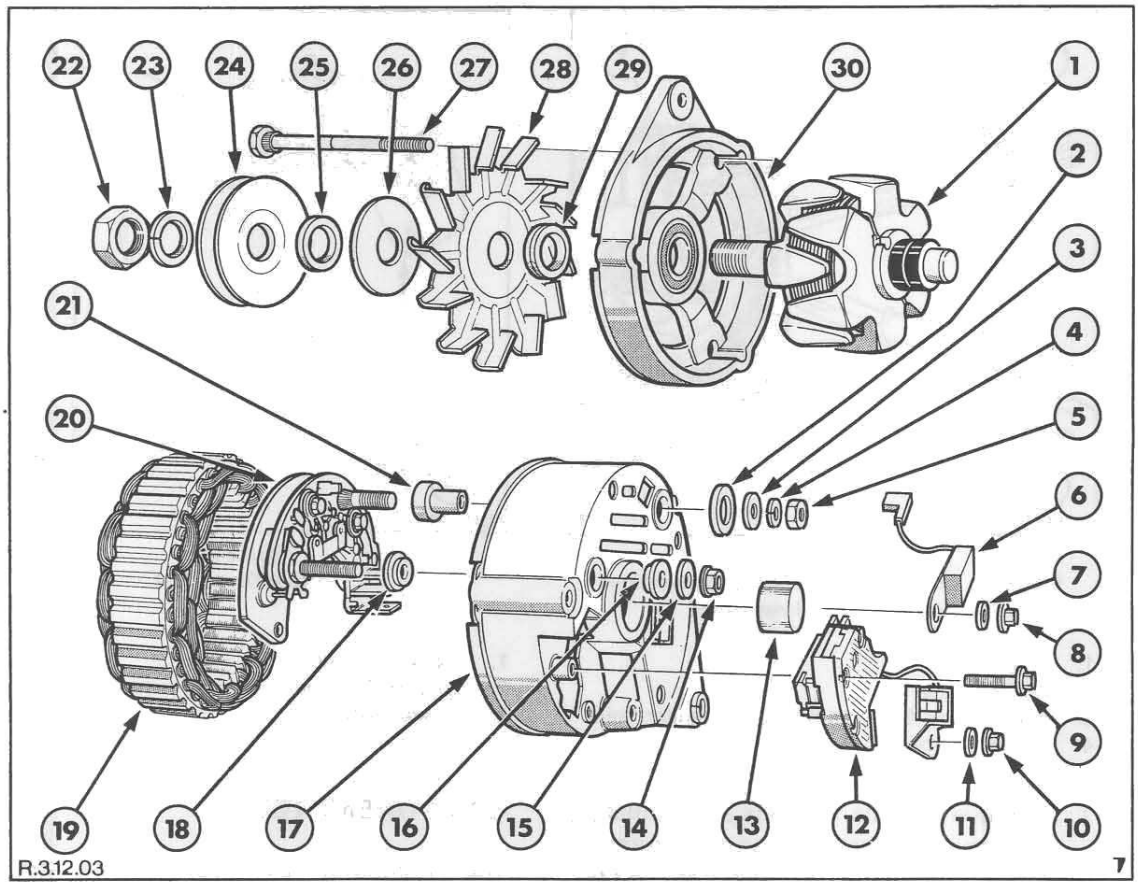

Figure 19
Alternator Components

1. Rotor
2. Insulator
3. Washer
4. Spring Washer
5. Nut
6. Suppressor (where fitted)
7. Washer
8. Nut
9. Bolt
10. Nut
11. Washer
12. Regulator/Brushbox
13. Bearing
14. Nut
15. Washer
16. Insulator
17. Rear End Bracket
18. Insulator
19. Stator
20. Rectifier
21. Insulator
22. Nut
23. Washer
24. Pulley
25. Spacer
26. Washer
27. Through Bolt
28. Fan
29. Double Spacer
30. End Bracket

DISASSEMBLY

With reference to Figure 19.

1. Remove the nut from the alternator throughbolt, allowing the radio interference suppressor (where fitted) to be disconnected and removed.
2. Remove the nut from the battery temperature sensor terminal.
3. Remove the three securing bolts and withdraw the regulator/brushbox assembly. Separate the wiring connection to the regulator.
4. Mark the alternator front end bracket, stator, and rear end bracket to ensure correct alignment on re-assembly.
5. Unscrew and remove the remaining three nuts from the alternator through bolts. With a soft mallet tap the threaded end of the through bolts to release the spline at hexagon head end.
6. Gently tap the rear face of the alternator front end bracket to separate the front end bracket and rotor assembly from the rear end bracket, stator and rectifier assembly.

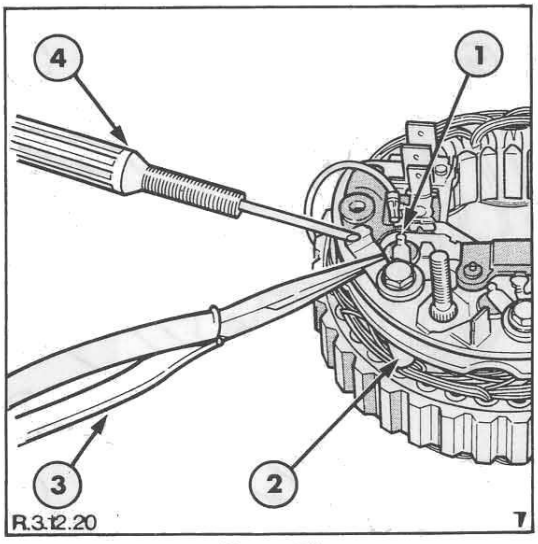

Figure 20
Soldering and Unsoldering Diode Connections Using Pliers as a Heat Guard

1. Diode
2. Stator Output Wire
3. Pliers Placed Between Diode and Solder Point
4. Soldering Iron

7. Remove the nuts, washers and insulators from the stud terminals on the alternator rear end bracket, and the two rectifier retaining screws. Remove the stator and rectifier from the rear end bracket.

8. Unsolder the stator leads from the tags on the rectifier, using a pair of pliers as a heat sink to prevent the diodes from becoming overheated. Figure 20.

9. Remove the nut, washer, pulley spacer, washer, fan and double spacer from the rotor shaft.

10. Press the rotor shaft out of the front end bracket bearing.

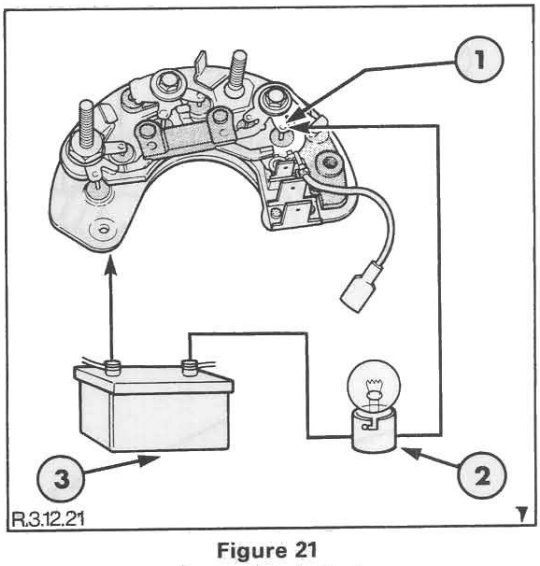

Figure 21
Output Diode Test

1. Diode Connecting Pin
2. 2.2 Watt Test Lamp
3. 12 Volt Battery

COMPONENT TEST

The following electrical equipment is required to test the rotor, stator windings and rectifier diodes.

- 12 Volt Battery
- Test Lamp (12 Volts 2.2 Watts)
- Test Lamp (12 Volts 36 Watts Minimum)
- 110 Volt Insulation Tester or 250V Megohm Meter

Rectifier Assembly – Positive/Negative Diodes

Test each of the six diodes separately as follows:

1. Connect a 12 volt battery and a 2.2 watt test lamp in series with one of the diodes. One test lead is applied to the diode connecting pin and the other lead to the plate into which the diode is mounted. Figure 21.

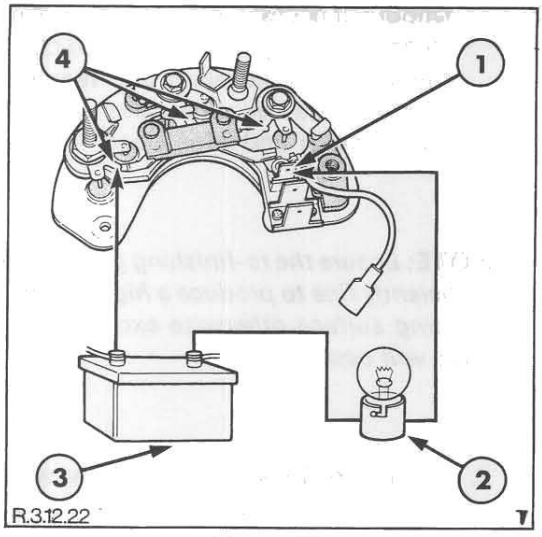

Figure 22
Field Diode Test

1. IND (Indicator) Terminal
2. 2.2 Watt Test Lamp
3. 12 Volt Battery
4. Field Diode Connections

2. Note if the lamp lights.

3. Reverse the test lead connections.

The lamp should light during one half of this test only. If any one diode fails this test, the complete rectifier assembly must be renewed.

Rectifier Assembly – Field Diodes

Three separate field diodes are contained within the field diode module. Test each diode separately as follows:

1. Connect a 12 volt battery and a 2.2 watt test lamp in series with the field diode module. Apply the negative test lead to the "IND" indicator terminal and the other lead in turn to each of the field diode module connections. Figure 22.

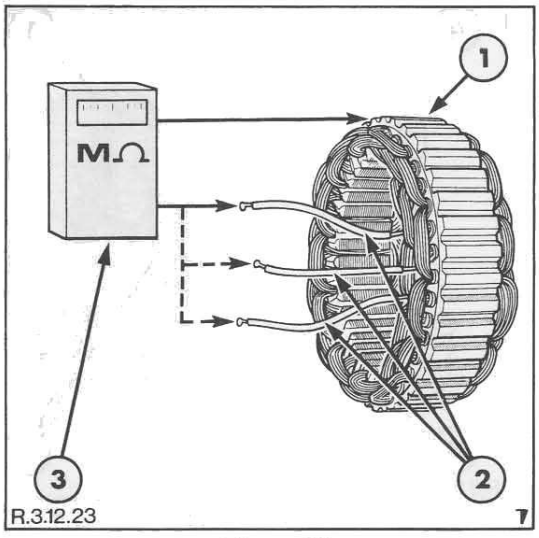

Figure 23
Stator Winding Insulation Test

1. Stator Laminations
2. Stator Output Wires
3. 110V Insulation Tester or 250V Megohm Meter

2. Note if the lamp lights.

3. Reverse the test lead connections.

The lamp should light during one half of this test only. If any one diode fails this test, the complete rectifier assembly must be renewed.

STATOR

Winding Insulation Test

With reference to Figure 23.

1. Using a 110V insulation tester or 250V megohm meter test the insulation between each of the three stator output leads and the stator laminations.

   If the test results prove unsatisfactory the stator assembly must be renewed.

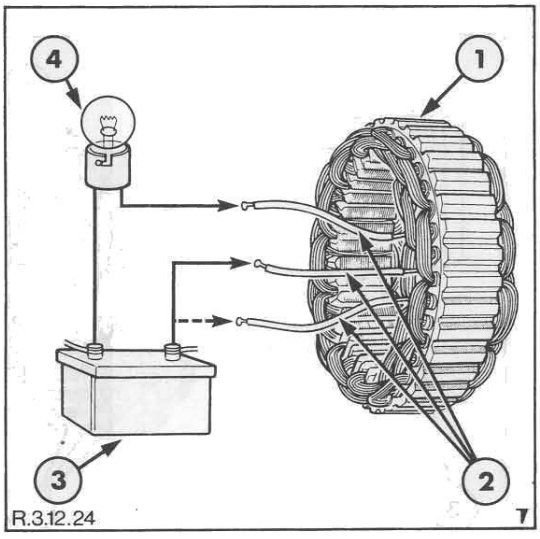

Figure 24
Stator Winding Continuity Test

1. Stator Windings
2. Stator Output Wires
3. 12 Volt Battery
4. 36 Watt Test Lamp

Windings Continuity Test

With reference to Figure 24.

1. Connect any two of the three stator output wires in series with a 12 volt battery operated test lamp of not less than 36 watts. The test lamp should light.

2. Transfer one of the test lamp leads to the third wire. The test lamp should light.

If the test results prove unsatisfactory the stator assembly must be renewed.

ROTOR

Prior to performing component tests on the rotor the following slip ring inspection should be carried out.

1. Ensure the slip rings are clean and smooth. If necessary the slip rings may be cleaned with a petrol-moistened cloth. If the slip rings are burnt and require re-finishing use very fine glass paper (not emery cloth) and wipe clean.

NOTE: *Ensure the re-finishing glass paper is sufficiently fine to produce a highly polished slip ring surface otherwise excessive brush wear will occur.*

2. If the slip rings are excessively worn a new rotor must be installed.

Field Winding Continuity/Resistance Test

With reference to Figure 25

1. Connect an ohmmeter between the two rotor slip rings. Check that the rotor field winding resistance is within acceptable tolerances, see "Specifications" – Chapter 5.

If the test result proves unsatisfactory, the rotor must be renewed.

Field Winding Insulation Test

With reference to Figure 26.

Using a 110V insulation tester or 250V megohm meter test the insulation between each of the slip rings and the rotor poles.

If the test results prove unsatisfactory the rotor assembly must be renewed.

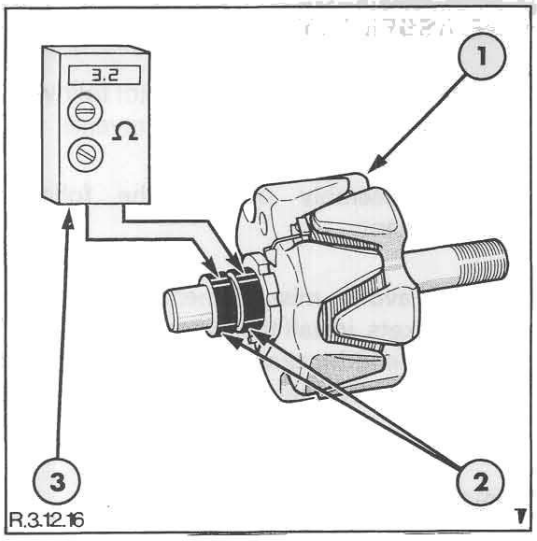

Figure 25
Field Winding Continuity/Resistance Test

1. Rotor
2. Slip Rings
3. Ohm Meter

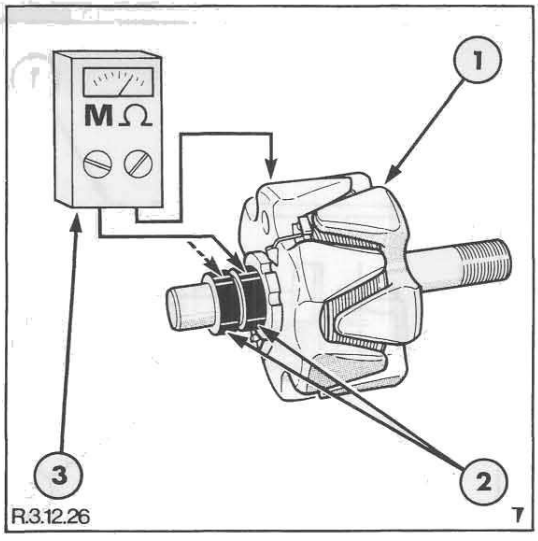

Figure 26
Field Winding Insulation Test

1. Rotor Pole
2. Slip Rings
3. 110V Insulation Tester or 250V Megohm Meter

INSPECTION AND REPAIR

1. Inspect the rotor poles and stator for signs of rubbing. Areas of rubbing indicate both bearings are excessively worn and need replacing.

2. If the front (drive) end bearing is defective the complete housing (front end bracket) and bearing assembly must be renewed.

3. Inspect the roller bearing located in the rear (slip ring) end bracket for wear and damage.

4. If bearing replacement is necessary support the housing (rear end bracket) and, using a suitable size mandrel, carefully drive out the bearing, Figure 27.

5. Clean and examine all components.

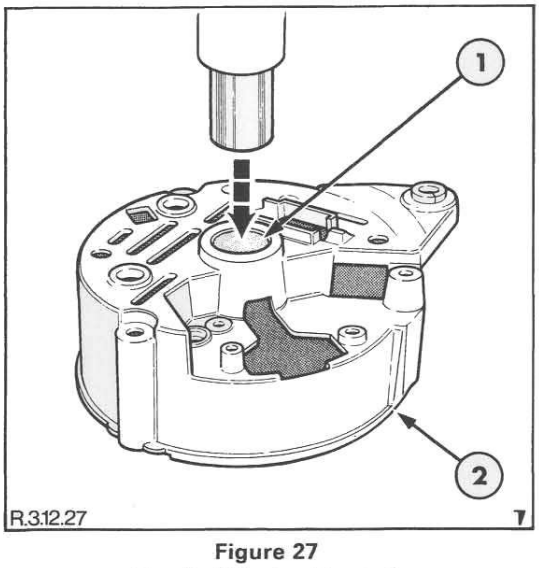

Figure 27
Rear End Bearing Removal

1. Bearing
2. Housing (Rear End Bracket)

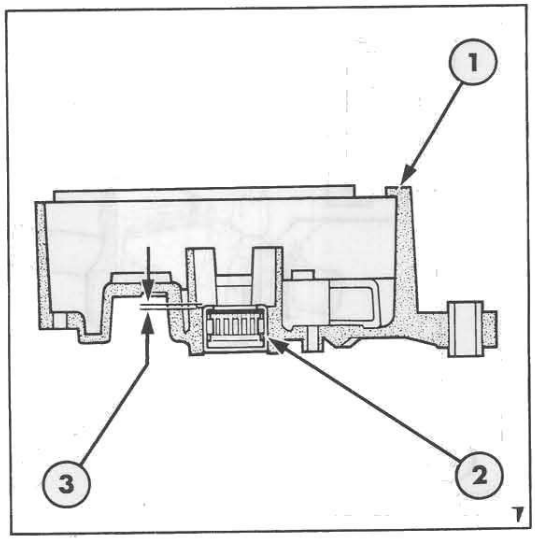

Figure 28
Rear End Bearing Installation

1. Housing
2. Bearing
3. Bearing Protrusion

6. Press the new bearing into the housing. The bearing should be positioned 0.50 – 0.70 mm (.020 – .028 in) proud of the inner face of the bearing boss, Figure 28.

RE-ASSEMBLY

1. Re-assembly of the alternator follows the disassembly procedure in reverse.

On re-assembly observe the following requirement:

- To avoid misalignment of the end brackets, install the stator assembly in the drive end bracket then assemble the slip ring end bracket to the stator laminations.

INSTALLATION

1. Installation of the alternator is the removal procedure in reverse.

On installation observe the following requirement:

- Ensure the battery ground (negative) cable is disconnected from the battery when installing the alternator.
- Adjust the alternator drive belt tension as previously described in this Chapter.

D. CHARGING SYSTEM A127/55 AMP ALTERNATOR WITH INTEGRAL REGULATOR – SPECIFICATIONS

Alternator Type	A127/45
Ground Polarity	Negative
Nominal Voltage	12V
Maximum Alternator rev/min.	15,000
Maximum Output (Hot) at Maximum Engine Speed	55A
Regulator Controlled Voltage	13.6 – 14.4V
Rotor Field Winding Resistance	3.2 ohms
Stator Winding Resistance (per phase)	0.18 ohms
New Brush Length (mm)	17 mm
Renew Brushes at	5mm
Brush Spring Pressure	1.3 – 2.7N (4.7 – 9.8 oz)

TORQUE SPECIFICATIONS

	lb:ft	Nm	kgfm
Alternator Through Bolts	4.0	5.5	0.55
Shaft Nut	44.0	60.0	6.08
Rectifier Attaching Screws	2.5	3.5	0.35
Regulator and Brushbox Screws	2.0	2.5	0.28
Main Output Terminal Nut (6mm)	3.0	4.0	0.41
Phase Terminal Nut (5mm)	3.0	4.0	0.41
Mounting Bolt	18.0	25.0	2.5
Tension Adjusting Bolt	8.0	11.0	1.10

PART 3
ELECTRICAL SYSTEM

Chapter 5
TROUBLE SHOOTING, SPECIFICATIONS AND SPECIAL TOOLS

Section		Page
A.	TROUBLE SHOOTING	1
B.	SPECIFICATIONS	5
C.	SPECIAL TOOLS	7

A. TROUBLE SHOOTING

INSTRUMENT AND EQUIPMENT TROUBLE SHOOTING GUIDE

PROBLEM	POSSIBLE CAUSES
Warning Lights and Gauges Inoperative	1. Key Start switch faulty 2. Fuse(s) burnt out
Temperature Gauge or Fuel Gauge Erratic or Inoperative	1. Loose or broken wiring 2. Defective gauge 3. Defective sender unit
Oil Pressure or Charging Lights Inoperative	1. Loose or broken wiring 2. Bulb burnt out 3. Defective sender unit

PROBLEM	POSSIBLE CAUSES
Front and Rear Work Lights, Front and Rear Light Clusters	1. Fuse burnt out 2. Bulb burnt out 3. Loose or broken wires 4. Relay(s) inoperative
Heater Motor, Front and Rear Wiper Motors	1. Fuse burnt out 2. Defective 3. Loose or broken wiring
Individual Warning Lights, Control Console Lights, Work Lights Burn out Repeatedly	1. Loose or corroded terminals 2. Alternator output regulator faulty 3. Light relay inoperative

ENGINE STARTING PROBLEM

PROBLEM	POSSIBLE CAUSES
Engine Will Not Crank and Solenoid Does Not Engage	1. Battery discharged 2. Key Starting Switch inoperative 3. Starting motor relay inoperative 4. Starting circuit open or has high resistance 5. Safety Start Switch inoperative
Engine Will Not Crank but Solenoid Engages	1. Battery discharged 2. Defective starting motor 3. Defective starting motor connection or loose battery connections 4. Engine seized 5. Burnt solenoid contacts
Starting Motor Turns but does not Crank Engine	1. Defective starting motor drive assembly 2. Defective flywheel ring gear
Engine Cranks Slowly	1. Discharged battery 2. Excessive resistance in starting circuit 3. Defective starting motor or solenoid 4. Tight engine

CHARGING SYSTEM TROUBLE SHOOTING GUIDE

PROBLEM	POSSIBLE CAUSES
Battery Low in Charge	1. Poor Battery Condition will not accept or hold a charge, Electrolyte level low 2. Loose or worn alternator drive belt 3. Excessive resistance due to loose charging system connections 4. Defective temperature sensor 5. Defective alternator
Alternator Charging at High Rate (Battery Overheating)	1. Defective battery 2. Defective temperature sensor 3. Defective alternator
No Output from Alternator	1. Alternator drive belt broken 2. Loose connection or broken cable in charging system 3. Defective alternator
Intermittent or Low Alternator Output	1. Alternator drive belt slipping 2. Loose connections or broken cables in charging system 3. Defective temperature sensor 4. Defective alternator

ALTERNATOR TROUBLE SHOOTING GUIDE

PROBLEM	POSSIBLE CAUSES
Warning Light Dims and/or Battery Low	Faulty: 1. External charging circuit connections 2. Rotor slip rings or brushes
Warning Light Goes Out – Becomes Bright with Speed	1. External charging circuit connections 2. Rectifier
Warning Light Normal but Battery Boiling	1. Regulator 2. Battery temperature sensor
Warning Light Normal but Flat Battery	1. Regulator 2. Stator 3. Rectifier

ALTERNATOR TROUBLE SHOOTING GUIDE (CONT'D)

PROBLEM	POSSIBLE CAUSES
Warning Light Illuminated Continuously and/or Flat Battery	1. Temperature sensor 2. Rotor, slip rings or brushes 3 Regulator 4. Stator 5. Rectifier
Warning Light Extinguished Continuously and/or Flat Battery	1. Warning light bulb 2. Alternator internal connections 3. Regulator 4. Rotor, slip rings or brushes 5. Stator
Warning Light Flashes Intermittently	1. External charging circuit 2. Alternator internal connections
Warning Light Dims Continuously and/or Flat Battery	1. Rotor, slip rings or brushes 2. Regulator

B. SPECIFICATIONS

BATTERY

Capacity/Amp/Hour	128
Voltage	12
Ground Terminal	Negative

ALTERNATOR – A127/55 AMP ALTERNATOR WITH INTEGRAL REGULATOR

Alternator Type	A127/55
Ground Polarity	Negative
Nominal Voltage	12V
Maximum Alternator rev/min.	15,000
Maximum Output (Hot) at Maximum Engine Speed	55A
Regulator Controlled Voltage	13.6 – 14.4V
Rotor Field Winding Resistance	3.2 ohms
Stator Winding Resistance (per phase)	0.18 ohms
New Brush Length (mm)	17 mm
Renew Brushes at	5 mm
Brush Spring Pressure	1.3 – 2.7N (4.7 – 9.8 oz)

STARTING SYSTEM

No-Load Current Draw (Maximum) at 12 volts and 5500-7500 starter rev/min.	120 amps
Current Draw (Starter installed on Warm Engine) at 12 volts and 150-200 Engine rev/min.	250-300 amps
Brush Length Minimum	0.31 in. (7.9 mm)
Brush Spring Tension with New Brush (Minimum)	55 oz (1559g)
Commutator Diameter (Minimum)	1.57 in. (39.878 mm)
Armature Shaft End Play (Maximum)	0.012 in. (0.305 mm)
Armature Shaft Runout (Maximum)	0.004 in. (0.102 mm)
Drive Pinion Clearance (Engaged)	0.012–0.060 in. (0.30–1.50 mm)

FUSE RATING CHART

Fuse No.	Rating	Colour	Circuit
1	15A	Blue	Rotating Beacon
2	15A	Blue	Hazard Warning Lights
3	—	—	
4	15A	Blue	Headlight Switch
5	5A	Brown	R.H. Side/Rear Lights and Fog Lamp
6	15A	Blue	Headlight Dip Beam
7	10A	Red	Turn Signals
8	5A	Brown	Fuel Shut-Off
9	15A	Blue	Wipe/Washer
10	5A	Brown	Radio
11	5A	Brown	L.H. Side/Rear Lights and Instrument Lights
12	15A	Blue	Headlight Main Beam
13	15A	Blue	Stop Lights
14	10A	Red	Horn
15	25A	Clear	Heater Blower
16	25A	Clear	Air Conditioning
17	5A	Brown	Gauges
18	5A	Brown	Transmission Shuttle Valve
19	5A	Brown	Return-to-Dig
20	25A	Clear	Thermostart
21	5A	Brown	Interior Light
22	—	—	
23	25A	Clear	Rear Work Lamps
24	25A	Clear	Front Work Lamps

NOTE: *Certain optional items of equipment may not be installed on the Unit however, the fuses are still installed and may be used as spares.*

TORQUE VALUES

Alternator

	Lbf.ft	Nm	Kgfm
Alternator Through Bolts	4.0	5.5	0.55
Shaft Nut	44.0	60.0	6.08
Rectifier Attaching Screws	2.5	3.5	0.35
Regulator and Brushbox Screws	2.0	2.5	0.28
Main Output Terminal Nut (6mm)	3.0	4.0	0.41
Phase Terminal Nut (5mm)	3.0	4.0	0.41
Mounting Bolt	18.0	25.0	2.5
Tension Adjusting Bolt	8.0	11.0	1.10

The following general nut and bolt installation torque requirements (lubricated) apply to any operation not previously listed.

Size	Lbf.ft.	Nm	Mkg.
METRIC BOLTS			
M4	2	2.7	0.28
M5	4.0-4.5	5.0-6.2	0.55-0.62
M6	6-8	8.5-10.6	0.9-1.1
M8	16-18.5	21-25	2.2-2.5
M10	30-37	41-51	4.2-5.1
M12	52-66	70-90	7.2-9.1
INCH BOLTS			
6-32	1	1.4	0.14
6-40	1	1.5	0.15
8-32	1.5-2.0	2.1-2.9	0.21-0.28
8-36	1.5-2.0	2.1-3.1	0.21-0.28
10-24	2-3	3.0-4.2	0.28-0.41
10-32	2.5-3.5	3.3-4.8	0.35-0.48
1/4-20	5-7.5	6.8-10.1	0.7-1.0
1/4-28	6-8	7.8-11.6	0.8-1.1
5/16-18	11-15	15-20	1.5-2.0
5/56-24	12-16	17-21	1.6-2.2
3/8-16	20-26	28-35	2.8-3.5
3/8-24	21-29	29-39	2.9-4.0

C. SPECIAL TOOLS

DESCRIPTION	CHURCHILL TOOL NO.	NUDAY TOOL NO.
Pulling Attachment (Small)	951	9190
Pulling Attachment (Large)	952	9526
Puller – Reversable Arm (Small)	1001	9196
Step Plate Adaptors	630S	9210

PART 4
POWER REVERSING TRANSMISSION

Chapter 1
4 × 4 FULLY SYNCHRONISED POWER REVERSING TRANSMISSION

Section		Page
A.	POWER REVERSING TRANSMISSION – DESCRIPTION AND OPERATION	1
B.	INTRODUCTION TO OVERHAULING THE TRANSMISSION	20
C.	GEARSHIFT LEVER, MODULATOR UNIT AND SOLENOID CONTROL VALVE – OVERHAUL	21
D.	FRONT END OVERHAUL	25
E.	COMPLETE OVERHAUL	31
F.	COMPONENT OVERHAUL	41

Chapter 2
8 × 8 FULLY SYNCHRONISED POWER REVERSING TRANSMISSION

Section		Page
A.	POWER REVERSING TRANSMISSION – DESCRIPTION AND OPERATION	1
B.	INTRODUCTION TO OVERHAULING THE TRANSMISSION	22
C.	GEARSHIFT LEVER, MODULATOR UNIT, LOCK-UP VALVE AND SOLENOID CONTROL VALVE – OVERHAUL	23
D.	FRONT END OVERHAUL	28
E.	COMPLETE OVERHAUL	34
F.	COMPONENT OVERHAUL	46

Chapter 3
TROUBLE SHOOTING SPECIFICATION AND SPECIAL TOOLS

Section		Page
A.	TROUBLE SHOOTING	1
B.	SPECIFICATIONS	6
C.	SPECIAL TOOLS	11

PART 4
POWER REVERSING TRANSMISSION

Chapter 1
4 × 4 FULLY SYNCHRONISED POWER REVERSING TRANSMISSION

Section		Page
A.	POWER REVERSING TRANSMISSION – DESCRIPTION AND OPERATION	1
B.	INTRODUCTION TO OVERHAULING THE TRANSMISSION	20
C.	GEARSHIFT LEVER, MODULATOR UNIT AND SOLENOID CONTROL VALVE – OVERHAUL	21
D.	FRONT END OVERHAUL	25
E.	COMPLETE OVERHAUL	31
F.	COMPONENT OVERHAUL	41

A. FULLY SYNCHRONISED POWER REVERSING TRANSMISSION – DESCRIPTION AND OPERATION

The transmission, Figure 1, consists of a torque converter, an internal rotor-type hydraulic pump, an oil distributor, a solenoid control valve assembly, two hydraulically operated clutches in a single housing, a 4-speed synchromesh gearbox, a transmission case and cooler tubes.

Incorporated with the transmission is an electrically operated modulator unit which is installed in the cab or ROP's steering console. The function of the modulator unit is to provide a cushioned engagement for the forward and reverse clutches during shifting at high engine speeds, thereby preventing sudden changes in direction of travel and reducing shock loads on the transmission components. It also provides a transmission disconnect feature to rapidly disengage the transmission from the engine to release engine power for the loader hydraulics.

The transmission case serves as an oil reservoir for the torque converter and hydraulic clutch assemblies. A conventional clutch is not used with this transmission.

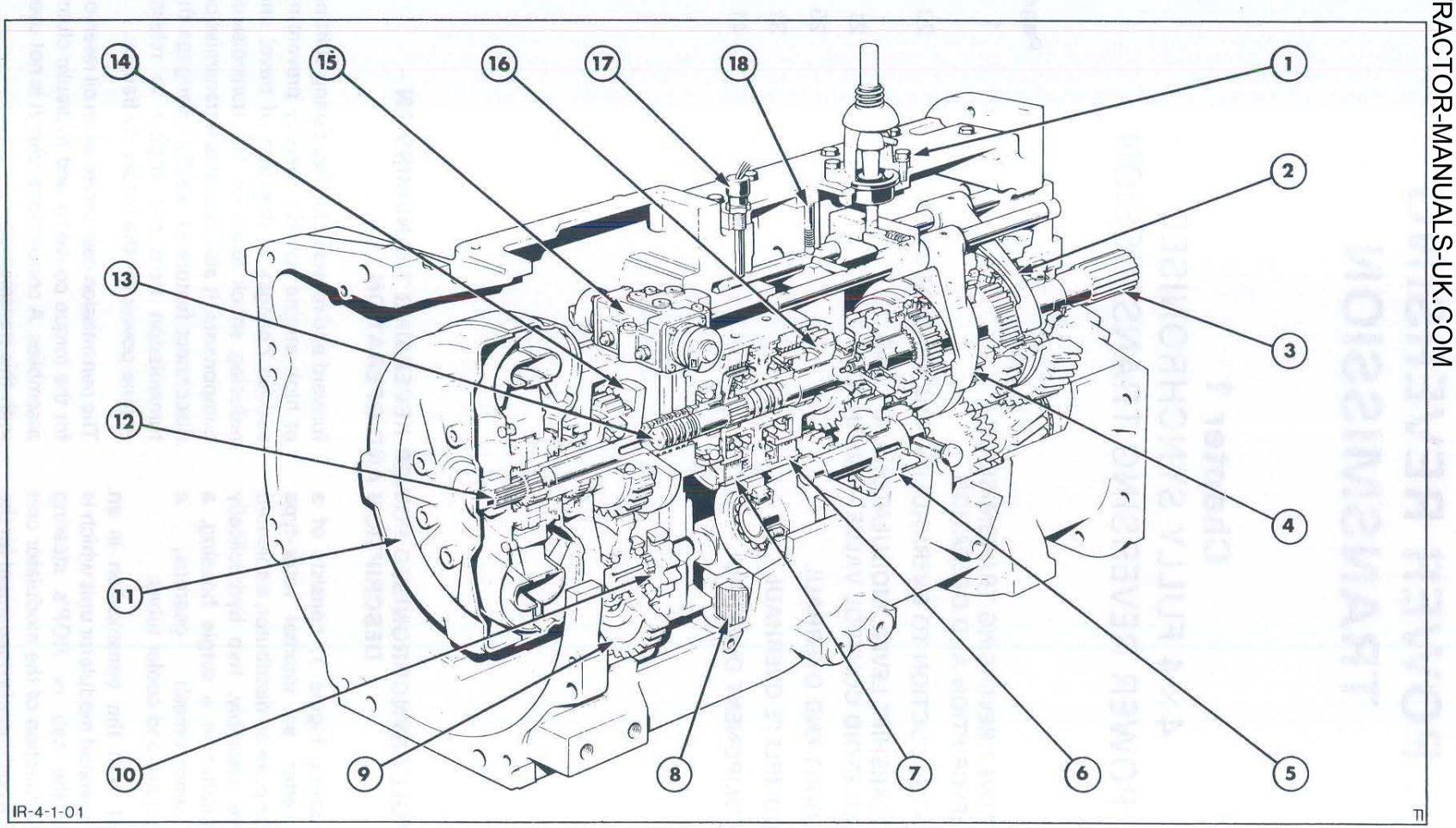

Figure 1
4 × 4 Fully Synchronised Power Reversing Transmission

1. Shift Cover and Lever
2. 1st/2nd Fork and Synchroniser
3. Output Shaft
4. 3rd/4th Fork and Synchroniser
5. Reverse Idler Gear
6. Reverse Clutch Pack
7. Forward Clutch Pack
8. Pump Inlet Filter
9. Pump Drive Gear
10. Hydraulic Pump
11. Torque Converter
12. Front Input Shaft
13. Rear Input Shaft
14. Stator Support
15. Solenoid Control Valve
16. Rear Clutch Hub
17. Safety Start Switch
18. Gear Shift Rail Detent

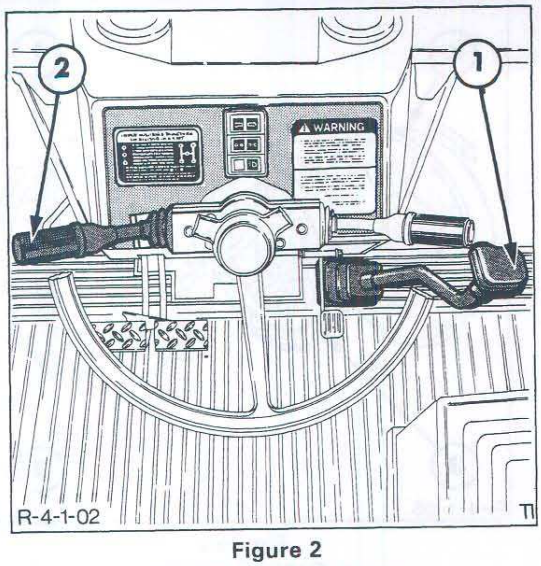

Figure 2
Transmission Shift Levers

1. Gearshift Lever
2. Power Reversing Lever

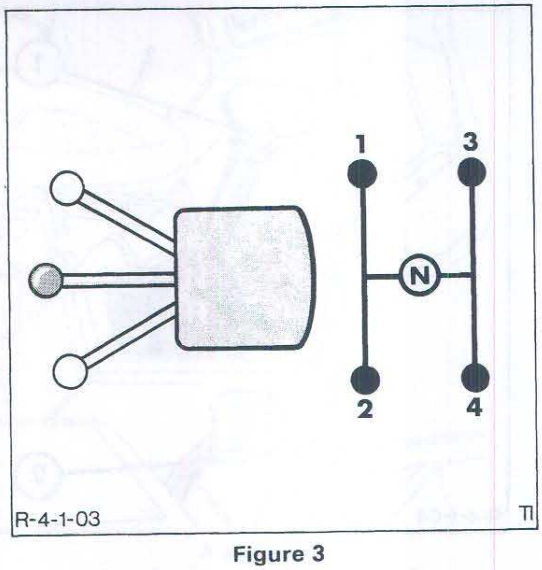

Figure 3
Gearshift Pattern

The gearbox receives power from the engine by means of oil reaction in the torque converter and hydraulic clutch assemblies.

The front clutch provides power for forward travel and the rear clutch power for reverse travel. Engagement of the front and rear clutch is controlled by the operator through the movement of the hand operated power reversing lever, shown in Figure 2.

The power reversing lever is linked to the modulating unit in the steering console by a wiring harness. A neutral lock is incorporated in the power reversing lever which prevents inadvertent engagement of the transmission and requires that the power reversing lever must be lifted upwards prior to selecting forward or reverse travel.

The gearshift lever, shown in Figure 2, is used to select any one of four synchronised gear ratios for forward or reverse travel. Figure 3 illustrates the gearshift pattern. In any gear ratio the operator need only move the power reversing lever to change direction of travel.

However, as a clutch is not used between the engine and the transmission, the power flow from the engine to the transmission must be interrupted to shift from one gear ratio to another. This is accomplished by using a transmission disconnect switch.

Two finger operated button type switches are provided, Figure 4, one on the gearshift lever knob, primarily to change gear ratios. The second on the loader control lever knob should be used during loader operations to divert full engine power to the backhoe/ loader hydraulic pump for faster loader operations.

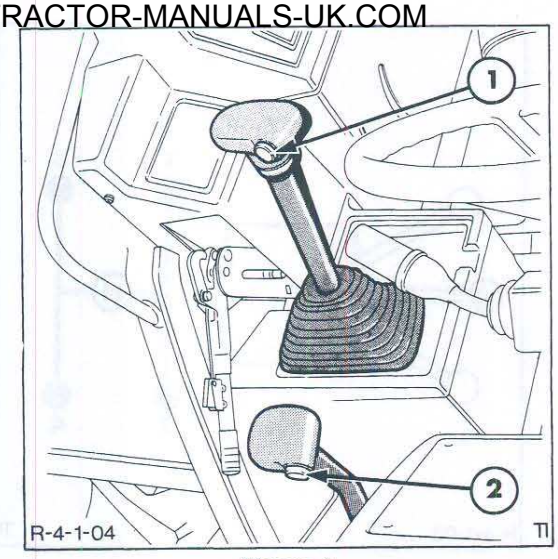

Figure 4
Transmission Disconnect Switches

1. Loader Control Lever Button
2. Gearshift Lever Button

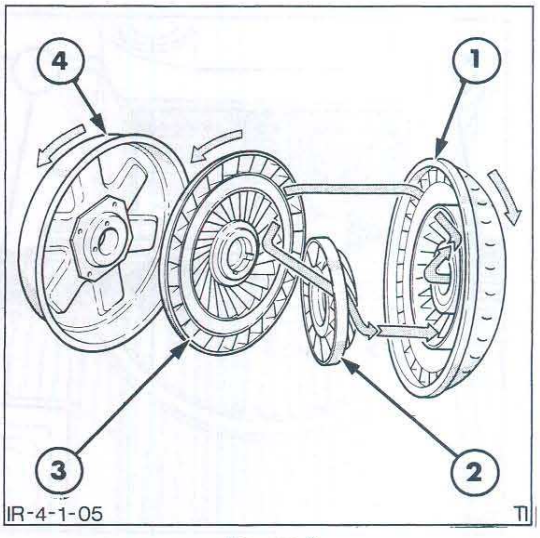

Figure 5
Torque Converter

1. Rear Cover and Impeller
2. Stator
3. Turbine
4. Front Cover

Easy upward and downward gear changes may be made with the fully synchronised gearbox, simply by depressing the transmission disconnect button on the gearshift lever whilst moving the lever from one ratio to another.

As a safety feature the transmission incorporates two safety start switches, wired in series with the starting circuit. The switches allow the engine to start only when the gearshift lever is in the neutral position.

TORQUE CONVERTER

The main parts of the torque converter are the impeller (pump), the turbine, the stator and the front and rear covers, Figure 5. The impeller is integral with the rear cover and is driven by the engine flywheel by means of a drive plate.

The turbine, splined to the front input shaft, is splined to a stationary shaft (stator support) through a one-way clutch that permits the stator to rotate only in the same direction as the impeller. All of the converter parts are enclosed in an oil-filled housing. The front and rear cover, being welded together, form the housing.

When the engine is running, the oil in the converter flows from the impeller to the turbine and back to the impeller through the stator. This flow produces a maximum torque increase of about 2.23:1 to 1 when the turbine is "stalled". When enough oil flow is developed by the impeller, the turbine begins to rotate, driving the front input shaft. The torque multiplication gradually decreases as turbine speed approaches impeller speed, and becomes 1 to 1 when the turbine is being driven at nine tenths impeller speed.

NOTE: *North America only. The torque converter installed in tractors for the North American market have a torque multiplication of 3.15:1 to 1.*

When the turbine is rotating at approximately nine tenths impeller speed, the converter stops multiplying torque because the oil is now acting on the rear face of the stator blades. The action of the oil on the rear face of the stator unlocks the one-way clutch, permitting the stator to rotate in the same direction as the turbine and impeller. Through this action the converter becomes an efficient fluid coupling by transmitting engine torque from the impeller to the turbine.

When the turbine is rotating less than nine tenths impeller speed, the converter is multiplying torque through the action of the stator. This action, produced by oil acting on the front face of the stator blades, tends to rotate the stator in the opposite direction of the impeller and turbine. However, the one-way clutch prevents this opposite rotation and allows the stator to direct oil back to the impeller, thereby producing torque multiplication.

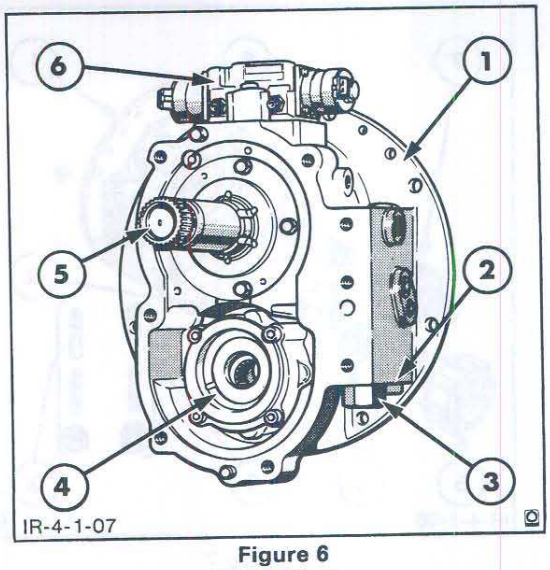

Figure 6
Oil Distributor

1. Oil Distributor Housing
2. Regulating Valve
3. Bypass Valve
4. Hydraulic Pump
5. Stator Support
6. Control Valve

OIL DISTRIBUTOR

The oil distributor, Figure 6, consists of a pressure regulating valve, a bypass valve, the hydraulic pump and a series of oil passages for oil distribution.

Oil from the hydraulic pump enters the distributor, under pressure through the inlet passage, and is directed to the pressure regulating valve and bypass valve by means of internal passages. Additional passages then direct the oil to the solenoid control valve and torque converter.

The bypass valve, working in conjunction with the pressure regulating valve, bypasses oil back to sump thereby limiting the maximum oil pressure for the torque converter.

The pressure regulating valve regulates oil pressure to the control valve which, in turn, directs this pressure regulated oil to the hydraulic clutch assemblies.

TRANSMISSION HYDRAULIC PUMP

The transmission hydraulic pump, Figure 7, is positioned in the lower section of the oil distributor assembly and consists of a driven gear, an inner and outer rotor, a pump plate and a pump body.

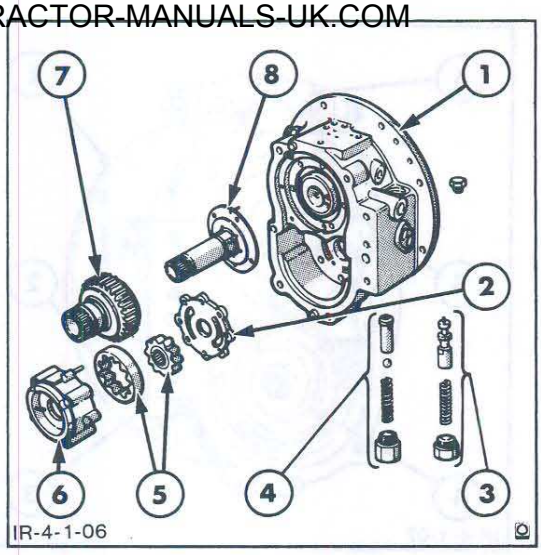

Figure 7
Transmission Hydraulic Pump

1. Distributor Housing
2. Pump Plate
3. Regulating Valve
4. Bypass Valve
5. Inner and Outer Rotors
6. Pump Body
7. Drive Gear
8. Stator Support

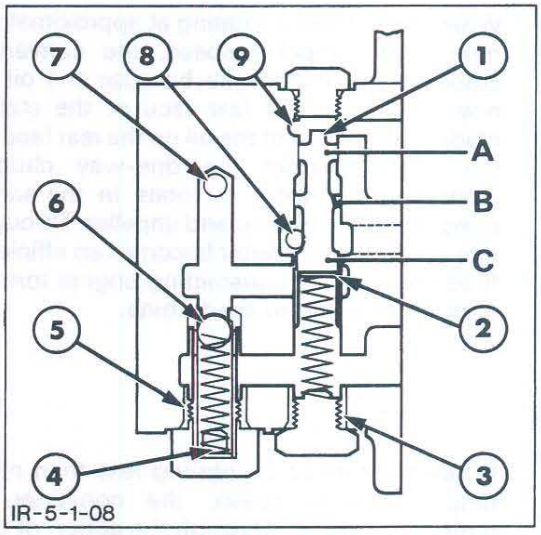

Figure 8
Pressure Regulating Valve and Bypass Valve

1. Regulating Valve
2. Regulating Valve Shim
3. Regulating Valve Plug
4. Bypass Valve Shim
5. Bypass Valve Sleeve
6. Bypass Valve Ball
7. Gallery to Torque Converter
8. Gallery to Control Valve
9. Return to Sump

A gear on the stator support, driven by the rear hub of the torque converter, drives the driven gear. The driven gear incorporates a splined shaft which drives the inner rotor of the pump.

Oil is picked up from the sump, via an internal filter, through the inlet section of the pump plate by the action of the rotors, and is forced through the outlet section of the pump plate to the oil distributor.

PRESSURE REGULATING VALVE AND BYPASS VALVE

Oil from the transmission hydraulic pump enters the valve bore area of the pressure regulating valve between lands "B" and "C", Figure 8. The area of the lands being equal, the valve will not move; however, land "B" incorporates a drilled passage or orifice that allows oil to enter the valve bore between lands "A" and "B".

The area of land "B" is greater than land "A"; therefore when the pressure between the lands reaches approximately 95 lbf/in² (6.5 bar), the spring force acting on the valve is overcome, causing the valve to move down.

This downward movement allows the valve to direct oil into the converter passage while maintaining a minimum pressure of 95 lbf/in² (6.5 bar). A pair of flats on the circumference of land "C" causes the valve to move further down as pump flow increases, which causes regulated pressure to increase with engine speed.

Because pressure to the solenoid control valve is higher than the pressure required for converter operation, the bypass valve must function to limit maximum pressure in the converter at high pump flow.

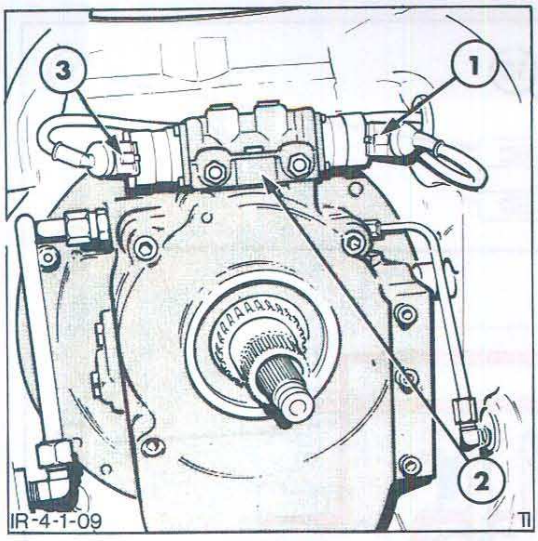

Figure 9
Solenoid Control Valve

1. Forward Solenoid
2. Control Valve
3. Reverse Solenoid

The bypass valve will open at approximately 75 – 80 lbf/in² (5.2 – 5.5 bar) to bypass oil back to sump; thereby preventing excessive pressure in the converter. Oil leaking past land "A" of the regulating valve also returns to sump.

SOLENOID CONTROL VALVE

The solenoid control valve is mounted on top of the distributor assembly, Figure 9, and consists of two identical spools, two identical solenoids, a return spring and a valve body.

The function of the solenoid control valve is to direct the pressure regulated oil from the hydraulic pump to one of the two clutch packs.

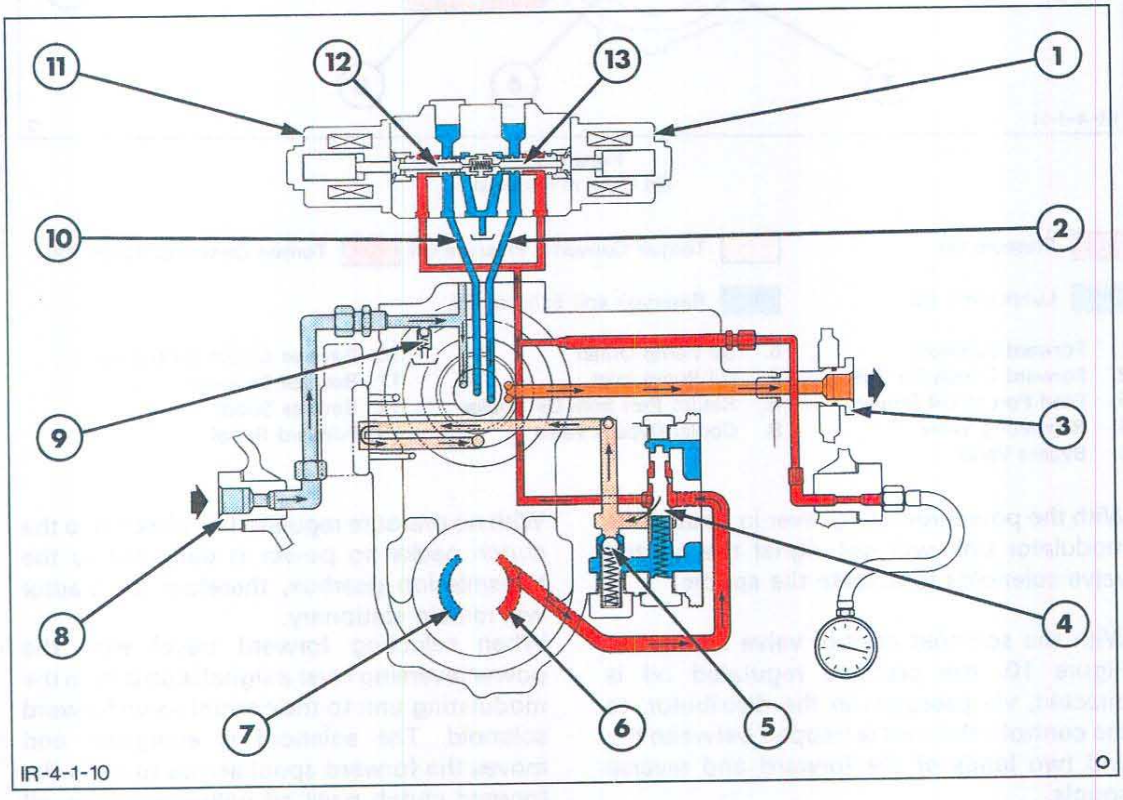

Figure 10
Oil Flow – In Neutral

Pressure Oil
Lubrication Oil
Torque Converter Pressure Oil
Reservoir and Exhaust Oil
Torque Converter Return Oil

1. Forward Solenoid
2. Forward Clutch Oil Gallery
3. Feed Port to Oil Cooler
4. Regulating Valve
5. Bypass Valve
6. Oil Pump Outlet
7. Oil Pump Inlet
8. Return from Oil Cooler
9. Cooler Bypass Valve
10. Reverse Clutch Oil Gallery
11. Reverse Solenoid
12. Reverse Spool
13. Forward Spool

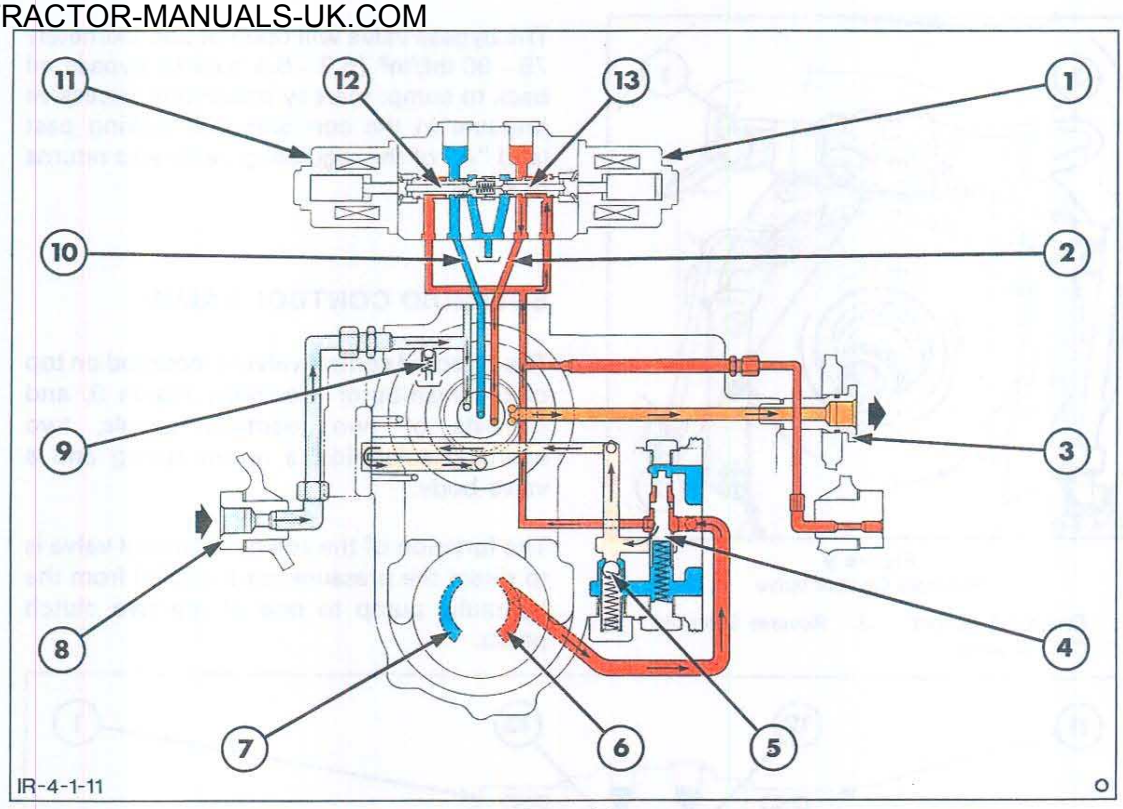

Figure 11
Oil Flow in Forward

Pressure Oil
Torque Converter Pressure Oil
Torque Converter Return Oil
Lubrication Oil
Reservoir and Exhaust Oil

1. Forward Solenoid
2. Forward Clutch Oil Gallery
3. Feed Port to Oil Cooler
4. Regulating Valve
5. Bypass Valve
6. Oil Pump Outlet
7. Oil Pump Inlet
8. Return Port from Oil Cooler
9. Cooler Bypass Valve
10. Reverse Clutch Oil Gallery
11. Reverse Solenoid
12. Reverse Spool
13. Forward Spool

With the power reversing lever in neutral the modulator unit will not signal the control valve solenoids to actuate the spools.

With the solenoid control valve in neutral, Figure 10, the pressure regulated oil is directed, via passages in the distributor, to the control valve and is trapped between the end two lands of the forward and reverse spools.

Pressure regulated oil is constantly delivered to the forward and reverse spools. With the spools held in neutral the forward and reverse clutch pack oil galleries are connected to exhaust via the forward and reverse spools in the control valve.

With no pressure regulated oil directed to the clutch packs no power is delivered to the transmission gearbox, therefore the tractor will remain stationary.

When selecting forward travel with the power reversing lever a signal is sent from the modulating unit to the control valve forward solenoid. The solenoid is energised and moves the forward spool across to align the forward clutch pack oil gallery with the oil gallery from the pressure regulating valve, Figure 11. The pressure regulated oil is directed to the forward clutch pack, while the reverse spool remains connected to exhaust. With the forward clutch pack engaged power is delivered to the transmission gearbox via the rear input shaft.

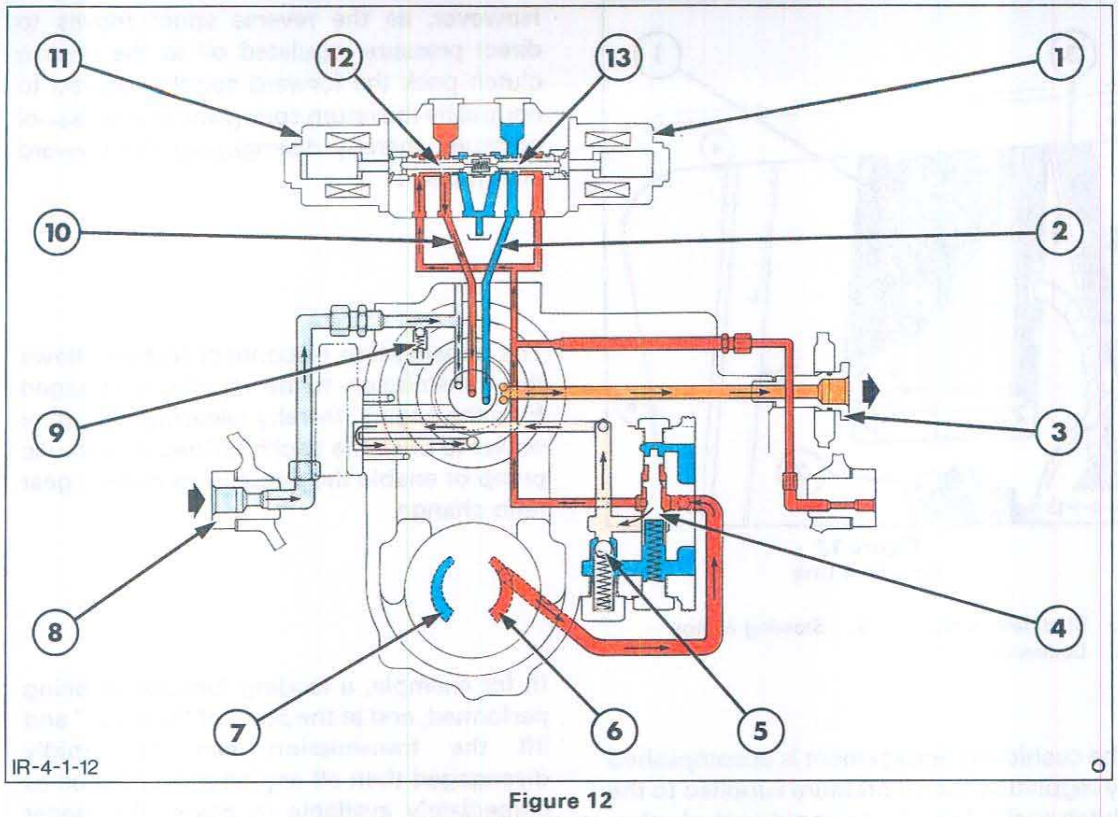

Figure 12
Oil Flow in Reverse

Pump Pressure Oil
Torque Converter Pressure Oil
Torque Converter Return Oil
Lubrication Oil
Reservoir and Exhaust Oil

1. Forward Solenoid
2. Forward Clutch Oil Gallery
3. Feed Port to Oil Cooler
4. Regulating Valve
5. Bypass Valve
6. Oil Pump Outlet
7. Oil Pump Inlet
8. Return Port from Oil Cooler
9. Cooler Bypass Valve
10. Reverse Clutch Oil Gallery
11. Reverse Solenoid
12. Reverse Spool
13. Forward Spool

Selecting reverse travel sends a signal from the modulating unit to the reverse solenoid of the control valve. The operation of the reverse section of the control valve is the same as the forward section, however, now the pressure regulated oil is directed to the reverse clutch pack, Figure 12, and power is delivered to the transmission gear box via the rear input gear (reverse clutch hub).

De-energised the forward solenoid moves back to the neutral position under spring pressure and the spool aligns the forward clutch pack oil gallery with the exhaust port.

MODULATOR UNIT

The function of the modulator unit, Figure 13, is to provide a cushioned engagement for the forward and reverse clutches during changes in direction of travel, and to disconnect the clutch packs when either transmission disconnect button is depressed.

The modulator unit contains a microprocessor which ensures that the voltage supplied to the forward and reverse control valve solenoids rises at a predetermined rate.

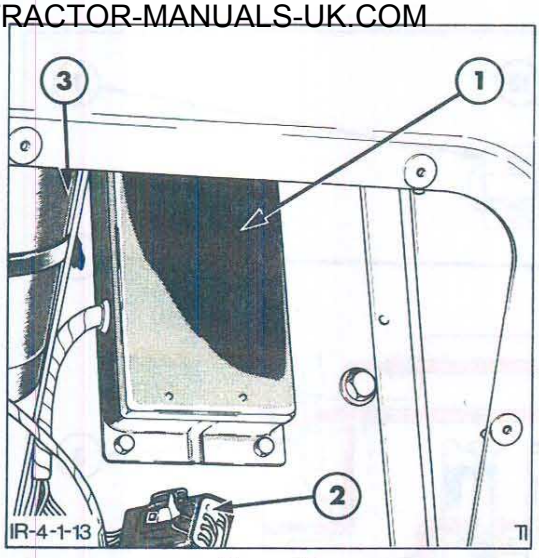

Figure 13
Modulator Unit

1. Modulator Unit
2. Connector
3. Steering Motor

The cushioned engagement is accomplished by regulating the oil pressure supplied to the clutch packs, from the solenoid control valve, in proportion to the voltage rise in the signal from the modulator unit to the control valve solenoids.

When the power reversing lever is moved to select forward travel the modulator unit signals the forward solenoid to move the control valve forward spool. The spool will move in proportion to the voltage rise of the signal to the solenoid, which requires approximately 1 – 2.5 seconds to engage fully, and the oil pressure to the clutch pack will rise by the same proportion until regulated pressure is achieved after 2.5 seconds.

Selecting reverse travel with the power reversing lever, the modulator unit cuts the current to forward solenoid and signals the reverse solenoid to move the reverse spool. The operation of the reverse solenoid and spool is the same as for forward engagement. However, as the reverse spool moves to direct pressure regulated oil to the reverse clutch pack the forward spool is moved to neutral by the return spring and reverse spool pressure, thereby disengaging the forward clutch pack.

The transmission disconnect feature allows the transmission to be rapidly disengaged from the engine, thereby releasing all engine power to drive the backhoe/loader hydraulic pump or enable the operator to make a gear ratio change.

If, for example, a loading function is being performed, and at the point of "tear out" and lift the transmission can be rapidly disengaged then all engine power becomes immediately available to power the loader hydraulic system, thereby increasing lift speed and cycle times.

The transmission disconnect is accomplished by depressing the button on the gearshift lever knob or the button on the loader control lever knob, either will disconnect the transmission.

Depressing the button on either of the levers interrupts the current to the modulator unit and thereby the current to the control valve solenoids. Removing the electrical supply will have the effect of cutting the flow of hydraulic oil to the clutch packs as the solenoid and spool return to neutral. In neutral the clutch pack oil galleries are open to exhaust and the pressure regulated oil is trapped between the end two lands of the spool.

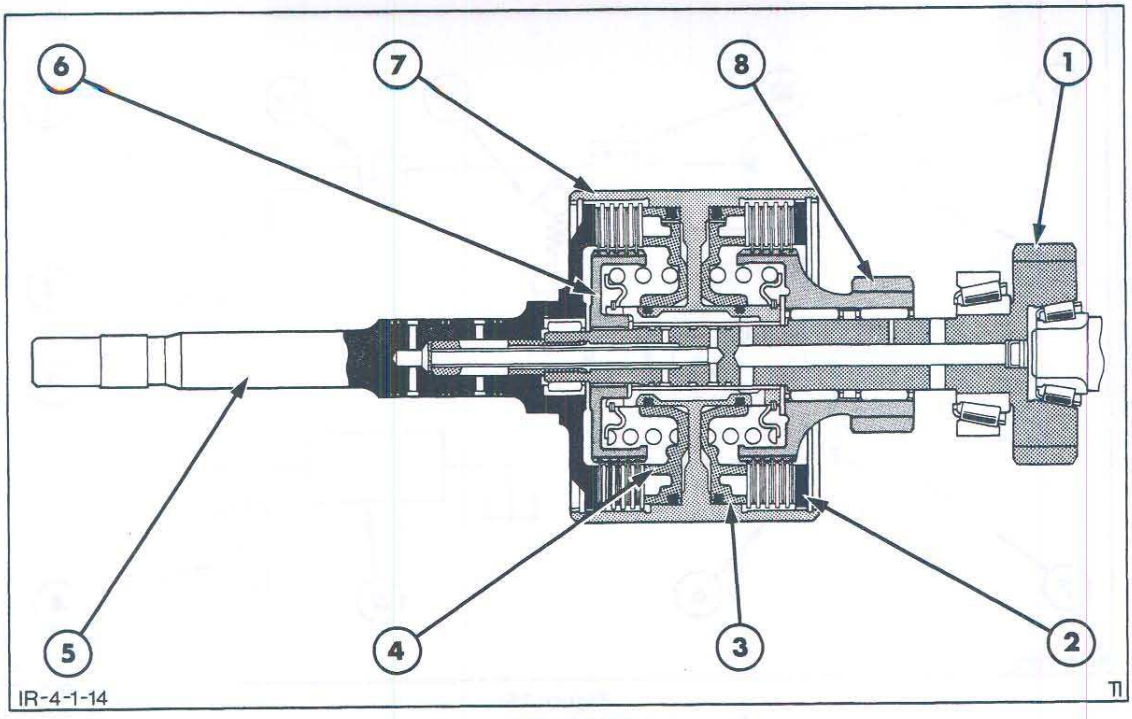

Figure 14
Hydraulic Clutch Assemblies

1. Transmission Rear Input Shaft
2. Reverse Clutch Pressure Plate
3. Reverse Clutch Piston
4. Forward Clutch Piston
5. Transmission Front Input Shaft
6. Forward Clutch Hub
7. Clutch Housing
8. Reverse Clutch Hub and Gear

When the button is released, the electrical supply is restored to the modulator unit and the control valve will direct pressure regulated oil to the appropriate clutch pack in proportion to the voltage supplied from the modulator unit.

HYDRAULIC CLUTCH ASSEMBLIES

The hydraulic clutch assemblies incorporate a housing, a hub, and a series of bronze and steel plates that are engaged through the action of the forward or reverse pistons when hydraulic pressure is applied.

The forward clutch hub, Figure 14, is splined internally to the transmission rear input shaft and externally to the bronze plates of the forward clutch assembly.

When hydraulic pressure is applied to the front clutch for forward travel, the piston is actuated, locking the steel plates to the bronze plates. The steel plates, being driven by the clutch housing, transmit power to the bronze plates. The bronze plates then drive the front hub which, in turn, drives the rear input shaft, thereby transmitting power to the countershaft through the forward gear.

When hydraulic pressure is applied to the rear clutch for reverse travel, the plates in the rear clutch are locked together to drive the rear hub (reverse idler input), Figure 14. The rear hub is not splined to the rear input shaft; however, it does mesh with the reverse idler gear that is in turn meshed with the reverse gear on the countershaft. It is through this reverse idler gear that power is transmitted to the countershaft.

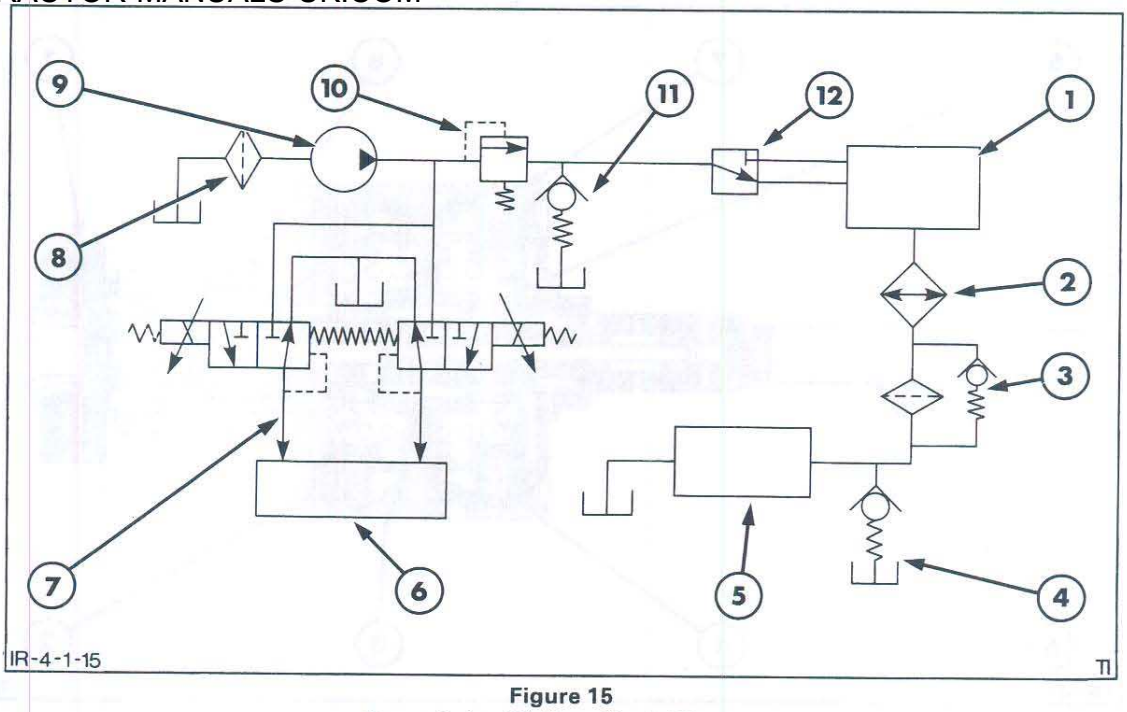

Figure 15
Transmission Oil Flow Circuit Diagram

1. Torque Converter
2. Oil Cooler
3. Line Filter
4. Cooler Line Bypass Valve
5. Transmission Lubrication
6. Hydraulic Clutch
7. Solenoid Control Valve
8. Inlet Filter
9. Oil Pump
10. Regulating Valve
11. Bypass Valve
12. Plate on Distributor Casing

Because the countershaft is being driven by the reverse idler gear and not the rear input shaft, the countershaft will rotate in the opposite direction as it does for foward travel.

OIL FLOW

Transmission oil flows from the reservoir to the distributor then to the solenoid control valve assembly as previously described. Oil from the bypass valve flows between the stator support and the torque converter hub into the converter, Figure 16.

Oil from the torque converter then flows back to the distributor between the stator support and the front input shaft. It is then picked up by the cooler tube on the left-hand side of the transmission case and directed to the cooler, Figure 17. The cooler is located in front of the engine coolant radiator with the backhoe/loader hydraulic oil cooler, Figure 19.

Oil from the cooler is returned to the transmission via a tube on the left-hand side of the tractor to the oil filter then over the transmission housing and through a tube on the right-hand side of the transmission case, Figure 18. The tube directs the oil via the distributor to the lubrication passages in the rear input shaft rear clutch hub and the output shaft for lubrication of bearings Figure 16.

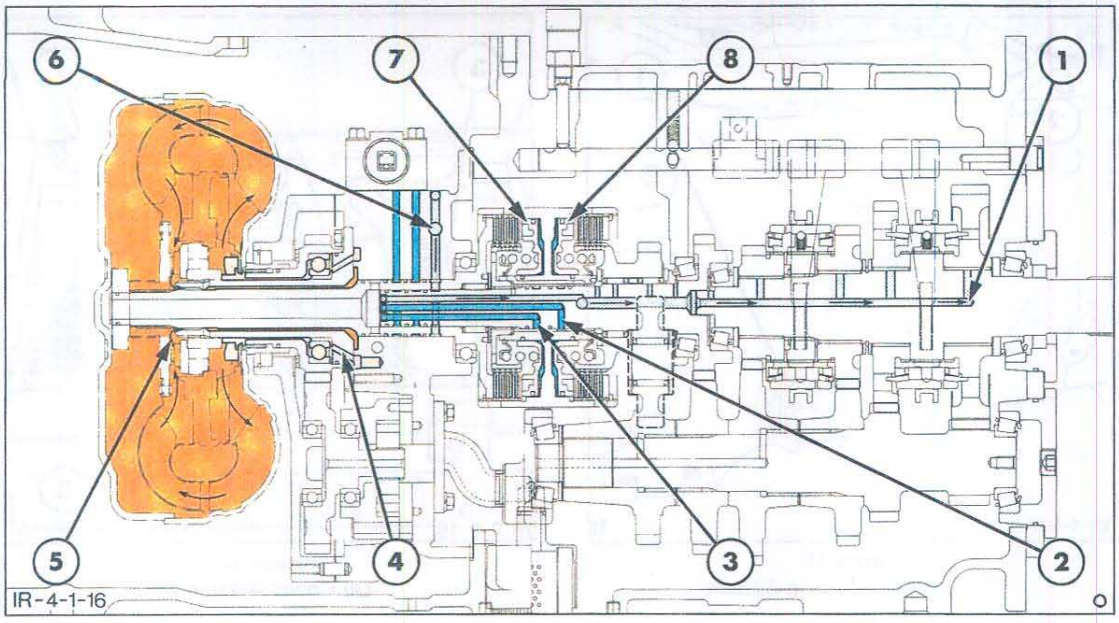

Figure 16
Transmission Lubrication Oil Flow

Torque Converter Pressure Oil
Torque Converter Return Oil
Lubrication Oil
Reservoir and Exhaust Oil

1. Lubrication Gallery
2. Reverse Clutch Gallery
3. Forward Clutch Gallery
4. Feed to Torque Converter
5. Return from Torque Converter
6. Return from Oil Cooler
7. Forward Clutch
8. Reverse Clutch

The lubrication passages, being smaller than the return tube, will act as an orifice and cause a pressure build-up. When the pressure reaches approximately 33 lbf/in² (2.26 bar) a bypass valve in the distributor housing will open allowing oil to return to sump.

OIL COOLER

The transmission cooling system, Figures 17 to 19, consists of a filter, a cooling unit and tubes and fittings. The oil is filtered after leaving the cooler. The filter incorporates a bypass valve that is st to open at 7 to 9 lbf/in² (0.5 to 0.6 bar) should the filter become clogged.

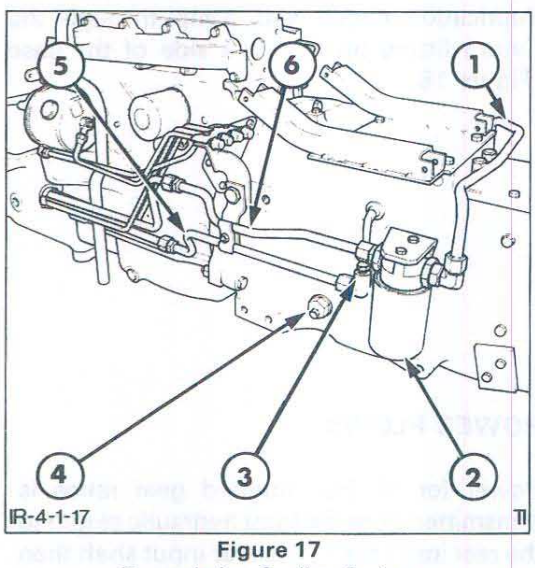

Figure 17
Transmission Cooling System

1. Filter Return Pipe
2. Filter
3. Temperature Switch
4. Pressure Test Point
5. Cooler Inlet Line
6. Cooler Outlet Line

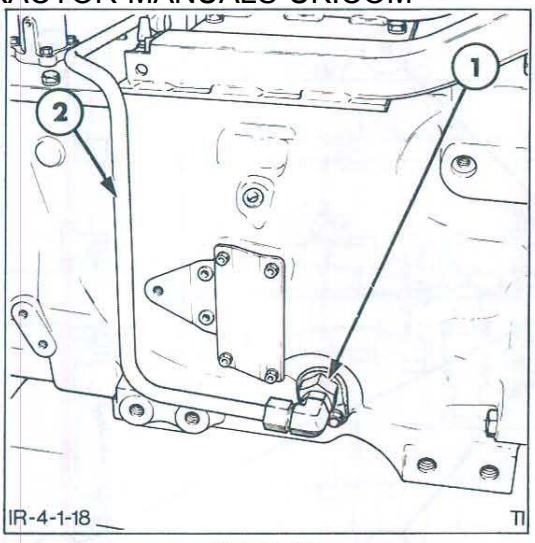

Figure 18
Transmission Cooling System

1. Adaptor
2. Filter Return Pipe

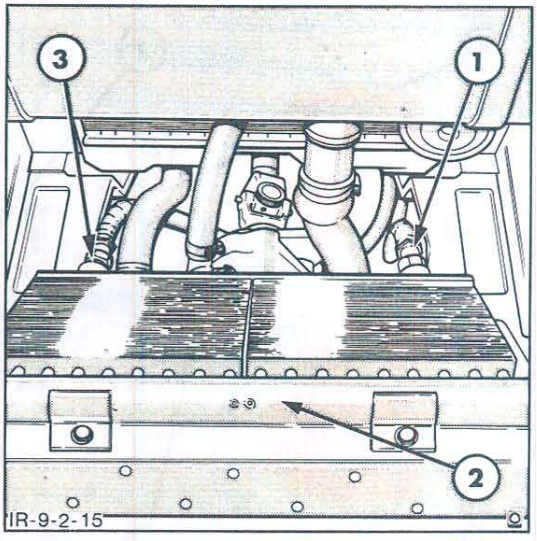

Figure 19
Oil Cooler Assembly

1. Inlet Connection
2. Transmission Oil Cooler
3. Outlet Connection

Oil from the torque converter enters the cooler inlet tube, Figure 17, on the left side of the transmission case, passes through the cooler and filter, and is returned to the lubrication circuit and sump through the return fitting on the right side of the case Figure 18.

POWER FLOWS

Power for all four forward gear ratios is transmitted from the front hydraulic clutch to the rear input shaft. The rear input shaft then transmits power to the countershaft forward gear and the countershaft in turn transmits power to the output shaft. Figures 20 and 21 illustrate the power flows.

Power flow for all four reverse gear ratios is the same as for all four forward gear ratios except that the rear clutch is engaged to transmit power to the reverse idler gear. The reverse idler gear in turn transmits power to the reverse gear on the countershaft.

Because power is being transmitted through the reverse idler gear, the countershaft and output shaft will rotate in the opposite direction as for forward gear ratios. The rear input shaft will also rotate in the opposite direction.

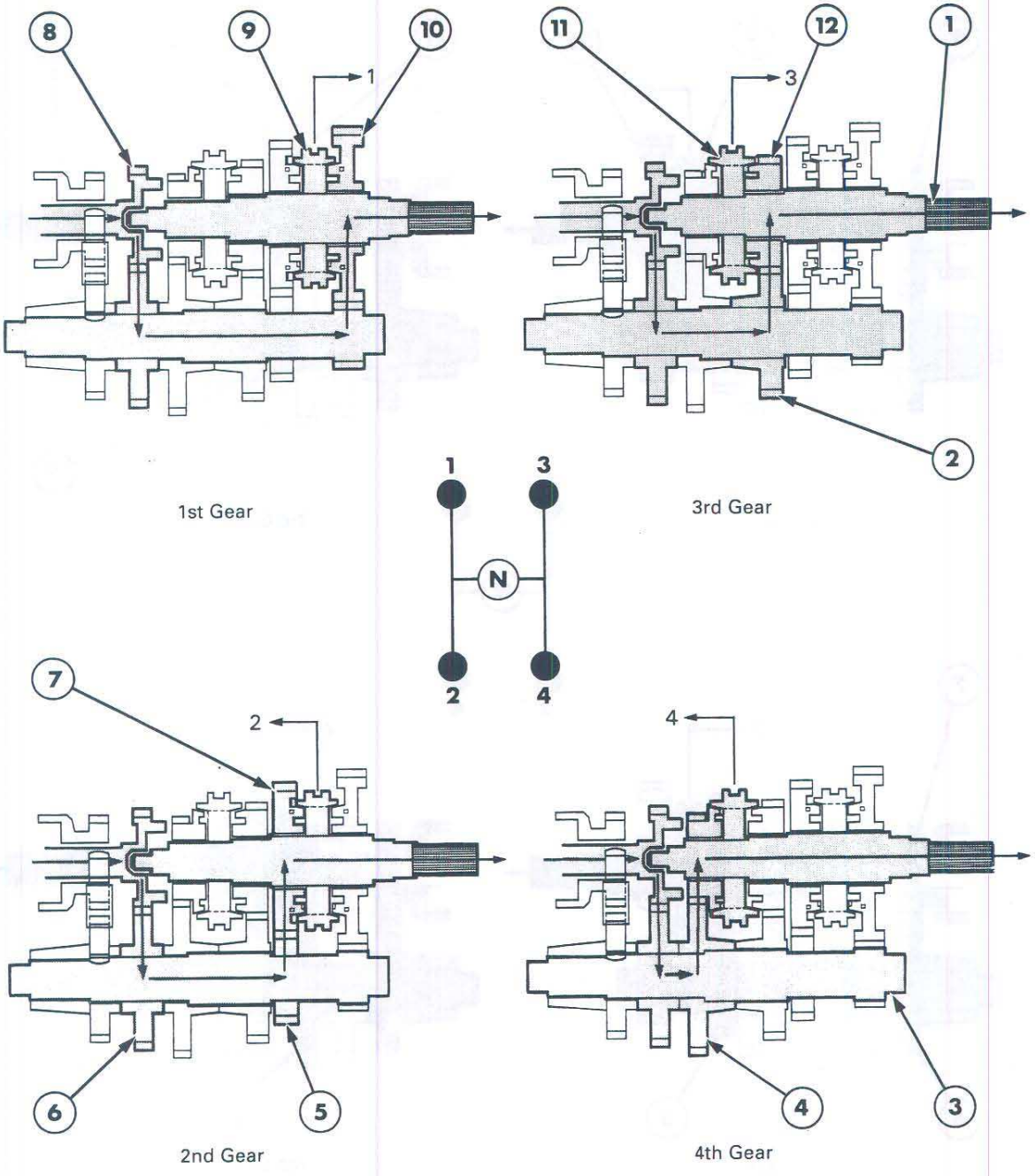

Figure 20
Power Flows in Forward

1. Output Shaft
2. 3rd Gear – Drive Gear
3. Countershaft
4. 4th Gear – Drive Gear
5. 2nd Gear – Drive Gear
6. Forward Gear
7. 2nd Gear – Drive Gear
8. Rear Input Shaft
9. 1st/2nd Synchroniser
10. 1st Gear – Driven Gear
11. 3rd/4th Synchroniser
12. 3rd Gear – Driven Gear

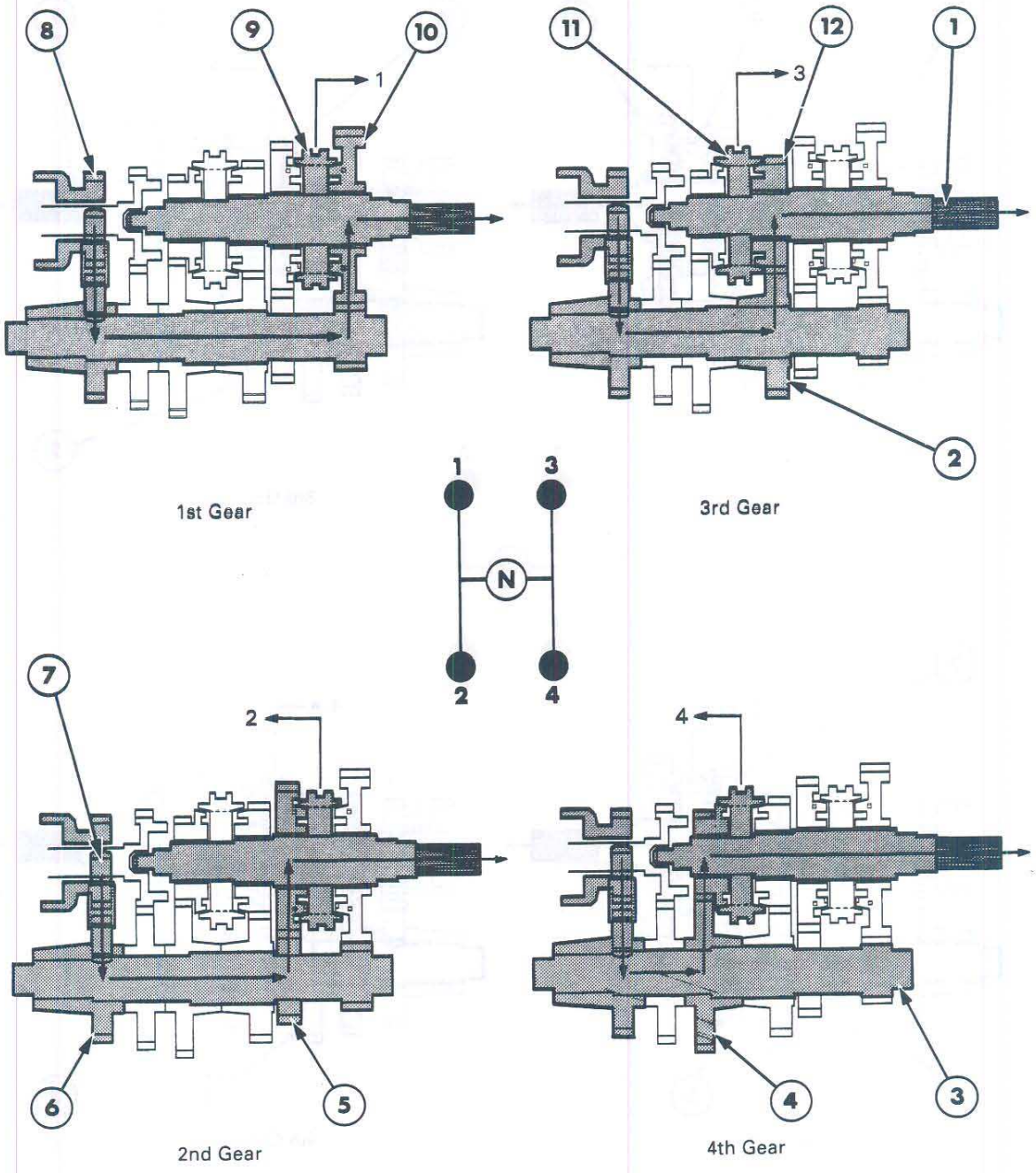

Figure 21
Power Flows in Reverse

1. Output Shaft
2. 3rd Gear – Drive Gear
3. Countershaft
4. 4th Gear – Drive Gear
5. 2nd Gear – Drive Gear
6. Reverse Gear
7. Reverse Idler Gear
8. Rear Clutch Hub
9. 1st/2nd Synchroniser
10. 1st Gear – Driven Gear
11. 3rd/4th Synchroniser
12. 3rd Gear – Driven Gear

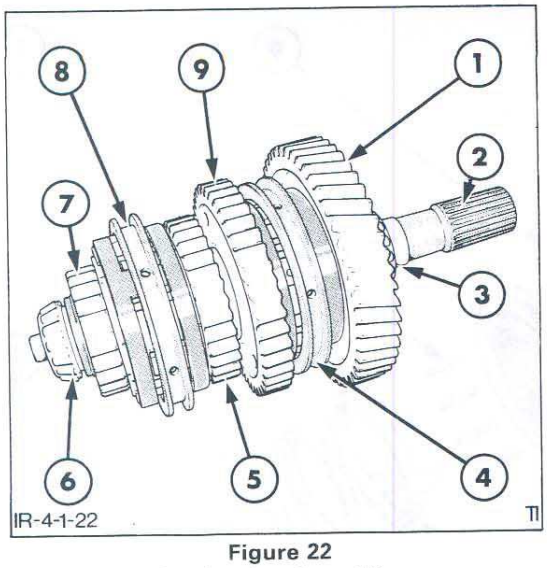

Figure 22
Synchroniser Assemblies

1. 1st Gear
2. Output Shaft
3. Rear Roller Bearing
4. 1st/2nd Synchroniser
5. 3rd Gear
6. Front Roller Bearing
7. 4th Gear
8. 3rd/4th Synchroniser

SYNCHRONISER

The synchronised 4 × 4 power reversing transmission incorporates two cone type synchronisers on the output shaft. One between the 3rd and 4th gears, the other between the 2nd and 1st gears, Figure 22. The two synchronisers operate in an identical way, however, the synchroniser ring for the 3rd and 4th gears is engaged to the gear via a retainer, Figure 24, while the synchroniser ring for the 1st and 2nd gears is engaged directly to the gears, Figure 23.

The cone type synchroniser, Figure 24, for the 3rd and 4th gears consists of a sliding sleeve splined to the output shaft. Six balls and springs are positioned in radial drillings in the sliding sleeve so that the balls are pressed into 'V' shaped recesses on the tangs of the two outer cones – three per outer cone. The outer cones are positioned either side of the sliding sleeve and locate through windows in the sleeve.

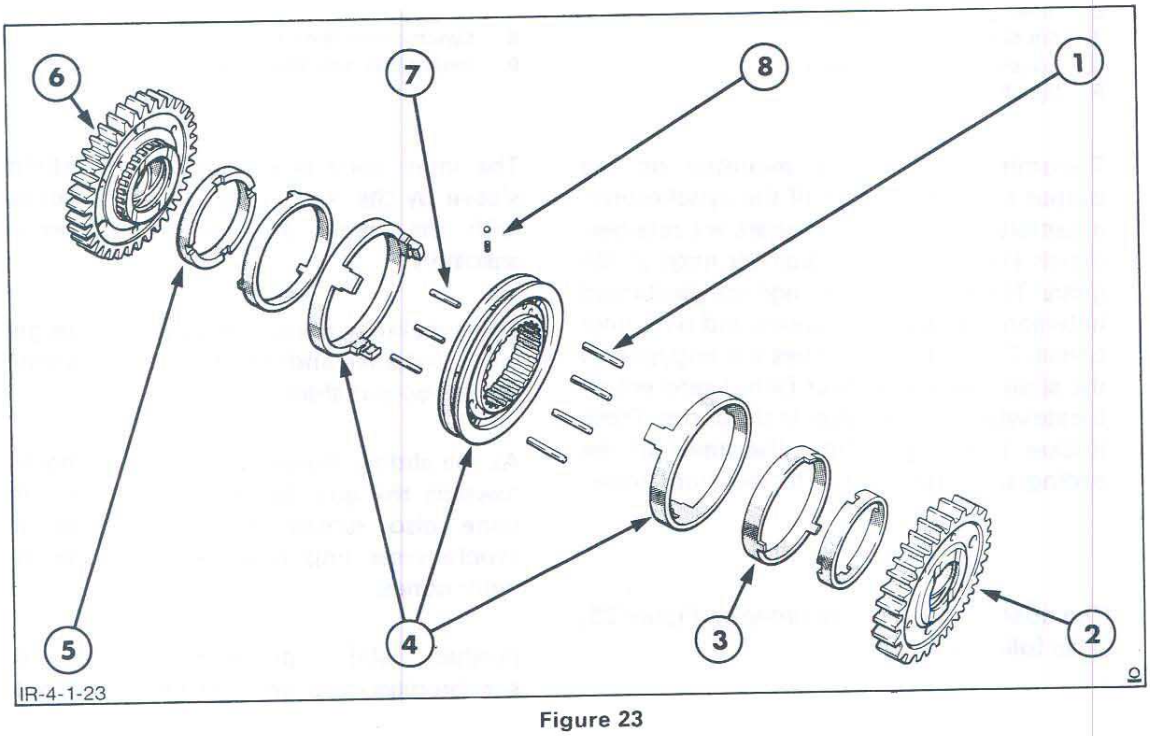

Figure 23
1st/2nd Synchroniser Exploded View

1. Inner Cone Drive Pins (4)
2. 1st Gear
3. Synchroniser Ring
4. Coupler Hub and Outer Cones
5. Inner Cone
6. 2nd Gear
7. Synchroniser Ring Locating Pins (3)
8. Detent Ball and Spring (6)

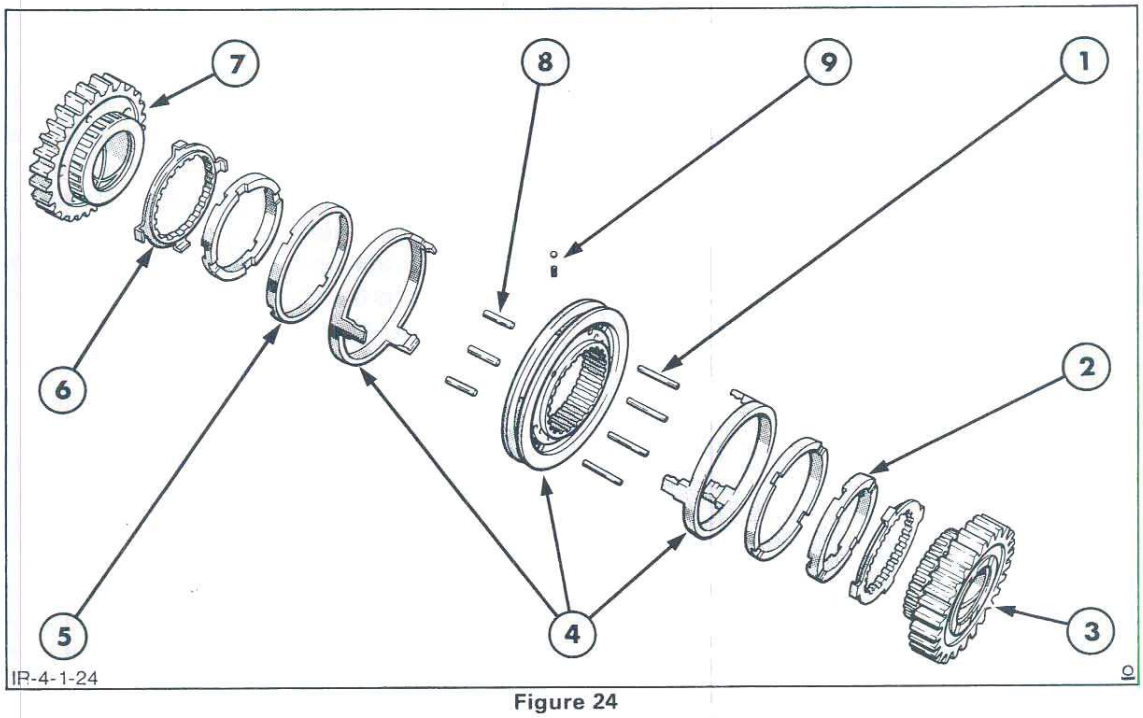

Figure 24
3rd/4th Synchroniser Exploded View

1. Inner Cone Drive Pins
2. Inner Cone
3. 4th Gear
4. Coupler and Outer Cones
5. Synchroniser Ring
6. Intermediate Cone Locator
7. 3rd Gear
8. Synchroniser Ring Locating Pins (3)
9. Detent Ball and Spring (6)

Transmission gears are mounted on the output shaft either side of the synchroniser assembly. Splined to the gears are retainers which engage the synchroniser rings to the gears. The synchroniser rings are positioned between the two outer cones and two inner cones. The two inner cones are engaged to the sliding sleeve by four (long) pins which locate within the cut-outs in the cones. Three thicker (short) pins limit the travel of the sliding sleeve in relation to the outer cone.

The operation of the synchroniser, Figure 25, is as follows:-

In the neutral position the sliding sleeve and outer cone are locked together by the balls and springs positioned in the sleeve and tangs of the outer cone.

The inner cone is engaged to the sliding sleeve by the four (long) pins and rotates with the sleeve and outer cone as an assembly.

The synchroniser ring, engaged to the gear via the retainer, and the gear are free to rotate on the output shaft.

As the sliding sleeve is moved from neutral towards the gear to be selected the outer cone also moves and compresses the synchroniser ring between the outer and inner cones.

Further shift pressure causes the synchroniser ring and the inner and outer cones to rotate at the same speed. The synchroniser ring and gear now rotating in synchronisation with the sleeve permits the chamfered teeth on the internal circumference of the sleeve to engage the teeth on the gear.

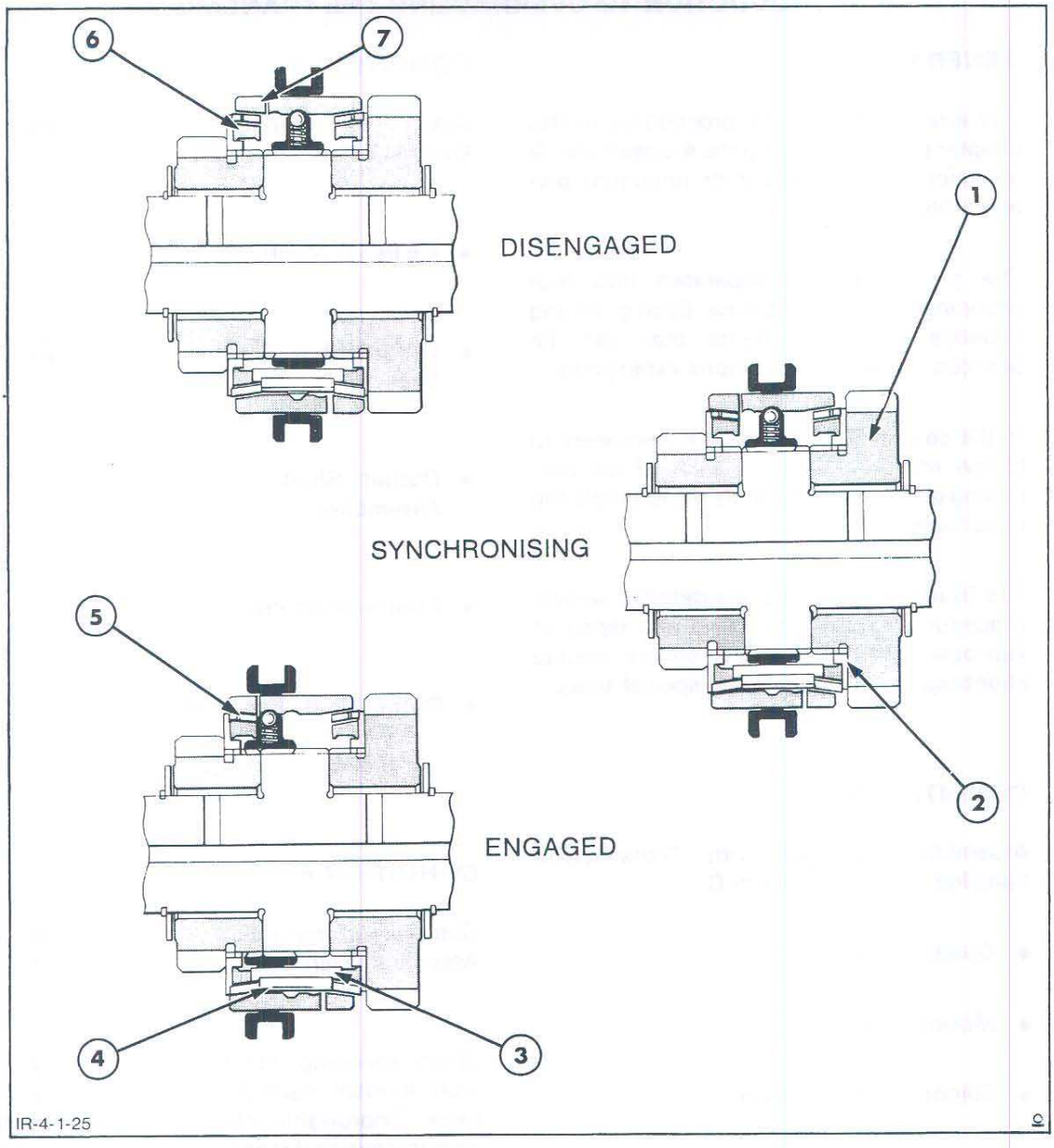

Figure 25
Synchroniser Operation

1. 3rd Gear
2. Synchroniser Ring Locator
3. Inner Cone Pins (Long)
4. Synchroniser Ring Pins (short)
5. Synchroniser Ring
6. Inner Cone
7. Outer Cone

Further shift pressure causes the outer cone to depress the balls and springs in the sliding sleeve and allow the sleeve to fully engage the gear.

The cone type synchroniser, Figure 23, for the 1st and 2nd gears operates in an identical way to the 3rd and 4th gear synchroniser, however, as previously described the 1st and 2nd gear synchroniser rings are engaged directly to the gears and do not use a retainer as in the 3rd and 4th gear synchroniser.

B. INTRODUCTION TO OVERHAULING THE TRANSMISSION

GENERAL

The arrangement of the procedures in this chapter permits servicing the 4-speed power reversing transmission with minimum disassembly.

The procedures are separated into four groupings as covered below. Each grouping includes the components that can be serviced under the conditions established.

In the case of Condition 3 it is necessary to follow the procedures in each of the preceding groups to completely disassemble the transmission.

The fourth grouping covers detailed service procedures for the inspection and repair of sub-assemblies. Chapter 3 covers trouble shooting, specifications and special tools.

CONDITION 1

Assemblies Serviced with Transmission Installed: Refer to Section C.

- Gearshift Lever
- Modulator Unit
- Solenoid Control Valve

CONDITION 2

Assemblies Serviced with Transmission Front End Overhaul: Refer to Section D.

- Torque Converter
- Transmission Hydraulic Pump and Oil Distributor
- Front Input Shaft and Clutch Housing

CONDITION 3

Assemblies Serviced with Complete Overhaul: Refer to Section E.

- Gearshift Mechanism
- Output Shaft Bearing Retainer and Oil Seal
- Output Shaft and Countershaft Gear Assemblies
- Countershaft Pre-Load
- Output Shaft Pre-Load

CONDITION 4

Component Inspection and Repair (Sub-Assembly Overhaul): Refer to Section F.

When servicing the transmission, always work in clean surroundings and with clean tools. Thoroughly clean the transmission case to prevent dirt entry. Use lint free towels when wiping parts or your hands. Lay cleaned parts out on clean paper so a thorough inspection can be made.

When installing the transmission components, do not use force. If the parts do not assemble freely, examine them for the cause of difficulty, and coat them with a film of petroleum jelly or transmission fluid to facilitate assembly. Also lubricate all shafts, bearings, oil seals and gears with a film of transmission oil before installing them in the transmission.

C. GEARSHIFT LEVER, MODULATOR UNIT AND SOLENOID CONTROL VALVE – OVERHAUL

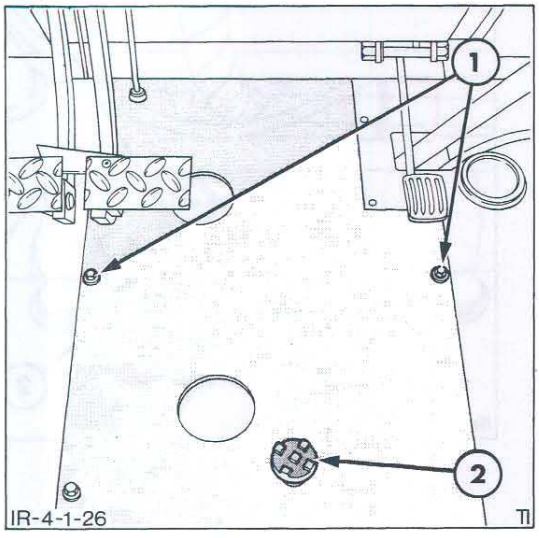

Figure 26
Transmission Access Plate Removal

1. Retaining Bolts
2. Differential Lock Pedal

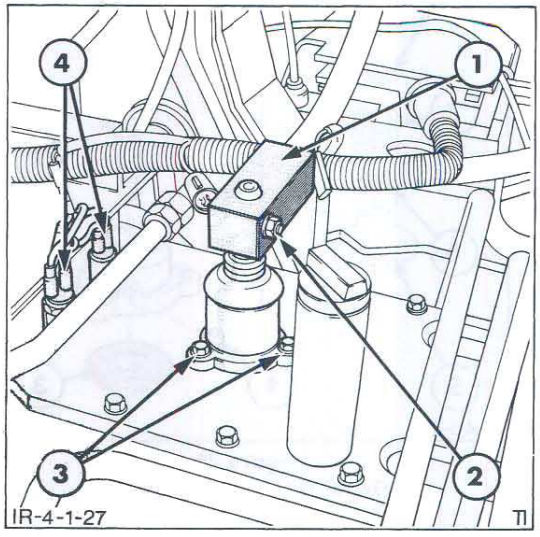

Figure 27
Gearshift Lever Removal

1. Gearshift Lever
2. Retaining Nut and Pin
3. Cup Retaining Bolts
4. Safety Start Switches

GEARSHIFT LEVER

REMOVAL

1. Remove the cab floor mat and the rubber gaiter from around the gearshift lever.

2. Remove the steering console lower panel situated in front of the gearshift lever.

3. Remove the bolts securing the transmission access plate to the cab floor, Figure 26, and lift off the plate.

4. Disconnect the transmission dump switch wire at the bottom of the gearshift lever.

5. Remove the three gearshift lever spigot support retaining bolts from the transmission top cover, Figure 27.

6. Lift the gearshift lever and lever spigot from the transmission top cover and remove through the aperture in the cab floor.

DISASSEMBLY

1. Remove the gearshift lever to lever spigot retaining pin and nut.

2. Remove the snap ring from the spigot to release the spring, cup and spigot from the support. Remove the 'O' ring seal from the lever spigot.

3. Remove the pin and rubber shield from the lever support, Figure 28.

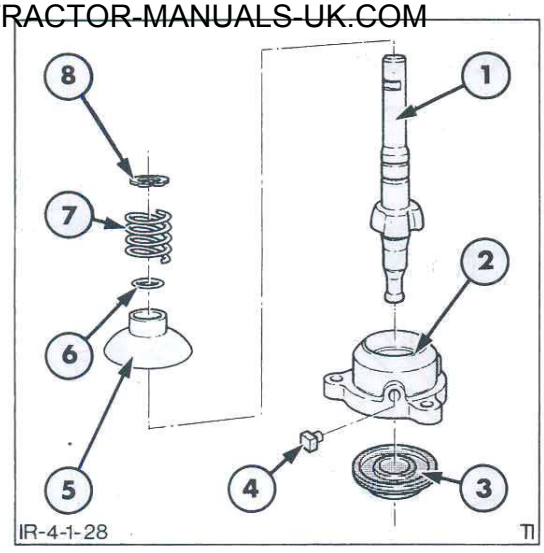

Figure 28
Gearshift Lever Components

1. Lever Spigot
2. Support
3. Rubber Shield
4. Pin
5. Cup
6. 'O' Ring
7. Spring
8. Snap Spring

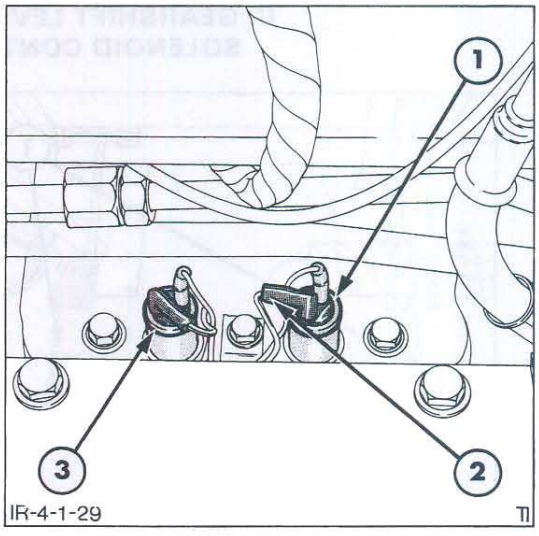

Figure 29
Safety Start Switches Removal

1. 3rd/4th Shift Rail Safety Switch
2. Wiring Harness
3. 1st/2nd Shift Rail Safety Switch

ASSEMBLY

1. Install the pin into the support then slide the lever spigot into the support.

2. Install the rubber shield over the lever spigot and onto the support.

3. Install the 'O' ring seal to the lever spigot then install the cup, spring and retain with the snap ring.

2. Install the gearshift lever through the cab floor aperture and over the lever spigot.

3. Retain the lever to the spigot with the pin and nut, tighten to the specified torque, see Specifications – Chapter 3.

4. Re-connect the dump switch wire and install the transmission access plate to the cab floor.

5. Install the steering console panel, gearshift lever gaiter and floor mat.

INSTALLATION

1. Install the lever spigot assembly and retaining bolts to the transmission top cover. Apply thread sealant to the bolts prior to installation – see "Specifications" – Chapter 3.

SAFETY START SWITCHES

REMOVAL

1. Remove the fuel tank as described in Part 2 "Fuel Systems" – Chapter 1.

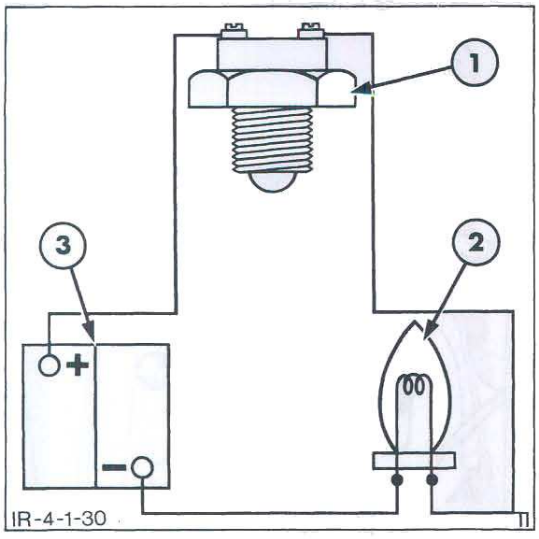

Figure 30
Safety Start Switch Test

1. Switch
2. Bulb
3. Battery

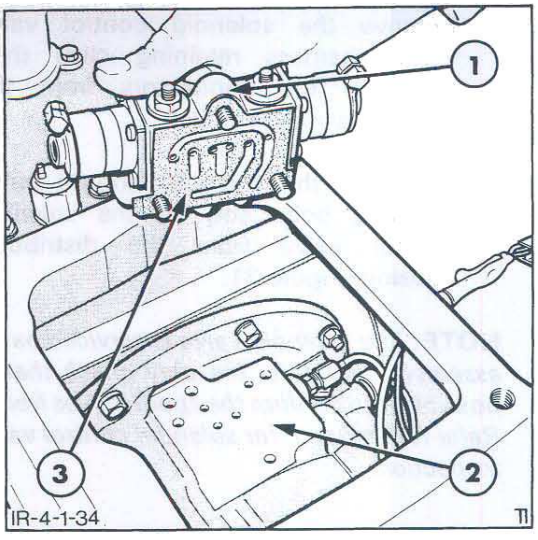

Figure 31
Solenoid Control Valve Removal

1. Solenoid Control Valve Assembly
2. Oil Distributor
3. Gasket

2. Remove the safety start switches from the transmission top cover, Figure 29, and then remove the switch plungers from the transmission housing.

INSPECTION

1. Inspect the conical ends of the switch plungers for nicks or burrs. If nicks or burrs exist that cannot be removed by polishing, install a new plunger.

2. Check the safety start switches for operation by connecting the switch to a suitable bulb and battery as illustrated in Figure 30.

3. Depress and then release the operating button. The switch is operating correctly if the light comes on when the button is depressed and goes out when the button is released. If the switch is faulty, install a new switch.

INSTALLATION

1. Install a new 'O' ring seal onto the safety start switches, then install into the transmission top cover and tighten to the specified torque – see "Specifications" – Chapter 3.

2. Install the fuel tank as described in Part 2 "Fuel Systems" – Chapter 1.

SOLENOID CONTROL VALVE

REMOVAL

1. Remove the fuel tank as described in Part 2 "Fuel Systems" – Chapter 1.

2. Remove the solenoid control valve access plate retaining bolts and lift the plate from the transmission.

3. Remove the solenoid control valve wiring harness retaining clips then withdraw the connectors from the control valve solenoids.

4. Withdraw the solenoid control valve retaining bolts and lift the solenoid control valve from the distributor housing, Figure 31.

NOTE: *The solenoid valve is serviced as an assembly, therefore, the only check that is possible is to confirm the spool moves freely. Refer to Section F for solenoid control valve inspection.*

INSTALLATION

1. Install the solenoid control valve with a new gasket onto the distributor housing and secure with the retaining bolts. Tighten the bolts to the specified torque, see "Specifications" – Chapter 3.

2. Reconnect the wiring harness to the solenoids and retain in position with the retaining clips.

3. Install the solenoid control valve access plate onto the transmission housing and secure with the retaining bolts. Tighten the bolts to the specified torque, see "Specifications" – Chapter 3.

4. Install the fuel tank as described in Part 2 "Fuel Systems" – Chapter 1.

MODULATOR UNIT

NOTE: *The modulator unit is serviced as an assembly and the only checks possible are of continuity and voltage checks.*

REMOVAL

1. Remove the steering console lower panel situated in front of the gearshift lever.

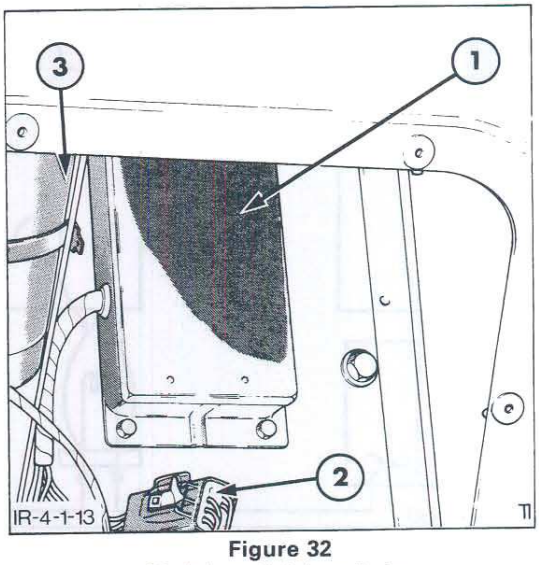

Figure 32
Modulator Unit Installation

1. Modulator Unit
2. Harness Connector
3. Steering Motor

2. Withdraw the retaining bolts and remove the modulator unit, Figure 32.

INSPECTION

See "Trouble Shooting" – Chapter 3 for the modulator unit inspection.

INSTALLATION

1. Install the modulator unit and secure in position tightening the retaining bolts to the specified torque, see "Specifications" – Chapter 3.

2. Install the steering console lower panel and tighten the retaining bolts to the specified torque, see "Specifications" – Chapter 3.

D. FRONT END OVERHAUL

ASSEMBLIES SERVICED WITH TRANSMISSION SEPARATED FROM ENGINE

- Torque Converter.
- Transmission Hydraulic Pump and Oil Distributor.
- Front Input Shaft and Clutch Housing.

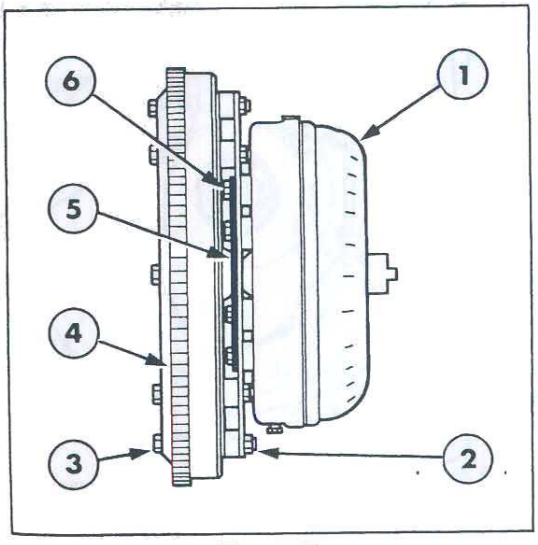

Figure 33
Torque Converter to Flywheel

1. Torque Convertor Assembly
2. Drive Plate Assembly
3. Flywheel to Drive Plate Bolts
4. Flywheel
5. Reinforcing Plate
6. Drive Plate to Torque Converter Bolts

SEPARATING THE TRANSMISSION FROM THE ENGINE

1. Drain the oil from the transmission by removing the drain plug.
2. Separate the transmission from the engine as described in PART 10 'Separating the Unit'.

DISASSEMBLY

TORQUE CONVERTER

1. Remove the torque converter and drive plate from the stator support, Figure 33.
2. Remove the drive plate from the converter by removing the attaching bolts and washers.
3. Normally, it is not necessary to remove the converter pilot hub. However, if the pilot hub is damaged it can be removed by removing the self-locking bolts.

CAUTION: *The bolts securing the converter pilot hub to the flywheel also hold the flywheel to the crankshaft. Before removing the bolts, make sure the flywheel is sufficiently supported to prevent it from falling.*

4. Refer to Section F for servicing the torque converter.

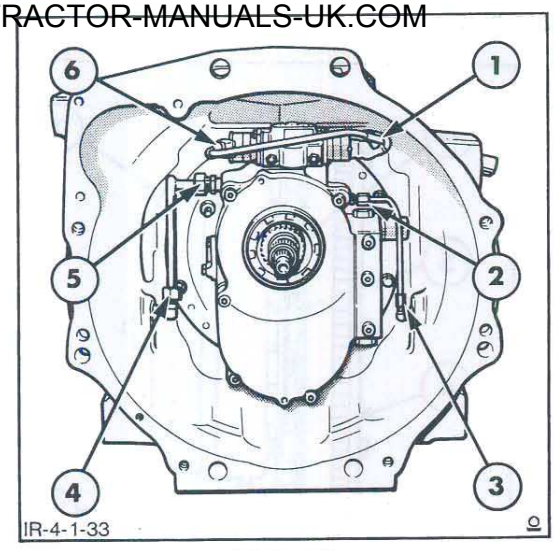

Figure 34
Front View of Transmission Case

1. Solenoid Connection
2. Test Port Line
3. Test Port Line
4. Return Line
5. Return Line
6. Solenoid Connection

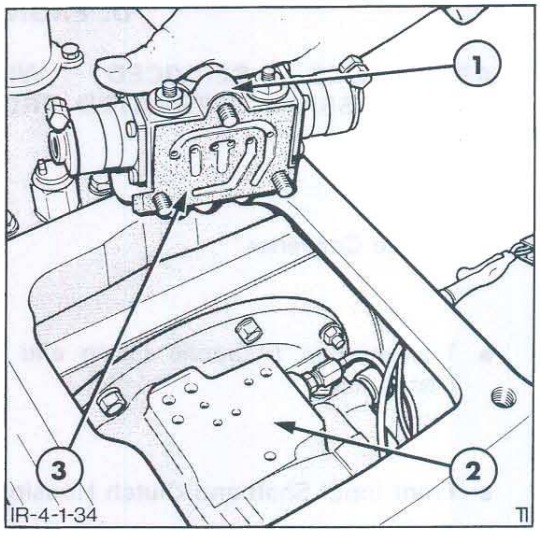

Figure 35
Solenoid Control Valve Removal

1. Solenoid Control Valve Assembly
2. Oil Distributor
3. Gasket

TRANSMISSION HYDRAULIC PUMP AND OIL DISTRIBUTOR HOUSING

1. Disconnect the oil cooler return pipe and elbow at the transmission case, Figure 34. Disconnect the return pipe at the oil distributor housing and remove the pipe from the transmission case.

2. Disconnect the pressure test port feed pipe and elbow at the transmission case. Disconnect the feed pipe at the oil distributor housing and remove the pipe from the transmission case, Figure 34.

3. Disconnect the wiring harness from the solenoid control valve and remove from the transmission case; note the colour and the position of the two connectors.

4. Remove the solenoid control valve securing bolts and remove the solenoid control valve from the distributor housing, Figure 35.

   Refer to Section F for the disassembly of the solenoid control valve assembly.

5. Remove the distributor housing retaining bolts. Obtain two M8 jacking bolts, approximately 30 mm (1.25 in.) long. Screw the bolts into the housing as shown in Figure 36, then continue to tighten until the distributor housing is freed from the transmission case. Lift the housing from the transmission and remove the jacking bolts.

NOTE: *The distributor housing is heavy, care should be exercised when removing the housing from the transmission case.*

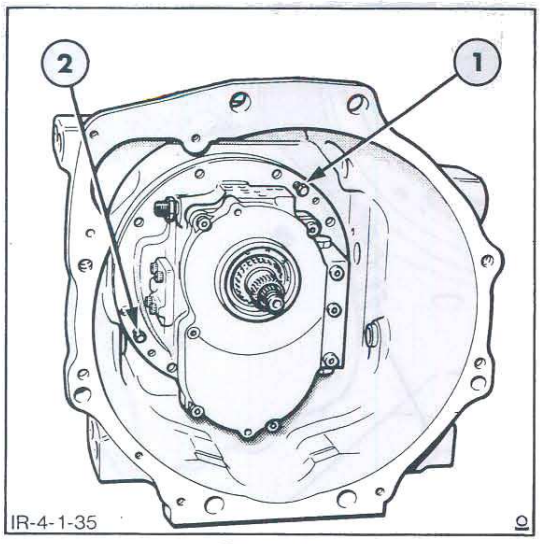

Figure 36
Distributor Housing Removal

1. Upper Jacking Bolt
2. Lower Jacking Bolt

Refer to Section F for disassembly of the distributor housing and hydraulic pump.

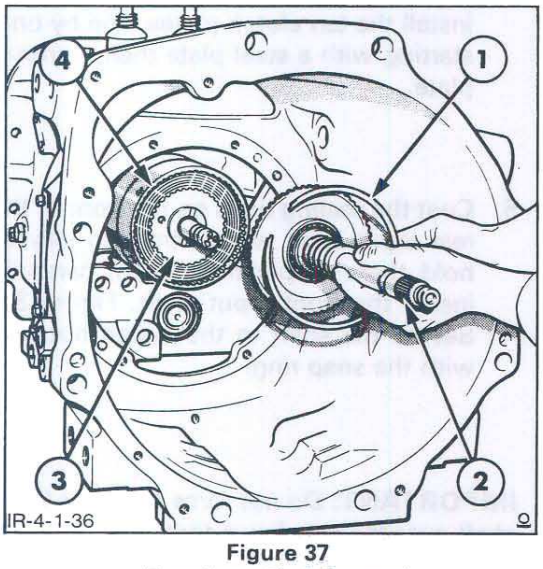

Figure 37
Front Input Shaft Removal

1. Snap Ring
2. Front Input Shaft
3. Forward Clutch Hub
4. Forward Clutch Plates

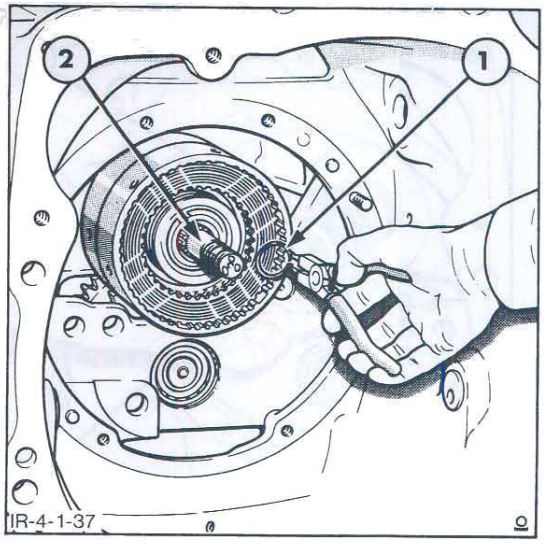

Figure 38
Removal

1. Clutch Housing Snap Ring
2. Rear Input Shaft

FRONT INPUT SHAFT AND CLUTCH HOUSING

1. Remove the front input shaft and bearing assembly from the clutch housing by removing the snap ring, Figure 37.

2. Pull the forward clutch hub, along with the thrust washer, from the rear input shaft, Figure 37, then remove the forward clutch plates.

   The clutches have five steel and five graphite bronze plates. All the plates are "flat". The friction plates are available in thicknesses of 0.090 in. (2.30 mm), 0.096 in. (2.44 mm) and 0.10 in. (2.60 mm).

3. Remove the snap ring, Figure 38, then pull the clutch housing from the rear input shaft.

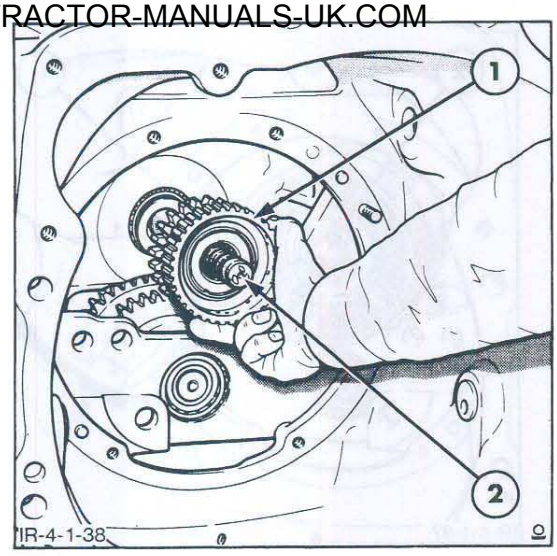

Figure 39
Reverse Idler Input Gear Removal

1. Reverse Idler Input Gear (Rear Clutch Hub)
2. Rear Input Shaft

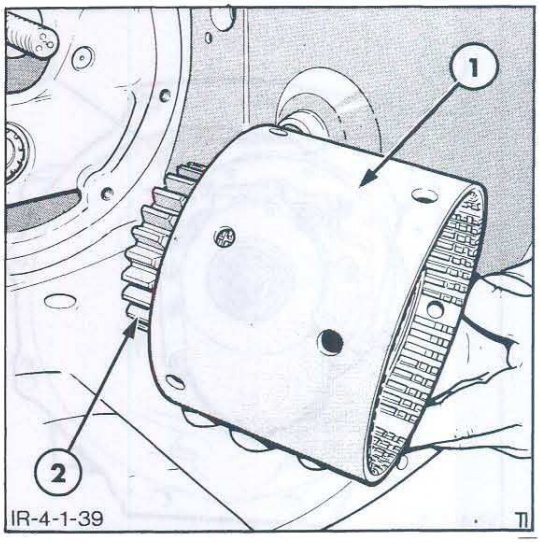

Figure 40
Clutch Housing Installation

1. Clutch Housing
2. Reverse Idler Input Gear

4. Remove the reverse idler input gear, thrust washer, needle bearings and shims from the rear input shaft, Figure 39, if not removed with the clutch housing.

5. Refer to Section F for disassembly of the rear clutch.

ASSEMBLY

FRONT INPUT SHAFT AND CLUTCH HOUSING

1. Assemble the rear clutch as described in Section F.

2. Install the partially assembled clutch housing, Figure 40, over the rear input shaft while exercising care to prevent damaging the roller bearings. Make sure the spacer, shim and thrust washer are installed on the rear input shaft.

3. Retain the clutch on the shaft by installing the appropriate snap ring, Figure 38.

4. Place the clutch hub and thrust washer, Figure 37, on the rear input shaft, then install the ten clutch plates, one by one, starting with a steel plate then a bronze plate.

5. Coat the sealing rings on the front of the rear input shaft with petroleum jelly to hold them in position. Then, carefully install the front input shaft, Figure 37. Secure the shaft to the clutch housing with the snap ring.

IMPORTANT: *Do not force the front input shaft over the rear input shaft, Figure 37. If difficulty is encountered, one of the sealing rings could have dropped out of position. If necessary, remove the front input shaft and reposition the sealing rings.*

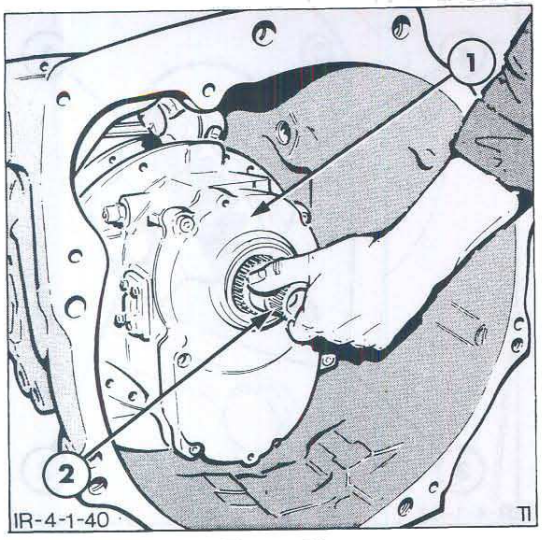

Figure 41
Oil Distributor Housing Installation

1. Oil Distributor
2. Stator Support

TRANSMISSION HYDRAULIC PUMP AND OIL DISTRIBUTOR HOUSING

1. Assemble the oil distributor as described in Section F.

2. Apply gasket sealant, see Specification – Chapter 3, to the portion of the new gasket between the lower two bolt holes, then install the gasket to the transmission casing.

3. Install the oil distributor housing onto the transmission casing, Figure 41, and secure with the retaining bolts. Exercise care when installing the oil distributor to prevent the sealing rings on the front input shaft from being damaged or dislodged. Tighten the retaining bolts to the specified torque, see 'Specifications' – Chapter 3.

4. Assemble the solenoid control valve assembly as described in Section F.

5. Install a new solenoid control valve gasket to the distributor housing. Install the solenoid control valve onto the oil distributor housing and secure with the retaining bolts. Tighten the retaining bolts to the specified torque, see 'Specifications' – Chapter 3.

6. Prior to installing the oil cooler return and the pressure test port feed elbows apply thread sealant to the threads, see 'Specifications' – Chapter 3. Install the elbows to the transmission casing.

7. Install the pressure test feed port pipe and tighten to the specified torque, see "Specifications" – Chapter 3.

8. Install the oil cooler return pipe and tighten to the specified torque, see "Specifications" – Chapter 3.

9. Thread the wiring harness through the transmission casing and connect to the solenoid control valve. Ensure that the connectors are matched to the connectors on the control valve, i.e. grey-to-grey and black-to-black. Secure the harness with the clip installed to the top distributor housing bolt.

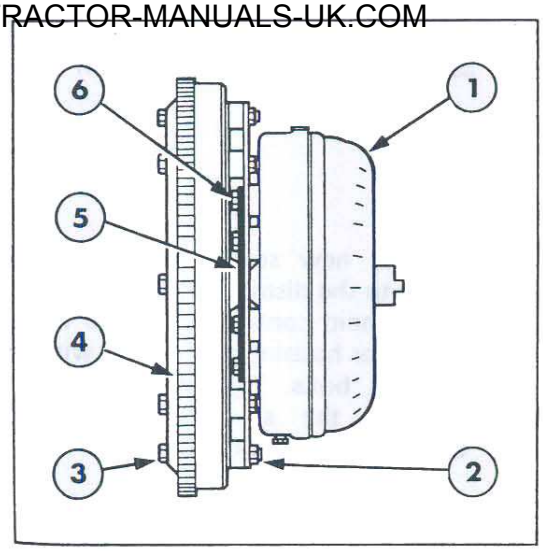

Figure 42
Torque Convertor to Flywheel Assembly

1. Torque Convertor Assembly
2. Drive Plate Assembly
3. Flywheel to Drive Plate Bolts
4. Flywheel
5. Reinforcing Plate
6. Drive Plate to Torque Convertor Bolts

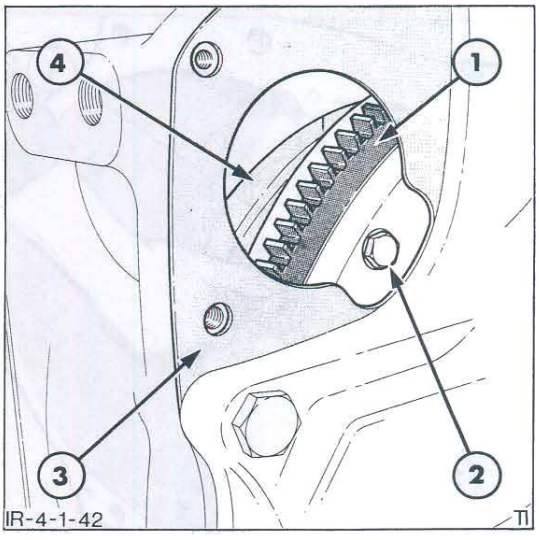

Figure 43
Starting Motor Aperture

1. Flywheel
2. Flywheel to Drive Plate Bolts
3. Engine Back Plate
4. Torque Converter

TORQUE CONVERTER

1. Secure the drive plate to the torque converter, Figure 42, with the six attaching bolts and flat washers. Tighten the bolts to the specified torque, see "Specifications" – Chapter 3.

2. Install the torque converter drain plug, if not previously installed, then push the assembled converter over the stator support. Exercise care to prevent damaging the oil seal on the front input shaft. Rotate the converter so the splines on the hub engage with the splines on the front input shaft.

CONNECTING THE TRANSMISSION TO THE ENGINE

1. Carefully move the engine towards the transmission making sure the converter pilot hub is aligned with the pilot of the torque converter.

2. Install the transmission to engine attaching bolts and washers.

3. Rotate the flywheel until the eight holes in the drive plate, align with the holes in the flywheel.

4. Working through the starting motor aperture, Figure 43, install the attaching bolts and washers finger tight. Rotate the flywheel as required until all eight bolts and washers are installed.

5. Rotate the flywheel approximately two full turns to centre the drive plate, then tighten the eight drive plate attaching bolts to the specified torque, see "Specifications" – Chapter 3.

6. Complete the connection as described in Part 10 "Separating the Unit".

E. COMPLETE OVERHAUL

Assemblies serviced with transmission removed from the tractor.

NOTE: *Although it is possible to service the gearshift mechanism and the output shaft bearing retainer and oil seal by separating the transmission from the rear axle, it is recommended that these items are serviced with the transmission removed from the tractor.*

- Output Shaft and Countershaft Gear Assemblies
- Countershaft Pre-Load
- Rear Cover
- Output Shaft Pre-Load
- Gearshift Components

SEPARATING THE TRANSMISSION FROM THE ENGINE AND REAR AXLE

1. Separate the transmission from the engine and rear axle, as described in PART 10, "Separating the Unit".

COMPONENT REMOVAL

1. Remove the transmission hydraulic pump and oil distributor as described in Section D.

2. Remove the front input shaft and clutch housing as described in Section D.

GEARSHIFT COMPONENTS

1. Remove the dipstick from the gearshift cover plate.

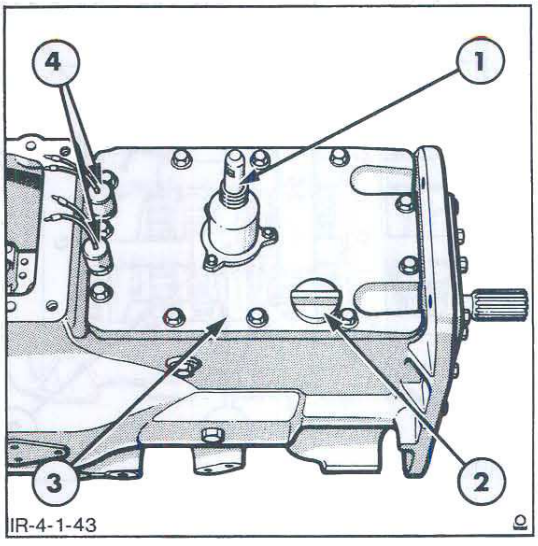

Figure 44
Transmission Top Cover

1. Gear Lever Spigot
2. Oil Filler and Dipstick
3. Top Cover
4. Safety Start Switches

2. Ensure the gearshift lever is in neutral and remove the cover plate retaining bolts then remove the cover plate and gasket, Figure 44.

3. Remove the detents, springs and balls from the bores in the top of the transmission case, Figure 46. If the balls will not lift out with a magnet, the balls may be removed after the shift rails have been removed from the transmission case.

4. Using a suitable pin punch, remove the spring pins retaining the 1st/2nd gearshift gate and the gearshift fork, Figure 45.

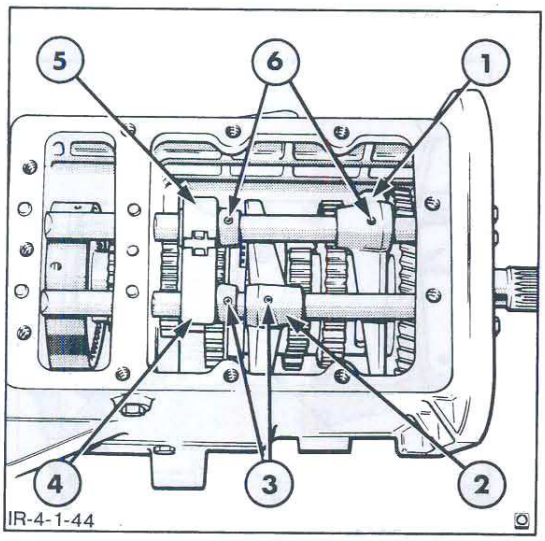

Figure 45
Gearshift Component Removal

1. 1st-2nd Shift Fork
2. 3rd-4th Shift Fork
3. 3rd-4th Shift Rail Roll Pins
4. 3rd-4th Shift Rail Gate
5. 1st-2nd Shift Rail Gate
6. 1st-2nd Shift Rail Roll Pins

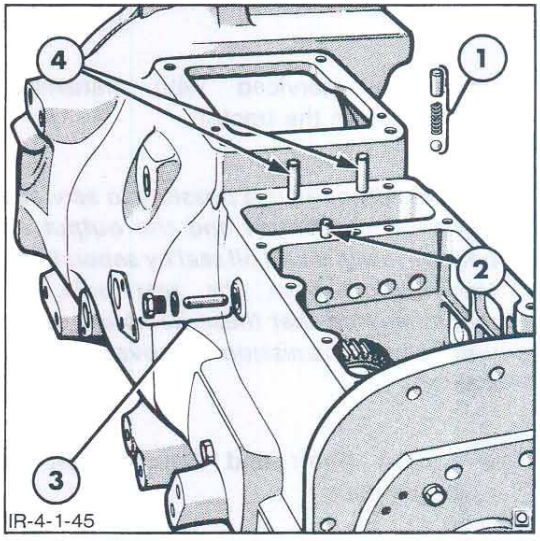

Figure 46
Gearshift Detents and Plungers

1. 1st-2nd Shift Rail Detent
2. 3rd-4th Shift Rail Detent
3. Interlock Plug and Plunger
4. Safety Start Switch Plungers

5. Remove the gearshift rail plugs from the rear end of the transmission case, then extract the gearshift rail rearwards, retrieving the gearshift gate and fork as the rail is removed from the transmission case. If the detent ball was not previously removed, exercise care to prevent the ball from falling into the transmission.

6. Using a suitable pin punch remove the spring pins retaining the 3rd/4th gearshift gate and gearshift fork, Figure 45.

7. Extract the gearshift rail by sliding the rail rearwards retrieving the gearshift gate and fork as the rail is removed from the transmission case.

NOTE: *In certain countries tractors are limited to a maximum speed of 20km/h when travelling on the public highway. In order to comply with this speed regulation the 4th gear is blocked out. These tractors then have a 3 × 3 transmission.*

When servicing this type of transmission it is necessary to retrieve the block collar, positioned on the 3rd/4th gearshift rail between the gearshift gate and the transmission inner wall, as the 3rd/4th gearshift rail is being extracted from the transmission housing.

8. Remove the interlock detent plug from the left-hand side of the transmission case and extract the interlock detent, Figure 46, which is positioned between the 1st/2nd and 3rd/4th gearshift rails.

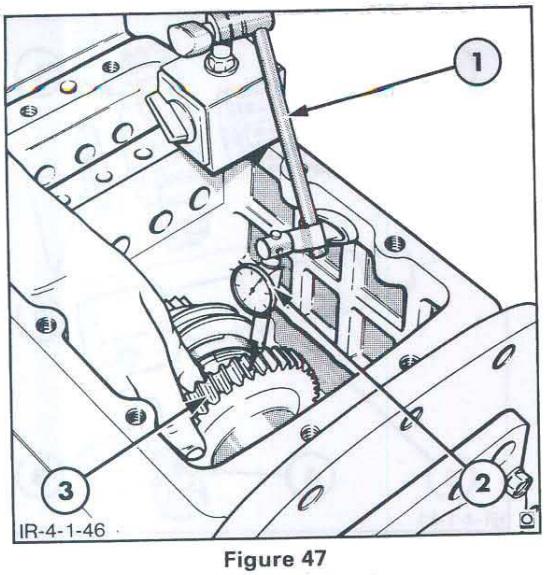

Figure 47
Gear Backlash Check

1. Gear Backlash Bracketry
2. Dial Indicator
3. Stylus

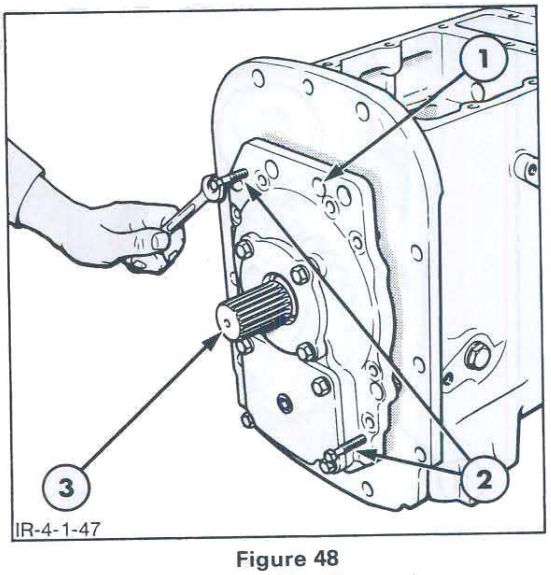

Figure 48
Rear Cover Plate Removal

1. Rear Cover
2. Jacking Bolts
3. Output Shaft

REAR COVER PLATE

1. If transmission gear wear is suspected then prior to removing the rear cover and output shaft bearing retainer check the gear backlash. Position a dial indicator gauge on the transmission casing as shown in Figure 47 and measure the backlash on output shaft gears.

2. Prior to removing the rear cover and output shaft bearing retainer tie the output shaft and countershaft together with a suitable length of cord.

3. Remove the rear cover retaining bolts then screw two jacking bolts into the rear cover as shown in Figure 48. Tighten the two jacking bolts equally until the rear cover is free of the transmission case. Remove the two jacking bolts and remove the rear cover assembly.

OUTPUT SHAFT AND COUNTER-SHAFT GEAR ASSEMBLIES

1. Release the cord retaining the output shaft and countershaft assemblies together then lift the output shaft assembly rearwards from the transmission case as shown in Figure 49.

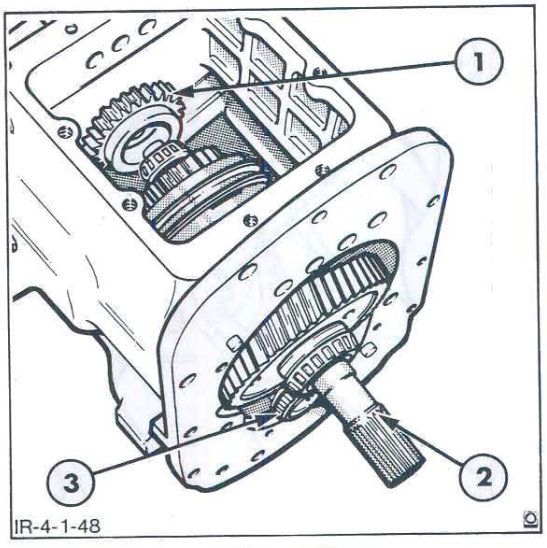

Figure 49
Output Shaft Removal

1. Rear Input Shaft
2. Output Shaft
3. Countershaft

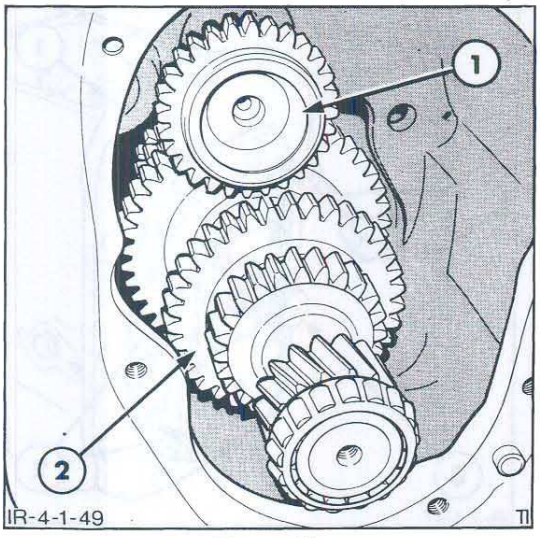

Figure 50
Countershaft Removal

1. Rear Input Shaft
2. Countershaft Assembly

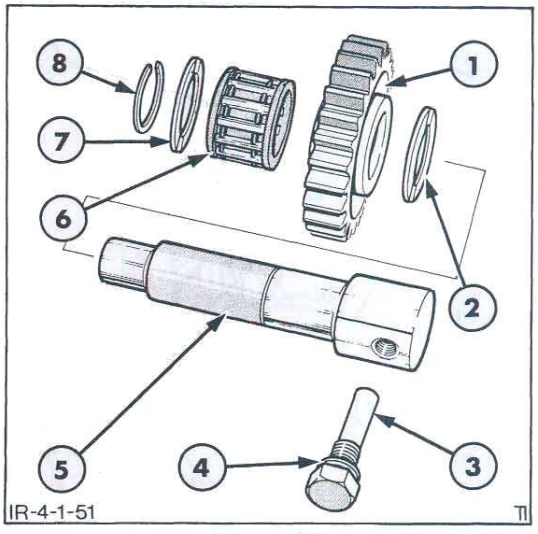

Figure 52
Reverse Gear Idler Components

1. Gear
2. Thrust Washer
3. Shaft Locating Bolt
4. Seal
5. Shaft
6. Roller Bearing
7. Thrust Washer
8. Snap Ring

2. Remove the rear input shaft assembly from the transmission case through the gearshift cover plate aperture.

3. Lift the countershaft assembly Figure 50 and remove from the rear end of the transmission case.

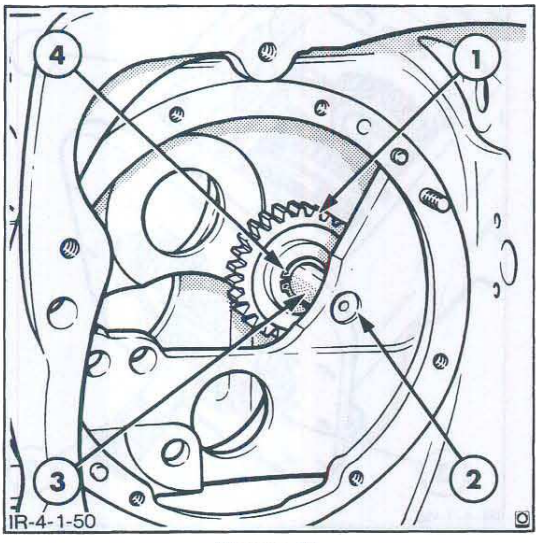

Figure 51
Reverse Gear Idler Removal

1. Gear
2. Shaft Spigot
3. Shaft
4. Snap Ring

4. Remove the reverse gear idler shaft retaining bolt from the left-hand side of the transmission case.

5. Remove the snap ring from reverse gear idler shaft, Figure 51, and slide the shaft rearwards from the transmission case retrieving the gear, bearing and thrust washers as the shaft is removed, Figure 52.

6. Refer to Section F for disassembly of the output shaft and countershaft assemblies.

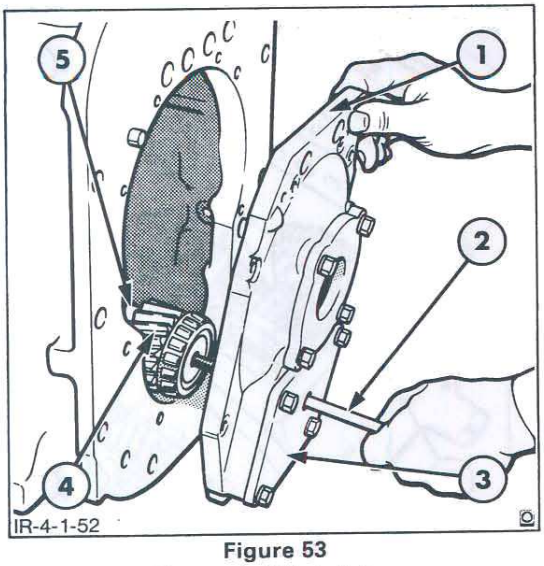

Figure 53
Countershaft Installation

1. Rear Cover
2. Rod
3. Bearing Cap
4. Countershaft Assembly
5. Point to Wrap Cord

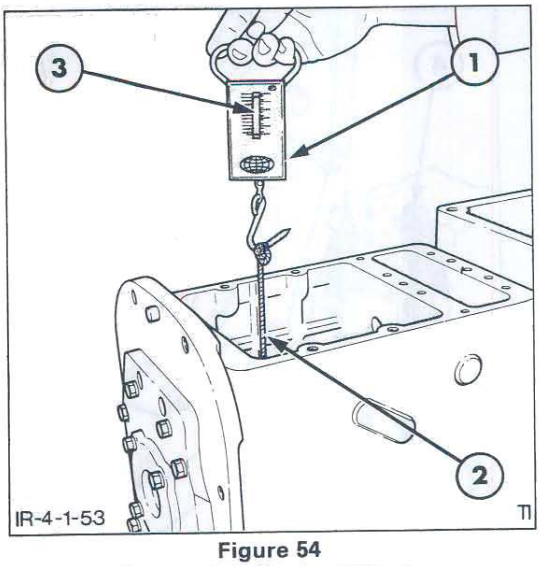

Figure 54
Countershaft Pre-Load Check

1. Pull Scale
2. Cord

INSTALLATION

COUNTERSHAFT PRE-LOAD CHECK

1. If any of the following parts have been renewed then it will be necessary to check the countershaft pre-load.

   - Taper roller bearings.
   - Countershaft.
   - Thrust washers.

   The pre-load is checked with all components removed from the transmission case except the countershaft. To determine the shims required to give the specified pre-load, see "Specifications" – Chapter 3, proceed as follows:

2. Assemble the countershaft and gear assembly as described in Section F.

3. Install the assembled countershaft and gear assembly through the rear of the transmission case and position in such a way that the rear bearing just protrudes from the rear of the case.

4. Ensure the countershaft bearing cap attaching bolts are tightened to the specified torque, see "Specifications" – Chapter 3.

5. Remove the bearing cap plug and insert a suitable rod through the hole in the cap into the countershaft, Figure 53.

6. Position the rear cover to the transmission case while lifting the countershaft with the rod.

7. Secure the rear cover to the transmission case and tighten the retaining bolts to the specified torque, see "Specifications" – Chapter 3.

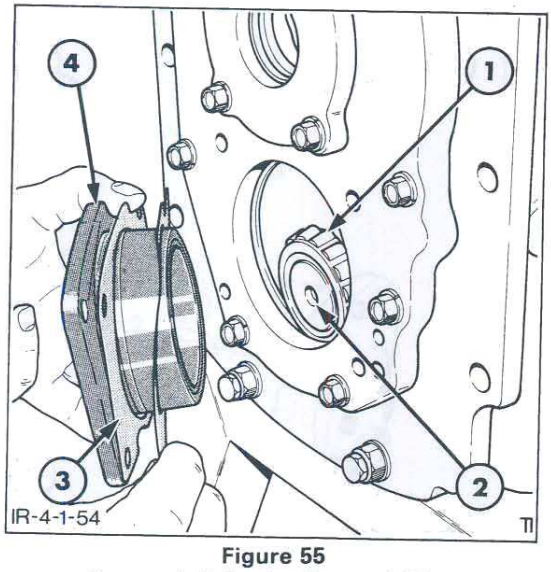

Figure 55
Countershaft Bearing Cap and Shims

1. Taper Rolling Bearing
2. Countershaft
3. Shims
4. Bearing Cap

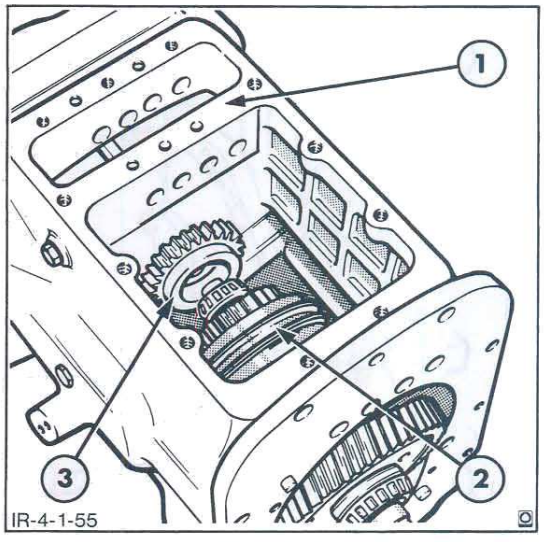

Figure 56
Rear Input Shaft Installation

1. Transmission Case Inner Wall
2. Output Shaft
3. Rear Input Shaft

8. Rotate the countershaft assembly until the bearings run smoothly.

9. Using a suitable length of cord and a pull scale as shown in Figure 54, wrap the cord around the countershaft just ahead of the helical gear, Figure 53. Ensure that the cord does not overlap.

10. If the pull required to rotate the countershaft is outside the specified limits, see "Specifications" – Chapter 3, remove the rear cover and bearing cap and add or delete shims as required Figure 55 and repeat the procedure.

NOTE: *When installing the bearing cap, apply a thread sealant to the retaining bolts prior to installation, see "Specifications" – Chapter 3, for specified thread sealant.*

11. When the pre-load check is complete remove the rear cover.

OUTPUT SHAFT PRE-LOAD CHECK

1. The pre-load on output shaft must be checked if any of the following components have been renewed.

   - Taper roller bearings.
   - Output shaft.
   - Thrust washers.
   - Rear input shaft.

The pre-load must be checked with all components removed from the transmission case except for the output shaft and rear input shaft. It will be necessary, therefore, to remove the countershaft if previously installed.

2. Assemble the output shaft and gear assembly as described in Section F.

3. Install the rear input shaft into the transmission case and rest across the transmission case inner wall, Figure 56.

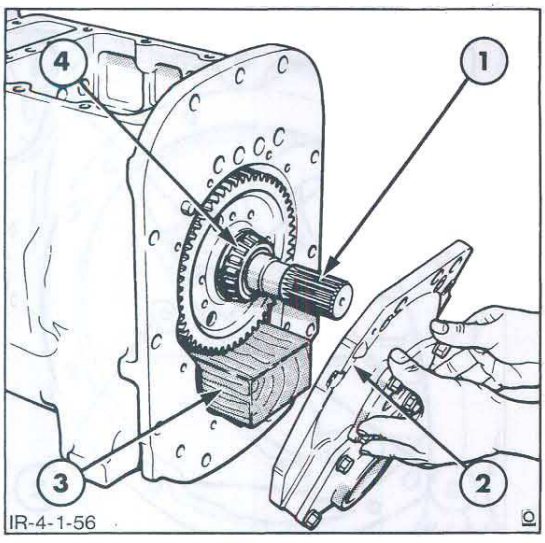

Figure 57
Output Shaft Installation

1. Output Shaft
2. Rear Cover
3. Wooden Block
4. Output Shaft Rear Bearing

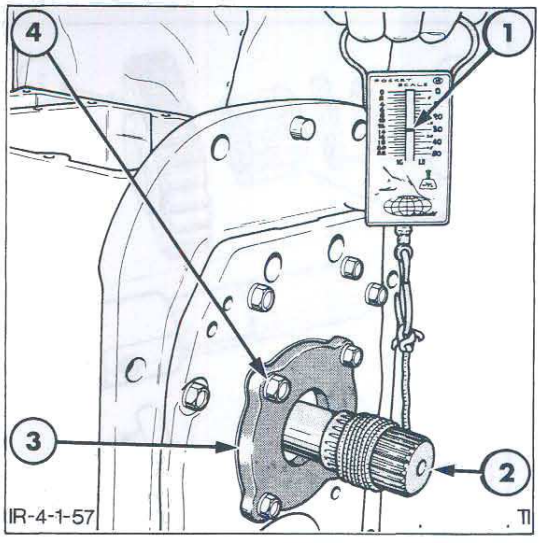

Figure 58
Output Shaft Pre-Load Check

1. Scale
2. Output Shaft
3. Bearing Cap
4. Retaining Bolts

4. Install the output shaft into the transmission case from the rear end and mate up with the rear input shaft. Temporarily support the output shaft with a suitable wooden block, Figure 57.

5. Install the rear cover plate to the transmission case while removing the wooden block from the casing. Install and tighten the cover retaining bolts to the specified torque, see "Specifications" – Chapter 3.

6. Ensure that the output shaft bearing cap retaining bolts are tightened to the specified torque, see "Specifications" – Chapter 3.

7. Rotate the output shaft several times to ensure the bearings are seated correctly.

8. Wrap a suitable length of cord around the output shaft splines, Figure 58. Ensure that the cord does not overlap. Attach a pull scale to the cord and measure the pull required to rotate the output shaft.

9. If the pull required to rotate the output shaft is outside the specified limits, see "Specifications" – Chapter 3, remove the rear bearing cap and cover assembly. Add or delete shims as required and repeat the pre-load procedure.

NOTE: *When installing the bearing cap apply a thread sealant to the retaining bolts prior to installation, see "Specifications" – Chapter 3 for the specified thread sealant.*

10. When the pre-load check is correct remove the rear cover assembly, the output shaft assembly and the rear input shaft from the transmission case.

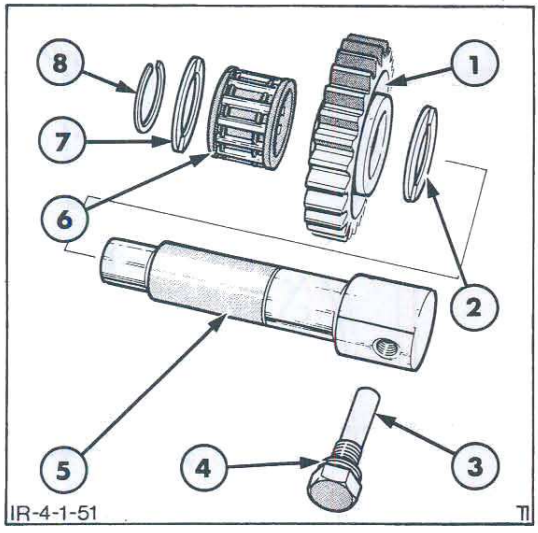

Figure 59
Reverse Gear Idler Components

1. Gear
2. Thrust Washer
3. Shaft Locating Bolt
4. Seal
5. Shaft
6. Roller Bearing
7. Thrust Washer
8. Snap Ring

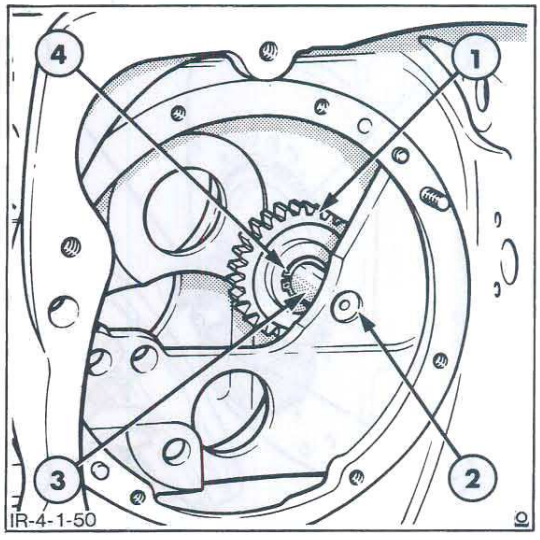

Figure 60
Reverse Gear Idler Installation

1. Gear
2. Shaft Spigot
3. Shaft
4. Snap Ring

OUTPUT SHAFT, COUNTERSHAFT AND REAR COVER ASSEMBLIES

1. Install the reverse gear idler shaft into the transmission casing and assemble the component parts for the assembly in the following sequence with reference to Figure 59.

   - Thrust washer.
   - Reverse idler gear and needle bearing.
   - Thrust washer.
   - Collar
   - Snap Ring.

NOTE: *Ensure that the thrust washers are installed with the oil grooves facing the reverse idler gear.*

2. Install the reverse idler shaft retaining bolt into the transmission case ensuring the bolt aligns with the shaft. Tighten the bolt to the specified torque, see "Specifications" – Chapter 3.

3. Install the countershaft and gear assembly into the transmission case from the rear end so that the front end taper roller bearing rests in the bearing cup.

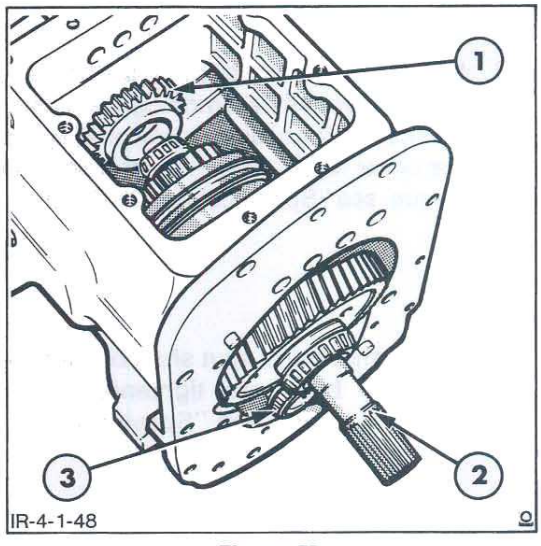

Figure 61
Output Shaft Installation

1. Rear Input Shaft
2. Output Shaft
3. Countershaft

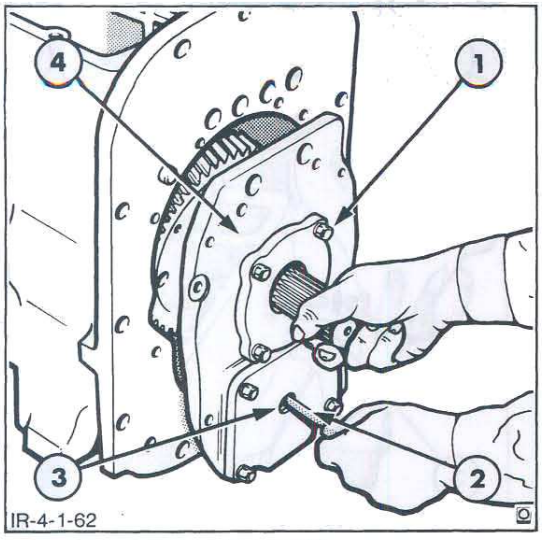

Figure 62
Rear Cover Plate Installation

1. Output Shaft Bearing Cap
2. Suitable Rod
3. Plug Hole
4. Rear Cover Plate

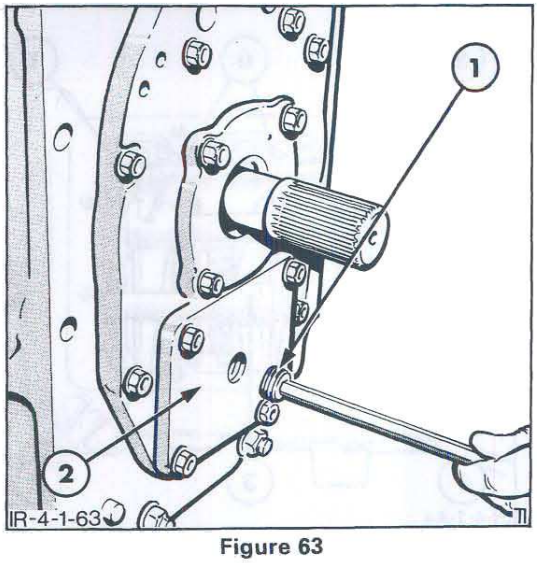

Figure 63
Countershaft Bearing Cap Plug

1. Access Plug
2. Bearing Cap

4. Install the rear input shaft into the transmission case and rest across the transmission case inner wall.

5. Install the output shaft and gear assembly into the transmission case from the rear end and position onto the countershaft and gear assembly just behind the rear input shaft, Figure 61.

6. Engage the rear input shaft with the output shaft and gear assembly, then engage with the countershaft and gear assembly so that the taper roller bearings rest in the respective bearing cups.

7. If not previously removed, remove the countershaft bearing cap plug.

8. Apply gasket sealant to the rear cover face, see "Specifications" – Chapter 3 for the specified sealant, then position the cover over the output shaft until the output shaft taper roller bearing contacts the respective bearing cap.

9. Insert a suitable rod through the countershaft bearing cap plug hole into the countershaft, Figure 62. Lift the countershaft while positioning the rear cover plate onto the transmission case, Figure 62.

10. Secure the rear cover plate assembly to the transmission case with the retaining bolts. Tighten the retaining bolts to the specified torque, see "Specifications" – Chapter 3.

11. Apply thread sealant, see "Specifications" – Chapter 3, to the countershaft bearing cap plug and install the plug into the cap, Figure 63. Tighten the plug to the specified torque, see "Specifications" – Chapter 3.

12. Rotate the gear train to ensure all gears turn smoothly.

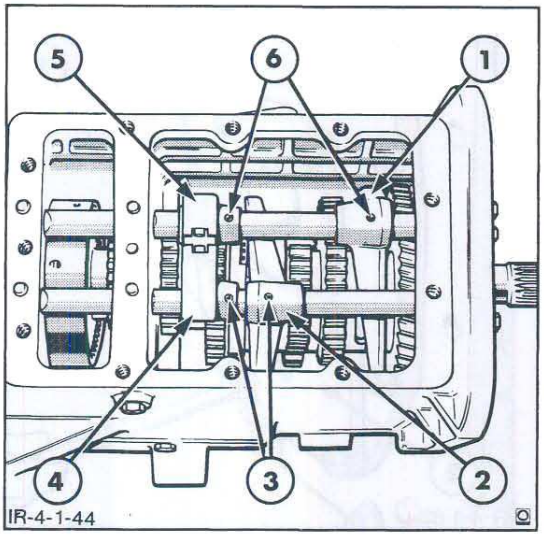

Figure 64
Gearshift Component Installation

1. 1st-2nd Shift Fork
2. 3rd-4th Shift Fork
3. 3rd-4th Shift Rail Roll Pins
4. 3rd-4th Shift Rail Gate
5. 1st-2nd Shift Rail Gate
6. 1st-2nd Shift Rail Roll Pins

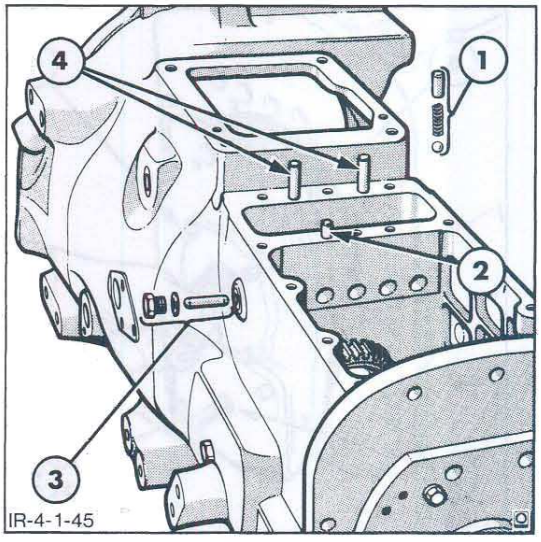

Figure 65
Gearshift Detents and Plungers

1. 1st-2nd Shift Rail Detent
2. 3rd-4th Shift Rail Detent
3. Interlock Plug and Plunger
4. Safety Start Switch Plungers

GEARSHIFT COMPONENTS

1. Install the 1st/2nd and 3rd/4th gear shift forks into the respective synchroniser assemblies, Figure 64.
2. Insert the 1st/2nd gearshift rail into the transmission case from the rear end of the transmission. Slide the rail through the 1st/2nd gearshift fork then install the 1st/2nd gearshift gate onto the rail. Continue sliding the rail until it is in approximately the neutral position, Figure 64.
3. Insert the interlock detent into the drilling on the left-hand side of the transmission case. Install the interlock detent plug and tighten to the specified torque, see "Specifications" – Chapter 3.
4. Insert the 3rd/4th gearshift rail into the transmission case from the rear end of the transmission. Slide the rail through the 3rd/4th gearshift forks, then install the 3rd/4th gearshift gate onto the rail. Continue sliding the rail until it is in approximately the neutral position.

NOTE: *If difficulty is encountered sliding the 3rd/4th gearshift rail into the neutral position check to ensure that the 1st/2nd gearshift rail is positioned in the neutral and the interlock detent is positioned correctly to the 1st/2nd gearshift rail. The interlock detent will prevent the 3rd/4th gearshift rail from entering the transmission case if the1st/2nd gearshift rail is not in neutral.*

5. Align the spring pin holes in the gearshift gate forks and rails then drive the spring pins into the holes.
6. Insert the safety start switch plungers into their respective bores, Figure 65. Insert the gearshift rail balls, springs and detents into their respective bores, Figure 65.
7. Install the two blind covers into the gearshift rail bores at the rear end of the transmission case cover plate.

COMPONENT INSTALLATION

1. Install the front input shaft and clutch housing as descibed in Section D.
2. Install the distributor housing as described in Section D.

F. COMPONENT OVERHAUL

- Torque Converter
- Transmission Hydraulic Pump and Oil Distributor Assembly
- Control Valve
- Front Input Shaft and Hydraulic Clutch
- Reverse Idler Gear Assembly
- Rear Input Shaft
- Output Shaft and Gear Assembly
- Countershaft and Gear Assembly

TORQUE CONVERTER

The torque converter, Figure 66, is a welded unit and cannot be disassembled. The only maintenance performed on the converter, other than the stall test covered in Chapter 3, is cleaning and visual inspection. A commercial torque converter cleaner may be used to clean the converter. However, if a commercial cleaner is not available, the converter should be cleaned as outlined below.

1. If not previously drained, remove the drain plug, Figure 66 and drain as much oil as possible from the converter by tilting the converter in all directions.
2. Install the drain plug, then fill the converter about half full, through the hub, with paraffin base solvent or any cleaning solvent specified for cleaning transmissions.
3. Plug the opening in the hub, then circulate the solvent inside the converter by shaking.
4. Remove the drain plug and the plug from the hub opening. Drain the solvent from the converter.
5. Repeat Steps 1 to 4, as required, until the solvent that is drained from the converter is clean.
6. Install the drain plug.

INSPECTION

Inspect the splines Figure 66 on the converter hub for wear or damage and the weld joints for cracks. If the hub is worn or damaged and/or the weld joints cracked, a new converter should be installed. A new drive plate should also be installed if it is warped.

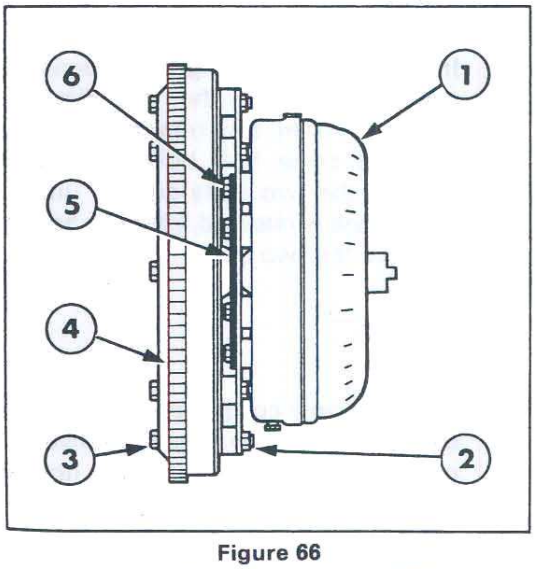

Figure 66
Torque Converter and Drive Plate

1. Torque Convertor Assembly
2. Drive Plate Assembly
3. Flywheel to Drive Plate Bolts
4. Flywheel
5. Reinforcing Plate
6. Drive Plate to Torque Converter Bolts

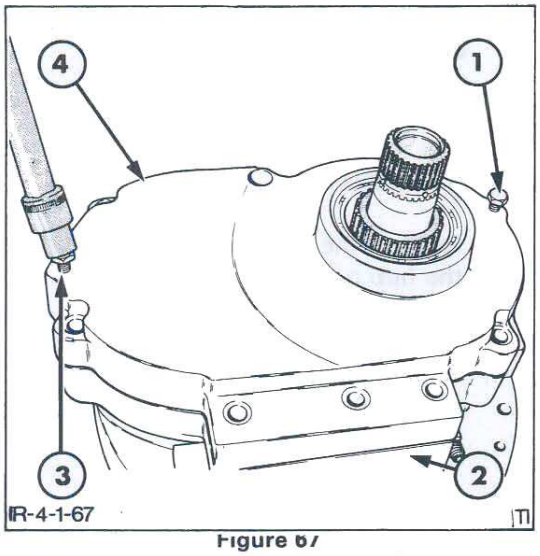

Figure 67
Front Cover Plate Removal

1. Jacking Bolt
2. Oil Distributor
3. Jacking Bolt
4. Front Cover Plate

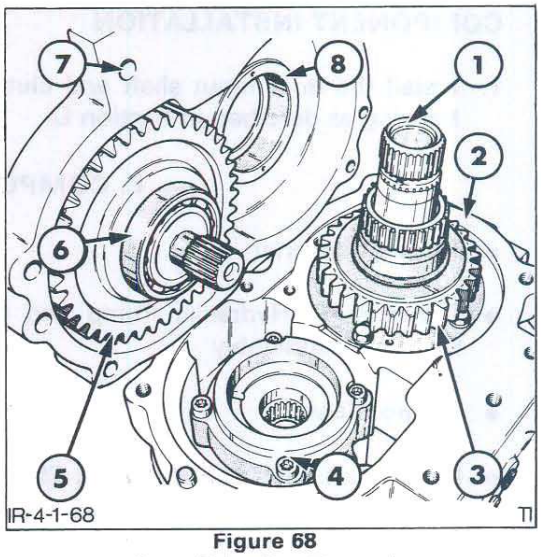

Figure 68
Pump Drive Gear Removal

1. Stator Support
2. Oil Distributor
3. Drive Gear
4. Transmission Pump
5. Driven Gear
6. Bearing
7. Front Cover Plate
8. Thrust Washer

TRANSMISSION HYDRAULIC PUMP AND OIL DISTRIBUTOR ASSEMBLY

DISASSEMBLY

1. Install the two jacking bolts, previously used to remove the oil distributor assembly from the transmission case, into the cover bolt holes, Figure 67. Tighten the two bolts equally until the front cover is released from the housing. Remove the two bolts.

2. Strike the front cover plate with a suitable soft faced mallet to release the hydraulic pump driven gear from the housing, Figure 69.

3. Slide the gear from the stator support. Remove the stator support retaining bolts then remove the support from the oil distributor housing, Figure 68.

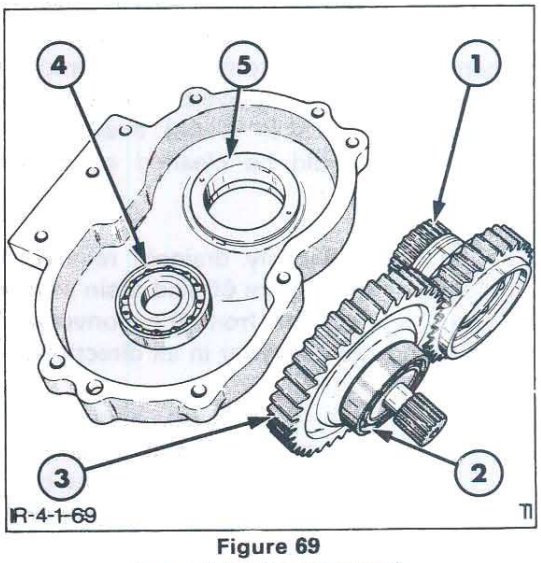

Figure 69
Pump Drive Gear Removal

1. Drive Gear Splines
2. Bearing
3. Driven Gear
4. Bearing
5. Thrust Washer

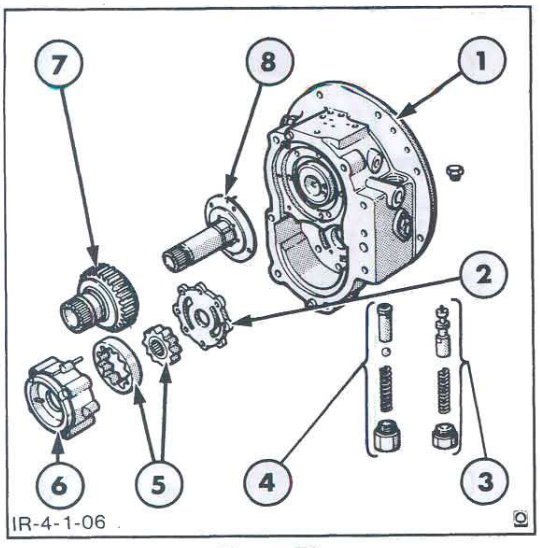

Figure 70
Oil Distributor Housing Components

1. Distributor Housing
2. Pump End Plate
3. Regulating Valve
4. By-Pass Valve
5. Pump Rotors
6. Pump Body
7. Pump Drive Gear
8. Stator Support

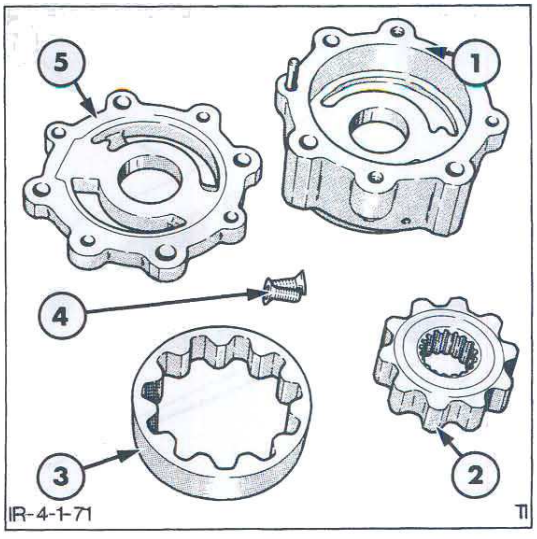

Figure 71
Transmission Pump Components

1. Pump Body
2. Inner Rotor
3. Outer Rotor
4. End Plate Screws
5. End Plate

4. Remove the hydraulic pump retaining bolts and lift the pump assembly from the distributor housing, Figure 70.

5. Remove the by-pass valve plug and extract the shim, spring ball and valve seat, Figure 70.

6. Remove the regulating valve plug and extract the spring, shim and spool.

7. Remove the 'O' ring seals from the valve plugs and discard. Install new 'O' rings on assembly.

INSPECTION

1. Thoroughly clean all the transmission hydraulic pump and oil distributor components with a suitable solvent and allow to dry. Use compressed air to clean the oil passages in the distributor housing.

2. Inspect the hydraulic pump driven gear and the bearings either side of the gear for wear or damage.

3. Inspect the front cover thrust washer for wear or scoring. If damaged, remove by prying the washer from the cover, do not remove if undamaged.

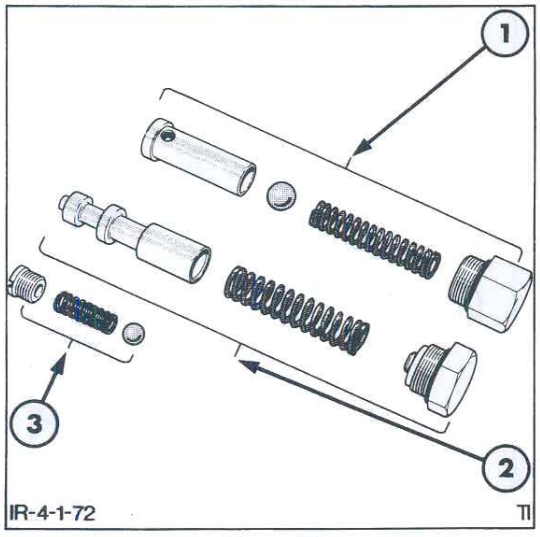

Figure 72
Transmission Hydraulic Valves

1. By-Pass Valve
2. Regulating Valve
3. Lubrication Valve

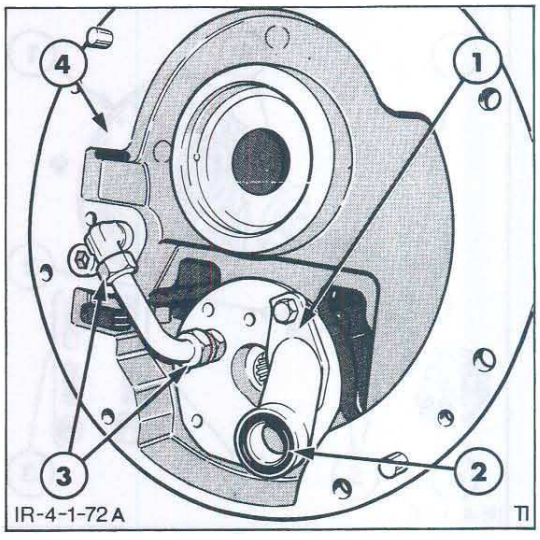

Figure 73
Transmission Pump Connections

1. Suction Tube
2. Seal
3. Pressure Tube Connections
4. Distributor Housing

4. Inspect the front cover torque convertor oil seal for damage. Do not remove the oil seal unless the seal is damaged. If damaged, remove the snap ring and drive the seal from the cover with a suitable punch and hammer.

5. Inspect the stator support gear and bearing for wear or damage. Check the seal rings for wear, nicks or other damage.

6. Disassemble the hydraulic pump, if not already disassembled, and inspect the inner and outer rotors for scratching and scoring or excessive wear.

7. Inspect the by-pass valve seat and ball for scratches and pitting, Figure 72. If scratch marks cannot be removed by polishing, install new parts during assembly. Check the spring and if suspect measure the spring, see "Specifications" – Chapter 3.

8. Inspect the regulating valve spool, Figure 72 for excess wear, grooves or scratches that may cause the spool to malfunction. If scratch marks cannot be removed by polishing, install new parts during assembly. Check the spring and if suspect, measure spring dimensions, see "Specifications" – Chapter 3.

9. Inspect the oil distributor housing for cracks and check the valve bores for wear or scoring. Check the pressure pipes connections are tight and renew the suction pipe seal on assembly, Figure 73.

ASSEMBLY

1. Install the regulating valve spool, shim and spring into the respective bore and retain in position with the plug. Tighten the plug to the specified torque, see "Specifications" – Chapter 3.

2. Install the by-pass valve seal, ball, spring and shim into the respective bore and retain with the plug. Tighten the plug to the specified torque, see "Specifications" – Chapter 3.

3. Assemble the transmission hydraulic pump components as shown in Figure 70. Install the pump onto the distributor housing and secure with the retaining bolts. Tighten the bolts to the specified torque, see "Specifications" – Chapter 3.

4. Install the stator support onto the distributor housing and secure with the retaining bolts. Tighten the bolts to the specified torque, see "Specifications" – Chapter 3.

5. Locate the gear onto the stator support, Figure 68.

6. If it was necessary to remove the oil seal from the front cover, install a new seal using Tool No. 630 or 9210 and a press. If the thrust washer was removed, install a new thrust washer using new knock pins.

7. Install the hydraulic pump drive gear and bearings to the front cover, the assembly is a push fit.

8. Install a new gasket then assemble the front cover plate to the oil distributor housing and secure with the retaining bolts. Tighten the retaining bolts to the specified torque, see "Specifications" – Chapter 3.

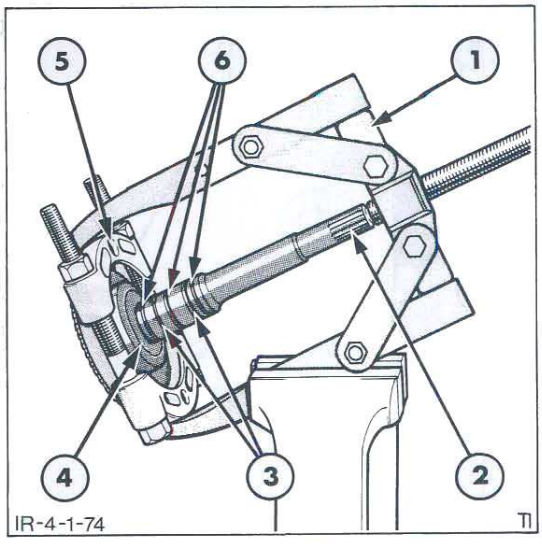

Figure 74
Front Input Shaft Bearing Removal

1. Puller – Tool No. 1003 or 9516
2. Front Input Shaft
3. Oil Passages
4. Front Input Shaft Bearing
5. Pulling Attachment – Tool No. 951 or 9190
6. Sealing Rings

FRONT INPUT SHAFT AND REAR CLUTCH ASSEMBLY

DISASSEMBLY

1. Normally it is not necessary to remove the ball bearing from the front input shaft, or the needle bearing from the rear face of the shaft. If the ball bearing is worn or damaged, it can be removed as shown in Figure 74. To remove the needle bearing, collapse the inner race with a hammer and chisel, then pull the outer race from the shaft with Tool Nos. 1003 and 951 or 9516 and 9190.

2. Unlock the sealing rings by squeezing them together, then remove them from the shaft.

3. If not previously removed, pull the bearings and spacer from the rear clutch hub (reverse idler input) and remove the gear from the clutch plates in the housing. Remove the thrust washer.

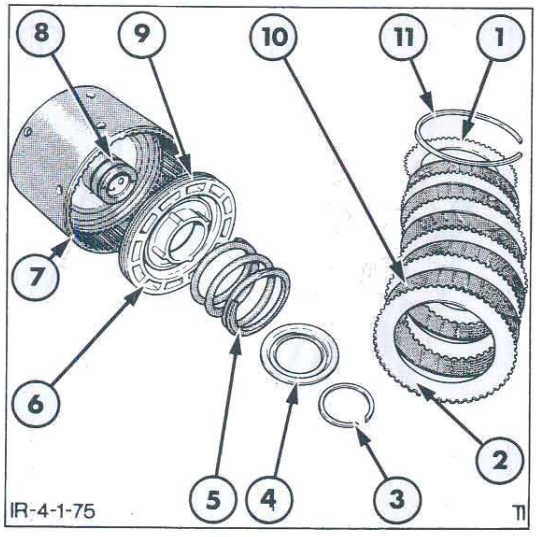

Figure 75
Rear Clutch Components

1. Drive Plate
2. Steel Disc – External Splines
3. Snap Ring
4. Spring Retainer
5. Return Spring
6. Piston
7. Clutch Housing
8. Inner Piston Seal
9. Outer Piston Seal
10. Friction Disc – Internal Splines
11. Snap Ring

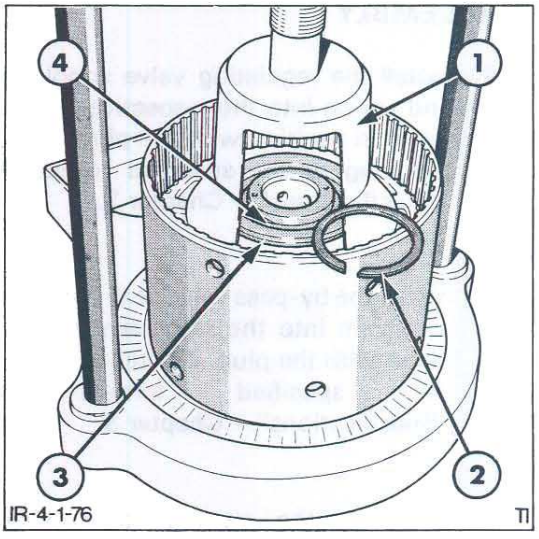

Figure 76
Clutch Piston Return Spring Removal

1. Modified Tool No. FT 4101 or 1312
2. Snap Ring
3. Spring Retainer
4. Snap Ring Groove

4. Remove the large snap ring, clutch drive plate and internal plates from the rear clutch.

5. Using a press and modified Tool No. FT4101 or 1312 see "Specifications" – Chapter 3 along with a suitable size washer as shown in Figure 76, compress the spring enough to remove the snap ring with a screwdriver. Gradually, relieve pressure on the spring, then remove the spring seat and spring.

6. Turn the clutch housing over and remove the snap ring, spring seat, and spring from the other end of the housing by repeating Step 5.

7. Remove the pistons (one in each end of the clutch housing) by directing compressed air into the oil passage in the hub of the clutch housing, Figure 75.

8. Remove the outer 'O' ring seal from each piston and the inner 'O' ring seals from the hub of the clutch housing.

INSPECTION

1. Thoroughly clean the front input shaft and bearings Figure 80 and the clutch components, Figure 78, with suitable solvent and allow to dry. Use air to clean out the oil passages in the input shaft and clutch housing. Do not spin the bearings with compressed air.

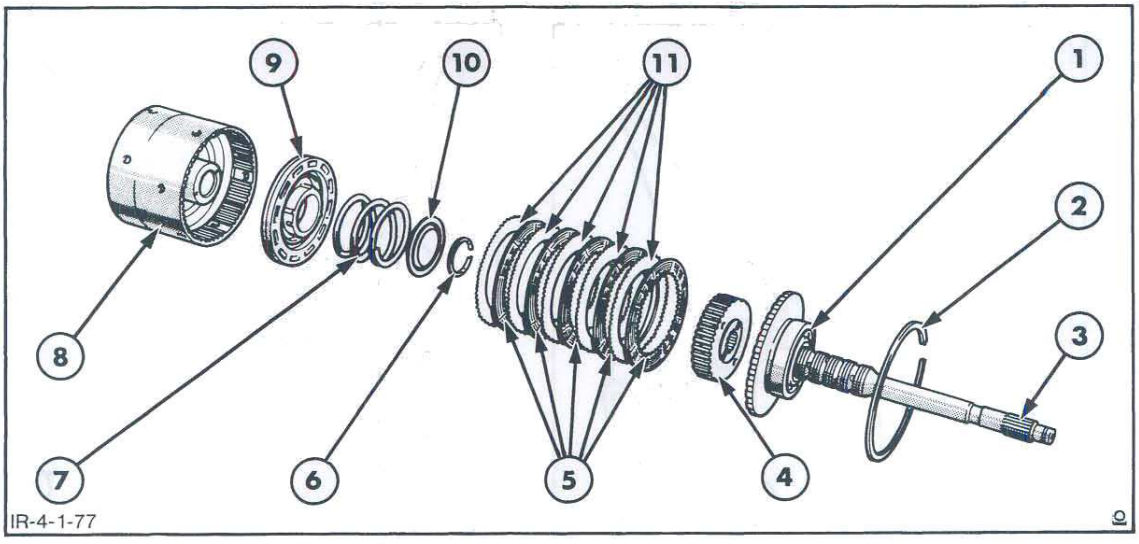

Figure 77
Forward Clutch Components

1. Ball Bearing
2. Snap Ring
3. Front Input Shaft
4. Front Hub
5. Friction Disc – Internal Splines
6. Snap Ring
7. Return Spring
8. Clutch Housing
9. Piston
10. Spring Retainer
11. Steel Disc – External Splines

2. Check the ball bearing on the front input shaft, Figure 79, for smooth rotation. If the bearing is worn, a new one should be installed during assembly. Also check the needle pilot bearing in the rear face of the shaft for smooth rotation.

3. Inspect the front shaft sealing rings, Figure 79, for cracks and wear, and the sealing ring grooves for wear. Install new parts as required, during assembly. Check the shaft oil passages to be sure they are clean.

4. Inspect the working surface of the clutch pistons, Figure 78, for scoring. If scored, fine emery cloth may be used to smooth the surface. Ensure the 'O' ring seal grooves are clean and that burrs do not exist.

5. Check all of the plates for warpage or distortion. Install new plates if they have taken a set.

6. Check the clutch housing and bushing for hole alignment and wear.

ASSEMBLY

1. Install new 'O' ring seals on the clutch pistons, Figure 75, and on the hub of the clutch housing. Coat the 'O' ring seals with grease, then install the pistons (one in each end of the housing) so they are seated against the centre web of the housing.

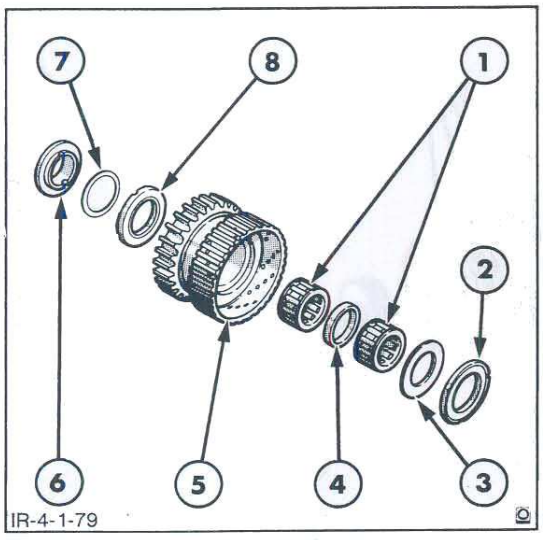

Figure 78
Rear Clutch Hub and Thrust Bearing

1. Bearings
2. Front Thrust Bearing
3. Spacer
4. Bearing Spacer
5. Rear Clutch Hub
6. Spacer
7. Thrust Bearing Seat
8. Rear Thrust Bearing

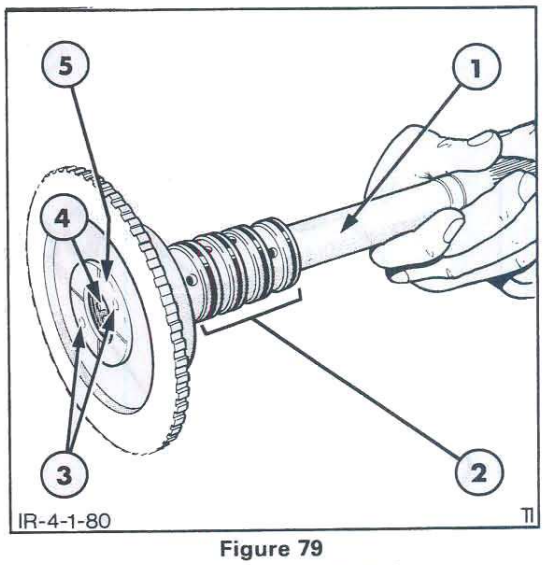

Figure 79
Front Input Shaft Assembly

1. Shaft
2. Sealing Rings
3. Knock Pins
4. Roller Bearing
5. Thrust Washer

2. Position the spring and spring seat on the piston, then compress the spring with a press, using modified Tool No. FT 4101 or 1312, and a suitable washer, as shown in Figure 76, so the snap ring can be installed. Make sure the snap ring is fully seated before relieving pressure on the spring.

3. Turn the clutch housing over and install the spring, spring seat, and the snap ring in the other end of the housing by repeating Step 2.

4. Place the thrust washer, Figure 78, on the flat hub of the clutch housing (the hub in the front of the housing is recessed), then install the rear clutch hub (reverse idler input), bearings, and spacer. Install the clutch plates, one by one, starting with a steel plate then a bronze plate.

5. Install the clutch drive plate and retain it in place by installing the appropriate snap ring.

6. If it was necessary to remove the ball bearing from the front input shaft, drive or press a new bearing into place using a hammer or press, and a sleeve of the appropriate diameter and convenient length. If the needle bearing was removed from the rear of the front input shaft, press a new bearing into place using a step plate from Tool No. 630-S or 9210.

7. Install the three sealing rings on the front input shaft, making sure each ring is locked in place.

8. Installation of the clutch housing and front input shaft is covered in Section D.

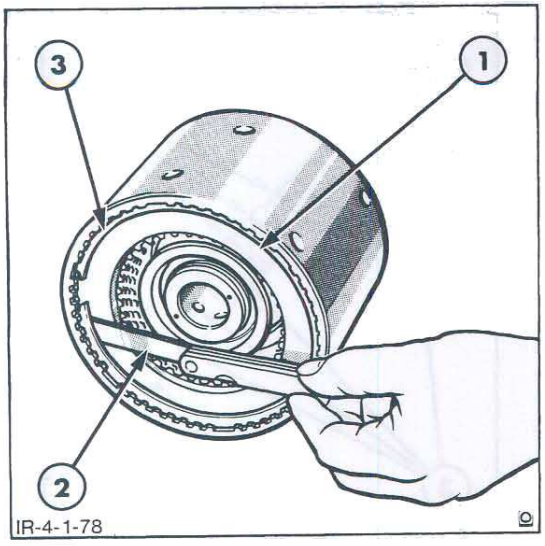

Figure 80
Clutch Pack Clearance

1. Pressure Plate
2. Feeler Gauge
3. Snap Ring

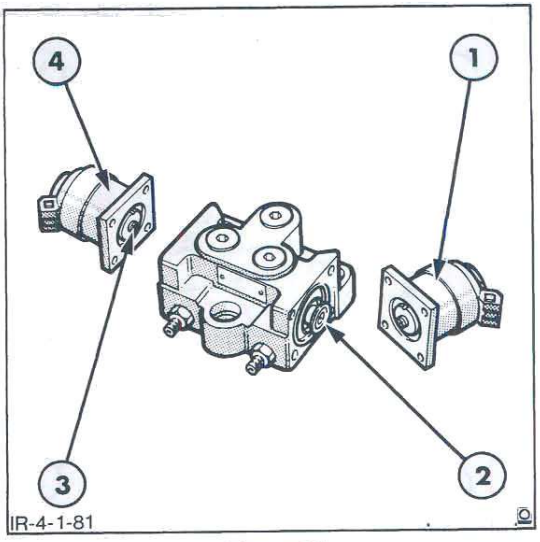

Figure 81
Solenoid Control Valve Assembly

1. Forward Solenoid
2. Forward Spool
3. Reverse Solenoid Plunger
4. Reverse Solenoid

CLUTCH PACK CLEARANCE CHECK

1. If a new clutch pack has been installed in the clutch housing, use the following procedure to check the clutch pack clearance:

- With the rear clutch pack assembly as previously described, use a feeler gauge to check the clearance between the clutch pressure plate and the snap ring, Figure 80, while holding the plate against the clutch disc.
- The clearance must be measured at three points equally spaced around the housing (120° intervals).
- Remove the clutch plate and install with the clutch discs on the opposite side of the housing using the same procedure.
- If the clearance is not within the specified limits, see "Specifications" – Chapter 3, change a clutch disc or discs to obtain the correct clearance, clutch disc thicknesses are specified in "Specifications" – Chapter 3.

SOLENOID CONTROL VALVE

DISASSEMBLY

1. Remove the control valve solenoid retaining bolts and disassemble the solenoid assembly from the control valve body.

INSPECTION

1. Manually check that the spool slides smoothly within the control valve body, then reassemble the control valve and solenoid. Tighten the retaining bolts to the specified torque.

NOTE: *The internal parts of the control valve assembly are not serviced separately.*

The control valve is serviced as a complete assembly, overhaul is limited to checking spool movement only.

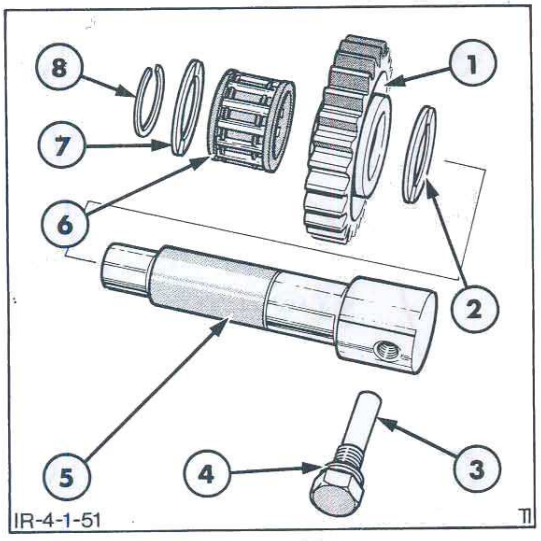

Figure 82
Reverse Idler Gear Components

1. Gear
2. Thrust Washer
3. Shaft Locating Bolt
4. Seal
5. Shaft
6. Roller Bearing
7. Thrust Washer
8. Snap Ring

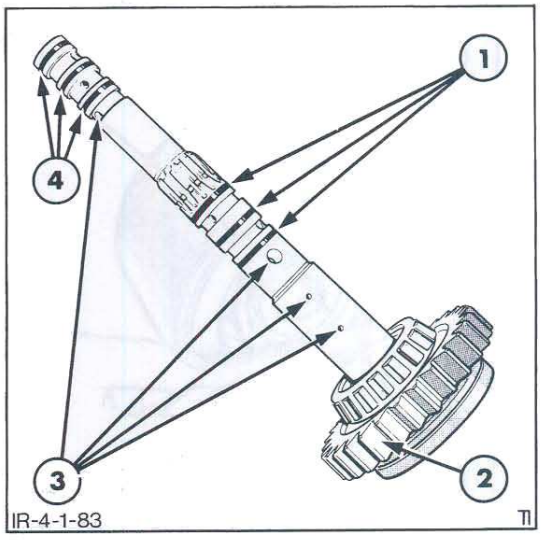

Figure 83
Rear Input Shaft Assembly

1. Rear Sealing Rings
2. Gear Shaft Assembly
3. Lubrication Gallery Oil Holes
4. Front Sealing Rings

REVERSE IDLER GEAR ASSEMBLY

INSPECTION

1. Thoroughly clean the reverse idler gear components, Figure 82 with a suitable solvent and allow to dry.

2. Inspect the thrust washers either side of the reverse idler gear for scoring or excessive wear.

3. Inspect the needle roller bearing for smooth rotation. If the bearing is worn, install a new bearing during assembly.

4. Inspect the gear for cracks, burrs or chipped teeth. Remove burrs with fine emery cloth or a fine pumice stone. If the gear is chipped or cracked, a new gear should be installed.

REAR INPUT SHAFT

INSPECTION

1. Thoroughly clean the rear input shaft with a suitable solvent and allow to dry. Use compressed air to clean out the oil passages. Do not spin the bearing with compressed air.

2. Check the bearing for smooth rotation. Normally the rear input shaft bearing need not be removed, however, if the bearing is worn or damaged it can be removed by clamping the shaft between two blocks of wood and driving the bearing from the shaft with a punch and hammer. If the bearing is removed a new one must be installed as the cage will be damaged during removal.

3. Inspect the rear input shaft sealing rings for nicks, cracks or scratches. Any seals which are suspect should be renewed on assembly. Ensure all oil passages are clean.

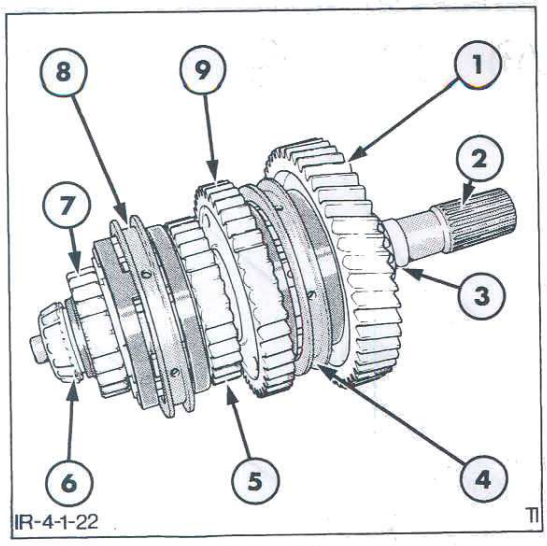

Figure 84
Output Shaft Assembly

1. 1st Gear
2. Output Shaft
3. Rear Bearing
4. Synchromesh Coupler
5. 3rd Gear
6. Front Bearing
7. 4th Gear
8. Synchromesh Coupler
9. 2nd Gear

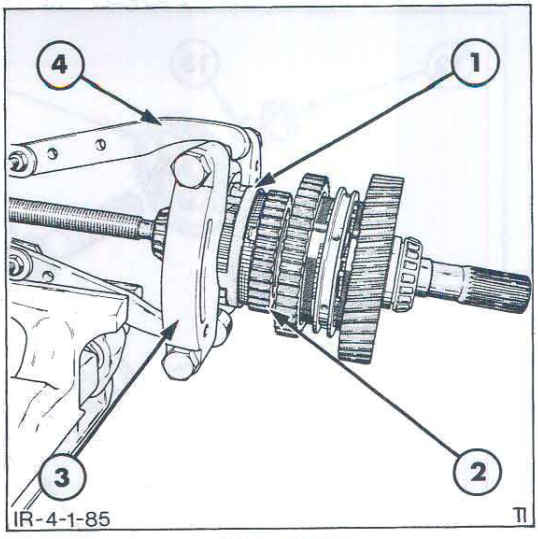

Figure 85
3rd/4th Gear Coupler Removal

1. Outer Cone
2. 3rd Gear
3. Clamp Tool No. 952 or 9526
4. Puller Tool No. 1003 or 9516

4. Inspect the gear teeth for burrs. Remove burrs with fine emery paper or a fine pumice stone. If the gear is chipped or cracked, a new one should be installed.

OUTPUT SHAFT AND GEAR ASSEMBLY

DISASSEMBLY

1. Engage the 3rd/4th gear synchroniser assembly to the 3rd gear as shown in Figure 85.

2. Attach a puller, Tool No. 1003 or 9516 with shaft protector Tool No. 625A or 9212 and bearing clamp Tool No. 952 or 9526, to the outer cone of the 3rd/4th gear synchroniser and remove the front bearing, thrust washer, 4th gear and the synchroniser assembly as shown in Figure 85.

NOTE: *Exercise care when pulling on the synchroniser assembly not to pull the outer cone from the synchroniser. If the outer cone does pull off, ensure the ball and springs in the sliding sleeve do not fly out.*

3. Remove the snap ring retaining the 3rd/4th gear coupler and remove the coupler from the shaft.

4. Remove the snap ring retaining the 3rd gear to the output shaft then remove the gear and thrust washer from the shaft.

5. Remove the snap ring retaining the 2nd gear then remove the thrust washer and gear from the shaft. Remove the 1st/2nd gear synchroniser assembly from the shaft.

6. Install a puller, Tool No. 1003 with shaft protector Tool No. 625A, to the 1st gear and remove the rear bearing, thrust washer and 1st gear from the shaft.

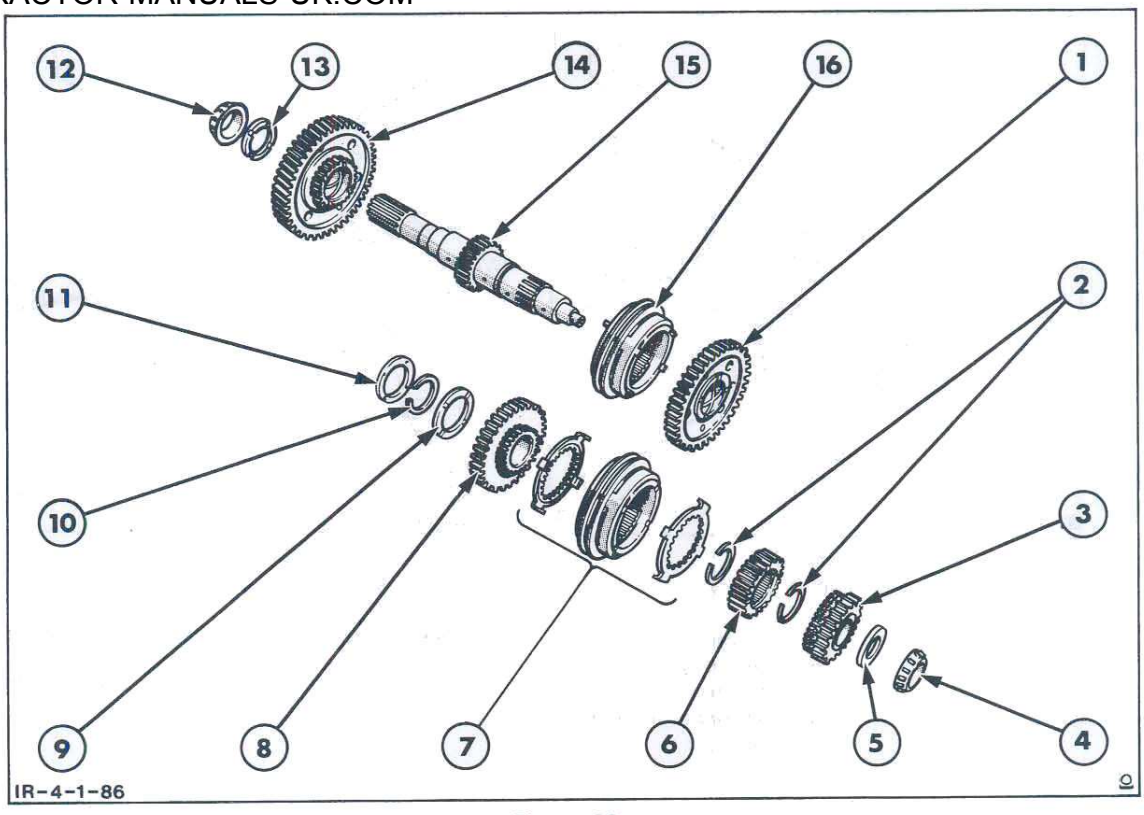

Figure 86
Output Shaft Components

1. 2nd Gear
2. Snap Rings
3. 4th Gear
4. Front Taper Roller Bearing
5. Thrust Washer
6. Splined Hub
7. 3rd-4th Synchroniser
8. 3rd Gear
9. Thrust Washer
10. Snap Ring
11. Thrust Washer
12. Rear Taper Roller Bearing
13. Thrust Washer
14. 1st Gear
15. Output Shaft
16. 1st-2nd Synchroniser

OUTPUT SHAFT AND GEAR ASSEMBLY

INSPECTION

1. Thoroughly clean the output shaft components, Figure 86, with a suitable solvent, then blow dry with compressed air. Do not spin the bearings with compressed air.

2. Check the front and rear bearings for smooth rotation. If the bearings are worn install new bearings and bearing caps during assembly.

3. Inspect the output shaft gears for cracks, burrs, or chipped teeth. Remove burrs with fine emery cloth or a fine pumice stone. If the gears are chipped or cracked, new gears should be installed.

4. Place the gears on the output shaft and check for excessive play between the gear bushings and shaft. If the play feels excessive, new gears should be installed, as the bushings are not serviced separately.

ASSEMBLY

With reference to Figure 86.

1. Install the 1st gear, thrust washer and rear bearing onto the shaft, then drive or press the bearing into place using a hammer or press, and a sleeve of the appropriate diameter and length.

2. Install the 1st/2nd gear synchroniser assembly over the front end of the shaft and locate onto the splines. Engage the tangs on the synchroniser ring to the 1st gear.

3. Install the 2nd gear, engage the gear with the synchroniser assembly, then install the thrust washer and retain with the appropriate snap ring.

4. Install the thrust washer and 3rd gear onto the shaft and retain in position with the appropriate snap ring.

5. Install the coupler onto the shaft and retain in position with the snap ring, then install the 3rd/4th gear synchroniser assembly onto the coupler.

6. Install the 4th gear onto the shaft followed by thrust washer and front bearing, then drive or press the bearing into place using a hammer or press, and a sleeve of appropriate diameter and convenient length.

7. Installation of the output shaft and gear assembly is covered in Section E.

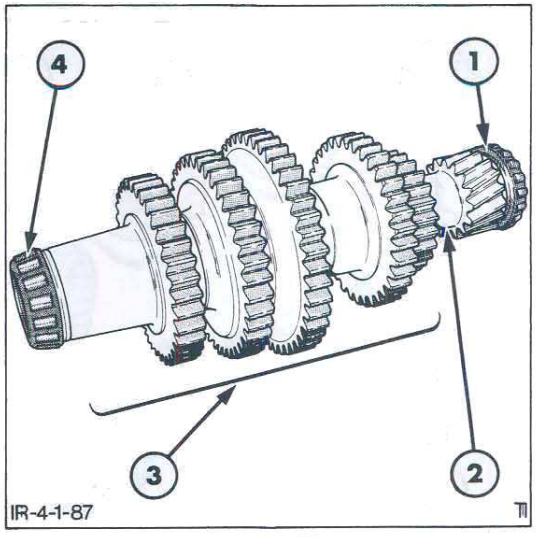

Figure 87
Countershaft Assembly

1. Rear Bearing
2. Shaft and Gear Assembly
3. Removal Gears
4. Front Bearing

COUNTERSHAFT AND GEAR ASSEMBLY

DISASSEMBLY

1. Remove the countershaft front bearing, thrust washer and gears, Figure 87, using a puller, Tool No. 1003 or 9516 with shaft protector Tool No. 625A or 9212 as shown in Figure 88.

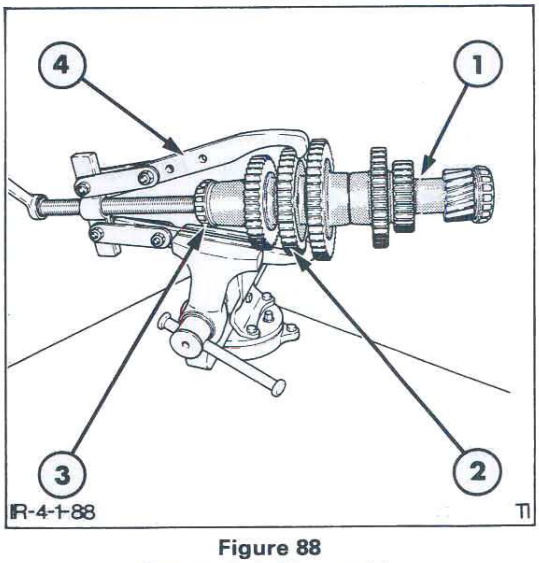

Figure 88
Countershaft Disassembly

1. Shaft
2. Forward Drive Gear
3. Front Bearing
4. Puller Tool No. 1003

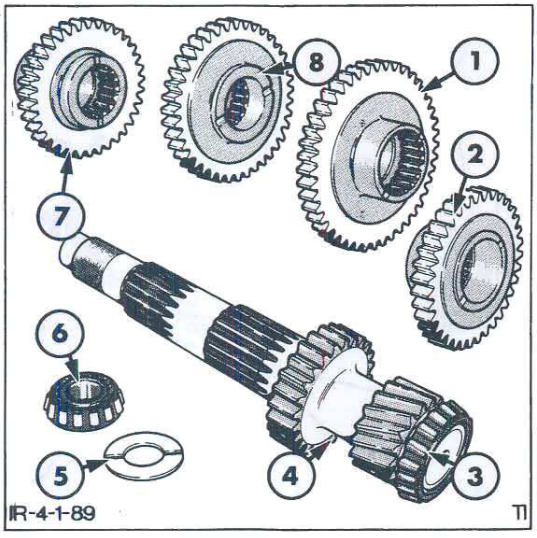

Figure 89
Countershaft Components

1. 4th Drive Gear
2. 3rd Drive Gear
3. Rear Bearing
4. Shaft and Gear
5. Thrust Washer
6. Front Bearing
7. Reverse Drive Gear
8. Forward Drive Gear

2. Normally, the countershaft rear bearing, Figure 89, need not be removed, however, if the bearing is worn or damaged it can be removed with a punch and hammer. If the bearing is removed, a new one must be installed as the cage will be damaged during removal.

NOTE: *If the countershaft rear bearing is replaced, the countershaft bearing cap must also be replaced.*

INSPECTION

1. Thoroughly clean the countershaft components, Figure 89, with suitable solvent, then blow dry with compressed air. Do not spin the bearings with compressed air.
2. Check the front and rear bearings for smooth rotation. If the bearings are worn, install new bearings during assembly.
3. Inspect the countershaft gears for cracks, burrs, or chipped teeth. Remove burrs with fine emery cloth or a fine stone. If the gears are chipped or cracked, new gears should be installed.
4. Place the gear on the countershaft and check for excessive play between the gear bushing and shaft. If the play feels excessive a new gear should be installed, as the bushing is not serviced separately.

ASSEMBLY

With reference to Figure 89.

1. Install the gears on the countershaft. Position the shaft and gears onto a press. Install the thrust washer then position the front bearing onto the shaft, using Tool No. 630S or 9210 and a sleeve of the appropriate diameter and convenient length press the bearing onto the shaft.
2. If it was necessary to remove the countershaft rear bearing, Figure 89, press a new bearing into place with the same size sleeve that was used for installing the front bearing, Step 1. Also install a new countershaft bearing cap.
3. Installation of the countershaft and gear assembly is covered in Section E.

PART 4
POWER REVERSING TRANSMISSION

Chapter 2
8 × 8 FULLY SYNCHRONISED POWER REVERSING TRANSMISSION

Section		Page
A.	POWER REVERSING TRANSMISSION – DESCRIPTION AND OPERATION	1
B.	INTRODUCTION TO OVERHAULING THE TRANSMISSION	22
C.	GEARSHIFT LEVER, MODULATOR UNIT, LOCK-UP VALVE AND SOLENOID CONTROL VALVE – OVERHAUL	23
D.	FRONT END OVERHAUL	28
E.	COMPLETE OVERHAUL	34
F.	COMPONENT OVERHAUL	46

A. FULLY SYNCHRONISED POWER REVERSING TRANSMISSION – DESCRIPTION AND OPERATION

The transmission, Figure 1, consists of a torque converter, an internal rotor-type hydraulic pump, an oil distributor, a solenoid control valve assembly, a lock-up valve, two hydraulically operated clutches in a single housing, an 8-speed synchromesh gearbox, a P.T.O. drive from the engine, a transmission case and cooler tubes.

Incorporated with the transmission is an electrically operated modulator unit which is installed in the cab or ROP's steering console. The function of the modulator unit is to provide a cushioned engagement for the forward and reverse clutches during shifting at high engine speeds, thereby preventing sudden changes in direction of travel and reducing shock loads on the transmission components. It also provides a transmission disconnect feature to rapidly disengage the transmission from the engine to release engine power for the loader hydraulics.

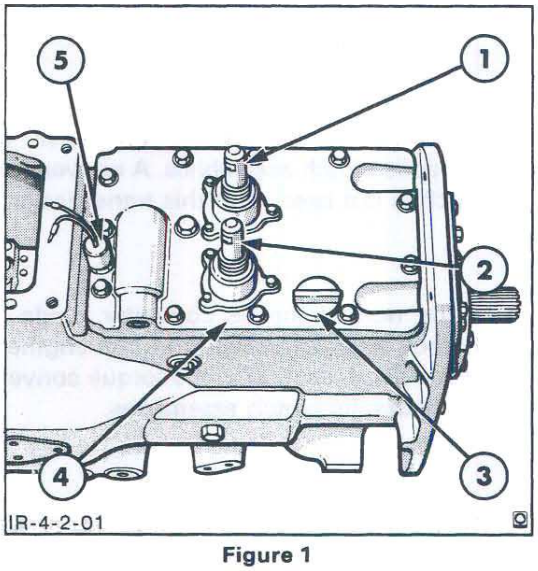

Figure 1
8 × 8 Fully Synchronised Transmission

1. Gearshift Lever
2. Range Lever
3. Oil Level Indicator
4. Top Cover
5. Safety Start Switch

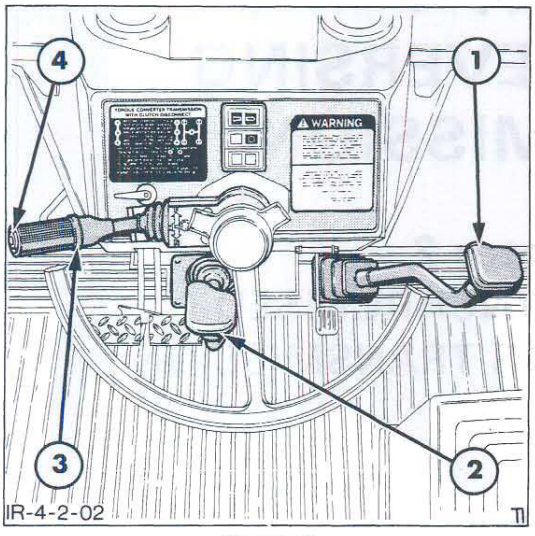

Figure 2
Transmission Shift Levers

1. Gearshift Lever
2. Range Lever
3. Power Reversing Lever
4. Lock-up Button

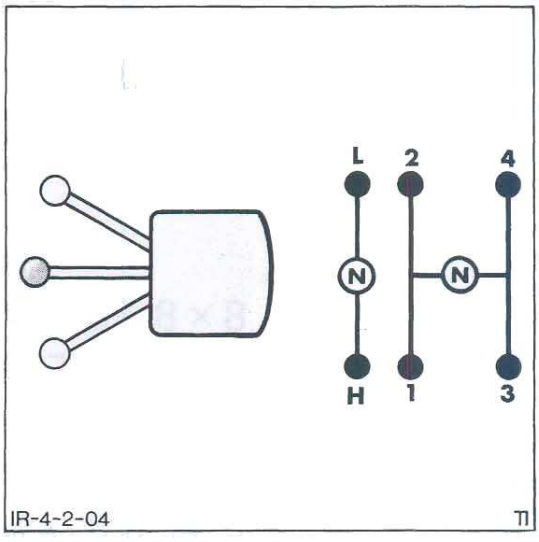

Figure 3
Gearshift Pattern

The 8 × 8 fully synchronized power reversing transmission also incorporates a lock-up feature, which enables the torque converter to be locked up to the engine flywheel in forward travel, (effectively engaging the transmission directly to the engine flywheel).

The transmission case serves as an oil reservoir for the torque converter and hydraulic clutch assemblies. A conventional clutch is not used with this transmission.

In the normal torque converter mode the gearbox receives power from the engine by means of oil reaction in the torque converter and hydraulic clutch assemblies.

The front clutch provides power for forward travel and the rear clutch power for reverse travel. Engagement of the front and rear clutch is controlled by the operator through the movement of the hand operated power reversing lever, shown in Figure 2.

The power reversing lever is linked to the modulating unit in the steering console by a wiring harness. A neutral lock is incorporated in the power reversing lever which prevents inadvertent engagement of the transmission and requires that the power reversing lever must be lifted upwards prior to selecting forward or reverse travel.

A spring loaded button on the end of the power reversing lever when depressed and released, with the lever engaged for forward travel will actuate a solenoid valve to re-direct hydraulic oil in the torque converter and allow a plate to lock the torque converter directly to the flywheel and thereby to the transmission. When the transmission is in the lock-up mode a warning light on the steering console will illuminate.

NOTE: *The lock-up feature will not engage for approximately 3 seconds after depressing the button.*

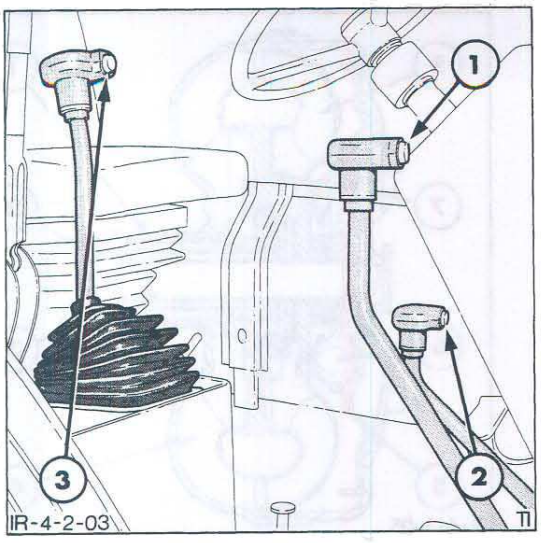

Figure 4
Transmission Disconnect Switches

1. Gearshift Lever Button
2. Range Lever Button
3. Loader Control Lever Button

The lock-up feature should be used when travelling on the highway or when using the P.T.O. driven equipment. To engage the transmission lock-up select the desired gear and move the power reversing lever for forward travel. Set the tractor in motion and attain the desired road speed then depress and release the button on the end of the power reversing lever to lock up the transmission.

IMPORTANT: *The lock-up feature must be disengaged before attempting to stop the tractor. With the torque converter in the lock up mode the tractor will not stop.*

To disengage the transmission lock-up simply depress and release the button on the power reversing lever and the transmission will revert to the normal torque converter mode immediately.

The right-hand gearshift lever, Figure 2, is used to select any one of four synchronised gear ratios for forward or reverse travel.

The left-hand gearshift lever is used to select high (H) or low (L) range which has the effect of doubling the number of gears available.

Figure 3 illustrates the gearshift pattern. In any gear ratio the operator need only move the power reversing lever to change direction of travel.

However, as a clutch is not used between the engine and the transmission, the power flow from the engine to the transmission must be interrupted to shift from one gear ratio to another or from one range gear to the other. This is accomplished by using a transmission disconnect switch.

Three finger operated button type switches are provided, Figure 4, one on the gearshift lever knob, primarily to change gear ratios. The second on the range lever knob, primarily to change from high to low or low to high range gears. The third on the loader control lever knob should be used during loader operations to divert full engine power to the backhoe/loader hydraulic pump for faster loader operations.

Easy upward and downward gear changes may be made with the fully synchronised gearbox, simply by depressing the transmission disconnect button on the gearshift lever whilst moving the lever from one ratio to another.

To make range gear changes from low to high simply depress the button on the range lever while moving the lever from one range to the other. When the high range gear has been selected release the button and allow the unit to gain engine speed and ground speed.

To make range gear changes from high to low or reduce ground speed, simply lower the engine speed, depress the range lever button and downshift the transmission. When the low range gear has been selected release the button and adjust the engine speed to suit ground speed requirements.

As a safety feature the transmission incorporates a safety start switch, wired in series with the starting circuit. The switch allows the engine to start only when the range lever is in the neutral position.

NOTE: *The 8 × 8 transmission also requires the P.T.O. lever to be in the disengaged position before the tractor can be started.*

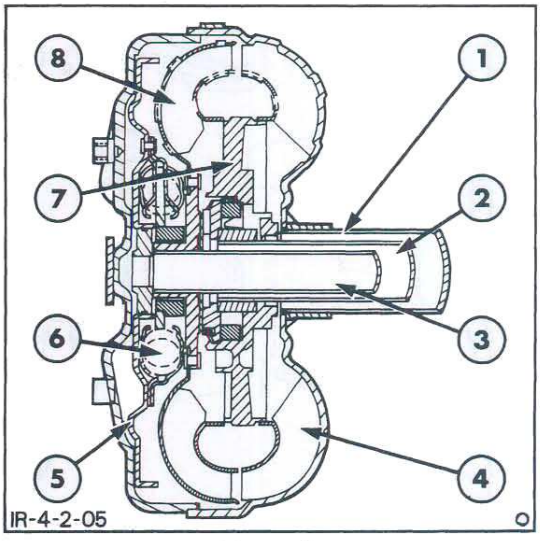

Figure 5
Torque Converter

1. Pump Drive Gear Shaft
2. Stator Support
3. Front Input Shaft
4. Rear Cover and Impeller
5. Lock-up Plate
6. Damper Springs
7. Stator
8. Turbine

TORQUE CONVERTER

The main parts of the torque converter are the impeller (pump), the turbine, the stator, the lock-up plate and the front and rear covers, Figure 5. The impeller is integral with the rear cover and is driven by the engine flywheel by means of a drive plate.

The turbine, splined to the front input shaft, is splined to a stationary shaft (stator support) through a one-way clutch that permits the stator to rotate only in the same direction as the impeller. The lock-up plate, located in front of the turbine, is splined to the front input shaft and the turbine, and moves along the splines to engage or disengage the plate and the turbine to the front cover. All of the converter parts are enclosed in an oil-filled housing. The front and rear cover, being welded together, form the housing.

In the normal torque converter mode when the engine is running, the oil enters the torque converter via a central drilling in the front input shaft and forces the lock-up plate off of the front cover.

The oil in the converter flows from the impeller to the turbine and back to the impeller through the stator. This flow produces a maximum torque increase of about 3.15:1 to 1 when the turbine is "stalled". When enough oil flow is developed by the impeller, the turbine begins to rotate, driving the front input shaft. The torque multiplication gradually decreases as turbine speed approaches impeller speed, and becomes 1 to 1 when the turbine is being driven at nine tenths impeller speed.

When the turbine is rotating at approximately nine tenths impeller speed, the converter stops multiplying torque because the oil is now acting on the rear face of the stator blades. The action of the oil on the rear face of the stator unlocks the one-way clutch, permitting the stator to rotate in the same direction as the turbine and impeller. Through this action the converter becomes an efficient fluid coupling by transmitting engine torque from the impeller to the turbine.

When the turbine is rotating less than nine tenths impeller speed, the converter is multiplying torque through the action of the stator. This action, produced by oil acting on the front face of the stator blades, tends to rotate the stator in the opposite direction of the impeller and turbine. However, the one-way clutch prevents this opposite rotation and allows the stator to direct oil back to the impeller, thereby producing torque multiplication.

In the torque converter lock-up mode, when the engine is running, the oil enters the torque converter via an oil passage between the stator support and the torque converter hub. The oil flows from the impeller and turbine into the area of outer casing.

The oil gallery in the front input shaft is now open to exhaust and the oil pressure from the rear of the lock-up plate will force the plate to contact and lock-up to the front cover. The lock-up plate also remains splined to the turbine driving the front input shaft.

With the lock-up plate driving the turbine the transmission is receiving drive directly from the engine flywheel and the torque converter is no longer used as a fluid coupling.

OIL DISTRIBUTOR

The oil distributor, Figure 6, consists of a pressure regulating valve, a bypass valve, the hydraulic pump and a series of oil passages for oil distribution.

Oil from the hydraulic pump enters the distributor, under pressure through the inlet passage, and is directed to the pressure regulating valve and bypass valve by means of internal passages. Additional passages then direct the oil to the solenoid control valve, lock-up valve and torque converter.

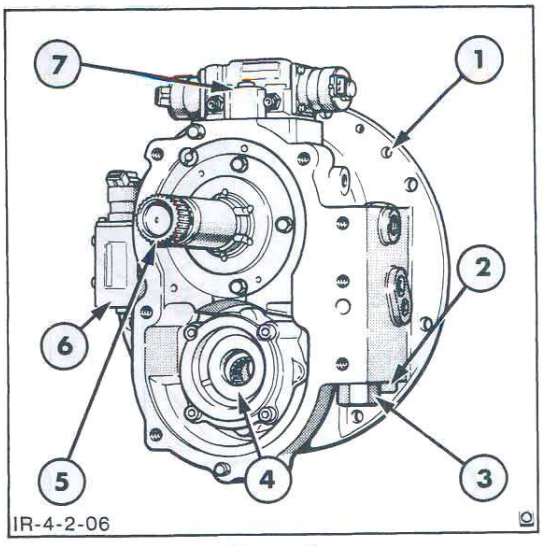

Figure 6
Oil Distributor

1. Oil Distributor Housing
2. Regulating Valve
3. Bypass Valve
4. Hydraulic Pump
5. Stator Support
6. Lock-Up Valve
7. Control Valve

The bypass valve, working in conjunction with the pressure regulating valve, bypasses oil back to sump thereby limiting the maximum oil pressure for the torque converter.

The pressure regulating valve regulates oil pressure to the control valve which, in turn, directs this pressure regulated oil to the hydraulic clutch assemblies.

TRANSMISSION HYDRAULIC PUMP

The transmission hydraulic pump, Figure 7, is positioned in the lower section of the oil distributor assembly and consists of a driven gear, an inner and outer rotor, a pump plate and a pump body.

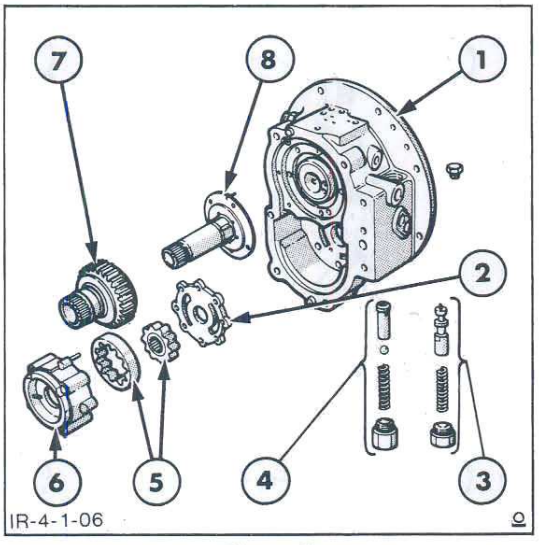

Figure 7
Transmission Hydraulic Pump

1. Distributor Housing
2. Pump Plate
3. Regulating Valve
4. Bypass Valve
5. Inner and Outer Rotors
6. Pump Body
7. Drive Gear
8. Stator Support

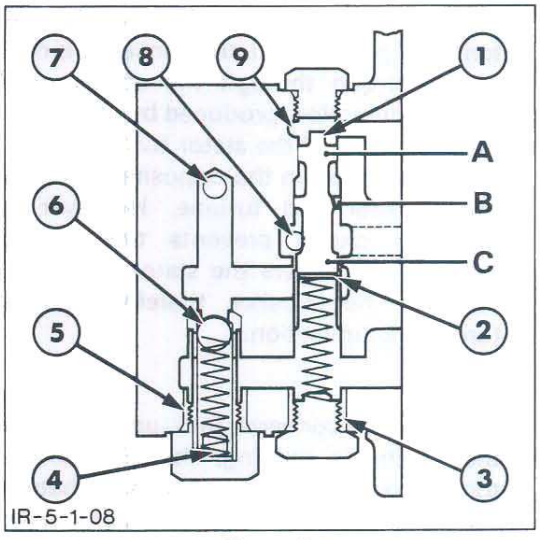

Figure 8
Pressure Regulating Valve and Bypass Valve

1. Regulating Valve
2. Regulating Valve Shim
3. Regulating Valve Plug
4. Bypass Valve Shim
5. Bypass Valve Sleeve
6. Bypass Valve Ball
7. Gallery to Torque Converter
8. Gallery to Control Valve
9. Return to Sump

A gear on the stator support, driven by the rear hub of the torque converter, drives the driven gear. The driven gear is splined to the P.T.O. shaft, which runs through the centre of the transmission countershaft and transfers the drive to the inner rotor of the pump.

Oil is picked up from the sump, via an internal filter, through the inlet section of the pump plate by the action of the rotors, and is forced through the outlet section of the pump plate to the oil distributor.

PRESSURE REGULATING VALVE AND BYPASS VALVE

Oil from the transmission hydraulic pump enters the valve bore area of the pressure regulating valve between lands "B" and "C", Figure 8. The area of the lands being equal, the valve will not move; however, land "B" incorporates a drilled passage or orifice that allows oil to enter the valve bore between lands "A" and "B".

The area of land "B" is greater than land "A"; therefore when the pressure between the lands reaches approximately 95 lbf/in² (6.5 bar), the spring force acting on the valve is overcome, causing the valve to move down.

This downward movement allows the valve to direct oil into the converter passage while maintaining a minimum pressure of 95 lbf/in² (6.5 bar). A pair of flats on the circumference of land "C" causes the valve to move further down as pump flow increases, which causes regulated pressure to increase with engine speed.

Because pressure to the solenoid control valve is higher than the pressure required for converter operation, the bypass valve must function to limit maximum pressure in the converter at high pump flow.

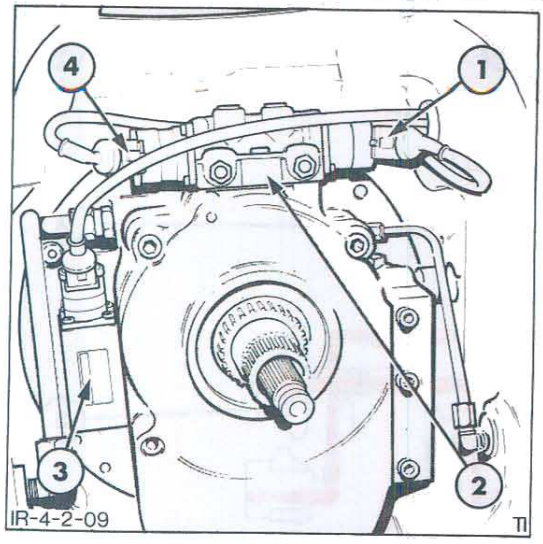

Figure 9
Solenoid Control Valve

1. Forward Solenoid
2. Control Valve
3. Lock-Up Valve
4. Reverse Solenoid

The bypass valve will open at approximately 75 – 80 lbf/in² (5.2 – 5.5 bar) to bypass oil back to sump; thereby preventing excessive pressure in the converter. Oil leaking past land "A" of the regulating valve also returns to sump.

SOLENOID CONTROL VALVE

The solenoid control valve is mounted on top of the distributor assembly, Figure 9, and consists of two identical spools, two identical solenoids, a return spring and a valve body.

The function of the solenoid control valve is to direct the pressure regulated oil from the hydraulic pump to one of the two clutch packs.

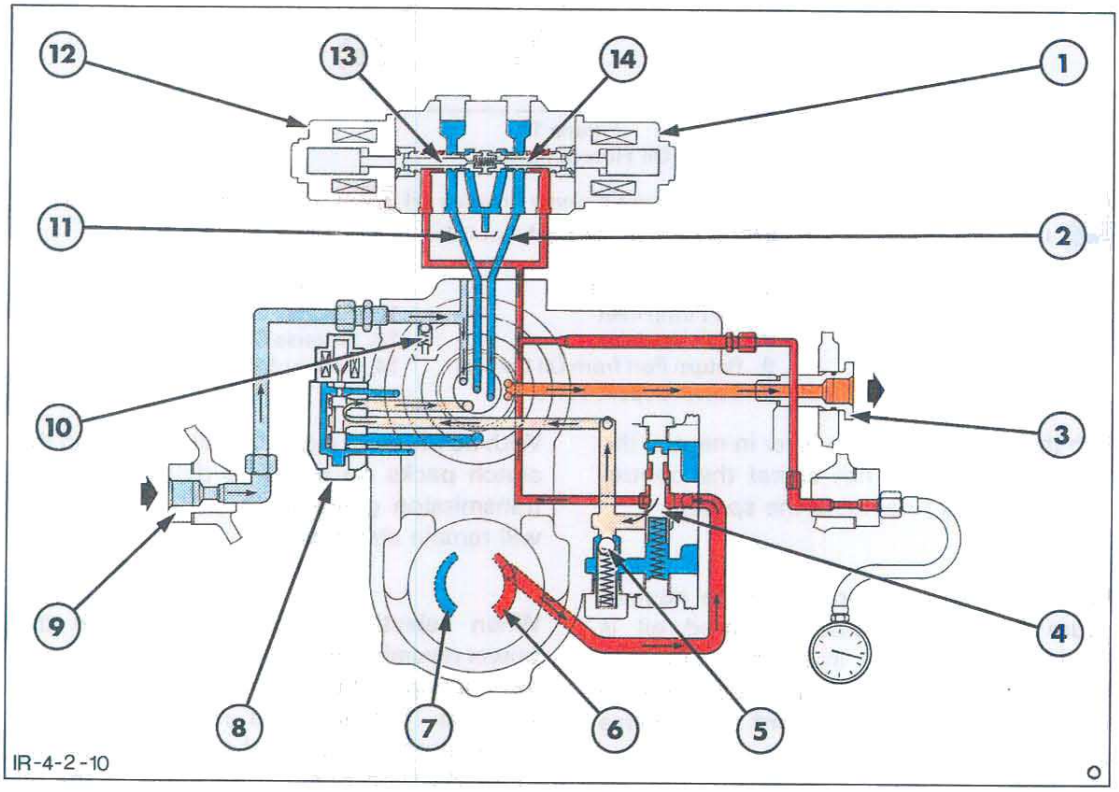

Figure 10
Oil Flow – In Neutral

Pressure Oil
Lubrication Oil
Torque Converter Pressure Oil
Reservoir and Exhaust Oil
Torque Converter Return Oil

1. Forward Solenoid
2. Forward Clutch Oil Gallery
3. Feed Port to Oil Cooler
4. Regulating Valve
5. Bypass Valve
6. Oil Pump Outlet
7. Oil Pump Inlet
8. Lock-Up Valve
9. Return from Oil Cooler
10. Cooler Bypass Valve
11. Reverse Clutch Oil Gallery
12. Reverse Solenoid
13. Reverse Spool
14. Forward Spool

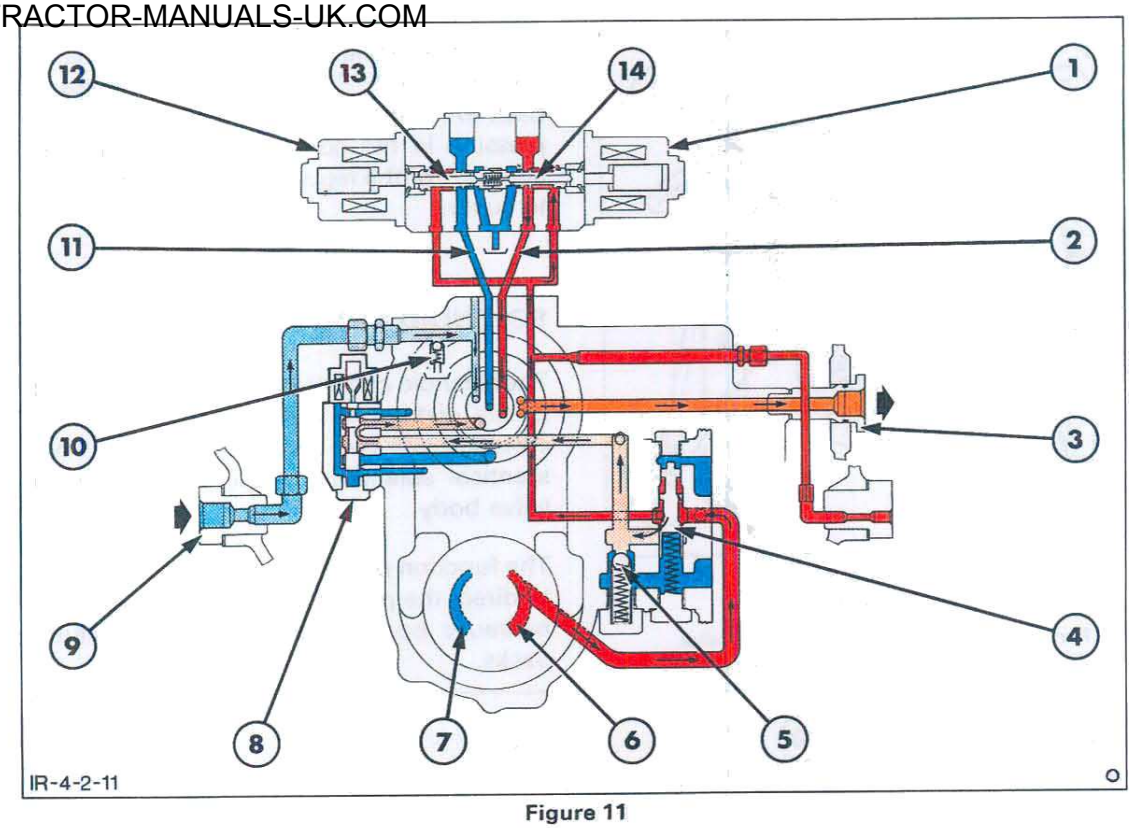

Figure 11
Oil Flow in Forward

Pressure Oil
Lubrication Oil
Torque Converter Pressure Oil
Reservoir and Exhaust Oil
Torque Converter Return Oil

1. Forward Solenoid
2. Forward Clutch Oil Gallery
3. Feed Port to Oil Cooler
4. Regulating Valve
5. Bypass Valve
6. Oil Pump Outlet
7. Oil Pump Inlet
8. Lock-Up Valve
9. Return Port from Oil Cooler
10. Cooler Bypass Valve
11. Reverse Clutch Oil Gallery
12. Reverse Solenoid
13. Reverse Spool
14. Forward Spool

With the power reversing lever in neutral the modulator unit will not signal the control valve solenoids to actuate the spools.

With the solenoid control valve in neutral, Figure 10, the pressure regulated oil is directed, via passages in the distributor, to the control valve and is trapped between the end two lands of the forward and reverse spools.

Pressure regulated oil is constantly delivered to the forward and reverse spools. With the spools held in neutral the forward and reverse clutch pack oil galleries are connected to exhaust via the forward and reverse spools in the control valve.

With no pressure regulated oil directed to the clutch packs no power is delivered to the transmission gearbox, therefore the tractor will remain stationary.

When selecting forward travel with the power reversing lever a signal is sent from the modulating unit to the control valve forward solenoid. The solenoid is energised and moves the forward spool across to align the forward clutch pack oil gallery with the oil gallery from the pressure regulating valve, Figure 11. The pressure regulated oil is directed to the forward clutch pack, while the reverse spool remains connected to exhaust. With the forward clutch pack engaged power is delivered to the transmission gearbox via the rear input shaft.

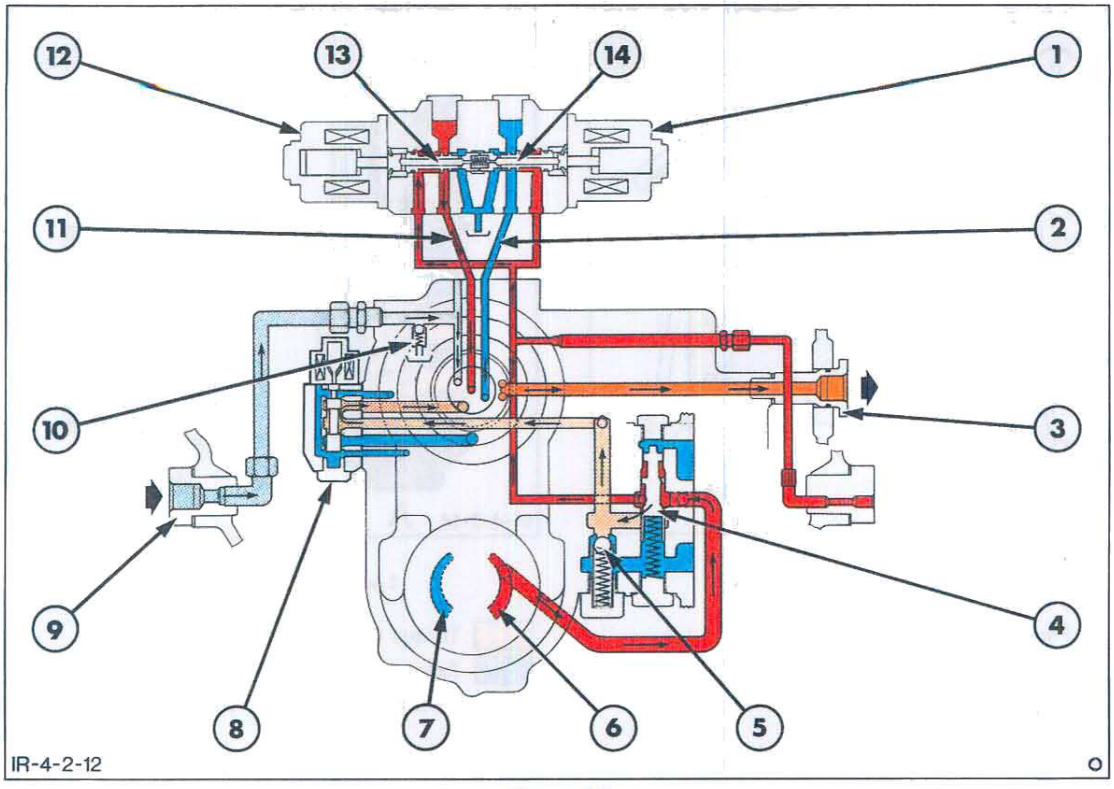

Figure 12
Oil Flow in Reverse

Pump Pressure Oil
Lubrication Oil
Torque Converter Pressure Oil
Reservoir and Exhaust Oil
Torque Converter Return Oil

1. Forward Solenoid
2. Forward Clutch Oil Gallery
3. Feed Port to Oil Cooler
4. Regulating Valve
5. Bypass Valve
6. Oil Pump Outlet
7. Oil Pump Inlet
8. Lock-Up Valve
9. Return Port from Oil Cooler
10. Cooler Bypass Valve
11. Reverse Clutch Oil Gallery
12. Reverse Solenoid
13. Reverse Spool
14. Forward Spool

Selecting reverse travel sends a signal from the modulating unit to the reverse solenoid of the control valve. The operation of the reverse section of the control valve is the same as the forward section, however, now the pressure regulated oil is directed to the reverse clutch pack, Figure 12, and power is delivered to the transmission gear box via the rear input gear (reverse clutch hub).

De-energised the forward solenoid moves back to the neutral position under spring pressure and the spool aligns the forward clutch pack oil gallery with the exhaust port.

LOCK-UP VALVE

The lock-up valve is mounted on the right-hand side of the distributor assembly, Figure 13, and consists of a solenoid, spool, return spring and a valve body.

The function of the lock-up valve is to direct oil from the by-pass valve to the torque converter.

With the lock-up valve solenoid de-energised the spool remains in the normal torque converter mode position with the return spring holding the spool as shown 'B' in Figure 14.

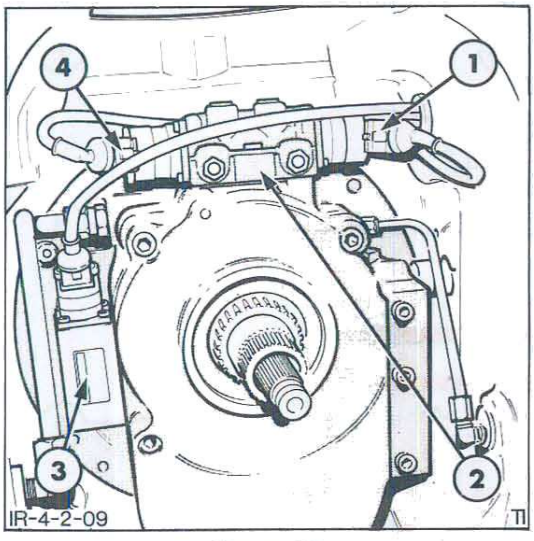

Figure 13
Lock-Up Valve Assembly

1. Forward Solenoid
2. Control Valve Housing
3. Lock-Up Valve
4. Reverse Solenoid

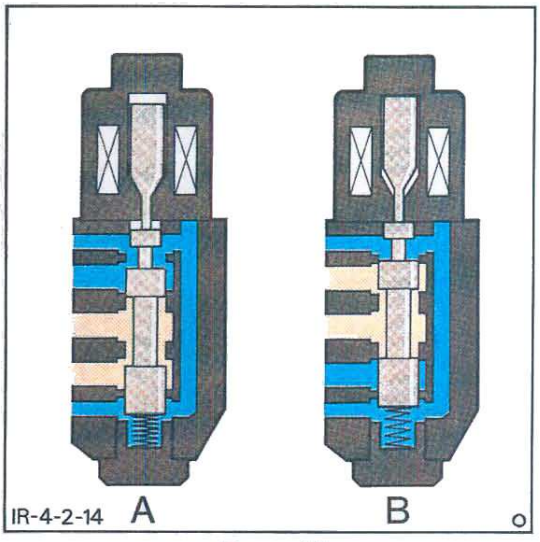

Figure 14
Lock-Up Valve Operation

Torque Converter Pressure Oil
Exhaust Oil
A. Lock-Up Mode B. Normal Mode

Oil is delivered to the lock-up valve from the by-pass valve and directed via a central drilling in the front input shaft to the torque converter.

The oil enters the torque converter at the front end between the front cover and lock-up plate disengaging the plate from the cover.

Depressing and releasing the lock-up button at the end of the power reversing lever, in forward travel, energises the lock-up valve via the modulator unit. The lock-up valve solenoid now energised will move the spool, 'A' Figure 14, directing pressure oil to the torque converter via the passage between the stator support and torque converter hub.

The oil enters the torque converter at the rear and forces the lock-up plate to engage and lock-up with the front cover and turbine.

MODULATOR UNIT

The function of the modulator unit, Figure 15, is to provide a cushioned engagement for the forward and reverse clutches during changes in direction of travel, provide a delayed engagement of the torque converter lock-up, and to disconnect the clutch packs when a transmission disconnect button is depressed.

The modulator unit contains a micro-processor which ensures that the voltage supplied to the forward and reverse control valve solenoids rises at a predetermined rate.

The cushioned engagement is accomplished by regulating the oil pressure supplied to the clutch packs, from the solenoid control valve, in proportion to the voltage rise in the signal from the modulator unit to the control valve solenoids.

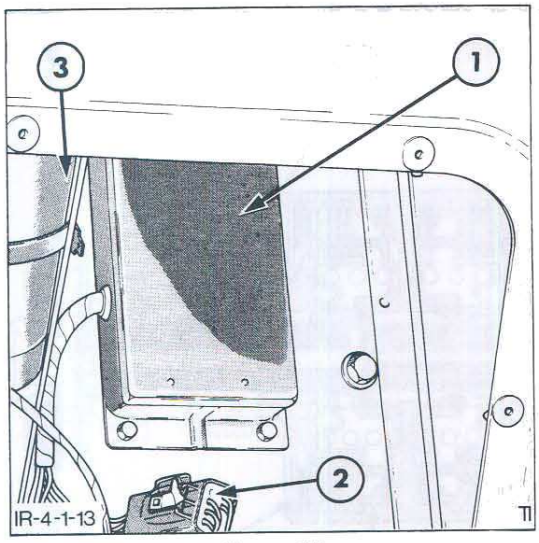

Figure 15
Modulator Unit

1. Modulator Unit
2. Connector
3. Steering Motor

When the power reversing lever is moved to select forward travel the modulator unit signals the forward solenoid to move the control valve forward spool. The spool will move in proportion to the voltage rise of the signal to the solenoid, which requires approximately 1 – 2.5 seconds to engage fully, and the oil pressure to the clutch pack will rise by the same proportion until regulated pressure is achieved after 2.5 seconds.

Selecting reverse travel with the power reversing lever, the modulator unit cuts the current to forward solenoid and signals the reverse solenoid to move the reverse spool. The operation of the reverse solenoid and spool is the same as for forward engagement. However, as the reverse spool moves to direct pressure regulated oil to the reverse clutch pack the forward spool is moved to neutral by the return spring and reverse spool pressure, thereby disengaging the forward clutch pack.

When the transmission lock-up mode is selected the modulator signals the lock-up valve solenoid to move the spool. As with the control valve the lock-up valve spool moves in proportion to the voltage rise of the signal to the solenoid, and the oil pressure to the torque converter will rise by the same proportion, thereby cushioning the lock-up plate engagement.

The transmission disconnect feature allows the transmission to be rapidly disengaged from the engine, thereby releasing all engine power to drive the backhoe/loader hydraulic pump or enable the operator to make a gear ratio change.

If, for example, a loading function is being performed, and at the point of "tear out" and lift the transmission can be rapidly disengaged then all engine power becomes immediately available to power the loader hydraulic system, thereby increasing lift speed and cycle times.

The transmission disconnect is accomplished by depressing the button on the gearshift lever knob or the button on the loader control lever knob, either will disconnect the transmission.

Depressing the button on either of the levers interrupts the current to the modulator unit and thereby the current to the control valve solenoids. Removing the electrical supply will have the effect of cutting the flow of hydraulic oil to the clutch packs as the solenoid and spool return to neutral. In neutral the clutch pack oil galleries are open to exhaust and the pressure regulated oil is trapped between the end two lands of the spool.

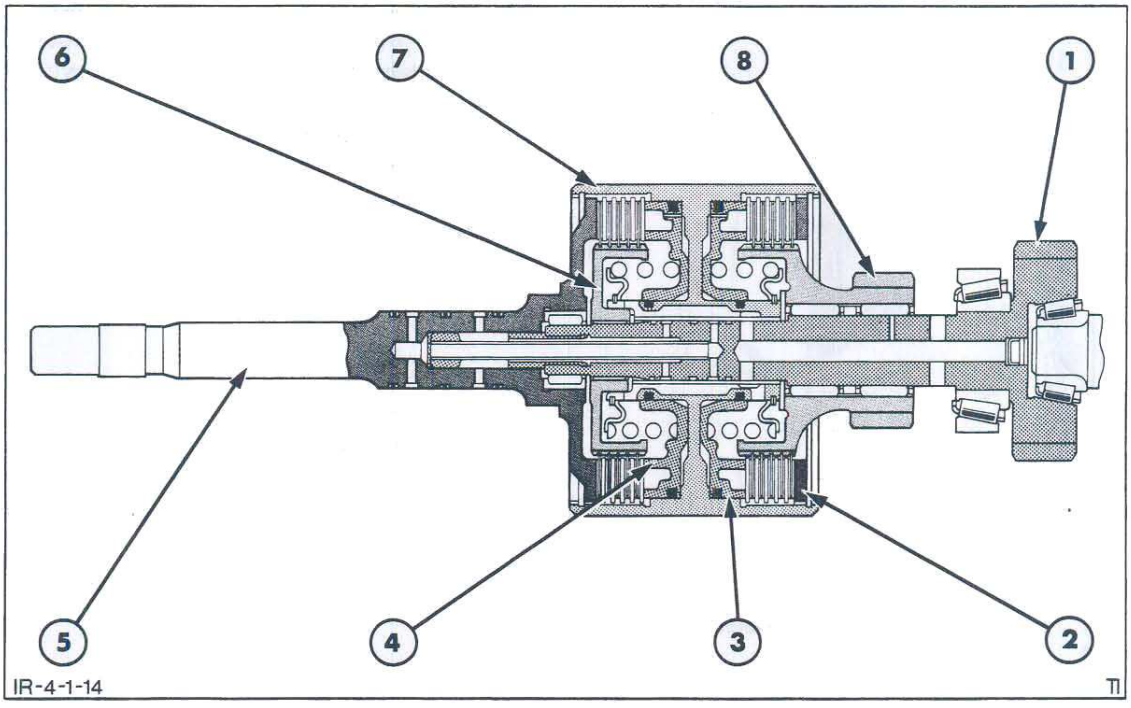

Figure 16
Hydraulic Clutch Assemblies

1. Transmission Rear Input Shaft
2. Reverse Clutch Pressure Plate
3. Reverse Clutch Piston
4. Forward Clutch Piston
5. Transmission Front Input Shaft
6. Forward Clutch Hub
7. Clutch Housing
8. Reverse Clutch Hub and Gear

When the button is released, the electrical supply is restored to the modulator unit and the control valve will direct pressure regulated oil to the appropriate clutch pack in proportion to the voltage supplied from the modulator unit.

HYDRAULIC CLUTCH ASSEMBLIES

The hydraulic clutch assemblies incorporate a housing, a hub, and a series of bronze and steel plates that are engaged through the action of the forward or reverse pistons when hydraulic pressure is applied.

The clutch hub, Figure 16, is splined internally to the transmission rear input shaft and externally to the bronze plates of the forward clutch assembly.

When hydraulic pressure is applied to the front clutch for forward travel, the piston is actuated, locking the steel plates to the bronze plates. The steel plates, being driven by the clutch housing, transmit power to the bronze plates. The bronze plates then drive the front hub which, in turn, drives the rear input shaft, thereby transmitting power to the countershaft through the forward gear.

When hydraulic pressure is applied to the rear clutch for reverse travel, the plates in the rear clutch are locked together to drive the rear hub (reverse idler input), Figure 16. The rear hub is not splined to the rear input shaft; however, it does mesh with the reverse idler gear that is in turn meshed with the reverse gear on the countershaft. It is through this reverse idler gear that power is transmitted to the countershaft.

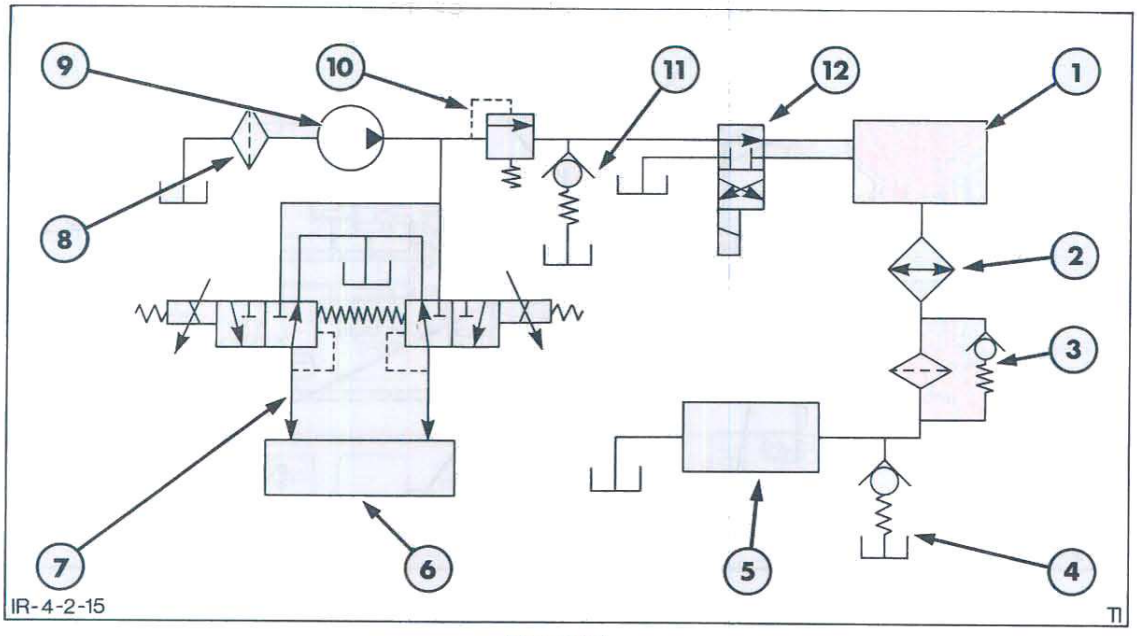

Figure 17
Transmission Oil Flow Circuit Diagram

1. Torque Converter
2. Oil Cooler
3. Line Filter
4. Cooler Line Bypass Valve
5. Transmission Lubrication
6. Hydraulic Clutch
7. Solenoid Control Valve
8. Inlet Filter
9. Oil Pump
10. Regulating Valve
11. Bypass Valve
12. Lock-Up Valve

Because the countershaft is being driven by the reverse idler gear and not the rear input shaft, the countershaft will rotate in the opposite direction as it does for forward travel.

Oil from the torque converter then flows back to the distributor between the stator support and the front input shaft. It is then picked up by the cooler tube on the left-hand side of the transmission case and directed to the cooler.

OIL FLOW

Transmission oil flows from the reservoir to the distributor then to the solenoid control valve assembly as previously described. Oil from the bypass valve flows to the lock-up valve and is then directed via a central drilling in the front input shaft to the torque converter in the normal mode or between the stator support and the torque converter hub into the converter in the lock-up mode, Figures 18 and 19.

Oil from the cooler is returned to the transmission via a tube on the left-hand side of the tractor to the oil filter then over the transmission housing and through a tube on the right-hand side of the transmission case.

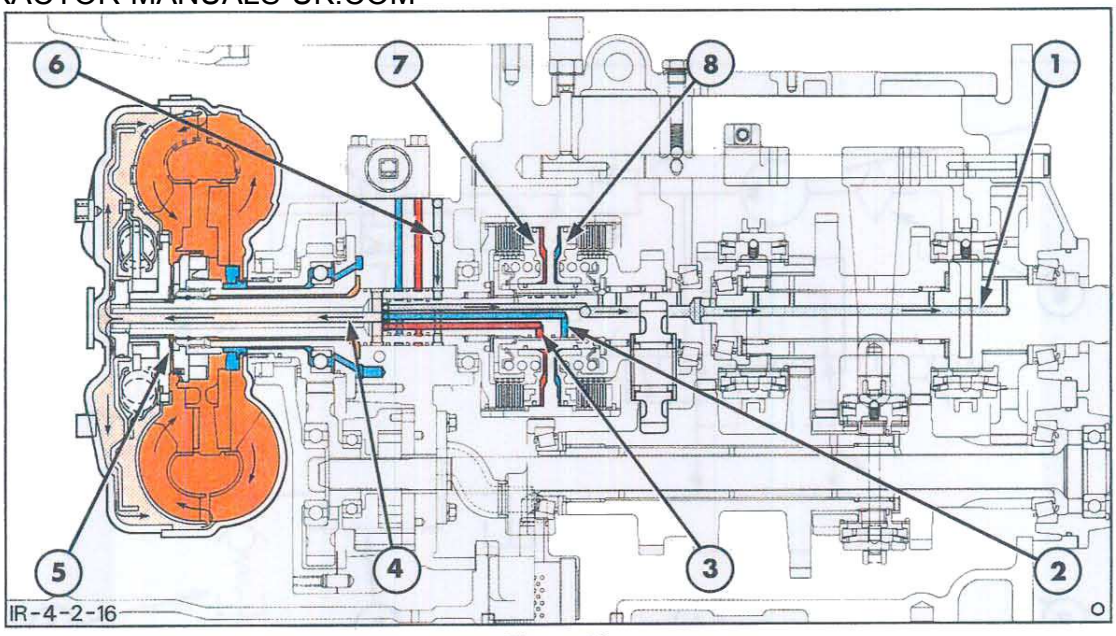

Figure 18
Transmission Lubrication Oil Flow – Normal Mode

Pressure Oil
Lubrication Oil
Torque Converter Pressure Oil
Reservoir and Exhaust Oil
Torque Converter Return Oil

1. Lubrication Gallery
2. Reverse Clutch Gallery
3. Forward Clutch Gallery
4. Feed to Torque Converter
5. Return from Torque Converter
6. Return from Oil Cooler
7. Forward Clutch
8. Reverse Clutch

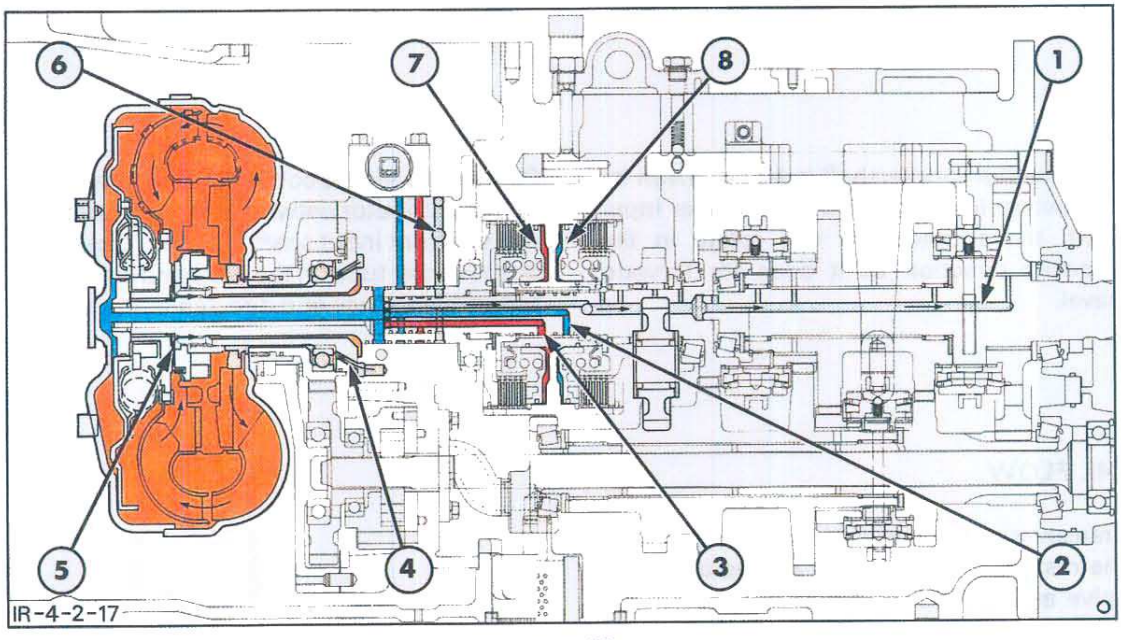

Figure 19
Transmission Lubrication Oil Flow – Lock-Up Mode

Pressure Oil
Lubrication Oil
Torque Converter Pressure Oil
Reservoir and Exhaust Oil
Torque Converter Return Oil

1. Lubrication Gallery
2. Reverse Clutch Gallery
3. Forward Clutch Gallery
4. Feed to Torque Converter
5. Return from Torque Converter
6. Return from Oil Cooler
7. Forward Clutch
8. Reverse Clutch

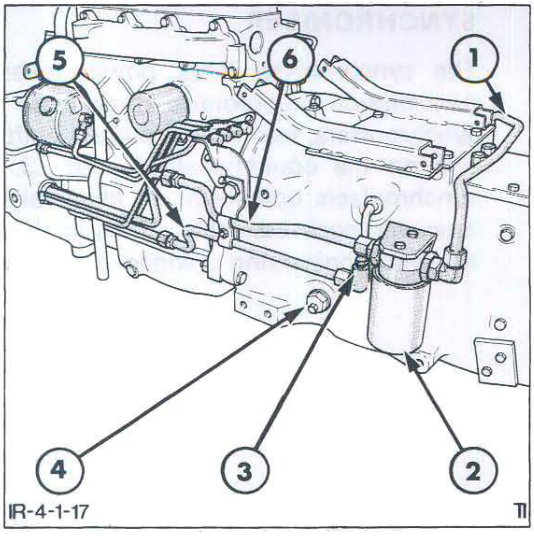

Figure 20
Transmission Cooling System

1. Filter Return Pipe
2. Filter
3. Temperature Switch
4. Pressure Test Point
5. Cooler Inlet Line
6. Cooler Outlet Line

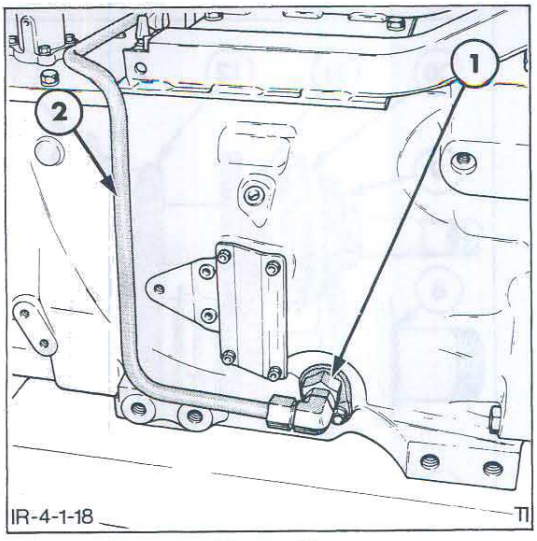

Figure 21
Transmission Cooling System

1. Adaptor
2. Filter Return Pipe

The lubrication passages, being smaller than the return tube, will act as an orifice and cause a pressure build-up. When the pressure reaches approximately 33 lbf/in² (2.26 bar) a bypass valve in the distributor housing will open allowing oil to return to sump.

OIL COOLER

The transmission cooling system, Figures 20 to 22, consists of a filter, a cooling unit and tubes and fittings. The oil is filtered after leaving the cooler. The filter incorporates a bypass valve that is set to open at 7 to 9 lbf/in² (0.5 to 0.6 bar) should the filter become clogged.

Oil from the torque converter enters the cooler inlet tube, Figure 20, on the left side of the transmission case, passes through the cooler and filter, and is returned to the lubrication circuit and sump through the return fitting on the right side of the case Figure 21.

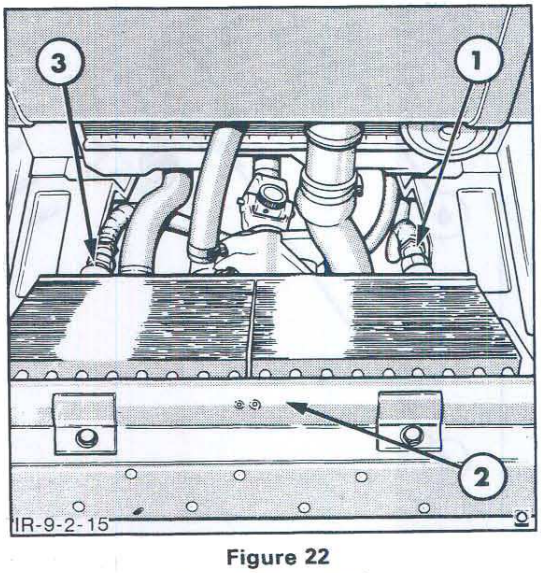

Figure 22
Oil Cooler Assembly

1. Inlet Connection
2. Transmission Oil Cooler
3. Outlet Connection

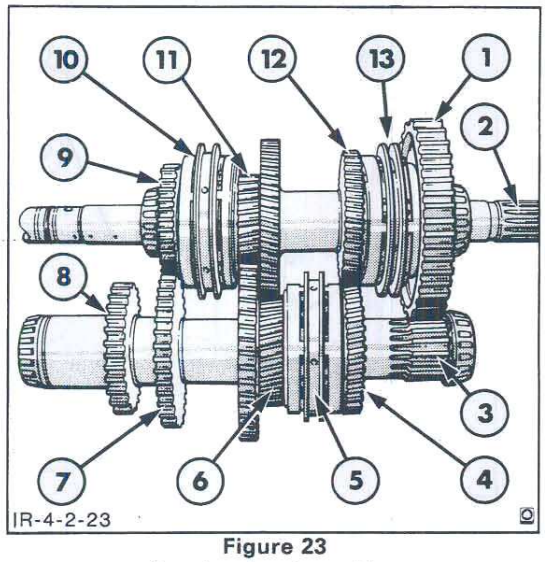

Figure 23
Synchroniser Assemblies

1. Low Range Gear
2. Output Shaft
3. Counter Shaft
4. 1st Gear
5. 1st/2nd Synchroniser
6. 2nd Gear
7. Forward Gear
8. Reverse Gear
9. 3rd Gear
10. 3rd/4th Synchroniser
11. 4th Gear
12. High Range Gear
13. High/Low Synchroniser

SYNCHRONISER

The synchronised 8 × 8 power reversing transmission incorporates three cone type synchronisers, two on the output shaft and one on the countershaft, Figure 23. The synchronisers operate in an identical way, however, each assembly differs in the way the synchroniser ring is engaged to the gear.

The 1st and 2nd gear synchronisers are retained to their respective gears via retainers, Figure 24. The 4th gear and the high range gear synchronisers are also retained to their respective gears via retainers, however, the 3rd gear and low range gear synchronisers have tangs to engage directly to their respective gears, Figure 25.

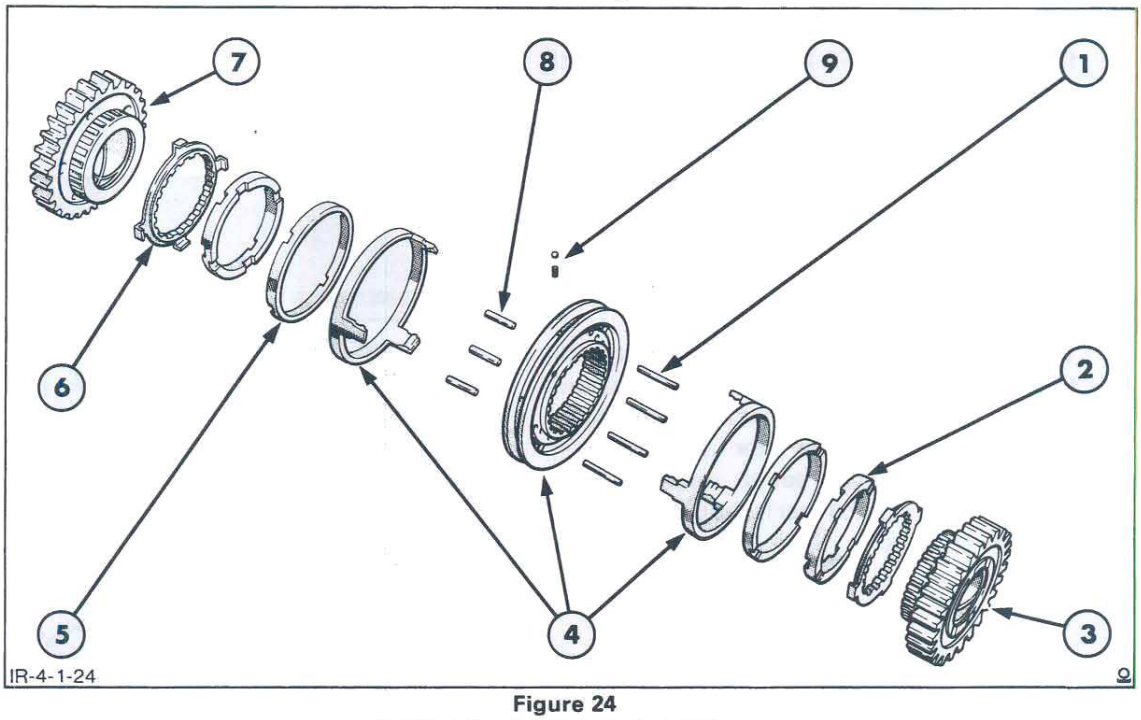

Figure 24
1st/2nd Synchroniser Exploded View

1. Inner Cone Drive Pins (4)
2. 1st Gear
3. Synchroniser Ring
4. Sliding Sleeve and Outer Cones
5. Inner Cone
6. Retaining Ring
7. 2nd Gear
8. Synchroniser Ring Locating Pins (3)
9. Detent Ball and Spring (6)

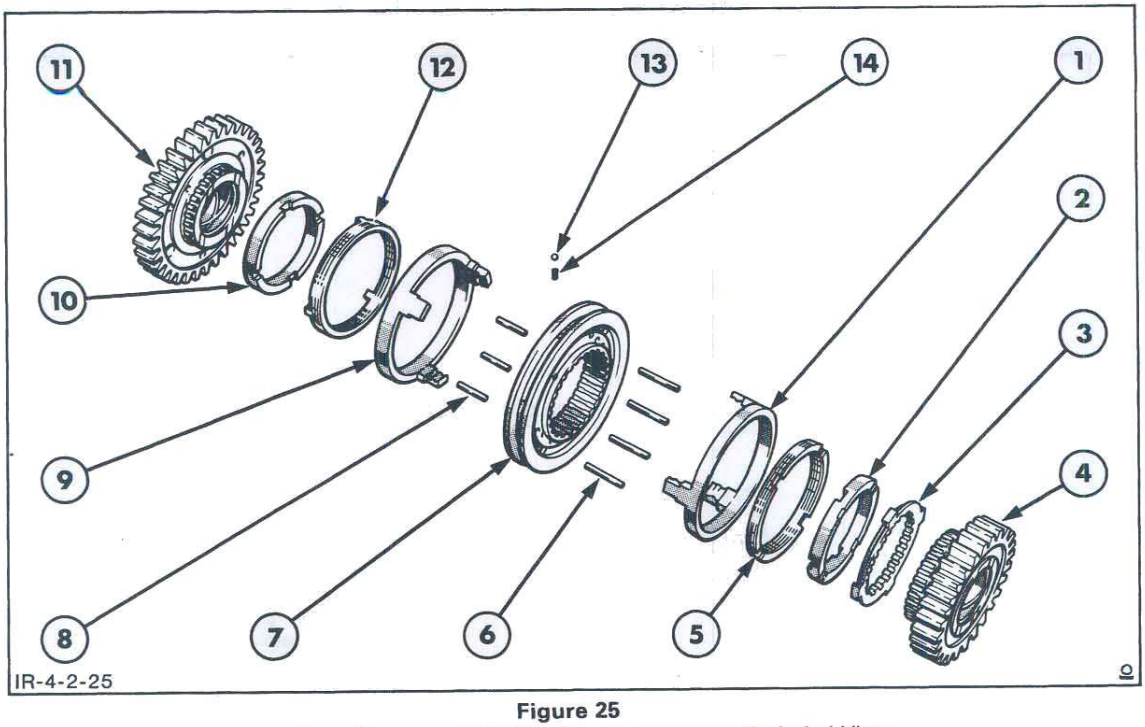

Figure 25
High/Low Range and 3rd/4th Gear Synchroniser Exploded View

1. Outer Cone
2. Inner Cone
3. Retainer
4. Gear
5. Synchroniser Ring
6. Inner Cone Drive Pins (4)
7. Sliding Sleeve
8. Synchroniser Ring Locating Pins (3)
9. Outer Cone
10. Inner Cone
11. Gear
12. Synchroniser Ring
13. Detent Ball
14. Detent Spring

The cone type synchroniser assembly, Figure 24, for the 1st and 2nd gears consists of a sliding sleeve splined to the countershaft. Six balls and springs are positioned in radial drillings in the sliding sleeve so that the balls are pressed into 'V' shaped recesses on the tangs of the two outer cones – three per outer cone. The outer cones are positioned either side of the sliding sleeve and locate through windows in the sleeve.

Transmission gears are mounted on the countershaft either side of the synchroniser assembly. Splined to the gears are retainers which engage the synchroniser rings to the gears.

The synchroniser rings are positioned between the outer cones and inner cones. The inner cones are engaged to the sliding sleeve by four (long) pins which locate within the cut-outs in the cones. Three thicker (short) pins limit the travel of the sliding sleeve in relation to the outer cone.

The operation of the synchroniser, Figure 26, is as follows:-

In the neutral position the sliding sleeve and outer cone are locked together by the balls and springs positioned in the sleeve and tangs of the outer cone.

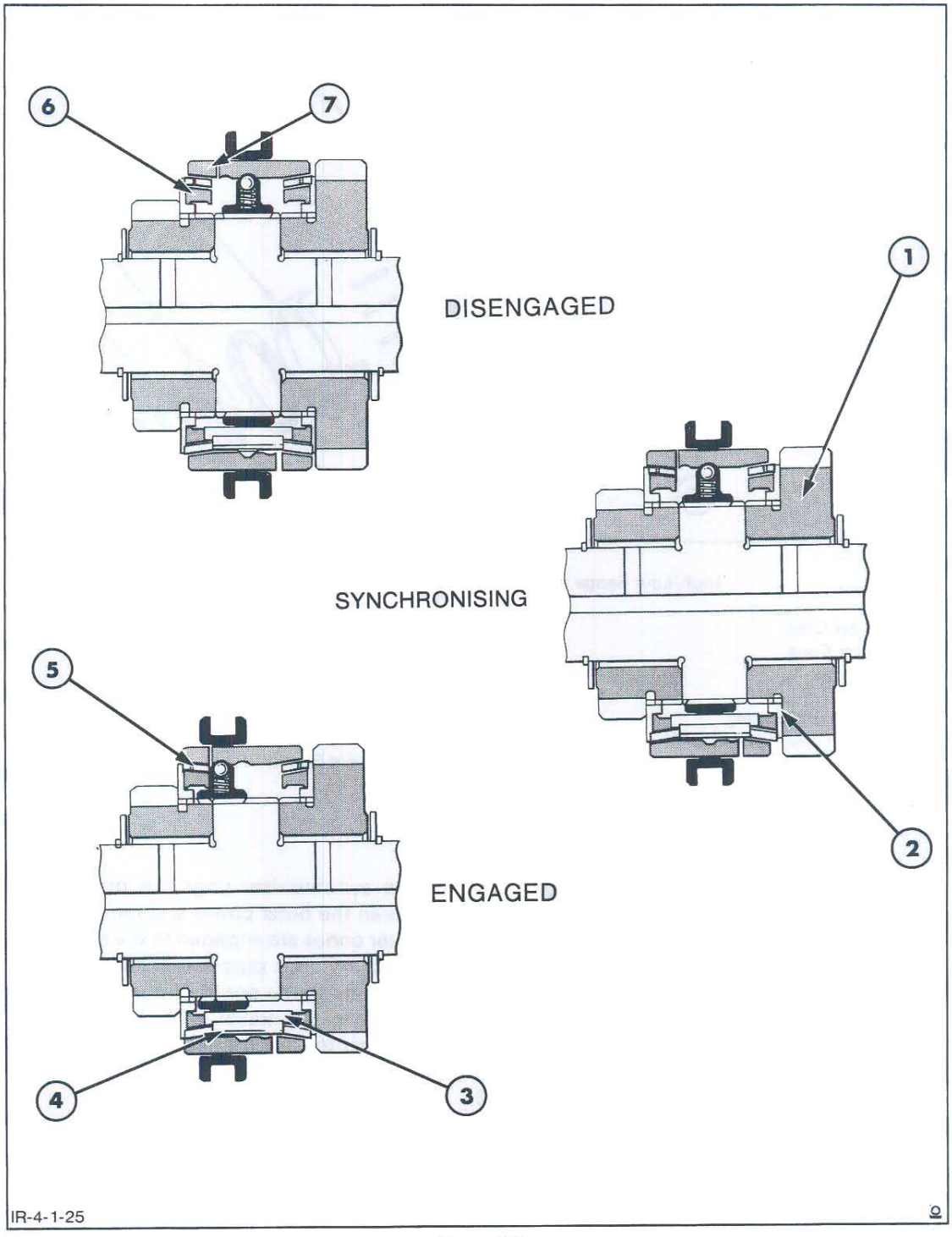

Figure 26
Synchroniser Operation

1. Gear
2. Synchroniser Ring Locator
3. Inner Cone Pins (Long)
4. Synchroniser Ring Pins (short)
5. Synchroniser Ring
6. Inner Cone
7. Outer Cone

The inner cone is engaged to the sliding sleeve by the four (long) pins and rotates with the sleeve and outer cone as an assembly.

The synchroniser ring, engaged to the gear via the retainer, and the gear are free to rotate on the countershaft.

As the sliding sleeve is moved from neutral towards the gear to be selected the outer cone also moves and compresses the synchroniser ring between the outer and inner cones.

Further shift pressure causes the synchroniser ring and the inner and outer cones to rotate at the same speed. The synchroniser ring and gear now rotating in synchronisation with the sleeve permits the chamfered teeth on the internal circumference of the sleeve to engage the teeth on the gear.

Further shift pressure causes the outer cone to depress the balls and springs in the sliding sleeve and allow the sleeve to fully engage the gear.

The cone type synchroniser, Figure 25, for the 3rd/4th and the high/low range gears operate in an identical way to the 1st and 2nd gear synchroniser, however, as previously described the 3rd gear and the low range gear synchroniser rings are engaged directly to the gears and do not use a retainer as in the 1st and 2nd gear synchroniser.

POWER FLOWS

Power for all eight forward gear ratios is transmitted from the front hydraulic clutch to the rear input shaft. The rear input shaft then transmits power to the countershaft forward gear and the countershaft in turn transmits power to the output shaft. Figures 27 and 28 illustrate the power flows.

Power flow for all eight reverse gear ratios is the same as for all eight forward gear ratios except that the rear clutch is engaged to transmit power to the reverse idler gear. The reverse idler gear in turn transmits power to the reverse gear on the countershaft.

Because power is being transmitted through the reverse idler gear, the countershaft and output shaft will rotate in the opposite direction as for forward gear ratios. The rear input shaft will also rotate in the opposite direction.

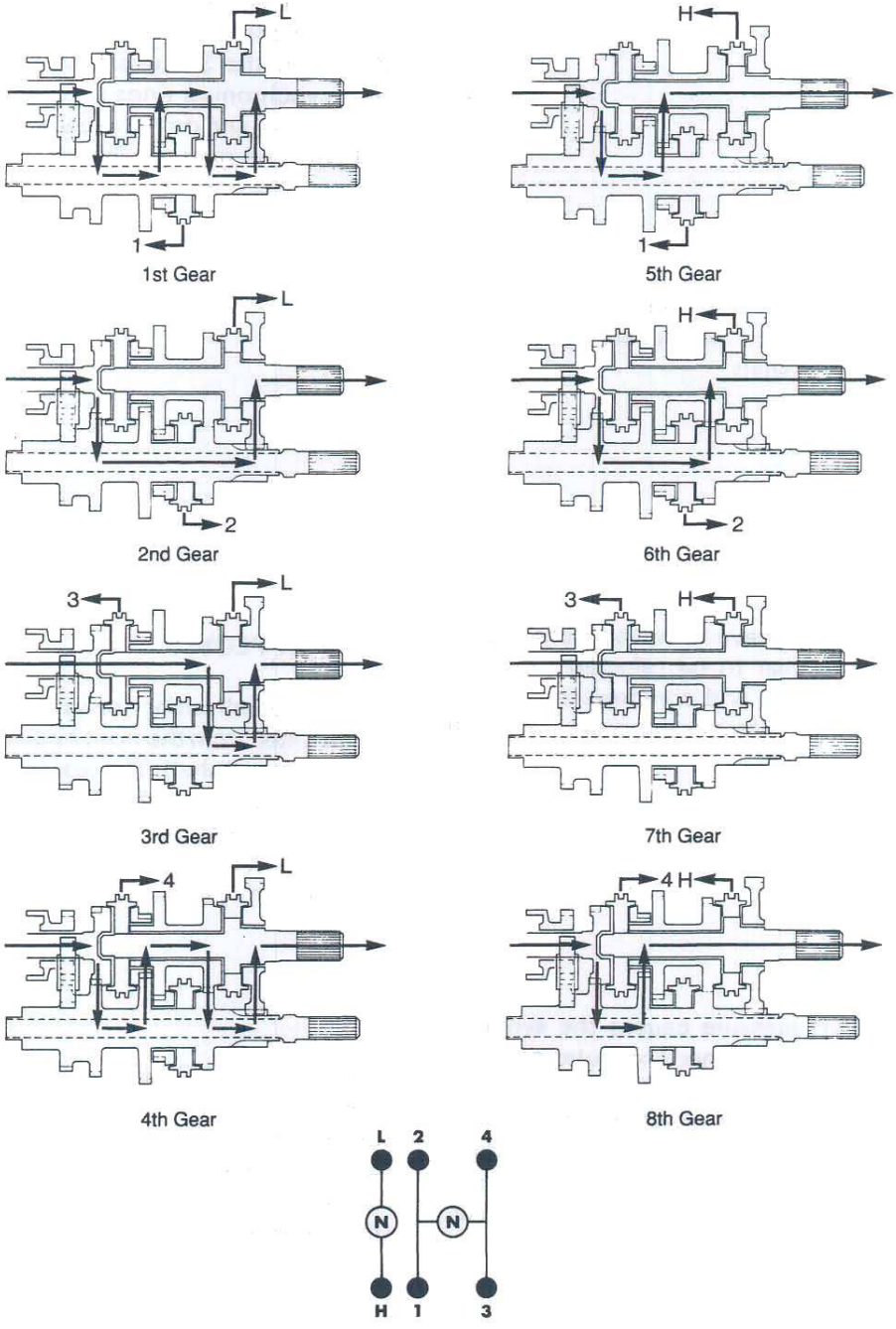

Figure 27
Power Flows in Forward

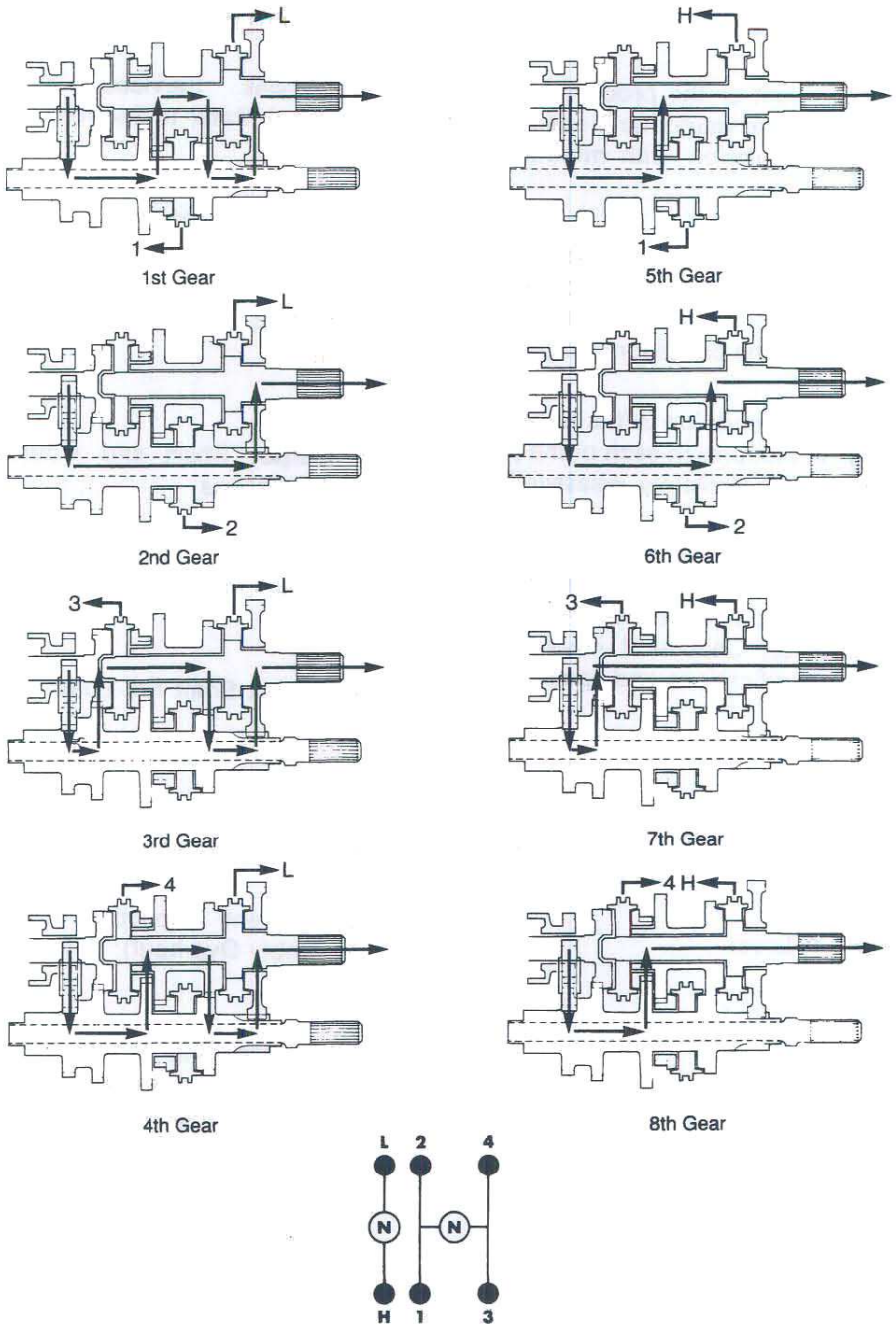

Figure 28
Power Flows in Reverse

B. INTRODUCTION TO OVERHAULING THE TRANSMISSION

GENERAL

The arrangement of the procedures in this chapter permits servicing the 8-speed power reversing transmission with minimum disassembly.

The procedures are separated into four groupings as covered below. Each grouping includes the components that can be serviced under the conditions established.

In the case of Condition 3 it is necessary to follow the procedures in each of the preceding groups to completely disassemble the transmission.

The fourth grouping covers detailed service procedures for the inspection and repair of sub-assemblies. Chapter 3 covers trouble shooting, specifications and special tools.

CONDITION 1

Assemblies Serviced with Transmission Installed: Refer to Section C.

- Gearshift Lever
- Modulator Unit
- Solenoid Control Valve
- Lock-Up Valve

CONDITION 2

Assemblies Serviced with Transmission Front End Overhaul: Refer to Section D.

- Torque Converter
- Transmission Hydraulic Pump and Oil Distributor
- Front Input Shaft and Clutch Housing

CONDITION 3

Assemblies Serviced with Complete Overhaul: Refer to Section E.

- Gearshift Mechanism
- Output Shaft Bearing Retainer and Oil Seal
- Output Shaft and Countershaft Gear Assemblies
- Countershaft Pre-Load
- Output Shaft Pre-Load

CONDITION 4

Component Inspection and Repair (Sub-Assembly Overhaul): Refer to Section F.

When servicing the transmission, always work in clean surroundings and with clean tools. Thoroughly clean the transmission case to prevent dirt entry. Use lint free towels when wiping parts or your hands. Lay cleaned parts out on clean paper so a thorough inspection can be made.

When installing the transmission components, do not use force. If the parts do not assemble freely, examine them for the cause of difficulty, and coat them with a film of petroleum jelly or transmission fluid to facilitate assembly. Also lubricate all shafts, bearings, oil seals and gears with a film of transmission oil before installing them in the transmission.

C. GEARSHIFT LEVER, MODULATOR UNIT, LOCK-UP VALVE AND SOLENOID CONTROL VALVE – OVERHAUL

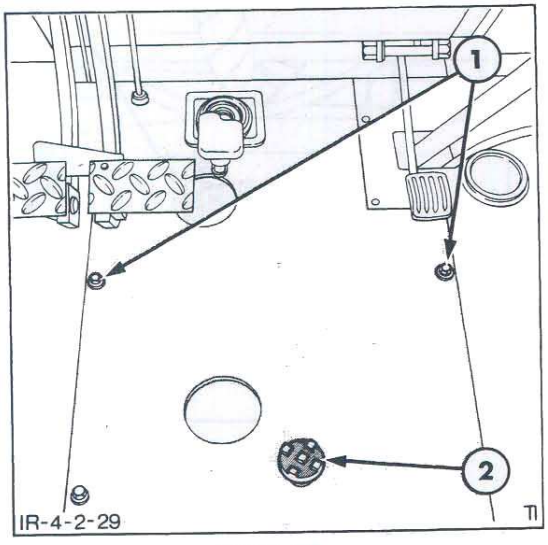

Figure 29
Transmission Access Plate Removal

1. Retaining Bolts
2. Differential Lock Pedal

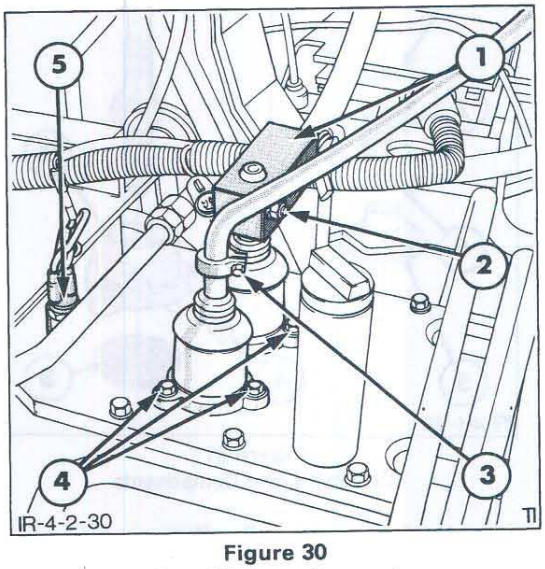

Figure 30
Gearshift Lever Removal

1. Gearshift Lever
2. Retaining Nut and Pin
3. Range Lever Clamp
4. Cup Retaining Bolt
5. Safety Start Switch

GEARSHIFT LEVER

REMOVAL

1. Remove the cab floor mat and the rubber gaiters from around the gearshift levers.

2. Remove the steering console lower panel situated in front of the gearshift levers.

3. Remove the bolts securing the transmission access plate to the cab floor, Figure 29, and lift off the plate.

4. Disconnect the transmission dump switch wires at the bottom of the gearshift levers.

5. Remove the three gearshift lever spigot support retaining bolts from the transmission top cover, Figure 30.

6. Lift the gearshift levers and lever spigots from the transmission top cover and remove through the aperture in the cab floor.

DISASSEMBLY

1. Remove the gearshift lever to lever spigot retaining pin and nut.

2. Remove the snap ring from the spigot to release the spring, cup and spigot from the support. Remove the 'O' ring seal from the lever spigot.

3. Remove the pin and rubber shield from the lever support, Figure 31.

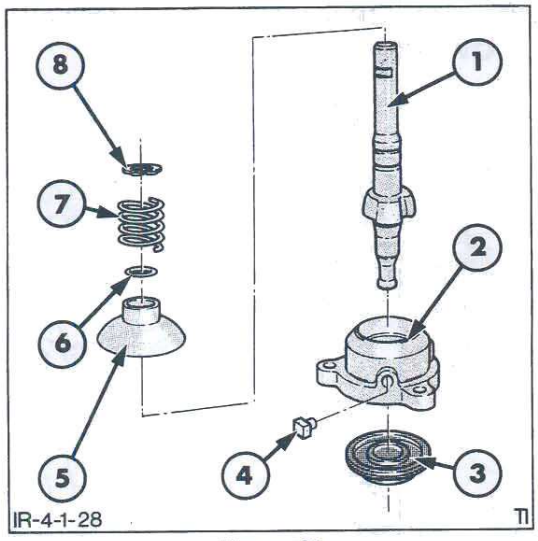

Figure 31
Gearshift Lever Components

1. Lever Spigot
2. Support
3. Rubber Shield
4. Pin
5. Cup
6. 'O' Ring
7. Spring
8. Snap Spring

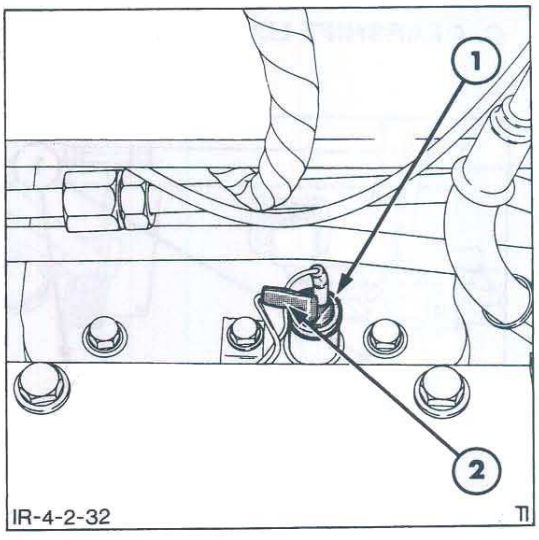

Figure 32
Safety Start Switch Removal

1. Safety Start Switch
2. Wiring Harness

ASSEMBLY

1. Install the pin into the support then slide the lever spigot into the support.
2. Install the rubber shield over the lever spigot and onto the support.
3. Install the 'O' ring seal to the lever spigot then install the cup, spring and retain with the snap ring.

INSTALLATION

1. Install the lever spigot assembly and retaining bolts to the transmission top cover. Apply thread sealant to the bolts prior to installation – see "Specifications" – Chapter 3.
2. Install the gearshift lever through the cab floor aperture and over the lever spigot.
3. Retain the lever to the spigot with the pin and nut, tighten to the specified torque, see "Specifications" – Chapter 3.
4. Re-connect the dump switch wires and install the transmission access plate to the cab floor.
5. Install the steering console panel, gearshift lever gaiters and floor mat.

SAFETY START SWITCHES

REMOVAL

1. Remove the fuel tank as described in Part 2 "Fuel Systems" – Chapter 1.

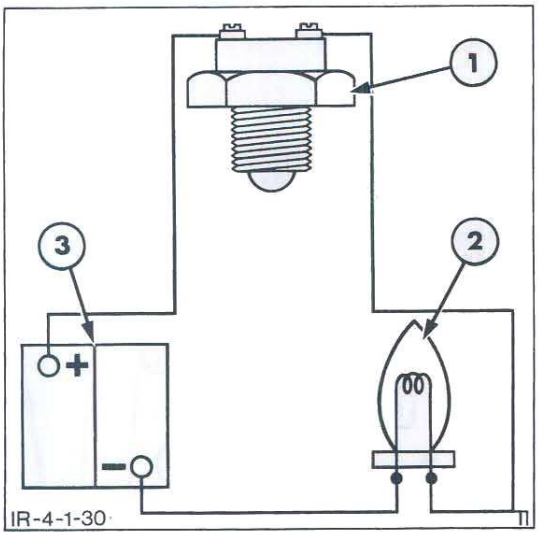

Figure 33
Safety Start Switch Test

1. Switch
2. Bulb
3. Battery

2. Remove the safety start switch from the transmission top cover, Figure 32, and then remove the switch plunger from the transmission housing.

INSPECTION

1. Inspect the conical ends of the switch plunger for nicks or burrs. If nicks or burrs exist that cannot be removed by polishing, install a new plunger.

2. Check the safety start switch for operation by connecting the switch to a suitable bulb and battery as illustrated in Figure 33.

3. Depress and then release the operating button. The switch is operating correctly if the light comes on when the button is depressed and goes out when the button is released. If the switch is faulty, install a new switch.

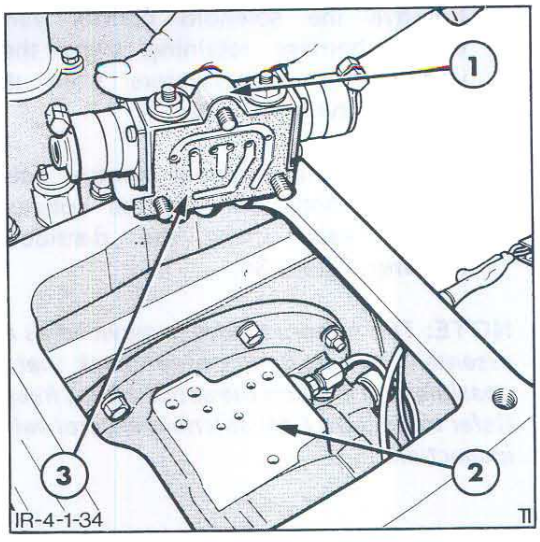

Figure 34
Solenoid Control Valve Removal

1. Solenoid Control Valve Assembly
2. Oil Distributor
3. Gasket

INSTALLATION

1. Install a new 'O' ring seal onto the safety start switch, then install into the transmission top cover and tighten to the specified torque – see "Specifications" – Chapter 3.

2. Install the fuel tank as described in Part 2 "Fuel Systems" – Chapter 1.

SOLENOID CONTROL VALVE

REMOVAL

1. Remove the fuel tank as described in Part 2 "Fuel Systems" – Chapter 1.

2. Remove the solenoid control valve access plate retaining bolts and lift the plate from the transmission.

3. Remove the solenoid control valve wiring harness retaining clips then withdraw the connectors from the control valve solenoids.

4. Withdraw the solenoid control valve retaining bolts and lift the solenoid control valve from the distributor housing, Figure 34.

NOTE: *The solenoid valve is serviced as an assembly, therefore, the only check that is possible is to confirm the spool moves freely. Refer to Section F for solenoid control valve inspection.*

INSTALLATION

1. Install the solenoid control valve with a new gasket onto the distributor housing and secure with the retaining bolts. Tighten the bolts to the specified torque, see "Specifications" – Chapter 3.

2. Reconnect the wiring harness to the solenoids and retain in position with the retaining clips.

3. Install the solenoid control valve access plate onto the transmission housing and secure with the retaining bolts. Tighten the bolts to the specified torque, see "Specifications" – Chapter 3.

4. Install the fuel tank as described in Part 2 "Fuel Systems" – Chapter 1.

MODULATOR UNIT

NOTE: *The modulator unit is serviced as an assembly and the only checks possible are of continuity and voltage checks.*

REMOVAL

1. Remove the steering console lower panel situated in front of the gearshift lever.

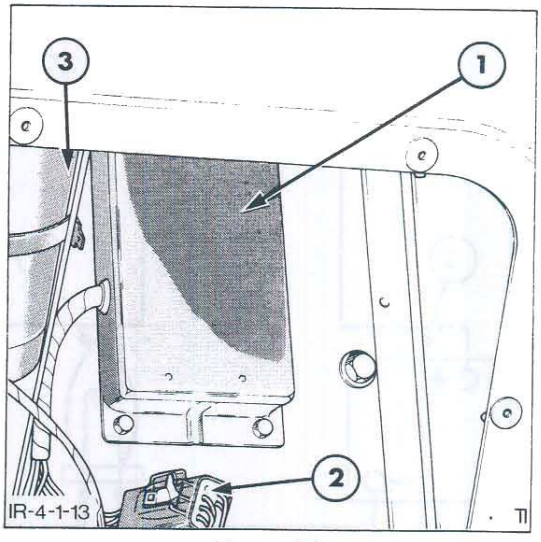

Figure 35
Modulator Unit Installation

1. Modulator Unit
2. Harness Connector
3. Steering Motor

2. Withdraw the retaining bolts and remove the modulator unit, Figure 35.

INSPECTION

See "Trouble Shooting" – Chapter 3 for the modulator unit inspection.

INSTALLATION

1. Install the modulator unit and secure in position tightening the retaining bolts to the specified torque, see "Specifications" – Chapter 3.

2. Install the steering console lower panel and tighten the retaining bolts to the specified torque, see "Specifications" – Chapter 3.

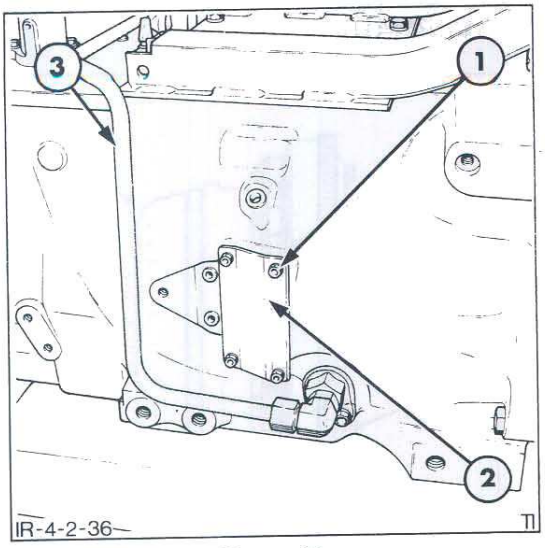

Figure 36
Lock-Up Valve Access Plate Removal

1. Retaining Bolt
2. Access Plate
3. Coder Return Tube

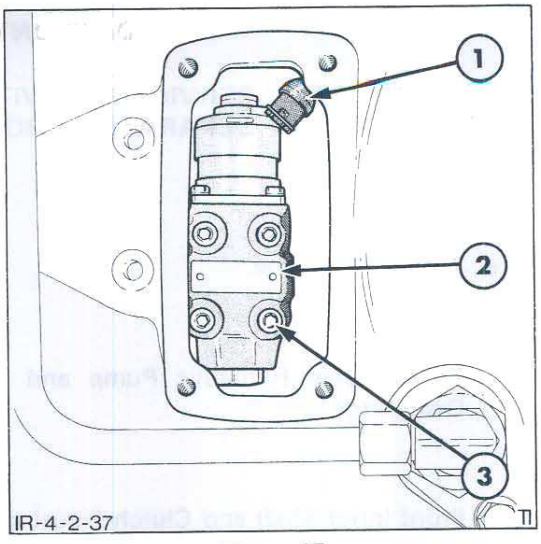

Figure 37
Lock-Up Valve Removal

1. Harness
2. Lock-Up Valve
3. Retaining Bolt

LOCK-UP VALVE

REMOVAL

1. Remove the lock-up valve access plate retaining bolts and lift the plate from the transmission, Figure 36.

2. Remove the lock-up valve wiring harness retaining clip then withdraw the connector from the valve solenoid.

3. Withdraw the lock-up valve retaining bolts and lift the lock-up valve from the distributor housing, Figure 37.

NOTE: *The lock-up valve is serviced as an assembly, therefore, the only check is possible is to confirm the spool moves freely. Refer to Section F for lock-up valve inspection.*

INSTALLATION

1. Install the lock-up valve with a new gasket onto the distributor housing and secure with the retaining bolts. Tighten the bolts to the specified torque, see "Specifications" – Chapter 3.

2. Reconnect the wiring harness to the solenoid and retain in position with the retaining clip.

3. Install the lock-up valve access plate onto the transmission housing and secure with the retaining bolts. Tighten the bolts to the specified torque, see "Specifications" – Chapter 3.

D. FRONT END OVERHAUL

ASSEMBLIES SERVICED WITH TRANSMISSION SEPARATED FROM ENGINE

- Torque Converter.
- Transmission Hydraulic Pump and Oil Distributor.
- Front Input Shaft and Clutch Housing.

SEPARATING THE TRANSMISSION FROM THE ENGINE

1. Drain the oil from the transmission by removing the drain plug.
2. Separate the transmission from the engine as described in PART 10 "Separating the Unit".

DISASSEMBLY

TORQUE CONVERTER

1. Remove the torque converter and drive plate from the stator support, Figure 38.
2. Remove the drive plate from the converter by removing the attaching bolts and washers.

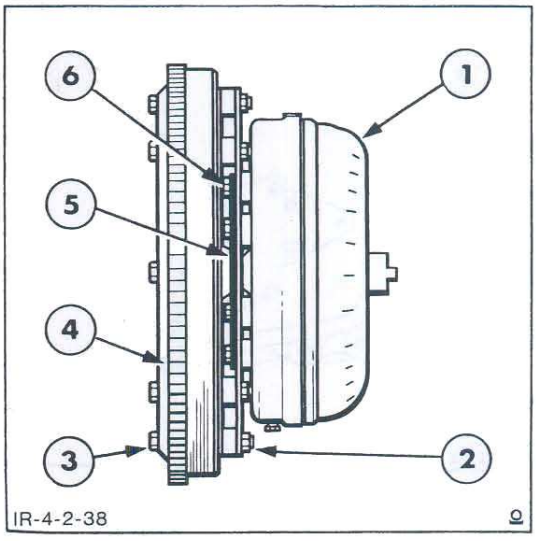

Figure 38
Torque Converter to Flywheel

1. Torque Converter Assembly
2. Drive Plate Assembly
3. Flywheel to Drive Plate Bolts
4. Flywheel
5. Reinforcing Plate
6. Drive Plate to Torque Converter Bolts

3. Normally, it is not necessary to remove the converter pilot hub. However, if the pilot hub is damaged it can be removed by removing the self-locking bolts.

CAUTION: *The bolts securing the converter pilot hub to the flywheel also hold the flywheel to the crankshaft. Before removing the bolts, make sure the flywheel is sufficiently supported to prevent it from falling.*

4. Refer to Section F for servicing the torque converter.