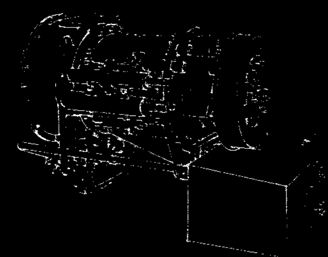
SERVICE MANUAL



SERIES CRT 3531, 3630

Allison

SERVICE MANUAL

Allison TORQMATIC® DRIVE

SERIES CRT 3531, 3630

TORQMATIC®

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Prepared
by

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TABLE OF CONTENTS

Section I. GENERAL INFORMATION

Section II. DESCRIPTION AND OPERATION

Section III. PREVENTIVE MAINTENANCE

Section III. PREVENTIVE MAINTENANCE (Continued)

Section IV. GENERAL OVERHAUL INFORMATION

Section V. DISASSEMBLY OF TRANSMISSION INTO SUBASSEMBLIES

Section VI. REBUILD OF SUBASSEMBLIES

Section VII. ASSEMBLY OF TRANSMISSION FROM SUBASSEMBLIES

Section VIII. WEAR LIMITS AND SPRING DATA

FOLDOUTS

Section I. GENERAL INFORMATION

1. SCOPE, ARRANGEMENT OF MANUAL

a. Models Covered. This service manual covers the CRT 3531-1 and CRT 3630-1 (fig. I-1, I-2) and the CRT 3531-3 (fig. I-3, I-4) Torqmatic transmissions. All 3531 and 3630 models are designed for operation in the 130 to 175 horsepower class. Several options are available with each model.

b. Section Content

(1) This service manual is composed of eight sections indicated by Roman numerals. The page numbers of each section begin with 1, following the section number. Each section is composed of paragraphs which are numbered beginning with 1. Subparagraphs under each paragraph begin with a. Further division of subparagraphs is indicated by (1), (2), etc.

(2) Section I contains general information; Section II describes the transmission and its function; Section III covers maintenance instructions; Section IV contains information required for general overhaul of the transmission; Section V, arranged with handy pictorial steps, covers disassembly of the transmission into subassemblies; Section VI outlines the rebuild of subassemblies; Section VII, also by pictorial steps, covers assembly of the transmission from subassemblies; Section VIII, primarily a tabulation of wear limits, also contains a spring chart.

c. Illustrations. Illustrations include photographs, line drawings, cross sections, and exploded views. Transmission features and overhaul procedures are illustrated mainly by photographs. Line drawings illustrate special tools and the hydraulic system. Cross sections show transmission construction and illustrate the torque paths through the transmission. Exploded views show in detail the relationship of all parts. Two cross sections, three hydraulic schematics, and a series of parts exploded views are in foldouts at the back of the manual. These can be opened for reference and used simultaneously with any section of the manual.

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

2. SUPPLEMENTARY INFORMATION

When new models and/or assemblies are introduced, which have features not covered in this service manual, supplementary information will be issued. Contact your TORQMATIC dealer or distributor for the latest service information. Such inquiries should include model, assembly number and serial number from the transmission name plate (fig. I-5 and para 5, below).

3. CONSTRUCTION FEATURES

a. Similarities, Differences

(1) All transmission models covered in this service manual are the full powershift type consisting of a torque converter coupled to planetary gearing controlled by hydraulic clutches. The gearing and clutches are arranged to give forward and reverse operation in every range.

(2) Three speed ranges are available in CRT 3531 and 3630 models. Models with -1 suffix have a transfer case with front and/or rear outputs located 20 inches vertically below the transmission input centerline (fig. I-1 and I-2). Those with -3 suffix have only a rear output directly in line with the input (fig. I-3 and I-4). Speed ranges, and forward and reverse, are manually selected at controls linked to hydraulic valves.

(3) The transmission is a single, compact unit which transmits power from the engine to the vehicle drive line. Individual features are discussed in subparagraphs b through g, below.

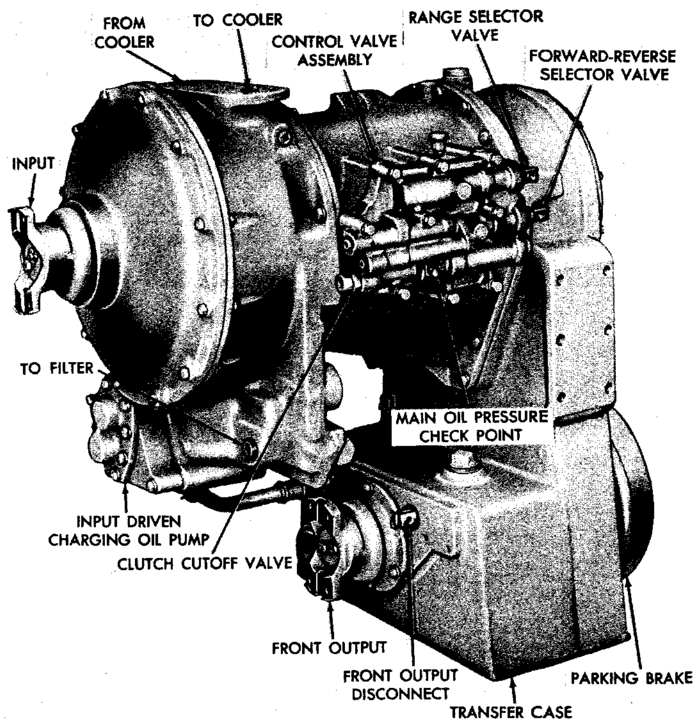


Fig. 1-1. Model CRT 3531-1 (or CRT 3630-1) Torqmatic transmission with remote-mount option—left-front view

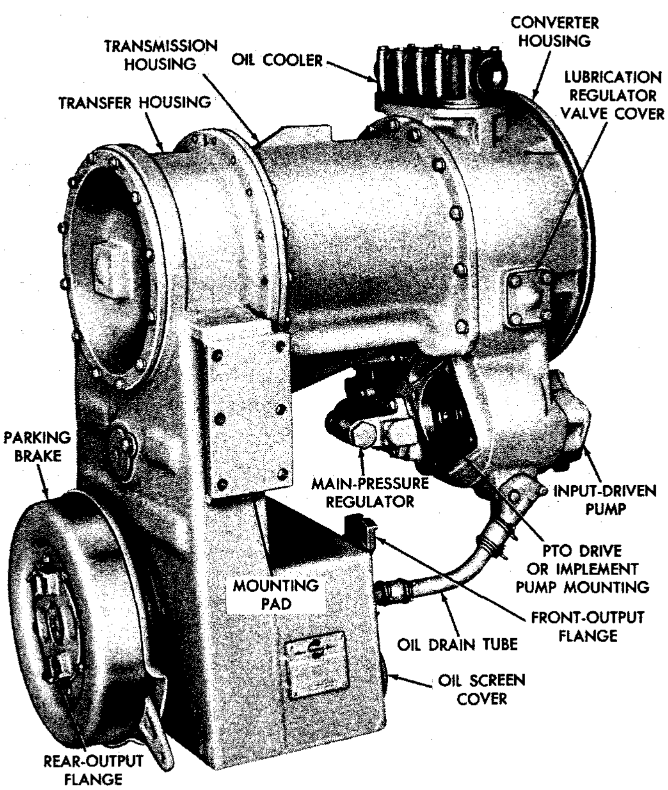


Fig. 1-2. Model CRT 3531-1 (or CRT 3630-1) Torqmatic transmission with direct-mount option—right-rear view

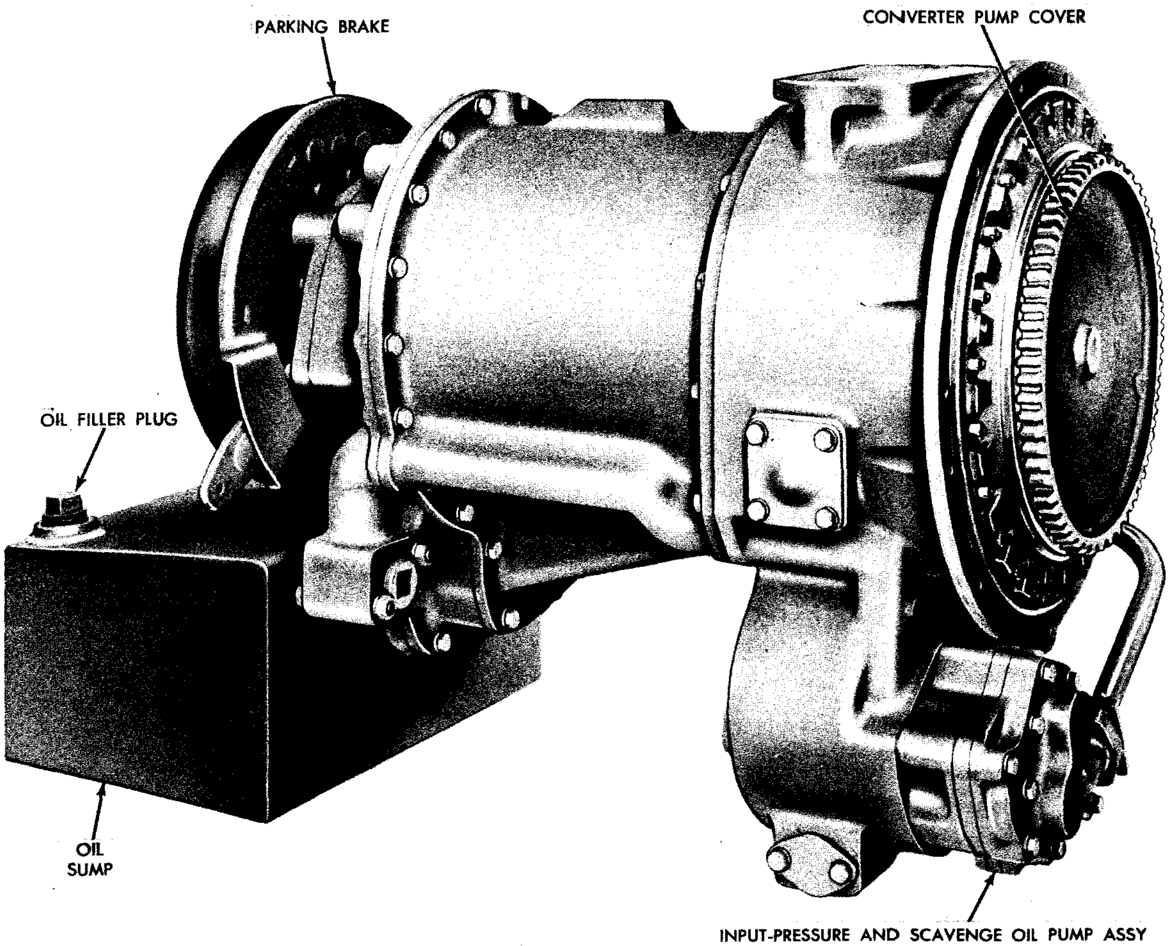


Fig. I-3. Model CRT 3531-3 Torqmatic transmission with direct-mount option—right-front view

b. Input Drive, Mounting

(1) All models are available with a closed torque converter housing and input drive flange for mounting the transmission remote from the engine (fig. I-1). Also, all models are available with provision for mounting the transmission directly on the engine (fig. I-3). Direct-mounted transmissions may have either of two types of input drives. On the earlier models, the torque converter is driven by a closed and sealed concentric gear arrangement in which grease is permanently retained (items 8, 10 and 12 (A, foldout 7). Later models use a flex disk drive (items 1, 2, 3 and 7 or items 2, 3, 4, 5 and 7 (A, foldout 7). In the flex disk drive, the outer circumference of the disks is bolted to the engine.

(2) Models having transfer cases are supported at the rear on 4-hole mounting pads at each side of the transfer case (fig. I-2). Straight-through models have tapped bosses on the adapter housing for rear support (fig. I-4). Remote-mount models have a trunnion, on the front cover, concentric with the input shaft, for front support. Direct-mount transmissions depend upon the engine flywheel housing for front support.

c. Torque Converter (foldout 1). The torque converter is a single-stage, polyphase, 3-element unit consisting of a converter pump 4, stator 3 and turbine 2. The torque converter elements are vaned, aluminum castings. The pump element is driven by the engine. The turbine element drives the plane-

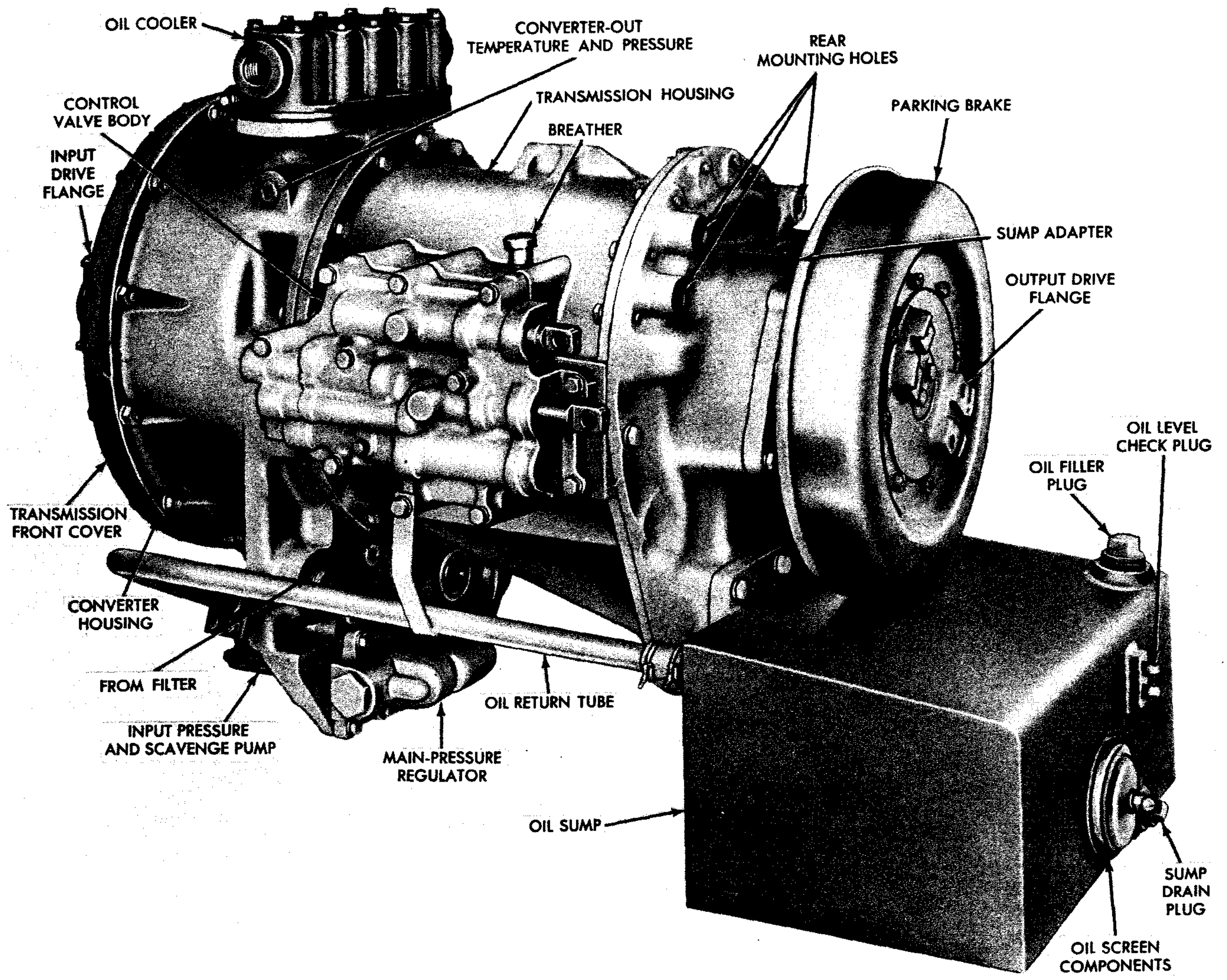


Fig. I-4. Model CRT 3531-3 Torqmatic transmission with remote-mount option—left-rear view

tary gearing. The stator is the reaction member which multiplies torque between the engine and transmission gearing.

d. Planetary Gearing, Clutches (foldout 1). CRT 3531 and 3630 model transmissions have four planetary gear sets and five clutches. The gear sets provide reverse 21, forward 20, high range 19 and low range 18. Each gear set is controlled by a hydraulic clutch concentric with the gear set. Intermediate-range clutch 7 is a direct drive which acts without a planetary gear set.

e. Transfer Gearing (foldout 1). Transmission models which have a -1 suffix include a drive gear 11 on transmission main shaft 10, an idler gear 12 in the transfer case, and a driven gear 15 on output shaft 14. This arrangement locates the transmission output twenty inches vertically below the transmission input centerline.

f. Outputs, Flanges. A variety of flanges and output arrangements are available among the different models. The -3 models (foldout 2) have an extended main shaft 10 which locates the transmission output at the rear, on a line with the input. Some -3 assemblies include an output flange, while others provide for coupling the splined end of the main shaft directly into the vehicle drive line. The transfer case models (-1 suffix) may have front or rear outputs, or both (foldout 1). Either of these may include a manual disconnect feature such as front output disconnect 17. All types and sizes of output flanges are available. A rear-mounted parking brake is optional for -1 or -3 models (fig. I-2, I-4).

g. Hydraulic System (foldouts 3, 4 and 5). A single, integral hydraulic system lubricates, cools and controls the transmission. A pump, which supplies pressure at any time the engine is running, draws oil from the sump. Control valves regulate pressures and direct the oil to various components. Oil pressure applies the clutches. Oil is the power-transmitting medium in the torque converter. The oil is continually circulated, filtered and cooled during transmission operation.

4. TORQMATIC OPTIONS

a. Service Instructions for Options. Servicing of the various optional components is covered in Sections V, VI and VII, along with the procedural instructions for the basic components. Notes are inserted to identify options during disassembly (sect. V) and assembly (sect. VII). In the rebuild of subassemblies (sect. VI) no distinction is made between basic and optional components.

b. Integral, Remote Oil Cooler. A flat mounting pad is located atop the converter housing (fig. I-1). There are 12 tapped bolt holes around the pad and two tapped oil passages near its ends. An oil cooler may be mounted on this pad. If a remote-mounted oil cooler is used, the lines which carry oil to and from the cooler are connected to the oil passages on the pad. Whether integral- or remote-mounted, the cooler has inlet and outlet connections for the coolant.

c. Remote-mount Oil Filter. Some transmissions are connected to a remote-mount oil filter. When such a filter is used, an oil transfer tube 5 (fig. III-7) is installed in the converter housing to direct the oil to the filter. Oil lines to (fig. I-1) and from (fig. I-4) the filter connect into tapped openings in the converter housing. No oil transfer tube is used, and the tapped openings are plugged, in installations not equipped with a filter.

d. Remote, Direct Mount

(1) Transmissions differ in the components which couple them to the engine. Remote-mount installations have a cover 1 (foldout 1) on the front of converter pump 4, to which an input shaft is bolted. An input flange 26 is splined to the input shaft. A front cover 25, bolted to the converter housing, encloses the input drive. The transmission and engine are connected by a shaft.

(2) Earlier direct-mount installations have a "grease ring" drive (foldout 2), in which concentric gears (internal and external teeth) connect the transmission and engine. The external-tooth gear is integral with converter pump cover (fig. I-3). The gear teeth are permanently lubricated and sealed. The converter housing is bolted directly to the engine, which supports the front of the transmission.

(3) Later direct-mount installations use a flex disk drive (A, foldout 7). A laminated steel disk 1, or 4 and 5, is bolted to converter pump cover 7 by bolts 2. The disk is bolted to the engine flywheel at the outer circumference.

e. Control Valve Bodies (foldout 15)

(1) Several types of control valve bodies have been used in various transmission installations. Earlier models were equipped with one of two different control valves. These were: inching control selector valve with hydraulic-actuated (from hydraulic brake system) clutch cutoff valve (foldout 3); and inching control with air-actuated (from air brake system) clutch cutoff control (foldout 3).

(2) Recent models use control valve body assemblies which retain the basic characteristics of earlier valve assemblies, but in

improved forms. The current valve body assemblies include three types: hydraulic-actuated clutch cutoff control valve body without the inching control (foldout 5); air-actuated clutch cutoff control valve body without inching control (foldout 5); and, inching control valve body without clutch cutoff (foldout 4).

(3) The description and function of the various valve body assemblies are covered in para 12b, sect. II, below.

f. Accessory Drives

(1) Speedometer drive. A speedometer drive option is available on -1 models. It is driven by the transmission main shaft and rotates at a speed equal to the transmission range speed.

(2) Steer pump drive. Available on remote-mount, transfer case (-1) models is an input pump assembly 23 (foldout 1) with an adapter 24 for mounting and driving a steer pump. This option consists of an extended front cover on the input pump, an extended pump drive gear, and a splined coupling. Space limitations prohibit the use of this option on direct-mount transmissions.

(3) Implement pump or PTO drive. On all models, an implement pump drive 22 (foldout 1) is provided for mounting an implement pump or power takeoff. Rotation is clockwise as viewed from the input end of the transmission. Speed is the same as engine speed and the drive rotates when the engine rotates.

g. Output Disconnects. Outputs and output disconnects vary between installations. On straight-through (-3) models, only a rear output, without the disconnect feature, is available (fig. I-4). On transfer case (-1) models, either front or rear outputs, or both, are available (fig. I-2). Either of these may include the manual disconnect feature, in which a splined collar is manually shifted to connect or disconnect the output shaft (refer to 17, foldout 1).

h. Parking Brake. A rear-mounted, internal-expanding, shoe-type parking brake is available for all model transmissions (fig. I-2). The brake is mechanical and can be linked to a hand control.

i. Torque Converter Ratios. Four torque multiplication ratios are used. These are: 2.6 to 1, 3.0 to 1, 3.1 to 1 and 3.4 to 1. These ratios are determined by the blade angle in the converter elements. Service procedures are identical for all ratios.

j. Transfer Gears (foldout 1). In CRT 3531-1 models, three transfer gears 11, 12 and 15 transfer the drive from the planetary gears to the output shaft at an overdrive ratio of 0.66 to 1. Different gearing is used on CRT 3630-1 models to obtain an overdrive ratio of 0.79 to 1. The ratio is available as an option for CRT 3531-1 models.

5. MODEL DESIGNATION

a. Identification. The transmission may be identified by the model, assembly number, and serial number stamped on the name plate (fig. I-5), located on the lower-right side of the transfer gear housing of -1 models, or on the top of the adapter housing at the rear of -3 models. The letters and numerals in the model designation indicate the following:

C - Torque converter
R - Reverse available in every basic speed range
T - Transmission
First numeral (3) - Converter series 300
Second numeral (5) or (6) - Transmission capacity code
Third numeral (3) - Basic speed ranges
Fourth numeral (0) - No major model change
Fourth numeral (1) - Major model change
Suffix (-1) - Transfer case (drop box) with front and/or rear outputs
Suffix (-3) - Straight-through transmission with rear output only

b. Model Differences. The major differences between the models covered in this manual are in the type of outputs (transfer case and straight-through). The CRT 3531-1 and 3630-1 have three speeds and a transfer case; the CRT 3531-3 has three speeds and a straight-through output. Because the differences in outputs are pronounced, the paragraphs covering the transfer case (or drop box) models are separate from those covering the straight output models. The CRT 3630-1 is different mainly in the low-range planetary which has a lower ratio (8.70 to 1), compared to 8.00 to 1 in other models.

6. ORDERING PARTS

a. How to Order. All parts orders or service information requests should be directed to your dealer. It is imperative that the transmission serial number (S/N), the assembly number (A/N) and the model number be used when ordering parts. These numbers can be found on the transmission name plate (fig. I-5), located on the lower-right of transfer case models and on top of the adapter housing at the rear of straight-through models. REFER TO THE SERIES 3531-1, 3531-3 and 3630-1 PARTS CATALOG (SA 1102) WHEN ORDERING PARTS. Do not use exploded view reference numbers in this service manual to order parts.

b. Service Kits. Parts service kits are available for overhauling the transmission. See sect. IV, para 5, below. Refer to the parts catalog for the specific kit and additional parts needed.

Fig. I-5. Torqmatic transmission name plate

7. TRANSMISSION OPERATING INSTRUCTIONS

a. Neutral. Always shift the range selector control to neutral while starting the vehicle engine. Always shift to neutral when the vehicle is left unattended. Always shift to neutral while checking operation of the vehicle engine.

b. Range Selection. Speed ranges are selected by moving the range selector control to low-, intermediate- or high-range position. The speed range best suited to operation will depend upon the load, terrain and the speed of travel desired. Range selection is the first operation in getting the vehicle under way. The throttle should be closed when a range is selected while the vehicle is standing.

c. Forward and Reverse. Forward or reverse must be selected before the vehicle can be moved, even though the range selector control is shifted to a range. This is true because two clutches must be engaged before power can be transmitted through the transmission. Forward or reverse selection is the second step in getting the vehicle under way. The throttle should be closed and the vehicle stopped, when forward or reverse is selected.

d. Throttle Operation. The throttle is opened to get the vehicle under way. When the engine accelerates, the torque converter transmits power from the engine to the turbine shaft, through the directional gearing, through the range gearing, and to the transmission output. The throttle may be left open while upshifting the transmission. The throttle may be left open while downshifting only if the speed of the vehicle does not exceed the maximum speed permissible in the lower range selected. The throttle should be closed and the vehicle should be stopped when the vehicle direction is reversed.

e. Changing Direction of Travel. When shifting from forward to reverse, or from reverse to forward, the throttle should be closed and the vehicle braked to a stop. Then the shift to the opposite direction can be made, after which the throttle may again be opened.

f. Clutch Cutoff Control. On transmissions equipped with clutch cutoff control, the application of the vehicle brakes actuates the clutch cutoff control valve. This valve movement cuts off pressure to the range clutch in earlier models, or to the forward or reverse clutch in recent models. Control pressure for the clutch cutoff valve may be either hydraulic or air, depending upon the type of brake system used on the vehicle. When the vehicle is traveling, in either direction, application of the brakes will interrupt the flow of power in the transmission. Release of the brakes restores power.

g. Inching Control. Two types of inching control have been used. The earlier version is built into the forward-reverse control valve. It involved only the design of the spool-type valve. Two lands on the valve are ground with a gradual taper to increase the linear travel of the valve between cutoff and full admission of clutch-apply pressure. In addition, the valve detent grooves are shallow and separated by straight lands. This permits more accurate control of the valve between detents. The more recent type of inching control involves the use of an additional spool-type valve to which a manual control, expressly for inching, is linked. This valve is manipulated to accurately control the application of main pressure to the forward or reverse clutch.

h. Parking Brake. The parking brake is controlled manually. It should be applied while the vehicle is unattended.

i. Output Disconnect. The output disconnect is manually controlled. Engagement or disengagement of the output disconnect should not be attempted while the vehicle is in motion.

j. Temperatures, Pressures. If the transmission is equipped with a temperature gage and a pressure gage, these instruments should be observed occasionally to determine if the operation of the transmission is normal. Clutch pressure should be 150 to 160 psi at full-throttle stall. Converter-out temperature should never exceed 250° F.

8. SPECIFICATIONS AND DATA

The following specifications apply to both the CRT 3531-1 and CRT 3531-3 and to the CRT 3630-1. Where information is limited to a particular configuration, this is indicated.

SPECIFICATIONS AND DATA CHART, next page

SPECIFICATIONS AND DATA
CRT 3531-1 and -3, and 3630-1 Transmissions

Item	Description
Transmission type	Torque converter and planetary gear
Input rating – max net	Torque: 350 lb ft Speed: 3000 rpm Horsepower: 175
Mounting, drive:	
rear, -1 models	Four 5/8-11 tapped holes in side pads, each side
rear, -3 models	Four 5/8-11 tapped holes in upper rear of adapter housing
front, direct mount	SAE 3 flange on converter housing, bolts to engine flywheel housing; grease ring drive or flex plate
front, remote mount	Trunnion concentric with input shaft; converter enclosed; input flange for shaft and universal joint coupling
Rotation (viewed from input end):	
input	Clockwise
outputs (forward operation)	Same as input

Converter (model):	TC 340	TC 350	TC 360	TC 370
number of stages	1	1	1	1
number of elements	3	3	3	3
stall torque multiplication (approx)	3.1:1	3.4:1	3.0:1	2.6:1

Note: Only the TC 340 converter is used in CRT 3630-1 models

Item	Description
Gear data:	
range gearing	Constant mesh planetary
transfer gearing	Constant mesh in-line
gears	Spur type

Planetary gear ratios:	Forward	Reverse
low	8.00:1 (3531 models) 8.70:1 (3630 models)	7.75:1
intermediate	2.90:1	2.81:1
high	1.00:1	0.97:1

Item	Description
Transfer gear ratio (CRT 3531-1)	0.66:1 (0.79:1 optional)
(CRT 3630-1)	0.79:1

(Continued on next page)

SPECIFICATIONS AND DATA - Continued

Item	Description			
Total torque ratio coverage (CRT 3531-1)				
Converter model	TC 340	TC 350	TC 360	TC 370
Low-gear stall (forward)	16.37:1	17.95:1	15.80:1	13.73:1
Low-gear stall (reverse)	15.86:1	17.39:1	15.30:1	13.30:1
High-gear travel (forward, 1.00:1 converter ratio)	0.66:1	0.66:1	0.66:1	0.66:1
High-gear travel (reverse, 1.00:1 converter ratio)	0.64:1	0.64:1	0.64:1	0.64:1
Total torque ratio coverage (CRT 3531-3)				
Converter model	TC 340	TC 350	TC 360	TC 370
Low-gear stall (forward)	24.80:1	27.20:1	24.00:1	20.80:1
Low-gear stall (reverse)	24.02:1	26.35:1	23.25:1	20.15:1
High-gear travel (forward, 1.00:1 converter ratio)	1.00:1	1.00:1	1.00:1	1.00:1
High-gear travel (reverse, 1.00:1 converter ratio)	0.97:1	0.97:1	0.97:1	0.97:1

Item	Description
Total torque ratio coverage (CRT 3630-1)	
Converter model	TC 340
Transfer ratio	0.79:1
Low-gear stall (forward)	19.59:1
Low-gear stall (reverse)	18.98:1
High-gear travel (forward, 1.00:1 converter ratio)	0.79:1
High-gear travel (reverse, 1.00:1 converter ratio)	0.77:1
Clutches	Multidisk, hydraulic-actuated, spring-released, oil-cooled, automatic wear compensation
Controls:	
forward and reverse	Manual shift force – 17 to 25 lb
range selection	Manual shift force – 25 to 40 lb
output disconnects (front or rear)	Manual shift force – 50 lb
functions	Forward and reverse control, inching control and range selection control are used for positioning and direction of vehicle. Clutch cutoff valve (air or hydraulic brake actuated), disengages transmission making full engine power available to accessory drives

(Continued on next page)

SPECIFICATIONS AND DATA - Continued

Item	Description
Oil system:	
oil pump (pressure)	Input driven, gear type, positive displacement
scavenge pump (-3 models)	Gear type, in common housing with pressure pump
oil type: above -10° F	Hydraulic transmission fluid type C-1
below -10° F	Hydraulic transmission fluid type C-1 Auxiliary preheat required to raise temperature in sump and external circuit compatible with ambient temperature recommendations Automatic transmission fluid type A, suffix A identification optional when hydraulic transmission fluid type C-1 is not available
oil capacity, US gal:	
CRT 3531-1, 3630-1	Initial fill – 7.5; refill – 5.5
CRT 3531-3	Initial fill – 9; refill – 7
oil filter	Remote mounted, furnished by customer
oil cooler	Integral or remote optional
converter-out oil temperature, F° max	250
Oil pressures:	
converter outlet (full throttle, stall)	25 psi min
(full throttle, no load)	65 psi max
main, full throttle, stall (approx)	150-160 psi
lubrication (full throttle)	15-30 psi
Oil temperature (max)	250° F
Flanges:	
input (remote-mount model):	Mechanics 6C, 7C Torqmatic coupling (Mechanics 6C) Spicer 1500, 1600 Rockwell 5N
front output (-1 models only)	Mechanics 6C, 7C, 8C Rockwell 6N
rear output	Mechanics 7C, 8C Spicer 1600 Rockwell 6N

(Continued on next page)

SPECIFICATIONS AND DATA - Continued

Item	Description
Implement pump drive (power takeoff):	
mounting flange	SAE mounting pad, size C, 4-bolt
location	Converter housing, lower-rear
rating (intermittent)	80 hp
(continuous)	50 hp
ratio	Equals engine speed
spline data	SAE C spline, 30° pressure angle, pitch diameter – 1.167 in., 14 teeth
coupling adapter	*SAE B spline, 30° pressure angle, pitch diameter – 0.8125 in., 13 teeth
Steer pump adapter (remote mount, -1 models only):	
mounting flange	Modified SAE A pad, 6-bolt
rating	**26 hp max
ratio	Same as engine speed
gear data	SAE A spline, 30° pressure angle, pitch diameter – 0.5625 in., 9 teeth
Parking brake:	
type	Drum, Timken, 13 3/8 x 2
rating	45,000 lb in. @ 2100 lb apply force
Dry weight (depending on options):	
-1 model	1170 to 1260 lb
-3 model	830 to 955 lb

*Optional reducer from SAE C to SAE B spline available.

** Total implement pump drive is 50 to 80 hp, as shown above. If steer pump and rear PTO are used simultaneously, 26 hp should be deducted from implement pump drive hp rating.

Section II. DESCRIPTION AND OPERATION

1. SCOPE OF SECTION II

This section describes in detail and explains the function of transmission components. The various features, whether they are options or basic equipment, for specific models, or for early or current models, are covered in the same manner.

2. MOUNTING AND INPUT DRIVE

a. Remote Mounting

(1) Remote-mount transmissions include a converter pump cover 10 (B, foldout 6), converter drive shaft 8 and transmission front cover 3. Converter pump cover 10 is bolted to the torque converter pump. It encloses the torque converter at its forward end and retains the converter oil. Converter drive shaft 8 is bolted to converter pump cover 10 and is splined to receive a drive flange. Converter drive shaft 8 extends through transmission front cover 3 and is supported on a ball bearing 5 in the cover hub. The ball bearing is lubricated by oil which escapes from an orifice in turbine shaft 25 (B, foldout 8).

(2) An oil seal 1 (B, foldout 6) in the hub of the front cover prevents the entrance of dirt or loss of oil. Transmission front cover 3 is bolted to converter housing assembly 34 (B, foldout 8). The hub of the cover is machined and extends forward to form a trunnion on which the front of the transmission is supported. A variety of input drive flanges 4, 5, 13, 14 and Torqmatic coupling 15 (A, foldout 6) have been used. They differ only in the area to which the drive line from the engine is coupled, except for the Torqmatic coupling 15. This is a rubber-cushioned coupling which absorbs torsional vibrations of the input drive line.

b. Direct Mounting

(1) Two types of direct mounting to the engine are available. Both are illustrated in A, foldout 7. One type includes a converter pump cover 7 to which is attached a flexible steel disk assembly consisting of items 4 and 5 or four disks 1. The outer circumferences of the disks are bolted to the engine flywheel. Cover 7 is bolted to the converter pump. The converter housing is bolted directly to the engine flywheel housing and supports the front of the transmission.

(2) The other type includes converter pump cover 12, drive ring 8 and seal 10. The pump cover is bolted to the front of the converter pump and retains oil in the converter. An external-tooth gear is formed on the front of cover 12. An internal-tooth drive ring 8 meshes with the gear on cover 12. The drive ring 8 is bolted to either an engine flywheel or driving disk. A large diameter ring seal 10 seats in a groove behind the external teeth on drive cover 12, and in a counterbore at the rear of the drive ring 8. This seal retains grease which completely covers the meshed teeth of the two components. A vent hole is drilled, toward the center of the flywheel or drive disk, to prevent pressure building up within the sealed cavity. The converter housing is bolted directly to the rear of the engine flywheel housing, and supports the front of the transmission.

c. Wet, Dry Converter Housing. On direct-mount transmissions, when it is desired that the inside of the converter housing be free of oil, a diaphragm 3 (A, foldout 8), oil seal 2, and seal ring 1 is installed. The diaphragm 3 and oil seal 2 restricts oil to the area around the oil pump drive gears. Seal ring 1 prevents loss of oil from the converter assembly. This is called a "dry" housing. Transmissions not equipped with these parts have a "wet" housing. Remote-mount transmissions can have only the wet housing because of the oil which must drain continuously from lubrication of the input shaft bearing 5 (B, foldout 6).

3. TORQUE CONVERTER

a. Four Models Available. The torque converter acts as a hydraulic torque multiplier and a fluid coupling. Four converters are available in the CRT 3531 and 3630 transmissions. The TC 340 has a torque multiplication ratio of 3.1 to 1 at stall; the TC 350 produces a ratio of 3.4 to 1; the TC 360 produces a ratio of 3.0 to 1; and the TC 370 produces a ratio of 2.6 to 1. The appearances of the four converters are very similar, the only difference is the blade angle of the converter elements. Only the TC 340 converter is applicable to CRT 3630-1 models.

b. Three-element Converter. The torque converter consists mainly of pump assembly 15 (B, foldout 7), turbine 3, and stator assembly 4. The pump, turbine and stators are vaned aluminum castings. The pump is the input element and is driven by the engine. The turbine is the output element and drives the transmission gearing. The stator is the reaction element and is mounted on rollers 6 which ride on a race 8 splined to the converter ground sleeve. All converter elements are enclosed in oil which circulates for cooling. When the engine rotates, oil is thrown by the pump vanes into the turbine vanes, causing the turbine to rotate. Oil returns between the stator vanes to the pump. The stator vanes direct the oil so that its unexpended energy assists the rotation of the pump. When the speed of the turbine approaches the speed of the pump, the stator begins to rotate (or freewheel) on its rollers. When turbine speed is significantly less than pump speed, the stator locks up on the roller race. Torque is multiplied only when stator assembly 4 is locked up.

4. FORWARD, REVERSE GEARING AND CLUTCHES

a. Planetary Gears. Two planetary gear sets make up the forward and reverse gearing system. The reverse planetary set includes carrier 13 (A, foldout 9), four 19-tooth pinions 12, four spindle pins 10, pinion rollers 9, thrust washers 11, 59-tooth ring gear 4 (B, foldout 9) and the 21-tooth sun gear (integral, between splined ends) on shaft 25 (B, foldout 8). The forward planetary set includes carrier 8 (B, foldout 9), six 14-tooth pinions 9, six spindle pins 11, pinion rollers 6, thrust washers 10, 50-tooth ring gear 13 and the 31-tooth sun gear 14 (A, foldout 9). The gears in both planetaries are 10-pitch and have straight teeth.

b. Clutches. The reverse clutch includes piston 2 (A, foldout 9), five polished steel plates 5, five bronze-faced steel plates 6, and various minor parts. The forward clutch includes piston 15 (B, foldout 9), three polished steel plates 2, three bronze-faced steel plates 1, and related minor parts. Springs 16 (A, foldout 9), pins 15 and anchor assembly 17 serve the reverse and forward clutches jointly.

c. Operation of Clutches, Planetaries

(1) During reverse operation, piston 2 (A, foldout 9) is hydraulically moved toward clutch plates 5 and 6. This compresses them against anchor assembly 17. Plates 5 are engaged with pins in the stationary anchor. Plates 6 are engaged with hub 8. Thus, when the clutch is applied, the reverse carrier is held stationary.

(2) The sun gear on shaft 25 (B, foldout 8) is the driving member. Pinions 12 (A, foldout 9) rotate on spindle pins 10 in stationary planetary carrier 13. This imparts reverse rotation to ring gear 4 (B, foldout 9). Ring gear 4 is splined to forward carrier 8 which transmits rotation to the high-range clutch and range gears. Reverse ratio is 2.81 to 1.

(3) When the forward clutch is engaged, ring gear 13 is held stationary. Sun gear 14 (A, foldout 9) is the driving member. When sun gear 14 rotates, pinions 9 (B, foldout 9) are forced to rotate within stationary ring gear 13. This causes carrier 8 to rotate and drive the range gearing. Forward ratio is 2.90 to 1.

5. RANGE GEARING, CLUTCHES

a. Range Gearing

(1) There are two planetary range gear sets. These are for low range (reduction) and high range (overdrive). In CRT 3531-1 or -3 models, the low-range gear set includes carrier 13 (B, foldout 11), six 14-tooth pinions 10, six spindle pins 12, needle pinion rollers 11, thrust washers 9, 65-tooth ring gear 6, and 37-tooth sun gear 9 (A, foldout 11).

(2) In CRT 3630-1 models, the low-range gear set includes six 16-tooth pinions 10 (B, foldout 11), 66-tooth ring gear 6, and a 33-tooth sun gear 9 (A, foldout 11). The high-range gear set includes carrier 6, six 14-tooth pinions 5, six pins 3, 59-tooth ring gear 15 and 31-tooth sun gear 11 (B, foldout 10). The gears in both planetaries are 10-pitch and have straight teeth. The low-range reduction in forward gear (forward planetary ratio times low-range planetary ratio) for CRT 3531-1 and -3 is 8.00 to 1; it is 8.70 to 1 for CRT 3630-1 models.

b. Range Clutches. There are three range clutches. Two of these – low and high range – control planetaries. The third clutch – intermediate range – is direct drive from the forward carrier to the transmission main shaft. The low-range clutch includes piston 16 (B, foldout 11), five polished steel plates 4, five bronze-faced steel plates 5 and minor related parts. The high-range clutch includes piston 11 (A, foldout 11), three polished steel plates 13, three bronze-face steel plates 14 and minor related parts. Anchor assembly 1 (B, foldout 11), pins 3 and springs 2 jointly serve the low- and high-range clutches. The intermediate-range clutch includes drum 2 (B, foldout 10), five bronze-face plates 14, four polished steel plates 15, hub 10, and minor related parts. The front face of high-range planetary carrier 6 (A, foldout 11) serves as the reaction plate.

c. Operation of Range Clutches and Planetaries

(1) When the low-range clutch is applied, piston 16 (B, foldout 11) compresses plates 4 and 5 against anchor assembly 1. This locks ring gear 6 stationary. Sun gear 9 (A, foldout 11) drives pinions 10 (B, foldout 11), causing them to rotate within the stationary ring gear 6. Pinions 10, in their rotation within the ring gear, cause carrier 13 to rotate at reduced speed.

(2) When the high-range clutch is applied, piston 11 (A, foldout 11) compresses plates 13 and 14 against anchor assembly 1 (B, foldout 11). This holds ring gear 15 (A, foldout 11) stationary. Carrier 6 is the driving member. When the carrier is rotated, pinions 5 are rotated at increased speed. This rotation is imparted to sun gear 11 (B, foldout 10) which drives the transmission main shaft.

(3) When the intermediate-range clutch is engaged, piston 5 (B, foldout 10) compresses plates 14 and 15 against carrier 1 (A, foldout 11). This locks the entire clutch and causes it to rotate as a unit. Rotation is transmitted, with no speed change, from the forward planetary carrier to the transmission main shaft, via drum 2 (B, foldout 10), plates 14 and 15, and hub 10.

6. OUTPUT TRANSFER GEARING, SHAFTS

a. Gears

(1) Transmissions having a transfer case (-1 models) include three 4-pitch transfer gears. Drive gear 2 (A, foldout 13) is splined to the transmission main shaft and is supported by bearings 1 and 3. Idler gear 10 (CRT 3531-1 models beginning with S/N 39334 and all CRT 3630-1 models) is supported on two straight roller bearing 9 and spindle 13. Idler gear 16 (CRT 3531-1 models prior to S/N 39334) is supported on self-alining roller bearing 17 and spindle 19. Driven gear 23 is splined to the output shaft (refer to b, below).

(2) The drive and driven gears produce a ratio of 0.66 to 1 except for certain CRT 3531-1 assemblies which have an optional gear set with 0.79 to 1 ratio. All 3630-1 models use the 0.79 to 1 ratio gear set. In the 0.66 to 1 ratio arrangement, the drive gear has 41 teeth; the driven gear has 27 teeth; and the idler gear has 46 teeth. In the 0.79 to 1 arrangement, the drive, driven and idler gears have 38, 30, and 46 teeth respectively.

b. Output Shafts, Disconnects. Several arrangements of the output shafts on the transfer case (-1) transmissions are available. The assembly may include front and rear output shafts with front disconnect, or rear output shaft only. Shafts at the lower-front and rear of the transfer case are supported on ball bearings. The output disconnect arrangement (B, foldout 12) consists of a sliding, internal-splined coupling 8, a shifter fork 9 or 15, a shifter shaft 12 or 14, a detent spring 11, and detent balls 10. The disconnect is manually shifted. When no disconnect is included, coupling 16 and snap ring 17 replace coupling 8, and items 9 through 15 are omitted. Cup 18 closes the opening in the housing, through which shifter shaft 12 or 14 normally operates.

c. Flanges. Popular, standard flanges are available for input (remote-mounted) and output drives. The Torqmatic coupling, a rubber-cushioned flange assembly, is used on some remote-mount transmissions at the input. Two types of fits have been employed at the splines by which flanges are attached. Instructions are provided for servicing both types.

7. PARKING BRAKE

An internal, expanding shoe-type parking brake is available for any model. The two brake shoes and their operating mechanism are mounted on a back plate 2 (B, foldout 14). The back plate is bolted to the rear-bearing retainer. Brake drum 7 is bolted to the output flange. The parking brake is operated by a hand lever mounted on the vehicle.

8. OIL PUMPS

a. Pressure Pumps. Two types of pressure pumps are available on transfer case models. The basic pump 4 (C, foldout 16) is a conventional 2-gear positive displacement pump. An optional pump 4 (B, foldout 16), which can be used only on -1 model, remote-mount transmissions, is the same except that it has an extended cover 7 on which a vehicle steer pump can be mounted. A splined extension of pump drive gear 12 drives the steer pump. The transmission oil pump supplies pressure for the hydraulic system.

b. Pressure and Scavenge Pump. All straight-through type (-3) transmissions require a 2-section oil pump assembly 5 (A, foldout 16). One section, which includes gears 14 and 15, is the pressure pump. The other section, which includes two gears 10, is the scavenge pump. The pressure section supplies oil to the hydraulic system. The scavenge section returns oil which accumulates in the converter housing, to the sump. A scavenge pump is not required on transfer case models because oil returns by gravity to the sump.

9. ACCESSORY PUMP MOUNTINGS

a. Implement Pump Mounting. At the lower-right rear of converter housing assembly 34 (B, foldout 8), a 4-hole, SAE size C mounting is provided. A pump with size C splined shaft can be mounted here, or an adapter will permit pumps with size B splines to be used. Some installations provide an oil seal 27 and seal ring 29 to prevent the loss of oil. Others do not have these seals, and the oil can flow past bearing 31 and lubricate the accessory mounted on the pad.

b. Steer Pump Mounting. The mounting pad on the oil pump (refer to 8a, above) is a modified SAE, size A, 6-bolt mounting for installation of a vehicle steer pump.

10. OIL STRAINER, FILTER

a. Strainer. All assemblies include a wire mesh-type strainer screen 6 (A, foldout 12). This screen is mounted in the oil sump and retained by a cover and nut or bolt, depending upon model. All oil which enters the system must pass through this screen. Foreign matter, if present, will remain outside the screen.

b. Filter. It is recommended that an oil filter be mounted remote from the transmission. The filter must be of the full-flow type and equipped with a bypass valve which opens at a differential pressure of 15 psi. When a filter is installed, oil transfer tube 33 (B, foldout 8) must be installed in the converter housing. When no filter is used, tube 33 must not be installed.

11. OIL COOLER

All installations use an oil cooler 5 through 8 (A, foldout 8). It may be of the type illustrated or it may be remote mounted. Oil leaving the torque converter flows through the cooler and returns to the lubrication system. All oil not required for lubrication returns to the sump. In the cooler, heat from the oil is transferred to water which flows continuously through one circuit of the cooler.

12. VALVE BODY ASSEMBLIES

a. Main-pressure Regulator Valve

(1) Two main-pressure regulator valve bodies have been supplied. Earlier models (A/N 6771647 before S/N 21354 and all others before S/N 22101) have a simple assembly which includes only one valve bore. Later models include an additional valve bore into which is installed a bypass valve assembly. C, foldout 15, illustrates the new type of valve. The pressure regulator valve assembly is 7. The pressure adjusting shim is 8. The pressure regulator spring is 9. The bypass valve and spring in the newer valve are 12 and 13, respectively.

(2) Complete valve body assemblies are interchangeable between transmissions. It is recommended, however, that older valve assemblies not be used on newer transmissions. The main-pressure regulator valve maintains a uniform pressure in the hydraulic system. The bypass valve prevents excessive converter-in pressure during cold-starting.

b. Control Valve Body

(1) Five control valve body assemblies have been supplied on the various transmission models, as described in sect. I, para 4e. Subparagraphs (2) through (6), below, outline the primary functions of each assembly and note specific features which aid in identifying each.

(2) Valve body assembly 5 (A, foldout 15) is the earlier inching control with hydraulic-actuated clutch cutoff. This assembly includes two spool-type valves with the stems projecting toward the rear of the valve body. The upper valve is the range selector control; the lower valve is the forward and reverse control. This type of valve can be identified as an early model by detent retaining plugs 6 at the upper and lower sides of valve body 34. It can be identified as having a hydraulic-actuated clutch cutoff by the 1/8-inch pipe thread in the rear of plug 15.

(3) The earlier valve body with air-actuated clutch cutoff is identical to valve body assembly 5 (A, foldout 15) except for items 14, 15 and 16. Items 14 and 16 are not used, and item 15 is slightly modified. This assembly may be recognized as an early model by the detent retaining plugs 6 and by the 5/8-18 thread in the rear of plug 15.

(4) Valve body assembly 6 (B, foldout 15) is a current assembly which includes the hydraulic-actuated clutch cutoff but does not include inching control. It can be identified as a current model by the absence of plugs at its top and bottom. It includes items 7 through 11 and 17 through 35. It is identified as having the hydraulic clutch cutoff feature by the 1/8-inch pipe threads at the front of plug 22.

(5) Valve assembly 6 also represents the current valve assembly which includes the air-actuated clutch cutoff. This assembly closely resembles the assembly described in (4), above, but is identified as having the air-actuated clutch cutoff by the 5/8-18 threads in the front bore of plug 16. It includes items 7 through 16 and 23 through 35.

(6) Valve assembly 6 also represents the current inching control valve without clutch cutoff. It is identified by the three valve stems 9, 34 and 42 projecting from the rear of the valve body. Valve 42 is linked to a control on the vehicle which is specifically used for inching control. Thus, the valve body assembly provides separate manual controls for range selection, forward and reverse selection, and inching control.

> Note: Earlier valve assemblies (see (2) and (3), above) include the clutch cutoff control in addition to the inching control. Current style valve assemblies have either an inching control valve or clutch cutoff valve but cannot have both.

c. Lubrication Regulator Valve.

The lubrication pressure is controlled by a spring-loaded, umbrella-type valve 4 (B, foldout 8), located in the right side of the converter housing. Oil returning from the oil cooler works against this valve and spring 5. Oil in excess of that required to maintain lubrication pressure opens the valve, passes by it, and returns to the transmission sump.

13. HOUSINGS, COVERS

a. Converter Housing. The converter housing 34 (B, foldout 8) is cast iron and is the main front member of the transmission. It encloses the converter components, houses the oil pump drive gear train, and provides a mounting for the oil pump, oil cooler, and main-pressure regulator. The front flange is SAE 3 size. The rear of the housing is machined to receive the reverse clutch piston, converter ground sleeve, and transmission housing.

b. Transmission Housing. Transmission housing 5 (A, foldout 10) is cast iron and is the main center member of the transmission. It houses the reverse, forward and range gears and clutches. The inside is machined to receive the clutch anchor assemblies. The front is machined to mate with the converter housing. The rear is machined to mate with the transfer case (-1 model) or adapter housing (-3 model). The left side is machined to receive the control valve body assembly.

c. Transfer Housing. Transfer housing 12 (A, foldout 12) is cast iron on earlier models and is fabricated steel on later models. It is the main rear member of the -1 model transmission. It houses the output transfer gears and the front and rear output shafts, bearings and disconnect mechanism. The rear is machined to receive the transmission rear cover and rear bearing retainer.

d. Adapter Housing. Sump adapter 4 (A, foldout 14) is cast iron and is the main rear member of -3 transmissions. It supports the transmission main shaft and provides a mounting for the oil sump. The front is machined to receive the low-range clutch piston and to mate with the transmission housing. The rear is machined to receive the rear-bearing retainer and oil sump. Four 5/8-11 tapped holes at the rear help support the transmission.

e. Transmission Front Cover. Transmission front cover 3 (B, foldout 6) is cast iron and is the front closure on remote-mount transmissions. It is bolted to the front flange of the converter housing. The center is bored to receive the input shaft ball bearing 5 and oil seal 1. A machined hub is formed on the front, concentric with the center bore, for fitting a trunnion-type support member.

f. Transmission Rear Cover. Transmission rear cover 4 (B, foldout 13) is a circular iron casting. It closes the rear of the transfer case on -1 models. It is machined in the center to receive the rear bearing on the transfer drive gear. On transmissions which include either a governor or speedometer drive, the center is further machined to receive the drive assembly.

14. HYDRAULIC ACTION — GENERAL

Paragraphs 15 through 21, below, explain the functions of the hydraulic system under various conditions. These explanations are aided by three schematic diagrams (foldouts 3 through 5, in the back of the manual) which illustrate the different hydraulic system arrangements which result from the use of the various hydraulic components which have been furnished. The schematic diagrams represent the transmission in operation in neutral condition. The basic hydraulic circuits are colored. After the explanation of neutral action, the hydraulic action of the transmission in forward and reverse, and in various gear ranges is explained. These subsequent explanations will refer to previous explanations, where applicable, rather than repeat them.

15. HYDRAULIC ACTION — NEUTRAL (foldouts 3 through 5)

a. Oil is drawn from the sump, through the oil strainer, by the input driven pressure pump and sent to the hydraulic system through the oil filter. From the filter, oil is directed to the main-pressure regulator valve, to the forward and reverse selector valve, and to the range selector valve. In its passage to the range selector valve, the oil (in early model systems) must pass through the clutch cutoff valve. The clutch cutoff valve may be either hydraulic- or air-operated.

b. The main-pressure regulator valve may or may not include a converter relief valve (bypass circuit). Earlier models were not so equipped, in which case the oil passage leads directly from the main-pressure regulator valve to the torque converter (foldout 3). The current type is shown in foldouts 4 and 5. In either type, oil pressure is regulated to 150 to 160 psi. The operation of each type is explained in para c, below.

c. Pump pressure exerts a leftward force on the valve, moving it against its spring. The leftward movement of the valve uncovers a port which allows main pressure (red) to flow to the passage which directs converter-in oil (yellow) to the torque converter. In the regulator which has no bypass (foldout 3), there is no provision for relieving excessive converter-in pressure. There is, however, a provision for relieving excessive main pressure. Excessive main pressure is relieved through ports in the tubular body of the regulator valve when the valve moves far enough to the left to aline these ports with the passage which brings oil directly from the pressure pump. Oil then flows into the hollow center of the valve and to the sump (blue).

d. The main-pressure regulator valve which includes a bypass valve (foldouts 4 and 5) provides for relief of excessive converter-in pressure (yellow). When converter-in pressure exceeds 65 psi, the bypass valve opens against its spring and returns oil to the sump. This escape of oil also relieves excessive main pressure.

e. Converter-in oil (yellow) flows into the torque converter. Converter-out oil (orange) flows through the transmission oil cooler and into the lubrication system (green). Excess oil, over that required to maintain lubrication pressure, returns to the sump (blue). Lubrication (green) flows through various passages to points where pressure lubrication is required, and returns eventually to the sump.

f. Main pressure (red) is connected to the forward and reverse selector valve. This valve may be any of three different types. Foldout 3 illustrates an earlier type, in which the inching control feature was included in the forward-reverse control valve. Foldouts 4 and 5 illustrate the later type of forward-reverse control valve. The later type valve does not have any function other than forward and reverse clutch control, and the metering of lubrication to the forward and reverse clutches when a separate inching control valve is used.

g. In the earlier type forward-reverse control valve with the inching control feature (foldout 3), main pressure (red) enters the valve bore at two places. When the valve is at neutral position, main pressure is blocked. When the valve is moved rightward, oil is admitted to the cavity surrounding the rightward, smaller diameter of the valve. Two passages lead away from the area of this cavity. One leads to the forward clutch; the other leads to the lubrication line for the forward clutch. Thus, when the valve first admits oil to the cavity, it flows into both passages. As the valve is moved rightward, the center land of the valve covers the forward lubrication passage. This forces all of the oil to the clutch, applying the clutch.

h. When the valve is moved leftward, oil is admitted to the cavity surrounding the detent notches in the valve. Two passages lead away from this area — to the reverse clutch and to the reverse-clutch lubrication line. Further leftward movement closes off the reverse-clutch lubrication and forces all the oil to the reverse clutch. When the valve is returned to neutral (or shifted to the opposite travel position) oil from the released clutch exhausts through the lubrication line for that clutch. Note that the detent notches in the valve are shallow and have straight lands between them. This permits an initial, small, lineal movement of the valve to dislodge the detent from its notch. Then there is a period of valve movement which is not hampered by the detent. This permits the operator to control the valve accurately for inching.

i. The later style forward-reverse valve (foldouts 4 and 5) has main pressure (red) entering the valve bore at two places. However, at the rightward passage, oil merely flows around the valve, out of the bore, and re-enters at the left. Here it surrounds a small diameter of the valve. When the valve is moved rightward, oil is admitted to a passage which leads to the forward clutch, applying the clutch. When the valve is moved leftward, oil is admitted to a passage leading to the reverse clutch, applying the clutch. When the valve is returned to neutral position (or to the opposite travel position), the clutch being released exhausts into the lubrication line for that clutch. Note that, in foldout 4, there is a lubrication feed line leading into the valve bore. Such a line is necessary in the circuit when an inching control valve is used. Refer to j, below, for an explanation of the function of this passage.

j. When the inching control valve is used (foldout 4), main pressure extends into the valve bore at two places. At the right, main pressure retracts the inching valve when it is released. At the left, it pushes rightward on the inching regulator valve. When the inching control valve is manually moved rightward (against main pressure) the inching regulator valve spring is extended, allowing the regulator valve to move rightward. This allows main pressure to escape into the lubrication feed line which carries it, through the forward-reverse valve bore, to the plates of the acting clutch. This escape of oil, which can be replenished only by flow through an orifice in the line which supplies main pressure to the forward or reverse clutch, lowers the pressure of oil downstream from the orifice. The inching control valve can be positioned to give partial or full release of the acting (forward or reverse) clutch.

k. On later style valve body assemblies which include either the air- or hydraulic-actuated clutch cutoff valve (foldout 5), the clutch cutoff valve is in the circuit which feeds the forward and reverse control valve and clutches. Toward the right end of the forward-reverse valve, main pressure (red) flows into the valve bore, around the valve, leaves the bore and flows to the clutch cutoff valve. Main pressure flows into the clutch cutoff valve bore, leaves the bore and re-enters the forward-reverse valve bore. Here, it is available for either the forward or reverse clutch.

l. If the forward-reverse control valve is shifted rightward, main pressure is directed to the forward clutch. If it is shifted leftward, pressure is directed to the reverse clutch. When the valve is returned to neutral (or shifted to the opposite travel position), the released clutch is exhausted through the lubrication line for that clutch. Note that, when a clutch cutoff valve is used, there is no lubrication feed such as that shown in foldout 4. This is not required except with the inching control valve.

m. When the vehicle brakes (air or hydraulic) are applied on vehicles which use the later style valve body with clutch cutoff control (foldout 5), the clutch cutoff valve moves rightward. This blocks the flow of main pressure to the forward-reverse control valve and exhausts the applied (forward or reverse) clutch. Thus, applying the brakes disconnects power from the vehicle drive line.

16. HYDRAULIC ACTION – FORWARD, LOW RANGE

a. In low range, the range selector valve is moved one detent notch from neutral. This applies the low-range clutch. The forward-reverse control valve is then moved one detent notch (to forward on the operator's control). This applies the forward clutch. Refer to foldouts 3 through 5 to determine the hydraulic flow paths established when the valves are positioned as described above.

b. When the range selector valve is returned to neutral position, the released range clutch will exhaust into the left end of the valve bore and then to the sump (foldouts 3 through 5). When the range selector valve is shifted from low range to a higher range, the low-range clutch will exhaust into the area of the valve bore surrounding the detent notches of the valve, and then to the sump. When the forward-reverse control valve is returned to neutral from either the forward or reverse position, the released clutch exhausts through the lubrication line for that clutch.

17. HYDRAULIC ACTION – FORWARD, INTERMEDIATE RANGE

a. In intermediate range, the range selector valve is positioned two notches from neutral. This directs oil to the intermediate-range clutch. The forward-reverse control valve is positioned in the forward position as described in para 16a, above. Refer to foldouts 3 through 5 to determine the hydraulic flow paths established when the valves are positioned as described above.

b. When the range selector valve is downshifted or returned to neutral, the intermediate-range clutch will exhaust into the left end of the valve bore, and then to the sump (foldouts 3 through 5). When the valve is shifted from intermediate to high range, the intermediate-range clutch will exhaust into the valve bore surrounding the detent notches in the valve, and then to the sump. Refer to para 16b, above, for explanation of forward clutch exhaust.

18. HYDRAULIC ACTION – FORWARD, HIGH RANGE

a. In high range, the range selector valve is positioned three detent notches from neutral. This directs oil to the high-range clutch. The forward-reverse control valve is positioned in the forward position as described in para 16a, above. Refer to foldouts 3 through 5 to determine the hydraulic flow paths established when the valves are positioned as described above.

b. When the range selector valve is downshifted or returned to neutral, the high-range clutch will exhaust into the valve bore, and then to the sump (foldouts 3 through 5). Refer to para 16b, above, for explanation of the forward clutch exhaust.

19. HYDRAULIC ACTION – REVERSE, LOW RANGE

a. In low range, the range selector valve is positioned one notch from neutral. This directs oil to the low-range clutch. The forward-reverse control valve is then moved one detent notch from neutral (to reverse on the operator's control). This directs oil to the reverse clutch. Refer to foldouts 3 through 5 to determine the hydraulic flow paths established when the valves are positioned as described above.

b. When the range selector valve is returned to neutral, the low-range clutch exhausts into the valve bore at the left end of the valve, and then to the sump (foldouts 3 through 5). When the valve is upshifted from low-range position, the low-range clutch exhausts into the area surrounding the detent notches on the valve, and then to the sump. When the forward-reverse control valve is returned to neutral (or shifted to forward position from reverse position), the reverse clutch exhausts through the reverse lubrication line.

20. HYDRAULIC ACTION – REVERSE, INTERMEDIATE RANGE

a. Refer to para 17, above, for explanation of the filling and exhausting of the intermediate-range clutch.

b. Refer to para 19, above, for explanation of the filling and exhausting of the reverse clutch.

21. HYDRAULIC ACTION – REVERSE, HIGH RANGE

a. Refer to para 18, above, for explanation of the filling and exhausting of the high-range clutch.

b. Refer to para 19, above, for explanation of the filling and exhausting of the reverse-range clutch.

22. TORQUE PATHS THROUGH TRANSMISSION – GENERAL

a. Figures II-1 through II-7 illustrate the flow of power through the transmission during operation in the various drive ranges. Paragraphs 23 through 29, below, explain the flow of power. In the illustrations, the power path is represented by a continuous red line from the transmission input to the output or outputs. Applied clutches are indicated by parallel, horizontal red lines on the clutch plates.

b. Torque is transmitted hydraulically from the engine to the transmission gearing by the torque converter (refer to para 3, above). Torque is transmitted from the range gearing to the output by transfer gears (para 6, above) in -1 models, or directly by the transmission main shaft in -3 models. Accordingly, all explanations will cover only the power flow in the forward, reverse, and range gearing.

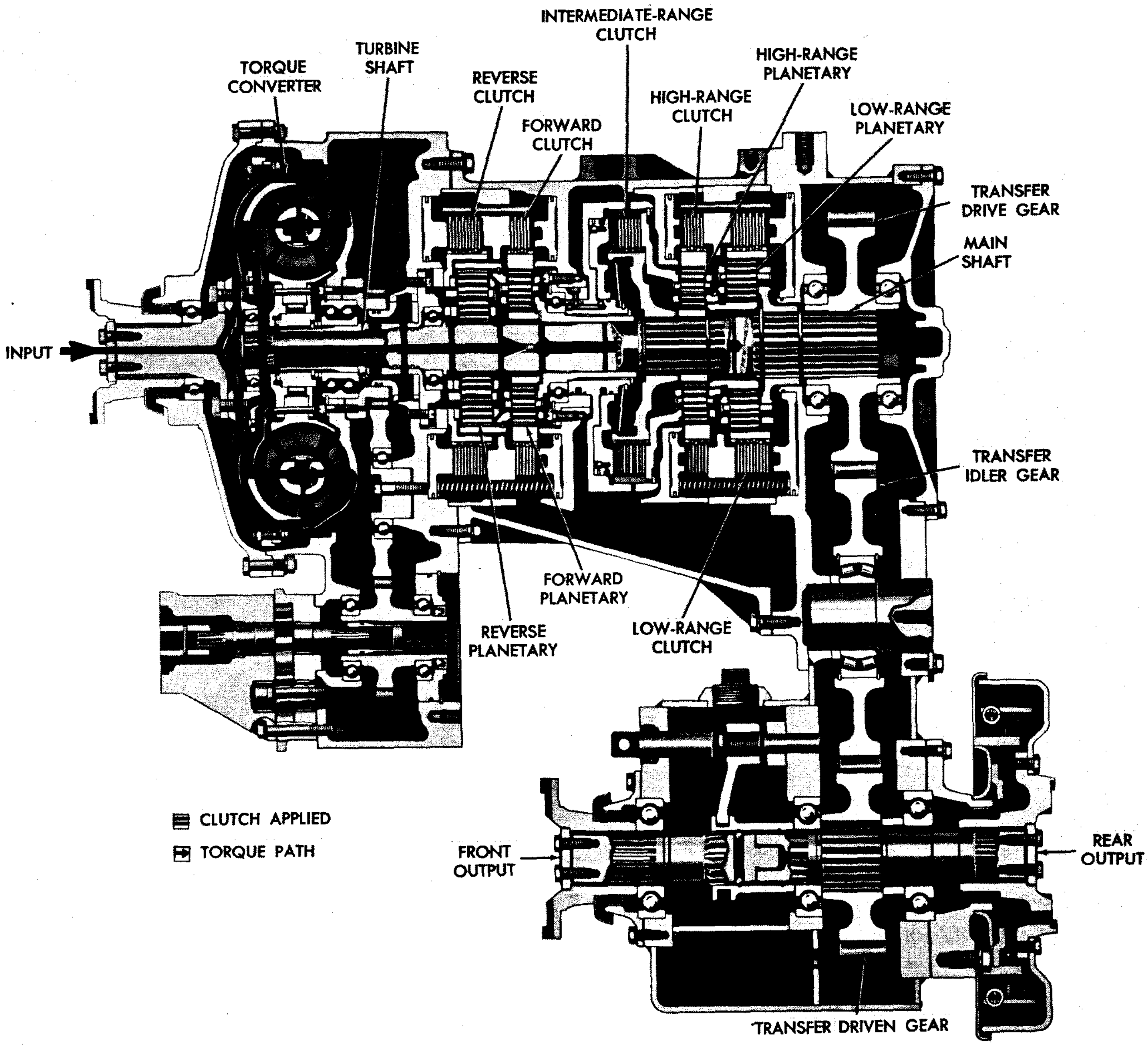


Fig. II-1. Neutral—torque path (CRT 3531-1 or CRT 3630-1)

23. TORQUE PATH – NEUTRAL (fig. II-1)

In neutral, no clutches are applied. As a result, no torque is transmitted beyond the forward and reverse sun gears.

24. TORQUE PATH – FORWARD, LOW RANGE (fig. II-2)

a. The forward clutch is engaged, holding the forward ring gear stationary. The forward sun gear drives the pinions in the forward car-

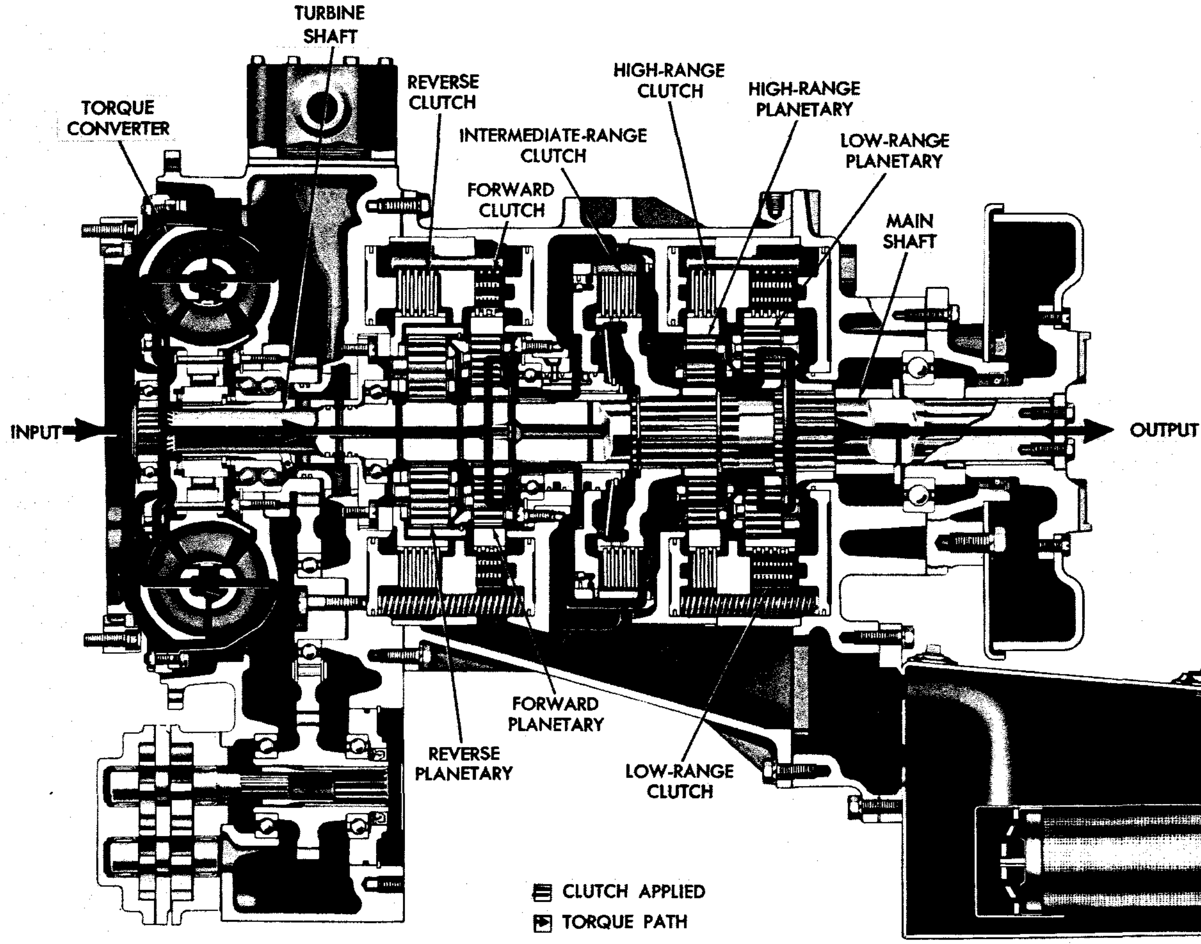


Fig. II-2. Forward, low range—torque path (CRT 3531-3)

rier, causing them to rotate within the ring gear. As the pinions rotate they cause the carrier to rotate at a speed reduction of 2.90 to 1. The carrier is splined to the intermediate-range clutch drum; the clutch drum is splined to the high-range planetary carrier; and the high-range planetary carrier is splined to the low-range sun gear. Thus, the torque from the forward planetary gear set is transmitted to one element of each range group.

b. In low range, the low-range clutch is engaged and holds the low-range ring gear stationary. The rotating sun gear causes the low-range carrier pinions to rotate within the stationary sun gear. This drives the low-range planetary carrier which is splined to the transmission output shaft. The speed reduction in the low-range planetary gears is 2.76 to 1 (CRT 3531) or 3.03 to 1 (CRT 3630). Thus, reduction in the forward gear set, combined with reduction in the low-range gear set is 8.00 to 1 (CRT 3531) or 8.70 to 1 (CRT 3630).

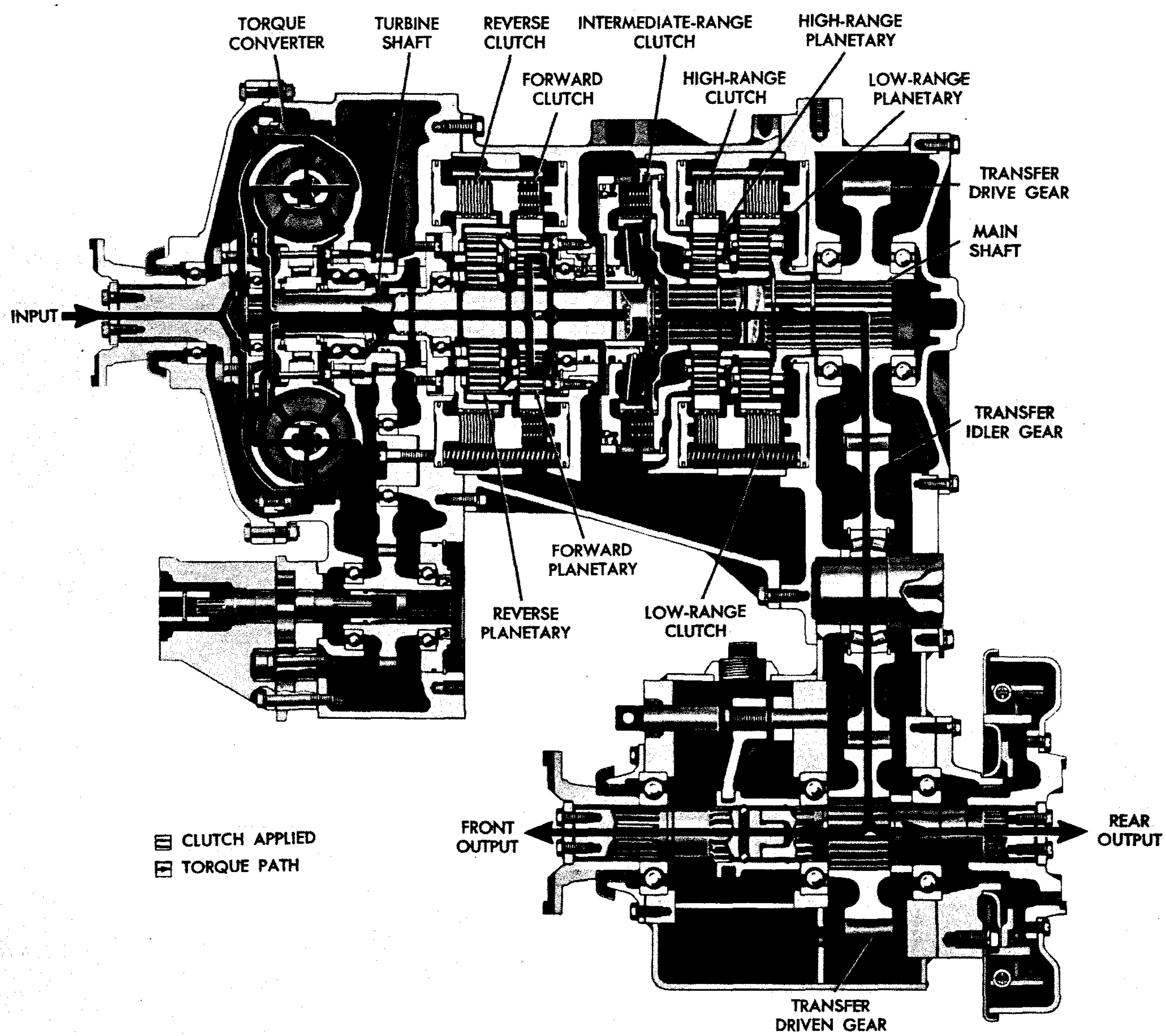


Fig. II-3. Forward, intermediate range—torque path (CRT 3531-1 or CRT 3630-1)

25. TORQUE PATH – FORWARD, INTERMEDIATE RANGE (fig. II-3)

a. Refer to para 24a, above, for the power flow through the forward planetary gear set.

b. In intermediate range, torque from the forward range planetary is transmitted from the intermediate-range clutch drum to the clutch hub and transmission main shaft, by the applied intermediate-range clutch. This is direct drive and involves no range planetary gear set. Thus, the total speed reduction is only that of the forward planetary (2.90 to 1).

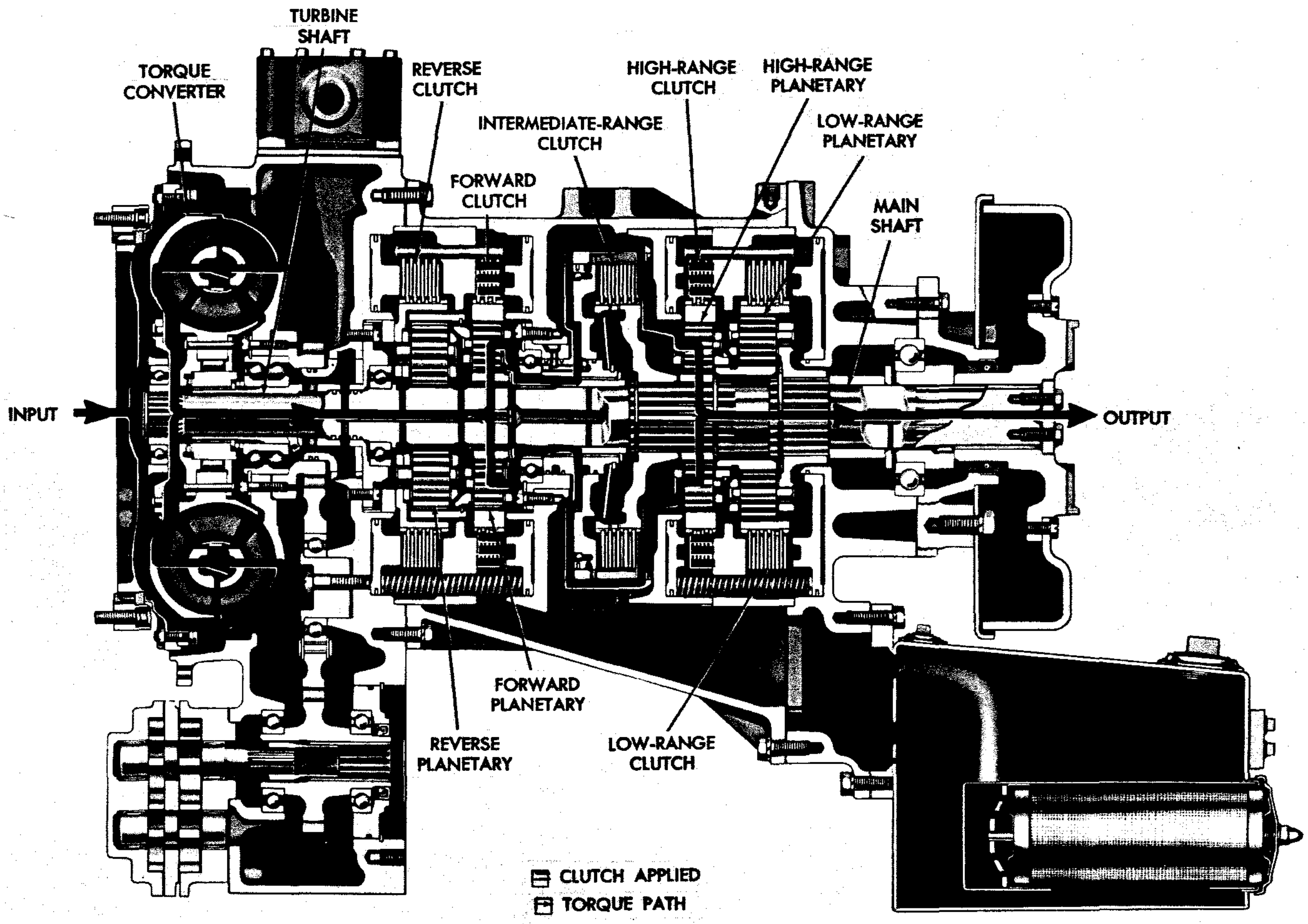


Fig. II-4. Forward, high range—torque path (CRT 3531-3)

26. TORQUE PATH – FORWARD, HIGH RANGE (fig. II-4)

a. Refer to para 24a, above, for the power flow through the forward planetary gear set.

b. In high range, the high-range clutch is engaged, holding the high-range ring gear stationary. Torque from the forward planetary gear set rotates the high-range planetary carrier. The carrier pinions, meshed with the teeth of the stationary ring gear, rotate and overdrive the high-range sun gear. The speed increase is 0.345 to 1. This increase, coupled with the 2.90 to 1 speed reduction of the forward-range planetary, gives a total ratio of 1.00 to 1.

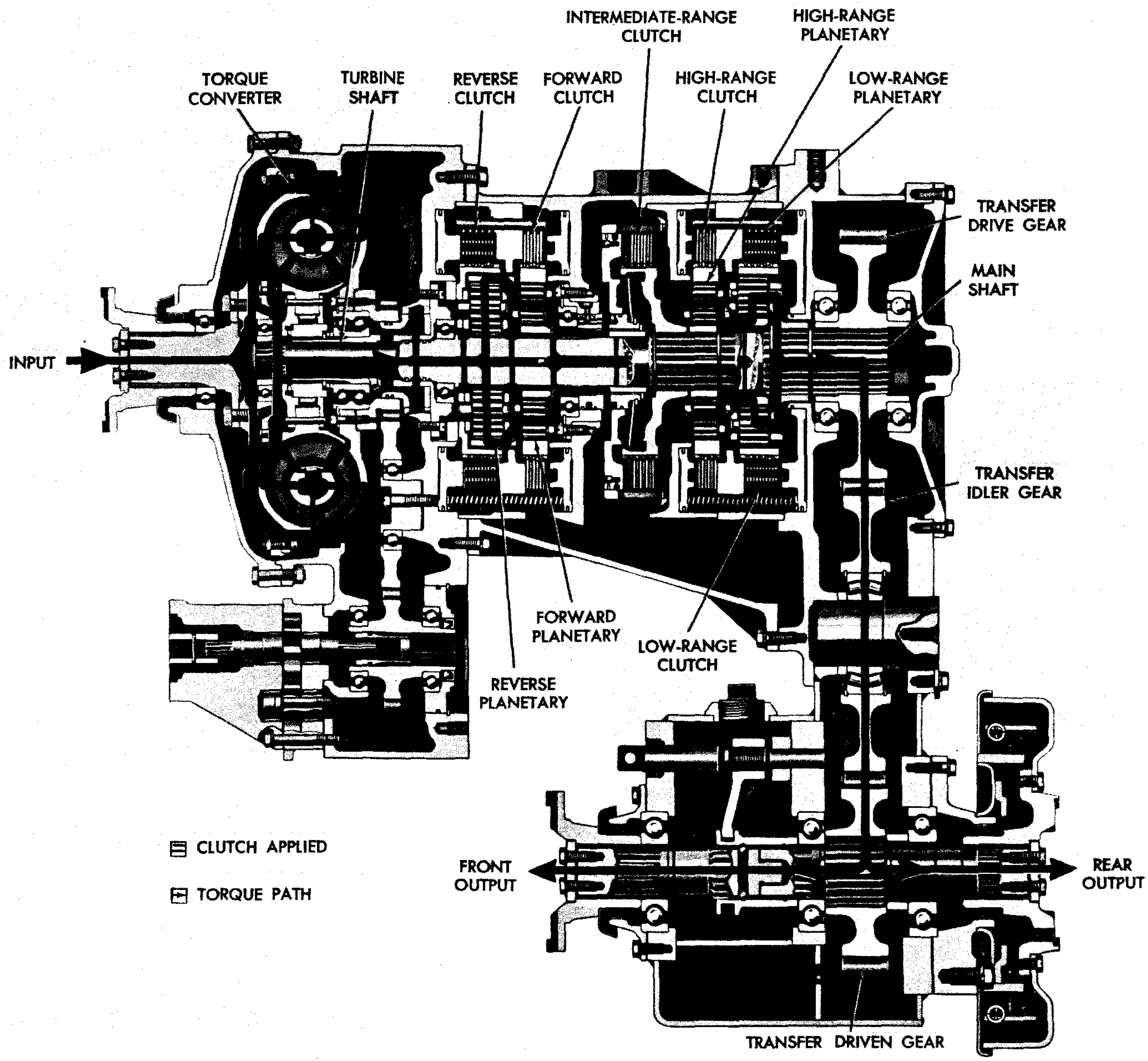


Fig. II-5. Reverse, low range—torque path (CRT 3531-1 or CRT 3630-1)

27. TORQUE PATH – REVERSE, LOW RANGE (fig. II-5)

a. The reverse clutch is engaged, holding the reverse planetary carrier stationary. The reverse sun gear rotates and drives the carrier pinions. The pinions, in turn, drive the reverse ring gear in the reverse direction. Rotation of the reverse ring gear is transmitted to the forward planetary carrier, to which it is splined. Thus, the rotation of the reverse ring gear is transmitted to one element of each range group as it is in forward operation (refer to para 24a, above).

b. Refer to para 24b, above, for explana-

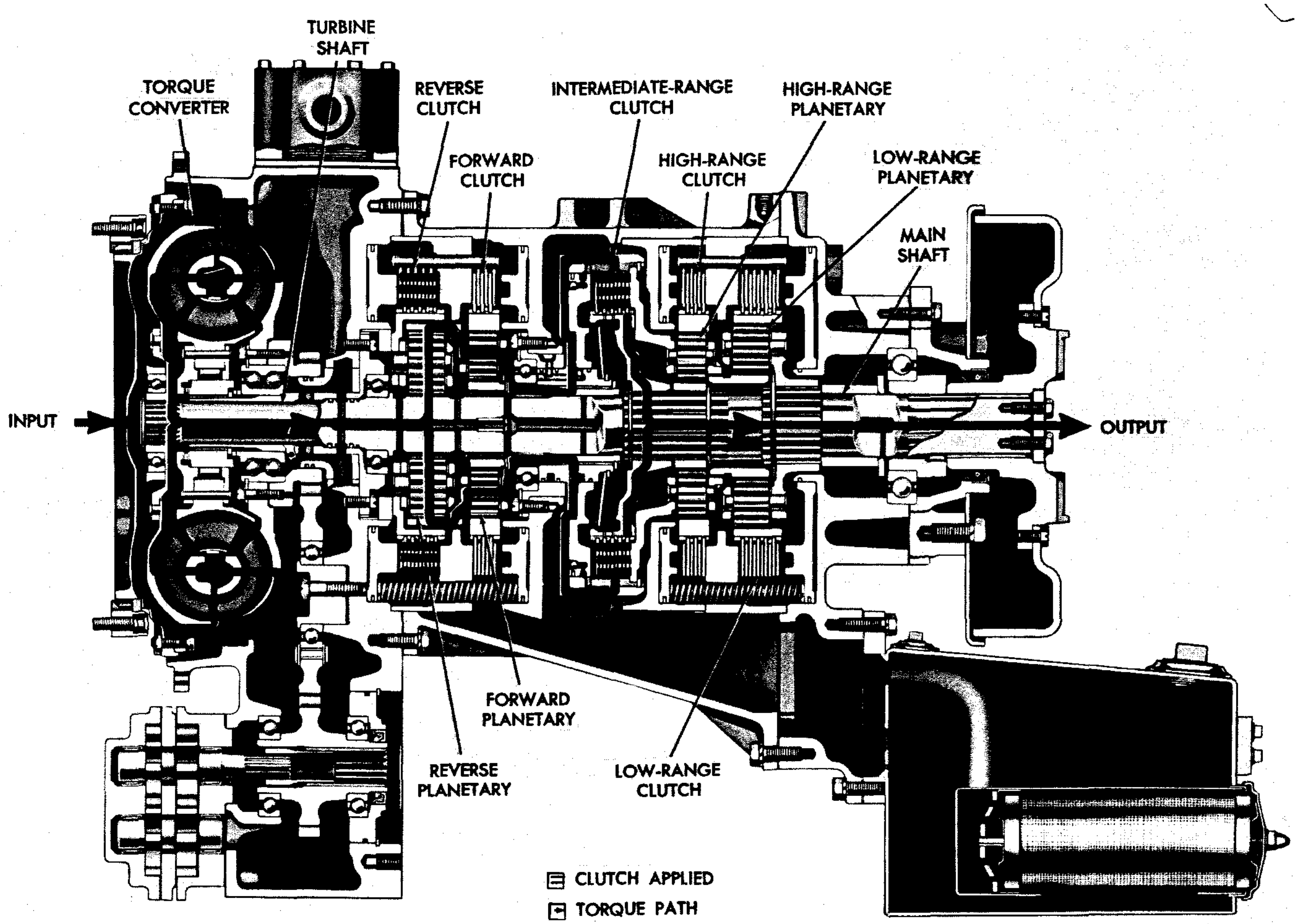


Fig. II-6. Reverse, intermediate range—torque path (CRT 3531-3)

tion of the power flow through the low-range components. The reverse planetary reduction of 2.81 to 1, coupled with the low-range planetary reduction of 2.76 to 1 (CRT 3531) or 3.03 to 1 (CRT 3630), gives a total reduction of 7.75 to 1 and 8.43 to 1, respectively.

28. TORQUE PATH – REVERSE, INTERMEDIATE RANGE (fig. II-6)

a. Refer to para 27a, above, for explanation of the power flow through the reverse planetary gear set.

b. Refer to para 25b, above, for explanation of the power flow through the intermediate-range clutch components. The 1.00 to 1 ratio of the intermediate-range clutch, coupled with the reverse planetary reduction of 2.81 to 1, gives a total reduction ratio of 2.81 to 1.

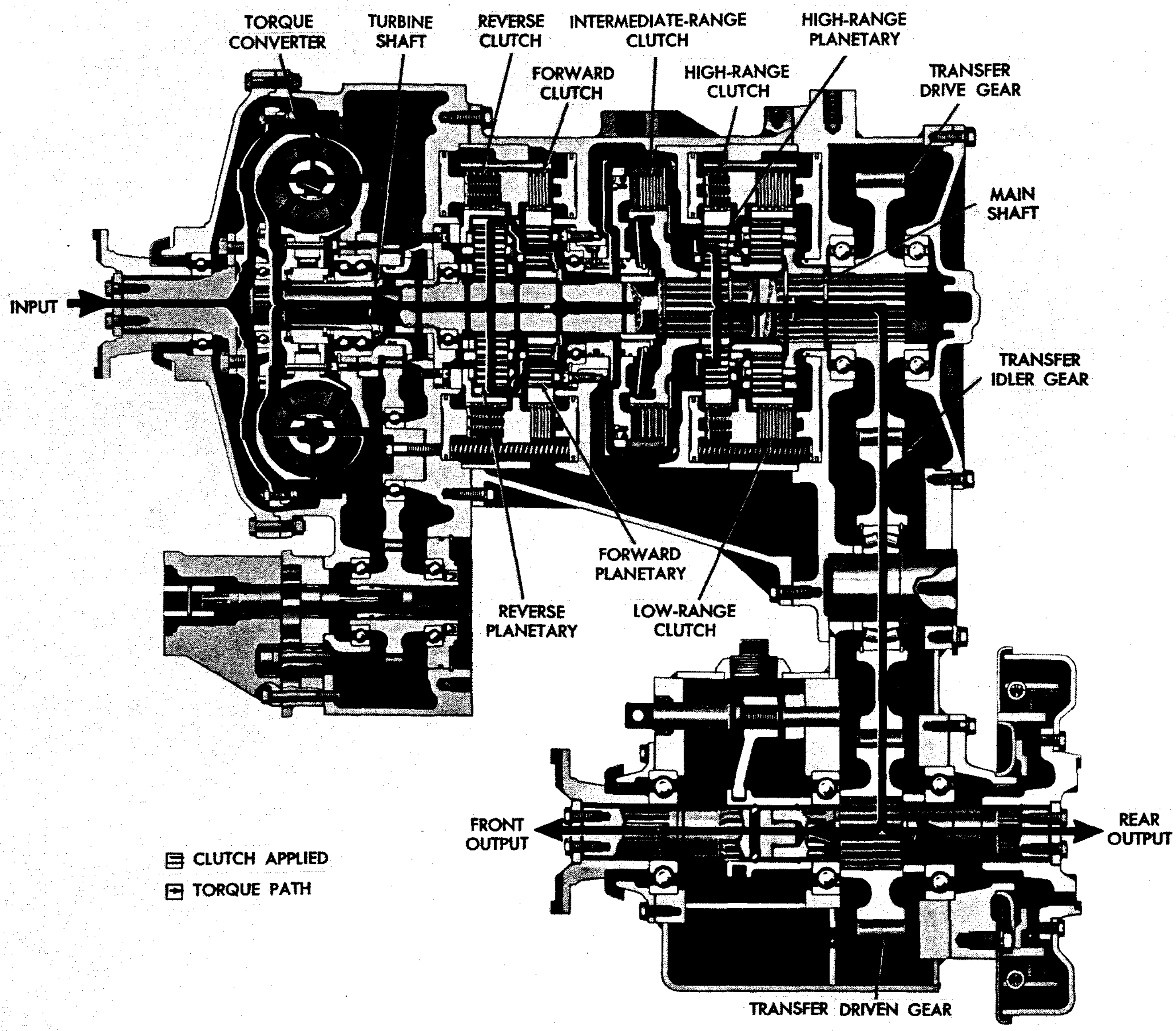


Fig. II-7. Reverse, high range—torque path (CRT 3531-1 or CRT 3630-1)

29. TORQUE PATH – REVERSE, HIGH RANGE (fig. II-7)

a. Refer to para 27a, above, for explanation of the power flow through the reverse planetary gear set.

b. Refer to para 26b, above, for explanation of the power flow through the high-range planetary gear set. The 2.81 to 1 speed reduction ratio of the reverse-range planetary gear set, coupled with the 0.345 to 1 overdrive ratio of the high-range planetary gear set, gives a total overdrive ratio of 0.97 to 1.

Section III. PREVENTIVE MAINTENANCE

1. SCOPE OF SECTION III

This section contains a discussion of checks, tests, adjustments and maintenance procedures which will increase the service life of the transmission. These procedures should keep downtime to a minimum. However, if trouble does occur, refer to para 9, below, and to the troubleshooting chart at the end of this section.

2. PERIODIC INSPECTIONS, CLEANING

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

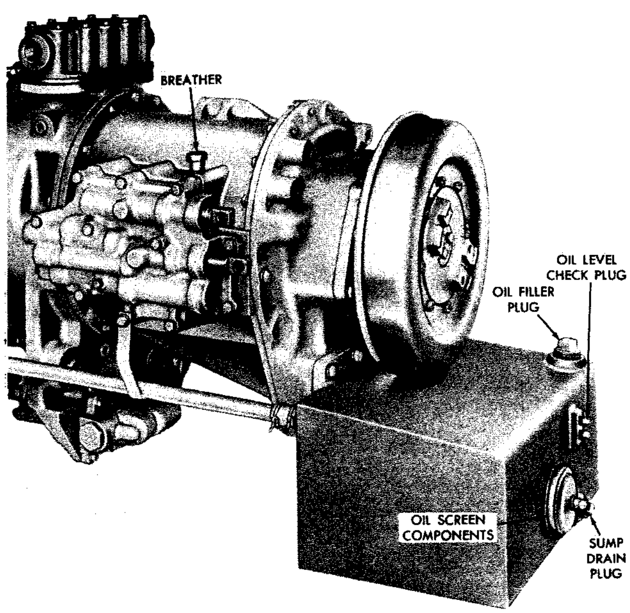


Fig. III-1. Model CRT 3531-3 transmission—partial left-rear view

b. Cleaning Breather. The prevalence of dirt and dust will determine the frequency at which the breather (fig. III-1) requires cleaning. Clean the area around the breather before removing it. Wash the breather thoroughly by agitating it in mineral spirits or gasoline. Dry it thoroughly, after cleaning, with compressed air. Always use a wrench of the proper size to remove or replace the breather – pliers, or a pipe wrench, will crush or damage it, and produce metal chips which may enter the transmission.

c. Cleaning Oil Screen. The transmission has a cylindrical oil screen located in the oil sump. The screen assembly is retained by a cover with a single bolt or nut and washer (fig. III-1). A new gasket should be used when replacing the cover after each cleaning. The flat washer used with the single central fastening should be replaced if it will not seal against oil leakage. Clean the screen assembly thoroughly. Examine the cover carefully for leakage after the transmission is refilled with oil. Use special care in tightening the bolt or nut which retains the cover. The recommended tightness is 8 to 10 pound feet. Excessive torque can pull the center stud loose from the sump.

3. CHECKING OIL LEVEL

a. Cold Check. The cold oil check (engine not running) is made only to determine if there is sufficient oil to permit safe starting of the engine. Where two oil level check plugs (fig. III-1) are provided on the oil sump, remove the top plug; where only one plug is provided, remove it. The oil level must be at or above the plug level before the engine is started.

b. Hot Check

(1) The hot oil check is made to determine if there is sufficient oil for working operation of the transmission. This check is made, while the engine is running, after 2

minutes operation at 1000 rpm, vehicle is standing level, and transmission is at normal operating temperature (180 to 200° F).

(2) On CRT 3531-1 or 3630-1 transmissions, the oil level plug may be located either at the lower-right side, or lower-left front of the transfer case (fig. III-2). Remove it for checking the oil. If the oil level is low, add sufficient oil to bring the level to the plug opening. If the level is high, drain to the level of the plug.

(3) On CRT 3531-3 transmissions, two oil level plugs are located at the rear of the sump (fig. III-1). Remove the upper plug. Under the conditions stated in (1), above, the oil level should be at the upper plug level. If the oil is below this level, add sufficient oil to bring it to the plug level. Drain excess oil until oil is at the upper plug level.

Note: Three quarts (US measure) are required to bring the oil level from the lower plug to the upper plug.

4. CHANGING OIL, FILTER ELEMENTS

a. Oil Capacity. CRT 3531-1 or 3630-1 transmissions require 7-1/2 US gallons for initial fill (dry). The same model requires only 5-1/2 US gallons for refill (approximately 2 gallons remain after draining). CRT 3531-3 models require 9 gallons initially, and 7 gallons at refill. These capacities do not include the additional oil required to fill the external system (cooler, filter, external oil lines). The requirements for the external system will vary among installations.

b. Intervals Between Changes. The interval between oil changes will vary with operating environment and conditions. The oil and filter elements should be changed when the oil becomes contaminated or has been overheated. Oil that has been overheated is discolored and has a strong odor. The presence of dirt, water or foreign matter in the oil may damage the transmission or cause malfunction. Under favorable operating conditions, the oil and filter elements should be changed after 2000 hours or six months of operation (whichever occurs first).

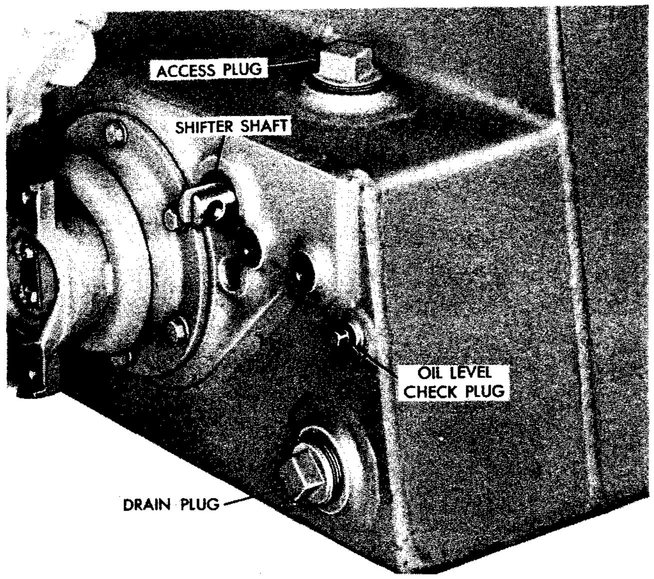


Fig. III-2. Model CRT 3531-1 or CRT 3630-1 transmission—left-front view, showing output disconnect and plugs

c. Draining Oil. The transmission should be warm when the oil is drained. Remove the drain plug (fig. I-4 or III-2), oil screen assembly and oil filter elements. Allow the system to drain thoroughly before replacing the drain plug. Clean the screen assembly (para 2c, above) and replace it. Install new oil filter elements (e, below).

d. Contamination of Oil. When the oil is drained, it should be examined for evidence of contamination. If water is present, check the oil cooler (heat exchanger) for leakage between the oil and water sides. Oil in the water side (radiator) is another sign of leakage – this, however, may indicate leakage from the engine oil system. Any accumulation of dirt or sludge in the sump should be removed with "flushing oil." Metal particles (except the usual minute particles normally removed by the oil filter) in the oil indicate damage or excessive wear of transmission parts. When this condition is found, the transmission should be disassembled, inspected, and rebuilt. The oil lines, cooler, filter and all areas where particles might lodge must be cleaned.

e. Replacing Filter Elements. Filter elements should be replaced whenever the oil is changed. The filter shells should be thoroughly cleaned. New gaskets (or seal rings) should be used when new filter elements are installed. After installation, inspect the filter components for oil leakage while the vehicle engine is running.

f. Filling Oil System

(1) Oil should be stored or handled in clean containers. Dust, dirt, water, or other foreign matter must not enter the transmission oil system. After draining, cleaning and replacement of components removed during draining, fill the system with hydraulic transmission fluid, type C-1. The oil filler arrangement varies among installations. Refer to a, above, for oil capacities of various models.

(2) When filling the system, pour 4 or 5 gallons of oil into the transmission, start the engine, and let it run idle for 2 or 3 minutes. If the main oil pressure fluctuates and will not stabilize during this period, more oil should be added. After enough oil is added to stabilize the pressure, operate the vehicle through all ranges until temperature reaches 180° F. Stop the vehicle and check the oil as outlined in para 3b, above. Add oil, as required, while the engine is running.

5. CHECKING OIL PRESSURES, TEMPERATURES

a. Oil Pressure Gage. A pressure gage may be installed on the vehicle instrument panel, to indicate the oil pressure. The gage is calibrated from 75 psi to 250 psi. The 75-140 psi segment is solid red, the 140-175 psi segment is solid green, the 175-250 psi segment is solid red.

Note: Main pressure can be raised by adding shims (item 8 in C, foldout 15) between main-pressure regulator valve assembly 7 and spring 9. Each shim will raise the pressure approximately 10 psi.

b. Oil Temperature Gage. An oil temperature gage may be installed on the vehicle instrument panel to indicate converter-out (to cooler) oil temperature. The gage sending unit is installed in a tapped hole at the upper-left side of the torque converter housing. The gage is marked with a range of 100 to 320 degrees F. The 100 to 250 degree segment has a green band; the 250 to 320 degree segment is red. The safe operating range is green. The red indicates overheating. The normal operating temperature of the transmission is 180 to 200 degrees F.

c. Checking Main Pressure. Main pressure can be checked by the gage on the instrument panel (if so equipped) or by connecting a gage to the 1/8-inch NPTF tapped opening on the outer side of the control valve body (fig. III-3). Main pressure at full-throttle stall should be approximately 150 to 160 psi on those transmissions equipped with main-pressure regulator valve assembly 6772429 (no ports in large diameter). On transmissions equipped with main-pressure regulator valve assembly 6771289 (ports in large diameter of valve), main pressure should be 140 to 150 psi.

Note: If the transmission is equipped with a later model manual selector valve body (P/N 6773644(the inching control valve must be released (retracted). If equipped with later model valve body (6773645 or 6773646— with clutch cutoff control), the vehicle brakes must be released.

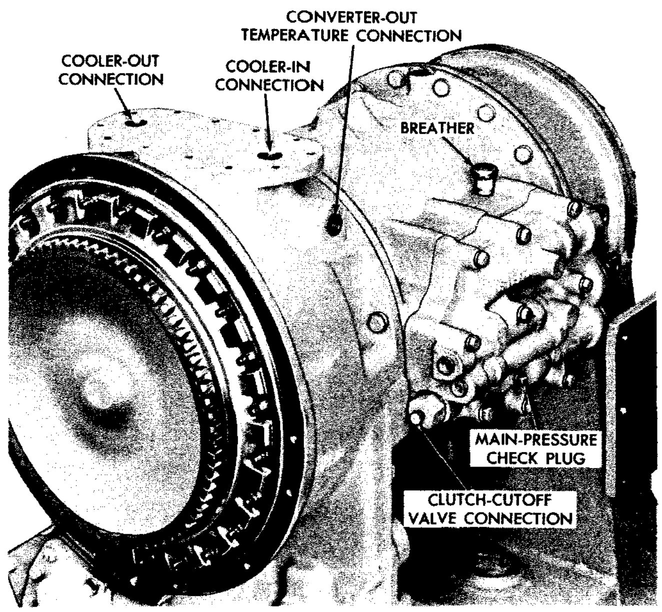


Fig. III-3. Model CRT 3531-1 or CRT 3630-1 transmission—partial left-front view

d. Checking Converter-out Pressure. Converter-out pressure may be checked at the point provided for attaching the temperature gage sending unit (1/2 NPTF tapped opening on the upper-left side of the converter housing — fig. III-3). Maximum converter-out pressure at full-throttle stall is 65 psi, with transmission at normal (180-200° F) operating temperature.

e. Checking Lubrication Pressure. On those transmissions equipped with a remote-mount oil cooler, the lubrication pressure may be checked by connecting a pressure gage into the oil return line which enters the torque converter housing at the right top. The lubrication oil pressure should be 15 to 30 psi when the transmission is in low range, forward, with the output stalled and the transmission at normal (180-200° F) operating temperature and engine running at 1000 rpm.

6. CHECKING, ADJUSTING LINKAGE

a. Frequent Inspection. All linkage between the operator's controls and the transmission should be inspected frequently for cleanliness, proper lubrication, adjustment, wear, damage and freedom of operation. Because linkage differs widely among installations, no specific adjustment procedures are given. However, general rules, which apply to all installations, are outlined in b through d, below.

b. Range Selector Linkage. The linkage must be adjusted so that the operator's control is positioned to correspond exactly to the detent positions of the range selector valve. With the linkage disconnected, place both the selector valve and the operator's control in neutral position. Adjust the linkage so that it can be freely connected without moving the valve or control. Then try the control in each range position. Make minor readjustments, if necessary, to insure that the selector valve detent seats at every range position of the operator's control.

c. Forward and Reverse, Inching Linkage

(1) The forward and reverse control linkage must be adjusted so that the neutral, forward, and reverse detent positions of the valve correspond exactly with those of the operator's control. This adjustment is made in a manner similar to the adjustment of the range selector linkage in b, above.

(2) On vehicles equipped with the later valve bodies, which have a separate valve for inching, the linkage must be adjusted to insure full application and full release. The inching control valve has a total linear movement of 2 inches from full-retract (released) to full-extension (applied).

d. Output Disconnect Linkage. There are two points of adjustment for the front-output disconnect on CRT 3531-1 or 3630-1 transmissions. The shifter shaft must be adjusted first, and then the linkage. Push the shifter shaft in (rearward) until the "engaged" detent seats. Adjust the shifter shaft by rotating it until the center of the linkage-connection hole is 0.610 to 0.650 inch (approximately 5/8 inch) from the front surface of the transfer case. When the shifter shaft is pulled outward (forward) the "disconnect" detent should seat when the center of the shaft hole is approximately 2 3/8 inches from the transfer case front surface. Adjust the linkage so that the "engaged" and "disconnect" positions of the operator's control correspond exactly with the detent positions of the shaft.

7. CONVERTER STALL TEST

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

Note: To conduct a stall test, it will be necessary to know the established normal stall speed of the specific engine and transmission combination. This information may be obtained from your Torqmatic dealer, or Allison Division, GM.

b. Procedures. The test is usually made while the engine and transmission are installed in the vehicle. The vehicle wheels must be blocked securely to prevent vehicle movement. The brakes should be applied except on those installations which include a clutch cutoff valve. Conduct the test as outlined below.

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

(2) Shift the transmission controls to high range and forward.

(3) Increase the engine speed to full throttle. Converter-out pressure should be 25 psi minimum.

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

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

c. Results. The only reading derived from the stall test is engine speed. The difference between established normal (see a, above) speed and the actual speed recorded is significant only if it exceeds 150 rpm. Refer to the troubleshooting chart in para 9, below, for malfunctions which may be indicated by excessively high- or low-speed readings derived in a stall test.

8. STORAGE

Note: New transmissions leave the Allison factory filled with preservative-type oil. Such transmissions can be safely stored for 6 months without further treatment.

a. Period of Storage. The preparations to be made for storage of a transmission will depend upon the conditions under which it is to be stored, and the period of time involved. Under severe storage conditions, preservative measures should be used if the idle period is to exceed 1 week. The following procedures will give protection for 12 months. Repeat the process if the storage period exceeds 12 months.

b. Preservatives and Procedures. Protective oil must meet government specification USA 2-126 grade 1. Preservative grease must meet specification ANC 124d. Moisture-proof tape is required. Drain the oil while the transmission is at operating temperature (180-200° F). Refill the system with preservative oil, and raise the transmission temperature to approximately 225° F. Shift the transmission slowly through all selector positions to thoroughly distribute the oil.

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

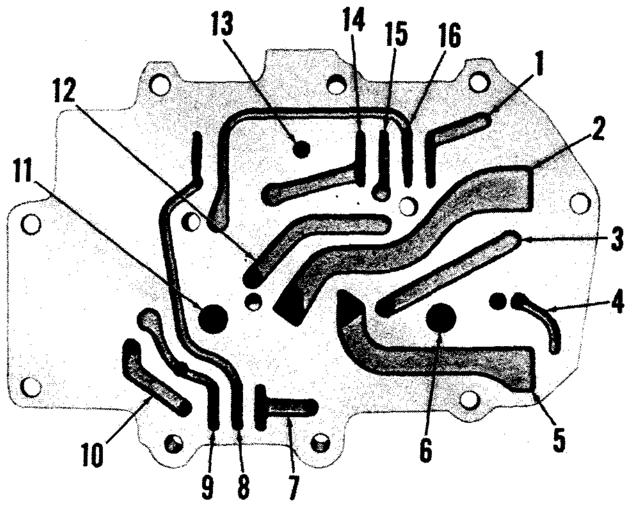
Stop the engine and allow the transmission to cool until the heat of the sump can be tolerated by hand. Tape all openings, and tape or grease all exposed metal surfaces. Control valves should be retracted to reduce the surface exposed. When outside storage is necessary, provide a ventilated, rain-proof covering.

c. Returning to Service. Remove the moisture-proof tape and grease. Start the engine and let it run at idle speed until the oil temperature reaches 150° F. Drain the oil, and refill as outlined in para 4, above.

Note: Do not operate the vehicle while using preservative oil, except within the warmup period, until 150° F is reached.

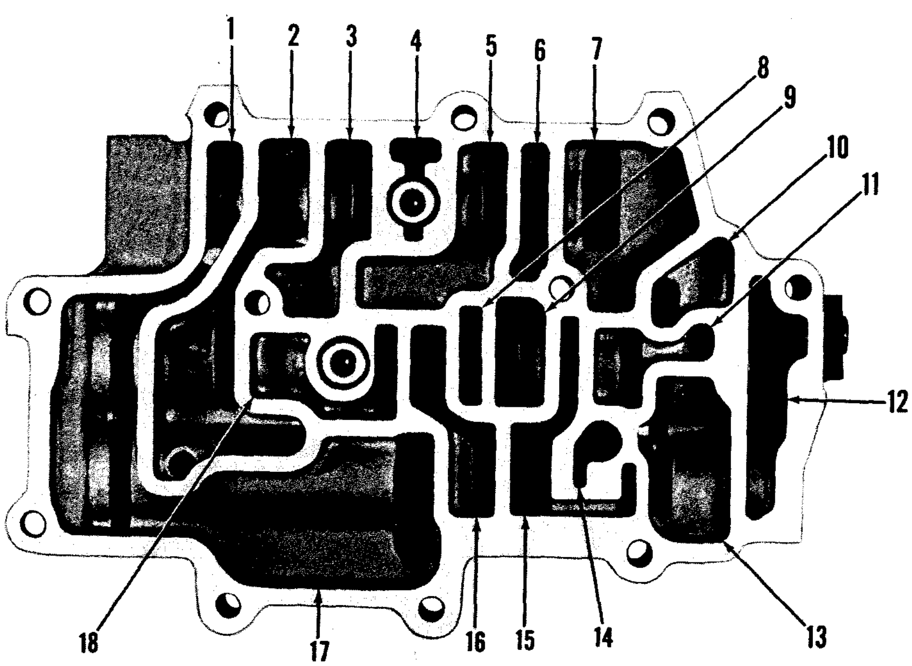
9. TROUBLESHOOTING

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



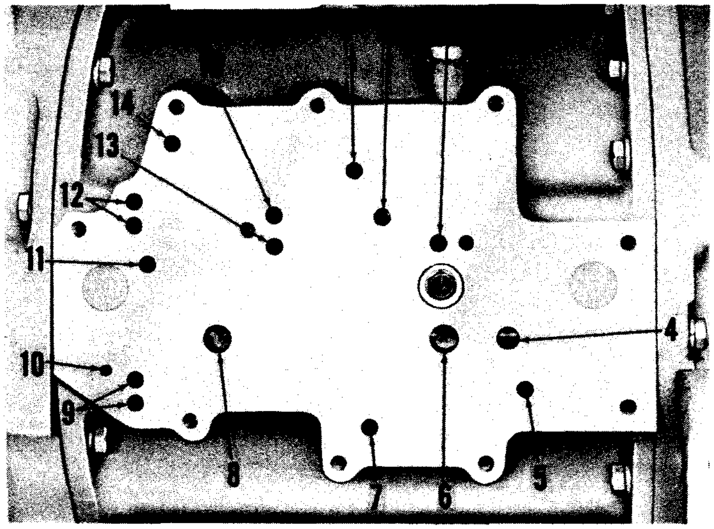
1 - Sump
2 - Forward lube pressure
3 - Reverse clutch apply pressure
4 - Sump
5 - Reverse lube pressure
6 - Main oil pressure
7 - Sump
8 - Main oil pressure
9 - Main oil pressure
10 - Sump
11 - Main oil pressure
12 - Forward clutch apply pressure
13 - Sump
14 - Low-range clutch apply pressure
15 - Intermediate-range clutch apply pressure
16 - High-range clutch apply pressure

Fig. III-4. Control valve body oil passages (early model)



1 - Sump
2 - Main oil pressure
3 - High-range clutch apply
4 - Sump
5 - Low-range clutch apply
6 - Intermediate-range clutch apply
7 - Sump
8 - Forward lube
9 - Forward apply
10 - Forward lube
11 - Reverse apply
12 - Sump
13 - Reverse lube
14 - Main
15 - Forward-reverse feed (main)
16 - Lube feed
17 - Sump
18 - Reverse lube

Fig. III-5. Control valve body oil passages (later model)



1 - Sump
2 - Low-range clutch apply pressure
3 - High-range clutch apply pressure
4 - Main oil pressure
5 - Sump
6 - Main oil pressure
7 - Sump
8 - Main oil pressure
9 - Reverse lube pressure
10 - Sump
11 - Reverse clutch apply pressure
12 - Forward lube pressure
13 - Forward clutch apply pressure
14 - Sump
15 - Intermediate-range clutch apply pressure

Fig. III-6. Transmission housing oil passages

1 - Sump
2 - Main oil pressure
3 - Converter-in oil pressure
4 - Main oil pressure
5 - Remote oil filter oil director transfer tube and passage
6 - Oil from remote oil filter (Passage for oil to filter shown in fig. I-2. For an alternate oil-to-filter passage, plug passage shown in fig. I-2 and connect the oil-to-filter line to passage which contains tube called out in 5, above).
7 - Low-range clutch apply
8 - Pump suction

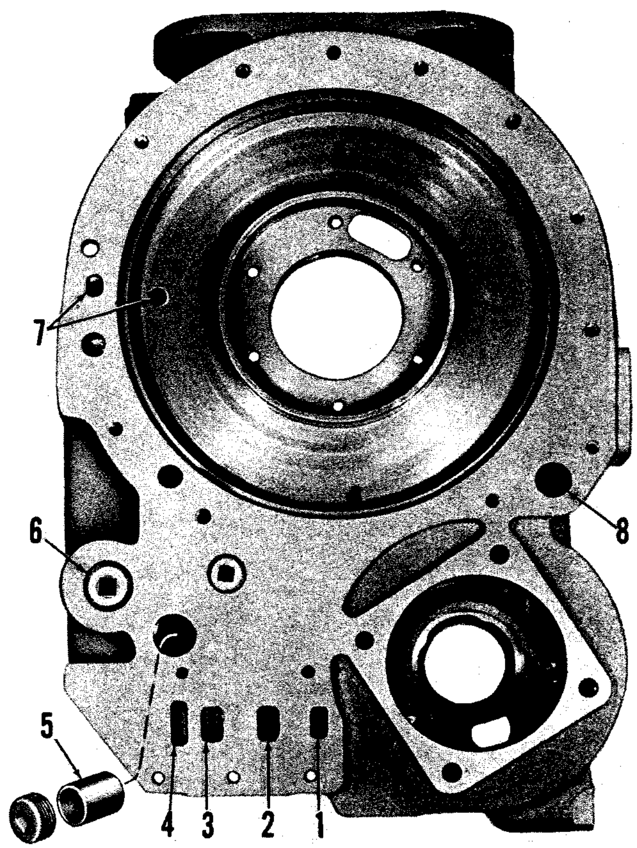


Fig. III-7. Converter housing oil passages

b. Preliminary Checks. The engine must be correctly adjusted and performing satisfactorily when troubleshooting is started. The various control linkages must be properly adjusted and functioning properly. The oil level in the transmission must be at the proper level. Refer to the engine service information for procedures pertaining to the engine. Refer to para 3 through 6, above, for procedures pertaining to the transmission.

c. Oil Passage Identification. Fig. III-4 through III-7, on the preceding pages, identify the oil passages in the selector valve body, the mounting pad on the transmission housing, the main-pressure regulator valve and its mounting pad on the converter housing. Use them as necessary for tracing the various circuits in the hydraulic system when locating hydraulic malfunctions.

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

TROUBLESHOOTING CHART

Cause	Remedy
(A) LOW MAIN PRESSURE	
1. Low oil level	1. Add oil to proper level (sect. III, para 3)
2. Clogged strainer screen	2. Clean screen (sect. III, para 2c)
3. Weak or broken main-pressure regulator spring	3. Replace spring (sect. VI, para 5 or 6)
4. Main-pressure regulator valve sticking open	4. Rebuild main-pressure regulator valve body assembly (sect. VI, para 5 or 6)
5. Clutch cutoff valve sticking open	5. Rebuild control valve body assembly (sect. VI, para 3 or 4)
6. Inching control valve linkage out of adjustment (later model valve body)	6. Adjust linkage (sect. III, para 6c(2)
7. Oil aerated, foaming	7. (a) High oil level – drain to proper level (sect. III, para 3) (b) Improper oil – drain, refill with recommended oil (sect. III, para 4c through 4f) (c) Dirty strainer screen – clean screen (sect. III, para 2c) (d) Ruptured control valve body gasket – replace gasket (sect. V, para 2; sect. VII, para 2) (e) Internal leakage – overhaul transmission (sect. IV through VIII)
8. Input oil pump worn or damaged	8. Rebuild pump (sect. VI, para 7, 8 or 9)
9. Lubrication pressure regulator valve dirty, open	9. Clean valve (sect. VII, para 2, step 38)

(Continued on next page)

TROUBLESHOOTING CHART - Continued

Cause	Remedy
(B) LOW CONVERTER-OUT PRESSURE	
1. Low main pressure	1. Refer to A, above
2. Converter-in bypass valve leaking	2. Rebuild main-pressure regulator valve (sect. VI, para 6)
(C) LOW LUBRICATION OIL PRESSURE	
1. Lubrication pressure regulator valve dirty, open	1. Clean valve (sect. VII, para 2, step 38)
2. Lubrication pressure regulator valve seal washer damaged	2. Replace washer (sect. VII, para 2, step 38)
3. Lubrication pressure regulator valve spring weak or broken	3. Replace spring (sect. VII, para 2, step 38)
4. Low main pressure	4. Refer to A, above
(D) HIGH OIL TEMPERATURE	
1. Low oil level	1. Add oil to proper level (sect. III, para 3)
2. High oil level	2. Drain oil to proper level (sect. III, para 3)
3. Low water level in cooling system	3. Add water — check for leaks
4. Low converter-out pressure (low flow rate)	4. Refer to B, above
5. Clogged or dirty oil cooler, cooler lines	5. Clean cooler and lines, or replace if necessary
6. Oil aerated, foaming	6. Refer to A7, above
7. Overheated water system	7. Check and correct water system troubles
8. Operating too long in an inefficient converter range	8. Adjust work cycle to allow operation in an efficient range
9. Stator (or stators) locked	9. Check for low top speed of vehicle. Check converter components (sect. V, para 2 and sect. VI, para 12)

(Continued on next page)

TROUBLESHOOTING CHART - Continued

Cause	Remedy
(E) LOSS OF POWER	
1. Low engine output	1. Check and tune engine
2. Converter element interference	2. Check for noise at stall – overhaul converter (sect. V, para 2 and sect. VI, para 12)
3. Clutch slipping	3. (a) Check clutch pressure (sect. III, para 5a and c) (b) Check for worn piston seals. Overhaul transmission if necessary (sect. IV through VIII)
4. Converter not properly functioning	4. Refer to D9, above
5. Control valves not properly positioned	5. Check linkage adjustments (sect. III, para 6a, b, and c)
6. Low main pressure	6. Refer to A, above
7. Overheating	7. Refer to D, above
(F) NO POWER TRANSMITTED IN ANY RANGE	
1. Low main pressure	1. Refer to A, above
2. Control valves not properly positioned	2. Check, adjust control valve linkage (sect. III, para 6a, b, and c)
3. Clutch slipping	3. Refer to E3, above
4. Mechanical failure	4. Disassemble and rebuild transmission (sect. IV through VIII)
(G) NO POWER TRANSMITTED IN ONE RANGE	
1. Clutch slipping	1. Refer to E3, above
2. Control valves not properly positioned	2. Check, adjust control valve linkage (sect. III, para 6a, b, and c)
3. Mechanical failure	3. Disassemble and rebuild transmission (sect. IV through VIII)

(Continued on next page)

TROUBLESHOOTING CHART - Continued

Cause	Remedy
(H) SLOW CLUTCH ENGAGEMENT	
1. Low main pressure	1. Refer to A, above
2. Worn piston seals	2. Overhaul transmission (sect. IV through VIII)
3. Slow clutch cutoff valve return	3. (a) Check brake system pressure release (b) Check cutoff valve movement in valve body (sect. VI, para 3 and 4) (c) Check cutoff valve spring (sect. VI, para 3 and 4)
(I) HIGH CONVERTER-OUT PRESSURE	
1. Restricted oil cooler or cooler lines	1. Clean cooler, clean or replace cooler lines
2. Lubrication pressure regulator valve sticking closed	2. Inspect, and correct sticking condition (sect. VII, para 2, step 38)

Note: In all conditions described in J through N, below, the vehicle will operate when the control valve for the failed clutch (forward-reverse or range clutch) is shifted to neutral. This is true because the failed clutch is locked and will not release.

Cause	Remedy
(J) VEHICLE OPERATES IN ALL FORWARD GEARS, BUT STALLS IN ALL REVERSE GEARS	
1. Forward clutch failed (will not release)	1. Overhaul transmission (sect. IV through VIII)
(K) VEHICLE OPERATES IN ALL REVERSE GEARS, BUT STALLS IN ALL FORWARD GEARS	
1. Reverse clutch failed (will not release)	1. Overhaul transmission (sect. IV through VIII)

(Continued on next page)

TROUBLESHOOTING CHART - Continued

Cause	Remedy
Ⓛ VEHICLE OPERATES FORWARD AND REVERSE IN LOW RANGE, BUT STALLS IN INTERMEDIATE AND HIGH RANGES	
1. Low-range clutch failed (will not release)	1. Overhaul transmission (sect. IV through VIII)
Ⓜ VEHICLE OPERATES FORWARD AND REVERSE IN INTERMEDIATE RANGE, BUT STALLS IN LOW AND HIGH RANGES	
1. Intermediate-range clutch failed (will not release)	1. Overhaul transmission (sect. IV through VIII)
Ⓝ VEHICLE OPERATES FORWARD OR REVERSE IN HIGH RANGE, BUT STALLS IN LOW AND INTERMEDIATE RANGES	
1. High-range clutch failed (will not release)	1. Overhaul transmission (sect. IV through VIII)

Section IV. GENERAL OVERHAUL INFORMATION

1. SCOPE OF SECTION IV

The transmission overhaul procedures are divided into five sections (sect. IV through VIII). Section IV deals with general overhaul information; Section V covers disassembly of the transmission into subassemblies; Section VI covers the rebuild of subassemblies; Section VII covers the assembly of the transmission from subassemblies; and Section VIII covers wear limits information and includes a spring chart.

2. PROCEDURES SUBJECT TO CHANGE

Because of the release of new models, and changes to models already in the field, instructions in the manual are subject to change. Therefore, always check the latest service information available at your dealer. When requesting service information or ordering parts from your dealer, be sure to include the part number, model and serial number from the name plate of your transmission (sect. I, para 5 and 6).

3. REMOVAL, INSTALLATION OF TORQMATIC TRANSMISSION

Consult your vehicle or equipment service manual for procedures to be followed in removing or installing the transmission in the drive line.

4. TOOLS, EQUIPMENT

a. Tools Needed. A minimum amount of special and improvised tools are required for overhaul procedures. The tools and their uses are listed below:

(1) Transfer idler gear spindle puller (fig. IV-1).

(2) Input or output flange puller (fig. IV-2).

(3) Sleeve for positioning parts prior to assembly of input or output flanges (fig. IV-3).

(4) Tool for installing stator thrust bearing (fig. IV-4).

b. Equipment Needed. The equipment outlined below should be available before overhaul is started:

(1) Proper hand tools and receptacles for small parts.

(2) A suitable hoist, 1-ton capacity.

(3) An arbor press.

(4) A disassembly and assembly table is essential for proper and efficient performance of overhaul procedures. A table suitable for this purpose is shown in fig. IV-5.

(5) A container for cleaning parts and a supply of mineral spirits or dry-cleaning solvent.

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

5. PARTS REPLACEMENT

Replace all seal rings and gaskets during overhaul. Handle all seal rings with care to prevent damage. Usually, service kits will be needed for partial or complete overhaul. Refer to sect. I, para 6 for information on ordering parts.

6. CLEANING, INSPECTION

a. Dirt, Abrasives Harmful. Whenever the transmission contains dirt or other abrasive matter, unnecessary wear will result. Inspect all parts for abrasive material any time

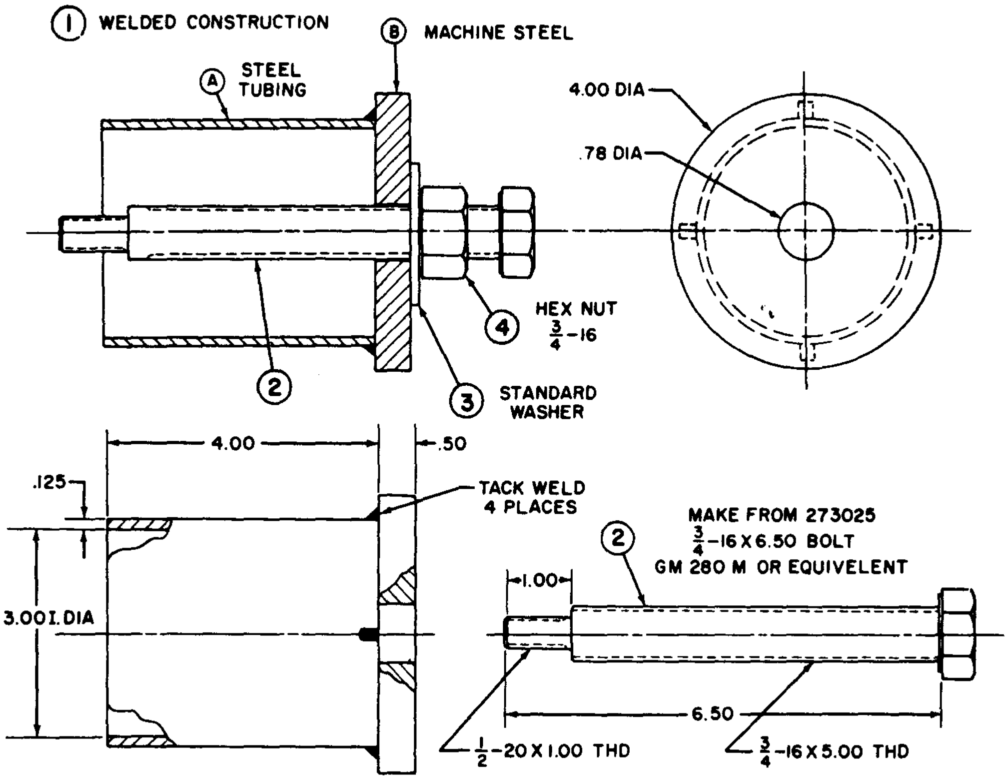


Fig. IV-1. Special tool for removing transfer idler gear spindle

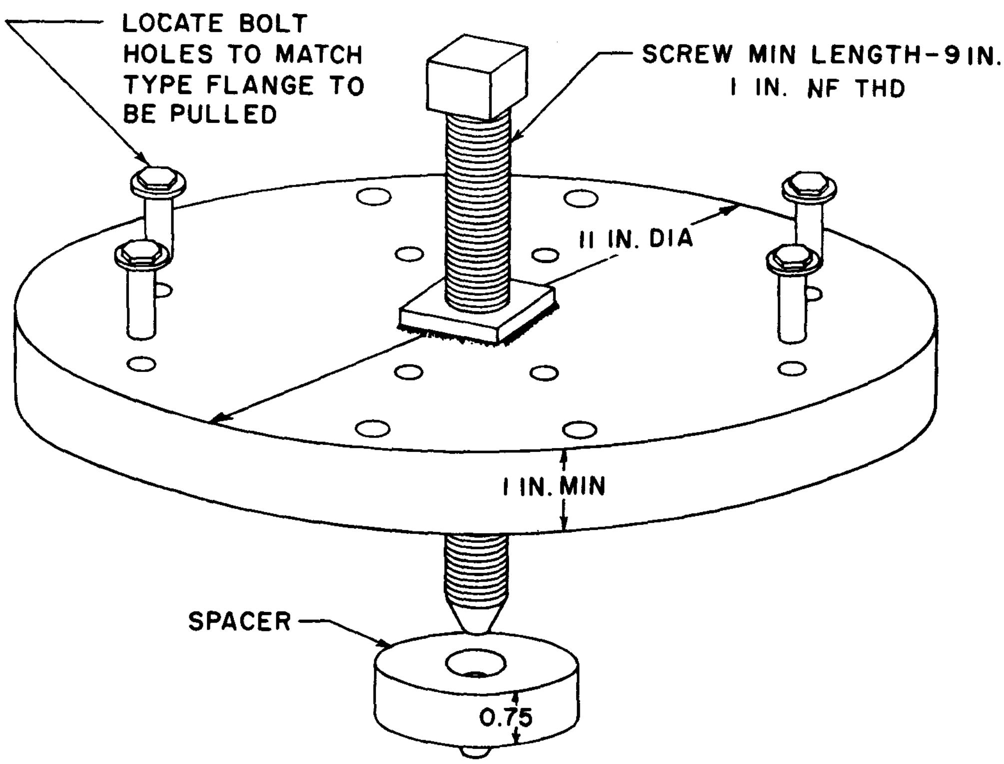


Fig. IV-2. Special tool for removing tight-fit flanges

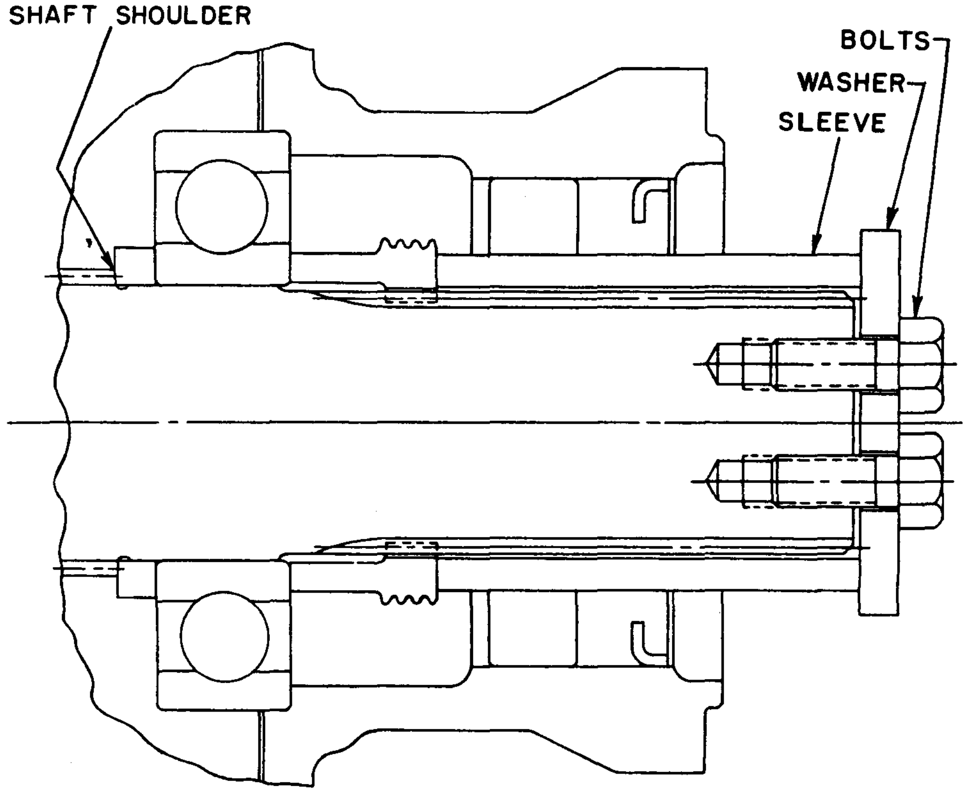


Fig. IV-3. Special tool for seating output shaft parts before installing flange

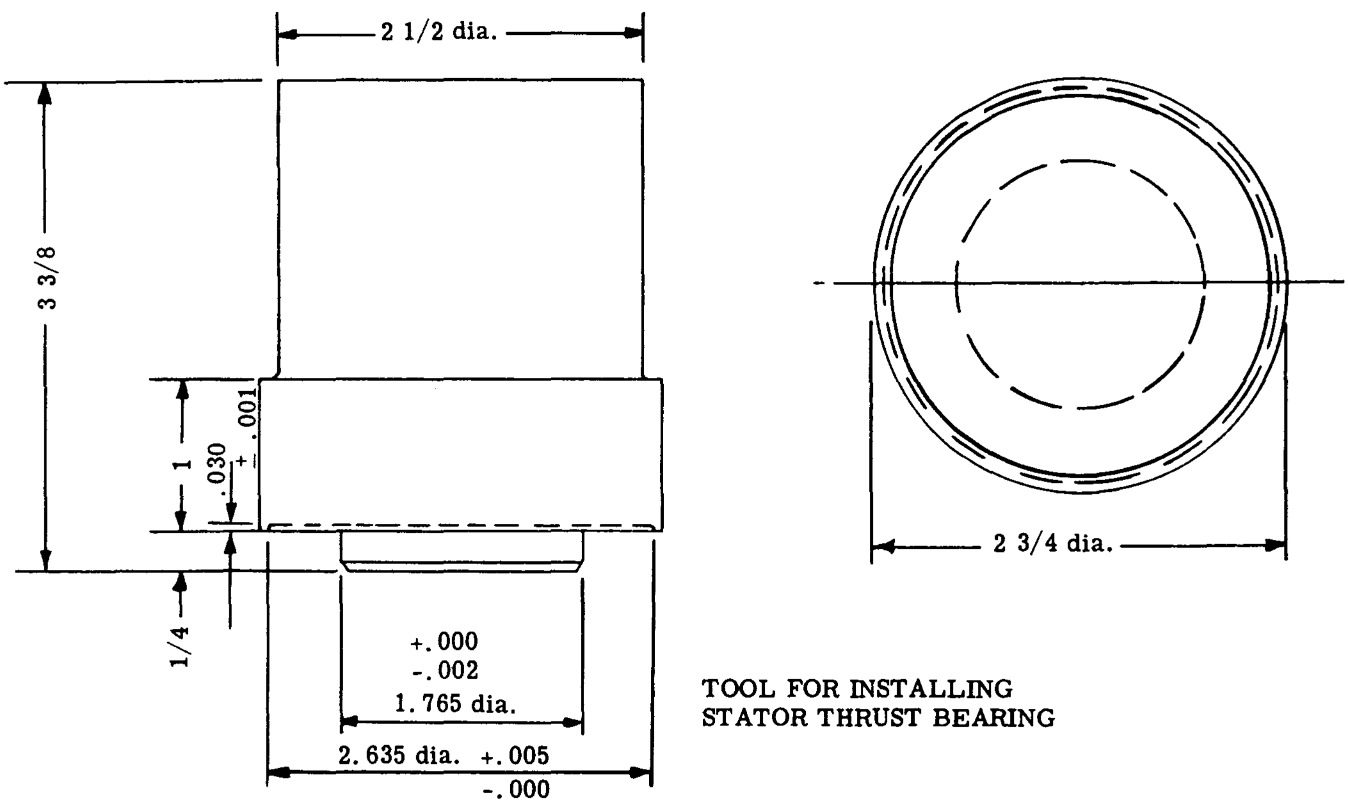


Fig. IV-4. Special tool for installing stator thrust bearing

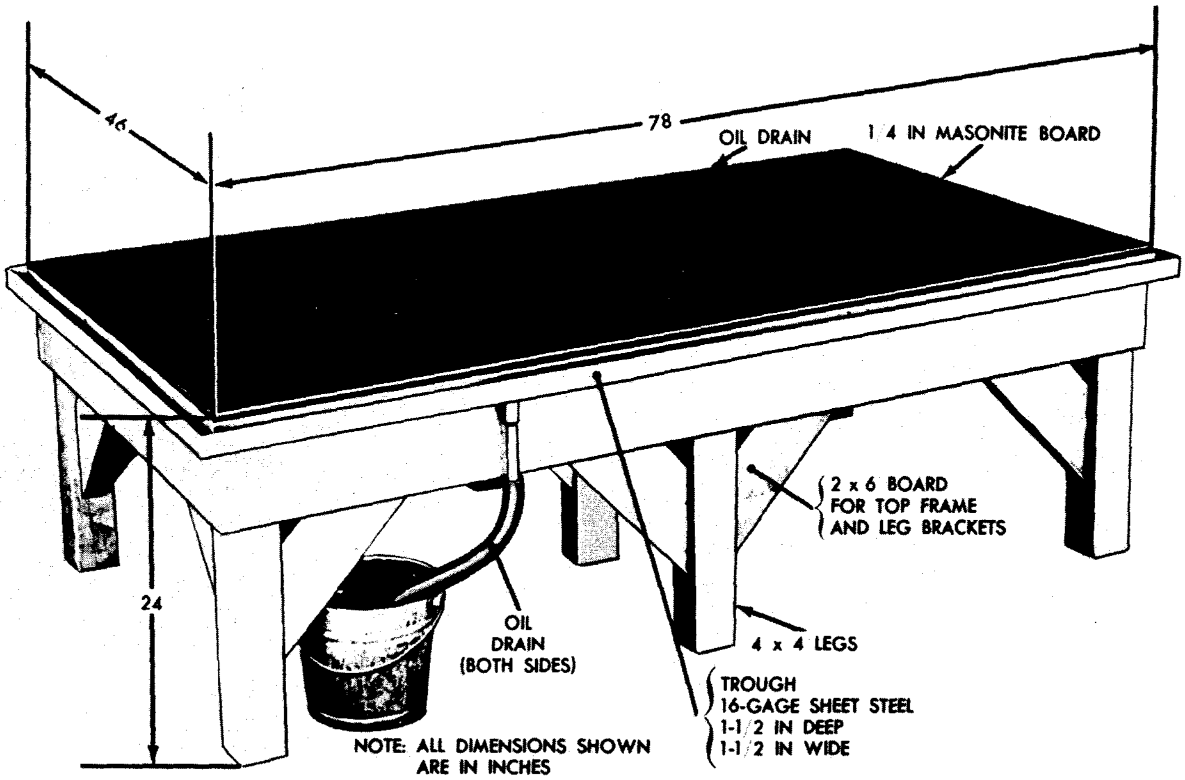


Fig. IV-5. Transmission disassembly and assembly table

the transmission is disassembled. Metallic contamination of oil is evidence of the failure of some part. If metal particles are found, the transmission must be thoroughly cleaned. Refer to sect. III, para 4d. Use information contained in cleaning and inspection in conjunction with wear limits and spring data in sect. VIII.

b. Cleaning Parts

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

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

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

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

c. Cleaning Bearings

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

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

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

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

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

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

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

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

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

e. Inspecting Cast Parts, Machined Surfaces

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

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

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

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

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

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

f. Inspecting Bearings

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

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

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

(4) When installing a bearing on a shaft, heat the bearing to 200° F if suitable facilities, such as an electric oven, are available. Coat the mating surfaces with white lead and use the proper size installation sleeve and an arbor press to seat the bearing.

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

g. Inspecting Bushings, Thrust Washers

(1) Inspect bushings for sharp edges, roundness, scores, burs, and evidence of overheating. Remove scores with crocus cloth. Remove burs and sharp edges with a scraper or knife blade. If the bushing is out-of-round, deeply scored, or excessively worn, replace it using the proper size replacer.

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

(2) Inspect thrust washers for distortion, scores, burs, and wear. Replace the thrust washer if it is defective or worn. It is much less expensive to replace such parts than to replace converter elements or transmission gearing, which can fail due to defective bearings, bushings, or thrust washers.

h. Inspecting Seals, Gaskets

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

(2) When replacing lip-type oil seals, make sure the spring-loaded side is toward the oil to be sealed in (toward the inside of the unit). Use a nonhardening sealing compound on the outside diameter of the seal to help prevent oil leaks. The press or drive tool (replacer) must contact the entire seal perimeter.

(3) Replace all composition gaskets.

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

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

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

i. Inspecting Gears

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

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

(3) Inspect the thrust faces of gears for scores, scratches, and burs. Remove such defects with a soft stone. If scratches and scores cannot be removed with a soft stone, replace the gear.

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

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

l. Inspecting 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 springs for signs of overheating, permanent set or wear due to rubbing of adjacent parts. Replace the spring if any one of these defects is found. Refer to the spring chart at the end of sect. VIII.

7. WEAR LIMITS

a. Data in Section VIII. All wear limits information has been collected into a section of its own at the end of this manual. Section VIII contains general wear limits information as well as tabular data. The section also contains a spring chart. Tabular data is keyed to the exploded views in the back of the book.

b. See Cleaning, Inspection. Instructions for cleaning and inspection, para 6, above, should be used in conjunction with wear limits and spring chart information in section VIII.

8. TIGHT-FIT FLANGES

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

a. Removal of Flanges

(1) Install a suitable heavy-duty puller to the face of the flange. A typical puller is illustrated in fig. IV-2.

Caution: A puller that pulls on the outside diameter of the flange may deform the pilot diameter and mounting face.

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

(3) Provide a means for preventing flange rotation.

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

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

b. Installation of Flanges

(1) Make sure that the output shaft is in its most outward position and the bearing between the shaft shoulder and the flange is tight against the shaft shoulder. A typical method is to insert a sleeve over the shaft and pull tight with bolts and washers as illustrated in fig. IV-3.

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

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

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

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

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

Caution: Do not let flange cool prior to installation.

(5) Install the flange retaining washer and bolts and tighten the bolts to 41 to 49 pound feet.

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

(6) After the assembly has cooled, it is good practice to check the bolt torque and, if necessary, retorque to 41 to 49 pound feet.

Note: Prior to final tightening, install shims (if used) and lock strip.

9. DETERMINING PTO BACKLASH LIMITS

a. Check Carefully. The backlash in power takeoff (PTO) installations should be carefully checked. Excessive or insufficient backlash can result in damage to the transmission and the PTO assembly.

b. Procedure. Where instructions are not immediately available from the vehicle manufacturer, the following method is suggested for determining the proper backlash.

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

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

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

(4) Add quantity "A" to quantity "B," then subtract this sum from quantity "C."

The remainder will be the backlash between the transmission gear and the PTO gear. Call this quantity "D."

(5) For safe PTO operation, the value of "D" should be 0.005 to 0.025 inch. The formula is stated: D = C - (A + B).

10. TORQUE SPECIFICATIONS

Unless otherwise specified, the torque specifications listed in the chart on the opposite page will apply to all assembly procedures. Refer to fig. IV-6, below, for a cross-section view of the transmission, showing specifications for all bolts shown.

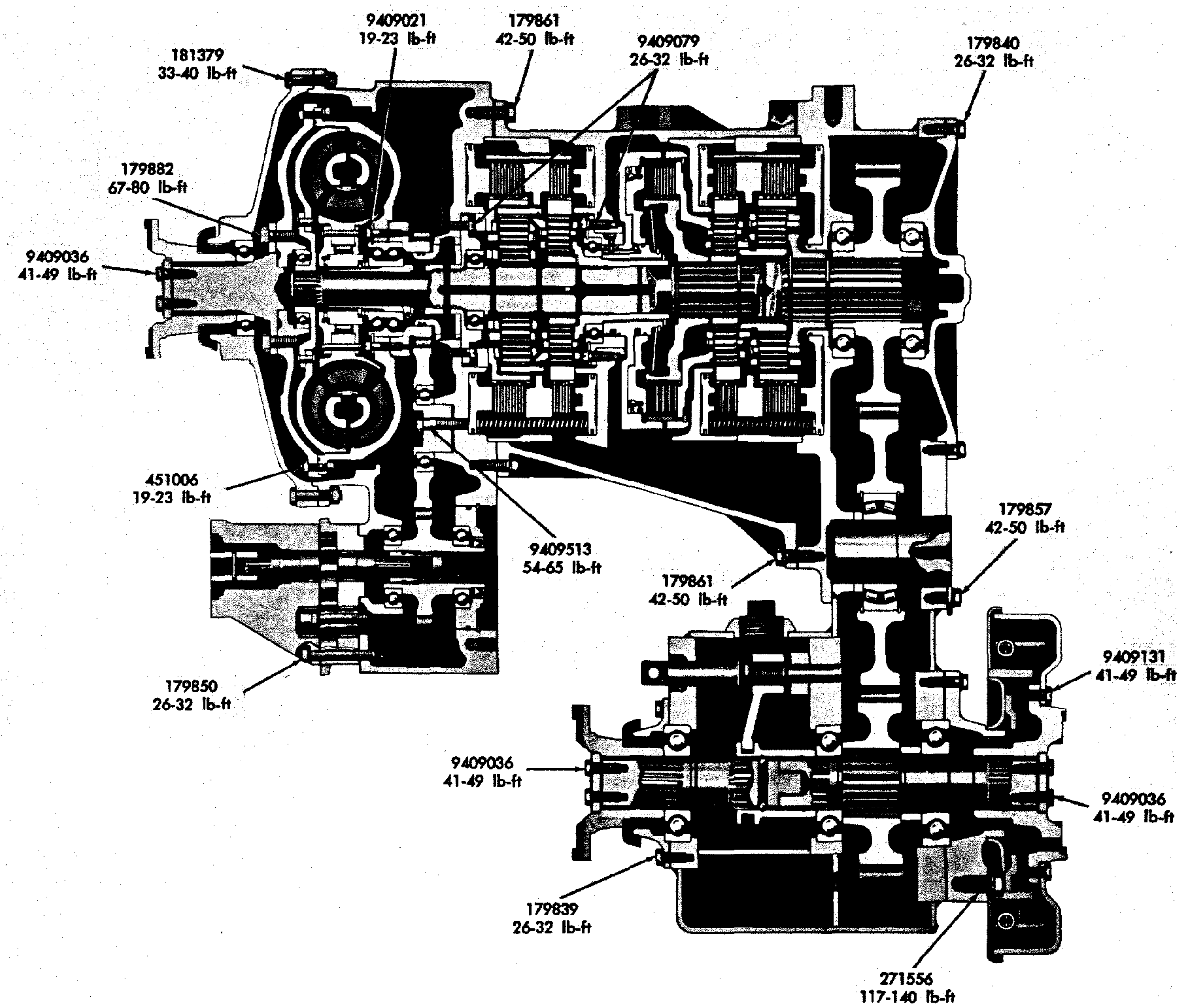
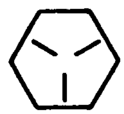
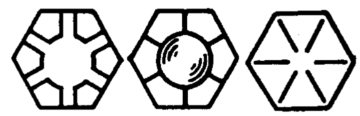


Fig. IV-6. Model CRT 3531-1 (or CRT 3630-1) transmission, showing torque values—cross section

GENERAL TORQUE SPECIFICATIONS – BOLTS AND SCREWS

(All torque values are given in pound feet)

Size	Threads per inch	Standard heat-treated bolts and screws	Special heat-treated bolts, screws, Allen-head screws, and self-locking capscrews
			
1/4	20	6-8	9-11
	28	8-10	10-12
5/16	18	15-18	17-20
	24	17-20	19-23
3/8	16	26-32	36-43
	24	33-40	41-49
7/16	14	42-50	54-65
	20	50-60	64-77
1/2	13	67-80	81-97
	20	83-100	96-115
9/16	12	85-100	103-123
	18	100-120	122-146
5/8	11	117-140	164-192
	18	134-160	193-225
3/4	10	180-210	284-325
	16	215-250	337-385
7/8	9	315-360	490-550
	14	372-425	575-650
1	8	445-500	685-770
	14	535-600	830-925

Section V. DISASSEMBLY OF TRANSMISSION INTO SUBASSEMBLIES

1. PRELIMINARY DISASSEMBLY

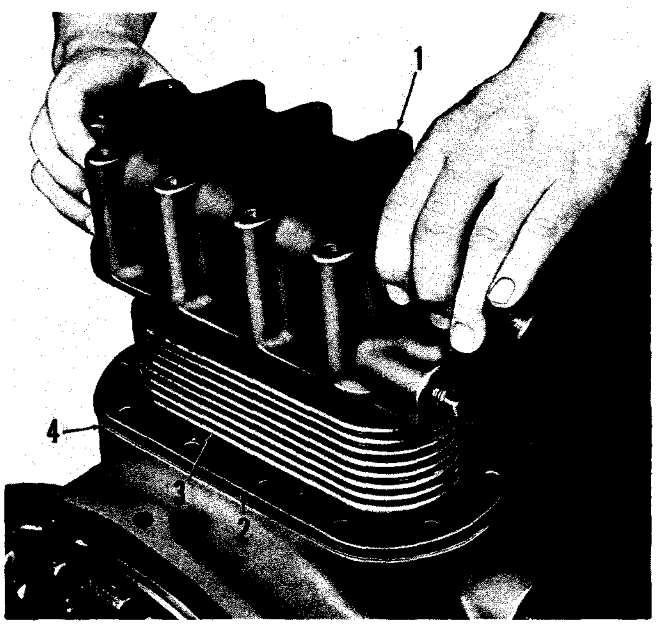
a. Scope of Section V

(1) This section covers the disassembly of the transmission into subassemblies. Rebuild of subassemblies is covered in Section VI.

(2) The pictorial, step-by-step arrangement in this section is designed to present easy-to-follow disassembly procedures. Directly beneath each picture are simple procedure instructions. These are keyed to the pictures by numbered callouts.

(3) Refer to the cross-section drawings for the functional location of parts (foldouts 1 and 2, at the end of this manual). Refer to the exploded views (foldouts 6 through 16) for parts identification.

b. Model Variation. The rebuild procedures in Section VI will vary according to the models (CRT 3531-1, CRT 3630-1 or CRT 3531-3) and the options. Disassembly of the CRT 3531-1 and CRT 3630-1 is covered in para 2, below. Disassembly of the CRT 3531-3 is covered in para 3, below.

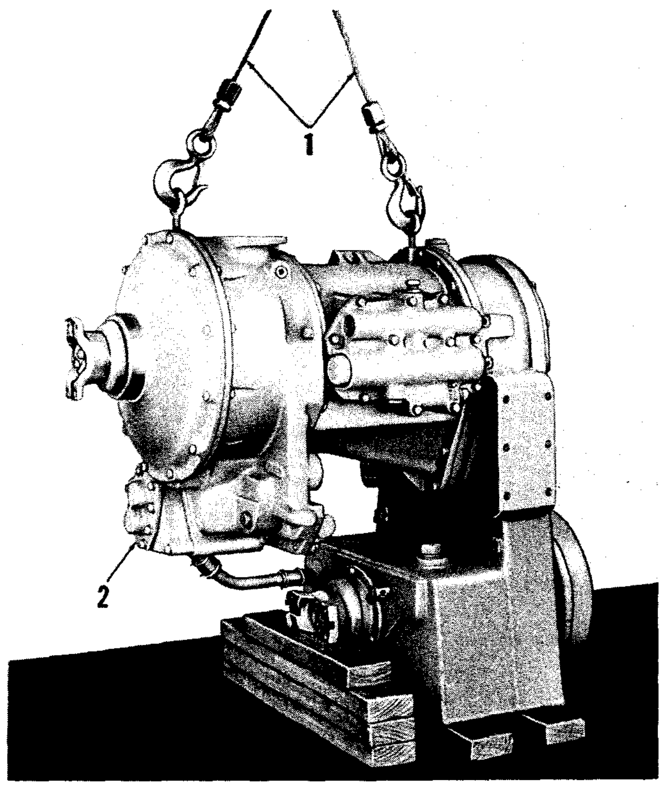


STEP 1

Remove twelve bolts which retain the oil cooler cover 1. Remove the cover, and gasket 2. Remove oil cooler core 3 and gasket 4.

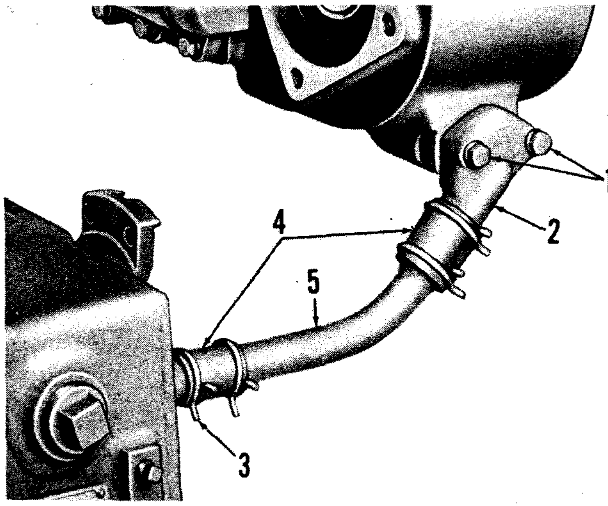
2. DISASSEMBLY OF CRT 3531-1 OR CRT 3630-1 TRANSMISSION

The steps which follow apply to Models CRT 3531-1 or CRT 3630-1 remote mount.



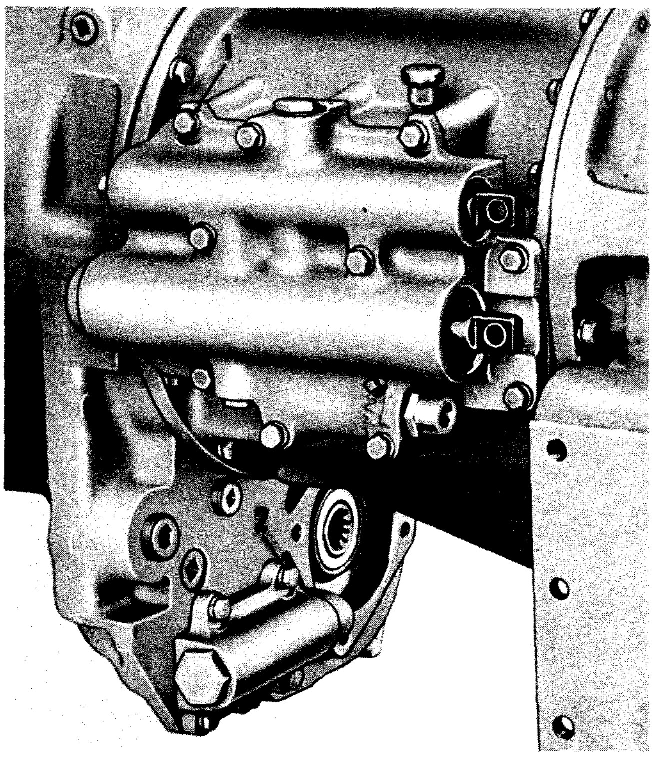
STEP 2

Attach lifting sling 1 to the transmission and lower it onto the work table, leveling with wooden blocks. Remove six bolts and lock washers from input-driven charging oil pump 2. Remove the pump, pump coupling and gasket.



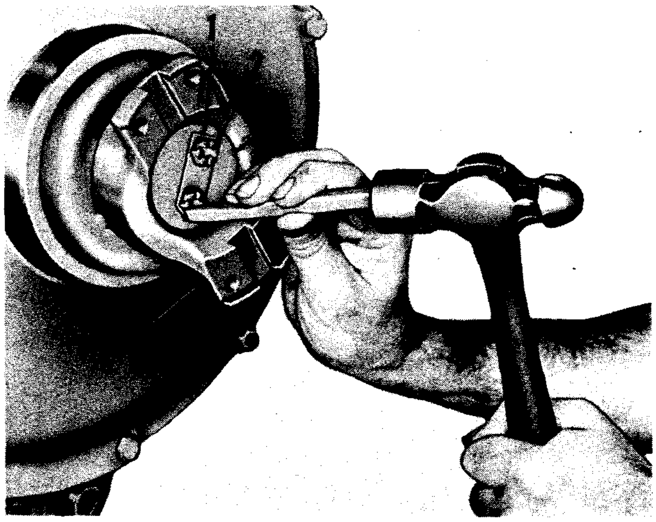
STEP 3

Remove two bolts and lock washers 1 from converter housing drain tube flange 2. Remove, as a unit, flange 2, hoses 4 and tube 5.



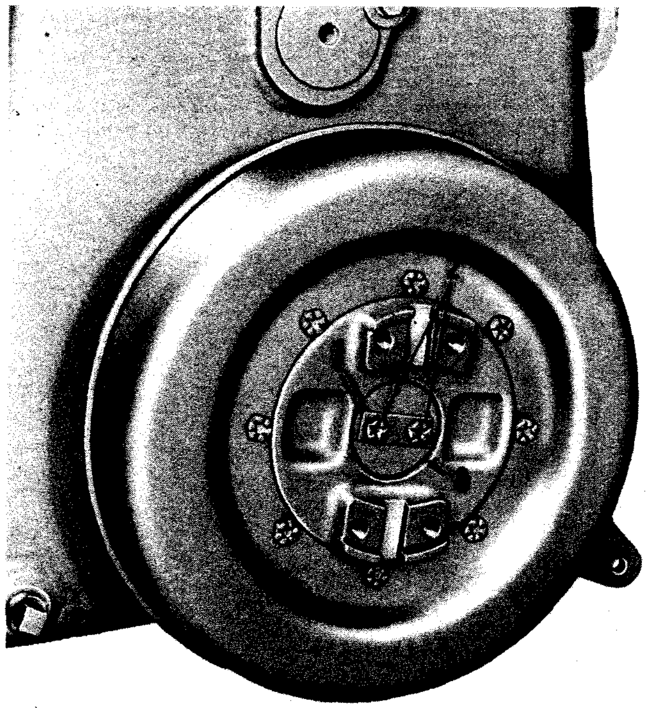
STEP 4

Remove eleven bolts and lock washers 1 from the selector valve body. Remove the valve assembly and gasket. Remove five bolts and lock washers 2 from the main-pressure regulator valve body. Remove the valve assembly and gasket.



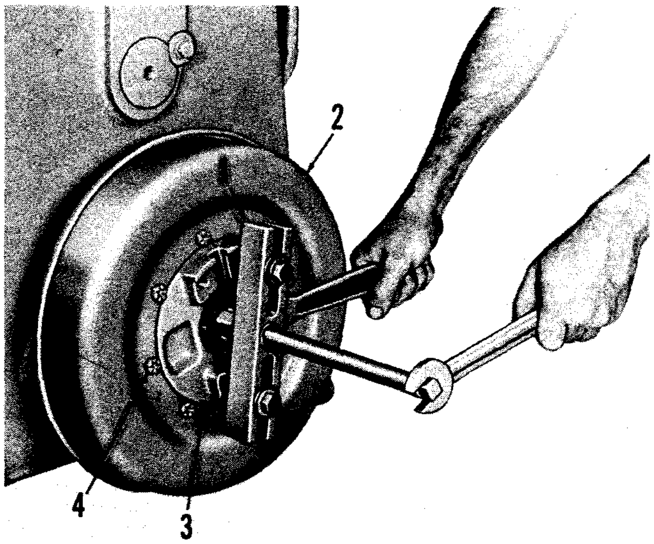
STEP 5 (remote mount only)

Flatten the corners of lock strip 1 and remove two self-locking bolts 2, flange retainer washer 3 and input flange 4. Refer to sect. IV, para 8. Note: Shims 7 (A, foldout 6) are used under some flange retainer washers. Tie these to the washer and identify the washer location.



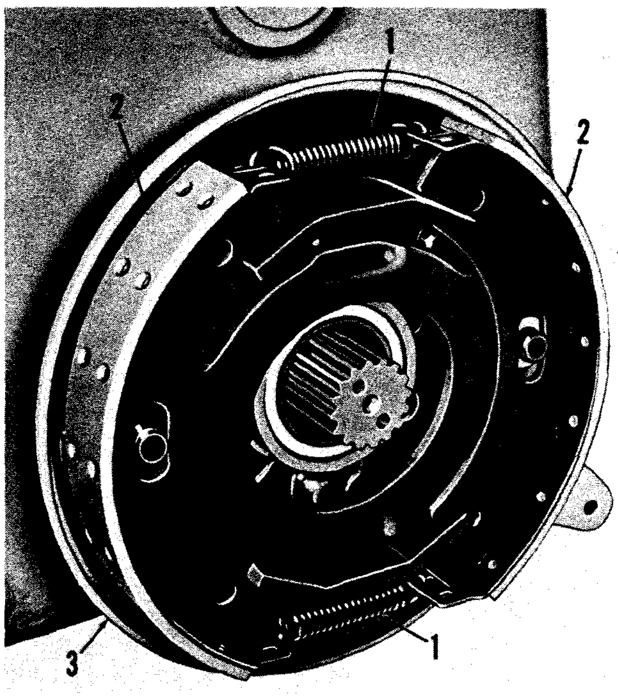
STEP 6

Flatten the corners of lock strip 1 and remove two self-locking bolts 2, the lock strip, and flange retainer washer 3.



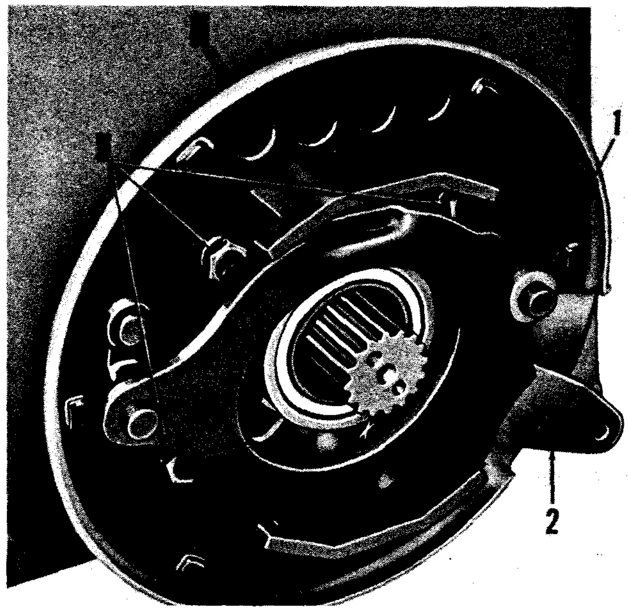
STEP 7

Using puller 1, remove as a unit, parking brake drum 2 and rear-output flange 3. Only if necessary for parts replacement, remove eight self-locking bolts 4 and remove the flange from the drum.



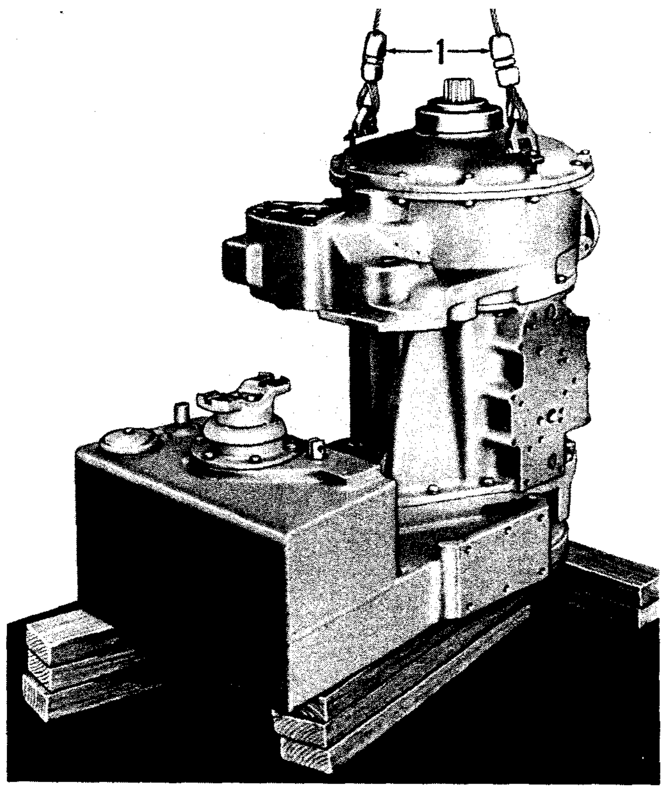
STEP 8

Remove brake return springs 1 and brake shoe assembly 2 from brake back plate 3.



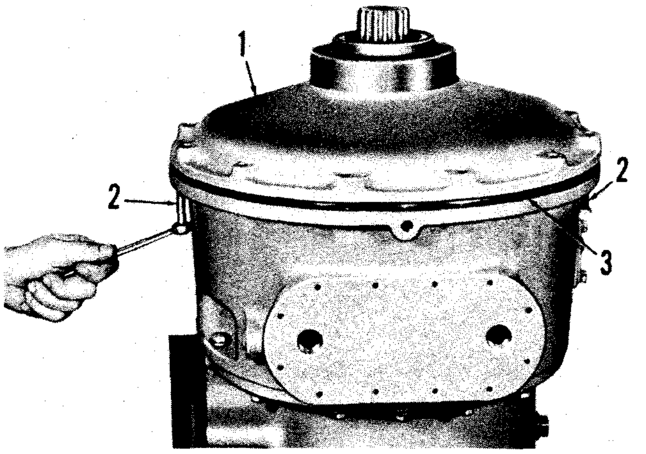
STEP 9

Remove brake roller 1 and brake apply lever 2. Remove three bolts and lock washers 3 and remove brake back plate 4.



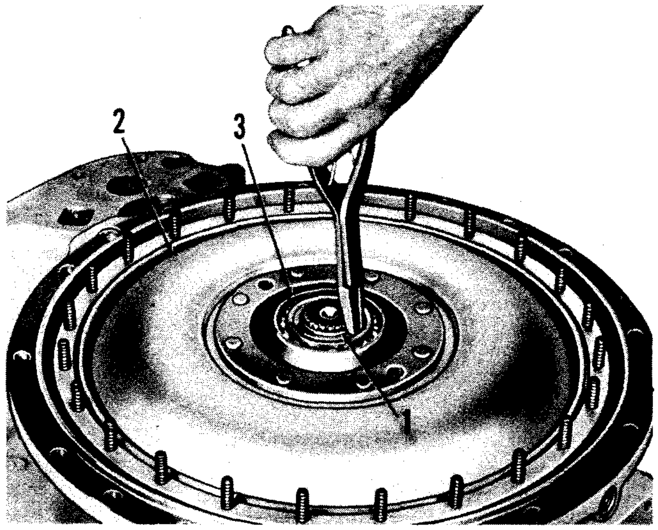
STEP 10

Attach lifting sling 1 to the front of the transmission and position the transmission to rest on its rear surface. Block the transmission sufficiently high to clear the output shaft.



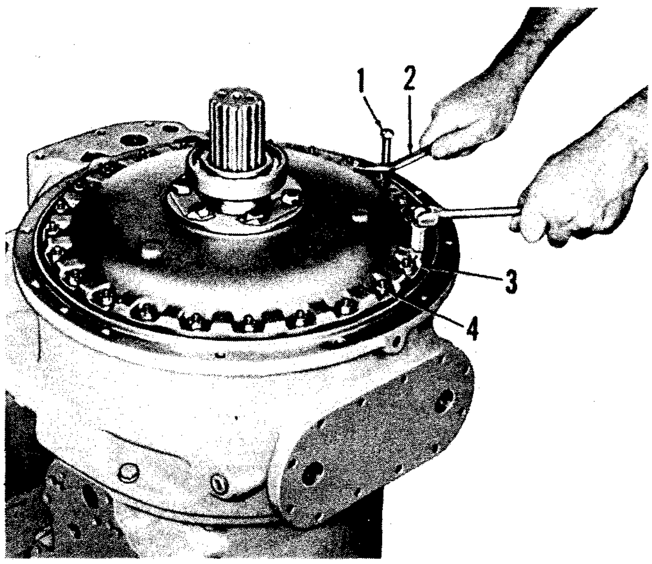
STEP 11 (remote mount, only)

Remove 12 nuts, bolts and lock washers from transmission front cover 1. Using jackscrews 2, loosen and remove the cover and gasket 3.



STEP 13

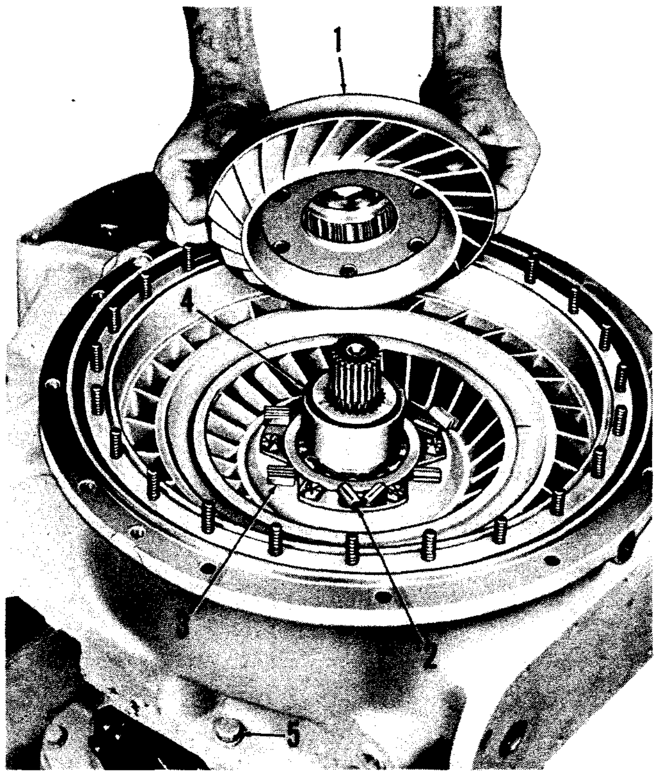
Using snap ring pliers, remove snap ring 1 from the converter shaft. Remove as a unit, turbine 2 and bearing 3. If necessary, use wire lifting hooks under the outer circumference of the turbine.



STEP 12 (remote mount, only)

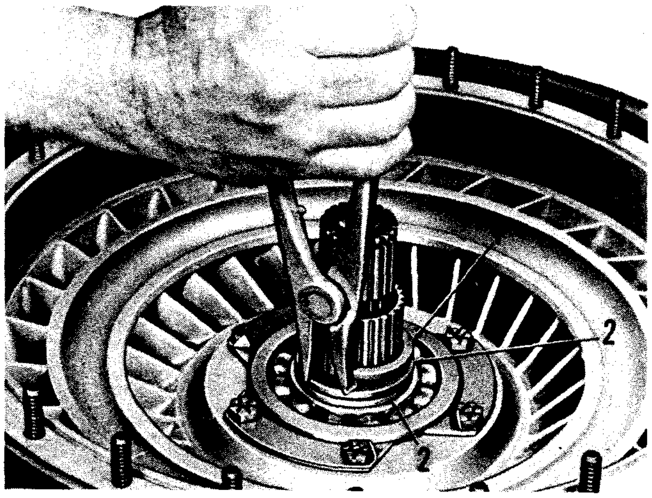
Using jackscrew 1 and wrench 2 to prevent converter pump cover 3 from rotating, remove 24 self-locking nuts 4. Remove the cover assembly.

Note: For removal of direct-mount front cover, refer to sect. VI, para 11.



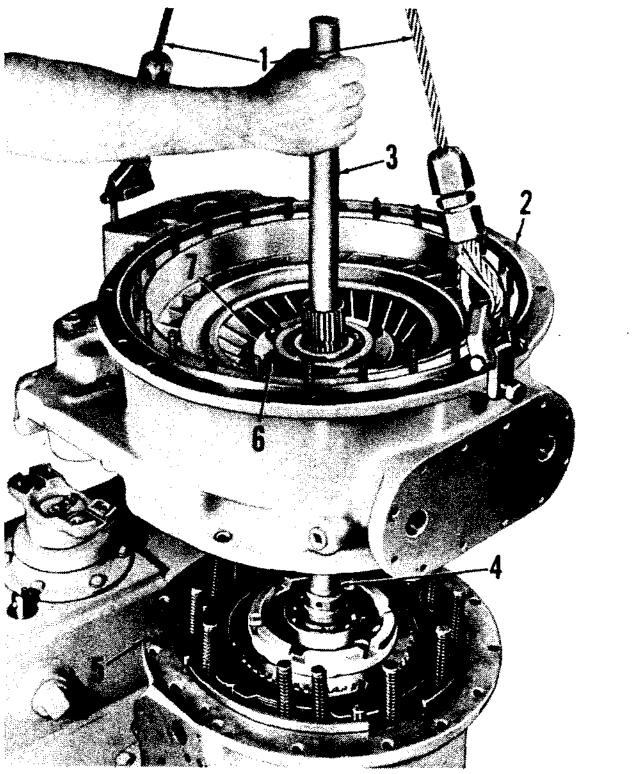
STEP 14

Remove stator assembly 1, ten freewheel rollers 2 and ten freewheel roller springs 3. Remove freewheel roller race 4. Remove 13 bolts and lock washers 5 from the converter housing. Caution: Some of the rollers and springs may drop out when the stator is lifted.



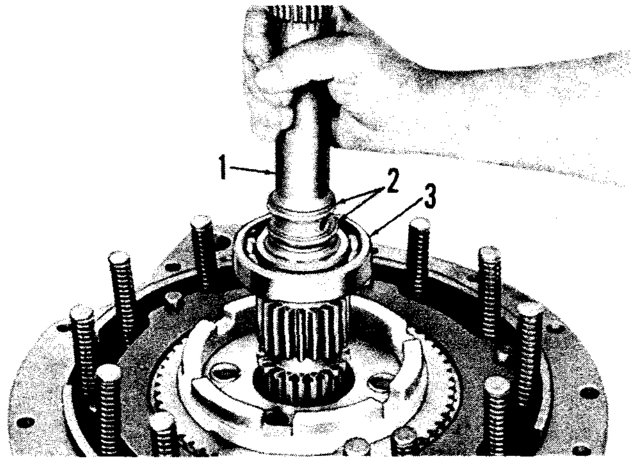
STEP 15

Using snap ring pliers, remove snap ring 1 from the converter ground sleeve. Remove two internal-splined spacers 2.



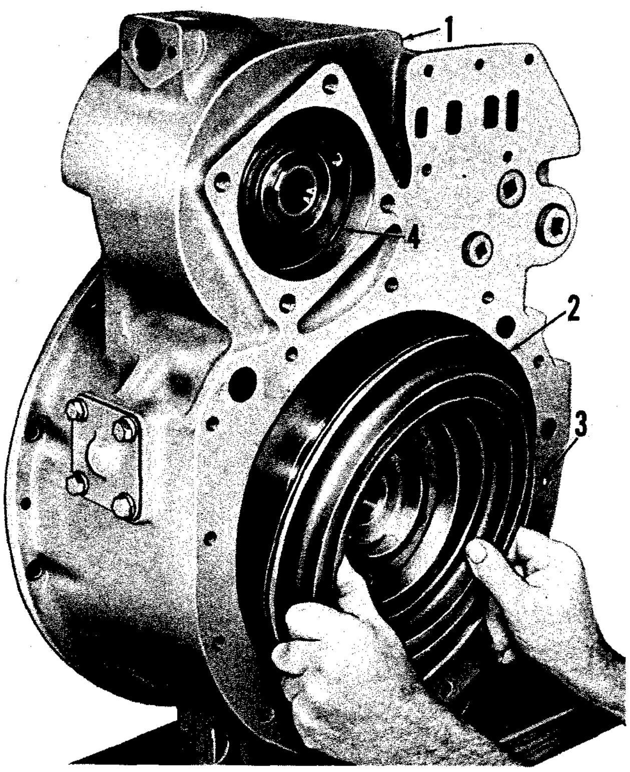
STEP 16

Attach lifting sling 1 to converter housing 2 and raise the converter housing assembly. Use drift 3 to prevent turbine shaft 4 from rising. Remove gasket 5. Remove six self-locking bolts 6, two lock strips and three bearing retainers 7.



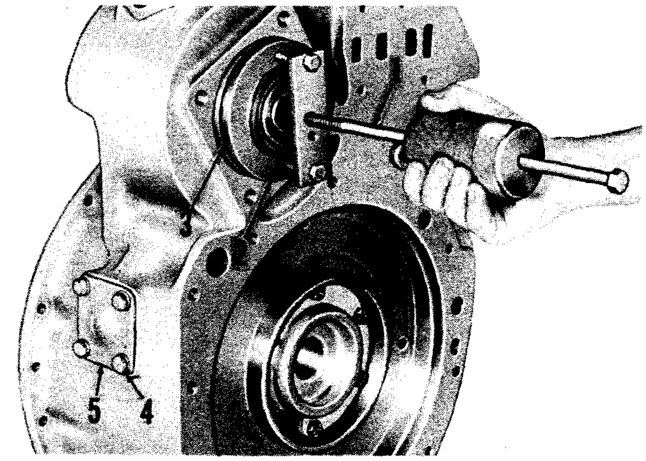
STEP 17

Remove turbine shaft assembly 1. Remove two hook-type seal rings 2. If necessary for parts replacement, remove bearing 3 by pressing toward the small end of the shaft.



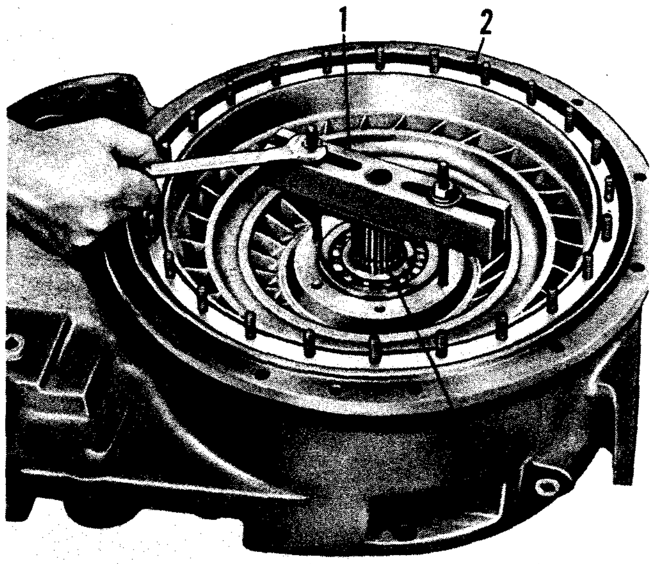
STEP 18

Position converter housing assembly 1 on the oil cooler pad and remove reverse-range piston assembly 2. (Use compressed air in piston apply hole 3 to loosen the piston.) Remove snap ring 4.



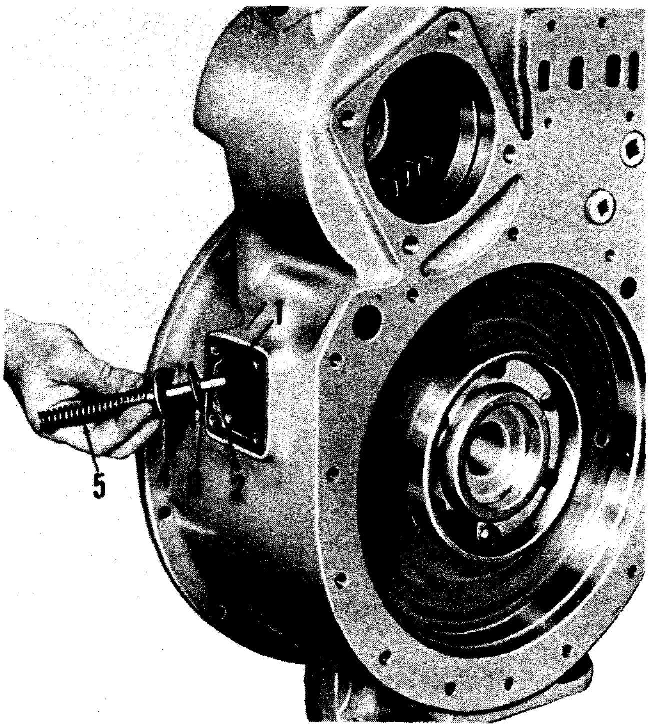
STEP 19

Using slide hammer remover 1, remove as a unit the implement pump gear bearing retainer, bearings and gear 2. Remove seal 3. Remove four bolts and lock washers 4. Remove lubrication regulator valve cover 5.



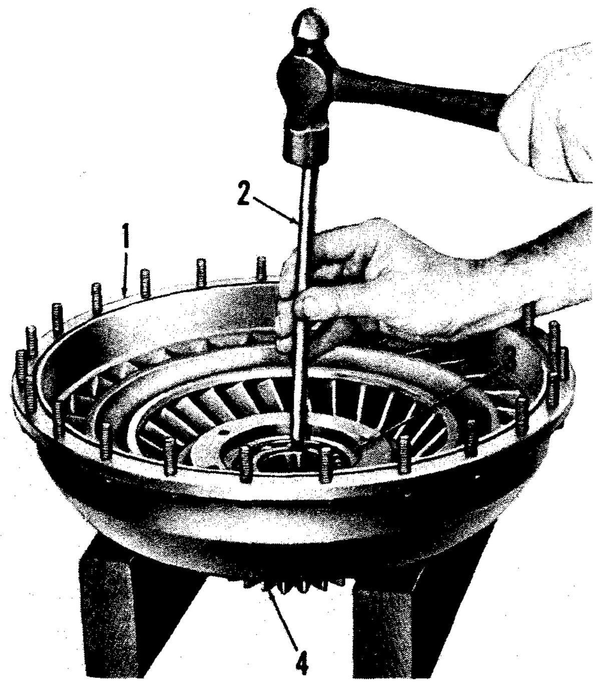
STEP 21

Position converter housing on its rear surface. Using puller 1, remove converter pump and bearing assembly 2 from ground sleeve 3.



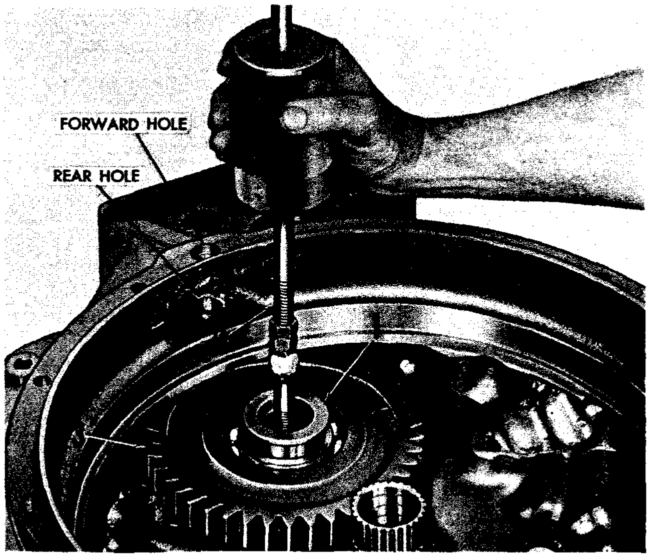
STEP 20

Remove gasket 1, pin 2, washer 3, lubrication regulator valve 4 and valve spring 5.



STEP 22

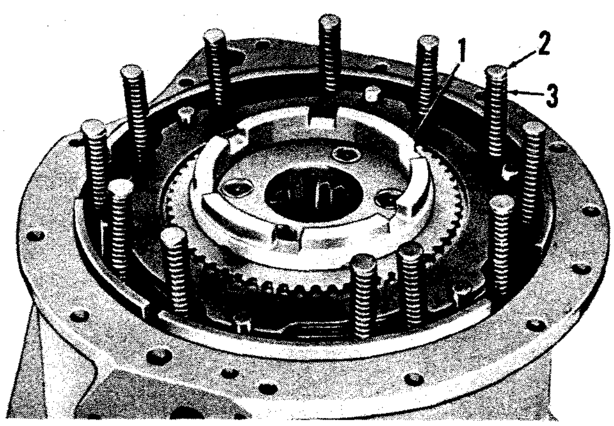
Position converter pump assembly 1 on wooden blocks. Using a soft drift 2, drive bearing 3 and pump drive gear 4 from converter pump 1.



STEP 23

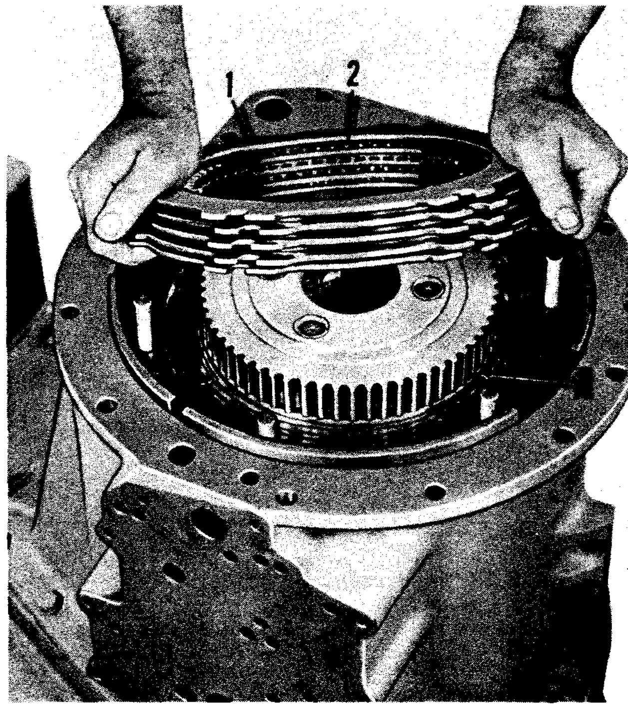
Note: Some assemblies include a diaphragm which must be removed before proceeding with the operation below. Refer to sect. VI, para 14.

Remove the spindle retainer bolt from implement pump idler gear spindle 1. Install slide hammer 2 and remove the spindle. Remove implement pump idler gear and bearing 3. Do not remove the bearing from the gear unless replacement is necessary. Refer to the note sect. VI para 14a. Note: Refer to sect. VI, para 15c(2) note for explanation of hole locations shown.



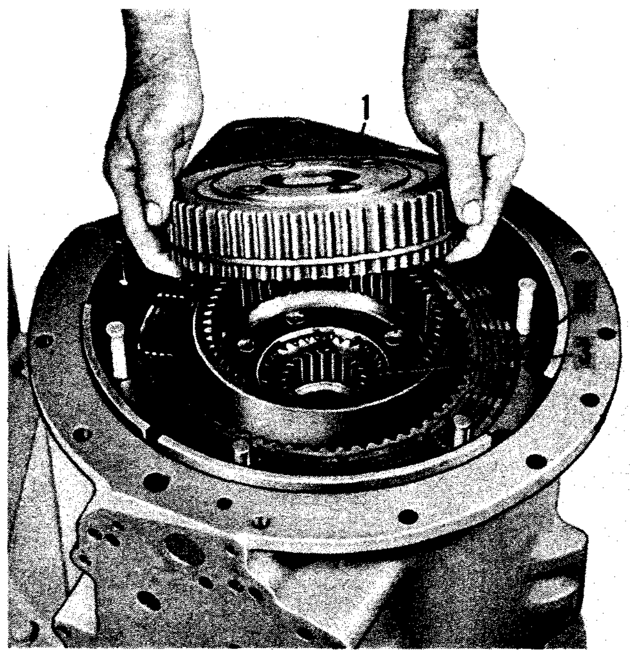
STEP 24

Remove thrust washer 1, twelve piston return spring guides 2 and springs 3.



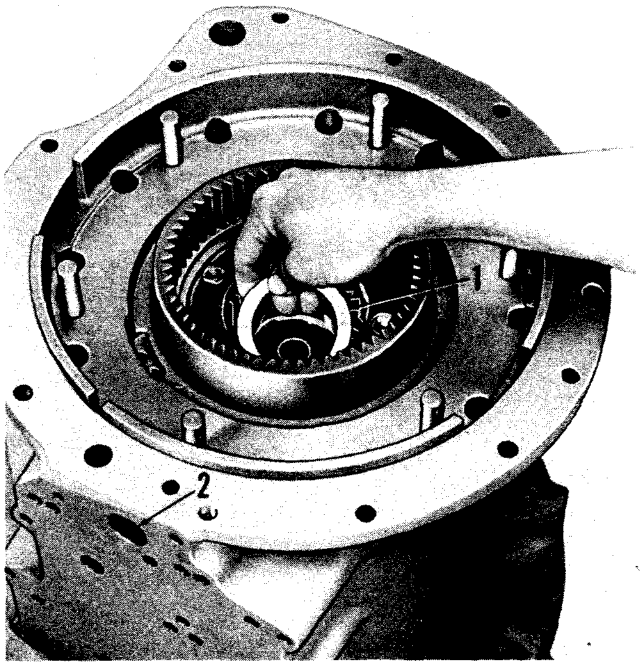
STEP 25

Remove five external-tanged 1 and four internal-splined 2 reverse clutch plates. Note clutch plate positioning ring 3.



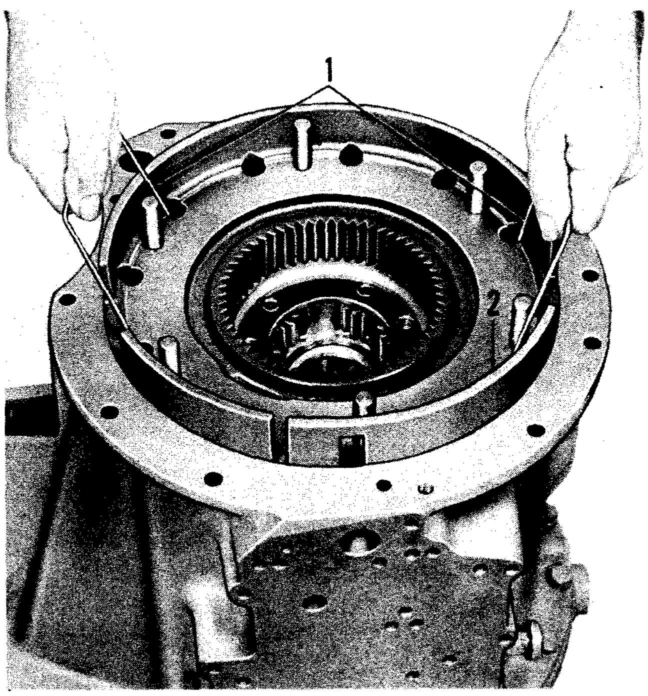
STEP 26

Remove reverse planetary carrier assembly 1 and remaining clutch plate 2. Remove forward sun gear 3.



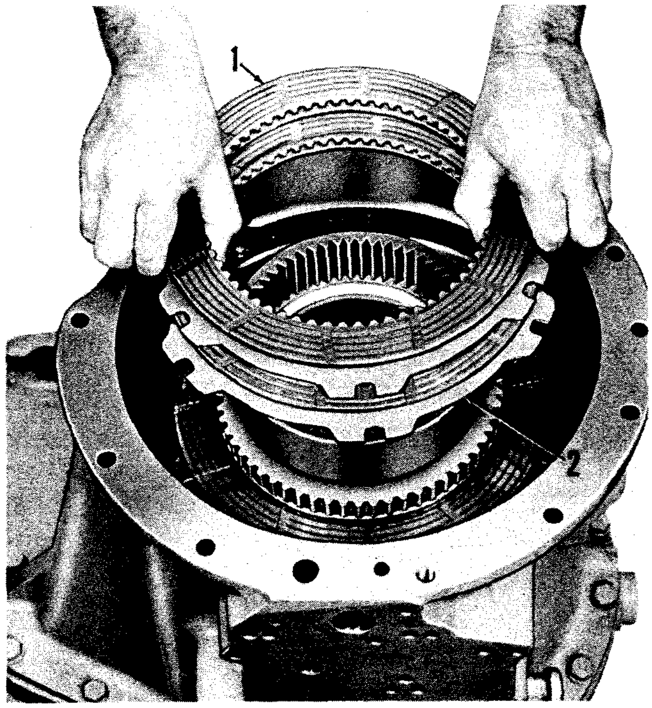
STEP 27

Remove forward sun gear thrust washer 1. Remove clutch anchor pin 2 from the transmission housing.



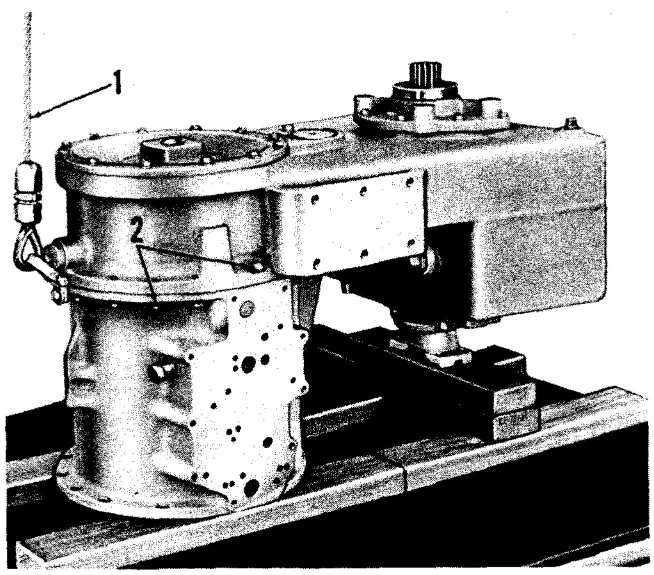
STEP 28

Using wire lifting hooks 1, remove forward and reverse clutch anchor 2.



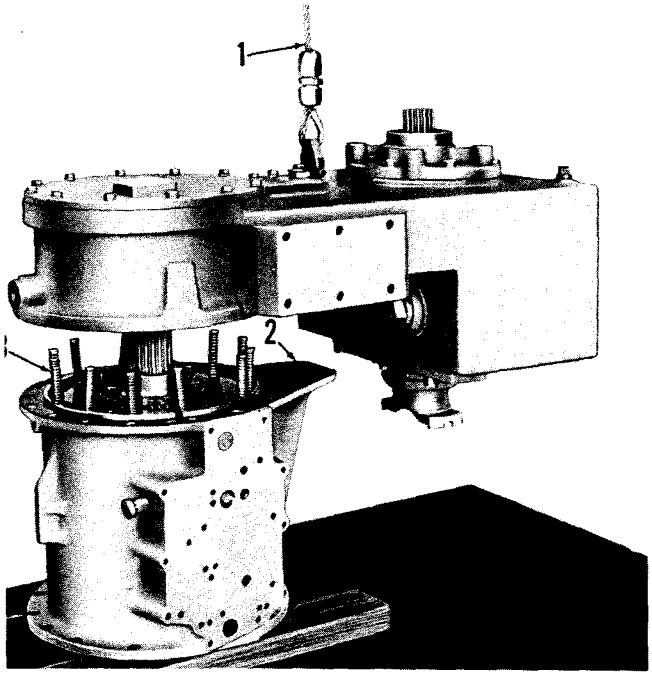
STEP 29

Remove two internal-splined 1 and two external-tanged 2 forward clutch plates.



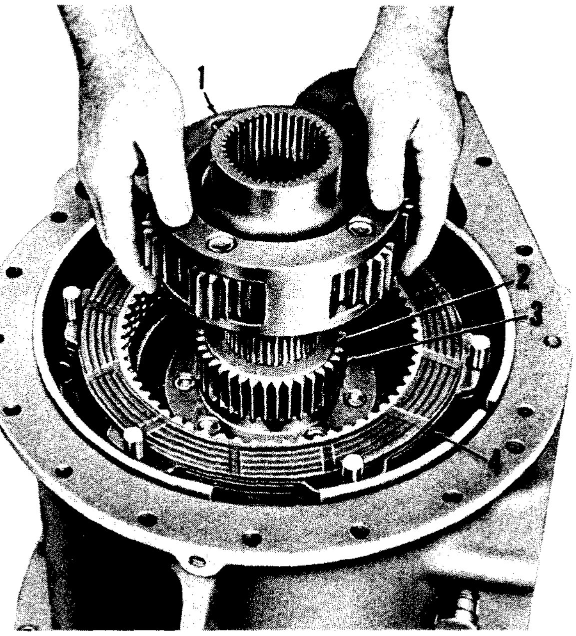
STEP 30

Attach lifting sling 1 to the rear lifting hole in the transmission housing and position the transmission on the work table with the rear end up. Block under flange to level. Remove eighteen bolts and lock washers 2.



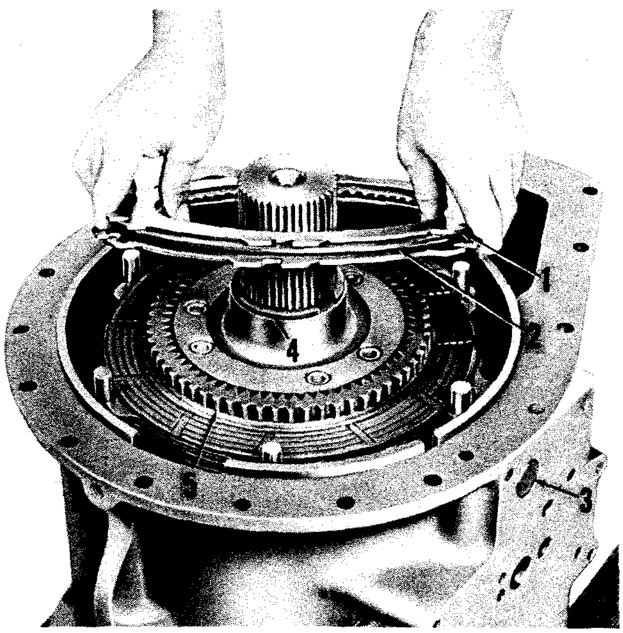
STEP 31

Attach lifting sling 1 to the center of the transfer gear housing and raise the transfer gear housing assembly. Remove gasket 2. Remove twelve low-range springs and spring guides 3.



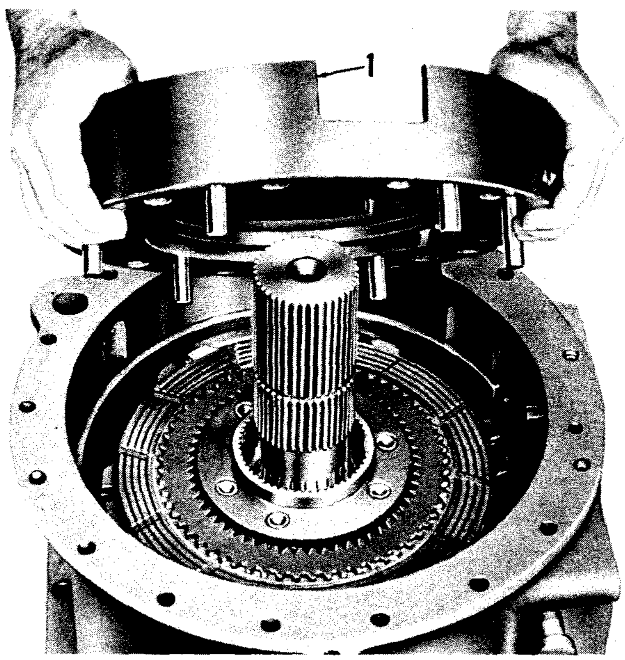
STEP 33

Remove low-range planetary carrier assembly 1, thrust washer 2 and low-range sun gear 3. Remove the remaining low-range clutch plates 4 (three external-tanged and four internal-splined).



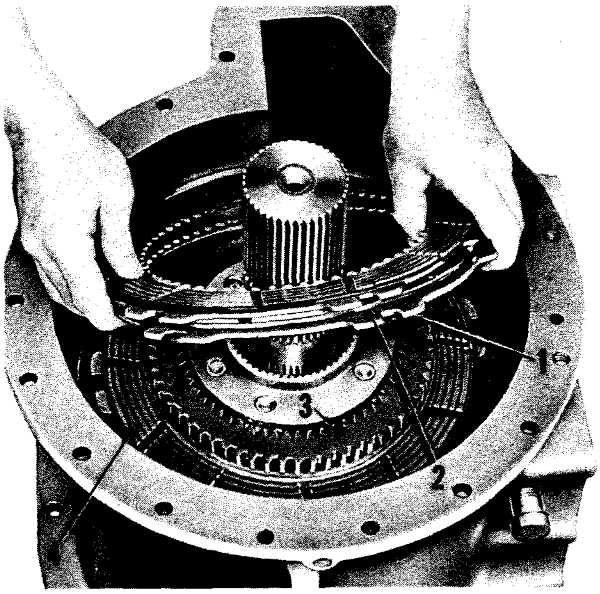
STEP 32

Remove two external-tanged 1 and one internal-splined 2 low-range clutch plates. Remove clutch anchor pin 3. Remove snap ring 4. Remove low-range ring gear 5.



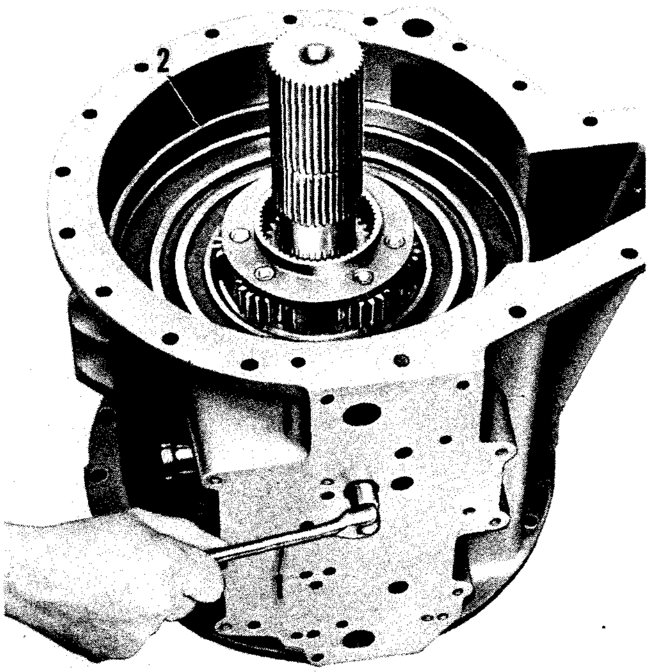
STEP 34

Remove high- and low-range clutch anchor assembly 1.



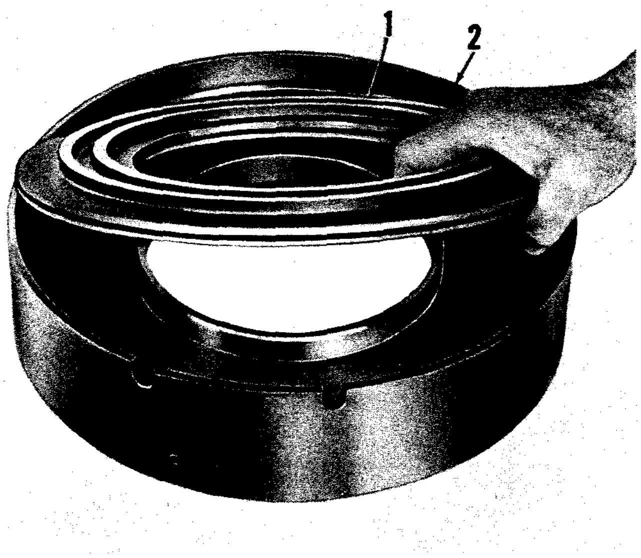
STEP 35

Remove two external-tanged 1 and two internal-splined 2 high-range clutch plates. Remove high-range ring gear 3. Remove remaining clutch plates 4 (one internal-splined and one external-tanged).



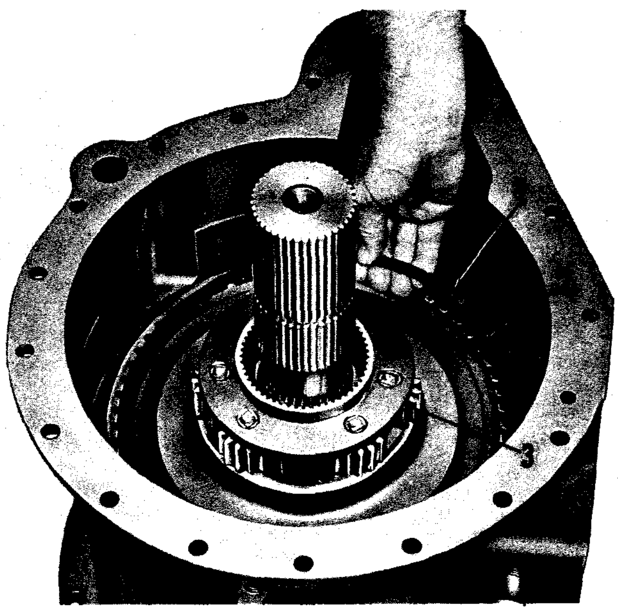
STEP 36

Using wrench 1, remove the high-range piston housing retainer bolt. Remove high-range piston and housing assembly 2.



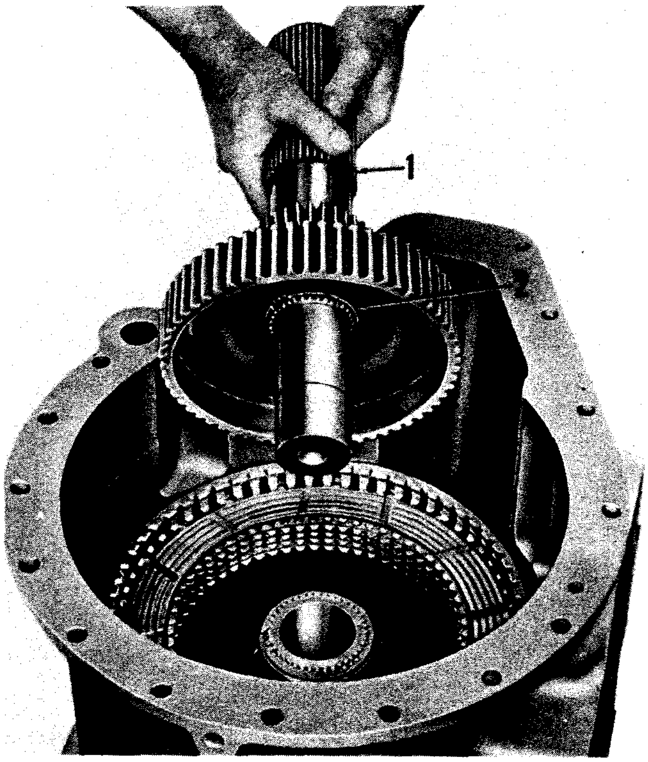
STEP 37

Remove high-range piston 1 from piston housing 2.



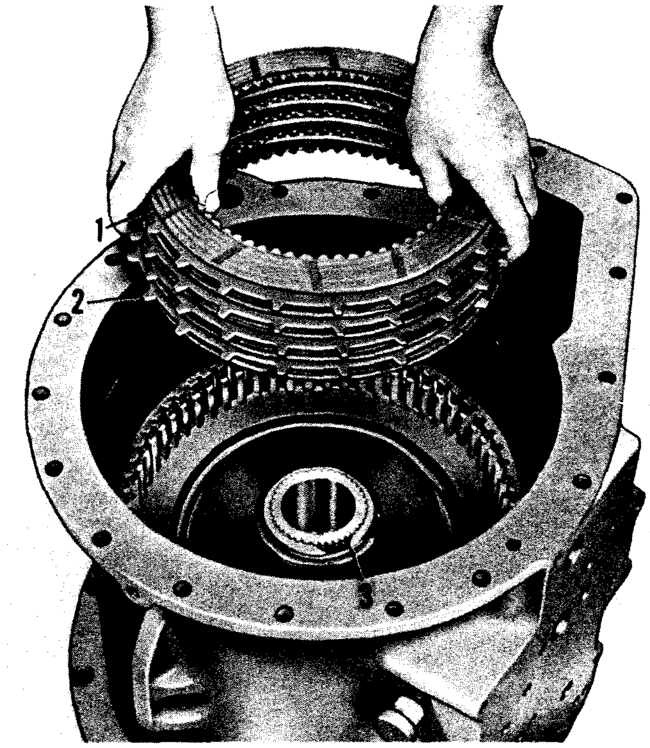
STEP 38

Remove internal-snap ring 1 from intermediate-range clutch drum 2. Remove high-range planetary carrier assembly 3.



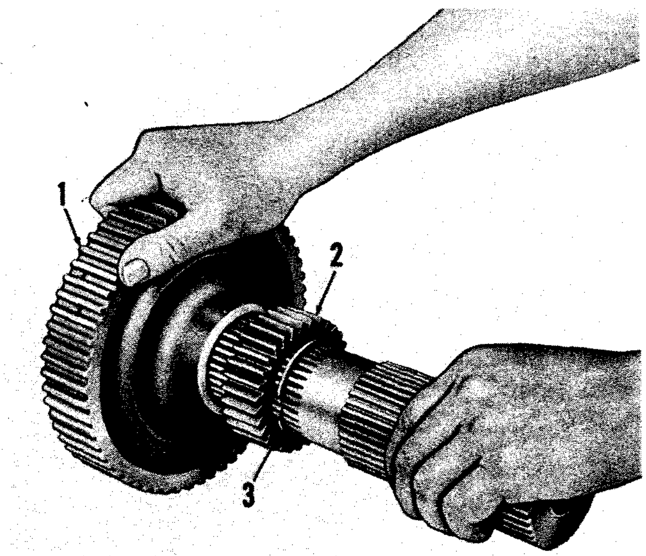
STEP 39

Remove transmission main shaft and attached parts 1. Remove snap ring 2 from the shaft.



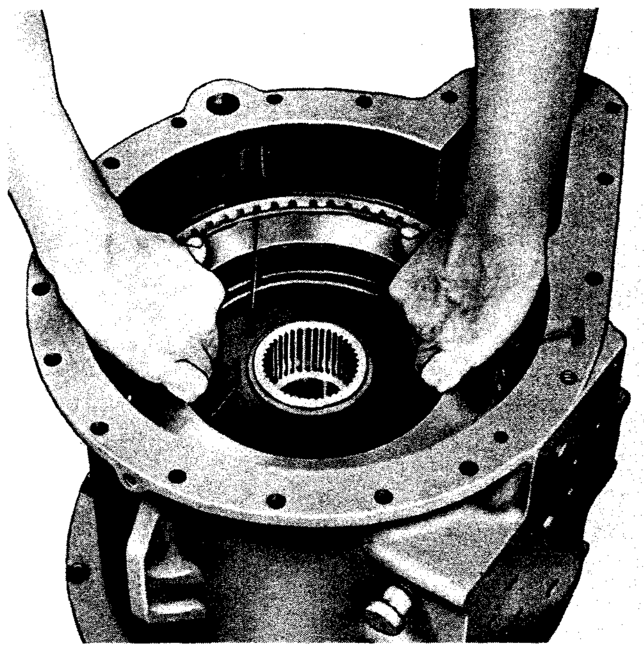
STEP 41

Remove five internal-splined 1 and four external-tanged 2 intermediate-range clutch plates. Remove snap ring 3 from the forward carrier shaft.



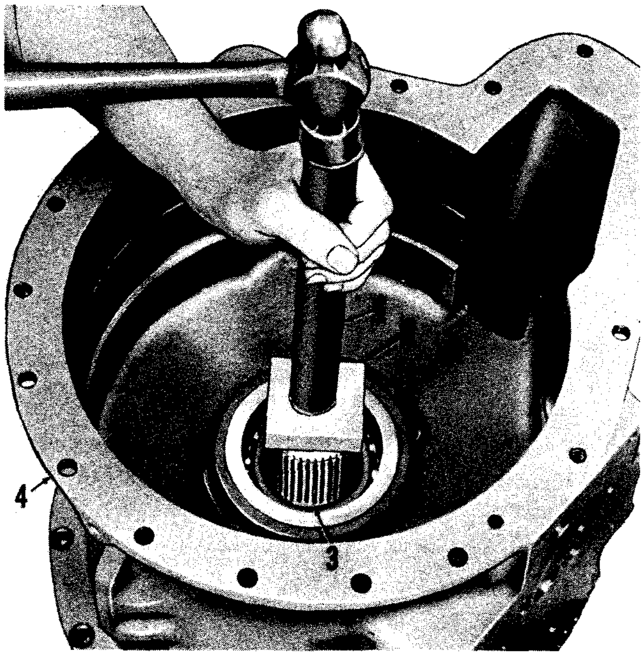
STEP 40

Remove intermediate-range clutch hub 1 and high-range sun gear 2. Remove snap ring 3 from the transmission main shaft.



STEP 42

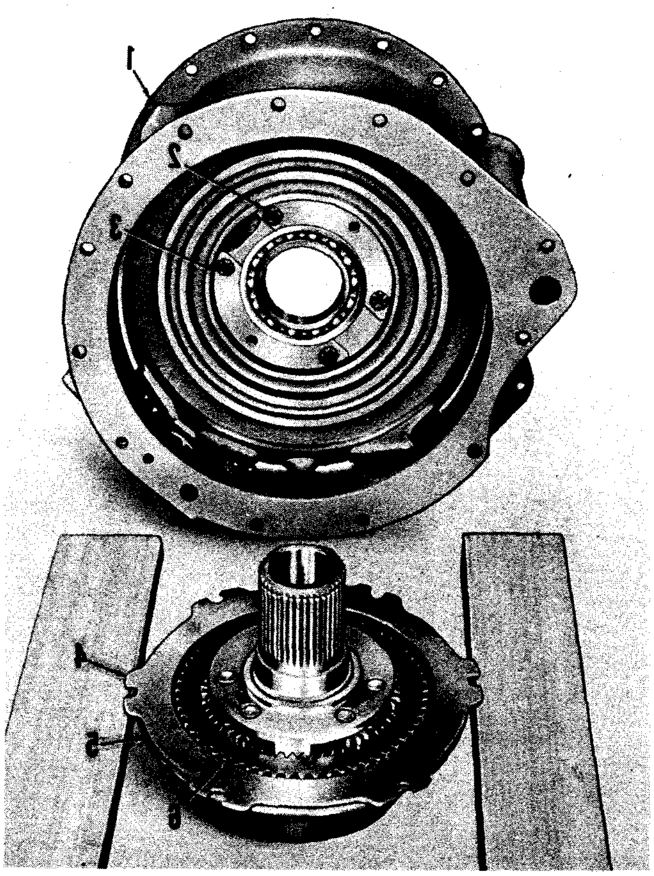
Install external-tanged clutch plate 1 and snap ring 2 into intermediate-range clutch drum 3. Grasp plate 1 and remove drum assembly 3.



STEP 43

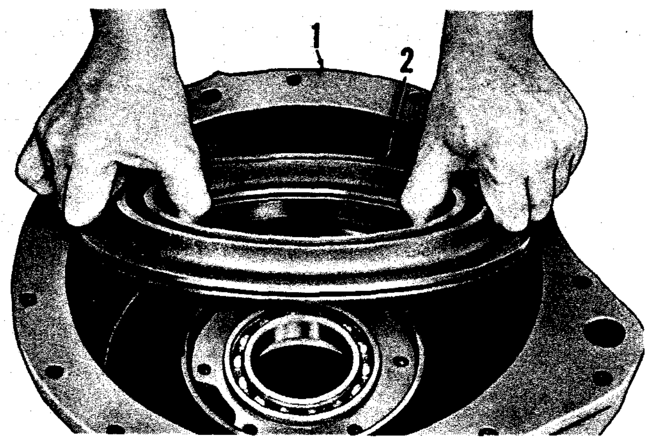
Using drift 1 and soft metal block 2, tap on forward carrier shaft 3.

> Caution: Make sure transmission housing 4 is blocked sufficiently high to allow the forward-range carrier to drop out. Provide a wooden block, or other soft surface, beneath the carrier to prevent damage due to dropping.



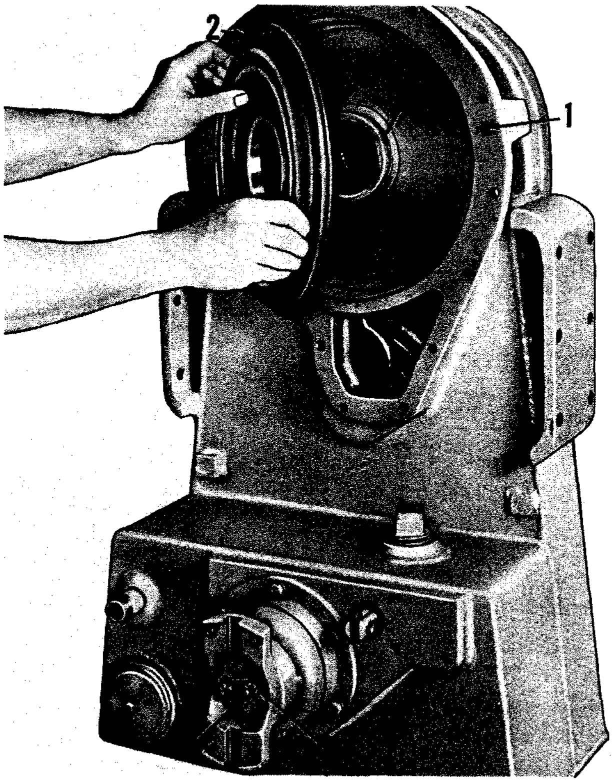
STEP 44

Position transmission housing 1 on its side and remove four self-locking bolts 2 and two bearing retainers 3. Remove one external-tanged 4 and one internal-splined 5 forward clutch plates. Remove forward ring gear 6.



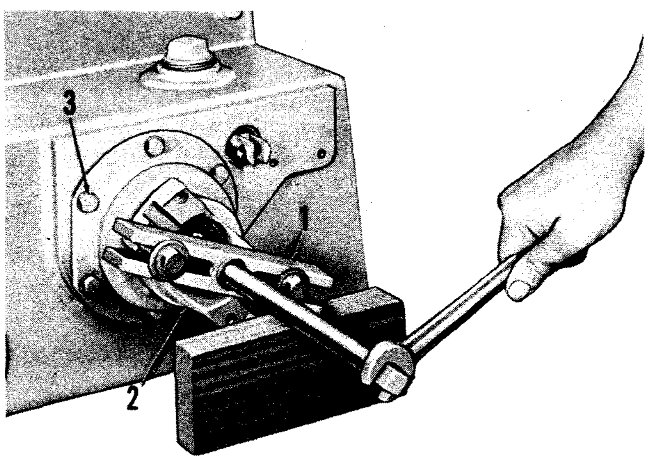
STEP 45

Position transmission housing 1 on the work table with the piston up and remove forward piston 2.



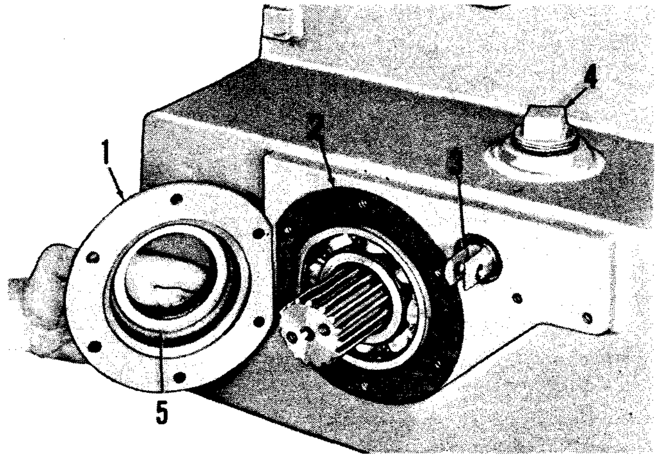
STEP 46

Using compressed air in piston apply hole 1, remove low-range piston 2. Remove hook-type seal 3. Flatten the corners of lock strip 4 and remove the two flange retainer washer bolts, lock strip and flange retainer washer 5.



STEP 47

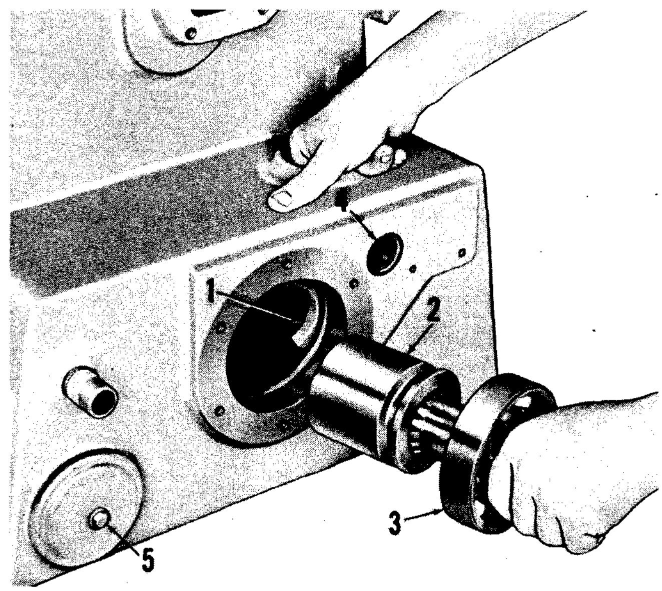
Using puller 1, remove front-output flange 2. Remove six bolts and lock washers 3 from bearing retainer. Refer to sect. IV, para 8.



STEP 48

Remove bearing retainer assembly 1 and gasket 2. Unthread shifter shaft 3 out of the shifter fork and remove it from the housing. Remove pipe plug 4. Press seal 5 toward the inside of retainer 1 to remove it.

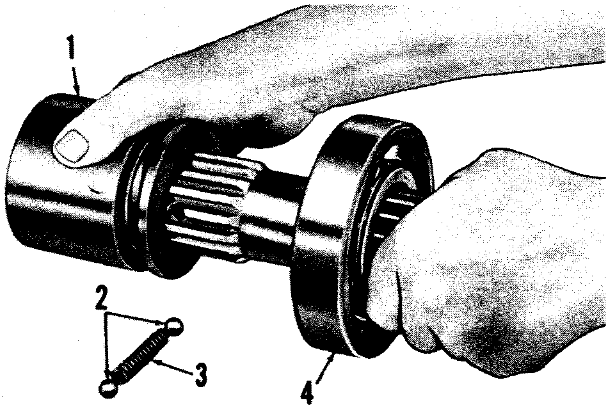
Note: Some assemblies will not include shaft 3.



STEP 49

Using one hand to hold shifter fork 1 in an upward position, grasp the front-output shaft with the other hand and remove, as a unit, the shaft, coupling 2 and bearing 3. Remove shifter shaft seal 4. Remove bolt and washer 5.

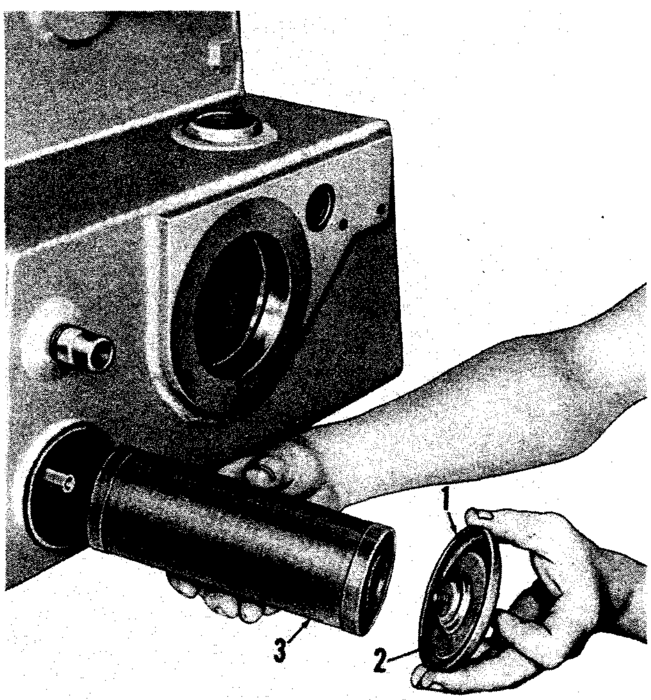
Note: Some assemblies will not include fork 1 and seal 4.



STEP 50

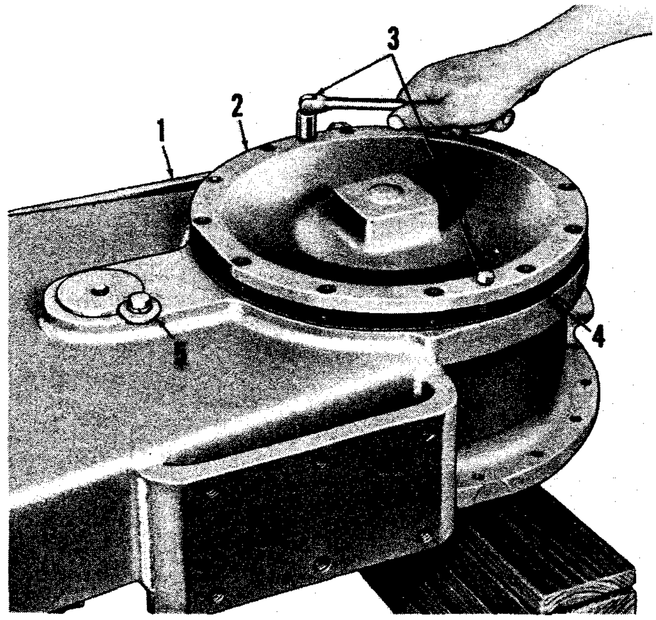
Remove front-output-disconnect coupling 1 from the front-output shaft. Remove two detent balls 2 and spring 3. If necessary, remove bearing 4 from the shaft.

Note: Some assemblies will not include balls 2 and spring 3. Do not remove the internal-snap ring from coupling 1 on such units.



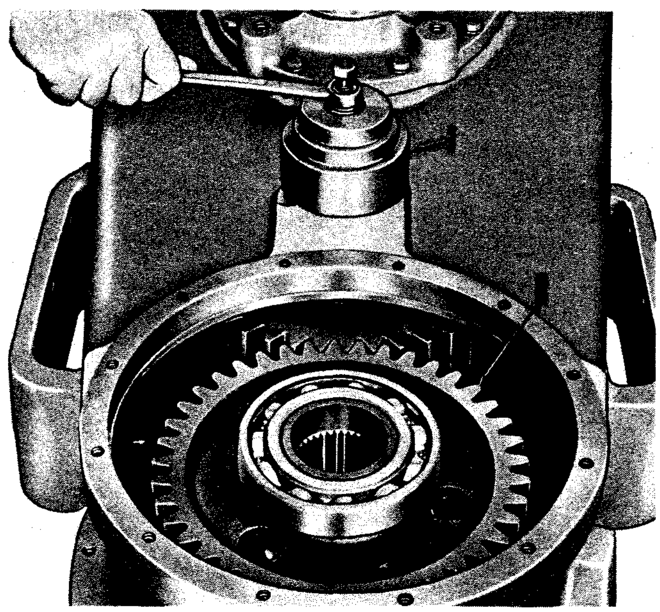
STEP 51

Remove oil screen cover and gasket 1. Remove retainer 2 and oil screen assembly 3.



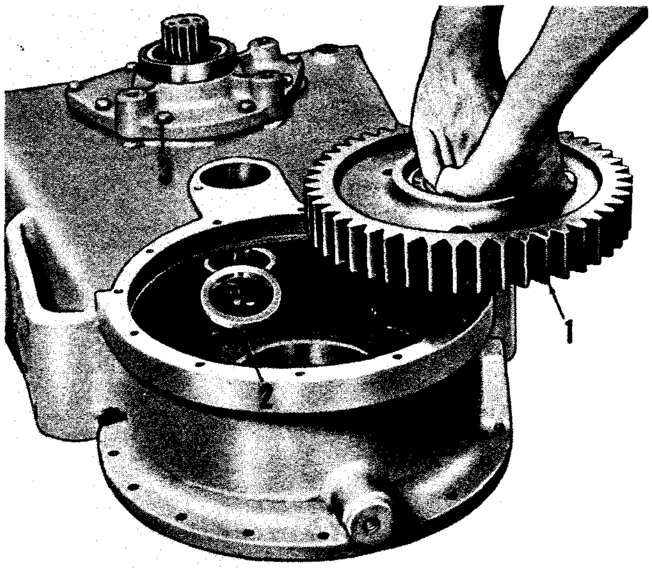
STEP 52

Position transfer gear housing assembly 1 on its front surface and level it with blocks. Remove twelve bolts and lock washers from transfer drive gear cover 2. Use jackscrews 3 to loosen the cover. Remove the cover and gasket 4. Remove bolt, lock washer and transfer idler gear spindle retainer washer 5.



STEP 53

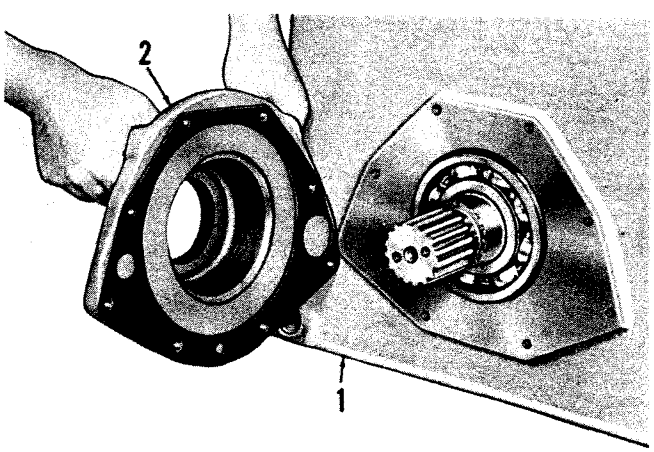
Using special tool 1 (fig. IV-1), remove the transfer idler gear spindle from the housing. Remove transfer drive gear and bearing assembly 2.



STEP 54

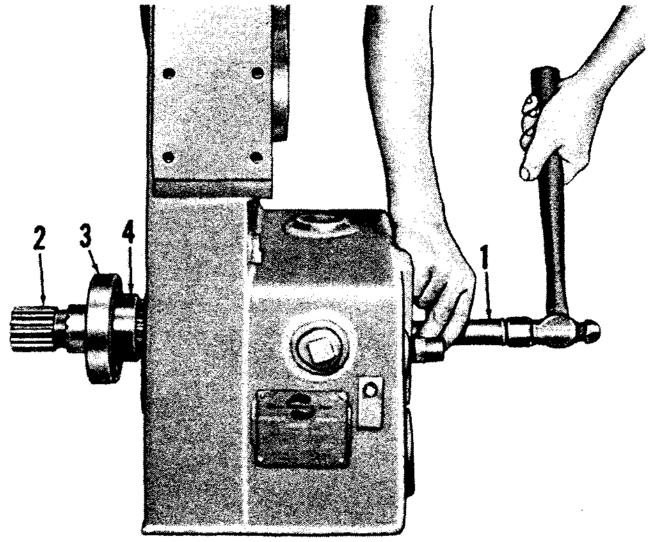
Remove transfer idler gear and bearing assembly 1. Remove transfer idler gear spacer 2. Remove eight (six in some assemblies) bolts and lock washers 3 from the rear bearing retainer.

Note: On CRT 3531-1 assemblies beginning with S/N 39334, and on all CRT 3630-1 transmissions, the arrangement of the idler gear bearings is different from that of earlier model CRT 3531-1 transmissions. Refer to items 8 through 13 on A, foldout 13.



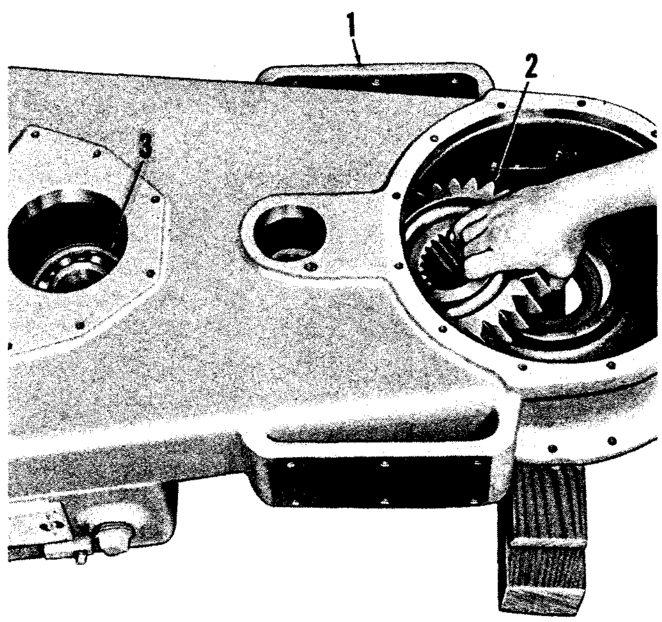
STEP 55

Position transfer gear housing assembly 1 upright on the work table and remove rear-output-bearing retainer assembly and gasket 2.



STEP 56

Using a hammer and soft drift 1, tap on rear output shaft 2 and remove the shaft, bearing 3 and spacer 4. Note: Use a drift of approximately 1 1/4-inch diameter so that drift will not enter the pilot bearing bore of the rear-output shaft. Leave the drift in place to support the driven gear until its removal.



STEP 57

Position transfer gear housing 1 on its front surface and remove the drift and transfer driven gear 2. Remove bearing 3 from the housing.