbs depending on options
Disconnect clutch (CRT-3330-1)	Front output flange, mechanical disconnect type
Accessory drives	Implement oil pump — 1.00 to 1 or 1.27 to 1 optional ratios, SAE mounting flange size C, governor drive (CRT-3330-1) — 1 to 1, speedometer drive (CRT-3330-3) — 1.0 to 0.50

SECTION II TORQMATIC PRINCIPLES

1. SCOPE

In this section the principles of Torqmatic Drive are explained. Because Torqmatic Drive uniquely employs oil and gears to multiply torque — a combination that at first may seem mysterious — we shall consider the fundamentals of torque multiplication. What torque multiplication is and how torque is multiplied are discussed first, and then these principles are applied to Torqmatic Drive. Remember in section I, a Torqmatic Drive was described as being a hydraulic torque multiplier with fluid coupling and planetary range gearing. Now, let us consider torque multiplication.

2. WHAT IS MEANT BY TORQUE MULTIPLICATION?

Torque multiplication means an increase in twisting or rotating effort — the multiplication of force. A good example of multiplying force may be found in the fulcrum and lever principle. To make the explanation of torque multiplication simpler, suppose we consider the Torqmatic converter a "floating" fulcrum (par 10). But first we will review the function of the fulcrum and lever, and see how it applies to the hydraulic torque converter.

3. FULCRUM AND LEVER PRINCIPLE

The fulcrum and lever principle illustrates how a force can be multiplied. In figure II-1, diagram A, x and y are in balance because the fulcrum f is equally distant from x and y, and x is equal to y. In diagram B, the fulcrum is closer to x and farther from y in order to keep the balance because of the load increase at x. In diagrams C and D two alternates are shown to move the load at x: increase the required force at y (diagram C) or multiply the force at y by moving the fulcrum closer to x (diagram D). Note the relationship of distances between lever travel on both sides of the fulcrum in each case illustrated. To multiply the force in D, we increased the distance of lever travel. You will see this same relationship when we consider gears. A conventional step-gear transmission employs the principle of the fulcrum and lever to multiply the torque of the engine. Gears are spinning levers. However, when we think of spinning levers we must consider two other terms in connection with multiplying force — torque and speed.

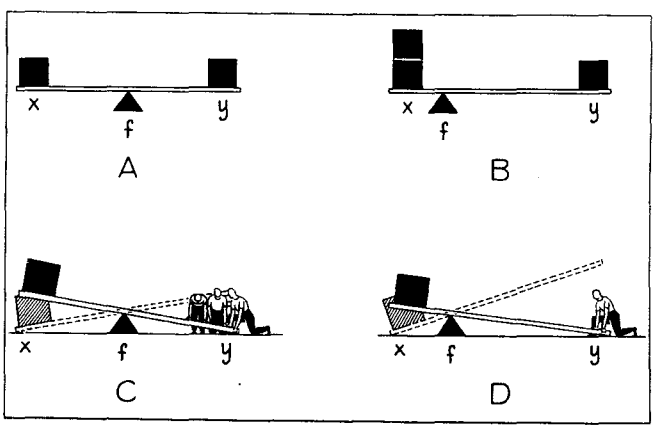


Fig II-1. Fulcrum and lever multiplying force or distance

4. TORQUE AND SPEED

a. ONE-TO-ONE RATIO. The accompanying diagrams (fig II-2), illustrate a one-to-one speed ratio and a one-to-one torque ratio (Part One). Note first that the output speed (rpm) will be the same as the input speed (rpm) because both gears are exactly the same size. And because they are the same size, whatever torque or twisting effort is put into the input gear will be transmitted through the output gear. If 20 lb-ft of torque go into A, 20 lb-ft of torque will come out at B, or if there is 30 lb-ft input, there will be 30 lb-ft output — no more — no less — so the torque ratio is one-to-one.

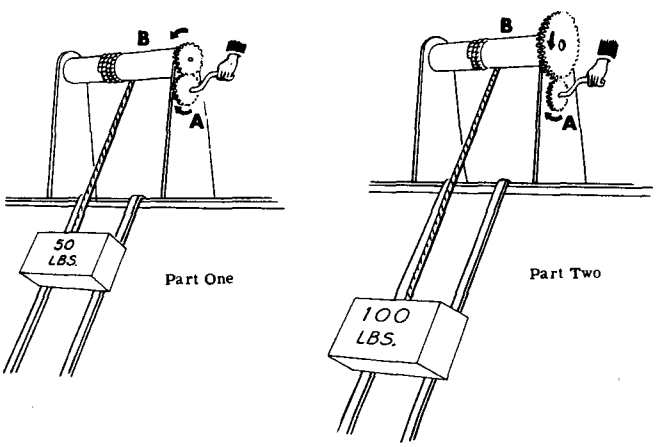


Fig II-2. Gears multiplying torque or speed

b. INCREASING TORQUE RATIO. Suppose it becomes necessary to double the lifting force. This can be done in two ways. Increase the power source or relocate the fulcrum. We relocate the fulcrum by moving into position a larger gear (fig II-2, Part Two). For every two revolutions of A, gear B will make one revolution. If the input twisting effort is 20 lb-ft the output torque will be 40 lb-ft.

c. SPEED, TORQUE AND LOAD. What effect will the speed of the input and the twisting effort have on raising the load attached to the windlass? Note in Part One of the diagram that the load will move twice as fast as the load will move in Part Two. But in Part Two, the load may be twice as large as the load in Part One.

d. MATHEMATICAL FORMULA

(1) There is a direct mathematical relationship between the input speed and output speed versus output torque and input torque. It can be stated as follows:

$$\frac{\text{Input Speed}}{\text{Output Speed}} = \frac{\text{Output Torque}}{\text{Input Torque}}$$

Suppose the input torque at A = 20 lb-ft and the input speed at A = 50 rpm. The gear ratio being 1:1 means the figures would look like this:

$$\frac{50}{50} = \frac{20}{20}$$

Applying this to Part Two in figure II-2, the formula will look like this if A = 50 rpm:

$$\frac{50}{25} = \frac{40}{20}$$

(2) Another formula important to torque, speed and horsepower is stated in this manner: $t = hp \times \frac{5252}{n}$; t stands for torque (lb-ft), hp for horsepower, and n for speed (rpm). For example, if at a governed speed of 1800 rpm (n) an engine develops 100 horsepower the torque (t) will be: $t = \frac{100 \times 5252}{1800} = 291\text{-}7/9$ lb-ft of engine output torque. For easy figuring we will call it 292 lb-ft. Using formula (1) above let's see what happens when we use a torque multiplier with a ratio of 3.5:1. The output torque is equal to the torque ratio times the input torque.

$$\text{Output Torque} = 3.5 \times 292 = 1022$$

$$\frac{\text{Input Speed}}{\text{Output Speed}} \; \frac{1800 \text{ rpm}}{X} = \frac{\text{Output Torque}}{\text{Input Torque}} \; \frac{1022}{292}$$

$$\text{Output Speed} = X = 514.2 \text{ rpm}$$

From this example it can be seen that ratio of input speed to output speed is equal to the torque ratio.

5. FULCRUM A REACTION MEMBER

At this point it will be well to consider the fulcrum in another light. The fulcrum can be considered a reaction member. Without its being able to react to the forces x and y in figure II-1, there could be no balance and no multiplication of force. The fulcrum is always "grounded". In the step-gear transmission, the transmission case is the "ground" against which the spinning levers (gears) react.

6. MECHANICAL STEP-GEAR TRANSMISSION

a. FULCRUM POINTS. Figure II-3 illustrates a conventional step-gear transmission. The fulcrum points are the various gear ratios. The limited number of gear ratios results in a limited number of fulcrum points. In the leverage distance between the load and the power there will be only five fulcrum points where the load and the engine will be in exact balance. These fulcrum points permit the driver to change the torque ratio to meet the variable load demand. Each time the fulcrum point is shifted, the power source must be disengaged from the load by a clutch while the driver shifts gears.

b. DRIVER MUST ADJUST FULCRUM. If the driver does not choose the right fulcrum point, the engine and load will be out of balance. The result of a wrong guess will mean a lugged down or stalled engine or the engine will be running at excessive speeds. In this type of transmission, the operator must choose the fulcrum points and they are limited to the fixed number of gear ratios in the transmission. The hydraulic torque con-

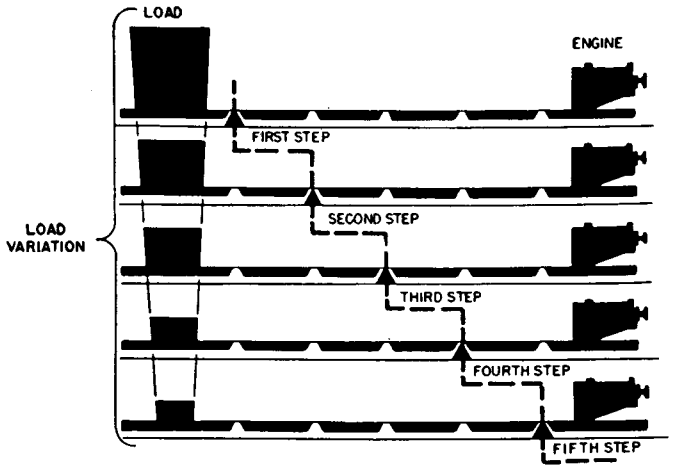


Fig II-3. Limited number of fulcrum points of a mechanical step-gear transmission.

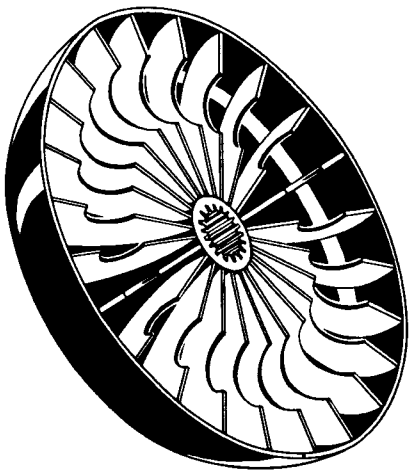


Fig II-4. Blading of hydraulic coupling—pump and turbine

verter has no such limits — but that's getting ahead of the story. Before we get into the hydraulic torque converter — let us first consider the hydraulic coupling.

7. HYDRAULIC COUPLING

a. SIMPLE TRANSMISSION. The hydraulic coupling is the simplest means of transmitting torque hydraulically. It can be called a fluid coupling, a fluid flywheel or a fluid clutch. The ratio of input to output torque is always one-to-one.

b. ELEMENTS OF HYDRAULIC COUPLING. The hydraulic coupling consists of two elements: a pump and a turbine. Each element has a number of straight, flat, radial blades leading from the hub to the outside edge (fig II-4).

c. HOW THE HYDRAULIC COUPLING WORKS

(1) A cover, integral with the pump, completely encloses the turbine (fig II-5). This enclosure is filled with oil.

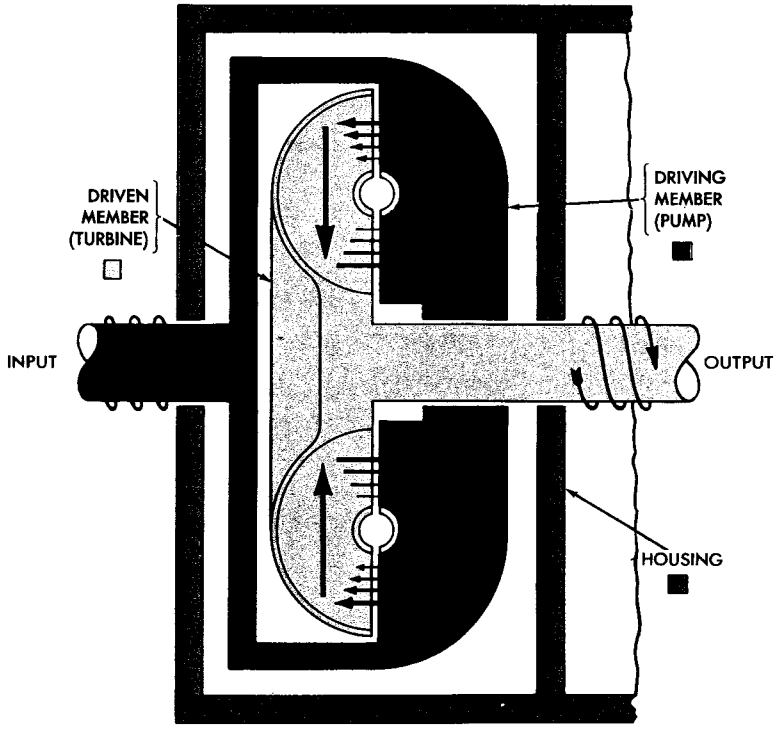


Fig II-5. Fluid coupling schematic

(2) When the engine is started, the pump starts turning. If the pump is turning fast, the oil will be thrown toward the outside circumference of the pump — just like marbles on a revolving phonograph turntable. But the design of the pump blading guides the "outward" flow of oil across to the turbine.

(3) When the oil hits the turbine blades with enough force, the turbine turns. This movement slows the oil which then travels inward toward the hub of the turbine, then across to the pump and the whole sequence is repeated. Note that the oil flows "outward" in the pump, and "inward" in the turbine. The ratio of input to output torque will always be one-to-one in a fluid coupling. Note also that there is no stationary or reaction member — there is no fulcrum, or "ground" on which to place a fulcrum. Hence the fluid coupling cannot multiply torque.

8. STATORS, LIKE FULCRUM, MAKE TORQUE MULTIPLICATION POSSIBLE

In order to make the hydraulic coupling perform as a torque multiplier, it is necessary only to add a reaction member, or fulcrum. The stator becomes the reaction member. By placing a stator (reaction member) between the load and power source, a fulcrum is provided. This fulcrum is "grounded" to the housing of the converter which is attached to the frame. A hydraulic converter has at least three elements — pump, turbine and one stator. (par 12a).

9. HOW A CONVERTER WORKS

Figure II-6 Illustrates a simple converter. A cover is fastened to the pump so as to enclose completely the turbine.

a. BLADE DESIGN. The oil circulates in the same manner as in the hydraulic coupling. But in the hydraulic coupling the blades of the pump and turbine are straight. In the hydraulic torque converter the blading is curved in all the elements — pump, turbine and stator (fig II-7).

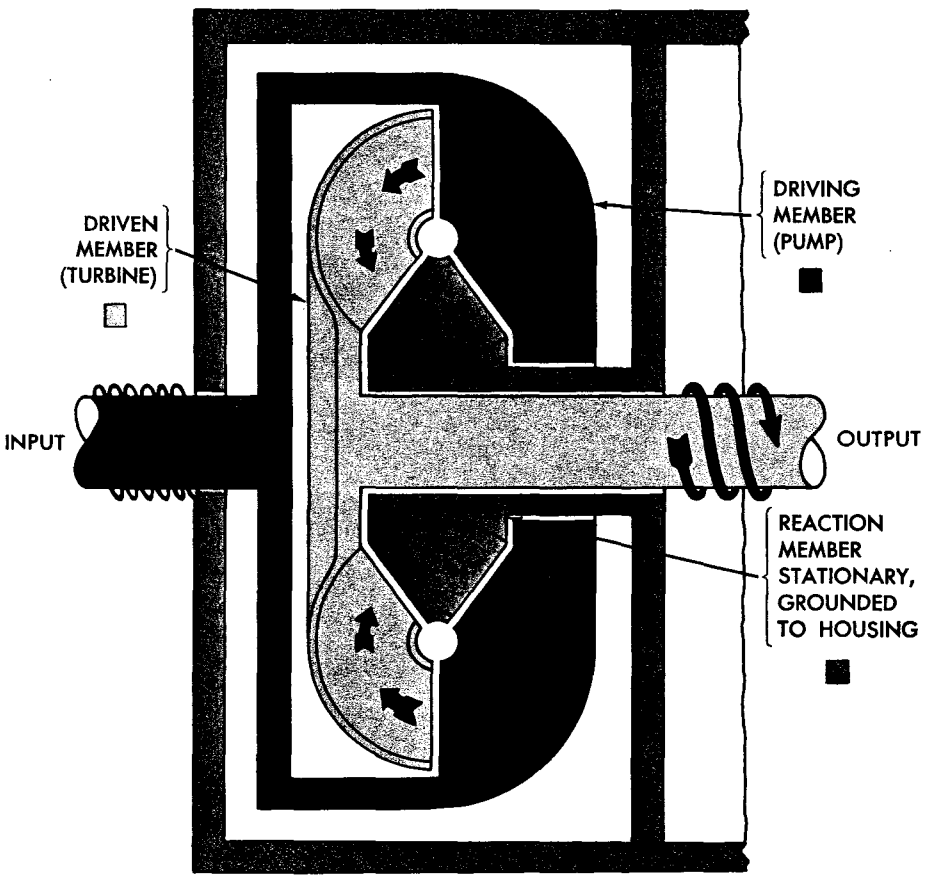


Fig II-6. Torque converter schematic

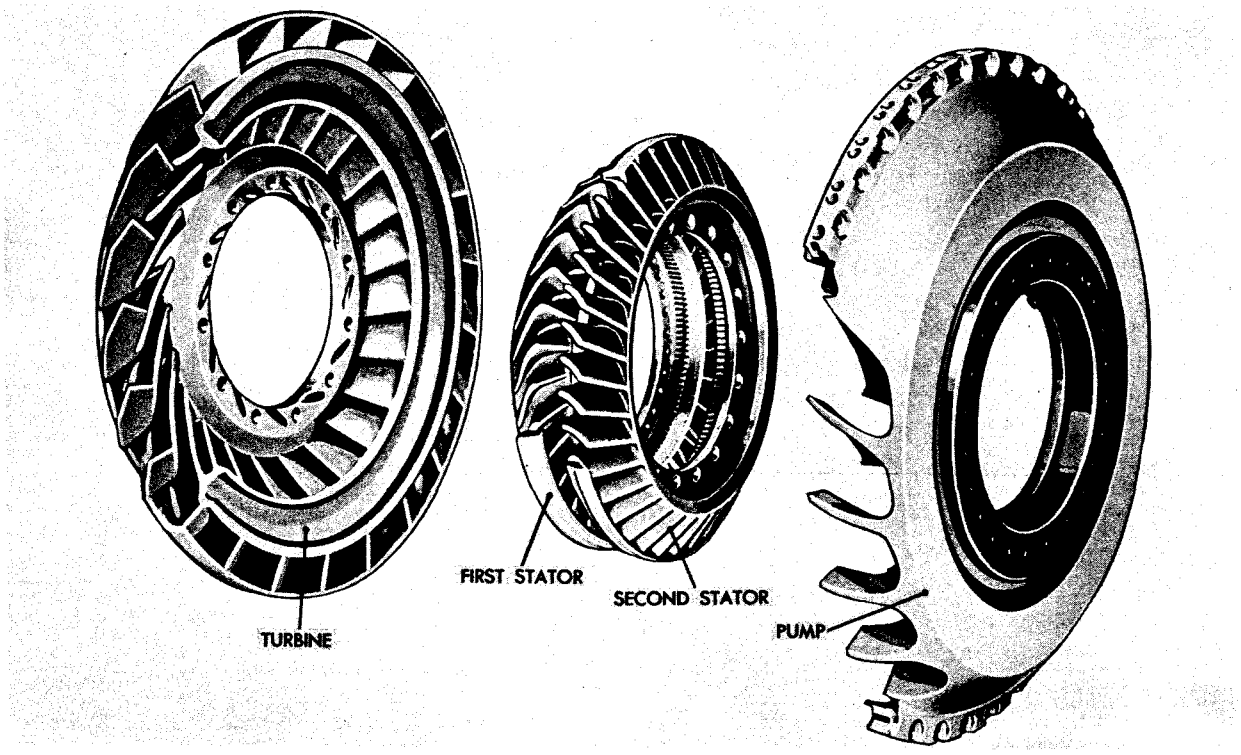


Fig II-7. Torque converter elements partially cut away to show blade curvature

b. FLOW PATTERN. The pump pushes the oil outward and in the direction the pump is turning. The oil strikes the turbine, causing the turbine to turn. After striking the blades, the oil is directed inward toward the inner circumference of the turbine. As the oil leaves the turbine it is moving in a direction opposite to pump rotation. The stator, being held stationary, causes the oil to change direction and add its motion to the pump.

c. SOME NEW TERMS. To aid us in understanding hydraulic torque multiplication, let us consider three new terms as applied to b above. First, kinetic energy: oil in motion has kinetic energy (imparted to the oil by the pump). A thrown baseball has kinetic energy. Anything in motion has kinetic energy. Second, rotary flow: the flow of oil around the outer circumference in the converter is rotary flow. Third, vortex flow: the flow of oil across the converter is called vortex flow. These will be fully explained in paragraph 13 below. Let's look first at kinetic energy as applied to b above.

d. KINETIC ENERGY AND THE STATOR

(1) Considering b above, note that only part of the kinetic energy was removed from the oil as it struck the turbine. The oil leaving the turbine has some kinetic energy left. The stator deflects the oil in motion with its remaining kinetic energy so that it enters the pump in the same direction the pump is moving — aiding the pump rather than hindering it. The multiplication of input torque results from the velocity (kinetic energy) imparted to the oil by the pump plus the velocity (kinetic energy) entering the pump from the stator. The more the turbine resists turning (heavy load) the greater will be the velocity of the vortex flow of the oil circulating in the converter and the greater will be the torque multiplication. The less the turbine resists turning (light load) the less will be the velocity of the vortex flow of the oil in the converter and the less will be the torque multiplication.

(2) Recall how in paragraph 4b, section II the smaller gear turns faster to multiply the input torque. We relocated the fulcrum by the use of the larger gear. Well, here we have somewhat the same relationship and action between the pump and turbine. The pump turns faster in relation to the turbine. The fulcrum is relocated by the use of an "expanding-contracting fluid gear". When torque demand is greatest, the "fluid-gear" contracts, resulting in greater torque multiplication. When torque demand diminishes, the

"fluid gear" expands, bringing the relationship of output and input torque closer to one-to-one.

10. FLOATING FULCRUM PRINCIPLE

Torqmatic Drive employs what we choose to call the floating-fulcrum principle of multiplying torque. Floating suggests (one) a cushioning of shock, and (two) an infinite number of torque ratios. That's exactly what Torqmatic Drive is. The step-gear transmission will provide generally not more than 10 exact fulcrum points, whereas Torqmatic Drive furnishes an infinite number of fulcrum points — and does so automatically, without guesswork on the part of the driver (fig II-8). Because the fulcrum is "floating", it absorbs drive line shock, protecting both engine and equipment — against harmful engine lugging, and permitting the engine to operate at high efficiency.

11. TORQMATIC DRIVE

a. HYDRAULIC TORQUE MULTIPLIER AND FLUID COUPLING. The Torqmatic converter operates as a hydraulic torque multiplier and a hydraulic coupling. This is possible because of the floating fulcrum principle. Note that in figure II-6, the stator is permanently "grounded". This illustrates a straight torque converter. In the Allison Torqmatic converter the stators can "float" so that when no torque multiplication is necessary, the Torqmatic converter becomes a hydraulic coupling, thus permitting a more economical overall range of operation.

b. TORQMATIC TRANSMISSION: The Torqmatic transmission with its planetary gearing provides six fixed gear ratios, three in forward direction and three in reverse. Whereas, the Torqmatic converter provides (within design limits) infinitely variable torque ratios hydraulically. It is this combination which provides the Torqmatic transmission with its flexibility, full power shifting, and at the same time, frees the engine from harmful lugging and prevents shock loads from reaching the engine or equipment. The oil in the converter absorbs the shock. Note also there will always be a smooth flow of power from low to high to reverse. Only three forward and three reverse shifts are employed — and they are selected by a flick of the wrist. The

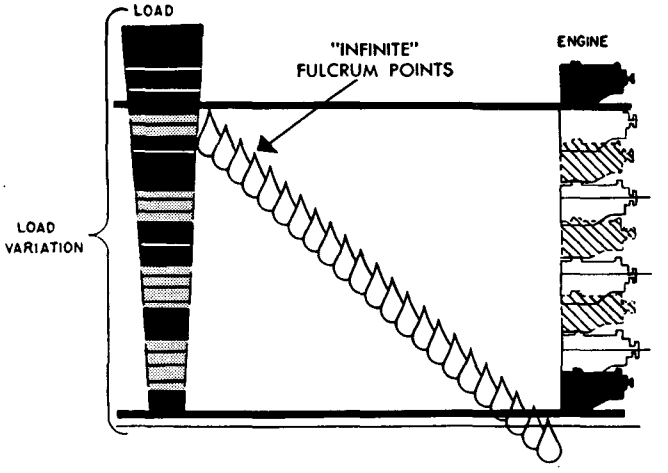


Fig II-8. "Infinite" number of fulcrum points of a hydraulic torque converter

heart of the Torqmatic method of torque multiplication is the Torqmatic converter. (figs VI-3 and VI-4).

12. TORQMATIC CONVERTER

a. ELEMENTS. All series Torqmatic converters, except the TC-200 Series, contain four elements. These elements are the pump, the turbine, the first stator, and the second stator. Figure II-9, illustrates a four element Torqmatic converter.

b. ROTATING HOUSING. The Torqmatic converter is a rotating housing type of converter. The elements are enclosed in a housing consisting of the converter pump cover assembly or the transmission front cover and the converter pump. The converter pump cover assembly is driven by the engine flywheel. Greater flexibility is obtained because the converter can operate as a torque multiplier and fluid coupling.

c. FREEWHEELING STATORS. The stators' design is such that they can freewheel, or automatically lock up to provide the necessary reaction for torque multiplication.

d. INPUT DRIVEN CHARGING OIL PUMP. Mounted on the converter housing is an oil pump driven through gearing by the hub of the converter pump (figs VI-3 and VI-4). The oil pump provides charging pressure to the converter and cooling flow for the converter and transmission. The pump also supplies oil pressure to the lube circuit and pressure for the hydraulic control of all clutches.

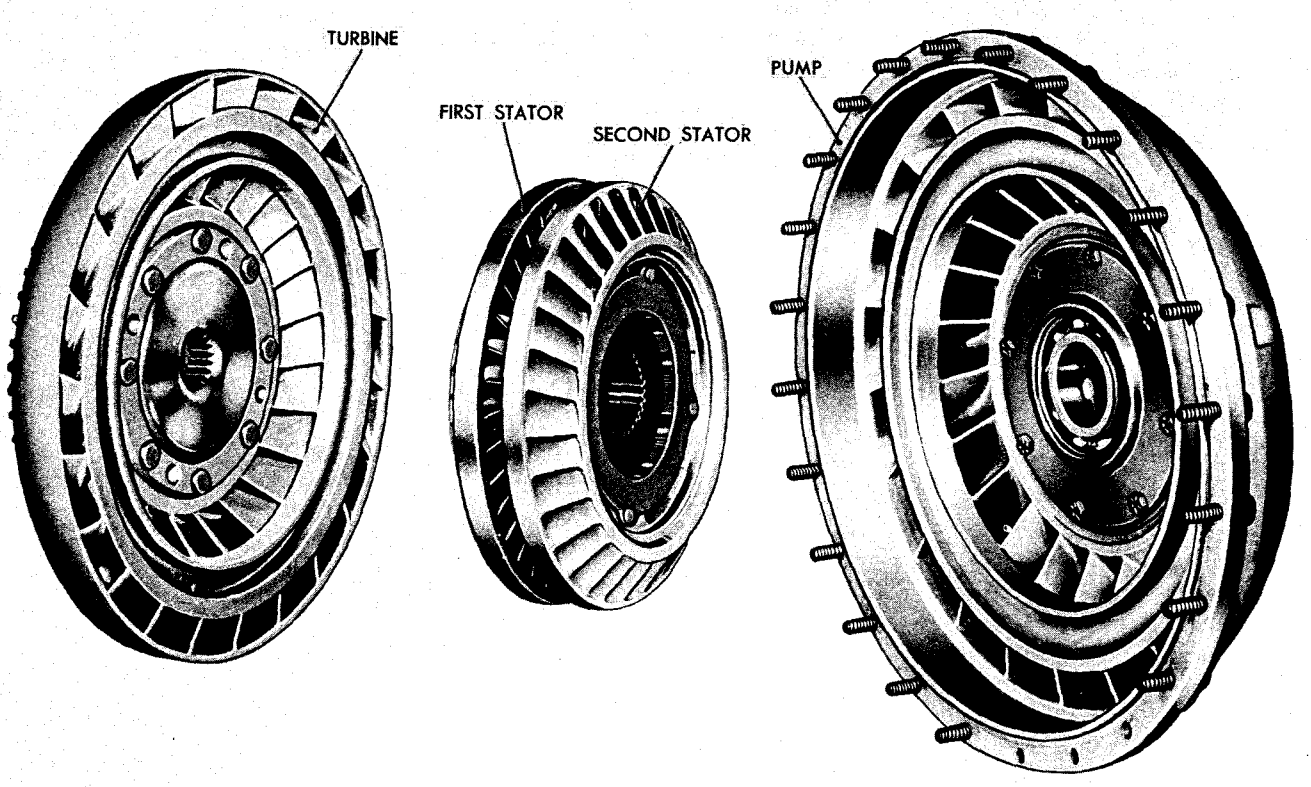


Fig II-9. Four element Torqmatic converter

e. OIL FLOW TO AND FROM THE CONVERTER. Incoming oil from the oil pump flows through internal passageways in the converter housing and through the ground sleeve. It then enters the converter elements between the second stator and the converter pump. The oil leaves the converter elements between the first stator and the turbine, flows inside the ground sleeve along the turbine shaft and out through a passageway in the ground sleeve and converter housing to the oil cooler. From the oil cooler the oil flows into the lube circuit and then back to the sump (figs 19 through 22).

13. HOW THE TORQMATIC CONVERTER WORKS

a. SAME PRINCIPLE FOR ONE- OR TWO-STATOR CONVERTER. Whether the three element or four element converter is discussed, the principle is the same. However, the four element converter will be described in order to have the complete story.

b. VORTEX AND ROTARY FLOWS

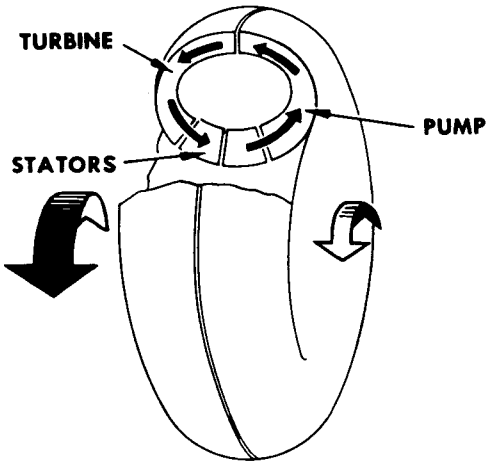
(1) Recalling the definitions of vortex and rotary oil flow in paragraph 9c above, let's see how they work. The instant the torque converter pump, which is driven by the engine flywheel, starts rotating, the oil spins around with the pump. This movement of oil is rotary flow. The converter turbine, connected to the load, resists turning as the oil strikes its blades. Because of the resistance, and because of the shape of the blades within the converter elements, the oil takes a second path of travel — crosswise. This second path is called vortex flow. See figure II-10.

(2) The greater the load resistance transmitted by the turbine, the greater will be the vortex flow with the engine operating at its governed output. The greater the vortex flow, the greater the torque multiplication. All the action is automatic. The "floating fulcrum" chooses automatically the exact torque ratio required. No guesswork here. At vehicle stall or when getting the load under

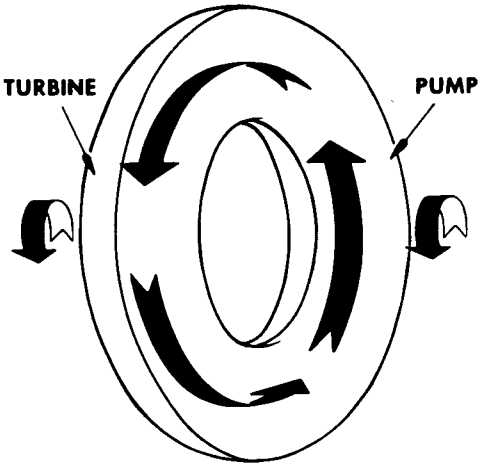
way, a torque ratio up to 3.5 to 1 is available from the Torqmatic converter alone, depending upon the model.

c. FIRST CONVERTER PHASE

(1) In tracing the action of Torqmatic Drive, remember, we are considering the four element, single stage converter. First converter phase means both stators are being held stationary, and the greatest torque multiplication between input torque and output torque is being accomplished (fig II-11).

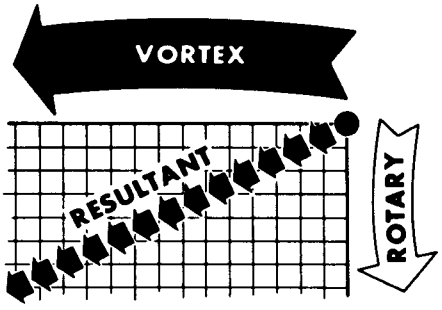


VORTEX FLOW

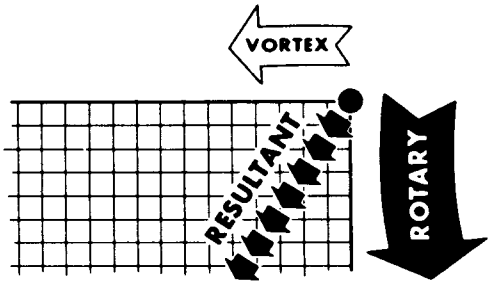


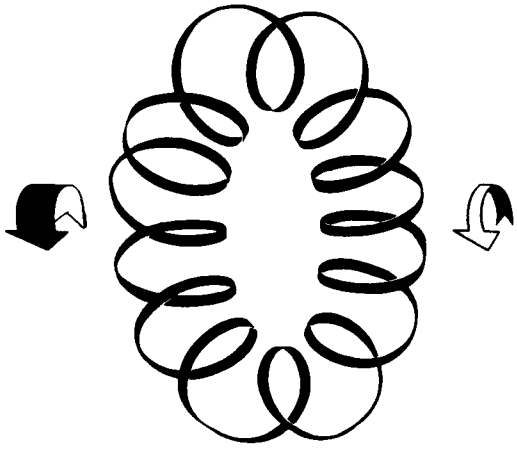
ROTARY FLOW

RESULTANT FLOW WHEN PUMP IS ROTATING MUCH FASTER THAN TURBINE



RESULTANT FLOW WHEN TURBINE SPEED APPROACHES SPEED OF PUMP





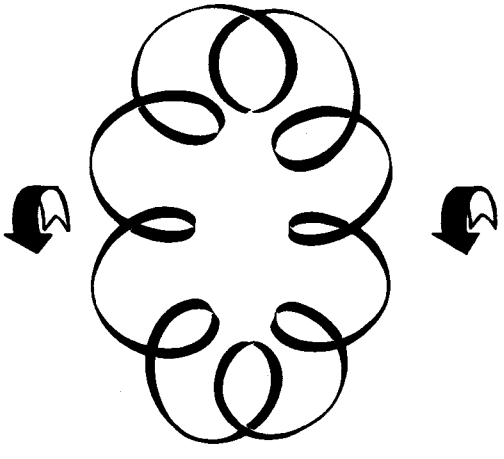


Fig II-10. Rotary and vortex flow schematic

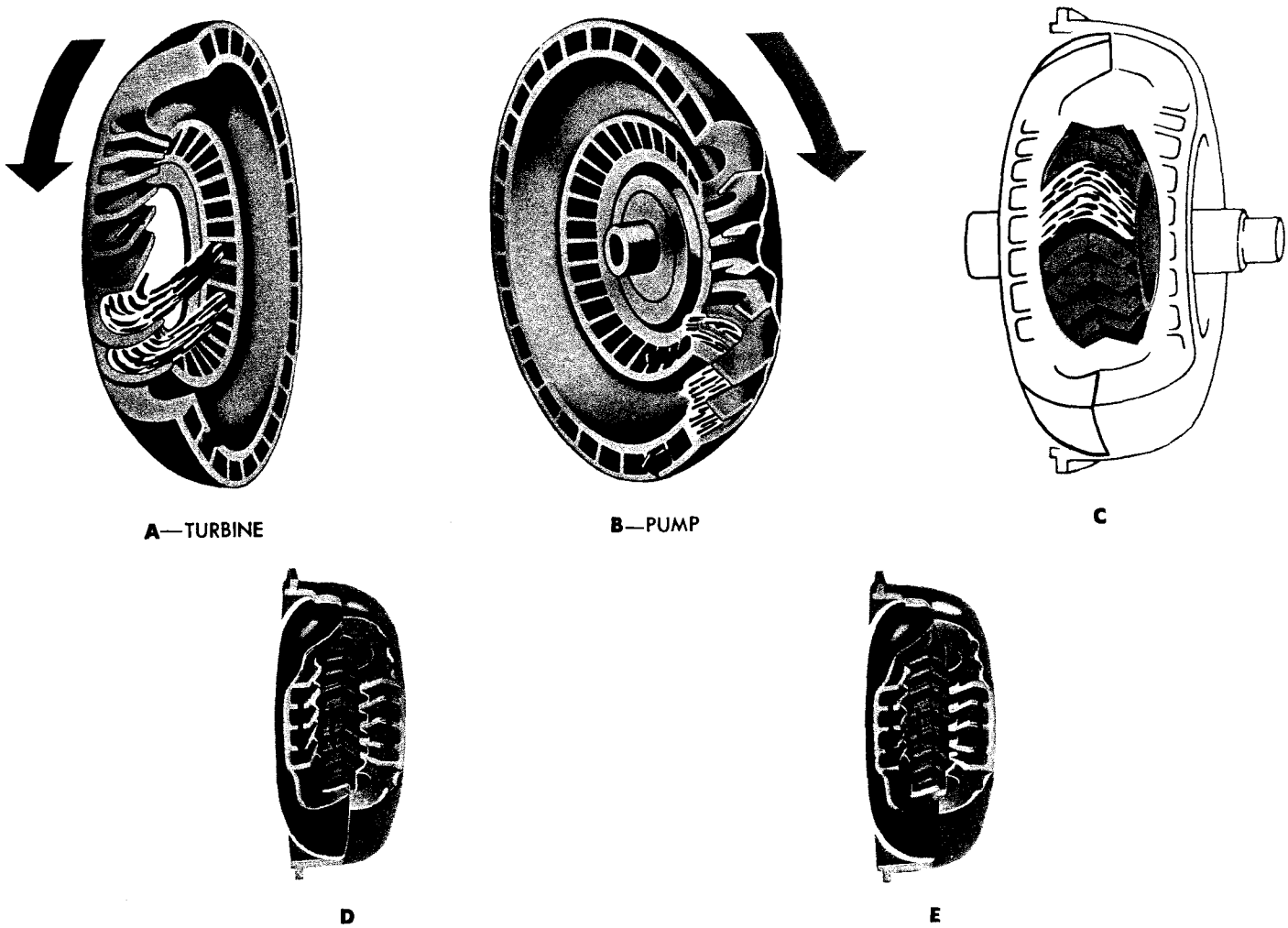


Fig II-11. Torqmatic converter in operation

(2) In this phase the stators are being held stationary because the oil leaving the turbine strikes the stators so that they try to turn in a direction opposite both the pump and turbine rotation. But the stators are mounted on cams on the ground sleeve (figs I-3, VI-3, and VI-4). These cams with rollers permit the stators to rotate in one direction only (the same as the pump and turbine) like a coaster brake on a bicycle permits the pedals to rotate forward only. The stators redirect the vortex flow of oil so that it enters the pump in the same direction it is turning. This flow aids the pump and multiplies torque as explained in paragraph 9 above.

d. SECOND CONVERTER PHASE. Second converter phase means that the first stator is freewheeling (fig II-11). The first stator starts to freewheel as soon as the load demand for output torque becomes less. This means that the turbine is turning faster in relation to the pump. As the turbine speed increases, the oil leaving the turbine strikes the blades of the first stator in such a manner that it no longer locks up on the cam, but starts to freewheel in the direction of the turbine. Torque multiplication is decreasing while turbine speed is increasing and vortex flow is becoming less.

e. FLUID COUPLING PHASE

(1) The torque converter is in fluid coupling when the second stator starts to freewheel. This means the turbine speed is approaching pump speed; input torque and output torque are approaching a one-to-one ratio. The vortex flow has practically stopped. This stopping of vortex flow permits the second stator to freewheel with the first stator. In this phase the converter is a fluid coupling (fig II-11).

(2) But just as soon as the turbine slows down and the demand ("load variation") for

output torque increases, the "floating fulcrum" adjusts the torque input to torque output demand. First one stator, then the other, becomes stationary to aid torque multiplication.

(3) Before we consider what happens to the torque coming out of the converter and entering into the Torqmatic planetary gearing let us look into planetary gearing principles.

14. PLANETARY GEARING PRINCIPLE

a. MEMBERS OF A PLANETARY UNIT

(1) A simple planetary gear system consists of four members: a planetary sun gear, two planetary pinions, a planetary pinion carrier, and a planetary ring gear (fig II-12). The sun gear meshes with the planetary pinions attached to the carrier, and the planetary pinions are in mesh with the ring gear. This is a different arrangement than the conventional "clash box", or sliding gear transmission, in which the gears have to be slid into mesh.

(2) In order to obtain the necessary reduction or variation in torque multiplication, another element is necessary, — a means to hold one member of the planetary unit while two other members become the driving and driven members.

(3) Figure II-13 illustrates in color a simple method of holding a planetary unit. In this example, the ring gear is held by a band. The sun gear is the driving unit and the planetary carrier is the driven unit. Note the direction of rotation of each of the moving elements.

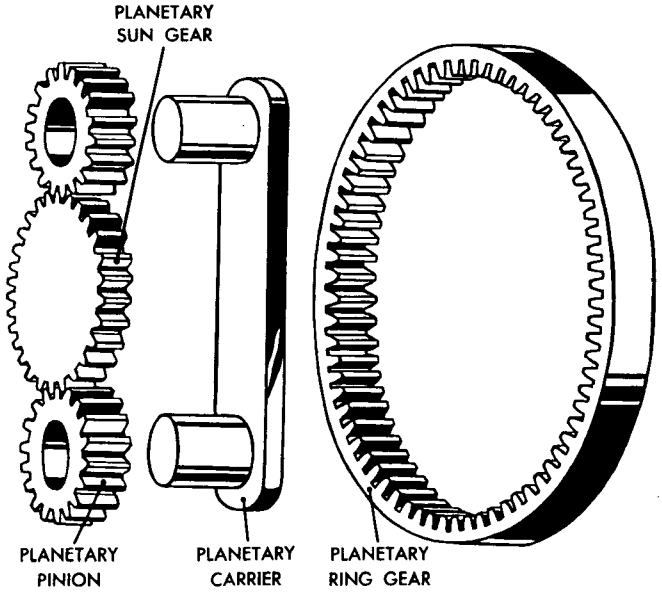


Fig II-12. Members of a planetary unit

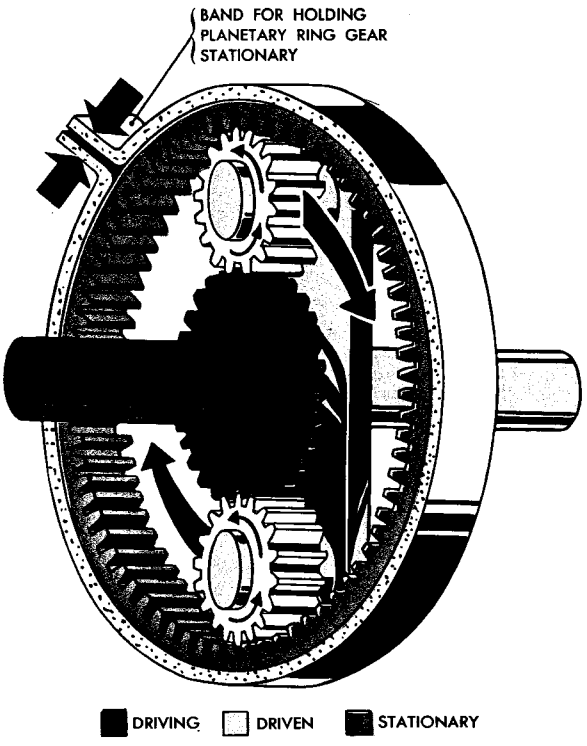


Fig II-13. Members of a simple planetary unit showing one as holding member

b. OUTPUT COMBINATIONS

(1) By making any one of three members — the sun gear, carrier or ring gear the stationary member, and either of the other two the driving or driven unit, six output combinations are possible.

(2) The Model CRT-3330 Torqmatic transmission uses three of these combinations in its planetary gearing. Figure II-14 illustrates in color these three output combinations.

(3) Under A of figure II-14 the input torque is transmitted to the sun gear clockwise; consequently, the planetary pinions must also rotate. Since the ring gear is being held, the planetary pinions rotate on their own shafts, and "walk" around the ring gear taking the planetary carrier with them. This makes the planetary carrier the driven member, or the output member. The planetary carrier will be turning more slowly than the sun gear, and in the same direction.

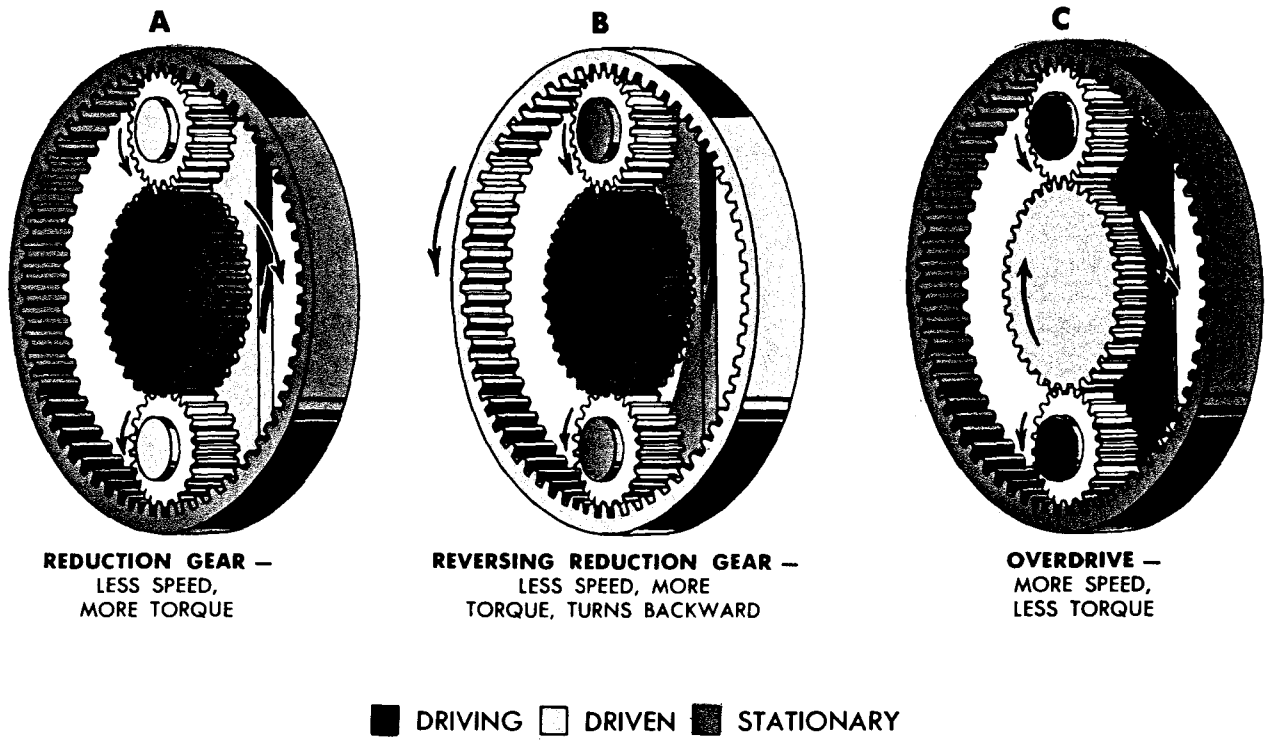


Fig II-14. Planetary output combinations

(4) Just what ratio, depends upon the size of the gears and the relationship of the grounded, driving, and driven members. We will not go into the details of how it is figured. However, as an example, with smallest practical planetary pinions in a simple planetary unit, the ratio cannot be less than 2.5 to 1. When the planetary sun gear and the planetary pinions are the same size, the ratio is 4 to 1.

(5) Under B of figure II-14 the input torque is transmitted to the sun gear clockwise; consequently, the planetary pinions must rotate counterclockwise. Since the planetary carrier is being held, the planetary pinions rotate on their own shafts and force the ring gear to rotate slowly in the same direction as the planetary pinions — counterclockwise. This imparts a reverse motion and a reduction in speed to the output.

(6) Under C of figure II-14 the input torque is transmitted to the planetary carrier clockwise; consequently, the planetary pinions must rotate counterclockwise. Since the ring gear is being held, the planetary pinions rotate on their own shafts and drive the sun gear clockwise with more speed. This makes the sun gear the driven member.

15. TORQMATIC PLANETARY GEARING

a. COMPOUND PLANETARY GEARING

(1) Range gearing extends the advantages of hydraulic torque multiplication by the torque converter. This combination makes available infinitely variable torque ratios with three forward speeds and three reverse speeds within the limits of the entire unit.

(2) The Model CRT-3330 Torqmatic transmission employs a compound planetary gearing system. The gearing operates as a simple planetary system in intermediate range either forward or reverse and as a compound planetary system in high and low ranges (fig II-15). When two planetary systems are used simultaneously to obtain a desired output ratio, the gearing is referred to as compound. Compound planetary gearing is used to obtain the desired gear ratios from the least number of parts in the smallest space possible. This will be further explained below.

(3) For either forward or reverse directions, both a direction clutch (forward or reverse) and a range clutch (intermediate,

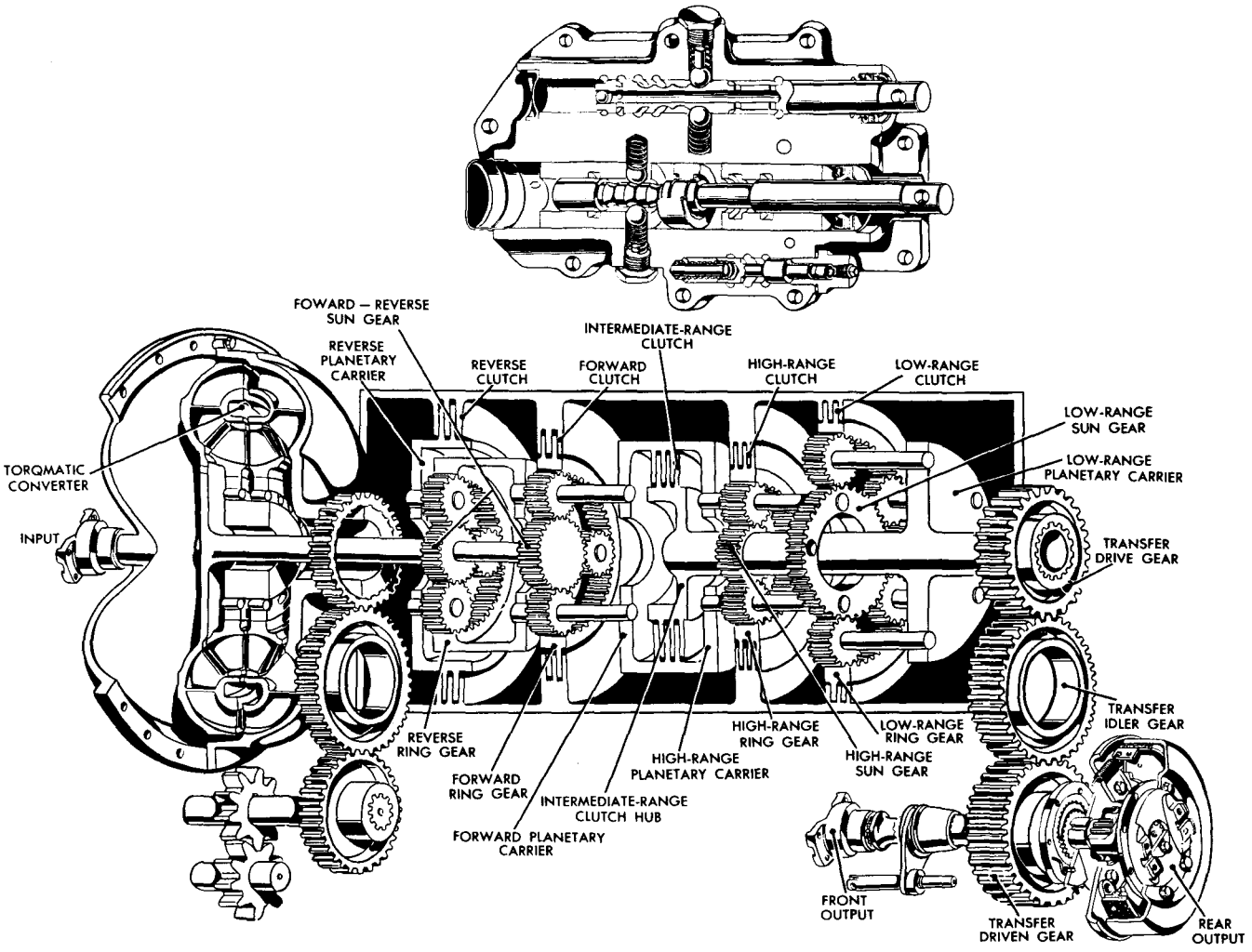


Fig II-15. Planetary gearing, torque converter, and selector valve schematic

low or high) must be engaged. If the intermediate-range clutch is applied, the forward planetary carrier is locked to the transmission shaft. In this range, since only the direction planetary is working, the gearing operates as a simple planetary system. If either the low- or high-range clutch is applied, both the direction planetary and the range planetary are working, hence, in low or high range the gearing operates as a compound planetary system.

b. FORWARD-REVERSE GEARING IN OPERATION (FIG II-15)

(1) When putting the vehicle in motion, both a direction clutch (either the forward or the reverse clutch) and a range clutch (intermediate, high, or low) must be applied. When the reverse clutch is applied, the drive is from the converter shaft through the reverse sun gear. Since the reverse clutch is applied, the reverse planetary is being held. The reverse sun gear drives the planetary pinions and, since the reverse planetary carrier is held, the pinions turn the reverse ring gear. The reverse ring gear drives the forward planetary carrier, which in turn drives the range gearing.

(2) Note that when the sun gear is driving, the planetary carrier is held, and the ring gear is driven, the motion of the ring

gear is opposite to that of the converter shaft. This causes the output shaft to turn backward. When the forward clutch is applied, input torque is transmitted to the sun gear; consequently, the planetary pinions must also rotate. Since the forward ring gear is being held, the planetary pinions rotate on their own shafts, and "walk" around the ring gear taking the planetary carrier with them. This makes the planetary carrier the driven member, or the output member. The planetary carrier will be turning more slowly than the sun gear, and in the same direction. This gives forward motion.

c. RANGE CLUTCHES. The hydraulically actuated clutches include two types of clutch plates. The friction plates are splined to the ring gears (high and low ranges) and to the intermediate-range clutch hub. The other plates are called reaction plates and are either grounded to the transmission housing (high range and low range) or to the intermediate-range clutch drum (intermediate range). Note that both the high-range ring gear and the low-range ring gear can be held.

16. HYDRAULIC DIRECTION AND RANGE CONTROL

a. GENERAL. The heart of the hydraulic direction and range control system is the selector valve body assembly (fig II-15). This assembly contains the valves that control shifting from one direction to the other and also from one range of operation to another. Both the forward and reverse valve and the range selector valve are actuated manually. The clutch cutoff valve is actuated hydraulically by the vehicle brakes. When the brakes are applied, hydraulic pressure is applied to the clutch cutoff valve, which in turn cuts off the hydraulic pressure to the range selector valve. The paragraphs below discuss the valve actions and hydraulic flow under each of the eight situations as indicated.

b. NEUTRAL RANGE (FIG II-16). No power flows through the transmission because none of the direction clutches or range clutches is applied, their lines being open to the sump through the forward and reverse valve and the range selector valve.

c. FORWARD-LOW RANGE (FIG II-17)

(1) When the forward and reverse lever is moved into forward position, the forward and reverse valve directs main oil pressure to the forward clutch to actuate the clutch.

(2) When the shift control lever is moved into low-range position, the range selector valve directs main oil pressure to the low-range clutch to actuate the clutch.

d. FORWARD-INTERMEDIATE RANGE (FIG II-18). The range selector valve allows pressure in the low-range clutch line to exhaust to the sump and directs pressure to the intermediate-range clutch line. The clutches function simultaneously for smooth shifting without an interruption in the transmission of torque to the wheels.

e. FORWARD-HIGH RANGE (FIG II-19). The range selector valve allows pressure in the intermediate-range clutch line to exhaust to the sump and directs pressure to the high-range clutch line. The clutches function simultaneously for smooth shifting without an interruption in the transmission of torque to the wheels.

f. REVERSE-LOW RANGE (FIG II-20)

(1) When the forward and reverse lever is shifted from forward to reverse direction, the forward and reverse valve allows pressure in the forward clutch line to exhaust to the sump and directs pressure to the reverse clutch line. The clutches function simultaneously for smooth shifting without an interruption in the transmission of torque to the wheels.

(2) The range selector valve allows pressure in the high-range clutch line to exhaust to the sump and directs pressure to the low-range clutch line. The clutches function simultaneously for smooth shifting without an interruption in the transmission of torque to the wheels.

g. REVERSE-INTERMEDIATE RANGE (FIG II-21). For this hydraulic and range control action, refer to d above. Shifting from low range to intermediate range is the same in reverse direction as it is in forward direction.

h. REVERSE-HIGH RANGE (FIG II-22). Refer to d above for this hydraulic and range

control action. Shifting from intermediate range to high range is the same in reverse as it is in forward direction.

i. TOW START. For a tow start of the engine, all hydraulic system pressure is supplied by the output driven oil pump assembly. Set the range control lever in the low range position and the direction lever in the same direction the vehicle is to be towed.

NOTE

Before pushing or towing the vehicle, be sure the transmission forward and reverse valve lever is in the forward position. In some applications when the transmission is driving in forward direction the vehicle is traveling in reverse direction. The vehicle must be traveling in the direction which allows the transmission to operate in forward direction.

Increase the towing speed until sufficient speed is reached to engage the low-range clutch, and the direction clutch. The transmission is then in low-range operation and the engine is cranked through the converter.

Paragraph 17, TORQUE PATHS THROUGH TRANSMISSION, begins on page II-22

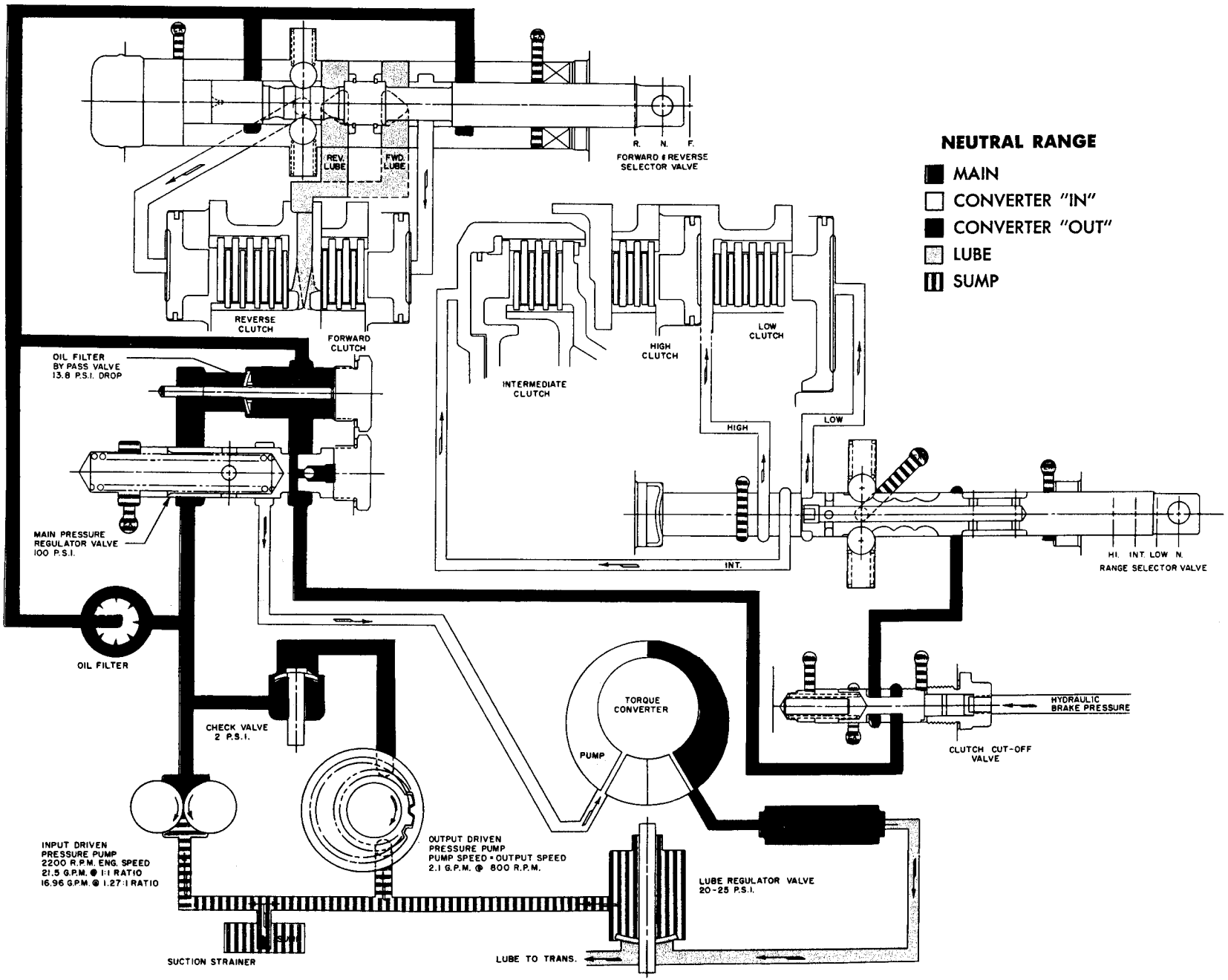


Fig II-16. Hydraulic schematic, neutral range

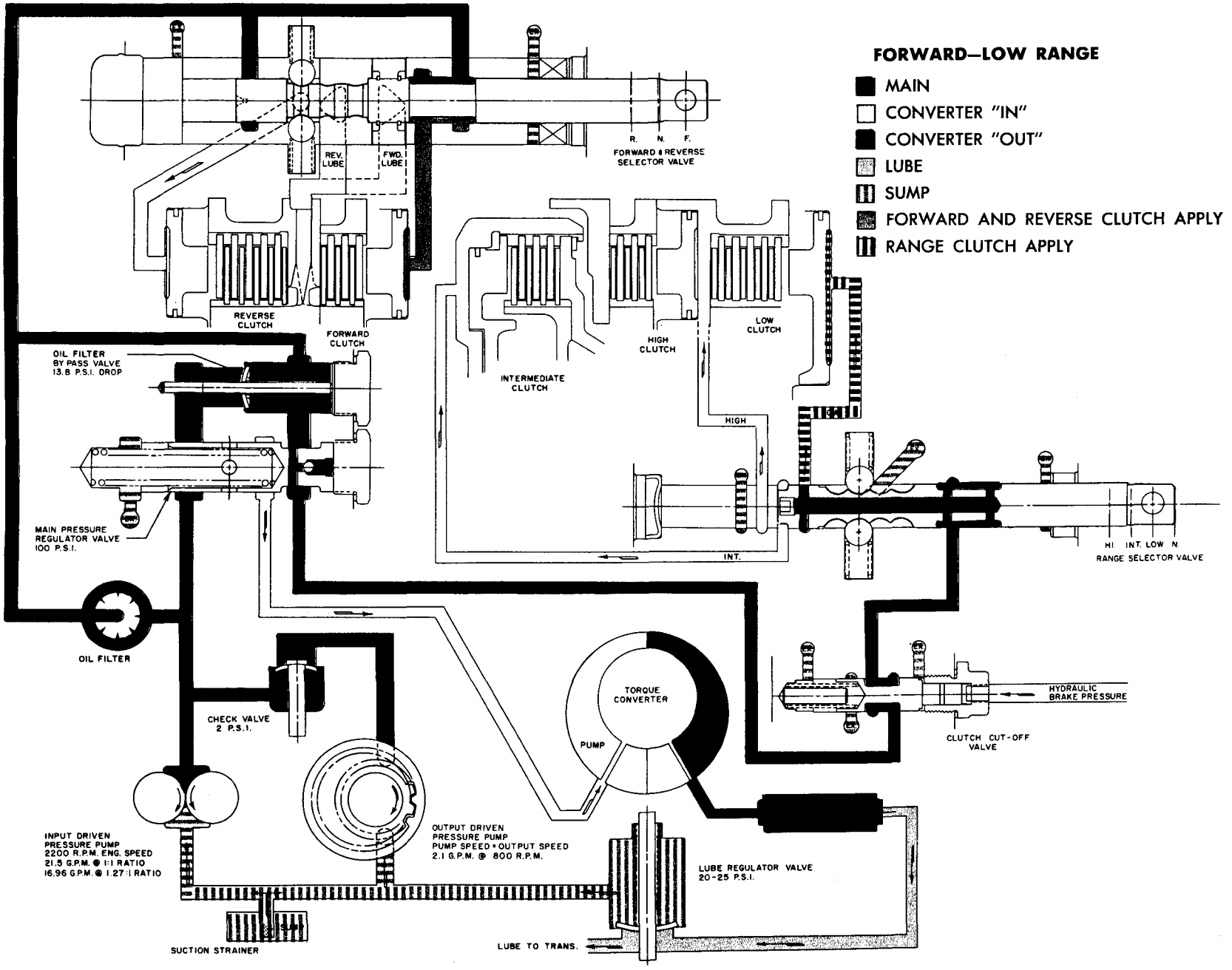


Fig II-17. Hydraulic schematic, forward-low range

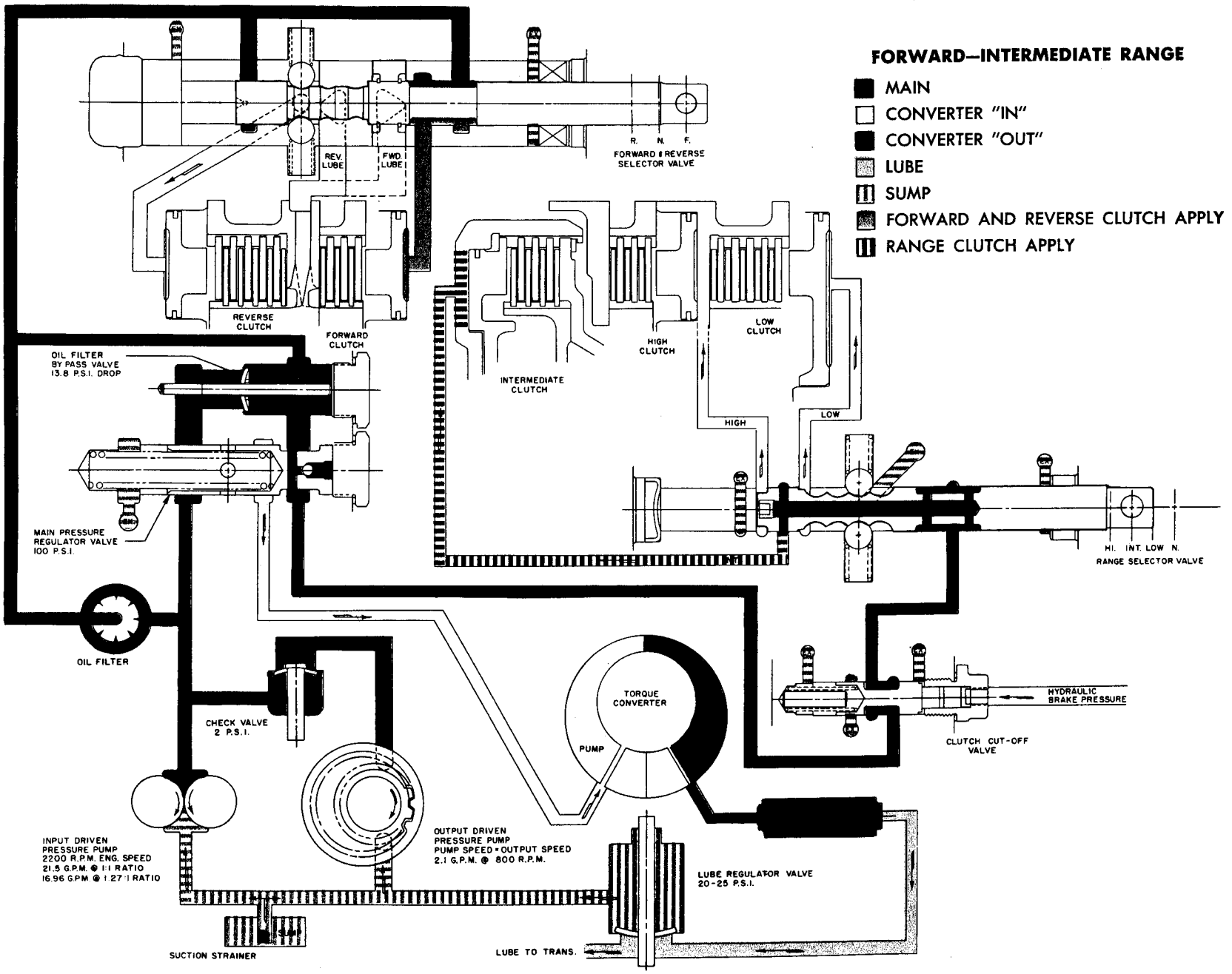


Fig II-18. Hydraulic schematic, forward-intermediate range

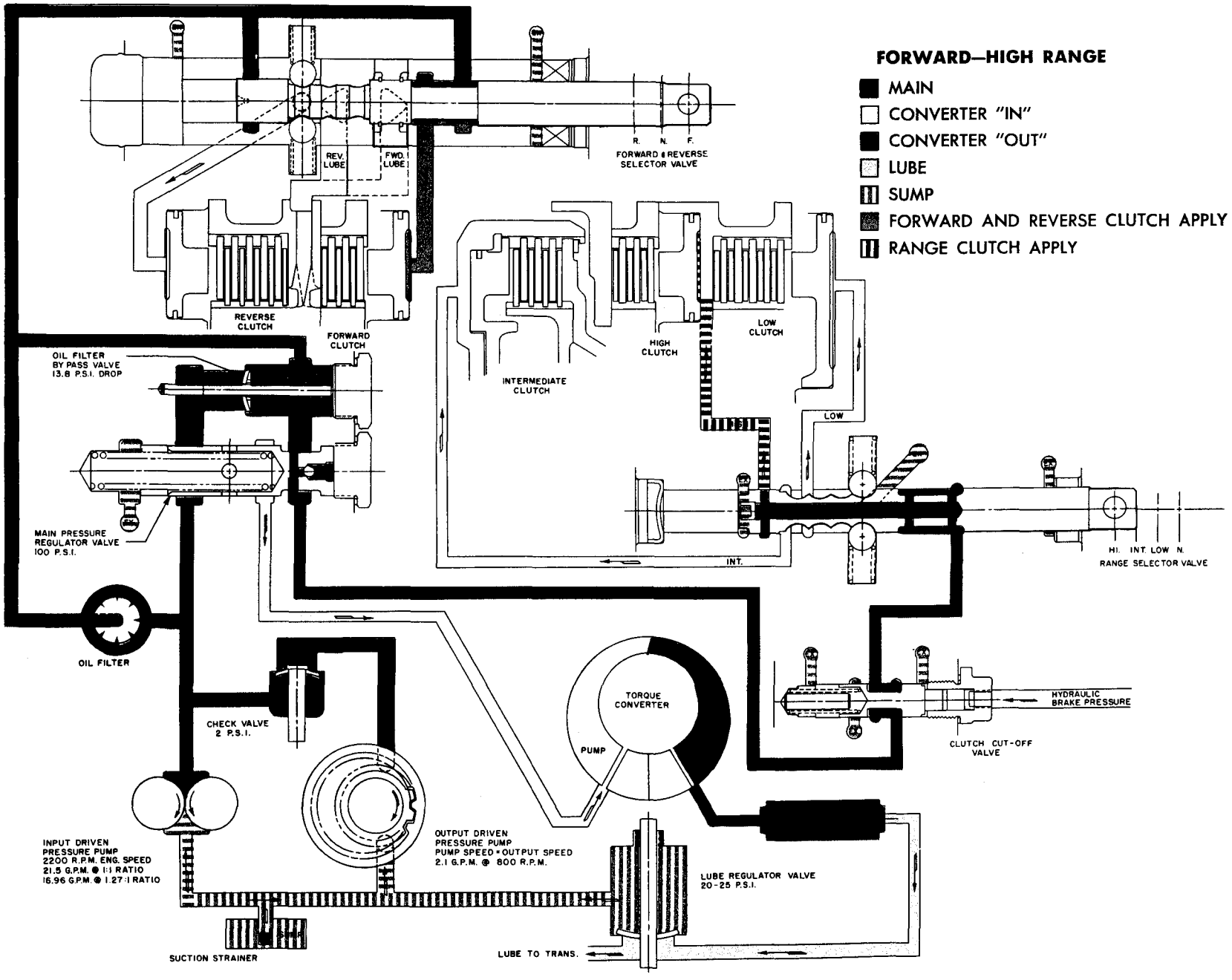


Fig II-19. Hydraulic schematic, forward-high range

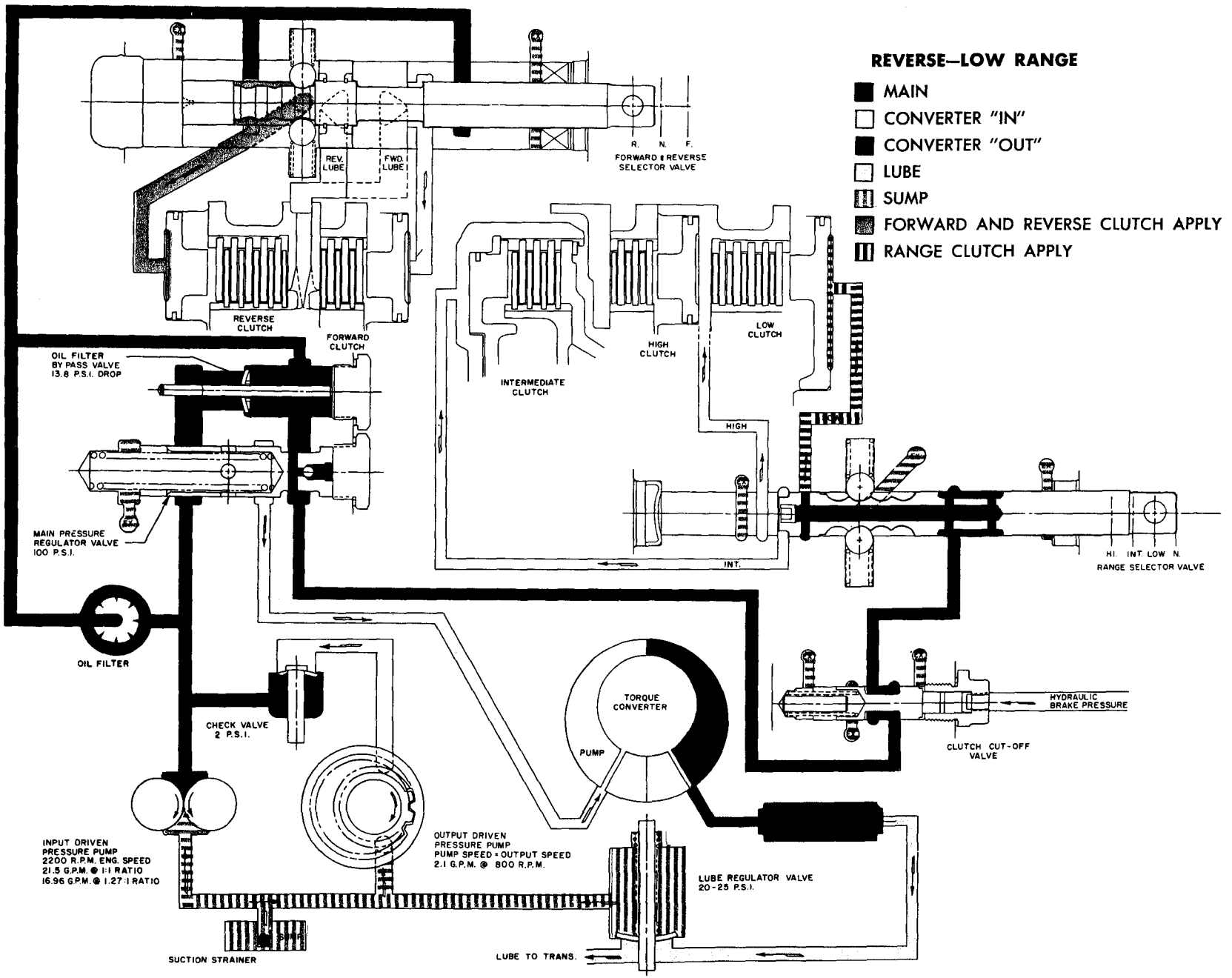


Fig 11-20. Hydraulic schematic, reverse-low range

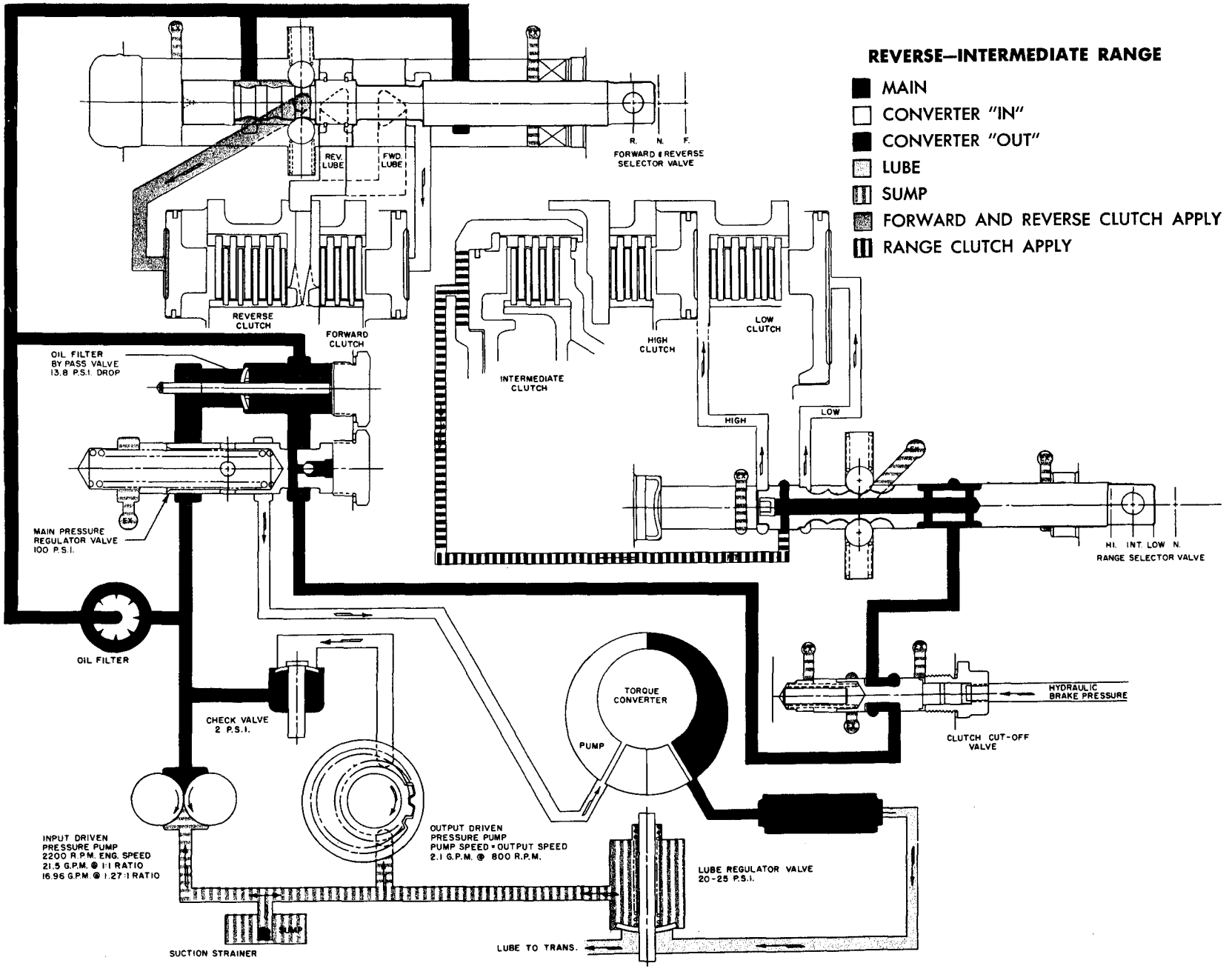


Fig II-21. Hydraulic schematic, reverse-intermediate range

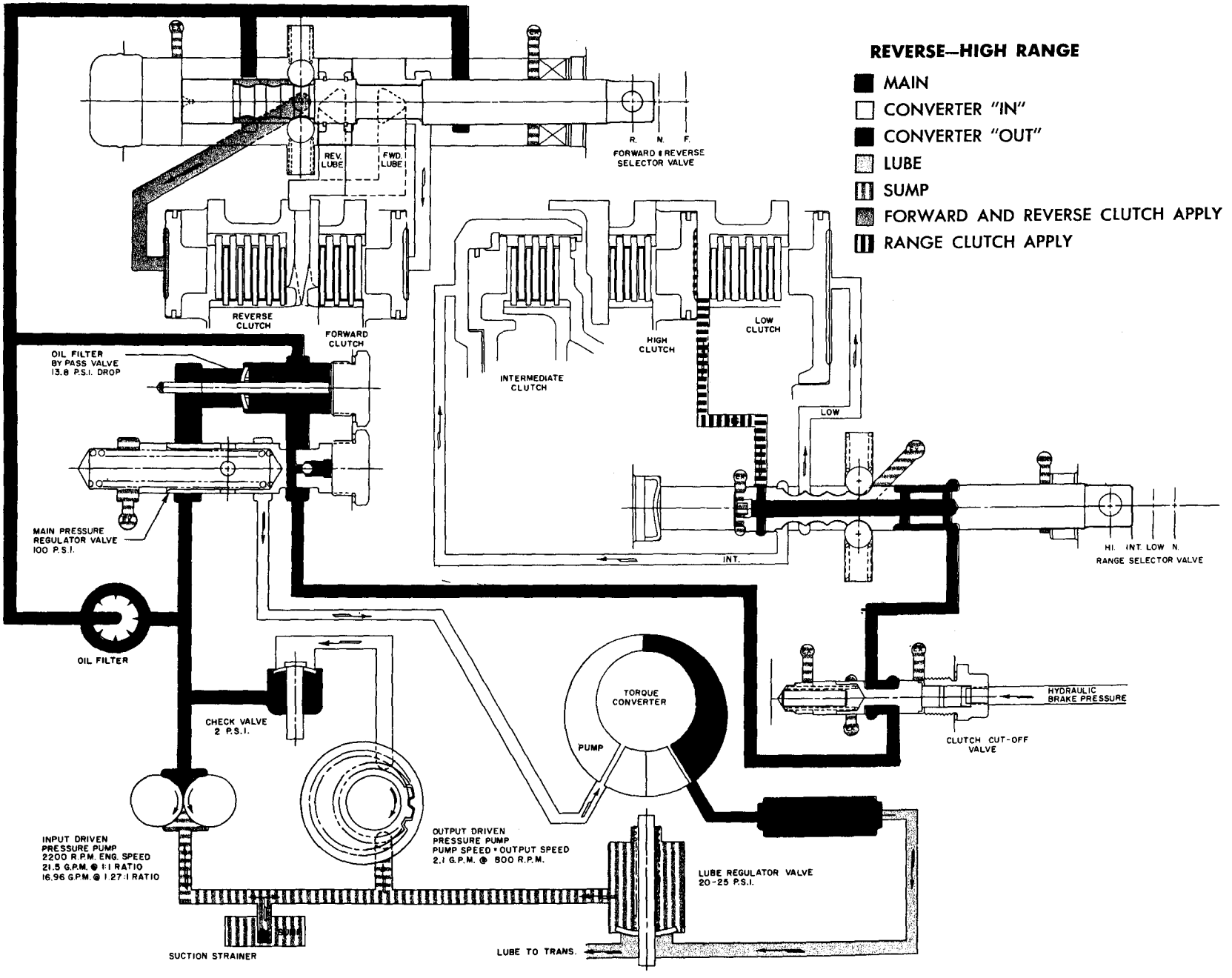


Fig 11-22. Hydraulic schematic, reverse-high range

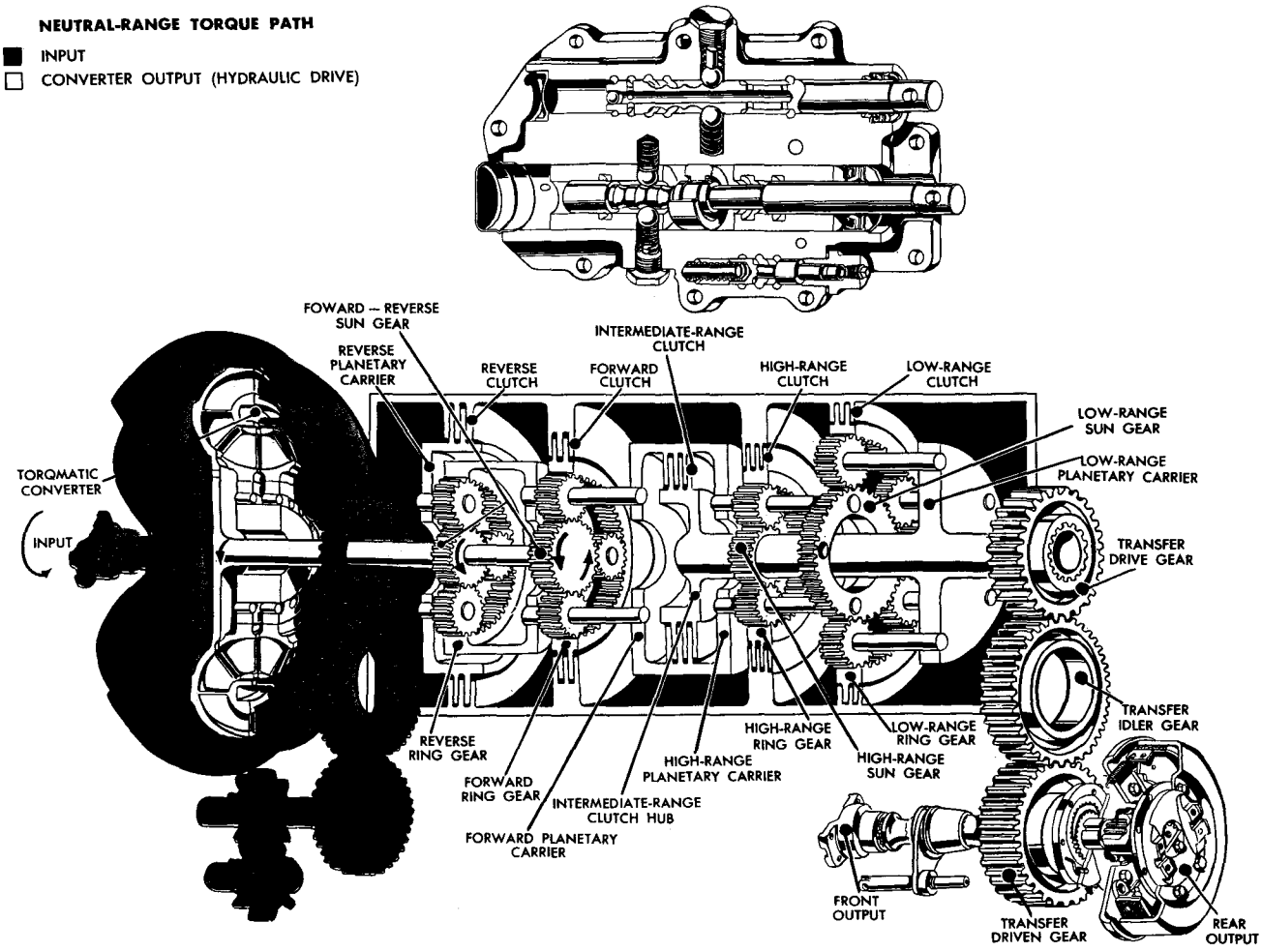


Fig II-23. Neutral-range torque path

17. TORQUE PATHS THROUGH TRANSMISSION

a. GENERAL. The flow of power or torque through the transmission is smooth and continuous and may take any one of seven different paths called torque paths. The seven torque paths are described below and illustrated in figures II-23 through II-29.

NOTE

Gear ratios are given with a 1 to 1 transfer gear ratio. There are also 1.62 to 1 and a 0.659 to 1 transfer gear ratios available.

b. NEUTRAL. Refer to figure II-23. There is no torque transmitted in neutral range from input to output. The forward and reverse sun gear is the driving member but since none of the clutches is applied there is no stationary member. With no stationary member there cannot be a driven member, consequently no output torque.

c. FORWARD-LOW RANGE TORQUE PATH (FIG II-24)

(1) The engine torque is transmitted through the hydraulic torque converter to the converter shaft assembly. The forward and reverse sun gear, splined to the converter shaft assembly, drives the forward planetary pinions. The forward ring gear is held stationary by the hydraulically actuated forward clutch. Therefore, the planetary pinions mechanically multiply the torque and drive their carrier counterclockwise.

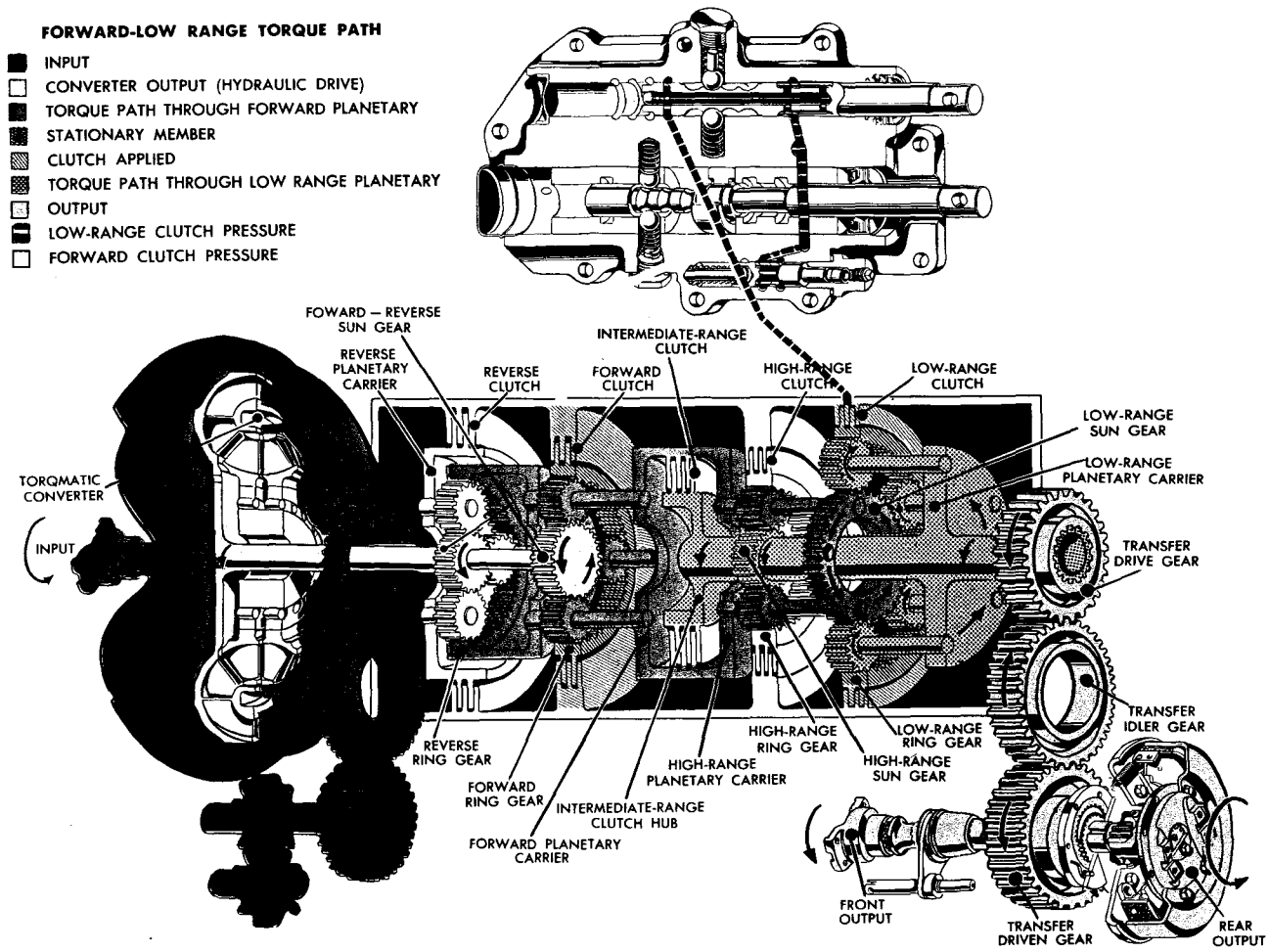


Fig II-24. Forward-low range torque path

(2) The intermediate-range clutch drum, which is splined to the forward planetary carrier, transmits the torque from the carrier to the high-range carrier. The low-range sun gear, which is attached to the high-range planetary carrier, drives the low-range planetary pinions. The low-range ring gear is held stationary by the hydraulically actuated low-range clutch. At this point, the torque is transferred from the low-range sun gear to the low-range planetary pinions where it is further multiplied mechanically. The pinions transmit the torque to their carrier which drives the transmission shaft assembly counterclockwise. The overall gear reduction is 8 to 1 in this range.

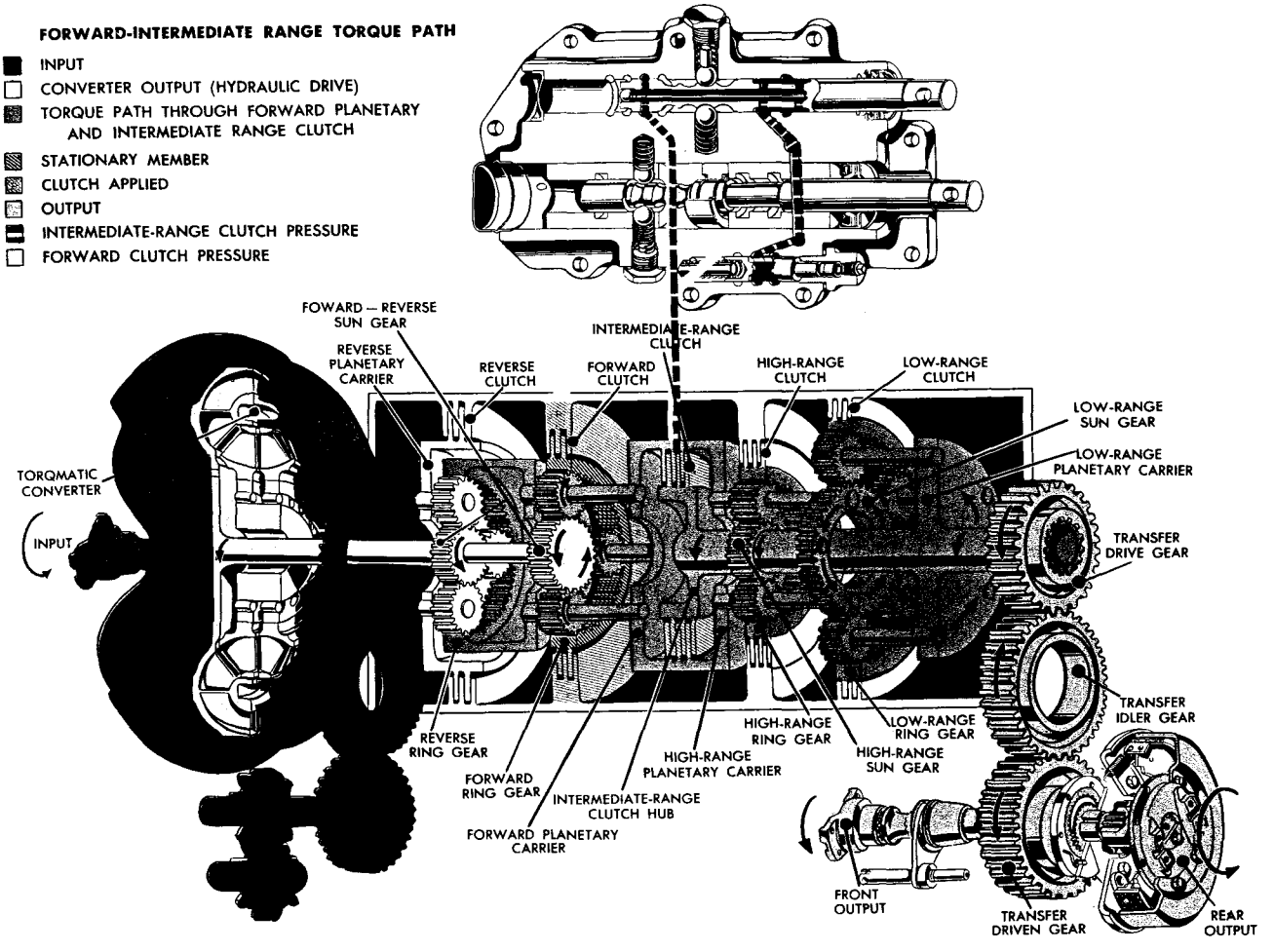


Fig II-25. Forward-intermediate range torque path

d. FORWARD-INTERMEDIATE RANGE TORQUE PATH (FIG II-25)

(1) The engine torque is transmitted through the converter to the converter shaft assembly. The forward and reverse sun gear, splined to the converter shaft assembly, drives the forward planetary pinions. The forward ring gear is held stationary by the hydraulically actuated forward clutch. Therefore the planetary pinions mechanically multiply the torque and drive their carrier counterclockwise.

(2) In intermediate range there is no planetary action in the range gearing. The hydraulically actuated intermediate-range clutch locks the intermediate-range clutch drum, clutch hub and high-range carrier together. The intermediate-range clutch drum is splined to the forward planetary carrier which is the input to the range gearing. The intermediate-range clutch hub is splined to the transmission shaft assembly. Therefore, the input torque to the range gearing is transmitted directly to the shaft assembly which is driven counterclockwise. The resulting gear reduction in this range is 2.90 to 1.

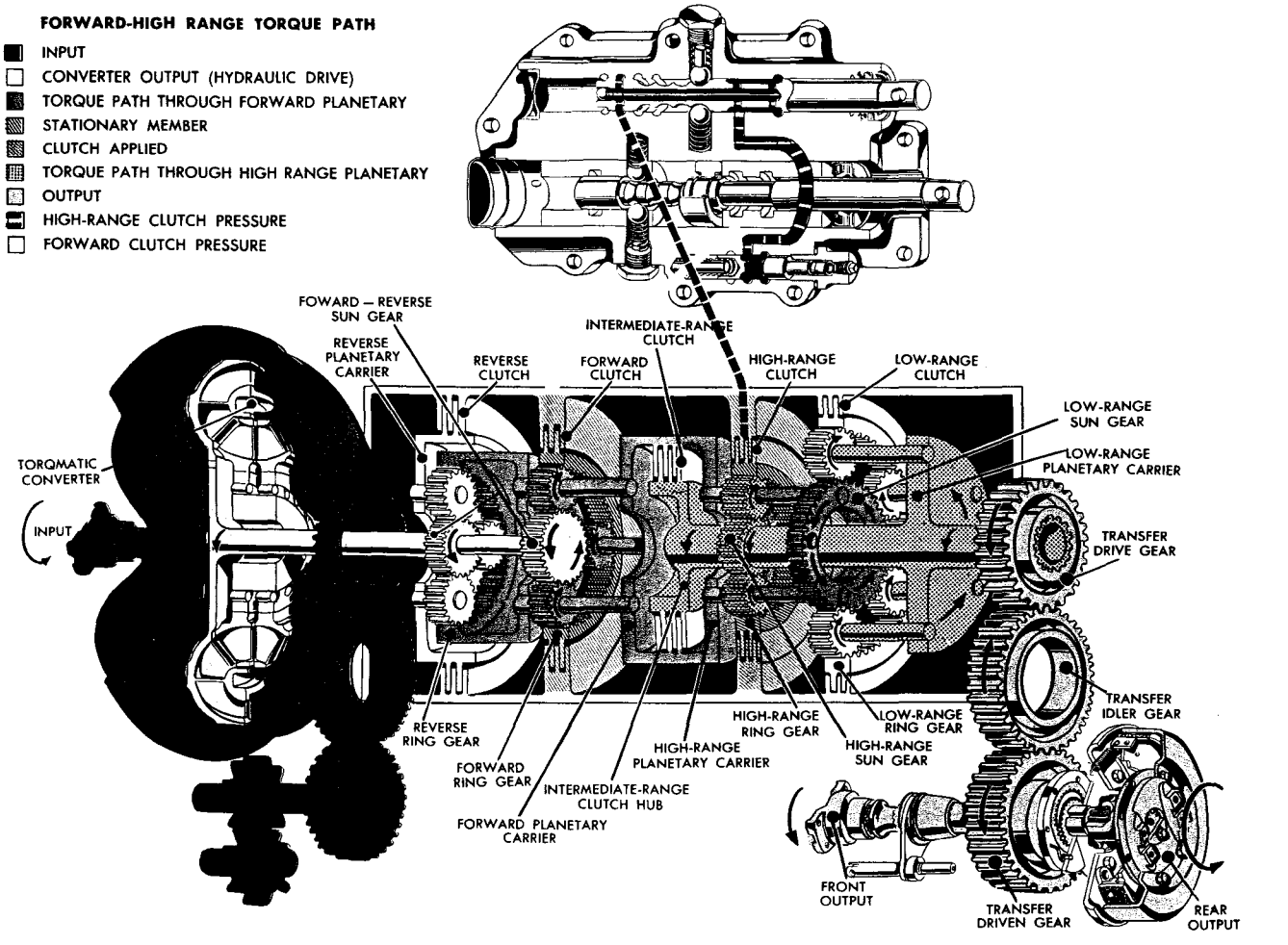


Fig II-26. Forward-high range torque path

e. FORWARD-HIGH RANGE TORQUE PATH (FIG II-26)

(1) The engine torque is transmitted through the converter to the converter shaft assembly. The forward and reverse sun gear, splined to the converter shaft assembly, drives the forward planetary pinions. The forward ring gear is held stationary by the hydraulically actuated forward clutch. Therefore, the planetary pinions mechanically multiply the torque and drive their carrier counterclockwise.

(2) The forward carrier transmits the torque to the intermediate-range clutch drum which is splined to the high-range carrier. The high-range ring gear is held by the hydraulically actuated high-range clutch. The high-range carrier, therefore, drives the high-range sun gear, which is splined to the transmission shaft assembly. Since the high-range ring gear is held and the high-range planetary carrier is driving the high-range sun gear counterclockwise, the planetary action results in an overdrive condition. The overall gear reduction is 1 to 1.

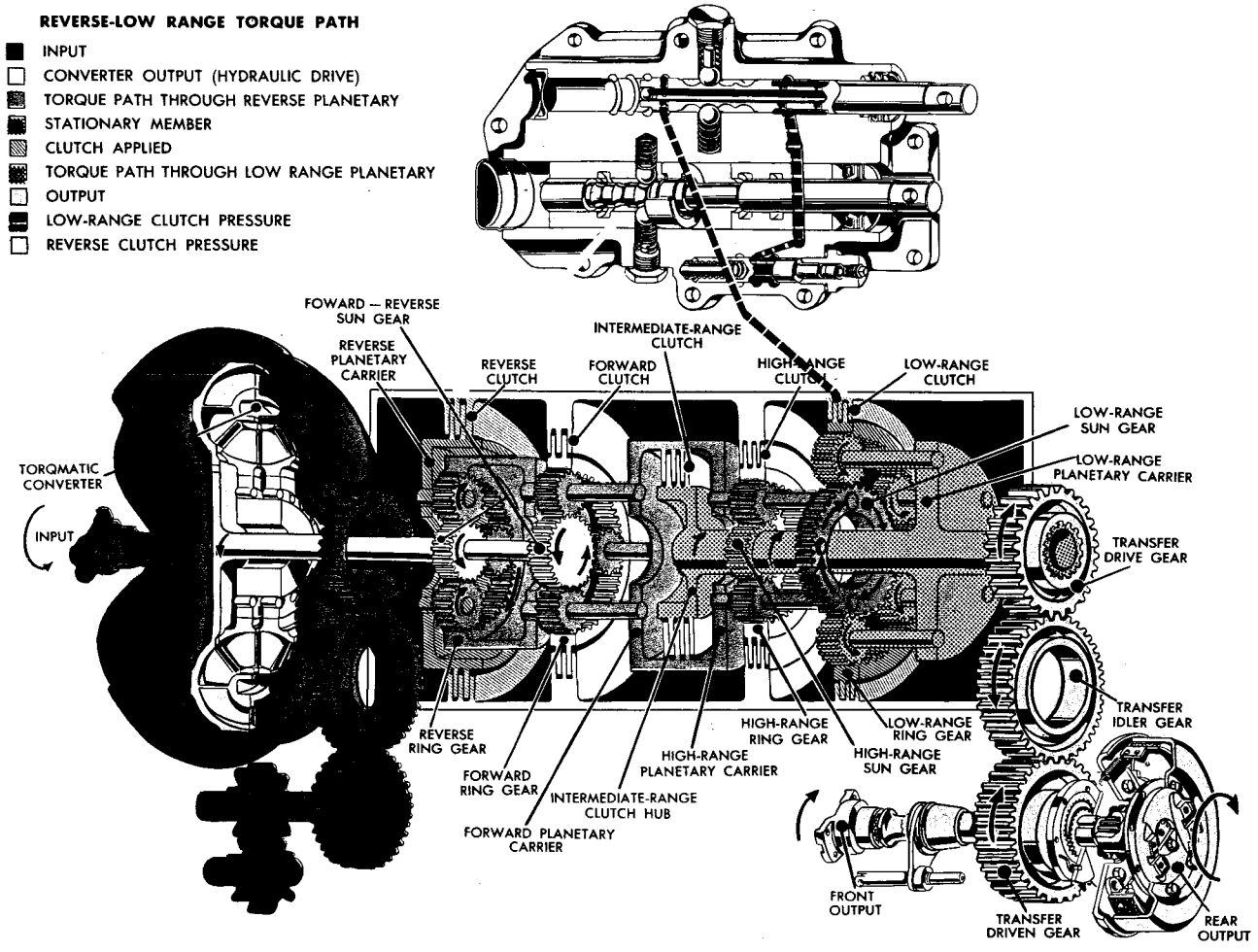


Fig II-27. Reverse-low range torque path

f. REVERSE-LOW RANGE TORQUE PATH (FIG II-27)

(1) The engine torque is transmitted through the converter to the converter shaft assembly. The forward and reverse sun gear, splined to the converter shaft assembly, drives the reverse planetary pinions. The pinions, in turn, drive the reverse ring gear. The reverse planetary carrier is attached to the reverse clutch hub which is held stationary by the hydraulically actuated reverse clutch. The planetary action here results in less speed, more torque, and rotation opposite to the rotation in forward. The ring gear now transmits the torque to, and drives, the forward planetary carrier clockwise.

(2) The intermediate-range clutch drum, splined to the forward planetary carrier, transmits the torque from the forward planetary carrier to the high-range planetary carrier. The low-range sun gear, which is attached to the high-range planetary carrier, drives the low-range planetary pinions. The low-range ring gear is held stationary by the hydraulically actuated low-range clutch. At this point the torque is transferred from the low-range sun gear to the low-range planetary pinions where it is further multiplied mechanically. The pinions transmit the torque to their carrier, which is splined to the transmission shaft assembly, clockwise. The overall gear reduction is 7.75 to 1 in this range.

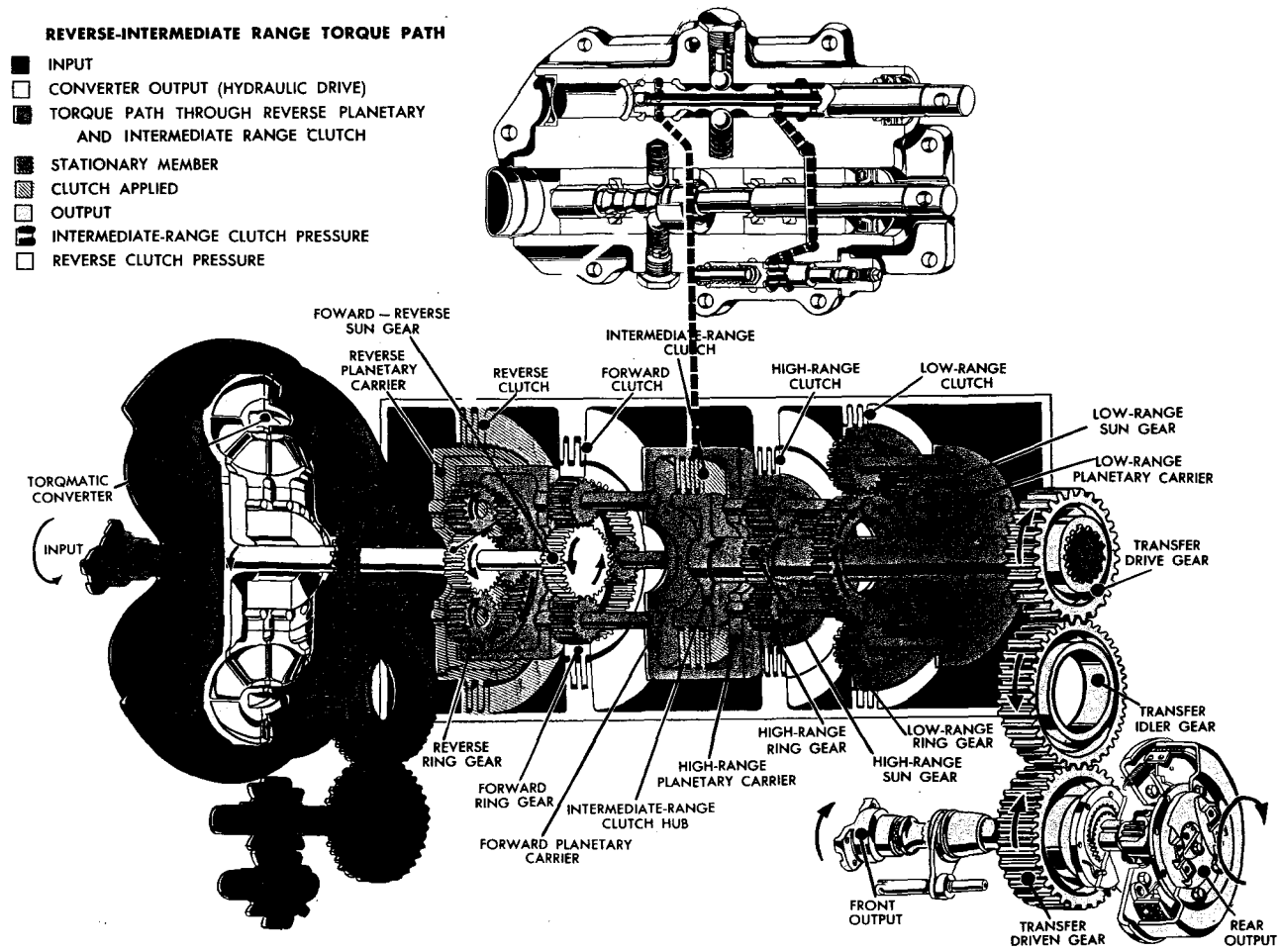


Fig II-28. Reverse-intermediate range torque path

g. REVERSE-INTERMEDIATE RANGE TORQUE PATH (FIG II-28)

(1) The engine torque is transmitted through the converter to the converter shaft assembly. The forward and reverse sun gear, splined to the converter shaft assembly, drives the reverse planetary pinions. The pinions, in turn, drive the reverse ring gear. The reverse planetary carrier is attached to the reverse clutch hub which is held stationary by the hydraulically actuated reverse clutch. The planetary action here results in less speed, more torque, and rotation opposite to the rotation in forward. The ring gear now transmits the torque to, and drives, the forward planetary carrier clockwise.

(2) In intermediate range there is no planetary action in the range gearing. The hydraulically actuated intermediate-range clutch locks the intermediate-range clutch drum, clutch hub and high-range planetary carrier together. The intermediate-range clutch drum is splined to the forward carrier which is the input to the range gearing. The intermediate-range clutch hub is splined to the transmission shaft assembly. Therefore, the input torque to the range gearing is transmitted directly to the transmission shaft assembly, which is driven clockwise. The total gear reduction in this range is 2.81 to 1.

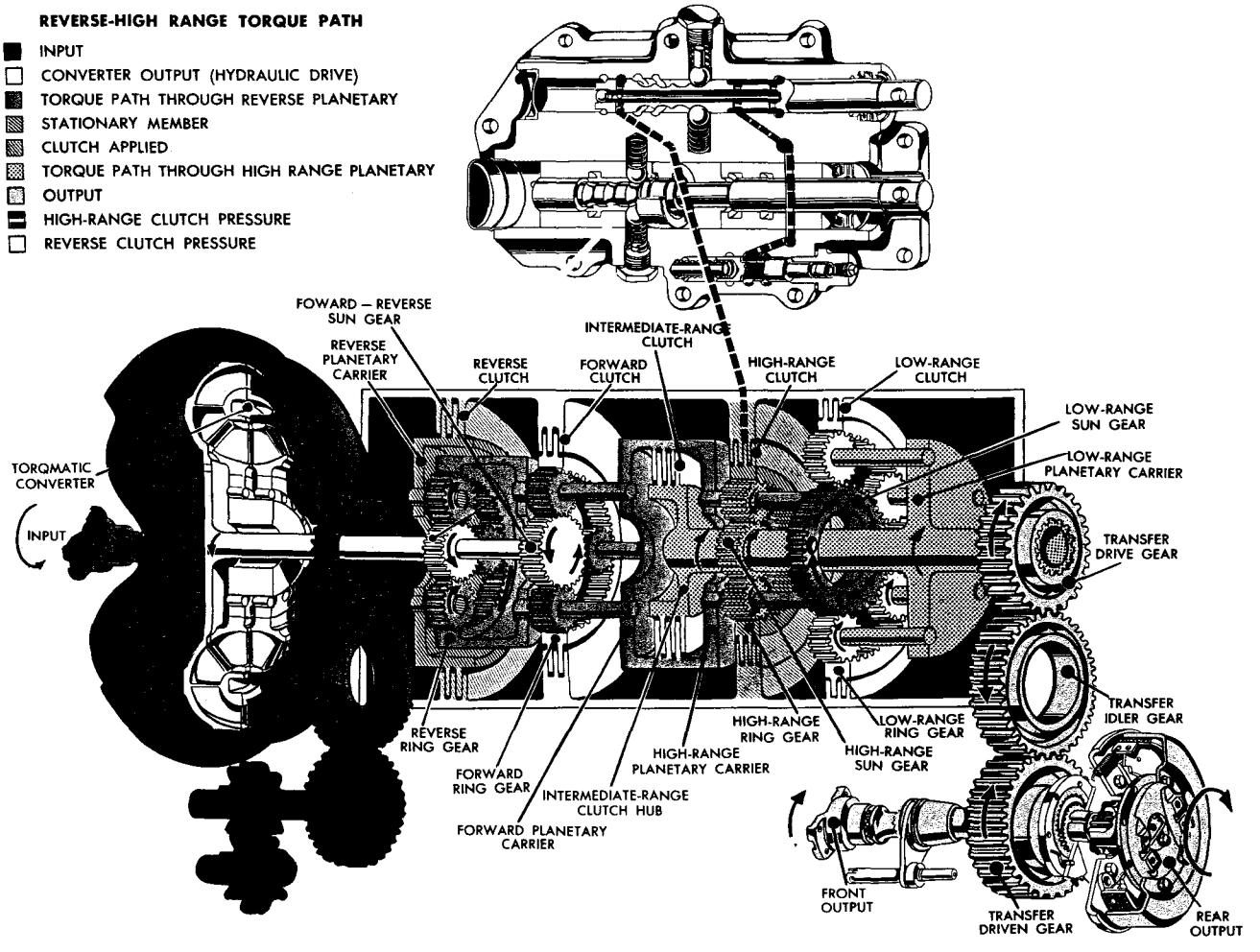


Fig II-29. Reverse-high range torque path

h. REVERSE-HIGH RANGE TORQUE PATH (FIG II-29)

(1) The engine torque is transmitted through the converter to the converter shaft assembly. The forward and reverse sun gear, splined to the converter shaft assembly, drives the reverse planetary pinions. The pinions, in turn, drive the reverse ring gear. The reverse planetary carrier is attached to the reverse clutch hub which is held stationary by the hydraulically actuated reverse clutch. The planetary action here results in less speed, more torque, and rotation opposite to the rotation in forward. The reverse ring gear now transmits the torque to, and drives, the forward planetary carrier clockwise.

(2) The forward planetary carrier transmits the torque to the intermediate-range clutch drum which is splined to the high-range planetary carrier. The high-range ring gear is held stationary by the hydraulically actuated high-range clutch. The high-range planetary carrier, therefore, drives the high-range sun gear which is splined to the transmission shaft assembly. Since the high-range ring gear is held and the high-range carrier is driving the high-range sun gear, the planetary action results in an overdrive condition. The transmission shaft assembly is driven clockwise with an overall gear reduction of 0.97 to 1.

SECTION III PREVENTIVE MAINTENANCE

1. SIMPLE MAINTENANCE

Like all mechanical equipment, your CRT-3330 Torqmatic transmission will need attention and servicing. Routine checks will help prevent down-time. The operator can aid in preventive maintenance by occasionally reading such gauges as may be provided to indicate the functioning of the Torqmatic transmission (par 2), and reporting weak or "borderline" malfunctioning. Because the transmission operates in oil and by oil, most of the maintenance is concerned with oil replenishment and oil cleanliness.

2. CRT-3330 TRANSMISSION GAUGE READING—INSTRUMENT PANEL

If the instrument panel contains these gauges, the readings should be as follows: clutch pressure, 90 to 125 psi; converter "OUT" pressure 20 psi min. at full throttle stall, 65 psi max. at full throttle no load; converter "OUT" temperature 250° F. maximum. Refer to the Specifications and Data Chart in section I.

3. MAINTENANCE INTERVALS AND PRECAUTIONS

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

b. KEEPING OIL CLEAN. Because the hydraulic system (par 11) is the "heart" of your transmission, it is especially important that the oil be kept clean. The area around the oil filler hole must be clean, and oil containers must be kept free from mud, dirt or other harmful matter (par 6).

4. HOW TO CHECK OIL LEVEL

a. COLD CHECK. The cold check (engine not running) is to be done only to make sure that there is sufficient oil in the hydraulic system to make it safe to start the engine — especially if the equipment has been standing idle for a long period. See b (2) below.

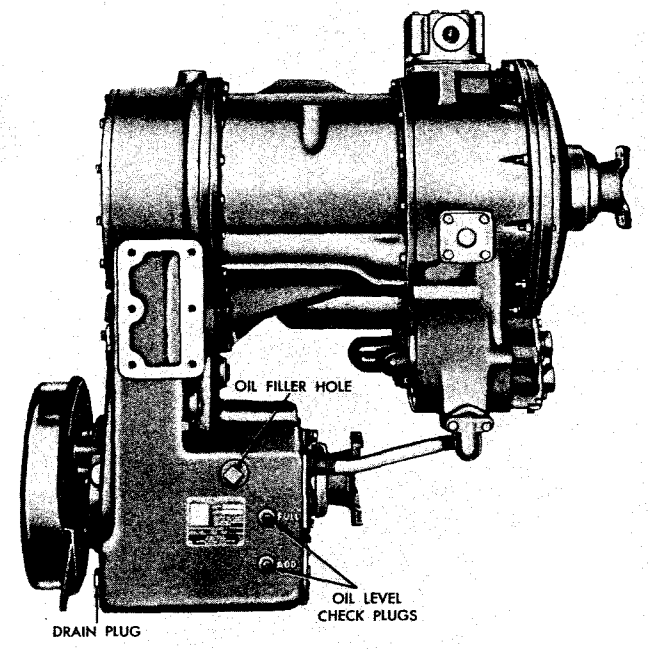


Fig III-1. Model CRT-3330-1 showing oil filler hole, drain, and check plugs.

b. HOT CHECK

(1) Checking oil level should be done with the engine running at idling speed, with the oil at operating temperature, and with the transmission in neutral range.

(2) For the Model CRT-3330-1 check the hydraulic system oil level at the transmission oil level plugs, on the right side of the transfer gear housing assembly (fig III-1). For the Model CRT-3330-3, check the oil level at the transmission oil level plugs, on the rear side of the sump (fig III-2). Oil in the transmission sump should be level with the top oil level plug. If oil is not level with the top plug, remove the lower oil level plug. Add oil if necessary so that the level is just even with the oil level plug hole, then replace the plug and add two quarts of oil at the transmission oil filler hole for the Model CRT-3330-1 (fig III-1) and three quarts for the Model CRT-3330-3 (fig III-2). See oil specifications, section I, paragraph 7.

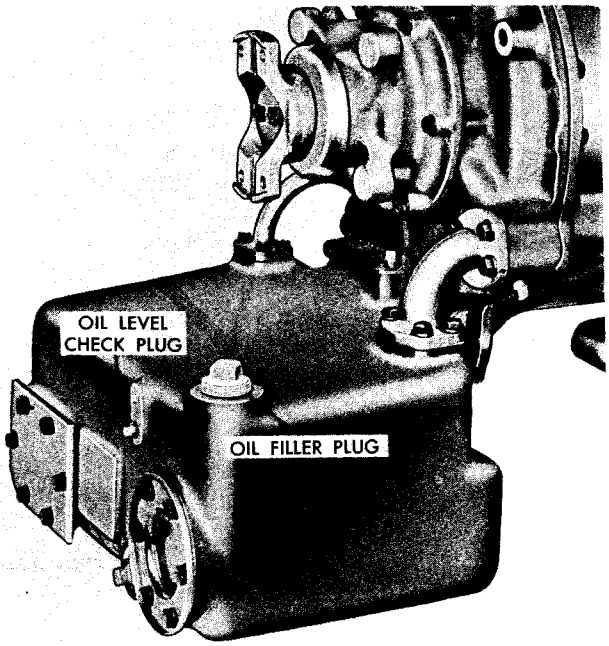


Fig III-2. Model CRT-3330-3 showing oil sump with filler and check plugs.

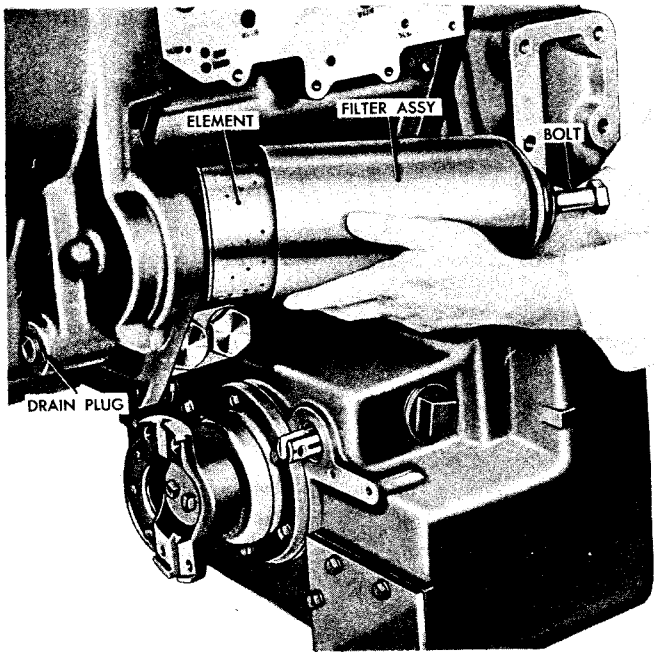


Fig III-3. Removing or installing oil filter assembly

NOTE

Some of the early CRT-3330 transmissions have only one oil level plug. Following the instructions outlined in b (1), check the hydraulic system oil level at the transmission oil level plug. If the oil level is below the plug, add enough oil to bring the oil level up to the plug.

5. OIL CAPACITY AND WHEN TO CHANGE OIL

a. OIL CAPACITY. The hydraulic system oil capacity of the Model CRT-3330-1 transmission is 7.5 gallons (U.S.) initial fill and 5.75 gallons refill. The Model CRT-3330-3 transmission oil capacity is 8.25 gallons initial fill and 7 gallons refill.

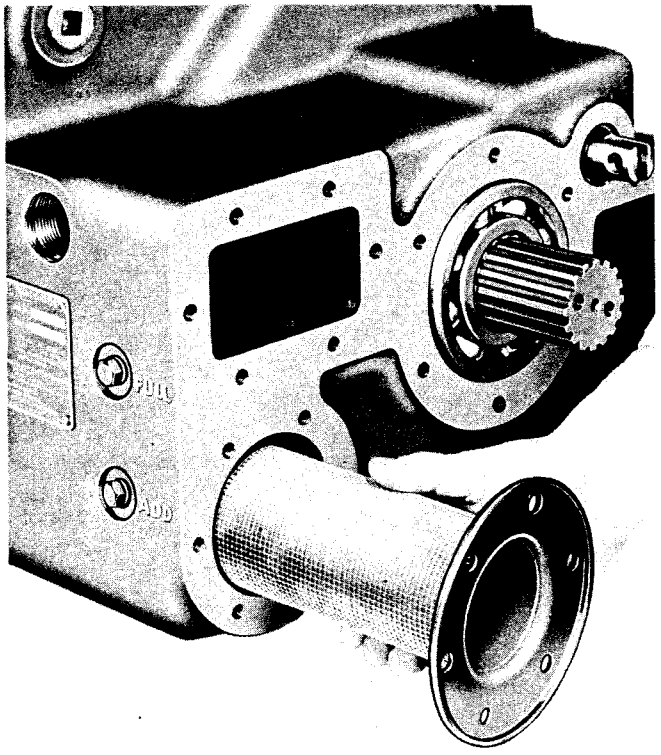


Fig III-4. Removing or installing oil strainer

b. WHEN TO CHANGE OIL. Oil should be changed in the hydraulic system every 1000 hours of operation, or oftener, depending upon the operating conditions. Also, the oil in the system must be changed whenever the oil shows traces of dirt or the effects of high operating temperature evidenced by discoloration or strong odor. If oil shows metal contamination, the system must be thoroughly drained and cleaned. See paragraph d below.

c. WHEN TO CHANGE FILTERS. The hydraulic system filter should be replaced with every oil change and the strainer should be cleaned with every oil change.

d. METAL CONTAMINATION OF OIL. If the oil in the hydraulic system becomes

contaminated with metal particles, all the components of the hydraulic system — transmission, torque converter assembly, oil lines and passages, sump, filter, strainer, cooler, valves, and oil pumps must be thoroughly cleaned. This usually means disassembly of the components (see sections IV through XIV.) Metal particles in the oil are evidence of failure of some part.

6. CHANGING OIL

a. HYDRAULIC SYSTEM. The oil should be warm when draining the oil from the hydraulic system. All filters, screens and strainers should be replaced or cleaned. Oil should be examined for metallic contamination and evidence of high temperature operation (par 5).

b. DRAINING TRANSMISSION

(1) Remove the drain plug from the rear of the transfer gear housing assembly (fig III-1) or the sump (fig III-2).

(2) Remove the strainer from the transfer gear housing (fig III-4) or sump (fig III-2). Clean the strainer with mineral spirits, using a soft bristle brush.

(3) Remove the filter drain plug, then remove and replace the filter element (fig III-3).

c. FILLING HYDRAULIC SYSTEM

(1) Install the drain plug in the rear of the transfer gear housing (fig III-1) or sump (fig III-2).

(2) Install the strainer in the transfer gear housing (fig III-4) or sump (fig III-2).

(3) Install the filter drain plug.

(4) Pour 4 to 5 gallons of specified oil through the transmission oil filler hole (fig III-1) or into the sump (fig III-2).

(5) Start the engine and let it run at idling speed with the transmission in neutral range to "charge" the hydraulic system.

(6) After the engine has been running at idling speed for two minutes, add enough of the specified oil to bring the oil up to the designated level (par 4).

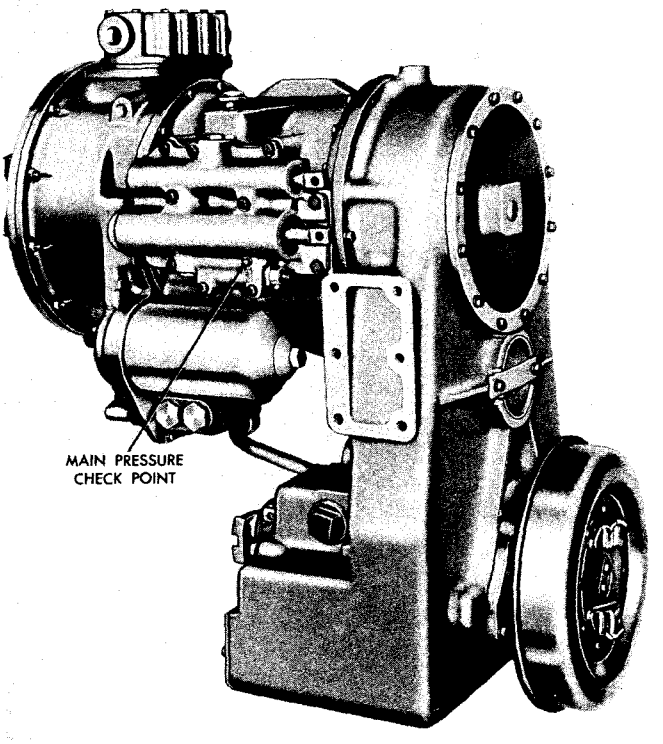


Fig III-5. Pressure gage check point.

7. CHECKING MAIN OIL PRESSURE

a. GENERAL. If the instrument panel does not include a main oil pressure gauge, the main oil pressure check can be made as follows.

b. PROCEDURE

(1) Install a pressure gauge at the range selector valve assembly check point (fig III-5).

(2) Start the engine and let it run at idling speed with the transmission in neutral range.

(3) Shift the transmission into each range and direction separately and read the main oil pressure. The pressure reading should be not less than 90 psi for any range.

(4) If the main oil pressure is less than minimum for any range, refer to the Trouble Shooting Chart, item G, Low Clutch Pressure.

8. CHECKING OIL TEMPERATURE

a. The maximum converter "OUT" oil temperature is 250° F. This temperature reading can be taken at the converter oil temperature check point (fig III-6).

b. CHECKING FOR LOCKED STATORS

(1) If it should become necessary to check for locked stators by observing temperature drop rate, increase converter "OUT" temperature to 230° F., using the following procedure.

(2) Start the engine and let it warm up. Run the engine at idling speed.

(3) Block the vehicle wheels securely. Do not apply the vehicle hydraulic brakes if the vehicle has a clutch cutoff valve (described in section I, paragraph 5c).

(4) Shift the transmission into high range, forward direction, and increase the engine speed to full throttle.

(5) When converter "OUT" temperature reaches 230° F. shift to neutral range. Release the throttle momentarily when shifting. Immediately check the rate of temperature drop with no load on the converter and maximum input rpm. Temperature should start to drop after 15 seconds. A slow temperature drop rate probably indicates that one or both stators are locked. A rapid temperature drop rate indicates normal stator operation.

9. CONVERTER STALL CHECK

a. PURPOSE. The stall check is for the purpose of determining whether or not the engine and the converter in the transmission are functioning satisfactorily as a unit. 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 engine manufacturer or from Allison.

b. PROCEDURE

(1) Start the engine and let it warm up. Run the engine at idling speed.

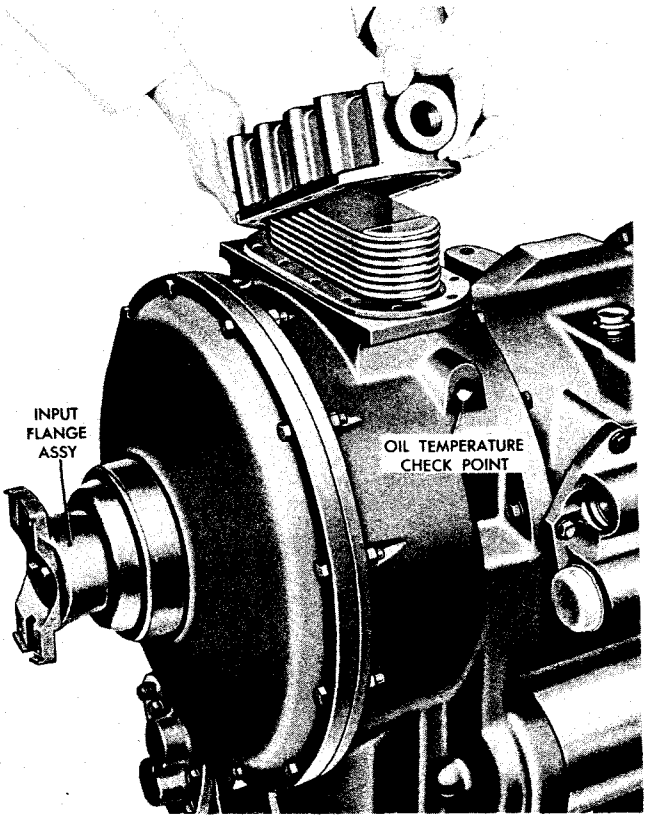


Fig III-6. Model CRT-3330-1, showing converter oil temperature check point

(2) Block the vehicle wheels securely. Do not apply the vehicle hydraulic brakes if the vehicle has a clutch cutoff valve (described in section I, paragraph 5c).

(3) Shift the transmission into high range, forward direction, and increase the engine speed to full throttle. Do not permit the converter "OUT" temperature to exceed 250° F.

(4) Record the engine speed and converter "OUT" pressure. The converter "OUT" pressure should be at least 20 psi. This completes the check. Compare the recorded engine speed at stall with the recommended engine speed at stall shown in the engine-converter matched performance curve.

10. CHECKING AND ADJUSTING LINKAGE

a. In subparagraphs b and c below the checking and adjustment of the range selector valve linkage is described. For the forward and reverse valve linkage the same procedure will generally apply.

b. CHECKING LINKAGE

(1) Before checking the transmission range selector valve linkage, lubricate the linkage connection between the range selector valve lever and the range selector valve assembly.

(2) With the engine stopped, move the range selector valve into each range position. The lever should move freely but with a definite "detent" feel as it is moved from one range position to the next.

(3) Check the shifting control linkage for bent or excessively worn parts. Straighten or replace parts as necessary.

c. ADJUSTING LINKAGE

(1) Move the range selector valve to high-range poppet position — the position in which the valve is farthest from the valve body.

(2) Disconnect the control linkage at the range selector valve. Check to see that both the range selector valve lever and range selector valve have remained in high-range position.

(3) Check the alignment of the hole in the end of the range selector valve with the corresponding hole in the shifting control linkage. If the holes do not align, make the necessary adjustment in the linkage.

(4) Connect the linkage and the selector valve, and repeat the above procedures. The only difference will be that the range selector valve lever and range selector valve will be moved into the range that is to be checked and adjusted.

11. TROUBLE SHOOTING

In this section you will find a trouble shooting chart which will help you to locate the source of transmission trouble. This chart is organized to cover first the troubles that may occur due to improper maintenance. Remember that the whole power package — engine and transmission — must be considered when running down the source of trouble.

12. HYDRAULIC SYSTEM SCHEMATICS

a. The schematics illustrated in section II, show the oil flows in neutral, forward-low range, forward-intermediate range, forward-high range, reverse-low range, reverse-intermediate range, and reverse-high range. The schematics also show the arrangement of the pumps, valves, the oil filter, the oil cooler, the torque converter and the clutches (par 16, section II).

b. These schematics may be used in trouble shooting any hydraulic malfunctions which may arise. By studying the schematic which applies to the particular area in which there seems to be trouble, it may be possible to correct or repair quickly and easily any malfunction which may occur in the hydraulic system.

TROUBLE SHOOTING CHART FOR CRT-3330-1 AND -3 TRANSMISSION

A. LOW CONVERTER "OUT" PRESSURE

Cause	Remedy
1. Low oil level.	1. Add oil. Refer to section III, paragraph 4.
2. Oil line leakage (remote mounted cooler or filter).	2. Check for oil leaks in oil lines.
3. Plugged oil strainer.	3. Check oil strainer. Clean if necessary.
4. Defective oil pump.	4. Check for wear in oil pump.

B. HIGH OIL TEMPERATURE

1. Low oil level (low flow rate).	1. Add oil. Refer to section III, paragraph 4.
2. High oil level.	2. Drain oil to full mark.
3. Low water level in cooling system.	3. Add water. Check for leaks.
4. Low converter "OUT" pressure.	4. Refer to A above.
5. Clogged or dirty heat exchanger.	5. Clean or replace as necessary.
6. Operating too long in an inefficient converter range.	6. Readjust work cycle to allow operation in an efficient converter range.
7. One or both stators locked.	7. (a) Check for low top speed of vehicle. (b) Refer to section III, paragraph 8b.
8. Stators interchanged (low stall speed).	8. (a) Check for lack of power at converter stall. Refer to section III, paragraph 9. (b) Disassemble converter and check stators. Refer to section VI, paragraphs 3d and e, and 4j.
9. Stator(s) installed without rollers (low stall speed).	9. Disassemble converter and install rollers. Refer to section VI, paragraphs 3d and e, and 4j.

C. HIGH ENGINE SPEED AT CONVERTER STALL
(Refer to section III, paragraph 9 for further information on converter stall)

1. Low oil level.	1. Add oil. Refer to section III, paragraph 4.
2. Low converter "OUT" pressure.	2. Refer to A above.
3. High oil temperature.	3. Refer to B above.
4. Slipping clutch.	4. Overhaul transmission. Refer to sections IV through XIV for overhaul procedures.

D. LOW ENGINE SPEED AT CONVERTER STALL
(Refer to paragraph 9 for further information on converter stall)

1. Low engine output torque.	1. Tune engine and check output.
2. Converter element interference.	2. Check for noise at stall. Overhaul converter if necessary.
3. Stators interchanged.	3. (a) Check for lack of power at converter stall (sect. III, par 9). (b) Disassemble converter and check stators (sect. VI, pars 3d and e, and 4j).
4. Stators installed without rollers.	4. Disassemble converter and install rollers. Refer to section VI, paragraphs 3d and e, and 4j.

(CONTINUED ON NEXT PAGE)

TROUBLE SHOOTING CHART FOR CRT-3330-1 AND -3 TRANSMISSION - Continued

E. LOSS OF POWER

Cause	Remedy
1. Stators interchanged.	1. (a) Check for lack of power at stall (sect. III, par 9). (b) Disassemble converter and check stators (sect. VI, pars 3d and e, and 4j).
2. Stators installed without rollers (low stall speed).	2. Disassemble converter and install rollers.
3. Low converter charging pressure.	3. Refer to A above.
4. Low engine speed at converter stall.	4. Refer to D above.
5. Clutch plates slipping.	5. (a) Check for low clutch pressure (sect. III, par 7 and G below). (b) Check for worn piston seals. Refer to sections IV through XIV for overhaul procedures.
6. Range selector valve inoperative.	6. Refer to F 1 below.
7. Low clutch pressure.	7. Refer to G below.
8. Foaming oil.	8. (a) Check for low oil level (sect. III, par 4). (b) Check for worn parts in input oil pump. (c) Check for air leaks at input oil pump. (d) Check for water in oil.

F. NO POWER TRANSMITTED IN ANY RANGE

1. Range selector valve inoperative.	1. (a) Check shifting linkage adjustment. Refer to section III, paragraph 10. (b) Check for failure of selector valve parts (sect. XIV, par 2).
2. Low clutch pressure.	2. Refer to G below.
3. Clutch cutoff valve inoperative.	3. Check for failure of cutoff valve parts (sect. XIV, par 2a (10)).

G. LOW CLUTCH PRESSURE

1. Low oil level.	1. Check oil level (sect. III, par 4).
2. Leaks in lube system.	2. Check for oil leaks in external pressure lines and air leaks on suction side of pump.
3. Parts failure in pressure regulator valve body assembly.	3. Overhaul pressure regulator valve body assembly (sect. XIV, par 1).
4. Worn input oil pump assembly.	4. Overhaul input oil pump assembly (sect. IX).
5. Plugged clutch piston cavity inlet line or oil strainer.	5. Drain oil and clean strainer. Disassemble transmission enough to check for plugged inlet line.

H. NO POWER TRANSMITTED IN ONE RANGE

1. Low clutch pressure in one range only.	1. (a) Check for worn piston seals. (b) Check for broken back plate. Refer to sections IV through XIV for overhaul.
2. Range selector valve inoperative.	2. Refer to F 1 above.

(CONTINUED ON NEXT PAGE)

TROUBLE SHOOTING CHART FOR CRT-3330-1 AND -3 TRANSMISSION - Continued

I. SLOW CLUTCH ENGAGEMENT

Cause	Remedy
1. Foaming oil.	1. Refer to E 8 above.
2. Low clutch pressure.	2. Refer to G above.
3. Worn piston seals.	3. Check for worn piston seals. Refer to sections IV through XIV for overhaul procedures.

J. FAILURE TO PUSH START

1. Engine not turning over during push start.	1. (a) Check for low oil level (sect. III, par 4). (b) Be certain transmission is in LOW range. (c) Check engine. (d) Check for clogged oil lines. (e) Check for worn parts in output oil pump assembly. (f) Clutch cutoff valve inoperative. Refer to F 3 above.

K. TRANSMISSION LOCKED IN ALL RANGES

1. Failed transmission parts.	1. Overhaul transmission. Refer to sections IV through XIV for overhaul procedures.

L. VEHICLE DRIVES IN LOW RANGE AND CREEPS FORWARD IN NEUTRAL BUT STALLS WHEN SHIFTED TO ANY OTHER RANGE

1. Failed low-range clutch.	1. Overhaul transmission. Refer to sections IV through XIV for overhaul procedures.

M. VEHICLE DRIVES IN INTERMEDIATE RANGE AND CREEPS FORWARD IN NEUTRAL BUT STALLS WHEN SHIFTED TO ANY OTHER RANGE

1. Failed intermediate-range clutch.	1. Overhaul transmission. Refer to sections IV through XIV for overhaul procedures.

N. VEHICLE DRIVES IN HIGH RANGE AND CREEPS FORWARD IN NEUTRAL BUT STALLS WHEN SHIFTED TO ANY OTHER RANGE

1. Failed high-range clutch.	1. Overhaul transmission. Refer to sections IV through XIV for overhaul procedures.

O. VEHICLE DRIVES IN REVERSE AND CREEPS BACKWARD IN NEUTRAL BUT STALLS WHEN SHIFTED TO FORWARD

1. Failed reverse clutch.	1. Overhaul transmission. Refer to sections IV through XIV for overhaul procedures.

P. VEHICLE DRIVES IN FORWARD AND CREEPS FORWARD IN NEUTRAL BUT STALLS WHEN SHIFTED TO REVERSE

1. Failed forward clutch.	1. Overhaul transmission. Refer to sections IV through XIV for overhaul procedures.

SECTION IV GENERAL INFORMATION FOR OVERHAUL

1. SCOPE

The overhaul procedures are divided into eleven sections. Section IV gives general information, cleaning and inspection procedures, and wear limits. Section V contains information on removal from, and installation into, the drive line. For additional pertinent information on the installation of the transmission in the drive line, consult your vehicle or equipment service manual. Sections VI through XIV give instructions for rebuild of each of the various models. Note that these procedures are for complete field rebuild and it may not be necessary to tear down completely your Torqmatic transmission to make certain repairs.

2. PROCEDURES SUBJECT TO CHANGE

Because of the release of new models and changes in models already in the field, instructions given in this manual are subject to change. Therefore, always check the latest Service Information Letters issued by the Allison Division Transmission Service Department. These letters can usually be found in the back pages of current Allison Parts Catalogs. When requesting service information, be sure to include the part number of your transmission. See section I, paragraph 4.

3. TOOLS AND EQUIPMENT

a. EQUIPMENT NEEDED. Proper equipment should be available before overhaul is started - a suitable hoist, proper hand tools, receptacles for small parts, an arbor press, and a transmission teardown stand — although convenient, the latter two are not necessary.

b. CAREFUL HANDLING. Handle the transmission parts with care. Nicks, scratches, or dents caused by careless handling of parts can cause subsequent transmission failure.

4. ORDERING PARTS

a. HOW TO ORDER. Each transmission has a part number besides its serial number. When ordering parts, always include this transmission part number (see transmission name plate, figure I-5) in addition to the part numbers of the required parts. REFER TO SERIES CRT-3000 PARTS CATALOG WHEN ORDERING PARTS. Do not use exploded view reference numbers in this manual to order parts.

b. NEW PARTS NEEDED. Replace all gaskets, worn seal rings, and cotter pins. If the converter has been overheated, replace all springs. Handle rubber and metal seal rings with care to prevent damage.

5. CLEANING AND INSPECTION

a. DIRT AND OTHER ABRASIVE MATERIAL HARMFUL. Whenever the transmission contains dirt or other abrasive matter, unnecessary wear will result. Inspect all parts for abrasive material any time the transmission is disassembled. Metallic contamination of oil is evidence of the failure of some part. If metal particles are found, both the transmission and torque converter assembly must be thoroughly cleaned. Refer to section III, paragraph 5d.

b. CLEANING PARTS

(1) All metallic parts of the transmission except bearings should be cleaned thoroughly with dry-cleaning solvent, volatile mineral spirits, paint thinner, or by the steam-cleaning method.

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

(3) Clean oil passages by working a piece of wire back and forth through the passages and flushing them with cleaning solvent or paint thinner. Dry the passages with compressed air.

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

c. CLEANING BEARINGS

(1) Thoroughly wash bearings that have

been in service in dry-cleaning solvent, volatile mineral spirits, or paint thinner.

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

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

NOTE

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

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

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

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

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

(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 AND MACHINED SURFACES

(1) Inspect bores for wear, grooves, scratches, and dirt. Remove burrs and scratches 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 burrs, 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, scratched, cracked, pitted, or chipped races, and for indication of excessive wear of rollers or balls. If one of these defects is found, replace the bearing.

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

(4) When installing a bearing on a shaft, heat the bearing to 300° F. 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 AND THRUST WASHERS

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

cloth. Remove burrs and sharp edges with a scraper or knife blade. If the bushing is out of round, deeply scored, or excessively worn, replace it using the proper size replacer.

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, burrs, 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 AND 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 non-hardening 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 (.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 .002 inch. If the sides of the ring grooves have to be reworked (.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 burrs. Remove such defects with a soft stone. If scores and scratches 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 burrs 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 burrs 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 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.

6. WEAR LIMITS

The Wear Limits Chart in this section lists the maximum variations from the original parts dimensions at which the transmission can be expected to function satisfactorily. It is possible that in individual cases parts may give satisfactory service beyond the limits specified. The chart is based on field service experience and is intended as a guide to parts replacement. Use this chart in conjunction with paragraph 5, Cleaning and Inspection. Wear Limits are illustrated in the exploded views throughout this manual and may be located by the figure numbers and letters in the chart.

WEAR LIMITS CHART

ILLUSTRATED	DESCRIPTION	LIMIT
Fig VII-1	**TORQUE CONVERTER GROUP**	
A	6755325 cover assembly bushing - 1.629 in. bore	1.634
B	6755004 washer - thickness	0.118 min.
C	6755850 washer - thickness. Step wear at roller race contact shall not be sufficient to reduce end clearance of stator pack to end of roller race below .007 inch (see figure VII-3)	0.296 min.
D	6754994 washer - thickness	0.191 min.
E	6755838 spacer - thickness wear	0.020 max.
Fig VII-3	With stator pack installed, end of roller race (surface H) shall be .007 inch or more beyond stator side plate (surface J). Dimension B minus dimension A shall not be less than .005 inch. Dimension D minus dimension C shall not be less than .010 inch. Dimension G shall not be less than .005 inch. Dimension F minus dimension E shall not be less than .005 inch.	
Fig VIII-1	**TORQUE CONVERTER HOUSING GROUP**	
A-B	6755403 lube valve guide - clearance with lube valve 6753544	0.007
C	6754707 lube valve spring - 35.1 ± 3.5 lb. load at 2.000 in. operating height	
Fig IX-1	**INPUT PRESSURE AND SCAVENGE OIL PUMP ASSEMBLY (-3) AND INPUT DRIVEN CHARGING OIL PUMP ASSEMBLY (-1)**	
A	6757165 input oil pump assembly - gear end clearance with unit assembled	0.010
B	6757298 body - 2.758 in. dia. bore	2.768
C	6757163 drive gear shaft - 1.000 in. dia.	0.9975
D	6757162 idler gear shaft - 1.000 in. dia.	0.9975
Fig X-1	**FORWARD AND REVERSE PLANETARY CARRIER ASSEMBLIES AND TRANSMISSION HOUSING GROUP**	
A	6757250 piston return spring - 24.3 ± 2.4 lb. load at 2.169 in. operating height	
B	6757251 piston return spring - 18 ± 1.8 lb. load at 1.531 in. operating height	
C	6757233 input sun gear washer - thickness	0.075
D	6757227 bushing - clearance with 6757188 shaft (fig XI-1C)	0.010
E	6758267 forward and reverse clutch anchor - reaction surface wear	0.020
F	6757183 forward and reverse clutch friction plate	thickness 0.130 cone 0.012 max.
G	6757182 forward and reverse clutch reaction plate	thickness 0.150 cone 0.030 max.

(Continued on next page)

WEAR LIMITS CHART - Continued

ILLUSTRATED	DESCRIPTION	LIMIT
H	6757190 reverse planetary carrier assembly - gear end clearance with unit assembled	0.055
J	6757195 forward planetary carrier assembly - gear end clearance with unit assembled	0.055
Fig XI-1	**INTERMEDIATE-, HIGH- AND LOW-RANGE CLUTCHES, HIGH- AND LOW-RANGE PLANETARY CARRIER ASSEMBLIES AND INTERMEDIATE-RANGE CLUTCH DRUM**	
A	6757202 intermediate-range Belleville spring - free height	0.223-0.243
B	6758196 thrust washer - .292 thickness(used on -3 model only)	0.284
C	6757188 shaft - clearance with bushing 6757227 (fig X-D)	0.010
D	6757251 piston return spring - 18 ± 1.8 lb. load at 1.531 in. operating height	
E	6757250 piston return spring - 24.3 ± 2.4 lb. load at 2.169 in. operating height	
F	6757330 piston assembly - face wear	0.005
G	6757183 intermediate- and high-range clutch friction plate	thickness 0.130 cone 0.012 max.
H	6757182 low-, intermediate- and high-range clutch reaction plate	thickness 0.150 cone 0.030 max.
J	6757206 planetary carrier-reaction surface wear	0.005
K	6757170 reaction plate-reaction surface wear	0.020
L	6758268 anchor housing - reaction surface wear	0.010
M	6757207 high range planetary carrier assembly - gear end clearance with unit assembled	0.055
N	6757212 low range planetary carrier assembly - gear end clearance with unit assembled	0.055
Fig XII-1	**TRANSFER GEAR HOUSING GROUP**	
A	6756835 rear output shaft and bushing - clearance with shaft 6757244 (fig XII-3A)	0.005
B	6757222 output oil pump assembly - gear end clearance with unit assembled	0.010
	Gear O.D. clearance	0.010
C	6756458 output pump check valve spring - 1.0 ± 0.1 lb. load at 0.900 in. operating height	
D-E	6756164 output pump check valve - clearance with output pump check valve guide 6756146	0.007
Fig XII-3	**FRONT OUTPUT SHAFT, DISCONNECT CLUTCH, FLANGE AND PARKING BRAKE**	
A	6757244 front output shaft - clearance in bushing 6756835 (fig XII-1A)	0.005
B	6757249 disconnect clutch detent spring - 28.6 ± 2.8 lb. load at 1.20 in. operating height	

(Continued on next page)

WEAR LIMITS CHART - Continued

ILLUSTRATED	DESCRIPTION	LIMIT
Fig XIII-1	**MODEL CRT-3330-3 OIL SUMP ADAPTER, OUTPUT DRIVEN OIL PUMP ASSEMBLY, PARKING BRAKE ASSEMBLY, AND OIL SUMP, EXPLODED VIEW**	
A	6757222 output oil pump assembly - gear end clearance with unit assembled	0.010
	Gear O.D. clearance	0.010
B-D	6756164 output pump check valve - clearance with output pump check valve guide - 6756146	0.007
C	6756458 output pump check valve spring 1.0 ± 0.1 lb. load at 0.900 in. operating length	
Fig XIV-1	**PRESSURE REGULATOR AND SELECTOR VALVE BODIES**	
A-G	6757262 range selector valve - clearance with valve body 6757252	0.004
B-D	6757258 reverse sleeve - clearance with forward-reverse valve 6757259	0.004
C-G	6757260 forward-reverse piston - clearance with valve body 6757252	0.009
E	6703162 selector valve detent spring - 15 ± 1.5 lb. load at 13/16 in. operating height	
F-D	6757261 forward sleeve - clearance with forward-reverse valve 6757259	0.004
H-G	6758304 clutch cutoff valve - clearance with valve body 6757252	0.004
J-L	6757210 main pressure regulator valve body - clearance with main pressure regulator valve 6757421	0.004
K	6757237 main pressure regulator valve spring - 111.0 ± 5.0 lb. load at 4.20 in. operating height	
M	6756623 filter bypass valve spring - 8.3 ± 0.8 lb. load at 2.0 in. operating height	
N	6757251 clutch cutoff valve spring - 18.0 ± 1.8 lb. load at 1.531 in. operating height	

SECTION V TORQMATIC TRANSMISSION IN DRIVE LINE

1. SCOPE

This section contains general information on removal from, and installation into, the vehicle. For detailed pertinent information on the installation of the transmission in the drive line, consult your vehicle or equipment service manual. For overhaul procedures refer to sections VI through XIV.

2. REMOVING TORQMATIC TRANSMISSION FROM DRIVE LINE (MODELS CRT-3330-1 AND CRT-3330-3)

a. PREPARATION FOR REMOVAL. Drain the transmission oil. Refer to section III, paragraph 6 for this procedure.

b. REMOVAL PROCEDURE

(1) Disconnect the oil cooler lines.

(2) Disconnect the oil temperature gauge line.

(3) Disconnect the clutch oil pressure gauge line.

(4) Disconnect the implement pump connection.

(5) Disconnect the linkage to the range selector valve and the forward and reverse valve.

(6) Disconnect the clutch cutoff valve line if used.

(7) On Model CRT-3330-1 transmissions, disconnect the linkage to the disconnect clutch. There is no disconnect clutch on the Model CRT-3330-3 transmission.

(8) If the Model CRT-3330-1 transmission is equipped with a governor drive, disconnect it. If the Model CRT-3330-3 transmission is equipped with a speedometer drive, disconnect it.

(9) Disconnect the drive lines from the flanges of the transmission.

(10) Attach a hoist of at least one ton capacity to the transmission.

(11) On models that are mounted directly on the engine, remove the bolts and disconnect the transmission from the engine.

(12) Remove the transmission mounting bolts and remove the transmission.

3. INSTALLING TORQMATIC TRANSMISSION IN DRIVE LINE (MODELS CRT-3330-1 AND CRT-3330-3)

a. INSTALLATION PROCEDURE

(1) Install the transmission in the drive line and install the mounting bolts.

(2) On models that are mounted directly on the engine, install the bolts through the transmission flange into the engine.

(3) Remove the hoist.

(4) Connect the drive lines to the flanges of the transmission.

(5) If the Model CRT-3330-1 transmission is equipped with a governor drive, connect it. If the Model CRT-3330-3 transmission is equipped with a speedometer drive, connect it.

(6) On Model CRT-3330-1 transmissions, connect the linkage to the disconnect clutch. There is no disconnect clutch on the CRT-3330-3 models.

(7) Connect the clutch cutoff valve if used.

(8) Connect the linkage to the range selector valve and the forward and reverse

valve, and make sure the linkage adjustment is correct. Refer to section III, paragraph 10.

(9) Connect the implement pump connection.

(10) Connect the oil temperature gauge line.

(11) Connect the oil cooler lines.

(12) Connect the clutch oil pressure gauge line.

b. FILLING TRANSMISSION WITH OIL. Refer to section III, paragraph 6 for the procedure for filling the transmission with oil.

SECTION VI TRANSMISSION OVERHAUL PROCEDURES

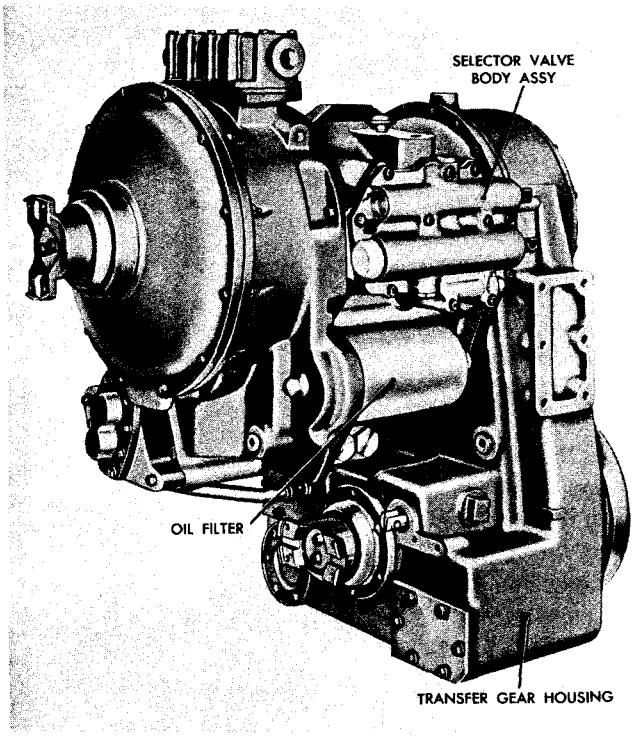


Fig VI-1. Model CRT-3330-1 Torqmatic transmission with transfer gear housing assembly and integral oil cooler, left front view

1. SCOPE

a. The disassembly and assembly procedures outlined in paragraphs 3 and 4 apply to the Model CRT-3330-1 Torqmatic transmission (figs VI-1 and VI-3). Disassembly and assembly procedures for the Model CRT-3330-3 Torqmatic transmission (figs VI-2 and 4) which deviate from the Model CRT-3330-1 are covered in paragraphs 5 and 6. Procedures for rebuild of the subassemblies are covered in sections VII through XIV.

b. Refer to the Torqmatic transmission cutaway views (figs VI-3 and VI-4) and the exploded views throughout sections VI through XIV for parts identification and functional relationship. Rebuild of the oil cooler as furnished by Allison is covered in section VIII and the parking brake rebuild is covered in section XII. Refer to section IV for wear limits.

2. DRAINING TRANSMISSION

a. Drain the transmission if it was not

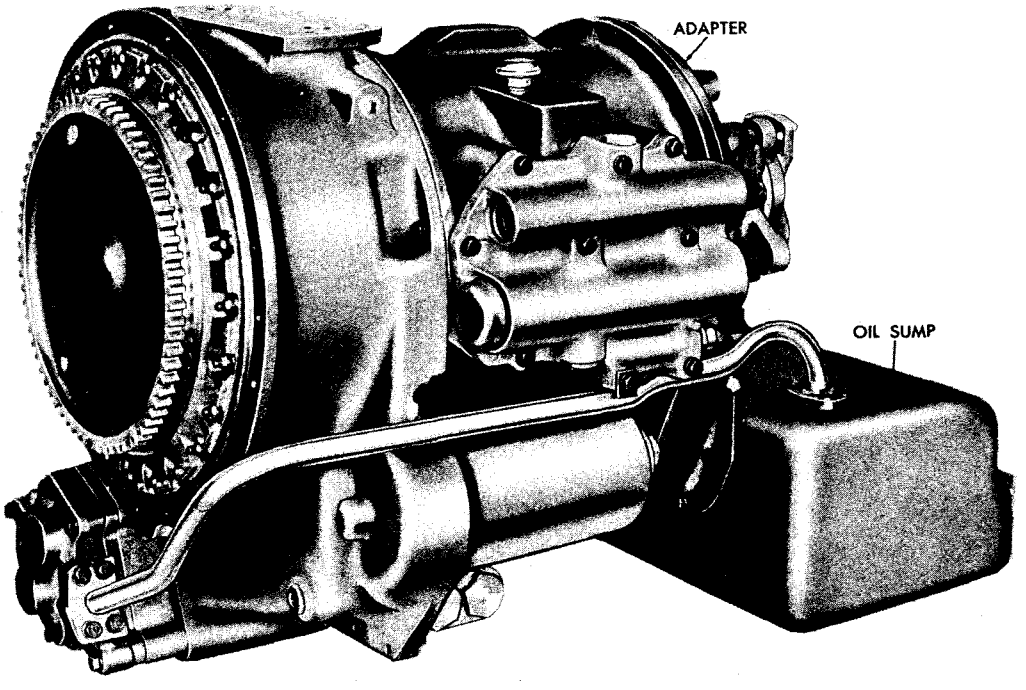


Fig VI-2. Model CRT-3330-3 Torqmatic transmission with bearing retainer, adapter, and oil sump, left front view

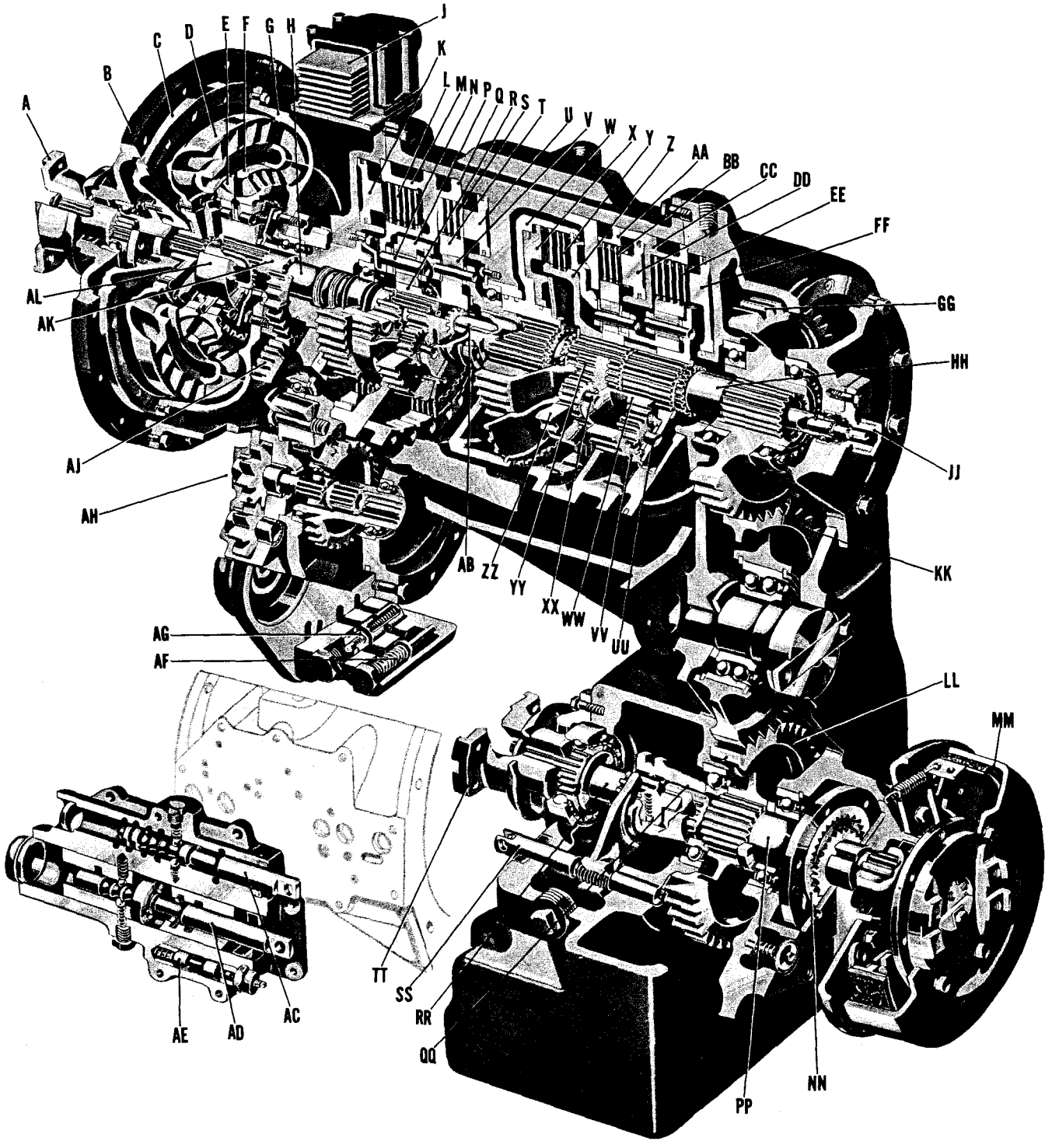


Fig VI-3. Model CRT-3330-1 Torqmatic transmission, cutaway view

drained before it was removed from the installation. Refer to section III, paragraph 6b for draining procedures.

b. Place the transmission, bottom side down, on the work table and level it with wood blocks.

A - Input flange
B - Transmission front cover
C - Converter pump cover
D - Turbine
E - First stator
F - Second stator
G - Converter pump
H - Converter shaft
J - Oil cooler
K - Reverse clutch apply piston
L - Reverse clutch plates
M - Reverse clutch anchor
N - Reverse planetary carrier assembly
P - Reverse planetary ring gear
Q - Forward clutch anchor
R - Forward and reverse planetary sun gear
S - Forward clutch plates
T - Forward planetary ring gear
U - Forward clutch apply piston
V - Forward planetary carrier assembly
W - Intermediate-range clutch drum
X - Intermediate-range clutch apply piston
Y - Intermediate-range clutch plates
Z - Intermediate-range clutch hub
AA - High-range clutch anchor
BB - High-range clutch plates
CC - High-range piston and low-range anchor housing
DD - High-range clutch apply piston
EE - Low-range clutch plates
FF - Low-range clutch piston
GG - Output drive gear
HH - Transmission shaft
JJ - Accessory drive
KK - Output idler gear
LL - Output driven gear
MM - Parking brake
NN - Output driven oil pump
PP - Rear output shaft
QQ - Disconnect clutch
RR - Front output shaft
SS - Shifter fork shaft
TT - Front output flange
UU - Low-range planetary carrier assembly
VV - Low-range planetary ring gear
WW - Low-range planetary sun gear
XX - High-range planetary carrier assembly
YY - High-range planetary sun gear
ZZ - High-range planetary ring gear
AB - Governor drive shaft
AC - Range selector valve
AD - Forward and reverse valve
AE - Clutch cutoff valve
AF - Oil filter check valve
AG - Main pressure regulator valve
AH - Input driven charging oil pump
AJ - Accessory drive idler gear
AK - Torque converter ground sleeve
AL - Freewheel race

Fig VI-3. Model CRT-3330-1 Torqmatic transmission, cutaway view, legend

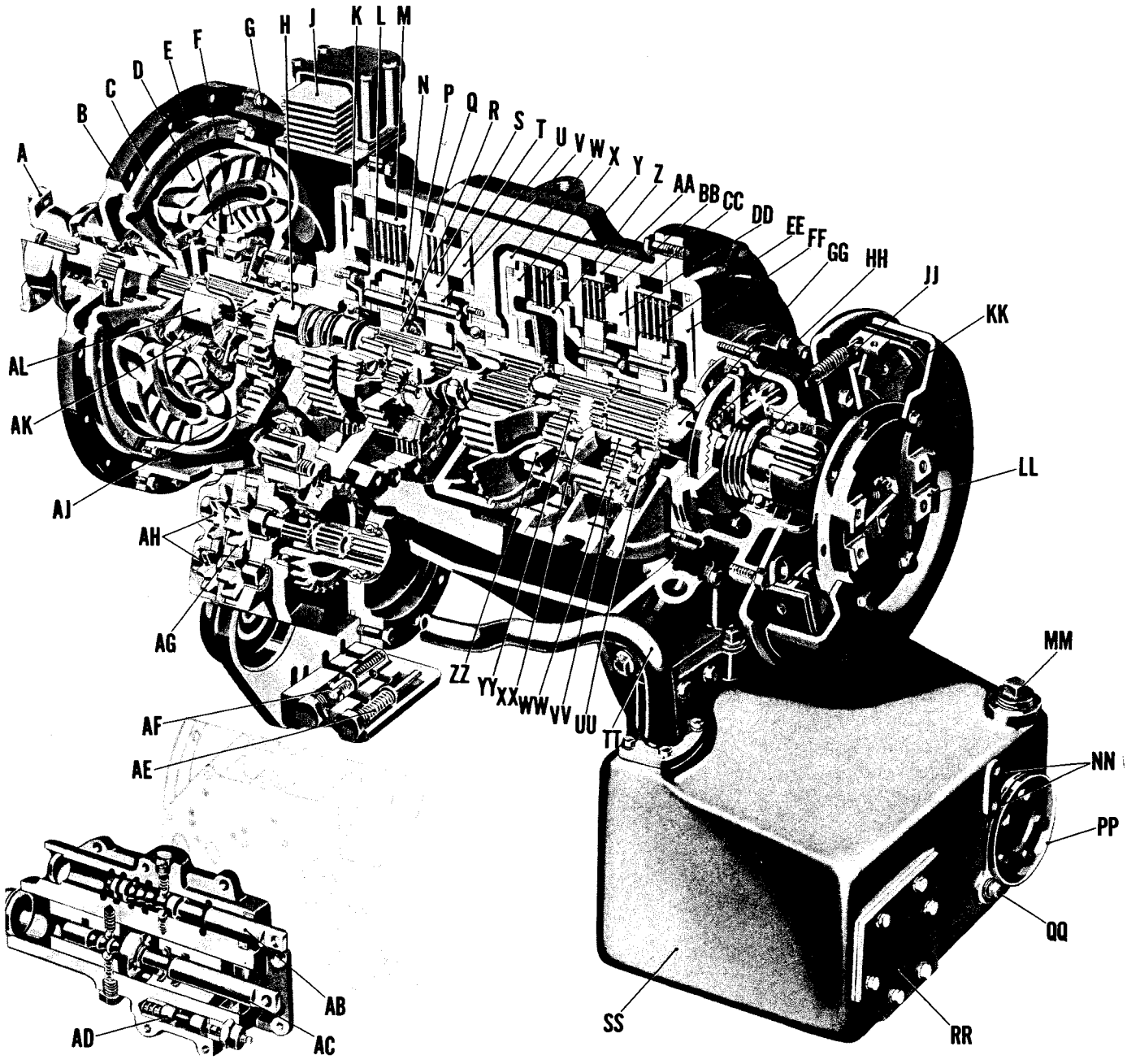


Fig VI-4. Model CRT-3330-3 Torqmatic transmission, cutaway view

A - Input flange
B - Transmission front cover
C - Converter pump cover
D - Turbine
E - First stator
F - Second stator
G - Converter pump
H - Converter shaft
J - Oil cooler
K - Reverse clutch apply piston
L - Reverse clutch plates
M - Reverse clutch anchor
N - Reverse planetary carrier assembly
P - Reverse planetary ring gear
Q - Forward clutch anchor
R - Forward and reverse planetary sun gear
S - Forward clutch plates
T - Forward planetary ring gear
U - Forward clutch apply piston
V - Forward planetary carrier assembly
W - Intermediate-range clutch drum
X - Intermediate-range clutch apply piston
Y - Intermediate-range clutch plates
Z - Intermediate-range clutch hub
AA - High-range clutch anchor
BB - High-range clutch plates
CC - High-range piston and low-range anchor housing
DD - High-range clutch apply piston
EE - Low-range clutch plates
FF - Low-range clutch piston
GG - Transmission shaft
HH - Output driven oil pump
JJ - Speedometer drive
KK - Parking brake
LL - Output flange
MM - Oil filler plug
NN - Oil level check plug holes
PP - Oil strainer assembly
QQ - Sump drain plug
RR - Inspection and cleanout cover
SS - Oil sump
TT - Oil drain tube
UU - Low-range planetary carrier assembly
VV - Low-range planetary ring gear
WW - Low-range planetary sun gear
XX - High-range planetary carrier assembly
YY - High-range planetary sun gear
ZZ - High-range planetary ring gear
AB - Range selector valve
AC - Forward and reverse valve
AD - Clutch cutoff valve
AE - Oil filter check valve
AF - Main pressure regulator valve
AG - Input driven charging oil pump
AH - Oil pump scavenge gears
AJ - Accessory drive idler gear
AK - Torque converter ground sleeve
AL - Freewheel race

Fig VI-4. Model CRT-3330-3 Torqmatic transmission, cutaway view, legend

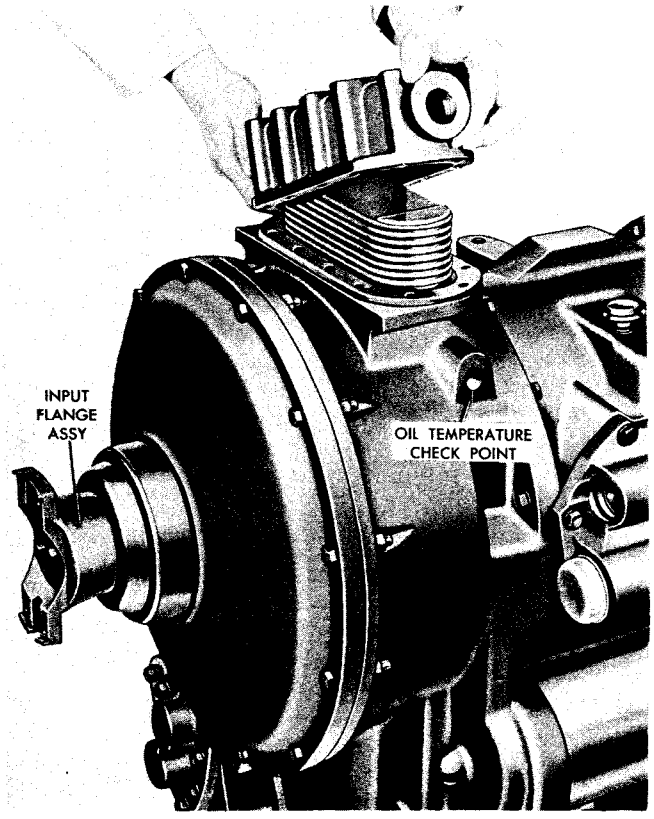


Fig VI-5. Removing or installing oil cooler cover

3. DISASSEMBLY OF MODEL CRT-3330-1 TRANSMISSION

a. REMOVING MINOR SUBASSEMBLIES

(1) Remove 12 bolts from the oil cooler cover.

(2) Remove the oil cooler cover (fig VI-5).

(3) Remove the oil cooler core assembly and gasket (fig VI-72). Converter "IN" is on the right.

(4) Remove 11 bolts that secure the selector valve body assembly.

(5) Remove the selector valve body assembly and gasket (fig VI-6). Refer to section XIV, paragraph 2 for rebuild of the selector valve body.

(6) Remove the hose clamps that secure the converter housing drain tube assembly to the inspection and converter drain cover assembly (fig VI-7).

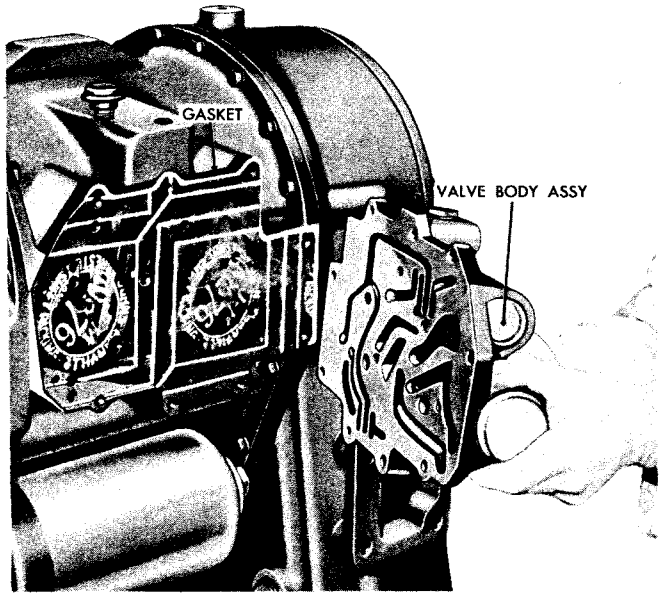


Fig VI-6. Removing or installing selector valve body assembly

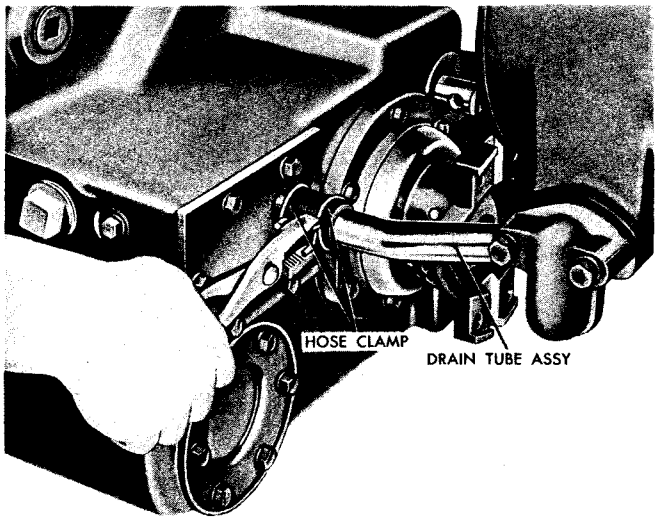


Fig VI-7. Removing or installing converter housing drain tube assembly hose clamps

(7) Remove two bolts that secure the converter housing drain tube assembly and remove the tube assembly (fig VI-7).

(8) Remove the bolt from the center of the oil filter assembly and remove the oil filter assembly and gasket (fig VI-8). Refer to section VIII, paragraph 2 for rebuild of the oil filter.

NOTE

If the transmission has a remote mounted oil filter as-

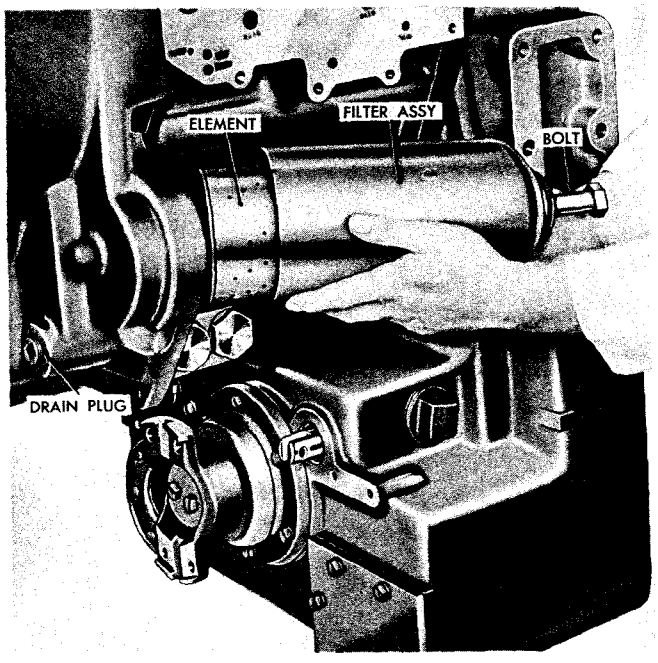


Fig VI-8. Removing or installing oil filter assembly

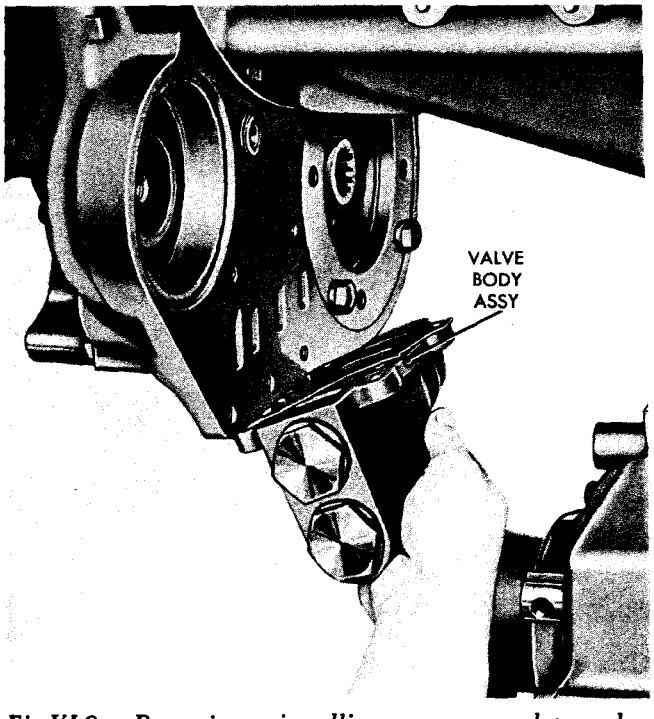


Fig VI-9. Removing or installing pressure regulator valve body assembly

sembly, remove the remote oil filter adapter from the transmission.

(9) Remove five bolts and lock washers that secure the pressure regulator valve body assembly to the converter housing and remove the valve body assembly and gasket (fig VI-9). Refer to section XIV, paragraph 1 for rebuild of the pressure regulator valve body.

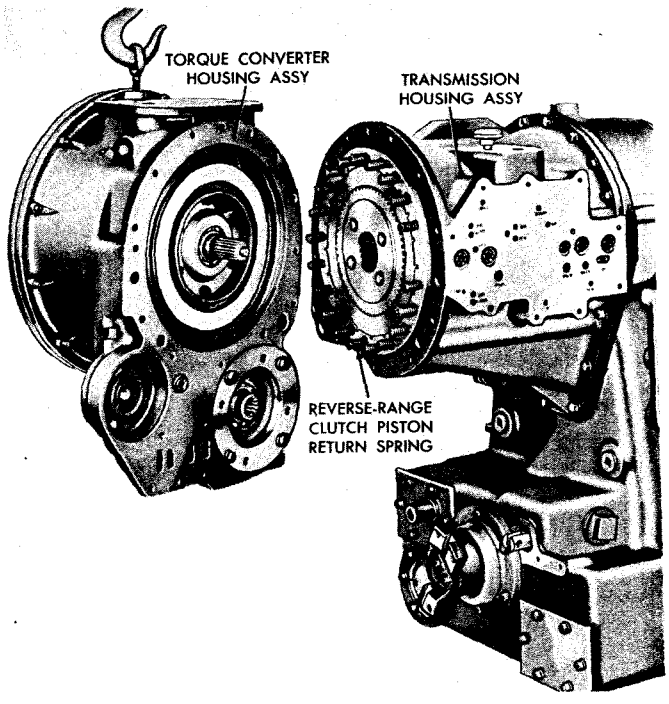


Fig VI-10. Removing or installing torque converter housing assembly from transmission housing assembly

b. REMOVING CONVERTER HOUSING ASSEMBLY, REVERSE PLANETARY GEARING ASSEMBLY, AND REVERSE CLUTCH PLATES.

(1) Support the converter housing assembly with a hoist (fig VI-71).

(2) Remove 13 bolts that secure the converter housing assembly to the transmission housing assembly (fig VI-71).

CAUTION

Do not drop the reverse clutch plates and planetary unit as the converter housing assembly is removed.

(3) Remove the converter housing assembly (fig VI-10).

(4) Remove 20 reverse piston return springs from the reverse clutch anchor (fig VI-10).

(5) Remove the reverse planetary car-

rier assembly and the forward and reverse sun gear (fig VI-11). Refer to section X, paragraph 1 for rebuild of the planetary carriers.

(6) Remove the reverse clutch plates (fig VI-70).

c. REMOVING TRANSMISSION HOUSING

(1) Install two lifting eyes and support the transmission housing with a hoist (fig VI-12).

(2) Remove 18 bolts and lock washers that secure the transmission housing assembly to the transfer gear housing assembly (fig VI-69).

(3) Remove the transmission housing assembly from the transfer gear housing assembly. Separate the sections slowly to prevent the low-range clutch piston return springs and low-range clutch plates from falling out (fig VI-12).

(4) Remove the springs and the plates. Remove the low-range clutch piston (fig VI-12). Refer to section XI, paragraph 6 for piston rebuild.

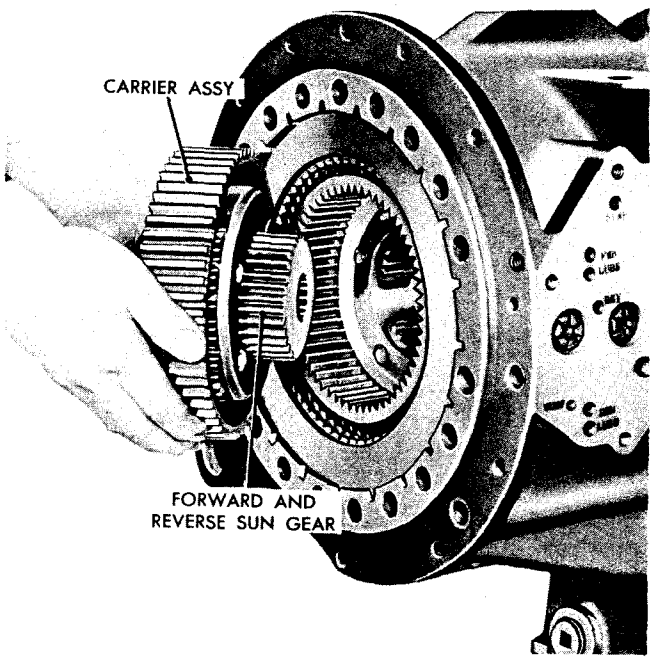


Fig VI-11. Removing or installing reverse planetary carrier assembly and forward and reverse sun gear

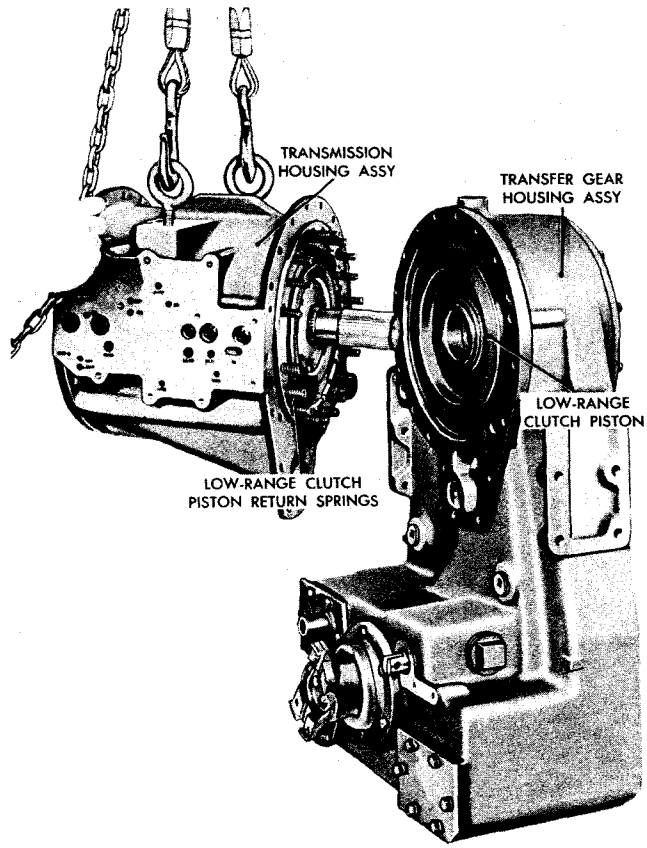


Fig VI-12. Removing or installing transmission housing assembly from transfer gear housing assembly

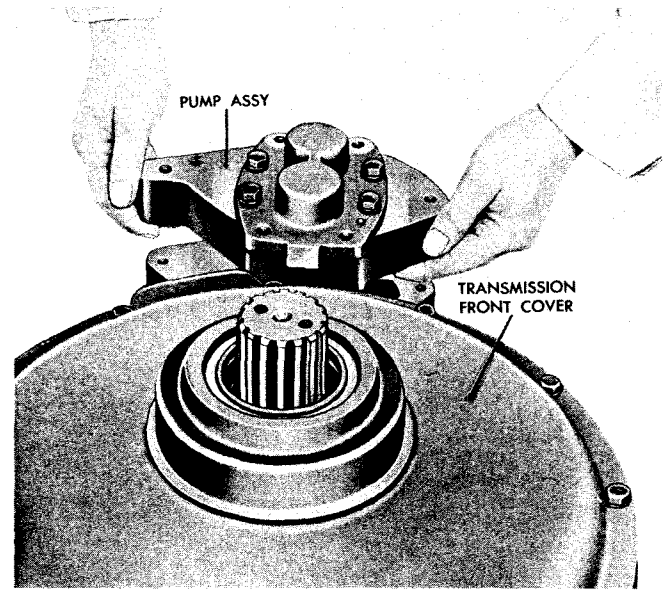


Fig VI-13. Removing or installing input driven charging oil pump assembly

d. REMOVING INPUT FLANGE AND INPUT CHARGING OIL PUMP ASSEMBLY

(1) To remove the input flange, bend

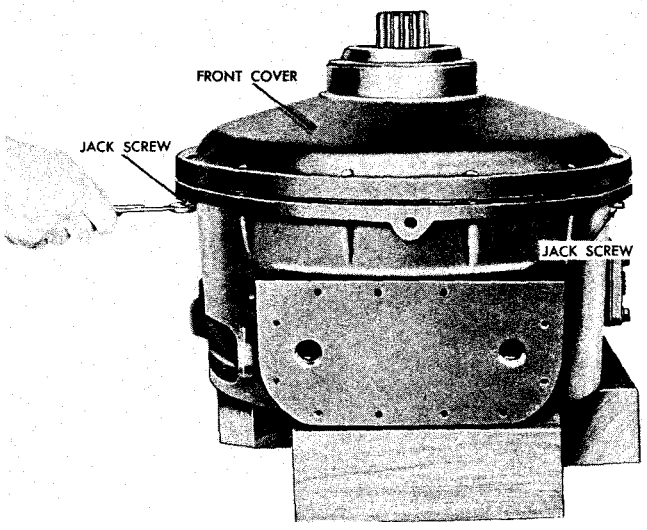


Fig VI-14. Using jack screws to loosen transmission front cover

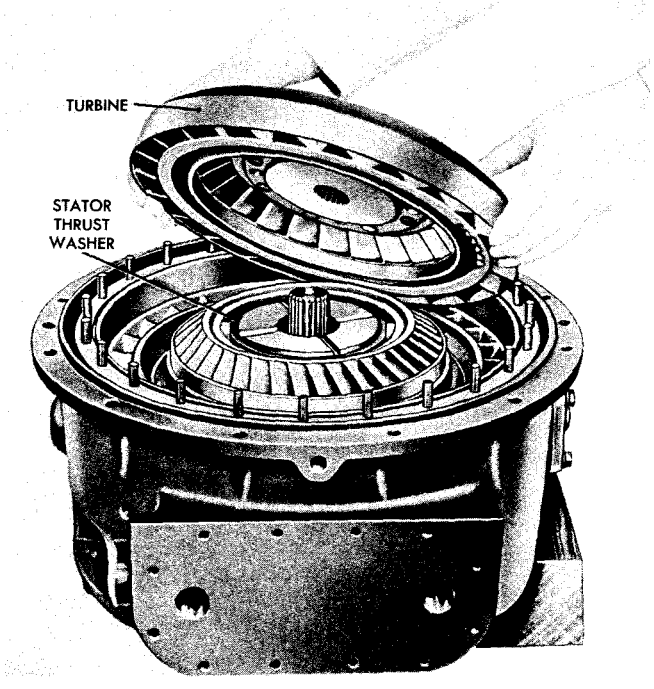


Fig VI-15. Removing or installing turbine

down the tabs on the locking strip. Remove the two bolts, locking strip, flange retainer washer and input flange.

(2) Remove the input charging oil pump assembly by removing four bolts and lock washers from the oil pump cover and two bolts and lock washers from the ends of the oil pump body (fig VI-13). Refer to section IX for rebuild of the input charging oil pump.

(3) Remove the oil pump drive coupling (fig VI-68).

e. REMOVING TRANSMISSION FRONT COVER, CONVERTER PUMP COVER ASSEMBLY, AND CONVERTER ELEMENTS (REMOTE ENGINE MOUNTED TRANSMISSION ONLY)

(1) Remove 12 bolts that secure the transmission front cover to the converter housing assembly (fig VI-13).

(2) Remove the transmission front cover and gasket, using jack screws in two holes that are accessible from underneath (fig VI-14).

(3) Remove 24 hexagon lock nuts from the converter pump cover assembly. Remove the converter pump cover assembly, converter drive shaft and bearing (fig VI-67). Do not remove the bearing from the shaft unless replacement is necessary.

NOTE

If the transmission is mounted directly on the engine, remove the converter pump cover assembly. There is no transmission front cover, drive shaft, or bearing.

(4) Remove the turbine thrust washer (fig VI-67). Remove the turbine (fig VI-15).

(5) Remove the stator thrust washer (fig VI-15).

(6) Remove the first stator, using a cylinder of shim stock to keep the freewheel rollers and the freewheel roller springs from falling out (fig VI-66). Refer to section VII, paragraph 4 for rebuild of stators.

(7) Remove the spacing washer (fig VI-16).

(8) Remove the second stator the same way that the first stator was removed.

(9) Remove the freewheel race (fig VI-65).

(10) Remove the snap ring from the ground sleeve (fig VI-17).

(11) Remove the stator spacer (fig VI-17).

(12) Remove the spacer that fits against the converter pump assembly (fig VI-64).

(13) Remove the converter pump assembly (fig VI-63). Refer to section VII, paragraph 3 for rebuild of the converter pump.

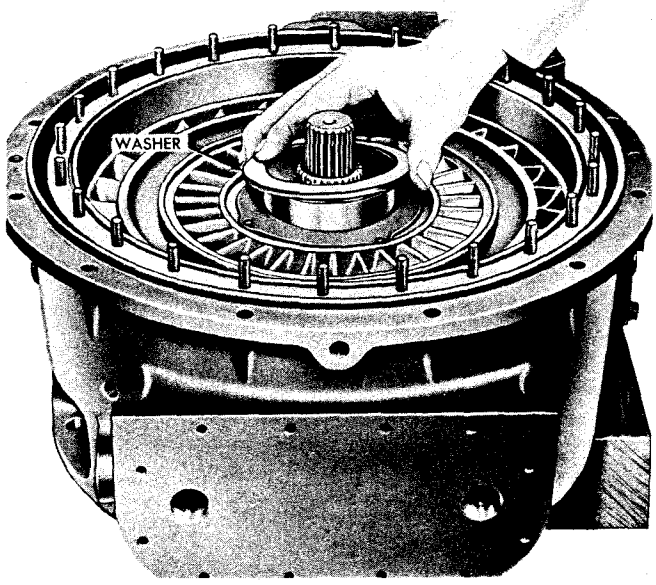


Fig VI-16. Removing or installing spacing washer

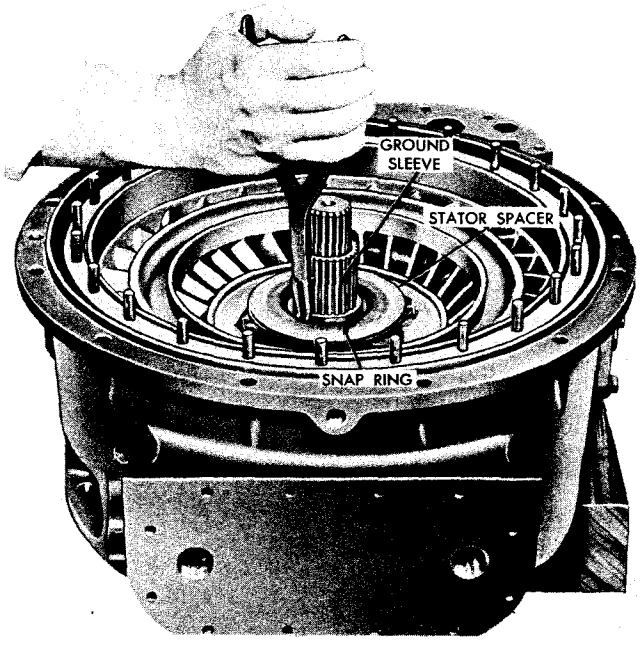


Fig VI-17. Removing or installing snap ring from ground sleeve

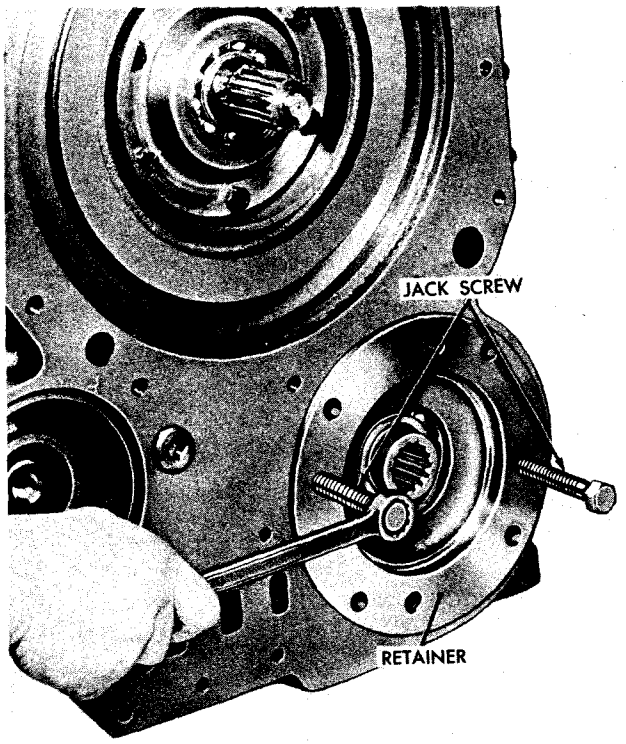


Fig VI-18. Using jack screws to loosen bearing retainer

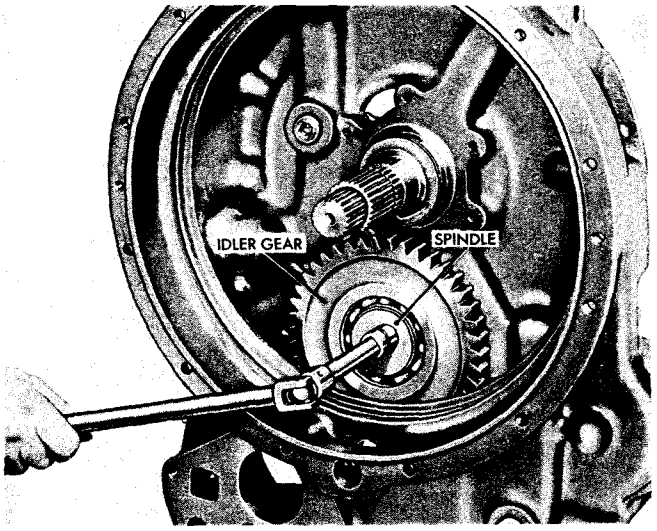


Fig VI-19. Removing or installing bolt from accessory drive idler gear spindle

f. REMOVING OIL PUMP DRIVE GEAR, ACCESSORY DRIVE IDLER GEAR, CONVERTER SHAFT ASSEMBLY, AND REVERSE PISTON

(1) Set the converter housing upright. Use a hoist or block the assembly to make certain that it can not fall over.

(2) Remove four bolts and lock washers from the bearing retainer. Loosen the bearing retainer using jack screws (fig VI-18).

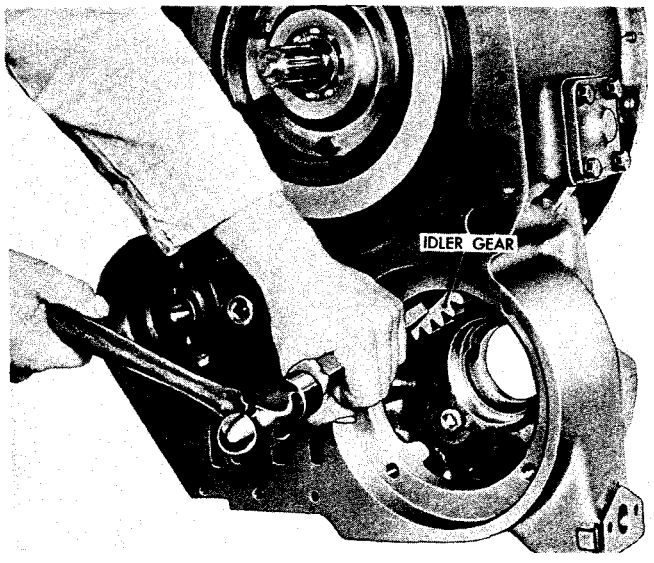


Fig VI-20. Removing accessory drive idler gear

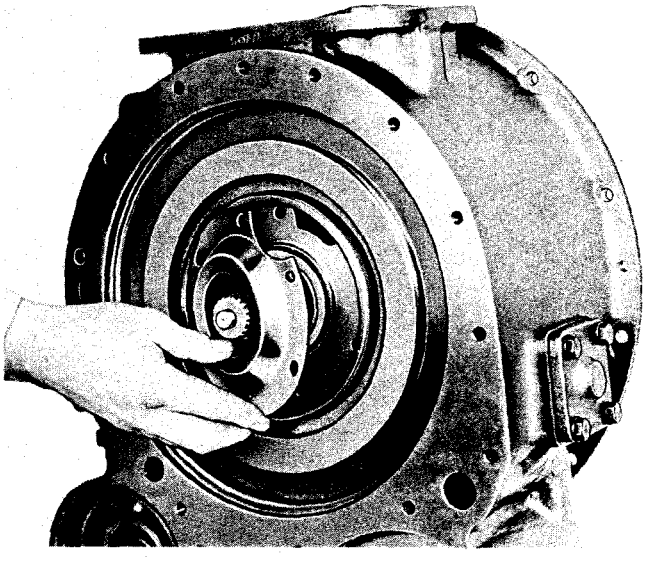


Fig VI-21. Removing or installing bearing retainer

(3) Remove the bearing retainer (fig VI-62). Remove the seal ring from the retainer.

(4) Remove the oil pump drive gear and bearings (fig VI-62).

(5) Remove the bolt from the accessory drive idler gear spindle (fig VI-19).

(6) From the other side of the housing, use a hammer and a drift to drive out the accessory drive idler gear (fig VI-20). Pry between the gear and the housing opposite the place where the drift is being used.

(7) Remove six bolts from the bearing

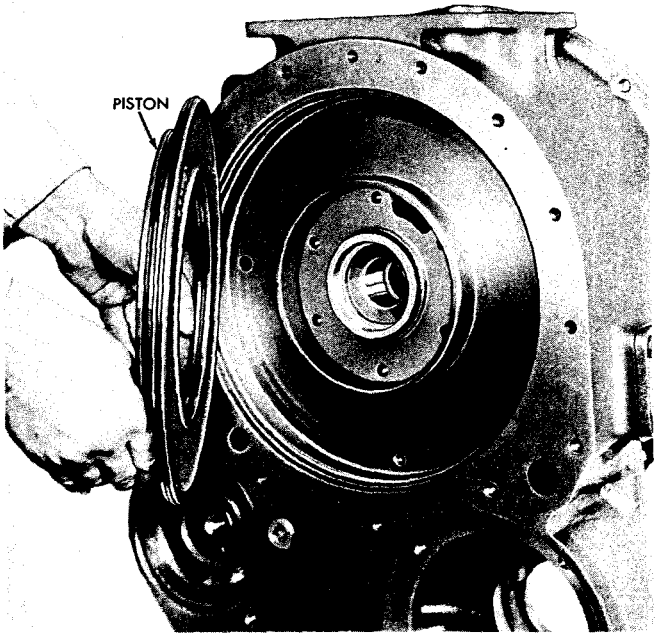


Fig VI-22. Removing or installing reverse clutch apply piston

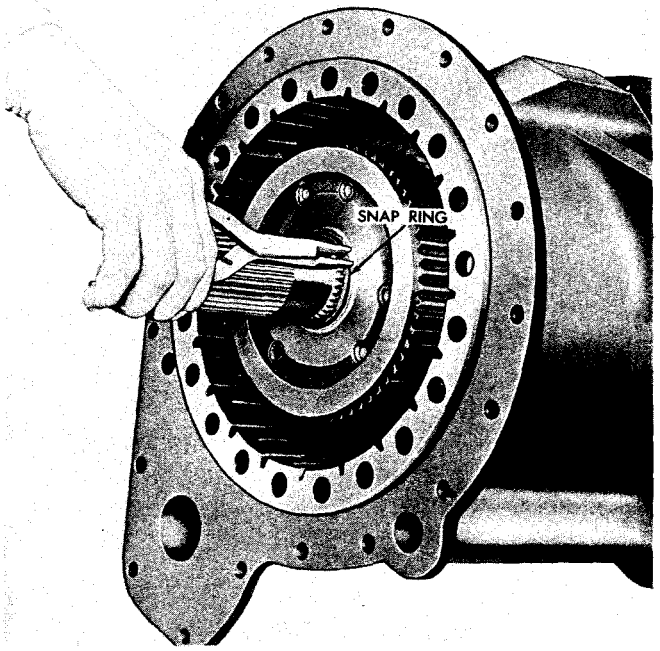


Fig VI-23. Removing or installing snap ring from transmission shaft assembly

retainer and remove the retainer from the converter ground sleeve (fig VI-21).

(8) Remove the converter shaft and bearing assembly (fig VI-61). Refer to section X, paragraph 4 for converter output shaft rebuild information.

(9) Remove the reverse clutch apply piston (fig VI-22). Refer to section X, para-

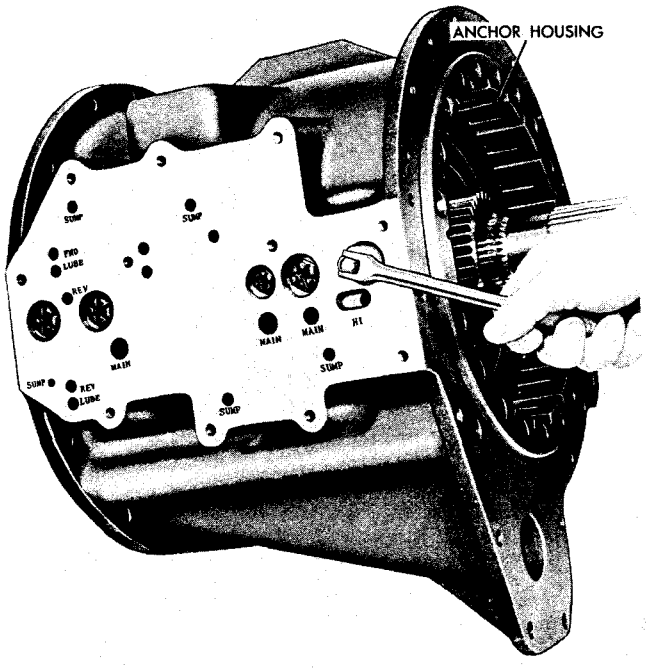


Fig VI-24. Removing or installing bolt that retains high-range piston and low-range anchor housing

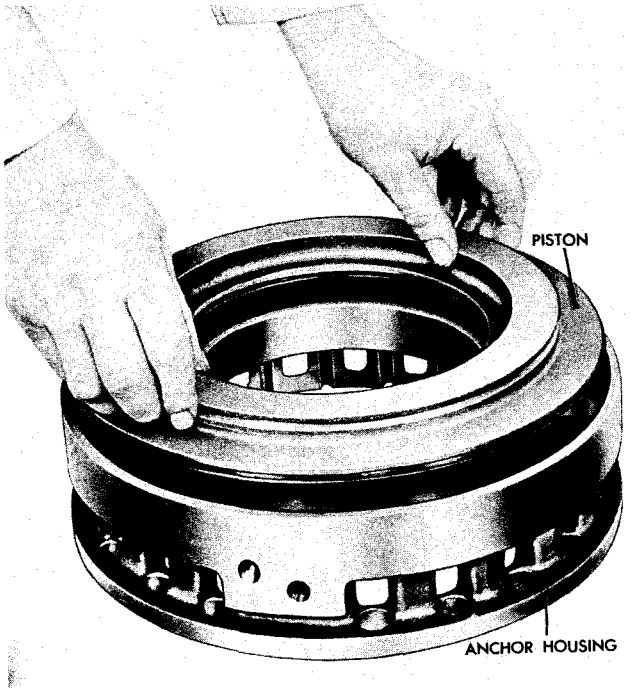


Fig VI-25. Removing or installing high-range clutch piston from high-range piston and low-range anchor housing

graph 3 for clutch piston rebuild information.

g. REMOVING LOW-RANGE PLANETARY GEARING AND CLUTCH ANCHOR

(1) Remove the snap ring from the transmission shaft assembly (fig VI-23).

(2) Remove the low-range planetary carrier assembly and the low-range planetary ring gear from the transmission shaft assembly (fig VI-60).

(3) Remove the ring gear from the carrier assembly (fig VI-60). Refer to section XI, paragraph 4 for rebuild of the low-range planetary carrier assembly.

(4) Remove the bolt that retains the high-range piston and low-range anchor housing (fig VI-24).

CAUTION

Use caution because the low-range anchor housing is under spring pressure.

(5) Remove the high-range piston and low-range anchor housing and the high-range clutch piston (fig VI-59).

(6) Remove the piston from the housing (fig VI-25). Refer to section XI, paragraph 6 for piston rebuild information.

h. REMOVING HIGH-RANGE PLANETARY GEARING AND CLUTCH PARTS

(1) Remove 20 high-range clutch piston return springs (fig VI-58).

(2) Remove the high-range clutch plates (fig VI-26).

(3) Remove the high-range ring gear (fig VI-26).

(4) Remove the bolt that secures the high-range clutch anchor (fig VI-26).

(5) Remove the high-range clutch anchor (fig VI-27).

(6) Remove the bolt that secures the high-range clutch reaction plate (fig VI-27).

(7) Remove the high-range clutch reaction plate using improvised hooks to get the

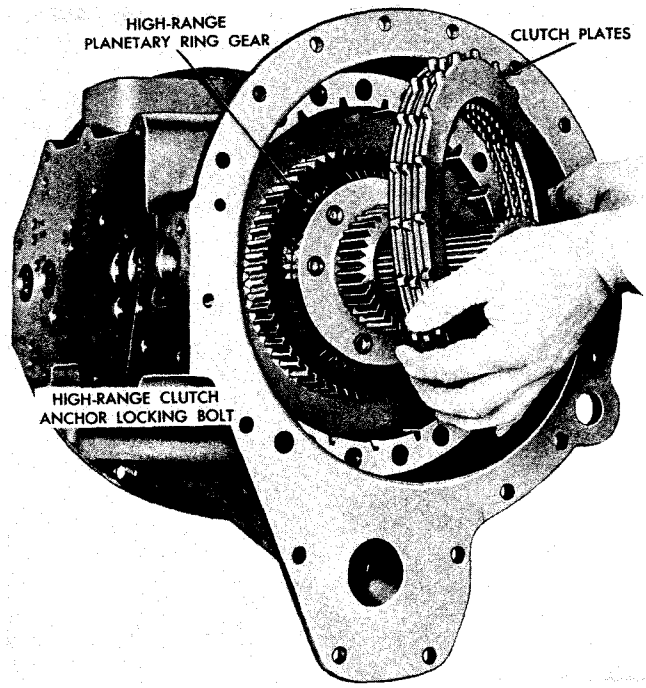


Fig VI-26. Removing or installing high-range clutch plates

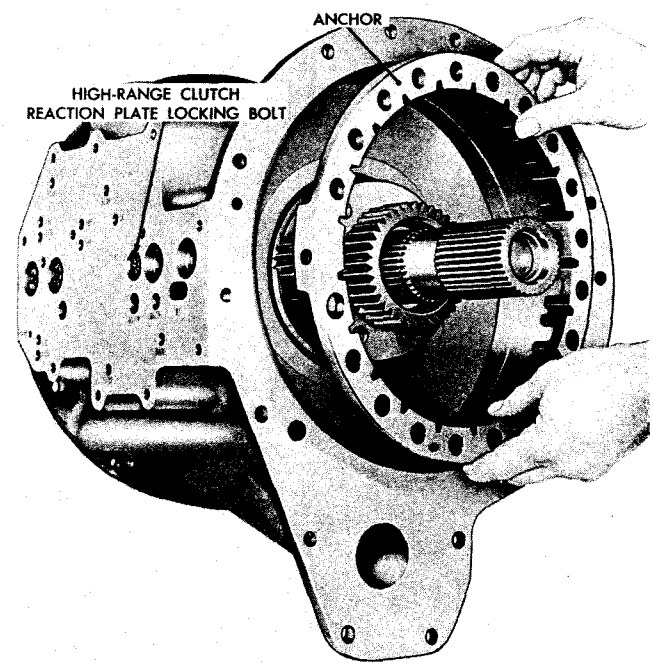


Fig VI-27. Removing or installing high-range clutch anchor

plate started (fig VI-57).

(8) Remove the snap ring that retains the high-range planetary carrier assembly (fig VI-28).

(9) Remove the high-range planetary carrier assembly and the low-range sun gear (fig VI-56). Refer to section XI, paragraph 3 for rebuild of the high-range planetary carrier assembly.

(10) Remove the spacer (fig VI-56).

(11) Remove the high-range sun gear (fig VI-56).

i. REMOVING INTERMEDIATE-RANGE CLUTCH PARTS

(1) Remove the intermediate-range clutch hub (fig VI-55).

(2) Remove the intermediate-range clutch plates (fig VI-29).

(3) Remove the transmission shaft assembly (fig VI-29).

NOTE

On the Model CRT-3330-3 transmission, remove a thrust washer after removing the shaft. This washer is not used on the Model CRT-3330-1.

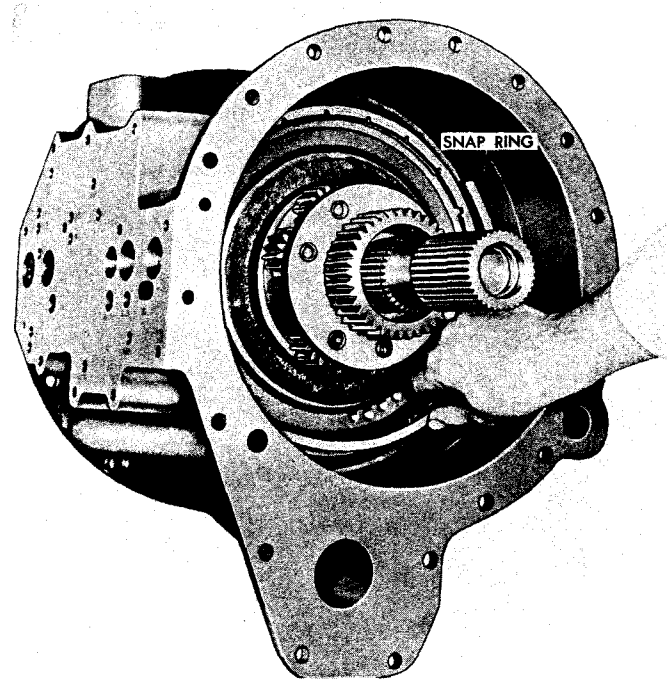


Fig VI-28. Removing or installing snap ring that retains high-range planetary carrier assembly

(4) Remove the snap ring from the forward planetary carrier assembly (fig VI-54).

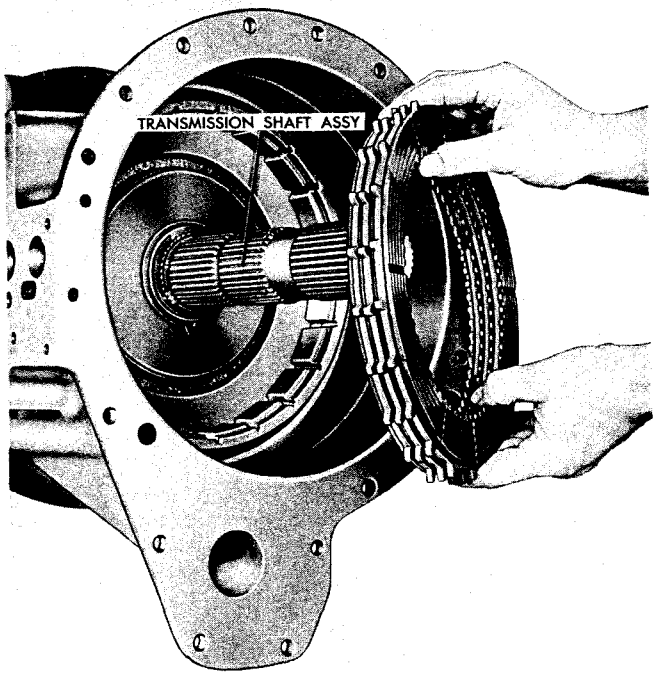


Fig VI-29. Removing or installing intermediate-range clutch plates

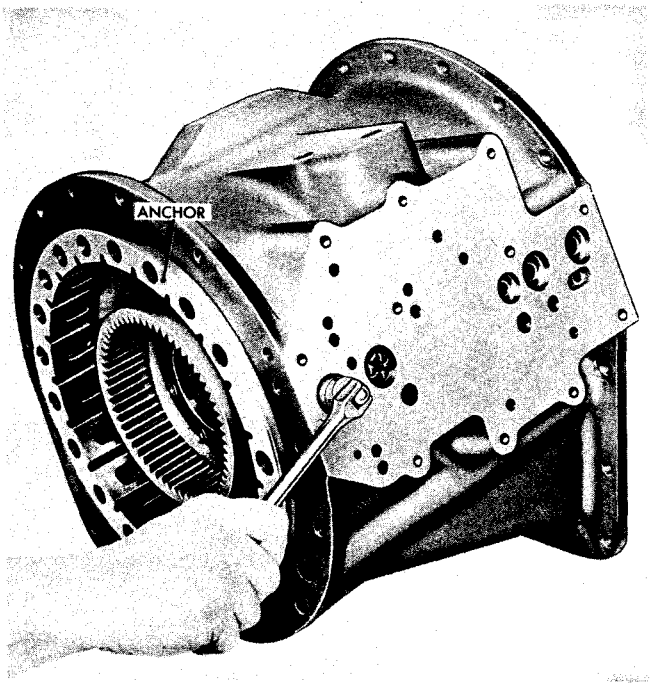


Fig VI-30. Removing or installing bolt that secures reverse clutch anchor

(5) Remove the intermediate-range clutch drum assembly (fig VI-53).

j. REMOVING REVERSE AND FORWARD CLUTCH PARTS

(1) Remove the bolt that secures the reverse clutch anchor (fig VI-30).

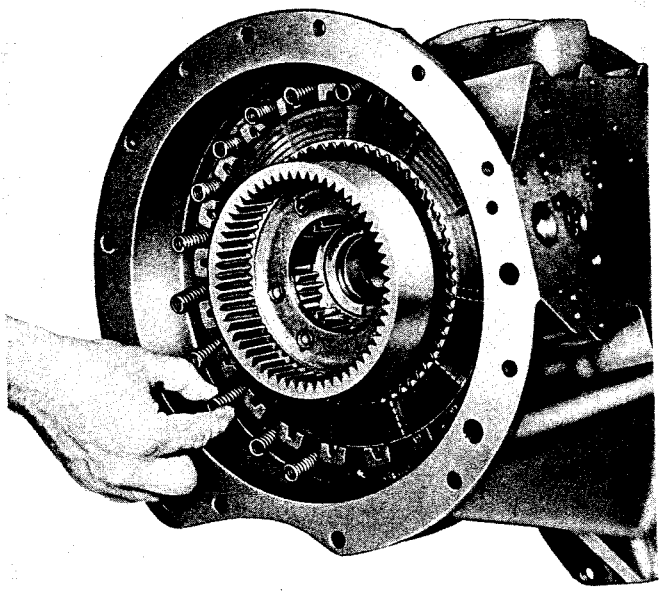


Fig VI-31. Removing or installing forward clutch piston springs

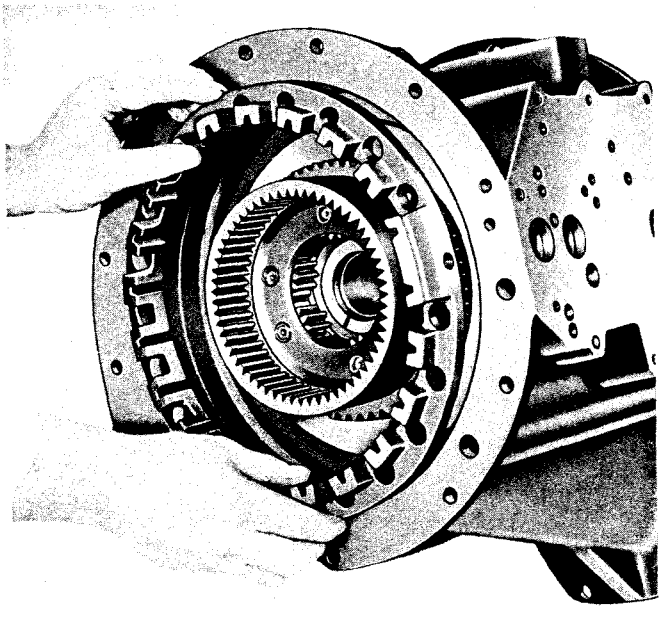


Fig VI-32. Removing or installing forward clutch anchor

CAUTION

Use caution because the reverse clutch anchor is under spring pressure.

(2) Remove the reverse clutch anchor (fig VI-52).

(3) Remove 20 forward clutch piston

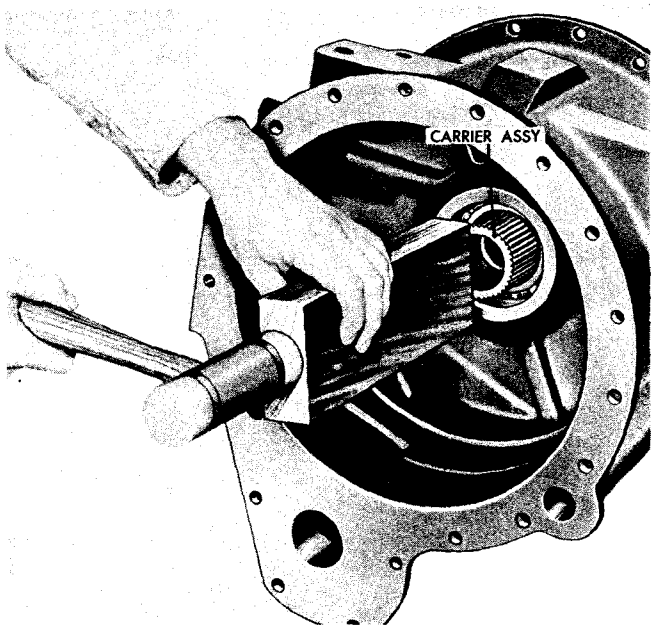


Fig VI-33. Loosening forward planetary carrier assembly

springs from the forward clutch anchor (fig VI-31).

(4) Remove the forward clutch plates (fig VI-51).

(5) Remove the bolt that secures the forward clutch anchor (fig VI-51).

(6) Remove the forward clutch anchor (fig VI-32).

(7) Loosen the forward planetary carrier assembly by tapping on the shaft end with a soft hammer (fig VI-33).

(8) Remove the forward planetary carrier assembly, the forward ring gear, and the reverse ring gear (fig VI-50). Support the carrier assembly as it begins to loosen, to prevent damage of parts.

(9) Remove the forward ring gear from the forward planetary carrier assembly (fig VI-50).

(10) Remove the thrust washer from the planetary carrier assembly (fig VI-34). Refer to section X, paragraph 1, for rebuild of the forward planetary carrier assembly.

(11) Remove the forward clutch apply piston (fig VI-49). Refer to section X, paragraph 3 for piston rebuild information.

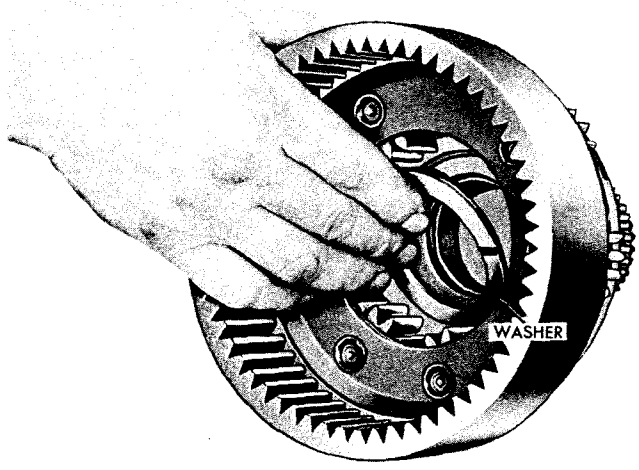


Fig VI-34. Removing or installing thrust washer from forward planetary carrier assembly

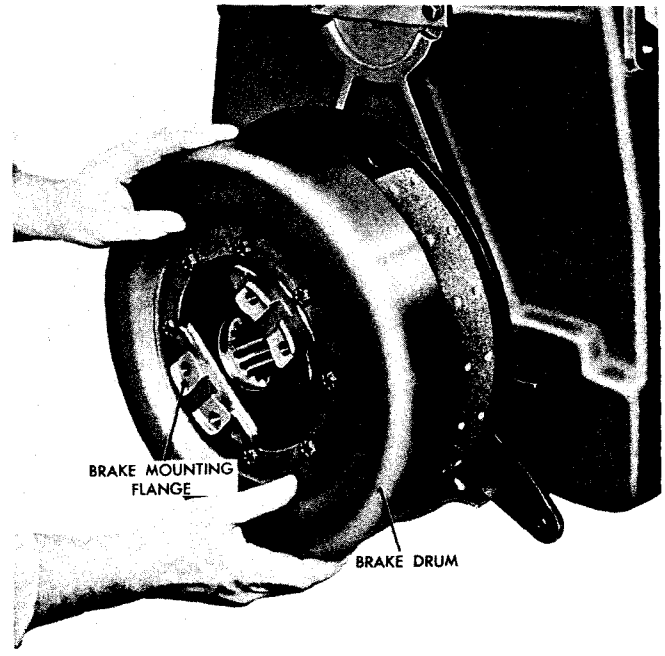


Fig VI-35. Removing or installing brake drum and brake mounting flange

k. REMOVING PARKING BRAKE

(1) Remove two bolts from the rear output shaft assembly and remove the locking strip and the flange retainer washer (fig XII-3).

NOTE

If the transmission is not equipped with a brake, remove the flange assembly. Some

transmissions may have a slip-fitting flange which is not secured to the shaft.

(2) Remove the brake drum and the brake mounting flange (fig VI-35).

(3) Remove the top brake spring (fig VI-48).

(4) Lift off the two brake shoes and the lower brake spring.

(5) Remove the brake lever (fig VI-36).

(6) Remove three bolts and lock washers that secure the brake backing plate to the rear oil pump housing (fig VI-36).

(7) Remove the brake backing plate (fig VI-47).

1. REMOVING OUTPUT DRIVE GEAR, OUTPUT OIL PUMP ASSEMBLY, AND FRONT OUTPUT FLANGE ASSEMBLY AND BEARING RETAINER

(1) Remove 12 bolts and lock washers from the output drive gear cover. Remove the cover and gasket (fig VI-37). Use jack screws in the holes provided if necessary.

(2) Remove the output drive gear and bearings (fig VI-37). Drive against the front side of the gear.

(3) Remove eight bolts and lock washers from the output oil pump assembly. Remove the pump assembly and the gasket (fig VI-46). Refer to section XII, paragraph 4 for rebuild of the output oil pump.

(4) Bend down the tabs on the locking strip and remove two bolts, the locking strip and the flange retainer washer from the front output flange assembly. Remove the front output flange assembly (fig VI-38).

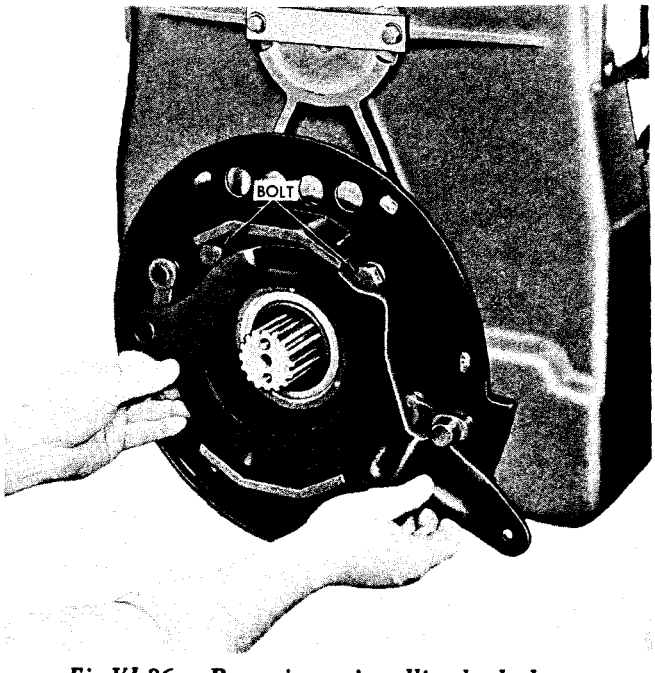


Fig VI-36. Removing or installing brake lever

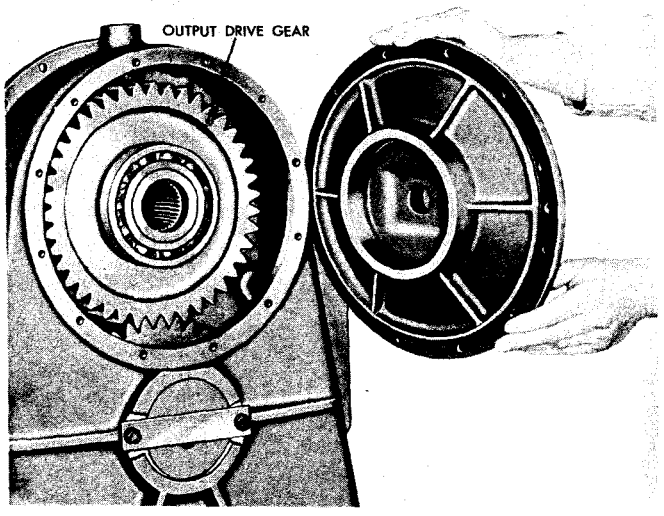


Fig VI-37. Removing or installing output drive gear cover

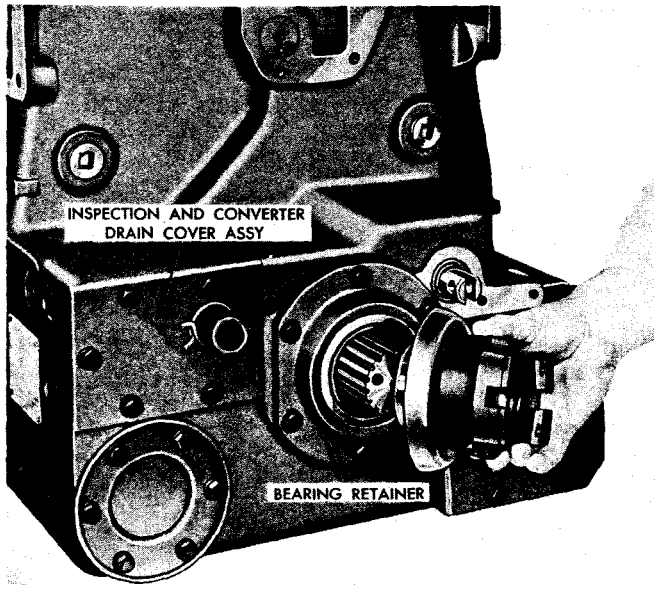


Fig VI-38. Removing or installing front output flange assembly

NOTE

Some transmissions may have a slip-fitting flange which is not secured to the shaft.

(5) Remove six bolts and lock washers from the front output shaft bearing retainer and remove the retainer and the gasket (fig VI-38).

m. REMOVING MISCELLANEOUS PARTS FROM TRANSFER GEAR HOUSING ASSEMBLY

(1) Remove six bolts and lock washers from the inspection and converter drain cover assembly. Remove the cover and gasket (fig VI-38).

(2) Remove six bolts and lock washers from the oil strainer. Remove the strainer (fig VI-45). Refer to section IV, paragraph 5b, e, and h for cleaning and inspection procedures.

NOTE

Steps (3), (4) and (5) below apply to transmissions equipped with a front output disconnect clutch. If a disconnect clutch is not used, remove the front output shaft, bearing assembly and straight coupling. Do not remove the snap ring from the coupling unless replacement is necessary.

(3) Support the shifter fork through the access hole and remove the shifter shaft by unthreading it from the shifter fork (fig VI-44). Figure VI-39 shows the relationship of the front output shaft, the shifter shaft and the shifter fork.

(4) Remove the front output shaft, bearing assembly, and coupling, (fig VI-40). Hold the shifter fork so that the front output shaft can pass through.

(5) Remove the shifter fork from the housing.

(6) Do not remove the check valve spring check valve, or check valve guide (figs

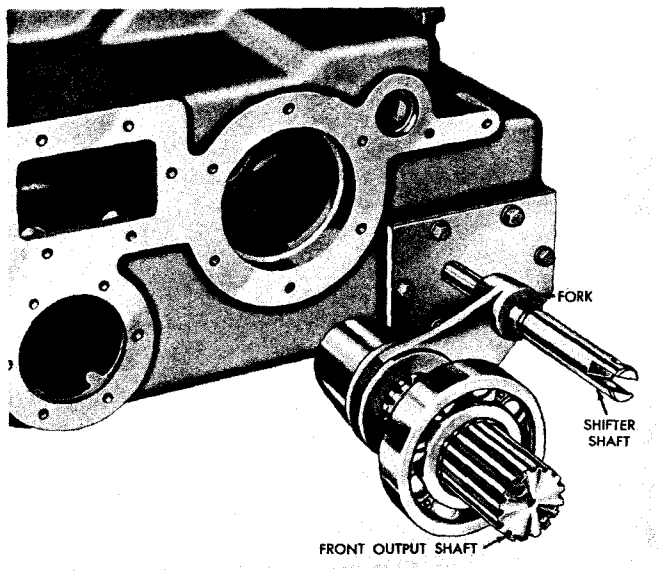


Fig VI-39. Front output shaft, shifter shaft and shifter fork assembled as in transfer gear housing

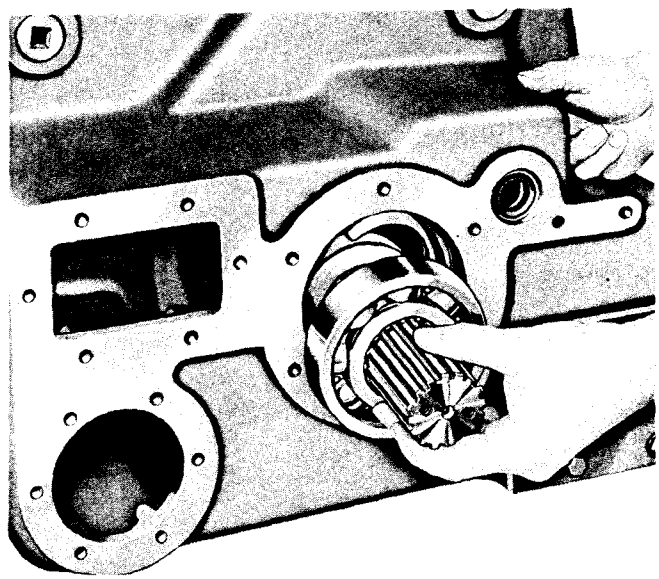


Fig VI-40. Removing or installing front output shaft and bearing assembly, and coupling

VI-46 and items 53, 54, and 55, fig XII-1) unless necessary for the replacement of parts. If removal is necessary, the guide must be pulled from the housing.

(7) Remove the hook-type seal ring (12, fig XII-1) from the hub of the transfer gear housing.

n. REMOVING REAR OUTPUT SHAFT ASSEMBLY, OUTPUT IDLER GEAR AND BEARING ASSEMBLY, SPINDLE, AND OUTPUT DRIVEN GEAR

(1) Remove the snap ring that retains

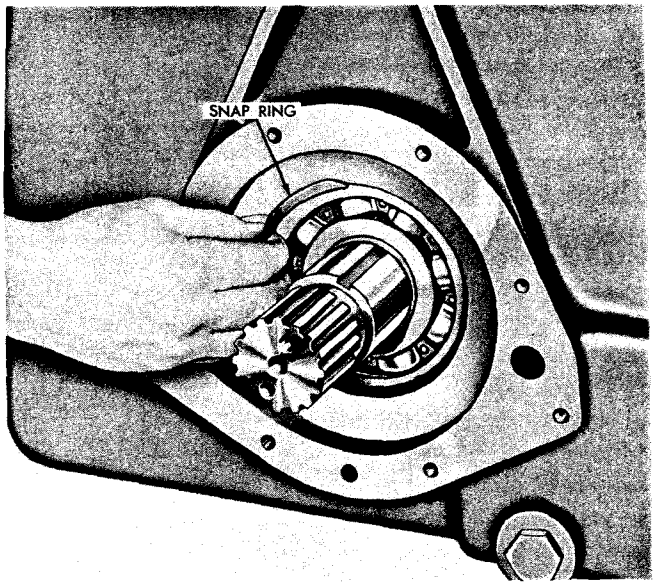


Fig VI-41. Removing or installing snap ring that retains rear output shaft assembly and bearing assembly

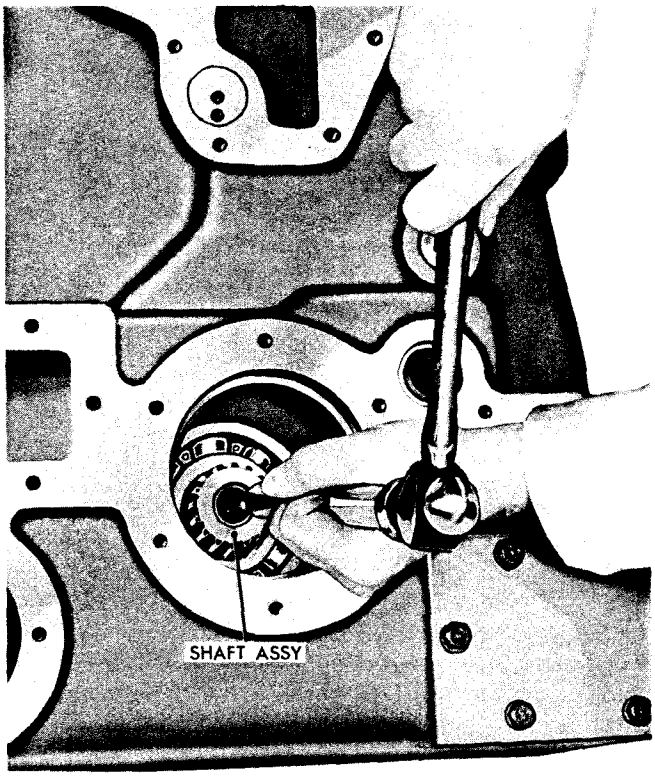


Fig VI-42. Driving out rear output shaft assembly, output driven gear spacer, and single row ball bearing assembly

the rear output shaft assembly and the bearing assembly (fig VI-41).

(2) Using a soft drift and a hammer, drive the rear output shaft assembly, the output driven gear spacer and the single row ball bearing assembly from the transfer gear housing assembly (fig VI-42).

(3) The output idler gear (80, fig XII-1) and related parts need not be disassembled except for replacement of parts. If it becomes necessary to replace the output idler gear, output idler gear spindle (47, fig XII-1) or the double row ball bearing assembly (49, fig XII-1), proceed as outlined below.

(4) Remove two bolts and lock washers from the output idler gear retainer. Remove the retainer (fig VI-43).

(5) Supporting the transfer gear housing as near the large end of the spindle as possible, press against the small end of the spindle to remove it from the housing.

(6) Remove the output idler gear and the double row ball bearing assembly from the transfer gear housing assembly. Remove the snap rings from the idler gear and remove the bearing from the gear.

(7) Remove the spacer (51, fig XII-1) from the transfer gear housing.

(8) Remove the output driven gear and the bearing assembly from the transfer gear housing assembly.

4. ASSEMBLY OF MODEL CRT-3330-1 TRANSMISSION

a. INSTALLING OUTPUT DRIVEN GEAR, REAR OUTPUT SHAFT ASSEMBLY, OUTPUT IDLER GEAR AND BEARING ASSEMBLY, AND OUTPUT IDLER GEAR SPINDLE

(1) If the output driven gear was removed, position the bearing assembly (24, fig XII-1) and the output driven gear (28, fig XII-1) in the transfer gear housing.

(2) Install the rear output shaft assembly (25, fig XII-1), the output driven gear spacer (29, fig XII-1) and the single row ball bearing assembly (30, fig XII-1) into the transfer gear housing, making sure the shaft splines enter the gear. Tap the shaft into place with a soft drift and a hammer.

(3) Install the snap ring that retains the rear output shaft assembly and the bearing assembly (fig VI-41).

(4) Pack the output idler gear spindle (47, fig XII-1) in dry ice for at least an hour.

(5) Install the spacer (51, fig XII-1) into the transfer gear housing.

NOTE

If the transmission has the standard 1 to 1 gear ratio in the transfer gear housing, install the spacer with the bore and the dowel holes up. If the transmission has an optional gear ratio of 1.62 to 1, install the spacer with the bore and the dowel holes down.

(6) Lay the transfer gear housing down with the large bore of the output idler gear spindle up. Block up the housing so that it is level.

(7) Install the double row ball bearing (49, fig XII-1) and snap rings (48, fig XII-1) into the output idler gear. Position the output idler gear and the double row ball bearing assembly in the transfer gear housing with the bore of the ball bearing assembly aligned with the bore in the transfer gear housing.

(8) Take the output idler gear spindle out of the dry ice and quickly install it in the transfer gear housing and the output idler gear.

(9) Install the retainer (fig VI-43).

(10) Install two bolts and lock washers in the retainer.

b. INSTALLING MISCELLANEOUS PARTS INTO TRANSFER GEAR HOUSING ASSEMBLY

(1) Install the shifter fork and hold it with one hand. Install the front output shaft, bearing assembly, and coupling with the other hand, guiding the fork into position on the coupling (fig VI-40).

(2) Support the shifter fork through the access hole and install the shifter shaft by threading it into the shifter fork (fig VI-44).

(3) Install the oil strainer (fig VI-45).

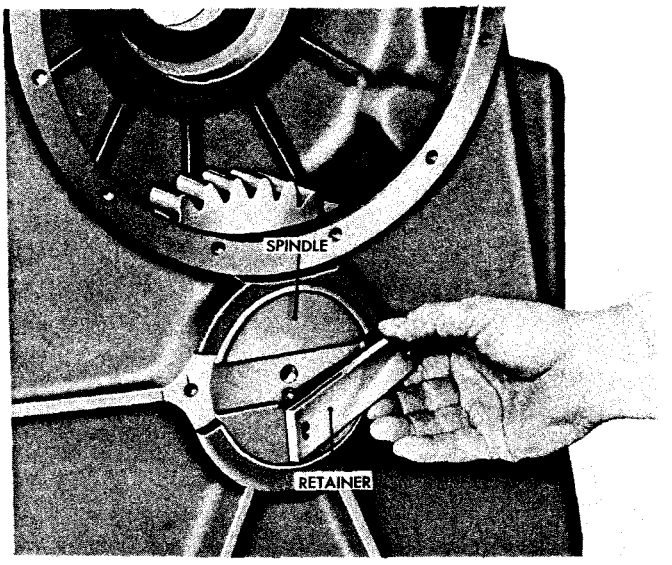


Fig VI-43. Removing or installing retainer from transfer gear housing assembly and output idler gear spindle

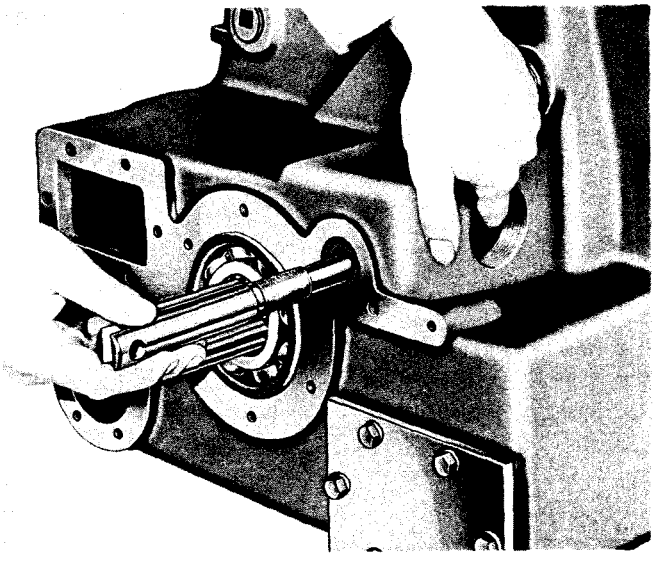


Fig VI-44. Removing or installing shifter shaft

Secure it with six bolts and lock washers.

(4) Install the inspection and converter drain cover assembly and gasket and secure it with six bolts and lock washers (fig VI-38).

c. INSTALLING FRONT OUTPUT SHAFT BEARING RETAINER, FRONT OUTPUT FLANGE ASSEMBLY, OUTPUT OIL PUMP ASSEMBLY, OUTPUT DRIVE GEAR, AND OUTPUT DRIVE GEAR COVER

(1) Install the bearing retainer on the front output shaft and secure it with six bolts and lock washers (fig VI-38).

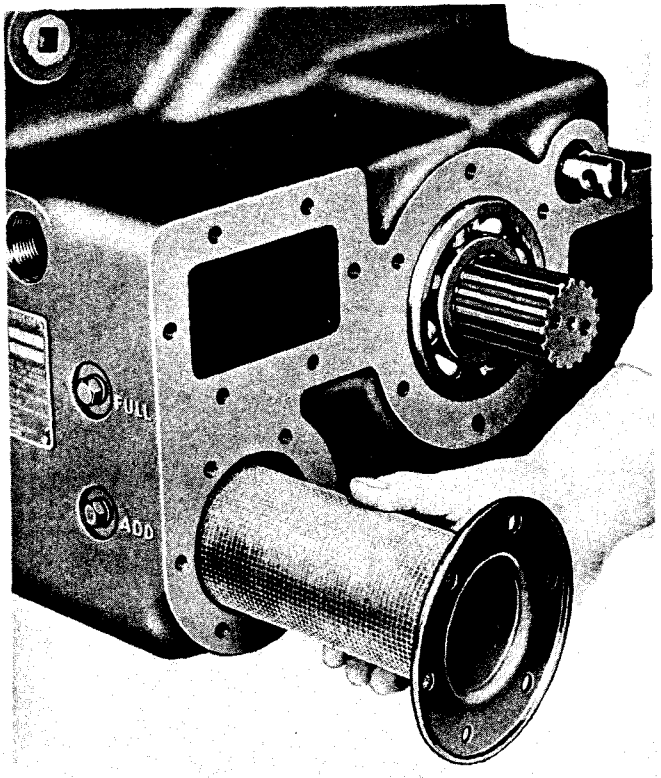


Fig VI-45. Removing or installing oil strainer

(2) Install the front output flange assembly on the splines of the front output shaft (fig VI-38). Install the flange retainer washer, the locking strip, and two bolts. Bend up the locking strip tabs up to lock the bolt heads.

(3) Inspect the check valve (fig VI-46) for freeness of operation and install the output oil pump assembly and the gasket (fig VI-46). Install eight bolts and lock washers in the pump assembly.

(4) Install the output drive gear and the bearings (fig VI-37). Tap the gear into position.

(5) Install the output drive gear cover and secure it with 12 bolts and lock washers (fig VI-37).

d. INSTALLING PARKING BRAKE

(1) Install the brake backing plate (fig VI-47) and secure it with three bolts and lock washers.

(2) Install the brake lever (fig VI-36).

(3) Install the two brake shoes and the lower brake spring (fig VI-48).

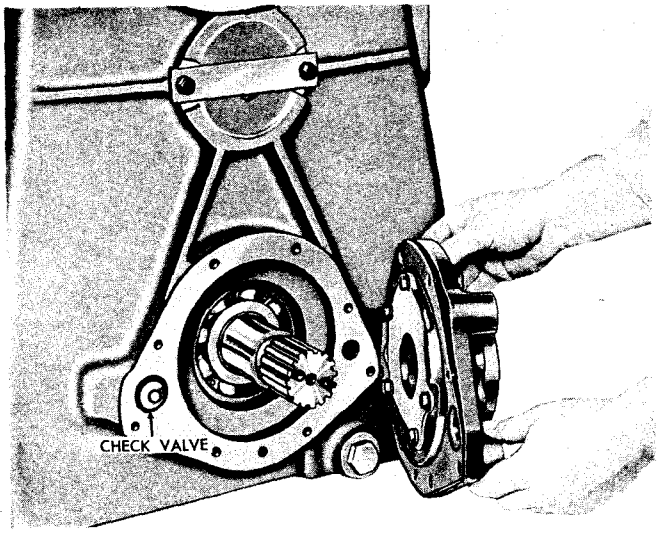


Fig VI-46. Removing or installing output oil pump assembly

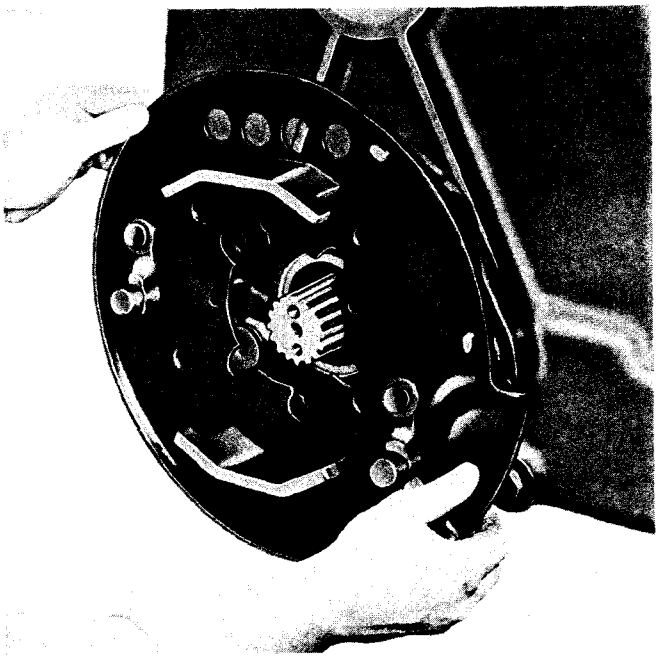


Fig VI-47. Removing or installing brake backing plate

(4) Install the upper brake spring (fig VI-48).

(5) Install the brake drum and the brake mounting flange (fig VI-35).

(6) Install the flange retainer washer, the locking strip and two bolts. Bend up the tabs on the locking strip to lock the bolts.

e. INSTALLING FORWARD AND REVERSE CLUTCH PARTS

(1) Install the forward clutch apply piston (fig VI-49).

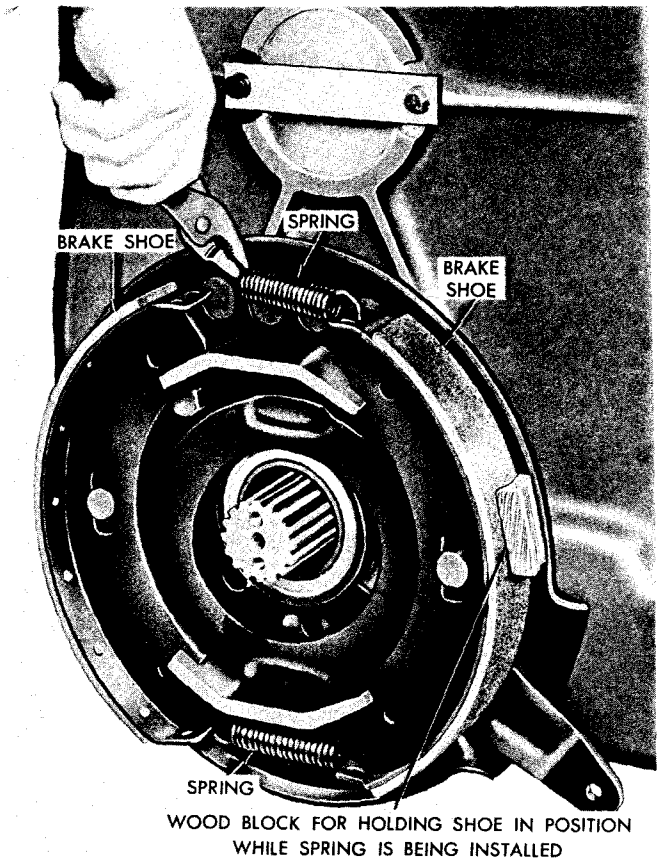


Fig VI-48. Removing or installing top brake spring

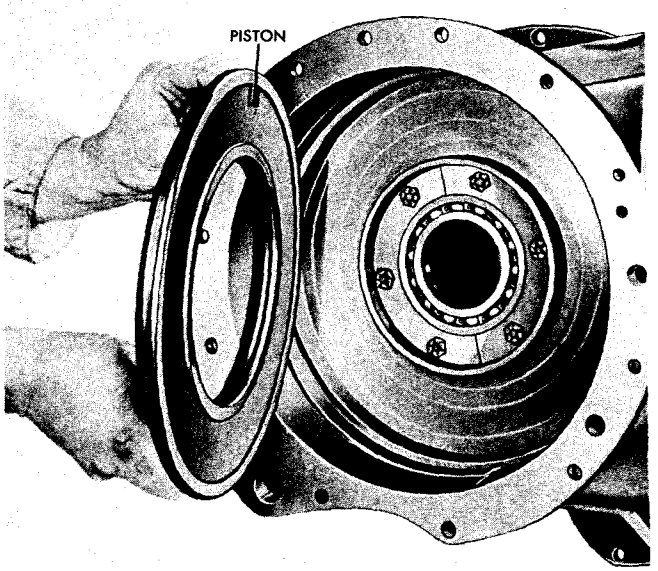


Fig VI-49. Removing or installing forward clutch apply piston

(2) Install the thrust washer into the forward planetary carrier assembly (fig VI-34).

(3) Install the forward ring gear on the forward planetary carrier assembly (fig VI-50).

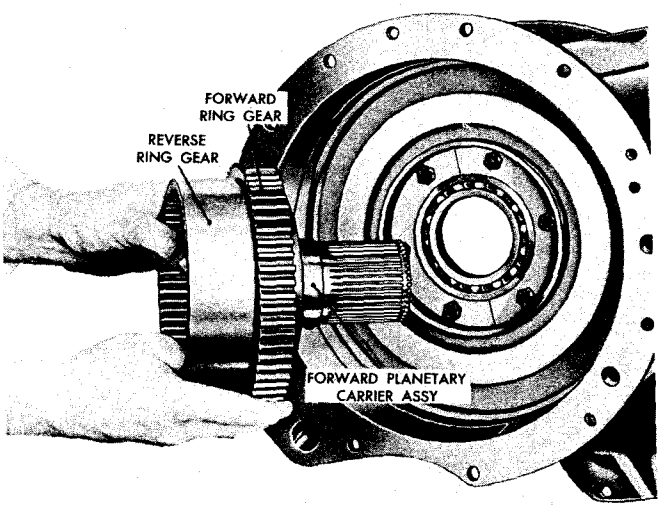


Fig VI-50. Removing or installing forward planetary carrier assembly, forward ring gear, and reverse ring gear

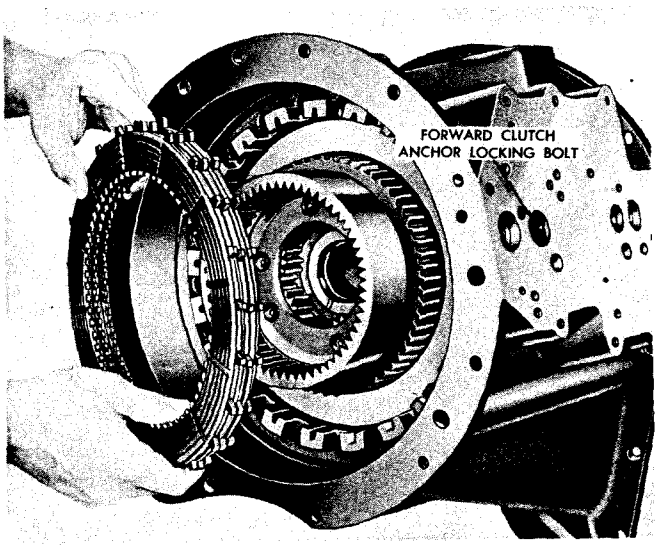


Fig VI-51. Removing or installing forward clutch plates

(4) Install the forward planetary carrier assembly, the forward ring gear, and the reverse ring gear (fig VI-50). Tap the assembly into position.

(5) Install the forward clutch anchor (fig VI-32). Install the bolt that locks the forward clutch anchor (fig VI-51).

(6) Install the forward clutch plates (fig VI-51).

(7) Install 20 forward clutch piston springs into the forward clutch anchor (fig VI-31).

(8) Install the reverse clutch anchor (fig VI-52). Install the bolt that locks the reverse clutch anchor (fig VI-30).

f. INSTALLING INTERMEDIATE-RANGE CLUTCH PARTS

(1) Install the intermediate-range clutch drum assembly (fig VI-53).

(2) Install the snap ring on the forward planetary carrier (fig VI-54).

NOTE

On the CRT-3330-3 model, install a thrust washer on the transmission shaft assembly. On the CRT-3330-1 model a snap ring is used in place of the thrust washer. Refer to section XI, paragraph 2.

(3) Install the transmission shaft assembly (fig VI-29).

(4) Install the intermediate-range clutch hub (fig VI-55).

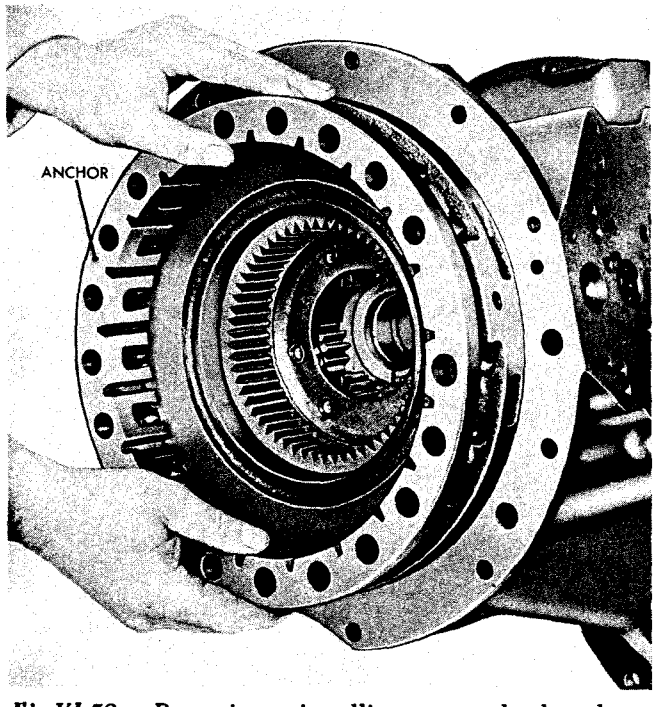


Fig VI-52. Removing or installing reverse clutch anchor

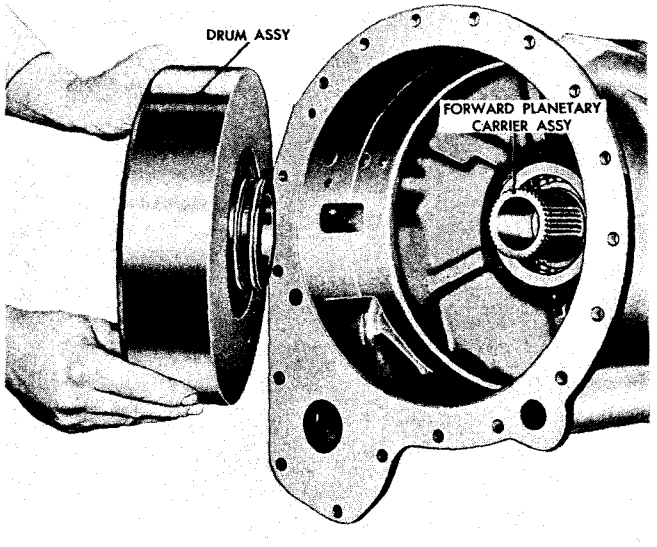


Fig VI-53. Removing or installing intermediate-range clutch drum assembly

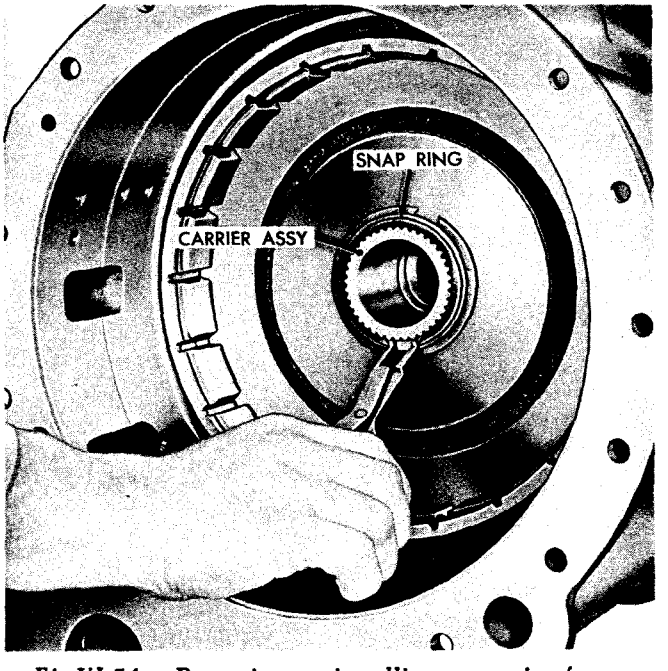


Fig VI-54. Removing or installing snap ring from forward planetary carrier assembly

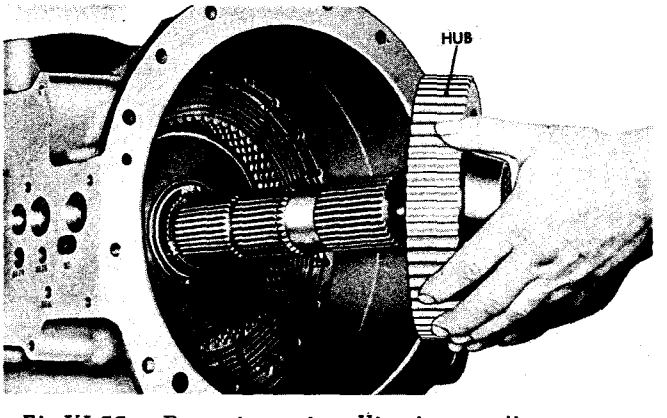


Fig VI-55. Removing or installing intermediate-range clutch hub

(5) Install the intermediate-range clutch plates (fig VI-29).

g. INSTALLING HIGH-RANGE PLANETARY GEARING AND CLUTCH PARTS

(1) Install the high-range sun gear (fig VI-56).

(2) Install the spacer (fig VI-56).

(3) Install the high-range planetary carrier assembly and the low-range sun gear (fig VI-56).

(4) Install the snap ring that retains the high-range planetary carrier assembly (fig VI-28).

(5) Install the high-range clutch reaction plate (fig VI-57). Install the bolt that locks the high-range clutch reaction plate (fig VI-27).

(6) Install the high-range clutch anchor (fig VI-27). Install the bolt that locks the high-range clutch anchor (fig VI-26).

(7) Install the high-range planetary ring gear (fig VI-26).

(8) Install the high-range clutch plates (fig VI-26).

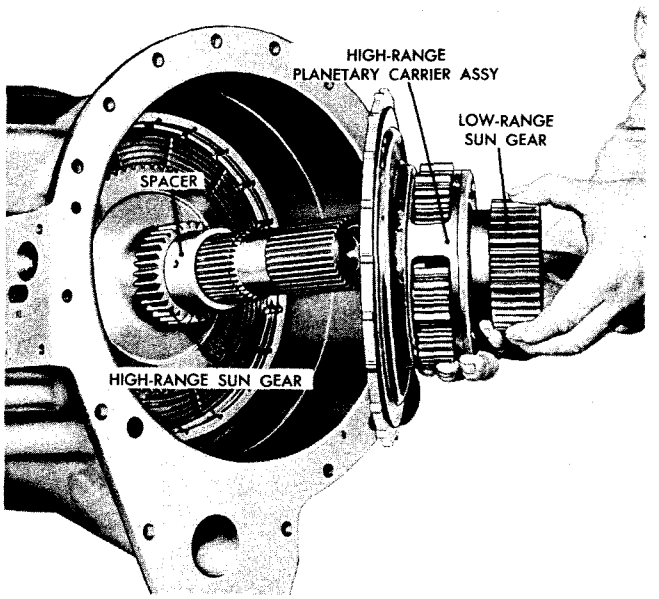


Fig VI-56. Removing or installing high-range planetary carrier assembly and low-range sun gear

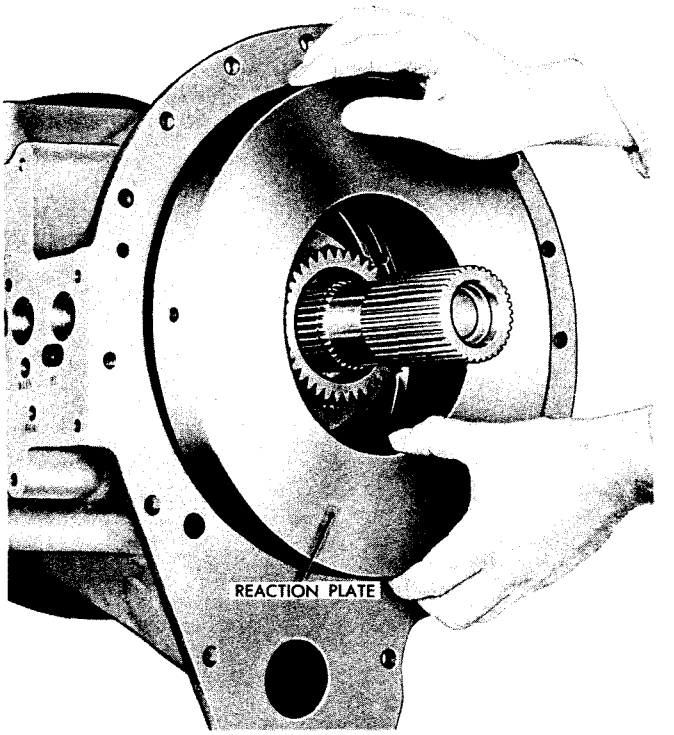


Fig VI-57. Removing or installing high-range clutch reaction plate

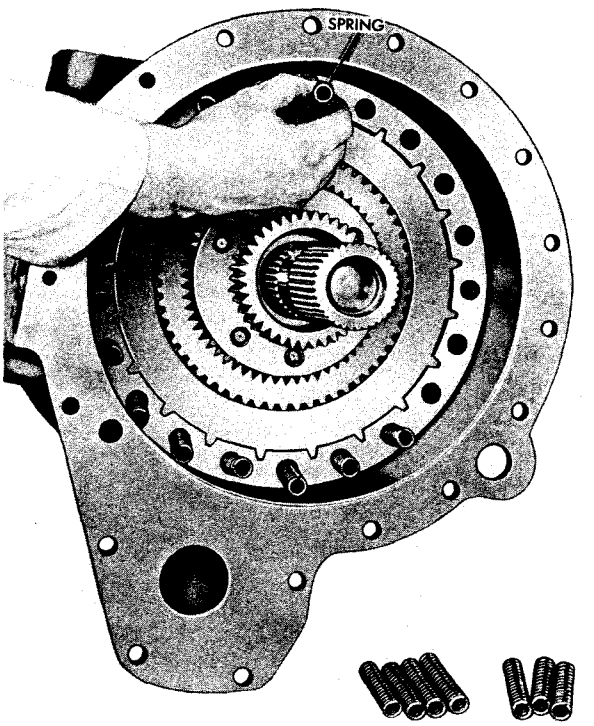


Fig VI-58. Removing or installing high-range clutch piston return springs

(9) Install 20 high-range piston return springs (fig VI-58).

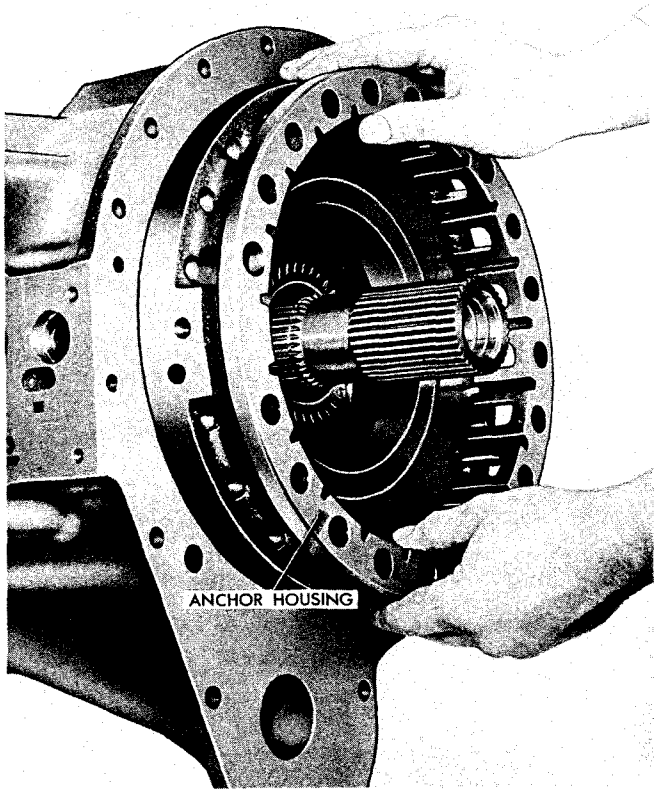


Fig VI-59. Removing or installing high-range clutch piston and low-range anchor housing

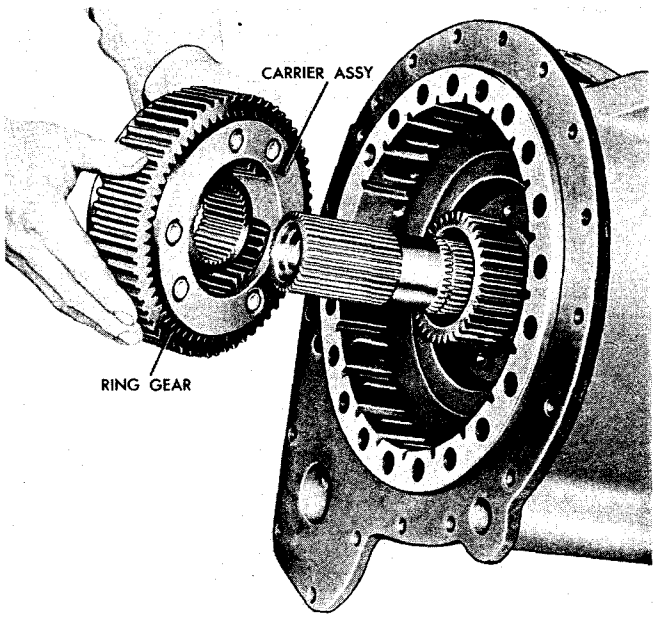


Fig VI-60. Removing or installing low-range planetary carrier assembly and low-range ring gear

h. INSTALLING LOW-RANGE PLANETARY GEARING AND CLUTCH ANCHOR

(1) Install the high-range clutch piston into the high-range piston and low anchor housing (fig VI-25).

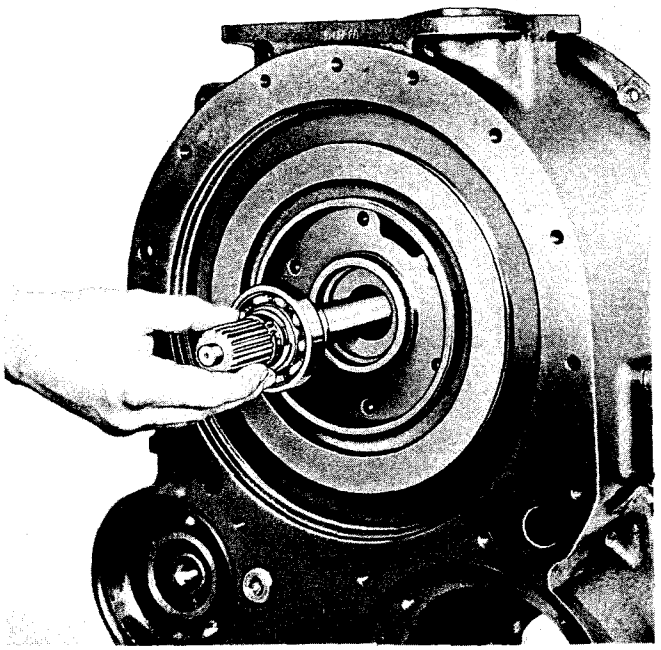


Fig VI-61. Removing or installing converter shaft and bearing assembly

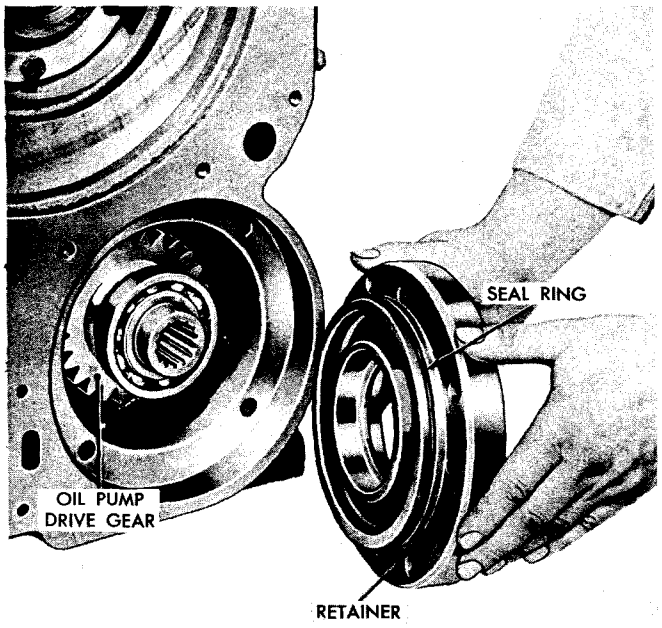


Fig VI-62. Removing or installing bearing retainer

(2) Install the high-range piston and low anchor housing into the transmission housing (fig VI-59). Install the bolt that locks the high-range piston and low anchor housing (fig VI-24).

(3) Install the low-range planetary ring

gear on the low-range planetary carrier assembly (fig VI-60).

(4) Install the low-range planetary carrier assembly and the low-range ring gear on the transmission shaft assembly (fig VI-60).

(5) Install the snap ring on the transmission shaft assembly (fig VI-23).

i. INSTALLING REVERSE PISTON, CONVERTER SHAFT ASSEMBLY, ACCESSORY DRIVE IDLER GEAR, AND OIL PUMP DRIVE GEAR

(1) Install the reverse clutch apply piston (fig VI-22).

(2) Install the converter shaft and bearing assembly (fig VI-61).

(3) Install the retainer (fig VI-21). Install six bolts to secure the retainer.

(4) Install the accessory drive idler gear and the ball bearing assembly (fig VI-19). The snap ring goes next to the housing. Align the bearing assembly with the bore in the converter housing and install the accessory drive idler gear spindle. Install the bolt in the spindle (fig VI-19).

(5) Install the oil pump drive gear and bearings (fig VI-62).

(6) Install the bearing retainer (fig VI-62). Install four bolts and lock washers in the bearing retainer.

j. INSTALLING CONVERTER ELEMENTS, CONVERTER PUMP COVER ASSEMBLY, AND INPUT CHARGING OIL PUMP ASSEMBLY

(1) Install the converter pump assembly (fig VI-63).

(2) Install the spacer against the converter pump assembly (fig VI-64).

(3) Install the stator spacer (fig VI-17).

(4) Install the snap ring on the converter ground sleeve (fig VI-17).

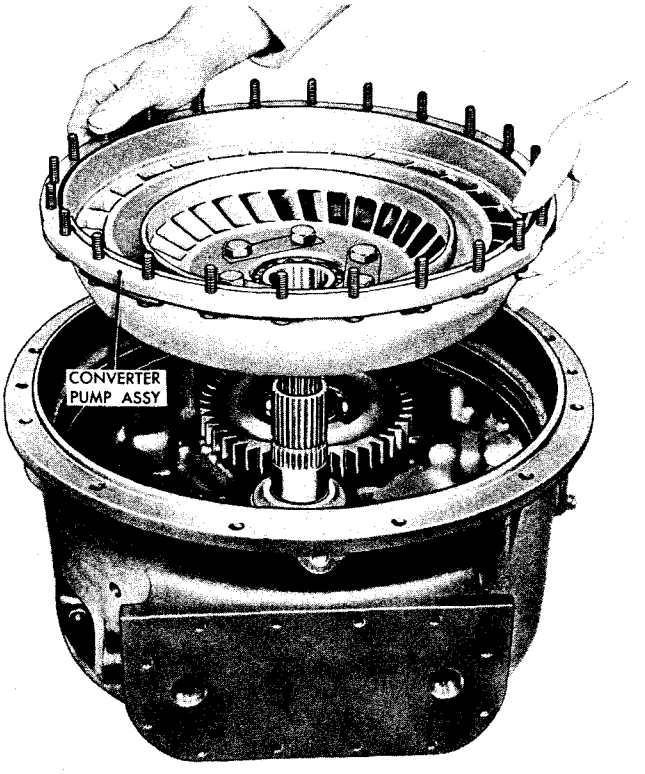


Fig VI-63. Removing or installing converter pump assembly

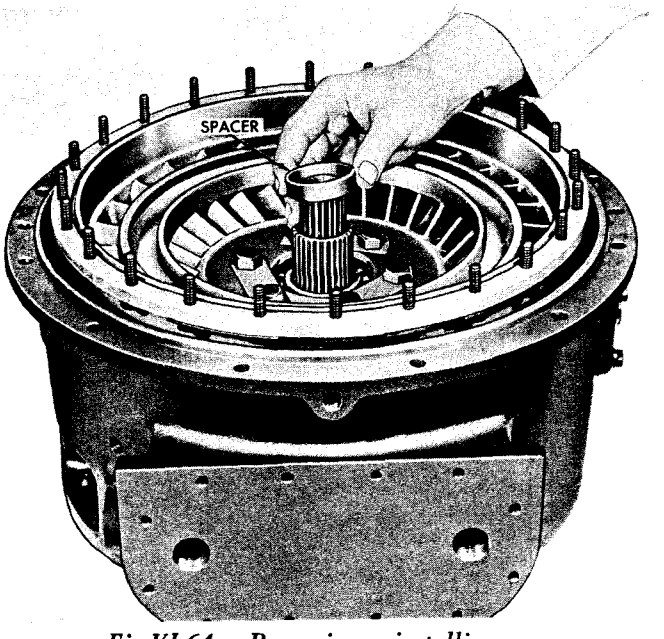


Fig VI-64. Removing or installing spacer

(5) Install the freewheel race (fig VI-65).

(6) Lay both stator assemblies, flat side up, on a table. A close examination will show that there is a difference in the thickness of

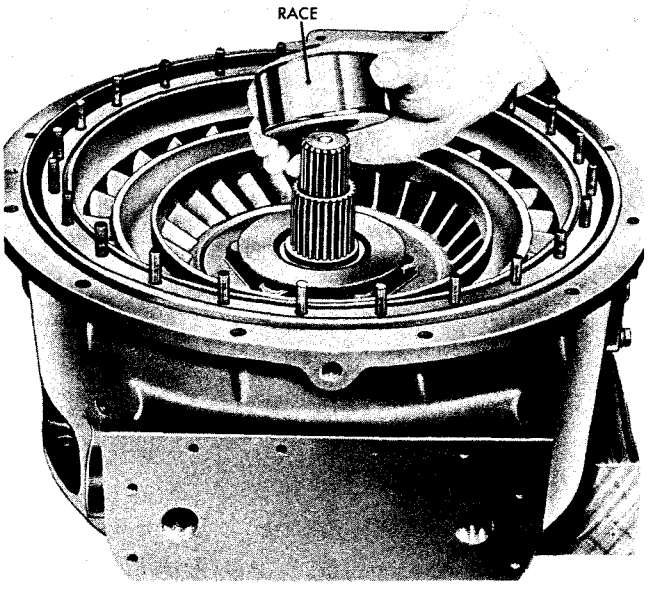


Fig VI-65. Removing or installing freewheel race

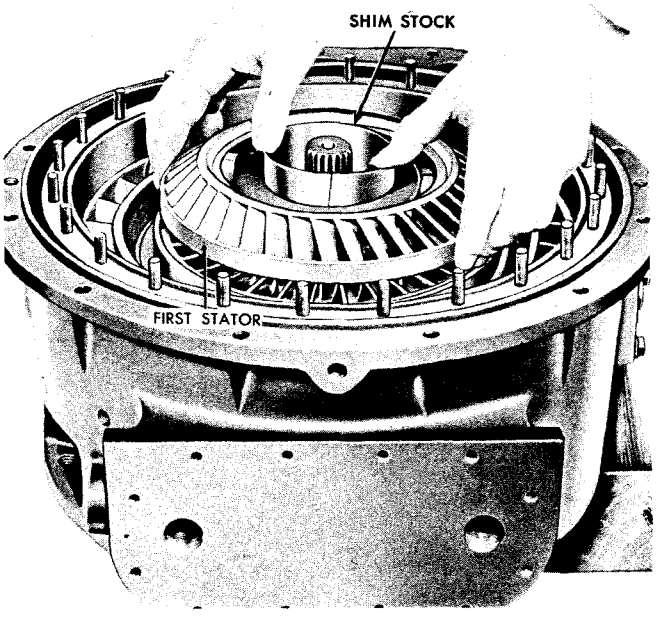


Fig VI-66. Removing or installing first stator

the edges of the stator blades. The stator with the thin-edge blades is the first stator. The stator with the thick-edge blades is the second stator.

(7) Install the second stator, using a cylinder of shim stock to keep the freewheel rollers and the freewheel roller springs from falling out. Refer to figure VI-66 showing the first stator.

(8) Install the spacing washer (fig VI-16).

(9) Install the first stator the same way that the second stator was installed (fig VI-66).

(10) Install the stator thrust washer (fig VI-15).

(11) Install the turbine (fig VI-15).

(12) Install the turbine thrust washer (fig VI-67). See figure VII-3.

(13) Install the converter pump cover assembly, the converter drive shaft and the bearing (fig VI-67).

NOTE

If the transmission is mounted directly on the engine, install only the converter pump cover assembly. If a converter housing seal diaphragm is used (70, fig VIII-1) install the seal ring (68, fig VIII-1) in the groove on the converter-pump-to-pump-cover mounting flange.

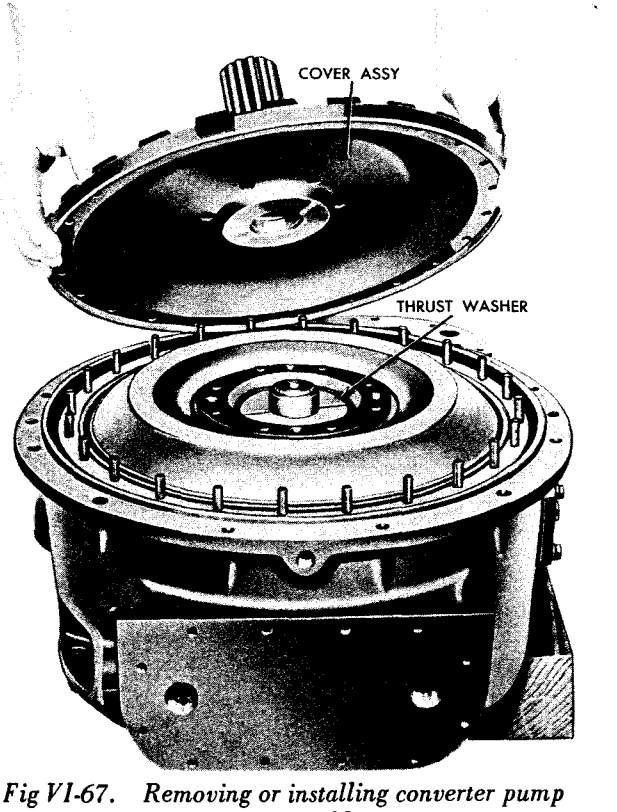


Fig VI-67. Removing or installing converter pump cover assembly

(14) Install 24 hexagon lock nuts on the converter pump cover assembly.

(15) Install the transmission front cover. Refer to figure 14 showing removal. Install 12 bolts to secure the transmission front cover to the converter housing assembly.

(16) Install the oil pump drive coupling (fig VI-68).

(17) Install the input driven charging oil pump assembly (fig VI-13). Install six bolts and lock washers in the oil pump cover—four corners and two ends.

(18) Install the input flange assembly, the flange retainer washer, the locking strip, and two bolts (fig VI-5). Bend up the tabs on the locking strip to lock the bolt heads.

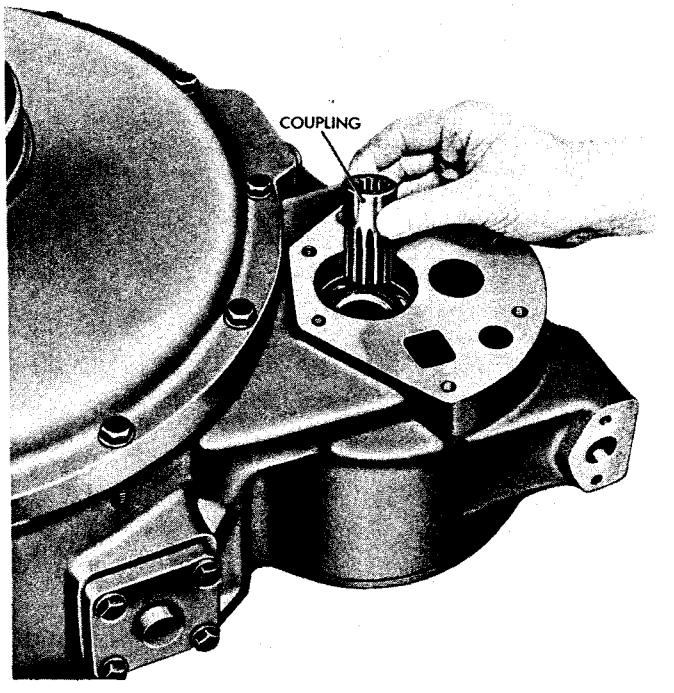


Fig VI-68. Removing or installing oil pump drive coupling

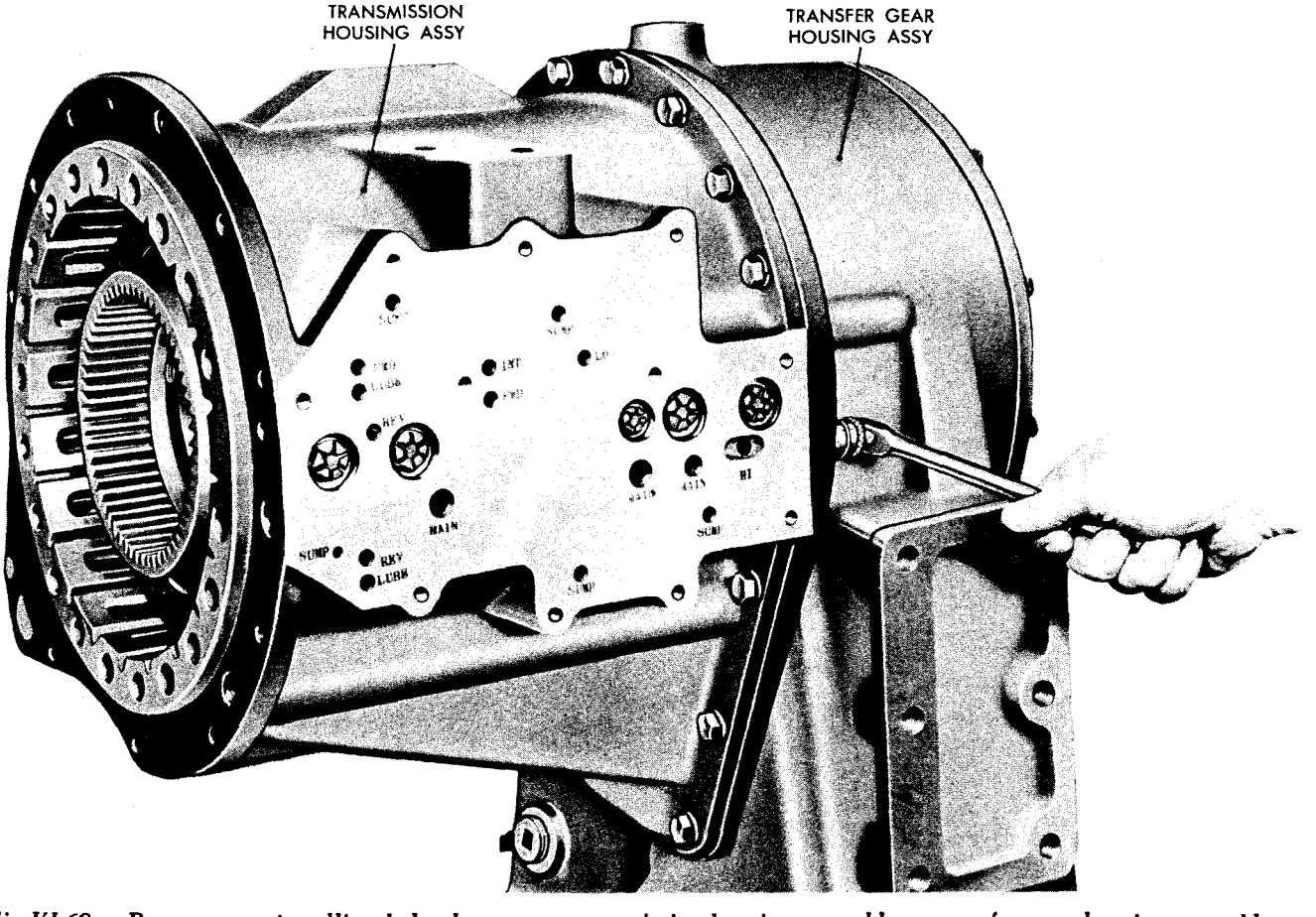


Fig VI-69. Removing or installing bolts that secure transmission housing assembly to transfer gear housing assembly

k. INSTALLING TRANSMISSION HOUSING ASSEMBLY ON TRANSFER GEAR HOUSING ASSEMBLY

(1) Install the low-range clutch plates and the low-range piston return springs.

(2) Install the transmission housing assembly on the transfer gear housing assembly (fig VI-12).

(3) Install 18 bolts and lock washers to secure the transmission housing to the transfer gear housing (fig VI-69).

l. INSTALLING REVERSE CLUTCH PLATES, REVERSE PLANETARY GEARING ASSEMBLY AND CONVERTER HOUSING ASSEMBLY

(1) Install the reverse clutch plates (fig VI-70).

(2) Install the reverse planetary carrier assembly and the forward and reverse sun gear (fig VI-11).

(3) Install 20 reverse piston return springs in the reverse clutch anchor (fig VI-10).

(4) Install the converter housing assembly on the transmission housing assembly (fig VI-10).

(5) Install 13 bolts and lock washers to secure the converter housing assembly to the transmission housing assembly (fig VI-71).

m. INSTALLING MINOR SUBASSEMBLIES

(1) Install the pressure regulator valve body assembly (fig VI-9). Install five bolts and lock washers in the valve body assembly.

(2) Install the oil filter assembly and gasket (fig VI-8). Install the bolt in the center of the filter assembly.

NOTE

If the transmission has a remote mounted oil filter assembly, install the remote oil filter adapter and gasket.

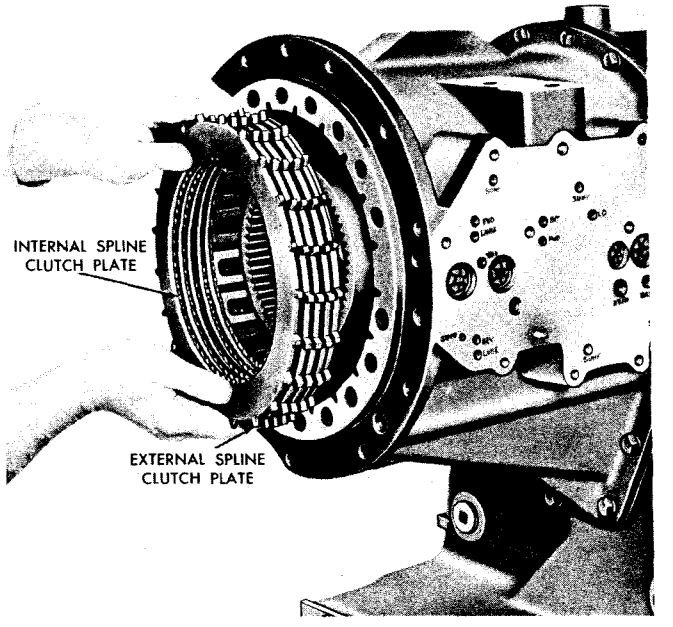


Fig VI-70. Removing or installing reverse clutch plates

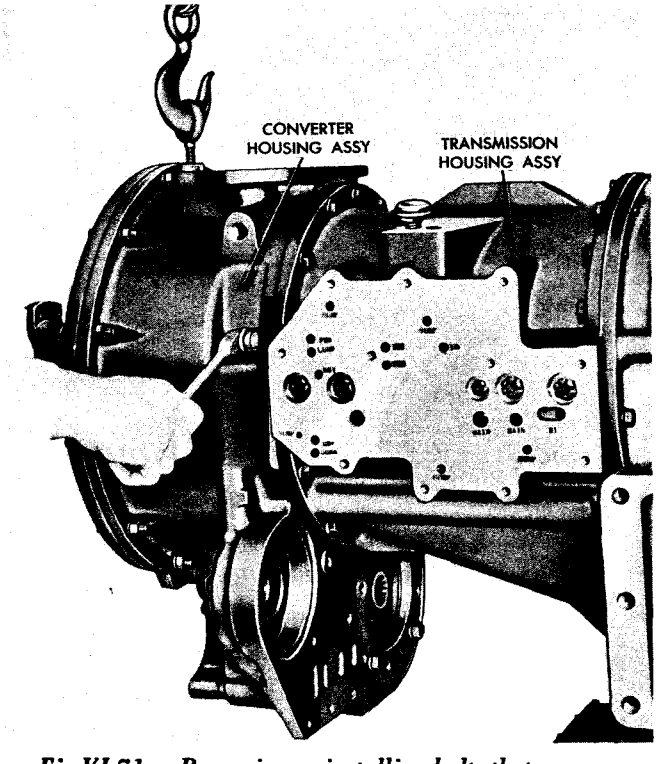


Fig VI-71. Removing or installing bolts that secure torque converter housing assembly to transmission housing assembly

(3) Install the converter housing drain tube assembly and install two bolts in the tube assembly (fig VI-7).

(4) Install the hose clamps on the converter housing drain tube assembly hose (fig VI-7).

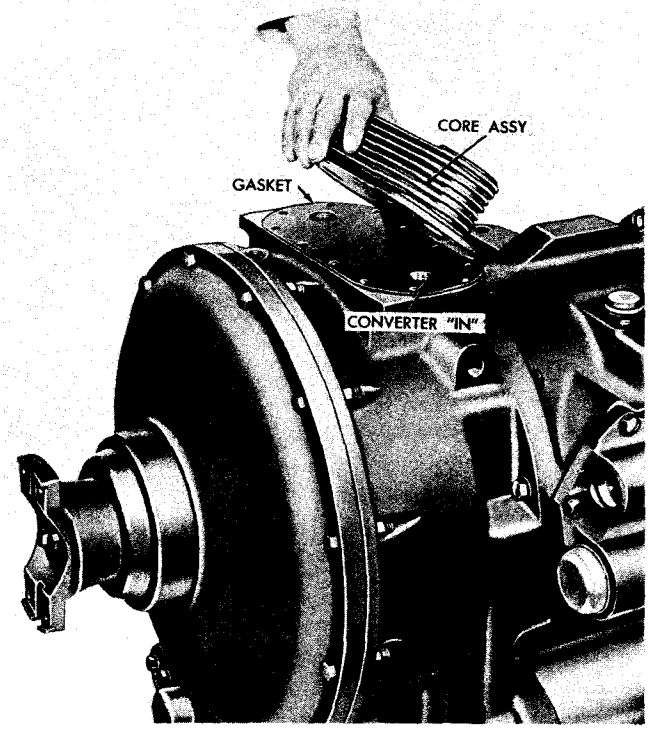


Fig VI-72. Removing or installing oil cooler core assembly

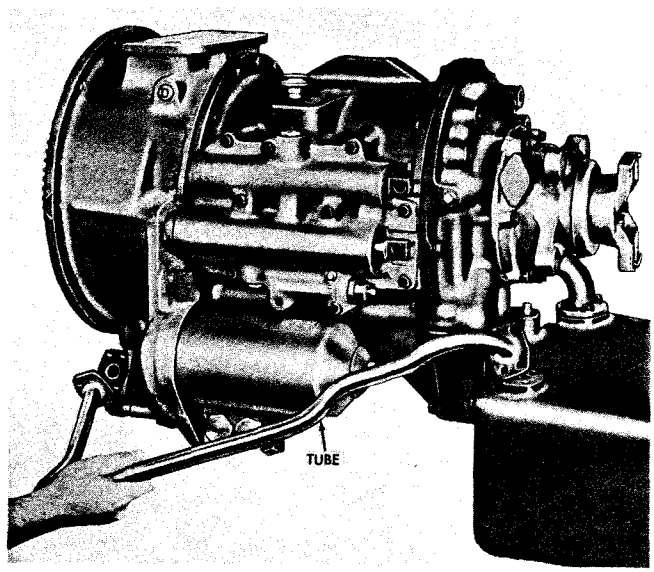


Fig VI-73. Removing or installing oil drain tube

(5) Install the selector valve body assembly and the gasket (fig VI-6). Install 11 bolts in the body assembly.

(6) Install the oil cooler core assembly and the gasket (fig VI-72). Install the oil cooler cover and gasket (fig VI-5). Install 12 bolts in the cover.

5. DISASSEMBLY OF MODEL CRT-3330-3 TRANSMISSION

a. BASIC SIMILARITIES

(1) The torque converter housing assembly and the transmission housing assembly of the model CRT-3330-1 transmission are identical to the same assemblies in the Model CRT-3330-3.

(2) The Model CRT-3330-1 has a transfer gear housing assembly, which contains the transfer gears. The Model CRT-3330-3 has an oil sump adapter, bearing retainer, and an oil sump in place of the transfer gear housing assembly.

(3) The Model CRT-3330-3 is disassembled as outlined in section VI, paragraph 3 with the exception of the removal of the oil sump adapter, oil sump, and related parts, which is outlined in b and c below.

NOTE

If only the adapter, oil sump, and related parts need to be removed, place the transmission on its front end (fig VI-74); the clutch plates in the transmission housing assembly will not tend to fall out. Otherwise place the transmission bottom side down (par 2b, section VI).

b. REMOVING OIL DRAIN TUBE, OUTPUT DRIVEN OIL PUMP SUCTION TUBE AND OIL SUMP

(1) Remove the bolts that secure the oil drain tube to the oil sump, the selector valve body, and the input pressure and scavenge oil pump assembly. Remove the oil drain tube and gaskets (fig VI-73).

(2) Set the transmission on its front end for easier access.

(3) Remove the bolts that secure the output driven oil pump suction tube to the oil sump and the adapter. Remove the oil pump suction tube and gaskets (fig VI-74).

(4) Remove the bolts that secure the