DANA SPICER®
Off-Highway Products

Service Manual

Powershift Transmission
24000 Series HR 4-Speed Long Drop

TSM-0009
April 2000

FOREWORD

This manual has been prepared to provide the customer and the maintenance personnel with information and instructions on the maintenance and repair of the Spicer Off-Highway Power Shift Transmission.

Extreme care has been exercised in the design" selection of materials and manufacturing of these units. The slight outlay in personal attention and cost required to provide regular and proper lubrication, inspection at stated intervals, and such adjustments as may be indicated will be reimbursed many times in low cost operation and trouble free service.

In order to become familiar with the various parts of the transmission, its principal of operation, trouble shooting and adjustments, it is urged that the mechanic study the instructions in this manual carefully and use it as a reference when performing maintenance and repair operations.

Whenever repair or replacement of component parts is required" only Spicer Off-Highway approved parts as listed in the applicable parts manual should be used. Use of "will-fit" or non-approved parts may endanger proper operation and performance of the equipment. Spicer Off-Highway does not warrant repair or replacement parts, nor failures resulting from the use thereof, which are not supplied by or approved Spicer Off-Highway. **IMPORTANT: Always furnish the Distributor with the transmission serial and model number when ordering parts.**

TOWING OR PUSH STARTING

Before towing the vehicle, be sure to lift the rear wheels off the ground or disconnect the driveline to avoid damage to the transmission during towing.

NOTE : If the transmission has 4 wheel drive, disconnect both front and rear drivelines. Because of the design of the hydraulic system, the engine cannot be started by pushing or towing

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NOTE: Metric Dimensions Shown in Brackets [ ].

HOW THE UNITS OPERATE

The transmission and hydraulic torque portion of the power train enacts an important role in transmitting engine power to the driving wheels. In order to properly maintain and service these units it is important to first understand their function and how they operate.

The transmission and torque converter function together and operate through a common hydraulic system. It is necessary to consider both units in the study of their function and operation.

To supplement the text below, and for reference use therewith, the following illustrations are provided:

SECTIONAL VIEWS AND PARTS IDENTIFICATION

The R, HR, and MHR Model Transmissions are of three basic designs.

The R Model consists of a separate torque converter" mounted to the engine with the powershlft transmission remotely mounted and connected to the torque converter with a drive shaft,

The HR Model consists of a torque converter and powershifted transmission in one package mounted directly to the engine.

The MHR version is a mid-mount torque converter and transmission assembly connected to the engine by means of a drive shaft, (See Fig, A for basic design silhouette.)

The shift control valve assembly may be mounted directly on the side of the converter housing or front transmission cover, or remote mounted and connected to the transmission by means of flexible hoses. The function of the control valve assembly is to direct oil under pressure to the desired directional and speed clutch. A provision is made on certain models to neutralize the transmission when the brakes are applied. This is accomplished through use of a brake actuated shutoff valve. The speed and direction clutch assemblies are mounted inside the transmission case and *are* connected to the output shaft of the converter either by direct gearing or drive shaft. The purpose of the speed or directional clutches is to direct the power flow through the gear train to provide the desired speed range and direction.

An axle disconnect is optional and is located on the output shaft, The drive to the front or rear axle can be disconnected or connected by manual shifting.

With the engine running, the converter charging pump draws oil from the transmission sump through the removable oil suction screen and directs it through the oil filter and the pressure regulating valve.

The pressure regulating valve maintains pressure to the transmission control cover for actuating the direc tion and speed clutches, This requires a small portion of the total volume of oil used in the system. The remaining volume of oil is directed through the torque converter circuit to the oil cooler and returns to the transmission for positive lubrication, This regulator valve consists of a hardened valve spool operating in a closely fitted bore. The valve spool is spring loaded to hold the valve in a closed position. When a specific pressure is achieved, the valve spool works against the spring until a port is exposed along the side of the bore, This sequence of events provides the proper system pressure.

After entering the converter housing the oil is directed through the stator support to the converter blade cavity and exits in the passage between the turbine shaft and converter support, The oil then flows out of the converter to the oil cooler. After leaving the cooler, the oil is directed to a lubricating fitting on the transmission and through a series of tubes and passages lubricates the transmission bearings and clutches. The oil then gravity drains to the transmission sump.

The hydraulic torque converter consists basically of three elements and their related parts to multiply engine torque, The engine power is transmitted from the engine flywheel to the impeller element through the impeller cover. This element is the pump portion of the hydraulic torque converter and is the primary component which starts the oil flowing to the other components which results in torque multiplication. This element can be compared to a centrifugal pump in that it picks up fluid at its center and discharges at its outer diameter.

The torque converter turbine is mounted opposite the impeller and is connected to the output shaft of the torque converter. This element receives fluid at its outer diameter and discharges at its center. Fluid directed by the impeller out into the particular design of blading in the turbine and reaction member is the means by which the hydraulic torque converter multiplies torque.

The reaction member of the torque converter is located between and at the center or inner diameters of the impeller and turbine elements, Its function is to take the fluid which is exhausting from the inner portion of the turbine and change its direction to allow correct entry for recirculation into the impeller element.

The torque converter will multiply engine torque to its designed maximum multiplication ratio when the output shaft is at zero RPM, Therefore, we can say that as the output shaft is decreasing in speed the torque multiplication is increasing.

The shift control valve assembly consists of a valve body with selector valve spools. A detent ball and spring in the selector spool provides one position for each speed range. A detent ball and spring in the direction spool provides three positions, one each for forward, neutral and reverse.

With the engine running and the directional control lever in neutral position, oil pressure from the regulating valve is blocked at the control valve, and the transmission is in neutral. Movement of the forward and reverse spool will direct oil, under pressure to either the forward or reverse direction clutch as desired, When either directional clutch is selected the opposite clutch is relieved of pressure and vents back through the direction selector spool. The same procedure is used in the speed selector.

The direction or speed clutch assembly consists of a drum with internal splines and a bore to receive a hy draulically actuated piston, The piston is "oil tight" by the use of sealing rings. A steel disc with external splines is inserted into the drum and rests against the piston. Next a friction disc with splines at the inner diameter is inserted. Discs are alternated until the required total is achieved. A heavy back-up plate is then inserted and secured with a snap ring, A Hub with O.D. splines is inserted into the splines of discs with teeth on the inner diameter. The discs and hub are free to increase in speed or rotate in the opposite direc tion as long as no pressure is present in that specific clutch.

To engage the clutch, as previously stated, the control valve is placed in the desired position. This allows oil under pressure to flow from the control valve, through a passageway, to a chosen clutch shaft. This shaft has a drilled passageway for oil under pressure to enter the shaft. Oil pressure sealing rings are located on the clutch shaft, These rings direct oil under pressure to a desired clutch. Pressure of the oil forces the piston and discs against the heavy back-up plate, The discs, with teeth on the outer diameter, clamping against discs with teeth on the inner diameter, enables the hub and clutch shaft to be locked together and allows them to drive as a unit.

There are bleed balls or bleed orifices, depending upon the model, in the clutch piston which allow quick escape for oil when the pressure to the piston is released.

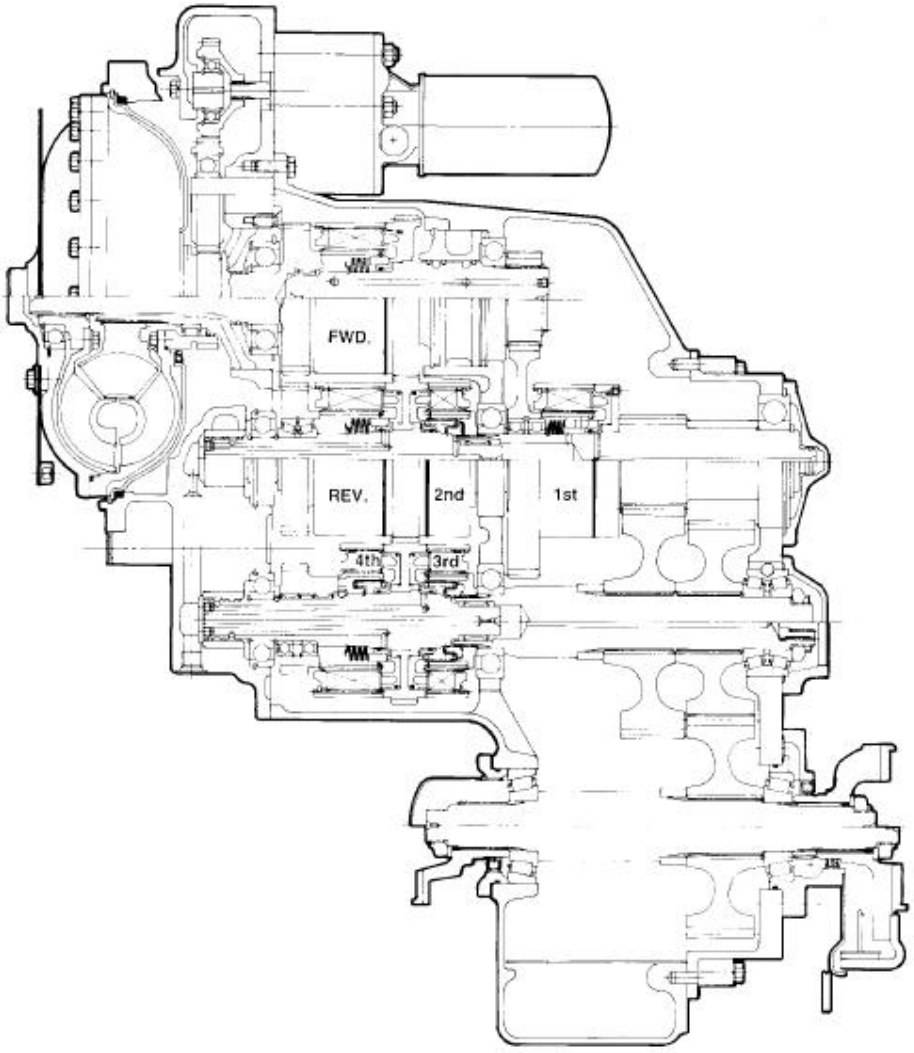

FIGURE A

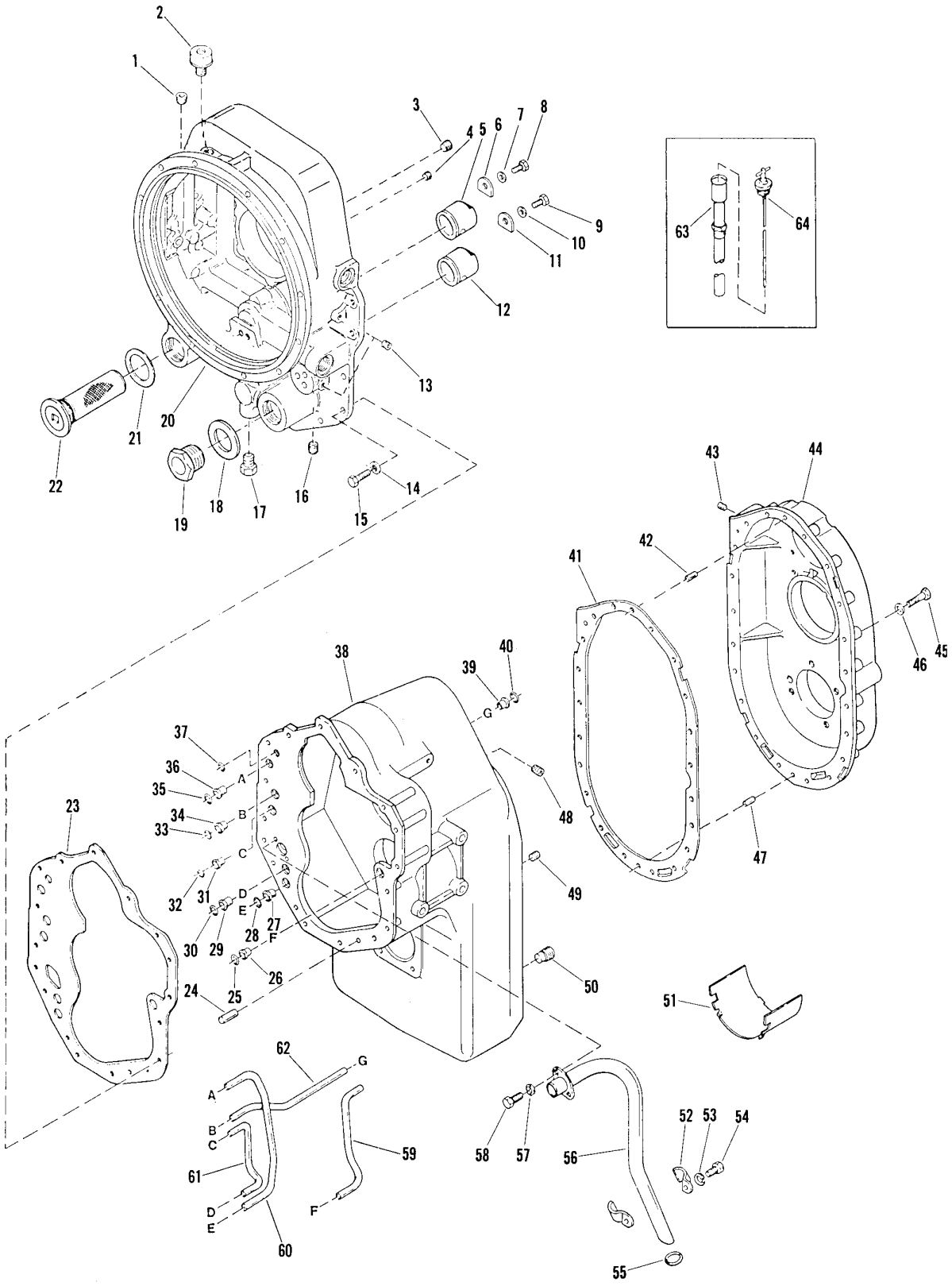
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Figure B

CONVERTER AND TRANSMISSION

CASE GROUP

ITEM	DESCRIPTION	QTY.
1	Pipe Plug	2
2	Air Breather	1
3	Pipe Plug	1
4	Pipe Plug	2
5	Converter Housing Sleeve	1
6	Clip	1
7	Clip Screw Lockwasher	1
8	Clip Screw	1
9	Clip Screw	1
10	Clip Screw Lockwasher	1
11	Clip	1
12	Converter Housing Sleeve	1
13	Pipe Plug	2
14	Converter Housing to Transmission Case Screw Lockwasher	17
15	Converter to Transmission Case Screw	17
16	Pipe Plug	2
17	Plug	1
18	Hole Plug Gasket	1
19	Case Assembly Hole Plug	1
20	Converter Housing	1
21	Screen Assembly Gasket	1
22	Screen Assembly	1
23	Converter Housing to Transmission Case Gasket	1
24	Converter Housing to Case Dowel Pin	1
25	Clutch Pressure Tube "O" Ring	1
26	Lube Tube Sleeve	1
27	Tube Sleeve	1
28	Clutch Pressure Tube "O" Ring	1
29	Tube Sleeve	1
30	Clutch Pressure Tube "O" Ring	1
31	Tube Sleeve	1
32	Clutch Pressure Tube "O" Ring	1
33	Clutch Pressure Tube "O" Ring	1
34	Tube Sleeve	1
35	Clutch Pressure Tube "O" Ring	1
36	Tube Sleeve	1
37	Clutch Pressure Tube "O" Ring	1
38	Transmission Case Assembly	1
39	Tube Sleeve	1
40	Clutch Pressure Tube "O" Ring	1
41	Rear Cover to Transmission Case Gasket	1
42	Transmission Case to Rear Cover Dowel Pin	1
43	Rear Cover Pipe Plug	1
44	Rear Cover	1
45	Rear Cover to Case Screw	20
46	Rear Cover to Case Screw Lockwasher	20
47	Transmission Case to Rear Cover Dowel Pin	1
48	Pipe Plug	1
49	Pipe Plug	1
50	Magnetic Drain Plug	2
51	Oil Baffle	1
52	Tube Clip	2
53	Clip Screw Lockwasher	1
54	Clip Screw	1
55	Suction Line Assembly "O" Ring	1
56	Suction Tube Assembly	1
57	Screw Lockwasher	2
58	Suction Line Screw	2
59	Clutch Lube Tube	1
60	3rd Speed Tube	1
61	High Speed Clutch Pressure Tube	1
62	Low Speed Clutch Pressure Tube	1
63	Dipstick Tube Assembly	1
64	Dipstick	1

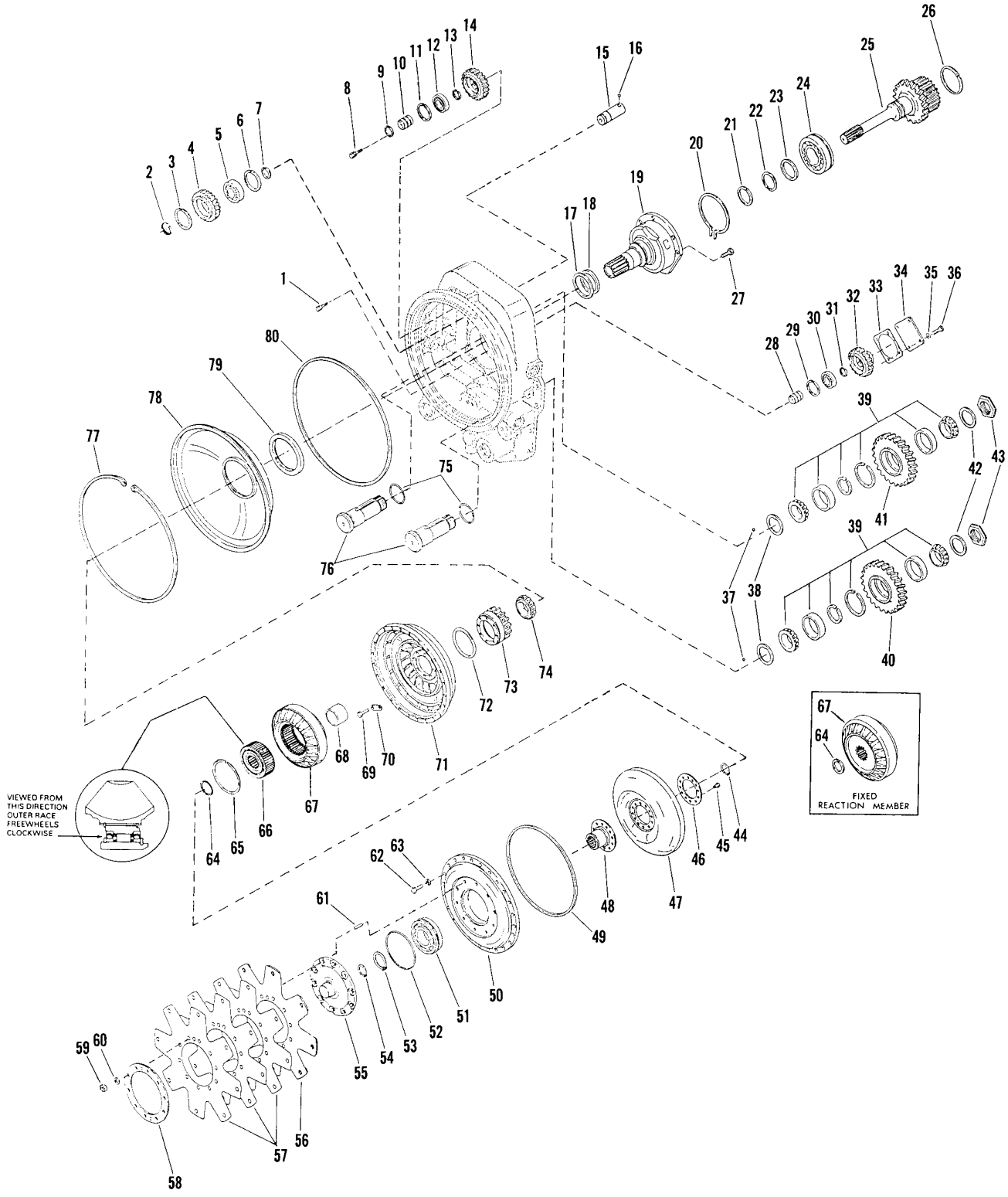
VIEWED FROM THIS DIRECTION OUTER RACE FREEWHEELS CLOCKWISE
FIXED REACTION MEMBER

Figure C

CONVERTER & PUMP DRIVE GROUP

ITEM	DESCRIPTION	QTY.
1	Bearing Support Screw & Lockwasher	2
2	Idler Gear Bearing Locating Ring	1
3	Idler Gear Bearing Retaining Ring	1
4	Pump Drive Idler Gear	1
5	Idler Stub Shaft Bearing	1
6	Bearing Retaining Ring	1
7	Bearing Locating Ring	1
8	Bearing Support Screw & Lockwasher	2
9	Bearing Locating Ring	1
10	Pump Drive Bearing Support	1
11	Bearing Retaining Ring	1
12	Pump Drive Gear Bearing	1
13	Bearing Locating Ring	1
14	Pump Drive Gear	1
15	Idler Gear Stub Shaft	1
16	Stub Shaft Lock Ball	1
17	Piston Ring Expander Spring	1
18	Piston Ring	1
19	Stator Support	1
20	Bearing Snap Ring	1
21	Piston Ring	1
22	Bearing Retaining Ring	1
23	Bearing Locating Washer	1
24	Turbine Shaft Bearing	1
25	Turbine Shaft	1
26	Baffle Ring	1
27	Stator Support Screw	6
28	Auxiliary Pump Drive Bearing Support	1
29	Bearing Retaining Ring	1
30	Pump Drive Gear Bearing	1
31	Bearing Locating Ring	1
32	Auxiliary Pump Drive Gear	1
33	Pump Mounting Cover Gasket	1
34	Pump Mounting Cover	1
35	Pump Mounting Cover Capscrew Lockwasher	4
36	Pump Mounting Cover Capscrew	4
37	Idler Shaft Lockball	2
38	Idler Gear Bearing Thrust Plate	2
39	Idler Gear Bearing Assembly	2
40	Idler Gear	1

ITEM	DESCRIPTION	QTY.
41	Reverse Idler Gear	1
42	Idler Gear Bearing Thrust Plate	2
43	Bearing Retaining Plate Nut	2
44	Turbine Retaining Ring	1
45	Turbine to Hub Screw	12
46	Turbine Hub Ring	1
47	Turbine	1
48	Turbine Hub	1
49	Impeller to Cover "O" Ring	1
50	Impeller Cover	1
51	Turbine Hub Bearing	1
52	Impeller Cover to Bearing Cap "O" Ring	1
53	Turbine Hub Bearing Retaining Ring	1
54	Turbine Retaining Ring	1
55	Impeller Cover Bearing Cap	1
56	Drive Plate Assembly	1
57	Drive Plate	3
58	Drive Plate Backing Ring	1
59	Drive Plate Mounting Nut	10
60	Drive Plate Mounting Stud Lockwasher	10
61	Impeller Cover Stud	10
62	Impeller to Cover Screw	24
63	Impeller to Cover Screw Lockwasher	24
64	Retaining Ring	1
65	Freewheel Outer Race Retainer Ring	1
66	Freewheel Assembly	1
67	Reaction Member	1
68	Impeller to Hub Bearing Spacer	1
69	Impeller to Hub Screw	8
70	Impeller to Hub Screw Lock Tab	4
71	Impeller	1
72	Impeller Hub "O" Ring	1
73	Impeller Hub Gear	1
74	Impeller Hub Gear Bearing	1
75	Idler Shaft "O" Ring	2
76	Idler Shaft	2
77	Oil Baffle Retaining Ring	1
78	Oil Baffle	1
79	Oil Seal	1
80	Oil Baffle Seal Ring	1

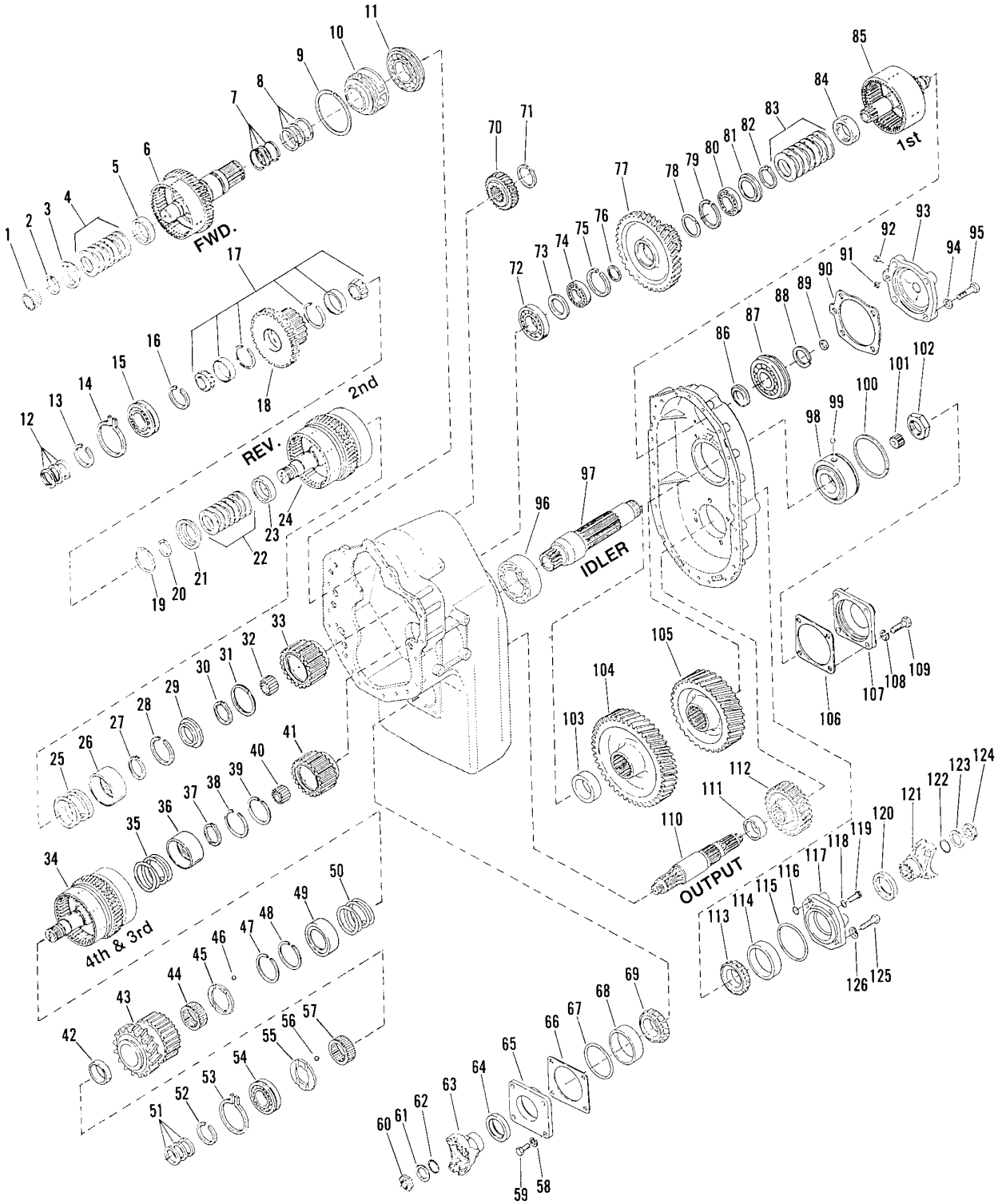

Figure D

CLUTCH AND GEAR GROUP

ITEM	DESCRIPTION	QTY.
1	Forward Shaft Pilot Bearing	1
2	Spring Retainer Ring	1
3	Spring Retainer	1
4	Piston Return Spring Belleville Washer	7
5	Piston Return Spring Spacer	1
6	Forward Clutch Shaft, Drum & Plug Assembly	1
7	Piston Ring Expander Spring	3
8	Forward Shaft Piston Ring	3
9	Piston Ring Sleeve Retaining Ring	1
10	Piston Ring Sleeve	1
11	Forward Shaft Rear Bearing	1
12	Reverse & 2nd Shaft Piston Ring	3
13	Front Bearing Retaining Ring	1
14	Front Bearing Snap Ring	1
15	Reverse & 2nd Shaft Front Bearing	1
16	Front Bearing Retaining Ring	1
17	Clutch Driven Gear Bearing Assembly	1
18	Reverse Clutch Gear & Hub Assembly	1
19	Baffle Ring	1
20	Spring Retaining Snap Ring	1
21	Spring Retainer	1
22	Piston Return Spring Belleville Washer	7
23	Piston Return Spring Spacer	1
24	Reverse & 2nd Clutch Drum & Plug Assembly	1
25	Piston Return Spring	1
26	Spring Retainer	1
27	Spring Retainer Snap Ring	1
28	Retainer Locating Ring	1
29	Retaining Ring Retainer	1
30	2nd Clutch Disc Hub Retaining Ring	1
31	Baffle Ring	1
32	Reverse & 2nd Shaft Rear Bearing	1
33	2nd Clutch Disc Hub	1
34	3rd & 4th Shaft, Drum & Plug Assembly	1
35	Piston Return Spring - 3rd Clutch	1
36	Spring Retainer	1
37	Spring Retainer Snap Ring	1
38	3rd Clutch Disc Hub Retaining Ring	1
39	Baffle Ring	1
40	3rd & 4th Shaft Rear Bearing	1
41	3rd Clutch Disc Hub	1
42	Clutch Driven Gear Bearing Spacer	1
43	4th Gear & Hub Assembly	1
44	Clutch Driven Gear Bearing	1
45	Rear Driven Gear Thrust Washer	1
46	Thrust Washer Lock Ball	1
47	Thrust Washer Locating Ring	1
48	Spring Retainer Snap Ring	1
49	Spring Retainer	1
50	Piston Return Spring	1
51	4th Shaft Piston Ring	3
52	Front Bearing Retaining Ring	1
53	Front Bearing Snap Ring	1
54	4th Clutch Shaft Front Bearing	1
55	Front Driven Gear Thrust Washer	1
56	Thrust Washer Lock Ball	1
57	Clutch Driven Gear Bearing	1
58	Front Bearing Cap Screw Lockwasher	4
59	Front Bearing Cap Screw	4
60	Flange Nut	1
61	Flange Washer	1
62	Flange "O" Ring	1
63	Front Output Flange	1
64	Front Bearing Cap Oil Seal	1

ITEM	DESCRIPTION	QTY.
65	Front Bearing Cap	1
66	Bearing Cap Shim	AR
67	Front Bearing Cap "O" Ring	1
68	Front Bearing Cup	1
69	Front Bearing Cone	1
70	Forward Shaft Gear	1
71	Gear Retaining Ring	1
72	1st Speed Clutch Shaft Front Bearing	1
73	Front Bearing Spacer	1
74	1st Speed Shaft Rear Bearing	1
75	1st Speed Gear Bearing Locating Ring	1
76	1st Speed Gear Bearing Spacer	1
77	1st Gear & Hub Assembly	1
78	Baffle Ring	1
79	Low Speed Gear Bearing Locating Ring	1
80	Low Speed Gear Bearing	1
81	Belleville Washer Retainer	1
82	Spring Retainer Snap Ring	1
83	Belleville Washer	7
84	Belleville Washer Spacer	1
85	1st Clutch Shaft Drum & Bleed Valve Assembly	1
86	1st Speed Shaft Rear Bearing Spacer	1
87	1st Speed Shaft Rear Bearing	1
88	1st Shaft Bearing Retainer Ring	1
89	1st Shaft Piston Ring	1
90	Bearing Cap Gasket	1
91	Bearing Cap "O" Ring	1
92	Bearing Cap Plug	1
93	Rear Bearing Cap	1
94	Bearing Cap Screw Lockwasher	4
95	Bearing Cap Screw	4
96	Idler Shaft Front Bearing	1
97	Idler Shaft	1
98	Idler Shaft Rear Bearing	1
99	Idler Shaft Rear Bearing Lock Ball	1
100	Rear Bearing Locating Ring	1
101	Pump Drive Sleeve	1
102	Idler Shaft Nut	1
103	Idler Gear Spacer	1
104	Idler Shaft Gear	1
105	Idler Shaft Gear	1
106	Idler Shaft Bearing Cap Gasket	1
107	Idler Shaft Bearing Cap	1
108	Idler Shaft Bearing Cap Screw Lockwasher	4
109	Idler Shaft Bearing Cap Screw	4
110	Output Shaft	1
111	Output Gear Spacer	1
112	Output Shaft Gear	1
113	Rear Bearing Cone	1
114	Rear Bearing Cup	1
115	Rear Bearing Cap "O" Ring	1
116	Rear Bearing Cap "O" Ring	1
117	Rear Bearing Cap	1
118	Rear Bearing Cap Screw Lockwasher	4
119	Rear Bearing Cap Screw	4
120	Rear Bearing Cap Oil Seal	1
121	Rear Output Flange	1
122	Flange "O" Ring	1
123	Flange Washer	1
124	Flange Nut	1
125	Rear Bearing Cap Screw	1
126	Rear Bearing Cap Screw Lockwasher	1

A.R. - As Required

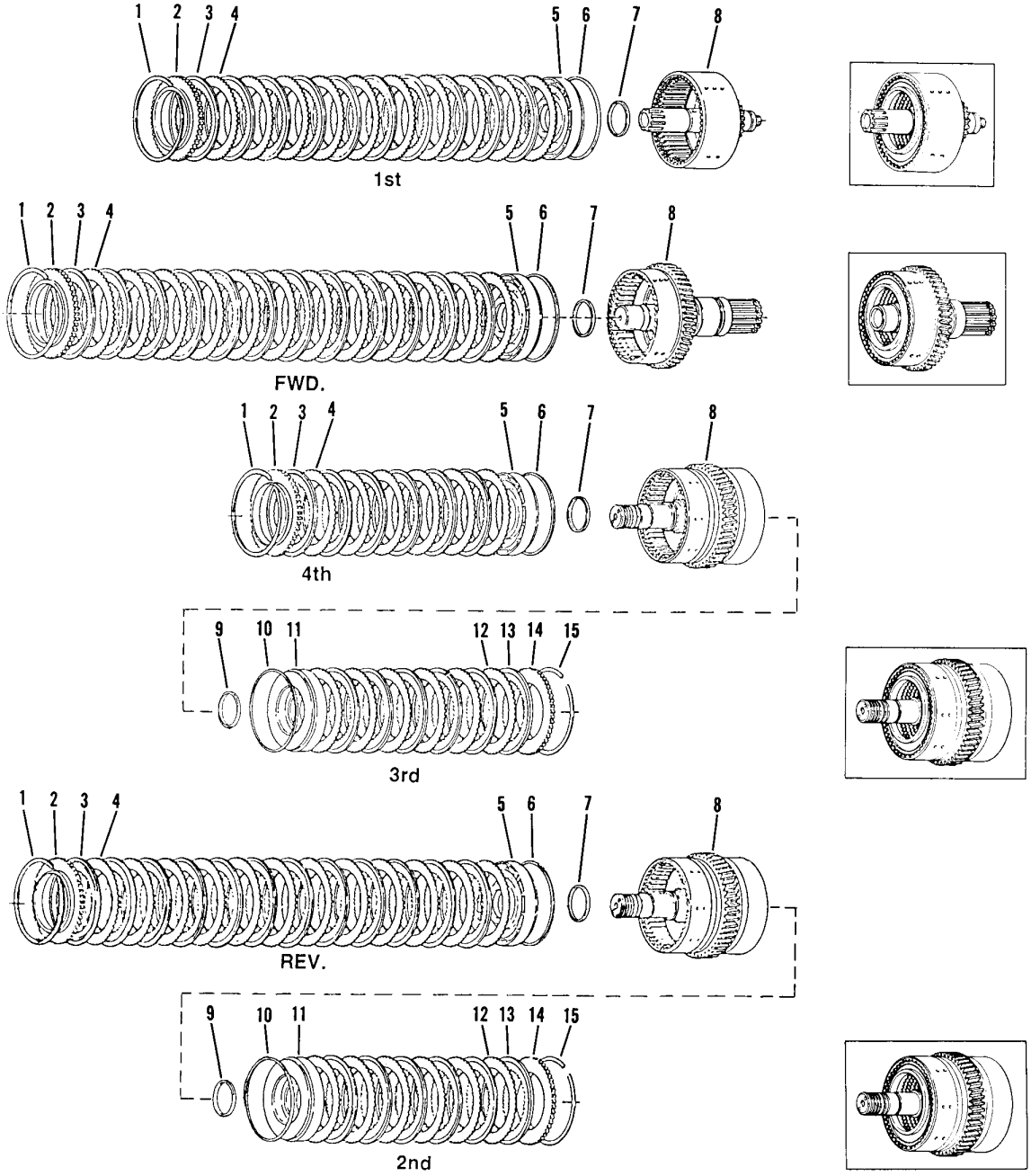

Figure E

CLUTCH ASSEMBLY-1ST

ITEM	DESCRIPTION	QTY.	ITEM	DESCRIPTION	QTY.
1	Backing Plate Retaining Ring	1	5	Clutch Piston	1
2	Clutch Disc Backing Plate	1	6	Clutch Piston Seal - Outer	1
3	Clutch Inner Disc	10	7	Clutch Piston Seal - Inner	1
4	Clutch Outer Disc	10	8	1st Clutch Drum Assembly	1

CLUTCH ASSEMBLY -FORWARD

ITEM	DESCRIPTION	QTY.	ITEM	DESCRIPTION	QTY.
1	Backing Plate Retaining Ring	1	5	Clutch Piston	1
2	Clutch Disc Backing Plate	1	6	Clutch Piston Seal - Outer	1
3	Clutch Inner Disc	12	7	Clutch Piston Seal - Inner	1
4	Clutch Outer Disc	12	8	Forward Clutch Drum Assembly	1

CLUTCH ASSEMBLY 4TH & 3RD

ITEM	DESCRIPTION	QTY.	ITEM	DESCRIPTION	QTY.
1	Backing Plate Retaining Ring	1	9	Clutch Piston Seal - Inner	1
2	Clutch Disc Backing Plate	1	10	Clutch Piston Seal - Outer	1
3	Clutch Inner Disc	6	11	Clutch Piston - 3rd	1
4	Clutch Outer Disc	6	12	Clutch Outer Disc	6
5	Clutch Piston - 4th	1	13	Clutch Inner Disc	6
6	Clutch Piston Seal - Outer	1	14	Clutch Disc Backing Plate	1
7	Clutch Piston Seal - Inner	1	15	Backing Plate Retaining Ring	1
8	4th & 3rd Clutch Drum Assembly	1			

CLUTCH ASSIEMBLY -REVERSE -2ND

ITEM	DESCRIPTION	QTY.	ITEM	DESCRIPTION	QTY.
1	Backing Plate Retaining Ring	1	9	Clutch Piston Seal - Inner	1
2	Clutch Disc Backing Plate	1	10	Clutch Piston Seal - Outer	1
3	Clutch Inner Disc	12	11	Clutch Piston - 2nd	1
4	Clutch Outer Disc	12	12	Clutch Outer Disc	6
5	Clutch Piston - Reverse	1	13	Clutch Inner Disc	6
6	Clutch Piston Seal - Outer	1	14	Clutch Disc Backing Plate	1
7	Clutch Piston Seal - Inner	1	15	Backing Plate Retaining Ring	1
8	Reverse & 2nd Clutch Drum Assembly	1			

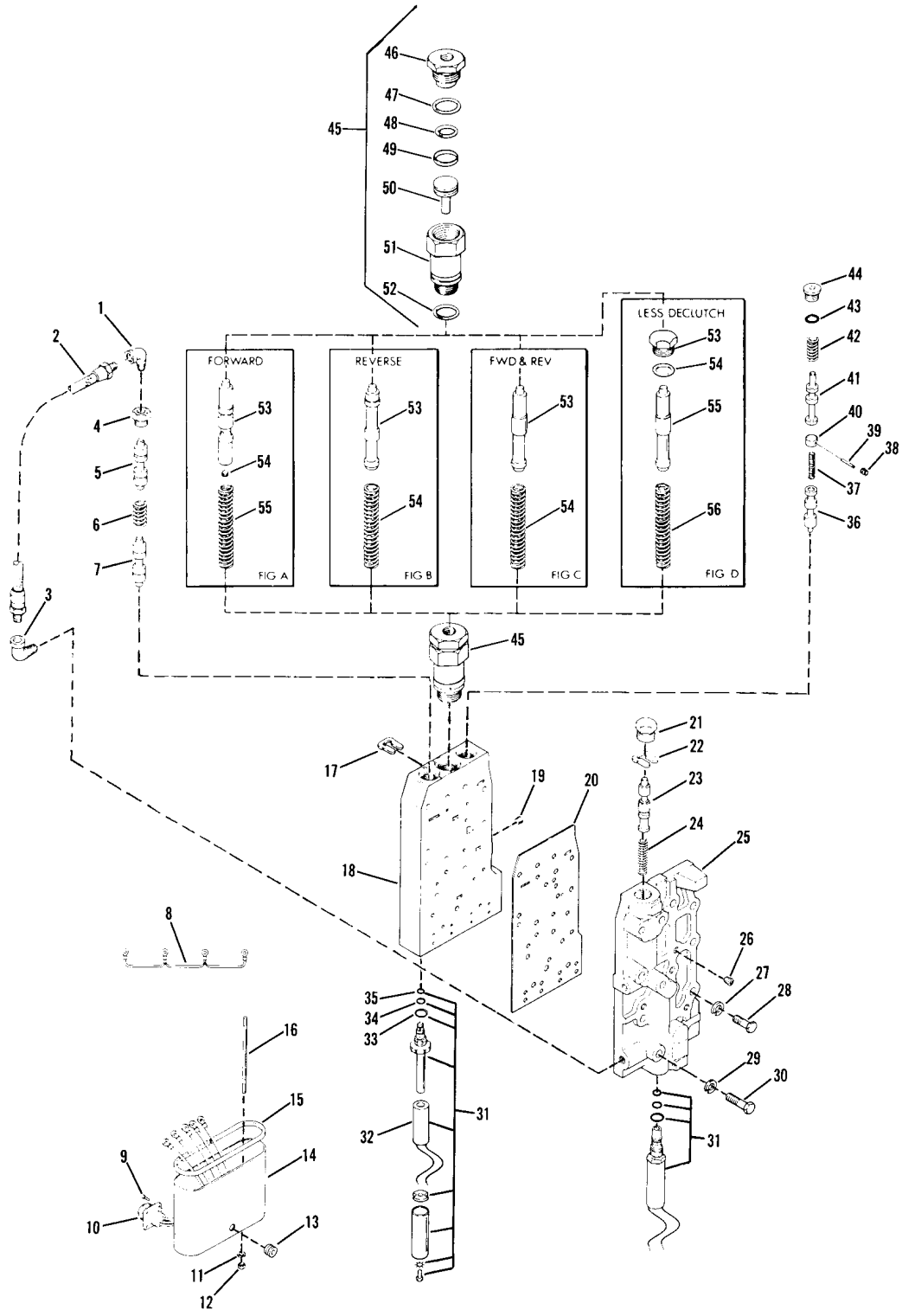

Figure F

CONTROL VALVE ASSEMBLY

ITEM	DESCRIPTION	QTY.
1	Elbow	1
2	Forward Pressure Tube Assembly	1
3	Elbow	1
4	Valve Plug	1
5	Forward & Reverse Shift Spool	1
6	Spool Position Spring	1
7	Forward & Reverse Shift Spool	1
8	Ground Wire Harness	1
9	Receptacle Mounting Screw	4
10	Receptacle & Wire Assembly	1
11	Dust Cover Mounting Stud Lockwasher	2
12	Dust Cover Mounting Stud Nut	2
13	Grommet	1
14	Dust Cover	1
15	Dust Cover Seal	1
16	Dust Cover Mounting Stud	2
17	Valve Spool Stop	1
18	Control Valve Housing	1
19	Pipe Plug	2
20	Shuttle Valve to Electric Control Gasket	1
21	Port Plug	1
22	Spool Stop	1
23	High-Low Shuttle Spool	1
24	Shuttle Spool Spring	1
25	Shuttle Valve Body	1
26	Pipe Plug	7
27	Valve Mounting Screw Lockwasher	2
28	Valve Mounting Screw	2
29	Valve Mounting Screw Lockwasher	1
30	Valve Mounting Screw	1
31	Shuttle Valve Solenoid	5
32	Solenoid Coil	5
33	Shuttle Valve Solenoid "O" Ring	5
34	Shuttle Valve Solenoid "O" Ring	5
35	Shuttle Valve Solenoid "O" Ring	5
36	1st Speed Shift Spool	1
37	Spring	1
38	Plug Stop	1
39	Roll Pin	1
40	Spool Stop	1
41	Shift Spool	1
42	Spool Position Spring	1
43	Bore Plug "O" Ring	1
44	Valve Housing Spool Bore Plug	1
45	Piston Housing Assembly	1
46	Stop Plug	1
47	Plug "O" Ring	1
48	Piston "O" Ring	1
49	Glyd Ring	1
50	Piston	1
51	Piston Housing	1
52	"O" Ring	1

Note: Items 53 thru 56 are various declutch options.

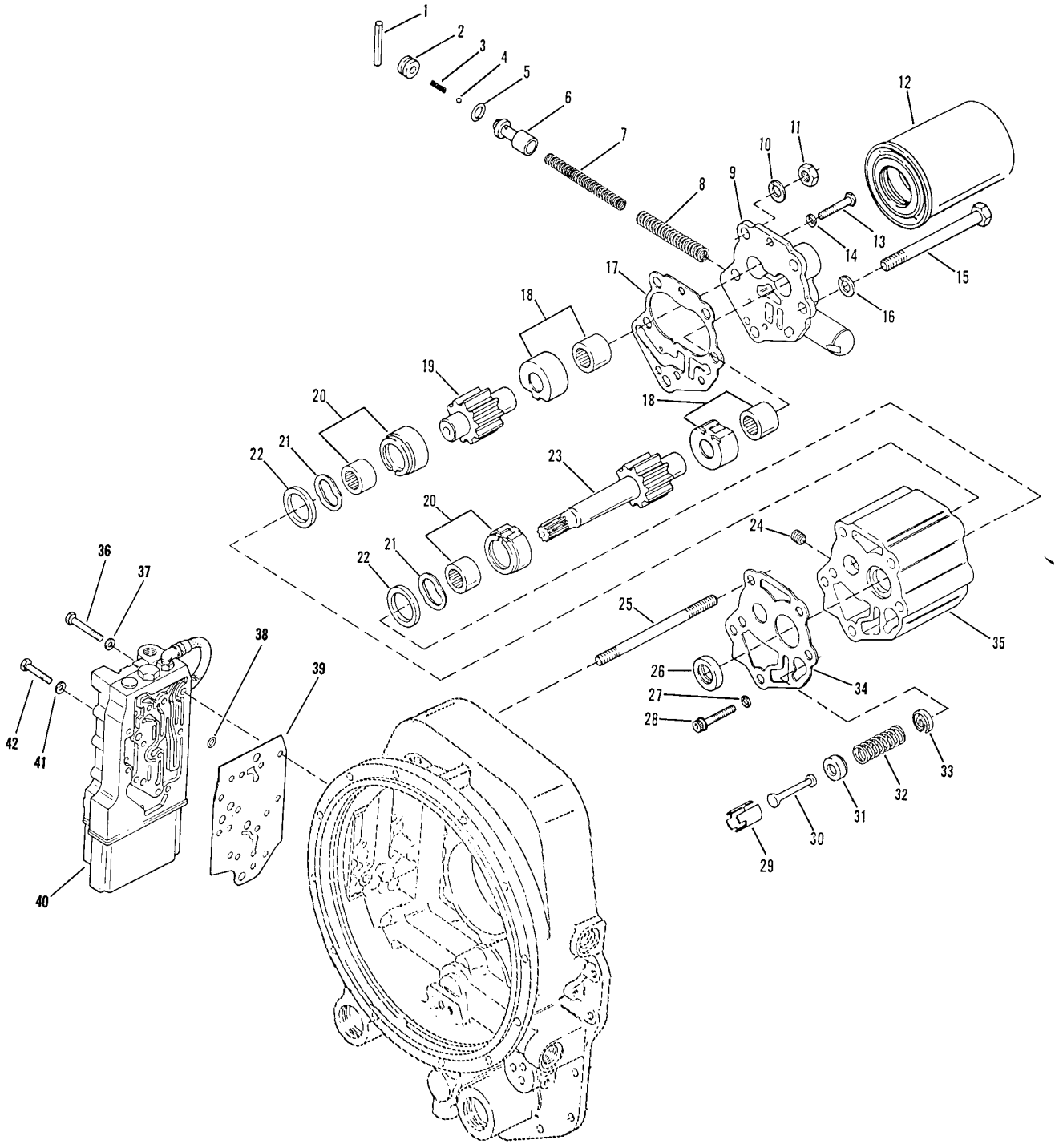
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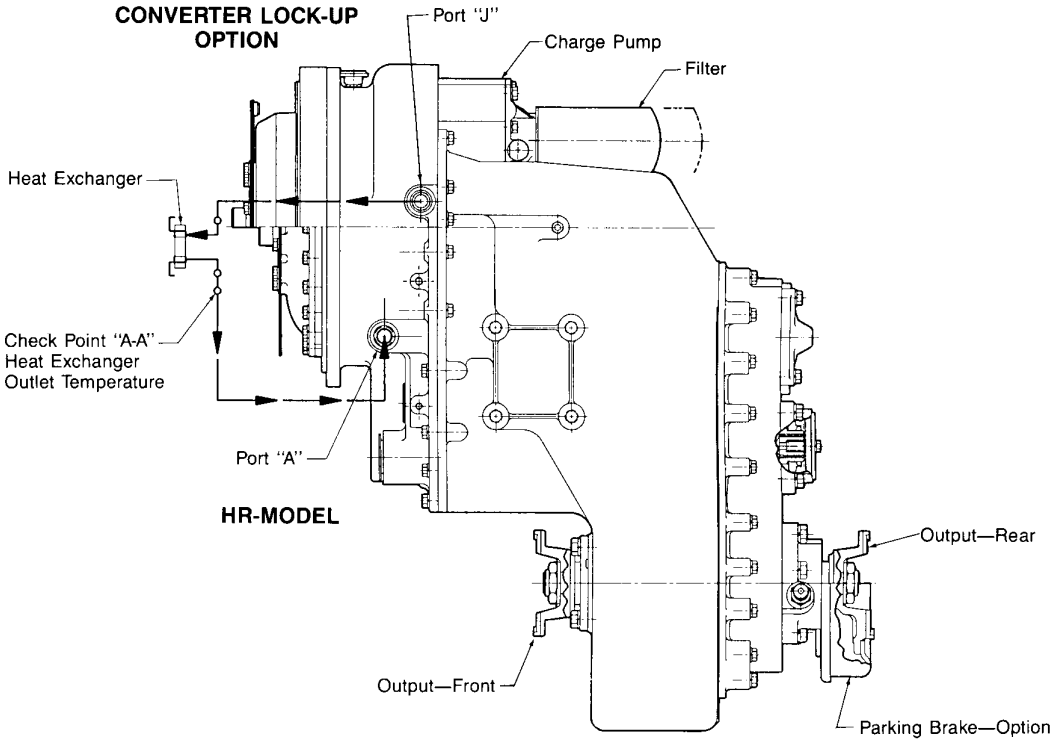
FIGURE G

CHARGING PUMP & VALVE ASSEMBLY GROUP

ITEM	DESCRIPTION	QTY.
1	Valve Stop Roll Pin	1
2	Valve Stop	1
3	Spring	1
4	Ball	1
5	Valve Stop "O" Ring	1
6	Valve Piston	1
7	Valve Spring - Inner	1
8	Valve Spring - Outer	1
9	Regulating Valve & Filter Adaptor Assembly	1
10	Pump Mounting Stud Lockwasher	2
11	Pump Mounting Stud Nut	2
12	Filter Assembly	1
13	Valve to Pump Capscrew	2
14	Valve to Pump Capscrew Lockwasher	2
15	Valve to Pump Capscrew	1
16	Valve to Pump Screw Lockwasher	1
17	Valve to Pump Gasket	1
18	Thrust Plate & Bearing Assembly	2
19	Pump Driven Shaft Assembly	1
20	Thrust Plate & Bearing Assembly	2
21	Wave Spring	2

ITEM	DESCRIPTION	QTY.
22	Thrust Plate Seal	2
23	Pump Drive Shaft Assembly	1
24	Pipe Plug	1
25	Pump Mounting Stud	2
26	Pump Drive Gear Oil Seal	1
27	Pump Mounting Screw Lockwasher	3
28	Pump Mounting Screw	3
29	Safety Valve Spacer	1
30	Safety Valve Poppet	1
31	Safety Valve Seat	1
32	Safety Valve Spring	1
33	Safety Valve Retainer	1
34	Pump Assembly to Converter Housing Gasket	1
35	Pump Body	1
36	Valve Mounting Screw	4
37	Valve Mounting Screw Lockwasher	4
38	High Clutch Pressure "O" Ring	1
39	Valve to Converter Housing Gasket	1
40	Control Valve Assembly	1
41	Valve Mounting Screw Lockwasher	5
42	Valve Mounting Screw	5


CONVERTER LOCK-UP OPTION
Port "J"
Charge Pump
Filter
Heat Exchanger
Check Point "A-A" Heat Exchanger Outlet Temperature
Port "A"
HR-MODEL
Output—Rear
Output—Front
Parking Brake—Option

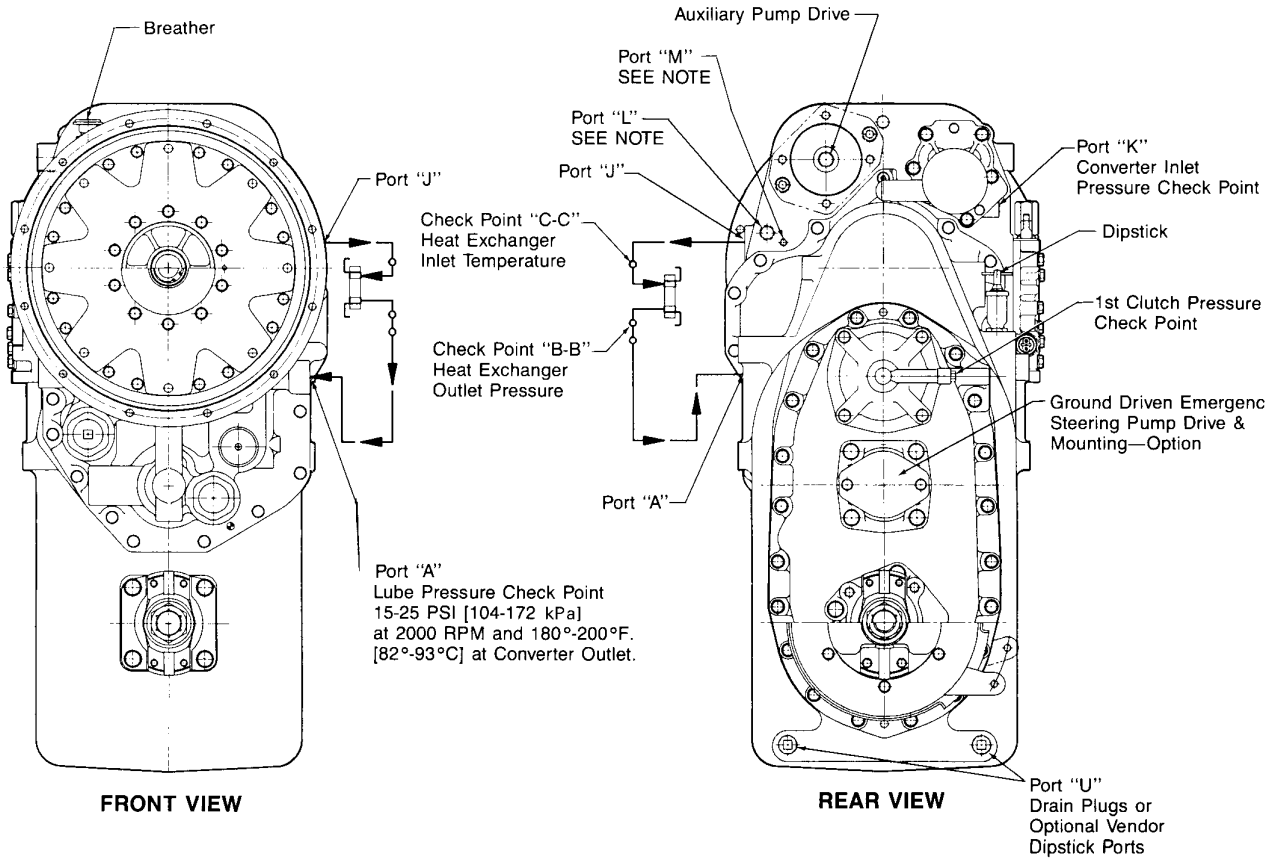
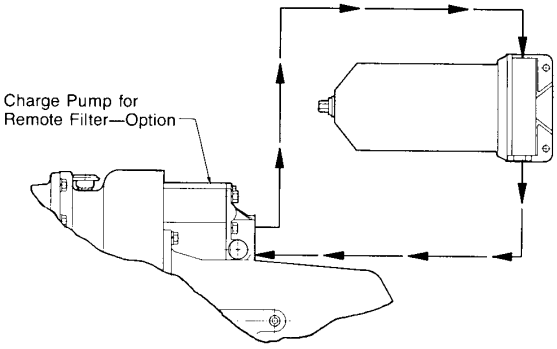
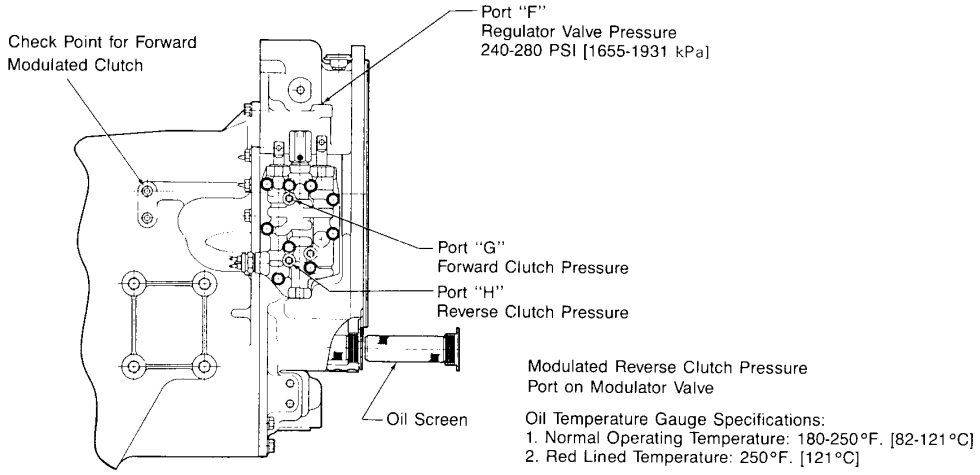

Breather
Port "J"
Check Point "C-C" Heat Exchanger Inlet Temperature
Check Point "B-B" Heat Exchanger Outlet Pressure
Port "A" Lube Pressure Check Point 15-25 PSI [104-172 kPa] at 2000 RPM and 180°-200°F. [82°-93°C] at Converter Outlet.
FRONT VIEW
Auxiliary Pump Drive
Port "M" SEE NOTE
Port "L" SEE NOTE
Port "J"
Port "A"
Port "K" Converter Inlet Pressure Check Point
Dipstick
1st Clutch Pressure Check Point
Ground Driven Emergenc Steering Pump Drive & Mounting—Option
Port "U" Drain Plugs or Optional Vendor Dipstick Ports
REAR VIEW

Figure H



REMOTE FILTER OPTION



Notes

Hose Line Operating Requirements :
1 Pressure Lines-Suitable for operation from ambient to 250°F [121°C] continuous operating temperature Must withstand 300 PSI [2068 kPa] continuous pressure, with 600 PSI [4137 kPa] intermittent surges Ref SA.E. Spec. No J517, 100R1 Hydraulic Hose Specifications
2 See Lubrication Specifications.
3 All hose lines used must conform to SAE Spec No J 1019 Tests and Procedures for High Temperature Transmission Oil Hose.

Port "L" Converter Outlet Temperature
Port is to be used for Converter Outlet Temperature pick-up. Gauge is to be located in the Operator Compartment See Oil Temperature Gauge Specifications

Port "M"-Converter Outlet Pressure.
Pressure must be measured during normal vehicle "Production Line" test Converter outlet pressure equals the total pressure drop of the Heat Exchanger, Heat Exchanger Lines and back pressure of the transmission lubrication system.

Test Conditions
1 Converter Outlet Oil Temperature 180-220°F [82-104°C]
2 Transmission in Neutral.

Operating Specifications
1 25 PSI [173 kPa] Min pressure at 2000 RPM engine speed and a max of 70 PSI [483 kPa] outlet pressure at a no-load governed speed

Ports "A" , "F". "K", "L. and "M"
These ports can be used for field "Trouble Shooting" or vehicle "Production Line.. tests

Ports "F"' "L" and "M'.
These ports are to be used as check points for normal vehicle "Production Line.. test

Port "F"-Clutch Pressure
It is recommended that clutch pressure be monitored by a gauge having an indicator dial range of 0 to 400 PSI [0 to 2758 kPa] and located in the Operator Compartment

Ports "G" and "H"-Back-up Warning These ports are provided for installation of Back-up Pressure Switch for Warning Light or Horn

Figure H

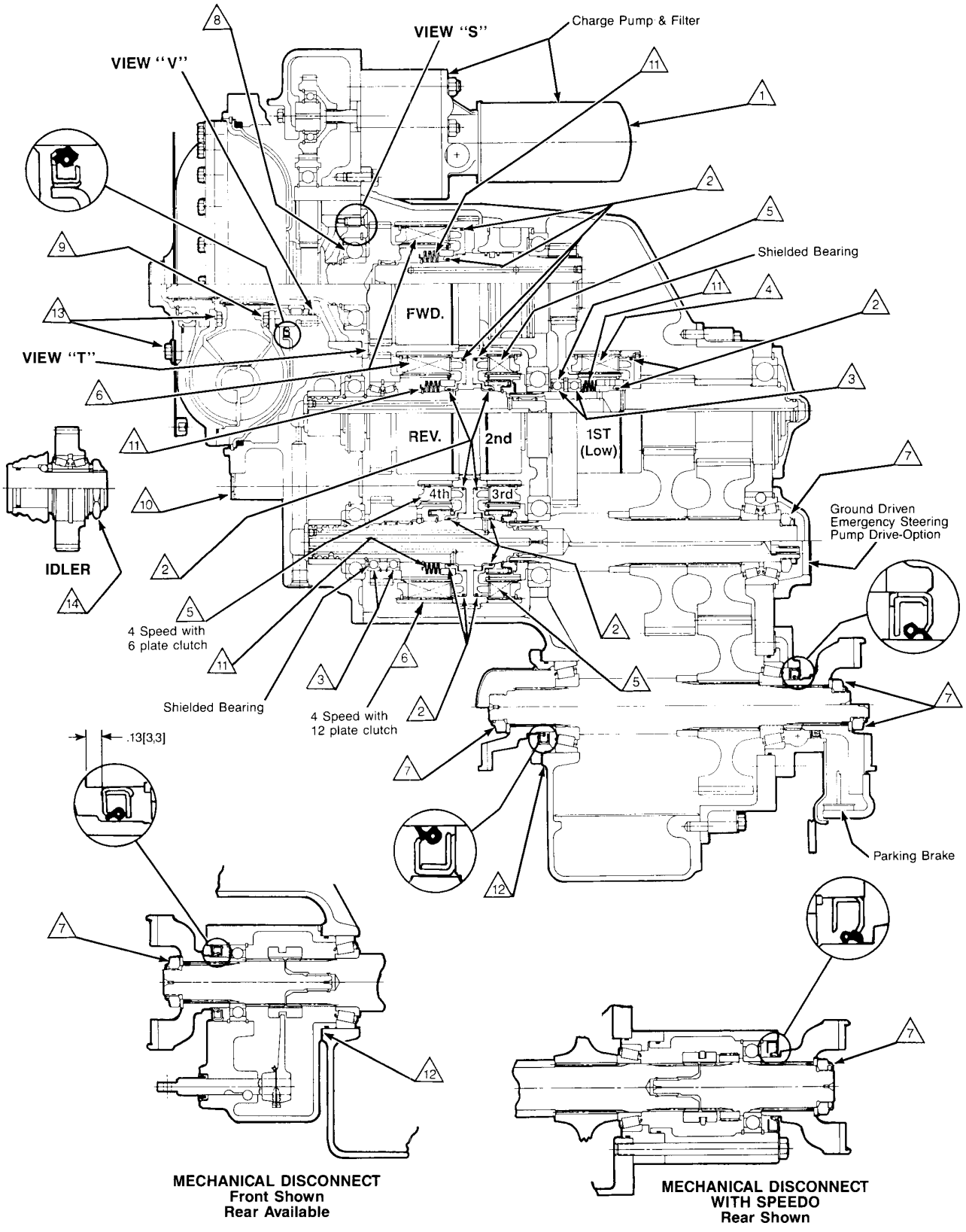
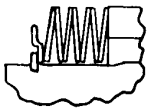

VIEW "S"
Charge Pump & Filter
VIEW "V"
Shielded Bearing
FWD.
VIEW "T"
REV.
2nd
1ST
(Low)
4th
3rd
IDLER
Ground Driven
Emergency Steering
Pump Drive-Option
4 Speed with
6 plate clutch
Shielded Bearing
4 Speed with
12 plate clutch
.13[3,3]
Parking Brake
MECHANICAL DISCONNECT
Front Shown
Rear Available
MECHANICAL DISCONNECT
WITH SPEEDO
Rear Shown

Figure I

1. Assemble oil filter and tighten 20 to 25 Lbs.Ft. [27,2-33,8 N·m]
2. Teflon seals must be sized prior to ass'y.
3. Must be loose internal fit bearing with a No. 3 etched on the bearing.
4. 10-outer steel plates, 10-inner friction plates. Alternately assemble, starting with outer steel plate.
5. 6-outer steel plates, 6-inner friction plates. Alternately assemble, starting with outer steel plate.
6. 12-outer steel plates, 12-inner friction plates. Alternately assemble, starting with outer steel plate.
7. Tighten 200 to 250 Lbs.Ft [271,2-338,9 N·m]
8. Special bearing loading notches opposite snap ring.
9. Bend lock tabs after tightening cap screws to proper torque.
10. Tighten oil screen assy 10 to 15 Lbs.Ft. [13,6-20,3 N·m]
11. Low, Forward and Reverse Clutch Springs - Concave side of first Belleville spring to be placed against clutch piston. Remaining six springs of each clutch to be stacked alternately reversed as shown.



12. Shim output shaft bearings to produce 6 to 8 Lbs. in. [0,68-0,90 N·m] pre load.
13. Clean mounting surfaces and tapped holes with solvent. Dry thoroughly, being certain tapped holes are dry and clean. **See text for proper installation.**
14. Tighten 200-250 Lbs. Ft. [271,2-338,9 N·m] and stake nut securely into shaft notch.
15. Stator support screw assembly: (View "S")
    1. Clean stator support mounting surface and tapped holes with solvent. Dry thoroughly, being certain tapped holes are clean and dry.
    2. Install 6 special stator support screws. Tighten screws 12 to 16 Lbs. Ft. [16,3-21,6 N·m] torque. See Caution.

Notes

All lead in chamfers for oil seals, piston rings, and "O" rings must be smooth and free from burrs. Inspect at assembly.

Lubricate all piston ring grooves and "O" rings with oil before assembly.

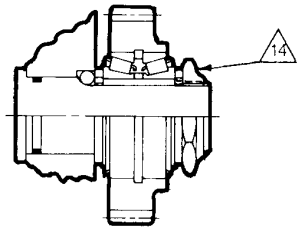
Apply a thin coating of grease between seal lips on lip type seals prior to assembly.

Apply a very light coat of Permatex No. 2 to O.D. of all oil seals and bore plugs before assy.

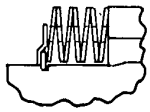
Apply a light coat of Loctite No. 92 to all plug threads.

Apply a light coat of Permatex No. 2 to all thru hole stud threads.

After assembly of parts using Loctite or Permatex, there must not be any free or excess material which might enter the oil circuit.

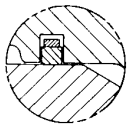


VIEW "T"
REVERSE IDLER



1ST
(Low)

VIEW "V"

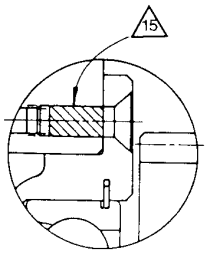


Enlarged view of stator support piston ring & expander

Note:
Expander gap to be approx. 180° from ring hook joint to aid assembly.

Caution:

Assembly of stator support to converter housing must be completed within a 15 minute period from start of screw installation. The special screw is to be used for one installation only. If screw is removed for any reason, it must be replaced. The Loctite left in the holes must be removed with the proper tap and cleaned with solvent. Dry hole thoroughly and use a new screw for reinstallation.



VIEW "S"

Torque Specification for Lubricated or Plated Screw Threads

NOM. SIZE	Grade 5 FINE THREAD LB-FT	[N·m]	Grade 5 COARSE THREAD LB-FT	[N·m]	Grade 8 FINE THREAD LB-FT	[N·m]	Grade 8 COARSE THREAD LB-FT	[N·m]
.2500	9 - 11	[12,3 - 14,9]	8 - 10	[10,9 - 13,5]	11 - 13	[15,0 - 17,6]	9 - 11	[12,3 - 14,9]
.3125	16 - 20	[21,7 - 27,1]	12 - 16	[16,3 - 21,6]	28 - 32	[38,0 - 43,3]	26 - 30	[35 3 - 40,6]
.3750	26 - 29	[35,3 - 39,3]	23 - 25	[31,2 - 33,8]	37 - 41	[50,2 - 55,5]	33 - 36	[44,8 - 48,8]
.4375	41 - 45	[55,6 - 61,0]	37 - 41	[50,2 - 55,5]	58 - 64	[78,7 - 86,7]	52 - 57	[70,6 - 77,2]
.5000	64 - 70	[86,8 - 94,9]	57 - 63	[77,3 - 85,4]	90 - 99	[122,1 - 134,2]	80 - 88	[108,5 - 119,3]
.5625	91 - 100	[123,4 - 135,5]	82 - 90	[111,2 - 122,0]	128 - 141	[173,6 - 191,1]	115 - 127	[156,0 - 172,2]
.6250	128 - 141	[173,5 - 191,2]	113 - 124	[153,2 - 168,1]	180 - 198	[224,0 - 268,5]	159 - 175	[215,6 - 237,3]
.7500	223 - 245	[302,3 - 332,2]	200 - 220	[271,2 - 298,3]	315 - 347	[427,1 - 470,5]	282 - 310	[382,3 - 420,3]

Figure I

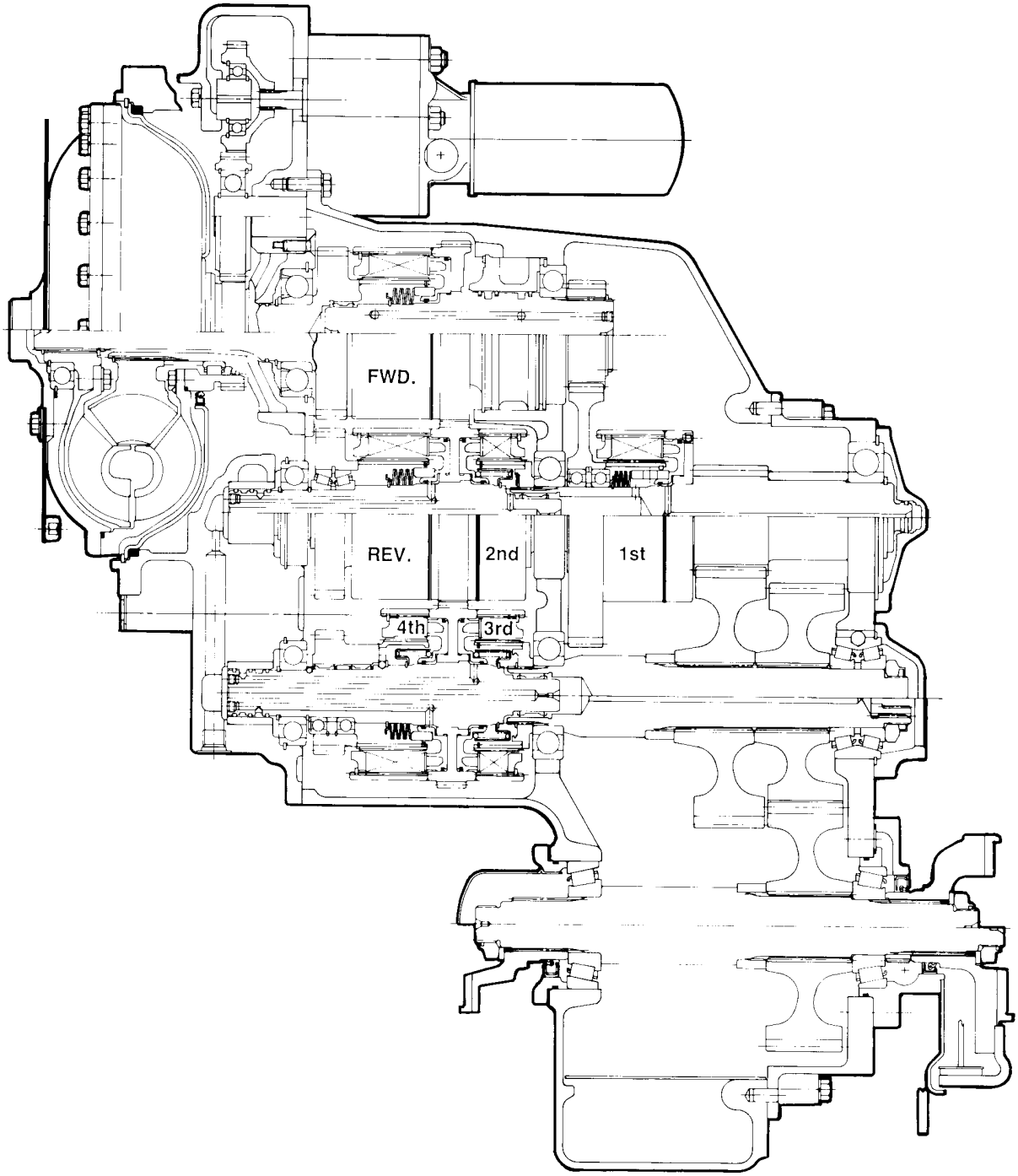


Figure J

MAINTENANCE AND SERVICE

The instructions contained herein cover the disassembly and reassembly of the transmission in a sequence that would normally be followed after the unit has been removed from the machine and is to be completely overhauled. It must also be understood that this is a basic 24000 4 speed long drop output transmission with many options. The units are very similar to trouble shoot, disassemble, repair and reassemble.

CAUTION: Cleanliness is of extreme importance and an absolute must in the repair and overhaul of this unit. Before attempting any repairs, the exterior of the unit must be thoroughly cleaned to prevent the possibility of dirt and foreign matter entering the mechanism.

DISASSEMBLY

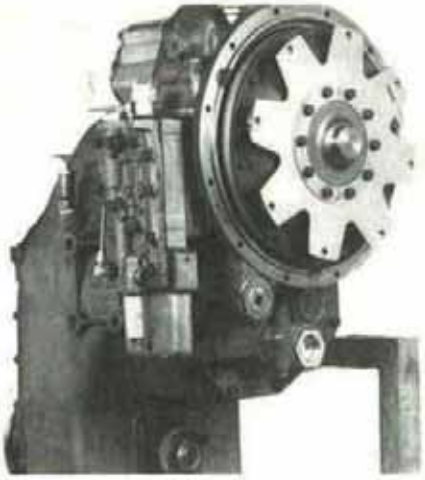


Figure 1
Side view of the HR24000 4 speed transmission with electric control valve and modulation.

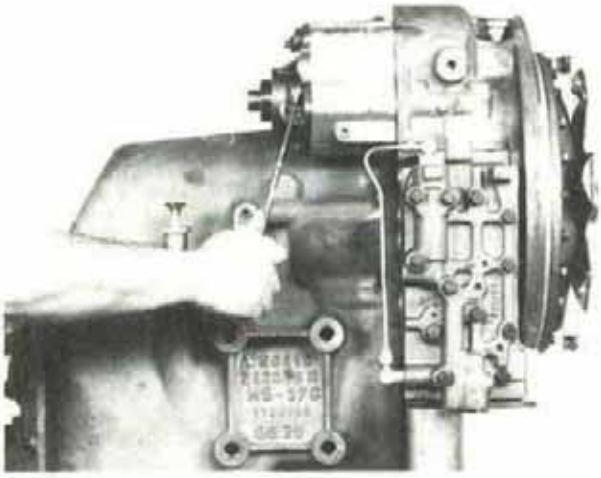


Figure 3
Remove pressure regulating valve and charging pump screws, stud nuts and washers.

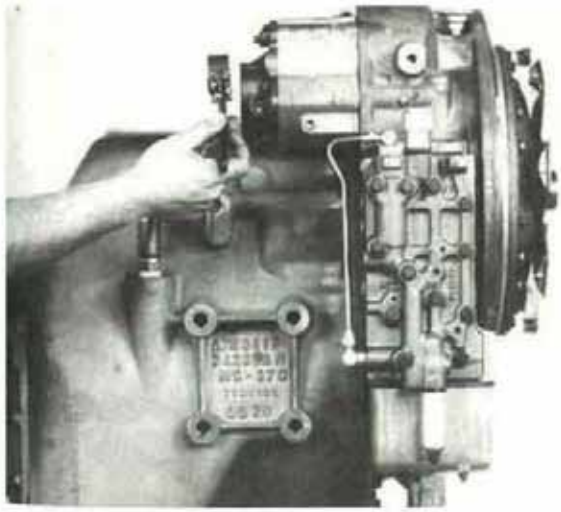


Figure 2
Remove oil filter element. It is recommended a small pan be used to catch remaining oil in element.

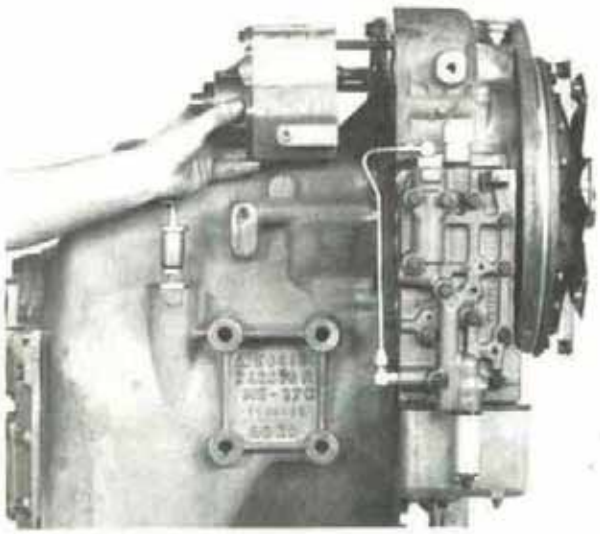


Figure 4
Remove regulating valve and pump assembly.

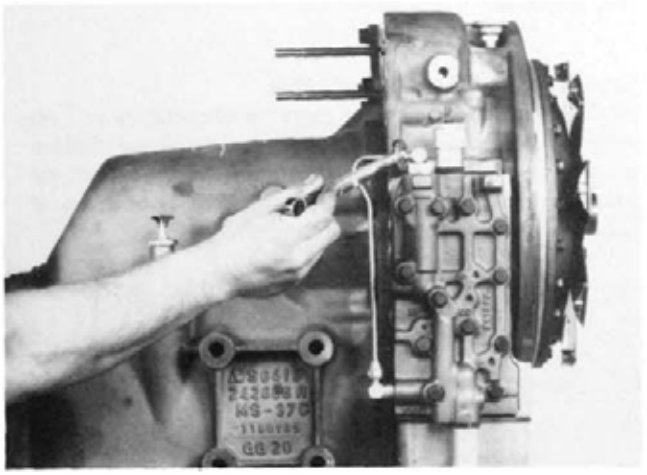


Figure 5
Disconnect shuttle valve cross-over tube.

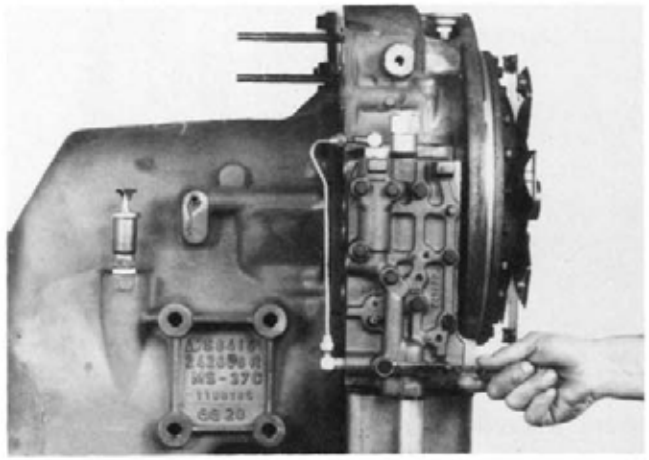


Figure 6
Remove two valve to converter housing cap screws. Install two aligning studs. Remove remaining cap screws.

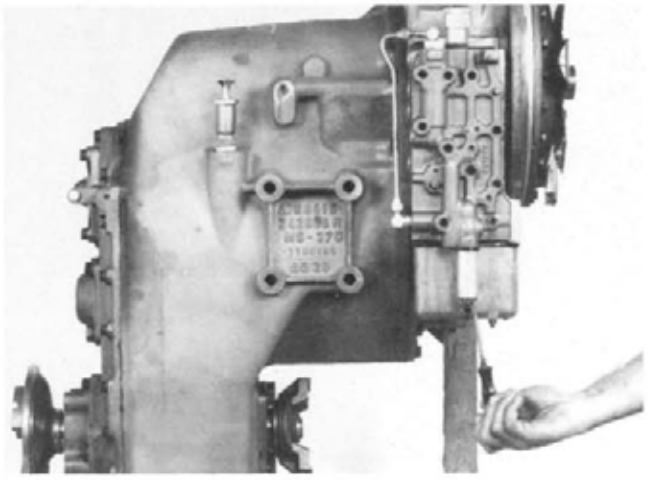


Figure 7
Remove shuttle valve solenoid wires.

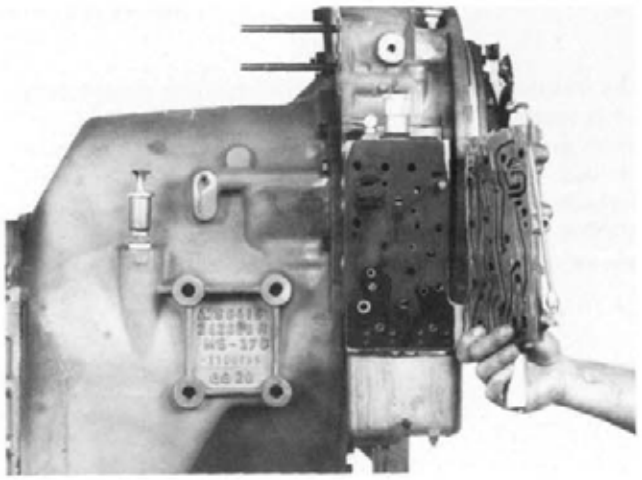


Figure 8
Remove shuttle valve assembly.

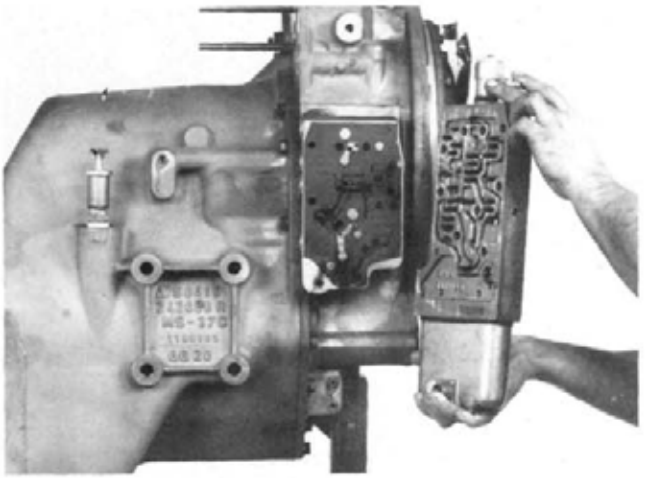


Figure 9
Remove control valve assembly.

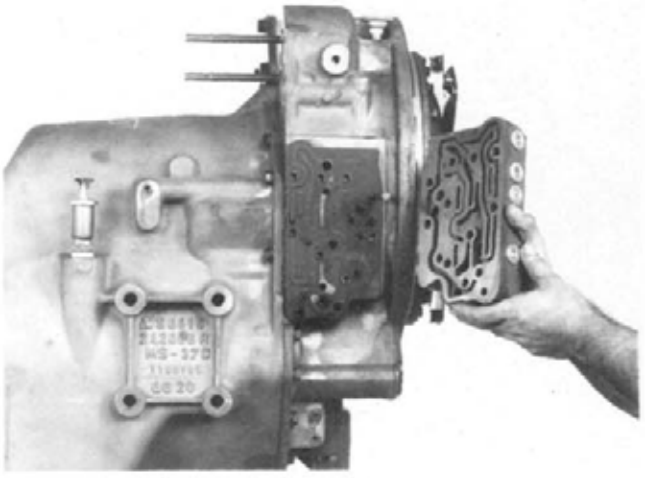


Figure 10
Remove modulator valve assembly.

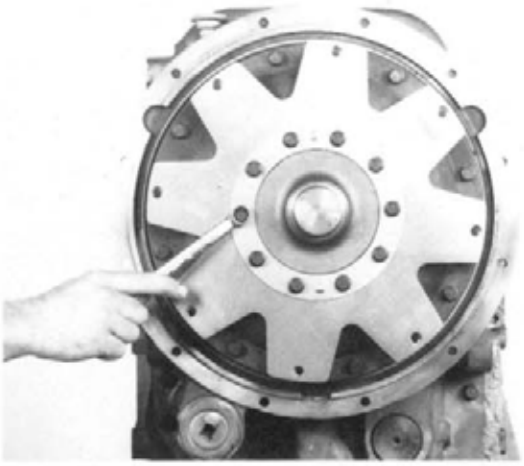


Figure 11
Remove drive plate attaching cap screws. Some units will have stud nuts and washers.

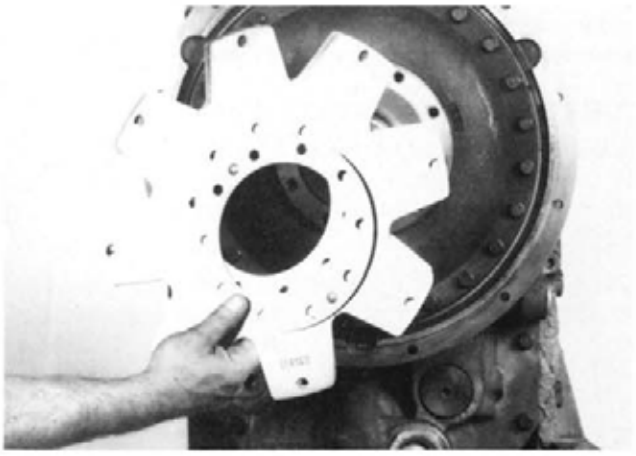


Figure 12
Remove drive plate and backing ring.

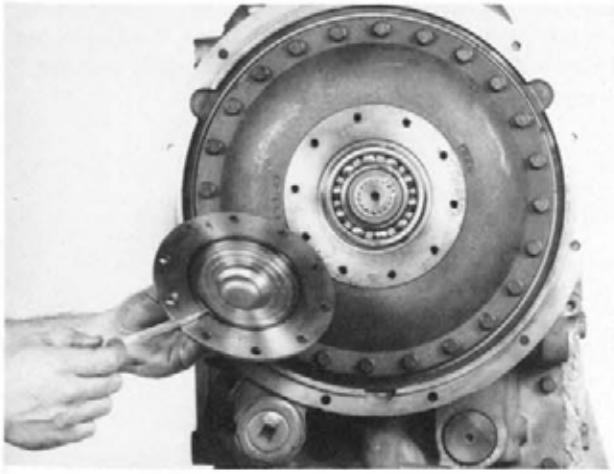


Figure 13
Remove impeller cover bearing cap.

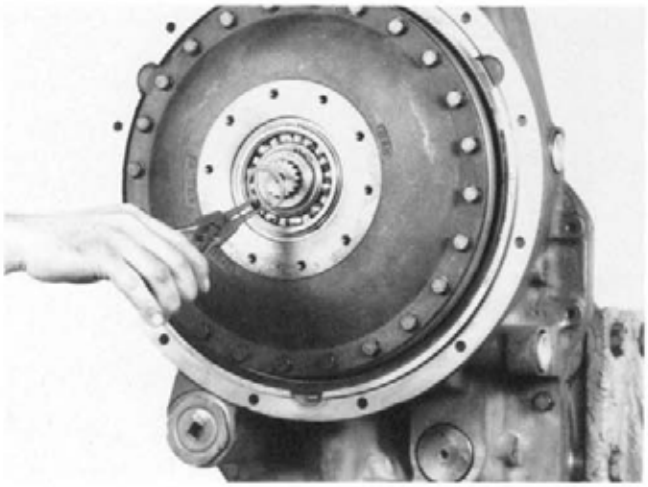


Figure 14
Remove turbine hub to turbine shaft retainer ring.

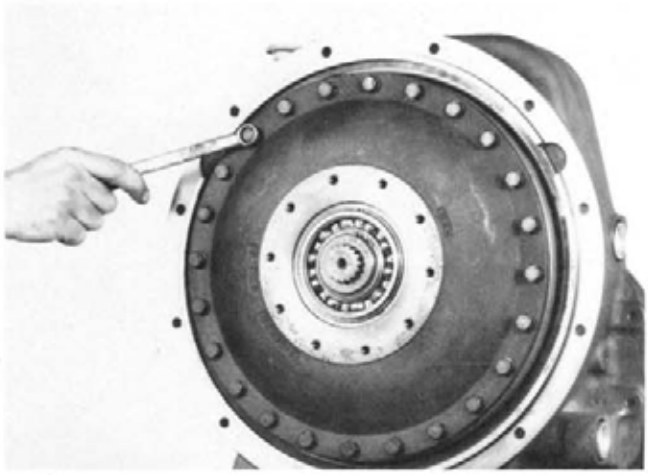


Figure 15
Remove impeller cover to impeller cap screws.

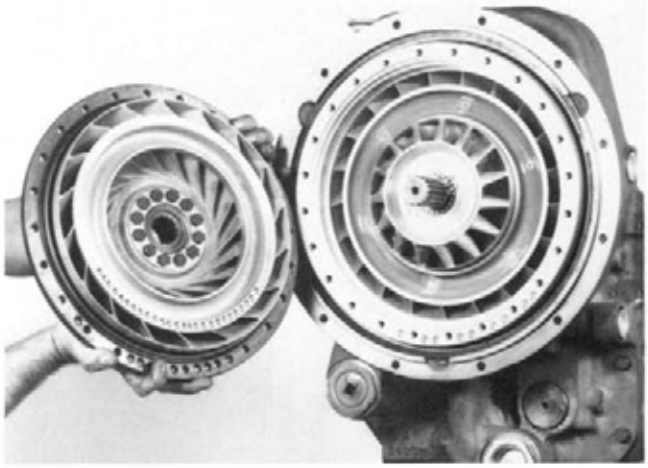


Figure 16
Remove impeller cover and turbine as an assembly.

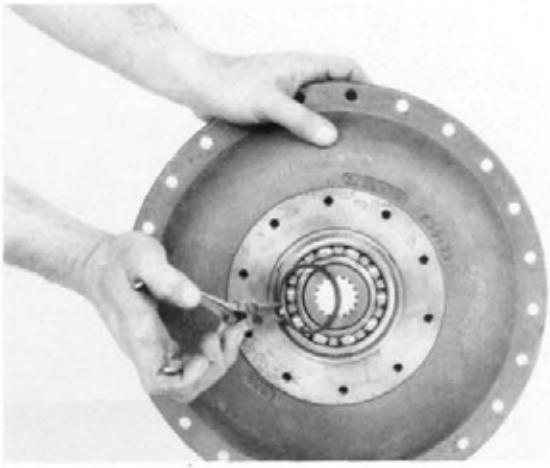


Figure 17
Remove turbine hub to impeller cover bearing retainer ring.

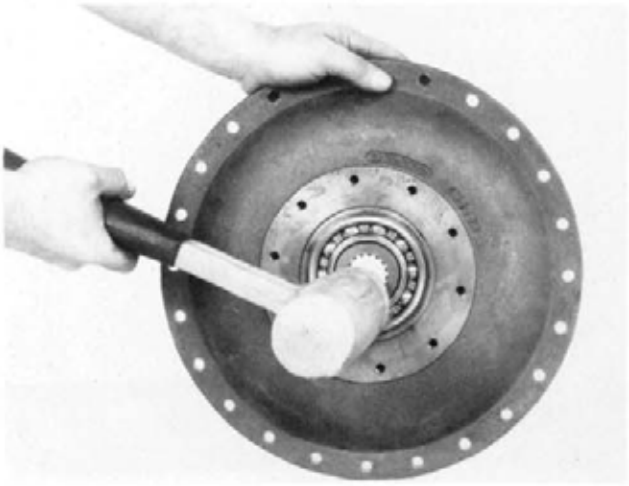


Figure 18
Tap turbine and hub from impeller cover.

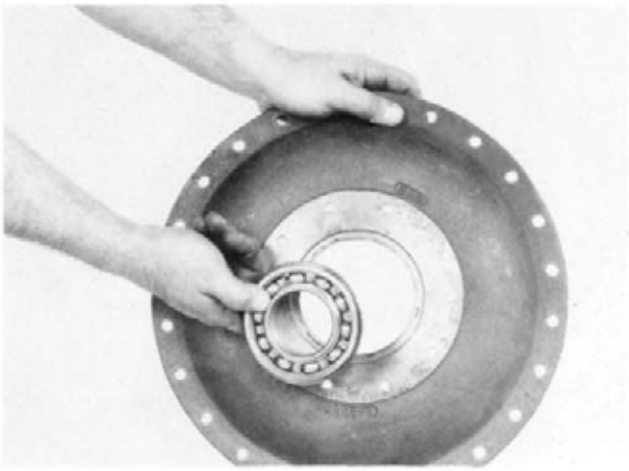


Figure 19
Remove impeller cover bearing.

IMPELLER COVER AND TURBINE REASSEMBLY

(See cleaning and inspection page.)

Figure 20
Install impeller cover bearing in cover with bearing locating ring up.

If the turbine or turbine hub was replaced or disassembled, this procedure must be used for reassembly.

TURBINE HUB ASSEMBLY WITH BACKING RING AND SPECIAL SELF LOCKING SCREWS

1. Clean hub mounting surface and tapped holes with solvent. Dry thoroughly being certain tapped holes are dry and clean.

2. Install backing ring and special screws to approximately .06 inch [1,5] of seated position. With a calibrated torque wrench, tighten screws 37 to 41 lbs. ft. torque [50,2-55,6 N.m.]. **NOTE:** Assembly of turbine hub must be completed within a fifteen minute period from start of screw installation. The screws are prepared with a coating which begins to harden after installation in the hub holes. If not tightened to proper torque within the fifteen minute period, insufficient screw clamping tension will result. The special screw is to be used for one installation only. If the screw is removed for any reason it must be replaced. The compound left in the hub holes must be removed with the proper tap and cleaned with solvent. Dry hole thoroughly and use a new screw for reinstallation.

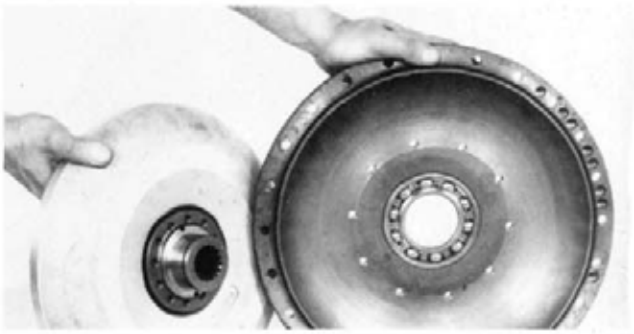


Figure 21
Position turbine assembly in impeller cover.

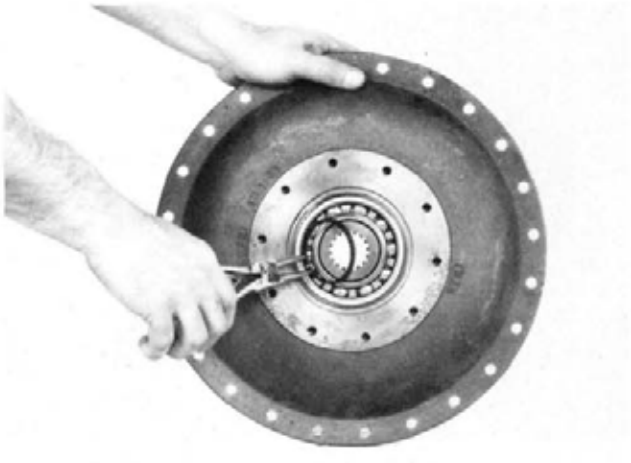


Figure 22
Install turbine hub to impeller cover bearing retainer ring.

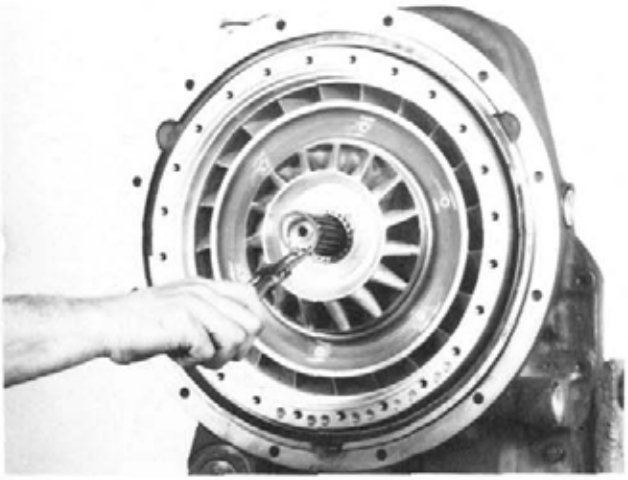


Figure 23
Remove turbine locating ring from turbine shaft.

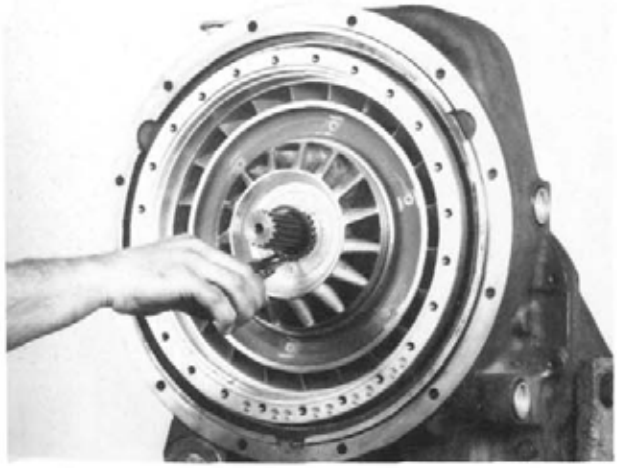


Figure 24
Remove reaction member retainer ring.

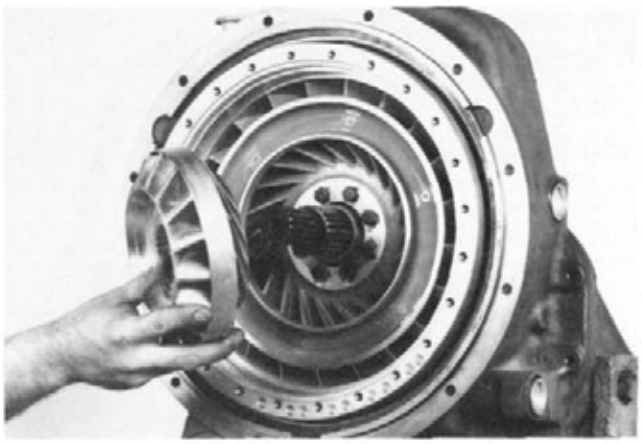


Figure 25
Remove reaction member. **NOTE:** Some units will have a fixed reaction member and some units will have a freewheeling reaction member. The fixed is a one piece and the freewheeling is an assembly. Remove as an assembly.

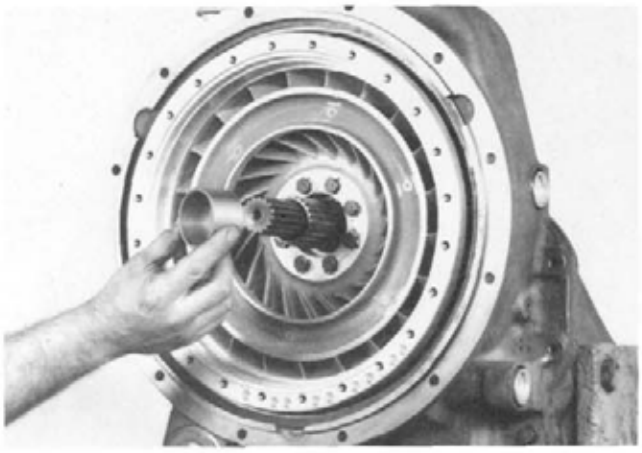


Figure 26
Remove reaction member spacer.

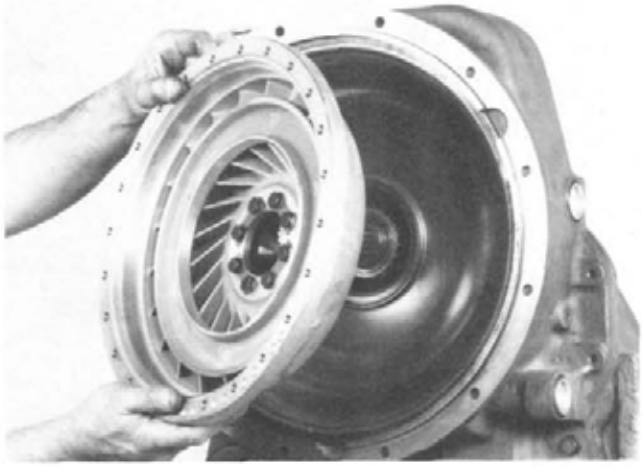


Figure 27
Remove impeller and hub assembly.

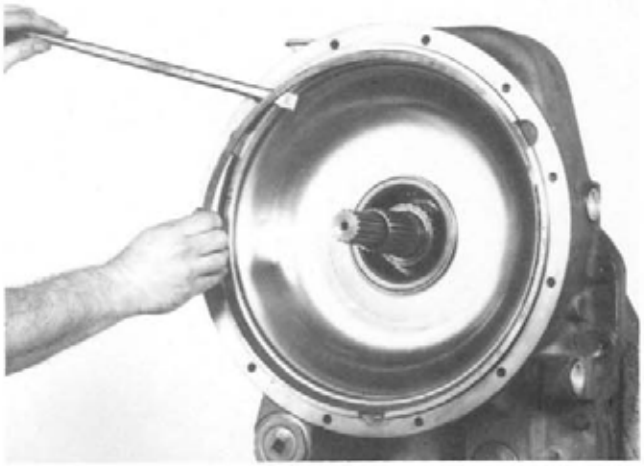


Figure 28
Remove oil baffle retainer ring.

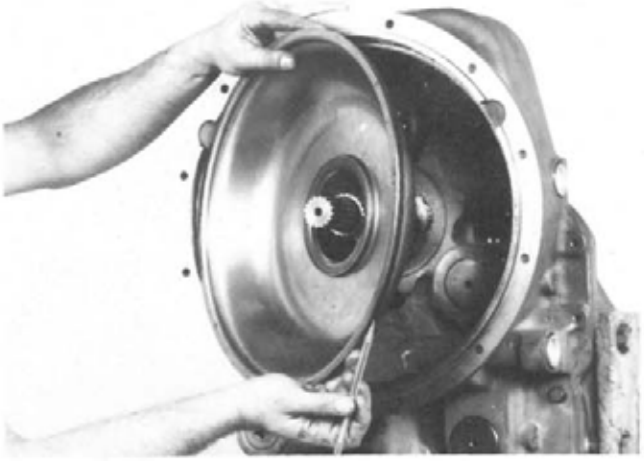


Figure 29
Pry oil baffle from housing. **NOTE:** A resistance will be noted because of the heavy oil sealing ring.

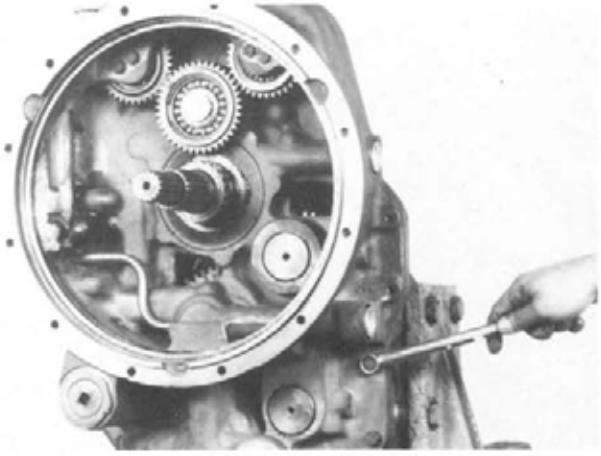


Figure 30
Support converter housing with a chain hoist. Remove converter housing to transmission case bolts.

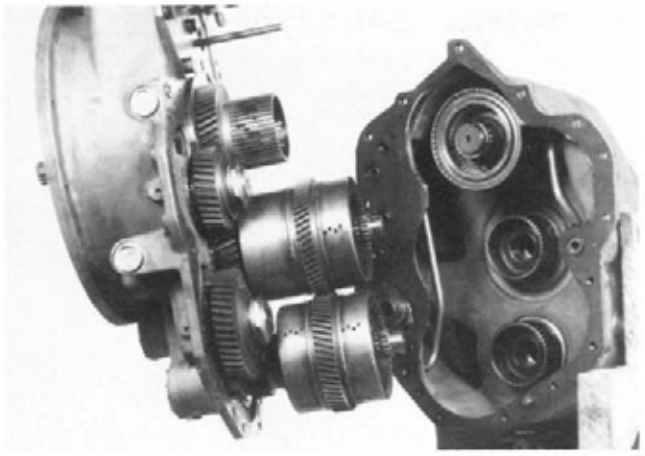


Figure 31
Seperate converter housing from transmission case assembly. **NOTE:** Reverse, second, third and fourth clutches will remain in the converter housing.

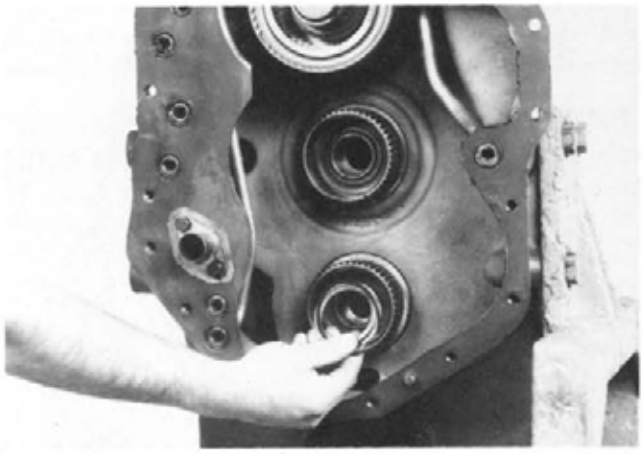


Figure 32
Remove 3rd speed clutch disc hub snap ring, retainer outer ring and retainer.

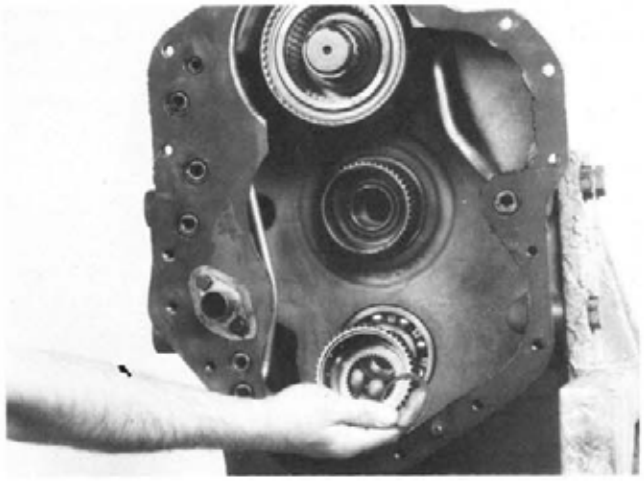


Figure 33
Remove disc hub retainer ring and disc hub.

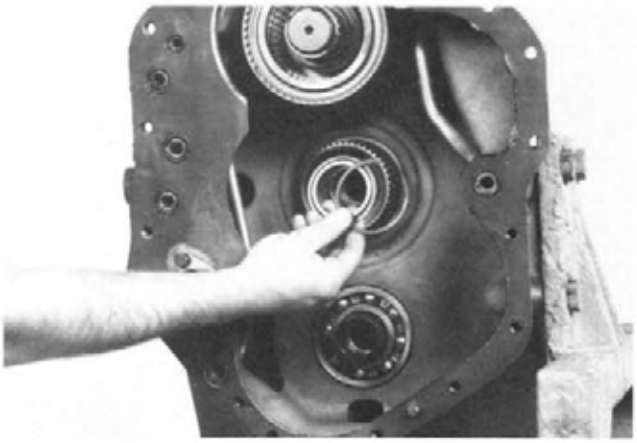


Figure 34
Remove 2nd speed clutch disc hub snap ring, retainer outer ring and retainer.

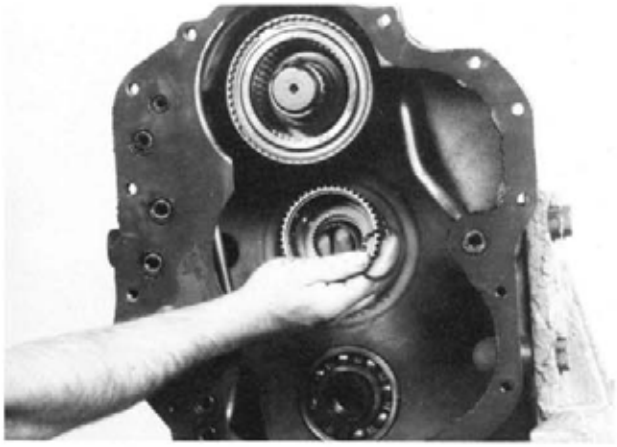


Figure 35
Remove disc hub retainer ring and disc hub.

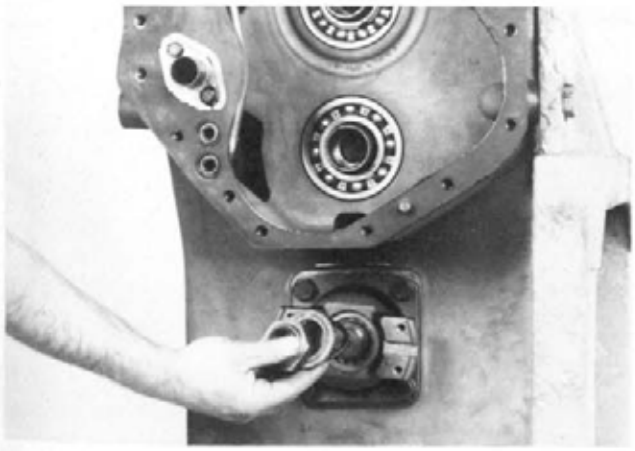


Figure 36
Using an impact wrench (if available), if not a flange retainer bar must be used to hold the companion flange from turning, loosen output flange nut. Remove nut, washer, "O" ring and flange.

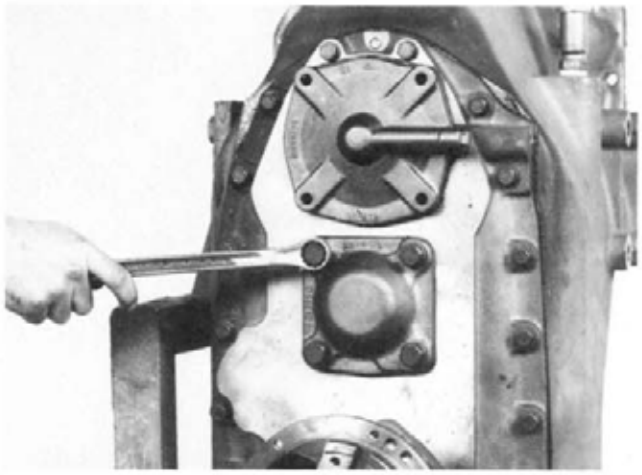


Figure 37
Remove the low clutch and idler shaft rear bearing cap bolts.

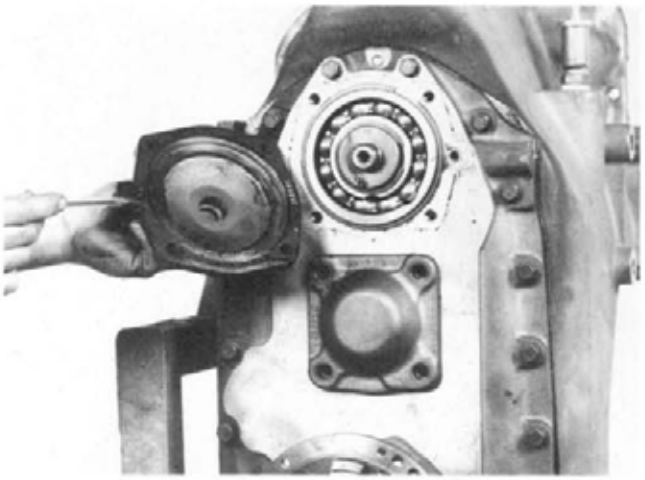


Figure 38
Remove low clutch rear bearing cap.

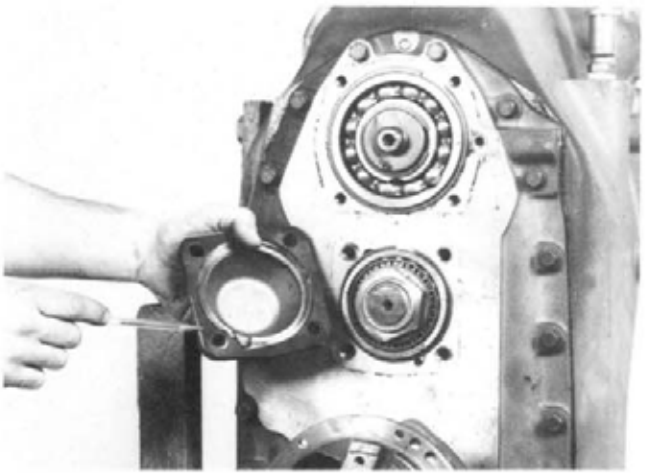


Figure 39
Remove idler shaft bearing cap.

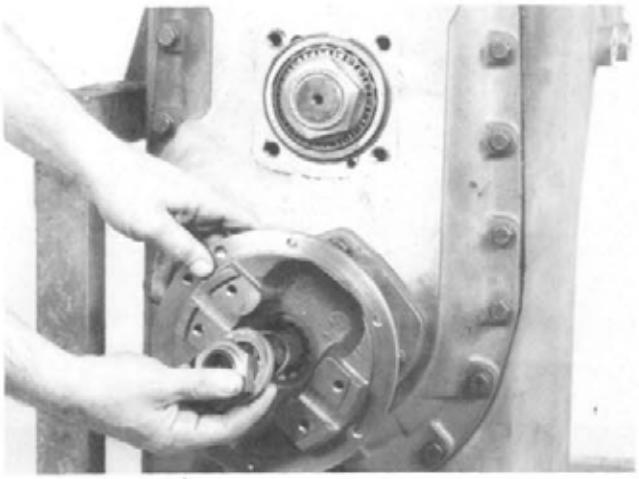


Figure 40
Remove the rear output flange nut, washer, "O" ring and flange.

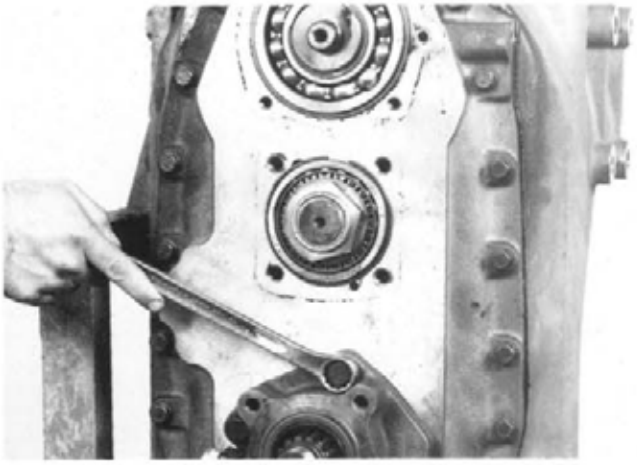


Figure 41
Remove output shaft rear bearing cap bolts.

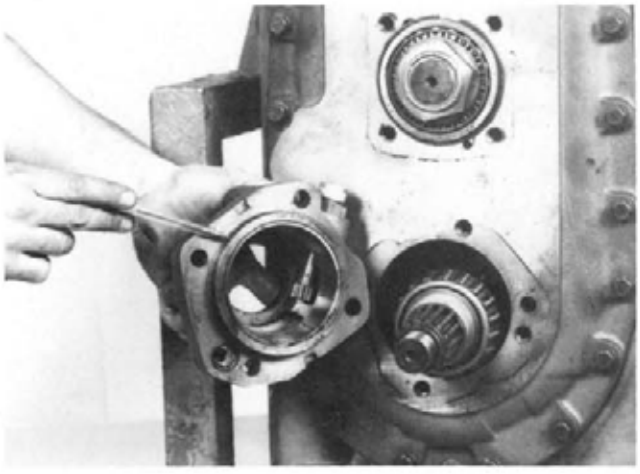


Figure 42
Remove bearing cap.

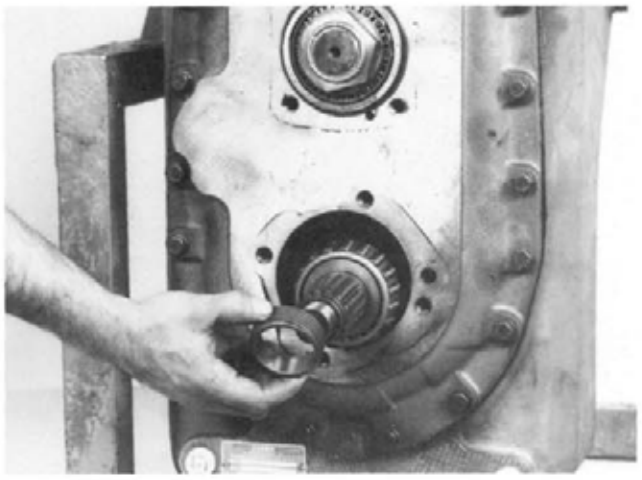


Figure 43
Remove flange spacer or speedometer drive gear.

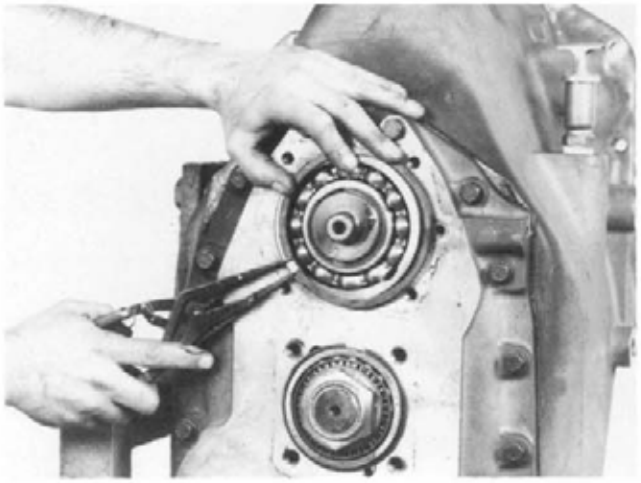


Figure 44
Remove the 1st clutch rear bearing locating ring.

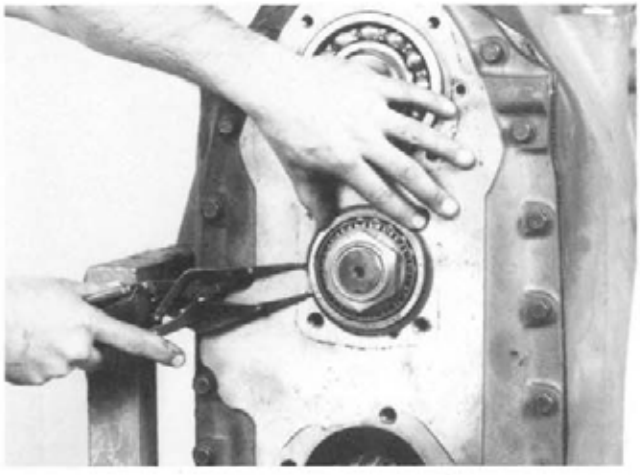


Figure 45
Remove the idler shaft rear bearing locating ring.

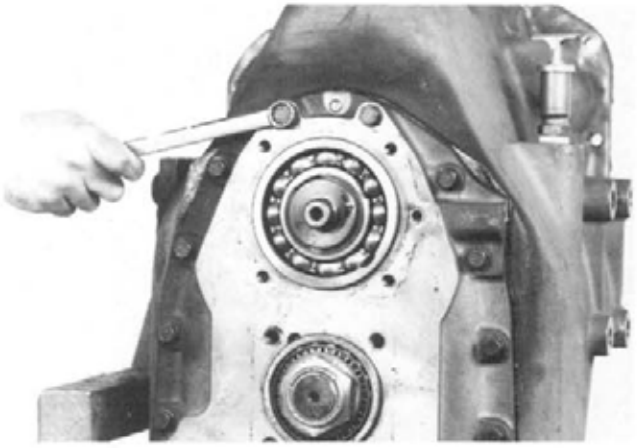


Figure 46
Remove rear cover to case bolts.

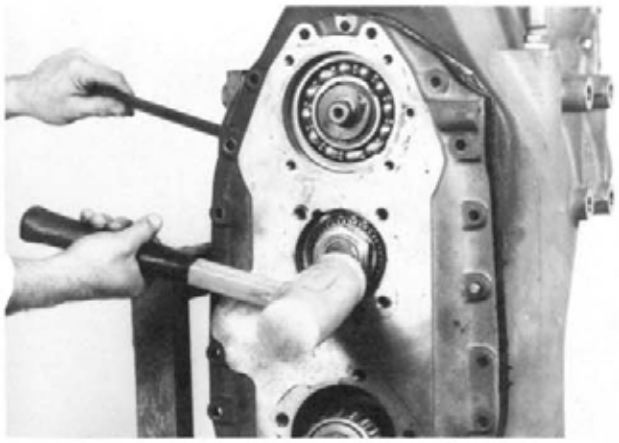


Figure 47
The use of aligning studs will facilitate the rear cover removal. Using pry slots provided, pry cover from transmission case. Using a soft hammer tap on the 1st clutch and idler shaft to prevent cover from binding.

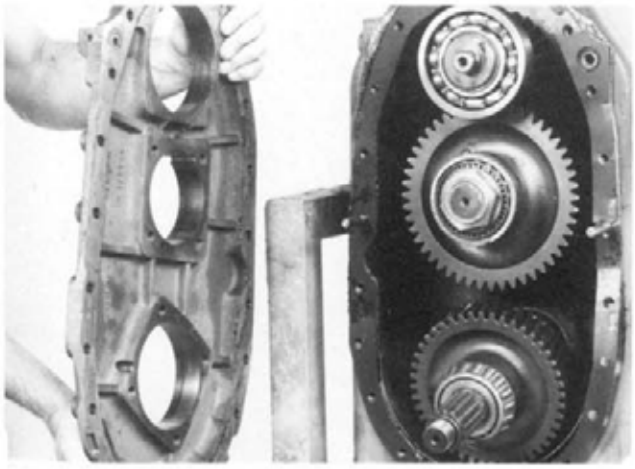


Figure 48
Remove rear cover.

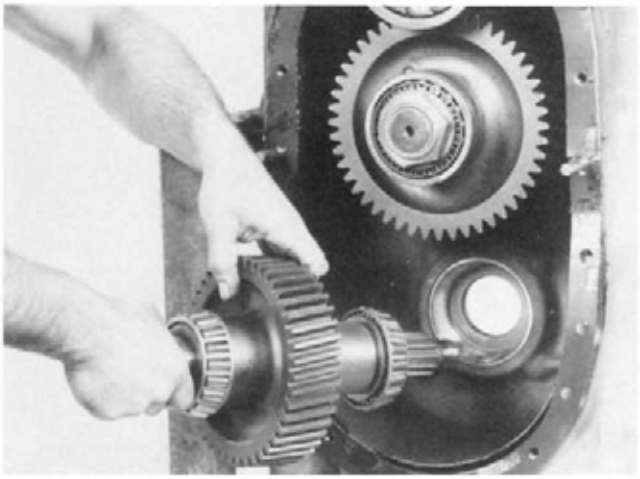


Figure 49
Remove output shaft assembly.

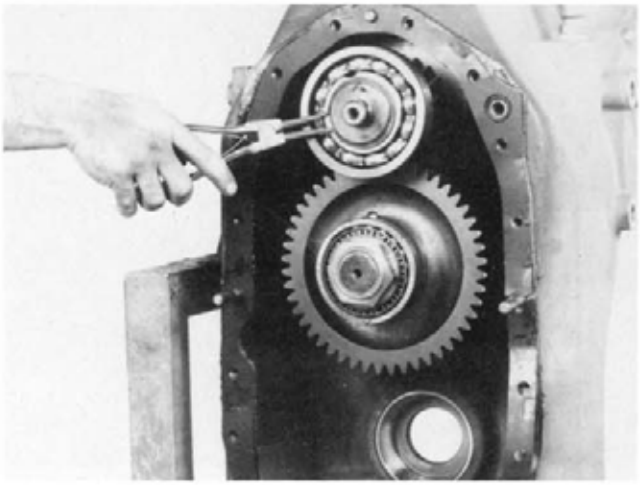


Figure 50
Remove 1st clutch rear bearing retainer ring.

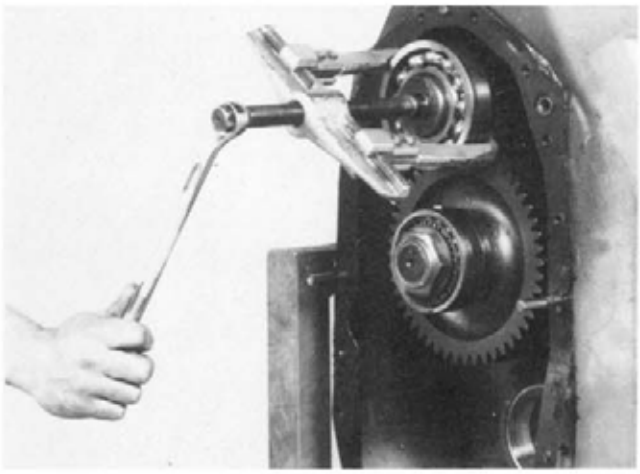


Figure 51
Remove rear bearing.

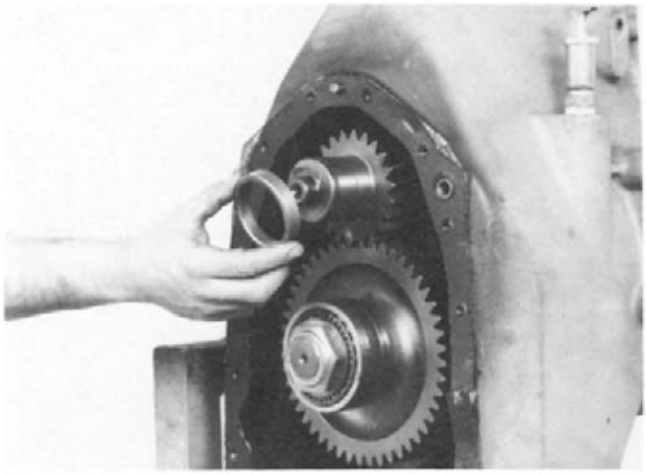


Figure 52
Remove bearing spacer.

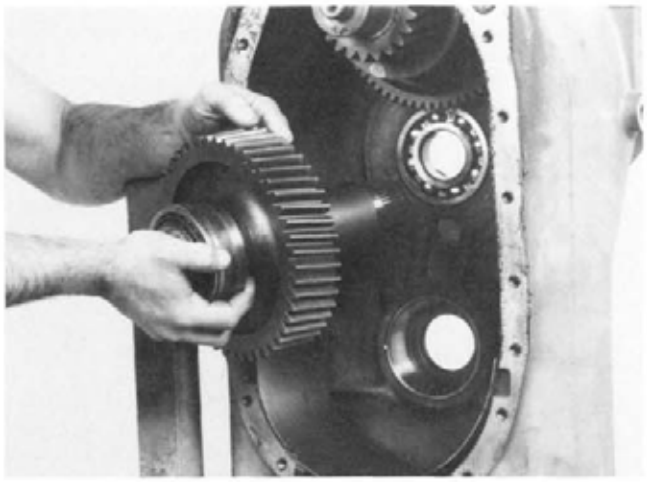


Figure 53
Remove idler shaft assembly.

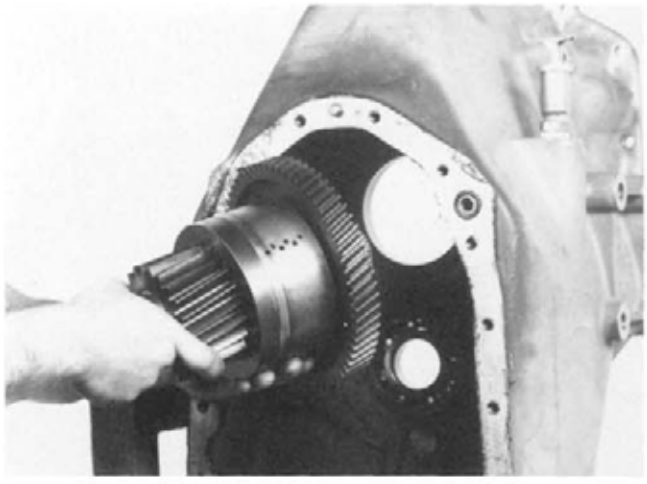


Figure 54
Remove 1st speed clutch assembly.

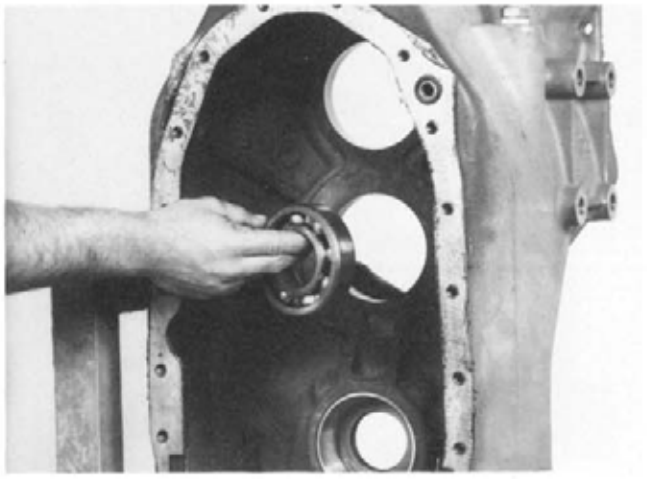


Figure 55
Remove idler shaft front bearing.

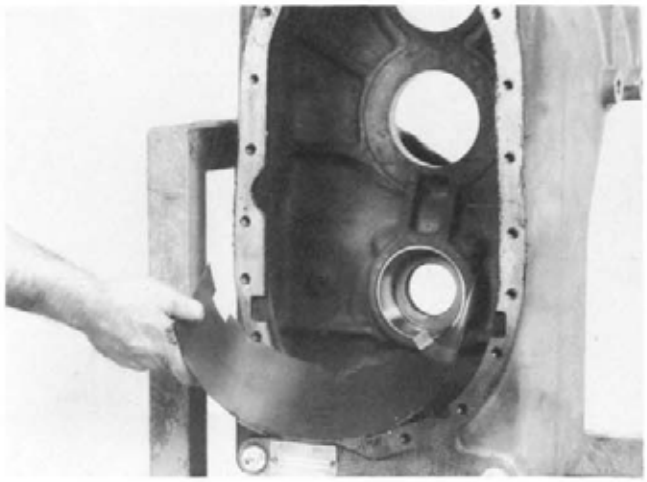


Figure 56
Remove oil sump oil baffle.

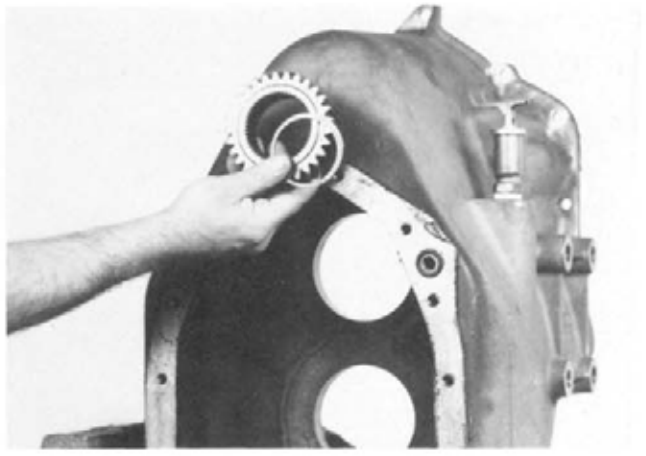


Figure 57
Remove forward clutch drive gear retainer ring and driv
gear. See Figure 57-A.

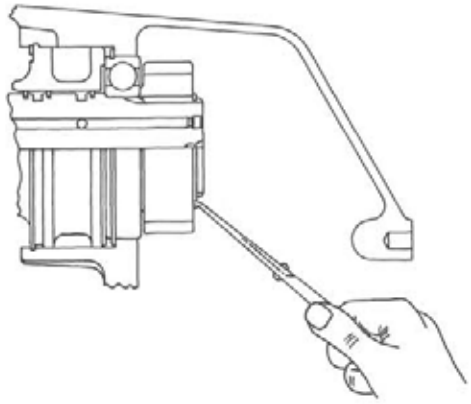


Figure 57-A

Figure 60
Remove sealing ring sleeve.

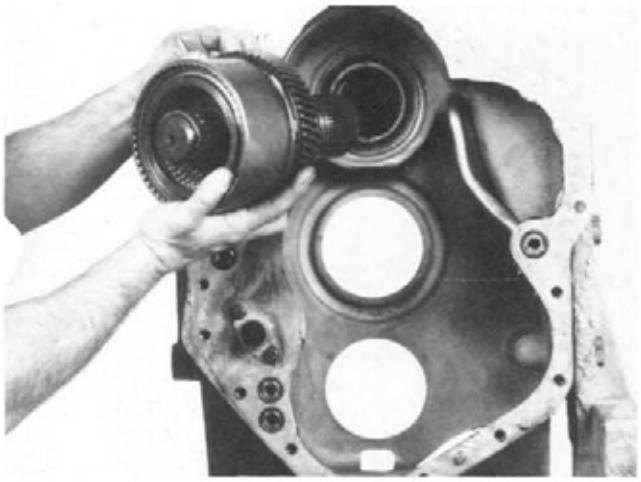


Figure 58
Remove forward clutch assembly.

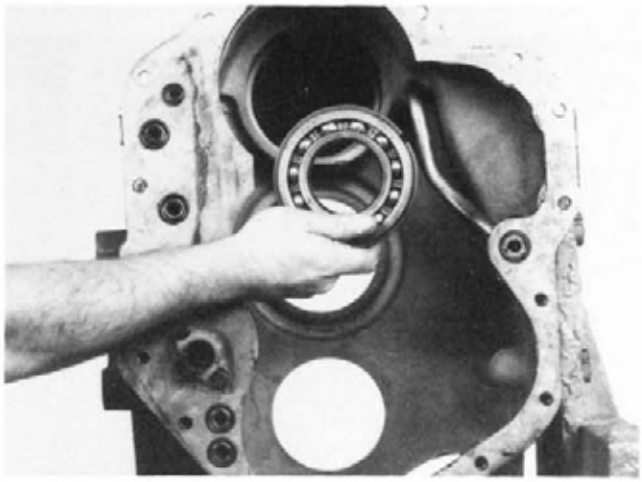


Figure 61
Remove forward clutch rear bearing.

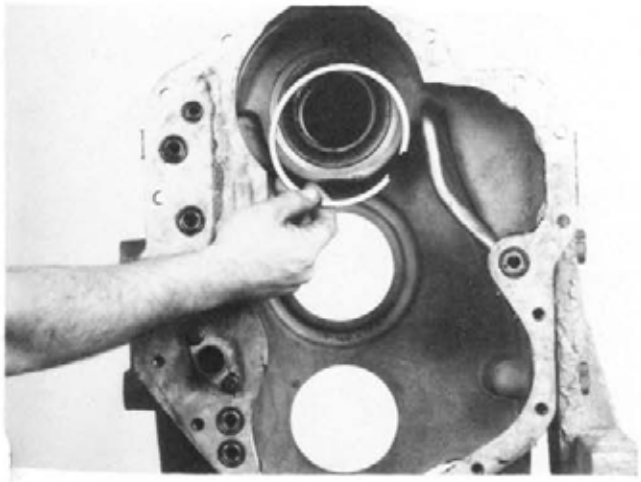


Figure 59
Remove sealing ring sleeve retainer ring.

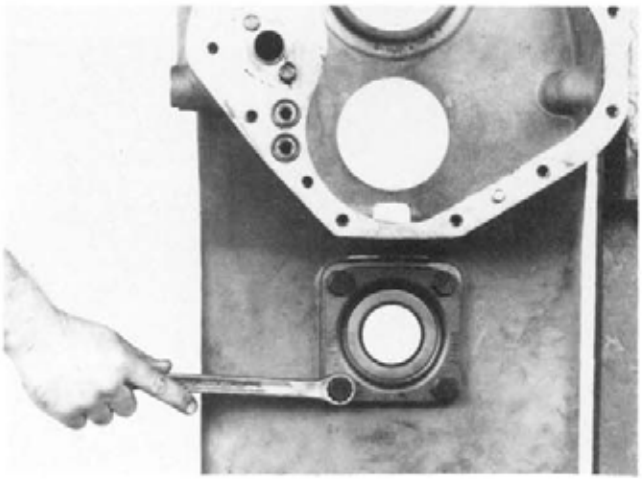


Figure 62
Remove output shaft front bearing cap bolts and washers.

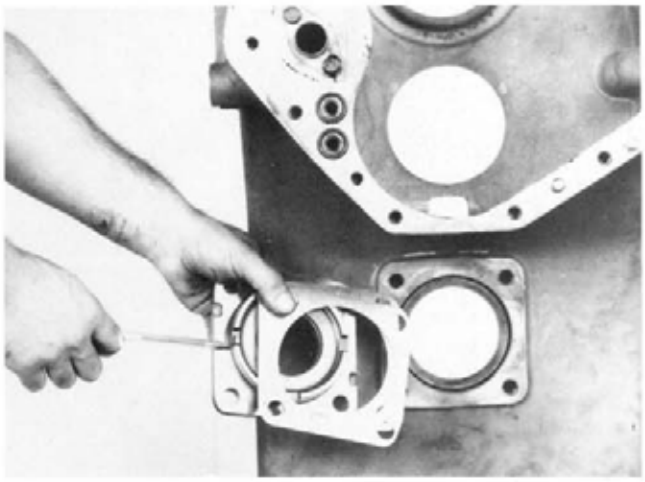


Figure 63
Remove bearing cap and shims.

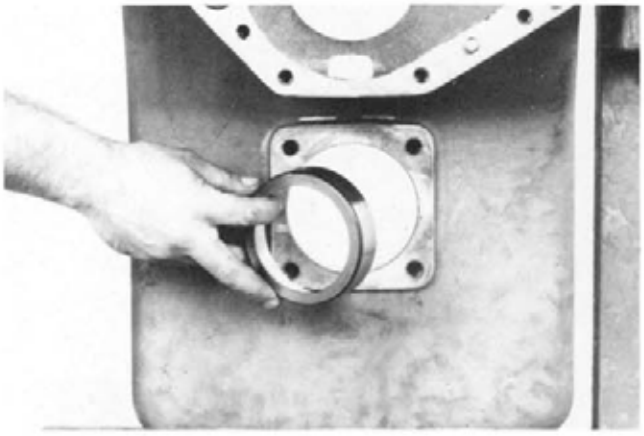


Figure 64
Remove output shaft front taper bearing cup.

CONVERTER HOUSING DISASSEMBLY

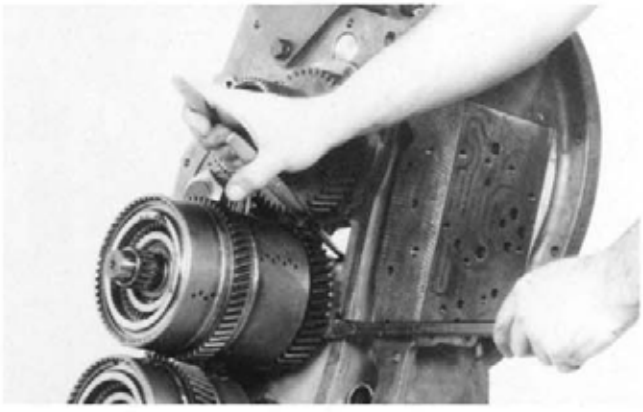


Figure 65
Spread reverse clutch front bearing locating ring. Pry clutch assembly from housing.

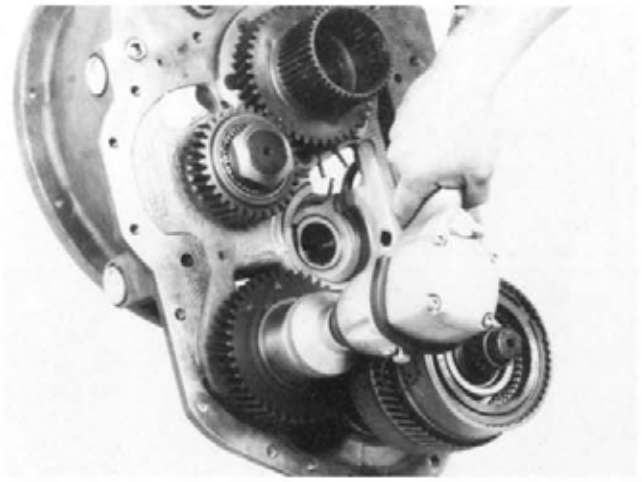


Figure 66
Unclinch lock nut by straightening upset metal in notch in idler shaft. Remove shaft nut.

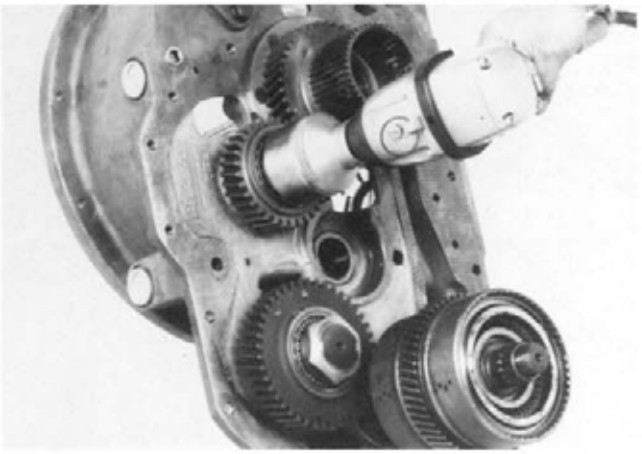


Figure 67
Repeat procedure in Figure 66 for reverse idler shaft.

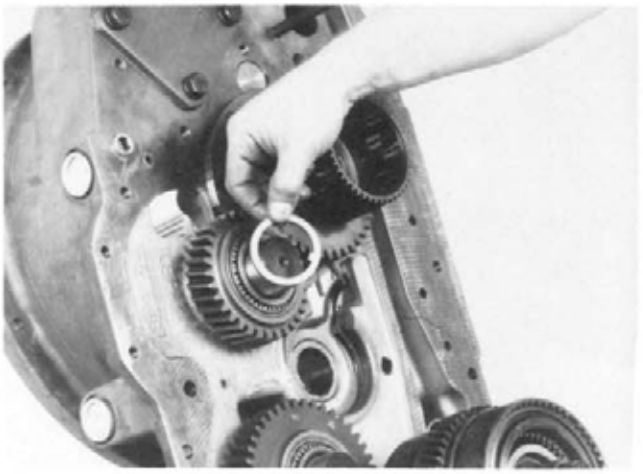


Figure 68
Remove bearing spacers.

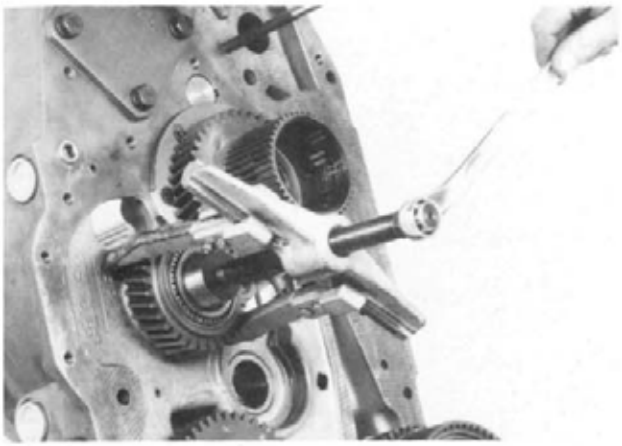


Figure 69
Remove reverse idler gear and outer taper bearing.

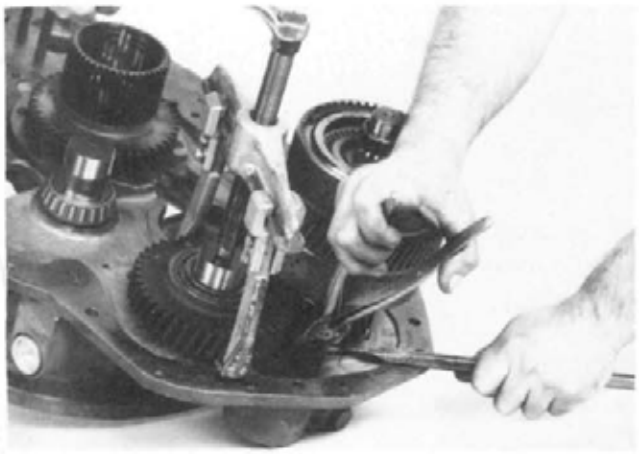


Figure 70
With the help of an assistant, spread the 4th speed clutch front bearing locating ring and pry clutch from converter housing while the assistant removes the idler gear and outer taper bearing.

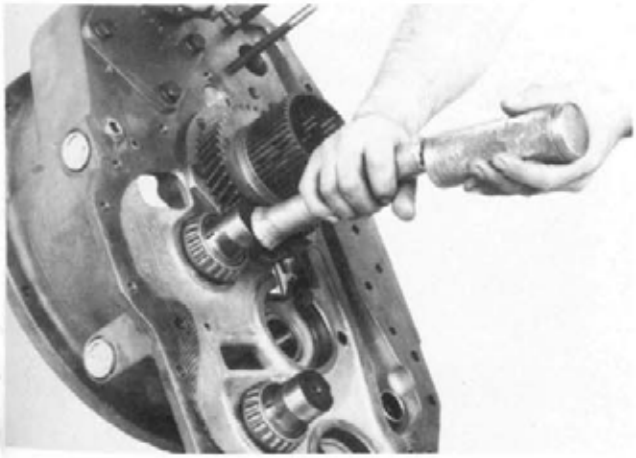


Figure 71
Using a soft bar, drive reverse idler shaft from taper bearing.

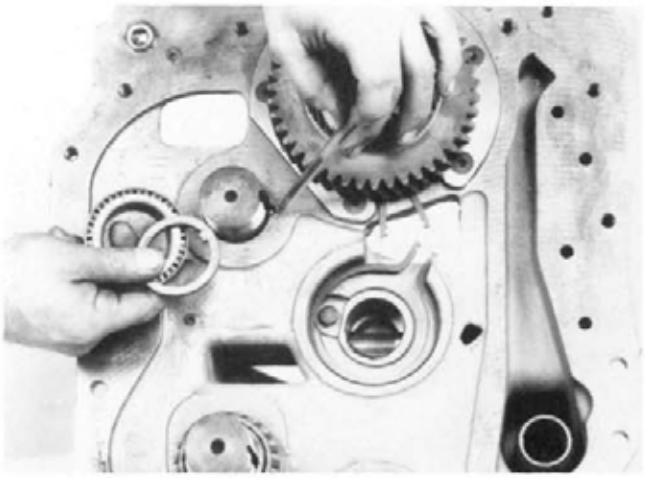


Figure 72
Remove taper bearing and thrust plate. Remove shaft. Use caution as not to lose lock ball.

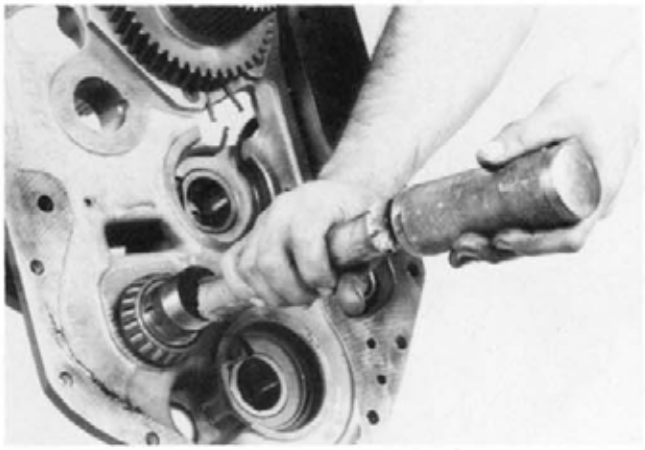


Figure 73
Repeat procedures in Figures 71 and 72 for idler shaft removal.

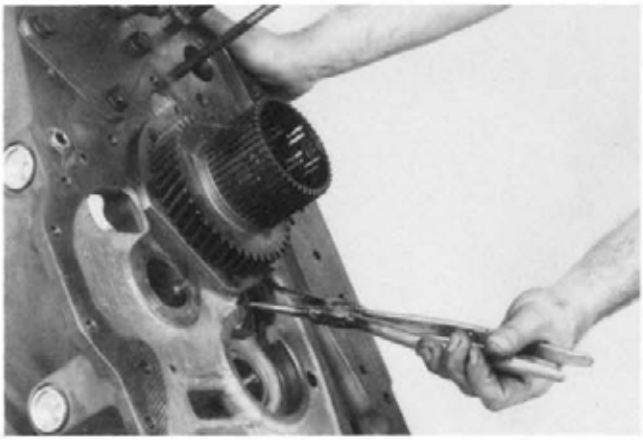


Figure 74
Spread the turbine shaft bearing locating ring.

Figure 75
Holding ring open, tap turbine shaft from stator support.

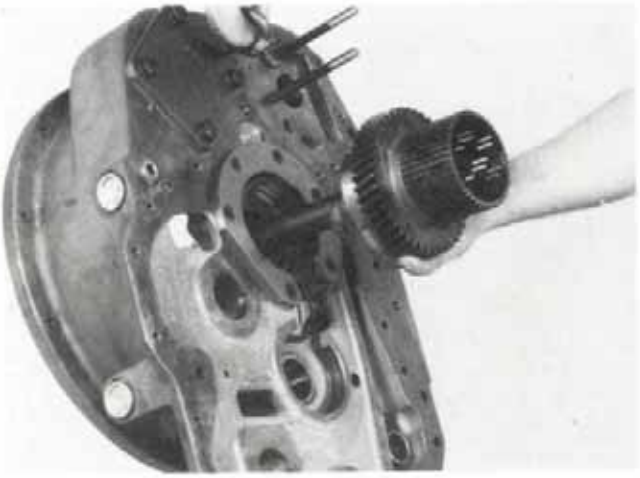


Figure 76
Remove turbine shaft.

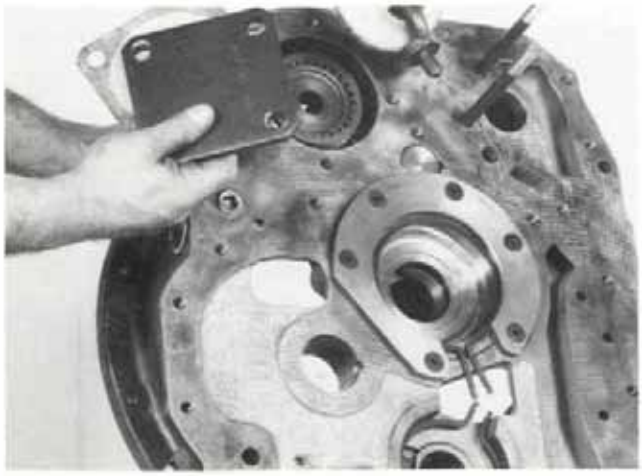


Figure 77
If used, remove auxiliary pump drive gear cover and gasket.

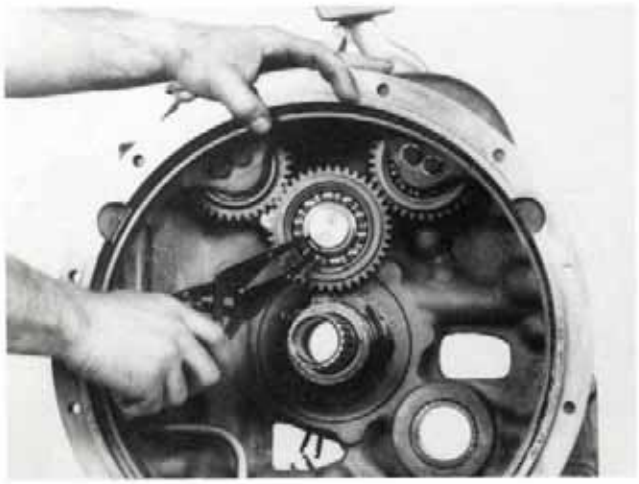


Figure 78
Remove pump idler gear retainer ring.

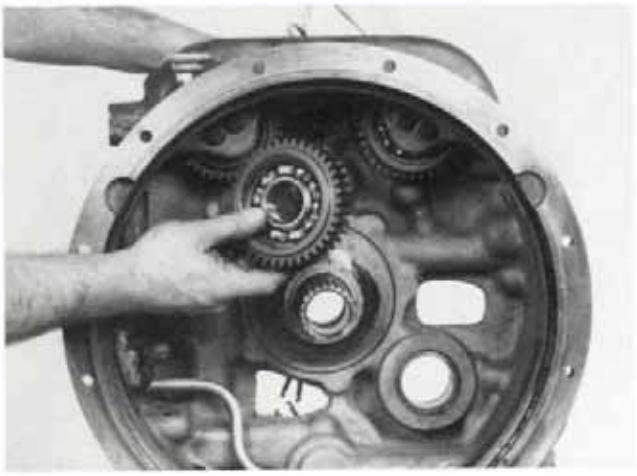


Figure 79
Remove idler gear.

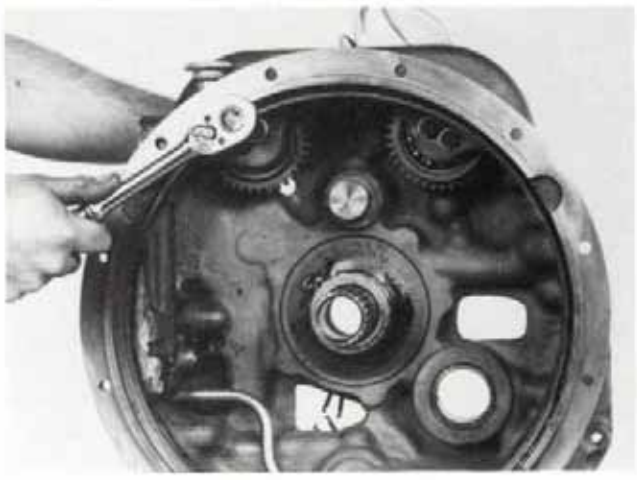


Figure 80
Remove the charging pump drive gear support bolts.

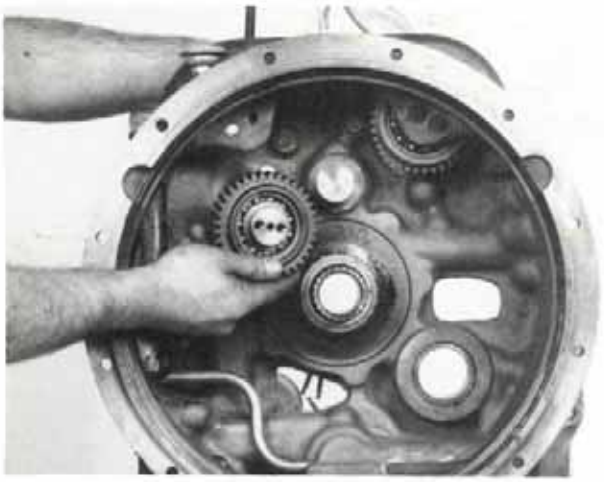


Figure 81
Remove drive gear and support assembly.

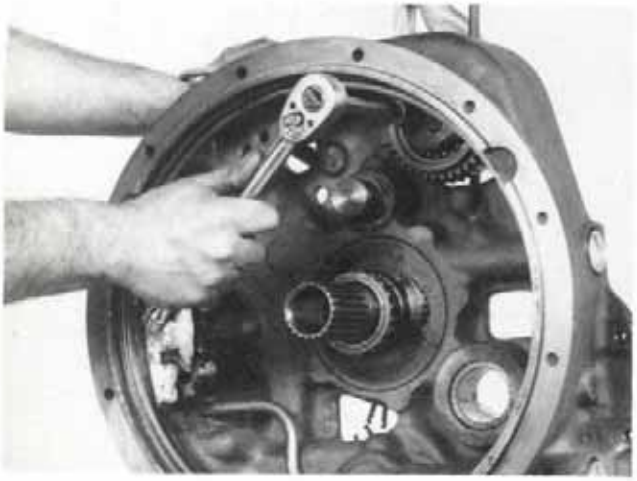


Figure 82
Remove the auxiliary pump drive gear support bolts.

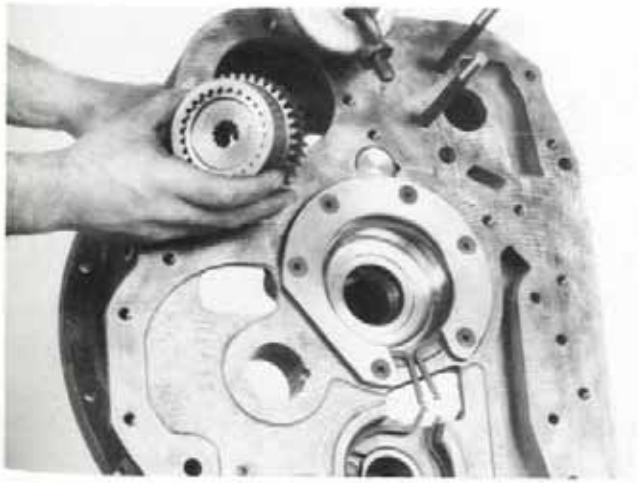


Figure 83
Remove auxiliary pump drive gear.

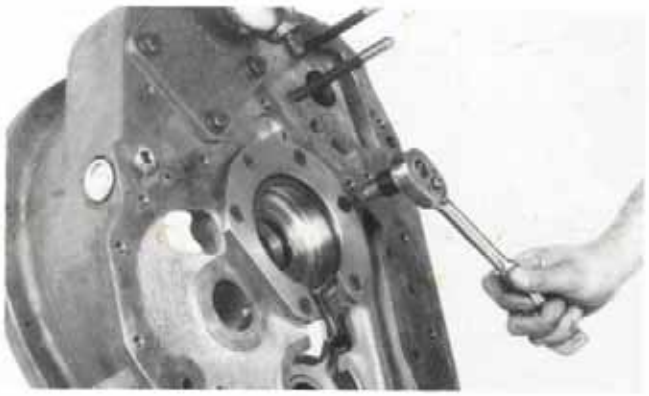


Figure 84
If stator support is to be replaced, remove support screws and tap support from housing.

See Figure 333 for oil sealing ring sleeve removal.

1st CLUTCH DISASSEMBLY AND REASSEMBLY

DISASSEMBLY

Figure 85
Remove front bearing.

Figure 86
Remove bearing spacer.

Figure 87
Remove low gear and outer bearing.

Figure 88
Remove clutch disc end plate retainer ring.

Figure 89
Remove end plate.

Figure 90
Remove inner and outer clutch discs.

Figure 91
Remove inner and outer bearing spacer.

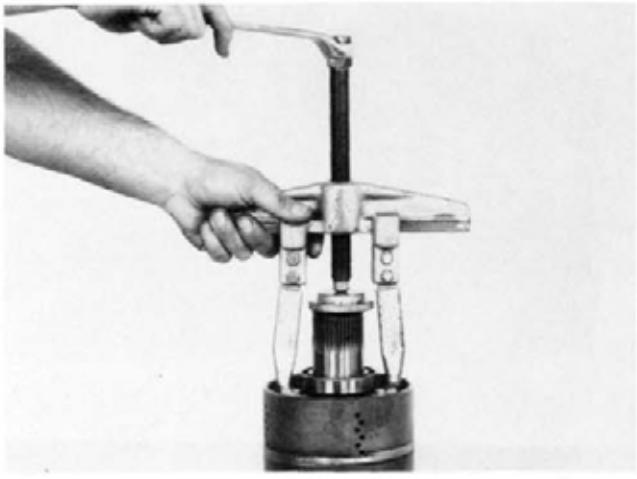


Figure 92
Remove low gear inner bearing.

Figure 93

Remove piston return spring (Belleville washer) retainer ring retainer.

Figure 94

Remove return spring retainer ring.

Figure 95

Remove return springs. (Belleville washers). **NOTE: Belleville washers in the 1st clutch are different than washers in the forward and reverse clutch. 1st clutch washers have (4) four holes in them (for identification only). Do not mix 1st clutch washers with forward and reverse washers.**

Figure 96

Remove piston spacer.

Figure 97

Turn clutch over and tap clutch shaft on a block of wood to remove clutch piston.

(See cleaning and inspection page.)

1st CLUTCH REASSEMBLY

Figure 98

Install clutch piston outer seal ring. **NOTE:** Ring must be sized before installing in clutch drum. Sizing is best accomplished by rotating piston while holding a round object against the new seal ring as shown. Rotate piston until seal ring is flush with outer diameter of piston.

Figure 99
Install clutch piston inner seal and size as explained in Figure 98.

Figure 100
Position piston in 1st clutch drum as shown. Use caution as not to damage inner and outer piston sealing rings.

Figure 101
Position piston return spring spacer over clutch shaft.

Figure 102
Install Belleville washers (piston return springs). See note in Figure 95. First washer with large diameter toward spacer. Alternate seven (7) washers. See Figure 105-A.

Figure 103
Install piston return spring (Belleville washers) retainer ring on clutch shaft.

Figure 104
Using a sleeve with the proper inner diameter, drive the Belleville washer ring into position. **NOTE:** Be certain retainer ring is in full position in ring groove.

Figure 105
Position ring retainer washer over retainer ring.

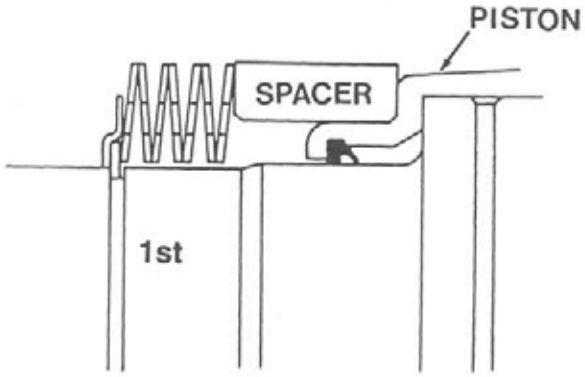


Figure 105-A
Cross section of 1st clutch.

Figure 106
Install one steel disc.

Figure 107
Install one friction disc. **NOTE**: The friction discs in the low clutch has a higher co-efficient rating than the friction discs in the other clutches, therefore the discs must not be mixed. The low clutch friction disc has a yellow mark of nonsoluble paint on the outer diameter for permanent identification. Alternate steel and friction discs until the proper amount of discs are installed. First disc next to the piston is steel. last disc installed is friction.

Figure 108
Install clutch disc end plate.

Figure 109
Install end plate retainer ring.

Figure 110
Install clutch gear inner bearing. **NOTE:** This bearing does not have shield in it.

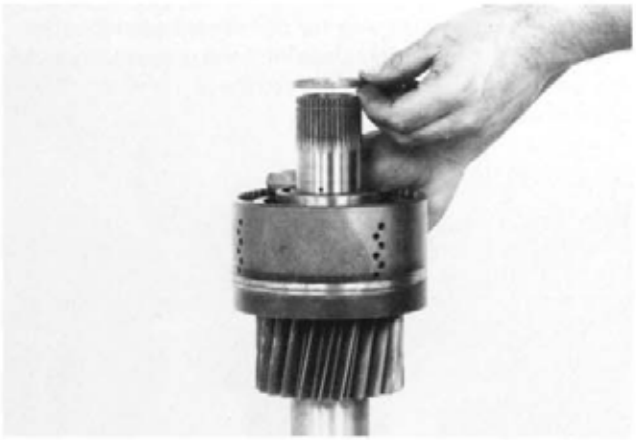


Figure 111
Position bearing spacer on clutch shaft.

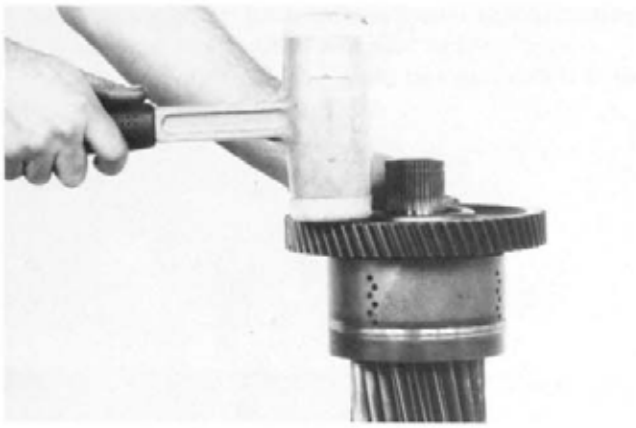


Figure 112
Install low clutch driven gear and hub into clutch drum. align splines on clutch hub with internal teeth of friction discs. Tap gear into position. Do not force this operation. Gear splines must be in full position with internal teeth of all friction discs.

Figure 113
Install clutch gear outer bearing. **NOTE:** Outer bearing has a shield in it, this shield must be up.

Figure 114
Position front bearing spacer on clutch shaft.

Figure 115
Install front bearing.

REVERSE AND 2nd CLUTCH DISASSEMBLY AND REASSEMBLY

DISASSEMBLY
(Reverse being disassembled)

Figure 116
Remove clutch shaft oil sealing rings.

Figure 117
Remove front bearing retainer ring.

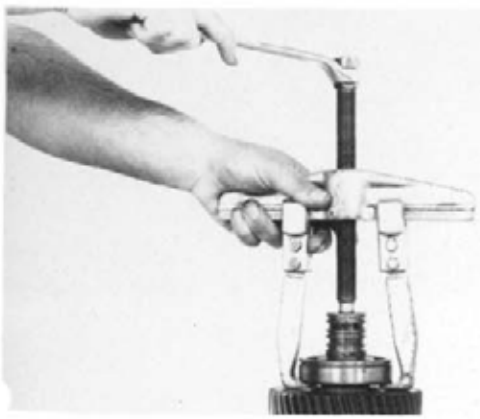


Figure 118
Remove front bearing.

Figure 119
Remove clutch gear bearing retainer ring.

Figure 120
Pry reverse gear from clutch assembly far enough to use a gear puller.

Figure 121
Remove reverse gear and bearing spacer.

Figure 122
Remove clutch end plate retainer ring.

Figure 123
Remove end plate.

Figure 124
Remove inner and outer clutch discs.

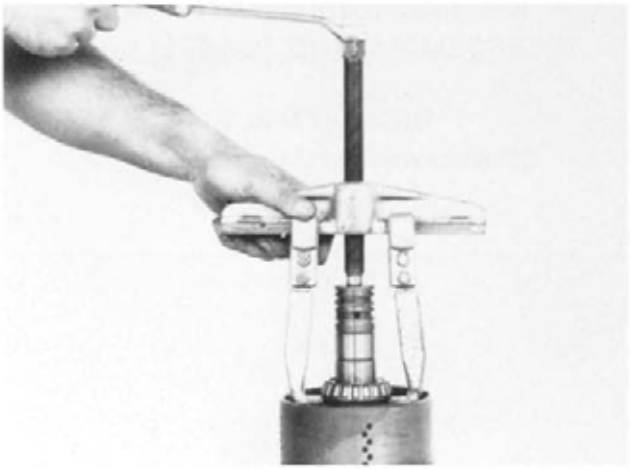


Figure 125
Remove inner reverse gear taper bearing.

Figure 126
Compress piston return springs (Belleville washers). Remove return spring retainer ring and ring retainer.

Figure 127
Remove piston return springs. (Belleville washers.)

Figure 128
Remove piston spacer.

Figure 129
Remove clutch piston.

DISASSEMBLY OF 2nd SPEED CLUTCH

Figure 130
Remove end plate retainer ring.

Figure 131
Remove end plate.

Figure 132
Remove inner and outer clutch discs.

Figure 133
Compress piston return spring retainer. Remove retainer ring.

Figure 134
Remove spring retainer and return spring.

Figure 135
Remove clutch piston.

(See cleaning and inspection page.)

2nd CLUTCH REASSEMBLY

Figure 136
Install clutch piston outer and inner seal rings. Size rings as explained in Figure 98.

Figure 137
Install clutch piston in clutch drum. Use caution as not to damage seal rings.

Figure 138
Position piston return spring and spring retainer on clutch shaft.

Figure 139
Compress spring and install retainer ring.

Figure 140
Install one steel disc.

Figure 141
Install one friction disc. Alternate steel and friction discs until the proper amount of discs are installed. First disc next to the piston is steel, last disc installed is friction.

Figure 142
Install clutch disc end plate.

Figure 143
Install end plate retainer ring.

REVERSE CLUTCH REASSEMBLY

Figure 144
Install clutch piston outer and inner seal rings. Size as explained in Figure 98.

Figure 145
Install clutch piston in clutch drum. Use caution as not to damage seal rings.

Figure 146
Install one steel disc.

Figure 147
Install one friction disc. Alternate steel and friction discs until the proper amount of discs are installed. First disc next to the piston is steel, last disc installed is friction.

Figure 148
Install clutch disc end plate.

Figure 149
Install end plate retainer ring.

Figure 150
Position piston return spacer over clutch shaft.

Figure 151
Install Belleville washers. First washer with large diameter toward spacer. Alternate seven (7) washers. **See Figure 152-A.**

Figure 149
Install clutch disc end plate.

Figure 150
Install end plate retainer ring.

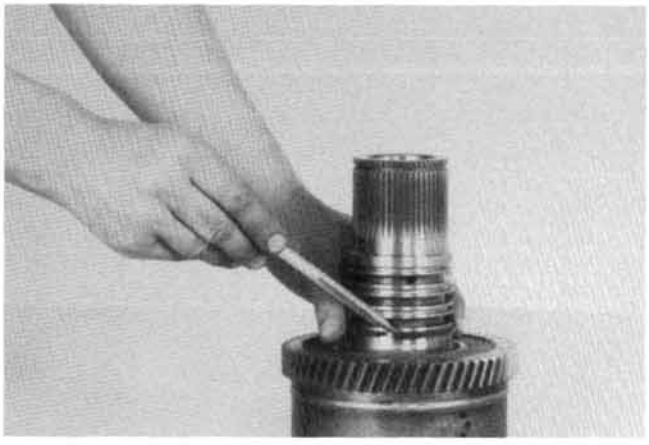


Figure 151
Install new piston ring expander springs per instructions on page 50.

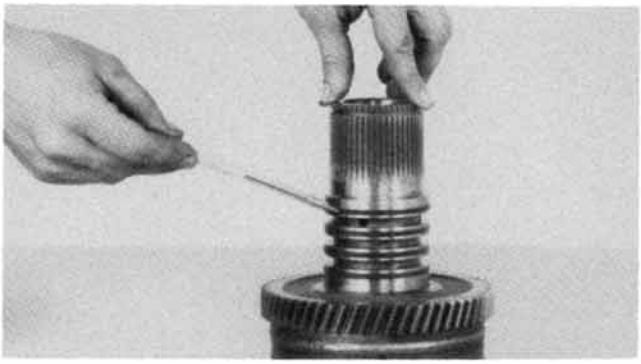


Figure 152
Install piston rings on clutch shaft per instructions on page 50. (3 each on standard converter, 4 each with lock-up converter).

REVERSE AND 2ND CLUTCH DISASSEMBLY AND REASSEMBLY

DISASSEMBLY
(2nd clutch being disassembled)

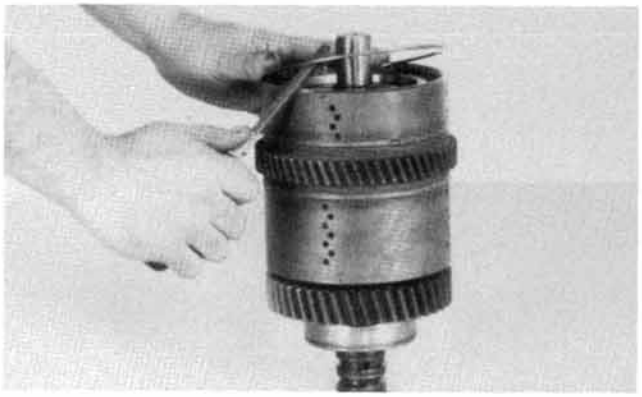


Figure 153
Remove end plate retainer ring.

Figure 154
Remove end plate.

Figure 157
Install front bearing retainer ring.

Figure 158
Install clutch shaft oil sealing rings. Grease rings to facilitate reassembly into front housing.

3rd AND 4th SPEED CLUTCH DISASSEMBLY AND REASSEMBLY

DISASSEMBLY (4th being disassembled)

Figure 159
Remove clutch shaft oil sealing rings.

Figure 160
Remove front bearing retainer ring.

Figure 161
Remove front bearing.

Figure 162
Remove gear front thrust washer.

Figure 163
Remove thrust washer lock ball.

Figure 164
Remove clutch gear and disc hub.

Figure 165
Remove clutch gear outer bearing.

Figure 166
Remove bearing spacer.

Figure 167
Remove inner bearing.

Figure 168
Remove gear rear thrust washer.

Figure 169
Remove thrust washer lock ball.

Figure 170
Remove thrust washer locating ring.

Figure 171
Remove clutch disc end plate retainer ring.

Figure 172
Remove end plate.

Figure 173
Remove inner and outer clutch discs.

Figure 174
Remove clutch disc return spring retainer ring.

Figure 175
Remove spring retainer and spring.

Figure 176
Remove clutch piston.

DISASSEMBLY OF 3rd SPEED CLUTCH

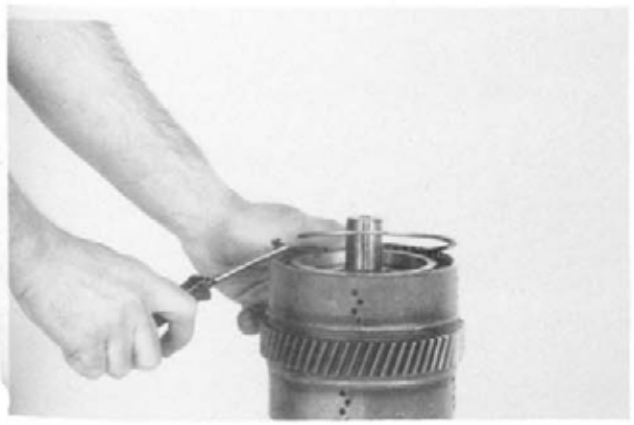


Figure 177
Remove end plate retainer ring.

Figure 178
Remove end plate.

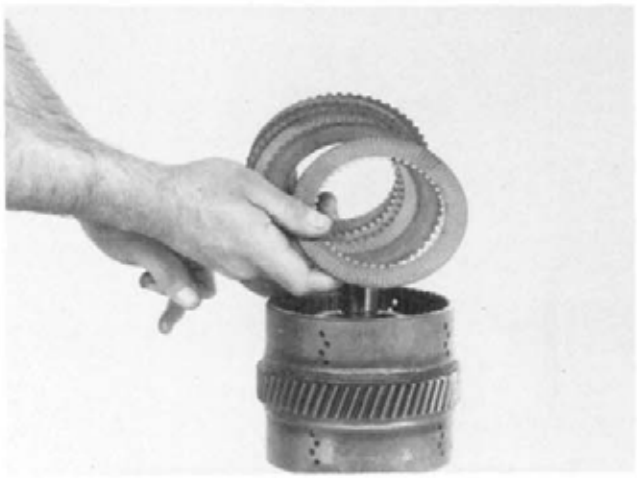


Figure 179
Remove inner and outer clutch discs.

Figure 180
Remove return spring retainer ring.

Figure 181
Remove spring retainer and spring.

Figure 182
Remove clutch piston.

(See cleaning and inspection page.)

REASSEMBLY OF 3rd SPEED CLUTCH

Figure 183
Install clutch piston outer and inner seal rings. Size as explained in Figure 98.

Figure 184
Install clutch piston in clutch drum. Use caution as not to damage seal rings.

Figure 185
Position return spring and spring retainer on clutch shaft.

Figure 186
Compress return spring and install spring retainer ring.

Figure 187

Install one steel disc.

Figure 188

Install one friction disc. Alternate steel and friction discs until the proper amount of discs are installed. First disc next to the piston is steel, last disc installed is friction.

Figure 189

Install end plate.

Figure 190

Install end plate retainer ring.

REASSEMBLY OF 4th SPEED CLUTCH

Figure 191

Install clutch piston outer and inner seal rings. Size as explained in Figure 98.

Figure 192

Install clutch piston in clutch drum. Use caution as not to damage seal rings.

Figure 193
Position return spring and spring retainer on clutch shaft.

Figure 194
Compress return spring and install spring retainer ring.

Figure 195
Install one steel disc.

Figure 196
Install one friction disc. Alternate steel and friction discs until the proper amount of discs are installed. First disc next to the piston is steel, last disc installed is friction.

Figure 197
Install end plate.

Figure 198
Install end plate retainer ring.

Figure 199
Install inner thrust washer locating ring.

Figure 200
Position lock ball in hole in shaft. A small amount of grease will hold ball in place.

Figure 201
Position inner thrust washer on shaft aligning notch in washer with lock ball.

Figure 202
Install clutch gear inner bearing.

Figure 203
Install bearing spacer.

Figure 204
Install outer bearing.

Figure 205

Install clutch driven gear and hub into clutch drum. Align splines on clutch hub with internal teeth of friction discs.

Figure 208

Install clutch shaft front bearing. **NOTE**: Bearing outer diameter locating ring groove must be up.

Figure 206

Position lock ball in hole in shaft.

Figure 209

Install bearing retainer.

Figure 207

Position outer thrust washer on shaft aligning notch in washer with lock ball.

Figure 210

Install clutch shaft oil sealing rings. Grease rings to facilitate reassembly into front housing.

FORWARD CLUTCH
DISASSEMBLY AND REASSEMBLY

DISASSEMBLY

Figure 211
Remove clutch disc end plate retainer ring.

Figure 212
Remove end plate.

Figure 213
Remove inner and outer clutch discs.

Figure 214
Compress piston return springs (Belleville washers). Remove return spring retainer ring and ring retainer.

Figure 215
Remove piston return springs. (Belleville washers).

Figure 216
Remove piston spacer.

Figure 217
Remove clutch piston. Remove clutch shaft oil sealing rings and expander springs.

(See cleaning and inspection page.)

FORWARD CLUTCH REASSEMBLY

Figure 218
Install clutch piston outer and inner seal rings. Size as explained in Figure 98.

Figure 219
Install clutch piston in clutch drum. Use caution as not to damage seal rings.

Figure 220
Position piston return spring spacer over clutch shaft.

Figure 221
Install Belleville washers. First washer with large diameter toward spacer. Alternate seven (7) washers. **See Figure 222-A.**

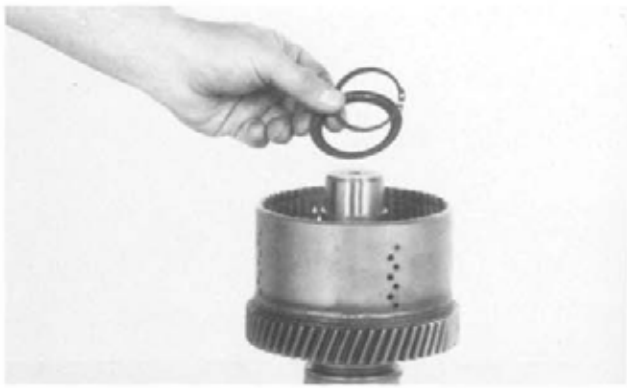


Figure 222
Install piston return spring retainer ring retainer and retainer ring on clutch shaft. Compress return springs and install retainer ring. Be sure ring is in full position in retainer.

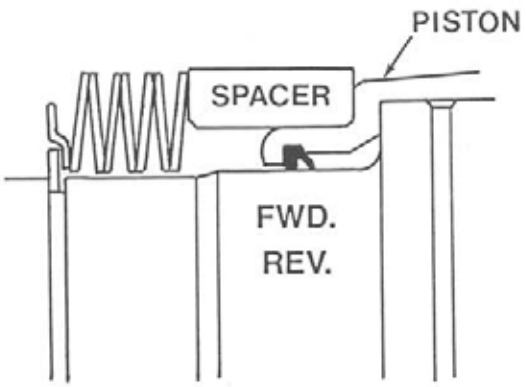


Figure 222-A

Figure 223

Install one steel disc.

Figure 224

Install one friction disc. Alternate steel and friction discs until the proper amount of discs are installed. First disc next to the piston is steel, last disc installed is friction.

Figure 225

Install clutch disc end plate.

Figure 226

Install end plate retainer ring. Install new expander springs and clutch shaft oil sealing rings.

OUTPUT SHAFT DISASSEMBLY

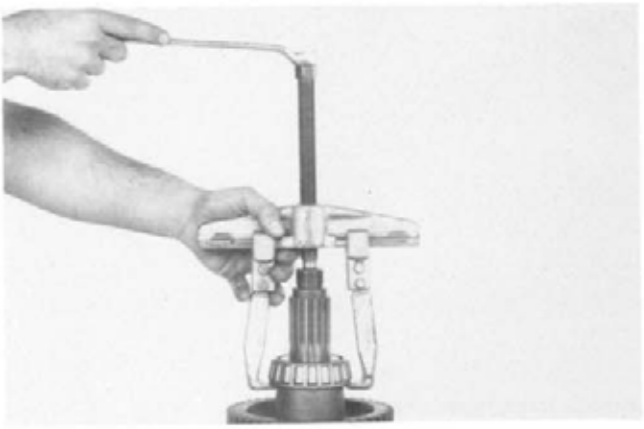


Figure 227

Remove rear taper bearing.

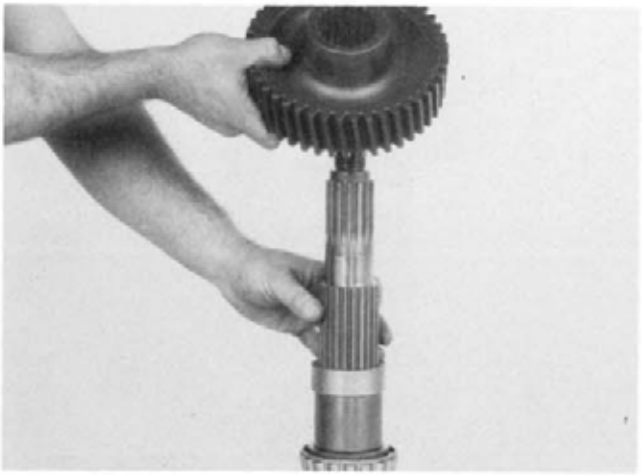


Figure 228
Remove output gear.

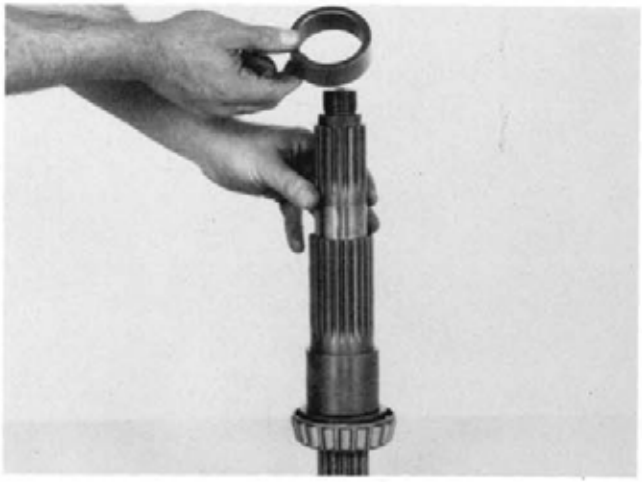


Figure 229
Remove gear spacer.

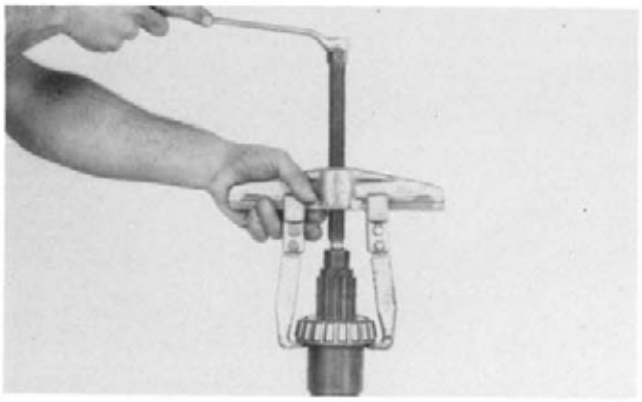


Figure 230
Remove front taper bearing.

(See cleaning and inspection page.)

OUTPUT SHAFT REASSEMBLY

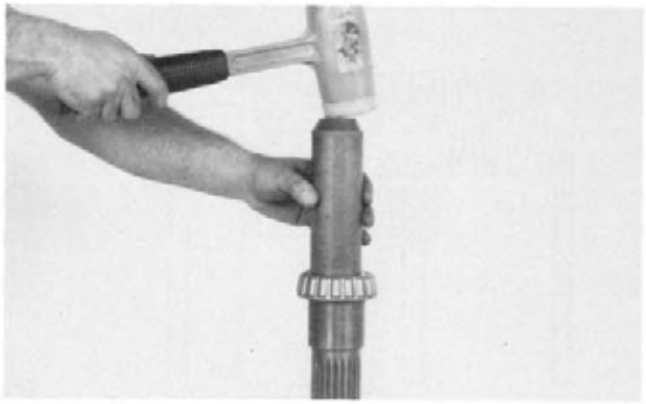


Figure 231
Install output shaft front taper bearing, large diameter of taper down.

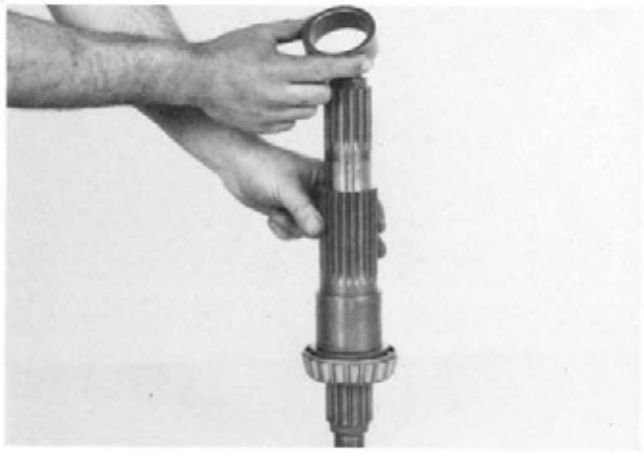


Figure 232
Position gear spacer on output shaft.

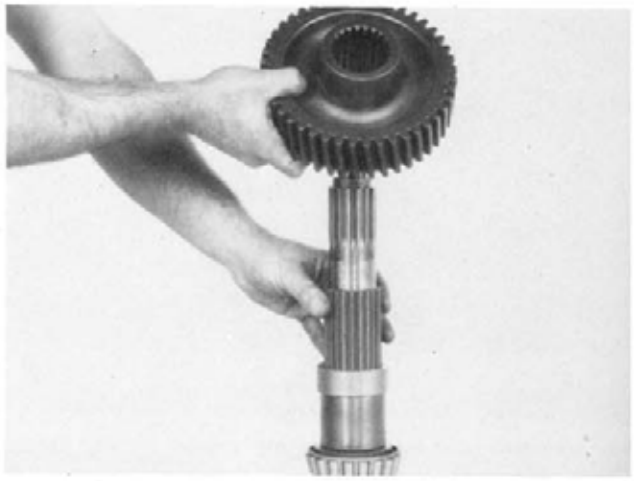


Figure 233
Position output gear on shaft with long hub of gear up.

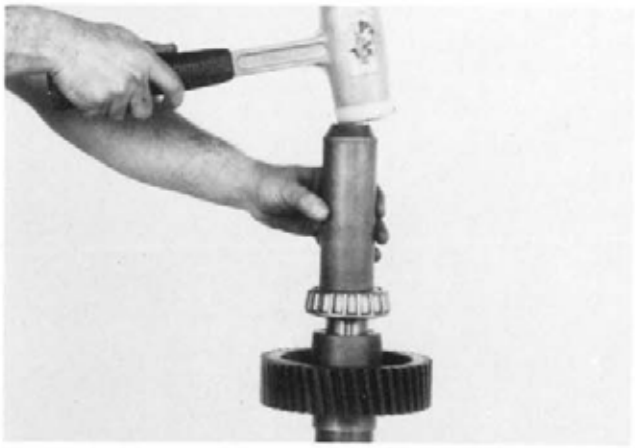


Figure 234

Install output shaft rear taper bearing, large diameter of taper down.

IDLER SHAFT DISASSEMBLY AND REASSEMBLY

DISASSEMBLY

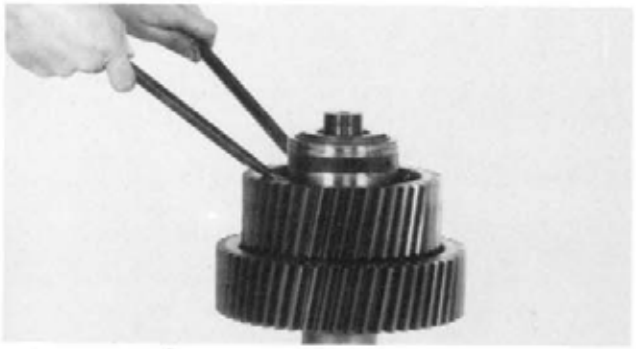


Figure 235

Remove idler shaft bearing retainer nut. Pry idler shaft rear bearing up far enough to use a bearing puller.

Figure 236

Remove rear bearing.

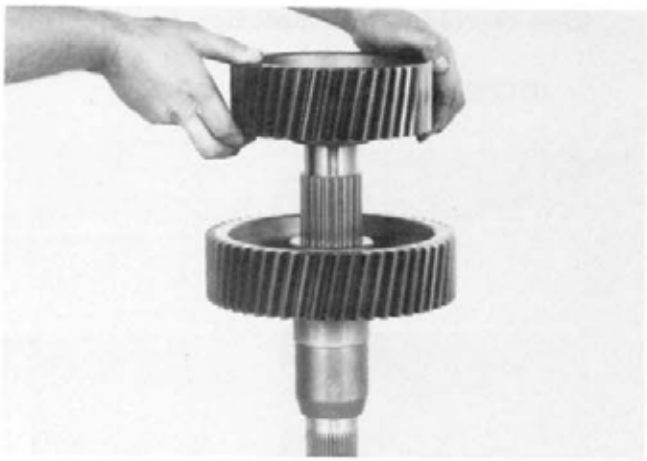


Figure 237

Remove small idler gear. **NOTE: Some special ratio units will have only one idler gear.**

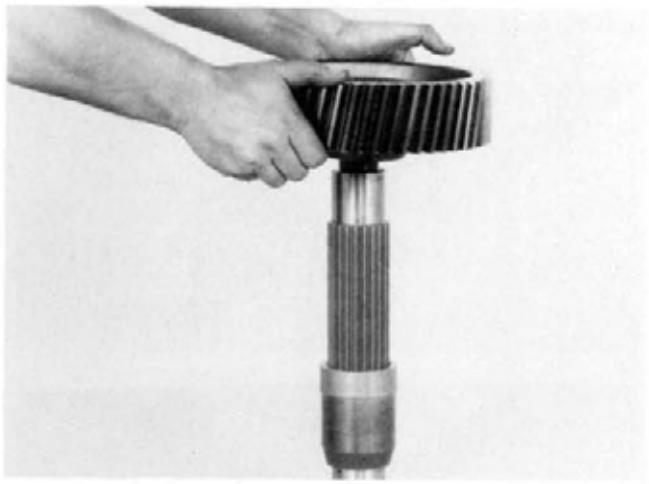


Figure 238

Remove large idler gear.

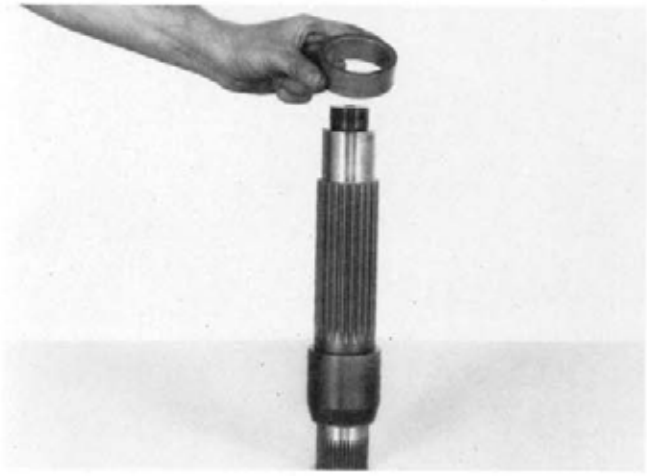


Figure 239

Remove gear spacer.

(See cleaning and inspection page.)

IDLER SHAFT REASSEMBLY

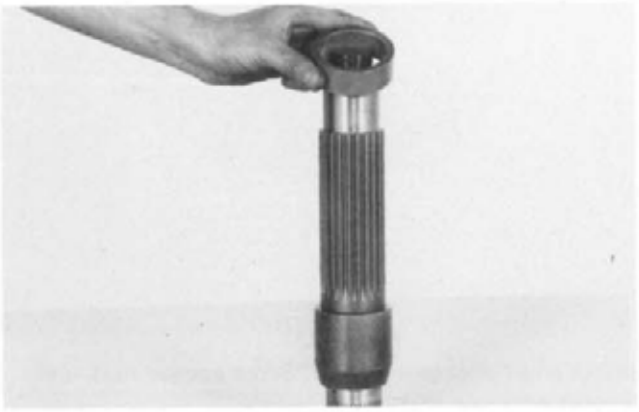


Figure 240
Position gear spacer on shaft.

Figure 241
Position large idler gear on shaft with long hub on gear down.

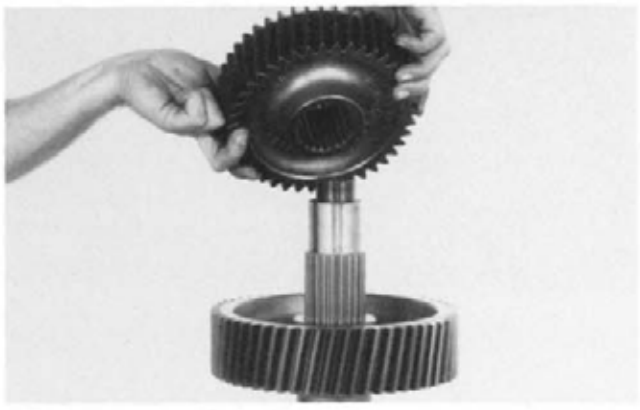


Figure 242
Position small idler gear on shaft with long hub of gear down.

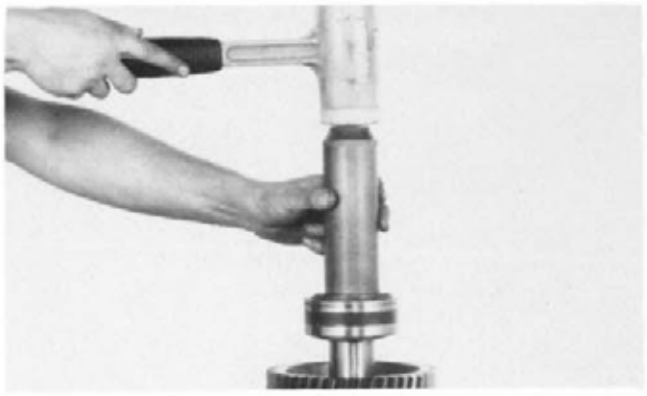


Figure 243
Install idler shaft rear bearing, outer locating ring groove up. Install bearing retainer nut, tighten nut 200 to 250 ft. lbs. torque [271,2 - 338,9 N.m].

(See cleaning and inspection page.)

REASSEMBLY OF TRANSMISSION

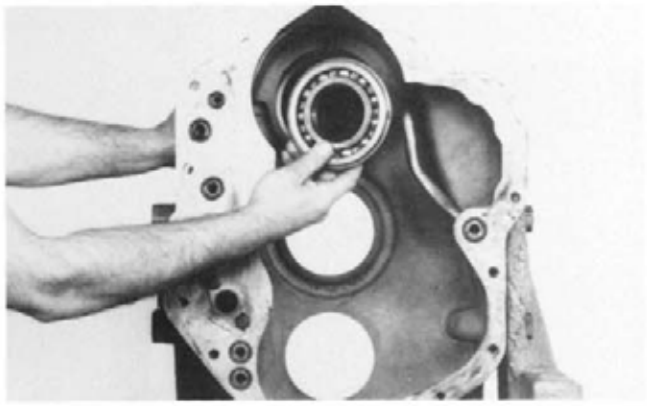


Figure 244
Install forward clutch rear bearing with bearing locating ring toward front of transmission case.

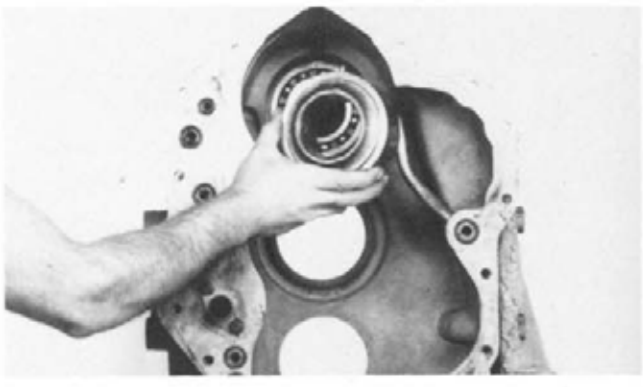


Figure 245
Align clutch oil sealing ring sleeve with notch in case. Tap sleeve into position.

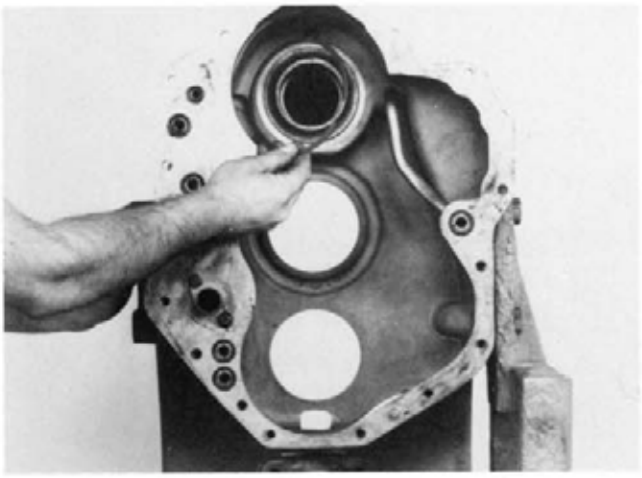


Figure 246
Install sleeve retainer ring.

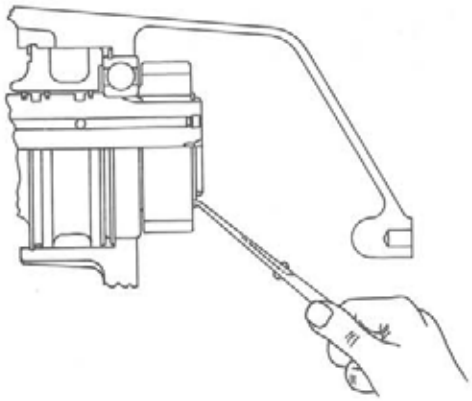


Figure 248-A

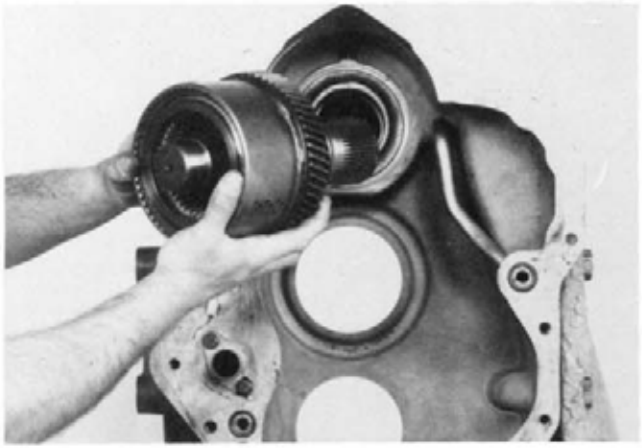


Figure 247
Position forward clutch assembly into sleeve, use caution as not to damage oil sealing rings on clutch shaft.

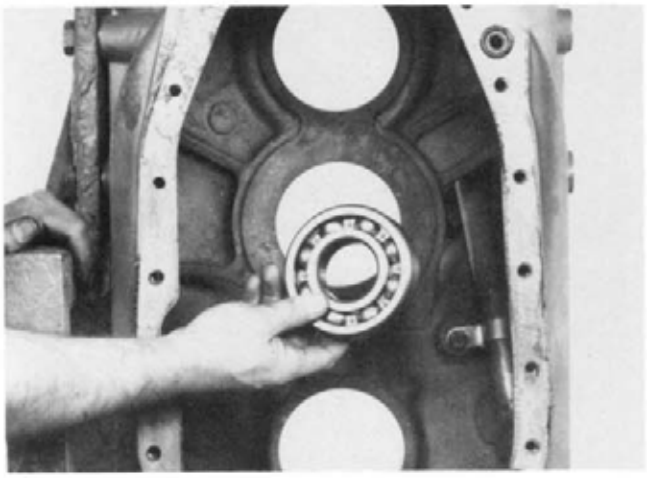


Figure 249
Install idler shaft front bearing.

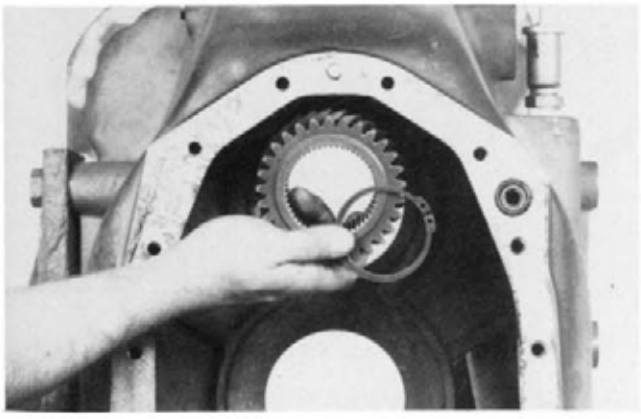


Figure 248
Position forward shaft gear on rear of clutch shaft with long hub of gear toward bearing. Install gear retaining ring. See figure 248-A.

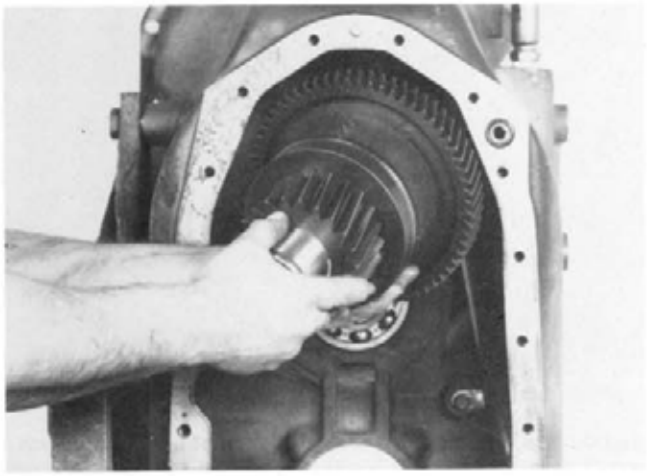


Figure 250
Install 1st clutch assembly in case.

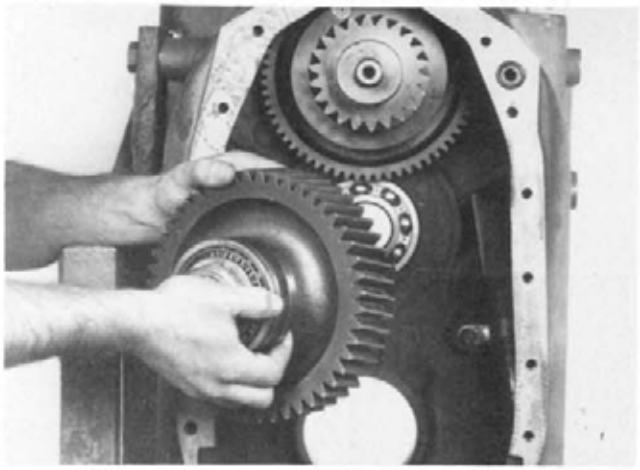


Figure 251
Install idler shaft assembly into front bearing.

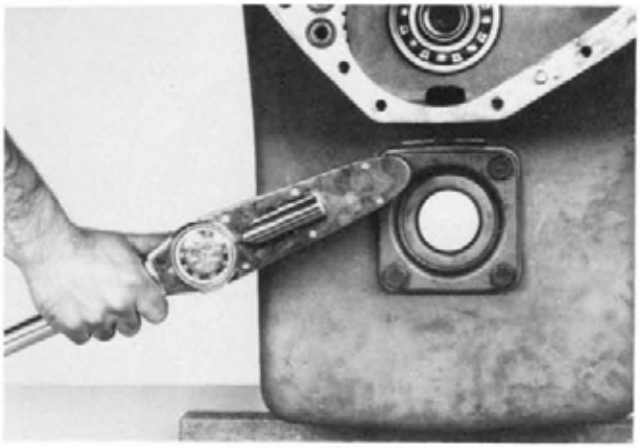


Figure 254
Install bearing cap capscrews and washers, tighten to specified torque. (See torque chart).

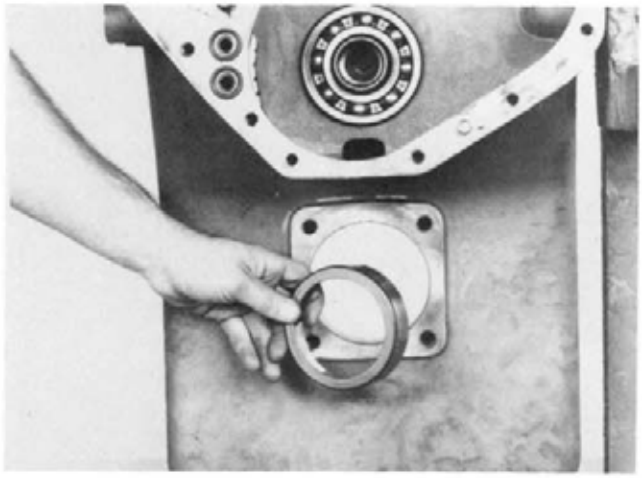


Figure 252
Install output shaft front bearing taper bearing cup with large diameter of taper in.

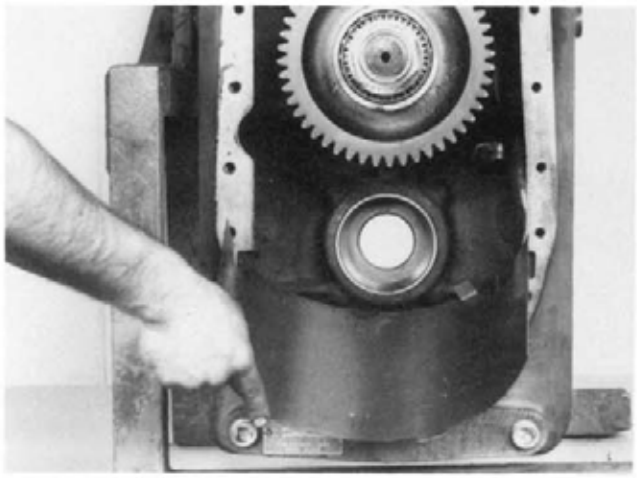


Figure 255
Position oil baffle in transmission sump.

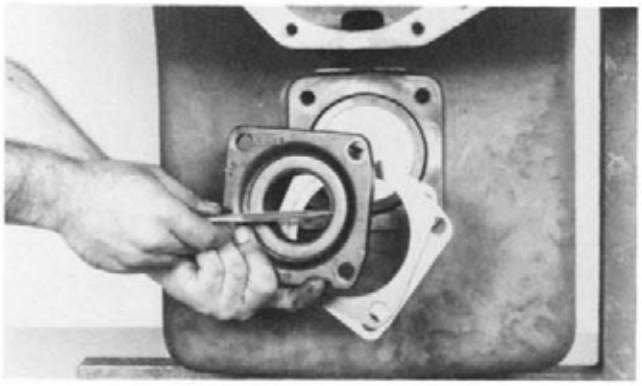


Figure 253
Coat outer diameter of oil seal with Permatex #2 and press seal in bearing cap with lip of seal in. Remove any excess sealant. Install new "O" ring on bearing cap. Install front bearing cap and shims.

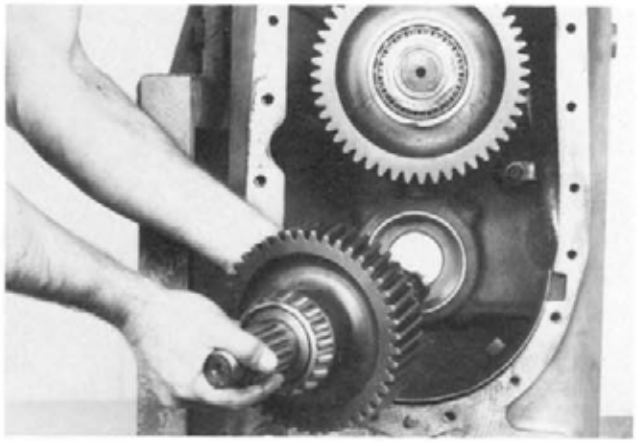


Figure 256
Position output shaft assembly in front bearing bore, use caution as not to damage front oil seal.

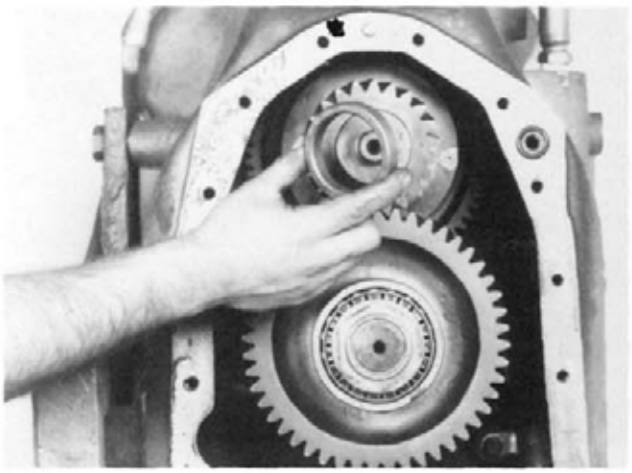


Figure 257
Install 1st clutch rear bearing spacer.

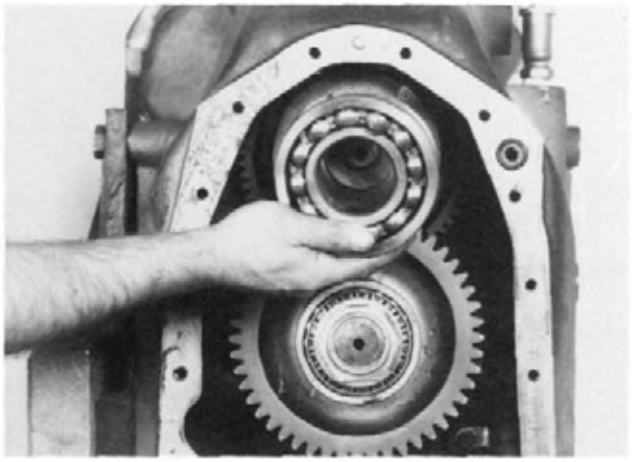


Figure 258
Install 1st clutch rear bearing. **NOTE**: Bearing locating ring groove must be out.

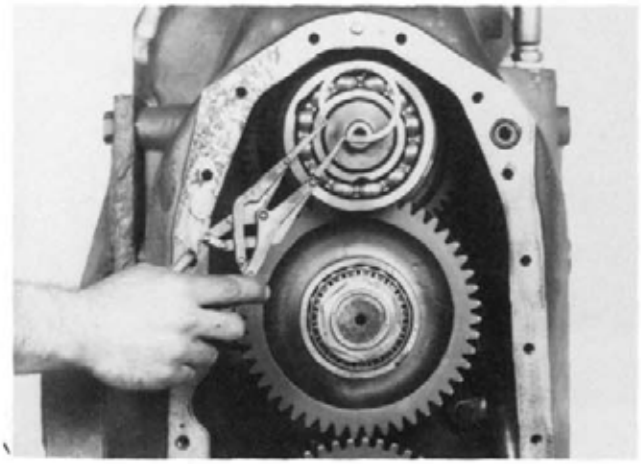


Figure 259
Install bearing retainer ring.

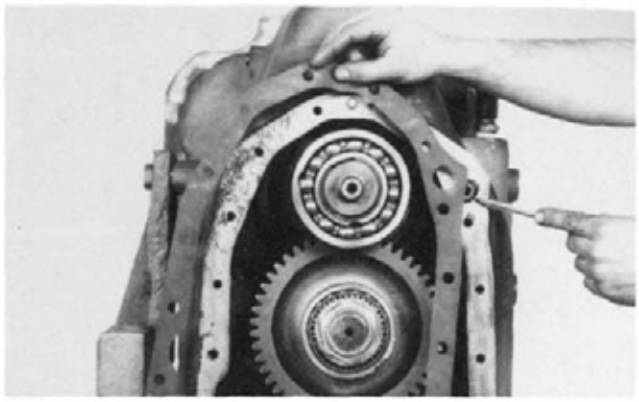


Figure 260
Position a new gasket and "O" ring on rear of housing. A light coat of chassis grease will hold the gasket in place. Install two aligning studs in housing, this will facilitate alignment of rear cover to housing.

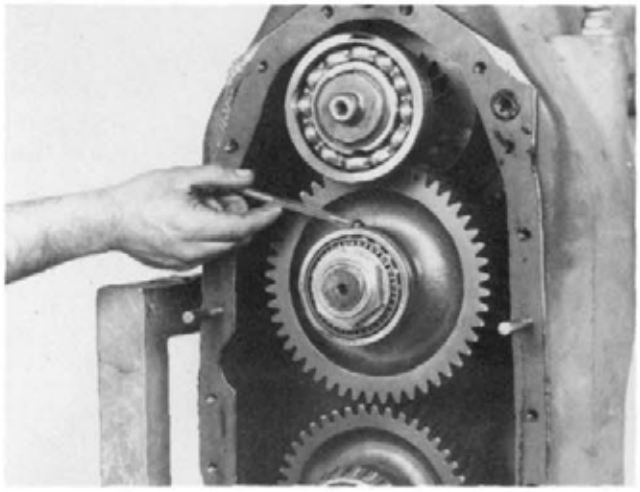


Figure 261
Position lock ball in idler rear bearing.

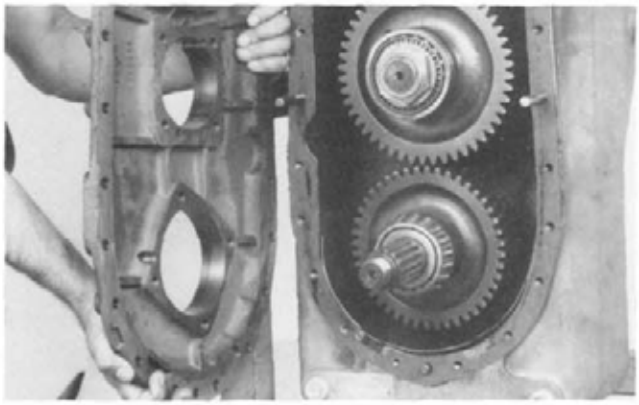


Figure 262
Align lock ball in idler shaft rear bearing with notch in rear transmission cover. Tap cover in place and secure with bolts and washers. Remove aligning studs.

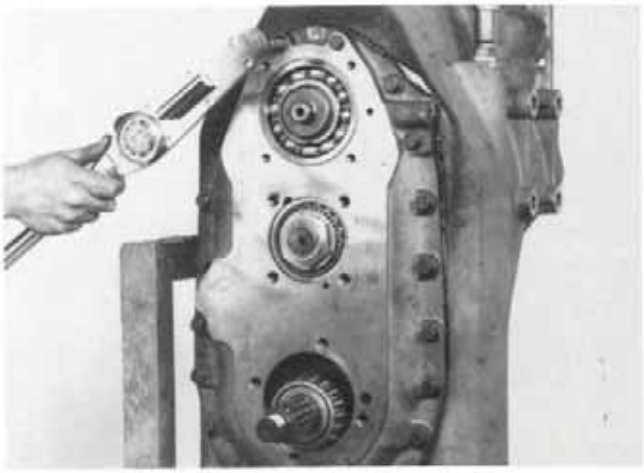


Figure 263

Tighten cover bolts to specified torque. (See torque chart).

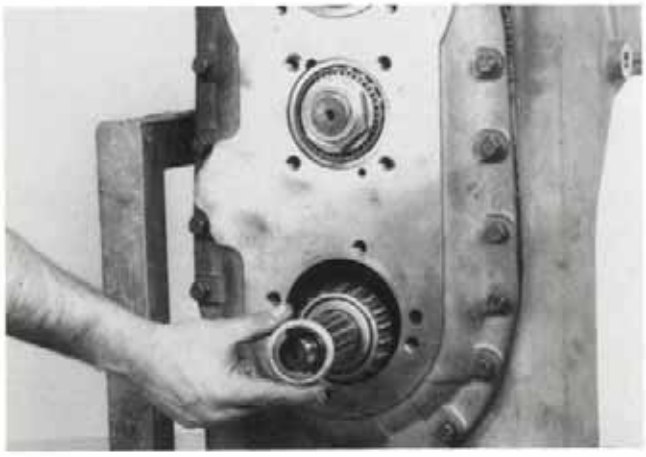


Figure 264

Position speedometer gear on output shaft. (Optional - not used on all models.)

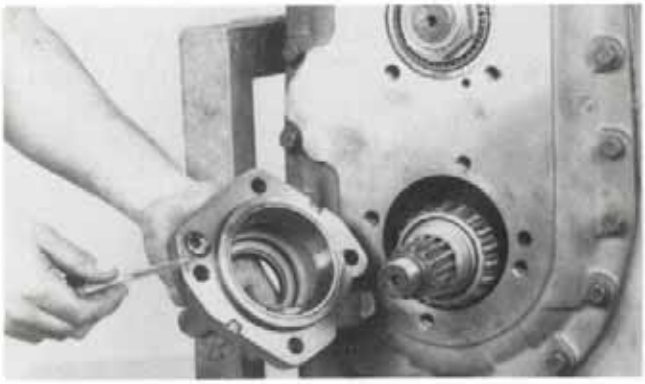


Figure 265

With rear taper bearing cup in rear bearing cap, apply a very light coat of Permatex #2 to the outer diameter of the rear output oil seal. Press seal in bearing cap with lip of seal in. With new "O" ring in position, install bearing cap.

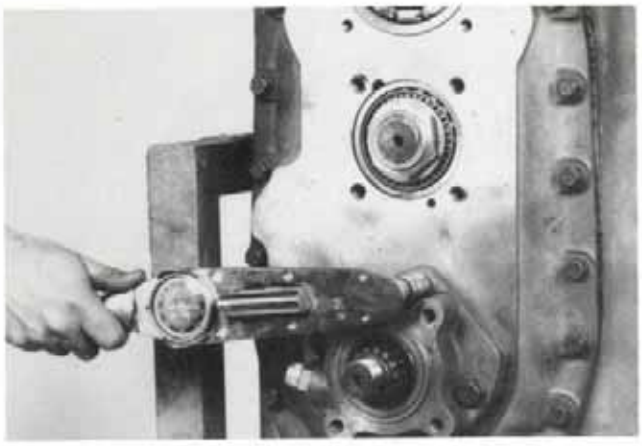


Figure 266

Install bolts and washers and tighten to specified torque. (See torque chart).

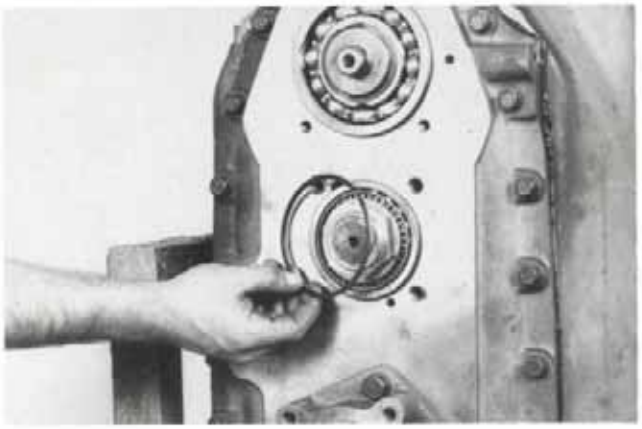


Figure 267

From the front, tap the idler shaft to the rear until the rear bearing locating ring groove is exposed. Install locating ring.

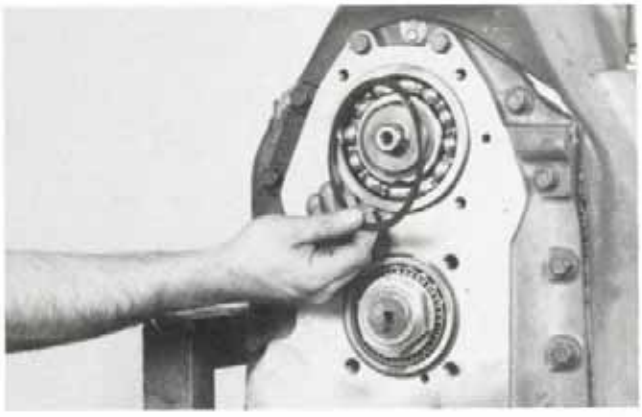


Figure 268

From the front, tap the 1st clutch to the rear until the rear bearing locating ring groove is exposed. Install locating ring.

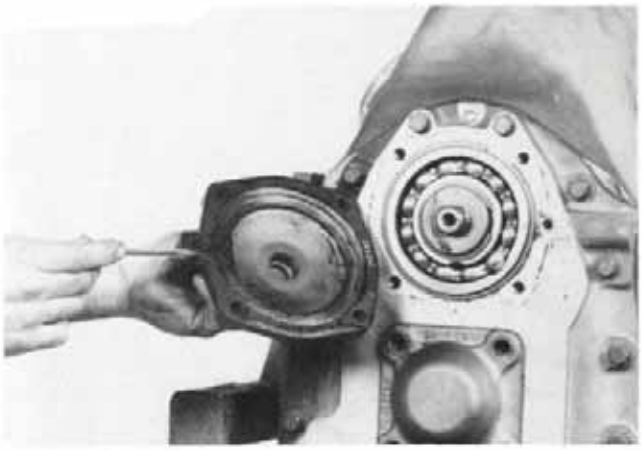


Figure 269

Position new "O" ring and gasket on 1st clutch rear bearing cap.

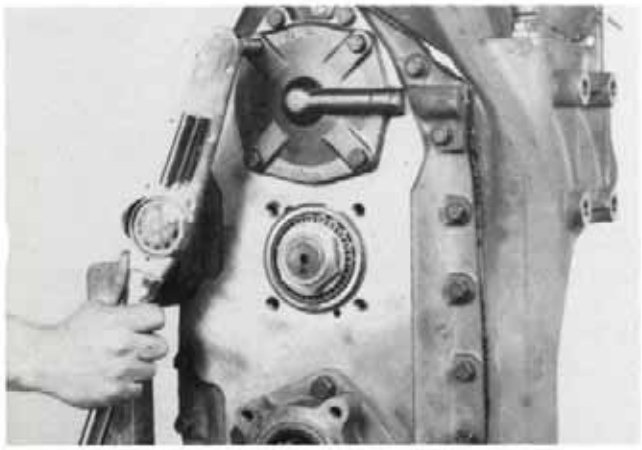


Figure 270

Install capscrews and washers, tighten to specified torque. (See torque chart.)

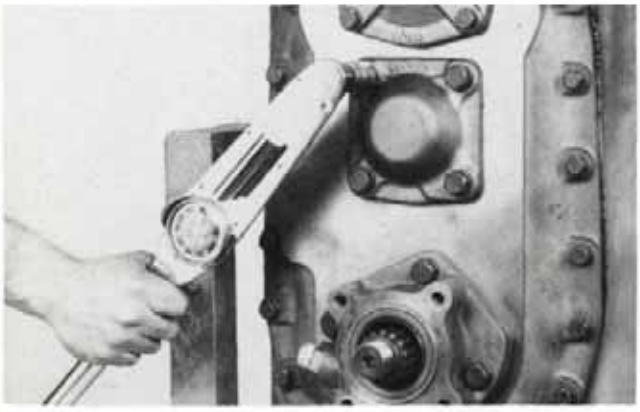


Figure 271

Position new gasket on idler shaft bearing cap. Install bearing cap, bolts and lockwashers, tighten to specified torque. (See torque chart.)

OUTPUT SHAFT ROLLING TORQUE PROCEDURE (Bearing Preload)

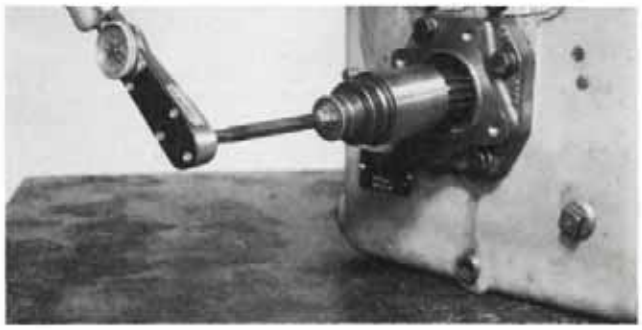


Figure 272

Tap output shaft front and rear to seat taper bearings. Loosen front bearing cap bolts. Using an inch lb. torque wrench, determine the rolling torque of the output shaft and record. Tighten front bearing cap bolts to specified torque. Check rolling torque with bolts tight. Torque must be 6 to 8 inch lbs. [0,68 - 0,90 N.m] more than when bearing cap bolts were loose. Add or omit shims on the front bearing cap to achieve the proper preload.

Figure 273

Install output flange, new "O" ring, washer and nut.

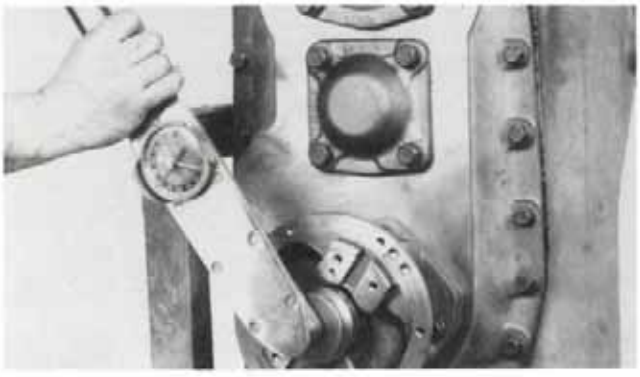


Figure 274

Using a flange retainer to prevent output shaft from turning, tighten flange nut 200 to 250 ft. lbs. torque. [271,2 - 338,9 N.m].

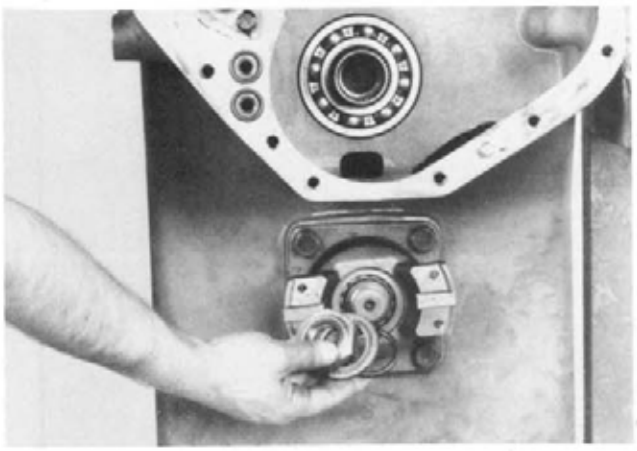


Figure 275
Install front output flange, "O" ring, washer and nut. Tighten as explained in Figure 274.

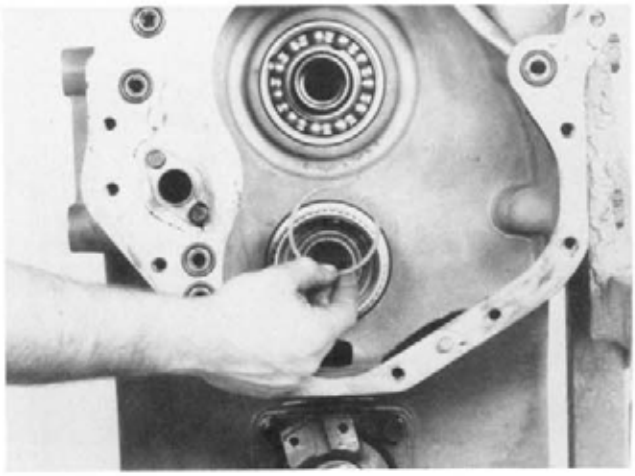


Figure 278
Install ring retainer, retainer ring.

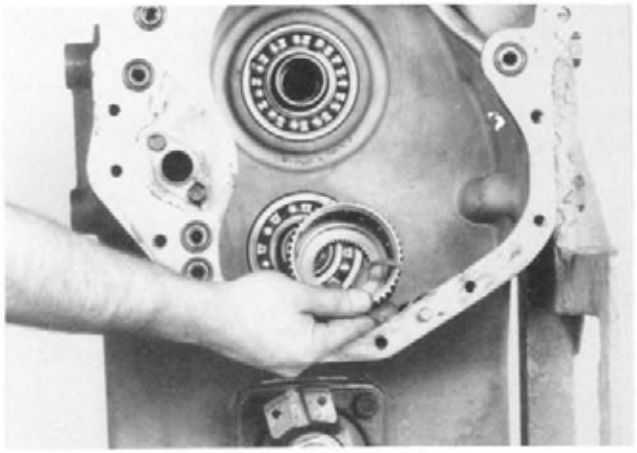


Figure 276
Position the 3rd clutch disc hub on the idler shaft. Install disc hub retainer ring.

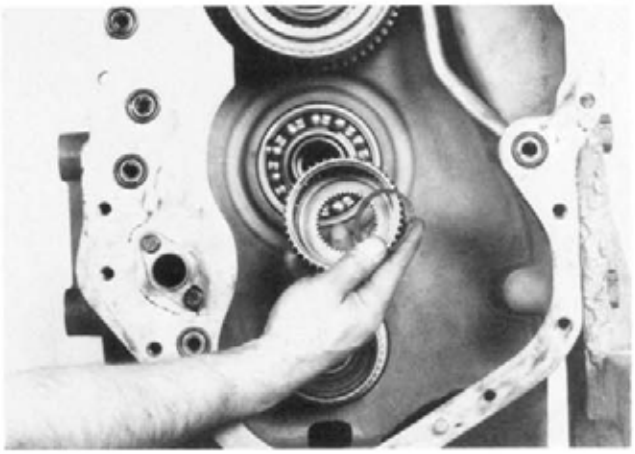


Figure 279
Install the 2nd clutch disc hub on the 1st clutch shaft. Install disc hub retainer ring.

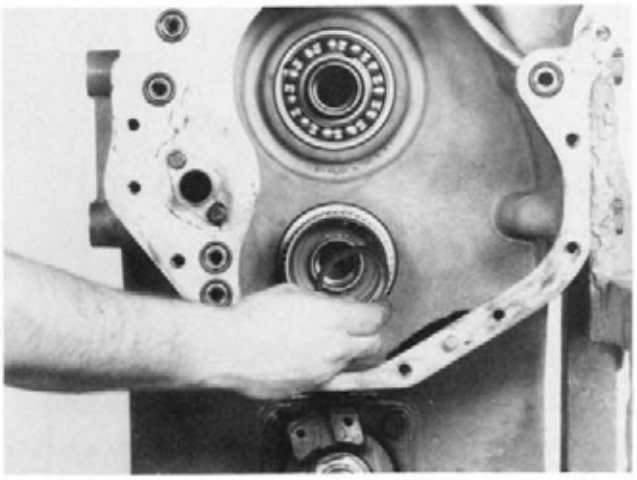


Figure 277
Install disc hub retainer ring retainer.

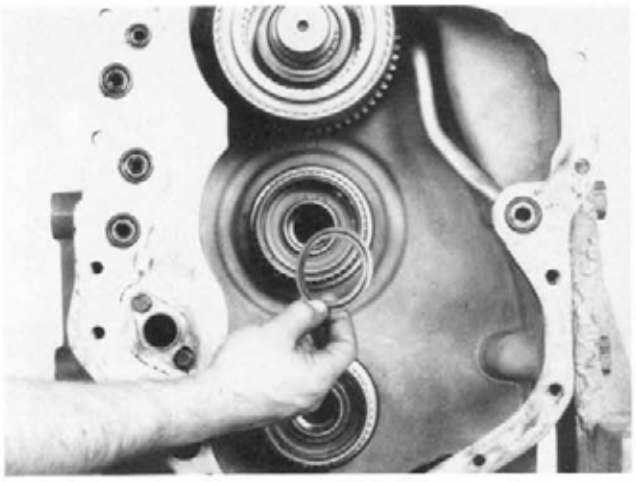


Figure 280
Install retainer ring retainer.

Figure 281
Install retainer retainer ring.

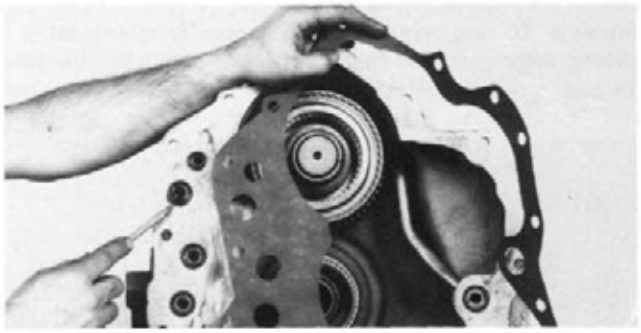


Figure 282
Position new "O" rings and gasket on front of transmission housing. A light coat of chassis grease will hold "O" rings and gasket in place.

(See cleaning and inspection page.)

CONVERTER HOUSING REASSEMBLY

See Figure 333 for oil sealing ring sleeve information.

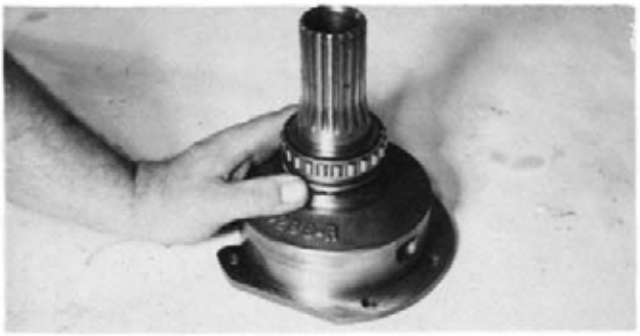


Figure 283
Install new sealing ring expander spring and oil sealing ring on support. Expander spring gap to be 180° from sealing ring hook joint. Press support bearing into position. **NOTE:** Bearing part number must be up.

Clean stator support mounting surface and tapped holes with solvent. Dry thoroughly, being certain tapped holes are clean and dry.

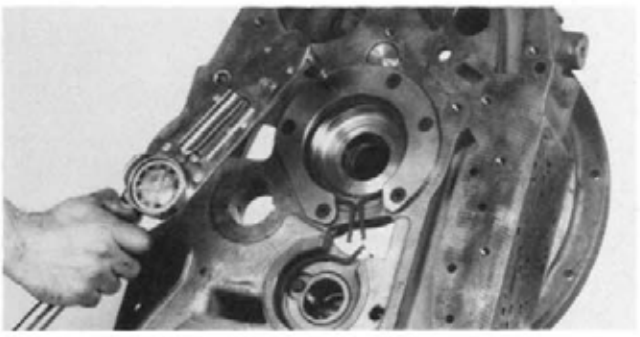


Figure 284
Position support in converter housing aligning holes in support with holes in housing. Tap support into position.

STATOR SUPPORT SCREW ASSEMBLY:
Install 6 special stator support screws. Tighten screws to 12-16 lbs. ft. [16,3-21,6 N.m] torque.

NOTE: Assembly of stator support to converter housing must be completed within a 15 minute period from start of screw installation. The special screw is to be used for one installation only. If the screw is removed for any reason it must be replaced. The Loctite left in the holes must be removed with the proper tap and cleaned with solvent. Dry hole thoroughly and use a new screw for reinstallation.

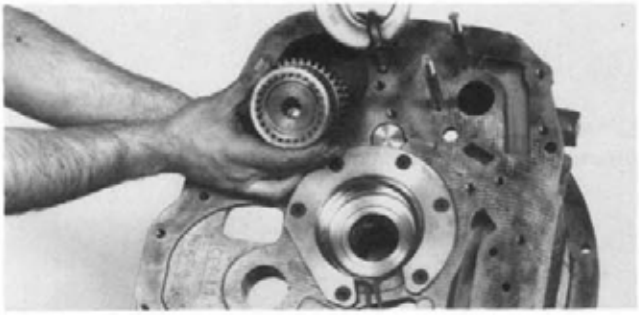


Figure 285
Position auxiliary pump drive gear, bearing and support in housing.

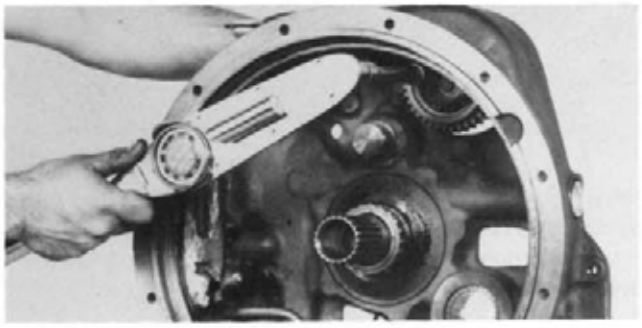


Figure 286
Align holes in bearing support with holes in housing. Install support screws and washers. Tighten to specified torque. (See torque chart.)

Figure 287

Position charging pump drive gear, bearing and support in housing. Install support screws and washers, tighten to specified torque. (See torque chart.)

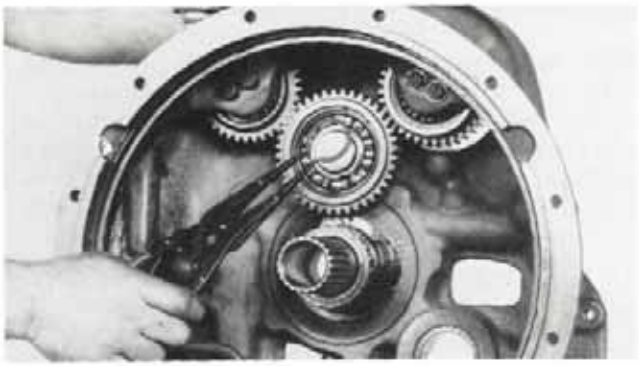


Figure 288

Position pump drive idler gear and bearing on idler gear stub shaft. Install idler gear to stub shaft retainer ring.

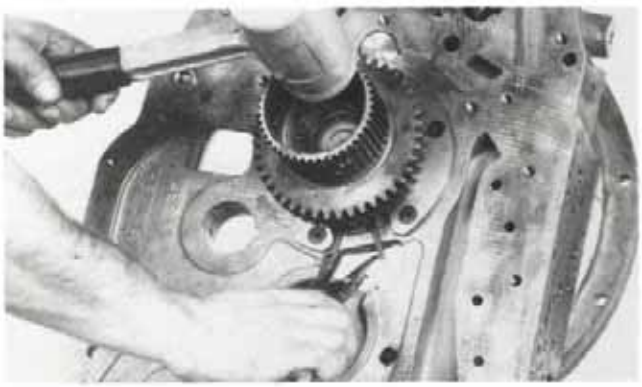


Figure 289

If bearing was removed, press turbine shaft bearing into position. **NOTE**: Bearing outer locating ring groove down. Install bearing washer and retainer ring. Install new turbine shaft oil sealing ring.

Spread ears on turbine shaft bearing retainer ring located in reaction member support. Tap turbine shaft and bearing into position, being certain bearing snap ring is in full position in snap ring groove.

Figure 290

With new "O" ring on shaft, position reverse idler shaft in housing. Align groove in shaft with notch in housing. Install lock ball.

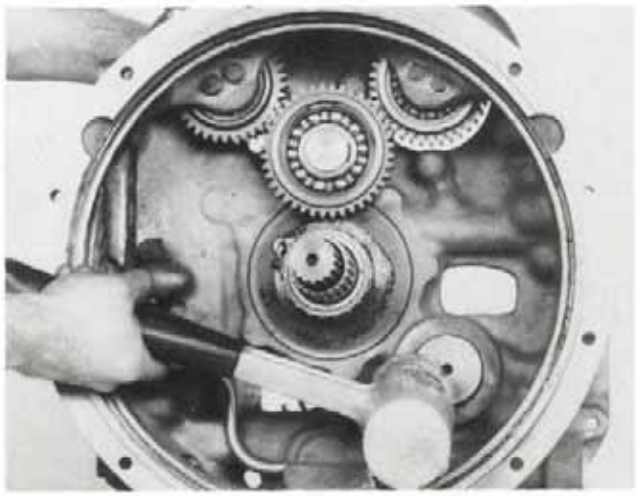


Figure 291

Tap shaft into position, use caution as not to lose lock ball.

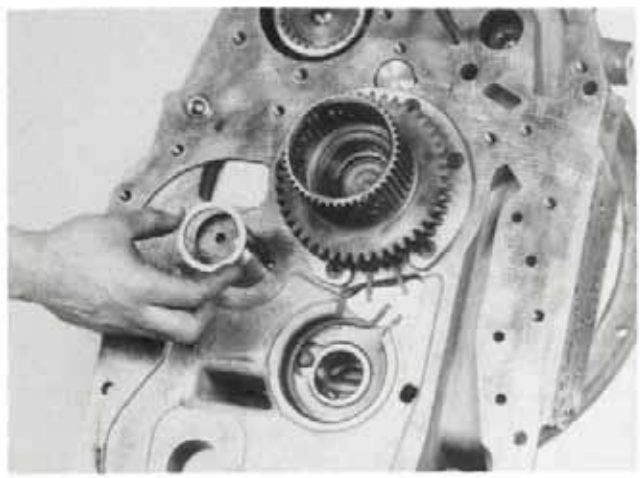


Figure 292

Install shaft spacer.

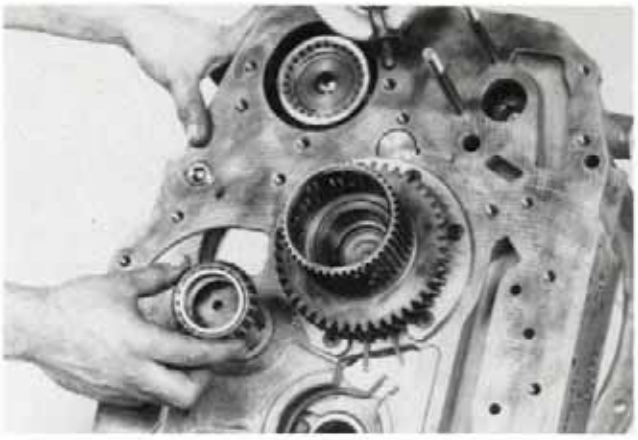


Figure 293
Install inner taper bearing on shaft with large diameter of taper down. Position bearing spacer on shaft.

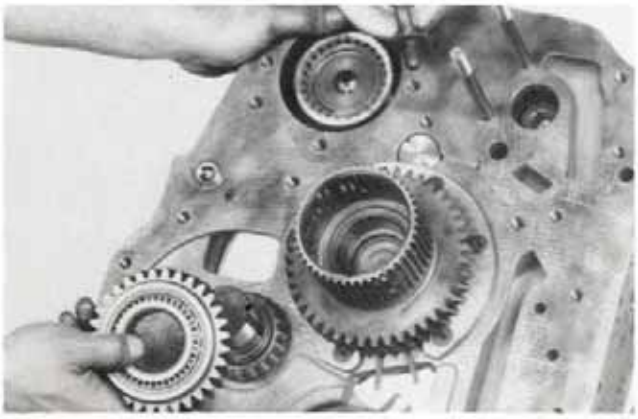


Figure 294
Position reverse idler gear on shaft with hub of gear up. Install outer taper bearing in gear with large diameter of taper up.

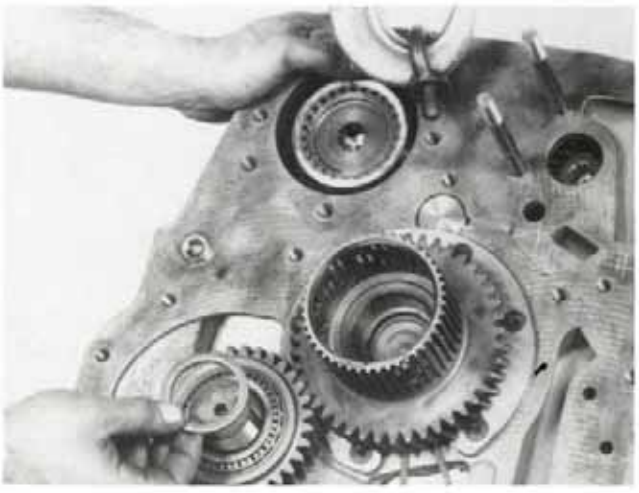


Figure 295
Position outer spacer on shaft.

Figure 296
Install shaft retainer nut. Tighten nut 200 to 250 ft. lbs. torque [271,2 - 338,8 N.m].

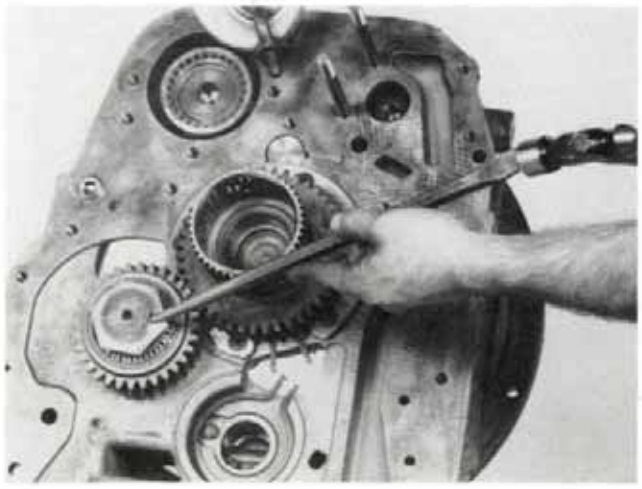


Figure 297
Stake nut securely in shaft notch.

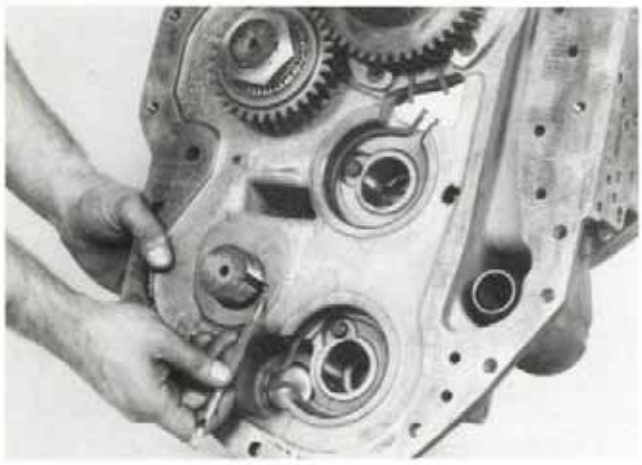


Figure 298
With new "O" ring on shaft, position idler shaft in housing. Align groove in shaft with notch in housing. Install lock ball.

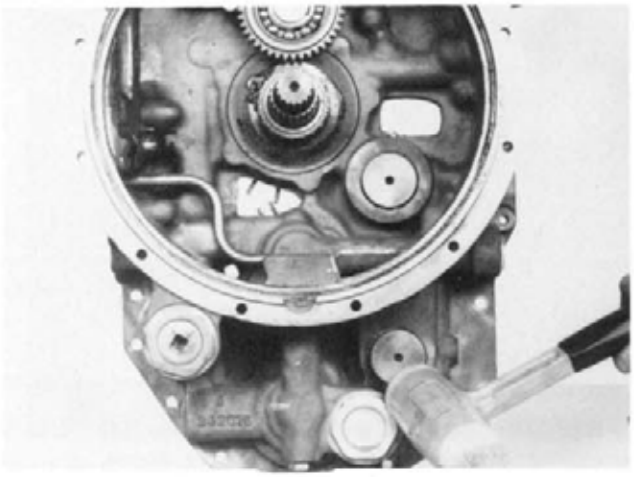


Figure 299
Tap shaft into position, use caution as not to lose lock ball.

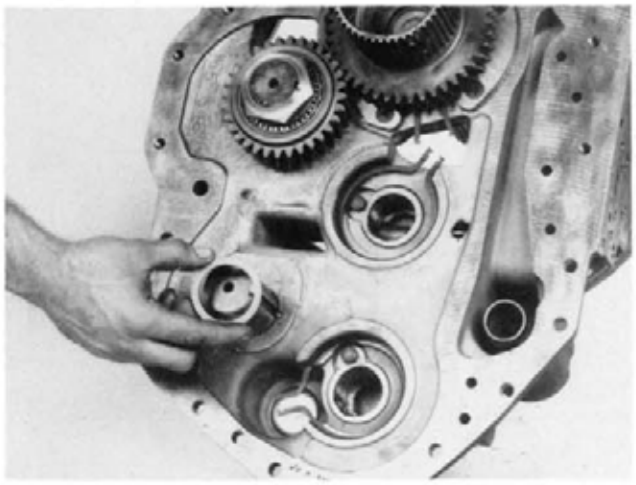


Figure 300
Install idler shaft spacer.

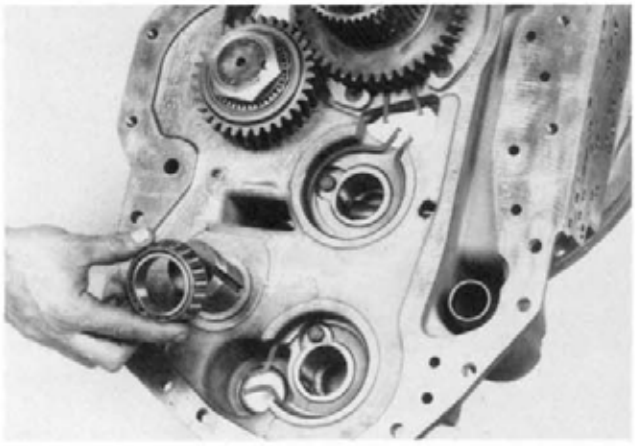


Figure 301
Install idler gear inner taper bearing on shaft with large diameter of taper down. Position bearing spacer on shaft.

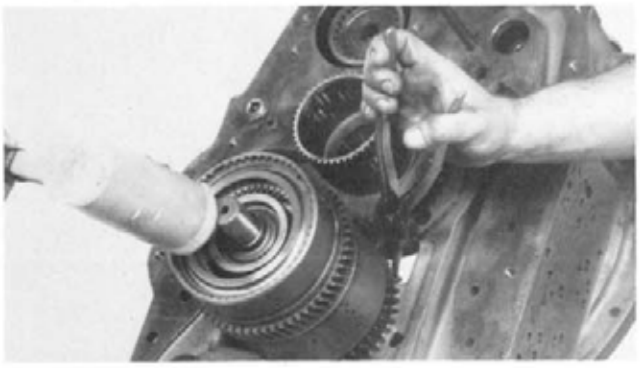


Figure 302
Spread ears on reverse clutch front bearing locating ring. Tap reverse and 2nd clutch assembly into converter housing. Align the snap ring groove in the bearing with the snap ring in the housing, being certain bearing snap ring is in full position in snap ring groove.

Figure 303
Position idler gear on bearing with hub of gear up.

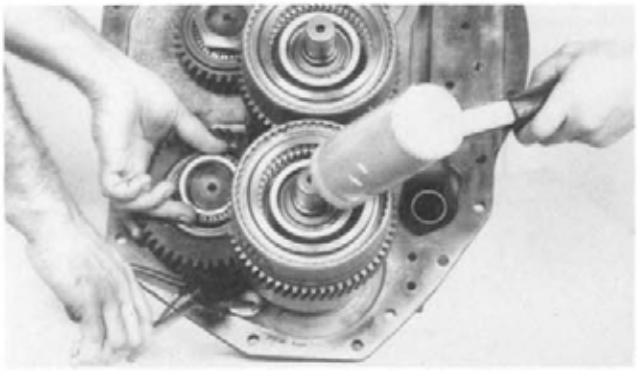


Figure 304
Spread ears on 4th clutch front bearing locating ring. **NOTE:** The idler gear and taper bearing cup assembly and the 4th clutch assembly must be installed in the converter housing at the same time as the idler gear must be positioned between the clutch front bearing and the clutch drum. Install the idler outer taper bearing with small diameter of taper down. Make sure locating ring is in full position in ring groove.

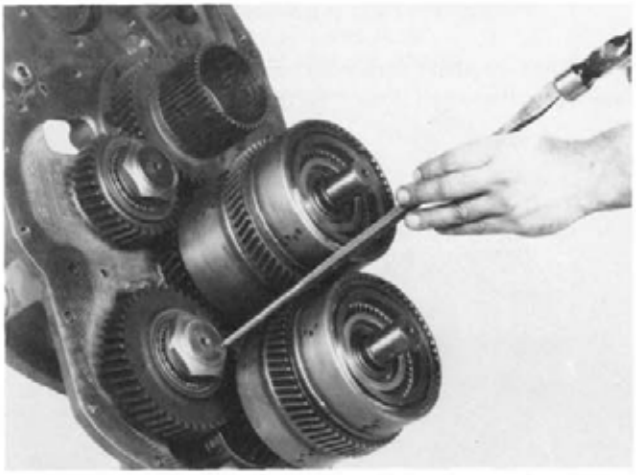


Figure 305
Repeat procedures shown in Figures 295 thru 297.

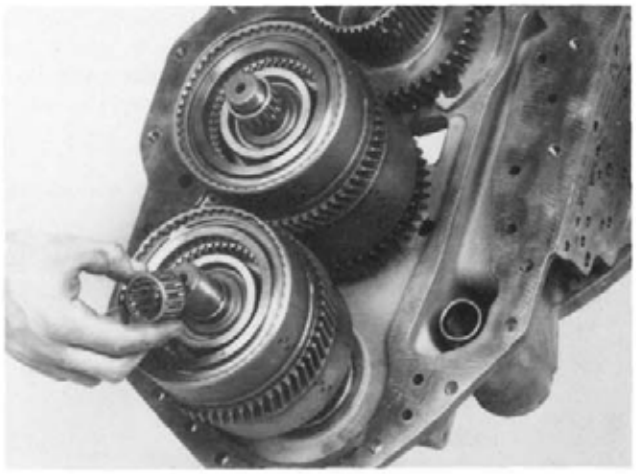


Figure 306
Position pilot bearings on 2nd and 3rd clutch shafts, a light coat of grease will hold pilot bearings in place.

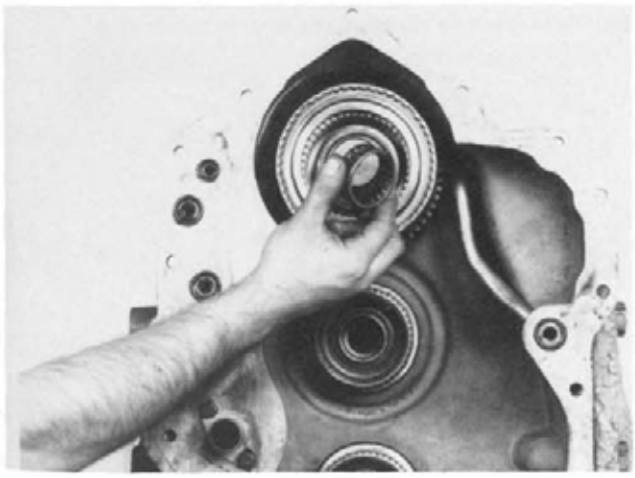


Figure 307
Install forward clutch pilot bearing.

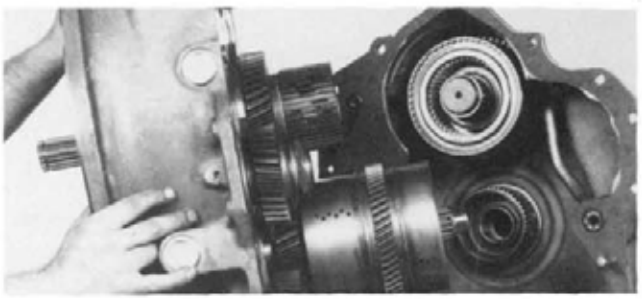


Figure 308
The use of two aligning studs will facilitate aligning the converter housing to the transmission housing. Install converter housing assembly to transmission assembly using extreme caution as to align the clutch pilots into the clutch disc hubs. As the clutch pilots enter the disc hubs turn the turbine shaft and output shaft back and forth. This will help align all of the clutch inner discs with the disc hubs. **DO NOT FORCE THIS OPERATION.** When all the clutches are properly aligned, the converter housing will be tight against the transmission housing. Install two housing to housing capscrews and lockwashers. Remove aligning studs. Install remaining capscrews and lockwashers. Tighten capscrews to specified torque. (See torque chart.)

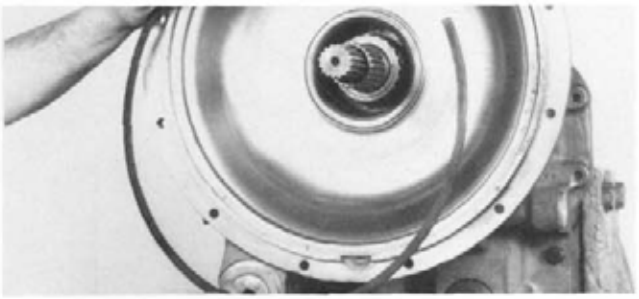


Figure 309
Apply a light coat of Permatex #2 to the outer diameter of the oil baffle oil seal. Press seal in baffle with lip of seal toward impeller hub bearing. Position new oil baffle sealing ring on oil baffle. Position oil baffle in housing and install retaining ring. Be sure ring is in full position in ring groove.

Figure 310
Install impeller and hub assembly using caution as not to damage the oil baffle oil seal. **NOTE:** Use extreme caution as not to cut, break or unhook the oil sealing ring on the support.

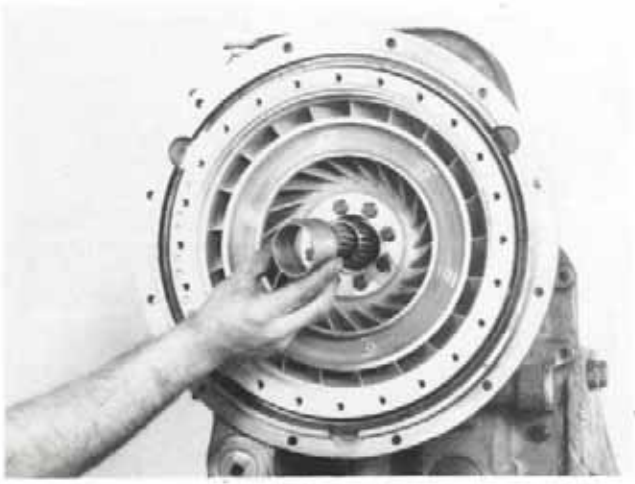


Figure 311
Position impeller hub bearing spacer on stator support.

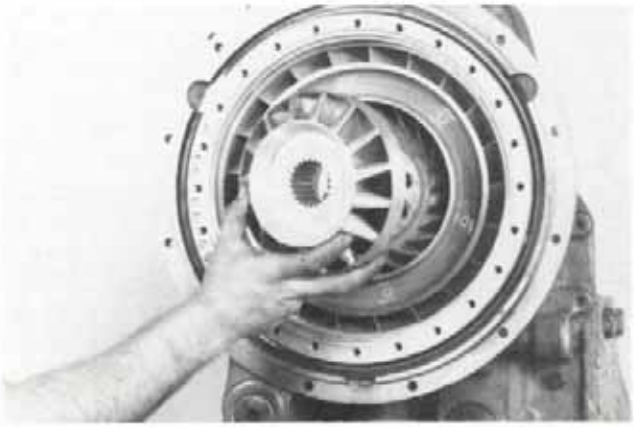


Figure 312
For fixed reaction member, install reaction member with thick side of blades out.

For freewheel reaction member see Figure 314.

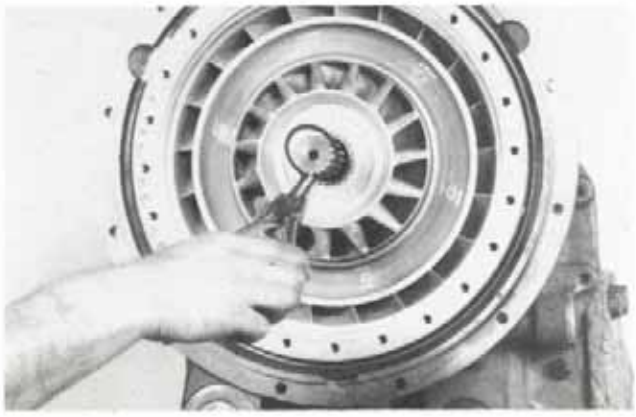


Figure 313
Install reaction member retainer ring. Proceed to Figure 318.

FREEWHEEL REASSEMBLY

NOTE: The freewheel assembly cannot be serviced. If the freewheel is damaged it must be replaced as an assembly.

Figure 314
Install outer race and sprag assembly in reaction member. **NOTE:** Undercut shoulder of race must go toward the rear of the reaction member.

Figure 315
Install outer race to reaction member retainer ring.

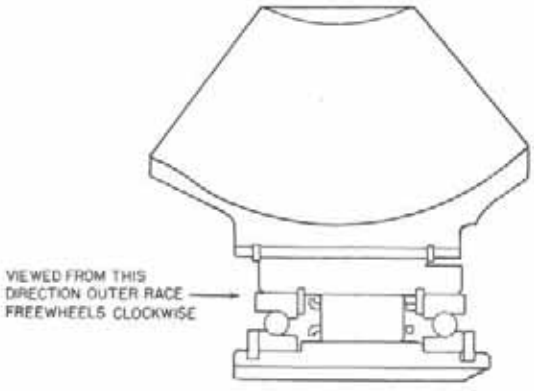


Figure 316

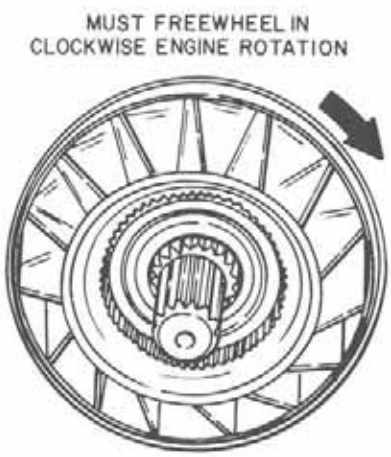


Figure 317

Position reaction member to impeller hub gear spacer on reaction member support. Install reaction member on support. Check rotation of freewheeling reaction member to be sure of proper freewheel assembly. Install reaction member retaining ring.

Figure 318

Install turbine locating ring on turbine shaft.

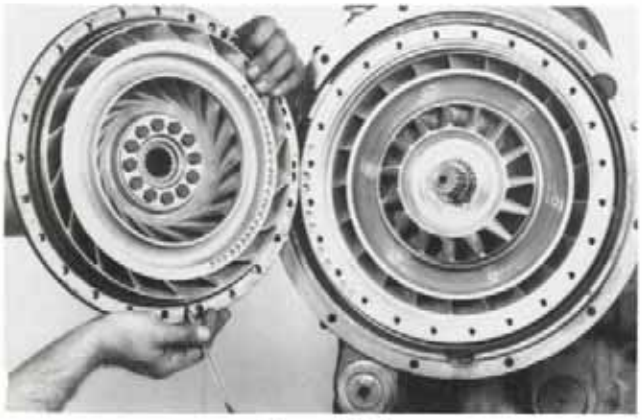


Figure 319

With a new impeller cover to impeller "O" ring in place, install turbine and impeller cover assembly on turbine shaft.

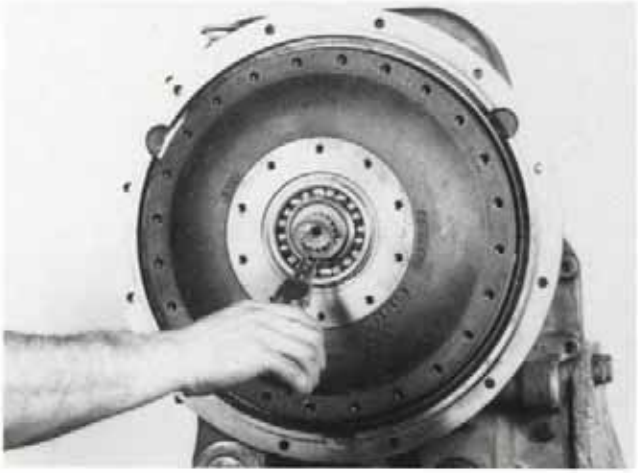


Figure 320

Install turbine hub to turbine shaft retainer ring.

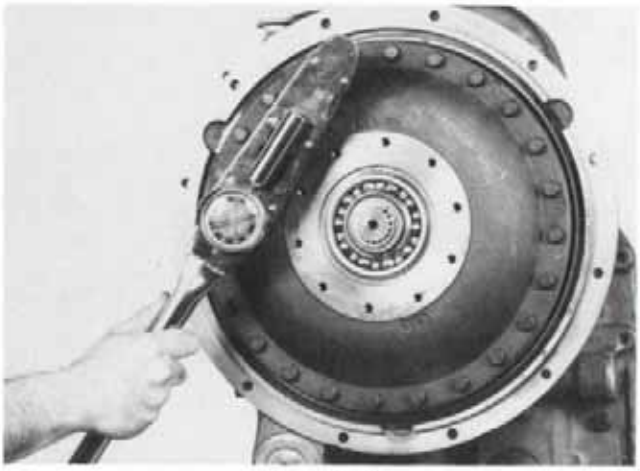


Figure 321

Install impeller cover to impeller screws and lockwashers. Tighten to specified torque. (See torque chart.)

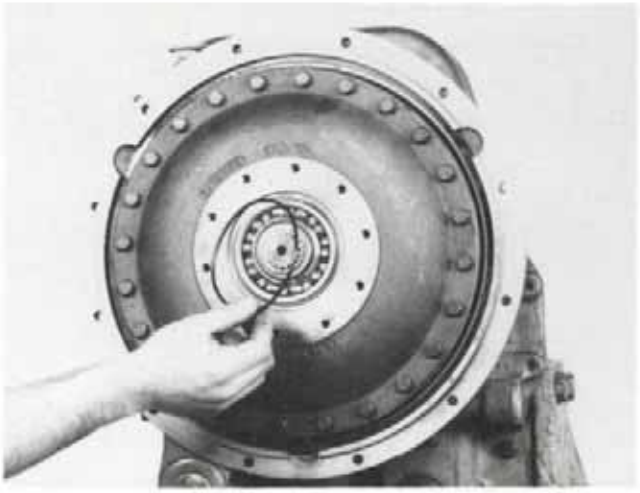


Figure 322

Position a new "O" ring over impeller cover bearing.

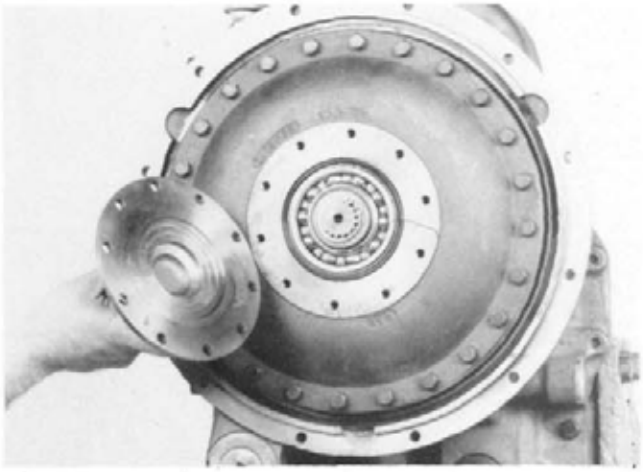


Figure 323
Position the impeller cover bearing cap on bearing.

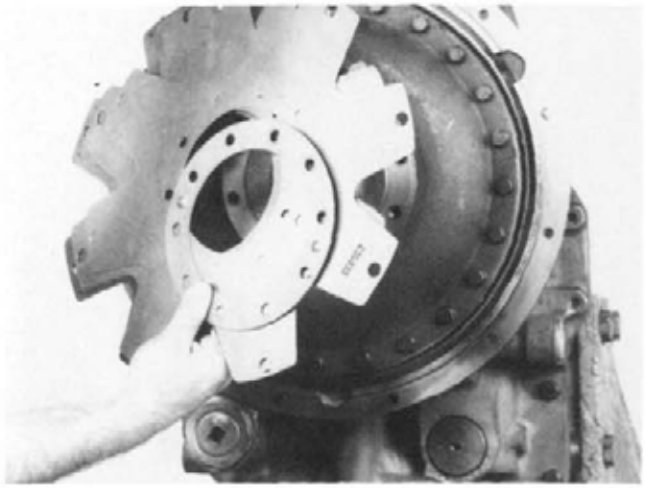


Figure 324
See special section on page 69 for drive plate installation.

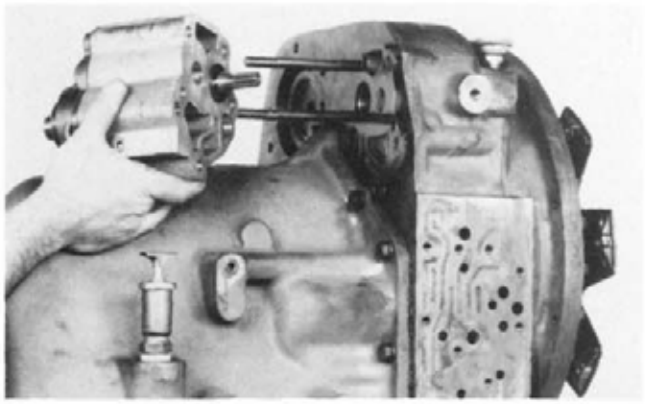


Figure 325
With a new gasket in place, install the charging pump assembly on mounting studs. Install washers, nuts and capscrews. Tighten to specified torque. (See torque chart.)

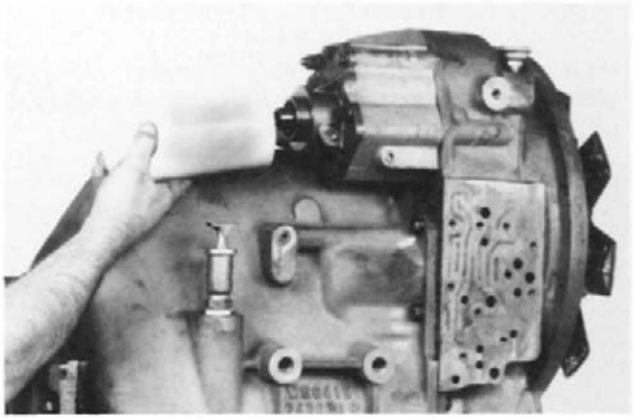


Figure 326
Install new oil filter cartridge. **NOTE:** It is recommended that the filter cartridge be changed after 50 and 100 hours of operation on new and rebuilt or repaired units.

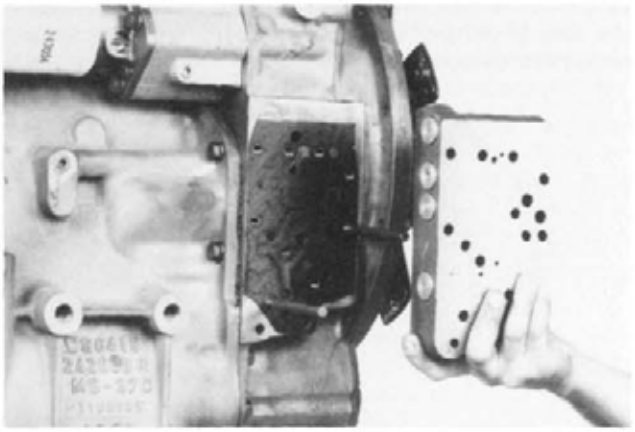


Figure 327
To install the control valve assembly it is recommended two aligning studs be used. Position new modulator valve to housing gasket on housing. Install valve assembly.

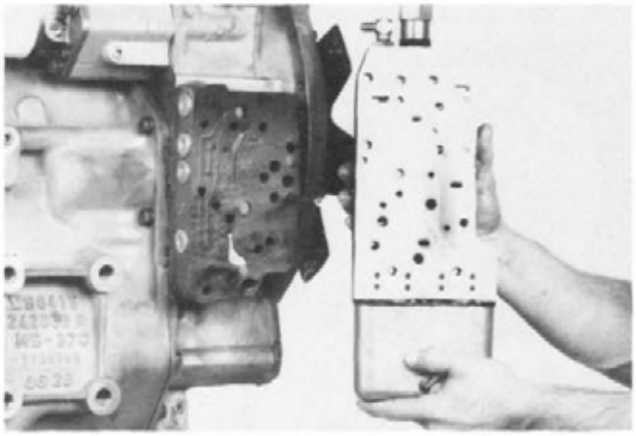


Figure 328
Position a new modulator to control valve gasket and install control valve assembly.

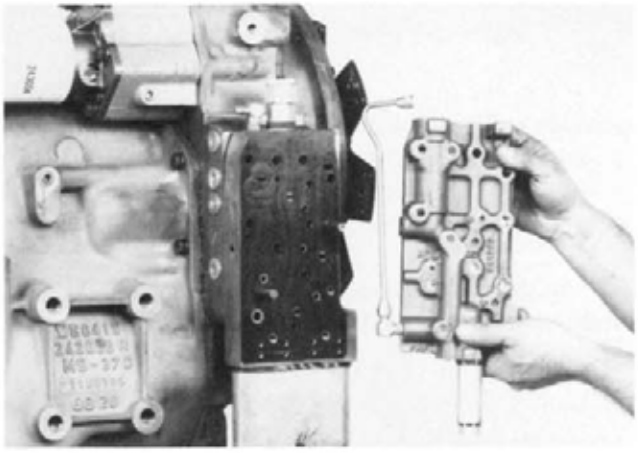


Figure 329

Position new shuttle valve gasket on control valve. Install shuttle valve assembly on control valve.

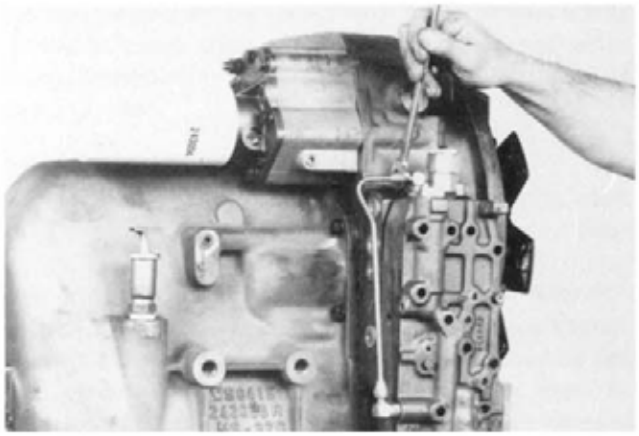


Figure 330

Connect the pressure line from the shuttle valve to the control valve. Connect the wires from the control valve to the shuttle valve solenoid.

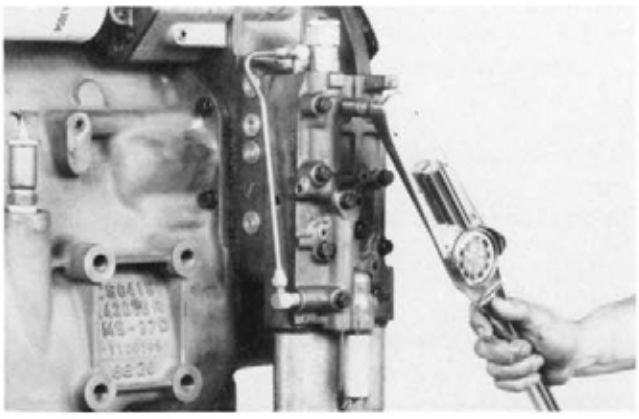


Figure 331

Install control valve to housing screws and lockwashers. **NOTE:** Use Loctite #262 on upper right hand screw. Tighten screws to specified torque. (See torque chart.)

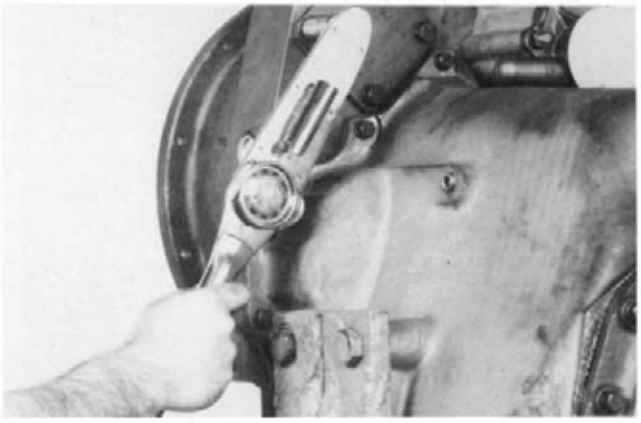


Figure 332

If the auxiliary pump drive is not used, position a new gasket and cover on opening. Install bolts and washers and tighten to specified torque. (See torque chart.)

OIL SEALING RING SLEEVE REMOVAL

NOTE: The following photos are not of the HR Converter Housing, but the sleeve removal procedure is identical.

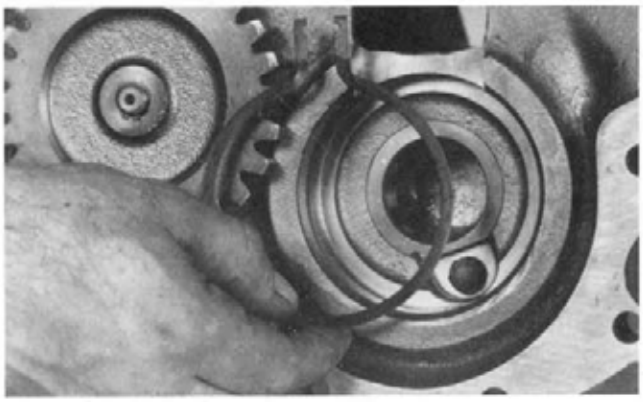


Figure 333

Remove clutch front bearing retaining ring.

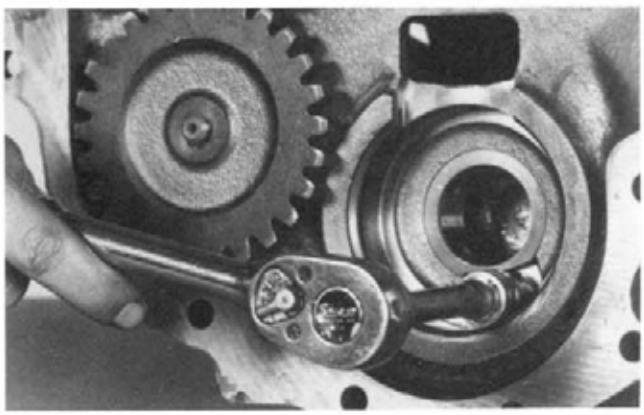


Figure 334

Remove front oil sealing ring sleeve retainer screw and washer. Remove sleeve lock.

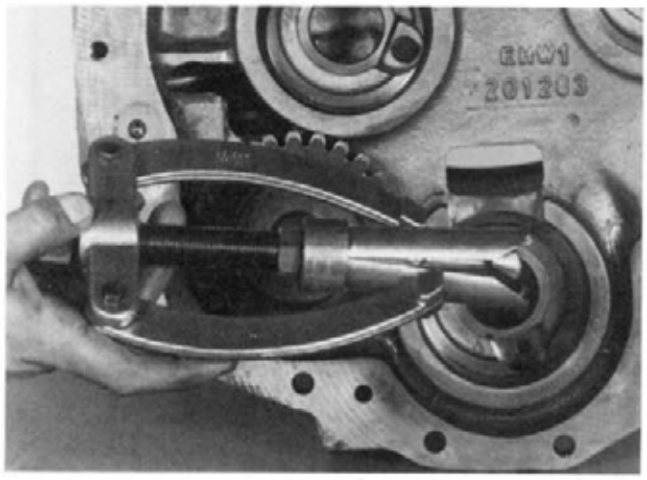


Figure 335
Using a sleeve puller like the one shown, remove sleeve.

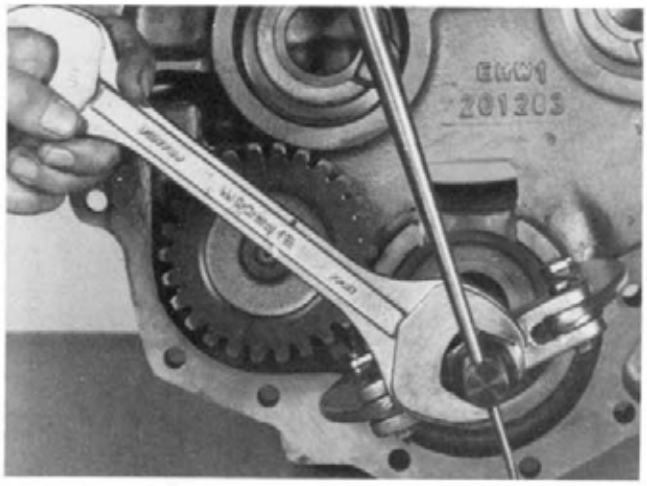


Figure 336
Sleeve being removed. **NOTE**: When installing a new sleeve it is recommended a press or a driver be used to prevent damage to the sleeve and be sure the notch in the sleeve is aligned with sleeve lock notch.

CLEANING AND INSPECTION

CLEANING

Clean all parts thoroughly using solvent type cleaning fluid. It is recommended that parts be immersed in cleaning fluid and moved up and down slowly until all old lubricant and foreign material is dissolved and parts are thoroughly cleaned.

CAUTION: Care should be exercised to avoid skin rashes, fire hazards and inhalation of vapors when using solvent type cleaners.

Bearings

Remove bearings from cleaning fluid and strike larger side of cone flat against a block of wood to dislodge solidified particles of lubricant. Immerse again in cleaning fluid to flush out particles. Repeat above operation until bearings are thoroughly clean. Dry bearings using moisture free compressed air. Be careful to direct air stream across bearing to avoid spinning. Do not spin bearings when drying. Bearings may be rotated slowly by hand to facilitate drying process.

Housings

Clean interior and exterior of housings, bearing caps, etc., thoroughly. Cast parts may be cleaned in hot solution tanks with mild alkali solutions providing these parts do not have ground or polished surfaces. Parts should remain in solution long enough to be thoroughly cleaned and heated. This will aid the evaporation of the cleaning solution and rinse water. Parts cleaned in solution tanks must be thoroughly rinsed with clean water to remove all traces of alkali. Cast parts may also be cleaned with steam cleaner.

CAUTION: Care should be exercised to avoid skin rashes and inhalation of vapors when using alkali cleaners.

All parts cleaned must be thoroughly dried immediately by using moisture-free compressed air or soft, lintless absorbent wiping rags free of abrasive materials such as metal filings, contaminated oil or lapping compound.

INSPECTION

The importance of careful and thorough inspection of all parts cannot be overstressed. Replacement of all parts showing indication of wear or stress will eliminate costly and avoidable failures at a later date.

Bearings

Carefully inspect all rollers, cages and cups for wear, chipping or nicks to determine fitness of bearings for further use. Do not replace a bearing cone or cup individually without replacing the mating cup or cone at the same time. After inspection, dip bearings in clean light oil and wrap in clean lintless cloth or paper to protect them until installed.

Oil Seals, Gaskets and Retaining Rings

Replacement of spring load oil seals, "O" rings, metal sealing rings, gaskets and snap rings is more economical when unit is disassembled than premature overhaul to replace these parts at a future time. Further loss of lubricant through a worn seal may result in failure of other more expensive parts of the assembly. Sealing members should be handled carefully, particularly when being installed. Cutting, scratching, or curling under of lip of seal seriously impairs its efficiency. Apply a thin coat of Permatex No. 2 on the outer diameter of the oil seal to assure an oil tight fit into the retainer. When assembling new metal type sealing rings, same should be lubricated with coat of chassis grease to stabilize rings in their grooves for ease of assembly of mating members. Lubricate all "O" rings and seals with recommended type Automatic Transmission Fluid before assembly.

Gears and Shafts

If magna-flux process is available, use process to check parts. Examine teeth on all gears carefully for wear, pitting, chipping, nicks, cracks or scores. If gear teeth show spots where case hardening is worn through or cracked, replace with new gear. Small nicks may be removed with suitable hone. Inspect shafts and quills to make certain they are not sprung, bent, or splines twisted, and that shafts are true.

Housing, Covers, etc.

Inspect housings, covers and bearing caps to be certain they are thoroughly cleaned and that mating surfaces, bearing bores, etc., are free from nicks or burrs. Check all parts carefully for evidence of cracks or condition which would cause subsequent oil leaks or failures.

SERVICING MACHINE AFTER TRANSMISSION OVERHAUL

The transmission, torque converter, and its allied hydraulic system are important links in the drive line between the engine and the wheels. The proper operation of either unit depends greatly on the condition and operation of the other; therefore, whenever repair or overhaul of one unit is performed, the balance of the system must be considered before the job can be considered completed.

After the overhauled or repaired transmission has been installed in the machine, the oil cooler, and connecting hydraulic system must be thoroughly cleaned. This can be accomplished in several manners and a degree of judgment must be exercised as to the method employed.

The following are considered the minimum steps to be taken:

1. Drain engine system thoroughly.

2. Disconnect and clean all hydraulic lines. Where feasible, hydraulic lines should be removed from machine for cleaning.

3. Replace oil filter elements, cleaning out filter cases thoroughly.

4. The oil cooler must be thoroughly cleaned. The cooler should be "back flushed" with oil and compressed air until all foreign material has been removed. Flushing in direction of normal oil flow will not adequately clean the cooler. If necessary, cooler assembly should be removed from machine for cleaning, using oil, compressed air and steam cleaner for that purpose. **DO NOT** use flushing compounds for cleaning purposes.

5. On remote mounted torque converters remove drain plug from torque converter and inspect interior of converter housing, gears, etc. If presence of considerable foreign material is noted, it will be necessary that converter be removed, disassembled and cleaned thoroughly. It is realized this entails extra labor; however, such labor is a minor cost compared to cost of difficulties which can result from presence of such foreign material in the system.

6. Reassemble all components and use only type oil recommended in lubrication section. Fill transmission through filler opening until fluid comes up to **LOW** mark on transmission dipstick.

   Run engine two minutes at 500-600 RPM to prime torque converter and hydraulic lines. Recheck level of fluid in transmission with engine running at idle (500-600 RPM).

   Add quantity necessary to bring fluid level to **LOW** mark on dipstick. Recheck with hot oil (180-200° F.) [82, 2-93, 3° C].

   Bring oil level to **FULL** mark on dipstick.

7. Recheck all drain plugs, lines, connections, etc., for leaks and tighten where necessary.

TOWING OR PUSH STARTING

Before towing the vehicle, be sure to lift the rear wheels off the ground or disconnect the driveline to avoid damage to the transmission during towing.

NOTE: If the transmission has 4 wheel drive, disconnect both front and rear drivelines. Because of the design of the hydraulic system, the engine **cannot** be started by pushing or towing.

SPECIFICATIONS AND SERVICE DATA—POWER SHIFT TRANSMISSION AND TORQUE CONVERTER

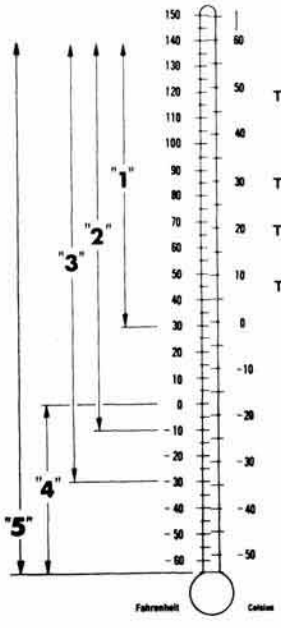
CONVERTER OUT PRESSURE	Converter outlet oil temp. 180° - 200° F. [82,3° - 93,3° C]. Transmission in **NEUTRAL.** Operating specifications: 25 P.S.I. [172,4 kPa] minimum pressure at 2000 R.P.M. engine speed **AND** a maximum of 70 P.S.I. [482,6 kPa] outlet pressure with engine operating at no-load governed speed.
CONTROLS	Forward and Reverse — Manual Speed Selection — Manual
CLUTCH TYPE	Multiple discs, hydraulically actuated, spring released, automatic wear compensation and no adjustment. All clutches oil cooled and lubricated.
CLUTCH INNER DISC	Friction.
CLUTCH OUTER DISC	Steel.
OIL FILTRATION	Full flow oil filter safety by-pass, also strainer screen in sump at bottom of transmission case.
CLUTCH PRESSURE	240 - 280 psi [1654,8 - 1930,5 kPa] — With parking brake set **(see note),** oil temperature 180° - 200°F. [82,2° - 93,3° C], engine at idle (400 to 600 RPM), shift thru direction and speed clutches. All clutch pressure must be equal within 5 psi. [34,5 kPa]. If clutch pressure varies in any one clutch more than 5 psi. [34,5 kPa] repair clutch. **NOTE: Never use service brakes while making clutch pressure checks. Units having brake actuated declutching in forward and/or reverse will not give a true reading.** **ALWAYS USE PARKING BRAKE WHEN MAKING CLUTCH PRESSURE CHECKS.**

LUBRICATION

TYPE OF OIL	See Lube Chart.
CAPACITY	Consult Operator's Manual on applicable machine model for system capacity. Torque Converter, Transmission and allied hydraulic system must be considered as a whole to determine capacity.
CHECK PERIOD	Check oil level DAILY with engine running at 500-600 RPM and oil at 180° to 200° F. [82, 2 - 93, 3° C]. Maintain oil level to FULL mark.
NORMAL * DRAIN PERIOD	Every 500 hours, change oil filter element. Every 1000 hours, drain and refill system as follows: Drain with oil at 150° to 200° F. [65, 6 - 93, 3° C]. **NOTE: It is recommended that filter elements be changed after 50 and 100 hours of operation on new and rebuilt or repaired units.** (a) **Drain transmission and remove sump screen. Clean screen thoroughly and replace, using new gaskets.** (b) **Drain oil filters, remove and discard filter elements. Clean filter shells and install new elements.** (c) **Refill transmission to LOW mark.** (d) **Run engine at 500-600 RPM to prime converter and lines.** (e) **Recheck level with engine running at 500 - 600 RPM and add oil to bring level to LOW mark. When oil temperature is hot (180-200° F.) [82,2-93,3° C] make final oil level check. BRING OIL LEVEL TO FULL MARK.**

RECOMMENDED LUBRICANTS FOR CLARK POWER SHIFTED TRANSMISSION AND TORQUE CONVERTERS

Prevailing Ambient Temperature



*Dexron is a registered trademark of General Motors Corporation.

Temperature Range	"1"	(a) C-2 Grade 30 (b) C-3 Grade 30 (c) Engine Oil:-Grade 30 API-CD/SE or CD/SF (d) MIL-L-2104C-Grade 30 (e) MIL-L-2104D-Grade 30
Temperature Range	"2"	(a) MIL-L-2104C-Grade 10 (b) MIL-L-2104D-Grade 10 (c) C-2 Grade 10 (d) C-3 Grade 10 (e) Engine Oil:-Grade 10 API-CD/SE or CD/SF (f) Quintolubric 822-220 (Non Phosphate Ester Fire Resistant Fluid)
Temperature Range	"3"	(a) *Dexron (b) *Dexron II D - **See Caution Below**
Temperature Range	"4"	(a) MIL-L-46167 (b) MIL-L-46167 A
Temperature Range	"5"	(a) Conoco Polor Start DN-600 Fluid

NOTES: Temperature ranges "2" and "3" may be used to lower ambient temperatures when sump preheaters are used. Temperature range "4" should be used only in ambient temperature range shown.

MODULATED SHIFT TRANSMISSIONS: H125, H200, H500, H600, 18000, 24000, 28000, 32000 & 34000 series transmissions with modulated shift use only C-3 or temperature range 3 items (a) & (b) *Dexron or *Dexron II D. **SEE CAUTION BELOW.** 3000, 4000, 5000, 6000, 8000 & 16000 series transmissions with modulated shift use only C-3 or temperature range 3 items (a) only *Dexron. Do **NOT** use *Dexron II D. **SEE CAUTION BELOW.**

CAUTION: *Dexron II D is not compatible with graphitic clutch plate friction material UNLESS IT MEETS THE APPROVED C-3 SPECIFICATIONS. *Dexron II D cannot be used in the 3000, 4000, 5000, 6000, 8000 or 16000 series power shift transmissions, or the HR28000, HR32000 & HR34000 series having converter lock-up, or the C270 series converter having lock-up UNLESS IT MEETS THE APPROVED C-3 SPECIFICATIONS.

Any deviation from this chart must have written approval from the application department of the Clark Components International Engineering and Marketing Department.

*** Normal drain periods and filter change intervals are for average environmental and duty-cycle conditions. Severe or sustained high operating temperatures or very dusty atmospheric conditions will cause accelerated deterioration and contamination. For extreme conditions judgment must be used to determine the required change intervals.**

TROUBLE SHOOTING GUIDE
For The
R & HR Model, 24000 Transmission

The following data is presented as an aid to locating the source of difficulty in a malfunctioning unit. It is necessary to consider the torque converter charging pump, transmission, oil cooler, and connecting lines as a complete system when running down the source of trouble since the proper operation of any unit therein depends greatly on the condition and operations of the others. By studying the principles of operation together with data in this section, it may be possible to correct any malfunction which may occur in the system.

TROUBLE SHOOTING PROCEDURE BASICALLY CONSISTS OF TWO CLASSIFICATIONS: MECHANICAL AND HYDRAULIC.

MECHANICAL CHECKS

Prior to checking any part of the system from a hydraulic standpoint, the following mechanical checks should be made:

1. A check should be made to be sure all control lever linkage is properly connected and adjusted at all connecting points.

2. Check shift levers and rods for binding or restrictions in travel that would prevent full engagement. Shift levers by hand at control valve, if full engagement cannot be obtained, difficulty may be in control cover and valve assembly.

HYDRAULIC CHECKS

Before checking on the torque converter, transmission, and allied hydraulic system for pressures and rate of oil flow, it is essential that the following preliminary checks be made:

Check oil level in transmission. This should be done with oil temperatures of 180 to 200° F. [82,2-93,3° C]. DO NOT ATTEMPT THESE CHECKS WITH COLD OIL. To bring the oil temperature to this specification it is necessary to either work the machine or "stall" out the converter. Where the former means is impractical, the latter means should be employed as follows:

Engage shift levers in forward and high speed and apply brakes. Accelerate engine half to three-quarter throttle.

Hold stall until desired converter outlet temperature is reached. **CAUTION:** FULL THROTTLE STALL SPEEDS FOR AN EXCESSIVE LENGTH OF TIME WILL OVERHEAT THE CONVERTER.

LOW CLUTCH PRESSURE

Cause	Remedy
1. Low oil level.	1. Fill to proper level.
2. Clutch pressure regulating valve spool stuck open.	2. Clean valve spool and housing.
3. Faulty charging pump.	3. Replace pump.
4. Broken or worn clutch shaft or piston sealing rings.	4. Replace sealing rings.
5. Clutch piston bleed valve stuck open.	5. Clean bleed valves thoroughly.

LOW CONVERTER CHARGING PUMP OUTPUT

1. Low oil level.	1. Fill to proper level.
2. Suction screen plugged.	2. Clean suction screen.
3. Air leaks at pump intake hose and connections or collapsed hose. (R24000 only)	3. Tighten all connections or replace hose if necessary.
4. Defective oil pump.	4. Replace pump.

OVERHEATING

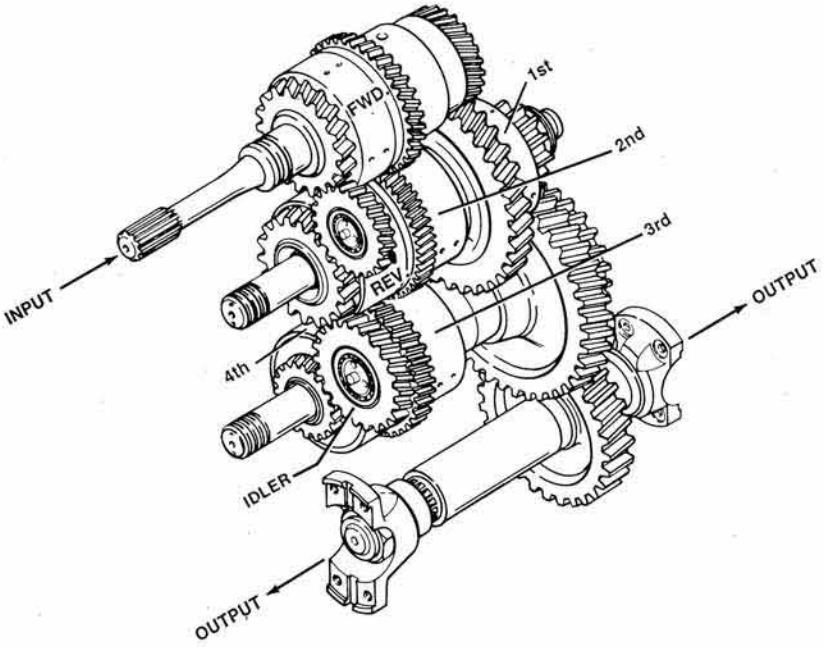
1. Worn oil sealing rings.	1. Remove, disassemble, and rebuild converter assembly.
2. Worn oil pump.	2. Replace.
3. Low oil level.	3. Fill to proper level.
4. Pump suction line taking air. (R24000 only)	4. Check oil line connections and tighten securely.

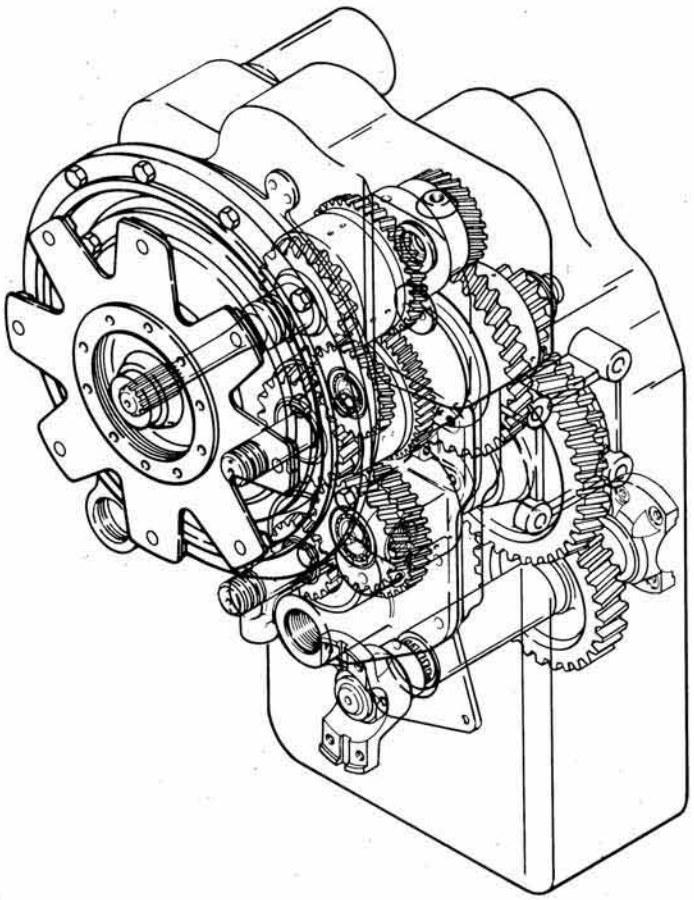
NOISY CONVERTER

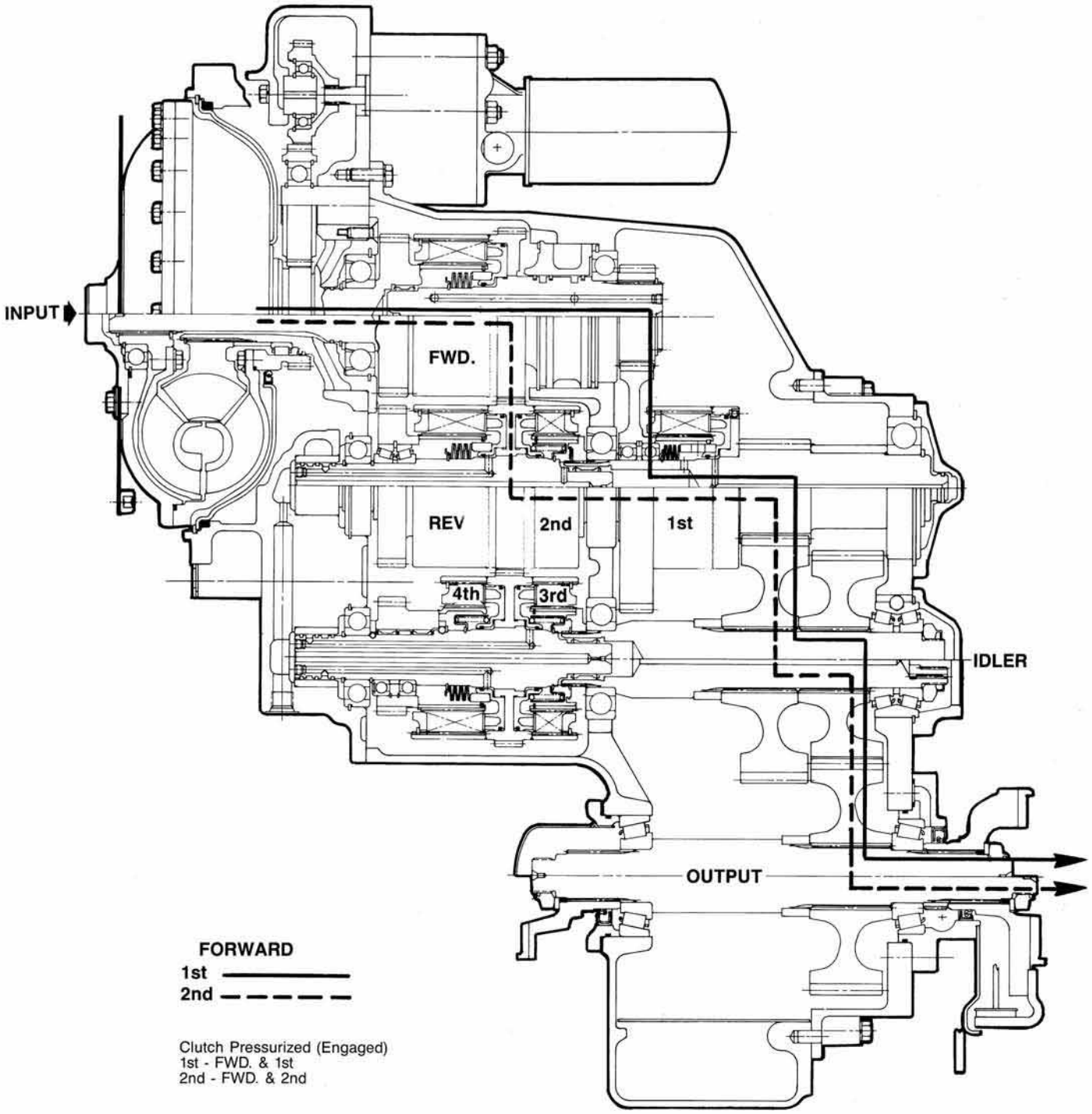
1. Worn oil pump.	1. Replace.
2. Worn or damaged bearings.	2. A complete disassembly will be necessary to determine what bearing is faulty.

LACK OF POWER

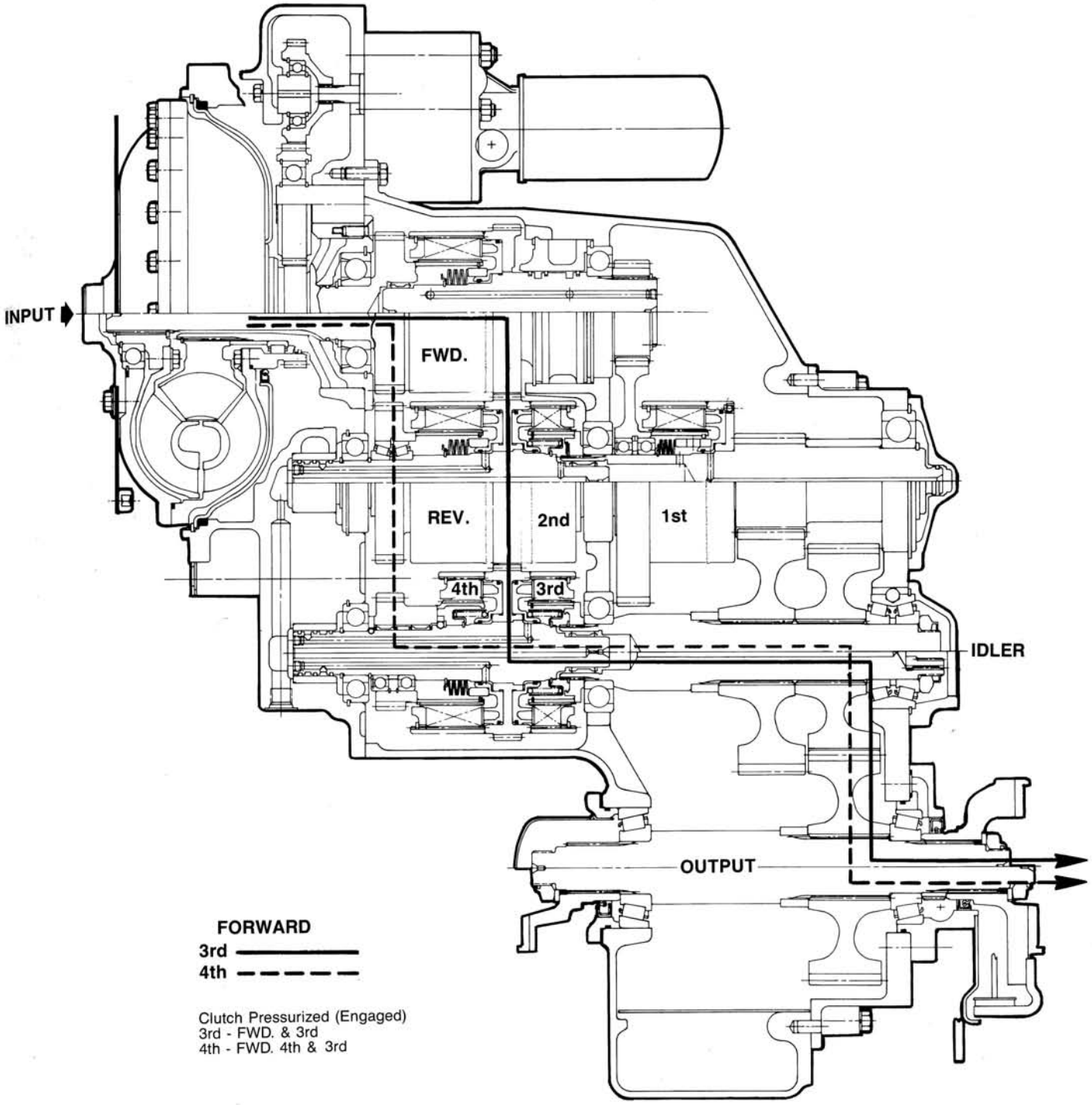
1. Low engine RPM at converter stall.	1. Tune engine check governor.
2. See "Overheating" and make same checks.	2. Make corrections as explained in "Overheating."


INPUT
FWD.
REV
1st
2nd
3rd
4th
IDLER
OUTPUT
OUTPUT

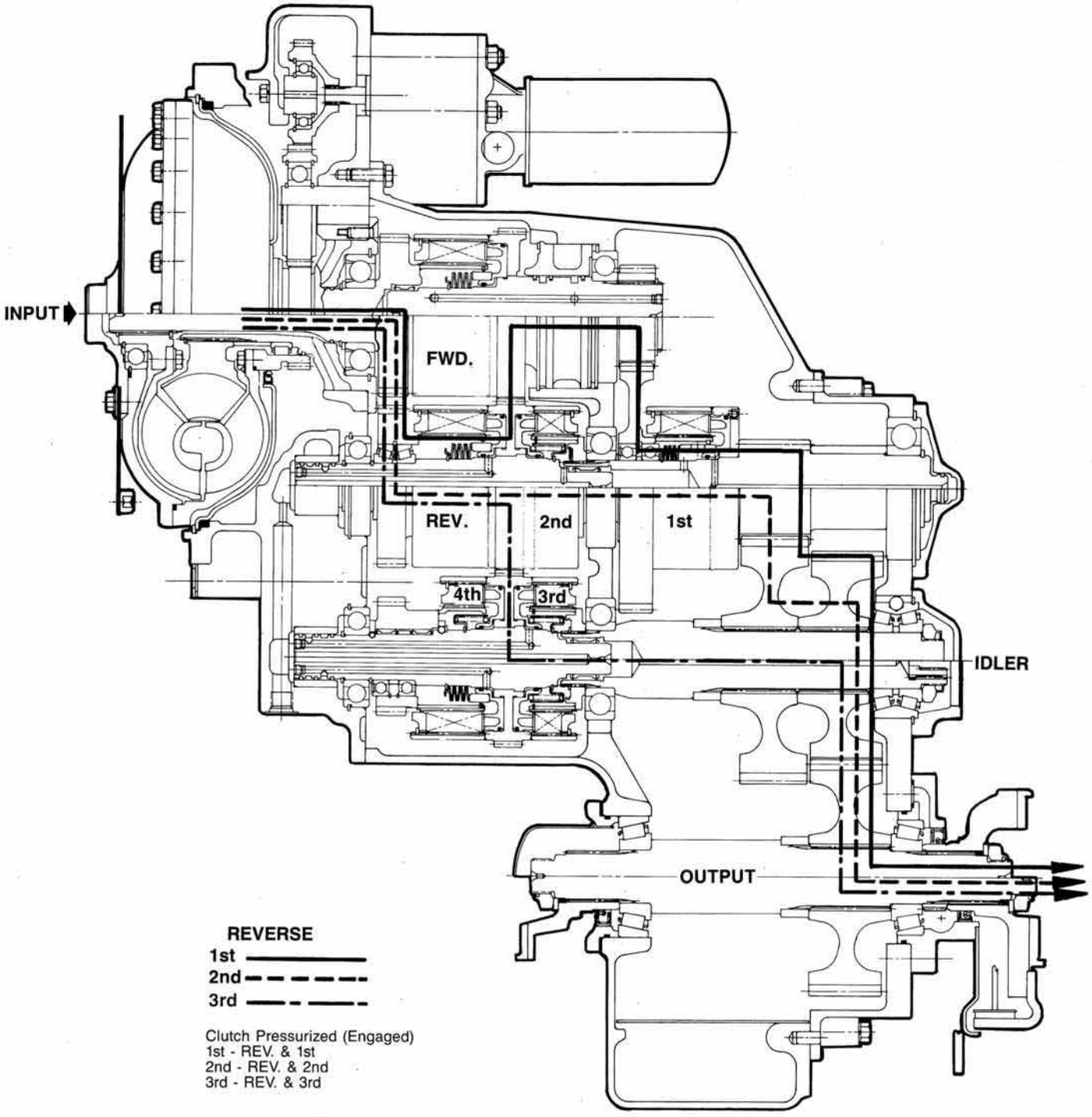




HR 24000 - 4 SPEED TRANSMISSION

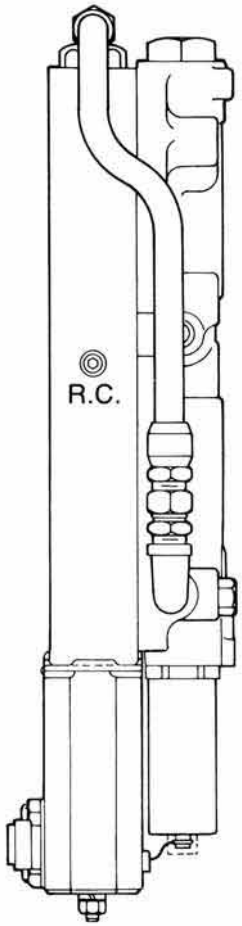


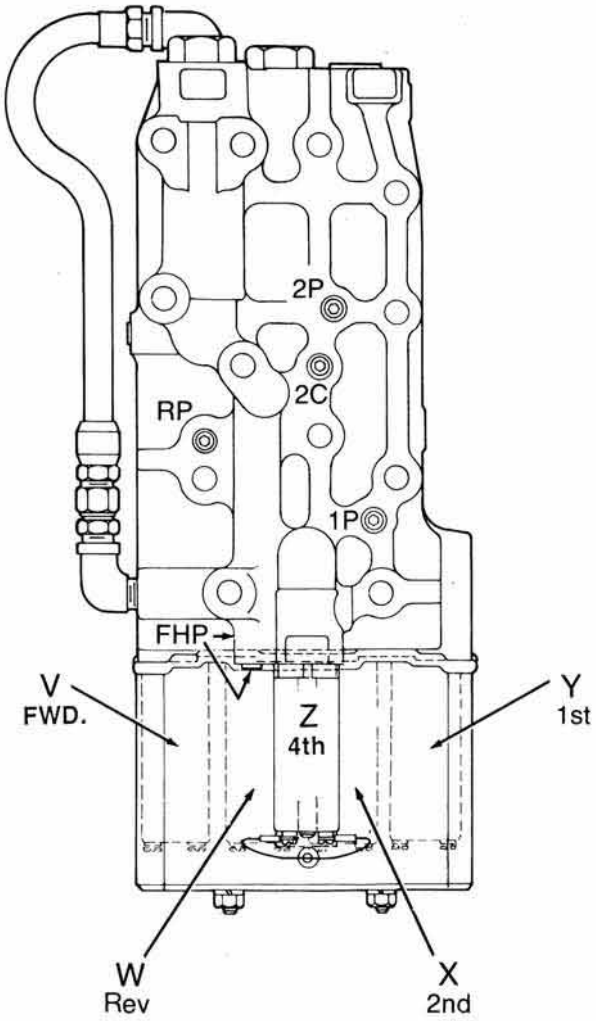
HR 24000 - 4 SPEED TRANSMISSION

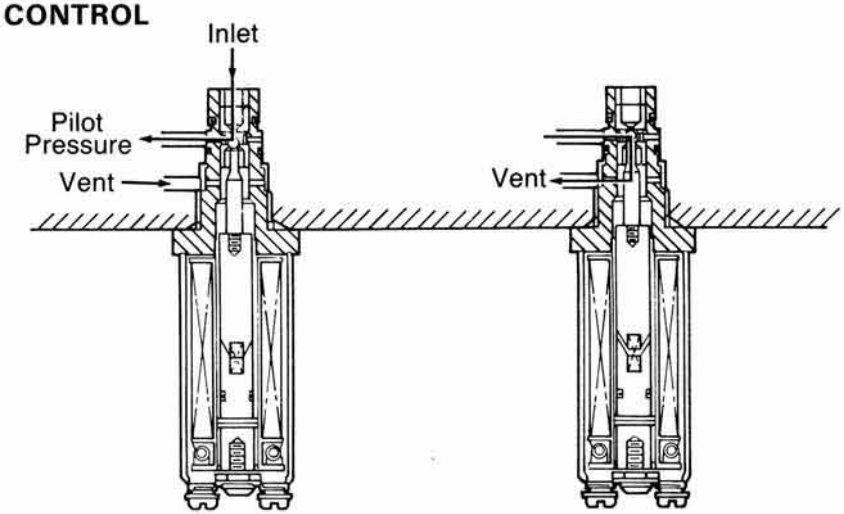


HR 24000 - 4 SPEED TRANSMISSION

4 SPEED TRANSMISSION
ELECTRIC SOLENOID CONTROL







ENERGIZED **DE-ENERGIZED**

DIRECTION & SPEED	SOLENOIDS ENERGIZED	CLUTCHES PRESSURIZED
Forward 1st	V X Y	Forward & 1st
Forward 2nd	V X	Fwd. & 2nd
Forward 3rd	V	Fwd. & 3rd
Forward 4th	V Z	4th & 3rd
Reverse 1st	W X Y	Rev. & 1st
Reverse 2nd	W X	Rev. & 2nd
Reverse 3rd	W	Rev. & 3rd

PILOT & CLUTCH PRESSURE CHECK POINTS

1P 1st Pilot
2P 2nd Pilot
2C 2nd Clutch
4P (FHP) 4th Clutch
R.P. Reverse Pilot
R.C. Reverse Clutch

CLARK

NOTE:
USE RELAY WHERE STARTER SOLENOID DRAW IS MORE THAN 6AMPS

RELAY NO.
DELCO-REMY 1114238DR-12VDC OR EQUIV.
DELCO-REMY 1114239DR-24VDC OR EQUIV.

CAB CONTROL IS SUPPLIED WITH 36INCHES OF LEAD WIRE - BLANK ENDS.

WIRE SIZE :-
NO. 18 A.W.G.

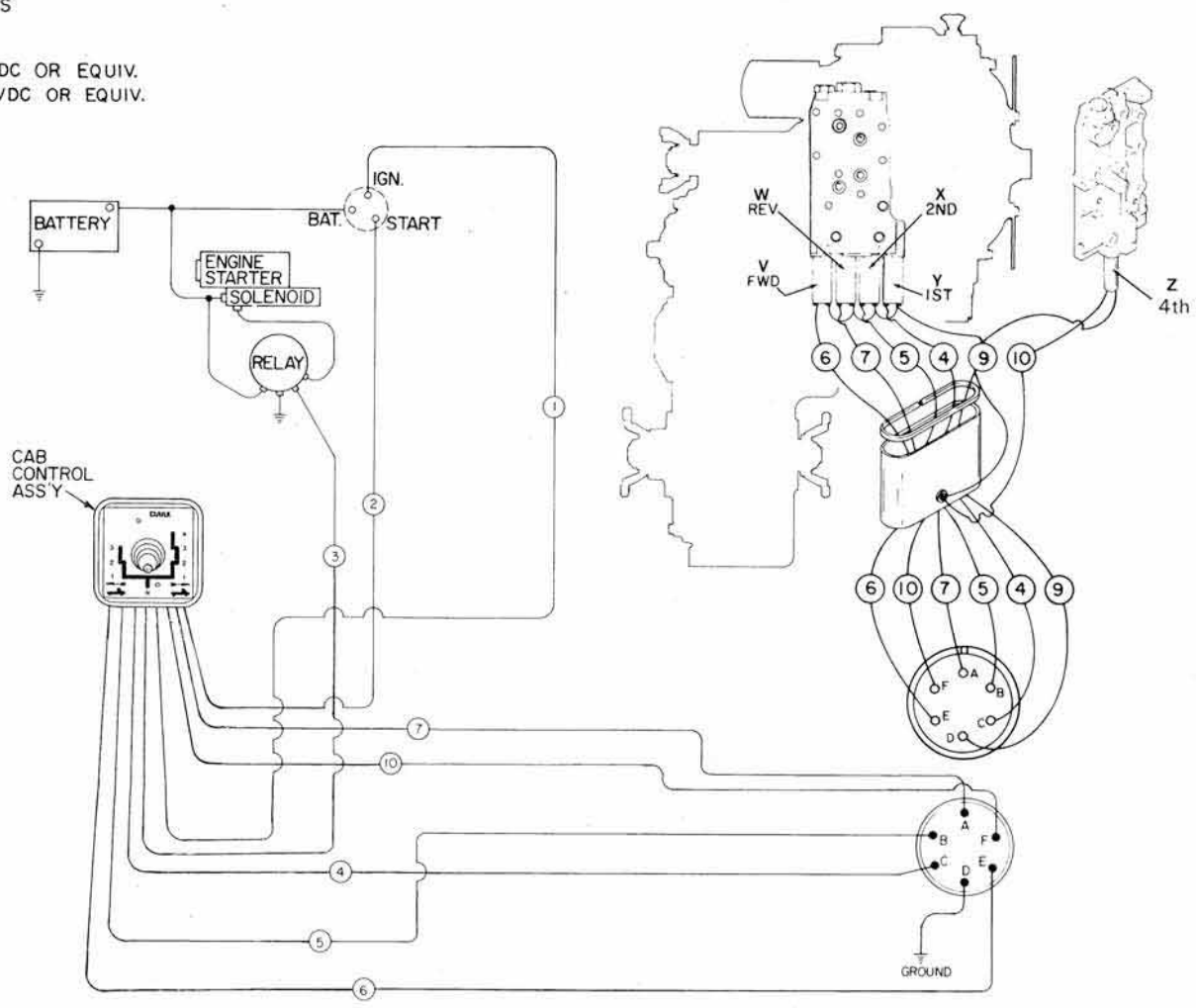
SPEED	ENERGIZED WIRES
F1	1-4-5-6
F2	1-5-6
F3	1-6
F4	1-6-10
N STARTING ENGINE	2-3
R 1	1-4-5-7
R 2	1-5-7
R 3	1-7

CAB CONTROL

WIRE NO.	COLOR CODE
1	WHITE
2	BLACK
3	RED
4	YELLOW
5	GREEN
6	BLUE
7	BROWN
8	BLACK
9	ORANGE
10	PINK

SYSTEM VOLTAGE	CONTROL VALVE ASS'Y.
12 VDC AND 24 VDC	SEE MODEL PARTS LIST

SOLENOID	CAPACITY
240212	12VDC
240224	24VDC

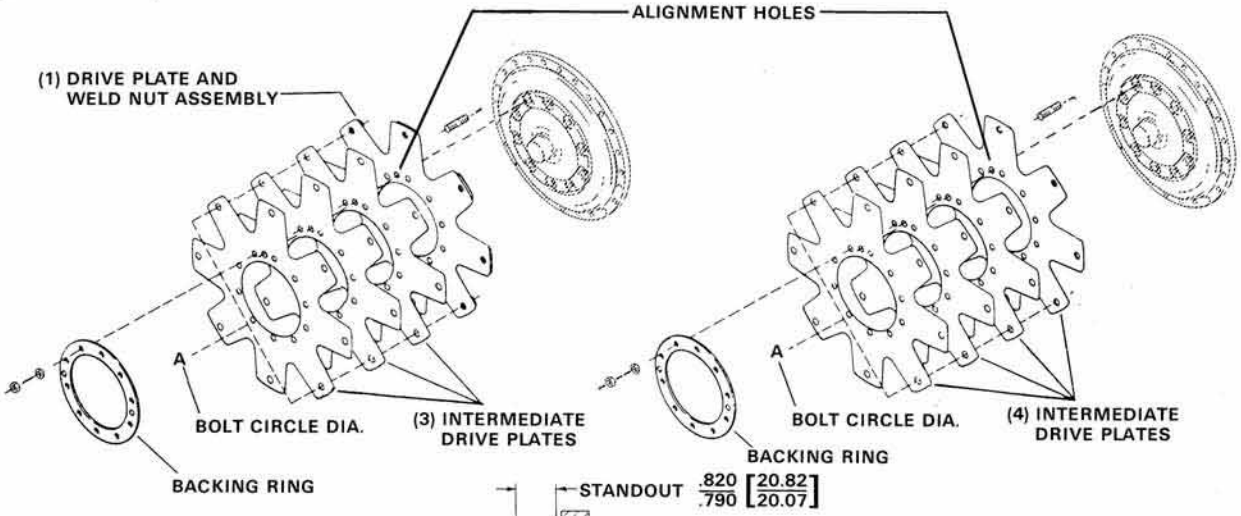


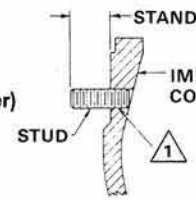
4 SPD. TRANSMISSION ELECTRIC SOLENOID CONTROL WIRING DIAGRAM - 12VDC AND 24VDC

DRIVE PLATE INSTALLATION

Measure the "A" dimension (Bolt Circle diameter) and order Drive Plate Kit listed below.

Note four (4) kits have three (3) intermediate drive plates and one (1) drive plate and weld nut assembly. Two (2) kits with four intermediate drive plates.





"A" Dimension (Bolt Circle Diameter)

11.38" [288,900 mm] Diameter
Kit No. 802215

13.125" [333,375 mm] Diameter
Kit No. 802216

13.50" [342,900 mm] Diameter
Kit No. 802214

17.00" [431,800 mm] Diameter
Kit No. 802264

Each Kit will include the following parts:

3	Intermediate Drive Plates.
1	Drive Plate and Weld Nut Assembly.
1	Backing Ring.
10	Studs.
10	Lockwashers.
10	Stud Nuts.
1	Instruction Sheet.

"A" Dimension (Bolt Circle Diameter)

13.50" [342,900 mm] Diameter
Kit No. 802217

13.125" [333,375 mm] Diameter
Kit No. 802263

Each kit will include the following parts:

4	Intermediate Drive Plates.
1	Backing Ring.
10	Studs.
10	Lockwashers.
10	Stud Nuts.
1	Instruction Sheet.

Drive Plate Installation Procedure

1 TO FACILITATE ASSEMBLY, ALIGN SMALL HOLES IN DRIVE PLATES — SEE ILLUSTRATION ABOVE.

Clean tapped holes and studs thoroughly with Loctite 755 Solvent. Must be free of any grease or oil. Spray Loctite 747 Primer "T" in tapped holes and on studs and allow to dry. Apply Loctite 262 Threadlocker to both tapped holes and (16 NC thread) stud end. Assemble to standout shown. Remove excess Loctite after assembly. Allow 30 minutes minimum before installing on engine. **NOTE**: If Loctite 747 Primer "T" is not used, allow 24 hours for the threadlocker to cure before installing on engine.

Position drive plate and weld nut assembly on impeller cover studs with weld nuts toward cover. Align intermediate drive plate and backing ring with studs in impeller cover. **NOTE**: Two dimples 180° apart in backing ring must be out (toward engine flywheel). Install washers and stud nuts. With a calibrated torque wrench, tighten nuts 26 to 29 ft. lbs. torque [35,3 - 39,3 N.m].

Over for TRANSMISSION TO ENGINE INSTALLATION PROCEDURE

TRANSMISSION TO ENGINE INSTALLATION PROCEDURE

1. Remove all burrs from flywheel mounting face and nose pilot bore. Clean drive plate surface with solvent.

2. Check engine flywheel and housing for conformance to standard S.A.E. #3 - S.A.E. J-927 tolerance specifications for pilot bore size, pilot bore runout and mounting face flatness. Measure and record engine crankshaft end play.

3. Install two 2.50 [63, 50 mm] long transmission to flywheel housing guide studs in the engine flywheel housing as shown. Rotate the engine flywheel to align a drive plate mounting screw hole with the flywheel housing access hole.

*4. Install a 4.00 [101, 60 mm] long drive plate locating stud .3750-24 fine thread in a drive plate nut. Align the locating stud in the drive plate with the flywheel drive plate mounting screw hole positioned in step No. 3.

5. Locate transmission on flywheel housing aligning drive plate to flywheel and transmission to flywheel housing. **NOTE:** Fig. 4 installation, align drive plate holes with flywheel studs.

   Install transmission to flywheel housing screws. Tighten screws to specified torque. Remove transmission to engine guide studs. Install remaining screws and tighten to specified torque.

*6. Remove drive plate locating stud.

7. Install drive plate attaching screw and washer. Snug screw but **do not tighten. NOTE:** Fig. 4 installation, install drive plate attaching washers and nuts. Tighten each nut 28 to 30 ft. lbs. torque [38,0 - 40,6 N.m]. Some engine flywheel housings have a hole located on the flywheel housing circumference in line with the drive plate screw access hole. A screwdriver or pry bar used to hold the drive plate against the flywheel will facilitate installation of the drive plate screws. Rotate the engine flywheel and install the remaining seven (7) flywheel to drive plate attaching screws. Snug screws but do not tighten. After all eight (8) screws are installed torque each one 25 to 30 ft. lbs. torque [33,9 - 40,6 N.m]. This will require torquing each screw and rotating the engine flywheel until the full amount of eight (8) screws have been tightened.

8. Measure engine crankshaft end play after transmission has been completely installed on engine flywheel. This value must be within .001 [0,025mm] of the end play recorded in step No. 2.

* Does not apply to units having 3 intermediate drive plates. See Fig. 4.

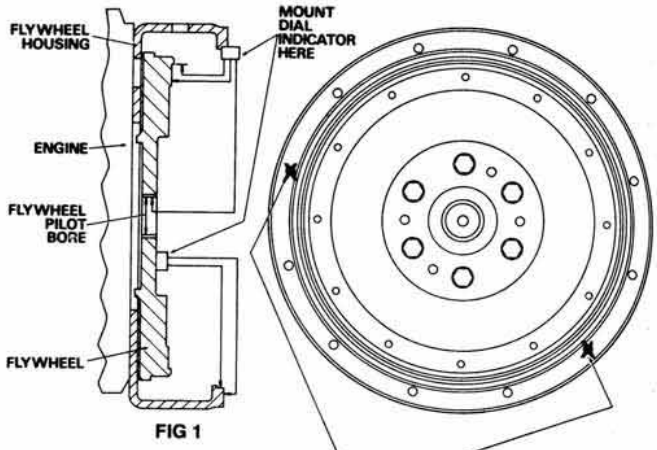


FIG 1

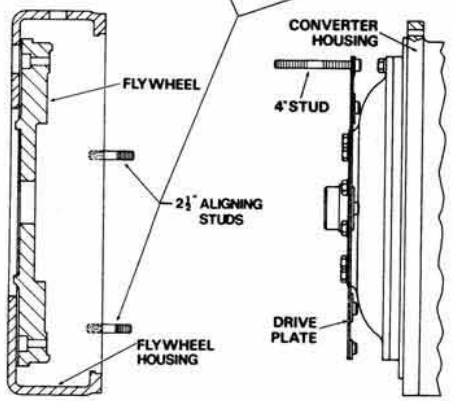


FIG 2

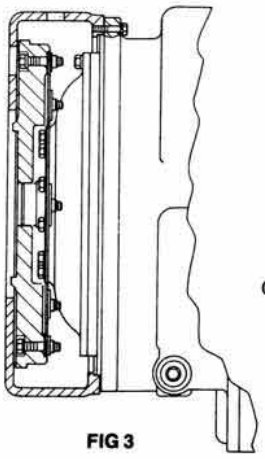


FIG 3

SPECIAL STUD, WASHER AND SELF LOCK NUT FURNISHED BY ENGINE MANUFACTURER.

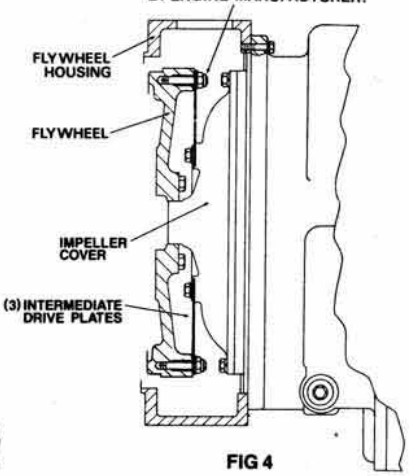


FIG 4

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