

FT700.2 FT800.2

Tractor
Retroexcavator

Repair Manual

Part No. 82995387
Finis No. 2995387
English

Volume 2

FIAT-HITACHI

WARNING

PLEASE READ THIS INSTRUCTION BOOK CAREFULLY BEFORE PROCEEDING TO SWITCH ON, USE, MAINTAIN, FILL UP WITH FUEL OR CARRY OUT ANY OTHER OPERATION CONNECTED WITH THE VEHICLE.

IMPORTANT NOTICE

This vehicle has been designed for the excavation and transport of earth and loose material.

All other uses are considered contrary to the manufacturer's intended application, and therefore the manufacturer cannot be held responsible for damage to any object or the vehicle itself, or any injury to persons that may be caused by it [by improper use]. It should be remembered that by taking the risk of improper use, one is also taking responsibility for any of the consequences.

Respect for the methods of use, maintenance and repair described in this instruction book is essential in defining the manufacturer's intended use. This vehicle must be used, maintained and repaired only by people who have been previously trained on the equipment and related safety regulations as well as being authorised to operate the vehicle itself.

The user is always required to observe the general safety and accident-prevention regulations, such as the highway code in the case of use on road open to traffic.

Any arbitrary modification made to this vehicle releases the manufacturer from all responsibilities relating to damage or injury.

The manufacturer and all the organisations in its distribution network, including but not only the national, regional and local dealers, reject all responsibility for damages caused by malfunction of parts and/or components not approved by the manufacturer, and used in the maintenance and/or repair of the product manufactured and marketed by the manufacturer. In any event, no guarantee of any kind can be issued or imposed for the product manufactured and marketed by the manufacturer for damages caused by the malfunction of parts and/or components not approved by the manufacturer.

Avoid using the rear excavator as a crane, as the machine was specifically designed for excavation work. Please keep to the national regulations concerning the use of the rear excavator for lifting.

MODEL CODES

In some markets the 4.4 litre naturally aspirated engine is replaced by the 4.2 litre turbocharged engine. These engines which develop sufficient horsepower, are manufactured to suit the characteristics of the machine and meet local legislation applicable to the various countries.

The new models listed below and described in the text of this manual by **engineering code**, are therefore not necessarily available to 'all' markets. Please consult your dealer for local information.

MODEL	ENGINEERING CODE (As used in this Manual)	ENGINE
FT700.2	DF0P	4.2 Litre – Naturally Aspirated = P
	DF1Q	4.2 Litre – Turbocharged = Q
	LF4P	4.4 Litre – Naturally Aspirated = P
	LF4Q	4.2 Litre – Turbocharged = Q
FT800.2	LF5Q	4.4 Litre – Turbocharged = Q

CONTENTS

VOLUME 1

Vº Bº INSPECCIÓN

Introduction	0-4
Section 1 – Engine	1-1
Section 2 – Fuel Systems	2-1
Section 3 – Electrical System	3-1

VOLUME 2

Section 4 – Transmission	4-1
4 x 4 Transmission	4-1
Description and operation	4-3
Overhauling the transmission	4-21
Gearshift lever, modulator unit and solenoid control valve – Overhaul	4-23
Front end overhaul	4-28
Complete overhaul	4-35
Component overhaul	4-46
8 x 8 Transmission	4-67
Description and operation	4-67
Overhauling the transmission	4-90
Gearshift lever, modulator unit, lock-up valve and solenoid control valve – overhaul ...	4-91
Front end overhaul	4-97
Complete overhaul	4-104
Component overhaul	4-118
Transmission Electrical Control Circuit	4-134
Basic control circuitry description	4-134
Transmission electrical operation	4-138
Troubleshooting	4-146
Hydraulic	4-169
Diagnosis guide	4-173
Specifications	4-176
Special tools	4-180
Section 5 – Rear Axle and Brakes	5-1
Rear Axle and Wheel Brakes	5-1
Description and operation	5-1
Overhaul	5-5
Planetary gear assembly	5-12
Rear wheel brakes	5-15

Differential and differential lock assembly	5-17
Drive pinion assembly	5-20
Brake pedal linkage and cross-shaft	5-24
Differential lock linkage	5-25
Twin cable hand brake operation	5-26
Specifications and Special Tools	5-27
Torque specifications	5-27
Special tools	5-28
Section 6 – Power Take-Off	6-1
Independent PTO	6-1
Description and operation	6-1
Pressure regulating valve and control valve – pressure tests	6-7
Pressure regulating valve	6-9
Control valve – overhaul	6-10
Clutch assembly overhaul	6-13
Reduction gear assembly	6-17
Hydraulic pump	6-20
Troubleshooting	6-27
Specifications	6-28
Special Tools	6-29
Section 7 – Steering and Front Axle	7-1
Steering	7-1
Hydrostatic steering – description and operation	7-1
Power-steering pump, reservoir, and cooler – overhaul	7-12
Hydraulic steering motor – overhaul	7-18
Reservoir filter and hydraulic tubes	7-31
Bleeding the steering system	7-32
Troubleshooting and pressure testing	7-33
Power-steering pump – troubleshooting and pressure testing	7-34
Specifications and special tools	
Two-Wheel Drive Front Axle	7-39
Front axle – description	7-39
Toe-in adjustment	7-40
Front wheel hub and spindle – overhaul	7-42
Steering cylinder and track control rod – overhaul	7-46
Front axle – overhaul	7-51
Troubleshooting – steering	7-53
Specification and special tools – two-wheel drive front axle	7-54
Front-Wheel Drive Front Axle	7-55
Description and operation	7-55
Planetary reduction assembly and wheel hubs – overhaul	7-57
Axle shafts – overhaul	7-64
Steering swivel pin bearing – overhaul	7-68
Steering cylinder and track control rod – overhaul	7-72
Front axle – removal and installation	7-77
Differential ring gear and pinion assembly – overhaul	7-80
Drive shaft – overhaul	7-91

Transfer Gear Assembly	7-93
Description and operation	7-93
Overhaul	7-95
Transfer gear operating cable – adjustments	7-103
Specifications – front-wheel drive axle and transfer gear assembly	7-105
Special tools	7-109

VOLUME 3

Section 8 – Hydraulic System, Controls and Frame	8-1
Section 9 – Cab	9-1
Section 10 – Separating the Tractor	10-1

SECTION 4

TRANSMISSION

4 X 4 TRANSMISSION

DESCRIPTION AND OPERATION

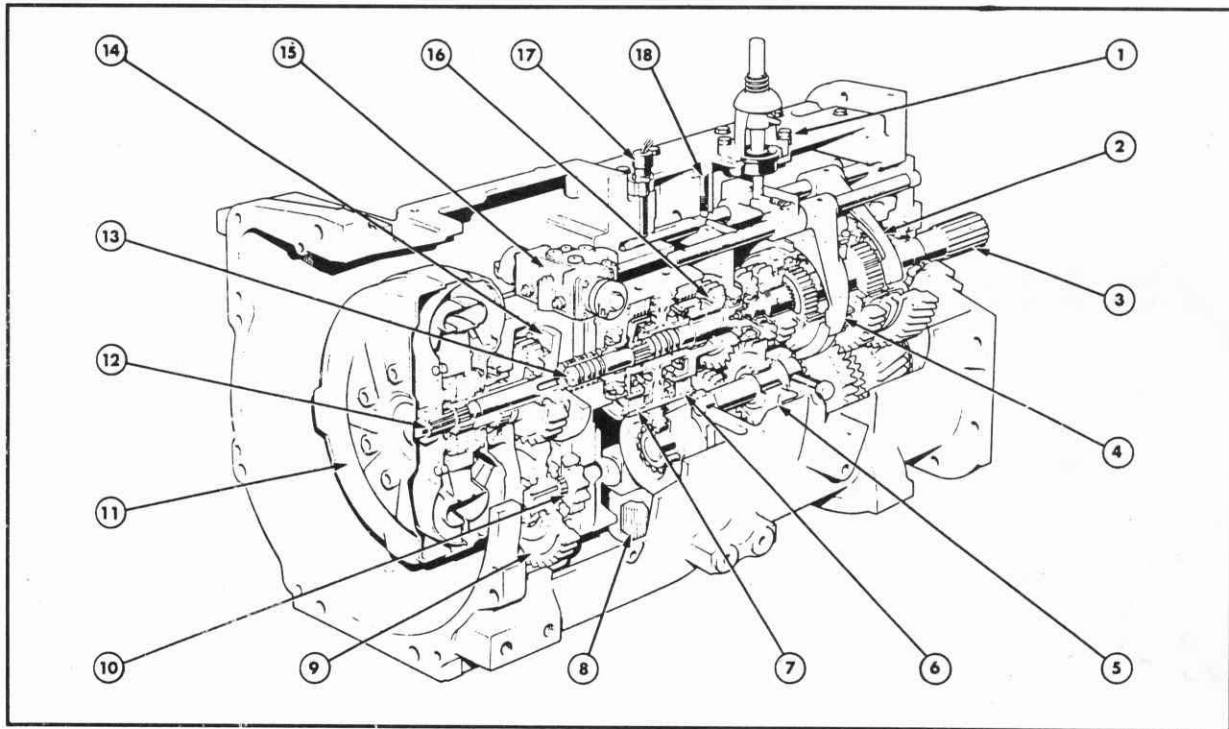


Figure 4-1

4 x 4 Fully Synchronised Power Reversing Transmission

- | | |
|----------------------------------|----------------------------|
| 1. Shift cover and lever | 10. Hydraulic pump |
| 2. 1st/2nd Fork and synchronizer | 11. Torque converter |
| 3. Output shaft | 12. Front input shaft |
| 4. 3rd/4th Fork and synchronizer | 13. Rear input shaft |
| 5. Reverse idler gear | 14. Stator support |
| 6. Reverse clutch pack | 15. Solenoid control valve |
| 7. Forward clutch pack | 16. Rear clutch hub |
| 8. Pump inlet filter | 17. Safety start switch |
| 9. Pump drive gear | 18. Gear shift rail detent |

The transmission, Figure 4-1, 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.

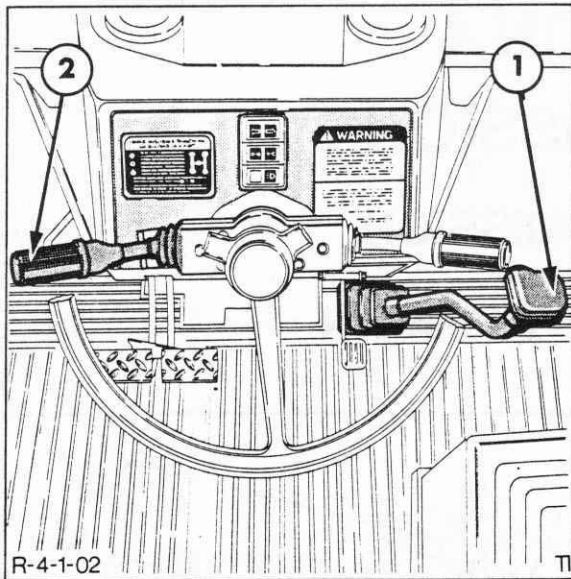


Figure 4-2

Transmission Shift Levers

1. Gearshift lever
2. Power reversing lever

GEAR RATIOS

Synchronized 4x4 Transmission

1st	4.2656:1
2nd	2.5:1
3rd	1.2735:1
4th	0.7281:1
R1	4.2875:1
R2	2.508:1
R3	1.28:1
R4	0.7318:1

Incorporated with the transmission is an electrically operated modulator unit which is mounted in the 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.

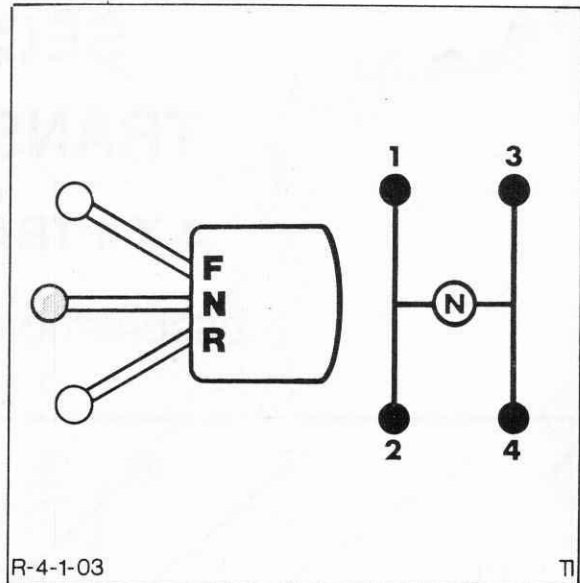


Figure 4-3

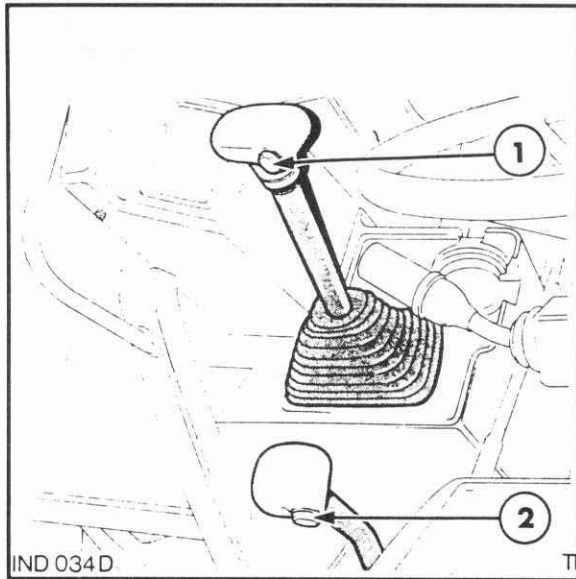
Gearshift Pattern

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.

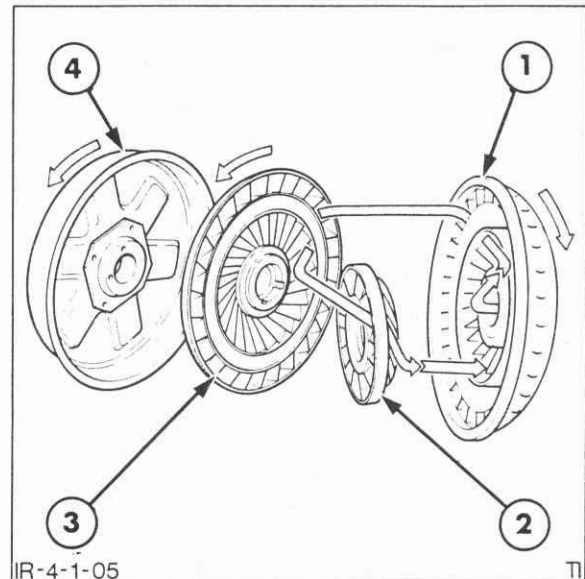
The gearbox receives power from the engine by means of oil reaction in the torque converter and hydraulic clutch assemblies.

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 4-2.

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.

**Figure 4-4****Transmission Disconnect Switches**

1. Loader control lever button
2. Gearshift lever button

**Figure 4-5**

1. Rear cover and impeller
2. Stator
3. Turbine
4. Front cover

The gearshift lever, shown in Figure 4-2, is used to select any one of four synchronized gear ratios for forward or reverse travel. Figure 4-3 illustrates the gearshift pattern. In any gear ratio the operator need only move the power reversing lever to change direction of travel.

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

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.

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

Two finger operated button type switches are provided, Figure 4-4, 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.

The main parts of the torque converter are the impeller (pump), the turbine, the stator and the front and rear covers, Figure 4-5. The impeller is integral with the rear cover and is driven by the engine flywheel by means of a drive plate.

SECTION 4 – TRANSMISSION

TORQUE CONVERTER RATIOS:			
Model	All Markets (Ex N/America)	North America Only	
	4X4	4X4	8X8
KF3P	—	—	2.83:1
DF0P	2.34:1	2.83:1	—
DF1Q	2.34:1	2.83:1	—
LF4P	2.34:1	2.83:1	—
LF4Q	2.34:1	2.83:1	—
LF5Q	2.34:1	2.34:1	—

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 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.

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. As listed, in the ratio table below. 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.

OIL DISTRIBUTOR

The oil distributor, Figure 4-6, consists of a pressure regulating valve, a bypass valve, the hydraulic pump and a series of oil passages for oil distribution.

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.

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.

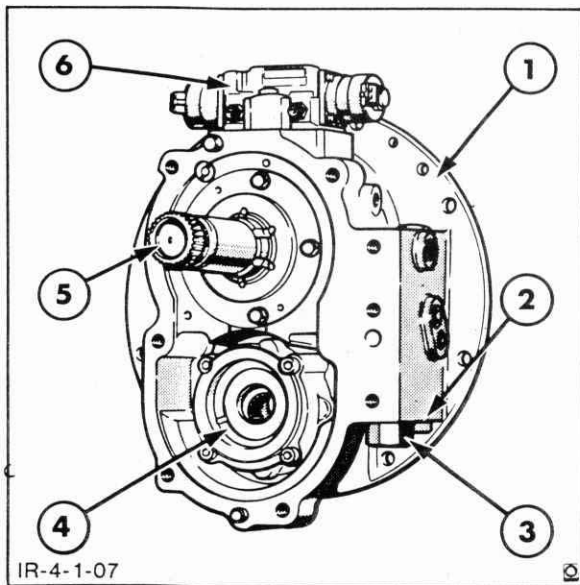


Figure 4-6
Oil Distributor

1. Oil distributor housing
2. Regulating valve
3. Bypass valve
4. Hydraulic pump
5. Stator support
6. Control valve

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 4-7, 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.

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.

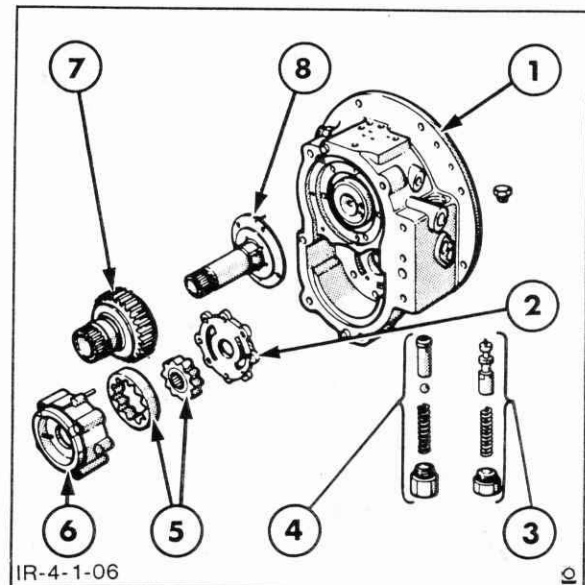


Figure 4-7
Transmission Hydraulic Pump

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

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 4-8. 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".

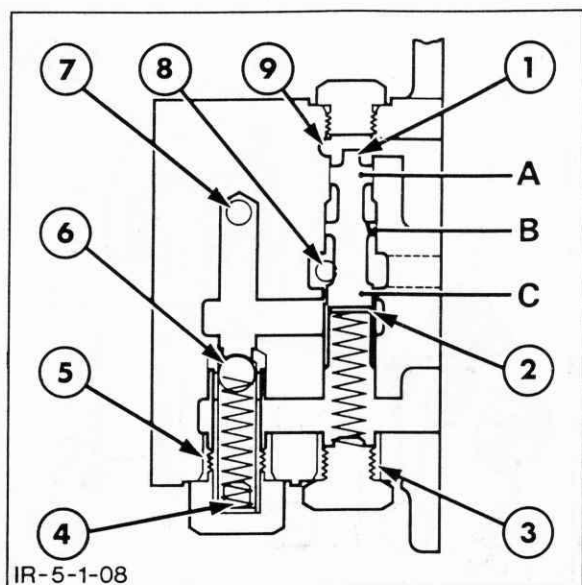


Figure 4-8

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

The area of land "B" is greater than land "A"; therefore when the pressure between the lands reaches approximately 100 PSI (5.5 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 100 PSI (5.5 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

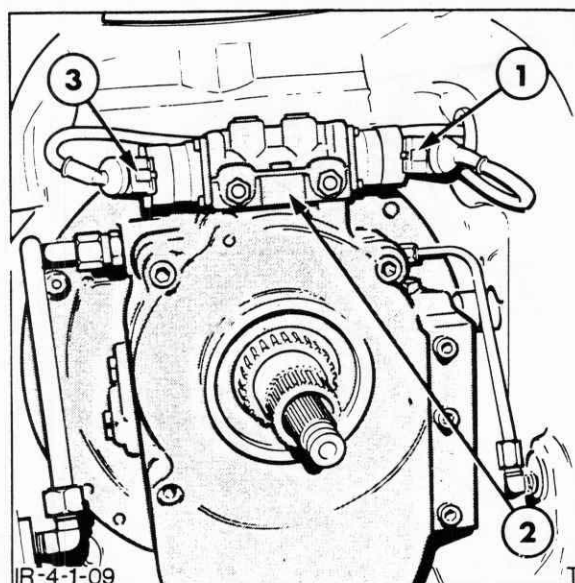


Figure 4-9

Solenoid Control Valve

1. Forward solenoid
2. Control valve
3. Reverse solenoid

converter operation, the bypass valve must function to limit maximum pressure in the converter at high pump flow.

The bypass valve will open at approximately 100 PSI (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 4-9, and consists of two identical spools, two identical solenoids, a return spring and a valve body.

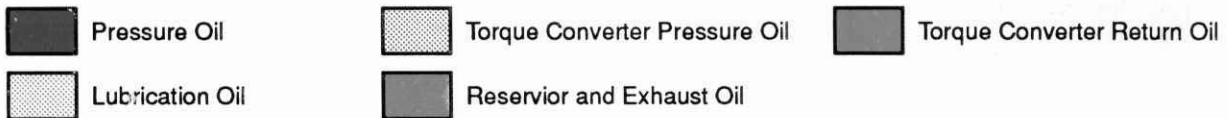
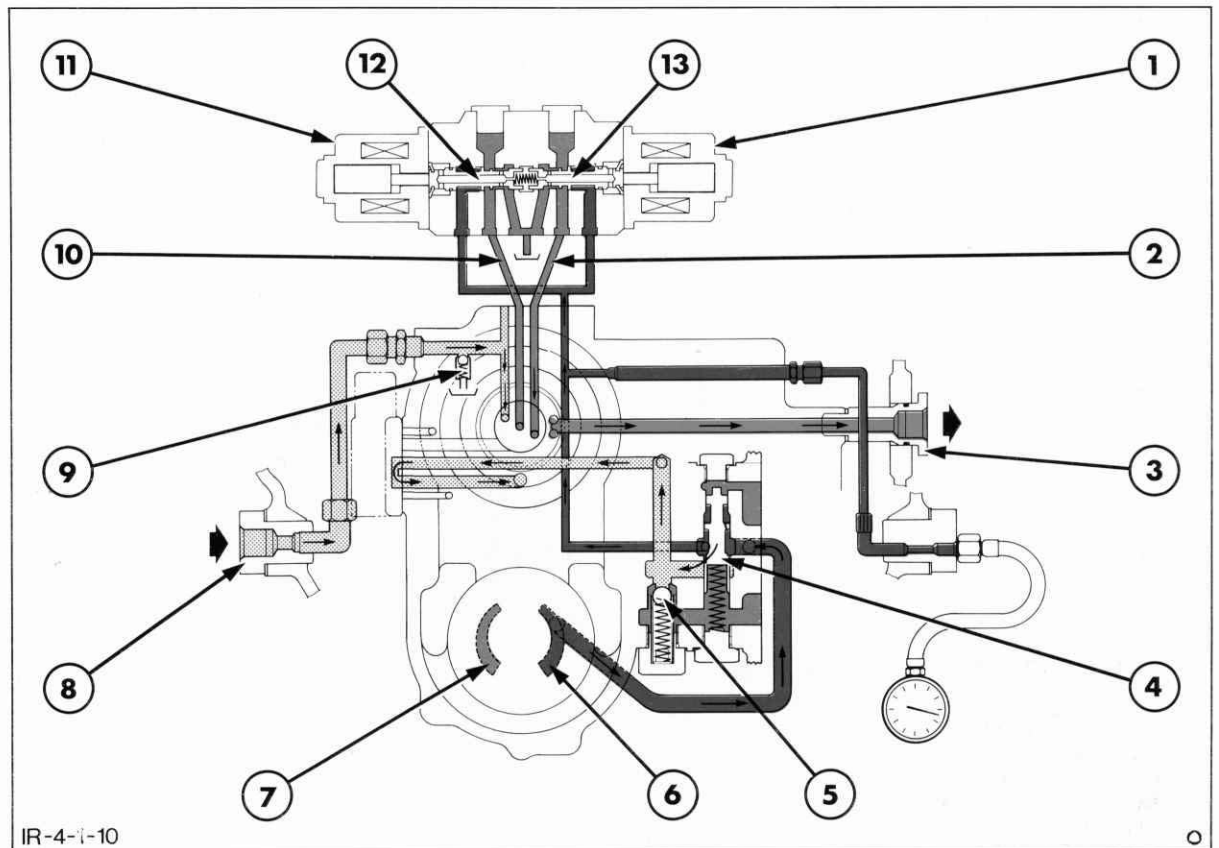


Figure 4-10
Oil Flow - In Neutral

- | | |
|-------------------------------|--------------------------------|
| 1. Forward solenoid | 8. Return from oil cooler |
| 2. Forward clutch oil gallery | 9. Cooler bypass valve |
| 3. Feed port to oil cooler | 10. Reverse clutch oil gallery |
| 4. Regulating valve | 11. Reverse solenoid |
| 5. Bypass valve | 12. Reverse spool |
| 6. Oil pump outlet | 13. Reverse spool |
| 7. Oil pump inlet | |

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.

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

With the solenoid control valve in neutral, Figure 4-10, 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.

SECTION 4 – TRANSMISSION

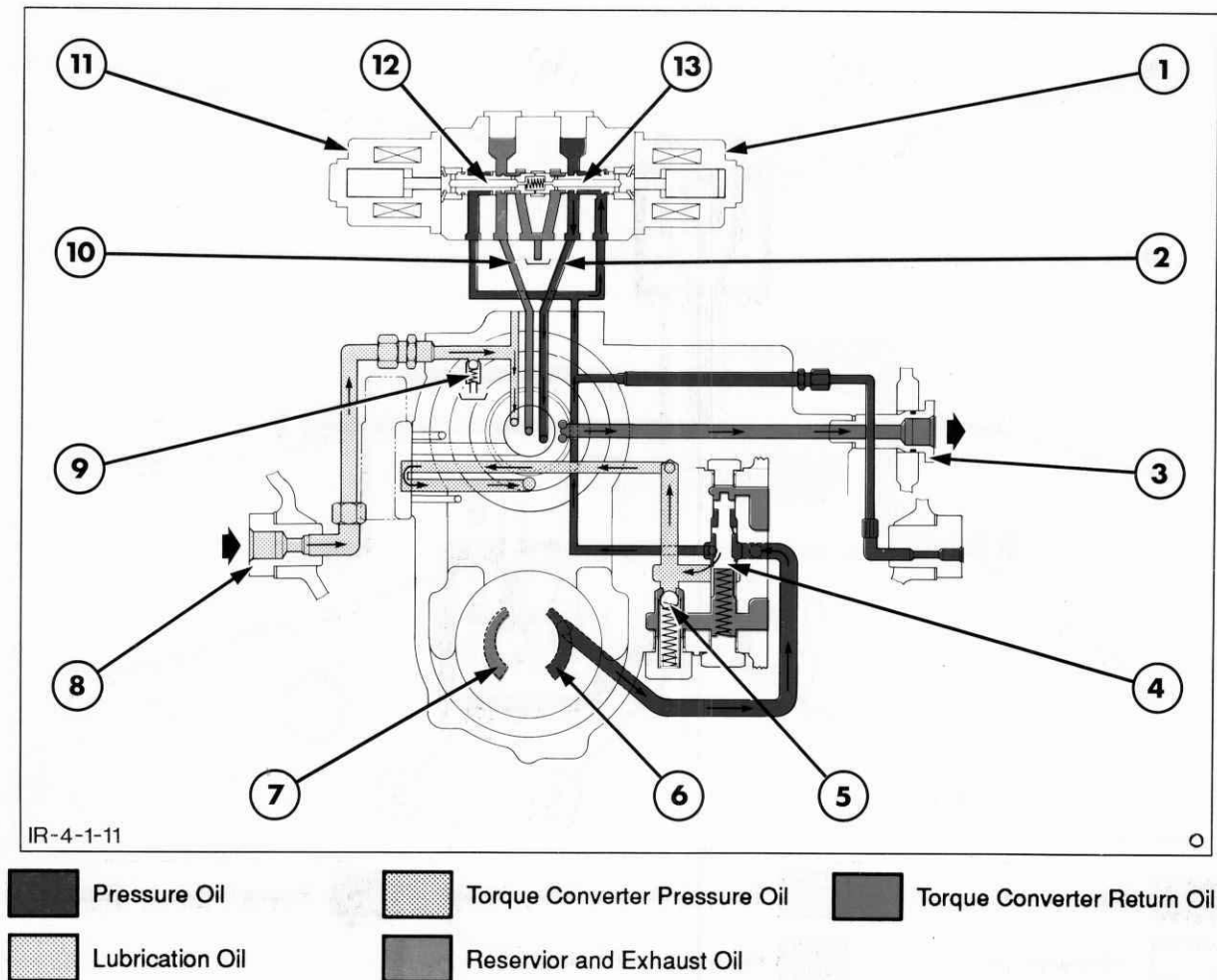


Figure 4-11
Oil Flow in Forward

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 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 energized and moves the forward spool across to align the forward clutch pack oil gallery with the oil gallery from the pressure regulating valve, Figure 4-11. 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.

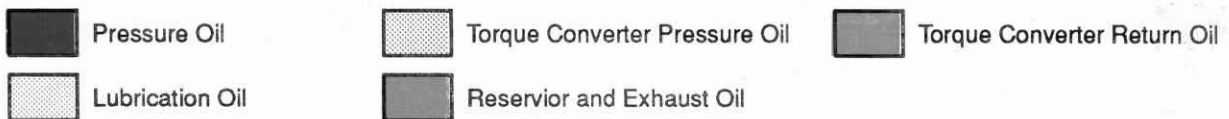
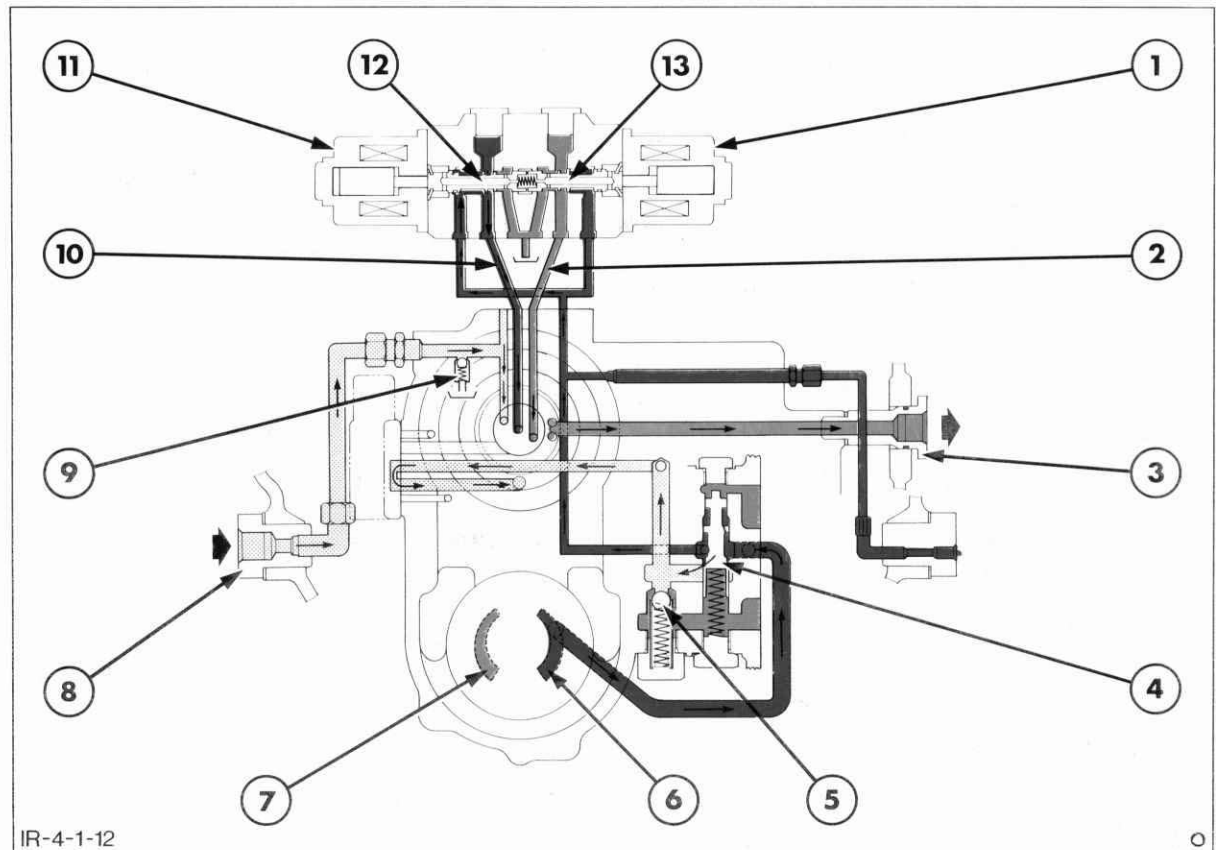


Figure 4-12
Oil Flow in Reverse

- | | |
|-------------------------------|--------------------------------|
| 1. Forward solenoid | 8. Return port from oil cooler |
| 2. Forward clutch oil gallery | 9. Cooler bypass valve |
| 3. Feed port to oil cooler | 10. Reverse clutch oil gallery |
| 4. Regulating valve | 11. Reverse solenoid |
| 5. Bypass valve | 12. Reverse spool |
| 6. Oil pump outlet | 13. Forward spool |
| 7. Oil pump inlet | |

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 4-12, and power is delivered to

the transmission gearbox via the rear input gear (reverse clutch hub).

De-energized, 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.

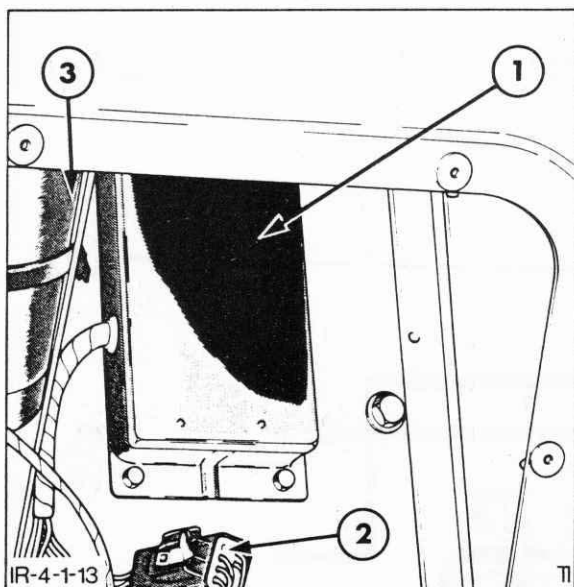


Figure 4-13
Modulator Unit

1. Modulator unit
2. Connector
3. Steering motor

MODULATOR UNIT

The function of the modulator unit, Figure 4-13, 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 solenoid 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.

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.

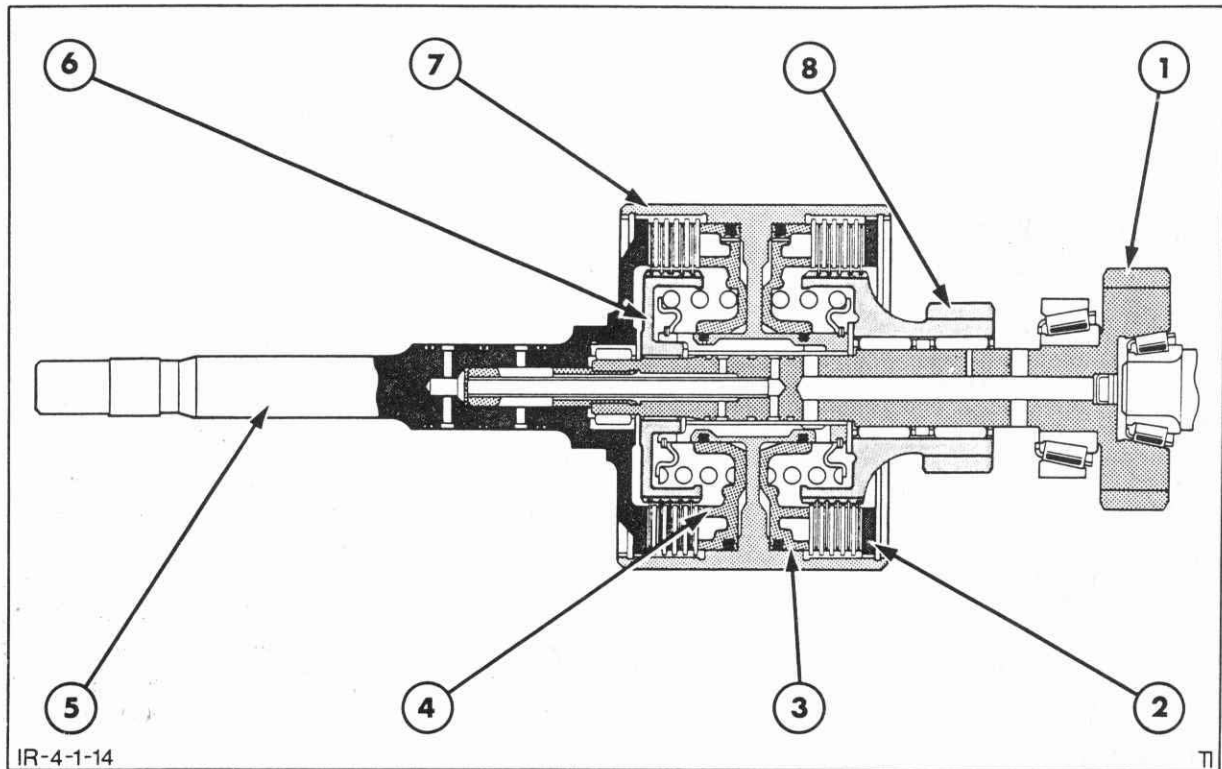


Figure 4-14
Hydraulic Clutch Assemblies

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

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.

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.

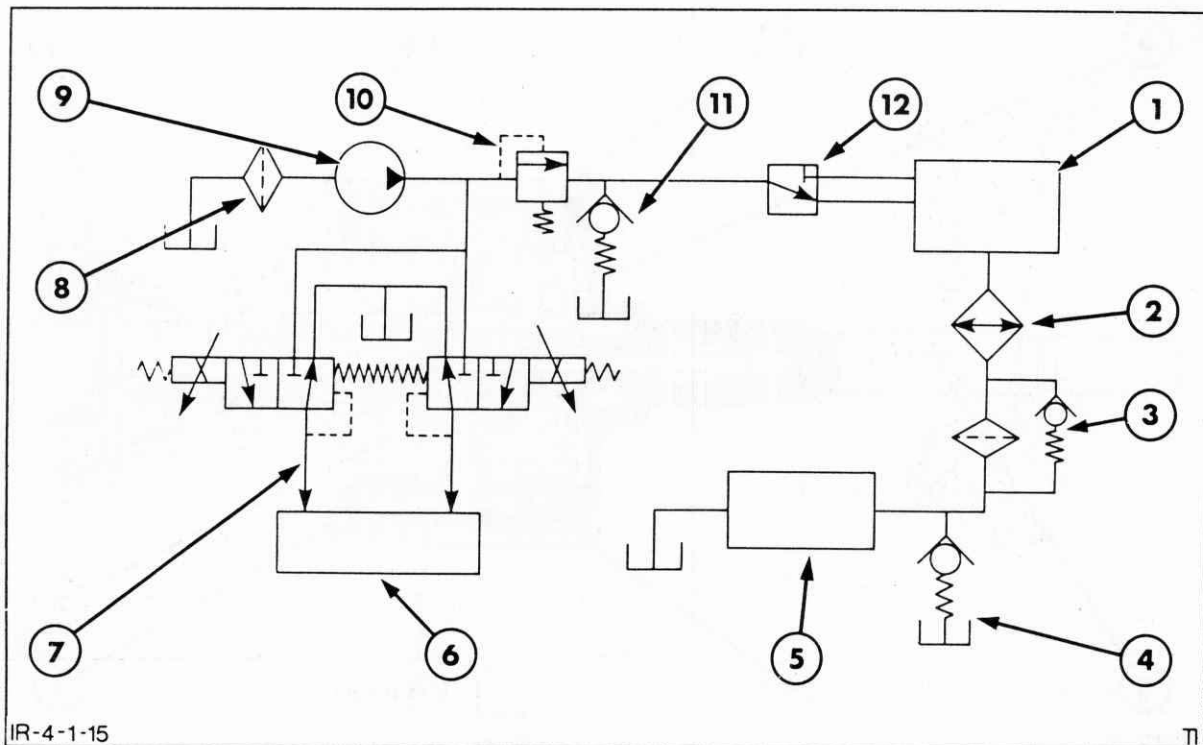


Figure 4-15

Transmission Oil Flow Circuit Diagram

- | | |
|-----------------------------|---------------------------------|
| 1. Torque converter | 7. Solenoid control valve |
| 2. Oil cooler | 8. Inlet filter |
| 3. Line filter | 9. Oil pump |
| 4. Cooler line bypass valve | 10. Regulating valve |
| 5. Transmission lubrication | 11. Bypass valve |
| 6. Hydraulic clutch | 12. Plate on distributor casing |

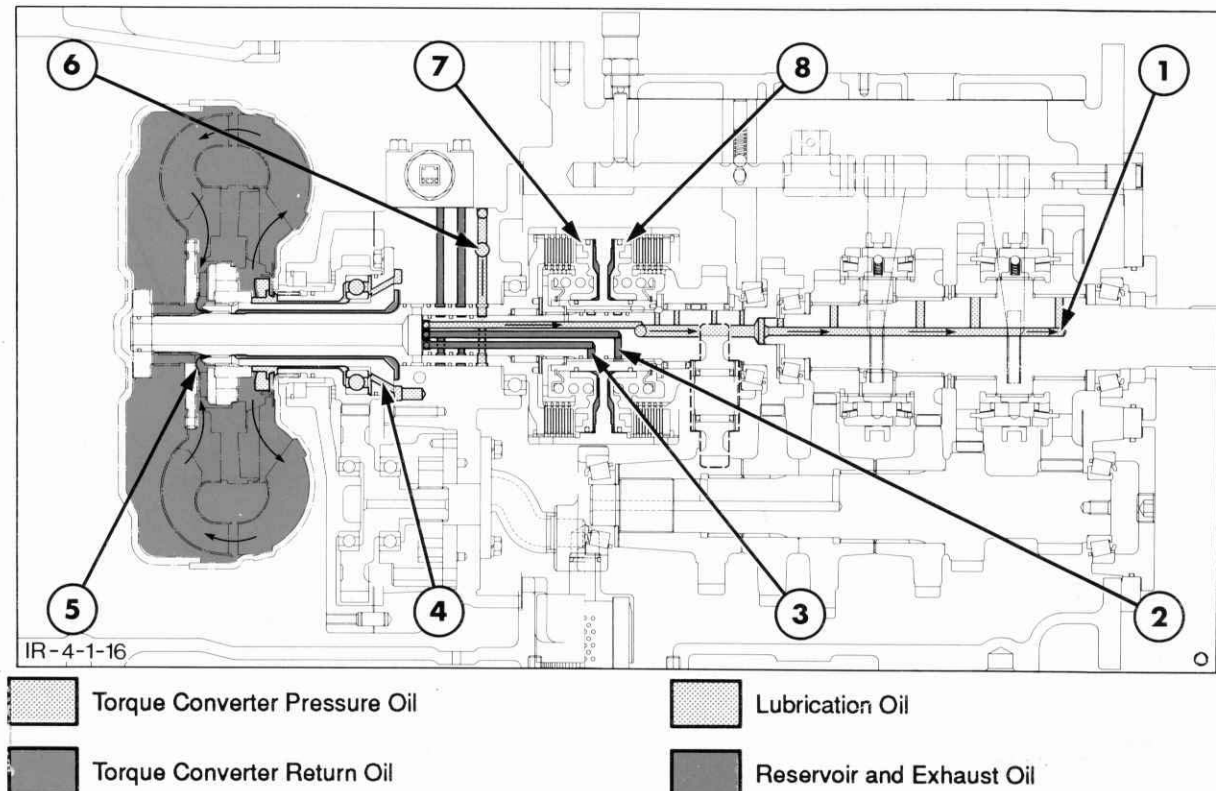
HYDRAULIC CLUTCH ASSEMBLIES

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 4-14, 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.

**Figure 4-16**

Transmission Lubrication Oil Flow

- | | |
|-----------------------------|---------------------------------|
| 1. Lubrication gallery | 5. Return from torque converter |
| 2. Reverse clutch gallery | 6. Return from oil cooler |
| 3. Forward clutch gallery | 7. Forward clutch |
| 4. Feed to torque converter | 8. Reverse clutch |

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 4-14. 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.

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 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 4-16.

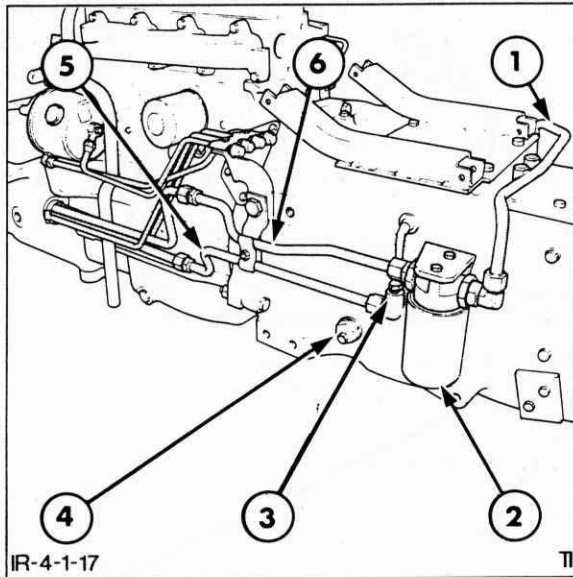


Figure 4-17

Transmission Cooling System

1. Filter return pipe
2. Filter
3. Temperature switch
4. Pressure test point
5. Cooler inlet line
6. Cooler outlet line

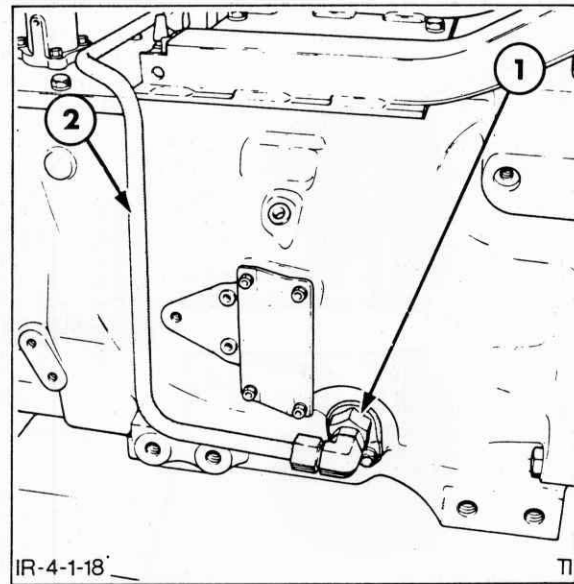


Figure 4-18

Transmission Cooling System

1. Adaptor
2. Filter return pipe

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 4-17. The cooler is located in front of the engine coolant radiator with the backhoe/loader hydraulic oil cooler, Figure 4-19.

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 4-18. 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 4-16.

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.

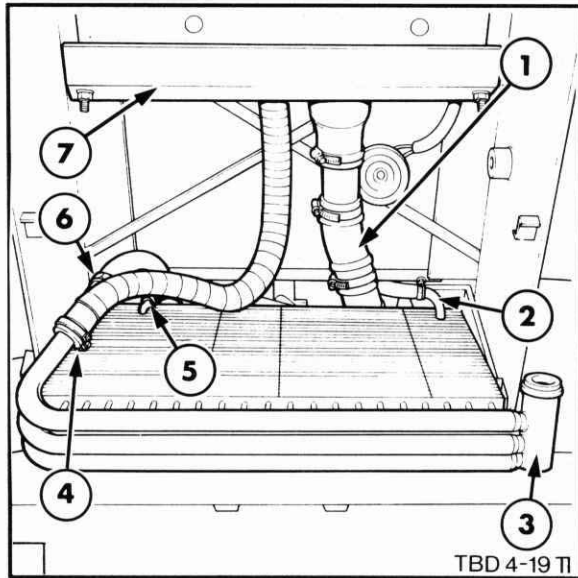


Figure 4-19
Oil Cooler Assembly

1. Hydraulic reservoir to pump feed
2. Transmission oil cooler tube "IN"
3. Hydraulic oil warm up valve (non serviceable)
4. Hydraulic oil tube to reservoir
5. Transmission oil cooler tube "OUT"
6. Hydraulic oil tube to cooler
7. Reservoir

OIL COOLER

The transmission cooling system, Figures 4-17 to 4-19, 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 set to open at 7 - 9 lbf/in² (0.5 - 0.6 bar) should the filter become clogged.

Oil from the torque converter enters the cooler inlet tube, Figure 4-17, 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 4-18.

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. Figure 4-20 and 4-21 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.

SECTION 4 – TRANSMISSION

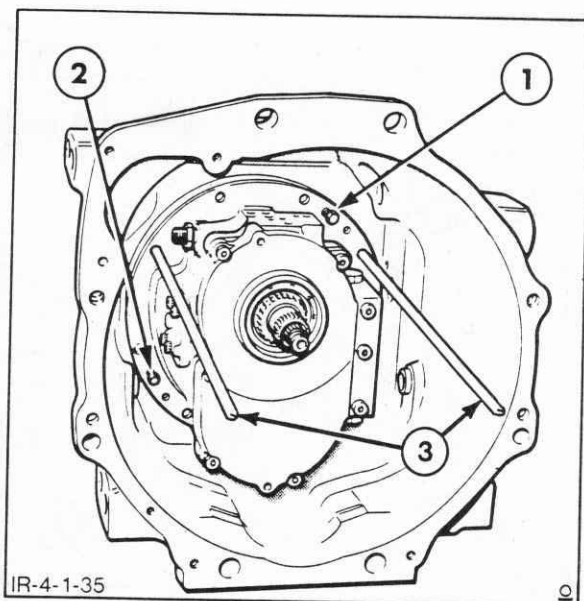


Figure 4-35

Distributor Housing Removal

1. Upper jacking bolt
2. Lower jacking bolt
3. Transmission aligning rods

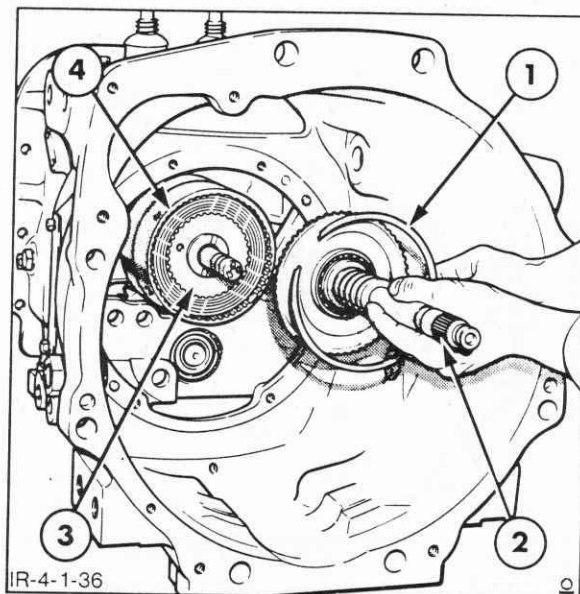


Figure 4-36

Front Input Shaft Removal

1. Snap ring
2. Front input shaft
3. Forward clutch hub
4. Forward clutch plates

5. Remove the distributor housing retaining bolts and install two aligning rods (OTC-FNH00224) to protect the shaft seals. Obtain two M8 (1.5 thread) jacking bolts, approximately 1.25" (30 mm) long. Screw the bolts into the housing as shown in Figure 4-35, then continue to tighten until the distributor housing is freed from the transmission case. Use the aligning rods to help support the weight. Lift the housing from the transmission and remove the jacking bolts.

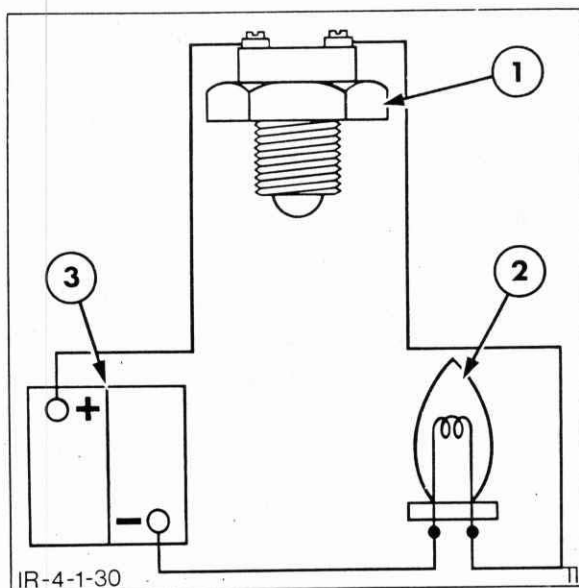
NOTE: The distributor housing is heavy, care should be exercised when removing the housing from the transmission case.

Refer to "component overhaul" for disassembly of the distributor housing and hydraulic pump.

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 4-36.
2. Pull the forward clutch hub, along with the thrust washer, from the rear input shaft, Figure 4-36, 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" (2.30 mm), 0.096" (2.44 mm) and 0.10" (2.60 mm).

**Figure 4-29**

Safety Start Switch Test

1. Switch
2. Bulb
3. Battery

4. Reconnect the dump switch wire and install the transmission access plate to the cab floor.
5. Install the steering console panel, gearshift lever boot and floor mat.

SAFETY START SWITCHES

REMOVAL

1. Remove the fuel tank as described in Section 2, Fuel Systems.
2. Remove the safety start switches from the transmission top cover, Figure 4-28, 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 4-29.
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.
2. Install the fuel tank.

SOLENOID CONTROL VALVE

REMOVAL

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

SECTION 4 – TRANSMISSION

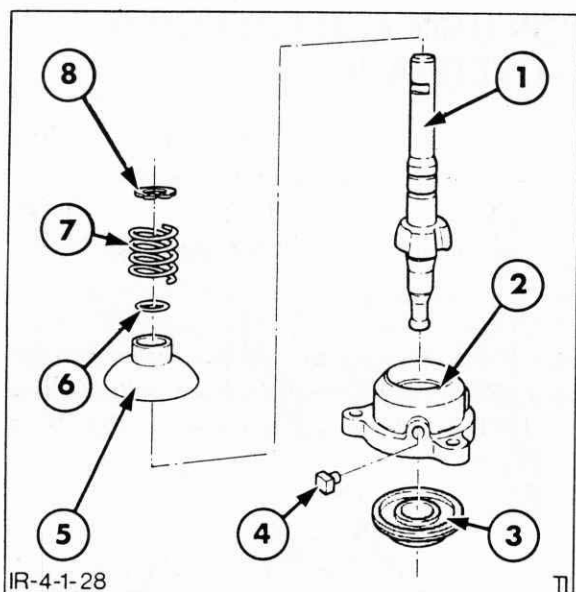


Figure 4-27

Gearshift Lever Components

1. Lever spigot
2. Support
3. Rubber shield
4. Pin
5. Cup
6. 'O' ring
7. Spring
8. Snap Spring

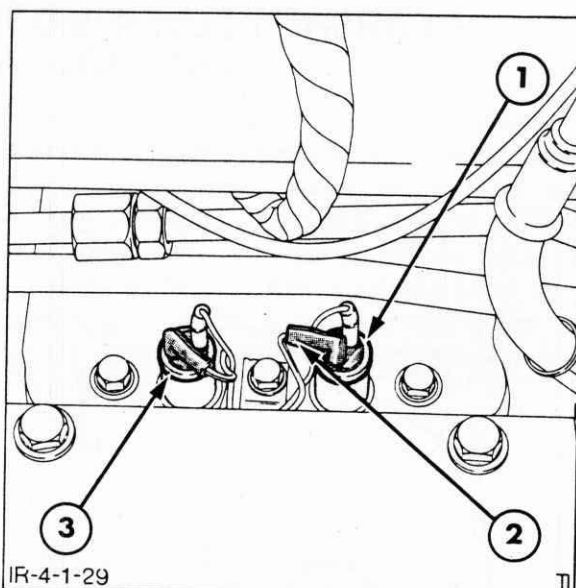


Figure 4-28

Safety Start Switches Removal

1. 3rd/4th Shift rail safety switch
2. Wiring harness
3. 1st/2nd Shift rail safety switch

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 4-27.

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.
2. Install the gearshift lever through the cab floor opening and over the lever spigot.
3. Retain the lever to the spigot with the pin and nut.

OVERHAULING THE TRANSMISSION

GENERAL

Transmission Hydraulic Pump and Oil Distributor

The arrangement of the procedures in this section permits servicing the transmission with minimum disassembly.

Front Input Shaft and Clutch Housing

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

Condition 3

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

Assemblies serviced with complete overhaul:

The fourth grouping covers detailed service procedures for the inspection and repair of sub-assemblies.

Gearshift Mechanism

Condition 1

Assemblies serviced with transmission installed:

Output Shaft Bearing Retainer and Oil Seal

Gearshift Lever

Modulator Unit

Output Shaft and Countershaft Gear Assemblies

Solenoid Control Valve

Condition 2

Countershaft Pre-Load

Assemblies serviced with transmission front end overhaul:

Torque converter

Output Shaft Pre-Load

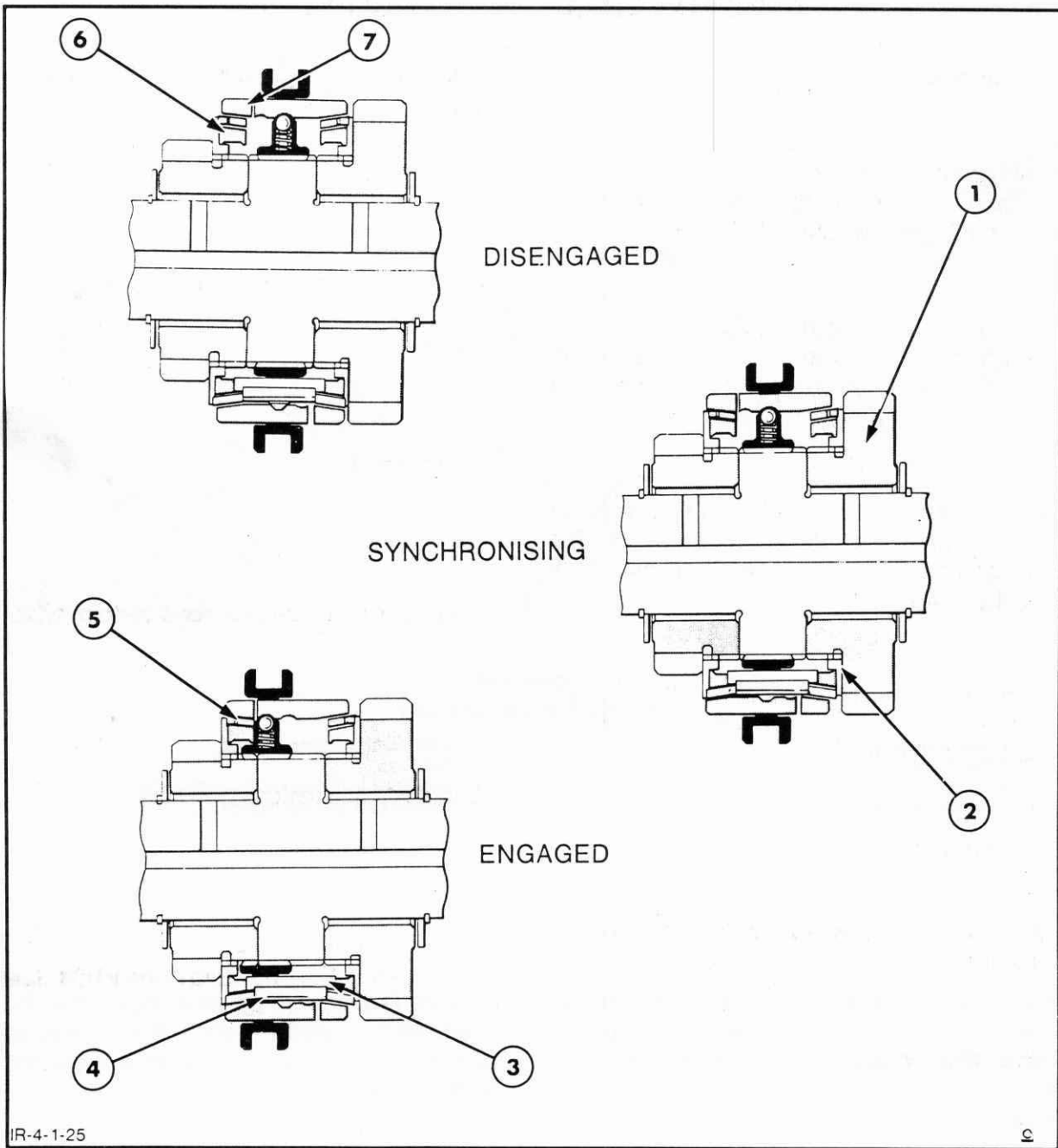


Figure 4-24
Synchronizer Operation

- | | |
|-----------------------------------|----------------------|
| 1. 3rd Gear | 5. Synchronizer ring |
| 2. Synchronizer ring locator | 6. Inner cone |
| 3. Inner cone pins (long) | 7. Outer cone |
| 4. Synchronizer ring pins (short) | |

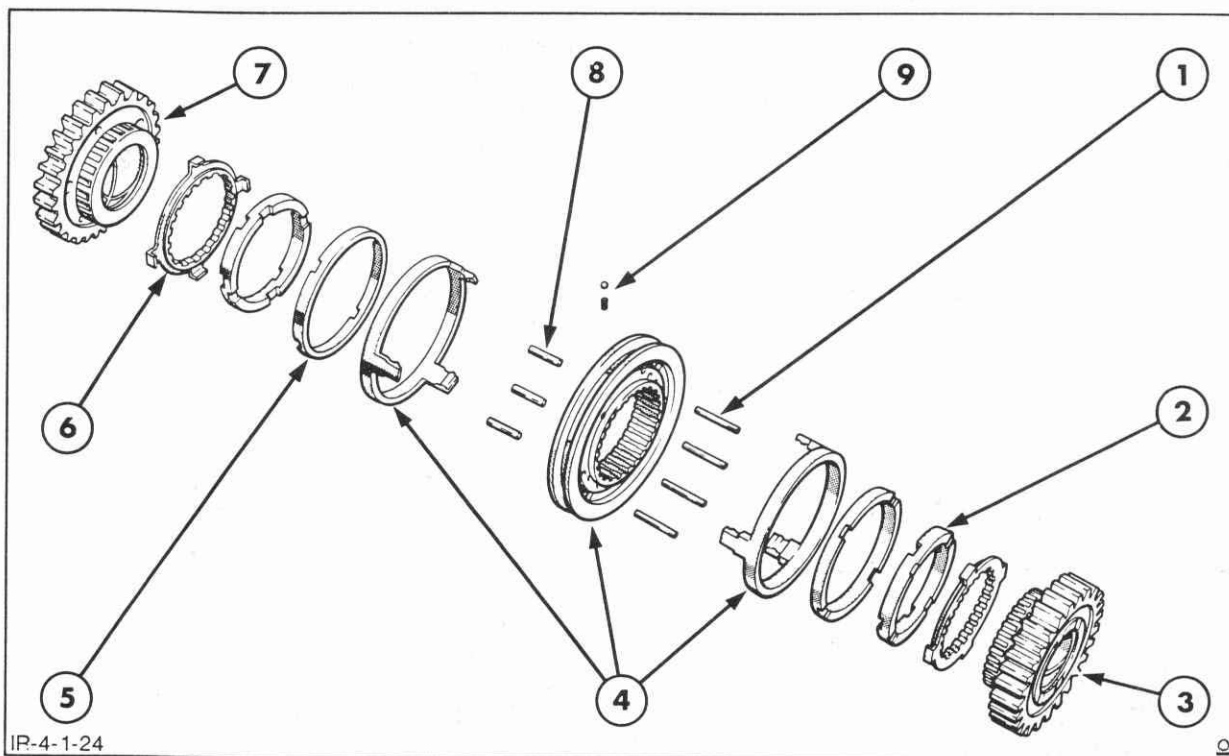


Figure 4-23
Synchronizer Exploded View

1. Inner cone drive pins
2. Inner cone
3. 4th Gear
4. Coupler and outer cones
5. Synchronizer ring

6. Intermediate cone locator
7. 3rd Gear
8. Synchronizer ring locating pins (3)
9. Detent ball and spring (6)

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

synchronization with the sleeves, permits the chamfered teeth on the internal circumference of the sleeve to engage the teeth on the gear.

Further shift pressure causes the synchronizer ring and the inner and outer cones to rotate at the same speed. The synchronizer ring and gear now rotating in

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.

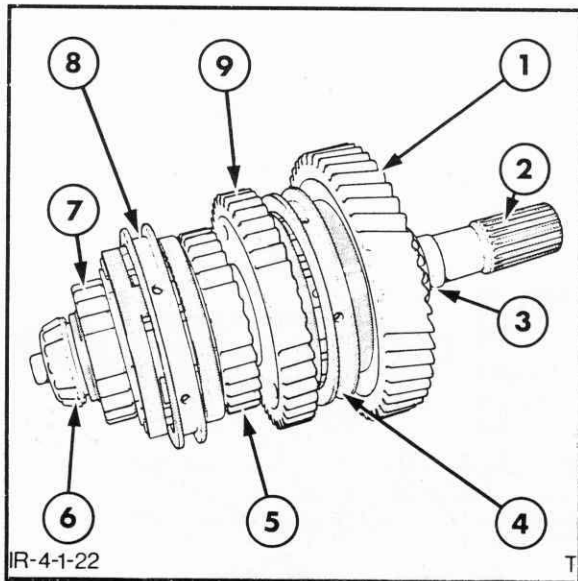


Figure 4-22
Synchronizer Assemblies

1. 1st Gear
2. Output shaft
3. Rear roller bearing
4. 1st/2nd synchronizer
5. 3rd Gear
6. Front roller bearing
7. 4th Gear
8. 3rd/4th synchronizer

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 slots in the sleeve.

Transmission gears are mounted on the output shaft either side of the synchronizer assembly. Splined to the gears are retainers which engage the synchronizer rings to the gears. The synchronizer 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 synchronizer, Figure 4-24, is as follows:

SYNCHRONIZER

The synchronized 4x4 power reversing transmission incorporates two cone type synchronizers on the output shaft. One between the 3rd and 4th gears, the other between the 2nd and 1st gears, Figure 4-22. The two synchronizers operate in an identical way, the synchronizer ring is engaged to the gear via a retainer, Figure 4-23.

The cone type synchronizer, Figure 4-23, consists of a sliding sleeve splined to the

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

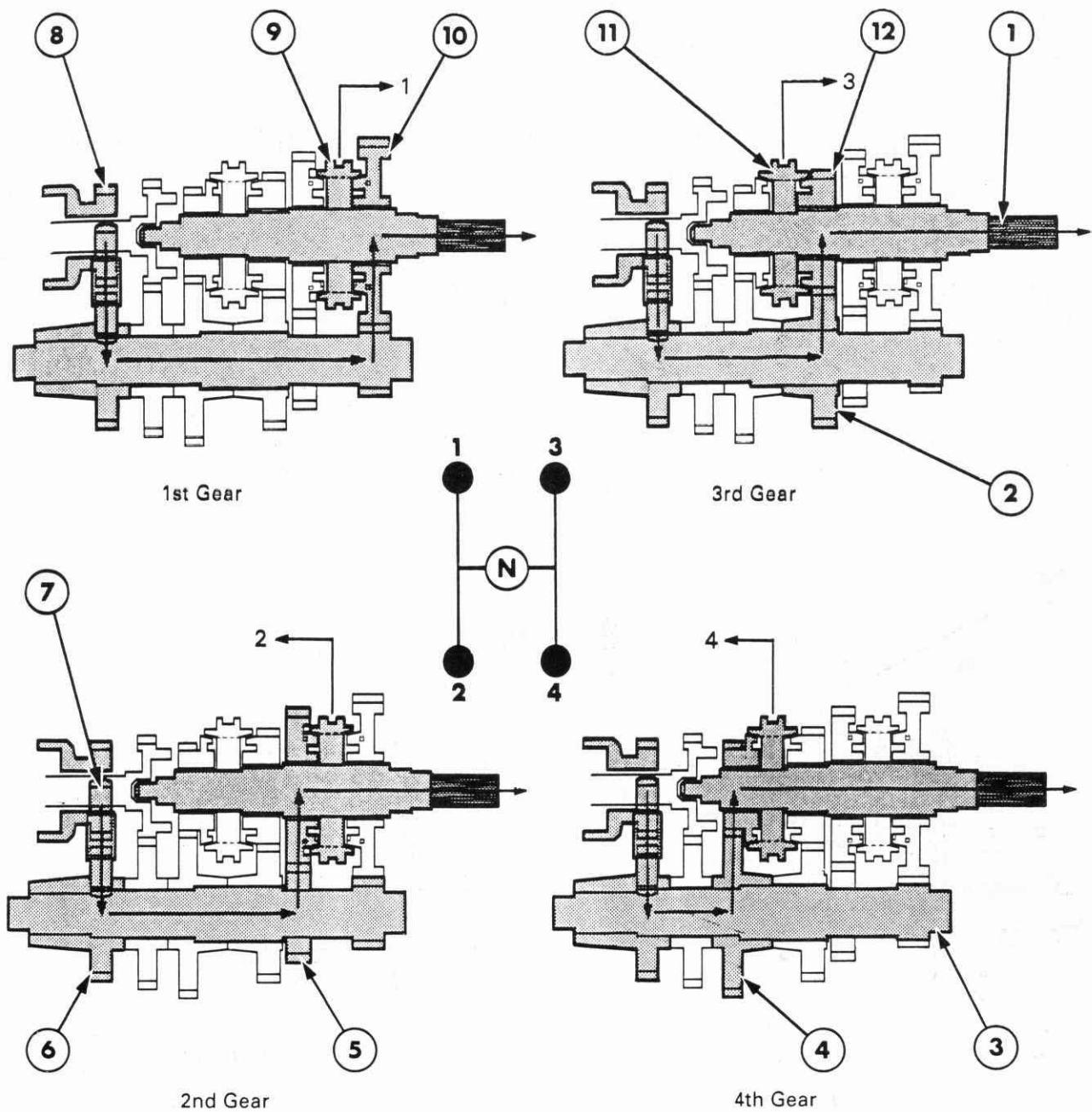


Figure 4-21

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. Forward gear

7. 2nd Gear - drive gear
8. Rear input shaft
9. 1st/2nd synchronizer
10. 1st Gear - driven gear
11. 3rd/4th synchronizer
12. 3rd Gear - driven gear

SECTION 4 – TRANSMISSION

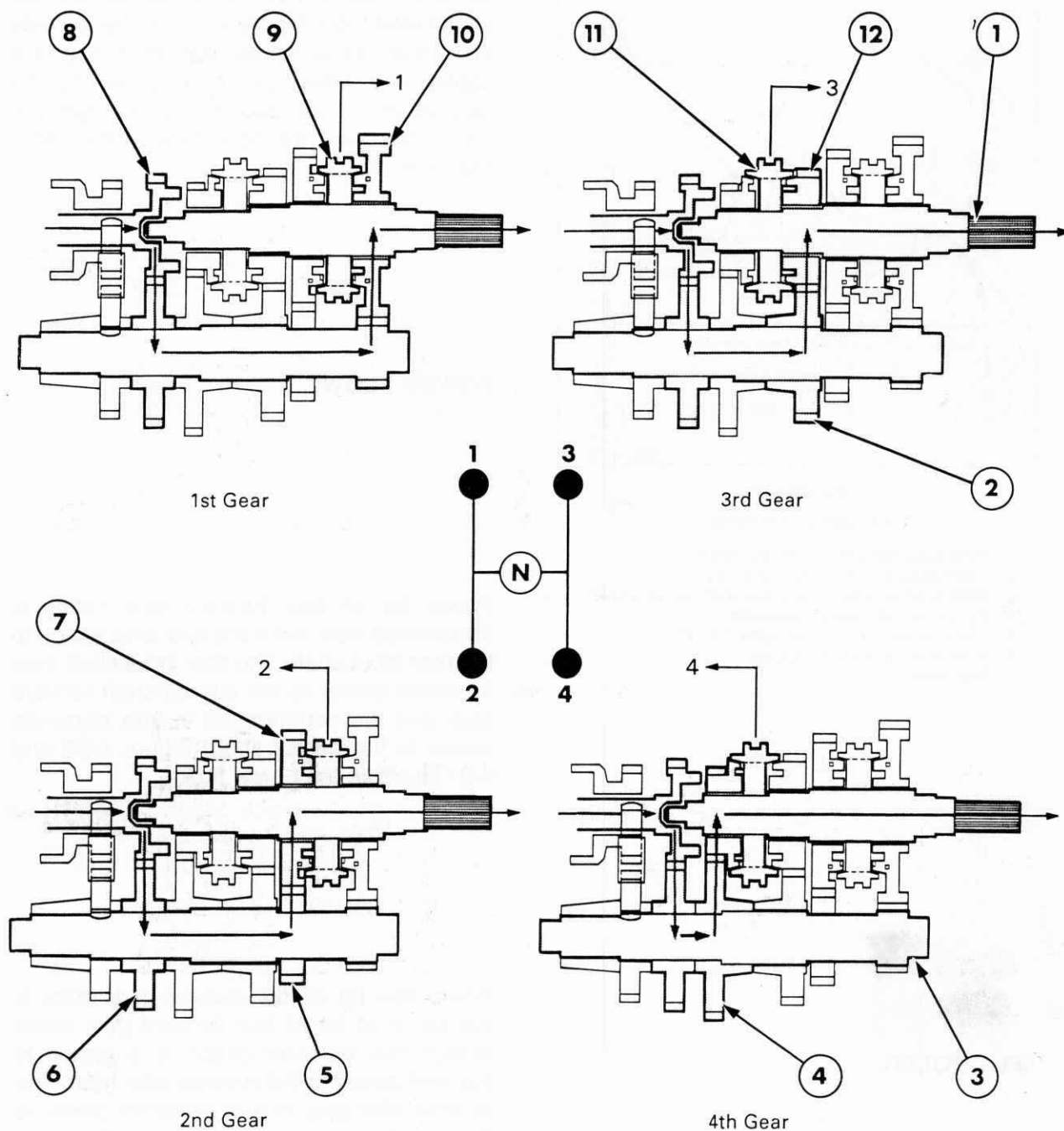


Figure 4-20
Power Flows in Forward

- | | |
|---|--|
| <ul style="list-style-type: none"> 1. Output shaft 2. 3rd Gear - drive gear 3. Countershaft 4. 4th Gear - drive gear 5. 2nd Gear - drive gear 6. Forward gear | <ul style="list-style-type: none"> 7. 2nd Gear - drive gear 8. Rear input shaft 9. 1st/2nd synchronizer 10. 1st Gear - driven gear 11. 3rd/4th synchronizer 12. 3rd Gear - driven gear |
|---|--|

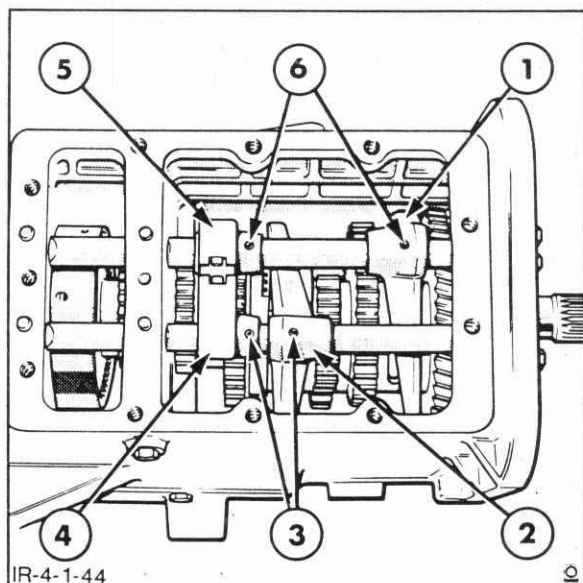


Figure 4-63

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

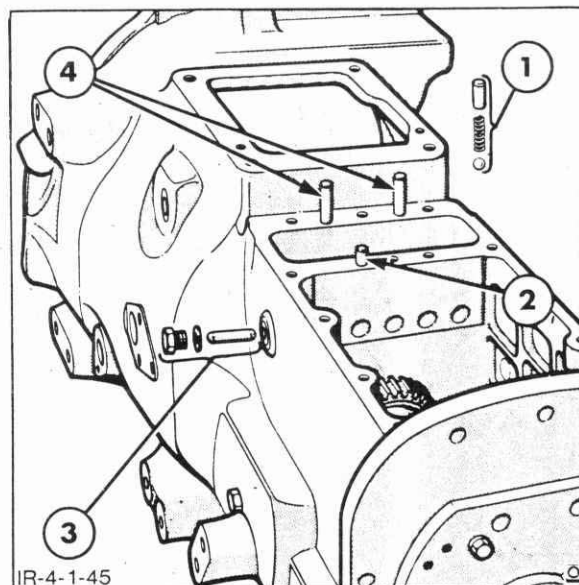


Figure 4-64

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

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 13-15 ft. lbs.
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.
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 4-64. Insert the gearshift rail balls, springs and detents into their respective bores, Figure 4-64.
7. Install the two blind covers into the gearshift rail bores at the rear end of the transmission case cover plate.

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 the 1st/2nd gearshift rail is not in neutral.

COMPONENT INSTALLATION

1. Install the front input shaft, clutch housing and the distributor housing as described previously in front end overhaul.

COMPONENT OVERHAUL

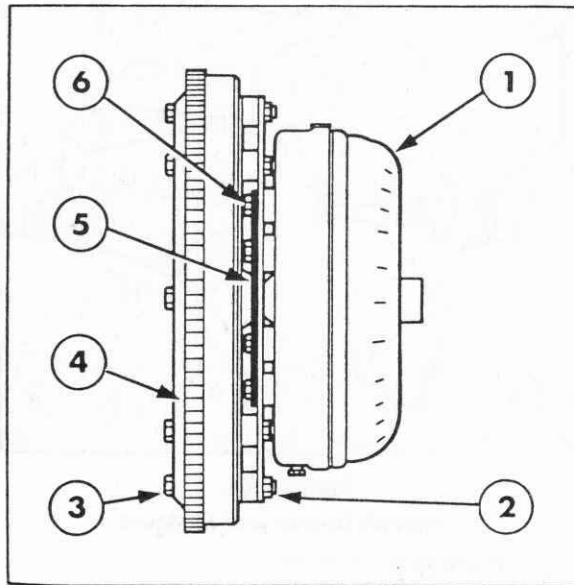


Figure 4-65

Torque Converter and Drive Plate

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
7. Splines

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 4-65, is a welded unit and cannot be disassembled. The only maintenance performed on the converter, other than the stall test, 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. Drain as much oil as possible from the hub of the converter by tilting the converter in all directions.
2. 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 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.

INSPECTION

Inspect the splines, Figure 4-65, 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.

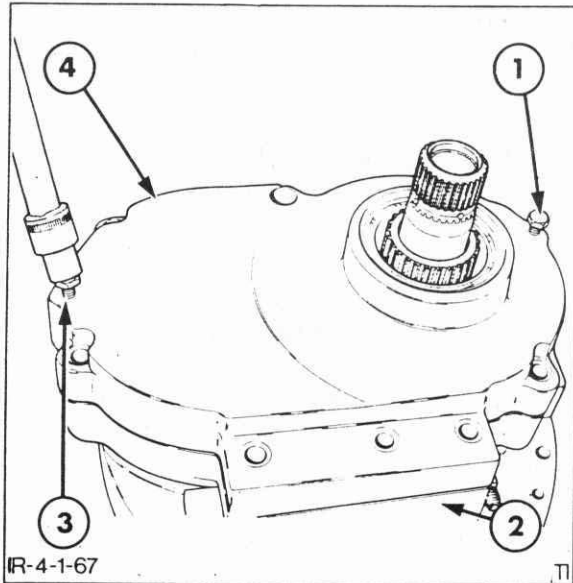


Figure 4-66
Front Cover Plate Removal

1. Jacking bolt
2. Oil distributor
3. Jacking bolt
4. Front cover plate

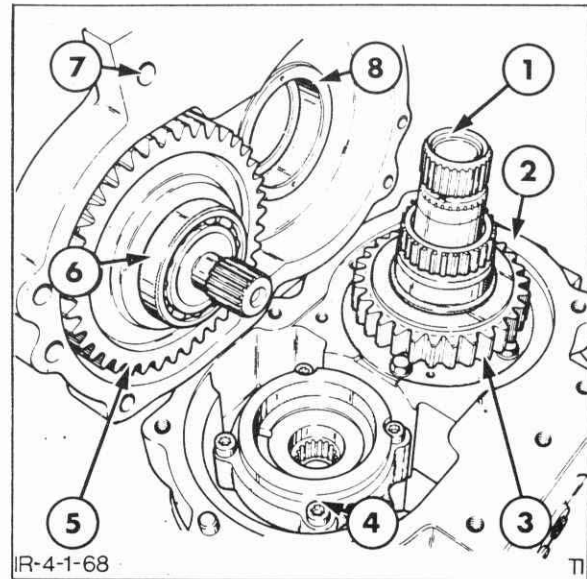


Figure 4-67
Pump Drive Gear Removal

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

then remove the support from the oil distributor housing, Figure 4-67.

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 4-66. 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 4-68.
3. Slide the gear from the stator support. Remove the stator support retaining bolts,

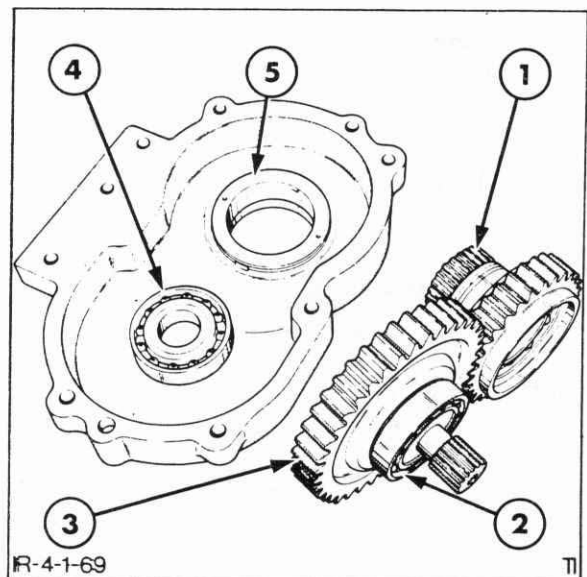


Figure 4-68
Pump Drive Gear Removal

1. Drive gear splines
2. Bearing
3. Driven gear
4. Bearing
5. Thrust washer

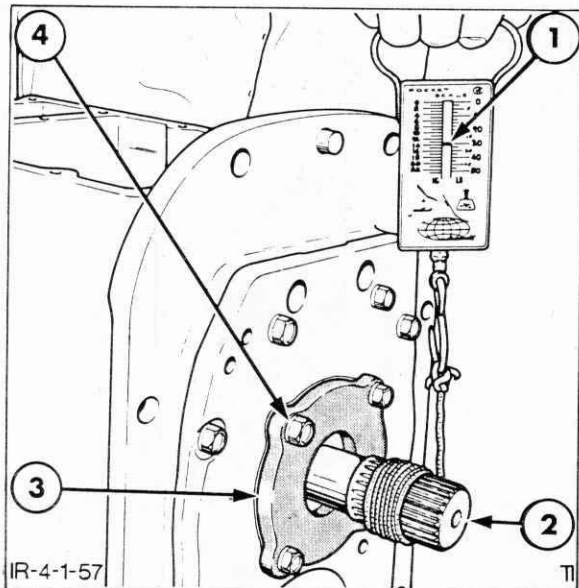


Figure 4-57

Output Shaft Pre-Load Check

1. Scale
2. Output shaft
3. Bearing cap
4. Retaining bolts

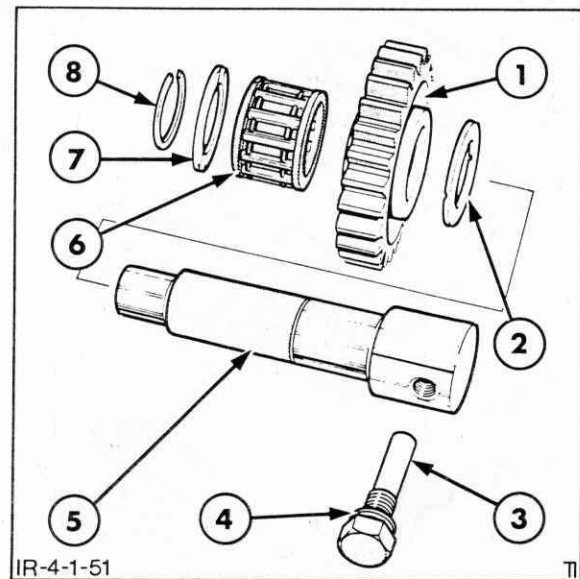


Figure 4-58

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

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 35-41 ft. lbs.

6. Ensure that the output shaft bearing cap retaining bolts are tightened to 35-41 ft. lbs.

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 4-57. 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 12-17 ft. lbs. (54-77 N·m) limits, remove the rear bearing cap and cover assembly. Add or delete shims are required and repeat the pre-load procedure.

NOTE: When installing the bearing cap, apply a thread sealant to the retaining bolts prior to installation.

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.

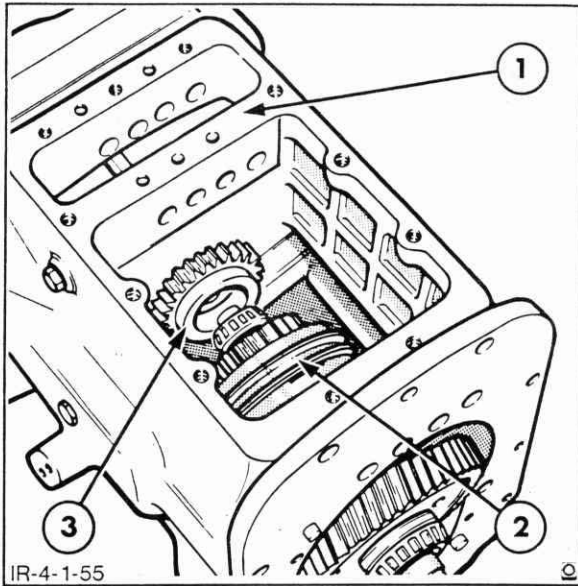


Figure 4-55

Rear Input Shaft Installation

1. Transmission case inner wall
2. Output shaft
3. Rear input shaft

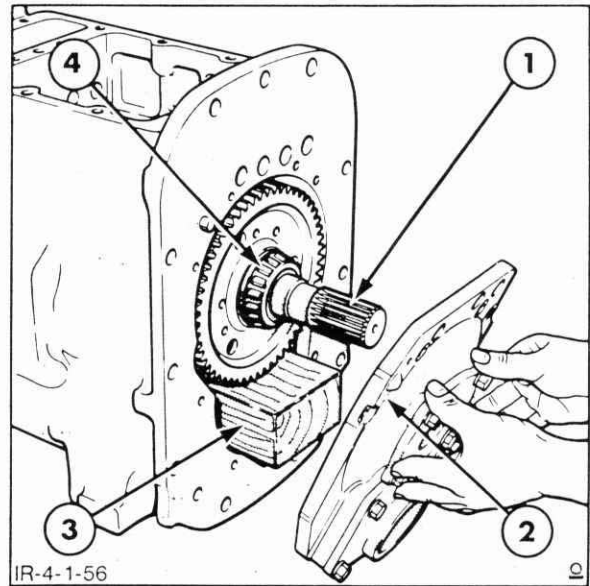


Figure 4-56

Output Shaft Installation

1. Output shaft
2. Rear cover
3. Wooden block
4. Output shaft rear bearing

OUTPUT SHAFT PRE-LOAD CHECK

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

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 "component overhaul".
3. Install the rear output shaft into the transmission case and rest it across the transmission case inner wall, Figure 4-55.
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 4-56.

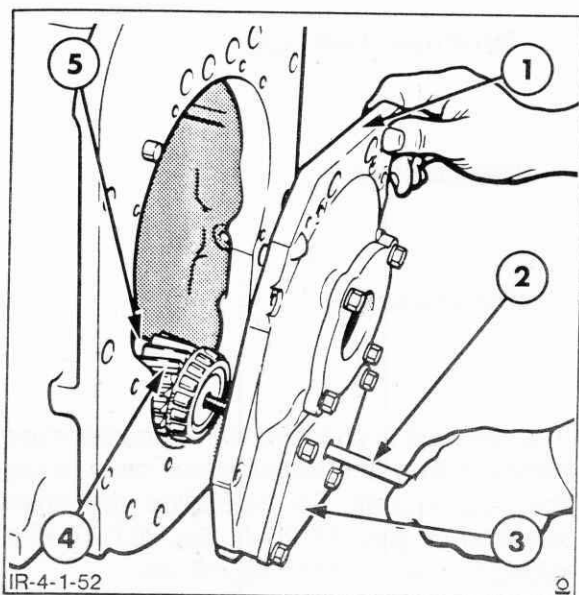


Figure 4-52

Countershaft Installation

1. Rear cover
2. Rod
3. Bearing cap
4. Countershaft assembly
5. Point to wrap cord

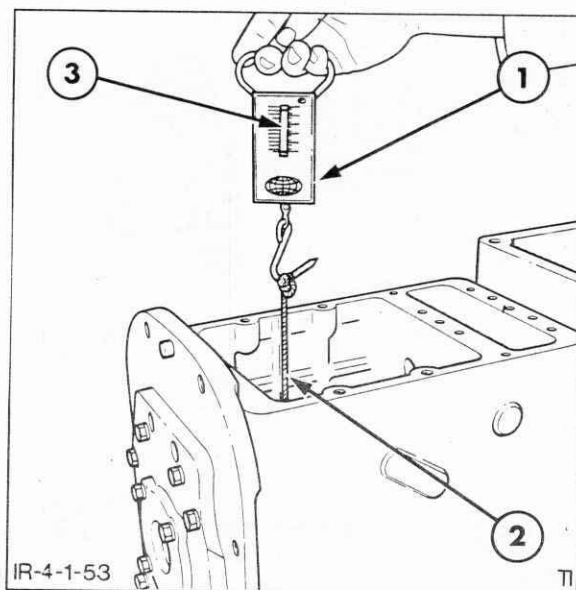


Figure 4-53

Countershaft Pre-Load Check

1. Pull scale
2. Cord

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 4-53, wrap the cord around the countershaft just ahead of the helical gear, Figure 4-52. Ensure that the cord does not overlap.
10. If the pull required to rotate the countershaft is outside the specified limits, remove the rear cover and bearing cap and add or delete shims as required, Figure 4-54, and repeat the procedure.

NOTE: When installing the bearing cap, apply a thread sealant to the retaining bolts prior to installation.

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

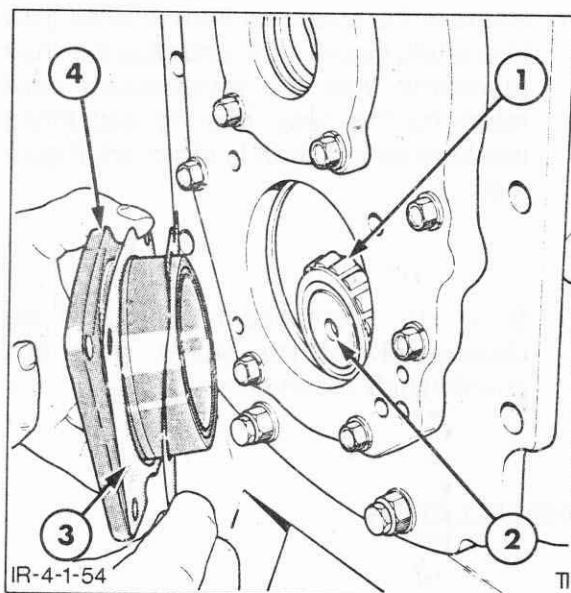


Figure 4-54

Countershaft Bearing Cap and Shims

1. Taper rolling bearing
2. Countershaft
3. Shims
4. Bearing cap

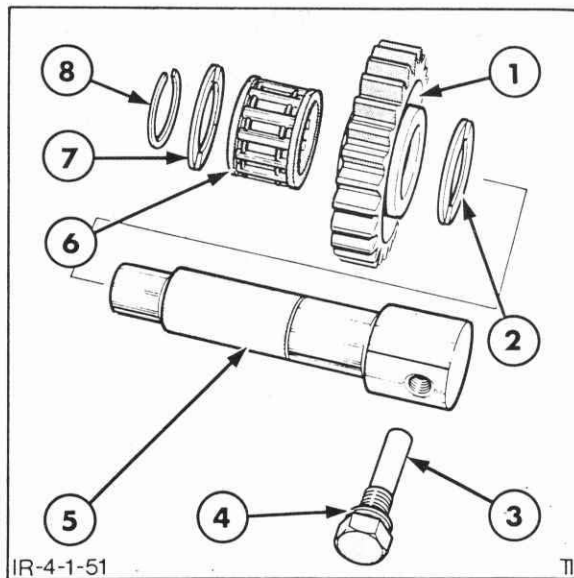


Figure 4-51

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
5. Remove the snap ring from reverse gear idler shaft, Figure 4-50, and slide the shaft rearwards from the transmission case retrieving the gear, bearing and thrust washers as the shaft is removed, Figure 4-51.
 6. Refer to "component overhaul" for disassembly of the output shaft and countershaft assemblies.

INSTALLATION

COUNTERSHAFT PRE-LOAD CHECK

1. If any of the following parts have been replaced, 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 15-20 ft. lbs. (67-87 N·m) rolling torque, proceed as follows:

2. Assemble the countershaft and gear assembly as described in "component overhaul".
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 35-41 ft. lbs.
5. Remove the bearing cap plug and insert a suitable rod through the hole in the cap into the countershaft, Figure 4-52.
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 35-41 ft. lbs.

SECTION 4 – TRANSMISSION

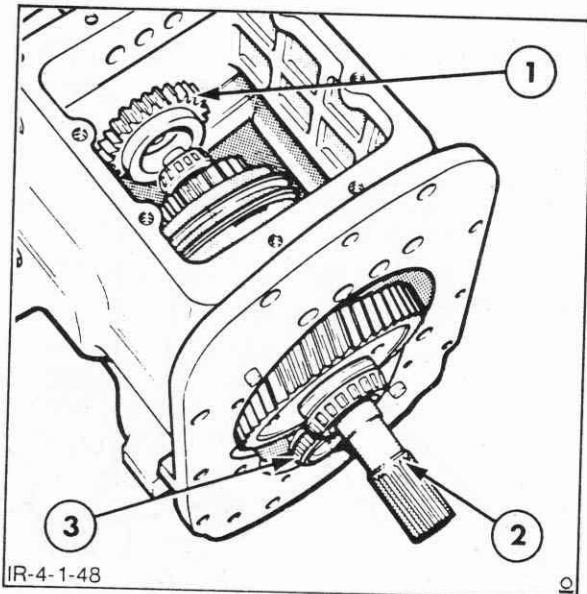


Figure 4-48
Output Shaft Removal

1. Rear input shaft
2. Output shaft
3. Countershaft

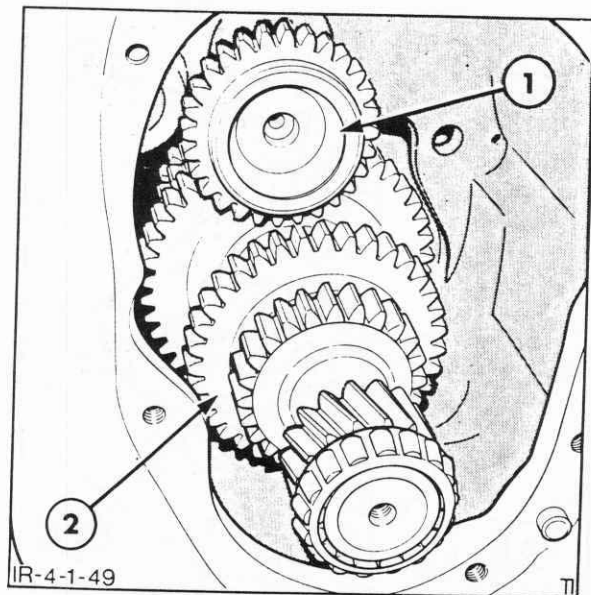


Figure 4-49
Countershaft Removal

1. Rear input shaft
2. Countershaft assembly

OUTPUT SHAFT AND COUNTERSHAFT 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 4-48.
2. Remove the rear input shaft assembly from the transmission case through the gearshift cover plate opening.
3. Lift the countershaft assembly, Figure 4-49, and remove from the rear end of the transmission case.
4. Remove the reverse gear idler shaft retaining bolt from the left-hand side of the transmission case.

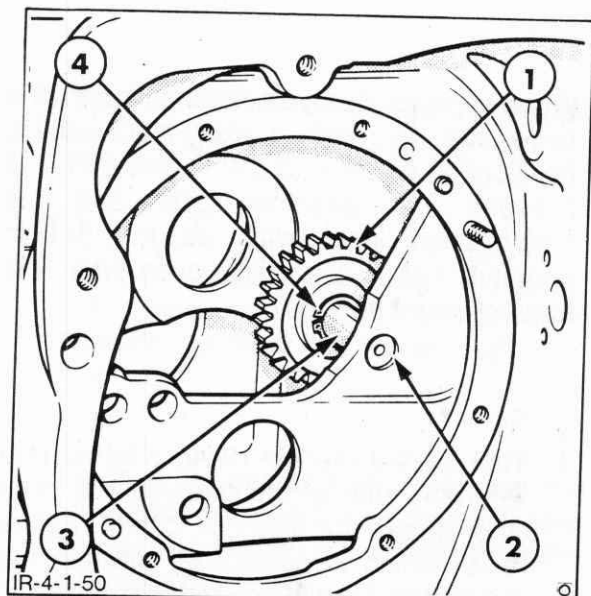
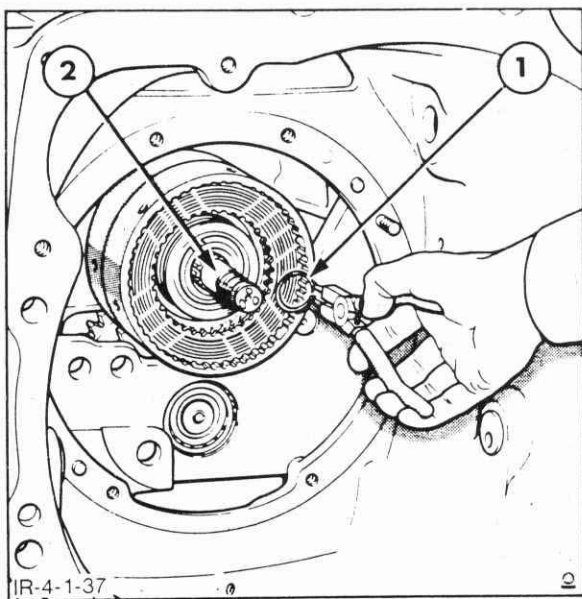
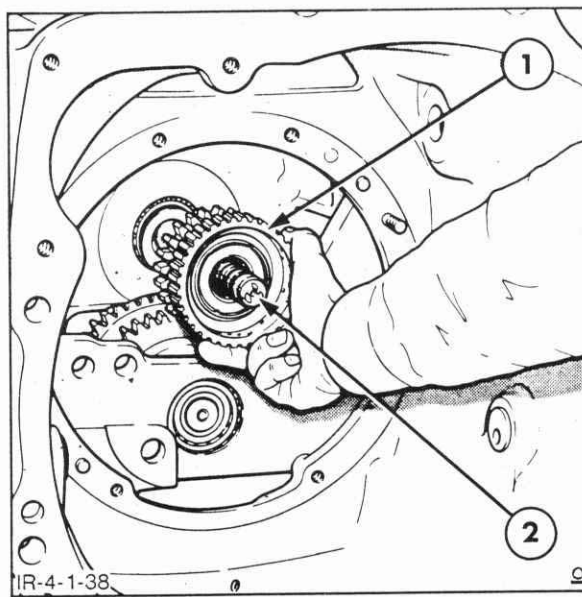


Figure 4-50
Reverse Gear Idler Removal

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

**Figure 4-37****Removal**

1. Clutch housing snap ring
2. Rear input shaft

**Figure 4-38****Reverse Idler Input Gear Removal**

1. Reverse idler input gear (rear clutch hub)
2. Rear input shaft

3. Remove the snap ring, Figure 4-37, then pull the clutch housing from the rear input shaft.

4. Remove the reverse idler input gear, thrust washer, needle bearings and shims from the rear input shaft, Figure 4-38, if not removed with the clutch housing.

5. Refer to "component overhaul" for disassembly of the rear clutch.

ASSEMBLY**FRONT INPUT SHAFT AND CLUTCH HOUSING**

1. Assemble the rear clutch as described in "component overhaul".
2. Install the partially assembled clutch housing, Figure 4-39, 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 4-37.

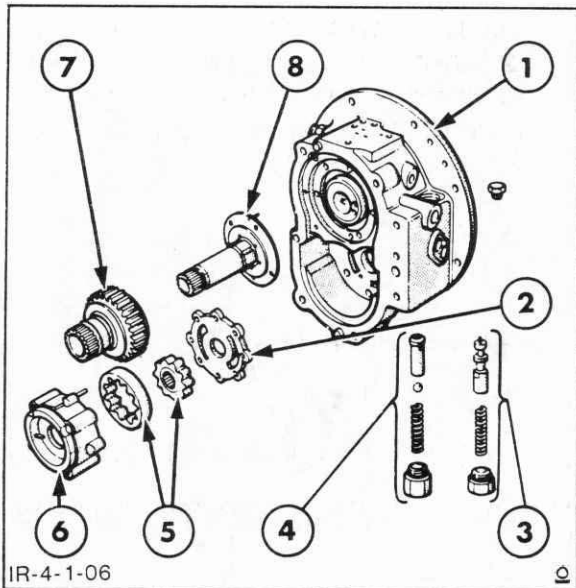


Figure 4-69

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 gears
8. Stator support

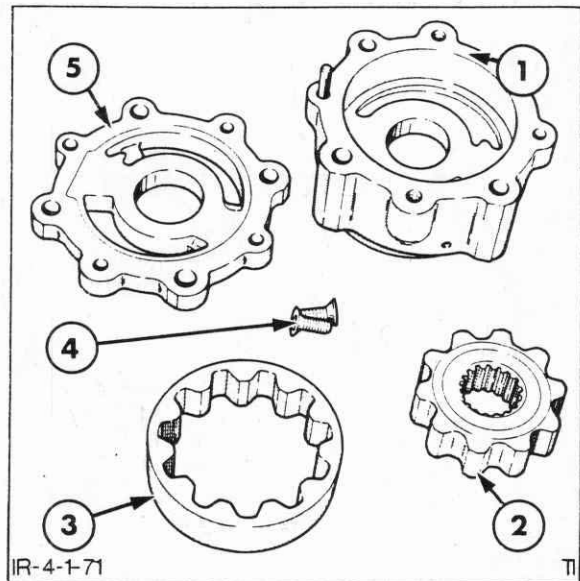


Figure 4-70

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 4-69.

5. Remove the by-pass valve plug and extract the shim, spring ball and valve seat, Figure 4-69.

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

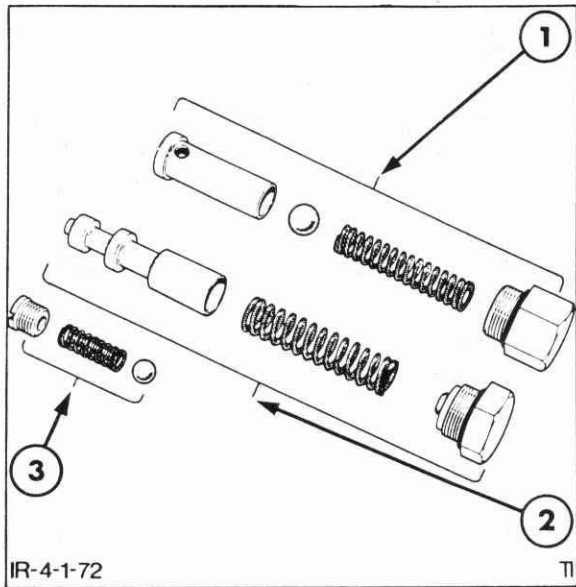
7. Remove the O ring seals from the valve plugs and discard. Install new O rings on assembly.

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 on 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 4-71**

Transmission Hydraulic Valves

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

4. Inspect the front cover torque converter 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 4-71. If

scratch marks cannot be removed by polishing, install new parts during assembly. Check the spring and if suspect, measure the spring. It should be 2.61" (66.3 mm) long.

BY-PASS VALVE SPRING

Outside diameter	0.543" (13.8 mm)
Free Length (Approx)	2.610" (66.3 mm)
Maximum Solid Height	1.205" (30.6 mm)
Height Under Load 8.6 kg.	1.811" (46.0 mm)

8. Inspect the regulating valve spool, Figure 4-71, 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. It should be 2.717" (69.0 mm) long.

REGULATING VALVE SPRING

Outside diameter	0.610" (15.5 mm)
Free Length (Approx)	2.717" (69.0 mm)
Maximum Solid Height	1.181" (30.0 mm)
Height Under Load 6.83 kg	2.205" (56.0 mm)

9. Inspect the oil distributor housing for cracks and check the valve bores for wear or scoring. Check that pressure pipe connections are tight and replace the suction pipe seal on assembly, Figure 4-72.



SECTION 4 – TRANSMISSION

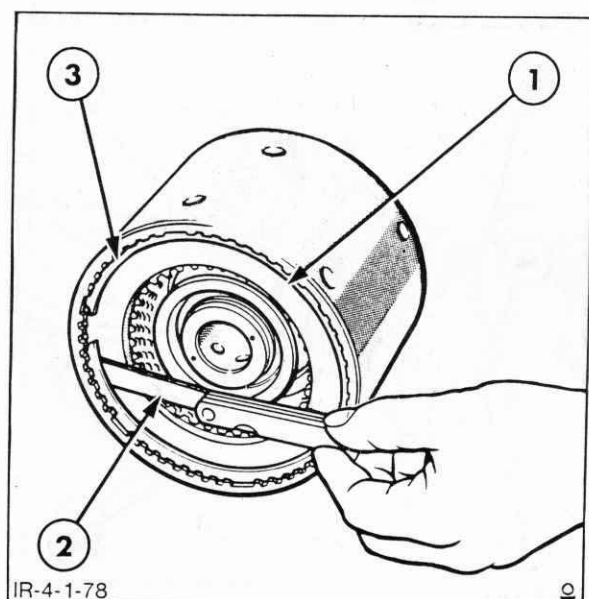


Figure 4-79

Clutch Pack Clearance

1. Pressure plate
2. Feeler gauge
3. Snap ring

ASSEMBLY

1. Install new O ring seals on the clutch pistons, Figure 4-74, 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 center web of the housing.
2. Position the spring and spring seat on the piston, then compress the spring with a press, using modified Tool #FT4101 or 1312, and a suitable washer, as shown in Figure 4-75, 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 4-77, 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 #630-S or FNH09210.

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

8. Install the clutch housing and front input shaft as covered previously in front end overhaul.

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 4-79, while holding the plate against the clutch disc.

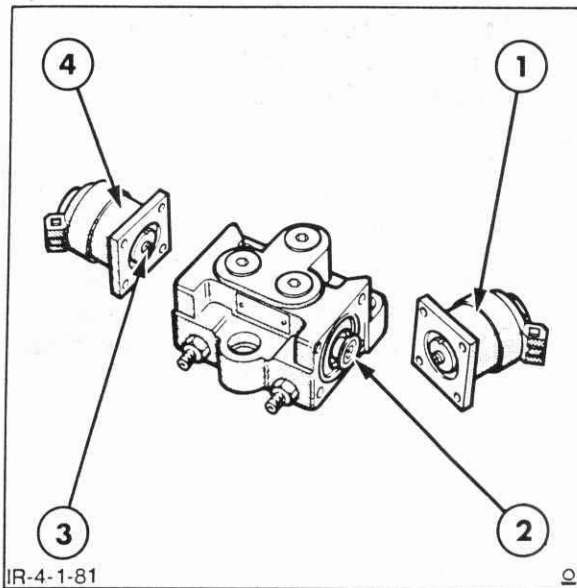


Figure 4-80

Solenoid Control Valve Assembly

1. Forward solenoid
2. Forward spool
3. Reverse solenoid plunger
4. Reverse solenoid

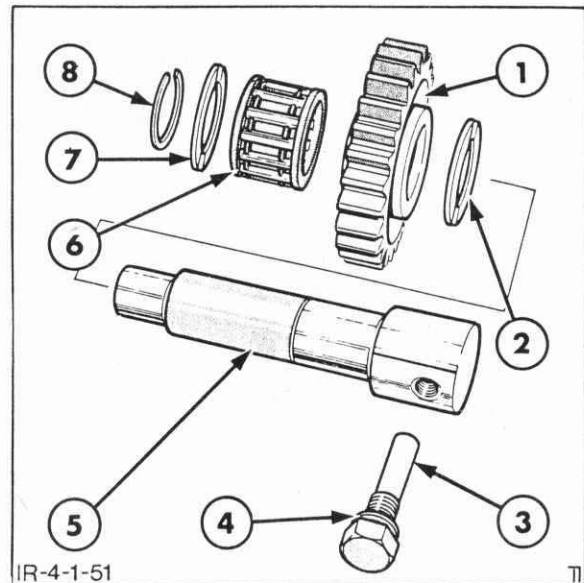


Figure 4-81

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

The clearance must be measured at three points equally spaced around the housing (120 degree 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 0.063" - 0.070" (1.6 mm - 1.8 mm), change a clutch disc or discs to obtain the correct clearance. Different thickness discs are available through parts.

They are:

- 0.090" (2.30 mm)
- 0.096" (2.44 mm)
- 0.100" (2.60 mm)

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 2 - 4 ft. lbs.

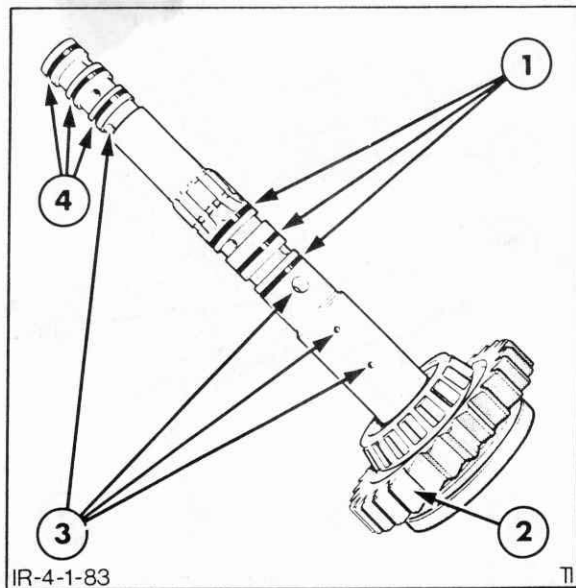


Figure 4-82

Rear Input Shaft Assembly

1. Rear sealing rings
2. Gear shaft assembly
3. Lubrication gallery oil holes
4. Front sealing rings

2. Inspect the thrust washer on 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

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.

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.

REVERSE IDLER GEAR ASSEMBLY

INSPECTION

1. Thoroughly clean the reverse idler gear components, Figure 4-81, with a suitable solvent and allow to dry.

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.

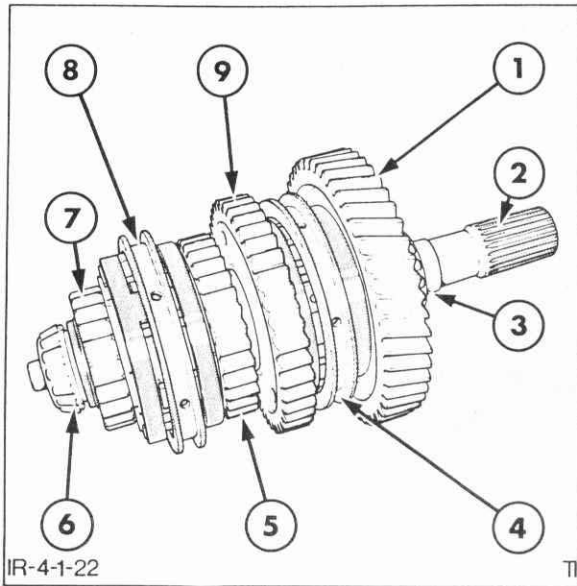


Figure 4-83
Output Shaft Assembly

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

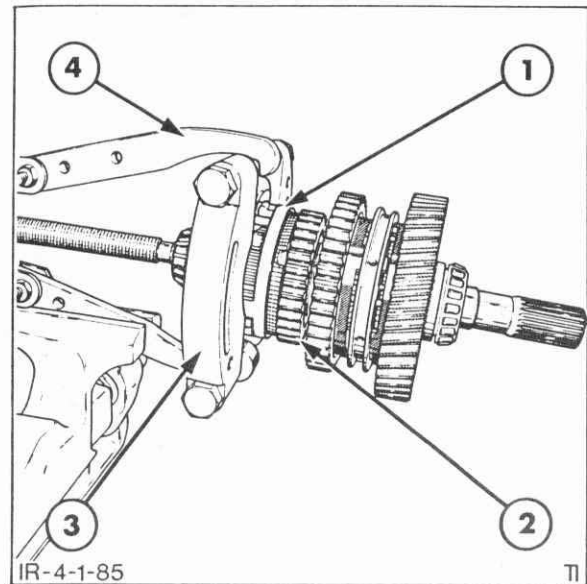


Figure 4-84
3rd/4th Gear Coupler Removal

1. Outer cone
2. 3rd Gear
3. Clamp tool no. 952 or FNH09526
4. Puller tool no. 1003 or FNH09516

3. Inspect the rear input shaft sealing rings for nicks, cracks or scratches. Any seals which are suspect should be replaced on assembly. Ensure all oil passages are clean.
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 synchronizer assembly to the 3rd gear as shown in Figure 4-84.

2. Attach a puller, Tool #1003 or FNH09516 with shaft protector Tool #625A or FNH09212 and the bearing clamp Tool #952 or FNH09526, to the outer cone of the 3rd/4th gear synchronizer and remove the front bearing, thrust washer, 4th gear and the synchronizer assembly as shown in Figure 4-84.

NOTE: Exercise care when pulling on the synchronizer assembly not to pull the outer cone from the synchronizer. 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.

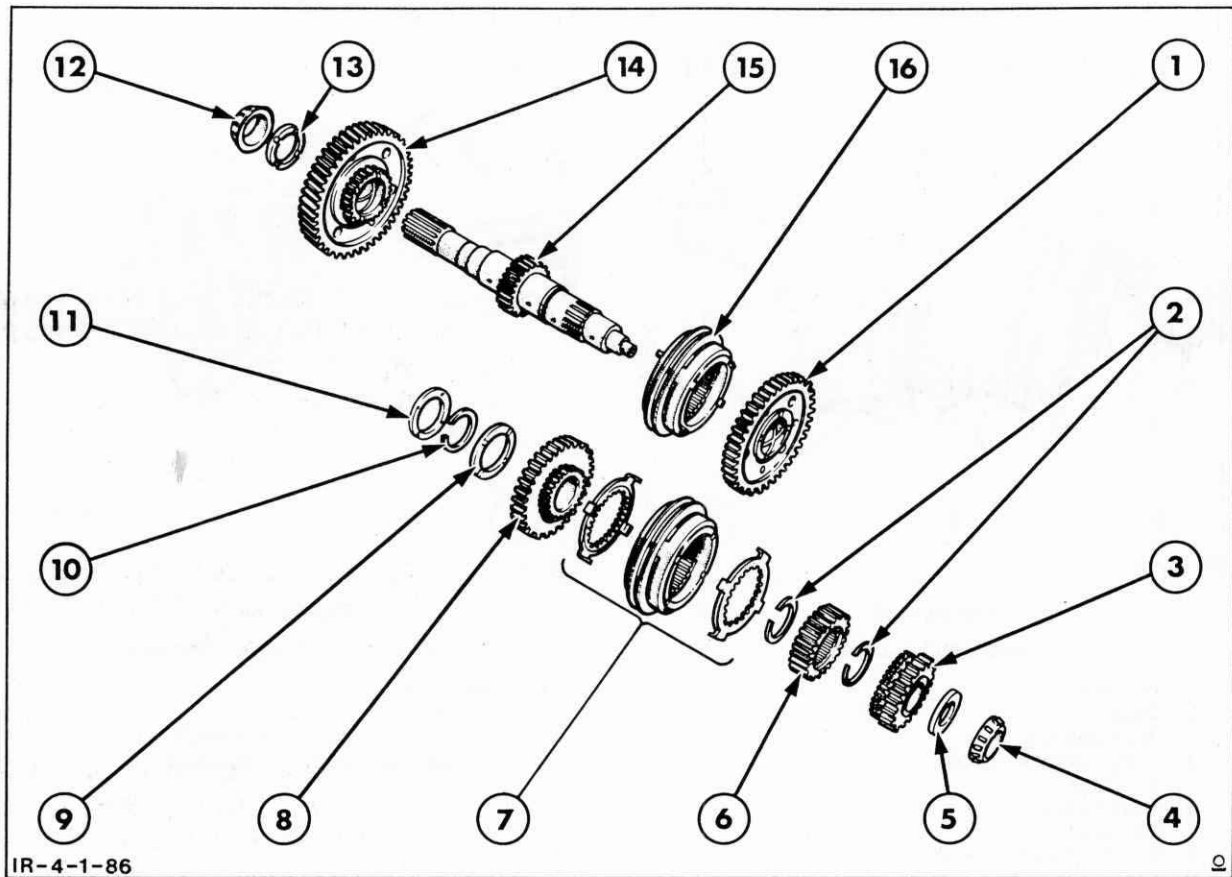


Figure 4-85

Output Shaft Components

- | | |
|-------------------------------|-------------------------------|
| 1. 2nd Gear | 9. Thrust washer |
| 2. Snap ring | 10. Snap ring |
| 3. 4th Gear | 11. Thrust washer |
| 4. Front taper roller bearing | 12. Rear taper roller bearing |
| 5. Thrust washer | 13. Thrust washer |
| 6. Splined hub | 14. 1st Gear |
| 7. 3rd-4th synchronizer | 15. Output shaft |
| 8. 3rd Gear | 16. 1st-2nd synchronizer |

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

the rear bearing, thrust washer and 1st gear 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 synchronizer assembly from the shaft.

OUTPUT SHAFT AND GEAR ASSEMBLY

INSPECTION

6. Install a puller, Tool #1003 or FNH09516 with shaft protector Tool #625A or FNH09212, to the 1st gear and remove

1. Thoroughly clean the output shaft components, Figure 4-85, with a suitable solvent, then blow dry with compressed air. Do not spin the bearings with compressed air.

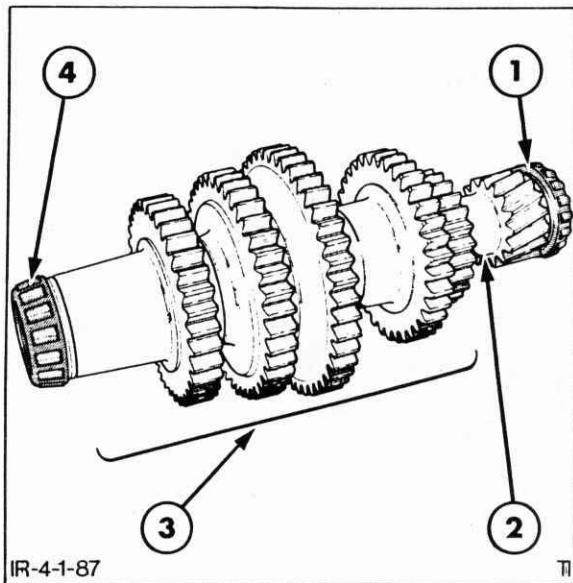


Figure 4-86

Countershaft Assembly

1. Rear bearing
2. Shaft and gear assembly
3. Removal gears
4. Front bearing

ASSEMBLY

Refer to Figure 4-85.

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 synchronizer assembly over the front end of the shaft and locate onto the splines.
 3. Install the 2nd gear, engage the gear with the synchronizer 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 synchronizer 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 as covered previously in complete overhaul.
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.

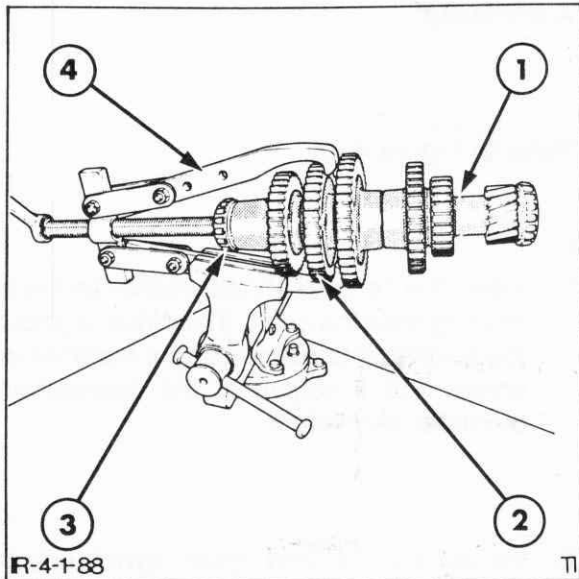


Figure 4-87

Countershaft Disassembly

1. Shaft
2. Forward drive gear
3. Front bearing
4. Puller tool no. 1003 or FNH09516

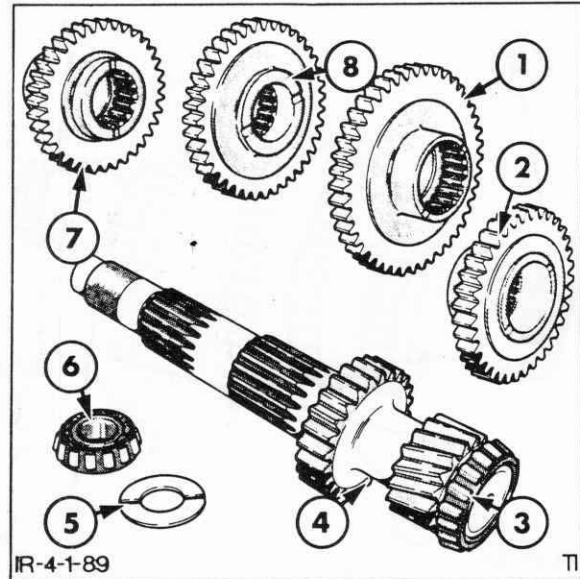


Figure 4-88

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

COUNTERSHAFT AND GEAR ASSEMBLY

DISASSEMBLY

1. Remove the countershaft front bearing, thrust washer and gears, Figure 4-86, using a puller, Tool #1003 or FNH09516 with shaft protector Tool #625A or FNH09212 as shown in Figure 4-87.
2. Normally, the countershaft rear bearing, Figure 4-88, 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 4-88, 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.

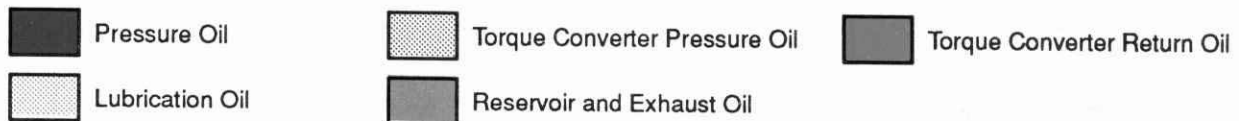
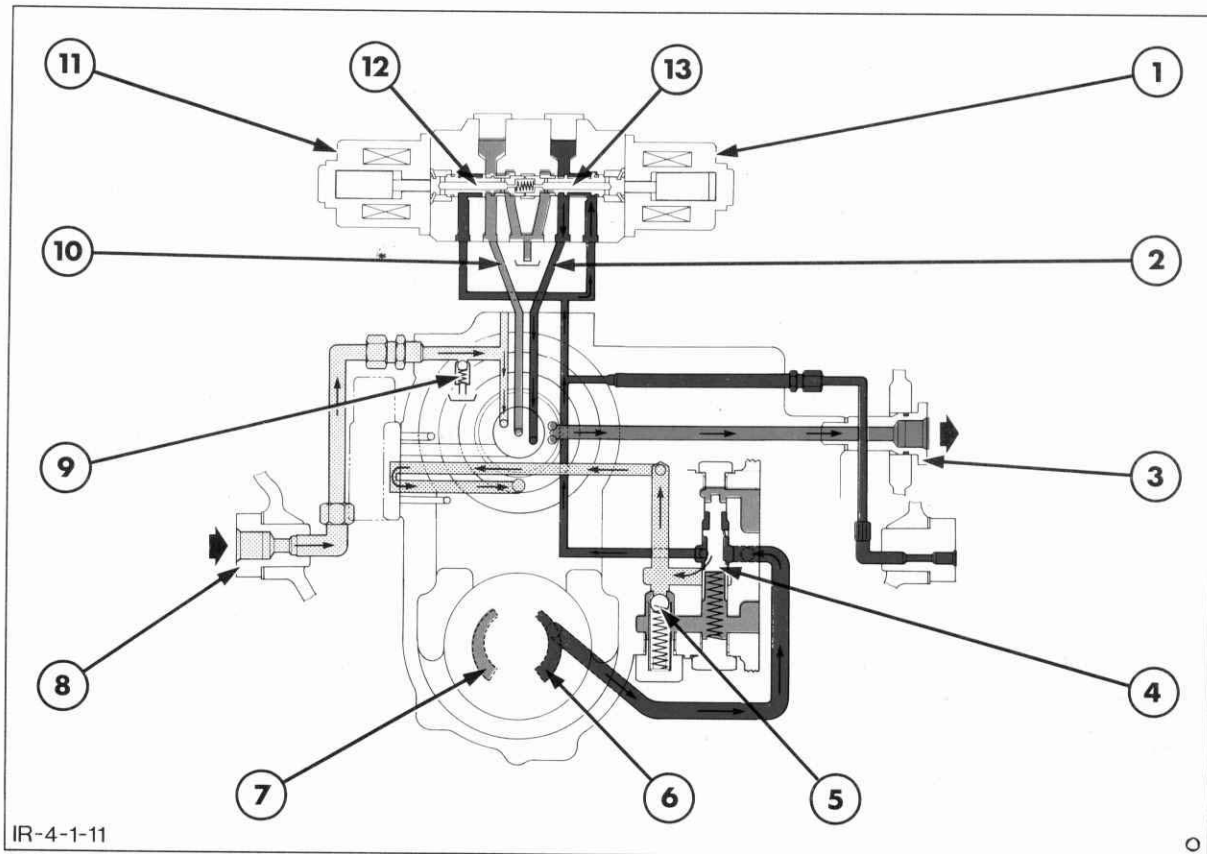


Figure 4-89

4 x 4 Power Reversing

Transmission Oil Flows in Forward

- | | |
|--------------------------------|---------------------------------|
| 1. Forward solenoid | 8. Cooler return |
| 2. Forward clutch feed gallery | 9. Lubrication valve |
| 3. Outlet to cooler | 10. Reverse clutch feed gallery |
| 4. Regulating valve | 11. Reverse solenoid |
| 5. Bypass valve | 12. Reverse control valve |
| 6. Pump pressure port | 13. Forward control valve |
| 7. Pump suction port | |

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.

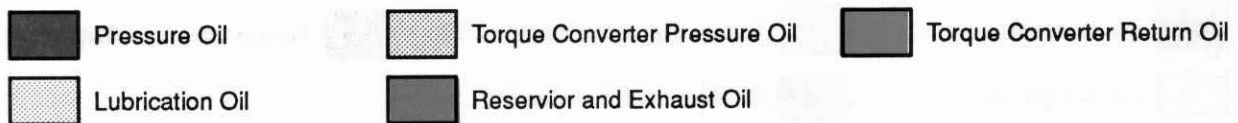
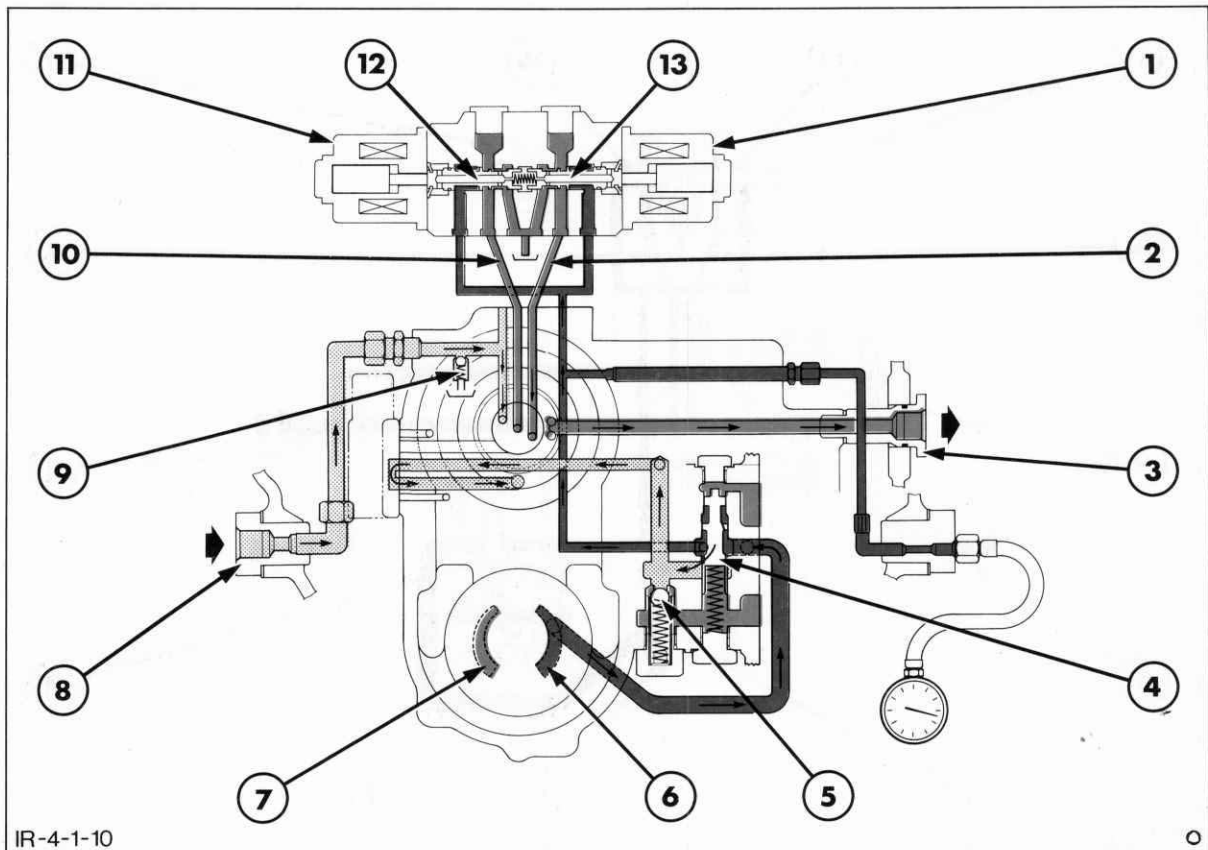


Figure 4-90
4 x 4 Power Reversing
Transmission Oil Flows in Neutral

- | | |
|--------------------------------|---------------------------------|
| 1. Forward solenoid | 8. Cooler return |
| 2. Forward clutch feed gallery | 9. Lubrication valve |
| 3. Outlet to cooler | 10. Reverse clutch feed gallery |
| 4. Regulating valve | 11. Reverse solenoid |
| 5. Bypass valve | 12. Reverse control valve |
| 6. Pump pressure port | 13. Forward control valve |
| 7. Pump suction port | |

ASSEMBLY

Refer to Figure 4-88.

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 FNH09210 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 4-88, 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. Install the countershaft and gear assembly.

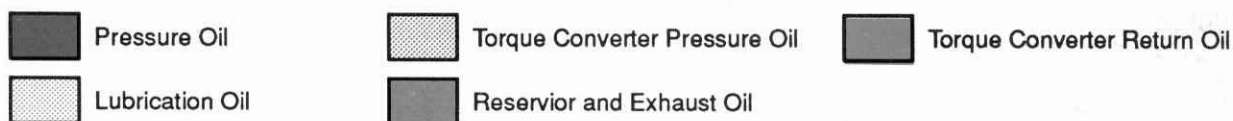
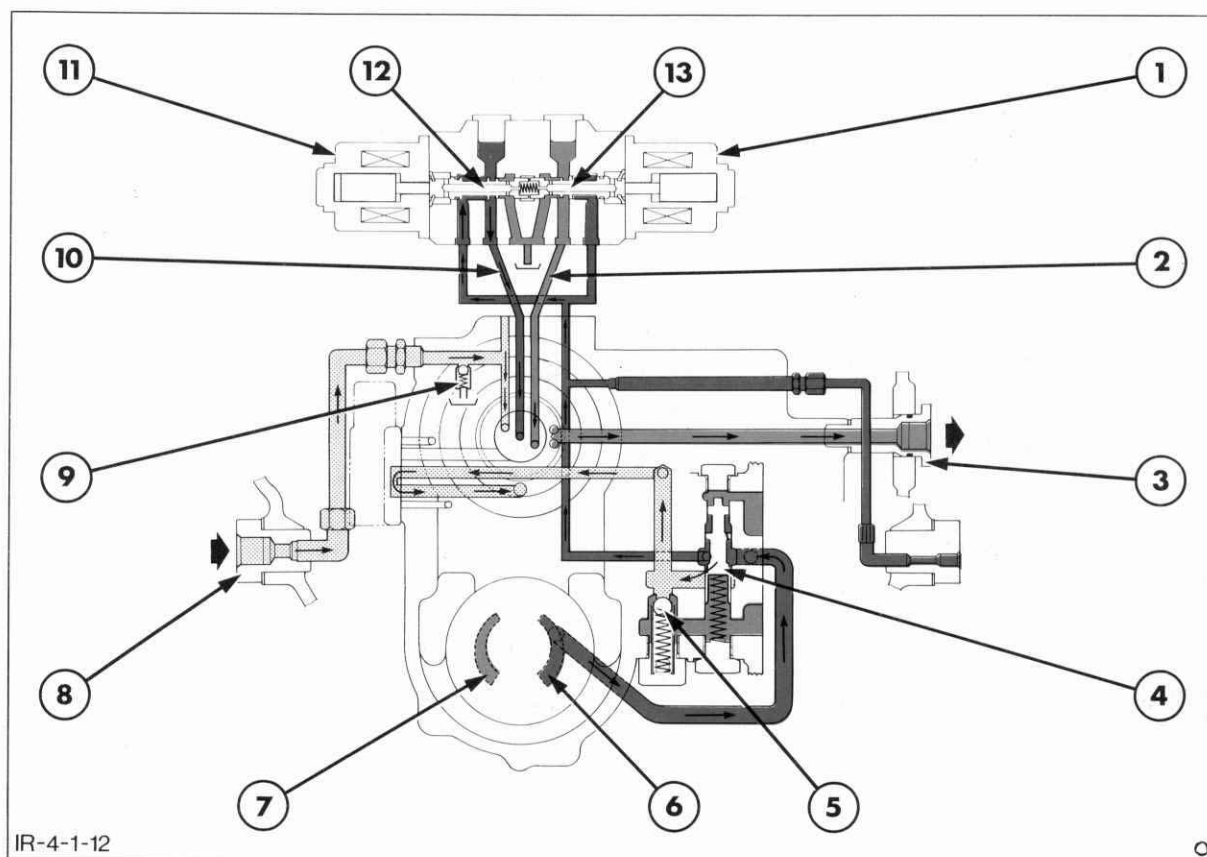


Figure 4-91

4 x 4 Power Reversing

Transmission Oil Flows in Reverse

- | | |
|--------------------------------|---------------------------------|
| 1. Forward solenoid | 8. Cooler return |
| 2. Forward clutch feed gallery | 9. Lubrication valve |
| 3. Outlet to cooler | 10. Reverse clutch feed gallery |
| 4. Regulating valve | 11. Reverse solenoid |
| 5. Bypass valve | 12. Reverse control valve |
| 6. Pump pressure port | 13. Forward control valve |
| 7. Pump suction port | |

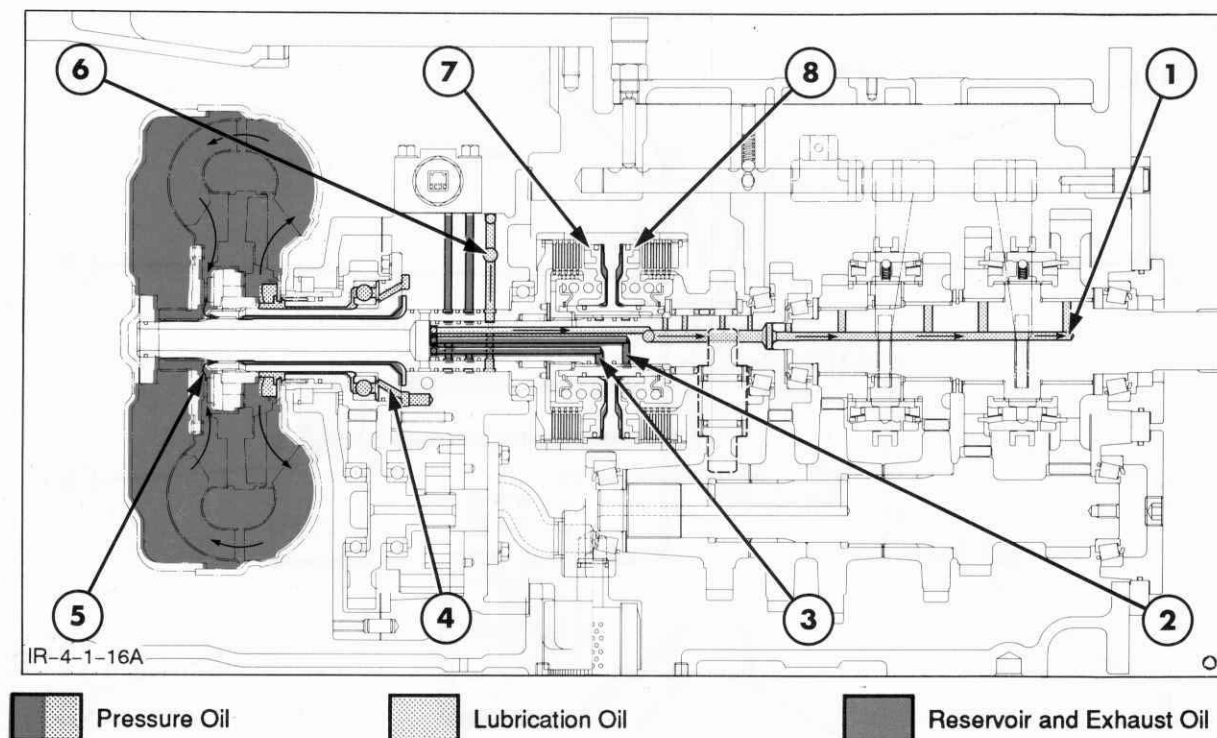


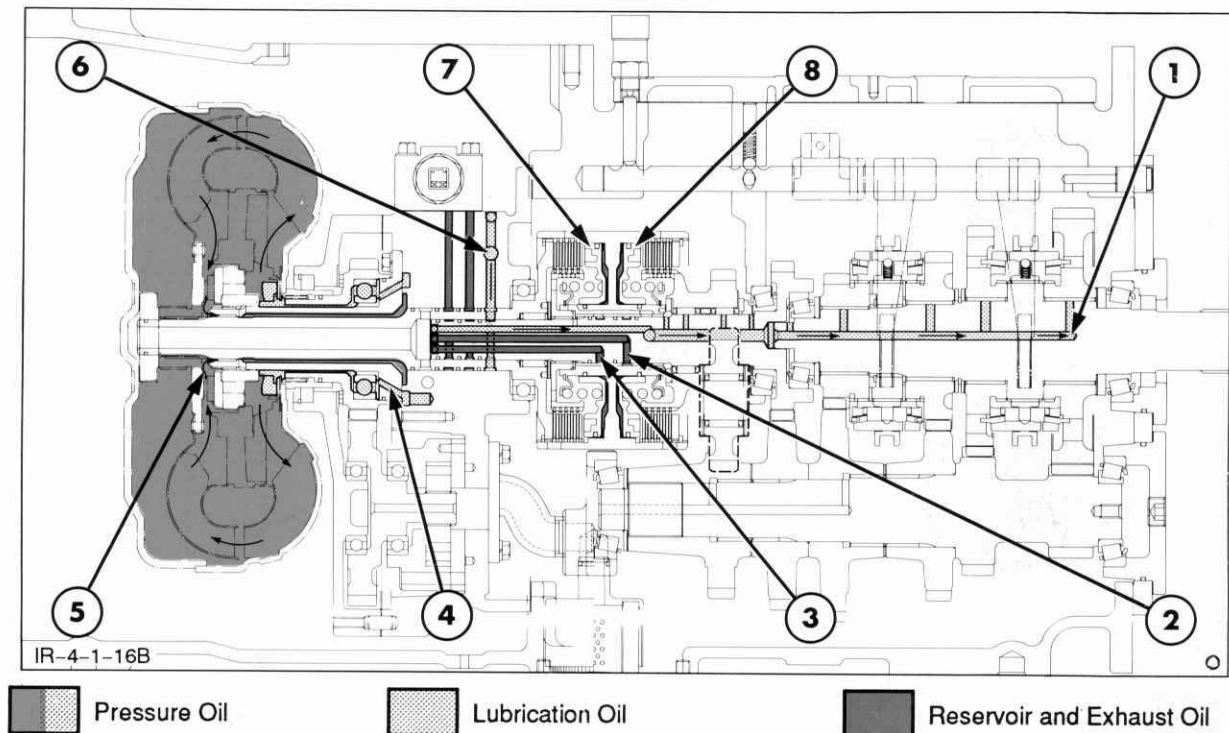
Figure 4-92

4 x 4 Power Reversing

Neutral And Lubrication Oil Flows

1. Output shaft lubrication gallery
2. Reverse clutch feed gallery
3. Forward clutch feed gallery
4. Transmission pump

5. Oil distributor
6. Solenoid control valve
7. Forward clutch piston
8. Reverse clutch piston

**Figure 4-93****4 x 4 Power Reversing****Forward Clutch And Lubrication Oil Flows**

- | | |
|-------------------------------------|---------------------------|
| 1. Output shaft lubrication gallery | 5. Oil distributor |
| 2. Reverse clutch feed gallery | 6. Solenoid control valve |
| 3. Forward clutch feed gallery | 7. Forward clutch piston |
| 4. Transmission pump | 8. Reverse clutch piston |

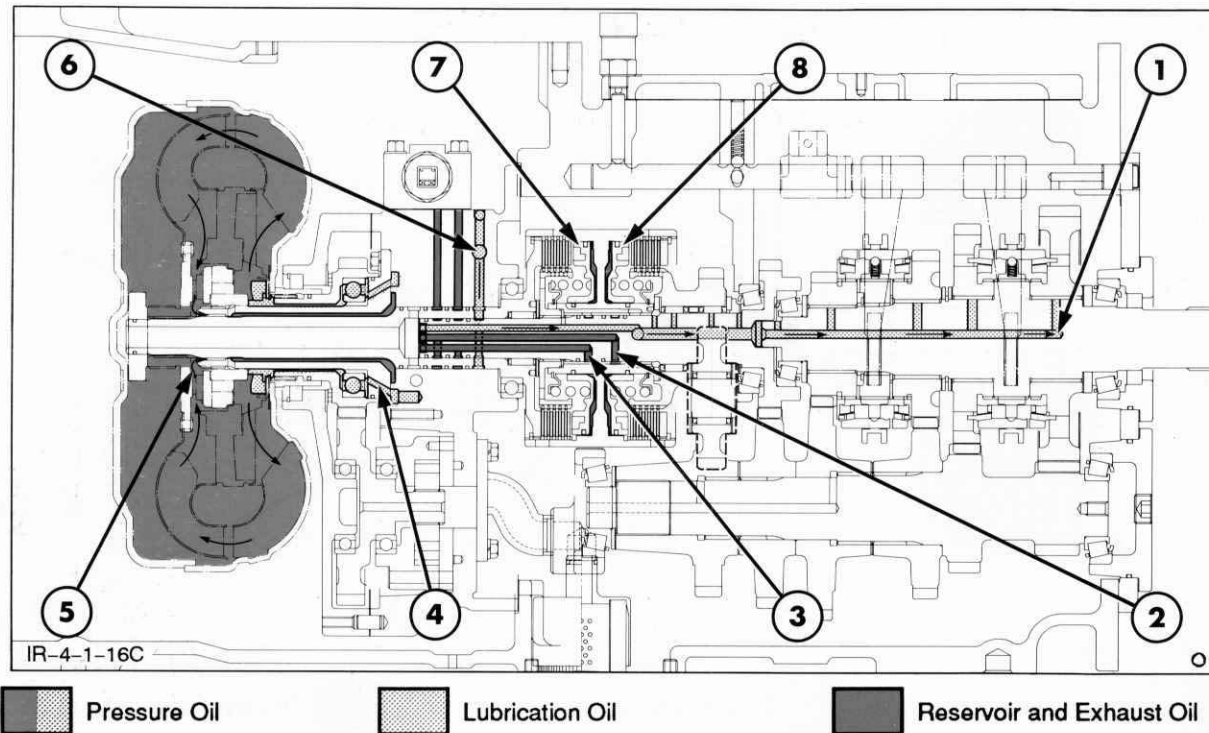


Figure 4-94

4 x 4 Power Reversing

Reverse Clutch And Lubrication Oil Flows

1. Output shaft lubrication gallery
2. Reverse clutch feed gallery
3. Forward clutch feed gallery
4. Transmission pump

5. Oil distributor
6. Solenoid control valve
7. Forward clutch piston
8. Reverse clutch piston

8X8 TRANSMISSION

DESCRIPTION AND OPERATION

The transmission, Figure 4-95, 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.

SYNCHRONIZED 8X8 TRANSMISSION

1st	7.9608:1
2nd	5.3724:1
3rd	3.5265:1
4th	2.4014:1
5th	2.2574:1
6th	1.5234:1
7th	1.0000:1
8th	0.6810:1
R1	8.0016:1
R2	5.4000:1
R3	3.5446:1
R4	2.4137:1
R5	2.2690:1
R6	1.5313:1
R7	1.0051:1
R8	0.6844:1

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.

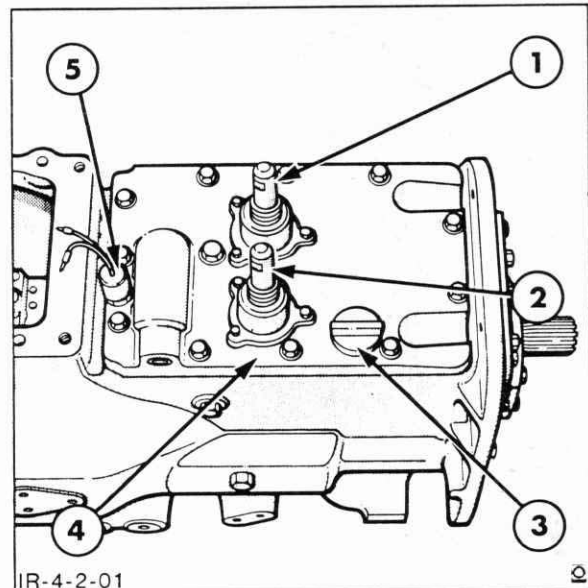


Figure 4-95

8 x 8 Fully Synchronised Transmission

1. Gearshift lever
2. Range lever
3. Oil level indicator
4. Top cover
5. Safety start switch

The 8x8 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.

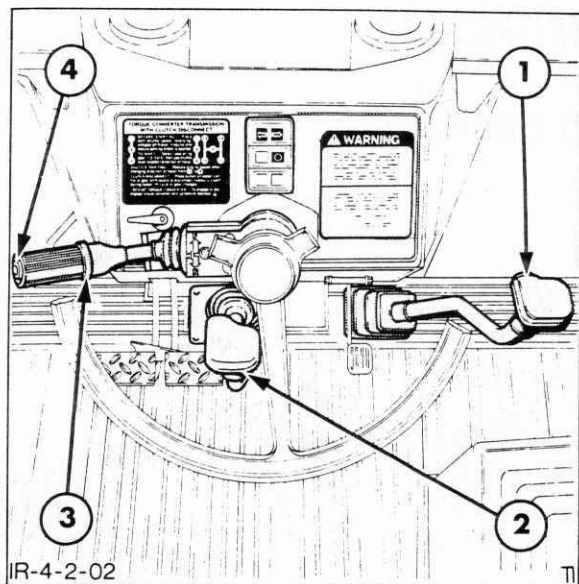


Figure 4-96

Transmission Shift Levers

1. Gearshift lever
2. Range lever
3. Power reversing lever
4. Lock-up button

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 4-96.

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 redirect 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.

The lock up feature should be used when traveling 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 4-96, is used to select any one of four synchronized 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.

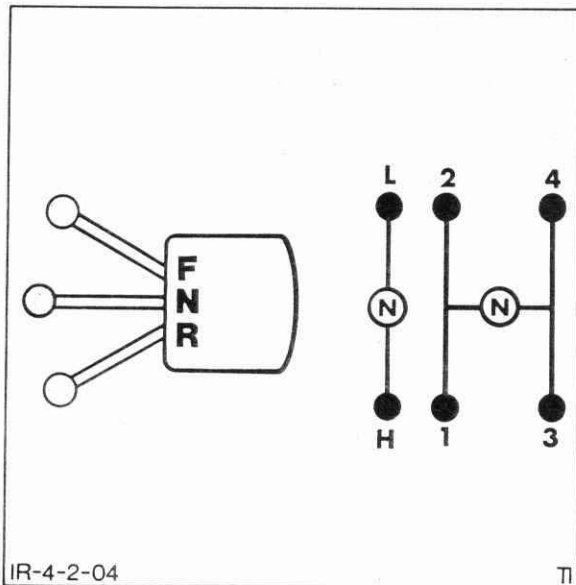


Figure 4-97
Gearshift Pattern

Figure 4-97 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 4-98, 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 operations to divert full engine power to the backhoe/loader hydraulic pump for faster loader operations.

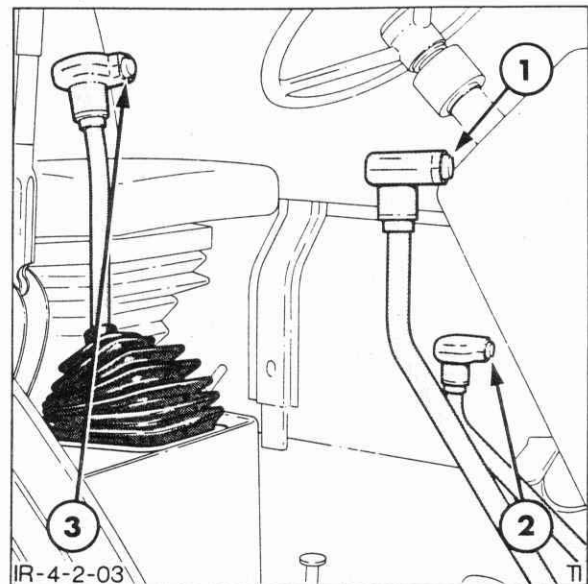


Figure 4-98
Transmission Disconnect Switches

1. Gearshift lever button
2. Range lever button
3. Loader control lever button

Easy upward and downward gear changes may be made with the fully synchronized gearbox, simply by depressing the transmission disconnect button the gearshift lever while 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.

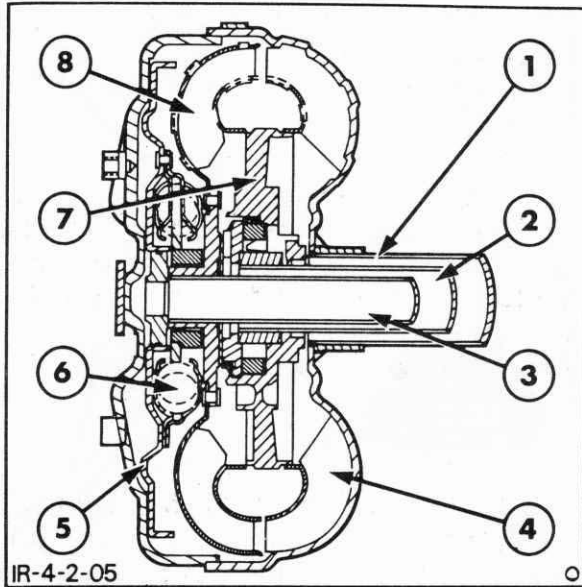


Figure 4-99

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

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: This 8x8 transmission also requires the P.T.O. lever to be in the disengaged position before the tractor can be started.

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 4-99. 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, formed 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:a (2.83:a Europe), 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.

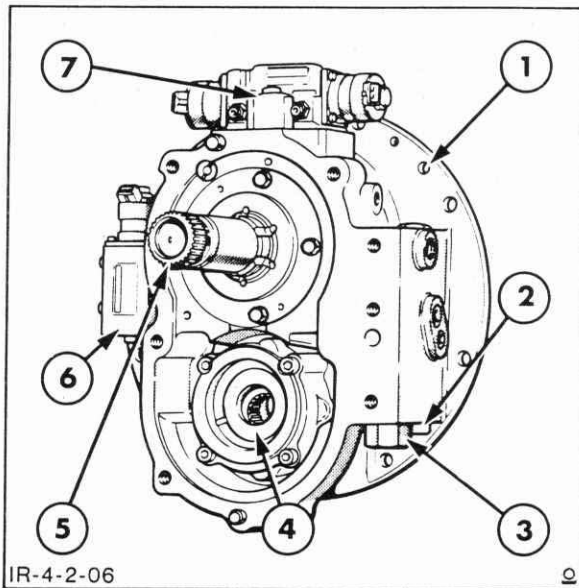


Figure 4-100
Oil Distributor

1. Oil distributor housing
2. Regulating valve
3. Bypass valve
4. Hydraulic pump
5. Stator support
6. Lock-up valve
7. Control valve

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 4-100, 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.

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.

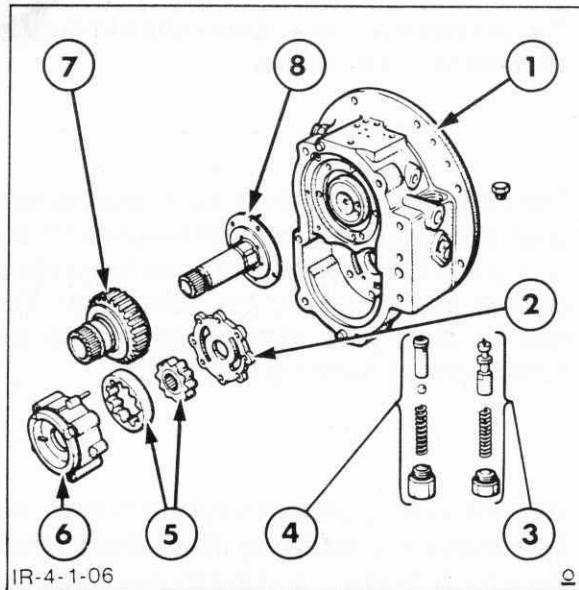


Figure 4-101

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

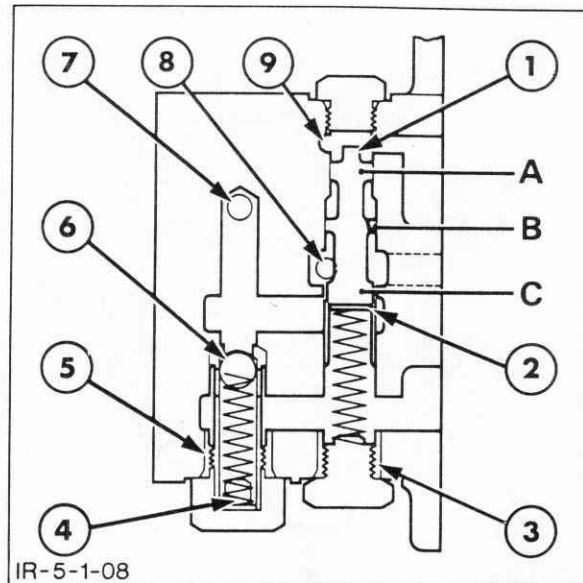


Figure 4-102

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

TRANSMISSION HYDRAULIC PUMP

The transmission hydraulic pump, Figure 4-101, 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.

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 center 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 4-102. 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 100 PSI (689 kPa), the spring force acting on the valve is overcome, causing the valve to move down.

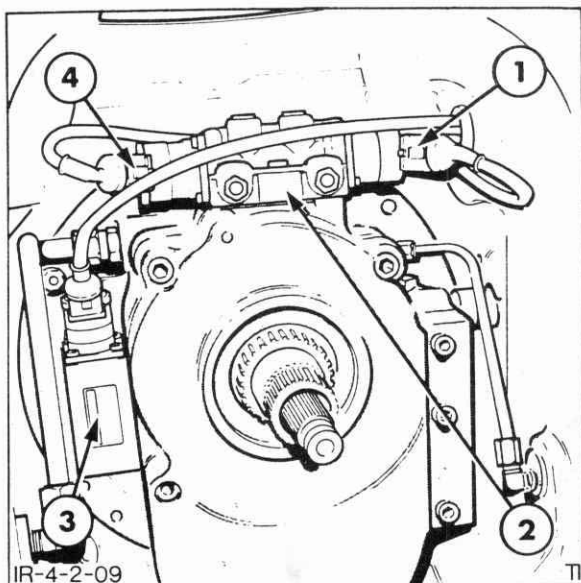


Figure 4-103

Solenoid Control Valve

1. Forward solenoid
2. Control valve
3. Lock-up valve
4. Reserve solenoid

This downward movement allows the valve to direct oil into the converter passage while maintaining a minimum pressure of 100 PSI (689 kPa). 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.

The bypass valve will open at approximately 100 PSI (689 kPa) 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 4-103, 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.

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

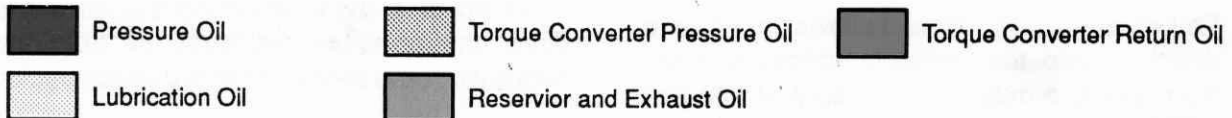
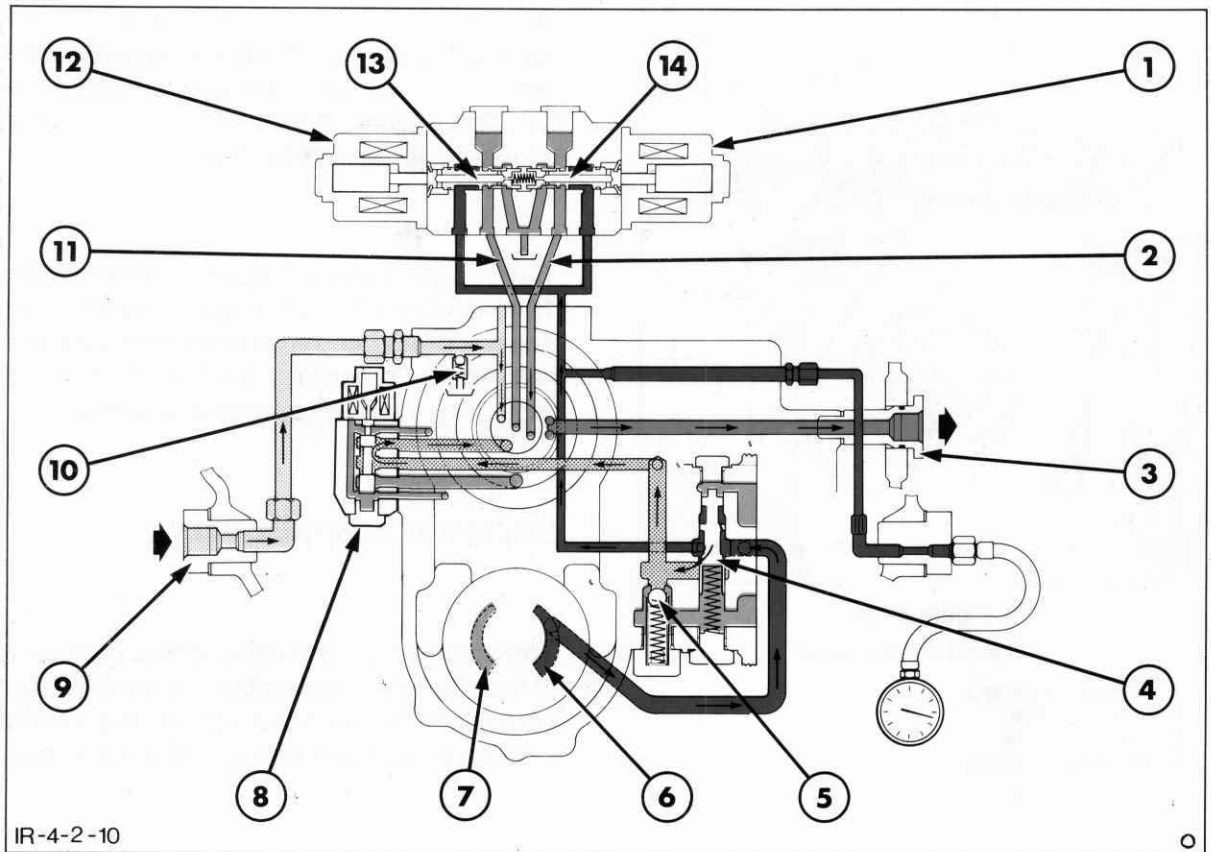


Figure 4-104
Oil Flow - In Neutral

- | | |
|-------------------------------|--------------------------------|
| 1. Forward solenoid | 8. Lock-up valve |
| 2. Forward clutch oil gallery | 9. Return from oil cooler |
| 3. Feed port to oil cooler | 10. Cooler bypass valve |
| 4. Regulating valve | 11. Reverse clutch oil gallery |
| 5. Bypass valve | 12. Reverse solenoid |
| 6. Oil pump outlet | 13. Reverse spool |
| 7. Oil pump inlet | 14. Forward spool |

With the solenoid control valve in neutral, Figure 4-104, 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.

clutch pack oil galleries are connected to exhaust via the forward and reverse spools in the control valve.

Pressure regulated oil is constantly delivered to the forward and reverse spools. With the spools held in neutral the forward and reverse

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

 Pressure Oil

 Lubrication Oil

 Torque Converter Pressure Oil

 Reservoir and Exhaust Oil

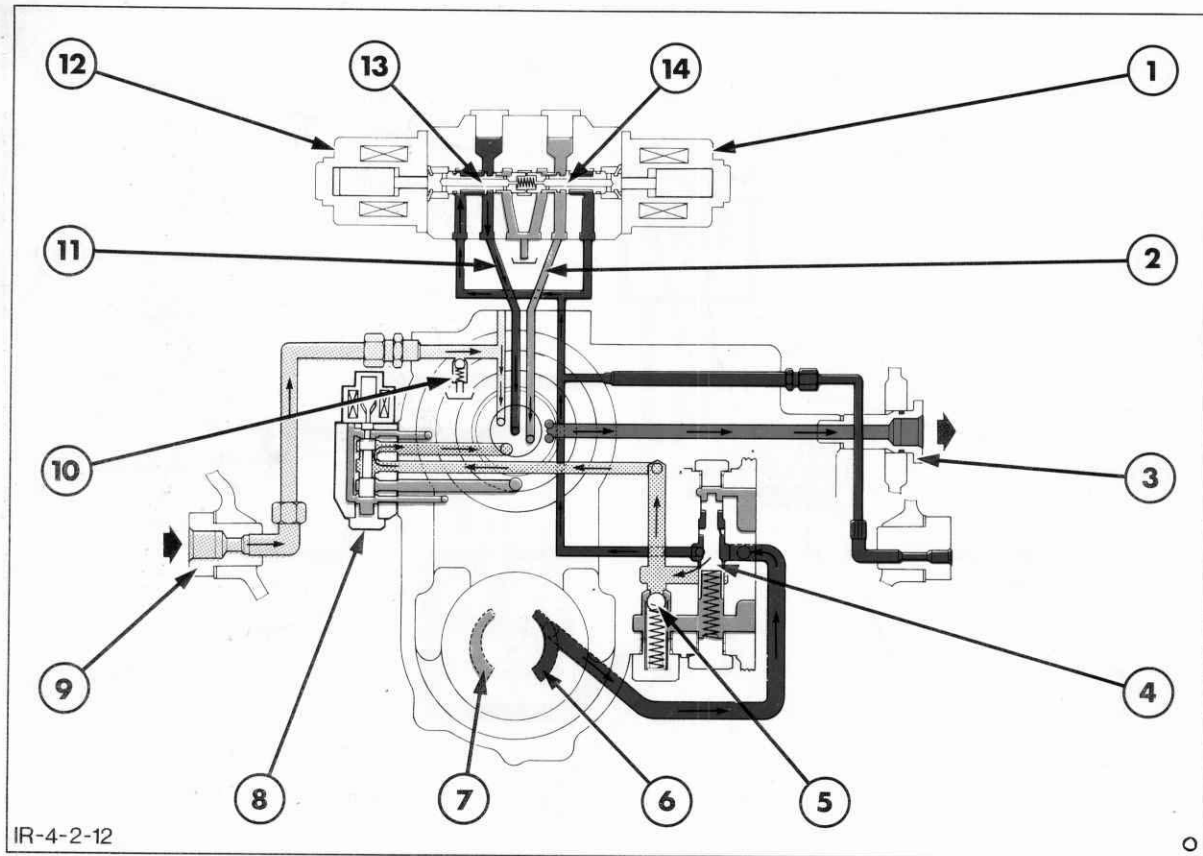
Torque Converter Return Oil

Figure 4-105
Oil Flow - In Forward

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 4-105. 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.



IR-4-2-12

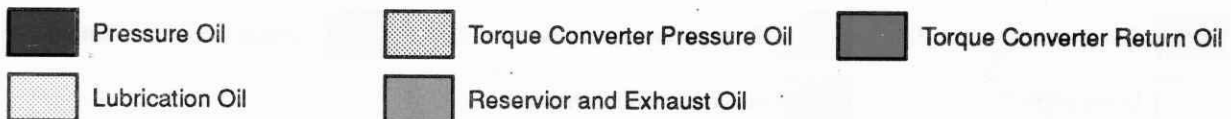


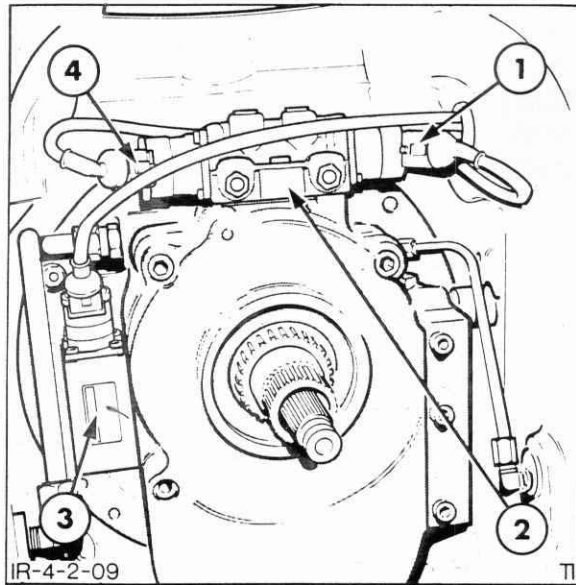
Figure 4-106
Oil Flow - In Reverse

- | | |
|-------------------------------|--------------------------------|
| 1. Forward solenoid | 8. Lock-up valve |
| 2. Forward clutch oil gallery | 9. Return from oil cooler |
| 3. Feed port to oil cooler | 10. Cooler bypass valve |
| 4. Regulating valve | 11. Reverse clutch oil gallery |
| 5. Bypass valve | 12. Reverse solenoid |
| 6. Oil pump outlet | 13. Reverse spool |
| 7. Oil pump inlet | 14. Forward spool |

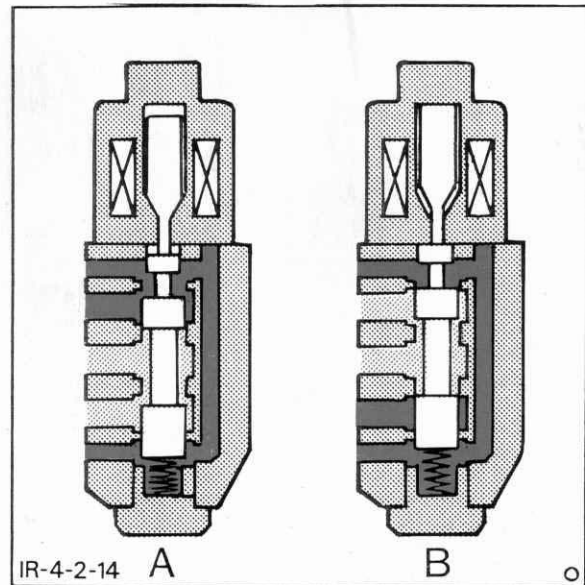
Selecting reverse travel sends a signal from the modulating unit to the reverse solenoid of the control valve. The operation of the reverse section of the control valve is the same as the forward section, however, now the pressure regulated oil is directed to the reverse clutch pack, Figure 4-106, and power is delivered to

the transmission gearbox via the rear input gear (reverse clutch hub).

De-energized, 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.

**Figure 4-107****Lock-up Valve Assembly**

1. Forward solenoid
2. Control valve housing
3. Lock-up valve
4. Reverse solenoid

**Figure 4-108****Lock-up Valve Operation**

- A. Lock-up mode
- B. Normal mode

LOCK-UP VALVE

The lock-up valve is mounted on the right-hand side of the distributor assembly, Figure 4-107, 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 bypass valve to the torque converter.

With the lock-up valve solenoid de-energized, the spool remains in the normal torque converter mode position with the return spring holding the spool as shown, B, Figure 4-108.

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, energizes the lock-up valve via the modulator unit. The lock-up valve solenoid now energized will move the spool, A, Figure 4-108, directing pressure oil to the torque converter via the passage between the stator support and torque converter hub.

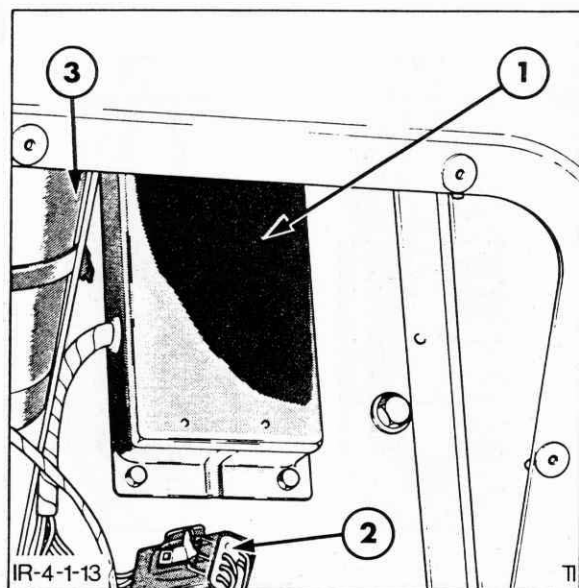


Figure 4-109
Modulator Unit

1. Modulator unit
2. Connector
3. Steering motor

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 4-109, 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 microprocessor 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.

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.

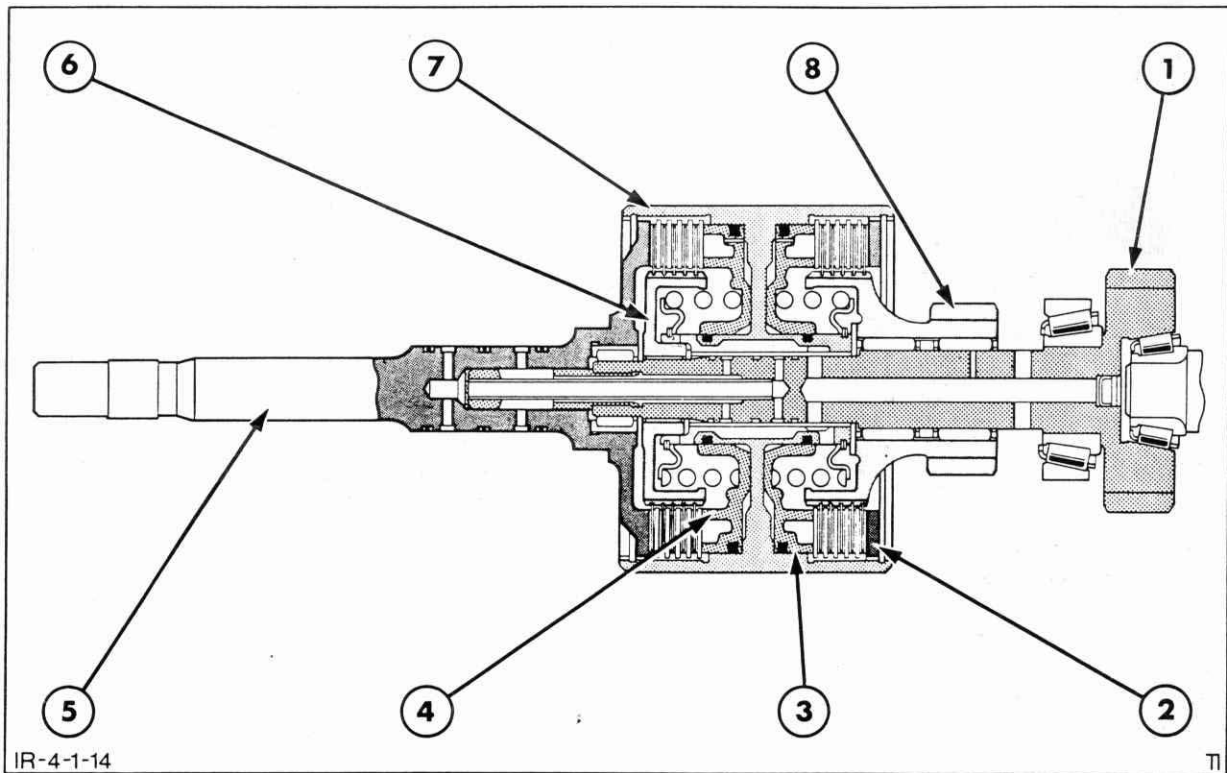


Figure 4-110
Hydraulic Clutch Assemblies

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. Hub housing
8. Reverse clutch hub and gear

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.

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 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.

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.

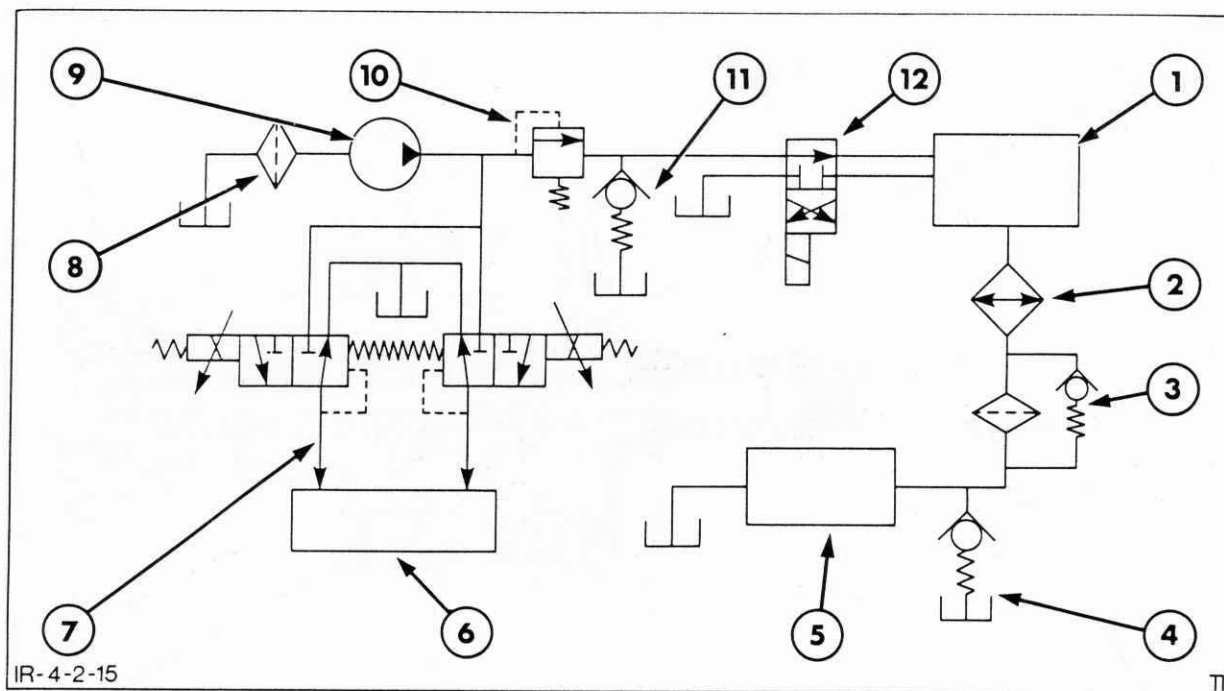


Figure 4-111

Transmission Oil Flow Circuit Diagram

- | | |
|-----------------------------|---------------------------|
| 1. Torque converter | 7. Solenoid control valve |
| 2. Oil cooler | 8. Inlet filter |
| 3. Line filter | 9. Oil pump |
| 4. Cooler line bypass valve | 10. Regulating valve |
| 5. Transmission lubrication | 11. Bypass valve |
| 6. Hydraulic clutch | 12. Lock-up valve |

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.

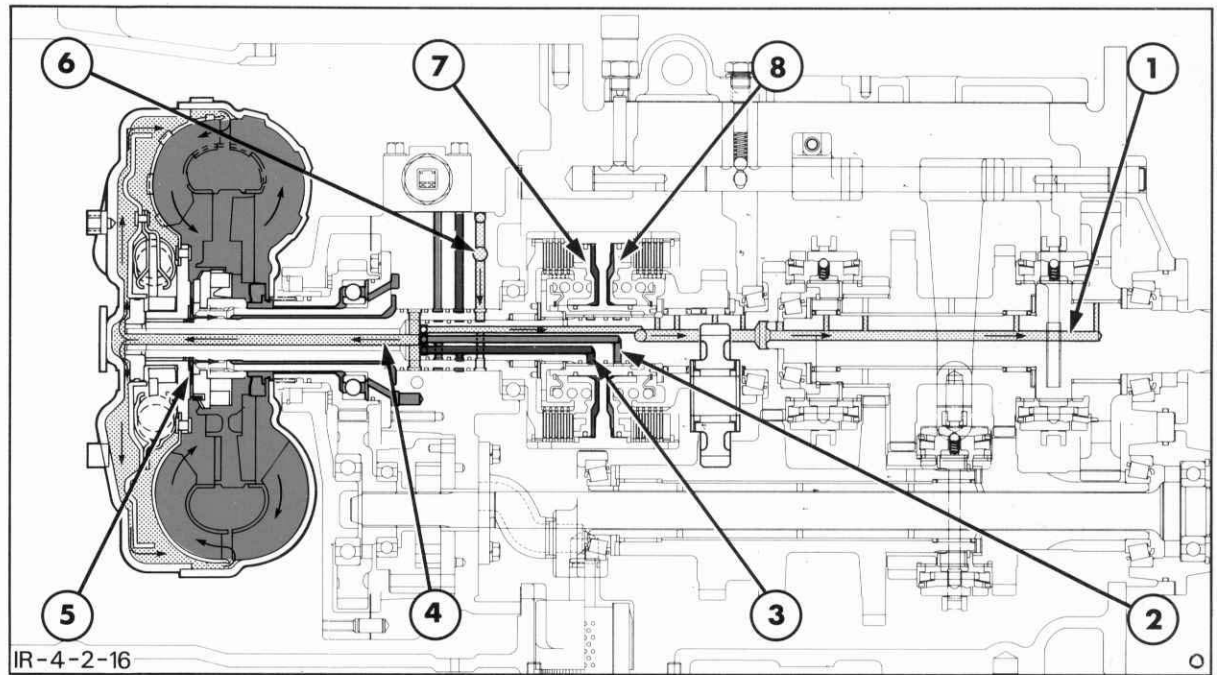
When the button is released, the electrical supply is restored to the modulator unit and the control valve will direct pressure regulated oil to the appropriate clutch pack in proportion

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 4-110, is splined internally to the transmission rear input shaft and externally to the bronze plates of the forward clutch assembly.



Pressure Oil

Torque Converter Pressure Oil

Torque Converter Return Oil

Lubrication Oil

Reservoir and Exhaust Oil

Figure 4-112

Transmission Lubrication Oil Flow - Normal Mode

- 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

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 4-110. 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.

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.

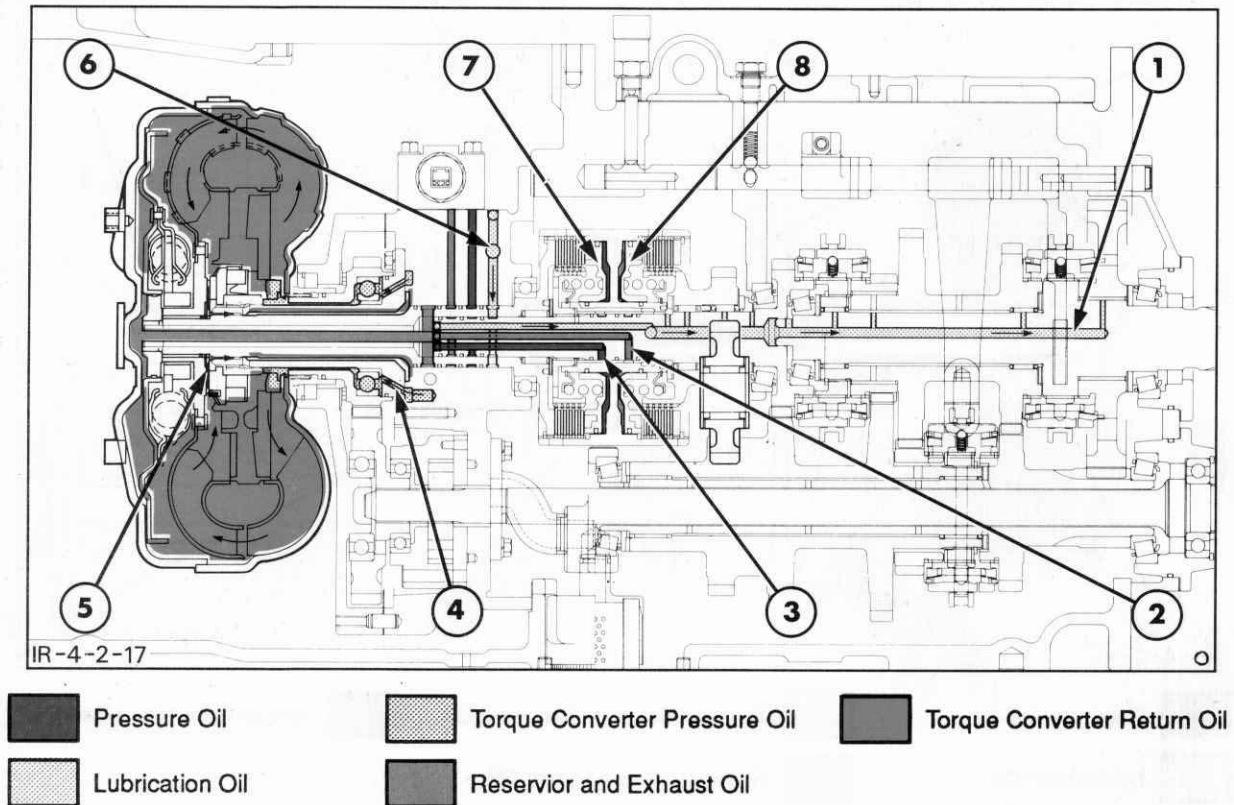


Figure 4-113
Transmission Lubrication Oil Flow - Lock-Up Mode

- | | | |
|---------------------------|---------------------------------|-------------------|
| 1. Lubrication gallery | 4. Feed to torque converter | 7. Forward clutch |
| 2. Reverse clutch gallery | 5. Return from torque converter | 8. Reverse clutch |
| 3. Forward clutch gallery | 6. Return from oil 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 4-112 and 4-113.

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 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.

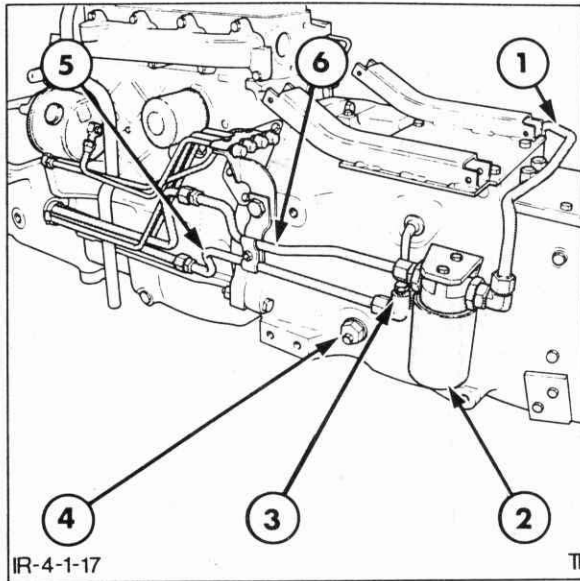


Figure 4-114
Transmission Cooling System

1. Filter return pipe
2. Filter
3. Temperature switch
4. Pressure test point
5. Cooler inlet line
6. Cooler outlet line

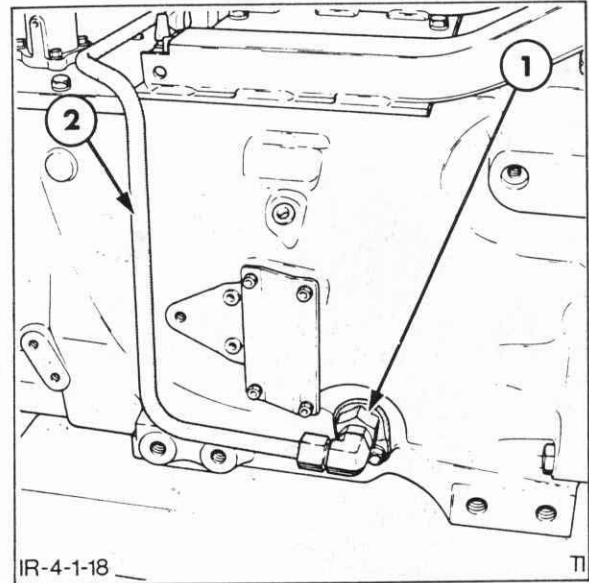


Figure 4-115
Transmission Cooling System

1. Adaptor
2. Filter return pipe

OIL COOLER

The transmission cooling system, Figures 4-114 and 4-116, 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 - 9 PSI (0.5-0.6 bar) should the filter become clogged.

Oil from the torque converter enters the cooler inlet tube, Figure 4-114, 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 4-115.

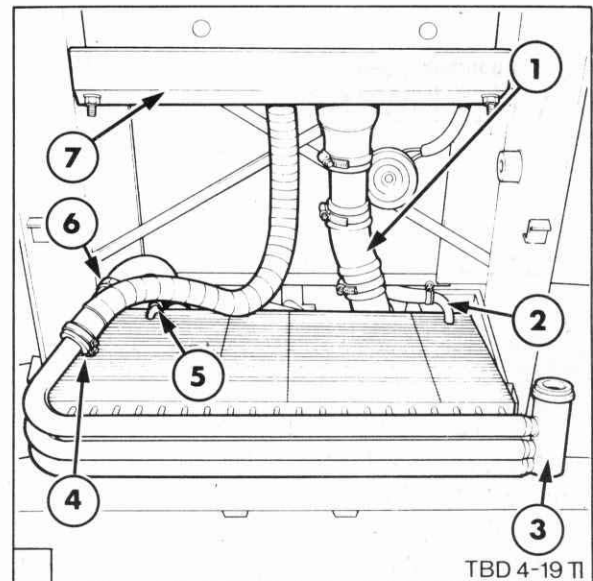


Figure 4-116
Oil Cooler Assembly

1. Hydraulic reservoir to pump feed
2. Transmission oil cooler tube "IN"
3. Hydraulic oil warm up valve (non serviceable)
4. Hydraulic oil tube to reservoir
5. Transmission oil cooler tube "OUT"
6. Hydraulic oil tube to cooler
7. Reservoir

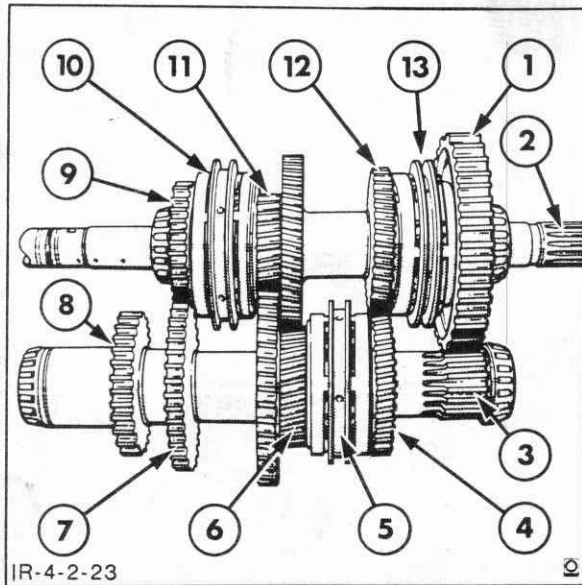


Figure 4-117
Synchronizer Assemblies

1. Low range gear
2. Output shaft
3. Counter shaft
4. 1st Gear
5. 1st/2nd synchronizer
6. 2nd Gear
7. Forward Gear
8. Reverse gear
9. 3rd Gear
10. 3rd/4th synchronizer
11. 4th Gear
12. High range gear
13. High/low synchronizer

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 30 PSI (2.26 bar), a bypass valve in the distributor housing will open allowing oil to return to sump.

SYNCHRONIZER

The synchronized 8x8 power reversing transmission incorporates three cone type synchronizers, two on the output shaft and one on the countershaft, Figure 4-117. The synchronizers operate in an identical way.

The cone type synchronizer assembly, Figure 4-118, 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 slots in the sleeve.

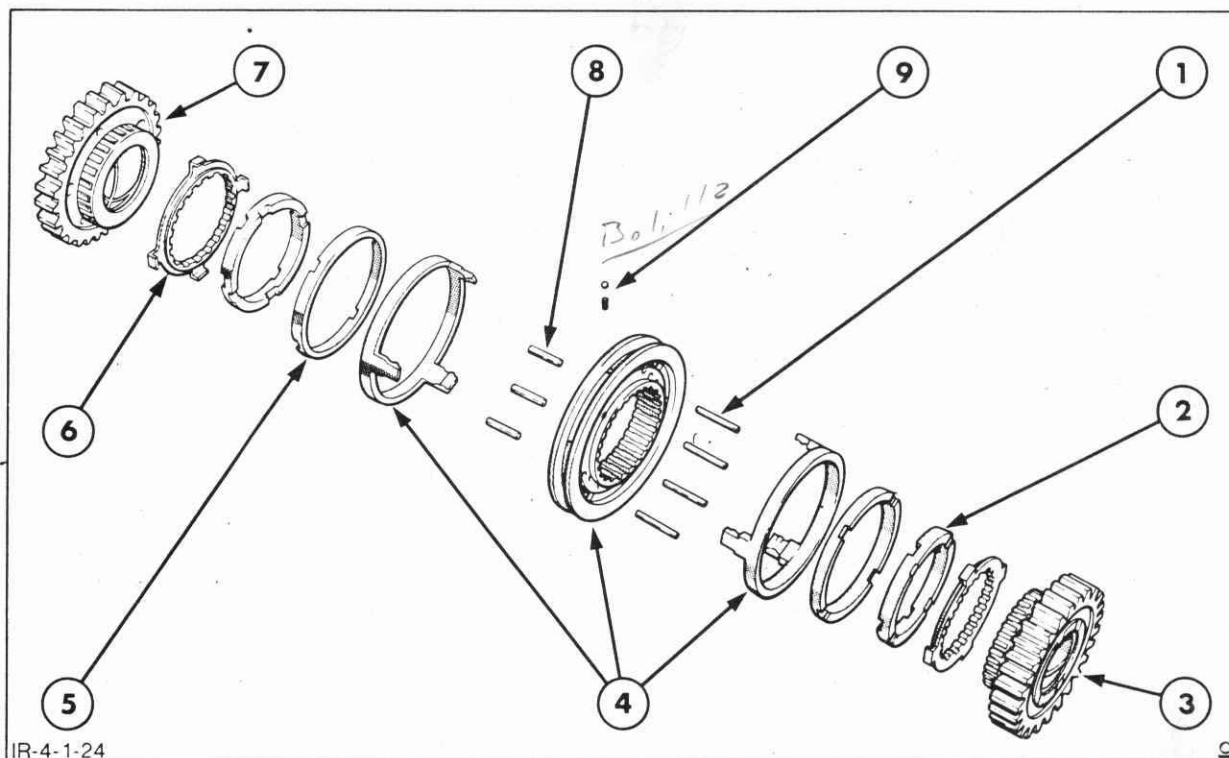


Figure 4-118

Exploded View

1. Inner cone drive pins (4)
2. 1st Gear
3. Synchronizer ring
4. Sliding sleeve and outer cones
5. Inner cones

6. Retaining ring
7. 2nd Gear
8. Synchronizer ring locating pins (3)
9. Detent ball and spring (6)

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

The synchronizer 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.

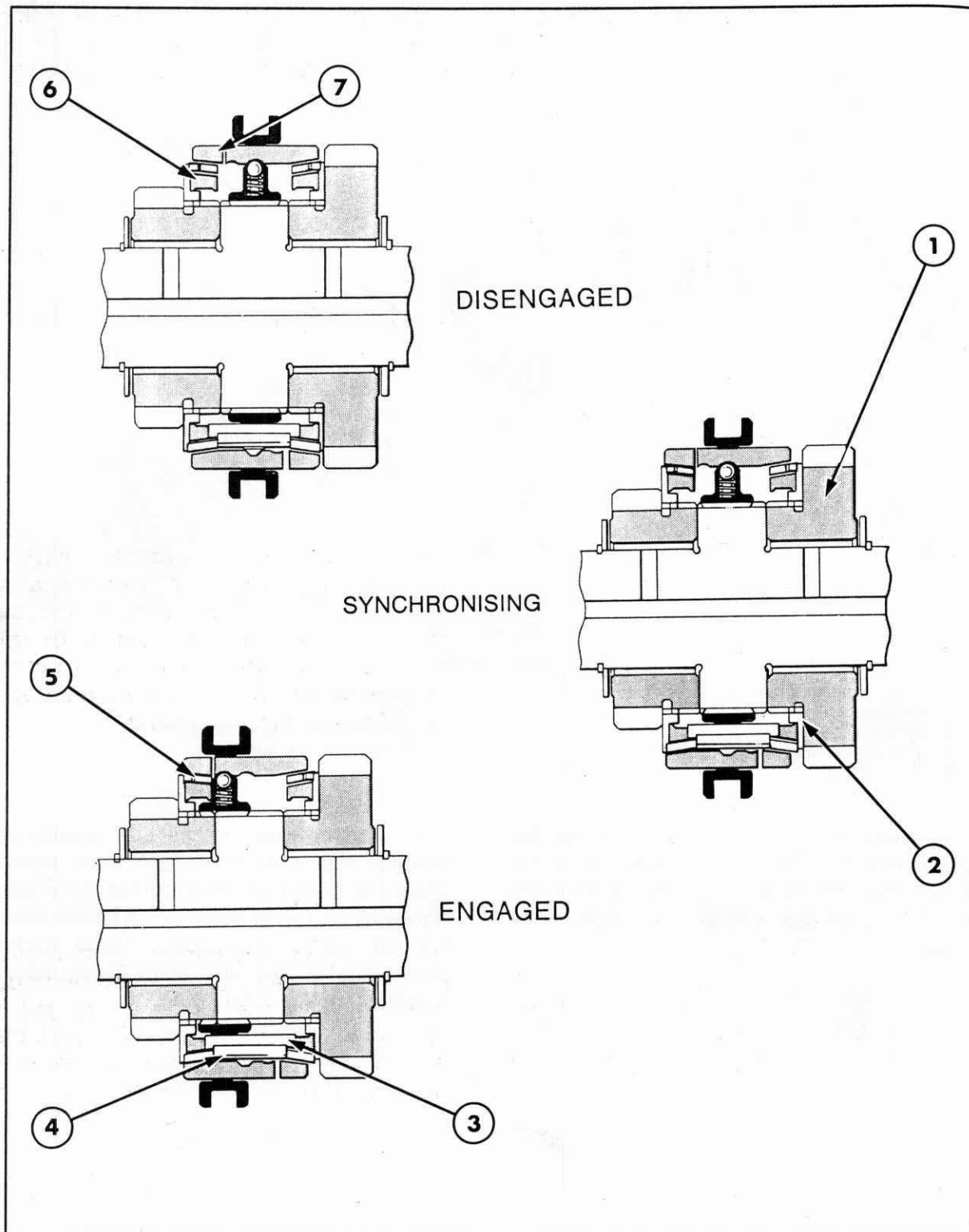


Figure 4-119
Synchronizer Operation

- | | |
|-----------------------------------|----------------------|
| 1. Gear | 5. Synchronizer ring |
| 2. Synchronizer | 6. Inner cone |
| 3. Inner cone pins (long) | 7. Outer cone |
| 4. Synchronizer ring pins (short) | |

SECTION 4

The operation of the synchronizer, Figure 4-119, is as follows:

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.

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.

POWER FLOWS

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.

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. Figure 4-120 and 4-121 illustrate the power flows.

The synchronizer 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 synchronizer ring between the outer and inner cones.

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.

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

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.

SECTION 4 – TRANSMISSION

OVERHAULING THE TRANSMISSION

GENERAL

The arrangement of the procedures in this Section permits servicing the 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.

Condition 1

Assemblies serviced with transmission installed: Refer to the next part.

Gearshift lever

Modulator unit

Solenoid control valve

Lock-up valve

Condition 2

Assemblies serviced with transmission front end overhaul: Refer to front end overhaul.

Torque converter

Transmission hydraulic pump and oil distributor

Front input shaft and clutch housing

Condition 3

Assemblies serviced with complete overhaul: Refer to complete overhaul.

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 component overhaul.

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.

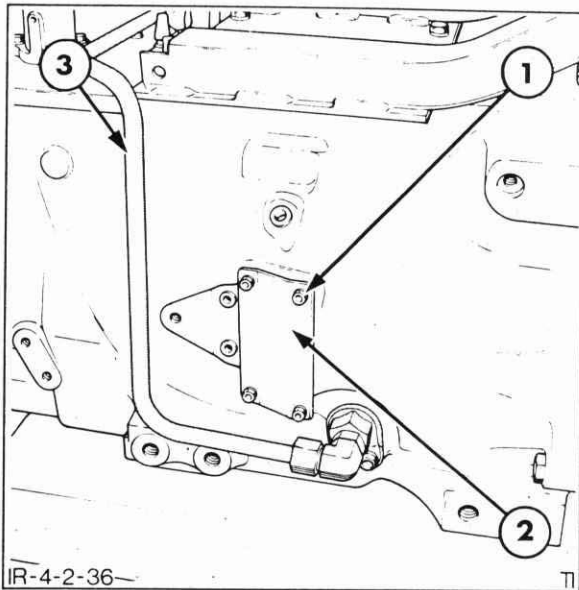


Figure 4-129

Lock-Up Valve Access Plate Removal

1. Retaining bolt
2. Access plate
3. Cooler return tube

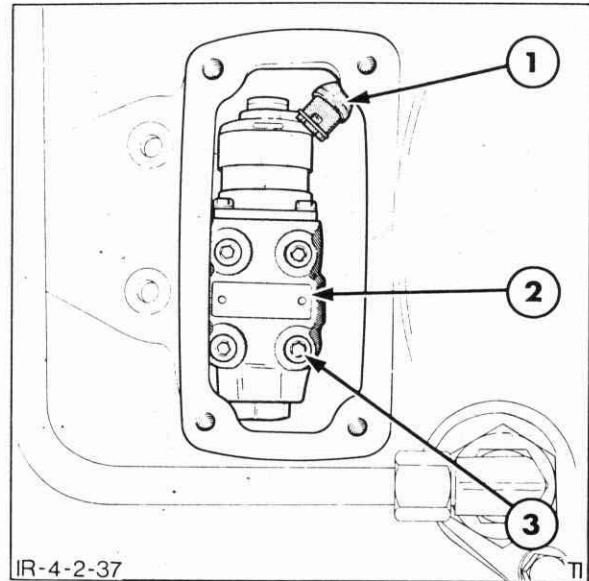


Figure 4-130

Lock-Up Valve Removal

1. Harness
2. Lock-up valve
3. Retaining bolt

3. Install the solenoid control valve access plate onto the transmission housing and secure with the retaining bolts. Tighten the bolts.
4. Install the fuel tank as described in Section 2 "Fuel Systems."

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.
2. Remove the retaining bolts and remove the modulator unit, Figure 4-128.

INSPECTION

See "Troubleshooting" for the modulator unit inspection.

INSTALLATION

1. Install the modulator unit and secure in position tightening the retaining bolts.
2. Install the steering console lower panel and tighten the retaining bolts.

LOCK-UP VALVE

REMOVAL

1. Remove the lock-up valve access plate retaining bolts and lift the plate from the transmission, Figure 4-129.



SECTION 4 – TRANSMISSION

2. Remove the lock-up valve wiring harness retaining clip then withdraw the connector from the valve solenoid.
3. Remove the lock-up valve retaining bolts and lift the lockup valve from the distributor housing, Figure 4-130.

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 "Component Overhaul" 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 6-7 ft. lbs.
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.

FRONT END OVERHAUL

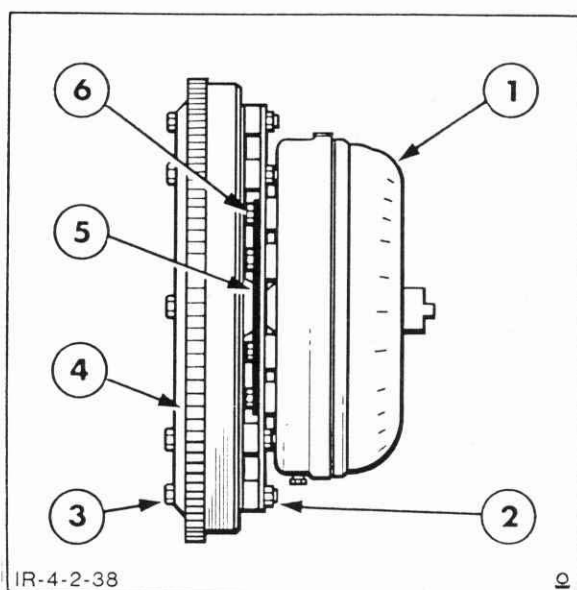


Figure 4-131

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 plate

ASSEMBLIES TRANSMISSION ENGINE	SERVICED SEPARATED	WITH FROM
--------------------------------------	-----------------------	--------------

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 Section 10, "Separating the Unit".

DISASSEMBLY

TORQUE CONVERTER

1. Remove the torque converter and drive plate from the stator support, Figure 4-131.
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 "servicing the torque converter".

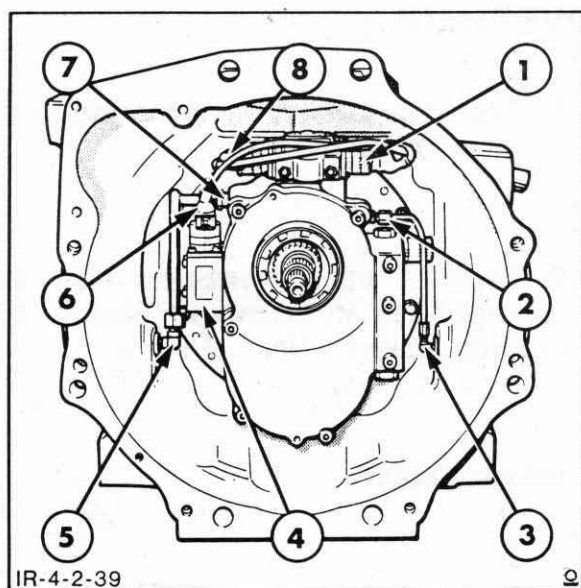


Figure 4-132

Front View Of Transmission Case

1. Solenoid connection
2. Test port line
3. Test port line
4. Lock-up valve
5. Return line
6. Solenoid connection
7. Return line
8. Solenoid connection

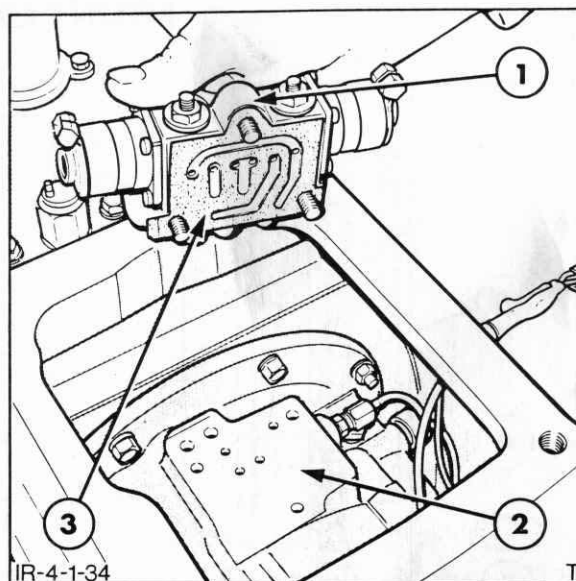


Figure 4-133

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 4-132. 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 4-132.

3. Disconnect the wiring harness from the lock-up valve and the solenoid control valve and remove from the transmission case; note the color and the position of the three connectors.

4. Remove the solenoid control valve securing bolts and remove the solenoid control valve from the distributor housing, Figure 4-133.

Refer to "Component Overhaul" for "disassembly of the solenoid control valve".

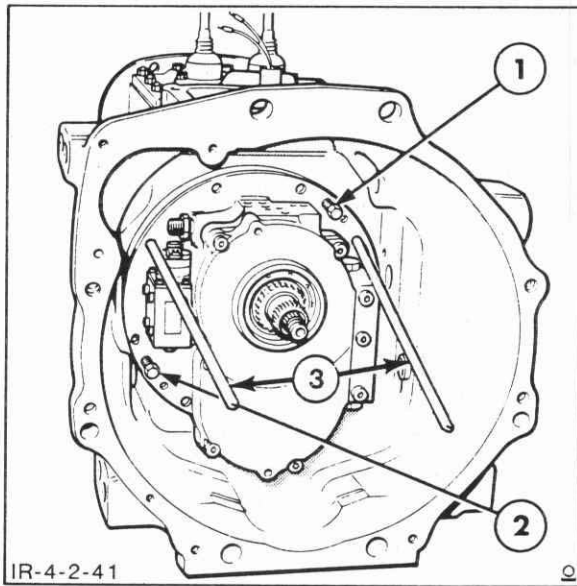


Figure 4-134

Distributor Housing Removal

1. Upper jacking bolt
2. Lower jacking bolt
3. Aligning rods FNH00224

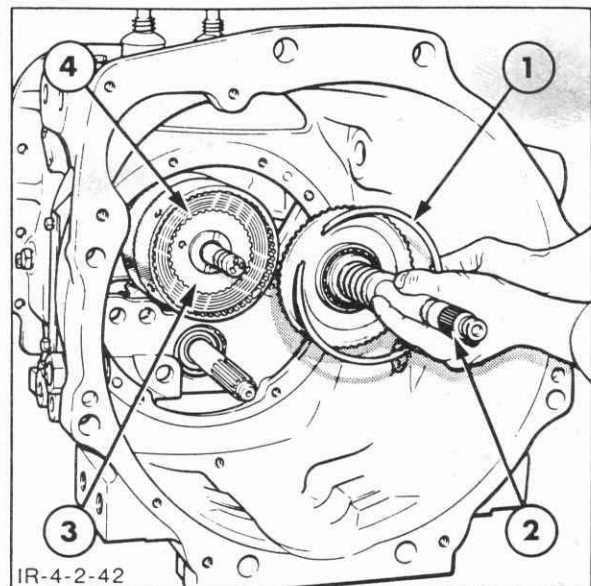


Figure 4-135

Front Input Shaft Removal

1. Snap ring
2. Front input shaft
3. Forward clutch shaft
4. Forward clutch plates

5. Remove the distributor housing retaining bolts. Install two aligning rods (OTC FNH00024). Obtain two M8 (1.25 thread) jacking bolts, approximately 1.25" (30 mm) long. Screw the bolts into the housing as shown in Figure 4-134, then continue to tighten until the distributor housing is freed from the transmission case. Use the aligning rods to help support the weight. 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.

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 4-135.
2. Pull the forward clutch hub, along with the thrust washer, from the rear input shaft, Figure 4-135, 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" (2.30 mm), 0.096" (2.44 mm) and 0.10" (2.60 mm).

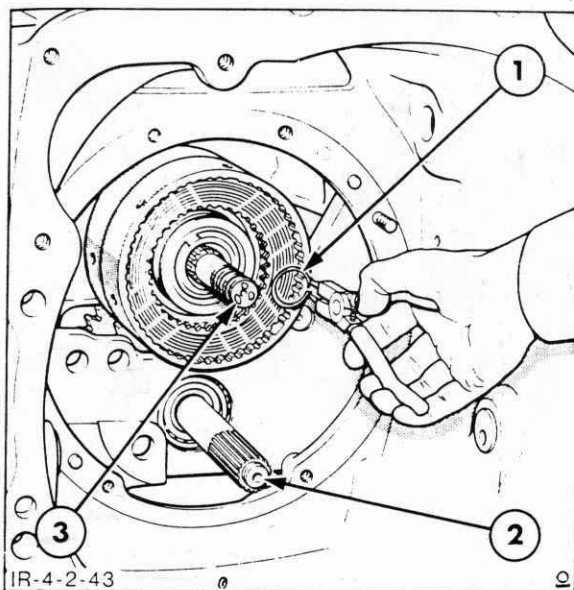


Figure 4-136

Clutch Housing Removal

1. Clutch housing snap ring
2. P.T.O. shaft
3. Rear input shaft

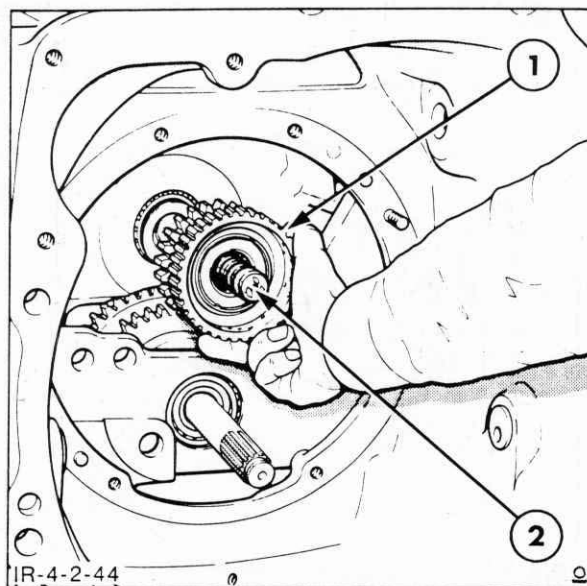


Figure 4-137

Reverse Idler Input Gear Removal

1. Reverse idler input gear (rear clutch hub)
2. Rear input shaft

3. Remove the snap ring, Figure 4-136, then pull the clutch housing from the rear input shaft.

4. Remove the reverse idler input gear, thrust washer, needle bearings and shims from the rear input shaft, Figure 4-137, if not removed with the clutch housing.

5. Refer to "Component Overhaul" for "disassembly of the rear clutch".

ASSEMBLY

FRONT INPUT SHAFT AND CLUTCH HOUSING

1. Assemble the rear clutch as described in component overhaul.

2. Install the partially assembled clutch housing, Figure 4-138, 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 4-136.

4. Place the clutch hub and thrust washer, Figure 4-135, 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 4-135. Secure the shaft to the clutch housing with the snap ring.

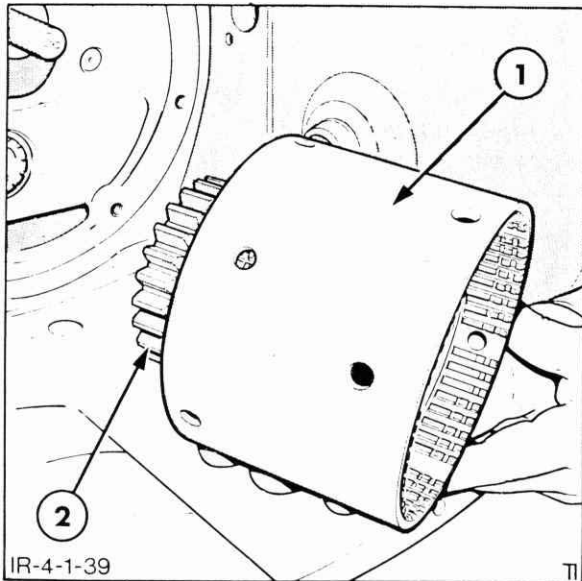


Figure 4-138

Clutch Housing Installation

1. Clutch housing
2. Reverse idler input gear

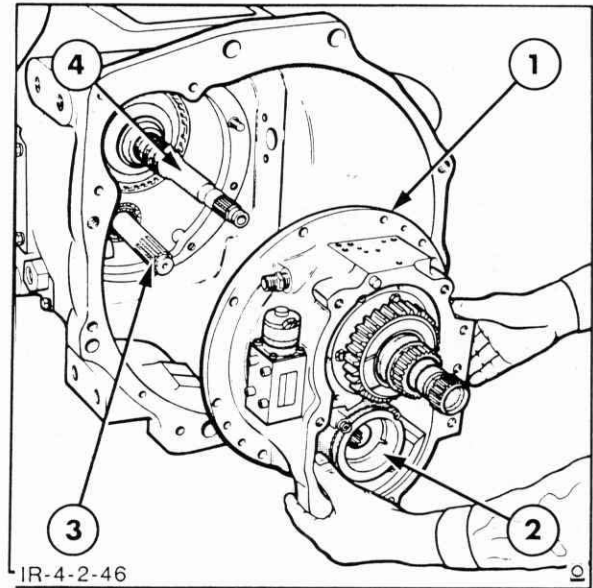


Figure 4-139

Oil Distributor Housing Installation

1. Oil distributor
2. Hydraulic pump
3. P.T.O. shaft
4. Front input shaft

IMPORTANT: Do not force the front input shaft over the rear input shaft, Figure 4-135. 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.

TRANSMISSION HYDRAULIC PUMP AND OIL DISTRIBUTOR HOUSING

1. Assemble the oil distributor.

2. Apply gasket sealant 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 using the two aligning rods FNH00224, onto the transmission casing, Figure 4-134, 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. If the P.T.O. shaft splines do not align with the hydraulic pump inner rotor, turn the shaft at the rear axle to align them. Tighten the retaining bolts to 35-41 ft. lbs.

4. Install a new gasket to the distributor housing front cover, then install the housing front cover plate and secure with the retaining bolts. Tighten the retaining bolts to 35-41 ft. lbs.

5. Assemble the solenoid control valve assembly as described in "Component Overhaul."

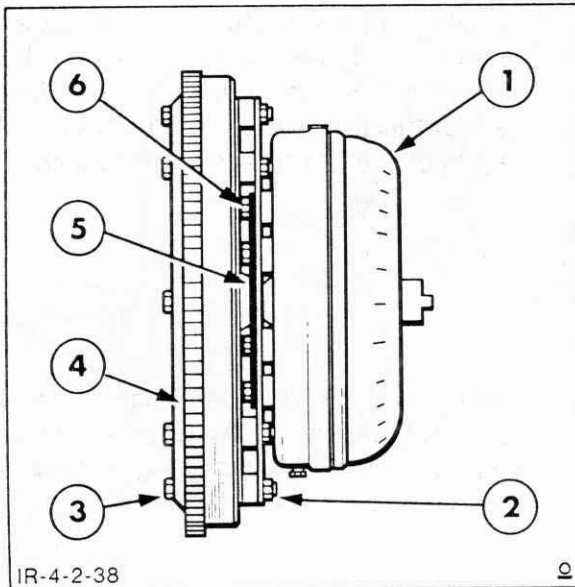


Figure 4-140

Torque Converter To Flywheel Assembly

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
 7. Drain plug
6. 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 17-20 ft. lbs.
 7. Prior to installing the oil cooler return and the pressure test port feed elbows apply thread sealant to the threads. Install the elbows to the transmission casing.
 8. Install the pressure test feed port pipe and tighten.
 9. Install the oil cooler return pipe and tighten.

10. Thread the wiring harness through the transmission casing and connect to the solenoid control valve and lock-up 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.

TORQUE CONVERTER

1. Secure the drive plate to the torque converter, Figure 4-140, with the six attaching bolts and flat washers. Tighten the bolts to 32 ft. lbs.
2. Install 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.

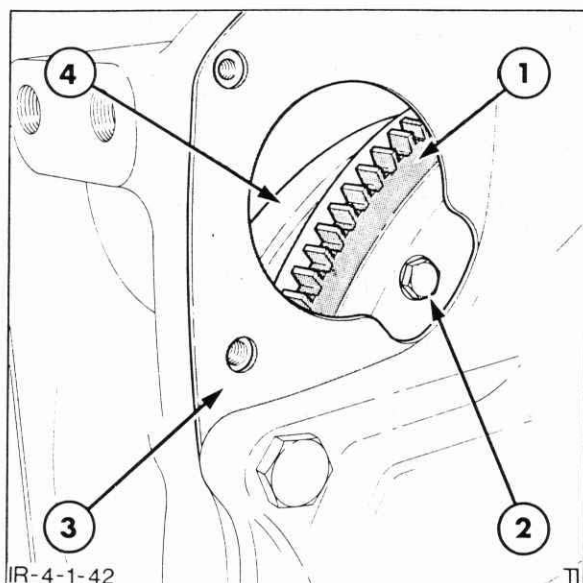


Figure 4-141

Staring Motor Aperture

1. Flywheel *volante del motor*2. Flywheel to drive plate bolts *tornillo placa propulsión devolante*3. Engine backplate *placa posterior motor*4. Torque converter *convertidor de torque*

4. Working through the starting motor opening, Figure 4-141, 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 center the drive plate, then tighten the eight drive plate attaching bolts to 32 ft. lbs.

6. Complete the connection as described in Section 10, "separating the unit".

COMPLETE OVERHAUL

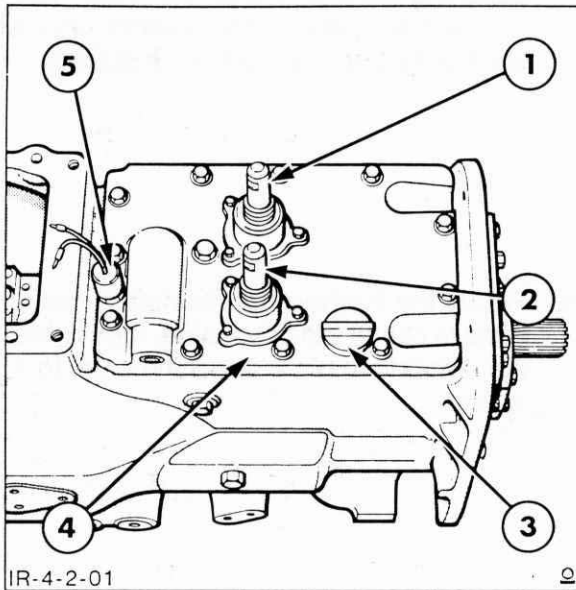


Figure 4-142

Transmission Top Cover

1. Gearshift lever spigot
2. Range lever spigot
3. Oil filter and dipstick
4. Top cover *cubierta superior*
5. Safety start switch

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 Section 10, "separating the unit".

COMPONENT REMOVAL

1. Remove the transmission hydraulic pump and oil distributor.
2. Remove the front input shaft and clutch housing.

GEARSHIFT COMPONENTS

1. Remove the dipstick from the gearshift cover plate.
2. Ensure the gearshift lever and range lever are in neutral. Remove the cover plate retaining bolts then remove the cover plate and gasket, Figure 4-142.

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

P.T.O. shaft

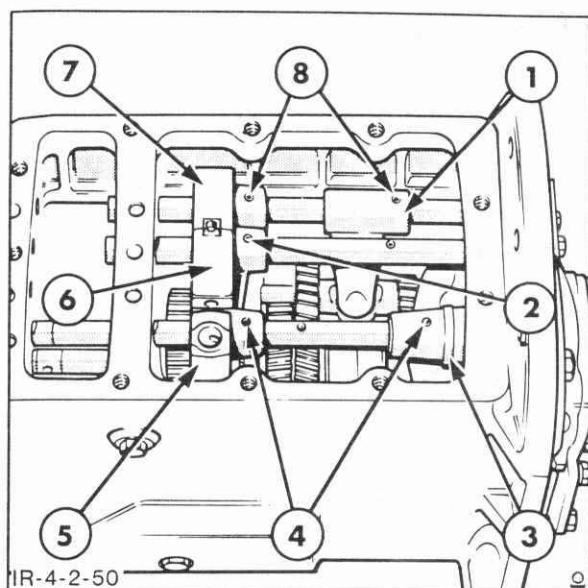


Figure 4-143

Gearshift Component Removal

1. 1st-2nd Shift selector arm
2. 3rd-4th Shift fork and roll pin
3. H-L shift fork
4. H-L shift rail roll pins
5. H-L shift rail gate
6. 3rd-4th Shift rail gate
7. 1st-2nd Shift rail gate
8. 1st-2nd Shift rail roll pins

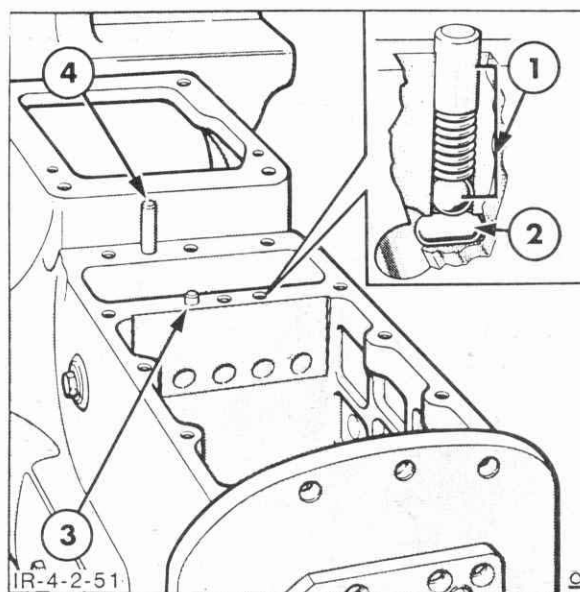


Figure 4-144

Gearshift Detents and Plungers

1. 1st-2nd Shift rail detent
2. Interlock detent
3. 3rd-4th Shift rail detent
4. Safety start switch plunger

3. Remove the detents, springs and balls from the bores in the top of the transmission case, Figure 4-144. 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 selector arm, Figure 4-143.
5. Remove the gearshift rail plugs from the rear end of the transmission case, then extract the gearshift rail rearward, retrieving the gearshift gate and selector arm 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 4-143.
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.
8. Using a suitable pin punch remove the spring pins retaining the H-L gearshift gate and gearshift fork, Figure 4-143.
9. Extract the gearshift rail by sliding the rail rearwards retrieving the gearshift gate and fork as the rail is removed from the transmission case.

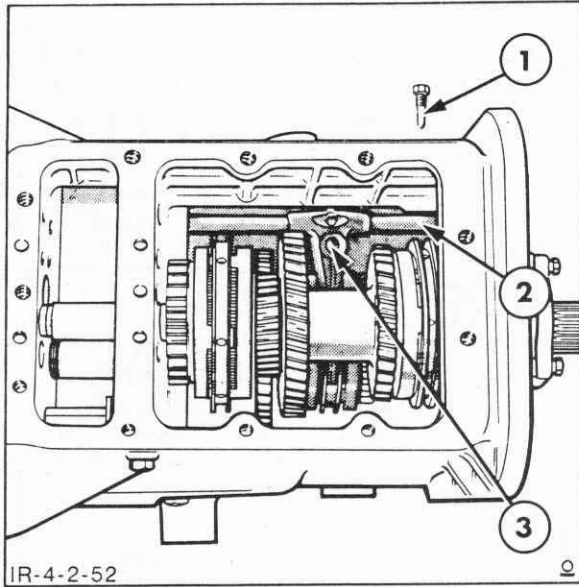


Figure 4-145

1st-2nd Lower Shift Rail Removal

1. Locating bolt
2. Lower shift rail
3. Shift fork

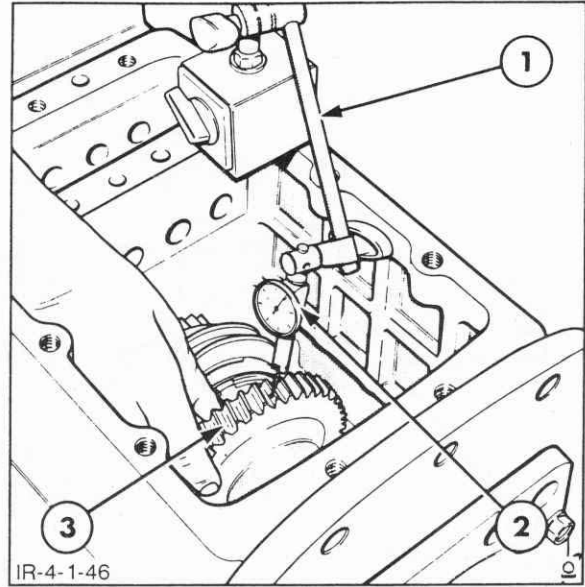


Figure 4-146

Gear Backlash Check

1. Gear backlash bracket
2. Dial indicator
3. Stylus

10. If necessary, remove the interlock detent plug from the left-hand side of the transmission case and extract the interlock detent, Figure 4-144, which is positioned between the 1st/2nd and 3rd/4th gearshift rails.

11. Remove the 1st/2nd lower shift rail locating bolt and extract the rail from the rear of the transmission. Exercise care to prevent the detent ball in the fork from falling into the transmission.

REAR COVER PLATE

1. If transmission gear wear is suspected, 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 4-146, and measure the backlash on output shaft gears.

2. Using a suitable pair of snap ring pliers, remove the internal snap ring retaining

the P.T.O. shaft bearing, Figure 1-147. Withdraw the P.T.O. shaft and bearing as an assembly from the rear cover plate.

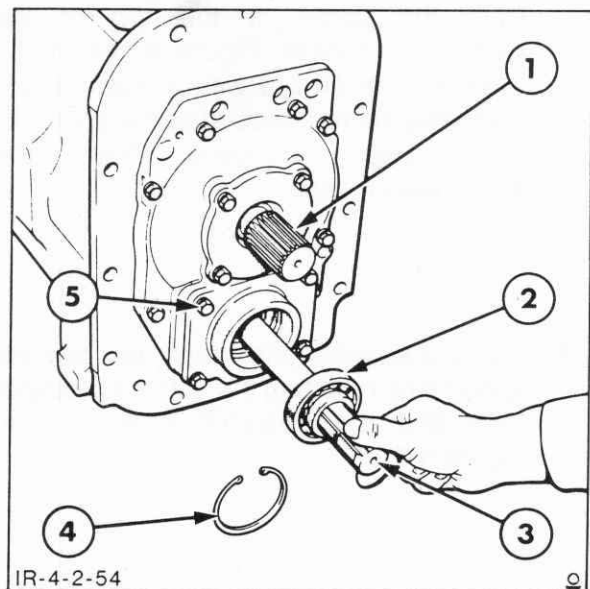


Figure 4-147

P.T.O. Shaft Removal

1. Output shaft
2. Bearing
3. P.T.O. shaft
4. Snap Ring
5. Bearing cap

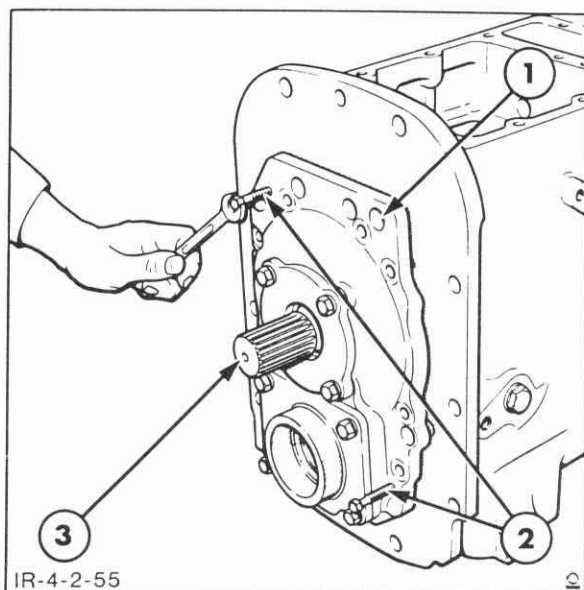


Figure 4-148

Rear Cover Plate Removal

1. Rear cover
2. Jacking bolts
3. Output shaft

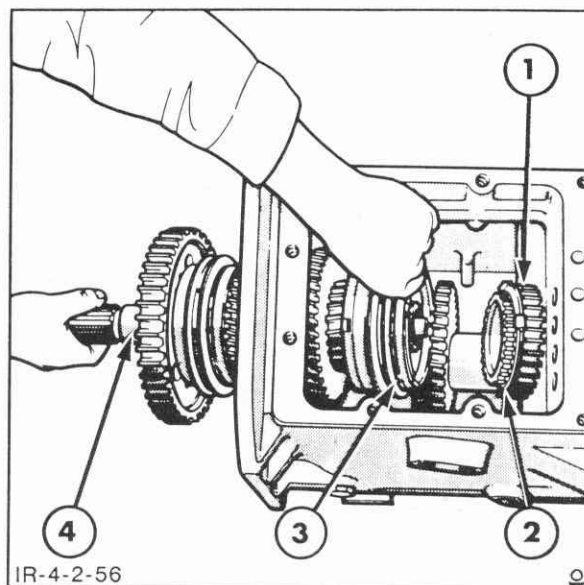


Figure 4-149

Output Shaft Removal

1. Rear input shaft
2. Retainer
3. synchronizer assembly
4. Output shaft

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

together then lift the output shaft assembly rearwards from the transmission case as shown in Figure 4-149.

4. Remove the rear cover retaining bolts then screw two jacking bolts into the rear cover as shown in Figure 4-148. 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.

NOTE: Exercise care when removing the output shaft assembly. Hold the inner cone of the synchronizer to prevent the pins of the synchronizer assembly from falling into the transmission housing.

OUTPUT SHAFT AND COUNTERSHAFT GEAR ASSEMBLIES

1. Release the cord retaining the output shaft and countershaft assemblies

2. Remove the retainer from the rear input shaft and place with the output shaft assembly.

3. Remove the rear input shaft assembly from the transmission case through the gearshift cover plate opening.

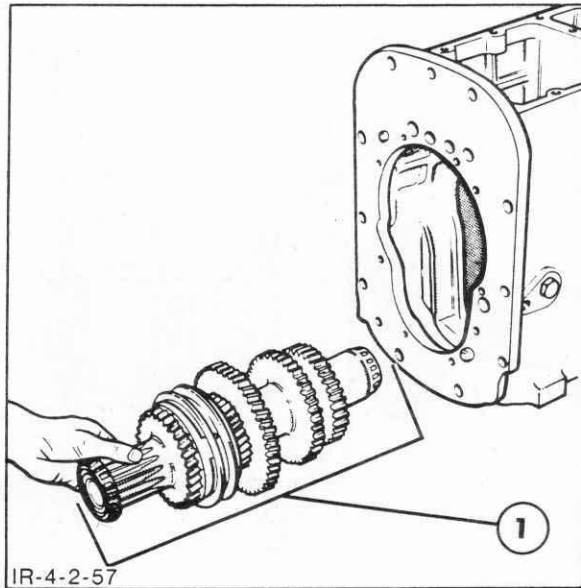


Figure 4-150
Countershaft Removal

1. Countershaft assembly

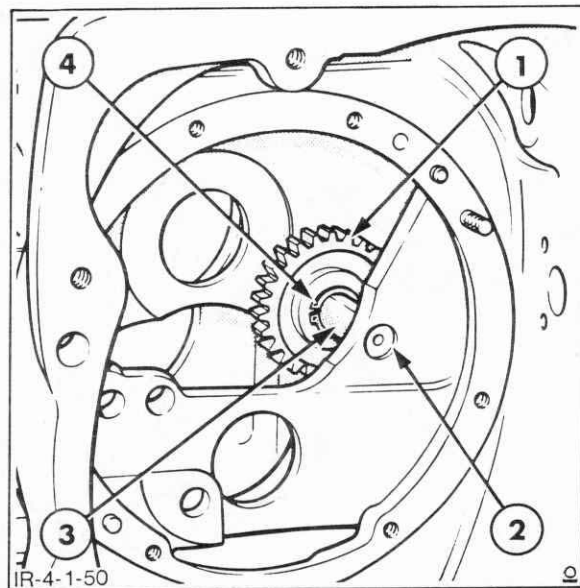


Figure 4-151
Reverse Gear Idler Removal

1. Gear
2. Shaft spigot
3. Shaft
4. Snap ring

4. Lift the countershaft assembly, Figure 4-150, and remove from the rear end of the transmission case.

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

6. Remove the snap ring from the reverse gear idler shaft, Figure 4-151, and slide the shaft rearwards from the transmission case retrieving the gear, bearing and thrust washers as the shaft is removed, Figure 4-152.

7. Refer to "Component Overhaul" for "disassembly of the output shaft and countershaft assemblies".

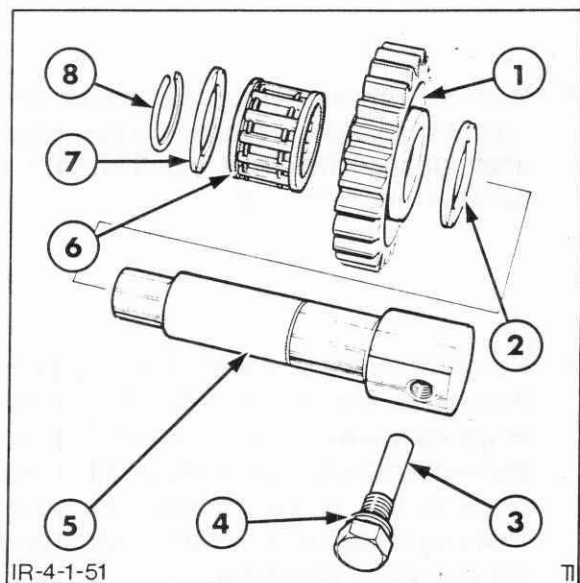


Figure 4-152
Reverse Gear Idler Components

1. Gear
2. Thrust washer
3. Shaft locating bolt
4. Seal
5. Shaft
6. Roller bearing
7. Thrust washer
8. Snap ring

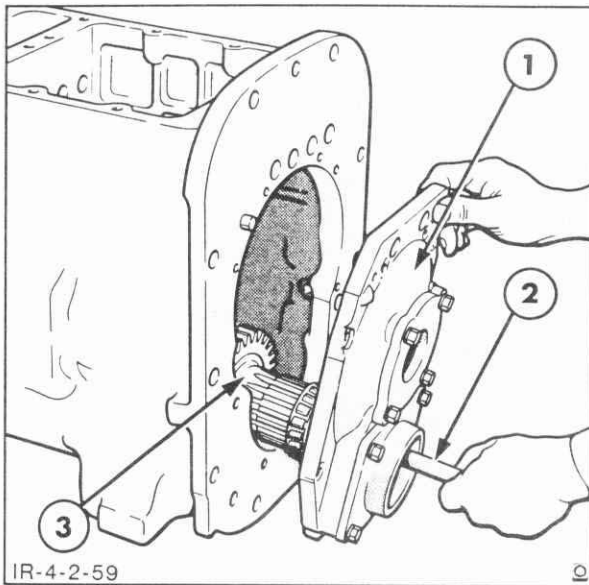


Figure 4-153

Countershaft Installation

1. Rear cover
2. Rod
3. Point to wrap cord

INSTALLATION

COUNTERSHAFT PRE-LOAD CHECK

1. If any of the following parts have been replaced, 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 of 12-16 ft. lbs. (54-72 N·m) rolling torque.

2. Assemble the countershaft and gear assembly as described in "component overhaul".
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 35-41 ft. lbs.
5. Insert a suitable rod through the bearing cap hole and into the countershaft assembly, Figure 4-153.
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 35-41 ft. lbs.
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 4-154, wrap the cord around the countershaft just ahead of the helical gear, Figure 4-153. Ensure that the cord does not overlap.

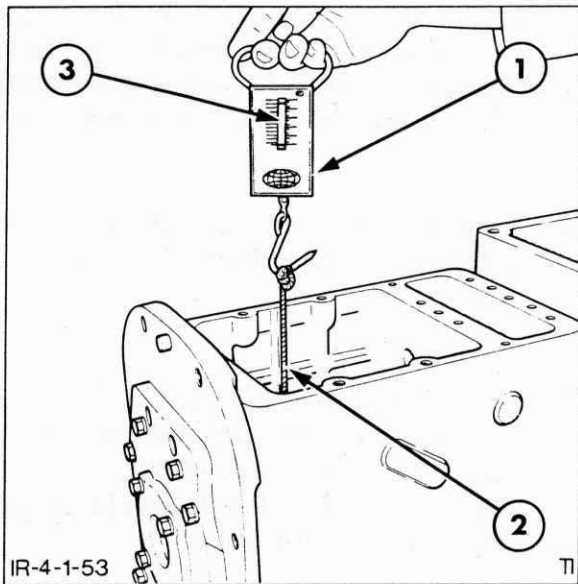


Figure 4-154

Countershaft Pre-Load Check

1. Pull scale
2. Cord

10. If the pull required to rotate the countershaft is outside the 12-16 ft. lbs. (54-72 N·m), remove the rear cover and bearing cap and add or delete shims as required and repeat the procedure.

Note: When installing the bearing cap, apply a thread sealant to the retaining bolts prior to installation.

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 replaced.

Taper roller bearings

Output shaft

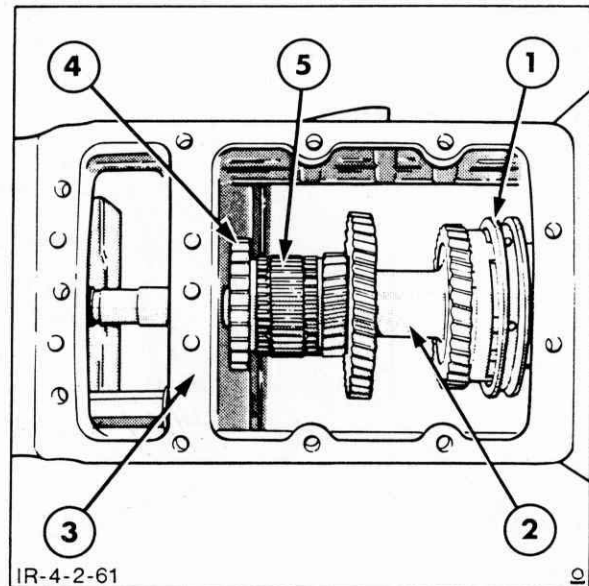


Figure 4-155

Rear Input Shaft Installation

1. H-L synchronizer assembly
2. Output shaft
3. Transmission case inner wall
4. Rear input shaft
5. 3rd-4th Gear splined hub

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.

It is also necessary to remove the 3rd/4th synchronizer assembly from the output shaft, prior to installing the output shaft into the transmission, for the pre-load check.

2. Assemble the output shaft and gear assemble as described in "Component Overhaul."
3. Install the rear input shaft into the transmission case and rest across the transmission case inner wall, Figure 4-155.

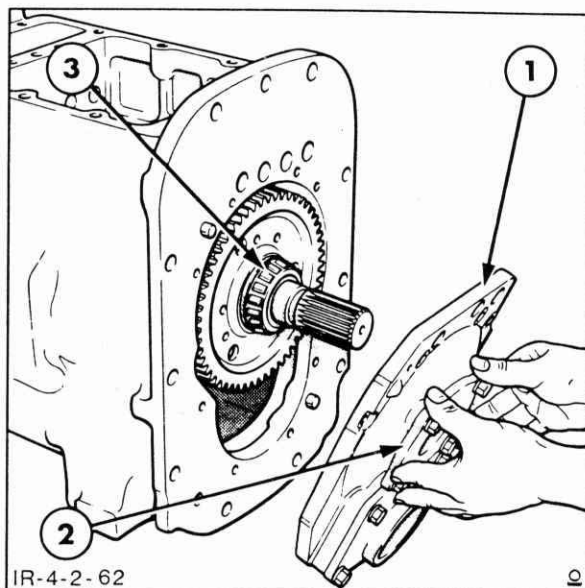


Figure 4-156

Output Shaft Installation

1. Rear cover
2. Output shaft rear bearing
3. Output shaft

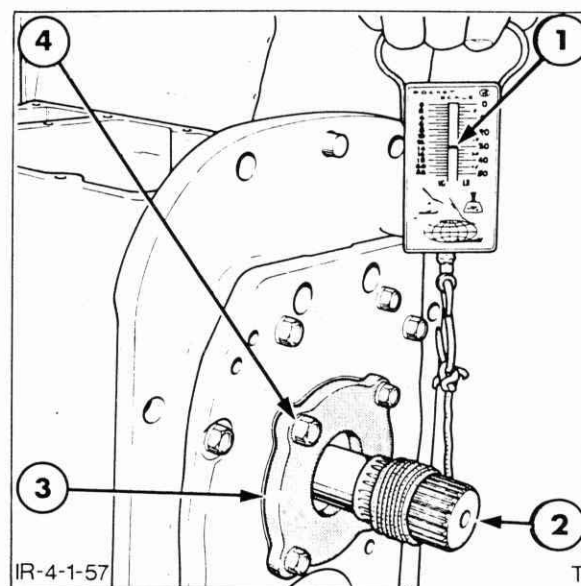


Figure 4-157

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 as shown in Figure 4-156.
5. Ensure that the output shaft bearing cap retaining bolts are tightened to 35-41 ft. lbs.
6. Install the rear cover plate to the transmission case. Install and tighten the cover retaining bolts to 35-41 ft. lbs.
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 4-157. 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 of 12-17 ft. lbs. (54-77 N·m), 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.

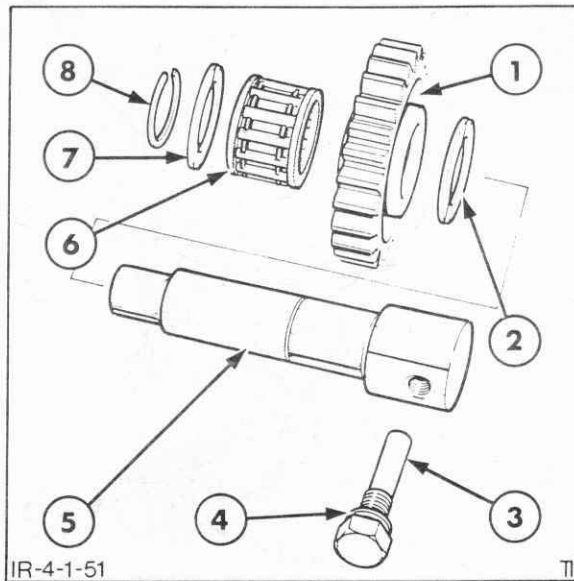


Figure 4-158

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

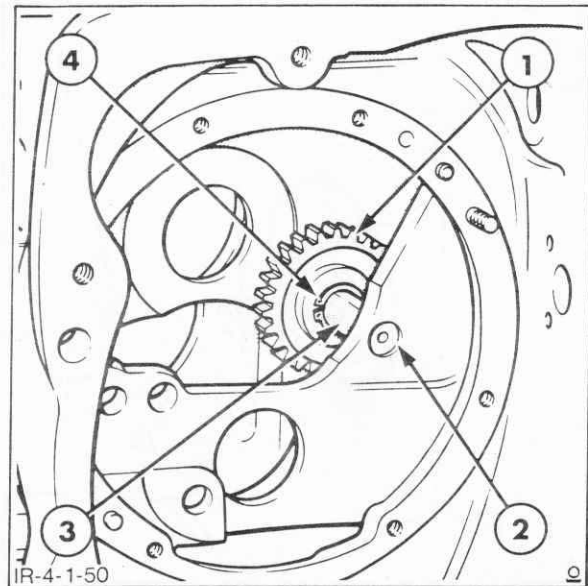


Figure 4-159

Reverse Gear Idler Installation

1. Gear
2. Shaft spigot
3. Shaft
4. Snap ring

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.

OUTPUT SHAFT COUNTERSHAFT AND REAR COVER ASSEMBLIES

1. Install the reverse gear idler shaft into the transmission casing and assembly the component parts for the assembly in the following sequence with reference to Figures 4-158 and 4-159.

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 47-54 ft. lbs.

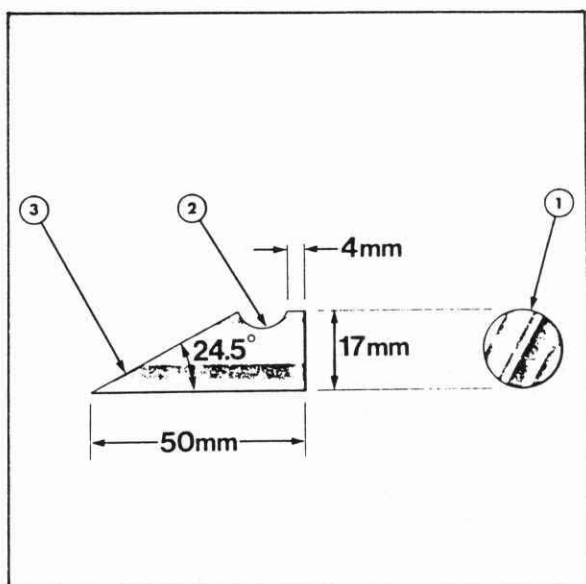
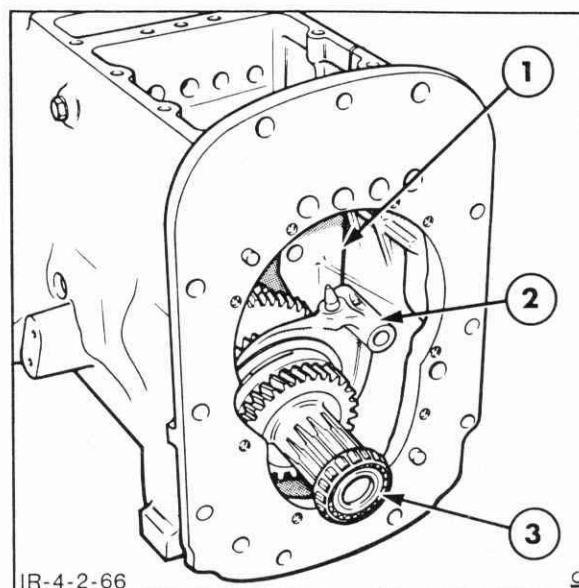


Figure 4-160

Lower Shift Rail Detent Retainer

1. 17 mm bar stock
2. Grind groove to accept detent ball
3. Grind ramp to give 24.5° angle (approx)



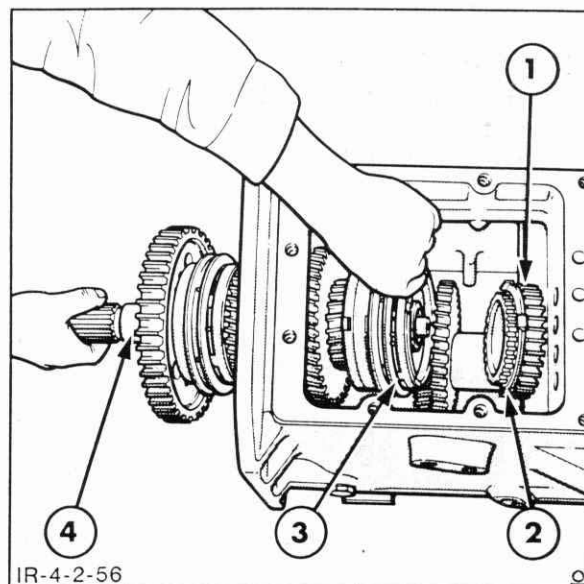
IR-4-2-66

Figure 4-161

Countershaft Installation

1. Brazing rod
2. 1st-2nd Shift rail fork
3. Countershaft rear bearing

3. Install the countershaft and gear assembly into the transmission case from the rear end so that the front end taper roller bearings rests in the bearing cup.
4. Fabricate a detent ball retainer as outlined in "Special tools". See Figure 4-160.
5. Install the detent spring and ball into the 1st/2nd shift rail fork and retain in position using the detent retainer.
6. Position the shift rail fork onto the 1st/2nd synchronizer assembly and using a suitable length of brazing rod support the fork so that it is positioned approximately 1/2" (2 cm) away from the transmission housing as shown in Figure 4-161.
7. Install the 3rd gear synchronizer cone retainer to the rear input shaft, Figure 4-162.



IR-4-2-56

Figure 4-162

Output Shaft Installation

1. Rear input shaft
2. Retainer
3. 3rd/4th synchronizer assembly
4. Output shaft

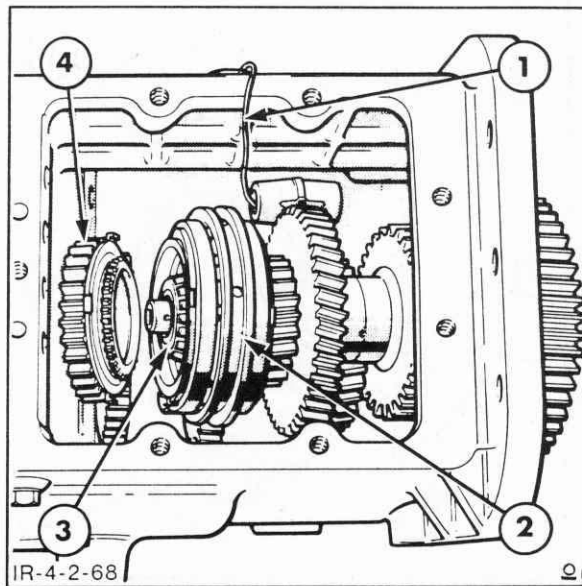


Figure 4-163
Output Shaft Installed

1. Brazing rod
2. 3rd-4th synchronizer
3. Output shaft front bearing
4. Rear input shaft and retainer

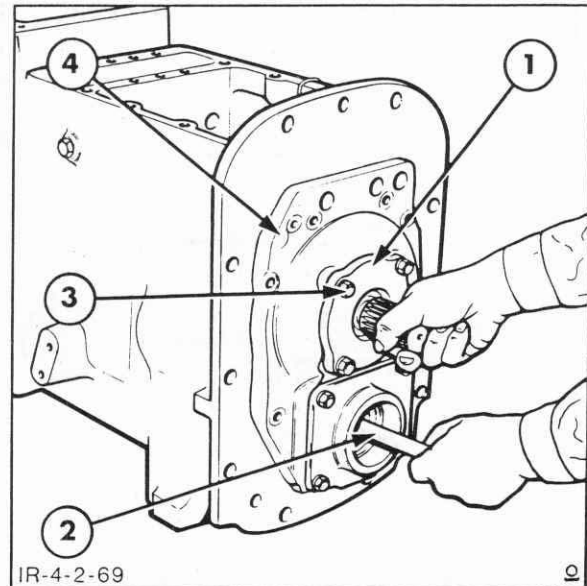


Figure 4-164
Rear Cover Plate Installation

1. Output shaft bearing cap
2. Suitable rod
3. Countershaft bearing cap
4. Rear cover plate

8. Install the rear input shaft and the retainer into the transmission case and rest it across the transmission case inner wall.

9. Install the output shaft and gear assembly into the transmission case from the rear end, while holding the front end of the synchronizer assembly to prevent the cones and pins dropping out, Figure 4-161, and position onto the countershaft and gear assembly just behind the rear input shaft, Figure 4-163.

10. 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.

NOTE: Ensure that the synchronizer retainer positioned on the rear input shaft is aligned with the synchronizer ring on the output shaft, and that both parts mesh correctly.

11. Apply gasket sealant to the rear cover face, then position the cover over the output shaft until the output shaft taper roller bearing contacts the respective bearing cap.

12. Insert a suitable rod through the countershaft bearing cap hole into the countershaft, Figure 4-164. Lift the countershaft while positioning the rear cover plate onto the transmission case, Figure 4-164.

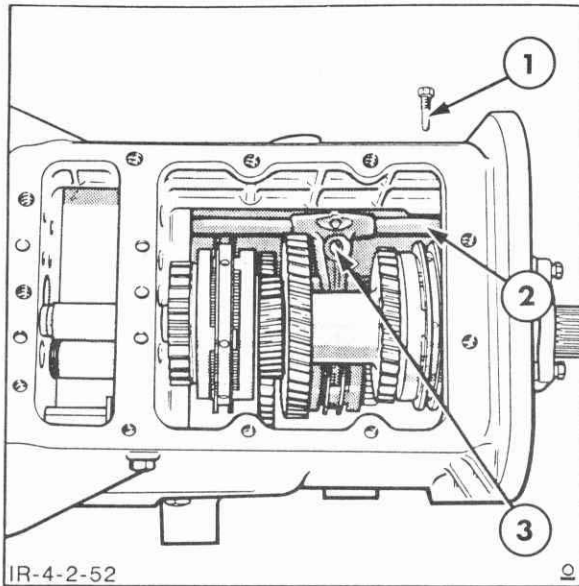


Figure 4-165

1st/2nd Lower Shift Rail Installation

1. Locating bolt
2. Lower shift rail
3. Shift fork

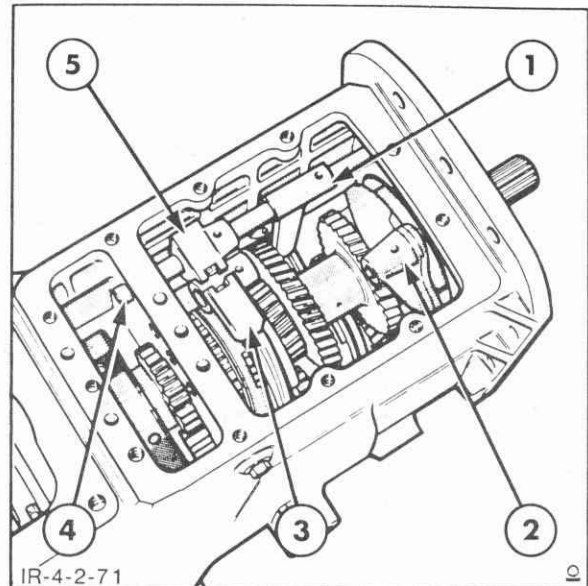


Figure 4-166

1st/2nd Gearshift Rail Installation

1. 1st/2nd Selector arm
2. H/L Shift fork
3. 3rd/4th Shift fork
4. 1st/2nd Shift rail
5. 1st/2nd Rail gate

13. Secure the rear cover plate assembly to the transmission case with the retaining bolts. Tighten the retaining bolts to 35-41 ft. lbs.

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

retrieve the detent ball retainer from the opposite side of the fork.

2. Install the lower shift rail locating bolt, Figure 4-165. Remove the brazing rod used to support the fork from the transmission. Tighten the locating bolt to 45-54 ft. lbs.

GEARSHIFT COMPONENTS

1. Install the 1st/2nd lower shift rail through the rear cover and engage with the shift fork. Drive the rail through the fork and

3. Install the 3rd/4th and H/L gearshift forks into the respective synchronizer assemblies, Figure 4-166.

4. Install the 1st/2nd shift rail selector arm into the shift fork.

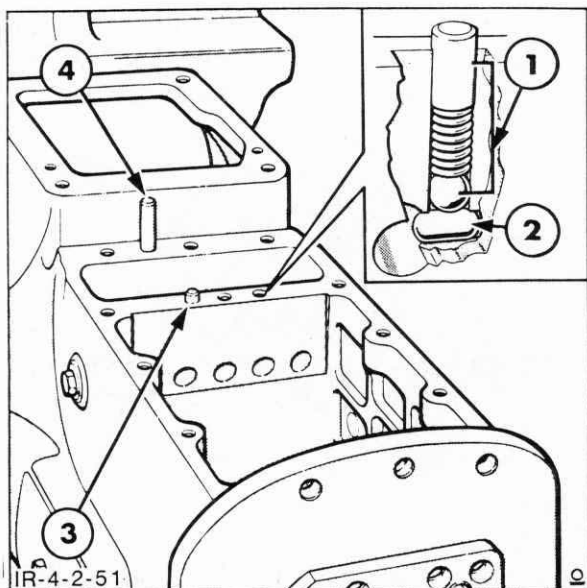


Figure 4-167

Gearshift Detents and Plungers

1. 1st/2nd Shift rail detent
2. Interlock detent
3. 3rd/4th Shift rail detent
4. Safety start switch plunger

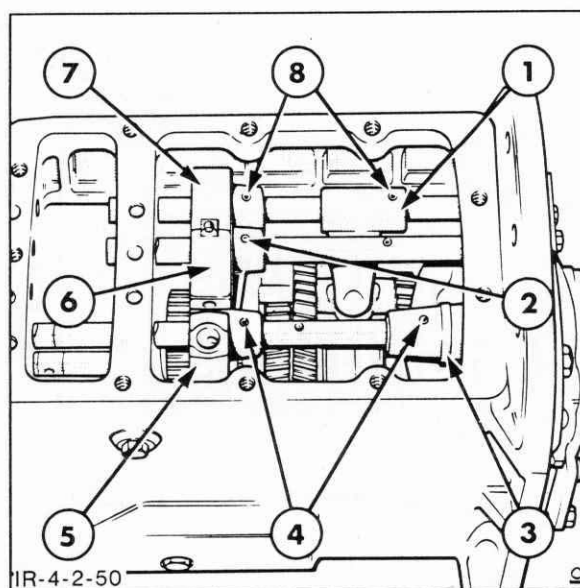


Figure 4-168

Gearshift Component Installation

1. 1st-2nd Shift selector arm
2. 3rd-4th Shift fork and roll pin
3. H-L Shift fork
4. H-L Shift rail roll pins
5. H-L Shift rail gate
6. 3rd-4th Shift rail gate
7. 1st-2nd Shift rail gate
8. 1st-2nd Shift rail roll pins

5. Insert the 1st/2nd gearshift rail into the transmission case from the rear end of the transmission. Slide the rail through the 1st/2nd selector arm then install the 1st/2nd gearshift gate onto the rail. Continue sliding the rail until it is in approximately the neutral position, Figure 4-166.

6. Install the interlock detent into the drilling between the 1st/2nd and 3rd/4th gearshift rail bores of the transmission inner wall, Figure 4-167.

7. 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 the 1st/2nd gearshift rail is not in neutral.

SECTION 4

8. Insert the H/L gearshift rail into the transmission case from the rear end of the transmission. Slide the rail through the H/L gearshift fork then install the H/L gearshift gate onto the rail. Continue sliding the rail until it is in approximately the neutral position, Figure 4-168.
9. Align the spring pin holes in the gearshift gate forks and rails then drive the spring pins into the holes.
10. Insert the safety start switch plunger into the respective bore, Figure 4-167. Insert the gearshift rail balls, springs and detents into their respective bores, Figure 4-167.
11. Install the 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 described previously in "Front End Overhaul."
2. Install the transmission hydraulic pump and oil distributor as described previously in "Front End Overhaul."

COMPONENT OVERHAUL

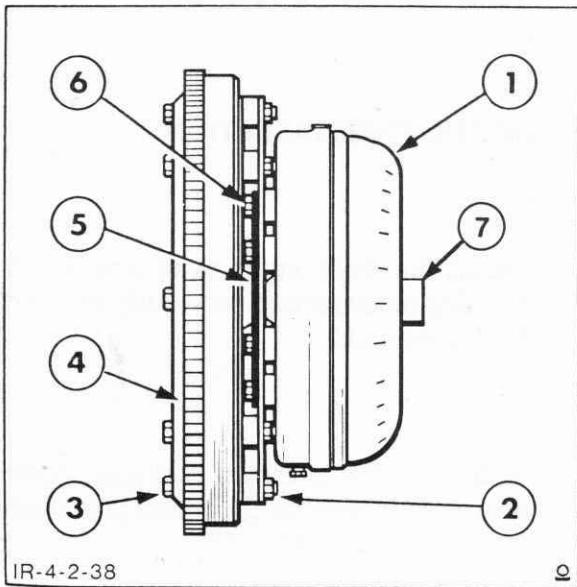


Figure 4-169

Torque Converter and Drive Plate

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
7. Splines

Torque converter

Transmission hydraulic pump and oil distributor assembly.

Solenoid control valve and lock-up 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 4-169, is a welded unit and cannot be disassembled. The only maintenance performed on the converter, other than the stall test, 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. Drain as much oil as possible from the converter by tilting the hub of the converter in all directions.
2. 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 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.

INSPECTION

Inspect the splines, Figure 4-169, 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.

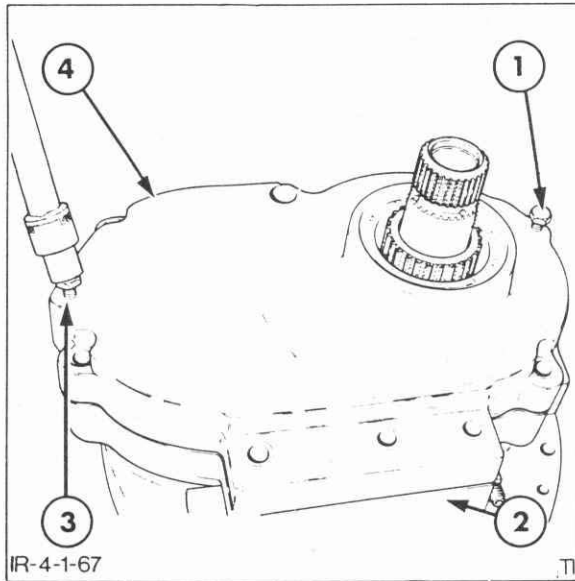


Figure 4-170

Front Cover Plate Removal

1. Jacking bolt
2. Oil distributor
3. Jacking bolt
4. Front cover plate

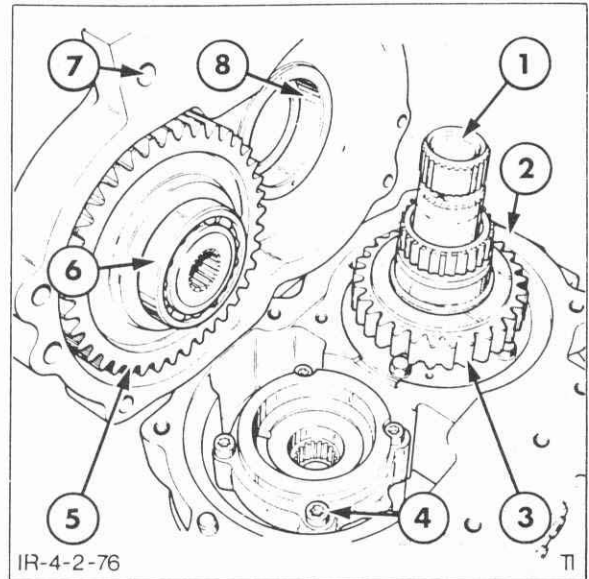


Figure 4-171

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

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 4-170. 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 4-172.

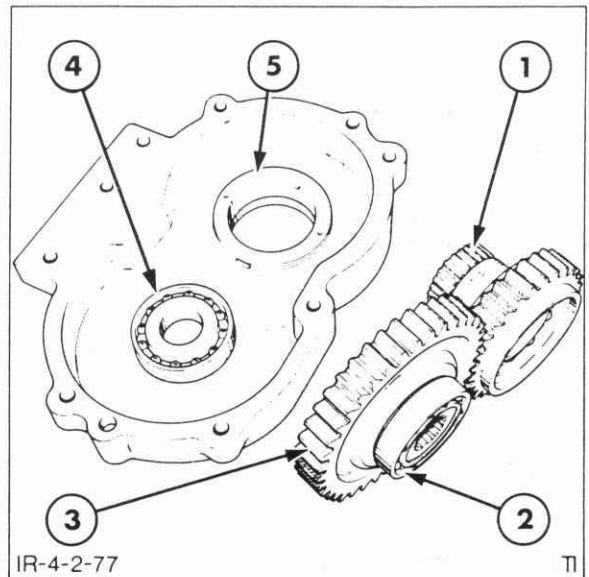


Figure 4-172

Pump Drive Gear Removal

1. Drive gear splines
2. Bearing
3. Driven gear
4. Bearing
5. Thrust washer

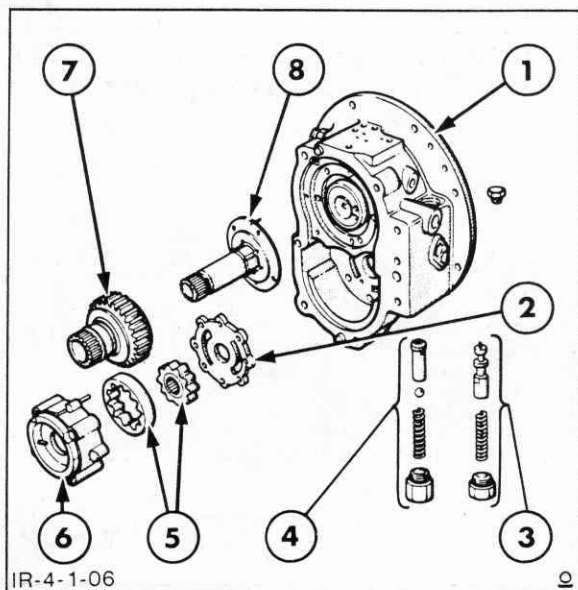


Figure 4-173

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

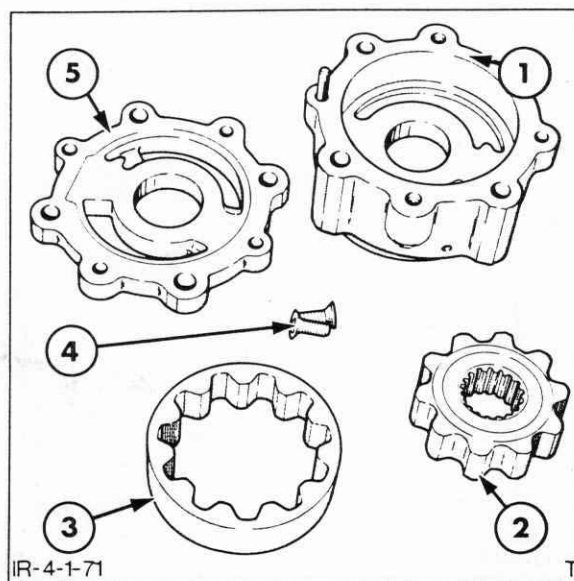


Figure 4-174

Transmission Pump Components

1. Pump body
2. Inner rotor
3. Outer rotor
4. End plate screws
5. End plate

3. Slide the gear from the stator support. Remove the stator support retaining bolts then remove the support from the oil distributor housing, Figure 4-171.

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

4. Remove the hydraulic pump retaining bolts and lift the pump assembly from the distributor housing, Figure 4-173.

5. Remove the by-pass valve plug and extract the shim, spring ball and valve, Figure 4-173.

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

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 on 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.

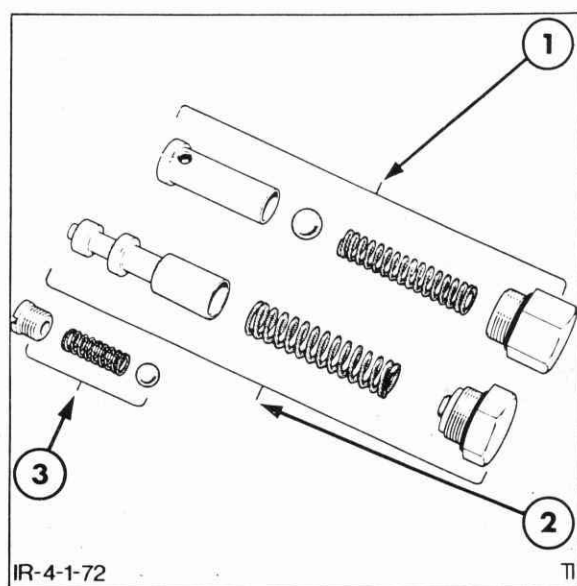


Figure 4-175

Transmission Hydraulic Valves

1. By-pass valve
 2. Regulating valve
 3. Lubrication valve
4. Inspect the front cover torque converter 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 4-175. If

scratch marks cannot be removed by polishing, install new parts during assembly. Check the spring and if suspect measure the spring as follows:

BY-PASS VALVE SPRING

Outside Diameter	0.543" (13.8 mm)
Free Length (Approx)	2.610" (66.3 mm)
Maximum Solid Height	1.205" (30.6 mm)
Height Under Load 8.6 kg	1.811" (46.0 mm)

8. Inspect the regulating valve spool, Figure 4-175, 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 as follows:

REGULATING VALVE SPRING

Outside Diameter	0.610" (15.5 mm)
Free Length (Approx)	2.717" (69.0 mm)
Maximum Solid Height	1.181" (30.0 mm)
Height Under Load 6.83 kg	2.205" (56.0 mm)

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 replace the suction pipe seal on assembly, Figure 4-176.

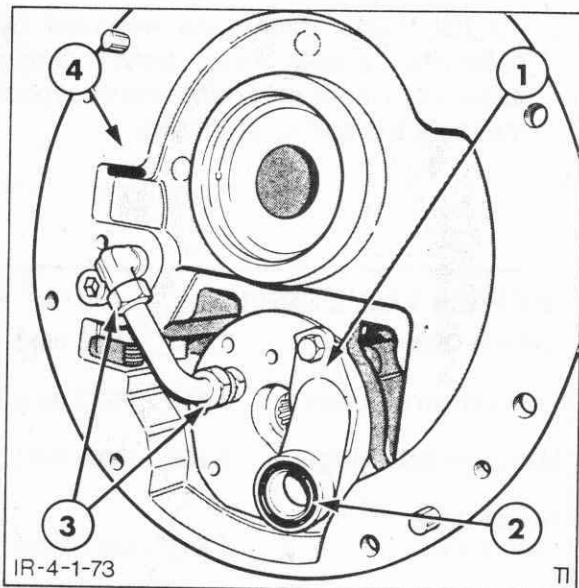


Figure 4-176

Transmission Pump Connections

1. Suction tube
2. Seal
3. Pressure tube connections
4. Distributor housing

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 57-66 ft. lbs.
2. Install the by-pass valve seal, ball, spring and shim into the respective bore and retain with the plug. Tighten the plug to 57-66 ft. lbs.
3. Assemble the transmission hydraulic pump components as shown in Figure 4-173. Install the pump onto the distributor housing and secure with the retaining bolts. Tighten the bolts to 19 ft. lbs.

4. Install the stator support onto the distributor housing and secure with the retaining bolts. Tighten the bolts to 19 ft. lbs.
5. Locate the gear onto the stator support, Figure 4-171.
6. If it was necessary to remove the oil seal from the front cover, install a new seal using Tool #630 or FNH09210 and a press. If the thrust washer was removed, install a new thrust washer using new lock pins.
7. Install the hydraulic pump drive gear and bearings to the front cover, the assembly is a push fit.
8. Do not install the front cover plate at this stage as it is necessary to align the P.T.O. shaft and pump drive gear during assembly.

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 4-177. To remove the needle bearing, collapse the inner race with a hammer and chisel, then pull the outer race from the shaft with Tool #1003 and 951 or FNH09516 and FNH9190.

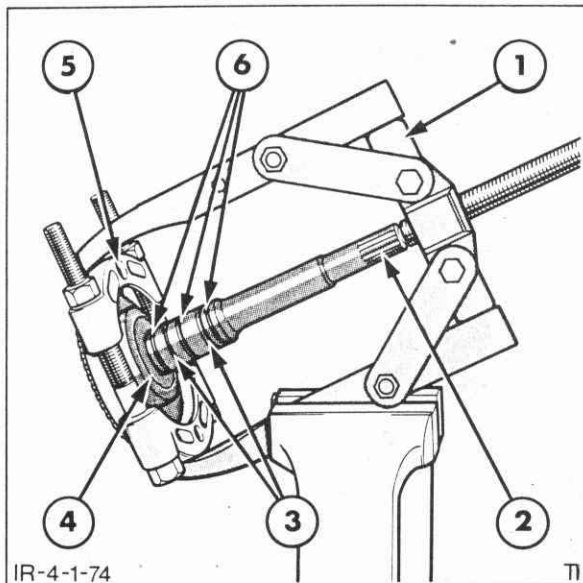


Figure 4-177

Front Input Shaft Bearing Removal

1. Puller - tool no. 1003 or FNH09516
2. Front input shaft
3. Oil passages
4. Front input shaft bearing
5. Pulling attachment - tool no. 951 or FNH09190
6. Sealing rings

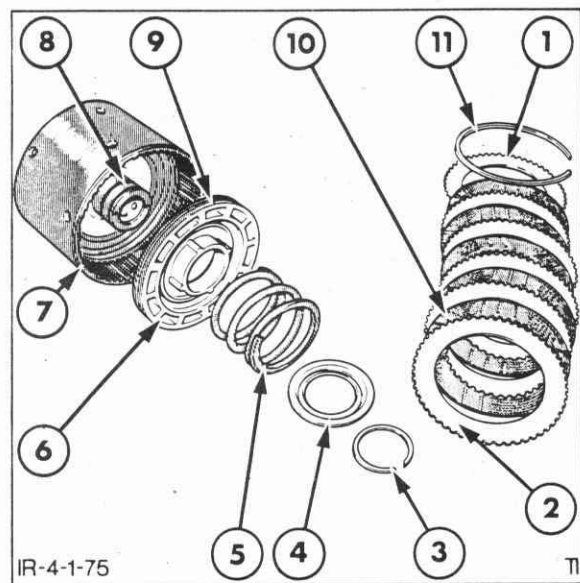


Figure 4-178

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

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.
4. Remove the large snap ring, clutch drive plate and internal plates from the rear clutch.
5. Using a press and modified Tool #FT4101 or FNH01312 (see specifications), along with a suitable size washer as shown in Figure 4-179, 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. Check the spring as follows:

CLUTCH PISTON SPRING

Outside Diameter	3.012" (76.5 mm)
Free Length (Approx)	2.362" (60.0 mm)
Maximum Solid Height	1.043" (26.5 mm)
Height Under Load 114.6 kg	1.181" (30.0 mm)

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 4-178.

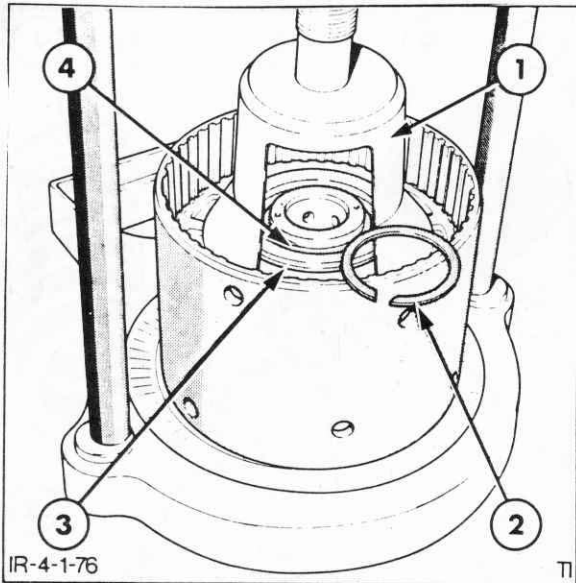


Figure 4-179

Clutch Piston Return Spring Removal

1. Modified tool no. Ft 4101 or FNH01312
2. Snap ring
3. Spring retainer
4. Snap ring groove

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 4-182, and the clutch components, Figure 4-179, 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.

2. Check the ball bearing on the front input shaft, Figure 4-182, 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.

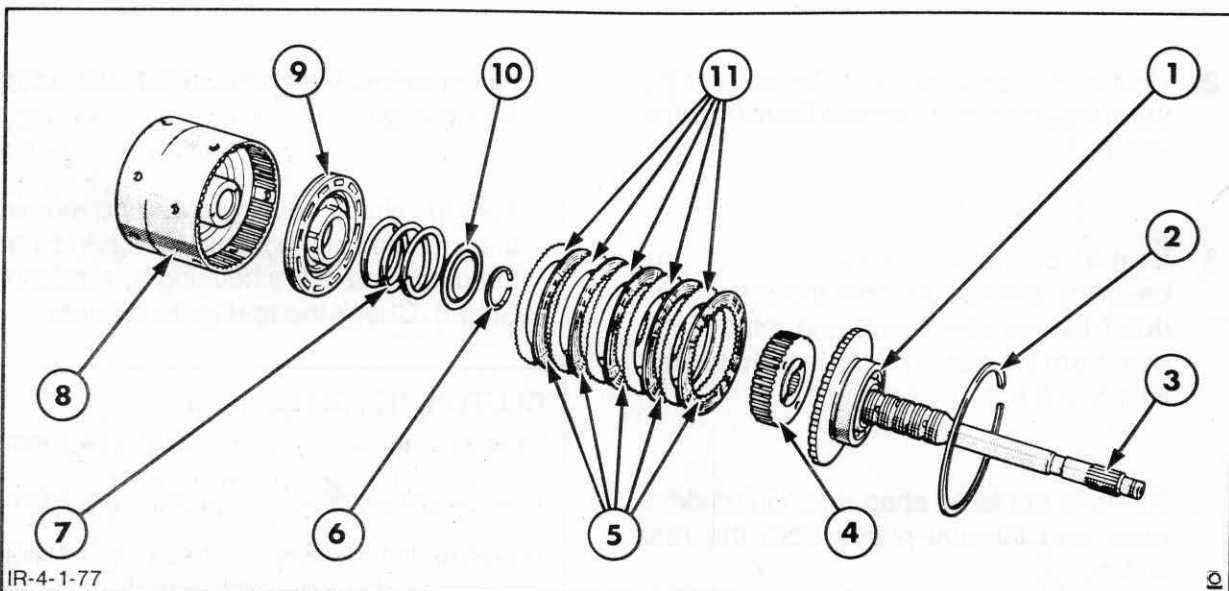


Figure 4-180

Forward Clutch Components

- | | |
|-------------------------------------|-----------------------------------|
| 1. Ball bearing | 7. Return spring |
| 2. Snap ring | 8. Clutch housing |
| 3. Front input shaft | 9. Piston |
| 4. Front hub | 10. Spring retainer |
| 5. Friction disc - internal splines | 11. Steel disc - external splines |
| 6. Snap ring | |

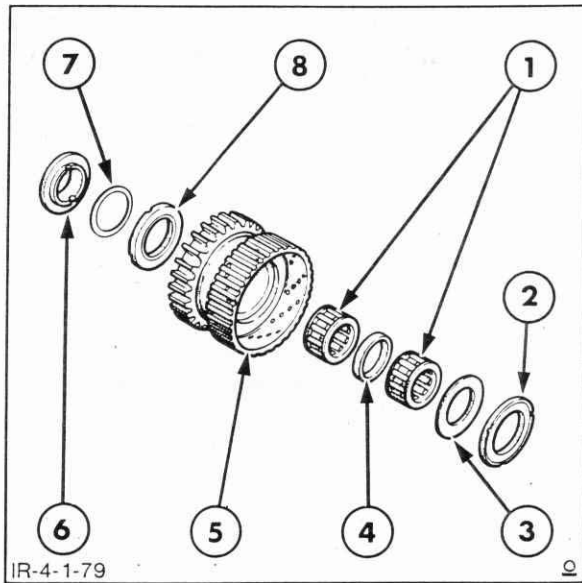


Figure 4-181

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

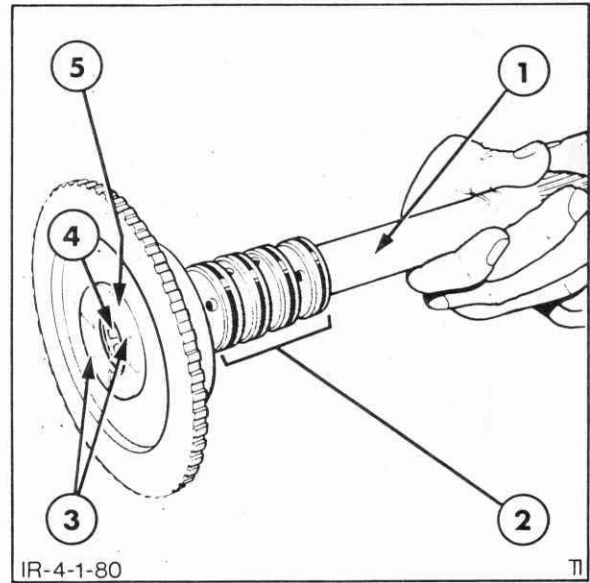


Figure 4-182

Front Input Shaft Assembly

1. Shaft
2. Sealing rings
3. Knock pins
4. Roller bearing
5. Thrust washer

3. Inspect the front shaft sealing rings, Figure 4-183, 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 4-180, 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 4-180, 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 center web of the housing.
2. Position the spring and spring seat on the piston, then compress the spring with a press, using modified Tool #FT4101 or FNH01312, and a suitable washer, as shown in Figure 4-179, so 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.

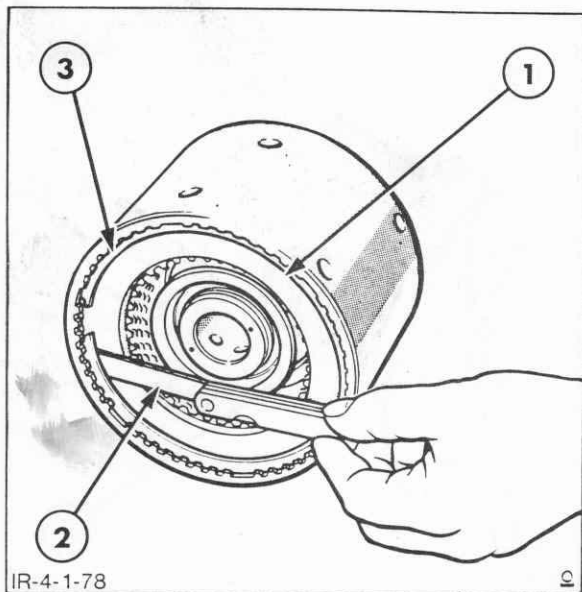


Figure 4-183

Clutch Pack Clearance

1. Pressure plate
2. Feeler gauge
3. Snap ring

4. Place the thrust washer, Figure 4-181, 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 #630-S or FNH09210.

7. Install the three sealing rings on the front input shaft, making sure each ring is locked in place.
8. Install the clutch housing and front input shaft as covered previously in "Front End Overhaul."

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 4-183, while holding the plate against the clutch disc.

The clearance must be measured at three points equally spaced around the housing (120 degree 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 0.063-0.070" (1.6-1.8 mm) limits, change a clutch disc. Different thickness discs are available through Parts. They are: 0.090" (2.30 mm) – 0.096" (2.44 mm) – 0.100" (2.60 mm).

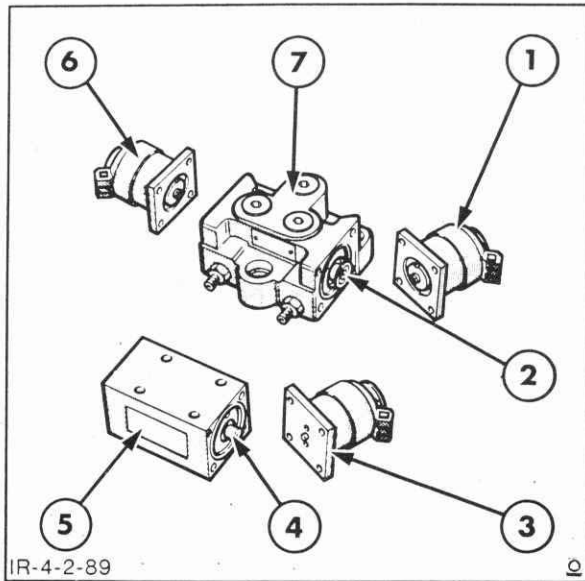


Figure 4-184

Solenoid Control Valve Assembly

1. Forward solenoid
2. Spool
3. Lock-up solenoid
4. Spool
5. Lock-up valve body
6. Reverse solenoid
7. Control valve body

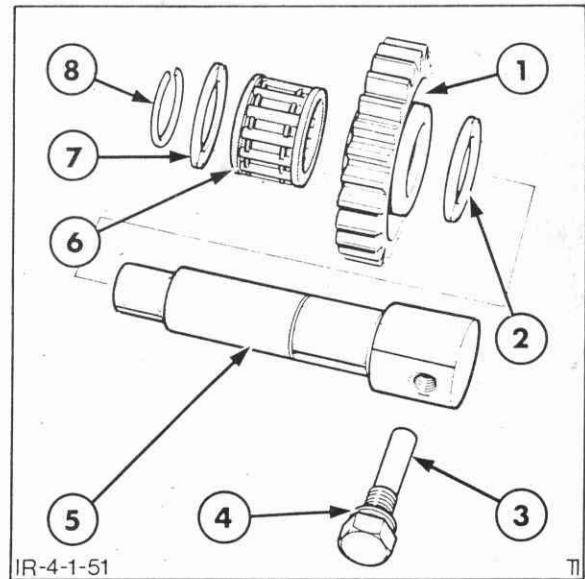


Figure 4-185

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

SOLENOID CONTROL VALVE AND LOCK-UP VALVE

DISASSEMBLY

1. Remove the lock-up valve and control valve solenoid retaining bolts and disassemble the solenoid assemblies from the valve bodies, Figure 4-184.

INSPECTION

1. Manually check that the spools slide smoothly within the valve bodies, then reassemble the lock-up and control valves and solenoids. Tighten the retaining bolts to 2-4 ft. lbs.

NOTE: The internal parts of the valve assemblies are not serviced separately.

The solenoid control valve and lock-up valve are serviced as complete assemblies, overhaul is limited to checking spool movement only.

REVERSE IDLER GEAR ASSEMBLY

INSPECTION

1. Thoroughly clean the reverse idler gear components, Figure 4-185, with a suitable solvent and allow to dry.

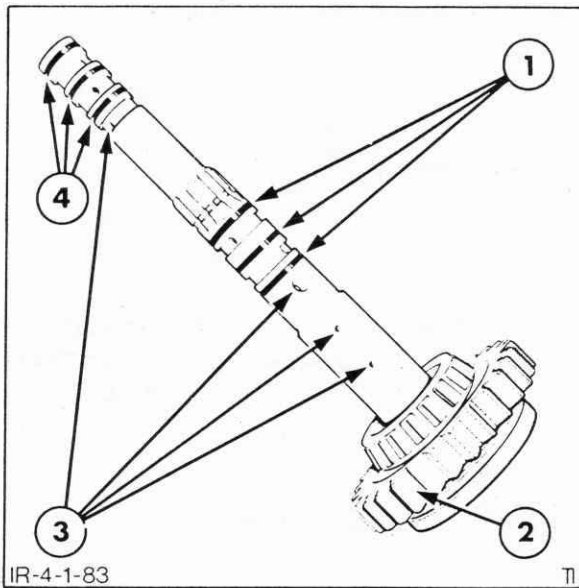


Figure 4-186

Rear Input Shaft Assembly

1. Rear sealing rings
2. Gear shaft assembly
3. Lubrication gallery oil holes
4. Front sealing rings

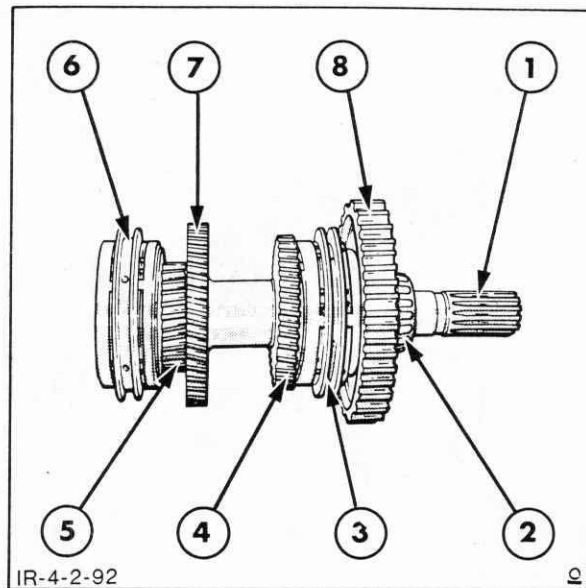


Figure 4-187

Output Shaft Assembly

1. Output shaft
2. Rear bearing
3. H/L synchronizer
4. High range gear
5. 4th Gear
6. 3rd/4th synchronizer
7. 2nd Gear driven
8. Low range gear

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

gear is chipped or cracked, a new gear should be installed.

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

REAR INPUT SHAFT

INSPECTION

1. Thoroughly clean the rear input shaft, Figure 4-186, with a suitable solvent and allow to dry. Use compressed air to clean out the oil passages. Do not spin the bearings with compressed air.

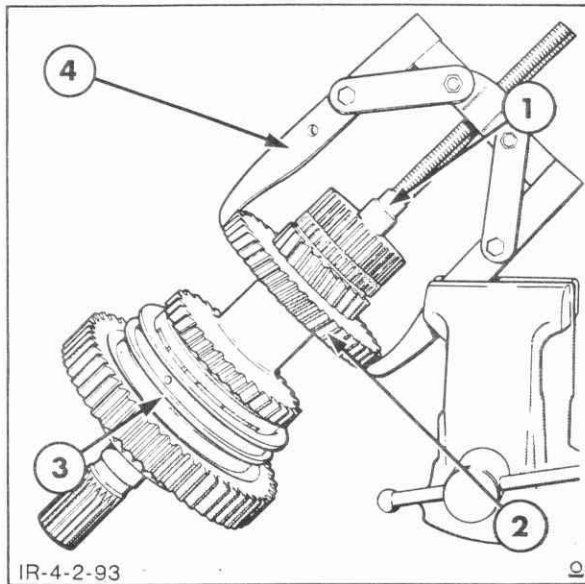


Figure 4-188

Output Shaft Front Bearing Removal

1. Shaft protector, tool no. 625A or FNH09212
 2. 2nd Gear driven
 3. H/L synchronizer
 4. Puller, tool no. 1003 or FHN09516
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 replaced on assembly. Ensure all oil passages are clean.
 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
- ### DISASSEMBLY
1. Remove the 3rd/4th gear synchronizer from the output shaft assembly and wire the assembly together to prevent the mixing of components with other synchronizer assemblies.
 2. Attach a puller, Tool #1003 or FNH09516 with shaft protector Tool #625A or FNH09212 to the 2nd gear driven and remove the front bearing, coupling, 4th gear and the 2nd gear driven and high range gear cluster, Figure 4-188.
 3. Remove the snap ring retaining the 3rd/4th gear coupler and remove the coupler from the gear cluster.
 4. Remove the snap ring retaining the 4th gear to the gear cluster, then remove the gear from the gear cluster.
 5. Remove the H/L range synchronizer from the output shaft and wire the assembly together to prevent the mixing of components with other synchronizer assemblies.
 6. Attach a puller, Tool #1003 or FNH09516 with shaft protector 625A or FNH09212 to the "L" range gear and remove the rear bearing, thrust washer and "L" range gear from the shaft.

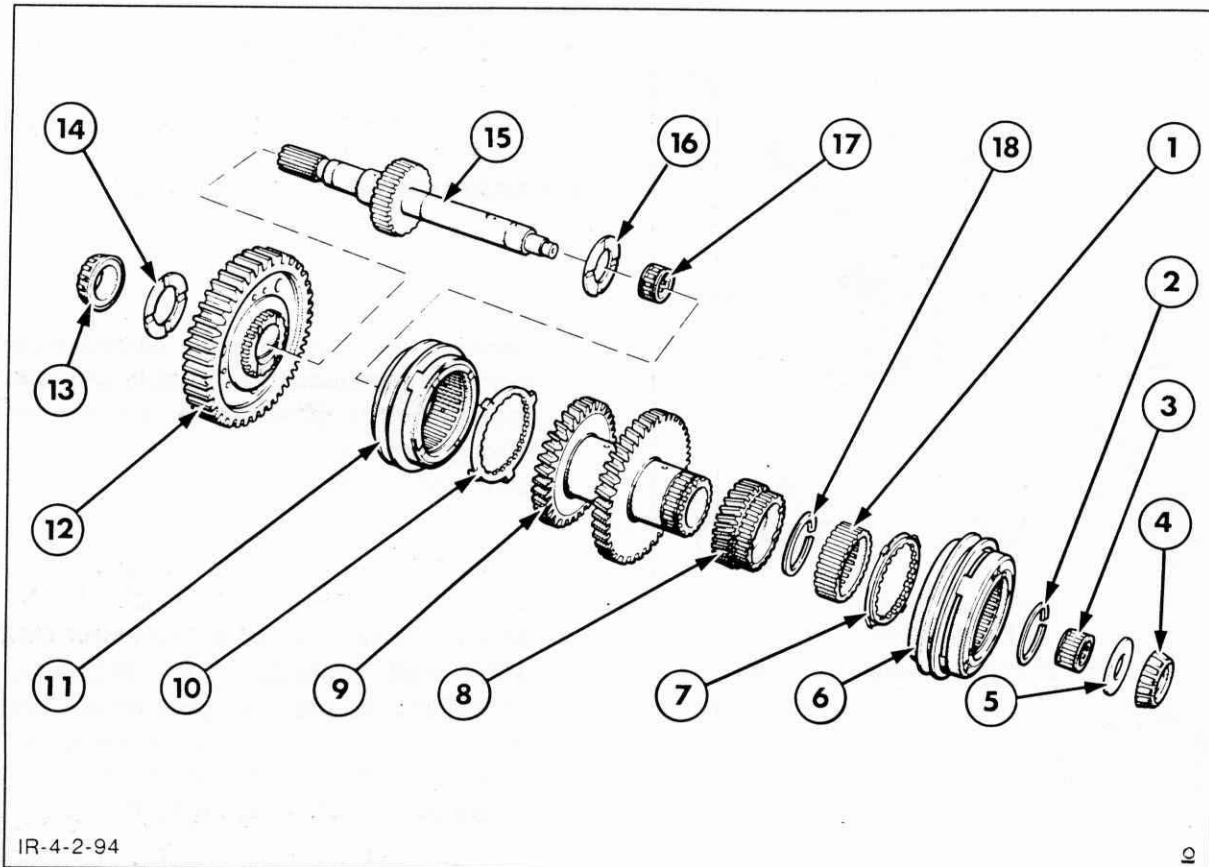


Figure 4-189

Output Shaft Components

- | | |
|-------------------------------|-------------------------------|
| 1. Coupler | 10. Retainer |
| 2. Snap ring | 11. L/H Range synchronizer |
| 3. Needle roller bearing | 12. Low range gear |
| 4. Front taper roller bearing | 13. Rear taper roller bearing |
| 5. Thrust washer | 14. Thrust washer |
| 6. 3rd/4th synchronizer | 15. Output shaft |
| 7. Retainer | 16. Thrust washer |
| 8. 4th Gear | 17. Needle roller bearing |
| 9. Cluster gear | 18. Snap ring |

OUTPUT SHAFT AND GEAR ASSEMBLY

INSPECTION

1. Thoroughly clean the output shaft components, Figure 4-189, 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.

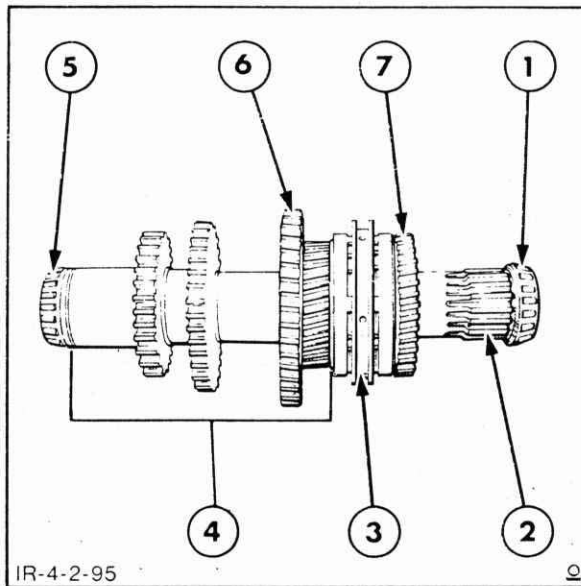


Figure 4-190
Countershaft Assembly

1. Rear assembly
 2. Shaft and gear assembly
 3. 1st/2nd synchronizer
 4. Cluster gears
 5. Front bearing
 6. 2nd Gear
 7. 1st Gear
1. Install the "L" range 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 L/H gear synchronizer assembly over the front end of the shaft and locate onto the splines.
 3. Install the thrust washer and needle roller bearing onto the shaft, then install the "H" range and 2nd driven gear cluster over the bearing.
 4. Install the second needle roller bearing onto the shaft and insert into the gear cluster.
 5. Install the 4th gear onto the gear cluster and retain with the appropriate snap ring, then install the coupler onto the shaft and retain in position with the snap ring.
 6. Install the thrust washer and front bearing onto the shaft, then drive or press the bearing into place using a hammer or press, and a sleeve of appropriate diameter and convenient length.
 7. Install the 3rd/4th gear synchronizer assembly onto the coupler.
 8. Install the output shaft and gear assembly as previously covered in "Complete Overhaul."
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.
 5. Inspect the synchronizer assembly for scoring, cracks or excessive wear. Check the pins, springs and balls for wear or cracks. If any components of the synchronizer are damaged, the complete assembly will require replacement as the components are not serviced separately.

ASSEMBLY

Refer to Figure 4-189.

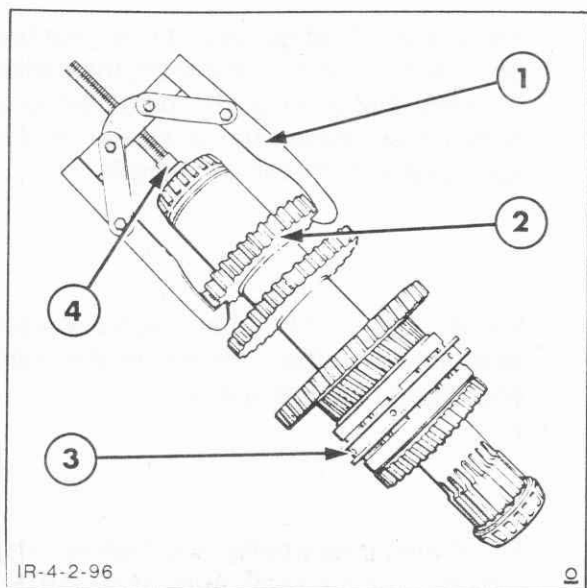


Figure 4-191

Countershaft Disassembly

1. Puller, tool no 1003 or FNH09516
2. Gear cluster
3. 1st/2nd synchronizer
4. Shaft protector, tool no. 625A or FNH09212

COUNTERSHAFT AND GEAR ASSEMBLY

DISASSEMBLY

1. Attach a puller, Tool #1003 or FNH09516 with shaft protector, Tool 625A or FNH09212 to the gear cluster as shown in Figure 4-191, and remove the front bearing, thrust bearing and thrust washer from the shaft.
2. Remove the gear cluster and 1st/2nd synchronizer from the shaft together with the needle roller bearings, thrust bearings and thrust washers, Figure 4-192.
3. Remove the 1st/2nd synchronizer assembly from the gear cluster and wire the assembly together to prevent the

mixing of components with other synchronizer assemblies.

4. remove the snap ring retaining the 1st/2nd gear coupler and remove the coupler thrust washers and 2nd gear from the gear cluster.
5. Normally, the countershaft rear bearing, Figure 4-192, 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 4-192, 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.

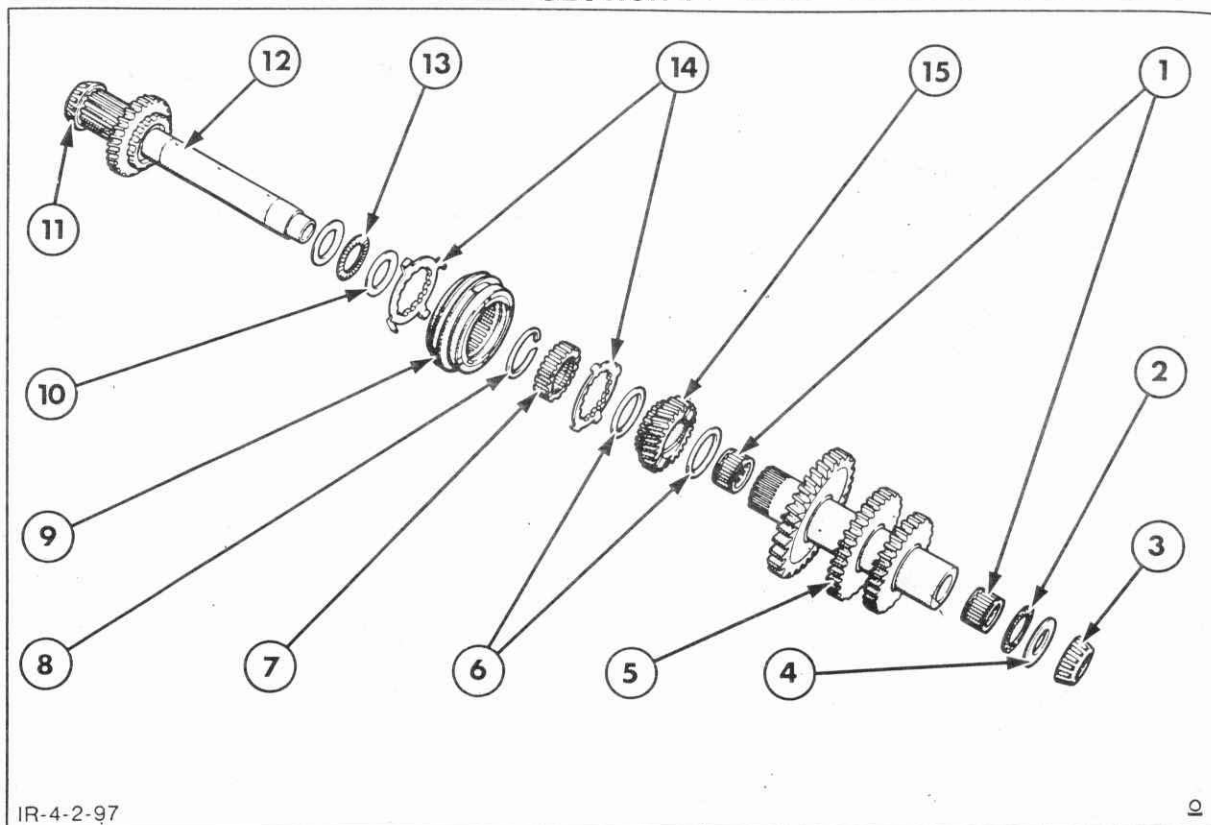


Figure 4-192

Countershaft Components

- | | | |
|---------------------------|--------------------|--------------------------|
| 1. Needle roller bearings | 11. Thrust washers | 6. Rear bearing |
| 2. Thrust bearing | 12. Coupler | 7. Countershaft and gear |
| 3. Front bearing | 13. Snap ring | 8. Thrust bearing |
| 4. Thrust washer | 14. Synchronizer | 9. Retainers |
| 5. Gear cluster | 15. Thrust washers | 10. 2nd Gear |

5. Inspect the synchronizer assembly for scoring, cracks or excessive wear. Check the pins, springs and balls for wear or cracks. If any components of the synchronizer are damaged, the complete assembly will require replacement as the components are not serviced separately.

ASSEMBLY

Refer to Figure 4-192.

1. If it was necessary to remove the countershaft rear bearing, press a new bearing into place using a sleeve of suitable diameter and of convenient length.

2. Install the 2nd gear and thrust washers onto the gear cluster then install the coupler and retain in position with the snap ring.
3. Install the 1st/2nd gear synchronizer onto the gear cluster then install the complete assembly with thrust bearing and thrust washers onto the countershaft.

4. Position the shaft and gears onto a press. Install the thrust bearing and thrust washer, then position the front bearing onto the shaft, using Tool 630S or FNH09212 and a sleeve of the appropriate diameter and convenient length, press the bearing onto the shaft.

5. Install the countershaft and gear assembly.

TRANSMISSION ELECTRICAL CONTROL CIRCUIT

BASIC CONTROL CIRCUITRY DESCRIPTION

Flat Deck	4X4	8X8
KF3P	X	X T.L. Only
DF0P, DF1Q	X	
LF4P/Q, LF5Q	X	

Figure 4-193

GENERAL

The D series flat deck tractors are available with a 4x4 power reversing transmission. The 8x8 transmission is only available on the KF3P when equipped as a tractor-loader, Figure 4-193.

The transmission is electrically operated by a modulator control box. It provides a cushioned engagement for the forward and reverse clutch packs during shifting at high speeds. Proper operating electrical control circuitry is essential to the function of the transmission.

POWER-UP CIRCUIT

Figure 4-194

Before the electrical control circuit can function, the control box must be powered-up, so it can receive and process directional control signals from the shuttle control lever.

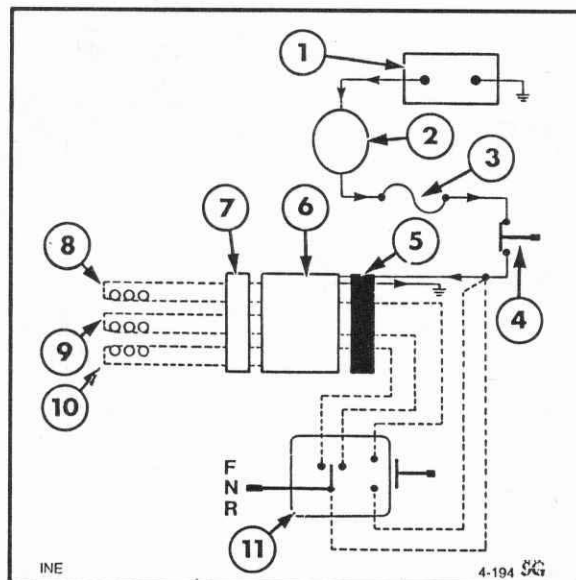


Figure 4-194

Powerup Circuit

1. Battery
2. Key switch
3. 5 Amp fuse
4. Disconnect switch
5. Black input connector
6. Modulator control
7. Grey output connector
8. Lock up (8X8 only)
9. Forward
10. Reverse
11. Shuttle control switch

When the key is turned to the "on" position, the system supplies main power to the modulator control box and to the shuttle control switch.

The current flow begins with the battery, travels through the key switch, through the five amp fuse, and through the disconnect switch to the modulator control box. Current enters the modulator control box and goes through the box to ground.

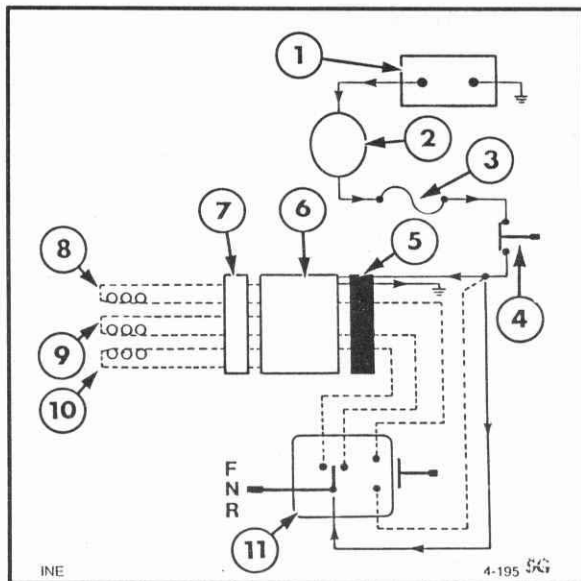


Figure 4-195
Neutral Circuit

1. Battery
2. Key switch
3. 5 Amp fuse
4. Disconnect switch
5. Black input connector
6. Modulator control
7. Grey output connector
8. Lock up (8X8 only)
9. Forward
10. Reverse
11. Shuttle control switch

When the circuit is completed, the modulator control box is electrically powered-up.

The control box determines whether the tractor should go forward or reverse by the input signal it receives from the shuttle control switch.

NEUTRAL CIRCUIT

Figure 4-195

The neutral circuit is a continuation of the power-up circuit.

Spliced into the main power wire is a wire that directs current to the transmission shuttle control switch.

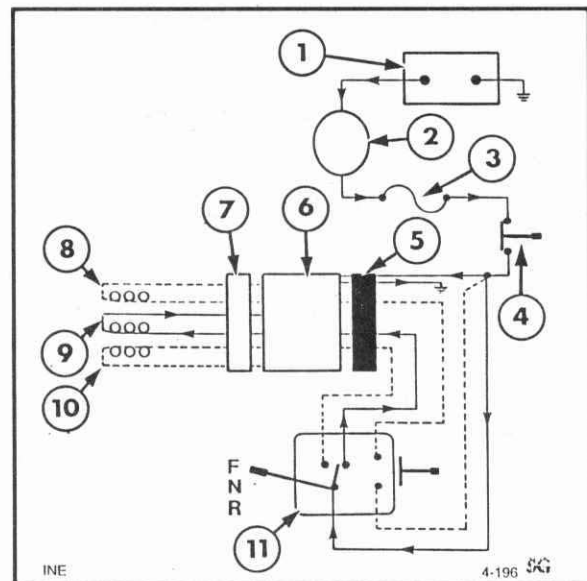


Figure 4-196
Forward Circuit

1. Battery
2. Key switch
3. 5 Amp fuse
4. Disconnect switch
5. Black input connector
6. Modulator control
7. Grey output connector
8. Lock up (8X8 only)
9. Forward
10. Reverse
11. Shuttle control switch

As long as the transmission shuttle control lever is in the neutral position, the circuit ends at the switch.

FORWARD CIRCUIT

Figure 4-196

The forward circuit includes the same components used in the power-up circuit, plus the forward directional solenoid, located on the transmission.

With the power-up circuit activated, the operator can move the control lever to forward, which sends current at battery voltage (approximately 12 volts) to the control box. The control box processes the forward signal and starts to send current to the forward solenoid.

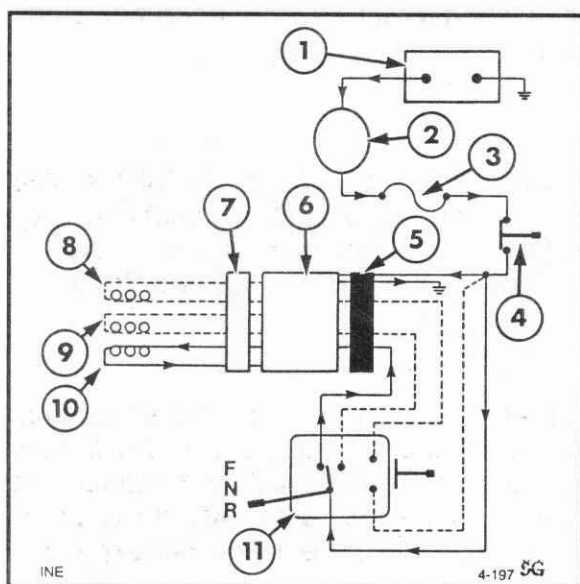


Figure 4-197
Reverse Circuit

1. Battery
2. Key switch
3. 5 Amp fuse
4. Disconnect switch
5. Black input connector
6. Modulator control
7. Grey output connector
8. Lock up (8X8 only)
9. Forward
10. Reverse
11. Shuttle control switch

Current then returns to the control box to complete the ground circuit. The forward circuit is not complete and the solenoid is not activated until the circuit is completed through the control box to ground.

Within approximately 4 seconds after completing the ground, the modulator control box increases current from 0 to 12 volts to the forward solenoid.

Because the forward solenoid is activated slowly and smoothly, the forward clutch pack is applied gradually, which results in a smooth application of power.

Because the disconnect is in series with the power-up circuit, depressing the disconnect button during forward operation will interrupt power flow to the modulator control box. therefore, the solenoid returns to the de-energized position and disengages the forward clutch pack.

When the disconnect button is released, the control box will receive power and again modulate current to the forward solenoid.

REVERSE CIRCUIT

Figure 4-197

The reverse circuit uses the same components as the power-up circuit plus a reverse direction solenoid that is mounted on the transmission. The reverse circuit operates in the same way as the forward circuit.

When the shuttle control lever is placed in reverse, the reverse switch is closed and battery voltage is sent to the reverse input circuit of the modulator control box.

The control box processes the input signal and sends power to the reverse solenoid and back to ground through the control box. Again, voltage is increased from 0 to approximately 12 volts over a 4-second interval to provide smooth activation of the solenoid, which ensures a smooth application of power in the reverse direction.

The disconnect button operates on the reverse circuit as it did on the forward circuit.

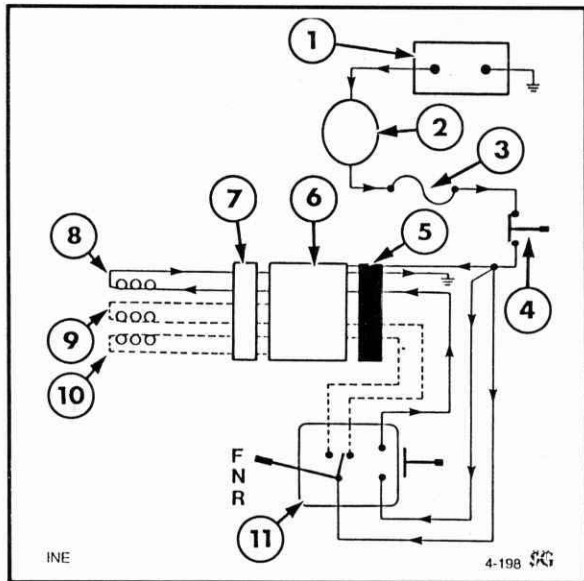


Figure 4-198

Torque Converter Lock-Up Circuit

1. Battery
2. Key switch
3. 5 Amp fuse
4. Disconnect switch
5. Black input connector
6. Modulator control
7. Grey output connector
8. Lock up (8X8 only)
9. Forward
10. Reverse
11. Shuttle control switch

which activates the forward directional control circuit.

When the button in the end of the shuttle control lever is depressed, current at battery voltage is sent through the switch to activate the modulator control box lock-up circuit.

The control box processes the signal and, after a 3-second delay, sends full battery voltage to activate the lock-up solenoid. The solenoid is not activated until the circuit is completed through the control box to ground.

Current to the lock-up solenoid is not modulated, so the solenoid moves instantly to eliminate slippage when engaging the torque converter lock-up piston. The converter then turns at engine speed.

To disengage the lock-up feature, you can:

Depress the disconnect switch.

Return the shuttle control lever to neutral.

Depress the lock-up button in the end of the shuttle handle.

Any of these actions interrupts current flow to the modulator control box lock-up circuit, which disengages the lock-up feature.

To reactivate the lock-up circuit, the shuttle control lever must be in the forward position and the lock-up button in the end of the shuttle lever depressed and released.

TORQUE CONVERTER LOCK-UP CIRCUIT

Figure 4-198

The torque converter lock-up circuit is standard on the 8x8 power reversing transmissions.

To activate the lock-up circuit, the shuttle control lever must be in the forward position,

TRANSMISSION ELECTRICAL OPERATION

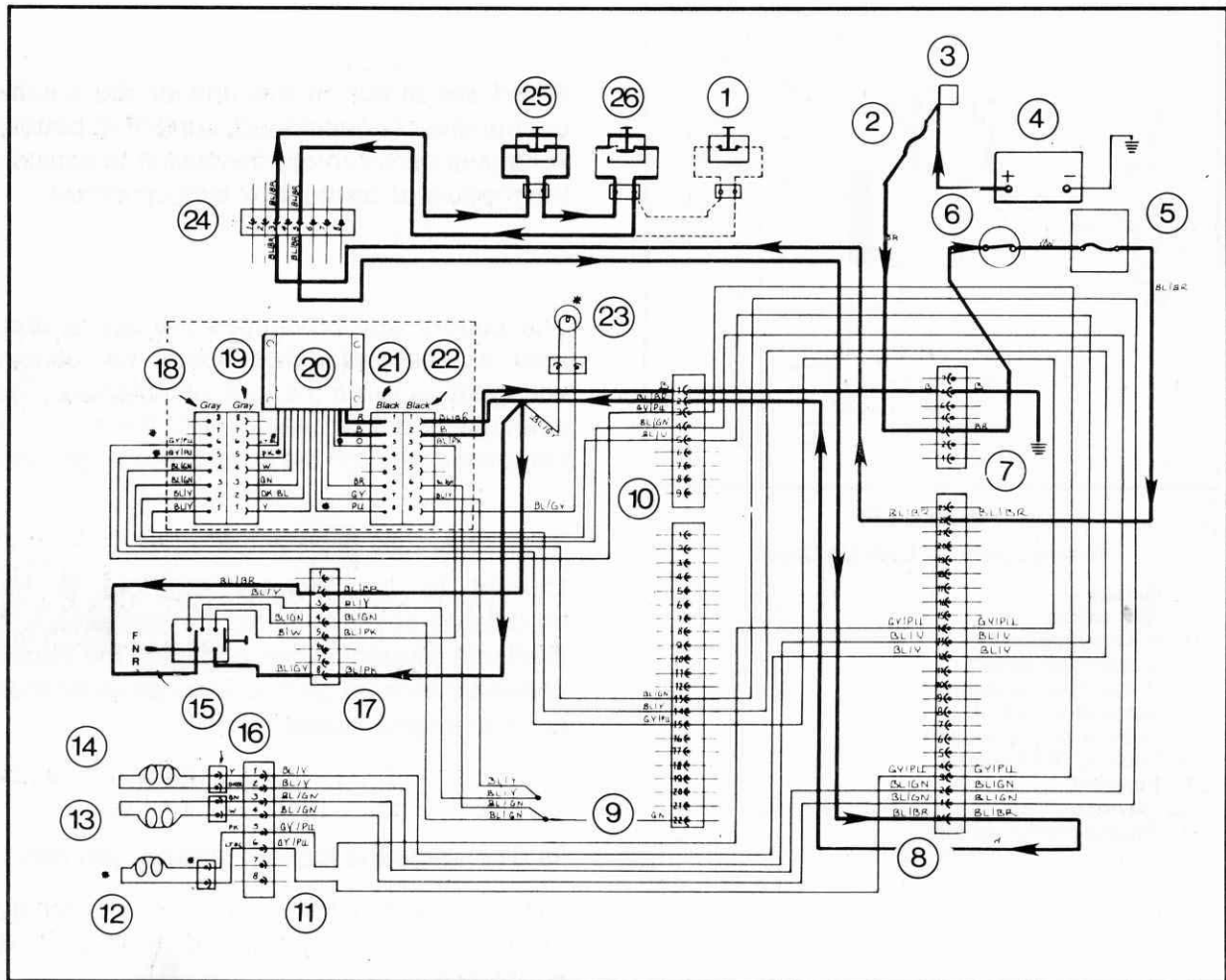


Figure 4-199

- | | | |
|-------------------------------|--------------------------------------|---|
| 1. Range lever switch | 11. Transmission connector | 20. Modulator control box (current style) |
| 2. Fuse link | 12. Lock-up solenoid | 21. Modulator input connector |
| 3. Start solenoid | 13. Forward solenoid | 22. Tractor input connector |
| 4. Battery | 14. Reverse solenoid | 23. Torque converter lock-up indicator lamp |
| 5. Fuse panel 5 Amp fuse #18 | 15. Shuttle control lever | 24. 8 pin R.T.D. connector |
| 6. Key switch | 16. Transmission solenoid connectors | 25. Loader lever switch |
| 7. 7 pin main connector | 17. 8 pin shuttle connector | 26. Gear shift lever switch |
| 8. 30 pin main connector | 18. Tractor output connector | |
| 9. 22 pin rear hood connector | 19. Modulator output connector | |
| 10. 9 pin rear hood connector | | |

NOTE: * = On 8X8 Equipped Model KF3P Only
BL/GN Wires may be *Turquoise* on some units

The following wiring colour code applies only to the above wiring diagram

BL = BLACK	BR = BROWN
Y = YELLOW	W = WHITE
GY = GREY	PU = PURPLE
GN = GREEN	LT = LIGHT
DK = DARK	PK = PINK
B = BLUE	

SECTION 4

The following gives a detailed description of current flow and operation of the individual circuits.

POWER-UP CIRCUIT

Refer to Figure 4-199.

Power begins at the battery and travels to the starter solenoid.

From the solenoid terminal, power travels through a fusible link to the 7 pin main connector. Power passes through the connector to the main feed terminal of the key switch.

With the key in the "on" position, power continues to the fuse panel. Power travels through the 5 amp transmission fuse to the 30 pin main connector, to the 8 pin Return-To-Dig (RTD) connector. At the RTD connector, power continues to the connector for the loader lever disconnect switch.

In its normal closed position, the switch passes power back through the connector and on to the gear shift disconnect switch connector. Power then flows to the gear shift disconnect switch.

When the operator presses a disconnect button, the disconnect switch opens to stop

the main power circuit and disengage the transmission.

When the switch is closed, power passes back through the gear shift connector, back through the RTD connector, and 30 pin main connector, to the 9 pin rear hood connector. Here, power flows through the connector to a splice in the wire.

The splice allows power to flow to the shuttle control lever connector. Power flows through the connector to the shuttle control lever on two wires.

One wire is for the neutral, forward, and reverse circuits switch, and one is for the torque converter lock-up switch, which only functions on Model _____ equipped with the 8x8 transmission.

Power also flows to the control box black connector, and on to the control box.

NOTE: Remember that the power-up circuit must be grounded before it is complete.

The ground wire leaves the control box and passes through the black connector, and the 7 pin main connector, to ground at the starter motor mount bolt.

Now the power-up circuit is complete and the control box is ready to receive input signals from the shuttle control.

1. Range lever switch	11. Transmission connector	20. Modulator control box (current style)
2. Fuse link	12. Lock-up solenoid	21. Modulator input connector
3. Start solenoid	13. Forward solenoid	22. Tractor input connector
4. Battery	14. Reverse solenoid	23. Torque converter lock-up indicator lamp
5. Fuse panel 5 Amp fuse #18	15. Shuttle control lever	24. 8 pin R.T.D. connector
6. Key switch	16. Transmission solenoid connectors	25. Loader lever switch
7. 7 pin main connector	17. 8 pin shuttle connector	26. Gear shift lever switch
8. 30 pin main connector	18. Tractor output connector	
9. 22 pin rear hood connector	19. Modulator output connector	
10. 9 pin rear hood connector		

The following wiring colour code applies only to the above wiring diagram	
BL = BLACK	BR = BROWN
Y = YELLOW	W = WHITE
GY = GREY	PU = PURPLE
GN = GREEN	LT = LIGHT
DK = DARK	PK = PINK
B = BLUE	

FORWARD CIRCUIT

Refer to Figure 4-200

When the control lever is moved to forward, power flows through the closed forward switch, to the connector, to the control box black input connector, and on to the control box. The forward input signal is received by the control box at full battery voltage.

The control box processes the signal and sends a modulated output signal through the

control box gray output connector, to the 22 pin rear hood connector and the 30 pin main connector, to the transmission connector, and on to the forward solenoid.

Again, the solenoid receives power but will not operate until the circuit is grounded through the modulator control box.

After the circuit is grounded, voltage is increased from 0 to 12 volts over a 4-second interval, which moves the solenoid smoothly and controls the engagement of the forward clutch pack.

SECTION 4 – TRANSMISSION

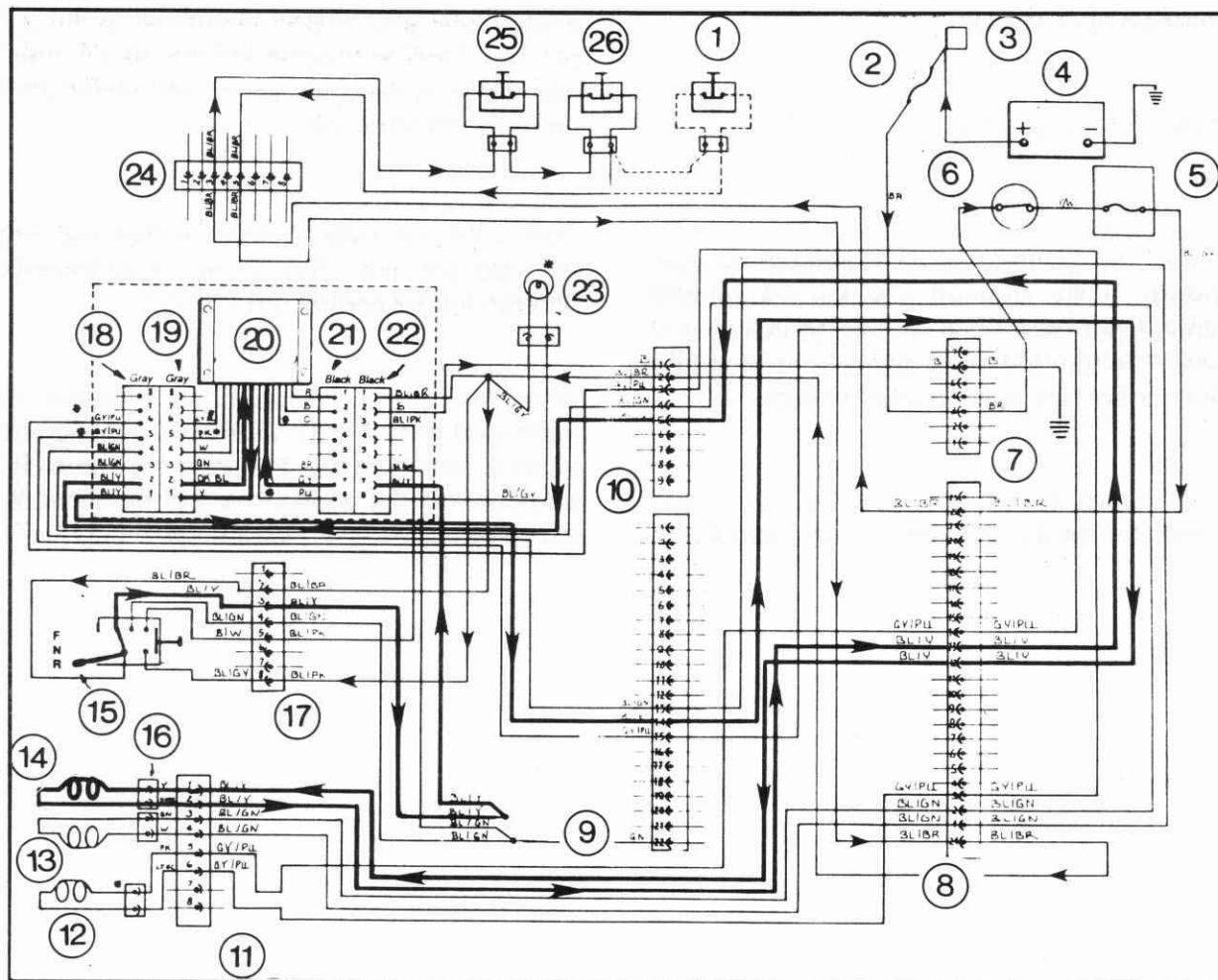


Figure 4-201

- | | | |
|--|--|--|
| <ul style="list-style-type: none"> 1. Range lever switch 2. Fuse link 3. Start solenoid 4. Battery 5. Fuse panel 5 Amp fuse #18 6. Key switch 7. 7 pin main connector 8. 30 pin main connector 9. 22 pin rear hood connector 10. 9 pin rear hood connector | <ul style="list-style-type: none"> 11. Transmission connector 12. Lock-up solenoid 13. Forward solenoid 14. Reverse solenoid 15. Shuttle control lever 16. Transmission solenoid connectors 17. 8 pin shuttle connector 18. Shuttle output connector 19. Modulator output connector | <ul style="list-style-type: none"> 20. Modulator control box (current style) 21. Modulator input connector 22. Tractor input connector 23. Torque converter lock-up indicator lamp 24. 8 pin R.T.D. connector 25. Loader lever switch 26. Gear shift lever switch |
|--|--|--|

NOTE: * = On 8X8 Equipped Model KF3P Only
BL/GN Wires may be *Turquoise* on some units

The following wiring colour code applies only to the above wiring diagram

BL = BLACK	BR = BROWN
Y = YELLOW	W = WHITE
GY = GREY	PU = PURPLE
GN = GREEN	LT = LIGHT
DK = DARK	PK = PINK
B = BLUE	

REVERSE CIRCUIT

The reverse circuit, Figure 4-201, operates similarly to the forward circuit.

When the control lever is moved to reverse, power flows through the closed reverse switch, to the connector, to the control box black input connector, and on to the control box. The reverse input signal is received by the control box at full battery voltage.

The control box processes the signal and sends a modulated output signal through the

control box gray output connector, to the 22 pin rear hood connector and the 30 pin main connector, to the transmission connector, and on to the reverse solenoid.

The solenoid receives power but will not operate until the circuit is grounded through the modulator control box.

After the circuit is grounded, voltage is increased from 0 to 12 volts over a 4-second interval, which moves the solenoid smoothly and controls the engagement of the reverse clutch pack.

SECTION 4 – TRANSMISSION

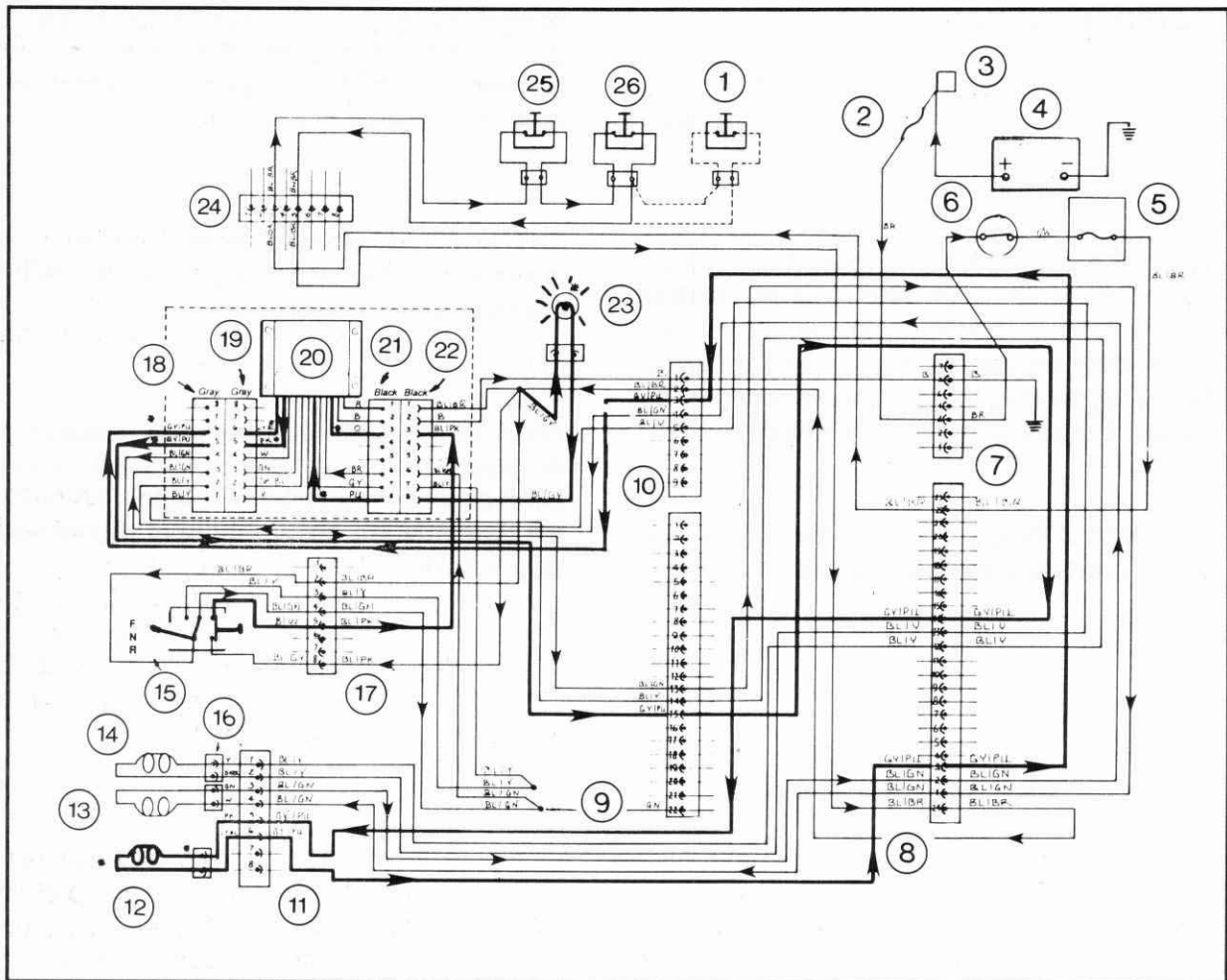


Figure 4-202

- | | | |
|--|--|--|
| <ul style="list-style-type: none"> 1. Range lever switch 2. Fuse link 3. Start solenoid 4. Battery 5. Fuse panel 5 Amp fuse #18 6. Key switch 7. 7 pin main connector 8. 30 pin main connector 9. 22 pin rear hood connector 10. 9 pin rear hood connector | <ul style="list-style-type: none"> 11. Transmission connector 12. Lock-up solenoid 13. Forward solenoid 14. Reverse solenoid 15. Shuttle control lever 16. Transmission solenoid connectors 17. 8 pin shuttle connector 18. Tractor output connector 19. Modulator output connector | <ul style="list-style-type: none"> 20. Modulator control box (current style) 21. Modulator input connector 22. Tractor input connector 23. Torque converter lock-up indicator lamp 24. 8 pin R.T.D. connector 25. Loader lever switch 26. Gear shift lever switch |
|--|--|--|

NOTE: * = On 8X8 Equipped Model KF3P Only
BL/GN Wires may be *Turquoise* on some units

The following wiring colour code applies only to the above wiring diagram

BL = BLACK	BR = BROWN
Y = YELLOW	W = WHITE
GY = GREY	PU = PURPLE
GN = GREEN	LT = LIGHT
DK = DARK	PK = PINK
B = BLUE	

**TORQUE CONVERTER LOCK-UP
CIRCUIT (8X8 TRANSMISSION ONLY)**

Torque converter lock-up, Figure 4-202, is only available on Model 8x8 power reversing transmissions. This circuit operates the same on the flat deck as on the straddle mount.

The lock-up circuit is completed when the shuttle control lever is in the forward position and the button on the end of the handle is pressed and released. Power then flows through the switch, back through the connector, and on to the modulator control box black input connector to the modulator control box.

The lock-up input signal is received by the control box at battery voltage. The control box processes the lock-up signal and, after a 3-second delay, sends an output signal at battery voltage through the control box gray connector, to the lock-up solenoid. The lock-up solenoid will not operate until the circuit is grounded.

Power passes through the solenoid, back through the control box gray connector, and through the control box to ground.

As soon as the ground circuit is complete, full battery voltage is available to the lock-up solenoid. This provides instant engagement of the lock-up piston in the torque converter, and eliminates any possible slippage.

The torque converter lock-up indicator lamp illuminates as soon as the lock-up button is depressed. The indicator light receives power from the power-up circuit. When the torque converter lockup input signal is received at the control box, the control box grounds the indicator light, which completes the circuit and causes the bulb to glow.

The torque converter lock-up indicator lamp only tells the operator that the lock-up circuit has been activated. It does not indicate that the torque converter has actually gone into the lock-up condition.

TROUBLESHOOTING

GENERAL

When a unit has a transmission problem, or the transmission has been overhauled, the tests outlined in this section should be performed to determine if the hydraulic pump, the modulator unit, the bypass valve, the control valve, the regulating valve, the torque converter, and the hydraulic clutch assemblies are operating satisfactorily. A problem can be caused by the electrical control circuit, the transmission hydraulics, or gear components.

You must check the electrical system thoroughly and determine that it is operating

properly before you can move on to testing the transmission hydraulic system.

The unit engine and brakes must be in satisfactory operating condition for the stall test to be effective. If the engine is in need of attention or the brakes need adjusting, the stall test should not be performed until after the necessary repairs are made.

The diagnosis guide, at the end of this section, lists the possible causes of the conditions that may be encountered during the tests. The troubleshooting guide lists other problems, not relating to the tests. Making use of these guides will help eliminate unnecessary trial-and-error methods when troubleshooting the power reversing transmission.

ELECTRICAL

The troubleshooting procedures in this section apply to all D- series tractor models. In the pages that follow, you'll find troubleshooting flowcharts designed to help you troubleshoot problems in the following categories:

Transmission won't operate in forward or reverse.

Transmission operates in one direction only.

Torque converter lock-up function does not operate on units equipped with the 8x8 transmission.

Harsh or sluggish shift engagement.

Intermittent electrical problems.

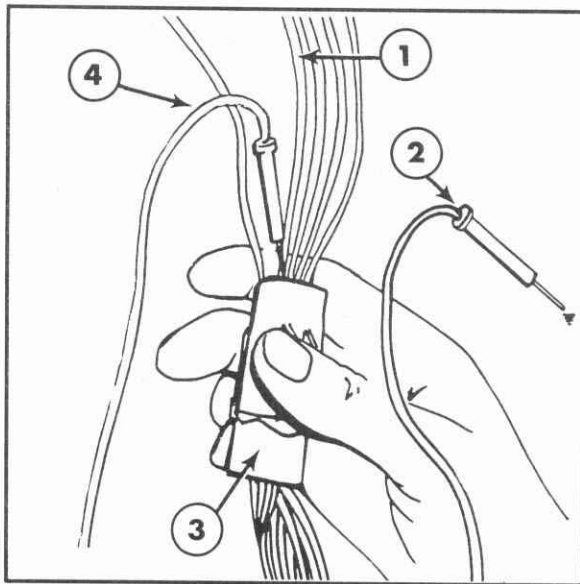
PRELIMINARY CHECKS

Before beginning in-depth troubleshooting, check the following possible causes of transmission problems:

Is the oil level full?

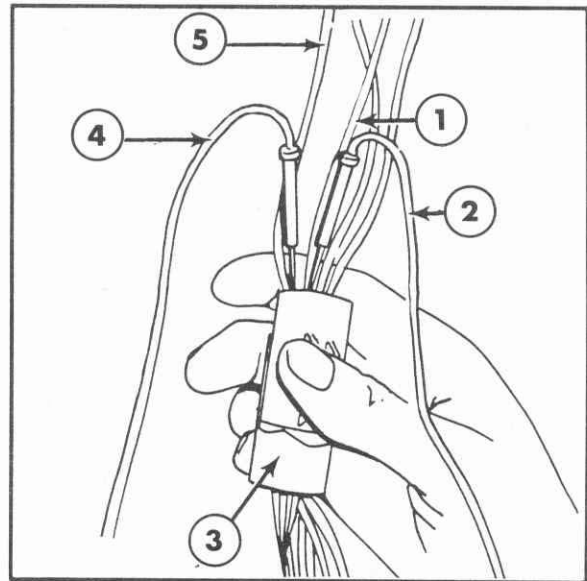
Is battery voltage 11-13.5V?

NOTE: Remember to only perform electrical tests when the battery is fully charged.

**Figure 4-203**

Dividing the System
Input Circuit Test

1. Brown wire to modulator control box
2. Voltmeter negative lead to a good ground
3. Black input connector
4. Voltmeter positive lead to brown wire

**Figure 203B**

Dividing the System
Output Circuit Test

1. Green wire from modulator control box
2. Voltmeter negative lead to green wire
3. Grey output connector
4. Voltmeter positive lead to white wire
5. White wire from modulator control box

TEST EQUIPMENT

The proper test equipment is vital to electrical troubleshooting.

Always use a high quality digital or analog volt-ohm-meter. Low voltage will affect system performance and can indicate a poor connection.

NEVER use a test light in place of a volt-ohm-meter. A test light will indicate power is present even if the voltage is extremely low.

NOTE: Test lights may activate the overload protection circuit in the control box, causing an incorrect diagnosis.

DIVIDING THE SYSTEM

Before you can begin to troubleshoot for specific problems, you need to understand how to perform some basic tests at the modulator control box.

Remember that the control box is divided into two circuits, input and output. You can use that information to divide the system quickly, Figure 4-203, and isolate a problem's cause to either the input or output circuit.

Divide the circuits by following these steps.

1. Check for input circuit power at the control box side of the black connector for the circuit to be tested.

2. Power present?

If no, the cause of the problem is that particular input circuit.

If yes, the problem is in the control box or output circuit and that circuit should be tested.

PERFORMING CIRCUIT TESTS**Testing an Input Circuit**

To test an input circuit:

1. Connect the positive lead on the voltmeter to the circuit to be tested. For example, if testing the forward circuit, you would connect the positive lead to the brown wire, Figure 4-203.
2. Connect the negative lead to a good ground.
3. Turn the key switch to the "on" position and move the shuttle lever to the "forward" position.

The voltmeter should read battery voltage. If it does not, there is a power interruption between the brown wire and its power supply. Perform additional voltage checks to determine the specific problem.

Testing an Output Circuit

This test should be performed at the modulator control box gray connector. Only conduct this test after testing shows the corresponding input circuit is operating properly.

To test the forward output circuit:

1. Make sure the connector halves are connected together.
2. Connect the positive lead on the voltmeter to the white wire, Figure 4-203.
3. Connect the negative lead to the green wire.
4. Turn the ignition switch "on" and shift the shuttle lever to "forward."

The voltmeter should increase from 0 to 12 volts in 3-5 seconds. If you do not achieve these results, the forward output circuit is not operating properly and requires additional testing.

The reverse circuit is tested the same way using the reverse circuit wire. On 8x8 units, the torque converter output circuit should go directly to battery voltage three seconds after the lock-up button is depressed.

You will use these tests of the input and output circuits frequently when troubleshooting the specific concerns that follow.

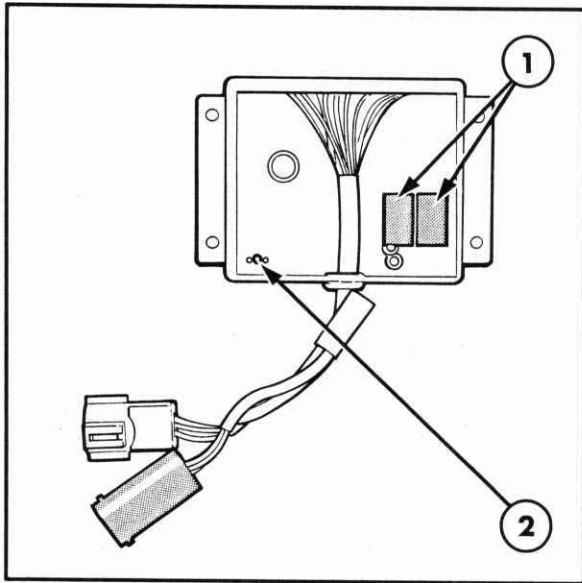


Figure 4-204

Modulator Control Box

1. Control relays
2. Test pin

MODULATOR CONTROL BOX

The control relays are visible when looking at the back of the control box and provide a positive neutral, Figure 4-204. Overload protection is provided by electrical components in the control box that open the output circuit when an overload is sensed.

To reset the current style control box overload circuit:

1. Return the shuttle control to the neutral position.
2. Activate and hold the disconnect button for five seconds or turn the key to the "off" position for five seconds.

The control box overload circuit will reset itself and work normally provided an overload condition is no longer present.

NOTE: The modulator control boxes used for 4x4 and 8x8 transmissions have always been different. The control box used on 8x8 units has the additional torque converter lock-up circuits. Be sure to install the correct modulator control box should replacement be necessary.

HARSH OR SLUGGISH SHIFT ENGAGEMENT

Normal engagement should occur between 3-6.5 seconds. If engagement is quicker, a harsh shift will result. Delayed engagement will result in excess slippage. Generally, the operator will experience the concern in both directions if the modulator control box is the cause.

To test the control box for proper modulation, use the procedures that follow.

Preliminary Tests

Before testing the control box, perform the following tests:

- Power-up circuit test for the affected circuits.
- Output circuit test for the affected circuits.

NOTE: The output circuits **MUST** be operating properly before performing the voltage modulation test on the control box. A problem in the output circuits will affect the results of the modulation test.

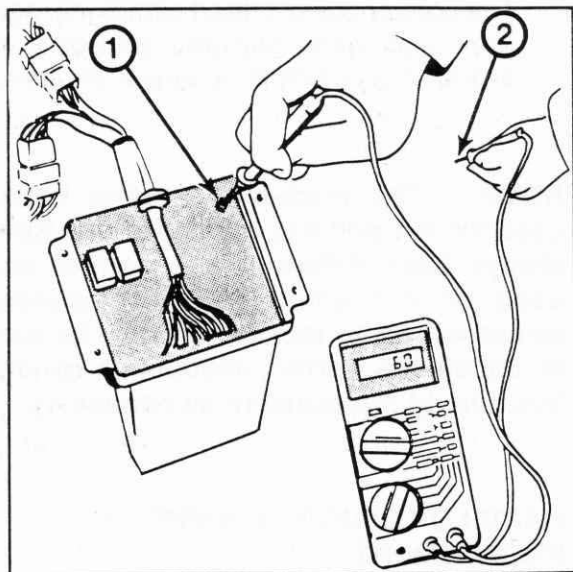


Figure 4-205
Control Box

1. Positive lead
2. Negative lead to a good ground

2. Connect a digital or analog voltmeter, as shown in Figure 4-205. Set the meter to a scale that will accurately read 0 to 10 volts D.C.
3. Turn the key switch to the "on" position, but do not start the engine.

NOTE: All transmission circuit connectors must be connected and the circuits must be in proper operating condition before proceeding.

Check the control box only after the output circuit test indicates the output circuits are working properly.

4. Move the shuttle control lever to forward while closely observing the meter. Voltage should read as follows:

1. Remove the control box from its mounting. Do not disconnect the electrical connectors.

Repeat the test for reverse. Voltage should modulate from 1.5V to 2.5V to 5.5V to 7 volts in 4 to 6.5 seconds when the shuttle is moved from neutral to forward or reverse. If voltage does not modulate as indicated, the control box should be replaced.

Key Switch	Shuttle Lever Position	Voltage Reading	Time Interval
Off	Neutral	0	4 - 6.5 seconds
On	Neutral	1.5 - 2.5	
On	Forward or Reverse	5.5 - 7	

INTERMITTENT ELECTRICAL PROBLEMS

Intermittent problems are the hardest to resolve because they don't occur consistently. To effectively troubleshoot these types of concerns, it is often necessary to have the operator run the unit with test equipment installed. This way, the operator can provide useful information when the problem does occur.

The majority of intermittent electrical problems are a result of momentary power loss at the power-up circuit. To troubleshoot intermittent problems:

1. Attach the positive lead of the voltmeter to the output wire (modulator control box gray connector) of the circuit to be tested. Attach the ground lead to the tractor.

2. If, during operation, the voltmeter drops from battery to 0 volts when the concern occurs, then slowly builds to battery voltage over a 3 to 5 second period when normal operation resumes, the input circuit has been interrupted. Further evaluation of the input circuit is required to correct the problem.
3. If the concern appears and the voltmeter reads constant battery voltage or drops to zero volts then returns instantly to battery voltage when normal operation resumes, the problem is in the output circuit and evaluation of the output circuit is required.

REMEMBER: A test light will not show the increase in power as well as a voltmeter. A test light with a high amperage draw may also cause the overload protection of the control box to activate and disengage the circuit, which will result in an inaccurate diagnosis.

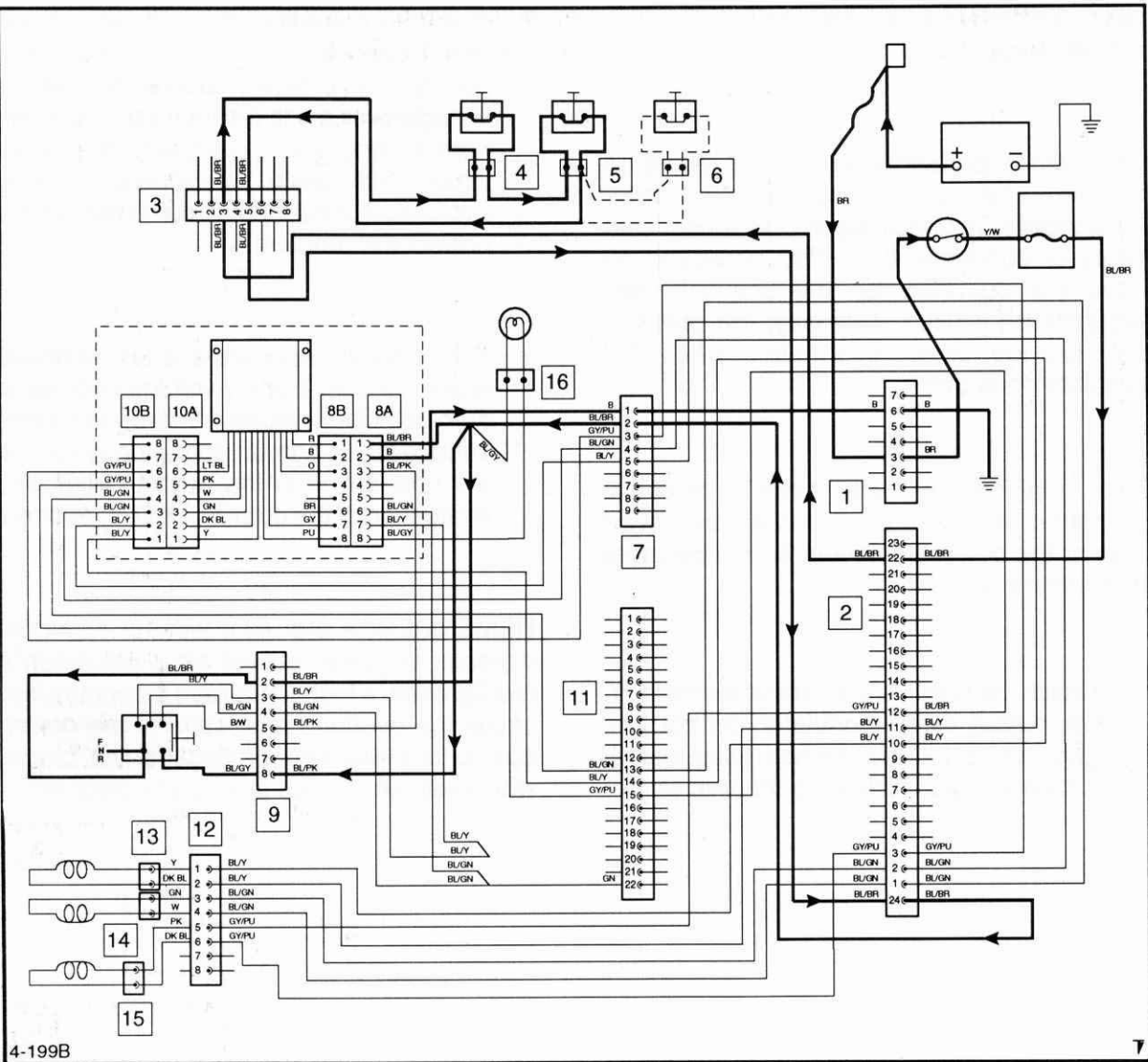


Figure 205A

Flat Deck Power-Up Circuit

1. 7 pin main connector
2. 30 pin main connector
3. 8 pin R.T.D. connector
4. Loader lever switch
5. Gear shift lever switch
6. Range lever switch
7. 9 pin rear hood connector
- 8A. Tractor input connector
- 8B. Modulator input connector
9. 8 pin shuttle connector
- 10A. Modulator output connector
- 10B. Tractor output connector
11. 22 pin rear hood connector
12. Transmission connector
13. Reverse solenoid
14. Forward solenoid
- *15. Transmission connector
- *16. Torque converter lock-up indicator lamp

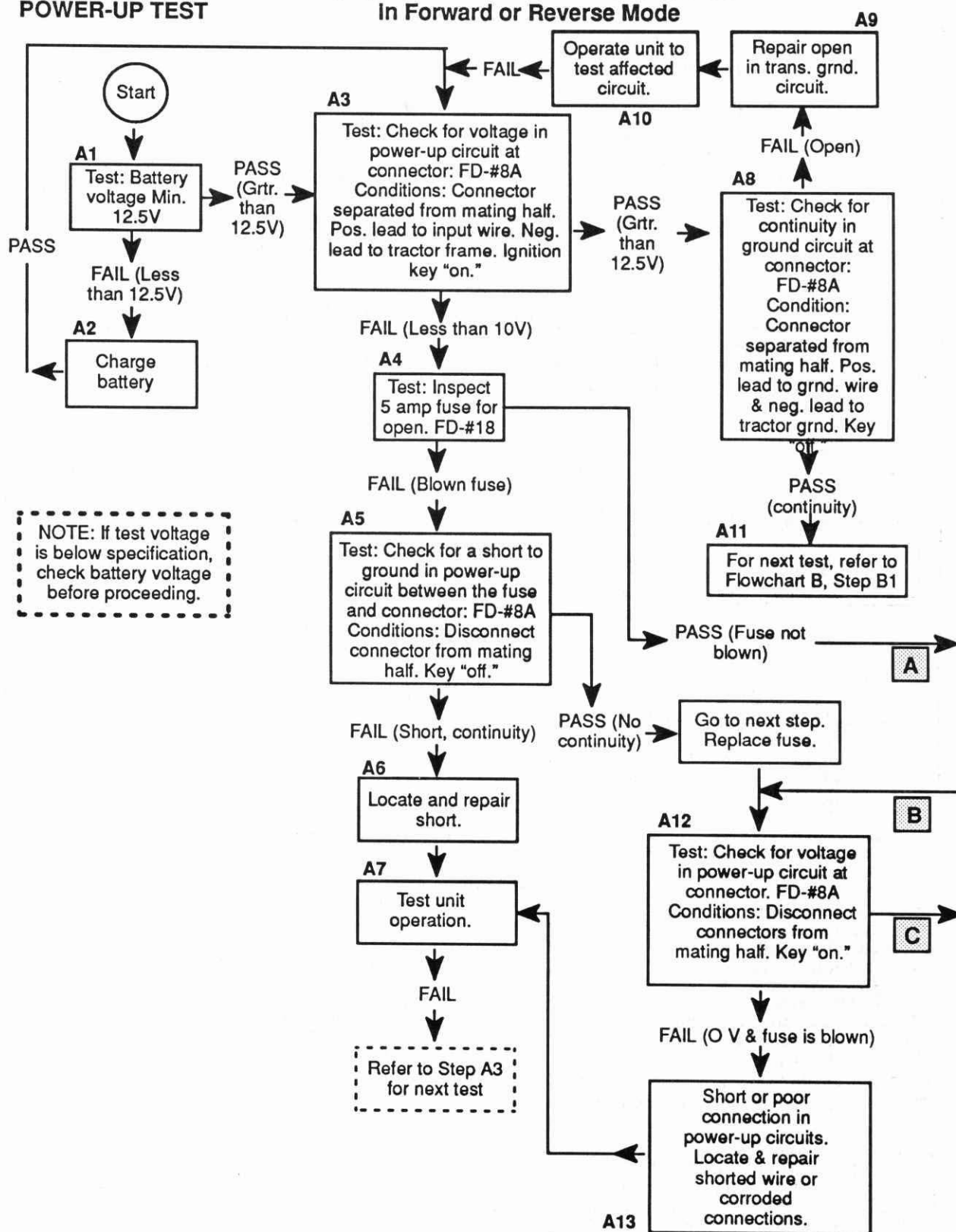
NOTE: * = On 8X8 Equipped Model KF3P Only
BL/GN Wires may be *Turquoise* on some units

The following wiring colour code applies only to the above wiring diagram

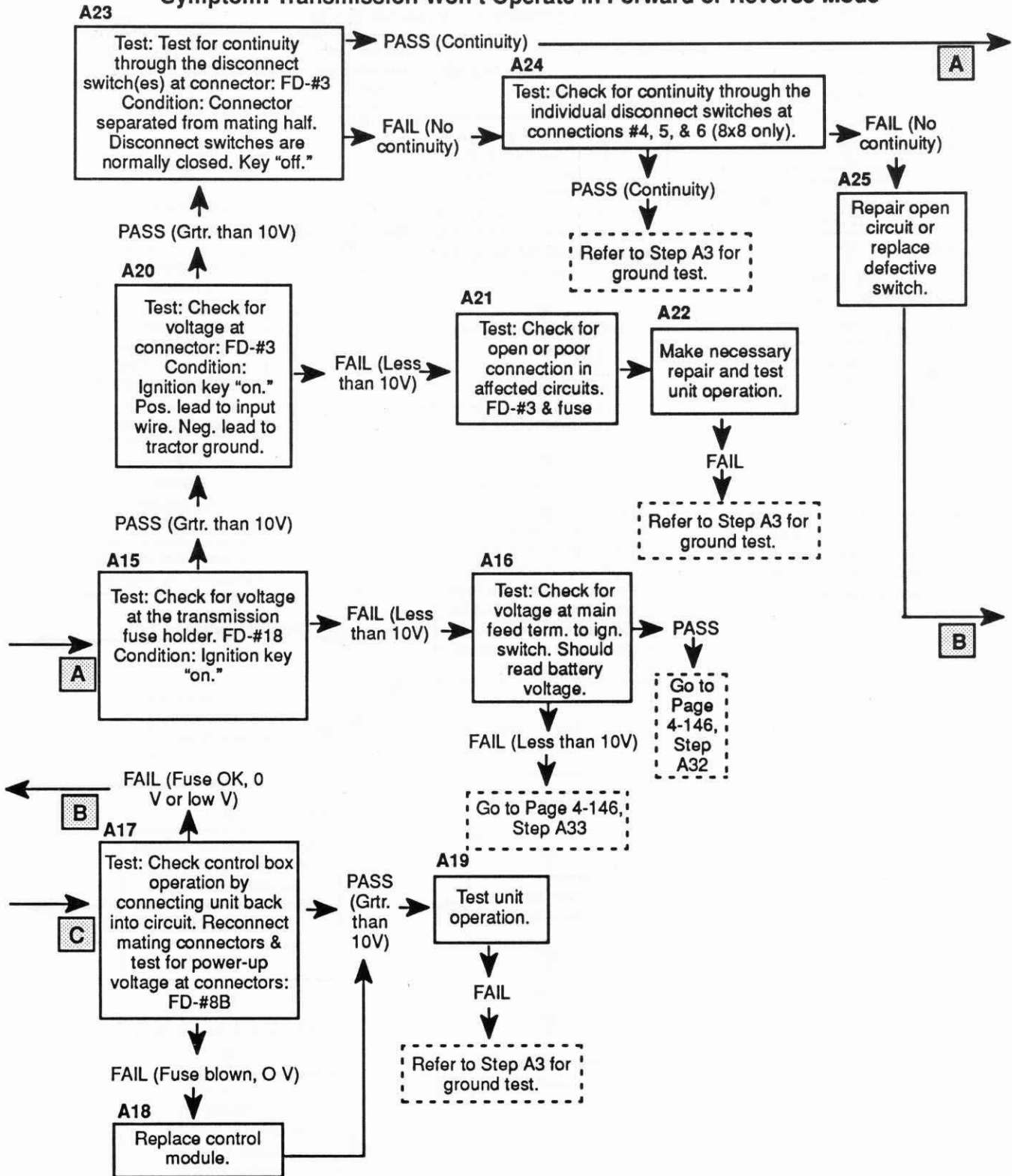
BL = BLACK	BR = BROWN
Y = YELLOW	W = WHITE
GY = GREY	PU = PURPLE
GN = GREEN	LT = LIGHT
DK = DARK	PK = PINK
B = BLUE	

FLOWCHART A **POWER-UP TEST**

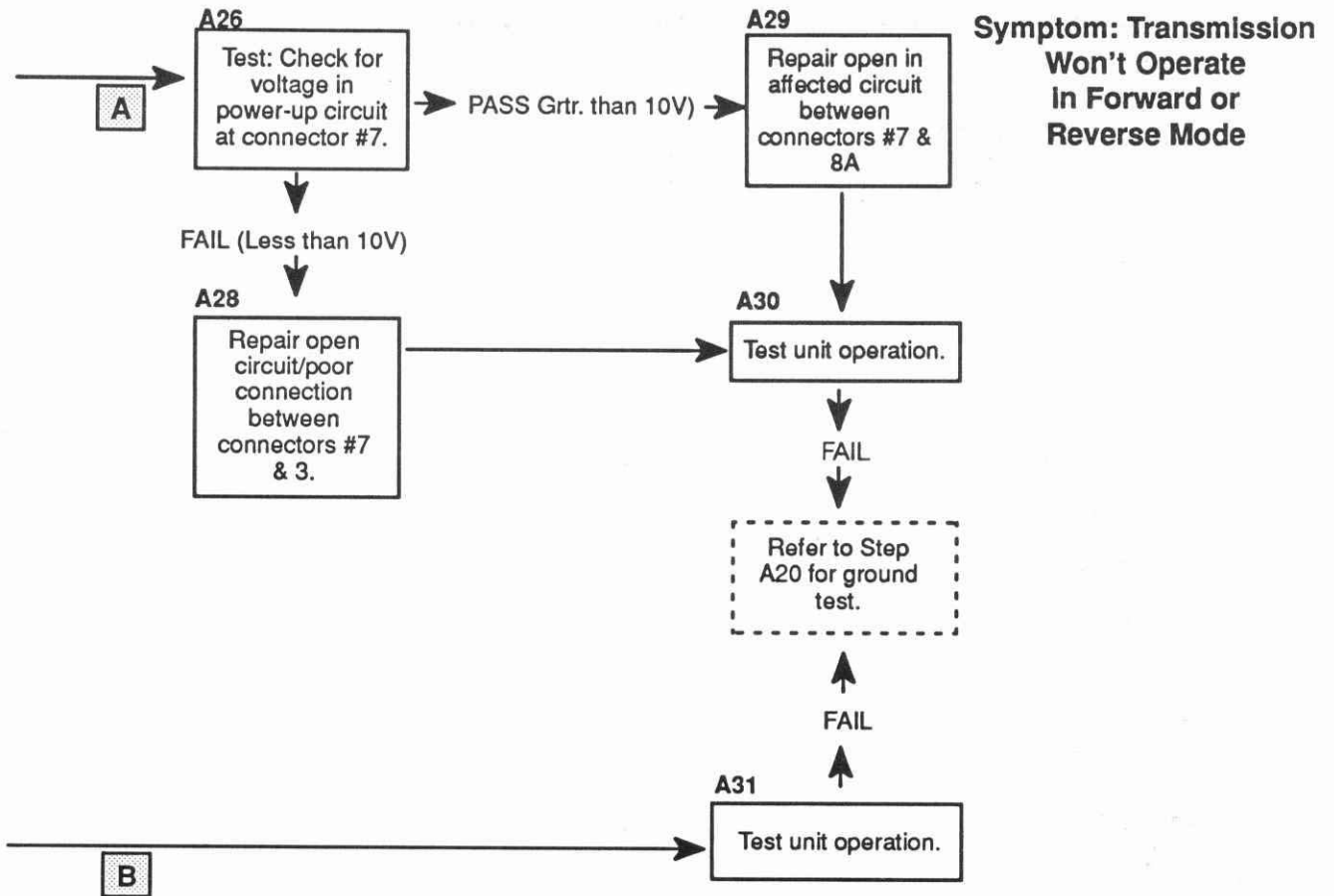
Symptom: Transmission Won't Operate **In Forward or Reverse Mode**



Symptom: Transmission Won't Operate In Forward or Reverse Mode

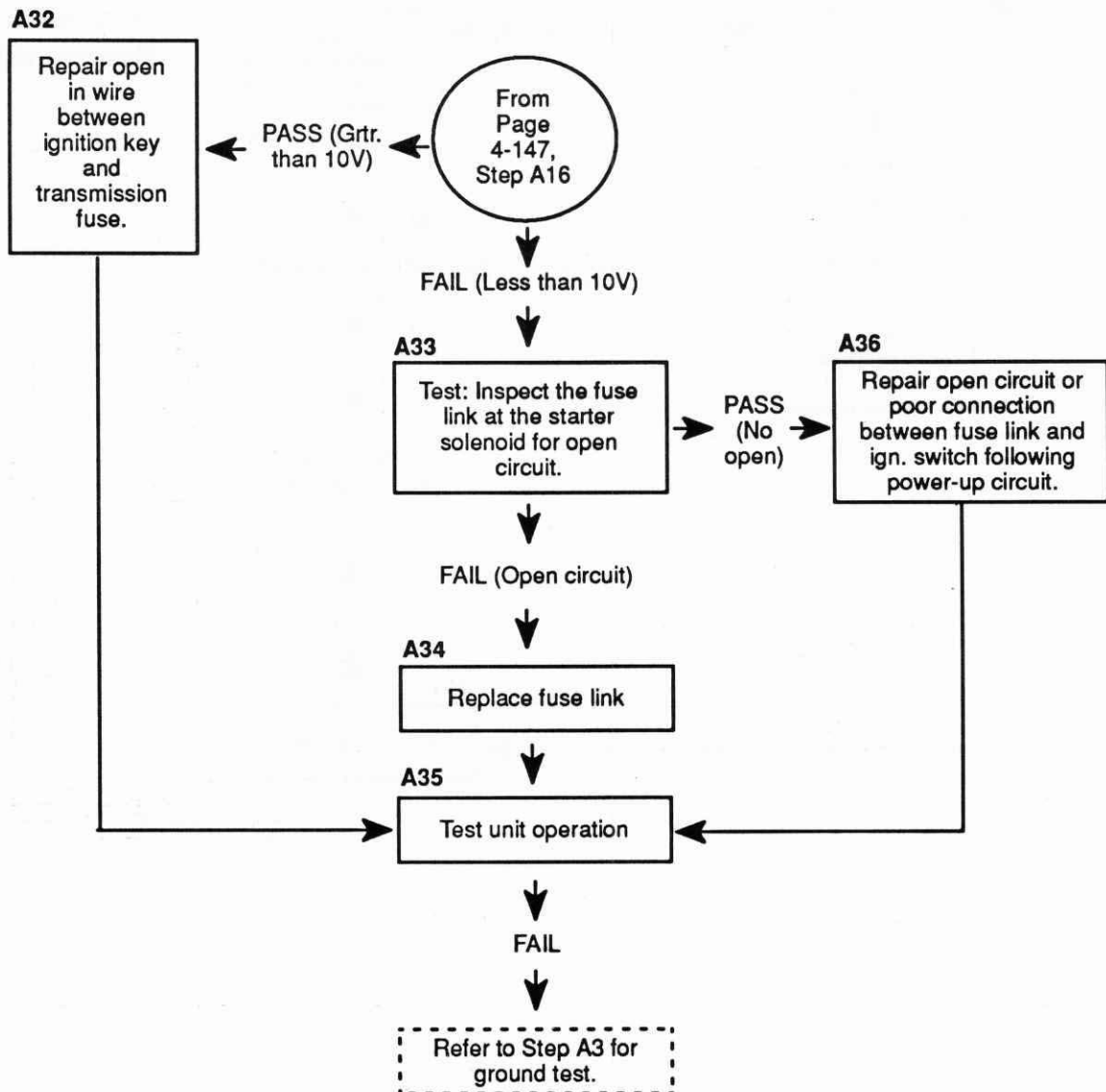


SECTION 4



SECTION 4 – TRANSMISSION

Symptom: Transmission Won't Operate In Forward or Reverse Mode



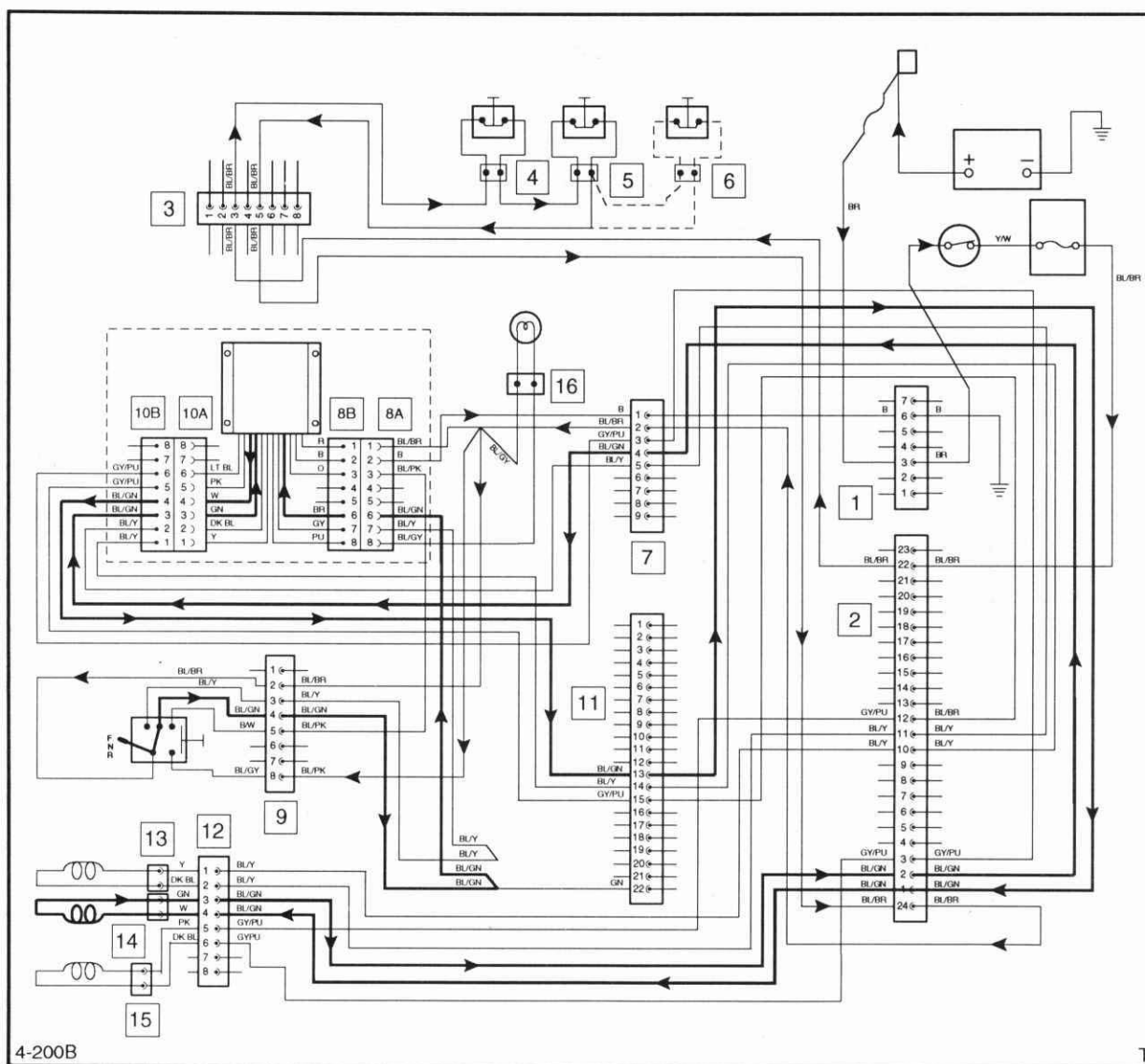


Figure 205B

Flat Deck Forward Circuit

1. 7 pin main connector
2. 30 pin main connector
3. 8 pin R.T.D. connector
4. Loader lever switch
5. Gear shift lever switch
6. Range lever switch
7. 9 pin rear hood connector
- 8A. Tractor input connector
- 8B. Modulator input connector
9. 8 pin shuttle connector
- 10A. Modulator output connector
- 10B. Tractor output connector
11. 22 pin rear hood connector
12. Transmission connector
13. Reverse solenoid
14. Forward solenoid
- *15. Transmission connector
- *16. Torque converter lock-up indicator lamp

NOTE: * = On 8X8 Equipped Model KF3P Only
BL/GN Wires may be *Turquoise* on some units

The following wiring colour code applies only to the above wiring diagram

BL = BLACK	BR = BROWN
Y = YELLOW	W = WHITE
GY = GREY	PU = PURPLE
GN = GREEN	LT = LIGHT
DK = DARK	PK = PINK
B = BLUE	

SECTION 4 – TRANSMISSION

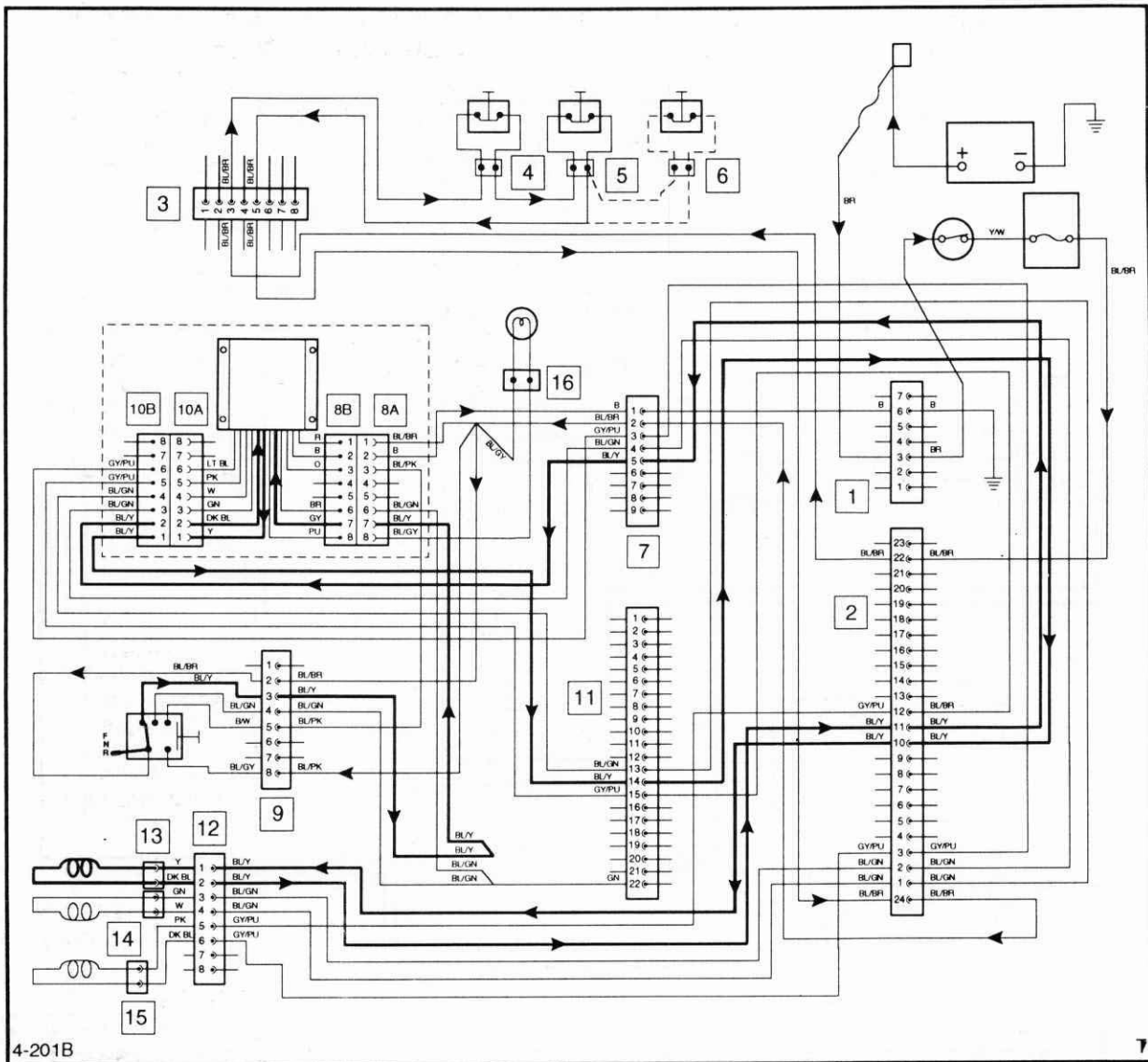


Figure 205C

Flat Deck Reverse Circuit

- | | |
|--|--|
| <p>1. 7 pin main connector
 2. 30 pin main connector
 3. 8 pin R.T.D. connector
 4. Loader lever switch
 5. Gear shift lever switch
 6. Range lever switch
 7. 9 pin rear hood connector
 8A. Tractor input connector
 8B. Modulator input connector</p> | <p>9. 8 pin shuttle connector
 10A. Modulator output connector
 10B. Tractor output connector
 11. 22 pin rear hood connector
 12. Transmission connector
 13. Reverse solenoid
 14. Forward solenoid
 *15. Transmission connector
 *16. Torque converter lock-up indicator lamp</p> |
|--|--|

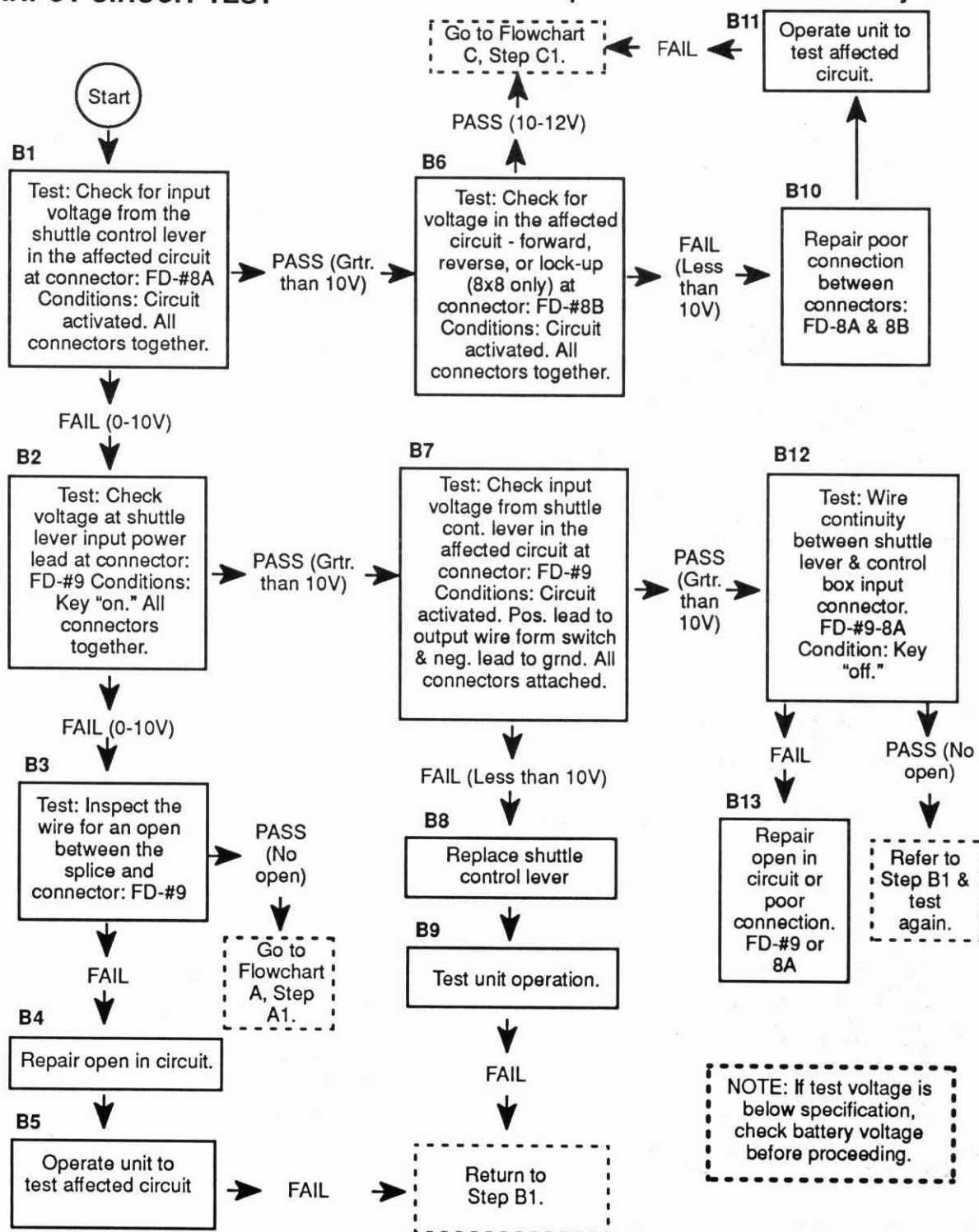
NOTE: * = On 8X8 Equipped Model KF3P Only
 BL/GN Wires may be *Turquoise* on some units

The following wiring colour code applies
 only to the above wiring diagram

BL = BLACK	BR = BROWN
Y = YELLOW	W = WHITE
GY = GREY	PU = PURPLE
GN = GREEN	LT = LIGHT
DK = DARK	PK = PINK
B = BLUE	

FLOWCHART B **INPUT CIRCUIT TEST**

Symptom: Transmission Won't Operate In Forward or Reverse Mode or Operates In One Direction Only



SECTION 4 – TRANSMISSION

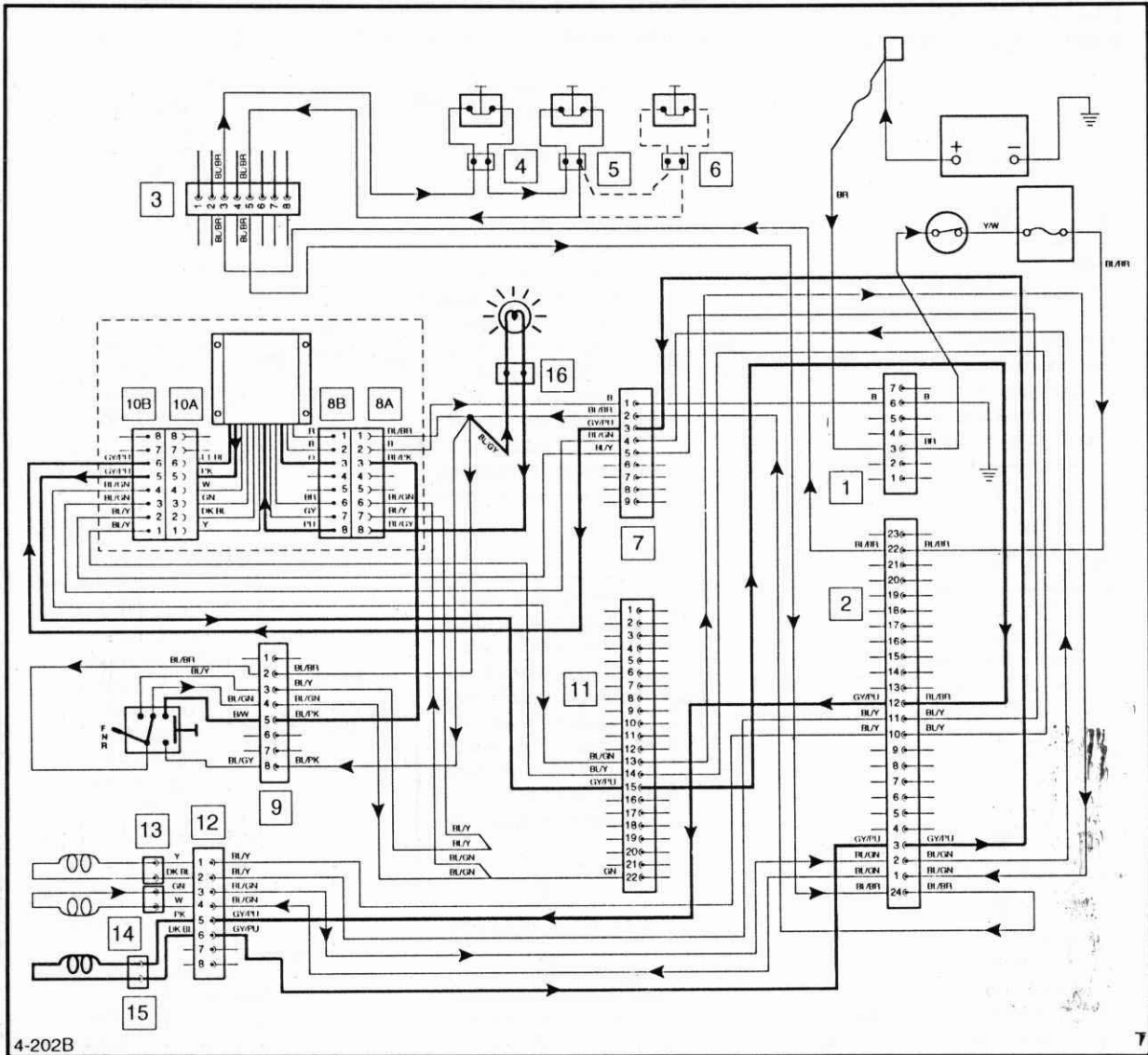


Figure 205D

Flat Deck Forward Circuit

- | | |
|---|---|
| <ul style="list-style-type: none"> 1. 7 pin main connector 2. 30 pin main connector 3. 8 pin R.T.D. connector 4. Loader lever switch 5. Gear shift lever switch 6. Range lever switch 7. 9 pin rear hood connector 8A. Tractor input connector 8B. Modulator input connector | <ul style="list-style-type: none"> 9. 8 pin shuttle connector 10A. Modulator output connector 10B. Tractor output connector 11. 22 pin rear hood connector 12. Transmission connector 13. Reverse solenoid 14. Forward solenoid *15. Transmission connector *16. Torque converter lock-up indicator lamp |
|---|---|

NOTE: * = On 8X8 Equipped Model KF3P Only
BL/GN Wires may be *Turquoise* on some units

The following wiring colour code applies only to the above wiring diagram

BL = BLACK	BR = BROWN
Y = YELLOW	W = WHITE
GY = GREY	PU = PURPLE
GN = GREEN	LT = LIGHT
DK = DARK	PK = PINK
B = BLUE	

SECTION 4

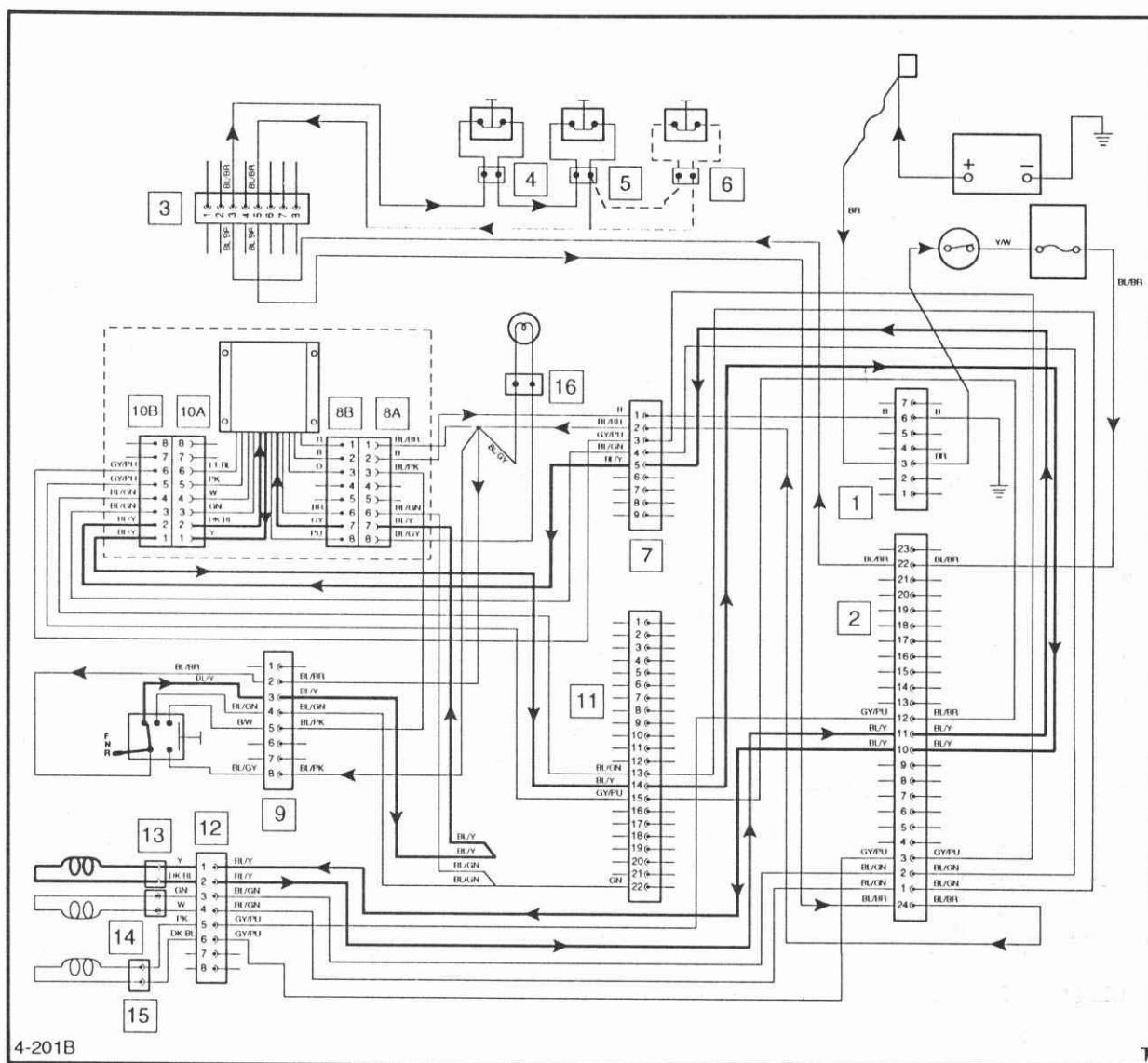


Figure 205E

Flat Deck Reverse Circuit

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. 7 pin main connector 2. 30 pin main connector 3. 8 pin R.T.D. connector 4. Loader lever switch 5. Gear shift lever switch 6. Range lever switch 7. 9 pin rear hood connector 8A. Tractor input connector 8B. Modulator input connector | <ol style="list-style-type: none"> 9. 8 pin shuttle connector 10A. Modulator output connector 10B. Tractor output connector 11. 22 pin rear hood connector 12. Transmission connector 13. Reverse solenoid 14. Forward solenoid *15. Transmission connector *16. Torque converter lock-up indicator lamp |
|---|---|

NOTE: * = On 8X8 Equipped Model KF3P Only
 BL/GN Wires may be *Turquoise* on some units

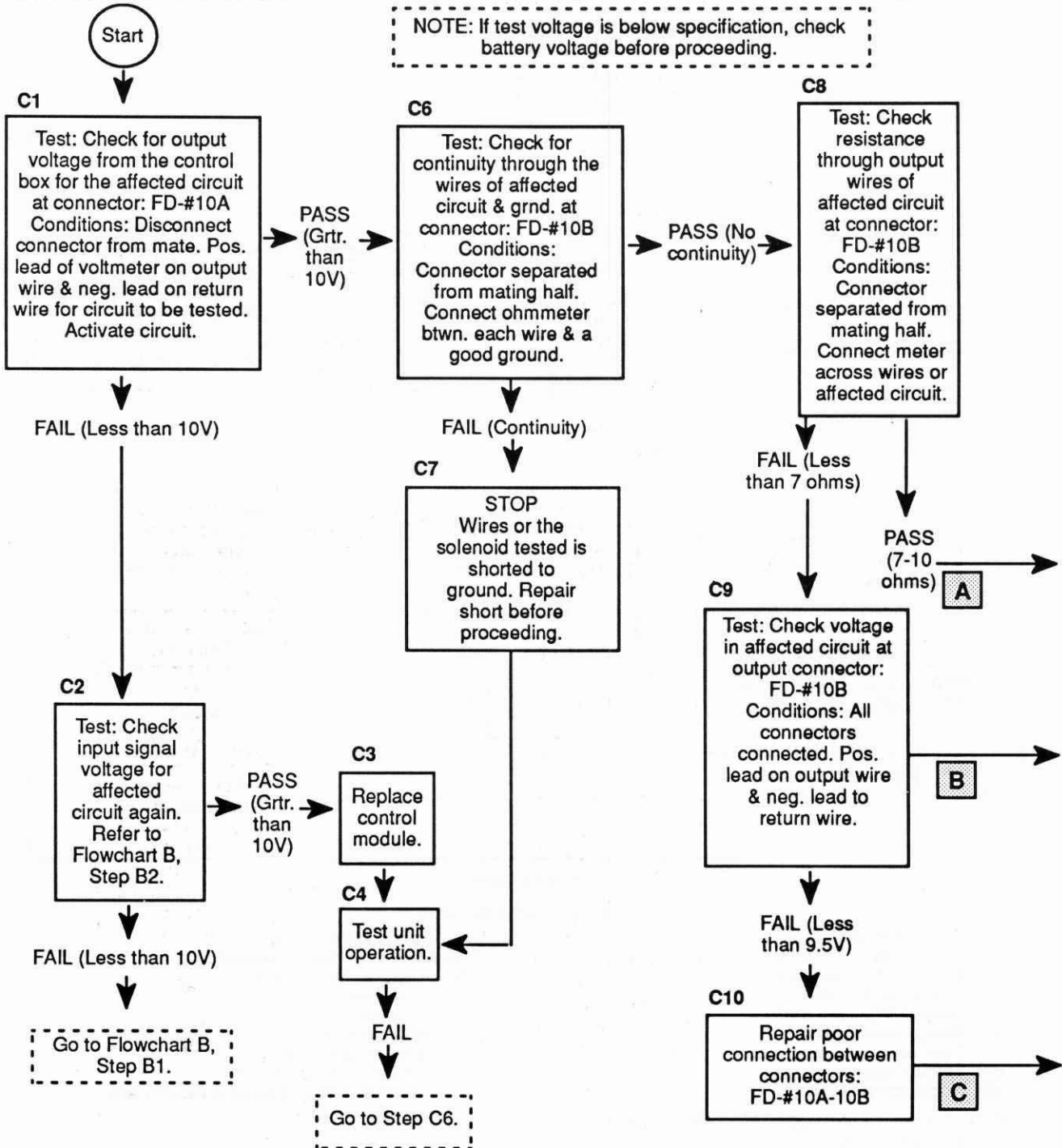
The following wiring colour code applies
 only to the above wiring diagram

BL = BLACK	BR = BROWN
Y = YELLOW	W = WHITE
GY = GREY	PU = PURPLE
GN = GREEN	LT = LIGHT
DK = DARK	PK = PINK
B = BLUE	

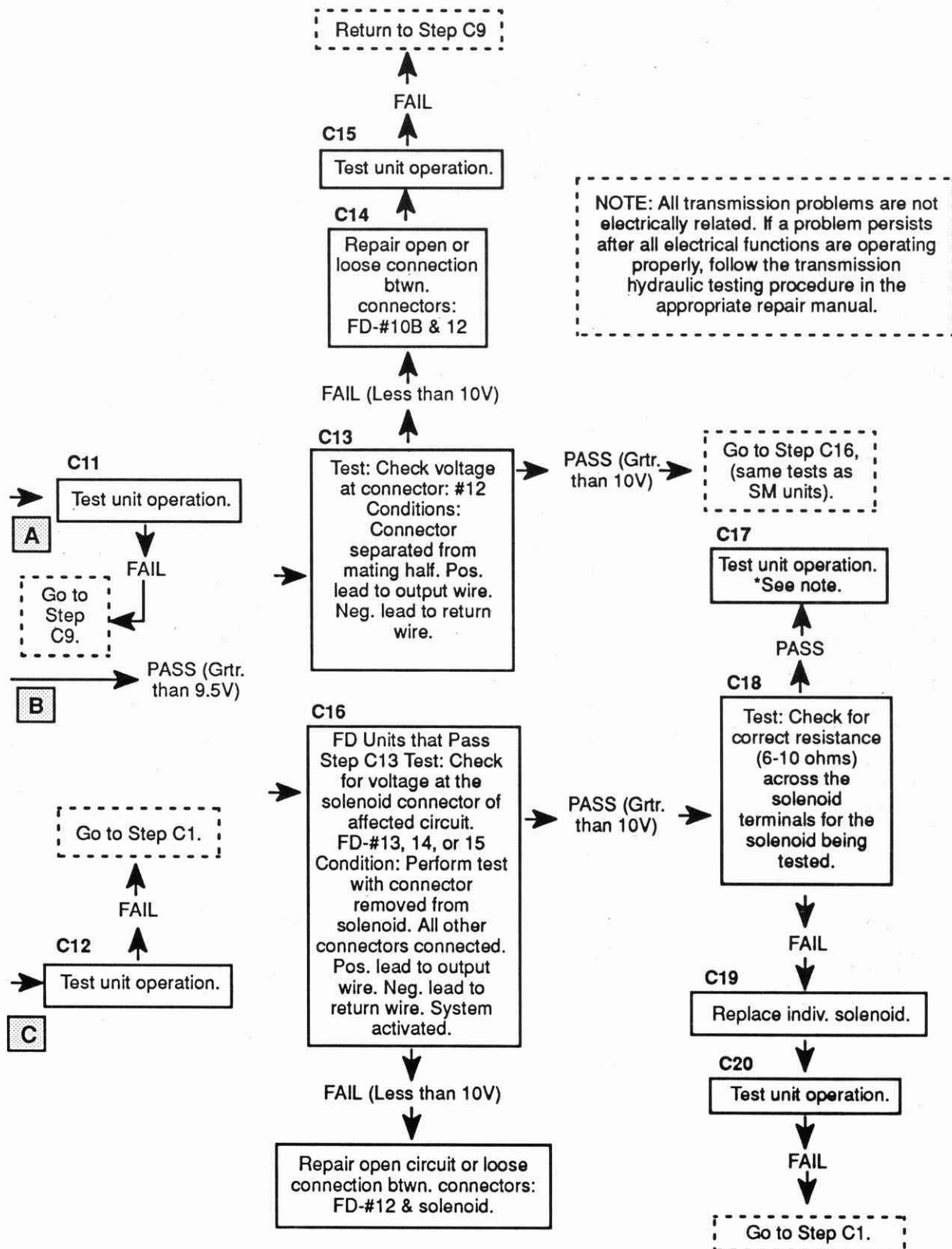
FLOWCHART C OUTPUT CIRCUIT TEST

Symptom: Transmission Won't Operate In Forward or Reverse Mode or Operates In One Direction Only

NOTE: If test voltage is below specification, check battery voltage before proceeding.



Symptom: Transmission Won't Operate In Forward or Reverse Mode or Operates In One Direction Only



SECTION 4 – TRANSMISSION

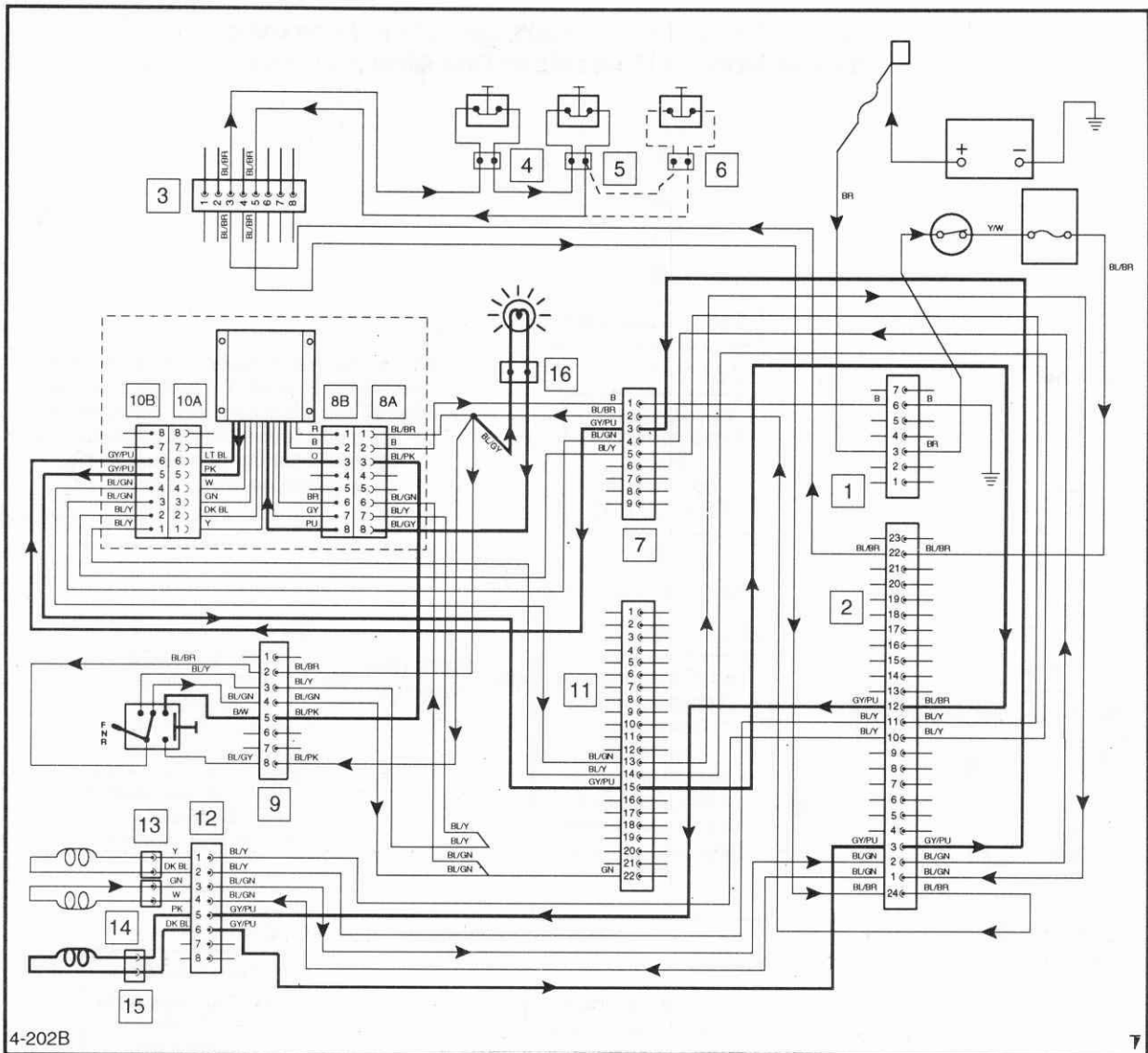


Figure 205F

Flat Deck Torque Converter Lock-Up Circuit (8 x 8 Transmission Only)

- | | |
|--|--|
| <p>1. 7 pin main connector
 2. 30 pin main connector
 3. 8 pin R.T.D. connector
 4. Loader lever switch
 5. Gear shift lever switch
 6. Range lever switch
 7. 9 pin rear hood connector
 8A. Tractor input connector
 8B. Modulator input connector</p> | <p>9. 8 pin shuttle connector
 10A. Modulator output connector
 10B. Tractor output connector
 11. 22 pin rear hood connector
 12. Transmission connector
 13. Reverse solenoid
 14. Forward solenoid
 *15. Transmission connector
 *16. Torque converter lock-up indicator lamp</p> |
|--|--|

NOTE: * = On 8X8 Equipped Model KF3P Only
 BL/GN Wires may be *Turquoise* on some units

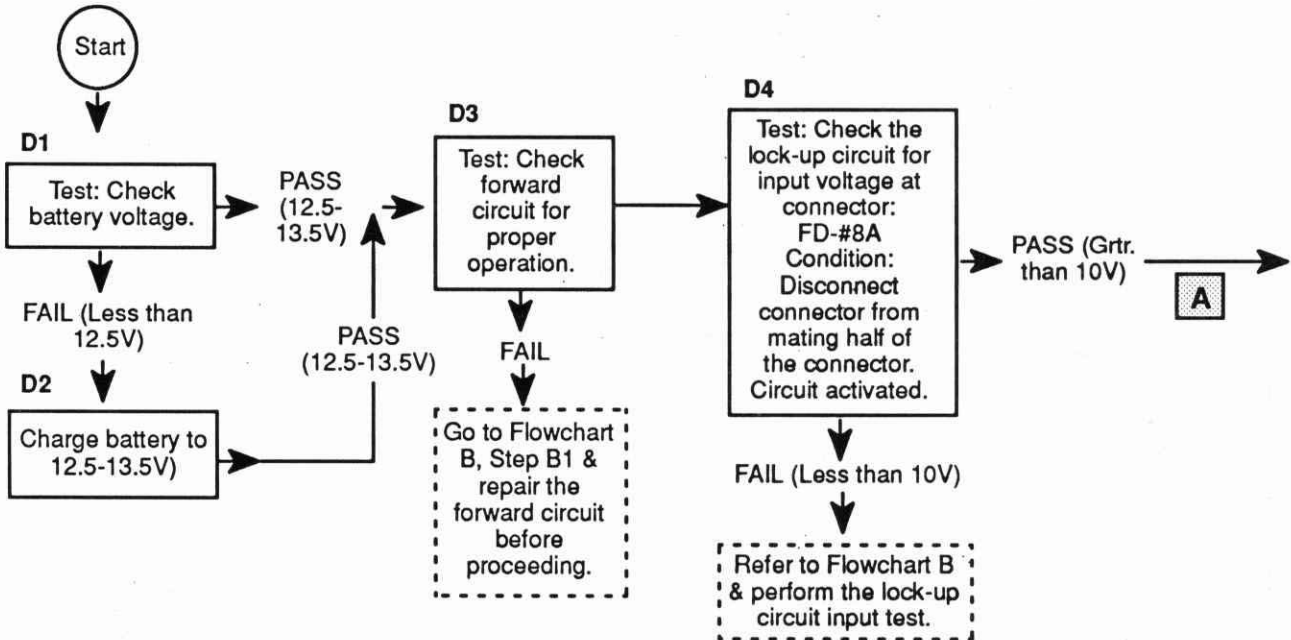
The following wiring colour code applies
 only to the above wiring diagram

BL = BLACK	BR = BROWN
Y = YELLOW	W = WHITE
GY = GREY	PU = PURPLE
GN = GREEN	LT = LIGHT
DK = DARK	PK = PINK
B = BLUE	

FLOWCHART D **TORQUE CONVERTER LOCK-UP CIRCUIT TEST**

**Symptom: Torque
Converter Lock-Up
Circuit (8x8 Only)
Won't Operate**

See the Notes and Quick Test below
before proceeding.



NOTES:

If test voltage is below specification, check battery voltage before proceeding.

The forward circuit must operate properly for the lock-up circuit to operate. test and repair the forward circuit (if required) before proceeding.

The lock-up circuit must be activated when performing voltage tests.

When checking lock-up circuit output voltage, there will be a 3- 5 second delay after the circuit is activated before a voltage reading will be obtained.

QUICK TEST:

Before proceeding to the flowchart, perform this quick test to determine if the electrical circuit is operating properly.

1. Place the ignition switch to the "on" position, but DO NOT START THE ENGINE.

2. Move the shuttle control lever to the "forward" position.

NOTE: The tractor must be in a quiet location when performing steps 3 and 4.

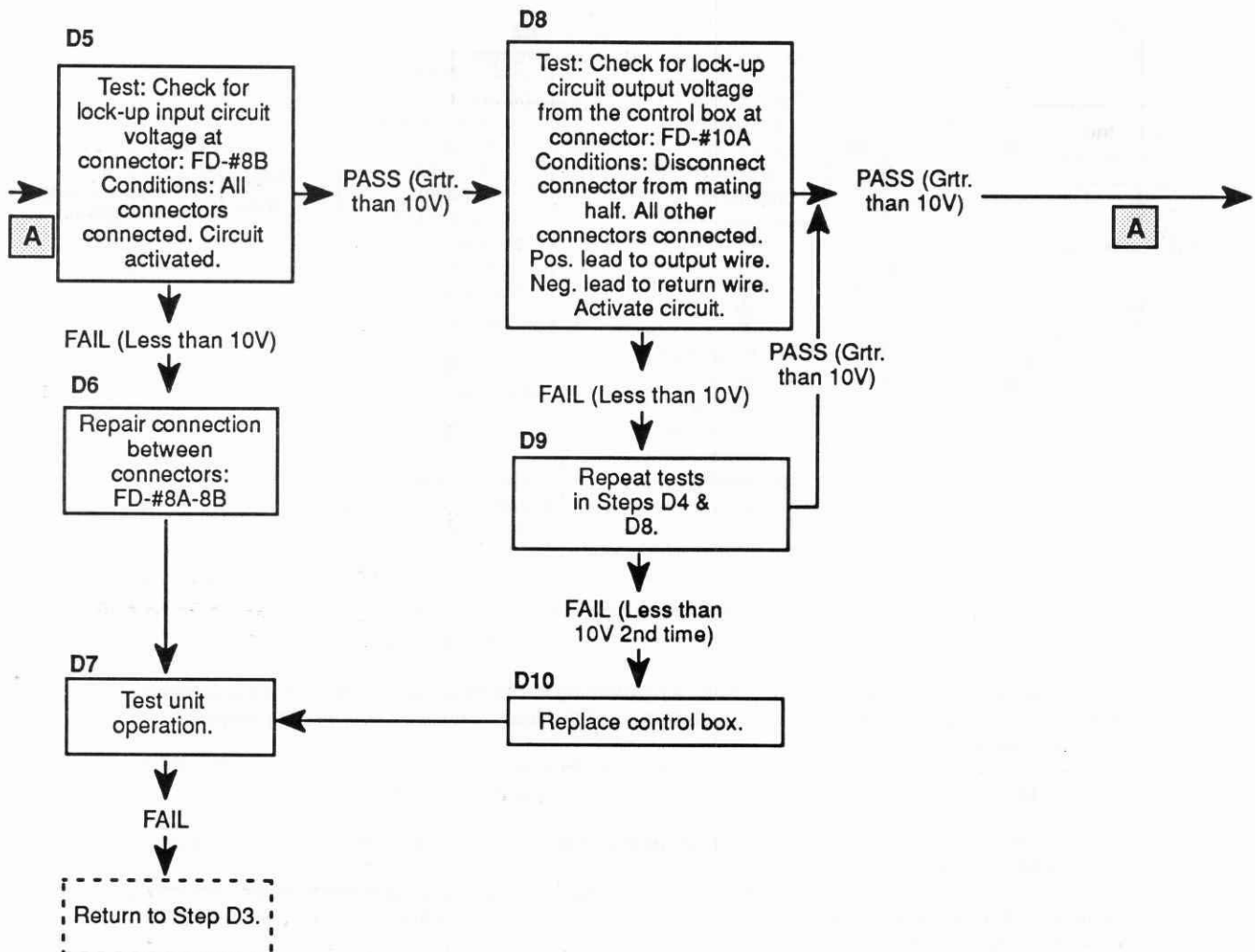
3. Depress, then release, the torque converter lock-up engagement button.

4. Three to five seconds after the lock-up button has been depressed, you should hear a faint "clicking" sound at the lock-up valve. The clicking sound is made when the lock-up solenoid is activated and depresses the control spool in the lock-up valve against the valve housing.

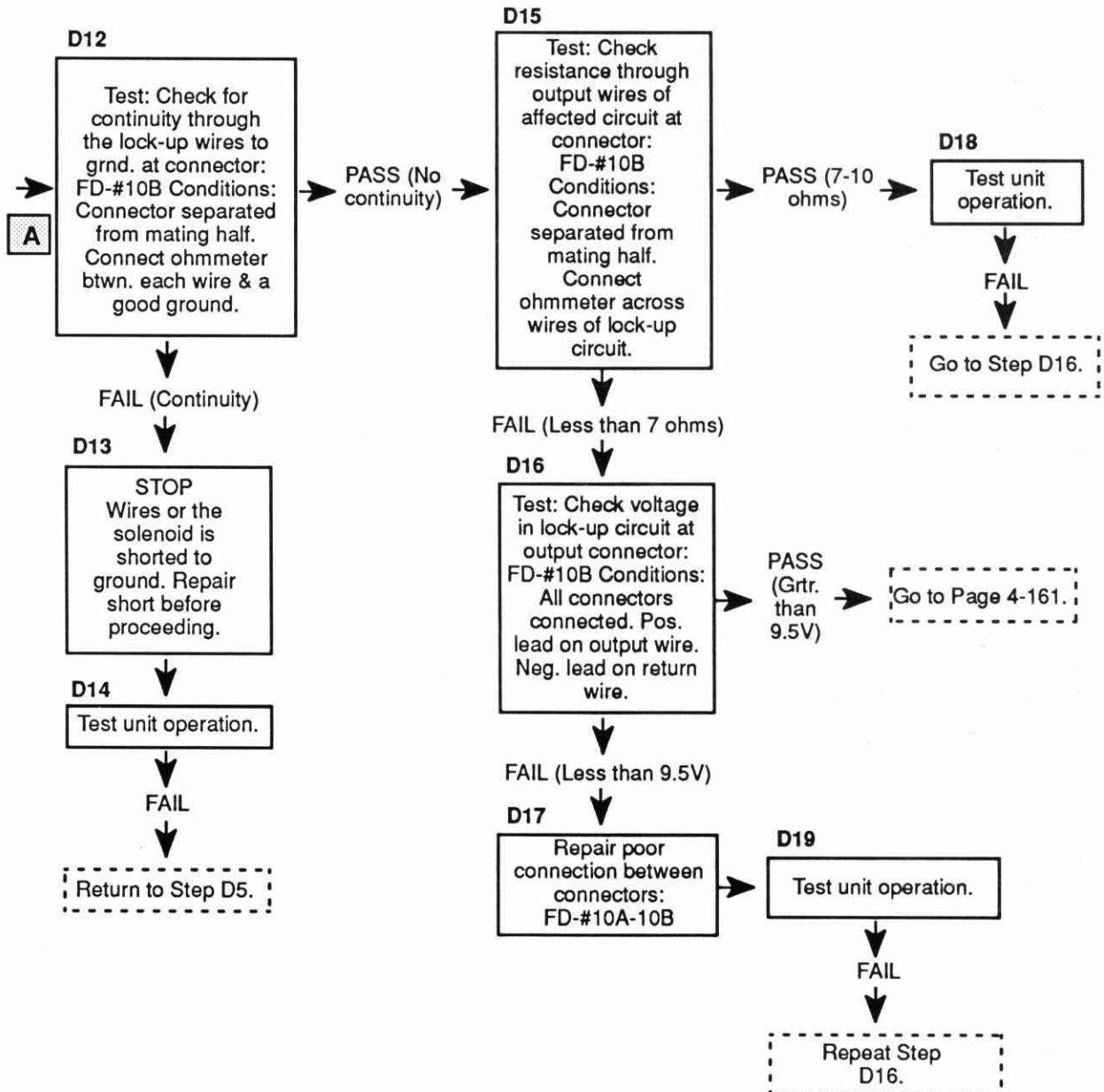
Repeat Step #4 several times.

If you hear the clicking sound: The electrical system, lock-up solenoid, and valve are working properly.

If you do not hear the clicking sound: Proceed to the flowchart.

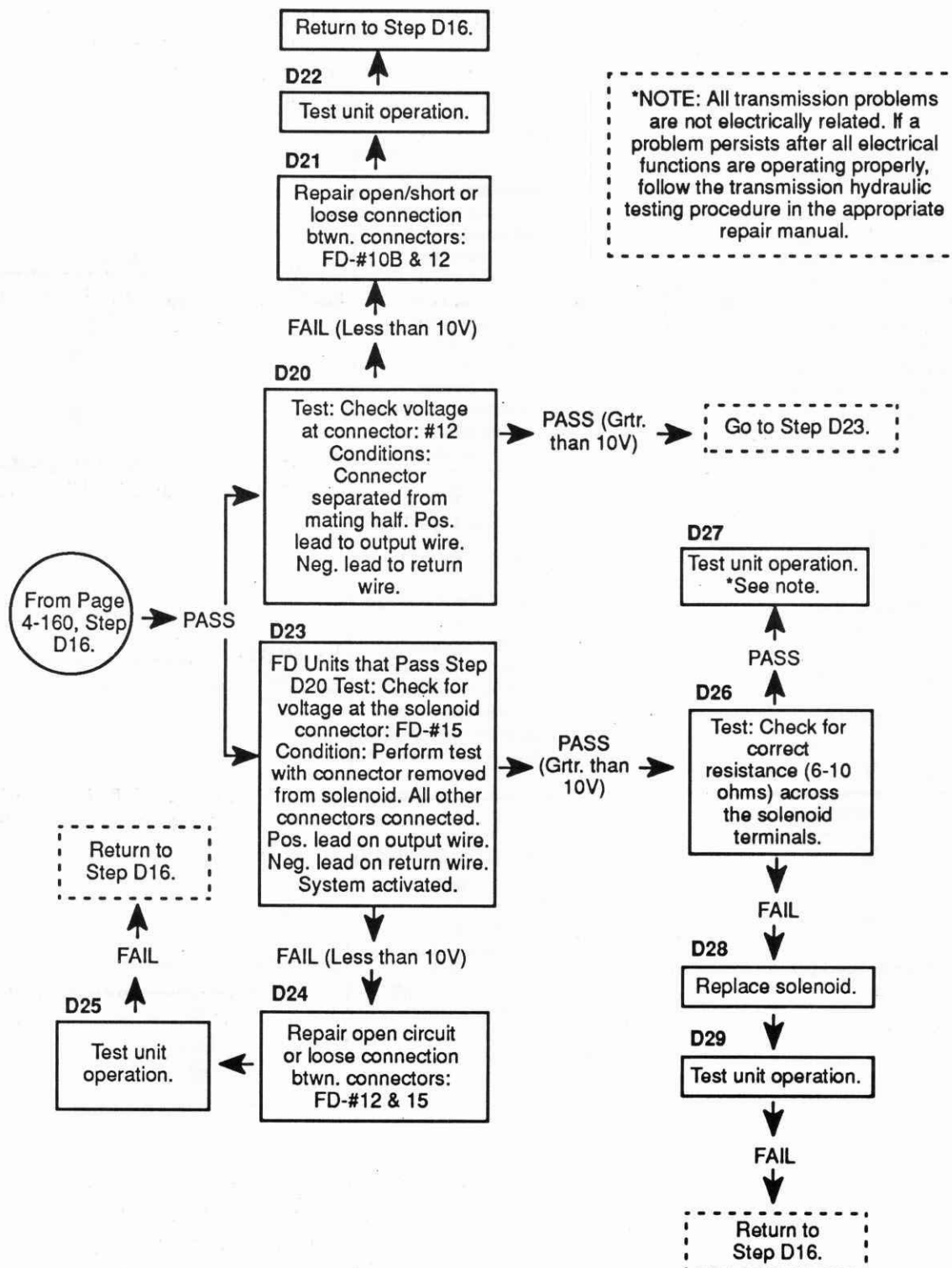
Symptom: Torque Converter Lock-Up Circuit (8x8 Only) Won't Operate

Symptom: Torque Converter Lock-Up Circuit (8x8 Only) Won't Operate



SECTION 4 – TRANSMISSION

Symptom: Torque Converter Lock-Up Circuit (8x8 Only) Won't Operate



HYDRAULIC

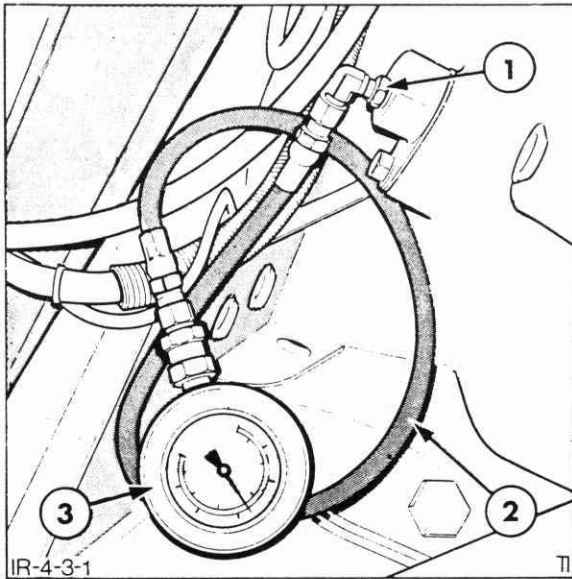


Figure 4-206

Gauge Installed in Pressure Test Port

1. Pressure test port
2. Hose - part no. E1NN-F493-AA
3. Low pressure gauge

Run the first check at 800 RPM. After one minute of operation, note the reading of the pressure gauge. It should register 130 lbf/in² (8.83 bar) with the oil temperature at 149° F (65° C).

Run a second check at 1600 RPM and again note the reading on the gauge. It should register 150 lbf/in² (10.3 bar) minimum.

Run a third check at 2100 RPM. The gauge should register 200-220 lbf/in² (13.7-15.2 bar) maximum.

INTERNAL LEAKAGE TEST

LINE PRESSURE TEST

The purpose of this test is to determine if the transmission hydraulic pump and pressure regulating valve are operating satisfactorily to produce the pressure required for hydraulic clutch operation. This test should be performed first.

Attach a 300 lbf/in² gauge to the pressure test port connection, Figure 4-206.

Operate the tractor engine 800-1000 RPM until the transmission oil reaches 149° F (65° C).

The purpose of this test is to determine if the sealing rings on the front and rear input shafts are sealing properly.

1. If not previously installed, attach a 300 lbf/in² gauge to the pressure test port, Figure 4-206.
2. With the gearshift lever and power reversing lever in the neutral positions, start the engine and set the engine speed at 800 RPM. Note the reading of the pressure gauge, then move the power reversing lever to its forward and reverse positions, noting the pressure drop in each case. If the pressure drop is greater than 7 lbf/in² (0.49 bar) refer to the diagnosis guide for possible causes.

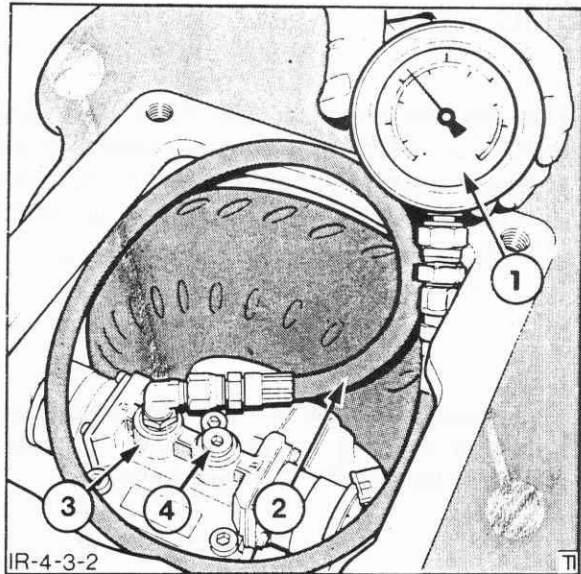


Figure 4-207

Control Valve Assembly - Attachment and Test Ports Through Upper Opening

1. Low pressure gauge
2. Hose E1NN-F493-AA
3. Reverse test point
4. Forward test port

4. Shift the power reversing lever into the reverse position and record the time it takes the reverse clutch pressure to reach 100 lbf/in² (7 bar). The clutch pressure should reach 100 lbf/in² (6.9 bar) after 1.7 seconds.

5. With the power reversing lever still in the reverse position, note the maximum reading on the gauge. It should register 200 to 220 lbf/in² (13.7-15.2 bar).

NOTE: The maximum pressure should be reached after 2.3 seconds following power reversing lever engagement.

CONTROL VALVE CHECK

1. Remove the access cover from the top of the transmission. Attach a 300 lbf/in² pressure gauge to the reverse test port on the control valve, Figure 4-207.

2. Operate the tractor engine at 800-1000 RPM until the transmission oil temperature reaches 149° F (65° C).

3. With the power reversing lever and gearshift lever in neutral and the hand brake applied set the engine speed at 1800 RPM. The gauge should read zero.

6. Attach the gauge to the forward test port on the control valve. Repeat Steps 2 through 5, shifting the power reversing lever from neutral to the forward position. The shift times and pressures should be the same as when shifting in reverse.

OIL-TO-COOLER TESTS

The purpose of these tests is to determine if the bypass valve and regulating valve are operating satisfactorily, and that the cooler tubes, the filter and the internal oil passages are free of obstructions.

PRESSURE TESTS

Install a 300 lbf/in² pressure gauge in the cooler return line connector on the right side of the transmission housing and run a pressure test.

Run these tests with the oil temperature at 149° F (65° C).

Run the first pressure test at 1600 RPM. The pressure gauge should read 71 lbf/in² (4.9 bar).

Run a second pressure test at 2200 RPM. The gauge should read 85 lbf/in² (5.88 bar) minimum to 114 lbf/in² (7.89 bar) maximum.

FLOW TEST

The flow rate from the transmission oil cooler to the transmission lubrication circuit can be checked practically as follows:

Remove the transmission oil filter from the filter housing on the left hand side of the unit.

Disconnect the fuel shutoff solenoid wire from the fuel injection pump.

Place a suitable container under the filter housing.

Crank the engine starting motor for 30 seconds and observe the oil flow from the filter housing.

The quantity of oil collected in the container should be 4.2 to 6.3 US Pts (2 to 3 liters).

If the oil flow from the cooler is not to the specified limits or is suspect, then a flowmeter must be used to determine the oil flow using the following procedure:

Install a flow meter into the cooler return line on the righthand side of the transmission housing. Using an adaptor or a hose with a female 1-14 UNF-2A O.F.S., connect it to the return line. Connect the other end to your flowmeter.

Remove the elbow from the return port in the transmission. Install a connector or hose with a 7/8" - 14 UNF 2A O ring seal into the return port on the transmission. Connect the other end of the hose to the flowmeter.

Ensure all connections are tight and the flowmeter load valve is fully open. Start the engine and run first flow test at 1600 RPM. The oil flow should be 3.2 US Gals (2.6 Imp. Gals) minimum.

Conduct a second flow test at 2200 RPM. The oil flow should be 3.8 US Gals (3.1 Imp Gals) minimum.

SECTION 4 – TRANSMISSION

STALL TEST

The purpose of this test is to determine if the torque converter and hydraulic clutch assemblies are operating satisfactorily. For the test to be conclusive, the transmission hydraulic pump and pressure regulating valve must be operating correctly. They can be checked by performing the "Line Pressure Test". The engine and brakes must also be in good working order.

1. Check the coolant level in the radiator and the oil level in the transmission. If low, add fluid as required to bring to the proper level.
2. With the gearshift lever and the power reversing lever in neutral, start the engine and run at 800-1000 RPM until the transmission temperature reaches 85° - 95° F (29° - 35° C).
3. Lock the brakes and shift into fourth gear, increase engine speed to approximately 900 RPM, then shift the power reversing lever to the forward position. This will position the control valve so as to direct high pressure oil to the front clutch.
4. Ensure the brakes are firmly locked so the unit will not move, gradually depress the foot accelerator and note the maximum engine speed obtained. Move the power reversing lever to the neutral position. The stall speed should be:

All Markets – Except North America

DFO	1575–1825 R.P.M
LF4	1575–1825 R.P.M
LF5	1750–2000 R.P.M

North America Only

KF3	1850–2100 R.P.M
DFO	1950–2200 R.P.M
DF1	1700–1950 R.P.M
LF4	1700–1950 R.P.M
LF5	1750–2000 R.P.M

IMPORTANT: To prevent the transmission from overheating, do not allow the engine to operate at wide open throttle for more than fifteen seconds.

5. Allow the transmission oil to cool to 85°-95° F (29°-35° C). Check the rear hydraulic clutch by repeating Steps 3 and 4, but with the power reversing lever in the rearward position. Again, cool the transmission oil by allowing the engine to run at approximately 1000 RPM for one minute.
6. The engine speed noted in Step 4 (stall speed) for both the front and rear clutch assemblies should be within 150 RPM of each other. If the stall speed is not within these limits, refer to the diagnosis guide for possible causes.
7. With the gearshift lever and power reversing lever in neutral, set the engine speed at 600-800 RPM, then shift into any gear ratio. If the gears clash, either the front or rear hydraulic clutch assembly is transmitting power, even though the power reversing lever is in neutral.

NOTE: If the unit creeps forward and the gears clash, the front clutch is at fault. The rear clutch is at fault if the unit creeps backward. If the unit does not creep and the gears still clash, use the stabilizers to raise the rear wheels off the ground, move the power reversing lever to neutral and shift into first gear. Check the rear wheels for rotational direction - if the wheel rotate rearward, then the rear clutch is at fault.

DIAGNOSIS GUIDE

PROBLEM	POSSIBLE CAUSES	CORRECTION
Line pressure test	1. Low line pressure 2. High line pressure	Inaccurate proof-meter worn or damaged transmission hydraulic pump. Sticking regulating valve or valve spring is weak. Worn or damaged control valve lands. Clogged oil distributor passages. Clogged sump oil strainer. Inaccurate proof-meter. Sticking regulating valve or valve spring is too strong.
Oil-to-Cooler test	1. Low pressure 2. High pressure 3. Low output 4. High output	Inaccurate proof-meter. Bypass valve spring too weak. Worn or damaged transmission hydraulic pump. Excessive leakage in control valve, clutch, or converter circuit. Inaccurate proof-meter. Bypass valve sticking closed or valve spring too strong. Clogged or restricted cooler lines. Clogged cooler oil filter. Cooler return regulator block spring too strong. Damaged or worn transmission hydraulic pump. Bypass valve spring too weak. Bypass valve spring too strong.

SECTION 4 – TRANSMISSION

PROBLEM	POSSIBLE CAUSES	CORRECTION
Internal leakage test	1. Excess pressure drop	Sealing rings on front or rear input shaft broken or worn. Damaged O rings in clutch housing. Cracked clutch power.
Stall test	1. Low stall speed 2. High stall speed	Hydraulic clutch not releasing. Stator support broken. Defective torque converter. Low engine power. Hydraulic clutch not applying or is slipping. Low line pressure. Sealing rings on rear input shaft broken. Defective torque converter.

TROUBLESHOOTING GUIDE

SYMPTOMS	POSSIBLE CAUSES
1. Transmission overheats	Low engine coolant level. Low transmission oil level. Hydraulic clutch slippage. Clogged cooler filter. Defective one-way clutch in torque converter. Excessive countershaft and/or output shaft pre-load. Operating in a gear range too high for load requirement causing low torque converter efficiency.
2. Slow acceleration (Driving tractor)	Poor engine performance. Defective torque converter. Brakes dragging. Broken sealing rings on rear input shaft.
3. No drive in any gear	Hydraulic clutch not applying. Broken shifter forks. Broken front or rear input shaft, output shaft, or traction coupler. Dump valve activated or control valve spool stuck in neutral position. Short circuit in transmission wiring circuit.
4. Oil leak at transmission bell housing	Transmission distributor housing gasket leaking. Pump gasket leaking. Transmission hydraulic seal leaking. Engine rear main bearing leaking. Torque converter leaking. Control valve gasket leaking. Lock-up valve gasket leaking. Internal pipe work ruptured or loose connections.
5. Temperature warning light remains on	Transmission overheated. Defective temperature sending unit. Short circuit.
6. Gear engagement difficult or gears clash	Operating without use of dump valve. Synchronizer unit worn.

SPECIFICATIONS

LUBRICANT

Capacity 31.7 Imp Pts (18 litres) 4.5 US Gal.
 For lubricant viscosity and type refer to the Ford Tractor Loader Backhoe Operators manual.

SEALANT

Gasket sealant Ford Specification ESE-M4G234A1 (Loctite 518)
 Thread sealant Ford Specification SJ-M4G9102A (Loctite 572)

GEAR RATIOS

Synchronized 4x4 Transmission

1st	4.2656:1	R1	4.2875:1
2nd	2.5:1	R2	2.508:1
3rd	1.2735:1	R3	1.28:1
4th	0.7281:1	R4	0.7318:1

Synchronized 8x8 Transmission

1st	7.9608:1	R1	8.0016:1
2nd	5.3724:1	R2	5.4000:1
3rd	3.5265:1	R3	3.5446:1
4th	2.4014:1	R4	2.4137:1
5th	2.2474:1	R5	2.2690:1
6th	1.5234:1	R6	1.5313:1
7th	1.0000:1	R7	1.0051:1
8th	0.6810:1	R8	0.6844:1

BY-PASS VALVE SPRING

Outside diameter 0.543" (13.8 mm)
 Free length (Approx) 2.610" (66.3 mm)
 Maximum solid height 1.205" (30.6 mm)
 Height under load 8.6 kg 1.811" (46.0 mm)

REGULATING VALVE SPRING

Outside diameter	0.610" (15.5 mm)
Free length (Approx)	2.717" (69.0 mm)
Maximum solid height	1.181" (30.0 mm)
Height under load 6.83 kg	2.205" (56.0 mm)

CLUTCH PISTON SPRING

Outside diameter	3.012" (76.5 mm)
Free length (Approx)	2.362" (60.0 mm)
Maximum solid height	1.043" (26.5 mm)
Height under load 114.6 kg	1.181" (30.0)

PRESSURE TESTING

Oil temperature 140° +/- 6° F (60° +/- 3° C)

P.T.O. Pressure regulating valve
(clutch disengaged)

@ 2300 engine RPM 220-230 lbf/in² (15.2-15.9 bar)
(Oil flow 1.5 gal/min) (15.5-16.2 kgf/cm²)
(6.8 litres/min) (1.8 Imp gal/min)

@1000-2300 engine RPM 200-230 lbf/in² (13.8-15.9 bar)
(Oil flow 0.6-1.5 gal/min) (14.1- 16.2 kgf/cm²)
(2.8-6.8 litres/min) (0.75-1.80 Imp gal)

P.T.O. control valve
(clutch engaged)

@ 1300 engine RPM 220-240 lbf/in² (15.2-16.5 bar)
(Oil flow 0.8 gal/min) 15.5-16.9 kgf/cm²)
(3.8 litres/min) (1.0 Imp gal/min)

PRE-LOAD

Output shaft - Pull on cord	12-17 lbs. (54-77N) (10-15 kgf)
Countershaft - Pull on cord	
4x4	15-20 lbs (65-87N)
8x8	12-16 lbs. (54-72N)
Pre-load shims available	0.002" (0.051 mm)
	0.004" (0.102 mm)
	0.012" (0.305 mm)
	0.031" (0.787 mm)

HYDRAULIC TESTS

Oil temperature 149° F +/- 9° F (65° C +/- 5° C)
 Oil pump capacity @ 2200 RPM 7.9 US gals. (30 litres) (6.6 Imp Gal)

Line Pressure Test

@800 RPM 130 lbf/in² (8.83 bar) (9 kgf/cm²)
 @1600 RPM 150 lbf/in² (10.30 bar) (10.5 kgf/cm²)
 @2200 RPM 200-220 lbf/in² (13.7-15.2 bar)
 (14-15.5 kgf/cm²)

Internal Leakage

@800 RPM Less than 7 lbf/in² (0.49 bar)
 (0.5 kgf/cm²) pressure drop

Cooler Pressure Test

@1600 RPM 71 lbf/in² (4.9 bar) (5 kgf/cm²)
 @2200 RPM
 - minimum 85 lbf/in² (5.88 bar) (6 kgf/cm²)
 - maximum 114 lbf/in² (7.89 bar) (8 kgf/cm²)

Cooler Flow Test

@1600 RPM minimum 3.2 gal (12 litres/min) (2.6 Imp gals)
 @2200 RPM minimum 3.8 gal (14 litres/min) (3.1 Imp gals)

By-Pass Valve Opening Pressure

@2200 RPM 128-142 lbf/in² (8.8-9.8 bar)
 (9-10 kgf/cm²)

Control Valve Pressure Test

@1800 RPM 100 lbf/in² (6.9 bar) (7 kgf/cm²) after 1.7
 seconds as clutch is engaged, rising to
 220 lbf/in² (15.2 bar) (15.5 kgf/cm²) after
 2.3 seconds when clutch is engaged.

Stall Speed

KF3P 1950-2200 RPM
 DF0P 2000-2500 RPM
 DF1Q 2175-2375 RPM
 LF4P/Q 2175-2325 RPM
 LF5Q T.B.A.

Lubrication Circuit By-Pass

Valve Opening Pressure 33 lbf/in² (2.3 bar) (2.3 kgf/cm²)

Oil Filter By-Pass Opening Pressure 7-9 lbf/in² (0.6-0.6 bar) (0.5-0.6 kgf/cm²)

TORQUE VALVES

Item Description	ft. lbs.	N-m	kgf/m
Reverse idle gear shaft retaining bolt	47-54	64-73	6.5-7.4
Solenoid retaining bolt (Control valve)	2-4	3-5	0.3-0.5
Solenoid retaining bolt (Lock-up valve)	2-4	3-5	0.3-0.5
Output shaft retainer bolt	35-41	48-56	4.9-5.7
Countershaft retainer bolt	35-41	48-56	4.9-5.7
Safety start solenoid	21-29	29-39	3.0-4.0
Bypass valve plug	57-66	77-90	7.9-9.2
Regulating valve plug (Upper)	35-41	48-56	4.9-5.7
Regulating valve plug (Lower)	57-66	77-90	7.9-9.2
Lock-up valve plate bolt	7-8	10-11	1.0-1.15
Cooler return pipe union	36-58	49-78	5.0-8.0
Cooler return pipe elbow	36-58	49-78	5.0-8.0
Oil pressure check port pipe union	2-4	3-5	0.3-0.5
Oil pressure check port pipe elbow	2-4	3-5	0.3-0.5
Hydraulic pump feed pipe union	7-12	10-16	1.0-1.6
Hydraulic pump feed pipe elbow	7-12	10-16	1.0-1.6
8x8 lower shift rail locatin bolt	45-54	62-73	6.3-7.4
4x4 interlock plug	13-15	18-21	1.8-2.1
4x4 rear cover plug	46-54	63-73	6.4-7.4
Cooler outlet connection plug	80-92	108-125	11.0-12.8
Control valve retaining bolt	17-20	23-27	2.3-2.7
Lock-up valve retaining bolt	6-7	8-10	0.8-1.0
Charge Oil pump retaining bolt	19	26	2.6
Front cover retaining bolt	38	52	5.2
Valve housing retaining bolt	38	52	5.2
Gearshift lever support retaining bolt	19	26	2.6
Rear cover retaining bolt	38	52	5.2
Transmission top cover retaining bolt	38	52	5.2
Strainer retaining bolt	38	52	5.2
Stator support retaining bolt	19	26	2.6
Proportional valve retaining bolt	19	26	2.6
Flywheel to flex plate	32	43	4.4
Flex plate to converter	32	43	4.4
Hub to flywheel	167	224	23

SECTION 4 – TRANSMISSION

SPECIAL TOOLS

DESCRIPTION	V.L. CHURCHILL TOOL NO.	NUDAY TOOL NO.	FNH TOOL NO.
Shaft protectors	625A	9212	FNH09212
Step plate adaptors	630S	9210	FNH09210
Step plate adaptors	630T	9211	FNH09211
Internal/external puller	943	9507	FNH09507
Slide hammer	943S	9567	FNH09567
Pulling attachment	951	9190	FNH09190
Pilot bearing puller	954C	9508	FNH09527
Puller/reversible arm	1002	9198	FNH09198
Puller-single end arm	1003	9516	FNH09516
Pressure gauge	FT4100	--	--
Pressure pipe	FT4100-1	1552	FNH01552
Spring compressor (modified)	FT4101	1312	FNH01312
Connector-pressure test	FT5006	--	--
Connector-flow test	FT5007	--	--
Flowmeter	MS820A	2015	FNH02755
Thread adaptor	FT820-1	--	--
Connector-flow test	FT8543	--	--

SECTION 4

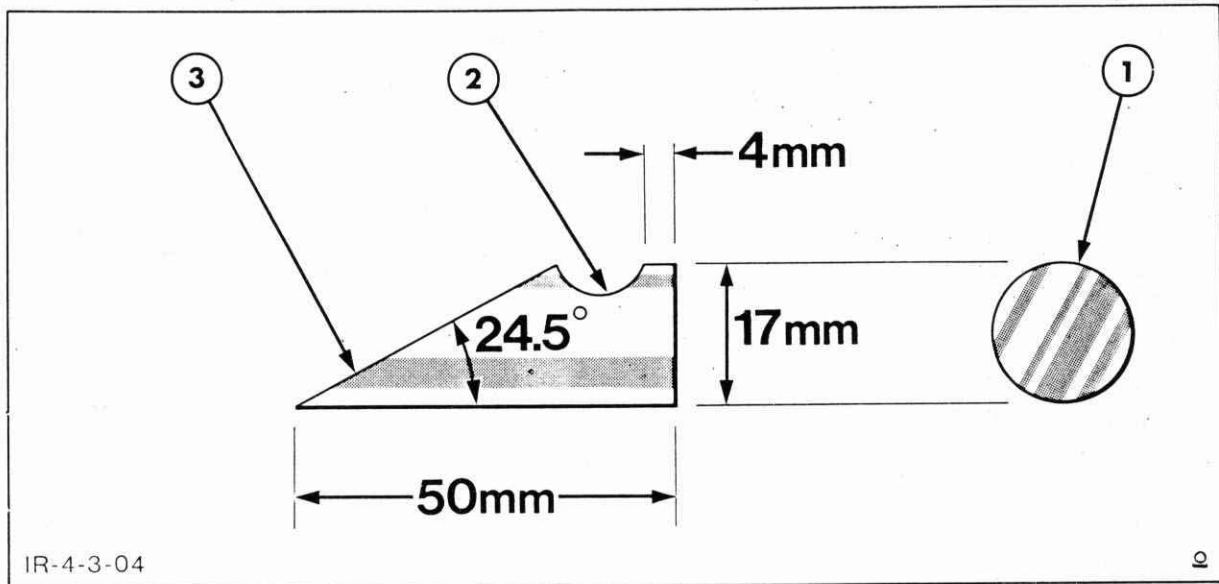


Figure 4-208

Lower Shift Rail Detent Retainer

1. 17 mm bar stock
2. Grind groove to accept detent ball
3. Grind ramp to give 24.5° angle (approx)

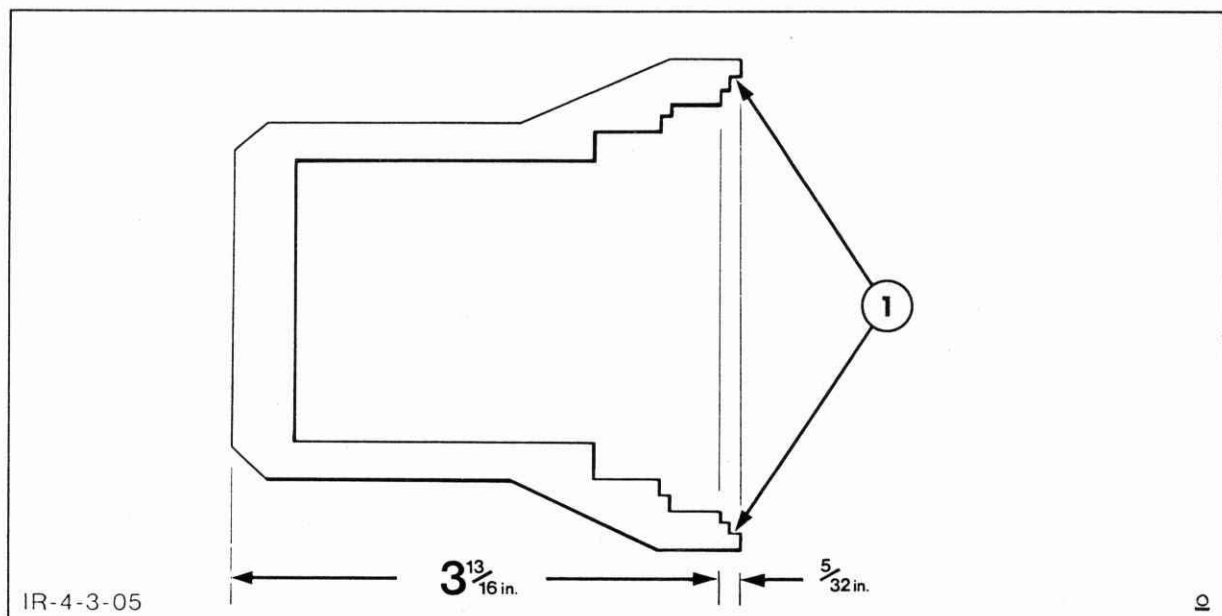


Figure 4-209

Spring Compressor FT4101 Modification

1. Remove stock from circumference of tool to give dimensions show

SECTION 5

REAR AXLE AND BRAKES

REAR AXLE AND WHEEL BRAKES

DESCRIPTION AND OPERATION

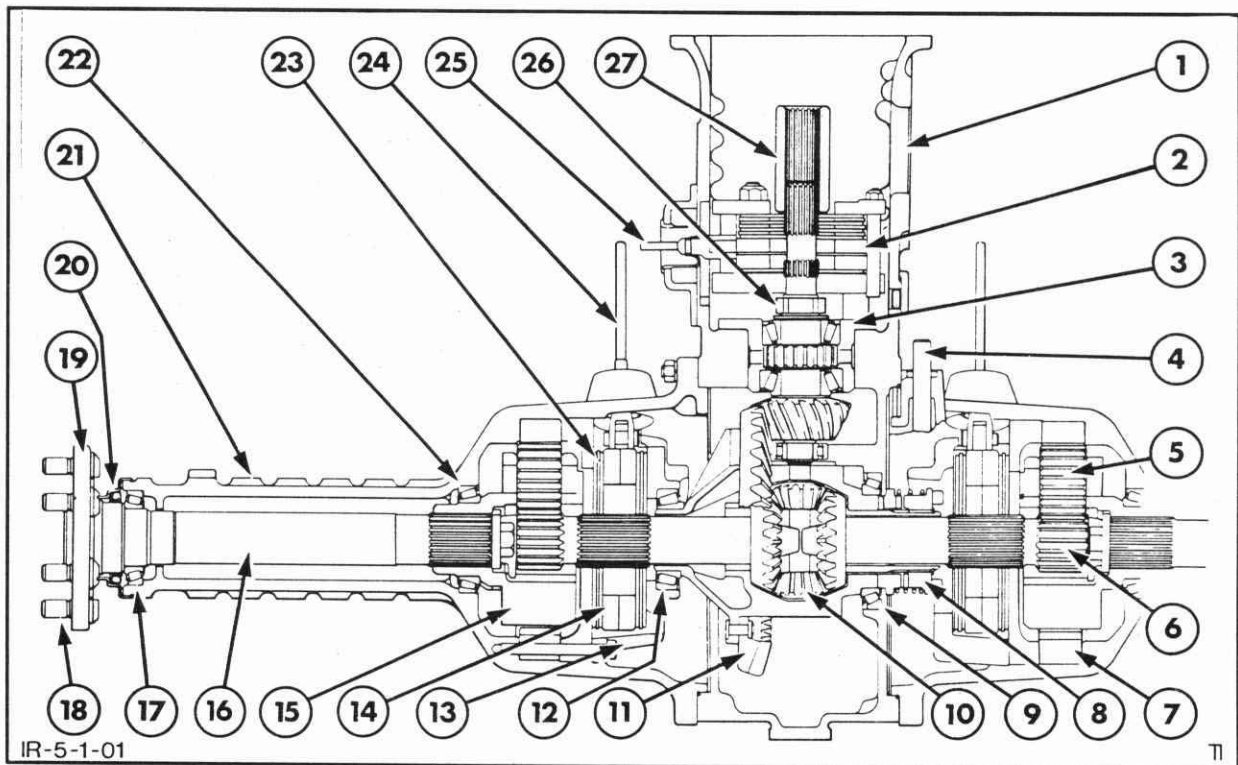


Figure 5-1

Rear Axle Sectional View

- | | | |
|--------------------------------------|-------------------------------|---|
| 1. Rear axle center housing | 11. Differential ring gear | 21. Axle shaft housing |
| 2. Transmission hand brake assembly | 12. Differential bearing | 22. Axle shaft inner bearing |
| 3. Drive pinion bearing retainer | 13. Brake outer housing | 23. Brake discs |
| 4. Differential lock operating shaft | 14. Brake actuating discs | 24. Brake actuating rod |
| 5. Planet gear | 15. Planet gear carrier | 25. Transmission hand brake actuating rod |
| 6. Sun gear and shaft | 16. Rear axle shaft | 26. Bearing preload adjuster |
| 7. Ring gear | 17. Axle shaft outer bearing | 27. Transmission coupling |
| 8. Differential lock assembly | 18. Rear wheel securing studs | |
| 9. Differential bearing | 19. Rear wheel flange | |
| 10. Differential assembly | 20. Axle shaft oil seal | |

The rear axle contains the differential, brakes, final reduction gears, axle shaft and the differential lock, Figure 5-1.

Power from the transmission output shaft is transmitted to the pinion by the drive shaft coupling. The spiral bevel pinion is held by preloaded opposed tape roller bearings.

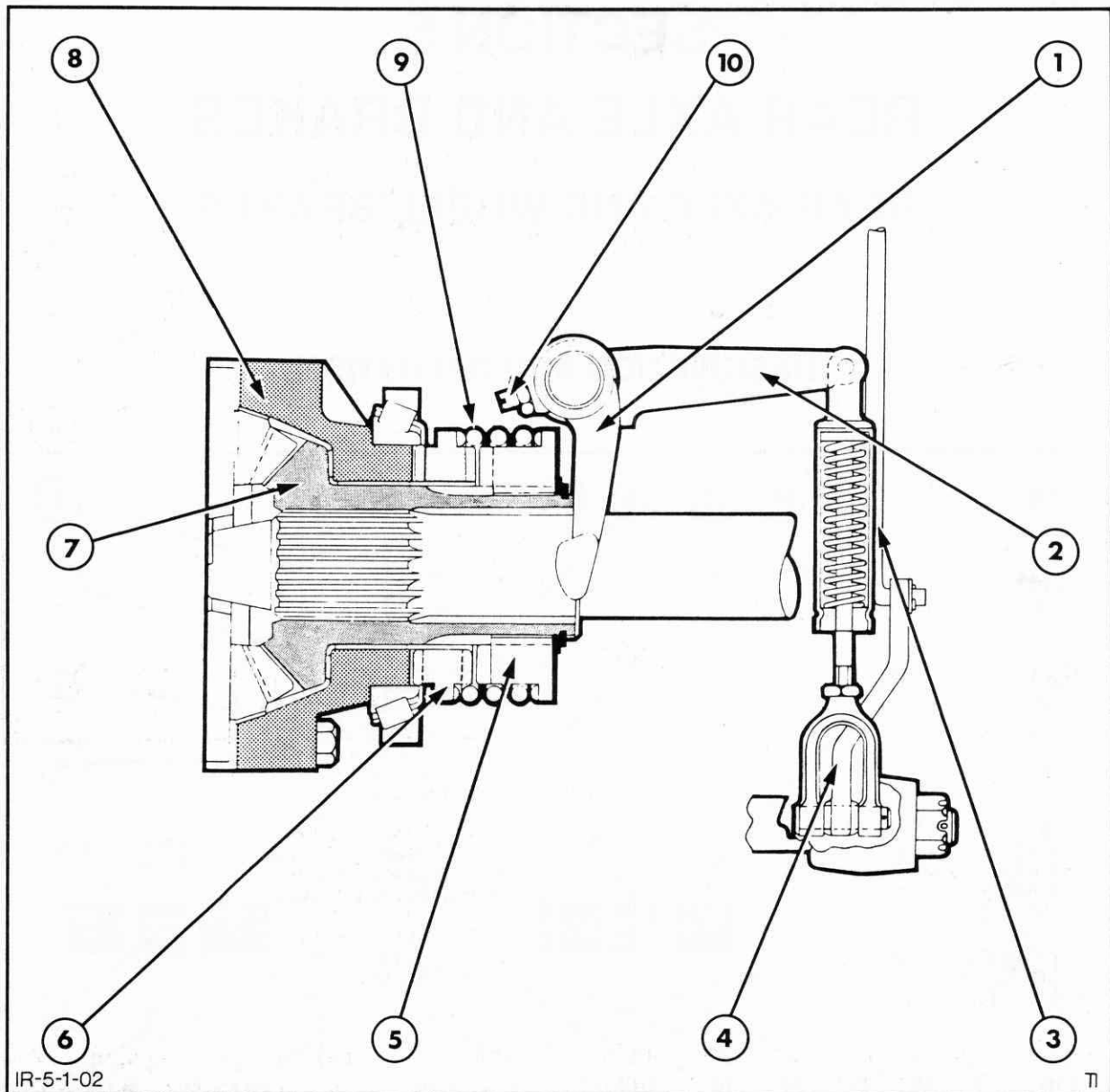


Figure 5-2
Differential Lock Assembly

1. Differential lock fork
2. Lever
3. Adjustable rod and clevis
4. Pedal lever
5. Coupling

6. Adaptor
7. Differential side gear
8. Differential housing
9. Spring
10. Fork retaining bolt

The differential ring gear is bolted to the differential case and the drive from the case is transmitted through a conventional four pinion differential to two sun gear shafts which are splined into the side gear of the differential.

The differential lock sliding coupling is located on the splines of the differential side gear, Figure 5-2. The coupling has dog teeth which match with the dog teeth on the differential lock adaptor. The adaptor dog teeth are in constant mesh with similar teeth machined in the differential case.

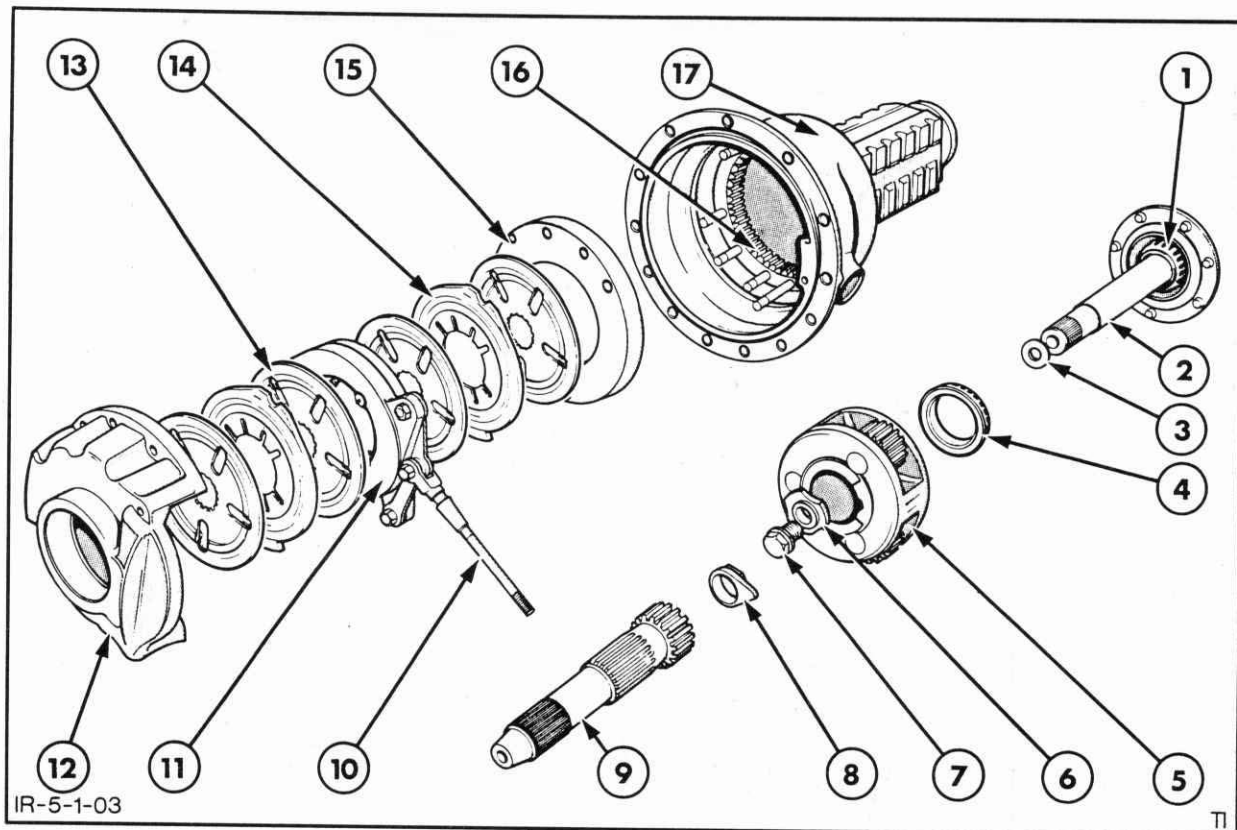


Figure 5-3

Axle Housing Assembly – Exploded View

- | | |
|-----------------------------|---------------------------|
| 1. Axle shaft outer bearing | 10. Brake actuating rod |
| 2. Axle shaft | 11. Brake actuating discs |
| 3. Spacer | 12. Inner brake housing |
| 4. Bearing | 13. Rotating brake discs |
| 5. Planet gear carrier | 14. Fixed brake discs |
| 6. Retaining washer | 15. Outer brake housing |
| 7. Retaining bolt | 16. Ring gear |
| 8. Lock plate | 17. Axle housing |
| 9. Sun gear and shaft | |

The differential lock operating spring separates the sliding coupling and adaptor. Depressing the differential lock pedal moves the differential lock fork which forces the sliding coupling into mesh with the adaptor, thus locking the side gear to the differential housing.

A common supply of oil is used for lubricating the rear axle and differential assemblies. The differential ring gear and differential assembly is partly immersed in oil providing adequate lubrication for bearings and bushings.

In each rear axle assembly a shaft projects through the side gear. This shaft terminates in a spur gear which is the sun gear of the

planetary reduction gear system. The planetary ring gear is pressed into the rear axle housing. The three planet gears are mounted in a carrier and are positioned around the sun gear and within the planetary ring gear.

The planet gears are mounted to the carrier by shafts and rotate on uncaged needle bearings. The carrier has internal splines into which the rear axle shaft locates.

As the sun gear is driven by the differential, the planet gears are forced to revolve inside the stationary planetary ring gear and force the carrier to revolve at a lower speed than the sun gear.

The rear axle shaft is held in opposed taper roller bearings and the end play is adjusted by means of selective shims held under the retaining bolt. The shaft terminates in a flange to which the rear wheel is bolted. An exploded view of one rear axle and brake half housing is shown in Figure 5-3.

The disc brakes consist of two sets of stationary and revolving discs. The revolving discs are splined to the shaft of the sun gear, located either side of an actuator assembly, Figure 5-3.

The KF3P incorporates three brake discs and one intermediate disc, while the DF0P, DF1Q, LF4P, LF4Q and LF5Q incorporate four brake discs and two intermediate discs.

The actuator assembly consists of two thrust plates with ramped "pockets" in which steel balls are located. The actuating discs are held in contact with the balls by four coil springs and are connected by suitable linkage with the appropriate foot brake pedal.

Operation of the foot brake pedal causes the rear brake actuating discs to rotate and the balls to rotate up the ramped "pockets". This expands the actuating discs and in so doing the actuating discs force the rear brake disc assemblies into contact with the intermediate disc, the actuating discs, and the inner and outer brake housings. Rotation of the stationary components of the brake unit is prevented by a large diameter torque pin held in the outer brake housing.

The twin cable hand brake also actuates the rear axle disc brakes.

DIFFERENTIAL LOCK OPERATION

When one rear wheel of a unit encounters a soft patch of ground and spins, the normal type differential action allows virtually all the drive to be applied to this wheel and a little to the opposite rear wheel which may be on firm ground. The result is that the unit is either brought to a complete halt or considerably slowed down.

When a differential lock is fitted, improved traction is possible because the lock enables traction to be obtained from the wheel which is on firm ground, thus enabling the unit to pull through the soft ground conditions.

Basically, the locking device consists of a dog-type coupling which is splined to, but free to slide on the differential side gear, and is designed to positively lock the differential side gear to the differential case. The connection is made through the differential lock adaptor which has dog teeth on both side faces. The teeth on the inside engaging with teeth machined on the differential case and the teeth on the outside with the differential lock coupling.

In operation, depression of the foot pedal first moves the coupling into contact with the adaptor and then compresses the spring in the operating rod assembly, Figure 5-2. As the teeth of the coupling come into alignment with the tooth spaces in the fixed adaptor, the spring tension will move the coupling into engagement with the adaptor. The fact that the spring supplies the final operating force prevents the possibility of damage should excessive force be applied to the foot pedal.

OVERHAUL

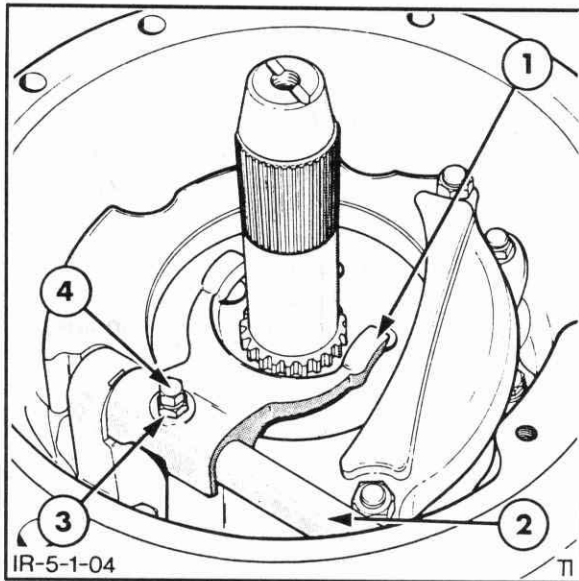


Figure 5-4

Differential Lock Operating Fork

1. Operating fork
2. Shaft
3. Locknut
4. Securing bolt

When full engagement has taken place (this will be noticeable by the reduced pedal pressure) the foot pedal should be released. The coupling and adaptor teeth side forces, resulting from the transfer of power from one wheel to another, will keep the coupling and adaptor teeth in mesh. As the drive becomes more equally distributed, the compressed operating spring overcomes the reduced teeth side forces and automatically disengages the differential lock.

REMOVAL

1. Remove the backhoe or rear counterweight as described in Section 10.
2. Remove the rear axle from the tractor as described in Section 10, "Separating the Unit."

3. Support the rear axle housing and remove the bolts and nuts which secure the housing to the rear axle center housing.
4. Separate the axle housing from the center housing. If the left-hand axle housing has been removed, lift out the differential to prevent it falling.

DISASSEMBLY

1. Remove the large O ring seal from the axle housing.
2. Left-Hand Axle Housings - Remove the two bolts securing the differential ring gear thrust block to the axle housing and remove the thrust block.

Right-Hand Axle Housing - Remove the differential lock fork by loosening the differential lock fork screw and locknut, Figure 5-4, and remove the differential lock lever shaft.

3. Remove the eight nuts that retain the inner disc brake housing assembly in the axle housing. Lift the brake housing out of the axle housing.
4. Remove the brake control rod fastener. Remove the brake rod seal if damaged. To remove the seal, place a sharp tool between the seal flange and the rear axle housing and pry the seal out. Remove the brake disc assemblies, intermediate discs, and actuating disc assembly.
5. Lift the sun gear out of the planet gear carrier.
6. Remove the outer brake housing from the axle housing.

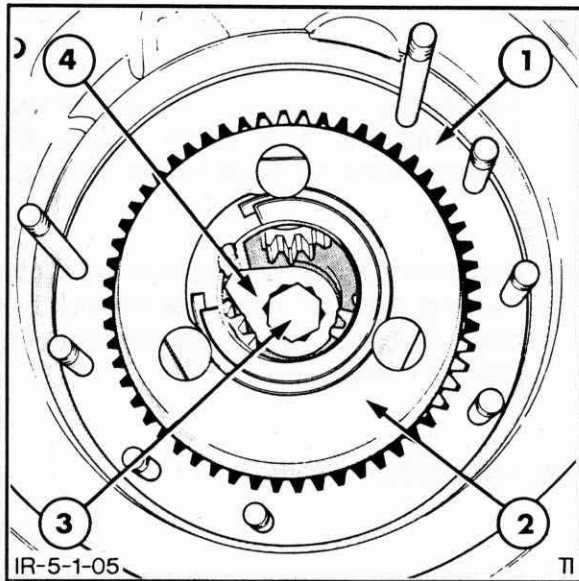


Figure 5-5

Axle Shaft Retaining Bolt

1. Ring gear
2. Planet gear carrier
3. Retaining bolt
4. Lock plate

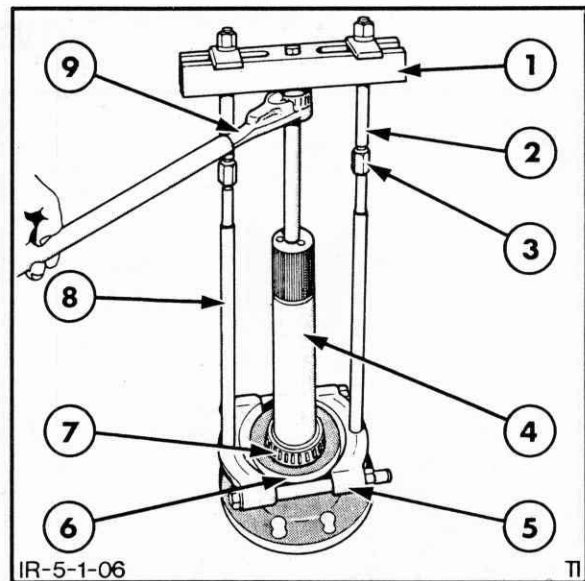


Figure 5-6

Removing Axle Shaft Outer Bearing and Oil Seal

1. Tool no. 938 or 9506
2. Tool no. 930E or 9207
3. Tool no. 924 or 9537
4. Axle shaft
5. Tool no. 952 or 9526
6. Oil seal retainer
7. Outer bearing
8. Tool no. 930B or 9521
9. Tool no. P61 or 9162

7. Remove the axle shaft bolt lock, axle shaft retaining bolt, axle shaft retaining washer, and selective spacer. The planet gears may have to be rotated to permit removal of the bolt lock, Figure 5-5.
8. Lift the planet gear carrier assembly out of the axle housing.
9. Separate the seal retainer from the end of the axle housing, by tapping down the staking with a copper drift and hammer. Remove the axle shaft from the axle housing.

INSPECTION AND REPAIR

1. Clean and repair all parts and install new parts where worn or damaged.

2. If necessary remove the axle shaft cone and roller assembly, seal and seal retainer using Tool #P61, 952, 938, 930B, 930E and 924, or Tool #9162, 9526, 9506, 9521, 9207 and 9537, Figure 5-6.
3. If necessary, remove the axle shaft outer bearing cup from the housing using Tool #943 or 9507 and 943S or 9567, Figure 5-7.

REASSEMBLY

1. Position a new oil seal and retainer assembly on the axle shaft and place a new oil seal retainer gasket in the seal retainer. Use a 2.68" (68.2 mm) inside diameter and 3.12" (79.4 mm) outside diameter sleeve of a suitable length to install the new outer bearing assembly onto the axle shaft. Apply a coat of petroleum jelly to both the seal and cone and roller assembly prior to installation.

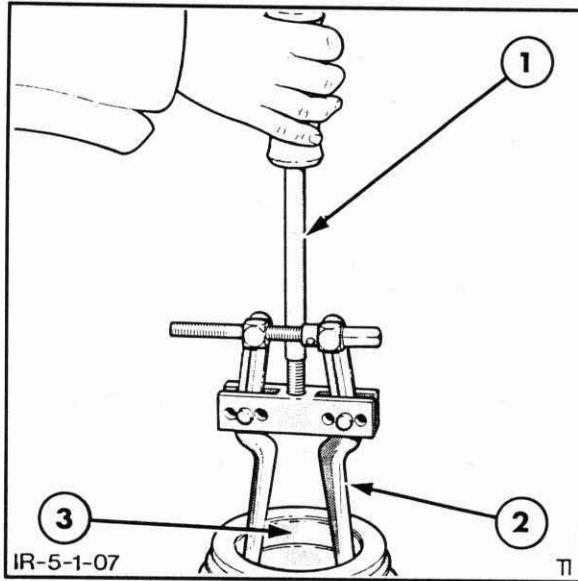


Figure 5-7

Removing Outer Bearing Track From Axle Housing

1. Tool no. 943S or 9567
2. Tool no. 943 or 9507
3. Bearing track

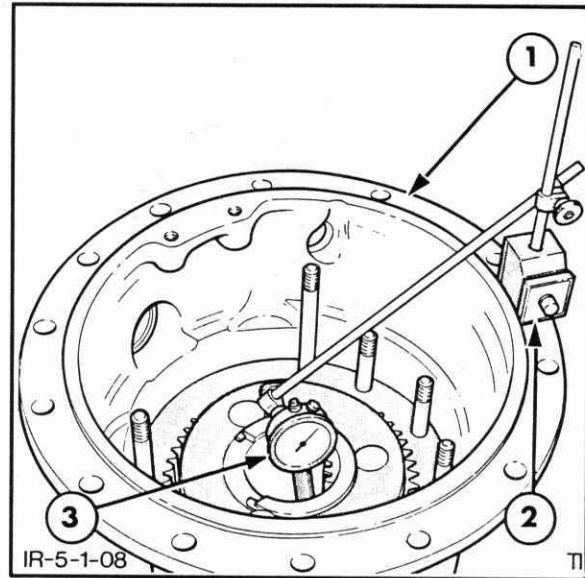


Figure 5-8

Checking Axle Shaft Bearing Pre-load

1. Axle housing
2. Magnetic base
3. Dial indicator

2. Install the axle housing on the axle shaft and, using a hammer and drift, stake the seal retainer to the housing in four equally spaced places.
3. Place the planet gear carrier assembly in the axle housing so that the planet gears mesh correctly with the planetary ring gear.

NOTE: It will be necessary at this stage to adjust the axle shaft bearing pre-load for which the following procedure should be adopted.

- a. Using the largest spacer available, 0.089" (2.261 mm), install the spacer and retaining washer and tighten the axle shaft bolt.
- b. Set up a dial indicator, as shown in Figure 5-8. It will be necessary to use an extended plunger on the dial indicator to enable a reading to be taken from the top of the axle shaft bolt.
- c. Set the dial indicator to zero and lift the axle housing. This can be done by prying up against the outer surface of the axle housing. Lifting the housing will result in a reading on the dial indicator. This is the free movement between the inner and outer bearing cone and roller assemblies and the cups, or end play.
- d. To determine the correct bearing pre-load, the reading obtained should be subtracted from the spacer size used, i.e. 0.089" (2.261 mm), and with the resulting figure, from the table below, the correct spacer may be selected.



SECTION 5 – REAR AXLE AND BRAKES

EXAMPLE:

Spacer used 0.089" (2.261 mm)
 End play reading – 0.026" (0.660 mm)
 Result 0.063" (1.600 mm)

From table below the correct spacer to be used: 0.065" (1.651 mm)

RESULT	SPACER TO BE USED
0.051-0.054" (1.295-1.371 mm)	0.053" (1.346 mm)
0.055-0.058" (1.397-1.472 mm)	0.057" (1.448 mm)
0.059-0.062" (1.499-1.575 mm)	0.061" (1.549 mm)
0.063-0.066" (1.600-1.676 mm)	0.065" (1.651 mm)
0.067-0.070" (1.702-1.778 mm)	0.069" (1.753 mm)
0.071-0.074" (1.803-1.880 mm)	0.073" (1.855 mm)
0.075-0.078" (1.905-1.988 mm)	0.077" (1.956 mm)
0.079-0.082" (2.007-2.083 mm)	0.081" (2.057 mm)
0.083-0.086" (2.108-2.184 mm)	0.085" (2.159 mm)
0.087-0.090" (2.210-2.286 mm)	0.089" (2.261 mm)

4. Position the selected spacer, shaft retaining washer and tighten the axle

shaft bolt to 395 ft. lbs (596 N·m) torque. To position the bolt lock may require that the bolt be tightened slightly so that the lock notches will fit the bolt head corners. Be sure that the bolt has the correct torque when the lock is installed.

5. Install the disc brake outer housing and brake torque pin.

NOTE: Prior to installing the sun gear and brake discs in the left-hand axle housing, it will be necessary to carry out the differential bearing pre-load adjustment if any of the following parts have been replaced with new components.

Rear axle housing

Planetary ring gear

Outer brake housing

Inner brake housing

Differential Bearing Pre-Load Adjustment

The bearing pre-load adjustment is made by adding or subtracting shims between the differential bearing cup and the inner brake housing. The bearing pre-load should be made to the left hand axle housing.

- a. Install the inner brake housing in the axle housing and secure with the eight nuts.

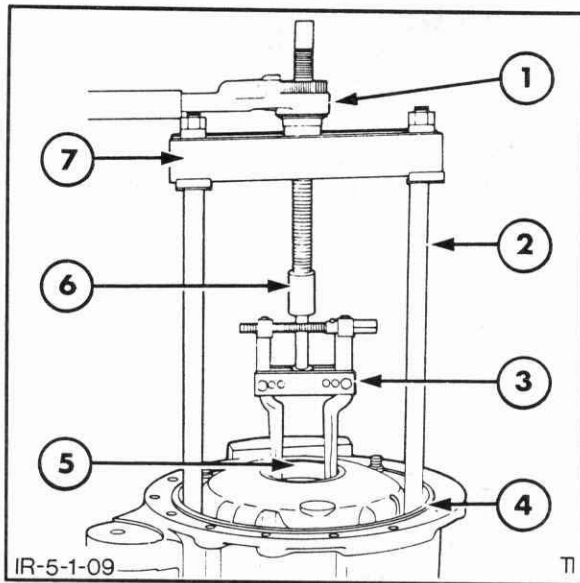


Figure 5-9

Removing Bearing Cup From Inner Brake Housing

1. Tool no. P61 or 9162
2. Tool no. 930B or 952
3. Tool no. 943 or 9507
4. Tool no. 938 or 9472
5. Bearing cup
6. Tool no. 9554
7. Tool no. 938 or 9506

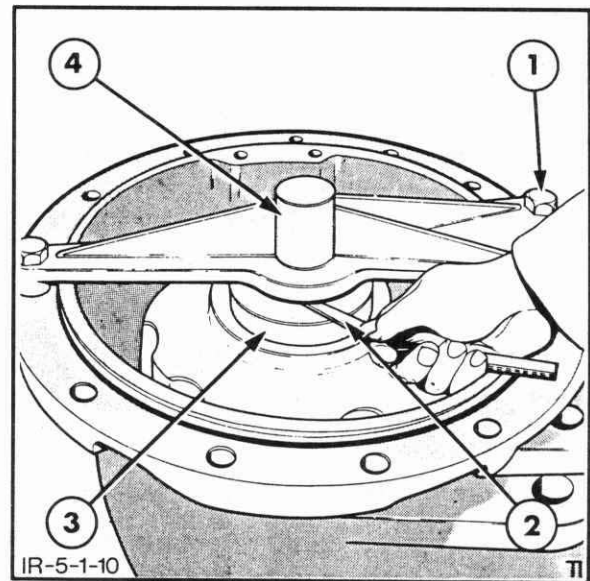


Figure 5-10

Checking Differential Bearing Pre-Load

1. Bolt
2. Feeler gauge
3. Gauge ring
4. Tool no. FT4501 or 2141

- b. Remove the differential bearing cup, together with the shims, from the inner disc brake housing, Figure 5-9.
 - c. Position the gauge ring Tool #FT4501 or FNH02141 in the inner disc brake housing. Be sure that the gauge ring seats correctly in the bearing cup recess.
 - d. Line up the pads of the bridge bar with three holes in the axle housing flange and bolt the bridge bar to the axle housing flange.
 - e. Using a feeler gauge, measure the gap between the bridge bar and the gauge ring, Figure 5-10.
 - f. With the resulting gap reading, the shim to be installed can be selected from table A or table B depending on which tool was used, FT4501 Churchill or FNH02141 O.T.C.
- IMPORTANT:** Be sure the correct table is used.

SECTION 5 – REAR AXLE AND BRAKES

**TABLE A - Use with Churchill
Tool No. FT4501**

Gap Measured	Shim Size to be Installed	Shim Part No. to be Installed
0.012-0.017" (0.305-0.432 mm)	0.038-0.040" (0.965-1.016 mm)	C5NN-4548-A
0.018-0.023" (0.457-0.584 mm)	0.044-0.046" (1.118-1.168 mm)	C5NN-4548-B
0.024-0.029" (0.610-0.737 mm)	0.050-0.052" (1.270-1.321 mm)	C5NN-4548-C
0.030-0.035" (0.762-0.889 mm)	0.056-0.058" (1.422-1.473 mm)	C5NN-4548-D
0.036-0.041" (0.914-1.041 mm)	0.062-0.064" (1.575-1.626 mm)	C5NN-4548-E
0.042-0.047" (1.067-1.194 mm)	0.068-0.070" (1.727-1.778 mm)	C5NN-4548-F
0.048-0.053" (1.219-1.346 mm)	0.074-0.076" (1.880-1.930 mm)	C5NN-4548-G
0.054-0.059" (1.372-1.499 mm)	0.080-0.082" (2.032-2.083 mm)	C5NN-4548-H

**TABLE B - Use with O.T.C.
Tool No. 2141**

Gap Measured	Shim Size to be Installed	Shim Part No. to be Installed
0.037-0.042" (0.94-1.08 mm)	0.038-0.040" (0.965-1.016 mm)	C5NN-4548-A
0.043-0.048" (1.09-1.23 mm)	0.044-0.046" (1.118-1.168 mm)	C5NN-4548-B
0.049-0.054" (1.24-1.38 mm)	0.050-0.052" (1.270-1.321 mm)	C5NN-4548-C
0.055-0.060" (1.39-1.53 mm)	0.056-0.058" (1.422-1.473 mm)	C5NN-4548-D
0.061-0.066" (1.54-1.68 mm)	0.062-0.064" (1.575-1.626 mm)	C5NN-4548-E
0.067-0.072" (1.69-1.83 mm)	0.068-0.070" (1.727-1.778 mm)	C5NN-4548-F
0.073-0.078" (1.84-1.98 mm)	0.074-0.076" (1.880-1.930 mm)	C5NN-4548-G
0.079-0.084" (1.99-2.13 mm)	0.080-0.082" (2.032-2.083 mm)	C5NN-4548-H

- g. Remove the bridge bar and gauge from the axle housing.
 - h. Install the selected shim together with the differential bearing cup in the inner disc brake housing.
 - i. Remove the inner disc brake housing from the axle housing and proceed as follows.
6. Position the sun gear in the planet gear carrier.
 7. Install the brake assembly in the following order. Refer to Figure 5-3 as needed.
 - a. Brake disc.
 - b. Intermediate disc with notch on the torque pin.

- c. Brake disc.
- d. Brake actuating disc assembly with the control rod passing through the brake control rod seal assembly, Figure 5-12. Position the notch over the torque pin. If the brake control rod seal assembly has been removed, install a new seal by tapping it into the rear axle housing and locking the seal in the annular groove on the brake control rod. Secure a new control rod fastener.
- e. Brake disc.
- f. Intermediate disc with notch on the torque pin.
- g. Brake disc.

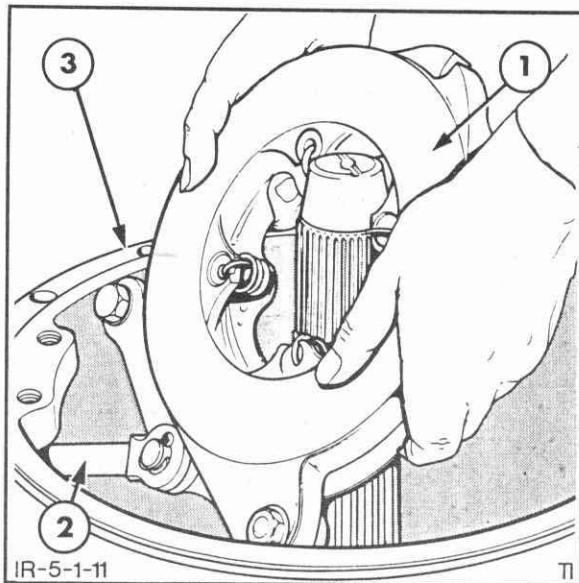


Figure 5-11

Installing Brake Actuating Mechanism

1. Actuating discs
2. Actuating link
3. Axle housing

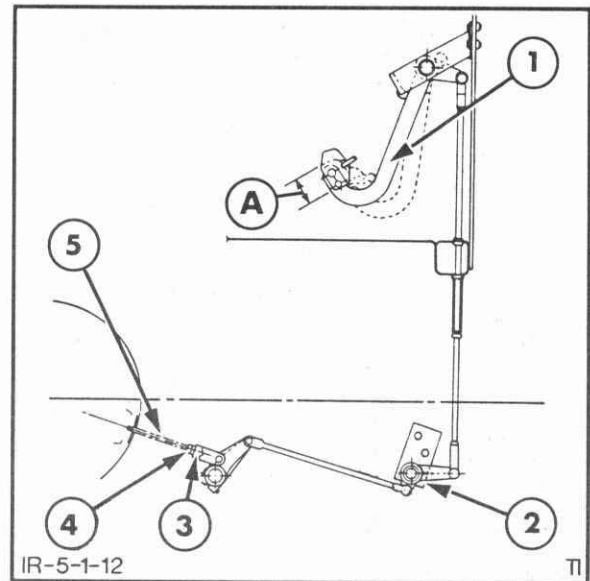


Figure 5-12

Brake Linkage

- A. 1.5 in. (38.0 mm)
1. Pedal
2. Pin and Bracket Assy.
3. Adjusting nut
4. Locknut
5. Pull rod

NOTE: Prior to installing the inner disc brake housing, be sure that the intermediate discs and actuating disc assembly are correctly centered. This will permit easier installation of the housing.

8. Install the inner disc brake housing and secure with eight nuts. Tighten the nuts to 81 ft. lbs. (110 N·m) torque.
9. Position the differential ring gear thrust block and secure with two bolts and lock washers. Install a new large O ring seal on the axle housing.
10. Right-Hand Axle Housing - Install the differential lock fork and differential lock lever. Tighten the screw and locknut.

INSTALLATION

1. Left-Hand Axle Housing - Install the differential assembly into the center housing.
2. Install the axle housing to the center housing. Tighten the securing nuts and bolts to 150 ft. lbs. (203 N·m).
3. Install the rear axle assembly to the transmission as described in Section 10.
4. Reconnect the brake linkage and adjust the linkage to provide the specified free pedal travel shown in Figure 5-12.
5. Install the rear wheels and the rear axle drain plug. Refill the rear axle with 134D oil.
6. Torque the rear wheel bolts to 400 ft. lbs. (540 N·m).

PLANETARY GEAR ASSEMBLY

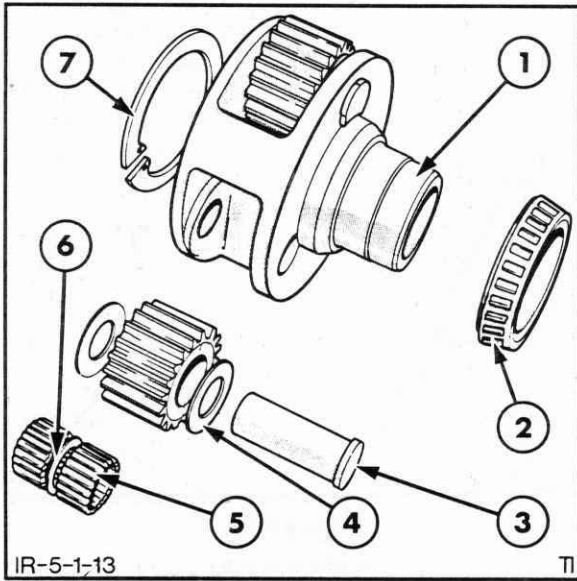


Figure 5-13

Planet Gear Carrier Assembly

1. Carrier
2. Bearing
3. Planet gear shaft
4. Thrust washer
5. Needle rollers
6. Spacer
7. Retaining ring

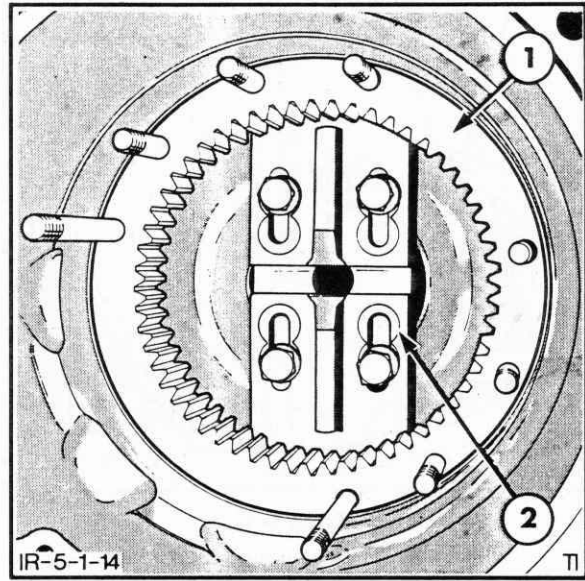


Figure 5-14

Removing Planetary Ring Gear

1. Ring gear
2. Tool no. FT4500

REMOVAL

Remove the axle housing as described previously and remove the planetary reduction gear assembly.

tool #1003 or 9516. Install a step plate adaptor into the end of the shaft.

INSPECTION AND REPAIR

DISASSEMBLY

1. To disassemble the planetary gear assembly, bend up one end of the planet gear shaft retaining ring and withdraw the retaining ring. Push the planet gear shafts from the carrier and remove the planet gears complete with needle roller bearings and thrust washer, Figure 5-13.
2. If the bearing on the planet gear carrier requires replacing, remove the roller and inner track assembly using Pulling attachment Tool #952 or 9526 and Puller

1. Clean and inspect all parts and install new parts where worn or damaged.
2. If necessary, remove the inner bearing race from the axle housing using Puller, Tool #943 or 9507 and 943S or 9567. Install a new bearing race.
3. Inspect the planetary ring gear located in the axle housing. If damaged or worn, replace as follows:
 - a. Remove the axle shaft from the axle housing.

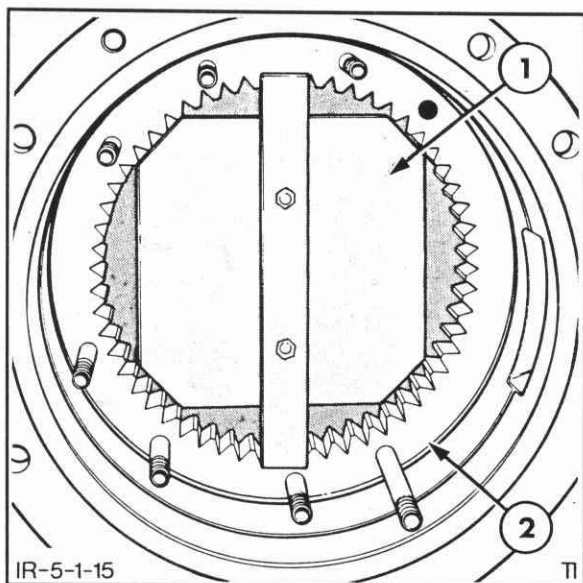


Figure 5-15

Removing Planetary Ring Gear

1. Tool no. FT2122
2. Ring gear

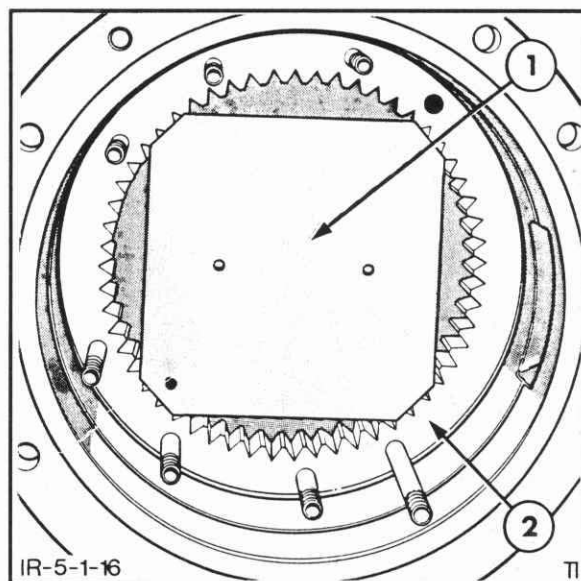


Figure 5-16

Installing Planetary Ring Gear

1. Tool FT4500 or 2122
2. Ring gear

b. Position Tool #FT4500 behind the ring gear, expand the movable plates and tighten the four locknuts, Figure 5-14. If tool 2122 is used, position the tool behind the ring gear and tighten the retaining nuts, Figure 5-15.

c. Place the axle housing on a press beam with the large end down. Insert a bar of suitable length into the small end of the bar against the Tool #FT4500 or 2122. Position the other end of the bar under the press ram and press out the ring gear.

d. Clean the new ring gear and the housing shoulder and position the ring gear in the axle housing, ensuring that the studs in the housing are aligned with the holes in the ring gear.

e. Place the axle housing on a press beam with the large end up. Position Tool #FT4500 or 2122 on the ring gear, Figure 5-16, and press the ring

gear into the housing. Be sure the ring gear is pressed squarely into the housing.

f. To check that the ring gear is seated correctly, use a feeler gauge to ascertain if there is a gap between the ring gear and housing shoulder.

REASSEMBLY

1. Coat the spacers in grease and position in the planet gears. Install sixteen needle rollers each side of the spacer in the planet gears and place a grease coated thrust washer on each end of the planet gears.

2. Place the three planet gears, complete with thrust washers, in the carrier. Align the bores in the planet gears with the bores in the carrier.

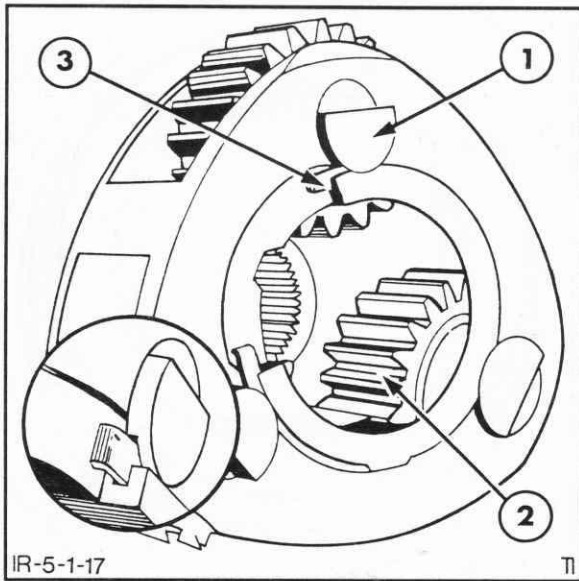


Figure 5-17

Plate Gear Carrier Assembly

1. Planet gear shaft
 2. Planet gear
 3. Planet gear shaft retainer
3. Insert all three planet gear shafts in the carrier housing. Position the shafts so that the flat portion of the shaft head is away

from the center of the carrier housing, Figure 5-17.

4. Install the planet gear shaft retainer, bending the ends of the retainer into the recess.
5. If the inner bearing race has been removed, install a new race using a hollow sleeve of suitable internal diameter.

INSTALLATION

1. Reassemble the rear axle following procedures described previously. Fill the rear axle with the specified lubricant and recheck the oil level after operation.

NOTE: If a new planetary ring gear has been installed in the left-hand axle housing, the differential bearing pre-load must be checked as described previously.

REAR WHEEL BRAKES

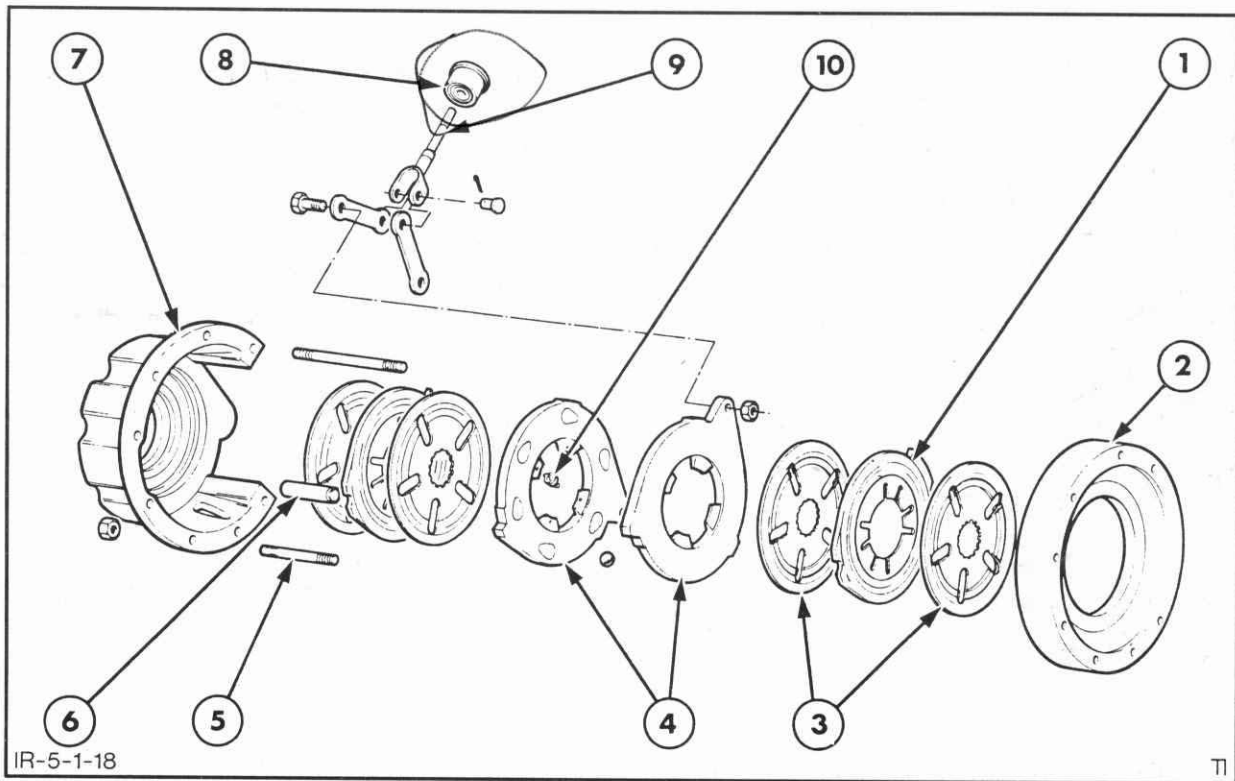


Figure 5-18

Brake Actuating Components (DF0P, DF1Q, LF4P/Q and LF5Q Shown)

- | | |
|---------------------------------|------------------------------------|
| 1. Fixed disc | 6. Torque pin |
| 2. Outer brake housing | 7. Brake inner housing |
| 3. Rotating disc | 8. Actuating rod seal |
| 4. Actuating discs | 9. Actuating rod |
| 5. Brake housing securing studs | 10. Actuating discs return springs |

REMOVAL

1. Remove the rear axle housing as described previously.
2. Remove the brake assembly from the axle housing as described previously.
2. Remove the four actuating disc return springs and separate the actuating discs, Figure 5-19.
3. Remove the six steel balls.

INSPECTION AND REPAIR

DISASSEMBLY

1. Detach the brake control rod and actuating links by removing the cotter pins, clevis pins and nuts, Figure 5-18.
1. Inspect the steel fixed plates for wear and warpage. The inspection should include the inner and outer brake housings. Replace parts which are scored or warped.

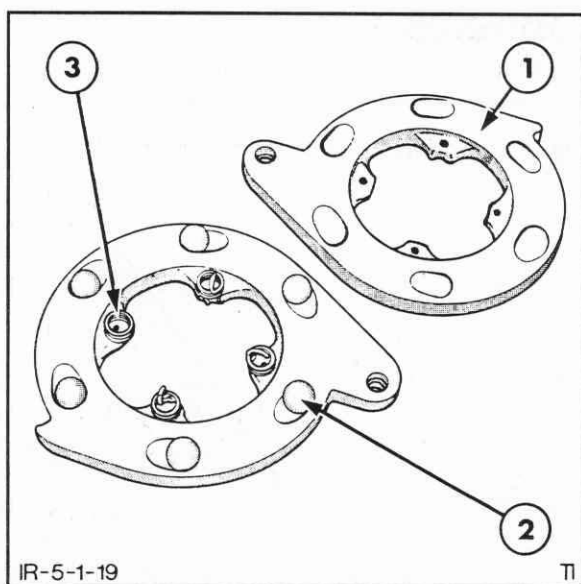


Figure 5-19
Brake Actuating Discs

1. Actuating disc
2. Actuating ball
3. Return spring

REASSEMBLY

1. Place one actuating disc with the pockets uppermost on a flat surface and position a steel ball in each pocket.
2. Position the other actuating disc over the first with the pockets locating on the steel balls. The actuating lugs should be approximately 1" (25.4 mm) apart.
3. Install the four actuating disc return springs on the lugs on the inner edge of the actuating discs.
4. Install the actuating links and secure using the clevis pins, cotter pins and nuts.

INSTALLATION

2. Inspect the rotating discs for wear and warpage. Replace the discs if the friction material has worn to the bottom of any grooves, or if the plates are warped more than 0.015" (0.381 mm).
3. Replace the actuating rod seal.
1. Install the brake actuating assembly and disc assemblies as described previously.
2. Install the axle housing to the rear axle center housing, and install the rear axle assembly as described in Section 10.
3. Reconnect the brake actuating linkage and adjust the brake linkage as described in Section 10.

DIFFERENTIAL AND DIFFERENTIAL LOCK ASSEMBLY

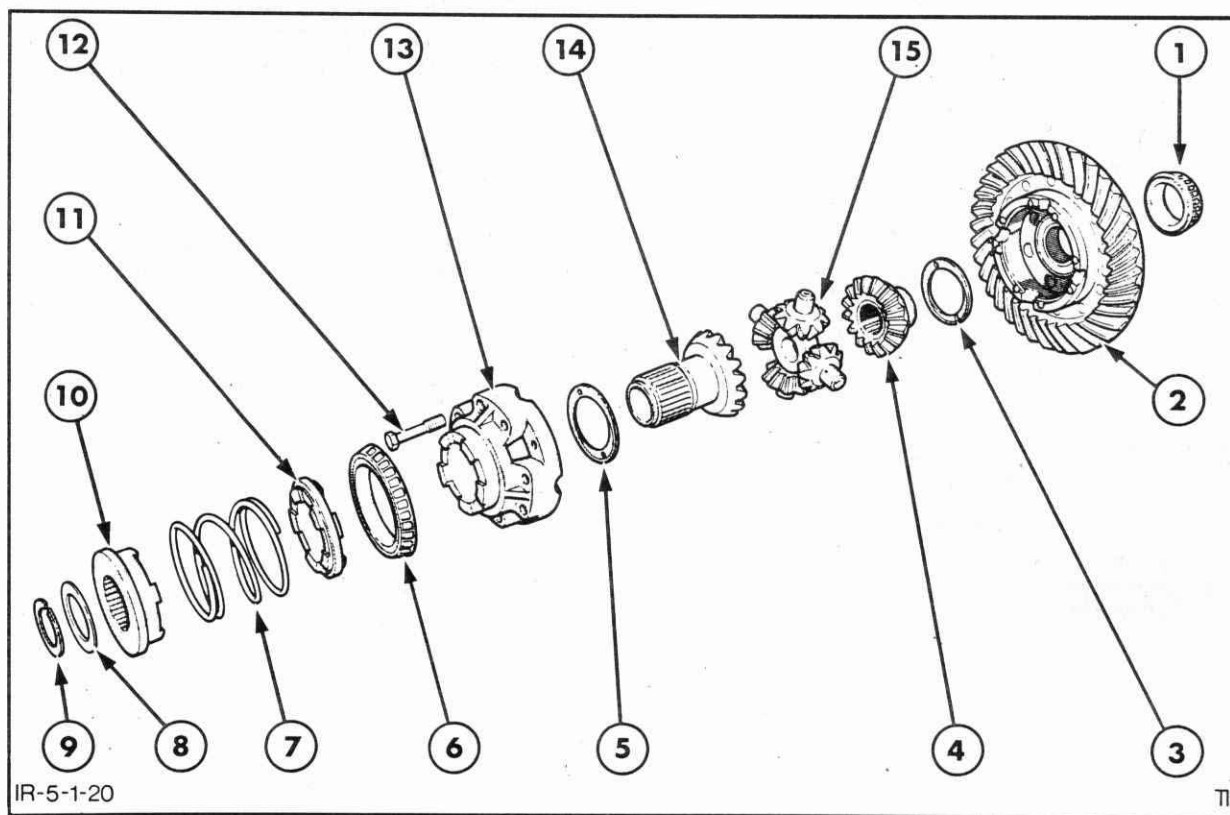


Figure 5-20

Differential Assembly – Exploded View

- | | |
|------------------|-----------------------|
| 1. Bearing | 9. Lock ring |
| 2. Ring gear | 10. Sliding coupling |
| 3. Thrust washer | 11. Adaptor |
| 4. Side gear | 12. Securing bolt |
| 5. Thrust washer | 13. Differential case |
| 6. Bearing | 14. Side gear |
| 7. Spring | 15. Pinion gears |
| 8. Stop washer | |

REMOVAL

Remove the left-hand axle housing as described previously and lift out the differential assembly.

DISASSEMBLY

1. Remove the differential lock ring that secures the sliding coupling to the side gear. Remove the stop washer, sliding coupling, coupling spring and gear case adaptor, Figure 5-20.
2. Mark the two halves of the differential case so that the two halves may be reassembled in the same relative position.
3. Loosen the securing bolts and separate the two halves of the differential case as the bolts are loosened.
4. Remove the bolts which secure the differential ring gear to the differential case and separate the ring gear from the case.

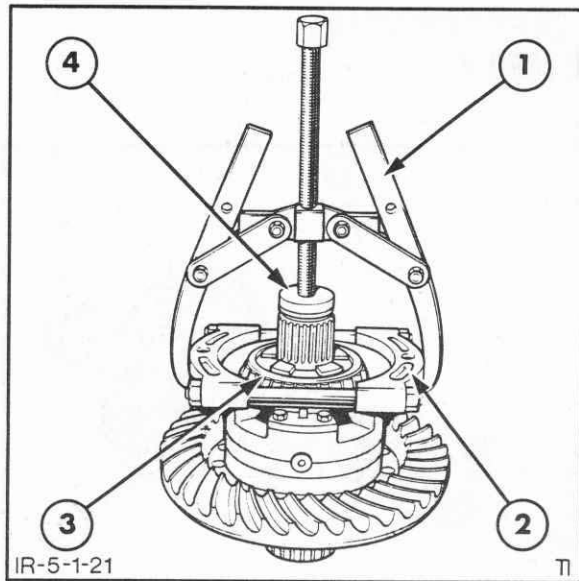


Figure 5-21

Removing Differential Bearing

1. Tool no. 1003 or 9516
2. Tool no. 952 or 9526
3. Bearing assembly
4. Tool no. 630S or 9210

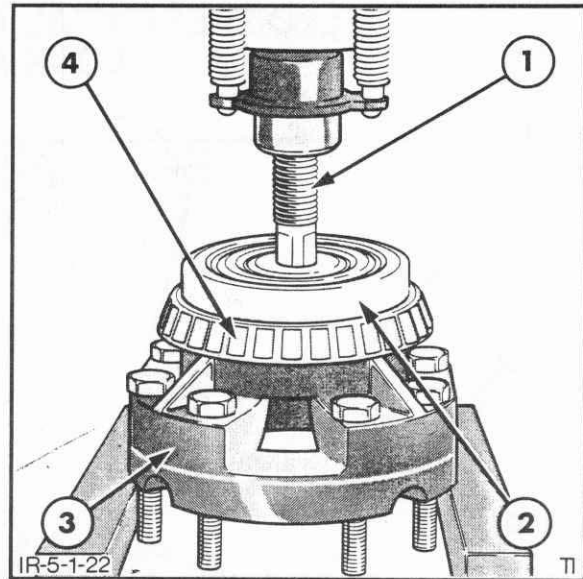


Figure 5-22

Replacing Differential Bearing

1. Press
2. Tool no. 630S or 9210
3. Differential case
4. Bearing assembly

INSPECTION AND REPAIR

1. Thoroughly clean and inspect all parts. Install new parts where worn or damaged.

NOTE: If a new differential ring gear is installed, a new drive pinion must also be used as outlined under "Drive Pinion Assembly," later in this section.

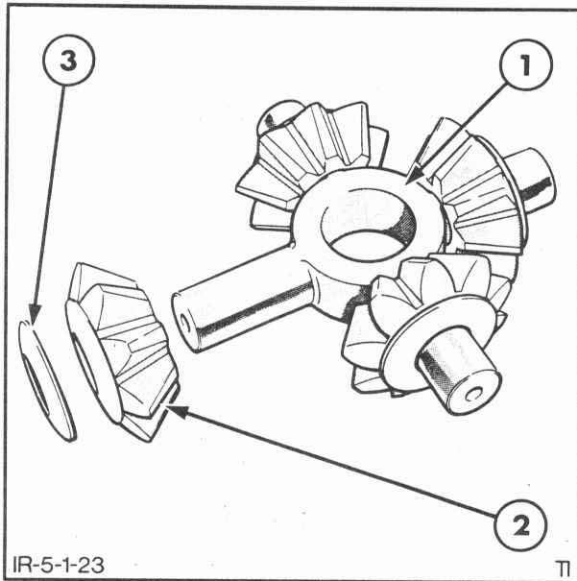
2. If it is necessary to replace the differential case bushings, drive out the old bushings using a suitable drift. Install new bushings from the inside face of the case.
3. If it is necessary to remove the differential bearing assembly from the differential case using Tool #952, 1003 and 630S or Tool #9526, 9516 and 9210 on right- and left-hand cases, Figure 5-21. Install new bearings using a press and suitable size step plate, Figure 5-22. Coat the bearings

with petroleum jelly prior to installation. Install the differential case bolts before installing the right-hand bearing.

4. The right-hand differential bearing outer race, located in the rear axle center housing, can be removed using slide hammer Tool #943 or 9507 and 943S or 9567.
5. The left-hand differential bearing outer race located in the brake housing can be removed using Tool #943 or 9507 and 943S or 9567. Replace the shims that are positioned behind this bearing race.

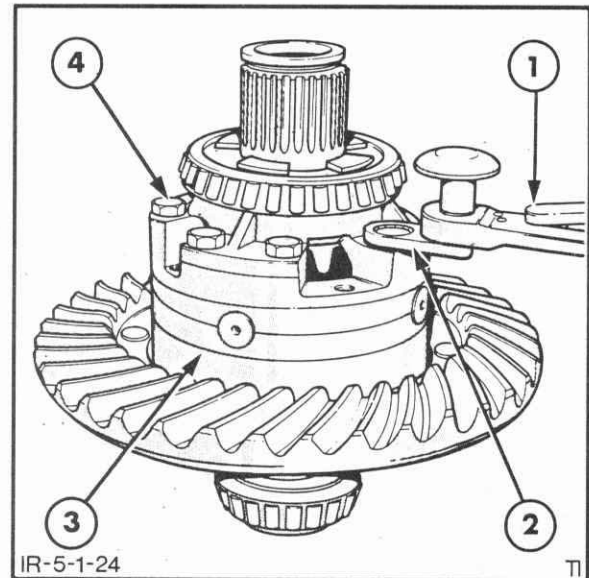
REASSEMBLY

1. Install the bolts which secure the differential ring gear to the differential half case and tighten the nuts to 48 ft. lbs. (65 N-m). Be sure that the ring gear locates securely on the differential case.

**Figure 5-23**

Differential Spider and Pinions

1. Spider
2. Pinion gear
3. Thrust washer

**Figure 5-24**

Tightening Differential Case Bolts

1. Torque wrench
2. Adaptor
3. Differential case
4. Differential case bolts

2. Assemble the pinions and thrust washers onto the spider, Figure 5-23. Install the side gear and thrust washer into the ring gear half of the differential case. Locate the other side gear and thrust washer on top of the assembly.

5. Install the differential lock gear case adaptor, coupling spring, sliding coupling and stop washer and retain with a new lock ring, Figure 5-25.

INSTALLATION

3. Assemble the two halves of the differential case, aligning the marks made prior to disassembly. Tighten the securing bolts evenly and finally torque to 70 ft. lbs. (95 N·m). If the differential bearing is installed, use a crowfoot adaptor to enable a torque wrench to be used with the bearing in position, Figure 5-24.

1. Position the differential assembly in the rear axle center housing.

4. Lubricate the assembly and turn the gears to check freedom of movement.

2. Reassemble the left hand and housing as described previously. Refill the axle with 134D hydraulic oil.

DRIVE PINION ASSEMBLY

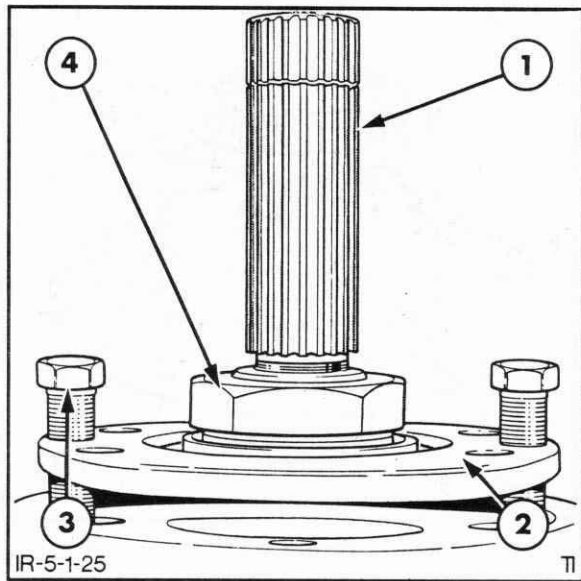


Figure 5-25

Removing Drive Pinion Assembly

1. Drive pinion shaft
2. Bearing retainer
3. Jacking bolts
4. Bearing preload adjuster

REMOVAL

1. Separate the rear axle from the unit as described in Section 10.
2. Remove the left-hand axle bolts and install two long (8") bolts equally spaced around the housing. Slide the axle housing and differential out to enable the pinion shaft bearing to clean the ring gear assembly.
3. Remove the four bolts that secure the drive pinion assembly to the rear axle center housing. Utilizing two of the securing bolts as jacking screws, install them in the two threaded holes in the drive pinion retainer, Figure 5-25.
4. Tighten the two jacking screws evenly and remove the drive pinion assembly.

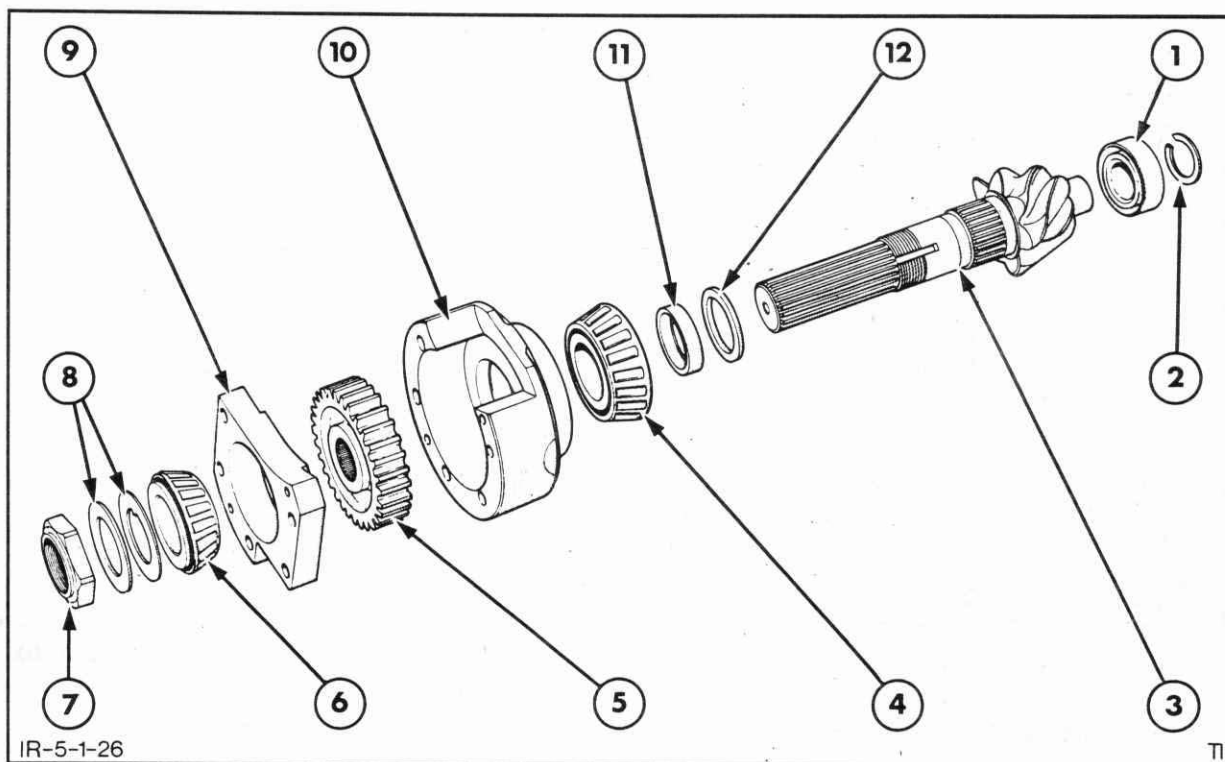


Figure 5-26

Drive Pinion Assembly – Exploded View

- | | | |
|-----------------------|------------------|---------------------------|
| 1. Pilot bearing | 5. F.W.D. gear | 9. Retaining plate |
| 2. Lock ring | 6. Front bearing | 10. Drive pinion retainer |
| 3. Drive pinion shaft | 7. Adjusting nut | 11. Spacer |
| 4. Rear bearing | 8. Thrust washer | 12. Spacer |

DISASSEMBLY

1. Unlock the staking then remove the bearing pre-load adjusting nut from the shaft. Remove the thrust washer from the shaft.
2. Remove the front pinion bearing and the housing from the pinion shaft.
3. Remove the lock ring from the rear end of the pinion gear and, using Tool #1002 or 9198 and 951 or 9190, pull the pilot bearing off the end of the shaft, Figure 5-27.

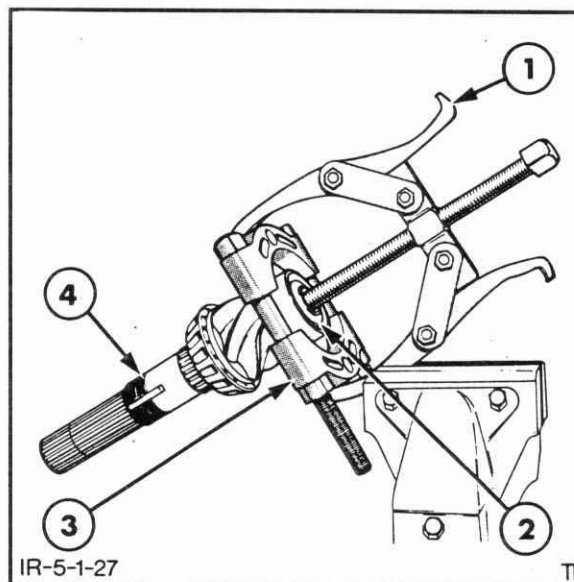


Figure 5-27

Removing Drive Pinion Pilot Bearing

1. Tool no. 1002 or 9198
2. Pilot bearing
3. Tool no. 951 or 9190
4. Drive pinion shaft

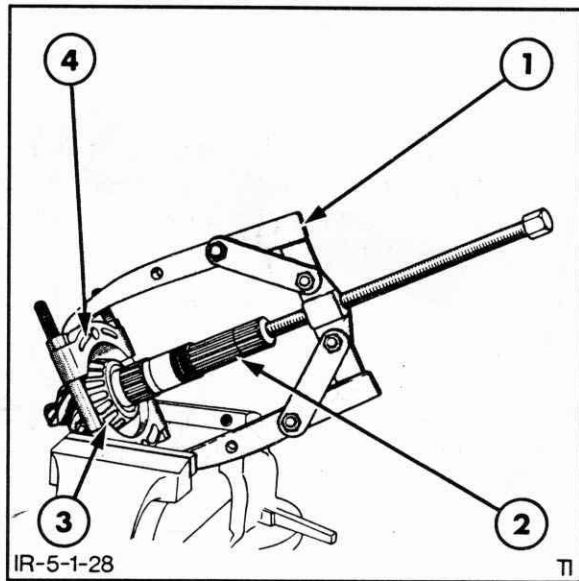


Figure 5-28

Removing Drive Pinion Rear Bearing

1. Tool no. 1003 or 9516
2. Drive pinion shaft
3. Bearing assembly
4. Tool no. 951 or 9190

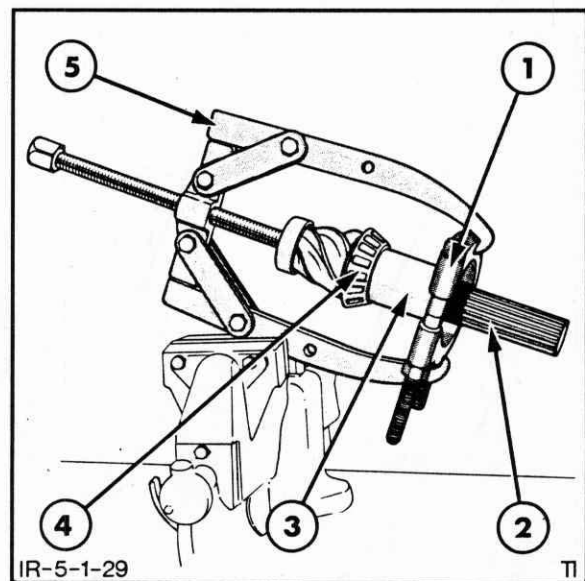


Figure 5-29

Installing Drive Pinion Rear Bearing

1. Tool no. 951 or 9190
2. Drive pinion shaft
3. Sleeve
4. Rear bearing assembly
5. Tool no. 1003 or 9516

INSPECTION AND REPAIR

1. Thoroughly clean and inspect all parts and install new parts if worn or damaged.
2. If necessary, to remove the rear pinion bearing, use Tool #1003 or 9516 and 951 or 9190 as shown in Figure 5-28. To install a new bearing use the same tool in conjunction with a sleeve of suitable size, Figure 5-29, to press the inner bearing track squarely against the pinion gear.
3. To remove the bearing outer race from the bearing housing, use Slide hammer and pulling attachment Tool #943 or 9507 and 943S or 9567.

NOTE: If a new drive pinion is to be installed, a new differential ring gear must also be used.

REASSEMBLY

1. Install the pilot bearing on the pinion using a suitable sleeve. Install a new lock ring.
2. Position the pinion shaft and rear bearing assembly in the bearing housing. Install the front bearing and the thrust washer onto the shaft.
3. Install the adjusting nut onto the shaft. Tighten the nut until the correct 20-26 ft. lbs. (89-116 N·m) pre-load is obtained using a pull scale.
4. When the correct pre-load is obtained, lock the adjusting nut in position by staking the collar of the nut.

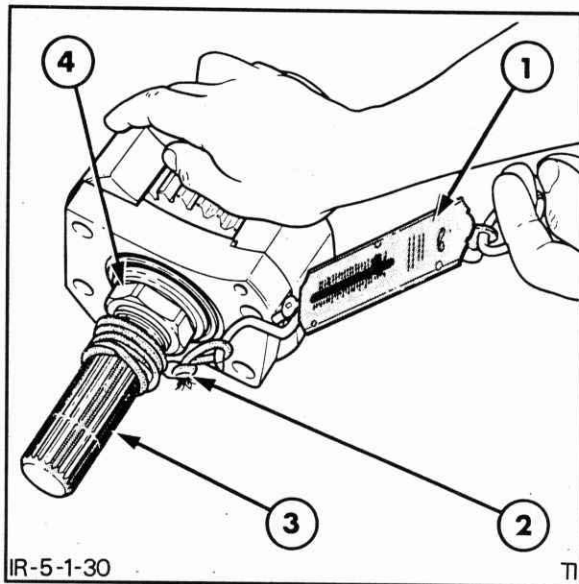


Figure 5-30

Checking Drive Pinion Bearing Pre-Load

1. Pull scale
2. Cord
3. Drive pinion
4. Bearing pre-load adjuster

INSTALLATION

1. Install the drive pinion assembly into the rear axle center housing and secure with the four retaining bolts. Tighten to 110 ft. lbs. (149 N·m).
2. Install the differential assembly in the rear axle center housing and reassemble the left-hand axle housing to the center housing.
3. Assemble the rear axle to the transmission as described in Section 10. Refill the axle with 134D oil, and check the level with the dipstick. Reconnect the brake linkage and adjust as outlined in Section 10.

BRAKE PEDAL LINKAGE AND CROSS-SHAFT

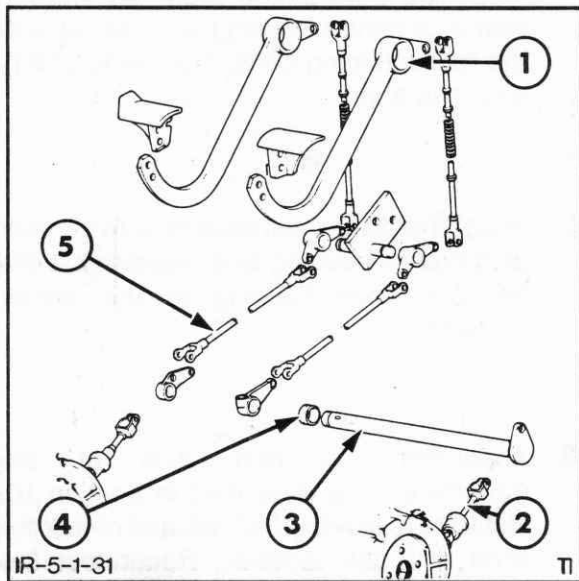


Figure 5-31

Brake Pedal and Linkage

1. Pedal
2. Control rod assembly
3. Brake cross shaft
4. Cross shaft seal
5. Brake control rod

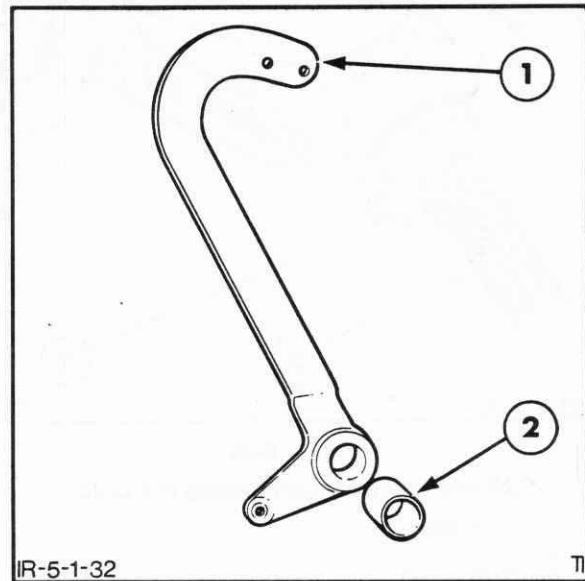


Figure 5-32

Brake Pedal Shank and Bushing Replacement

1. Shank
2. Bushing

Refer to Figure 5-31.

Operating linkage from the pedals extends along side of the transmission housing. The inner set of linkage connects to a cross-shaft that extends through the rear axle center housing to operate the brake on the opposite side of the tractor. The brake cross-shaft is sealed in the center housing by replaceable seals installed in the center housing casting side walls.

Whenever installing a new cross-shaft seal assembly, do not remove the grease coating from the seal lip. This coating was placed on the seal lip at time of manufacture to lubricate the lips which do not touch oil. Install the new seal as follows.

1. Remove and discard the dust seal.
2. Inspect the brake cross-shaft for gouges, corrosion and scratches on the sealing surfaces. If the shaft is severely gouged, pitted or scratched, it should be replaced.
3. Carefully press the seal into the rear axle center housing with the closed end of the seal facing outwards.

The brake pedal shank contains a replaceable bushing, Figure 5-32. Following installation of a new bushing, it may be necessary to burnish the inside of the bushing for the shaft to fit correctly.

DIFFERENTIAL LOCK LINKAGE

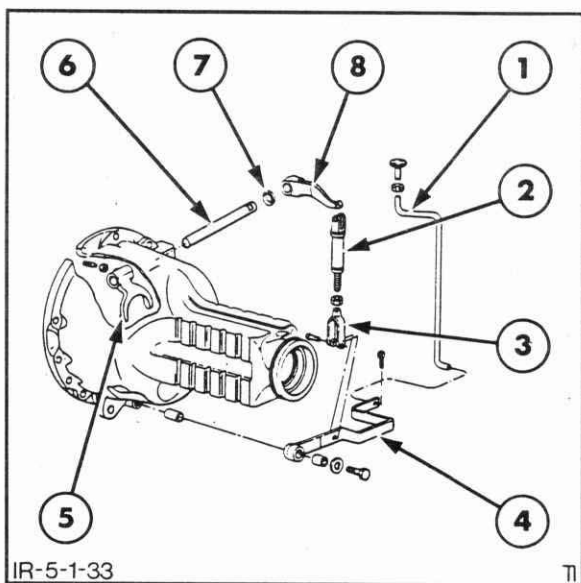


Figure 5-33

Differential Lock Linkage

1. Pedal assembly
2. Operating rod
3. Clevis
4. Lever assembly
5. Fork
6. Shaft
7. Seal
8. Operating lever

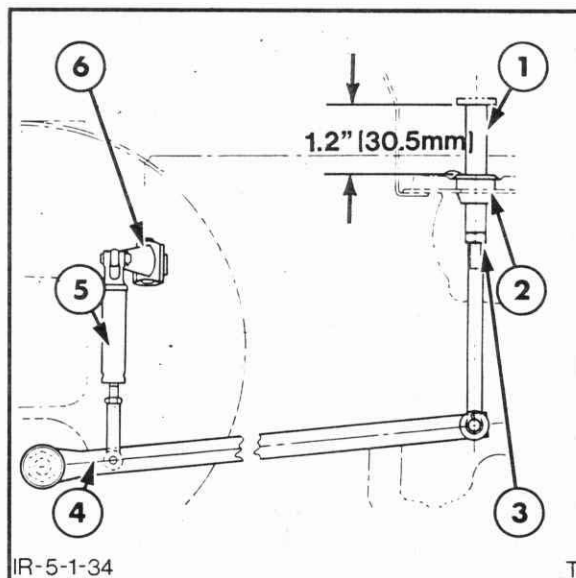


Figure 5-34

Differential Lock Adjustment

1. Differential lock operating pedal
2. Pedal bushing
3. Jam nut
4. Connecting lever
5. Rod and clevis assembly
6. Operating lever

The differential lock linkage, Figure 5-33, serves to operate the differential lock fork located in the right-hand rear axle assembly.

the underside of the pedal assembly and the top side of the pedal bushing. See Figure 5-34.

Adjustment of the linkage is as follows, refer to Figure 5-34.

1. With the differential lock linkage assembled, loosen the jam nut.
2. Adjust the pedal assembly until a 1.2" (30.5 mm) block can be inserted between the underside of the pedal assembly and the top side of the pedal bushing.
3. Retighten the jam nut to 55 ft. lbs. (75 N·m).
4. Check that when the load is removed from the pedal assembly and the rear wheels are free to rotate, the differential lock linkage disengages automatically and the pedal assembly returns to the raised position. The wheels should then rotate independently.

TWIN CABLE HAND BRAKE OPERATION

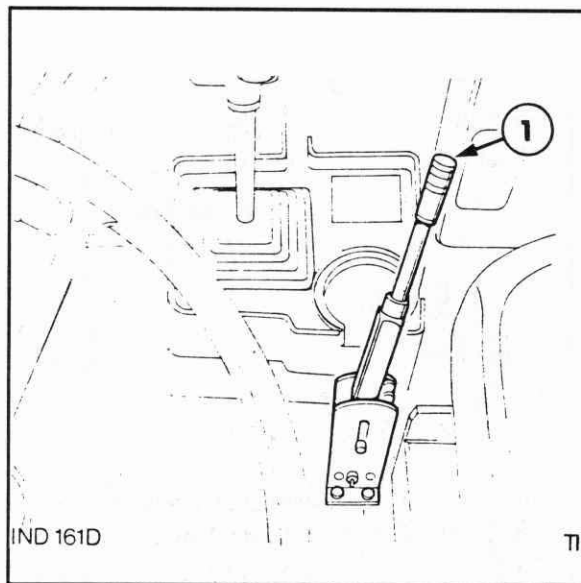


Figure 5-35

Hand Brake Lever

1. Tension knob

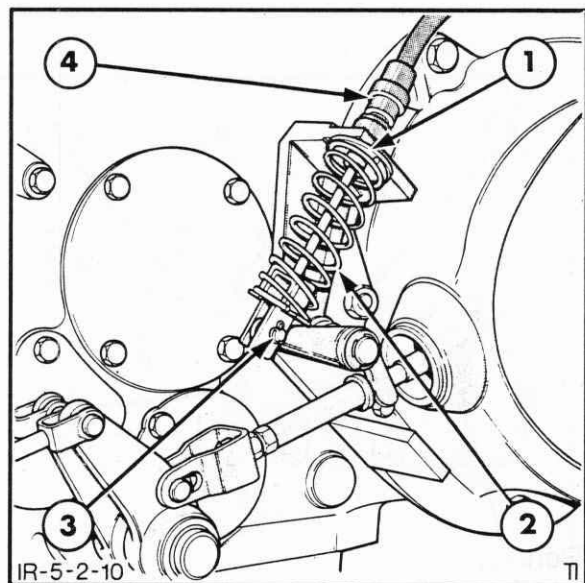


Figure 5-36

Hand Brake Components

1. Snap ring
2. Return spring
3. Clevis pin
4. Cable

The twin cable hand brake mechanism consists of a single hand brake lever, Figure 5-35, operating two cables which are connected to the rear axle brake pull rods.

The hand brake lever, Figure 5-35, is of the "over-center" type mechanism with the cable adjustment being maintained by an adjuster at the end of the lever. Pulling the lever into the "raised" position pulls on twin cables mounted on the rear axle housing, Figure 5-36 which in turn actuate the tractor disc brake, as described earlier.

REMOVAL

1. Disconnect the hand brake cables from the levers mounted on the rear axle housing, Figure 5-36.
2. Remove the cable retaining snap ring, collapse the return spring and pull the cable through the bracket mounted on the axle housing.

3. Remove the loader control lever/hand brake-lever housing.

4. Remove the clevis pins from the hand brake lever to disconnect the cables.

INSTALLATION

Installation of the hand brake assembly follows the removal procedure in reverse. On installation, observe the following:

To aid in installing the E-clip, thread a wire through the center of the spring. Bend the two ends toward each other and twist. Use a pair of pliers to twist the wire and collapse the spring.

Adjust the hand brake to achieve the specified pull, see previous settings.

SPECIFICATIONS AND SPECIAL TOOLS

SPECIFICATIONS

Brake pedal free travel	1.0-2.5" (50-63 mm) with a pressure of 15 lbs. (67 N) applied to pedals
Brake pedal drop rod length:	
4x4 Transmission	35" (890 mm)
8x8 Transmission	27.5" (700 mm)
Transmission hand brake bell crank free travel ...	1.25" (32 mm)
Hand brake pull	50-60 lbs. (222-266 N)
Differential lock gauge block thickness	1.20-1.25" (30.5-31.5 mm)
Differential drive pinion bearing pre-load:	
With transmission hand brake	20-26 lbs. (89-116 N) pull scale
Less transmission hand brake	16-21 lbs. (71-93 N) pull scale
Rear axle shaft end play	0.001" loose - 0.003" tight (0.025 mm loose - 0.0076 mm tight)

TORQUE SPECIFICATIONS

TORQUE VALUES	ft. lbs.	N-m	kgm
Axle housing bolts	150	203	21
Axle housing nuts	188	255	23
Disc brake housing nuts	81	110	14
Axle shaft retaining bolt	395	536	55
Differential case bolts	70	95	10
Differential ring gear nuts	48	65	7
Differential pinion bearing retainer bolts	110	149	15
Hand brake rear reaction plate	--	--	--
Retaining bolts	110	149	15
Hand brake cover retaining bolts	35	47	5
Hand brake mechanism	--	--	--
Retaining nuts - small	28	38	4
Hand brake mechanism	--	--	--
Retaining nuts - large	82	111	11
Differential pinion bearing	--	--	--
Pre-load adjuster clamp bolts	23	31	3
Wheel securing nuts	400	540	48
Brake pin and bracket mounting bolts	30	41	4
Differential lock fork retaining bolt	22	30	3
Differential lock oper. rod clevis jam nut	55	75	8
Differential pedal locknut	55	75	8
Axle top cover plate bolts	66	90	9
Axle top cover plate breather bolt	44	60	6

SPECIAL TOOLS

DESCRIPTION	V.L. CHURCHILL TOOL NO.	NUDAY TOOL NO.	O.T.C. TOOL NO.
Heavy-duty ratchet	P61	9162	
Double threaded adaptors (set)	924	9537	FNH09537
Step plate adaptors (set)	630S	9210	FNH09210
Push-puller legs (set)	930B	9521	FNH09521
Push/puller legs (set)	930E	9207	FNH09207
Push/puller	938	9506	FNH09506
Internal/External puller	943	9507	FNH09507
Slide hammer	943S	9567	FNH09567
Pulling attachment (small)	951	9190	FNH09190
Pulling attachment (large)	952	9526	FNH09526
Puller/reversible arm (medium)	1002	9198	FNH09198
Puller/single end arm (large)	1003	9516	FNH09516
Rear axle planetary		2122	FNH02122
Ring gear remover/		2123	FNH02123
Replacer	FT4500	2119	
Differential bearing			
Pre-load gauge	FT4501	2141	FNH02141

SECTION 6

POWER TAKE-OFF

INDEPENDENT PTO

DESCRIPTION AND OPERATION

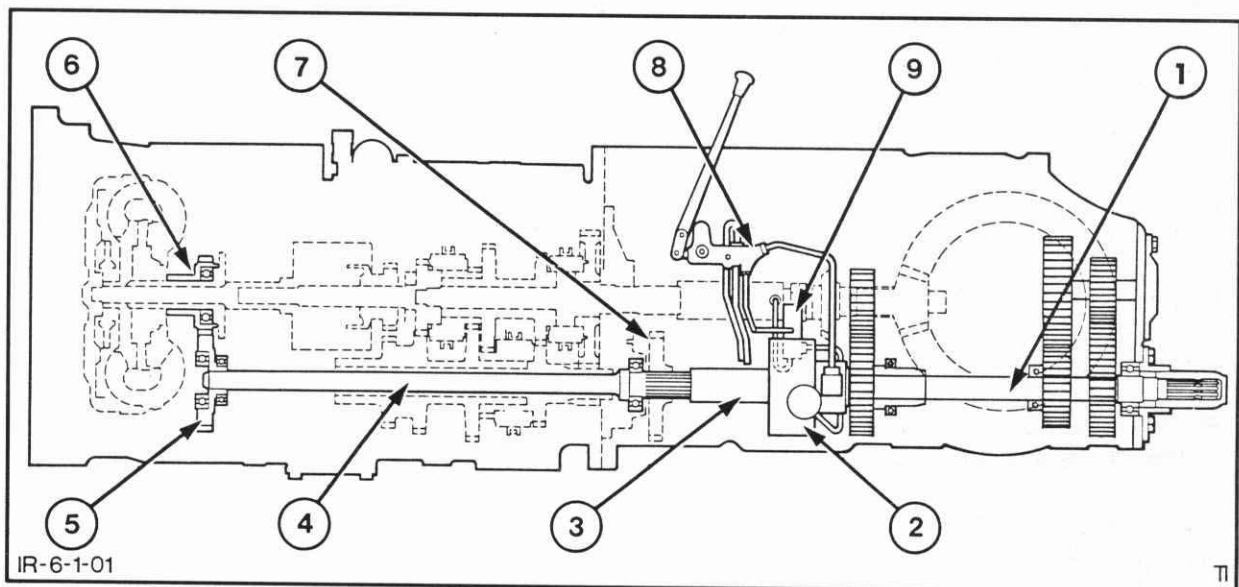


Figure 6-1
Independent PTO - Schematic

- | | |
|--|------------------------------|
| 1. Rear shaft | 6. Stator support |
| 2. Clutch assembly | 7. Hydraulic pump drive gear |
| 3. Clutch input shaft | 8. Valve assembly |
| 4. Countershaft | 9. Brake regulating valve |
| 5. Transmission hydraulic pump driven gear | |

The drive for the independent power take-off (PTO) as featured for the KF3P tractors with 8 x 8 transmission is taken from transmission hydraulic pump driven gear, Figure 6-1.

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 center for the PTO countershaft to engage.

The transmission PTO shaft transmits the drive through the hollow transmission countershaft to the rear of the transmission assembly. The transmission PTO shaft is splined at the rear end to accept the hydraulic pump drive gear and the PTO clutch input shaft.

The independent PTO is controlled by a hydraulically operated clutch assembly located on and between the clutch input shaft and the rear shaft.

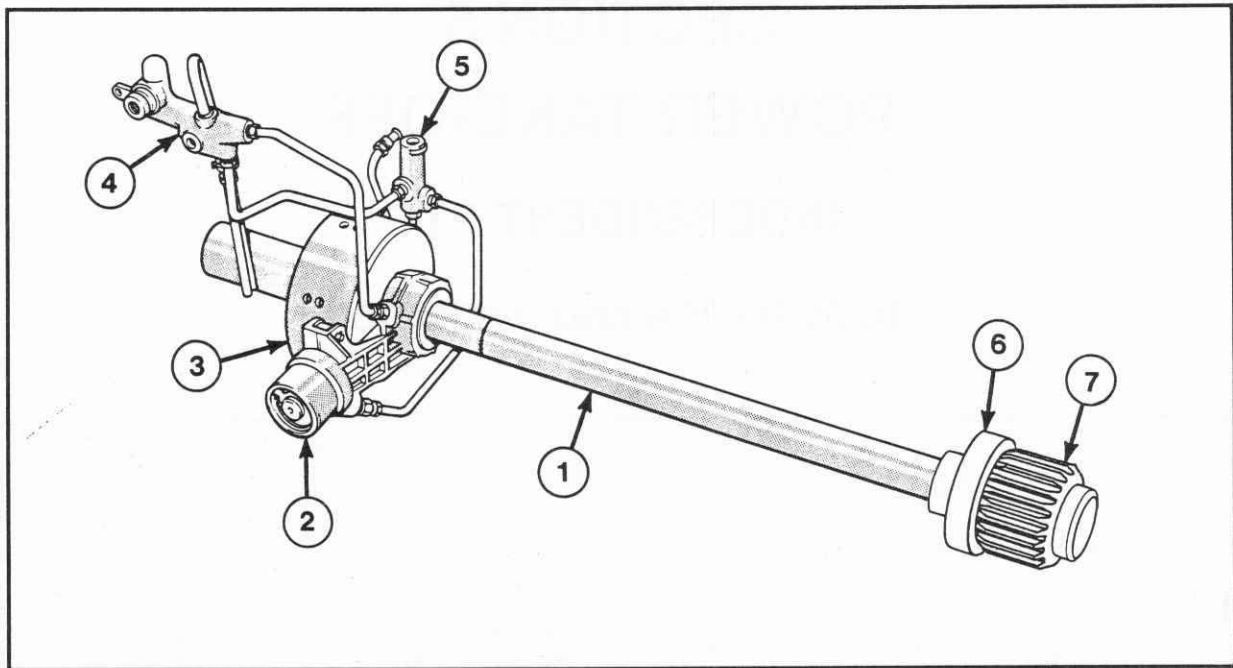


Figure 6-2
Independent PTO Assembly

1. Rear PTO shaft
2. Brake assembly
3. Clutch assembly
4. Control valve assembly

5. Brake pressure regulating valve
6. Bearing PTO shaft
7. Drive gear

The clutch assembly comprises 7 internally splined sintered bronze drive plates, mounted on the clutch shaft hub, and sandwiched between these plates are 7 driven steel plates, which together with a pressure plate are externally splined to the clutch housing.

controlled by a double-sided piston assembly. When the brake is applied, a brake pad is forced against the PTO clutch housing to stop the rotation of the PTO shaft. When the PTO clutch is engaged, the brake is automatically released.

The PTO rear shaft has a gear reduction box as shown in Figure 6-3.

A piston, located within the clutch housing to the rear of the plates, is retained in the disengaged position by a spring, washer and snap ring.

Mounted on the rear of the PTO clutch is a brake and support assembly. The brake is

Also, when the tractor engine is stopped, the hydraulic pressure acting on the brake piston diminishes, releasing the brake and allowing the PTO shaft to be turned.

Located on the left-hand side within the rear axle center housing is the PTO control valve assembly, and on the right-hand side is the brake pressure regulating valve.

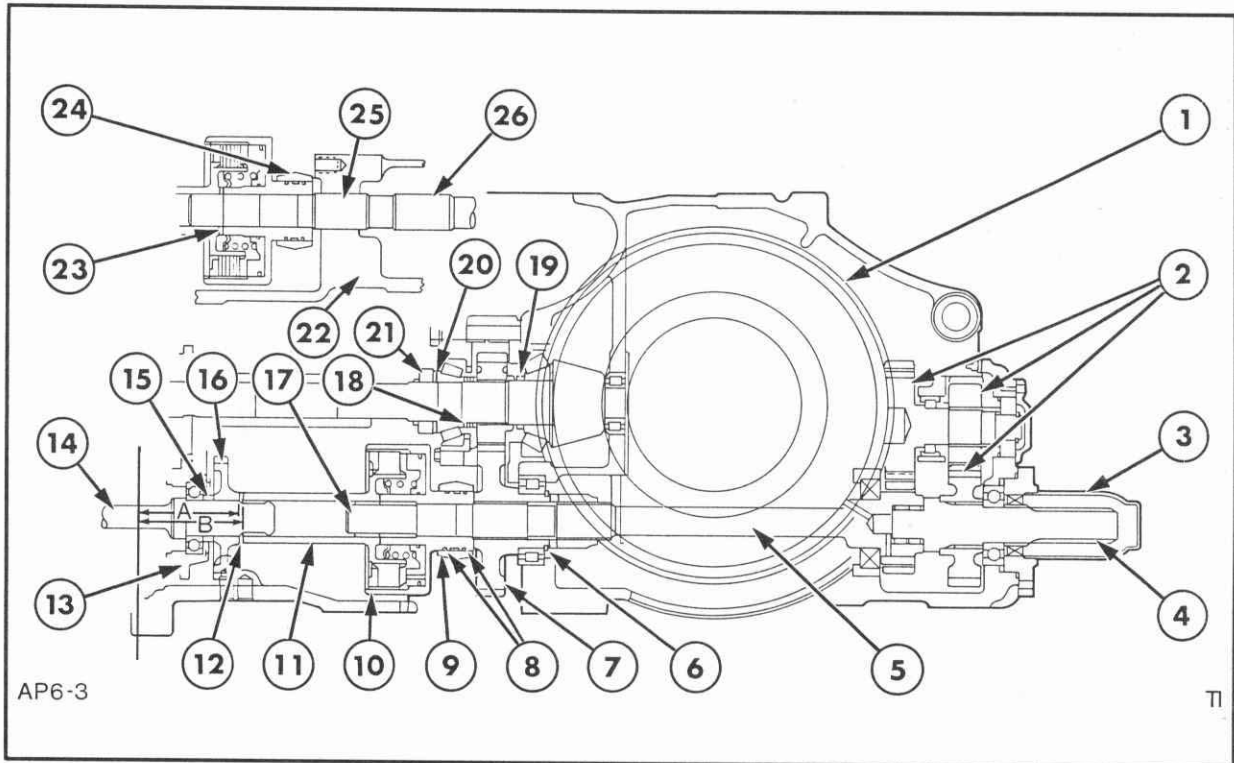


Figure 6-3

- | | | |
|-----------------------------|--------------------------|--------------------------------|
| 1. Rear axle center housing | 11. 0.762mm thick washer | 21. Rear nut |
| 2. PTO reduction gears | 12. Retainer | 22. Spacer |
| 3. PTO shield | 13. Clutch input shaft | 23. Washer |
| 4. PTO output shaft | 14. PTO ring | 24. Rear axle housing assembly |
| 5. Rear PTO shaft | 15. PTO shaft | 25. Spacer |
| 6. Retaining ring | 16. Collar | 26. Rear PTO shaft |
| 7. Gear assembly | 17. Thrust washer | 27. Bushing |
| 8. Seal (2 required) | 18. Clutch housing | 28. Support |
| 9. Support | 19. Gear | |
| 10. Clutch housing | 20. Busing | |

INPUT SHAFT SHIMMING PROCEDURE						
DIMS. (MM)	0.14	0.90	1.66	2.42	3.18	3.95
A-B	0.89	1.65	2.41	3.17	3.94	4.70
SHIMS	0	1	2	3	4	5

The internal components of the PTO are shown in Figure 6-3.

The PTO turns at 540 RPM when the engine is turning at 1850 RPM.

The oil supply from the rear section of the hydraulic pump is fed to the pressure regulating valve. Oil at constant pressure is

supplied to the brake piston. The outlet port from the pressure regulating valve is connected to the control valve which either exhausts the oil to sump or directs the oil under pressure to the clutch piston and brake release piston.

The control valve is operated by an externally mounted selector lever which is controlled from the operator's seat.

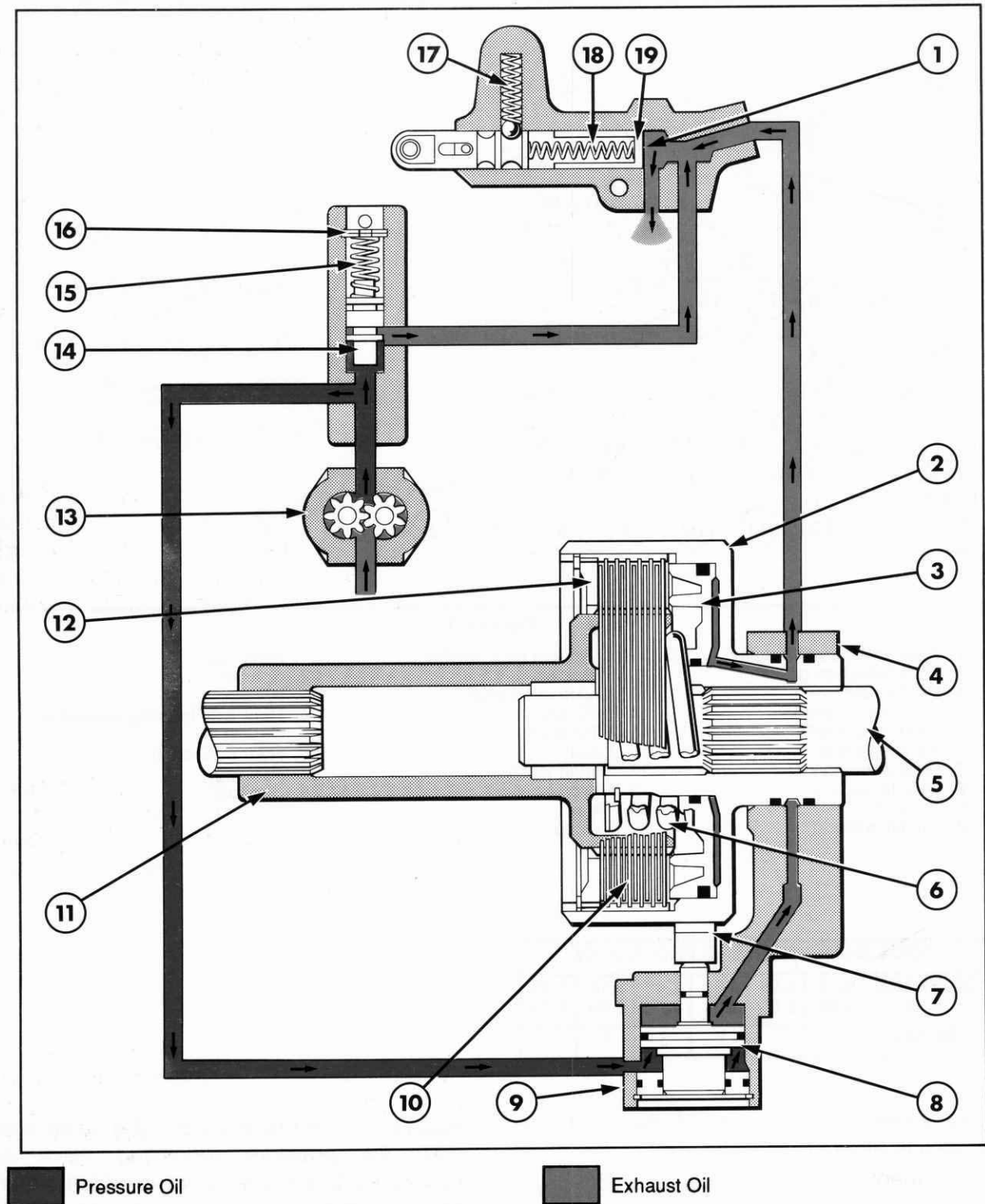


Figure 6-4

Oil Flow in the Disengaged Position

- | | | |
|-------------------------------|---|--|
| 1. Control valve piston | 8. Brake piston | 15. Brake pressure regulating valve spring |
| 2. Clutch housing | 9. Brake housing | 16. Shims |
| 3. Clutch piston | 10. Clutch discs | 17. Control valve detent |
| 4. Support assembly | 11. Coupling | 18. Control valve spring |
| 5. Rear PTO shaft | 12. Pressure plate | 19. Shims |
| 6. Clutch spring | 13. Pump | 20. Thrust washer |
| 7. Brake arm and pad assembly | 14. Brake pressure regulating valve plunger | |

OPERATION

With the engine running, oil is supplied to the brake pressure regulating valve. The spring-loaded plunger in the regulating valve ensures that, regardless of engine speed, oil at a constant pressure acts on one side of the brake piston forcing the brake against the clutch housing, Figure 6-4. Oil from the regulating valve outlet passes through a tube to the control valve. Placing the control in the disengaged position fully opens the sump port in the valve and allows the oil to pass directly to sump, Figure 6-4. The return spring in the clutch forces the clutch piston rearwards to disengage the clutch plates, allowing the drive plates to rotate freely within the stationary clutch assembly.

Moving the PTO control lever to the engaged position, Figure 6-5, forces the control valve plunger rearwards to cover the sump port in the valve. Pressurized oil is directed through the tube and clutch support to the clutch piston. The oil forces the piston forwards against the action of the piston return spring and compresses the clutch plates together to engage the clutch.

Simultaneously, the pressurized oil flows around the clutch hub and through a drilling to

act on the larger surface of the double-sided brake piston. The pressurized oil acting on the larger surface area forces the piston away from the clutch and releases the brake allowing the clutch housing to rotate.

The drive from the transmission PTO shaft is thus transmitted via the clutch plates to the gear reduction shown in Figure 6-3.

When the clutch is fully engaged and the brake released, the buildup of oil pressure forces the control valve piston forward against the control spring, to uncover the sump port and allow the excess oil to return to sump.

With the engine stopped, the hydraulic pressure in the circuit diminishes releasing the brake and allowing the clutch piston spring to force the clutch piston rearwards, disengaging the clutch.

A small groove in the brake pressure regulating valve plunger allows the oil trapped in the brake circuit to return through the pressure regulating valve to sump. With the clutch disengaged and the brake released, the external PTO shaft can be turned to align the splines for coupling to an implement shaft.

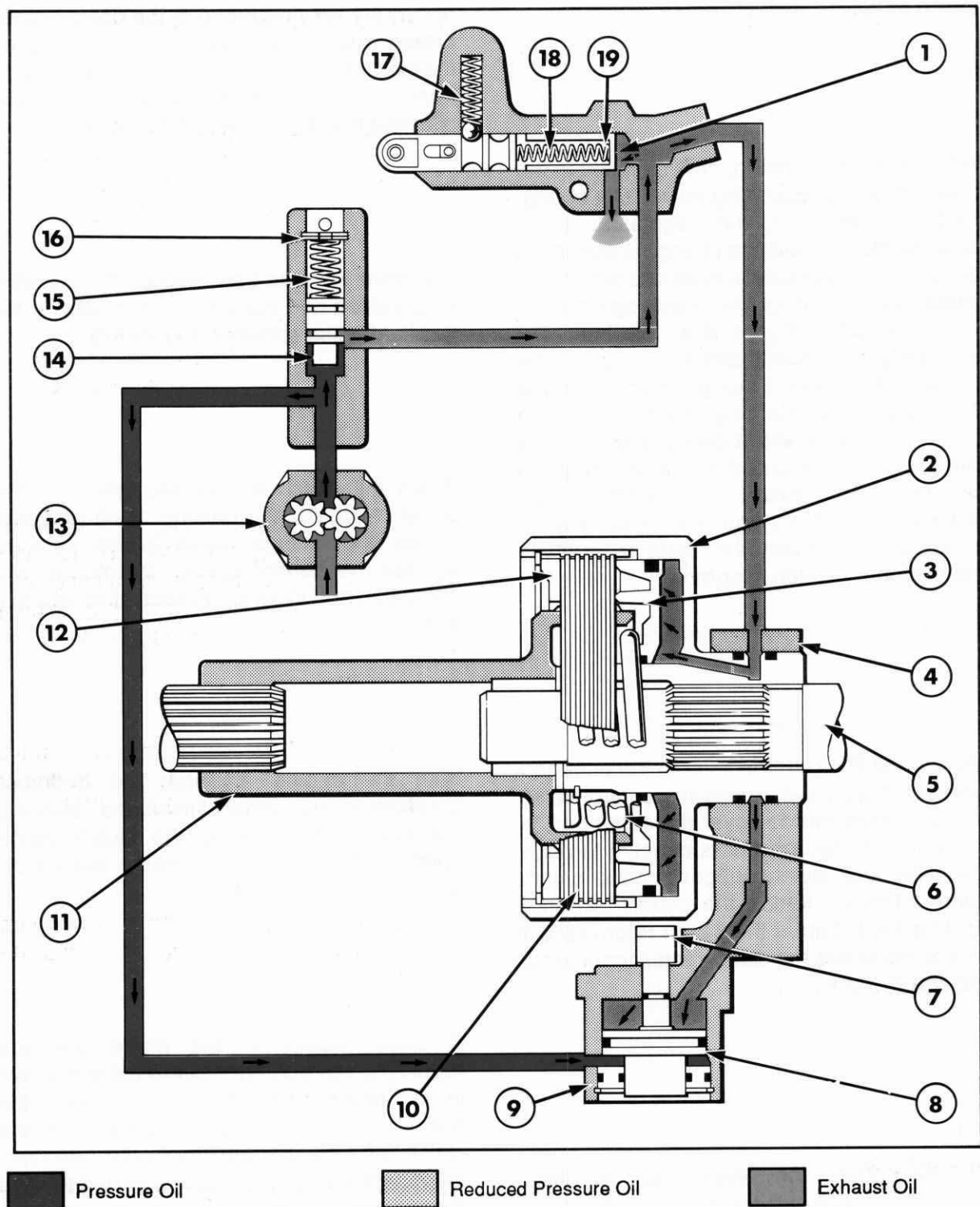


Figure 6-5
Oil Flow in Engaged Position

1. Control valve piston
2. Clutch housing
3. Clutch piston
4. Support assembly
5. Rear shaft
6. Clutch spring
7. Brake arm and pad assembly
8. Brake piston
9. Brake housing
10. Clutch discs
11. Coupling
12. Pressure plate
13. Pump
14. Brake pressure regulating valve plunger
15. Brake pressure
16. Shims
17. Control valve detent
18. Control valve spring
19. Shims

PRESSURE REGULATING VALVE AND CONTROL VALVE - PRESSURE TESTS

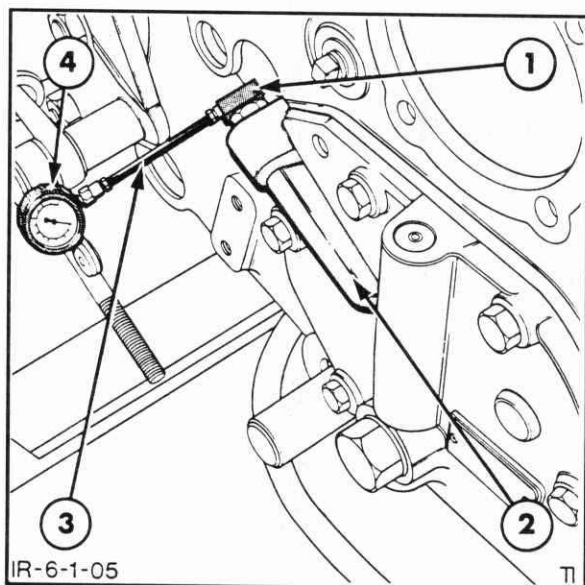


Figure 6-6

Brake Pressure Regulating Valve Pressure Test

1. Adaptor tool no. FT.4100-2 or 4657
2. Hydraulic pump
3. Tube, tool no. FT.4100 or 1552
4. Pressure gauge, tool no. FT.4100 or 0074

2. Install Adaptor Tool #FT4100-2 or 4657, Tube Tool #FT4100-1 or 1552 and the Pressure gauge, Tool #FT4100 or 0074 onto the pressure test port, Figure 6-6.

3. Start the tractor and set the speed to 2300 RPM and set the PTO control lever to the disengaged position. Note the pressure gauge reading.

4. If the pressure obtained is outside the specified range, 220 - 230 PSI (15.2 - 15.9 Bar), adjust the pressure regulating valve setting by adding or removing shim(s), located in the pressure regulating valve.

5. Check that the pressure reading remains within the specified limits with an engine speed of 1000 RPM to 2300 RPM.

6. Remove the gauge, tube and adaptors from the pressure test port and install the plug.

If the PTO clutch fails to operate as described, or following overhaul of the clutch control valve and pressure regulating valve, the following pressure tests must be carried out.

Run the tractor until the hydraulic oil is at operating temperature, then stop the engine.

BRAKE PRESSURE REGULATING VALVE

1. Remove the PTO pressure test plug from the rear of the hydraulic pump.

PTO CONTROL VALVE

The PTO control valve pressure setting can be checked with the test equipment installed as for the brake pressure regulating valve, Figure 6-6. With the engine speed set to 2300 RPM, engage the PTO clutch and note the pressure gauge reading. If the pressure reading is not greater than that obtained for the brake pressure regulating valve or is not within the specified range, 220 - 230 PSI (15.2 - 15.9 Bar), the control valve pressure setting must be checked as follows:

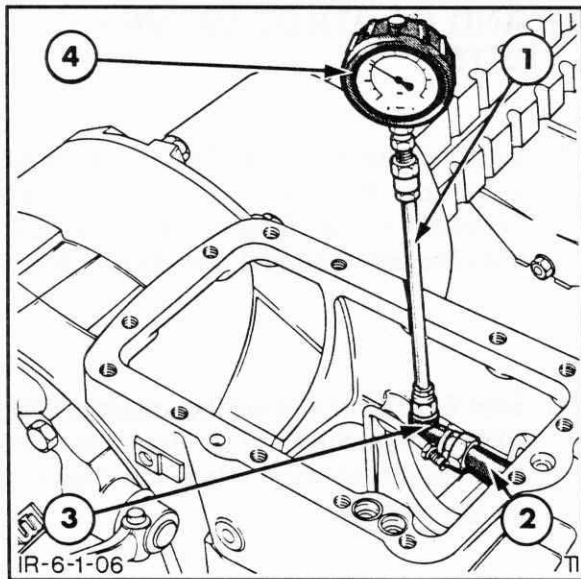


Figure 6-7

PTO Control Valve Pressure Test

1. Tube, tool no. FT.4100-1 or 1552
 2. PTO control valve
 3. Adaptor, tool no. FT.4097 or 1221
 4. Pressure gauge, tool no. FT.4100 or 0074
2. Disconnect the control valve to clutch support housing tube from the control valve, Figure 6-7.
 3. Install Adaptor Tool #FT4097 or 1221, tube Tool #FT4100-1 or 1552 and the Pressure gauge, Tool #FT4100 or 0074 onto the control valve, Figure 6-7.
 4. Start the tractor and place the PTO control lever in the engaged position. Set the engine speed to 1300 RPM, then disengage and engage the PTO clutch several times noting the pressure gauge readings. The readings obtained with the clutch engaged should be within 220 - 340 PSI (15.2 - 16.5 Bar).
 5. If necessary, adjust the pressure setting by adding or removing shims located between the valve piston and spring. Do not exceed a maximum of five shims. For shim thicknesses see "specifications"(at the end of this section).
 6. After testing, remove the gauge, tube and adaptor and reconnect the tube to the control valve. Replace the rear axle top cover. See Section 5 - "Rear Axle and Brakes."

PRESSURE REGULATING VALVE

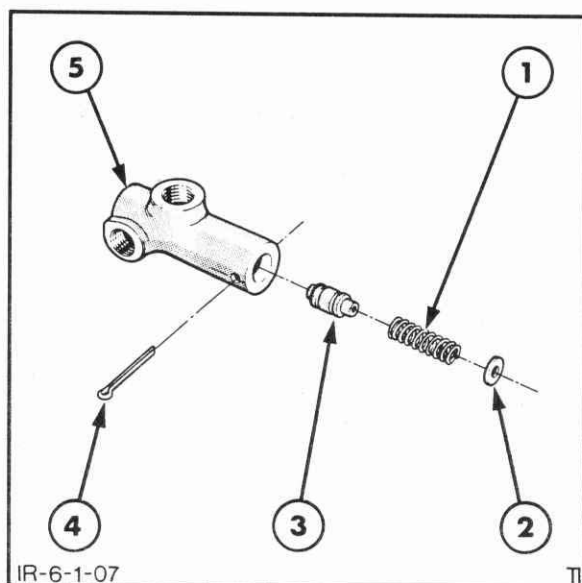


Figure 6-8
Pressure Regulating Valve

1. Spring
2. Shims
3. Plunger
4. Split pin
5. Valve body

DISASSEMBLY

Refer to Figure 6-8.

Remove the split pin and withdraw the shims, spring and plunger.

INSPECTION AND REPAIR

1. Inspect the plunger and valve bore for damage and wear and replace if necessary.
2. Check the spring for damage and, if necessary, replace.

REASSEMBLY

Reassemble the components, coating the plunger in oil prior to reassembly. The plunger must be installed into the bore with the notched land towards the base of the valve.

REMOVAL

1. Remove the rear axle top cover, (see Section 5 - "Rear Axle and Brakes"). Drain the rear axle oil until the pressure regulating valve is fully exposed.
2. Disconnect the tubes from the pressure regulating valve and remove the valve from the rear axle center housing.

INSTALLATION

1. Install the pressure regulating valve, tightening the tube connection.
2. Prior to installing the rear axle top cover, pressure test the valve as previously described. Refer to Figure 6-7.

CONTROL VALVE - OVERHAUL

SHIMS

LOCATION	SIZE AVAILABLE
PTO Pressure Regulating Valve	0.050" (Nominal) (1.20 mm)
PTO Control Valve	0.015" (0.381 mm) 0.030" (0.762 mm)
PTO Drive Shaft - (Refer to Chart Below for Shim Thickness)	0.030" (0.762 mm)

Gap Measurement	Shims to be Installed	Gap Measurement	Shims to be Installed
0.006" (0.14 mm) 0.035" (0.89 mm)	0	0.096" (2.42 mm) 0.124" (3.17 mm)	3
0.036" (0.90 mm) 0.065" (1.65 mm)	1	0.125" (3.18 mm) 0.155" (3.94 mm)	4
0.066" (1.66 mm) 0.095" (2.41 mm)	2	0.156" (3.95 mm) 0.185" (4.70 mm)	5

REMOVAL

1. Remove the rear axle top cover. See "Rear Axle and Brakes" - Section 5.
2. Disconnect the control valve to clutch and brake assembly tube at the control valve.
3. Disconnect the brake pressure regulating valve to control valve tube at the control valve.
4. Remove the split pin and clevis pin and disconnect the valve plunger from the control lever link.
5. Remove the valve spigot bolt and retaining bolt and withdraw the valve assembly from the rear axle center housing.
6. Unscrew the retaining bolt and remove the exhaust tube clamp.
7. Pull the exhaust tubes free from the valve body.

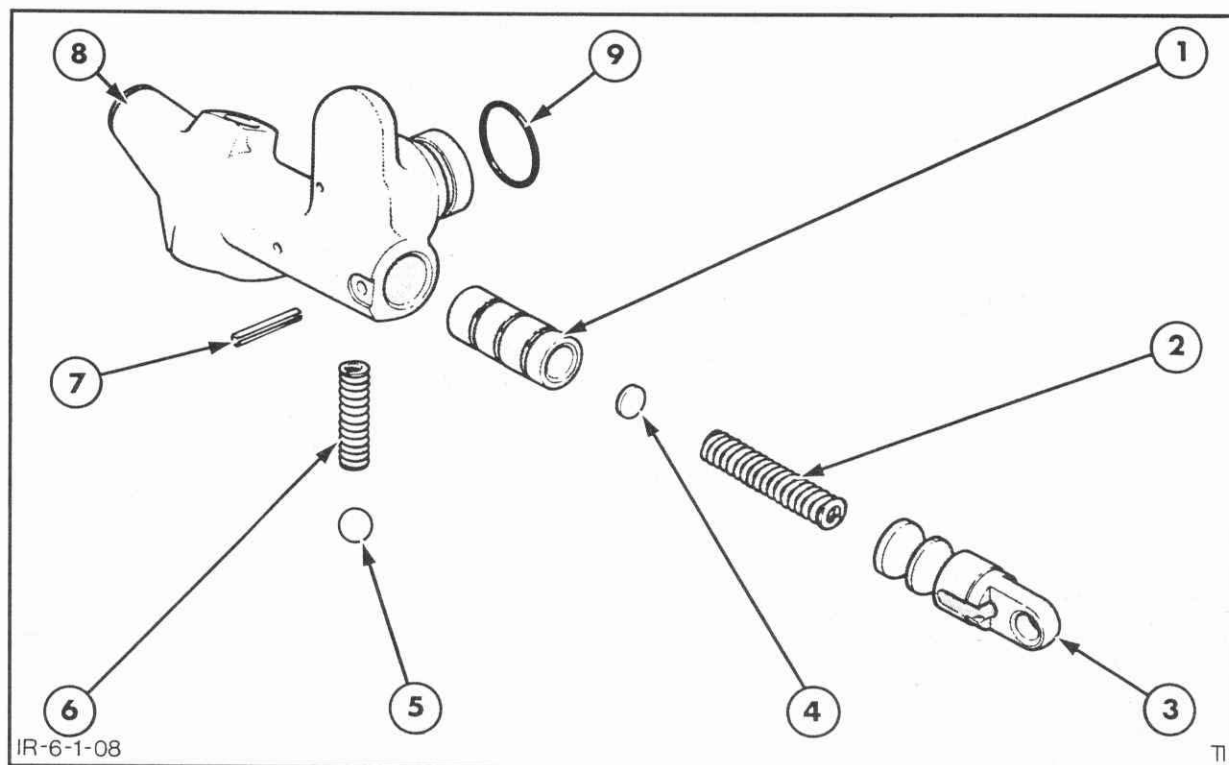


Figure 6-9
PTO Control Valve Assembly

- | | |
|------------------|-------------------------------|
| 1. Piston | 6. Detent spring |
| 2. Valve spring | 7. Plunger retaining roll pin |
| 3. Valve plunger | 8. Valve body |
| 4. Shim | 9. O ring |
| 5. Detent ball | |

DISASSEMBLY

Refer to Figure 6-9.

1. Punch the plunger retaining roll pin out of the valve housing.
2. Withdraw the plunger, detent ball and spring from the valve housing.
3. Remove the control valve spring and piston from the valve housing. Extract the shim(s) from within the piston.

INSPECTION AND REPAIR

1. Inspect the valve piston for excessive wear or scoring.

2. Inspect the control valve spring for weakness or distortion. Inspect the valve body for excessive wear or scoring of the piston bore.
3. Check the valve plunger detent spring for weakness or wear. Replace any component which shows signs of excessive wear or damage.

REASSEMBLY

Reassembly of the control valve follows the disassembly procedure in reverse. Prior to reassembly observe the following requirements:

- Clean all components with a suitable solvent, then dry with compressed air.
- Lightly lubricate all machined surfaces with hydraulic oil.
- Replace all O ring seals.

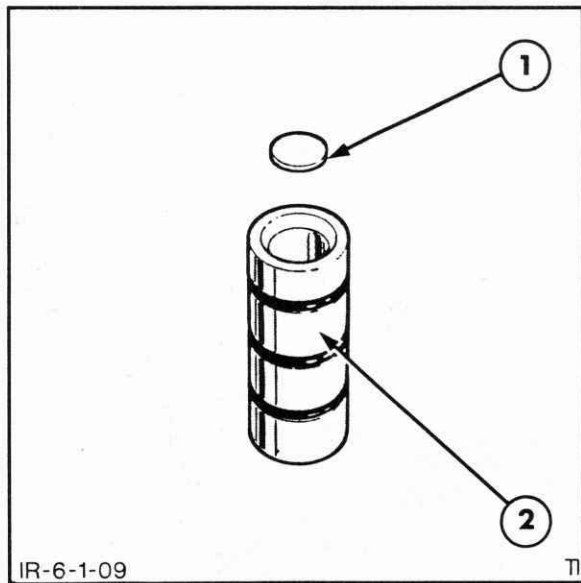


Figure 6-10

PTO Control Valve Piston and Shim

1. Shim
2. Piston

INSTALLATION

Installation of the control valve follows the removal procedure in reverse.

- When installing the control valve, observe the following requirements:
- Install the control valve retaining bolt finger tight.
- Install the control valve spigot bolt and tighten to 33 ft. lbs. (45 N·m).
- Tighten the control valve retaining bolt to 33 ft. lbs. (45 N·m) torque.

Prior to installing the rear axle top cover, pressure test the control valve as previously described. If the pressure obtained is incorrect, add or subtract shims between the valve piston and the valve spring, Figure 6-10.

CLUTCH ASSEMBLY OVERHAUL

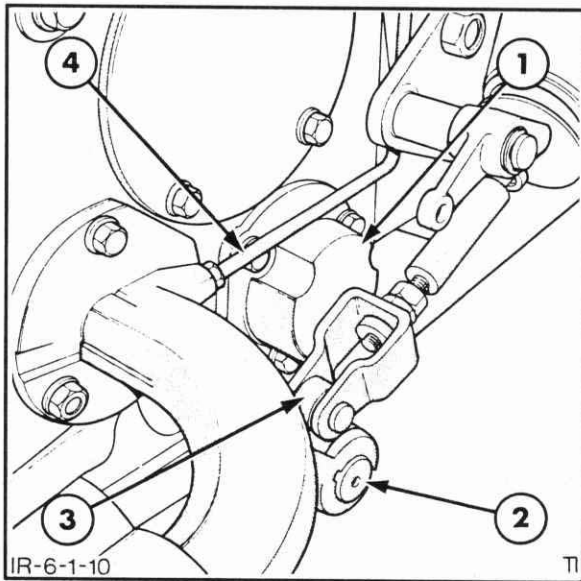


Figure 6-11

Left-Hand Side of Rear Axle Assembly

1. Clutch brake plate
2. Brake cross-shaft
3. Left-hand brake operating lever
4. Dipstick tube (if equipped)

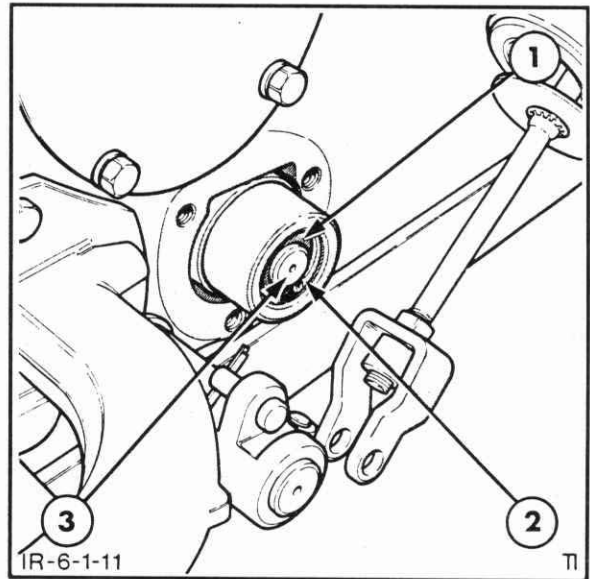


Figure 6-12

Clutch Brake Installation

1. Piston guide
2. Retaining ring
3. Piston

NOTE: Replacement of the clutch brake seals may be performed without removing the rear axle top cover or separating the tractor as follows:

CLUTCH BRAKE SEALS

REMOVAL

Refer to Figures 6-11 and 6-12.

1. Release the pinch bolt, then pull the left-hand brake operating lever off the brake cross-shaft.
2. Drain the rear axle oil and disconnect the dipstick tube from the filter support.

3. Remove the retaining bolts and remove the clutch brake plate.

4. Remove the ring retaining the piston guide in the cylinder and remove the piston guide and piston from the brake cylinder.

5. Separate the piston from the guide and replace the seals located on the piston and piston guide.

INSTALLATION

Installation of the piston follows the removal procedure in reverse. Be sure that the plate retaining bolts are tightened to 50 ft. lbs. (68 N·m) torque, and refill the rear axle with 134D hydraulic oil.

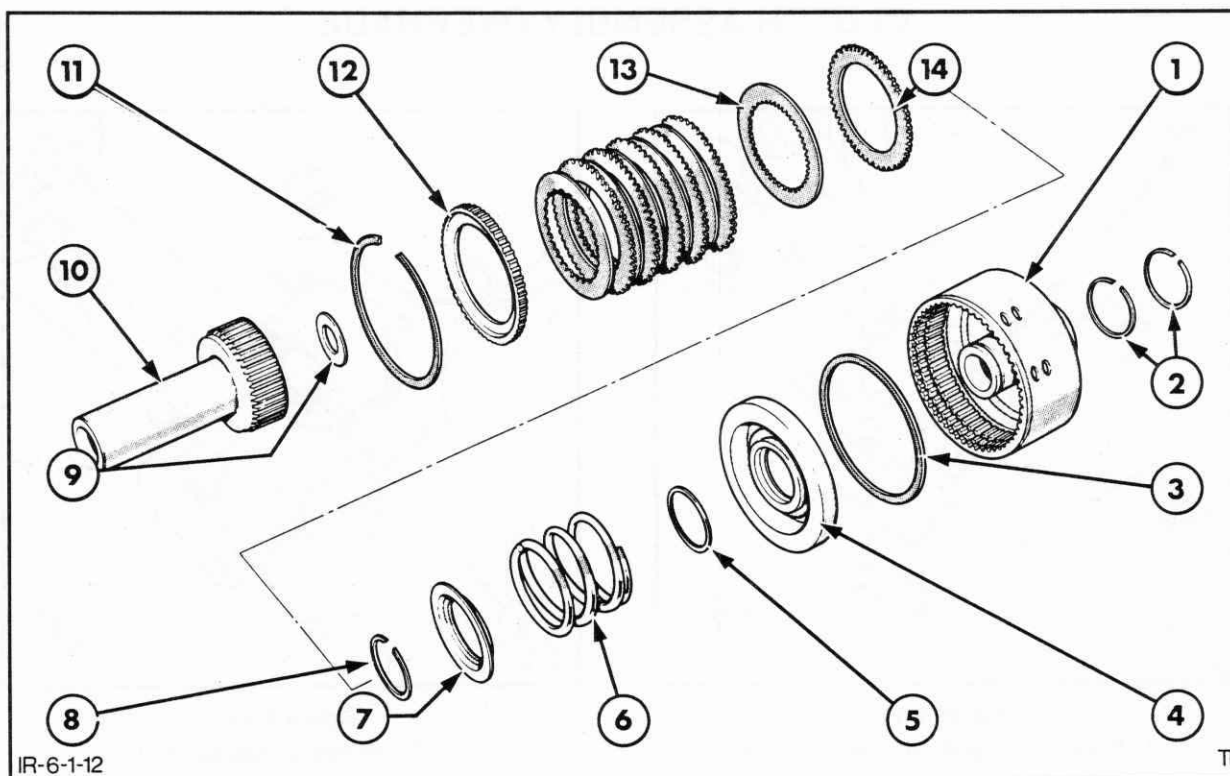


Figure 6-13
PTO Clutch Assembly

- | | |
|------------------------------|---------------------------|
| 1. Housing | 8. Snap ring |
| 2. Housing sealing rings | 9. Thrust washer |
| 3. Outer piston sealing ring | 10. Clutch drive coupling |
| 4. Piston | 11. Snap ring |
| 5. Inner piston sealing ring | 12. Pressure plate |
| 6. Piston spring | 13. Drive plate |
| 7. Spring retaining washer | 14. Driven plate |

CLUTCH AND BRAKE ASSEMBLY

REMOVAL

1. Separate the tractor between the front and rear transmission assemblies. See "Separating the Tractor", Section 10.
2. Remove the hydraulic pump as outlined later in this section.
3. Remove the retaining bolts and remove the hydraulic pump inlet filter and tube assembly.
4. Remove the clutch drive coupling and disconnect the tube connection to the

clutch support from the control valve. Disconnect from the pressure regulating valve the tube that is located under the clutch support connecting to the brake cylinder.

5. Remove the clutch pack then the brake support.

DISASSEMBLY

Refer to Figure 6-13.

1. Separate the brake and support assembly from the clutch by pulling the support off the rear of the clutch.

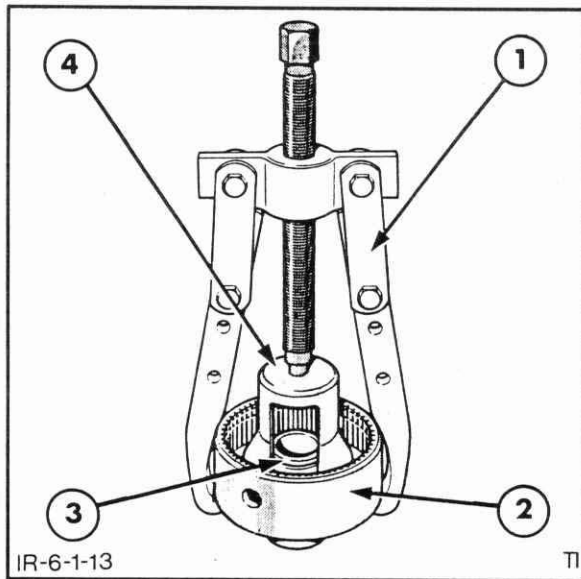


Figure 6-14

Compressing Clutch Spring

1. Puller, tool no. 1003 or 9516
2. Clutch housing
3. Snap ring
4. Compressor, tool no. FT.4101 or 1312

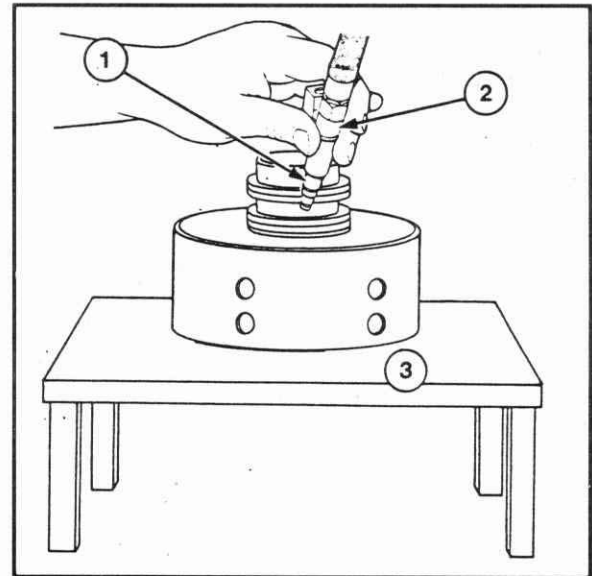


Figure 6-15

Clutch Piston Removal

1. Tyre valve
2. Air-line
3. Clutch housing
4. Piston

2. Remove the snap ring which retains the pressure plate in the clutch housing, then remove the drive and driven plates.

3. Using Puller, Tool #1003 or 9516 or a press and Compressor, Tool #FT4101 or 1312, compress the clutch piston return spring and withdraw the snap ring, Figure 6-14.

4. Slowly release the tension, then remove the retaining washer and return spring.

5. Turn the clutch so that the piston faces down on the bench and use air pressure to remove the piston, Figure 6-15.

6. Remove the housing and piston sealing rings.

BRAKE AND SUPPORT ASSEMBLY

Refer to Figure 6-16.

1. Remove the ring retaining the brake piston guide and remove the piston and guide.
2. Remove the split pin and clevis pin, then remove the arm and pad assembly from the brake housing.

INSPECTION AND REPAIR

1. Examine the clutch housing for excessive wear or scoring on the spigot or the bore.
2. Check the drive and driven plates for excessive wear, damaged splines or warping.
3. Examine the clutch spring for weakness or breakage.

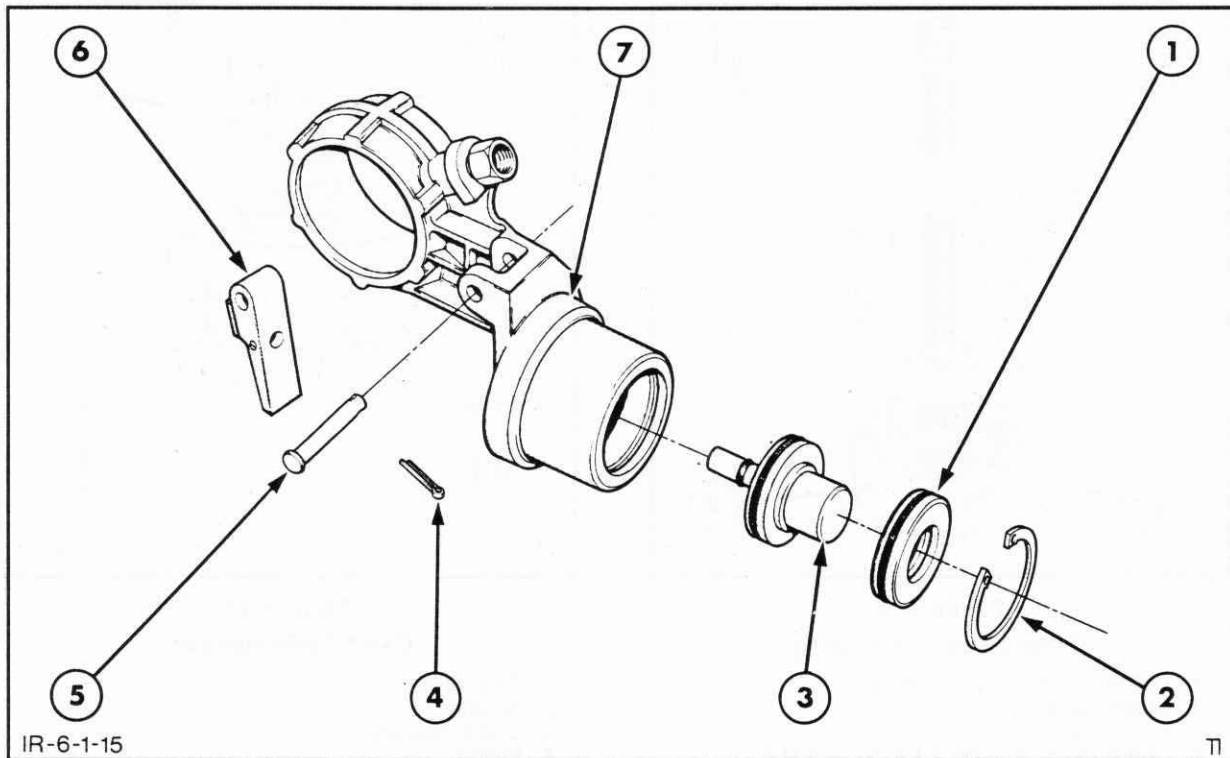


Figure 6-16
PTO Clutch Brake Assembly

1. Piston guide
2. Retaining ring
3. Brake piston
4. Split pin

5. Clevis pin
6. Brake arm and pad assembly
7. Brake housing

4. Inspect the brake housing bore for excessive wear or scoring.
5. Examine the brake arm and pad for excessive wear or scoring.
6. Replace any defective components and all O rings prior to reassembly.

- Lightly lubricate all O rings to prevent damage on assembly.

REASSEMBLY

Reassembly of the PTO clutch and brake assembly follows the disassembly procedures in reverse. On reassembly, observe the following requirements:

- Clean all components with a suitable solvent and dry with compressed air.

INSTALLATION

Installation of the PTO clutch and brake assembly follows the removal procedure in reverse.

Check that the clutch engages and disengages correctly and that the brake stops the shaft at 2200 engine RPM. Be sure that the PTO shaft is free to rotate with the engine stopped and clutch disengaged.

If new parts have been installed which affect the shimming dimension between the hydraulic pump drive gear lock ring and the PTO clutch drive coupling, the following procedure must be carried out to determine the shim thickness:

SECTION 6

1. With the hydraulic pump removed, install the shims previously installed and reconnect the rear axle to the transmission.
2. Through the hydraulic pump opening in the rear axle center housing, measure the gap between the hydraulic pump drive gear snap ring and the PTO clutch drive coupling using a feeler gauge.
3. Refer to the table in "Specifications" (at the end of this section) for the specified shim thickness for the gap measured.
4. Separate the transmission from the rear axle and install the specified shims. Reconnect the rear axle to transmission and install the hydraulic pump.

REDUCTION GEAR ASSEMBLY

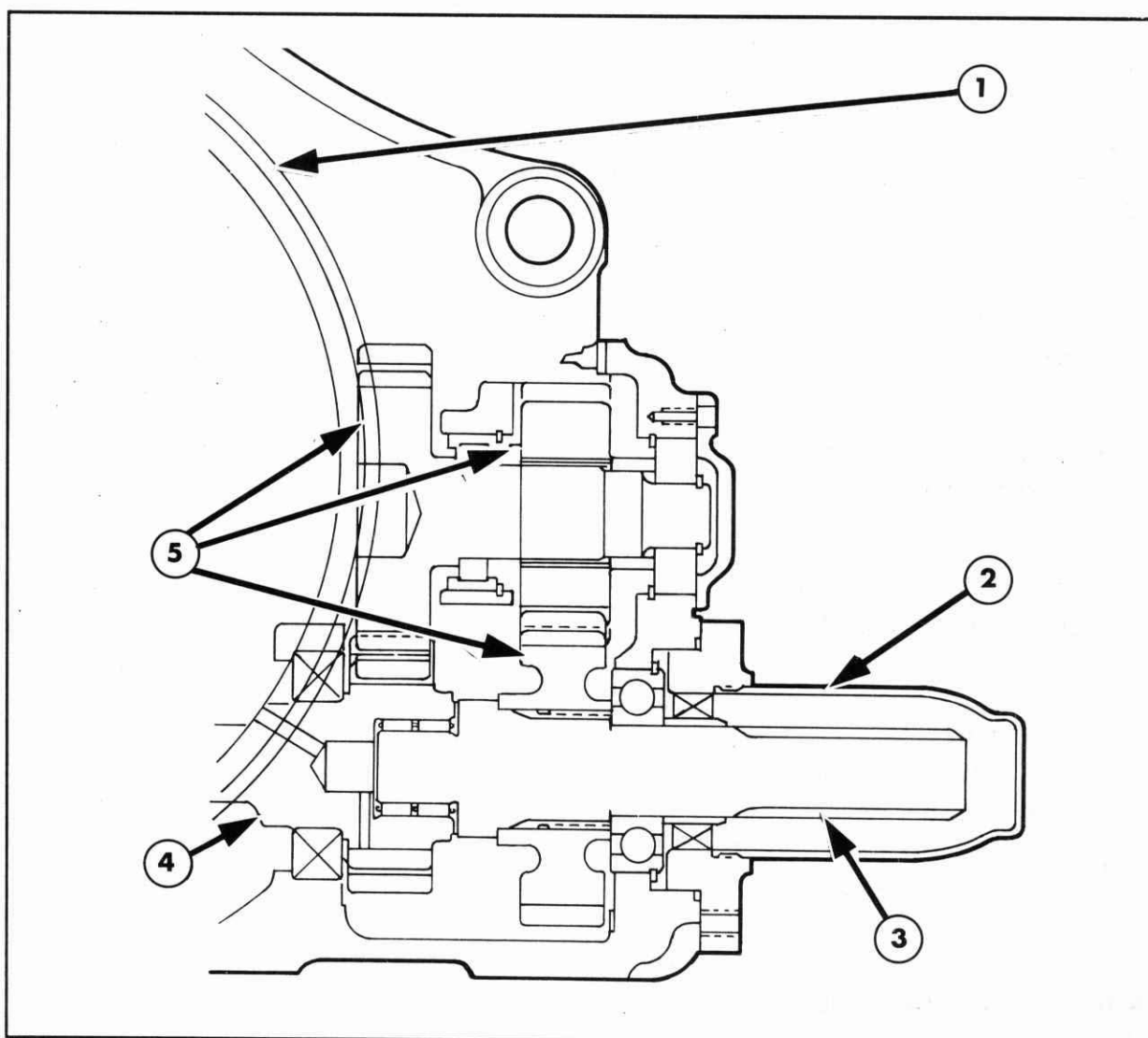


Figure 6-17

- | | |
|-----------------------------|------------------------|
| 1. Rear axle center housing | 4. Rear PTO shaft |
| 2. PTO shield | 5. PTO reduction gears |
| 3. PTO output shaft | |

DISASSEMBLY

Refer to Figure 6-17.

1. Drain the oil from the rear axle center housing and then remove the rear shaft cap.

2. Inspect the gears for wear or chipped teeth; if damaged, replace.

3. Inspect the shaft for chipped or worn splines or teeth and discoloration. Replace if necessary.

REASSEMBLY

2. Remove the bolts retaining the PTO cover to the rear axle center housing.

IMPORTANT: Prior to reassembly, clean all components with a suitable solvent and dry with compressed air.

3. Remove the drop box, Figure 6-17, as an assembly from the center housing.

4. Remove the bearing end caps retaining the gears and shaft, Figure 6-17.

Reassembly of the PTO rear shaft follows the disassembly procedure in reverse.

5. Remove the gears and shafts.

See Figures 6-17 and 6-18.

6. Remove the rear PTO shaft out the rear of the tractor using a pry bar to dislodge the bearing from the center housing.

When reassembling the PTO rear shaft, be sure that the PTO cover retaining bolts are tightened.

INSPECTION AND REPAIR

1. Inspect the bearings for excessive wear or discoloration due to overheating. Replace if necessary.

NOTE: The main PTO shaft cannot be pushed into the PTO clutch due to the thrust washer between the PTO coupler and PTO clutch. Be sure that the washer is positioned correctly on the shaft, Figure 6-4.

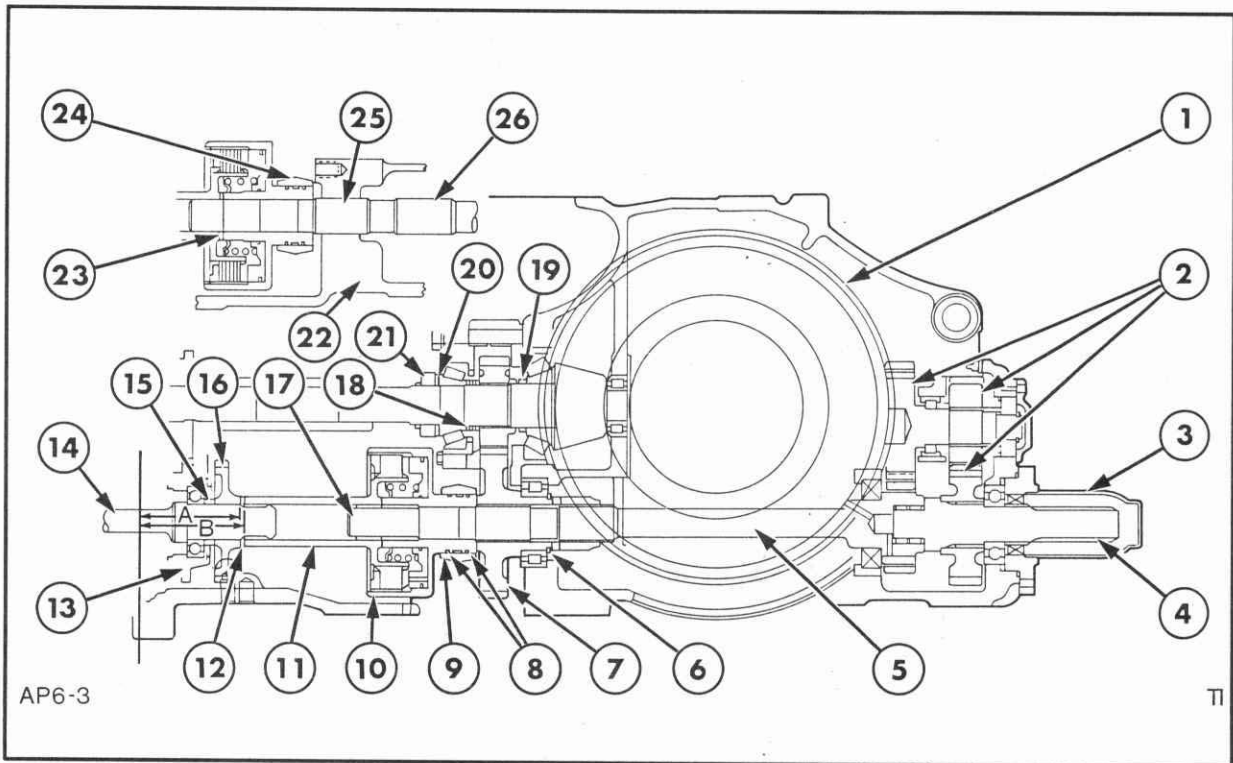


Figure 6-18

- | | | |
|-----------------------------|--------------------------|-------------------|
| 1. Rear axle center housing | 7. Seal (2 required) | 13. PTO ring |
| 2. PTO shield | 8. Support | 14. Thrust washer |
| 3. PTO output shaft | 9. Clutch housing | |
| 4. Rear PTO shaft | 10. 0.762mm thick washer | |
| 5. Retaining ring | 11. Retainer | |
| 6. Gear assembly | 12. Clutch input shaft | |

INPUT SHAFT SHIMMING PROCEDURE						
DIMS. (MM)	0.14	0.90	1.66	2.42	3.18	3.95
A-B	0.89	1.65	2.41	3.17	3.94	4.70
SHIMS	0	1	2	3	4	5

HYDRAULIC PUMP

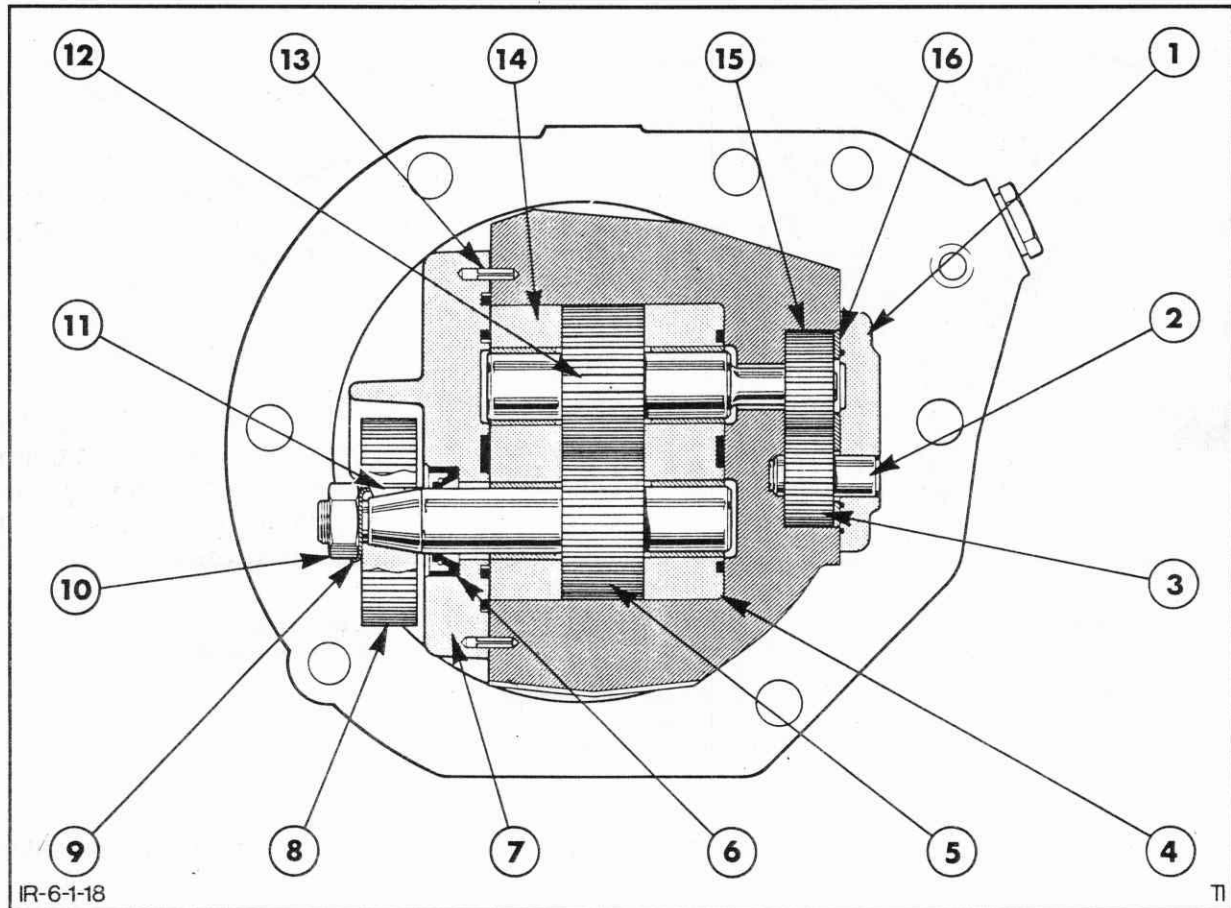


Figure 6-19

Cross-Section of Transmission Mounted Hydraulic Gear Type Pump

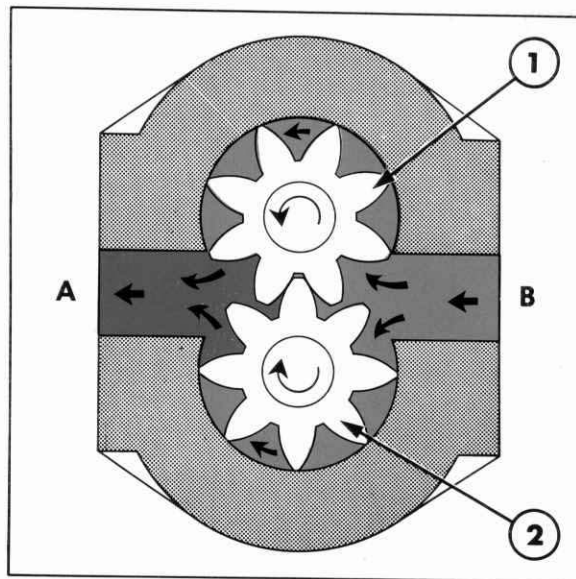
- | | |
|---------------------------|------------------------|
| 1. Rear cover | 9. Tab washer |
| 2. Rear driven gear shaft | 10. Nut |
| 3. Rear driven gear | 11. Shaft key |
| 4. Rear gear bearing | 12. Front driven gear |
| 5. Front drive gear | 13. Roll pin dowel |
| 6. Shaft seal | 14. Front gear bearing |
| 7. Front cover | 15. Rear drive gear |
| 8. Driven gear | 16. Pressure plate |

A cross-section of the transmission mounted gear type hydraulic pump is shown in Figure 6-19.

The pump is a tandem gear type unit mounted in the lower right-hand side of the rear axle center housing.

The pump is driven directly by a gear splined to the rear end of the transmission PTO shaft.

Two sets of spur gears are incorporated within the pump body. The gears, which are coupled together and revolve at the same speed, are in constant operation whenever the engine is running. The front gears pump oil to the hydraulic system (if equipped), while the smaller rear gears pump oil to the independent PTO clutch and brake energizing circuits.

**Figure 6-20**

Oil Flow in Hydraulic Gear Type Pump

1. Driven gear
2. Drive gear

come into mesh. The oil is then expelled through an outlet port via a passage formed in the pump flange into the rear axle center housing reservoir.

Hydraulic intake oil also passes to the pump rear gears via a transfer passage drilled within the pump body. The oil is carried around by the rotating gears and is expelled through a rear outlet port into a passage formed in the pump flange.

This passage leads to a port on the pump mounting face which directs the oil, through the wall of the rear axle center housing, into a rigid pipe leading to the independent PTO brake pressure regulating valve.

REMOVAL

1. Drain the oil from the rear axle center housing.
2. Disconnect the brake control rods.
3. Disconnect the brake levers from the pull rods.
4. Withdraw the pump to rear axle center housing retaining bolts.
5. Remove the pump from the side of the rear axle center housing.

OIL FLOW

Refer to Figure 6-20.

Hydraulic oil is supplied to the pump from the rear axle center housing reservoir via a replaceable full flow micronic intake filter. On entering the pump, the oil fills the spaces between the teeth of the revolving front gears and is carried around, within the pump body, to a point where the teeth of the two gears

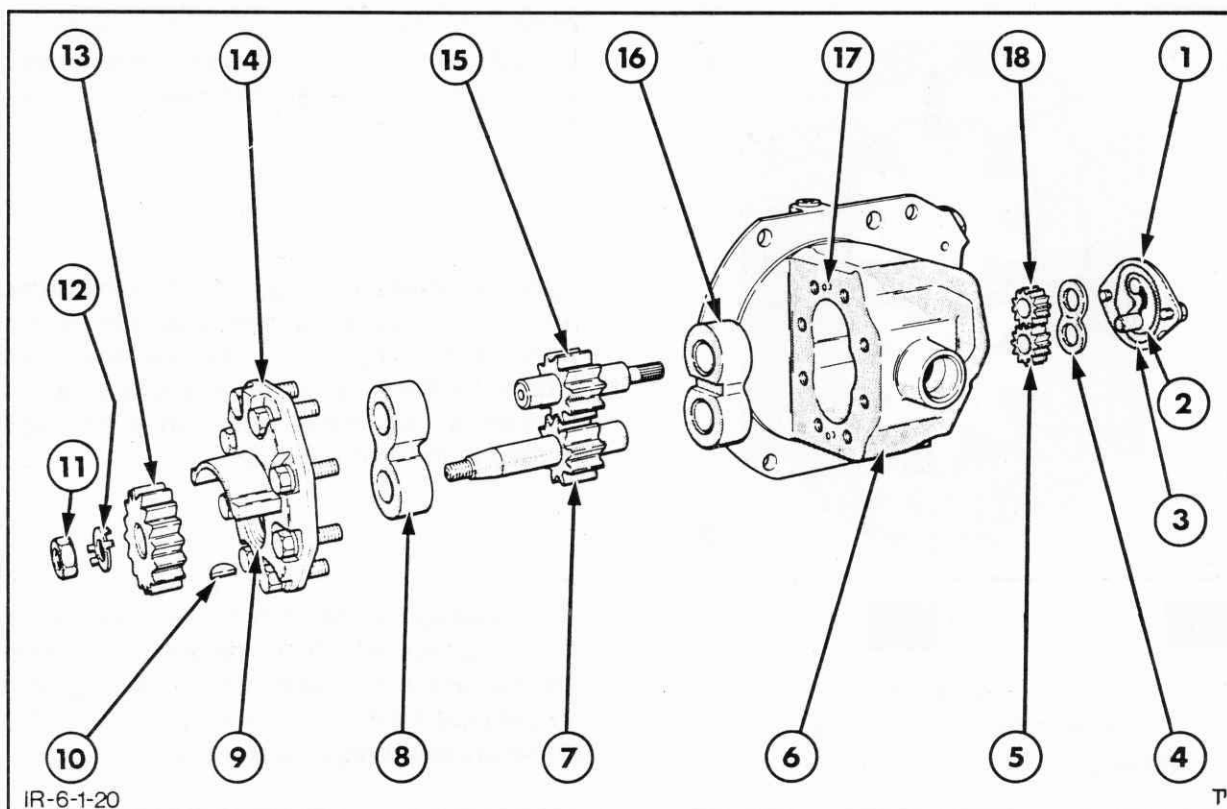


Figure 6-21

Hydraulic Gear Pump - Exploded

- | | |
|---------------------------|---------------------------|
| 1. Rear cover | 10. Shaft key |
| 2. Pressure loading ring | 11. Nut |
| 3. Outer sealing ring | 12. Tab washer |
| 4. Pressure plate | 13. External driven gear |
| 5. Rear driven gear (PTO) | 14. Front cover |
| 6. Pump body | 15. Front driven gear |
| 7. Front drive gear | 16. Rear gear bearing |
| 8. Front gear bearing | 17. Roll pin dowel |
| 9. Front seal | 18. Rear drive gear (PTO) |

DISASSEMBLY

Refer to Figure 6-21.

1. Straighten the locking tab and remove the external driven gear retaining nut.
2. Remove the external driven gear from the shaft.
3. Remove the shaft key.
4. Remove the front cover retaining bolts and washers and remove the front cover.
5. Pull the front drive gear and bearing from the pump body.
6. Separate the front drive gear from the bearing.
7. Remove the front driven gear from the pump body.
8. Remove the rear cover retaining bolts and washers and remove the rear cover.

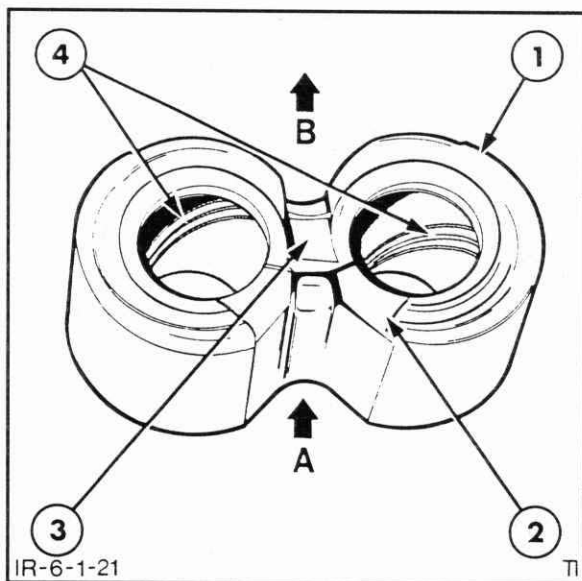


Figure 6-22
Pump Bearing

- A. Pump inlet
- B. Pump outlet
- 1. Relieved radius
- 2. Recess on face adjacent to gears
- 3. Seal bridge
- 4. Lubrication scrolls

9. Extract the pressure plate from the rear of the pump.
10. Using a pair of long-nose pliers, remove the rear gears.
11. Remove the rear gear bearing.

NOTE: To facilitate removal of the rear gear bearing, it may be necessary to push the bearing from the rear end using a suitable rod inserted in the oil transfer passage.

INSPECTION AND REPAIR

1. Wash all parts in a suitable solvent to remove any foreign particles and dry with a clean, lint-free cloth or compressed air.
2. Examine each bearing for wear on the face and in the bore. Pay particular attention to the condition of the lubrication scrolls and

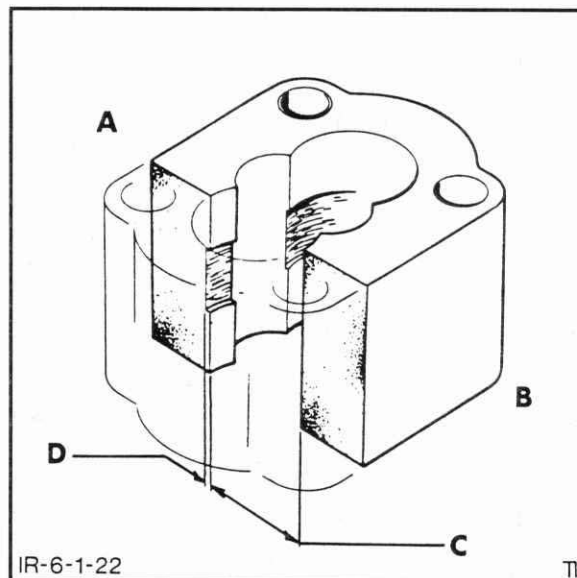


Figure 6-23
Gear Track In Body

- A. Inlet side
- B. Outlet side
- C. Bore diameter (bearing location)
- D. Depth of gear track

the seal bridge, Figure 6-22. At the stage of major overhaul, bearings should be replaced but light score marking may be removed by polishing as follows:

- a. Place a sheet of "O" grade emery paper, lubricated with paraffin, on a truly flat surface, then polish the bearing face using light rotary motion.
- b. Outer diameter may be lightly polished to obtain free movement in the body.
3. Inspect the pump body for external damage and cracks. Examine the bores for wear and damage.

NOTE: It is normal for the gears to cut a light track on the inlet side of the body bore and, providing the depth of the track does not exceed 0.004" (0.10 mm), the body is reusable. Using an internal micrometer, measure the body at the bearing location and then at the track position to assess the track depth, see Figure 6-23.

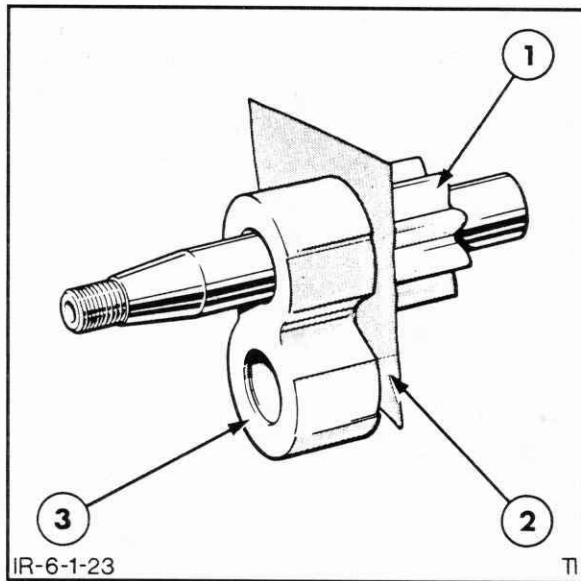


Figure 6-24
Polishing Gear Faces

1. Gear
2. Emery paper 'o' grade
3. Scrap bearing

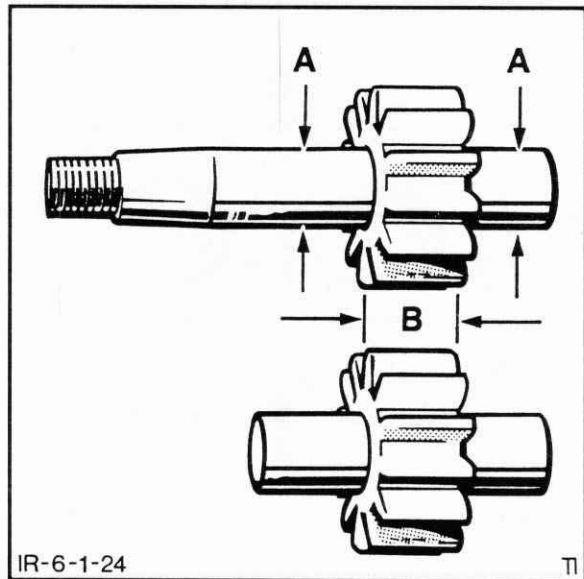


Figure 6-25
Gear Pairing

- A. Journals paired within 0.0005 in (0.013 mm)
- B. Gear widths paired within 0.0002 in (0.005 mm)

Burrs at the edge of the gear track should be removed with "O" grade emery paper.

each other to ensure satisfactory pump efficiency, see Figure 6-25.

4. Examine the gears for scored or worn side faces or journals, damaged teeth, thread or keyway and surface cracks. Slight wear and scoring on the journals may be erased by mounting between lathe center and polishing with "O" grade emery paper lubricated with paraffin. Lightly scored side faces may be renovated by sandwiching emery paper between the gear face and a scrap bearing and rotating the gear, Figure 6-24.

- b. Journals must be within 0.0005" (0.013 mm) of each other, Figure 6-25.

- c. Gear faces must be flat. This feature may be checked by blueing a bearing face and rotating against the gear. This check will also reveal any sharp edges on the teeth.

IMPORTANT: While servicing the drive and driven gears, particular attention must be paid to the following points:

- a. Gear widths of drive and driven gears must be within 0.0002" (0.005 mm) of

5. Inspect the cover for damage or cracks, particularly adjacent to the port, filter connection and pump face. Be sure that the internal passages are clear.

6. Check the external gears and housing for damage, wear or cracks. Be sure that the idler gear runs freely on the shaft.

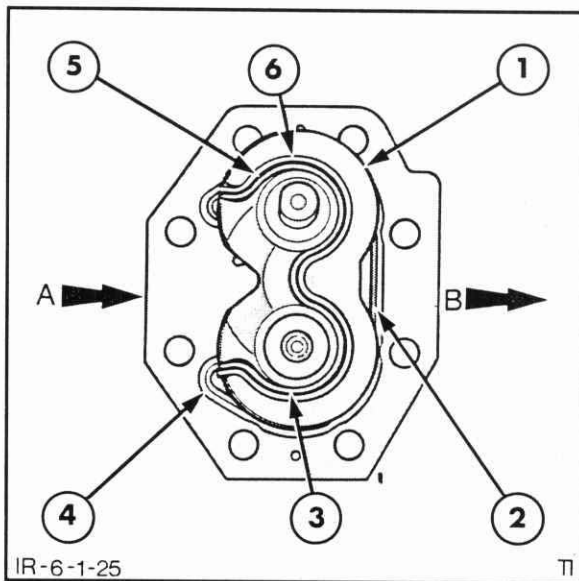


Figure 6-26

Position of Sealing Rings and Relationship of Bearings to Inlet Side of Body

- A. Inlet
- B. Outlet
- 1. Relieved radius on outlet side of pump
- 2. Pressure loading seal
- 3. Back up strip
- 4. Seal back up ring
- 5. Pressure loading strip
- 6. Back up strip

7. Install new seals and O rings when servicing the pump.

In the event of components being unsuitable for further use, the advisable action is to clean out the hydraulic system and replace the complete pump unit. Worn components can, in an emergency, be replaced, but the following points must be noted:

Under working conditions, hydraulic pressure within the pump loads the gears towards the inlet side of the body, thereby cutting the running track. If the bearings or gear journals wear, the gears move over, thus deepening the track.

If the running track is worn to or beyond the limit for re-use, the installation of new bearings will re-center the gears and prevent the tips of the teeth bottoming in the track, thereby resulting in pump inefficiency.

REASSEMBLY

Reassembly of the transmission mounted gear type pumps follows the disassembly procedure in reverse.

IMPORTANT: If used bearings are to be refitted, they should be installed in their original positions. Inspection of the bearings indicates two distinct features which may be used to ensure correct location.

1. A Y-shaped recess in the bearing face.

2. Relieved radii on one side of the bearing.

Assemble the bearings with the Y-shaped recesses adjacent to the gear faces and the relieved radii facing the outlet side of the body, see Figure 6-26.

SECTION 6 – POWER TAKE-OFF

On reassembly, observe the following requirements:

Lubricate all parts with hydraulic oil.

Coat all seals and O rings with petroleum jelly and be sure that the pump sealing rings are correctly positioned, Figure 6-26. Be sure that the sealing strips are flush to 0.01" (0.25 mm) exposed from the bearing block on reassembly.

Coat the seal lip with grease.

If the pump is not to be re-used immediately, the ports should be capped.

INSTALLATION

Installation of the transmission mounted gear type pumps follows the removal procedure in reverse.

IMPORTANT: *Prior to installation on the tractor, introduce hydraulic oil into the suction port and rotate the gears by hand.*

TROUBLESHOOTING

IMPORTANT: Whenever making a repair, the cause of the problem must be investigated and corrected to avoid repeat failures. The following table lists problems and their possible causes with recommended corrective action.

PROBLEM	POSSIBLE CAUSES	CORRECTION
PTO will not engage with load or stop without load	1. Low rear axle oil level 2. Selector lever linkage broken 3. PTO pump fails 4. Fracture of clutch feed tube 5. Broken PTO control valve 6. Pressure regulating valve broken	Check level and top-up Inspect and repair Pressure test pump Inspect and repair Check valve operation, replace components if necessary Check valve operation, replace components if necessary
PTO will not engage with load but shaft stops without load	1. PTO clutch to support sealing rings leak 2. PTO control valve piston stuck or spring broken 3. PTO clutch plates worn or teeth broken 4. PTO clutch piston seals leaking 5. PTO clutch piston or housing cracked 6. Blocked PTO oilways	Inspect and replace rings Inspect and replace components Inspect and replace plates Inspect and replace seals Inspect and replace components if necessary Inspect and repair
PTO engages but will not disengage	1. Selector lever linkage broken 2. PTO control valve stuck 3. PTO clutch return spring broken 4. Blocked PTO oilways 5. Seized or warped plates	Inspect and repair Check valve operation, replace components if necessary Inspect and replace spring Inspect and repair Inspect lubrication circuit
PTO clutch brake fails to operate, shaft rotates without load and with clutch disengaged	1. Brake pad or band worn or broken, band incorrectly adjusted 2. Blocked PTO oilways 3. Broken PTO control valve 4. Brake piston seals leaking 5. Brake pressure oilways leaking	Inspect and repair Inspect and repair Check valve operation, replace components if necessary Inspect and replace Inspect and repair

SPECIFICATIONS

PTO SPEED 540 RPM @ 1850 engine RPM

SHIMS

LOCATION	SIZE AVAILABLE
PTO Pressure Regulating Valve	0.050" (Nominal) (1.20 mm)
PTO Control Valve	0.015" (0.381 mm) 0.030" (0.762 mm)
PTO Drive Shaft - (Refer to Chart Below for Shim Thickness)	0.030" (0.762 mm)

Gap Measurement	Shims to be Installed	Gap Measurement	Shims to be Installed
0.006" (0.14 mm) 0.035" (0.89 mm)	0	0.096" (2.42 mm) 0.124" (3.17 mm)	3
0.036" (0.90 mm) 0.065" (1.65 mm)	1	0.125" (3.18 mm) 0.155" (3.94 mm)	4
0.066" (1.66 mm) 0.095" (2.41 mm)	2	0.156" (3.95 mm) 0.185" (4.70 mm)	5

PTO SHAFT END PLAY

PTO drive shaft end play 0.000-0.025" (0.00-0.630 mm)

PTO output shaft turning torque (engine stopped) . 0-2 ft. lbs. (0-3 N·m, 0-0.3 Mkg)

PRESSURE TESTING

Oil temperature 140 +/- 6° F (60 +/- 3° C)

PTO pressure regulating valve
(clutch disengaged)

@ 2300 engine RPM 220-230 lbf/in² (15.2-15.9 bar)
(15.5-16.2 kgf/cm²)
(Oil flow 1.8 gal/min) (6.8 litres/min) (1.5 Imp gal/min)

(clutch engaged)

@ 2300 engine RPM 200-230 lbf/in² (13.8-15.9 bar)
(14.1- 16.2 kgf/cm²)
(Oil flow 0.75-1.8 gal/min) (2.8-6.8 litres/min) (0.6-1.50 Imp gal)

PTO control valve (clutch engaged)

@ 1300 engine RPM 220-240 lbf/in² (15.2-16.5 bar)
(15.5-16.9 kgf/cm²)
(Oil flow 1.0 gal/min) (3.8 litres/min) (0.8 Imp gal/min)

TORQUE SPECIFICATIONS

	ft. lbs.	N·m	Mkg
Control valve spigot bolt	33	45	4.6
Control valve retaining bolt	33	45	4.6
Clutch brake plate retaining bolts	50	68	6.9
Tube connections	9	12	1.2
Pump port to brake pressure regulating valve connector	25	35	3.6
PTO valve dump tube clamp bolt	6	8	0.8
Tube adaptors in PTO clutch support	10	14	1.4
Selector lever retaining bolt	37	50	5.1
Rear cover retaining bolts	50	68	6.9

SPECIAL TOOLS

DESCRIPTION	V.L. CHURCHILL TOOL NO.	NUDAY TOOL NO.	O.T.C. TOOL NO.
Ratchet	P61	9162	--
Step plate adaptors	630S	9210	FNH09210
Bushing kit	818	9514	FNH09514
Adaptor	924	9537	FNH09537
Puller legs	930B	9521	FNH09521
Puller legs	930E	9207	FNH09207
Puller	938	9506	FNH09506
Puller	943	9507	FNH09507
Slide hammer	943S	9567	FNH09567
Pulling attachment	951	9190	FNH09190
Pulling attachment	952	9526	FNH09526
Puller	1002	9198	FNH09198
Puller	1003	9516	FNH09516
Pressure gauge	FT4096	7284	--
Adaptor	FT4096-1	4646	FNH04646
Test pipe/adaptor	FT4097	1221	FNH01221A
Pressure gauge	FT4100	0074	FNH00074
Pressure pipe	FT4100-1	1552	FNH01552
Adaptor	FT4100-2	4657	--
Compressor	FT4101	1312	FNH01312
Test hose and connector	T8503-4	--	--
Consists of:			
Adaptor	--	0835	FNH00835
Adaptor	--	1384	--
Adaptor	--	1389	--
Hose	--	1392	--

SECTION 7

STEERING AND FRONT AXLE

STEERING

HYDROSTATIC STEERING - DESCRIPTION AND OPERATION

DESCRIPTION

The reservoir and the power-steering pump are an integral unit.

The steering system is a hydraulic power-assisted hydrostatic system. The major components are shown in Figure 7-1. The components are serviced separately and consist of steering column shaft, a steering motor, a power-steering pump, steering cylinder, a front axle assembly, and the hoses and tubes required to connect the system.

Hydraulic oil, stored in the power-steering pump oil reservoir, is pumped through the steering system and returned to the reservoir.

STEERING COLUMN SHAFT

The steering wheel is secured to the steering column shaft which is protected by a steel outer tube. The lower end of the shaft is coupled to the power-steering motor input shaft by a coupler and two pins. Two spring wire retaining rings located around the circumference of the shaft coupler hold the pins in position.

The steering column assembly is bolted to the power-steering motor support.

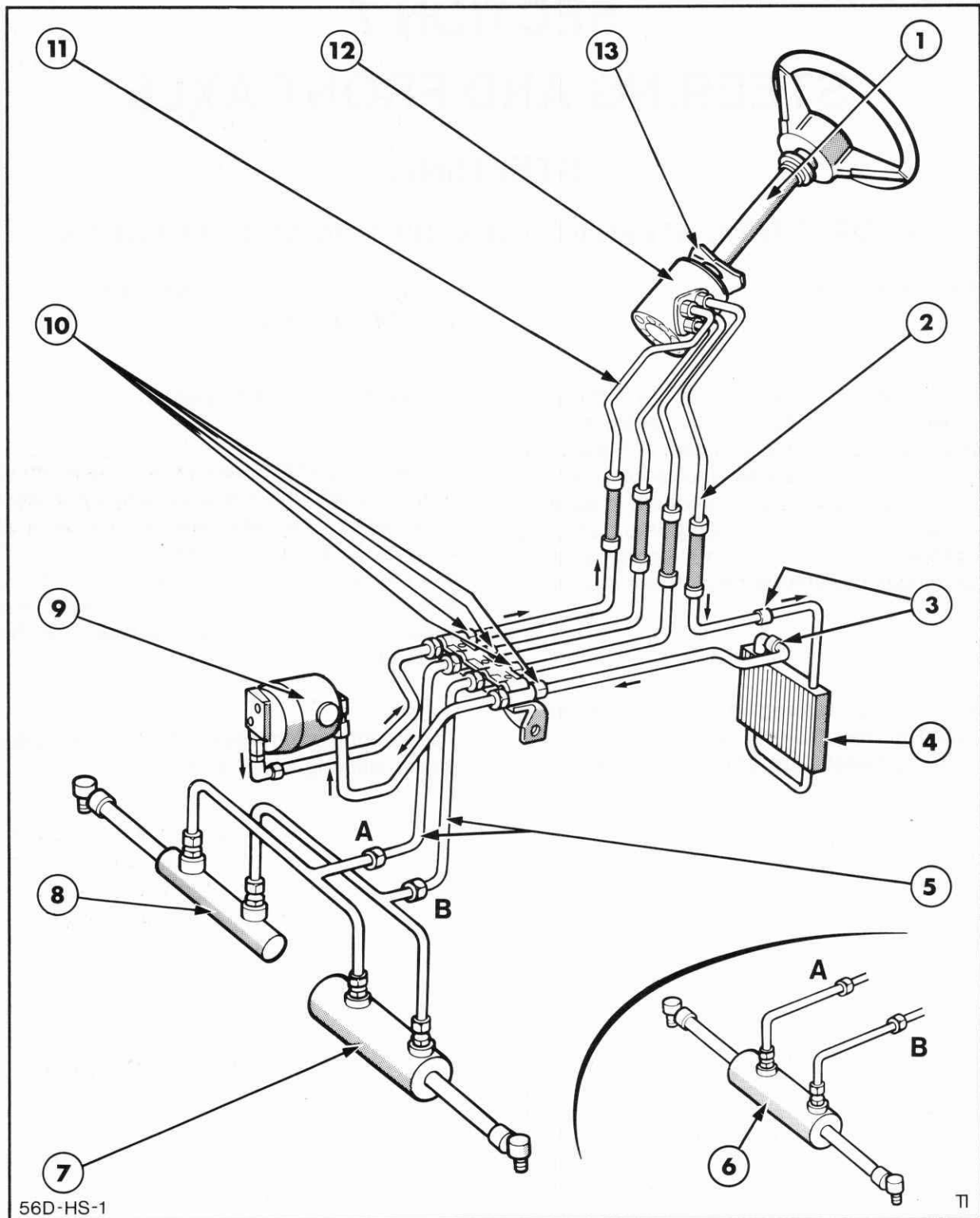


Figure 7-1
Hydrostatic Steering System Component Layout

- | | |
|--|---|
| 1. Steering column | 8. 4 wheel drive right hand steering cylinder |
| 2. Return pipe to cooler | 9. Steering pump and reservoir |
| 3. Cooler connections | 10. Steering pipe connections |
| 4. Oil cooler | 11. Pressure supply pipe |
| 5. Steering cylinder pipes | 12. Steering motor |
| 6. 2 wheel drive left hand steering cylinder | 13. Cab front panel (motor mounting) |
| 7. 4 wheel drive left hand steering cylinder | |

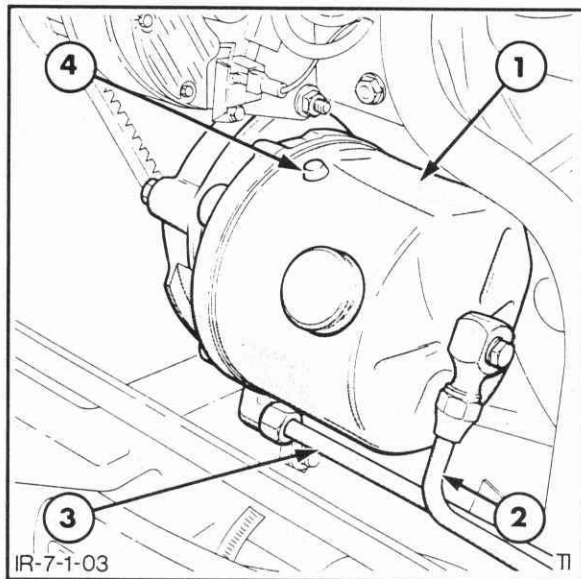


Figure 7-2

Steering Pump and Reservoir Installation

1. Reservoir
2. Return tube
3. Outlet tube - pressurized
4. Breather

POWER-STEERING PUMP AND RESERVOIR

The integral power-steering pump and reservoir, Figure 7-2, are mounted on the engine front cover plate on the left-hand side of the engine. The pump and reservoir are connected to the steering motor by two tubes.

The gear-type pump is driven counterclockwise by the camshaft gear. The pump-driven gear is half the diameter of the camshaft drive gear, thus the pump is driven at engine speed.

The pump output is 4.5 GPM at 1500 RPM and a pump delivery pressure of 2000 PSI. This pump uses a flow valve to keep the pump output approximately 4.0 GPM through the entire engine RPM range. The steering pump also contains the system relief valve to protect the steering system.

STEERING COOLER

The steering cooler, Figure 7-1, located under the cab on the right side of the tractor. The cooler is positioned in the return line from the steering motor to dissipate heat from the power steering oil.

STEERING MOTOR

The hydrostatic steering motor, Figure 7-3, utilizes a linear control valve to control the direction of the steered wheels and a metering unit to control the rate of turn.

STEERING MOTOR VALVE FUNCTIONS

IMPORTANT: The relief valves in the steering motor are factory set. If the valves are to be removed for overhaul ensure the following is observed:- remove the appropriate end plug but before removal of the valve adjuster, use a depth micrometer to determine the distance from the adjuster to the outside face of the motor and record the reading. On re-assembly return the adjuster to the original setting depth.

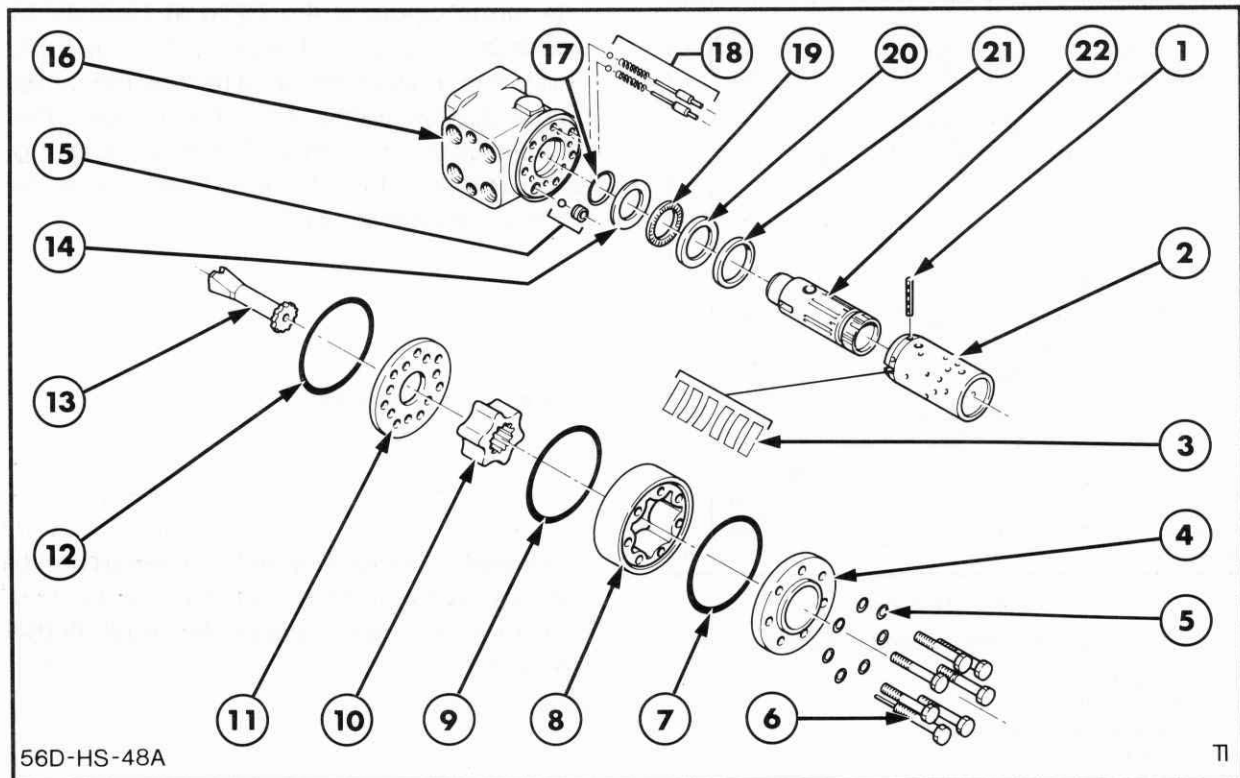


Figure 7-3

Control Valve and Metering Valve Exploded View

- | | | |
|----------------------------------|------------------------------|------------------------------|
| 1. Drive pin | 9. * 'O' ring | 17. * Lip type seal |
| 2. Valve sleeve | 10. Rotor | 18. Suction valves |
| 3. Centring springs | 11. Distributor plate | 19. Thrust bearing |
| 4. End plate | 12. * 'O' ring | 20. Thick thrust washer |
| 5. Washers | 13. Drive link | 21. Spring retaining ring |
| 6. Meter section retaining bolts | 14. Thin thrust washer | 22. Valve spool |
| 7. * 'O' ring | 15. Check valve and retainer | * Items included in seal kit |
| 8. Stator | 16. Housing | |

Check Valve: Regenerates steering cylinder return oil to the metering unit and pressure side of the steering cylinder when manual steering.

Cylinder Relief (Shock) Valves: Protect steering cylinders from excess pressure during front wheel impact with obstructions.

Suction Vales (Anticavitation): Ensure oil suction to avoid cavitation in the steering cylinders.

NOTE: The motor and cylinder relief valves have seats which are bonded in the housing and not serviced separately.

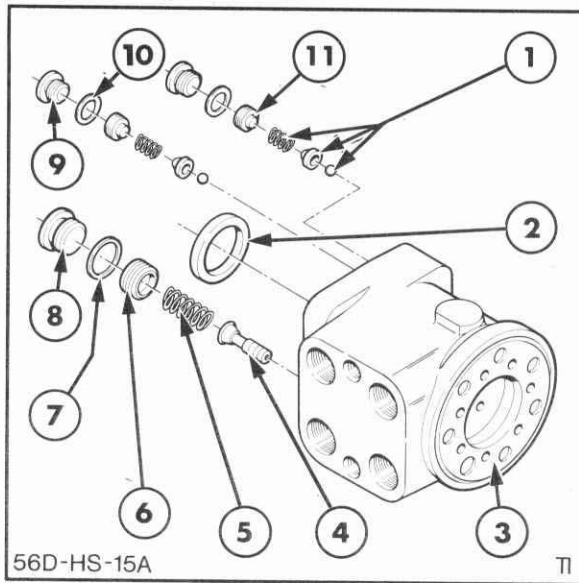


Figure 73A

Steering Motor Relief Valves

1. Cylinder relief valve
2. Dust seal
3. Housing
4. Motor relief valve
5. Spring
6. Adjuster
7. Seal
8. Plug
9. Plug
10. Seal
11. Adjuster

The steering motor directs oil to the steering actuating cylinder, Figure 7-4, when the steering wheel is turned. The steering motor incorporates a metering unit which regulates the volume of oil supplied to the cylinder so that it is proportional to the angular movement of the steering wheel.

This metering unit, in combination with suction valves, also allows the steering to be manually operated without pressurized oil being supplied from the pump. The valve of the steering motor is of the open-center design.

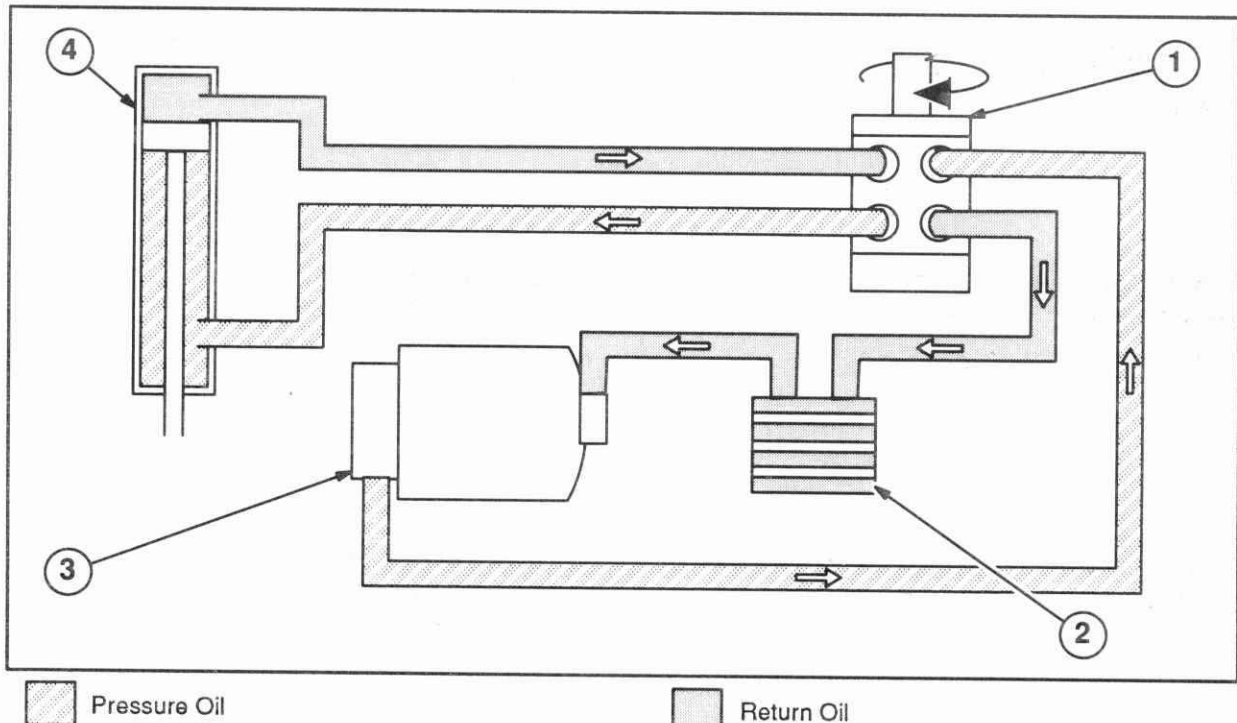
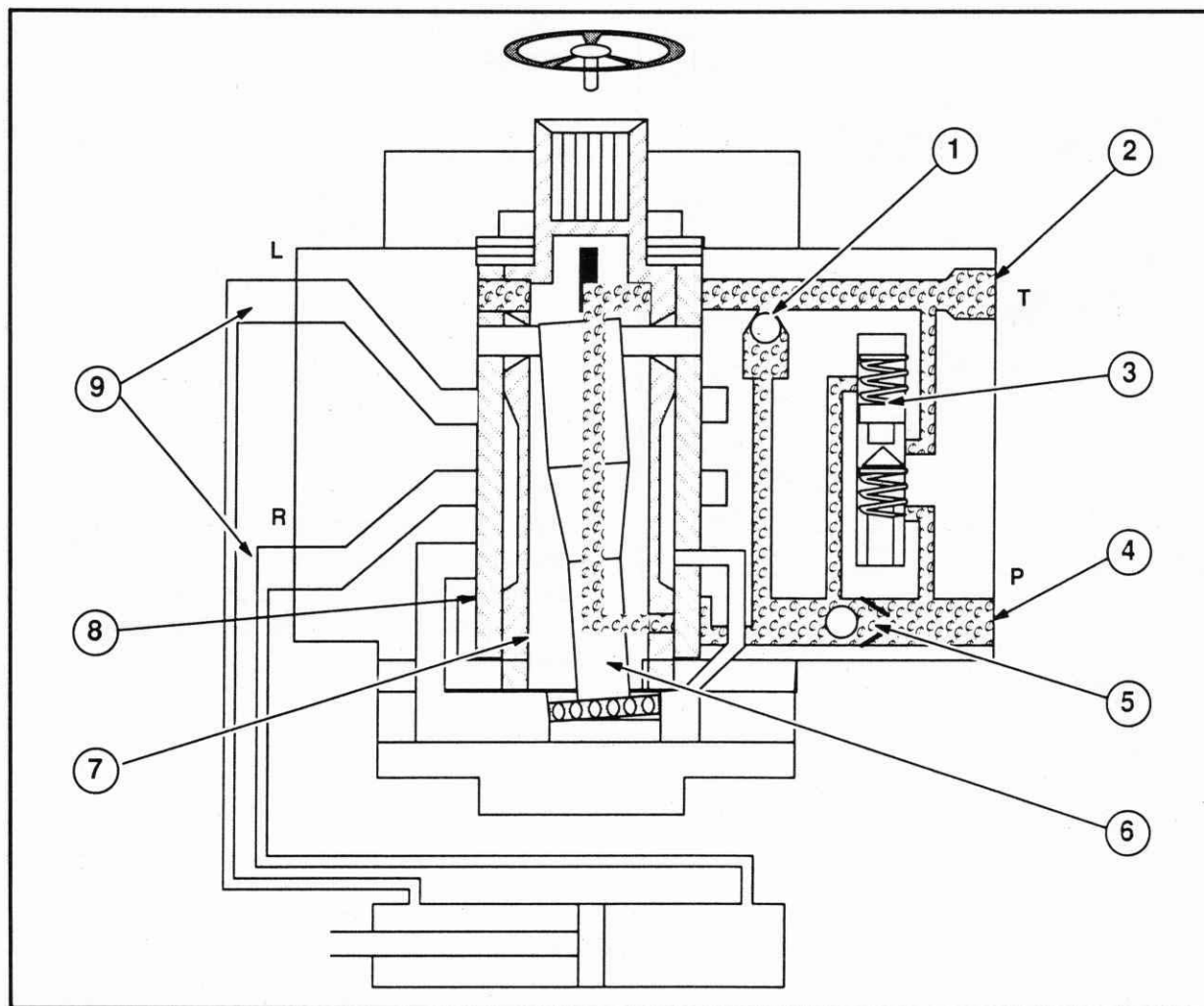


Figure 7-4

Steering System Flow Diagram

- | | |
|-------------------|----------------------|
| 1. Steering motor | 3. Pump |
| 2. Oil cooler | 4. Steering cylinder |



□ Trapped Oil

▨ Pump Oil

Figure 7-5
Steering Schematic – Neutral

- | | |
|-------------------|----------------------------------|
| 1. Suction valve | 6. Rotor |
| 2. Return to pump | 7. Inner valve sleeve |
| 3. Relief valve | 8. Outer valve sleeve |
| 4. From pump | 9. Steering cylinder connections |
| 5. Check valve | |

STEERING MOTOR - OPERATION

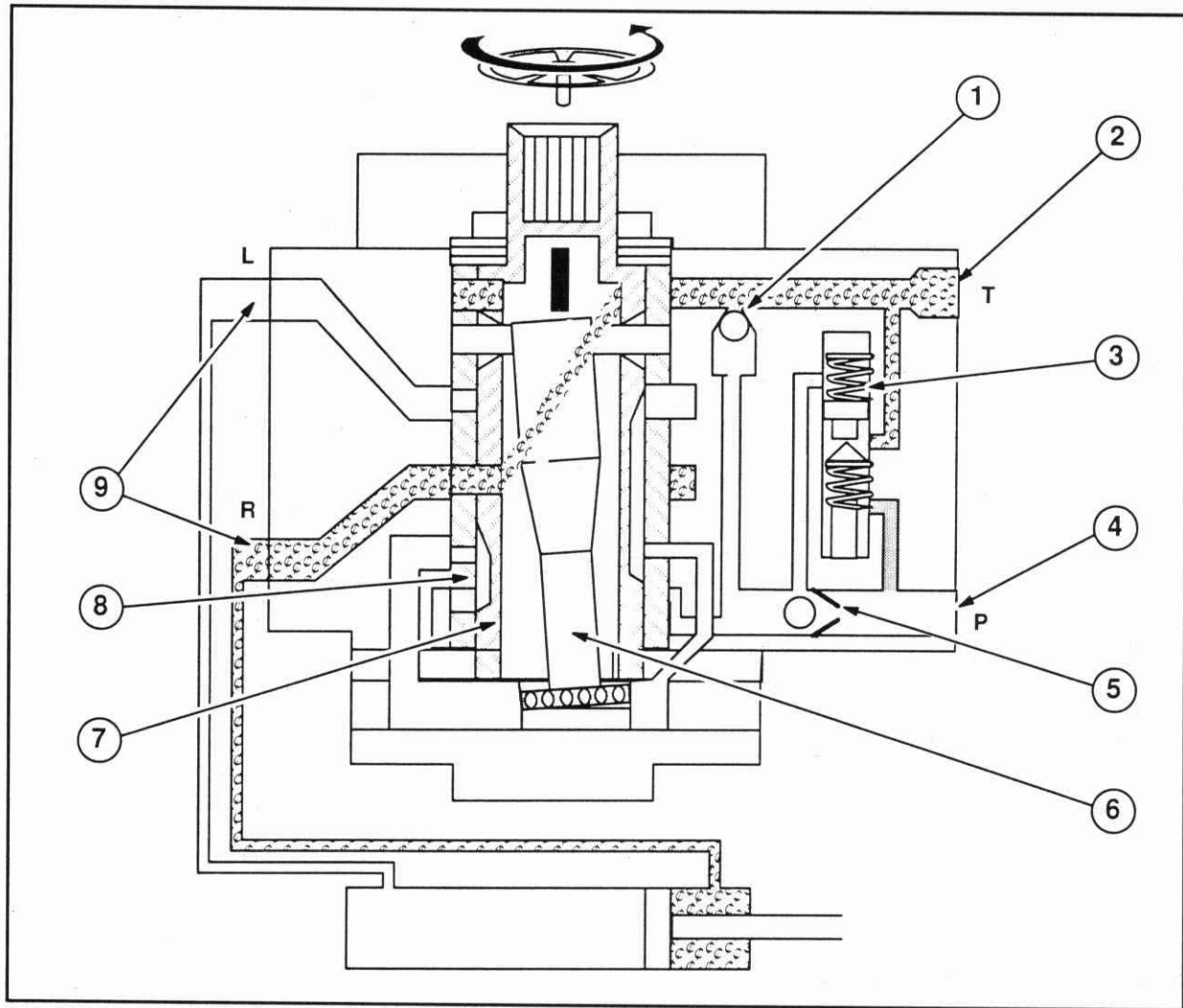
NEUTRAL POSITION - FIGURE 7-5

Pressurized oil from the power-steering pump enters the valve body at port, P. The oil flows through the check valve, past the relief valve, and through the radial holes in the outer valve sleeve to the center of the inner valve sleeve. The radial holes in the outer valve sleeve are indexed to grooves in the inner valve sleeve.

In the neutral position, the oil flows through the hollow inner valve sleeve and returns to the reservoir via point "T."

Passage to ports "L" and "R" leading to the cylinder are blocked by the valve sleeves. Oil contained in the tubes and cylinder is trapped and the cylinder remains static, with the front wheels set in the straight ahead position.

The system is fully hydraulic and, as such, there is no road feel or front-wheel reaction transmitted to the steering wheel.



□ Pressurised Oil

▤ Return Oil

Figure 7-6

Steering Schematic – Left Turn

1. Suction valve
2. Return to pump
3. Relief valve
4. From pump
5. Check valve

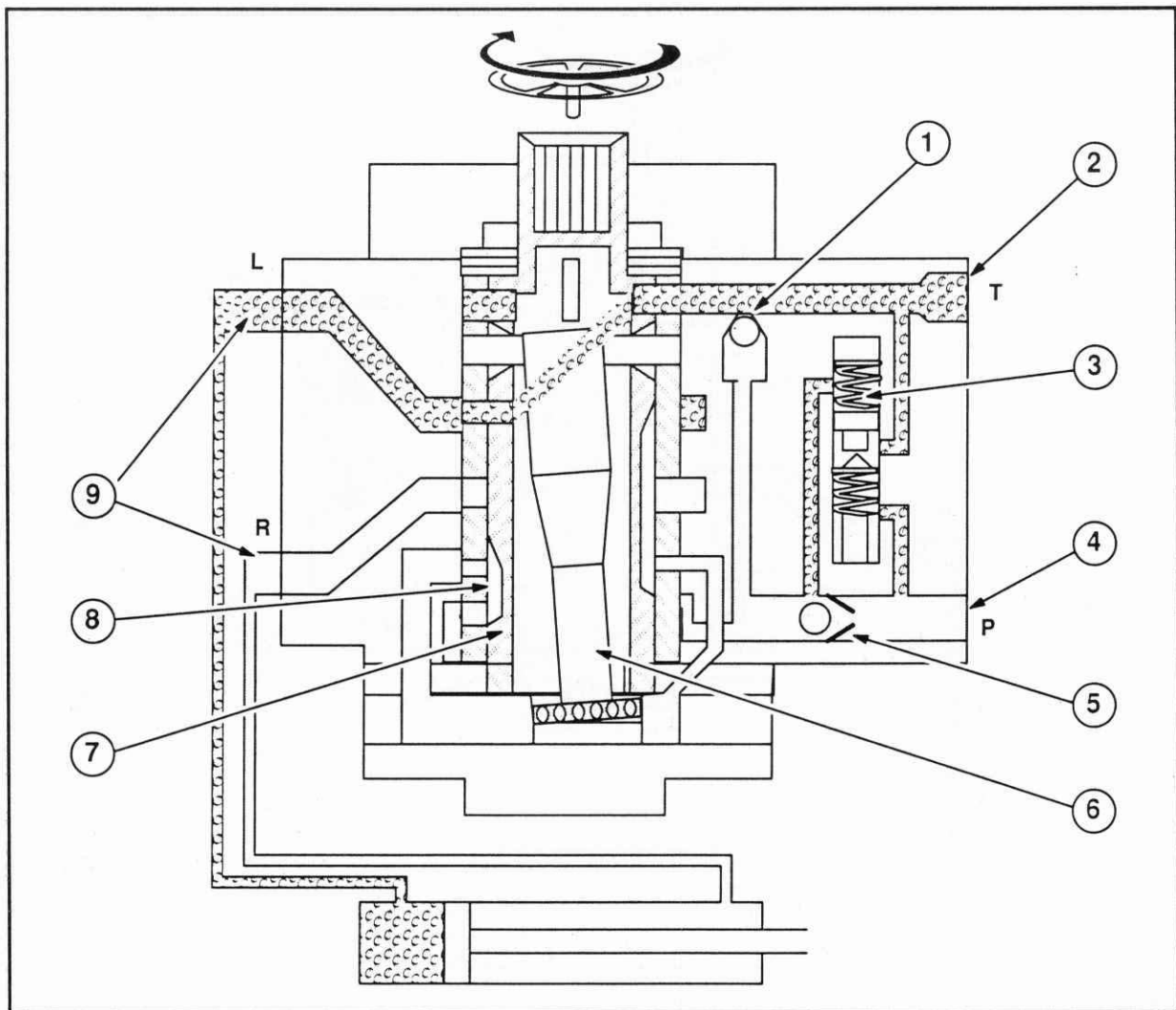
6. Rotor
7. Inner valve sleeve
8. Outer valve sleeve
9. Steering cylinder connections

LEFT TURN - FIGURE 7-6

Turning the steering wheel to the left rotates the inner valve sleeve, which aligns grooves in the inner sleeve with holes in the outer sleeve so that oil from the pump flows through the sleeves and enters the metering unit. Since the metering unit rotor is being turned counterclockwise, the oil flows through the

valve assembly to port, L. From port, L, the pressurized oil flows to the piston side of the power-steering cylinder and causes the front wheels to turn left.

The oil contained in the rod side of the cylinder returns to the control valve through port, B, and is directed back to the reservoir through port, T.



□ Pressurised Oil

▨ Return Oil

Figure 7-7

Steering Schematic – Right Turn

1. Suction valve
2. Return to pump
3. Relief valve
4. From pump
5. Check valve

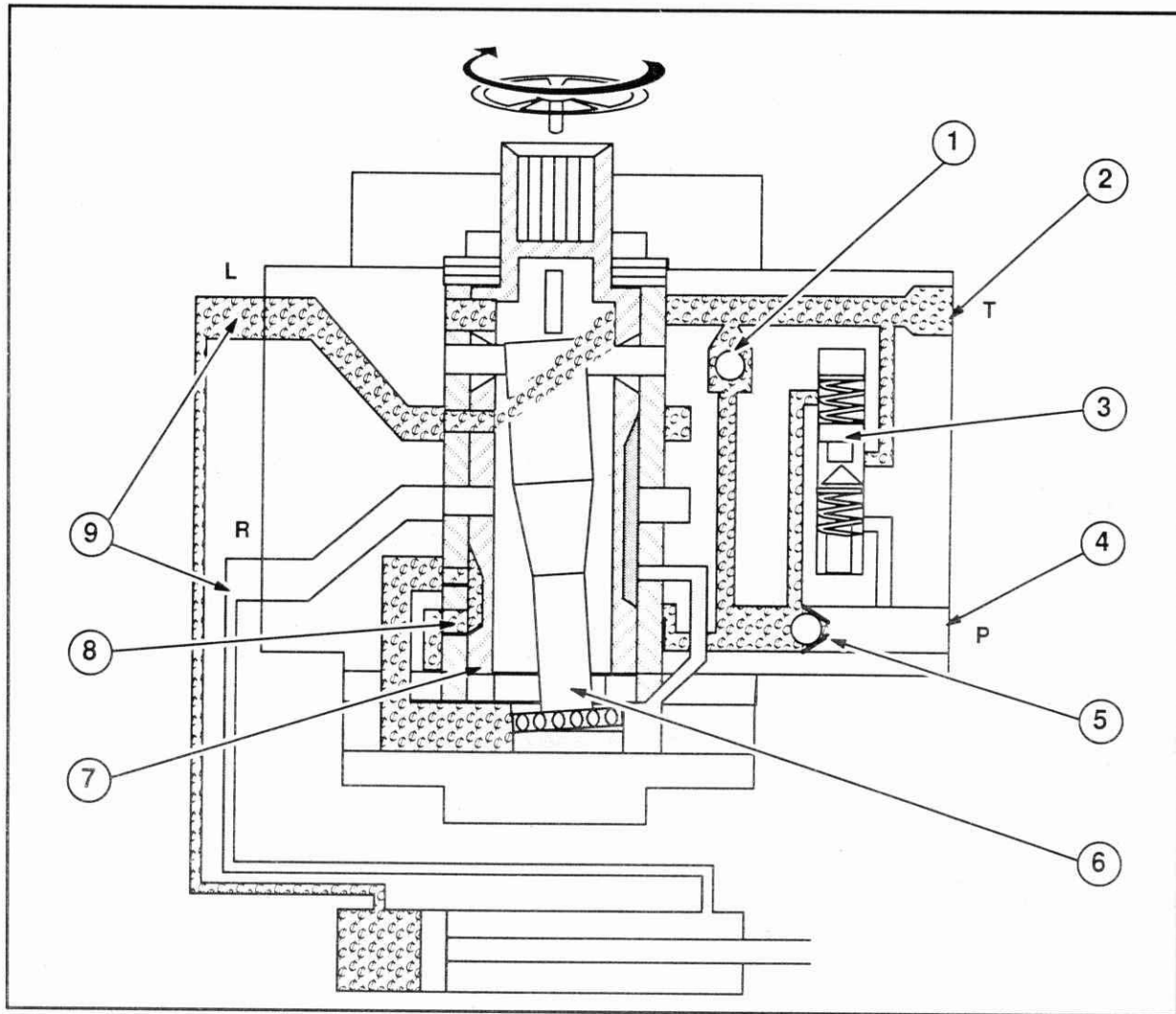
6. Rotor
7. Inner valve sleeve
8. Outer valve sleeve
9. Steering cylinder connections

RIGHT TURN - FIGURE 7-7

Turning the steering wheel to the right rotates the inner valve sleeve which aligns the grooves in the inner sleeve with holes in the outer sleeve so that the oil from the pump flows through the valve sleeves and enters the metering unit. Since the metering unit rotor is being turned clockwise, the oil flows

through the valve assembly to port, R. From port, R, the pressurized oil flows to the rod side of the power-steering cylinder and cause the front wheels to turn right.

The oil contained in the piston side of the cylinder is forced out and returns to the control valve, L, port and is directed back to the reservoir through port, T.



□ Pressurised Oil

▤ Suction Oil

Figure 7-8

Steering Schematic - Manual Right Turn

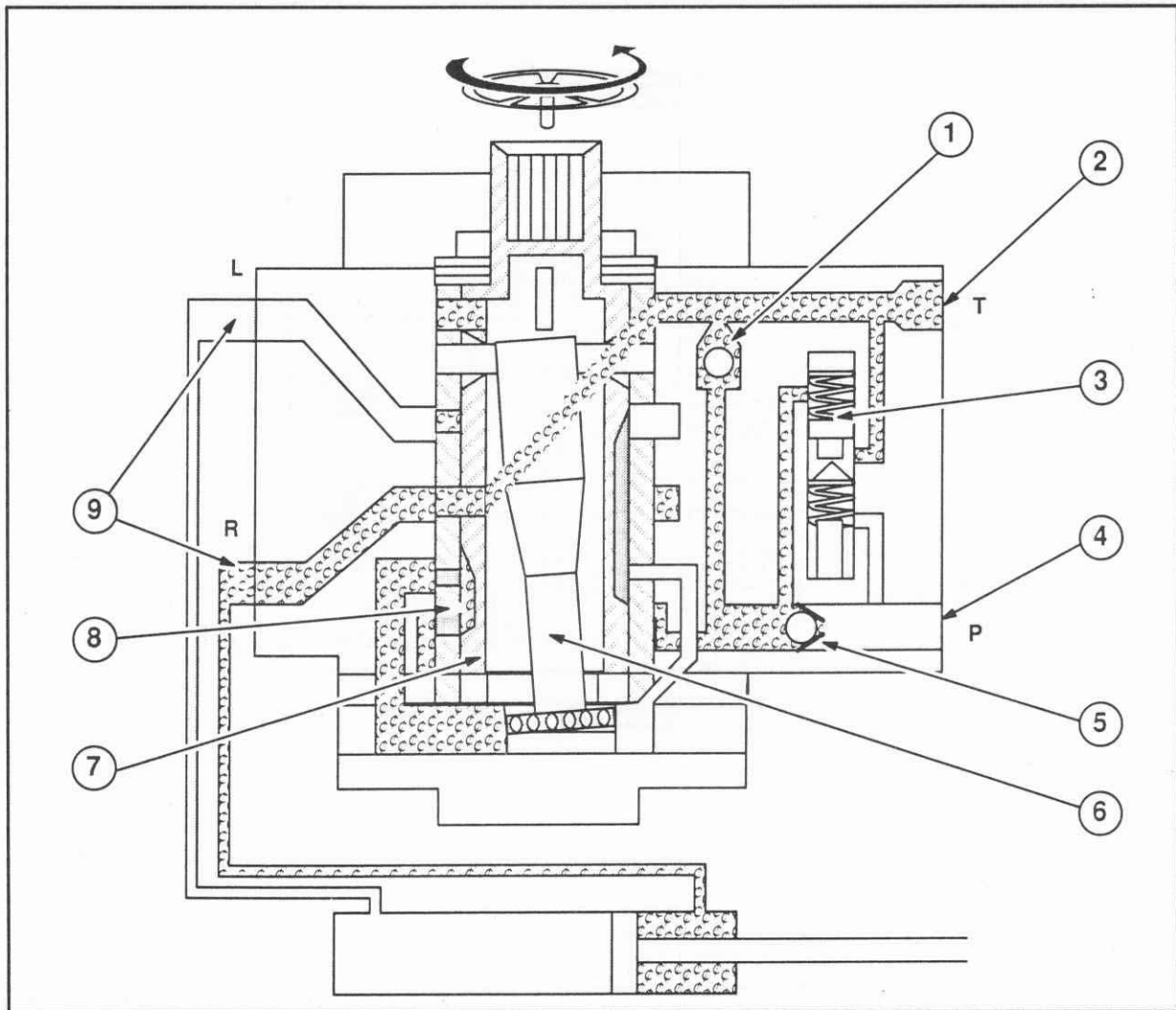
- | | |
|-------------------|----------------------------------|
| 1. Suction valve | 6. Rotor |
| 2. Return to pump | 7. Inner valve sleeve |
| 3. Relief valve | 8. Outer valve sleeve |
| 4. From pump | 9. Steering cylinder connections |
| 5. Check valve | |

METERING UNIT - OPERATION

MANUAL RIGHT TURN - FIGURE 7-8

In the event of a power-steering pump failure or loss of oil pressure, the power-steering

system can be operated manually. Turning the steering wheel rotates the metering unit rotor which forces oil into the rod side of the power-steering cylinder. On the suction side of the metering unit, return oil flows from the cylinder and is drawn through the suction valve to feed the metering unit.



□ Pressurised Oil

◻ Suction Oil

Figure 7-9

Steering Schematic – Manual Left Turn

1. Suction valve
2. Return to pump
3. Relief valve
4. From pump
5. Check valve

6. Rotor
7. Inner valve sleeve
8. Outer valve sleeve
9. Steering cylinder connections

MANUAL LEFT TURN - FIGURE 7-9

Turning the steering wheel rotates the metering unit rotor, which forces oil into the piston side of the power-steering cylinder. When additional oil supply is required, as in making a left turn, additional oil is drawn from the power-steering reservoir through the suction valve to the metering unit.

HOSES, TUBES, AND STEERING CYLINDERS

Oil flows, under pressure, from the power-steering motor through the hoses and tubes to the steering cylinder.

Two types of steering cylinders are fitted dependent on whether a two- or four-wheel drive front axle has been installed.

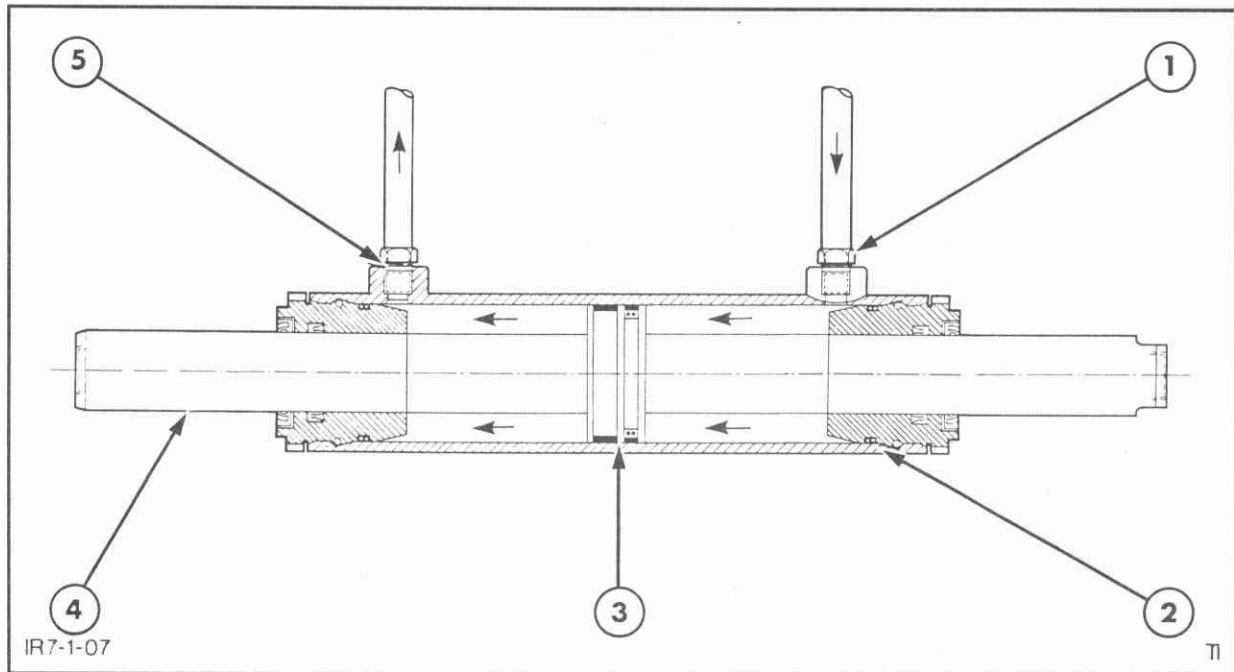


Figure 7-10
Steering Cylinder

- 1. Cylinder port
- 2. Cylinder barrel
- 3. Piston

- 4. Cylinder rod
- 5. Cylinder port

On two-wheel drive axles, the cylinder is housed within the center of the axle; on four-wheel drive units, the cylinder is anchored on the left-hand side of the axle.

The metered oil enters the cylinder and exerts pressure on the piston which, on two-wheel drive units, is centrally mounted on the cylinder rod, Figure 7-10. The exhaust oil on the opposite side of the piston returns to the steering motor, allowing the piston to move in direct relationship to the degree of turn on the steering wheel.

The principle of operation for both cylinders is the same as follows.

Metered oil is directed from the steering motor outlet ports to either the right- or left-hand turn port on the steering cylinder.

For overhaul of the cylinders, refer to "Two and Four-Wheel Drive Front Axle" assemblies, later in this section.

VoBo INSPECTION

POWER-STEERING PUMP, RESERVOIR, AND COOLER - OVERHAUL

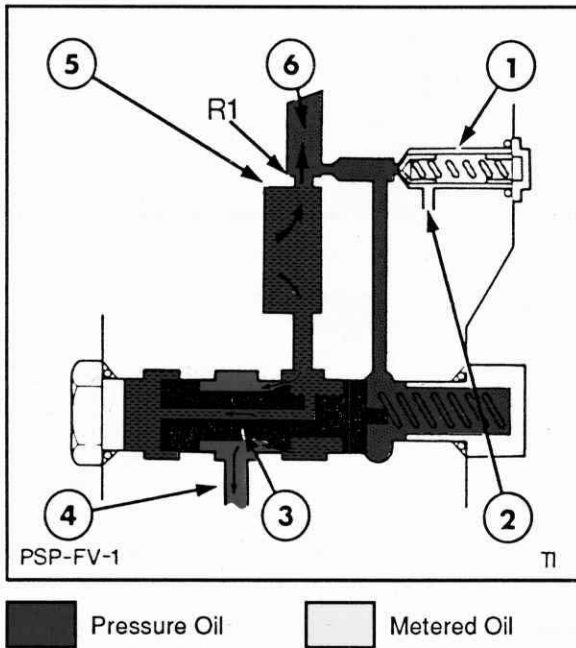


Figure 7-10A

Pump Flow Valve Operation

1. Relief valve
2. Reservoir return
3. Flow control
4. Reservoir return
5. Pump pressure side
6. Pump outlet

PUMP FLOW VALVE OPERATION

The flow control valve returns surplus pump output to the reservoir when the engine speed is above 1700 rpm to limit flow to the steering motor and when the relief valve blows off.

Below 1700 erpm the pump output flow to the motor through restrictor 'R1' does not create differential pressure across the flow control valve. Therefore, pressure on both ends of the flow control valve (3) is equal, the valve spring 'closes' the outlet (4) to the reservoir, Figure 7-10A.

Above 1700 erpm the pump output flow to the motor through restrictor 'R1' causes differential pressure across the flow control valve; the higher pressure sensed through the drilled

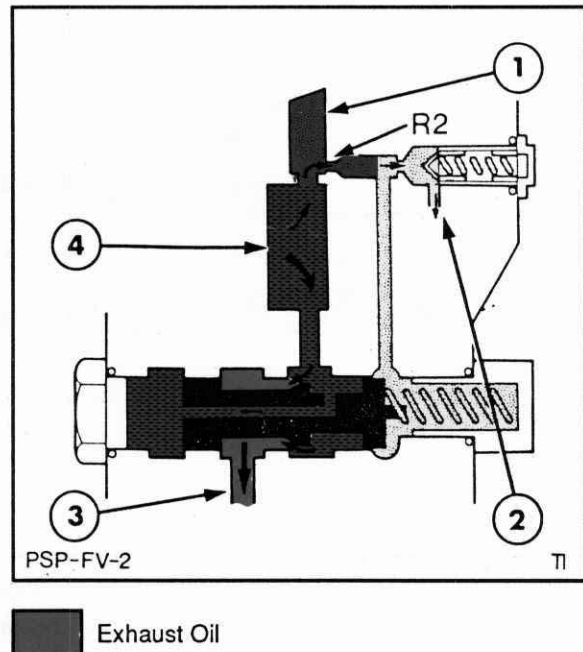


Figure 7-10B

Pump Flow Valve Operation

1. Pump outlet
2. Reservoir return
3. Reservoir return
4. Pump pressure side

gallery in the flow control valve pushes the valve against the spring, opening the gallery to the reservoir. Excess pump flow is dumped.

RELIEF VALVE OPERATION

The pump relief valve limits maximum steering system pressure to;

182–196 bar (2600–2800 lbf/in²) in the event of the steering motor relief valve (140–145 bar/2000–2100 lbf/in²) malfunctioning.

As system pressure rises to relief valve setting, the relief valve unseats, pump flow through restrictor R2 and causes pressure differential which operates the flow control valve to also dump oil to the reservoir.

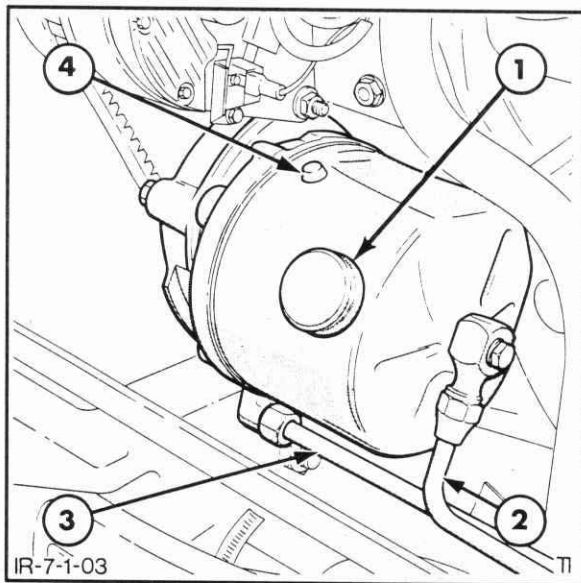


Figure 7-11

Steering Pump and Reservoir Installation

1. Reservoir filler cap
2. Return tube
3. Outlet tube - pressurized
4. Breather

REMOVAL

1. Position a suitable container under the pump and reservoir assembly.
2. Disconnect the pump pressure and return tube and allow the oil to drain. Refer to Figure 7-11.
3. Plug the disconnected tubes and ports to prevent the entry of dirt.
4. Remove the bolts retaining the pump in the timing gear casing.
5. Remove the pump from the unit and drain the remaining oil from the reservoir.
5. Remove the reservoir retaining bolt and pull off the reservoir casing. Discard the large O ring seal and filter element.
6. Noting their positions relative to the pump body for reassembly, remove the bearing blocks and pump gears.
7. Remove the snap ring retaining the drive shaft oil seal in the pump flange and extract the oil seal.

DISASSEMBLY

Refer to Figure 7-12 for Component Identity.

1. Remove the reservoir retaining bolt and pull off the reservoir casing. Discard the large O ring seal and filter element.
2. Straighten the tab on the lock washer locating the drive gear retaining nut. Remove the nut, lock washer, and drive gear.
3. Remove the key from the drive gear shaft.
4. Withdraw the pressure relief valve from the pump body.
5. Remove the four bolts and separate the pump end cover and pump flange from the pump body.
6. Noting their positions relative to the pump body for reassembly, remove the bearing blocks and pump gears.
7. Remove the snap ring retaining the drive shaft oil seal in the pump flange and extract the oil seal.

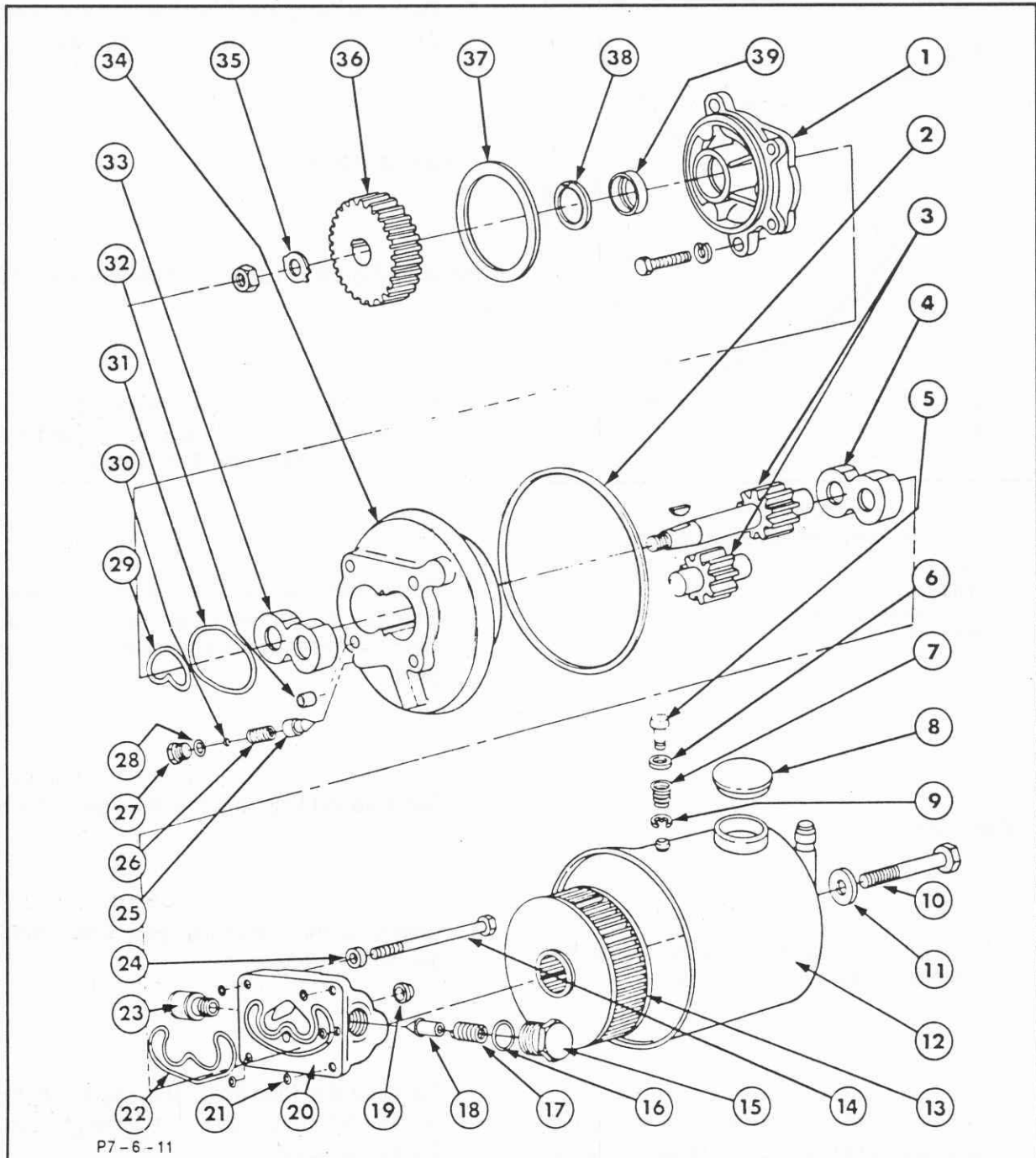


Figure 7-12

Power Steering Pump and Reservoir Components

- | | | |
|-----------------------|------------------------|-------------------------------|
| 1. Pump flange | 16. Seal (2) | 31. Outer seal |
| 2. 'O' rings | 17. Spring | 32. Seal ring |
| 3. Pump gears | 18. Flow control valve | 33. Bearing/Bushing |
| 4. Bearing/Bushing | 19. Spacer | 34. Pump body |
| 5. Vent valve | 20. Pump cover | 35. Tab washer |
| 6. Seal | 21. Seal | 36. Main drive gear |
| 7. Vent spring | 22. Cover seal | 37. 'O' ring (pump to engine) |
| 8. Cap | 23. Flow control plug | 38. Circlip |
| 9. Retaining ring | 24. Washer | 39. Gear seal |
| 10. Reservoir bolt | 25. *Relief valve | |
| 11. Seal ring | 26. *Spring | |
| 12. Reservoir | 27. *Relief plug | |
| 13. Filter | 28. *Seal | |
| 14. Pump bolt | 29. Inner seal | |
| 15. Flow control plug | 30. *Shim | |

* These parts are deleted in some models, where this occurs system pressure can only be adjusted by the steering motor pressure relief valve.

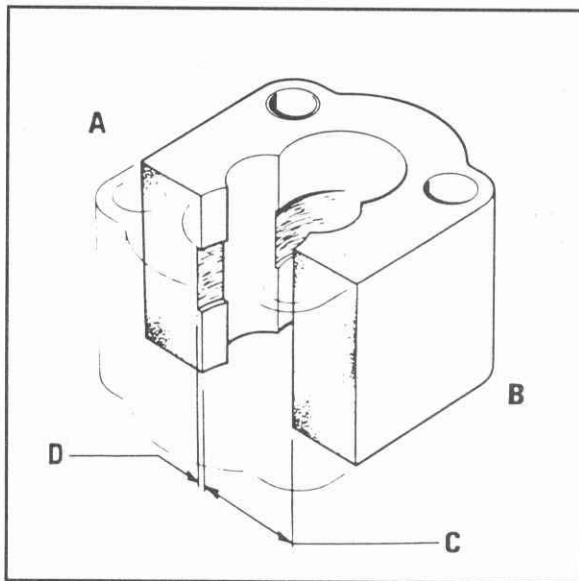


Figure 7-13

Gear Track in Body

1. Inlet side
2. Outlet side
3. Bore diameter
4. Depth of gear track

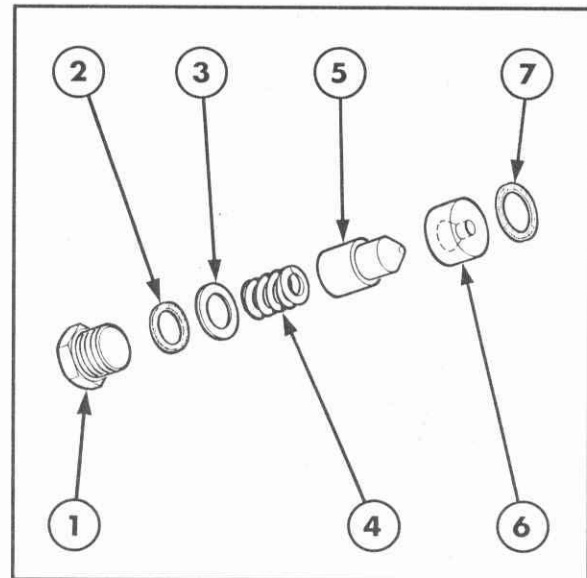


Figure 7-14

Power Steering Relief Valve Assembly

1. Plug
2. Seal
3. Shim
4. Spring
5. Relief valve
6. Relief valve seat
7. Seal

INSPECTION AND REPAIR

1. Clean all parts in a suitable solvent and air dry. Lightly oil machine surfaces. Keep disassembled parts in position to facilitate assembly.
2. Examine the pump body and gears for wear or damage.

The wear track on the inlet side of the pump body interior should be free from scoring and no deeper than 0.0025" (0.064 mm), Figure 7-13.

The pump gears should not be scored or pitted. Runout across the gear face to the tooth edge should not exceed 0.001" (0.025 mm). Shaft journals can be polished lightly with "O" grade emery paper and paraffin (kerosene) to remove wear marks. Gear faces may be polished by sandwiching the emery paper between

the gear face and a scrap bearing block, then rotating the gear.

The pump body and gears are not supplied for service, if they are excessively worn a complete replacement pump must be installed.

3. Inspect the bearing blocks for signs of seizure or scoring. Light scoring on the sides can be removed by careful lapping on a surface plate using "O" grade emery paper and paraffin (kerosene). Be sure that such parts are thoroughly washed and dried prior to reassembly. Should the wear be excessive, install new bearing blocks.
4. Use the soft jaws of a vise to grip the seat of the pump pressure relief valve. Unscrew the head and body and check the components for wear or swarf contamination, Figure 7-14.

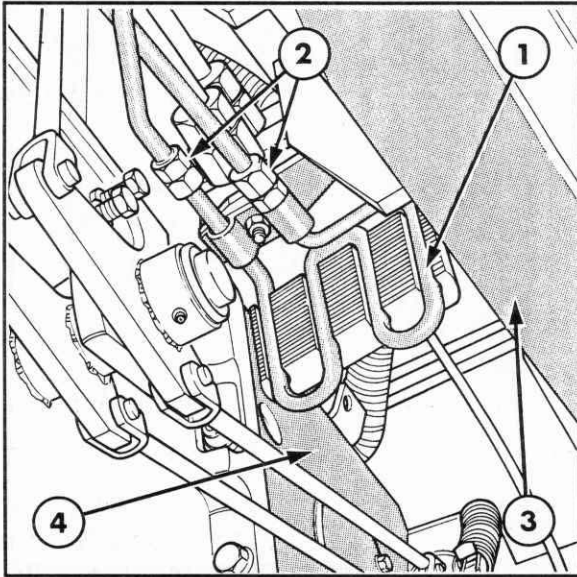


Figure 7-15

Steering Cooler Removal

1. Steering system cooler
2. Steering line connections
3. Loader subframe
4. Rear axle center housing

REASSEMBLY

Reassembly of the power-steering pump follows the disassembly procedure in reverse. On reassembly, observe the following requirements:

- Replace all rubber seals, O rings, and the drive shaft oil seal.
- Apply grease to specification, ESN M1C137-B, to the drive shaft oil seal and the pump bolt O ring seals.
- Ensure correct installation of the bearing blocks and seals.
- Tighten the four through bolts evenly and torque to 26 ft. lbs. (35.5 N·m).

- Install a new lock washer under the pump drive gear retaining nut. Tighten the nut to 31 ft. lbs. (42.0 N·m) torque and secure with the lock washer tab.
- Pour a small quantity of clean oil into the pump for initial lubrication and ensure the pump drive can be turned by hand.
- Install a new oil filter element. Tighten the reservoir retaining bolt until the reservoir engages the reservoir O ring seal. Tighten the bolt to 12 ft. lbs. (16.3 N·m) torque which is usually achieved after one turn of the bolt.

INSTALLATION

Installation of the power-steering pump follows the removal procedure in reverse. On installation, observe the following requirements:

- Fill the power-steering reservoir with oil. Purge the air from the system as described later in this section.

COOLER

REMOVAL

The steering cooler is located on the left side of the unit under the cab floor, just inside the step. See Figure 7-15.

Cooler removal is as follows:

1. Have a suitable container to collect any hydraulic oil lost during removal.

2. Remove the clamp, Figure 7-15, securing the cooler lines to the mounting bracket.
3. Separate the two fittings attaching the cooler to the lines and remove the cooler.

INSPECTION

1. Check the cooler fins and tubes for damage. Straighten any bent fins.
2. If leaks or cracks are detected, the cooler must be replaced.

INSTALLATION

1. Replace the O rings in the fitting with new ones.
2. Connect the two cooler to line fittings and tighten connection. Do not overtighten these fittings, as leaks will occur.
3. Secure the cooler assembly to the mount with the clamp.
4. Fill the power-steering reservoir with hydraulic oil, and purge the air from the system.

HYDROSTATIC STEERING MOTOR - OVERHAUL

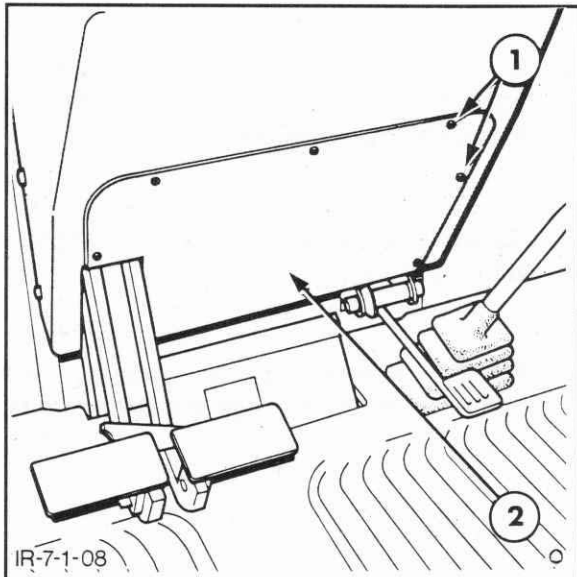


Figure 7-16
Lower Console

1. Attaching screws
2. Lower console

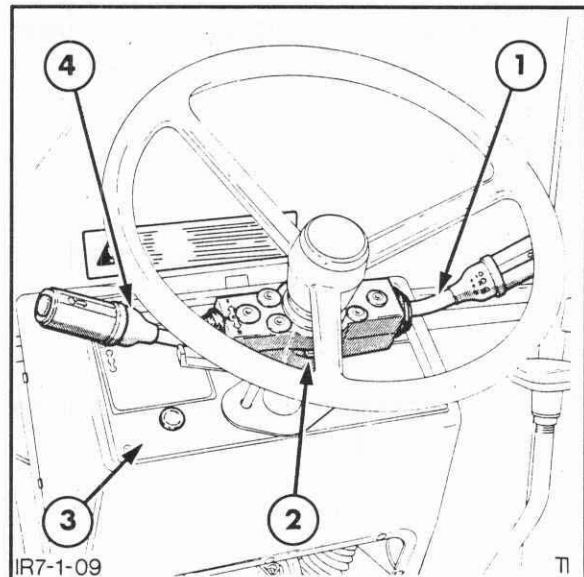


Figure 7-17
Reversing Lever and Steering Console

1. Turn signal switch (European)
2. Hexagon socket screw
3. Steering console panel
4. Power reversing lever

REMOVAL

1. Disconnect the battery ground cable at the battery.
2. Remove the lower console cover, Figure 16.
3. Remove the steering wheel cap and nut. Lift the steering wheel from the steering column.
4. Remove the two hexagon socket screws securing the power-reversing lever to the

steering column, Figure 7-17. Ease the lever(s) away from the column.

5. Remove the steering console panel screws and carefully slide the panel, Figure 7-17, up the steering column. This will provide access to the power-reversing and turn signal switch harness connectors.
6. Disconnect the connectors, identify the location of the steering console indicator lights, and remove the panel from the steering column, Figure 7-18.

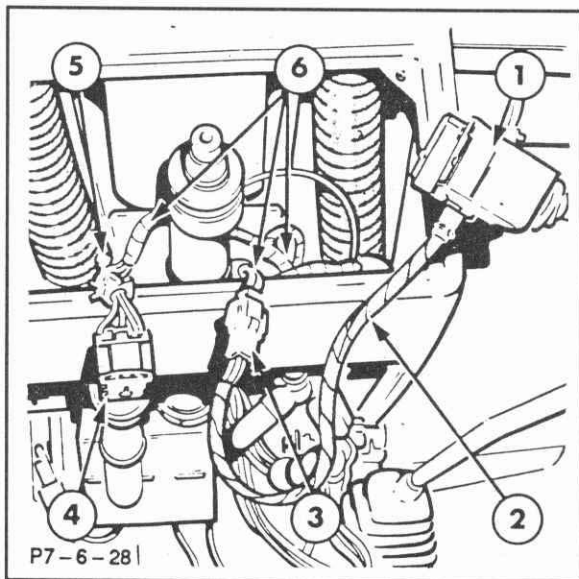


Figure 7-18

Steering Console Connectors

1. Turn indicator/flasher/horn switch
2. Integral harness
3. Connector (22 pin)
4. Transmission control switch
5. Connector (9 pin)
6. Steering console harness

7. Clean the steering connections, Figure 7-19.

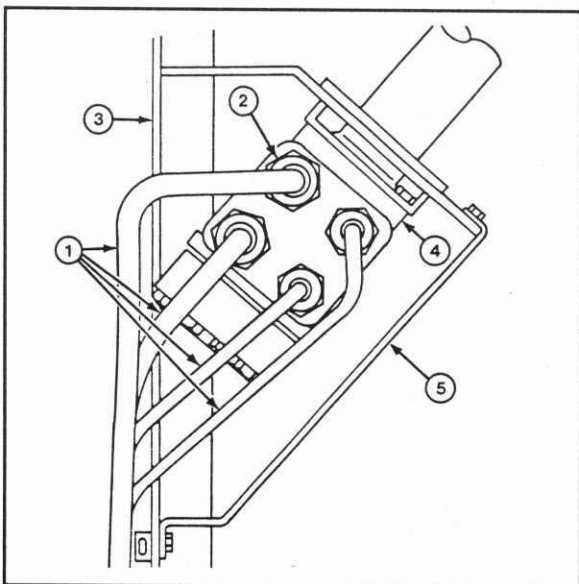


Figure 7-19

Steering Motor and Lines

1. Steering lines
2. Steering line connections
3. Fire wall
4. Steering motor
5. Steering motor access cover

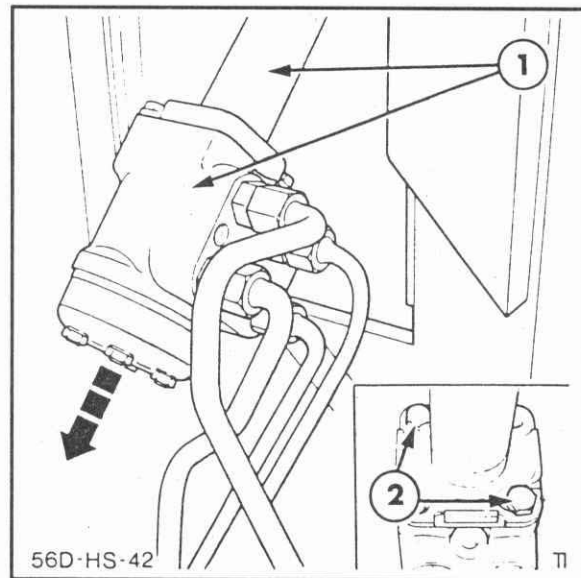


Figure 7-20

Steering Column Removal

1. Motor and column assembly
2. *Column to motor retaining bolts

8. With a suitable container positioned to catch escaping steering oil, separate the steering tubes from the steering motor, Figure 7-20. Cap and seal the tubes using suitable plugs.

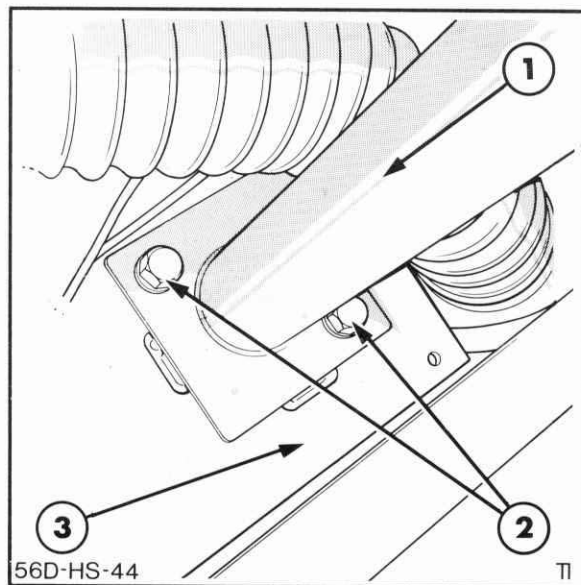


Figure 7-21

Mounting Bolt Access

1. Column
2. *Bolts
3. Cab front panel

SECTION 7 – STEERING AND FRONT AXLE

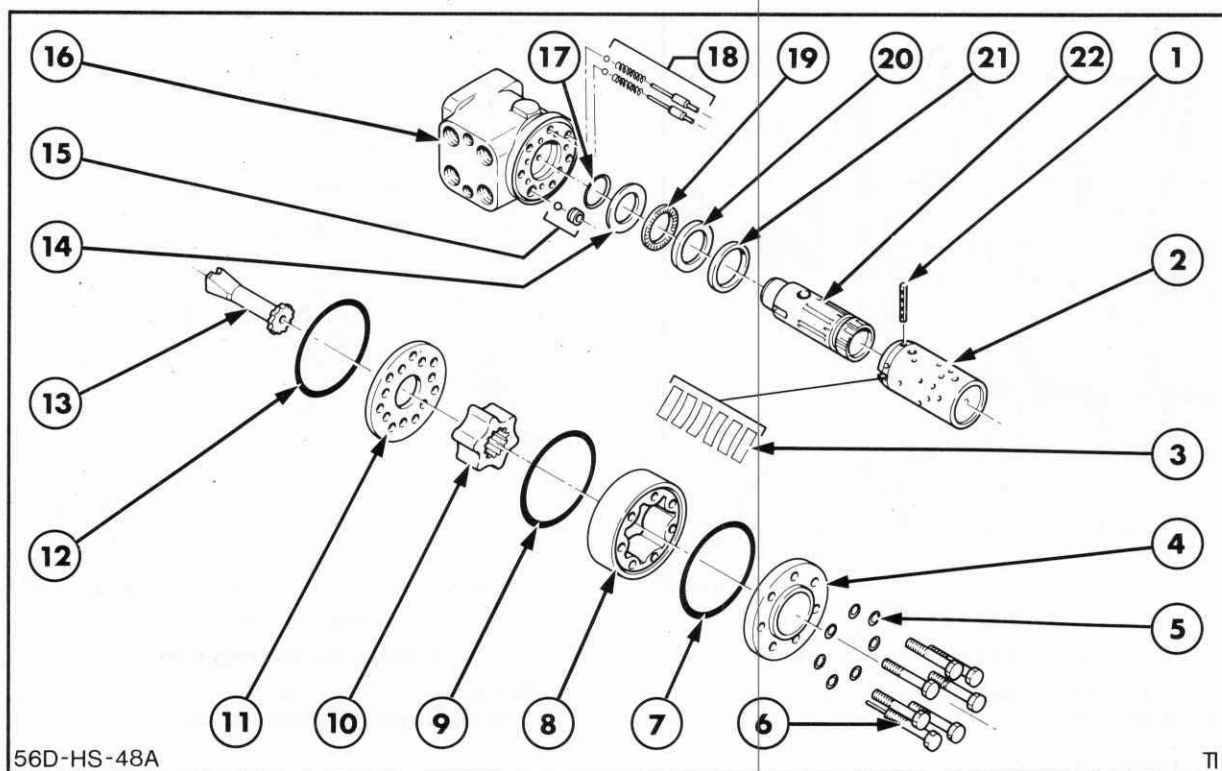


Figure 7-22

Steering Motor – Exploded View

1. Drive pin
2. Valve sleeve
3. Centring springs
4. End plate
5. Washers
6. Meter section retaining bolts
7. *O' ring
8. Stator

9. *O' ring
10. Rotor
11. Distributor plate
12. *O' ring
13. Drive link
14. Thin thrust washer
15. Check valve and retainer
16. Housing

17. *Lip type seal
18. Suction valves
19. Thrust bearing
20. Thick thrust washer
21. Spring retaining ring
22. Valve spool

* Items Included In seal kit

9. Remove the motor mounting bolts, Figure 7-21, and lower the motor from the mounting flange. Now lift the motor out of the fire wall.

DISASSEMBLY

IMPORTANT: The relief valves in the steering motor are factory set. If the valves are to be removed for overhaul ensure the following is observed:- remove the appropriate end plug but before removal of the valve adjuster use a depth micrometer to determine the distance from the adjuster to the outside face of the motor and record the reading. On re-assembly return the adjuster to the original setting depth.

Refer to Figure 7-22A for identification of parts during disassembly and assembly.

Cleanliness in servicing the power-steering system is imperative. If it is necessary to disassemble any of the units, be sure to use a clean workbench or table.

Plug the four port holes and clean the exterior of the motor thoroughly. Then remove the plugs.

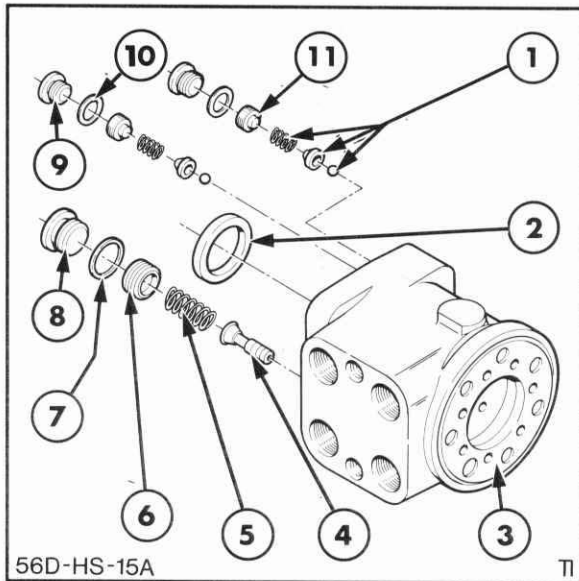


Figure 7-22A

Steering Motor Relief Valves

1. Cylinder relief valve
2. Dust seal
3. Housing
4. Motor relief valve
5. Spring
6. Adjuster
7. Seal
8. Plug
9. Plug
10. Seal
11. Adjuster

When disassembled, parts should be cleaned only in clear-clean petroleum base solvent and blown dry with clean air. Other solvents may cause deterioration of rubber seals. Avoid wiping parts with cloth and never steam clean hydraulic steering assemblies.

1. Invert the steering motor and remove the seven end plate securing bolts, Figure 7-23.

NOTE: One bolt has a pin connected to the end which forms part of the check valve assembly, Figure 7-24.

2. Remove the end plate, O ring seal and rotor cap, Figure 7-24.

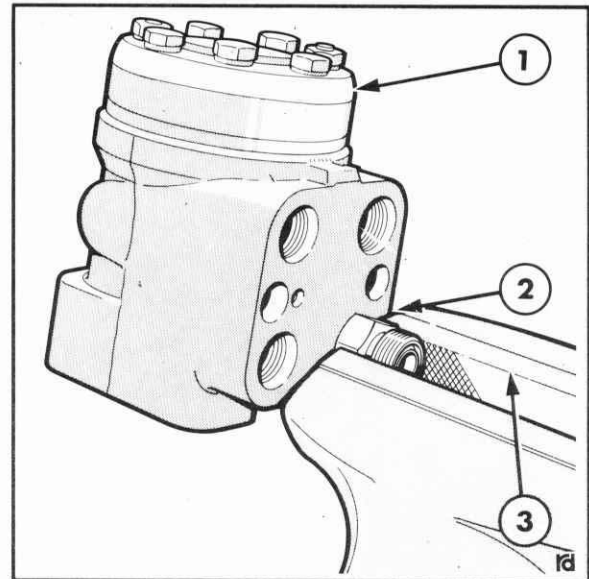


Figure 7-23

Hydrostatic Steering Motor

1. Motor
2. Pipe adaptor
3. Vice

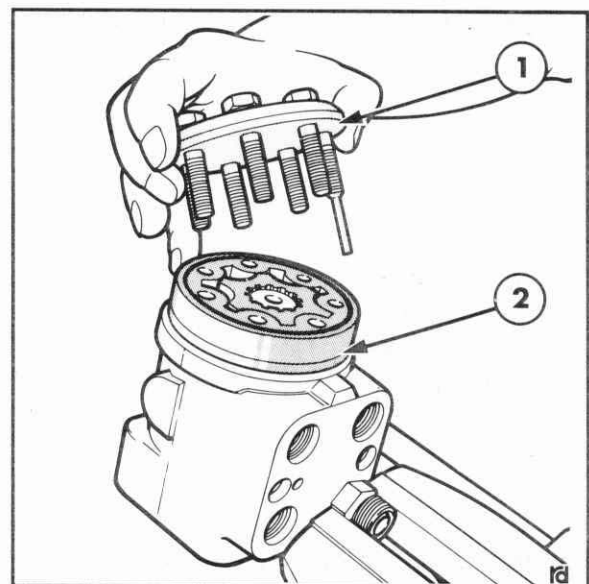


Figure 7-24

End Plate Removal

1. End plate
2. Housing

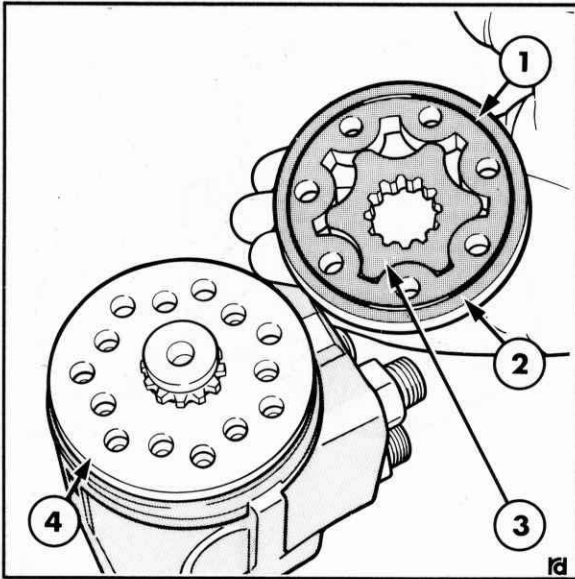


Figure 7-25

Metering Unit Removal

1. 'O' ring
2. Stator
3. Rotor
4. Manifold plate

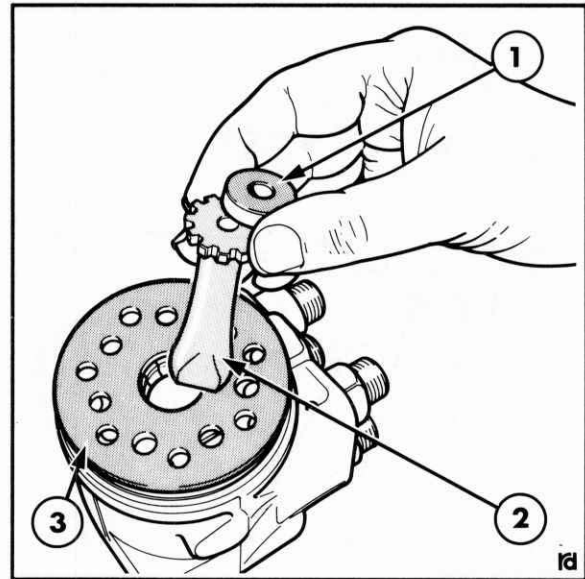


Figure 7-26

Drive Removal

1. Spacer
2. Drive shaft
3. Manifold plate

3. Remove the metering unit from the steering motor housing together with its O ring seals, Figure 7-25. Note the mating surfaces of the metering unit and valve plate for correct reassembly.
4. Remove the valve plate and its O ring seal from the motor housing.
5. Lift out the rotor drive shaft, Figure 7-26 and valve plate, Figure 7-26A.
6. Unscrew the check valve threaded bushing, Figure 7-27, and shake out the check valve ball and suction valve assemblies.

IMPORTANT: The relief valves fitted to the steering motor are factory set. With the end plug removed, but before removal of the adjuster use a depth micrometer (noting the readings) to determine the position of the valve adjuster in the body. On re-assembly return the adjusters to their original setting depth.

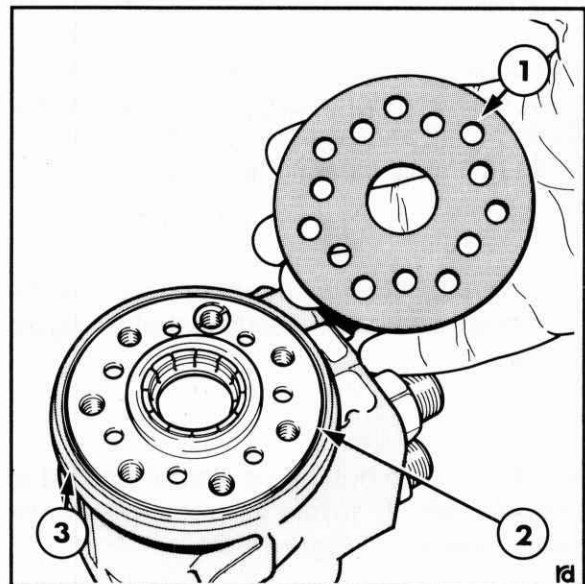


Figure 7-26A

Valve Plate

1. Manifold plate
2. 'O' ring
3. Motor housing

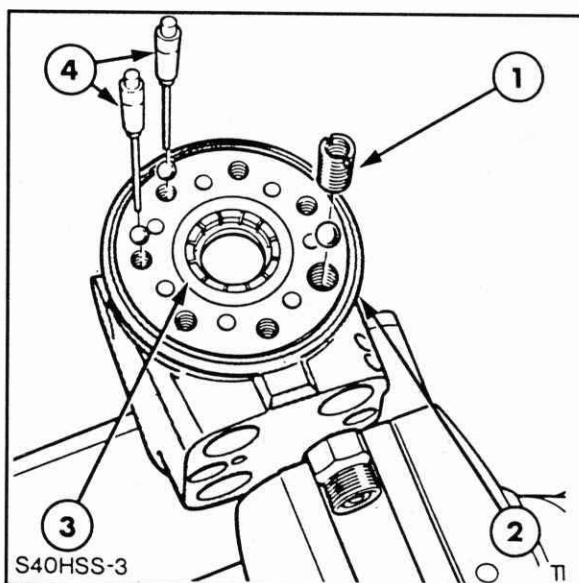


Figure 7-27

Suction and Check Valves

1. Check valve and retainer
2. Housing
3. Control valve
4. Suction valves

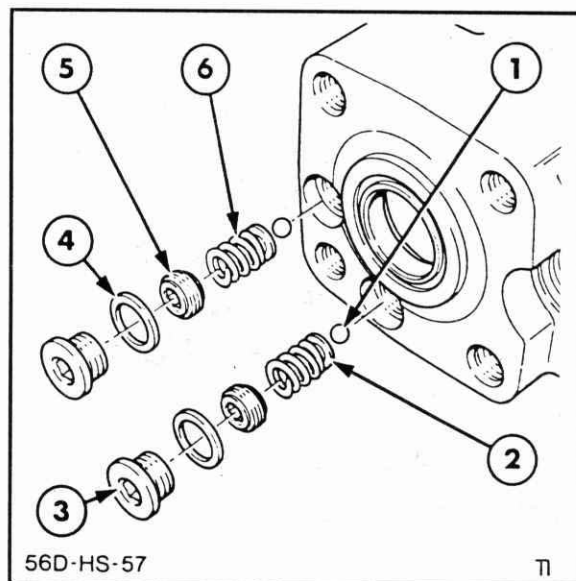


Figure 7-28

Cylinder Relief Valves

1. Ball valve
2. Spring seat
3. Plug
4. Washer
5. Adjuster
6. Spring

8. Remove the inner and outer valve sleeves complete with bearing race, needle bearing, and thrust washer by pressing the assembly out of the housing, Figure 7-29.

NOTE: The drive pin through the valve sleeves must be kept horizontal during this operation. The pin is visible through the open end of the valve sleeve.

9. Remove the retaining ring, bearing race, needle bearing, and thrust washer from the valve assembly, Figure 7-30.

10. Push the leaf springs from the valve assembly. Note the arrangement of the leaves for correct reassembly, Figure 7-31.

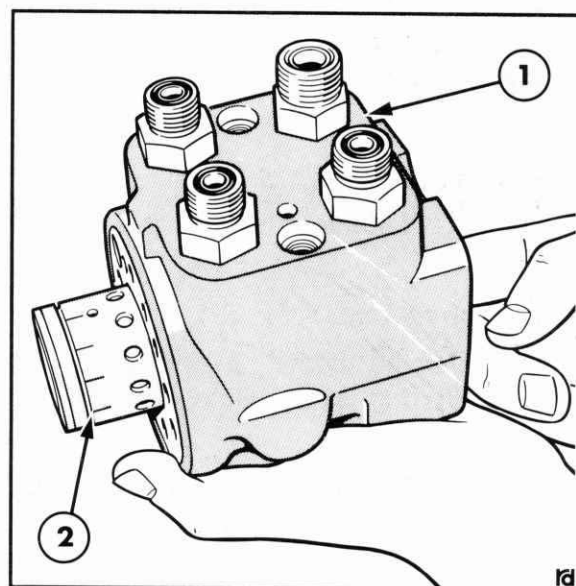


Figure 7-29

Control Valve Removal

1. Steering motor housing
2. Control valve spool and sleeve

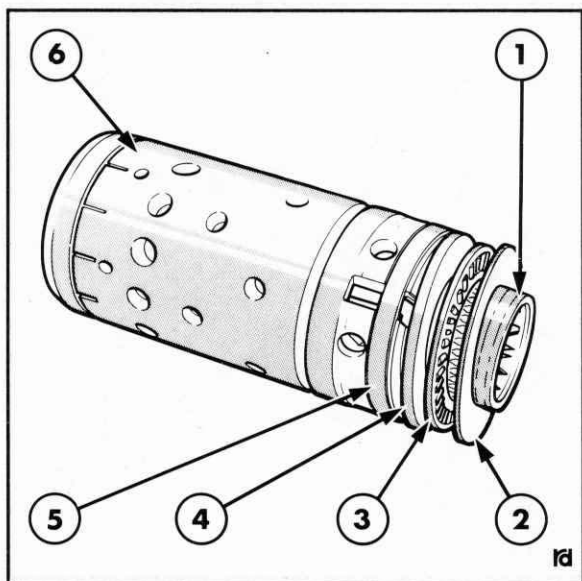
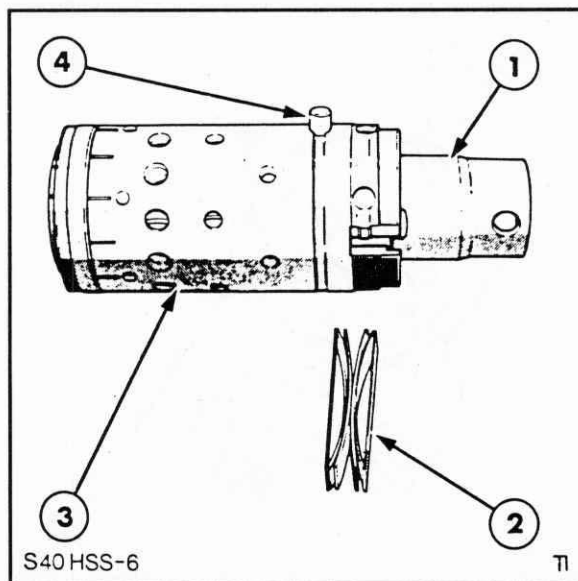


Figure 7-30
Control Valve

1. Valve spool
2. Thin thrust washer
3. Thrust bearing
4. Thick thrust washer
5. Retaining ring
6. Valve sleeve



S40 HSS-6

Figure 7-31

Drive Pin and Centring Springs

1. Control valve spool
2. Centring springs
3. Control valve sleeve
4. Drive pin

11. Push the drive pin completely from the valve assembly with a suitable driver, Figure 7-32.

be sure that all parts are thoroughly washed and cleaned prior to reassembly.

12. Disassemble the valve by carefully pushing the inner sleeve from the outer sleeve.

13. Remove the upper O ring seal and back-up ring from within the steering motor housing.

INSPECTION

1. Wash all parts in a suitable solvent to remove any foreign particles and dry with a clean lint-free cloth or compressed air.
2. Inspect the inner and outer valve sleeves for burrs, damage, or wear. Minor burrs or scratches can be removed with a fine abrasive. After use of abrasive material,

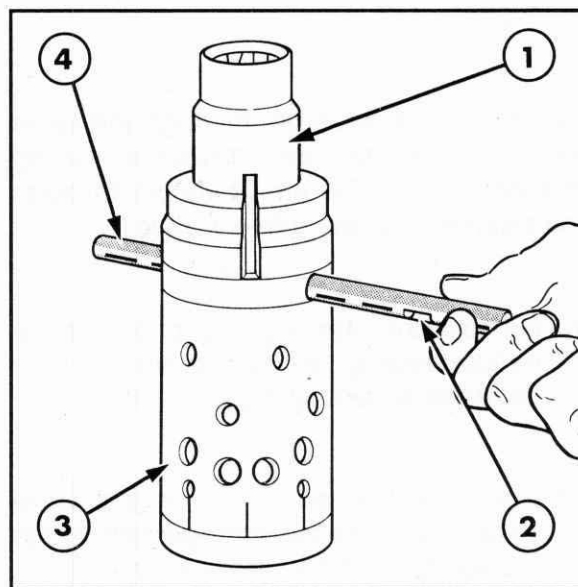


Figure 7-32

Removing Drive Pin From Valve Assembly

1. Inner valve sleeve
2. Driver
3. Outer valve sleeve
4. Drive pin

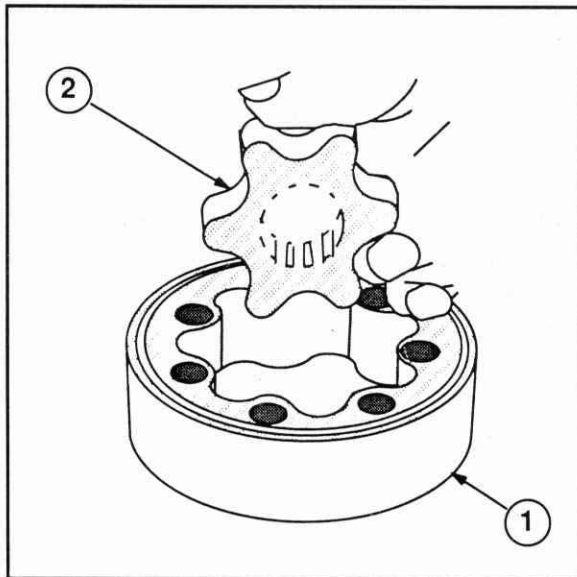


Figure 7-33
Metering Unit Disassembly

1. Stator
2. Rotor

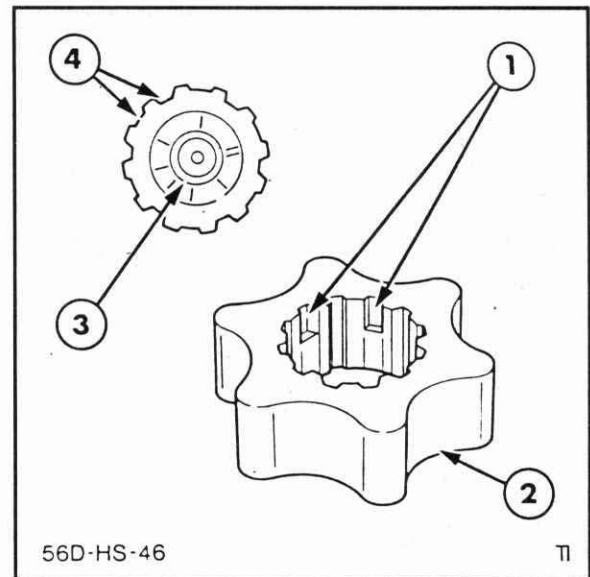


Figure 7-34
Rotor - Drive Shaft Splines

1. Locating splines
2. Rotor
3. Drive shaft
4. Indexing splines

3. Check the leaf springs and, if they are cracked or showing signs of deterioration,

replace with new parts during reassembly.

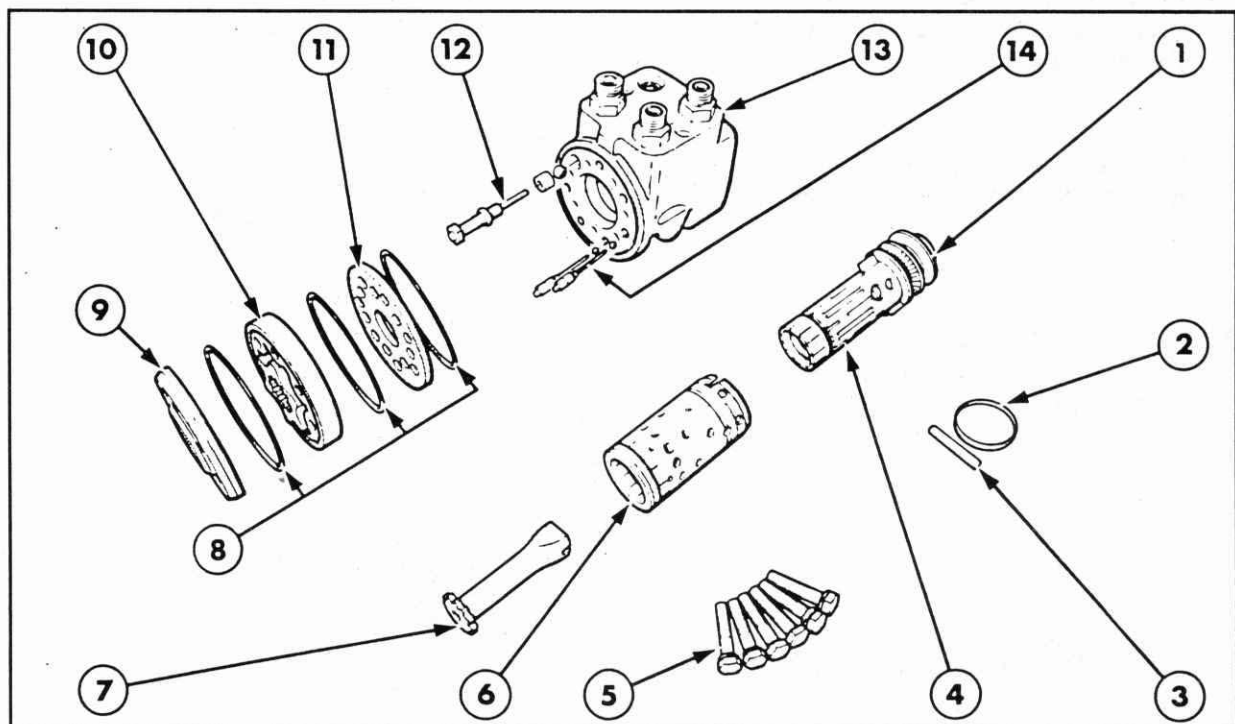


Figure 7-35

Hydrostatic Steering Motor Components

- | | | | |
|-------------------------------|------------------------|-----------------------|----------------------|
| 1. Thrust washers and bearing | 4. Control valve spool | 8. 'O' ring seals | 12. Check valve bolt |
| 2. Retaining ring | 5. Bolts | 9. End plate | 13. Housing |
| 3. Drive pin | 6. Control valve | 10. Metering unit | 14. Suction valves |
| | 7. Drive link | 11. Distributor plate | |

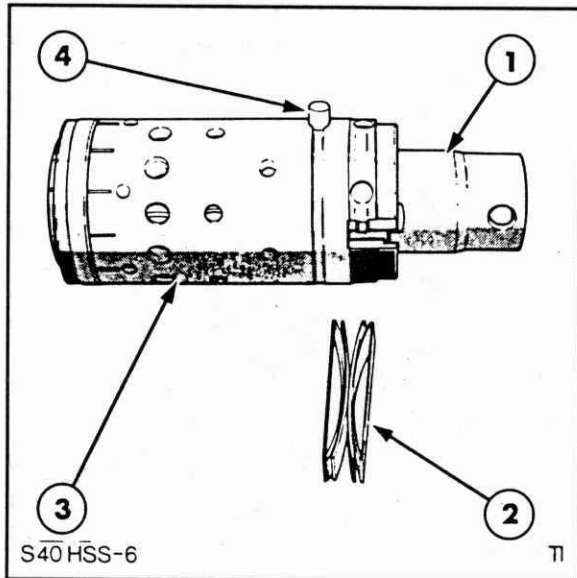


Figure 7-36

Control Valve Re-Assembly

1. Control valve spool
2. Centring springs
3. Control valve sleeve
4. Drive pin

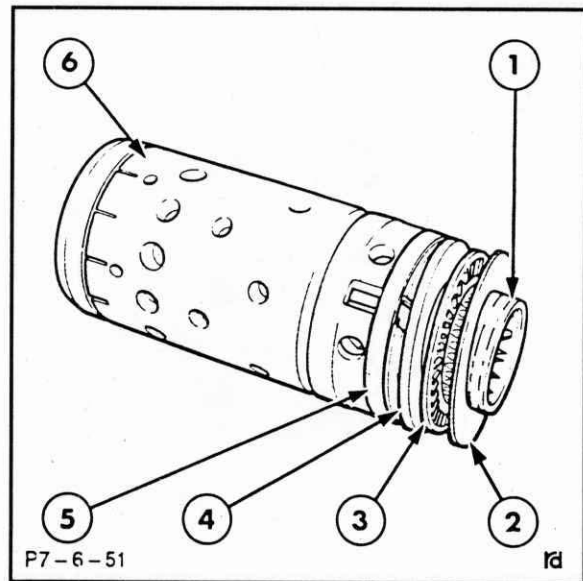


Figure 7-37

Control Valve Thrust Washers

1. Control valve spool
2. Thin thrust washer
3. Thrust bearing
4. Thick thrust washer (chamfer to valve sleeve)
5. Retaining ring
6. Control valve sleeve

4. Remove metering unit rotor from the stator, Figure 7-33, and inspect both components for damage and wear.

5. Check drive shaft spline and rotor spines for damage or wear Figure 7-34

6. Discard all O ring seals and replace with new seals on reassembly. An exploded view of the steering motor is shown in Figure 7-35.

NOTE: Ensure drive pin is in a horizontal position during re-assembly.

3. Position the two flat leaf springs in the slot. Install the curved springs between the flat springs, Figure 7-36. Compress the extended ends of the spring and slide the springs fully into the valve sleeves. Be sure that the springs are centralized.

REASSEMBLY

1. Install the inner valve sleeve into the outer sleeve so that the slots for the leaf springs align.

2. Install the drive pin into the hole in the valve assembly, Figure 7-36, and press into position.

4. Assemble the leaf spring retainer, bearing race, needle bearing, and thrust washer onto the valve assembly, Figure 7-37. The bearing race must be positioned with the chamfer side facing the spool.

IMPORTANT: The thick thrust washer must be re-installed with internal diameter chamber towards the valve sleeve.

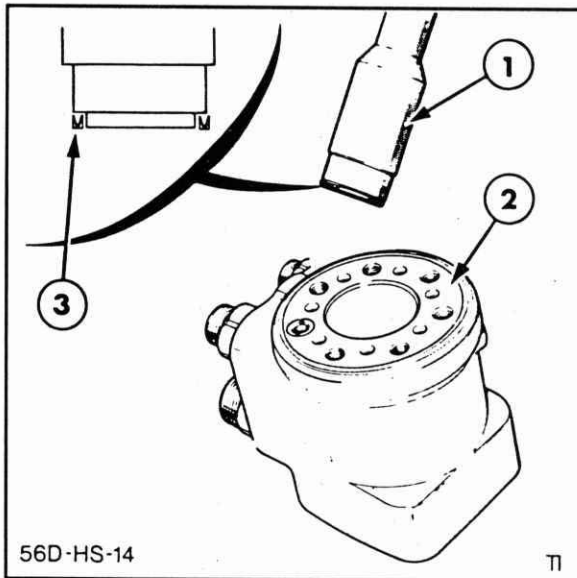


Figure 7-38

1. Special tool
2. Steering motor body
3. Lip oil seal

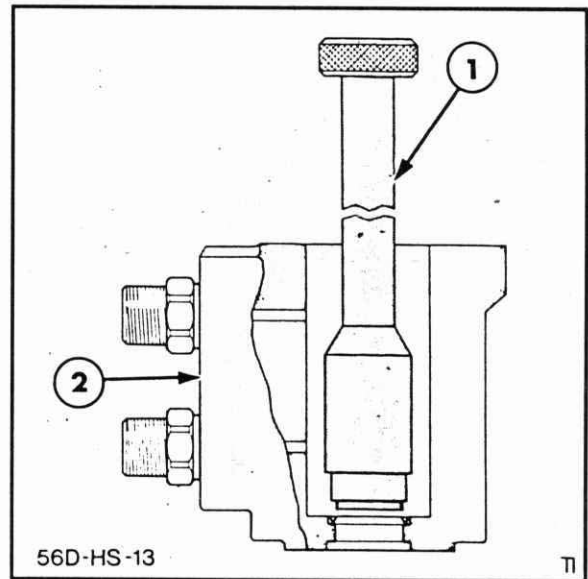


Figure 7-38A

1. Special tool
2. Steering motor body

5. Lightly coat the O ring and back-up ring with hydraulic fluid and position them onto the seal installer guide, Figure 7-38.

6. Assemble the guide into the end of the tool inner rod.

7. Insert the outer sleeve of the tool into the motor housing and push to the bottom. Slide the inner rod and guide to the bottom of the outer sleeve.

8. Press and turn the O ring and back-up ring into position.

9. Withdraw the inner and outer parts of the tool from the housing, leaving the guide in the housing.

10. Firmly push the complete valve assembly into the housing, Figure 7-39. This will push the seal guide from the housing, leaving the O ring and back-up seal in position.

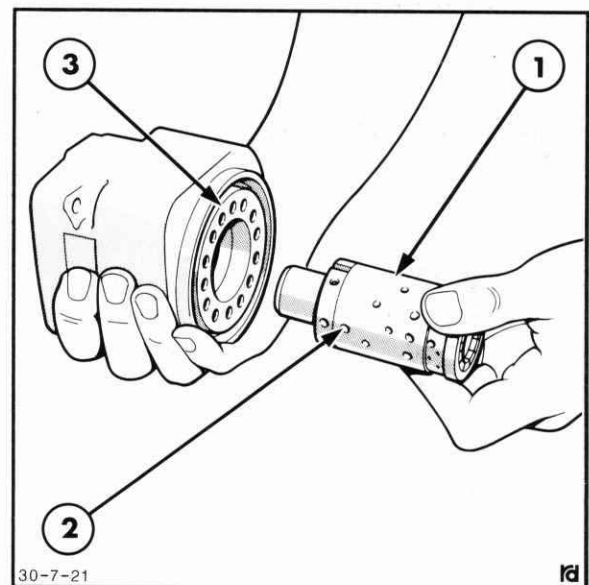


Figure 7-39

Reinstall Control Valve Housing

1. Control valve
2. Drive pin
3. Housing

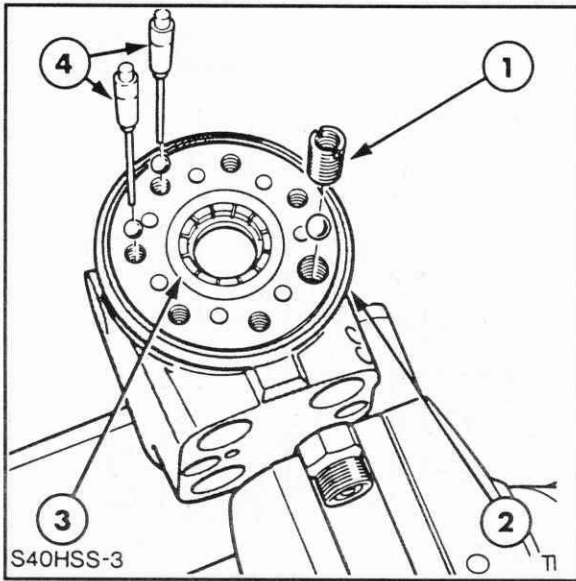


Figure 7-39A

Check Valve and Suction Valves

1. Check valve and retainer
2. Housing
3. Control valve
4. Suction valves

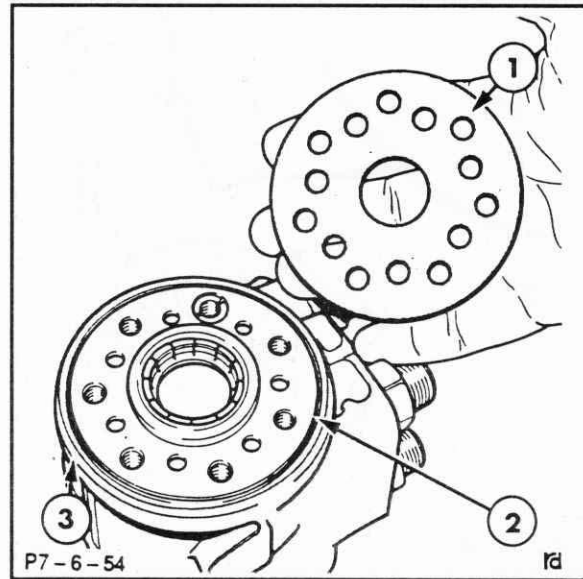


Figure 7-40

Valve Plate

1. Manifold plate
2. 'O' ring
3. Motor housing

11. Install the check valve ball into the large bolt hole and install the threaded bushing. Install the two suction valve assemblies, Figure 7-39A.

12. Install an "O" ring in the groove of the steering motor housing, Figure 7-40.

NOTE: Lubricate the O ring with clean hydraulic oil on assembly.

13. Position the manifold plate, Figure 7-40, on the housing so that all the holes are aligned.

14. Align the spool and sleeve assembly in the housing so that the pin is positioned parallel with the port face, as shown in Figure 7-41.

15. Assemble the drive shaft into the body and engage with the pin.

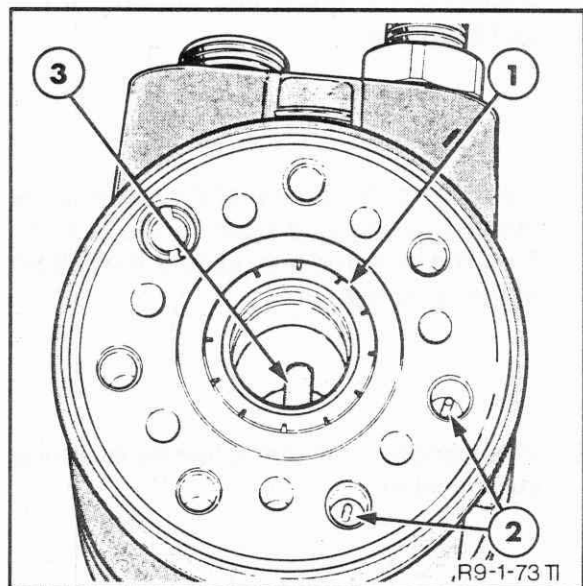


Figure 7-41

Drive Pin Position

1. Control valve
2. Suction valves
3. Drive pin

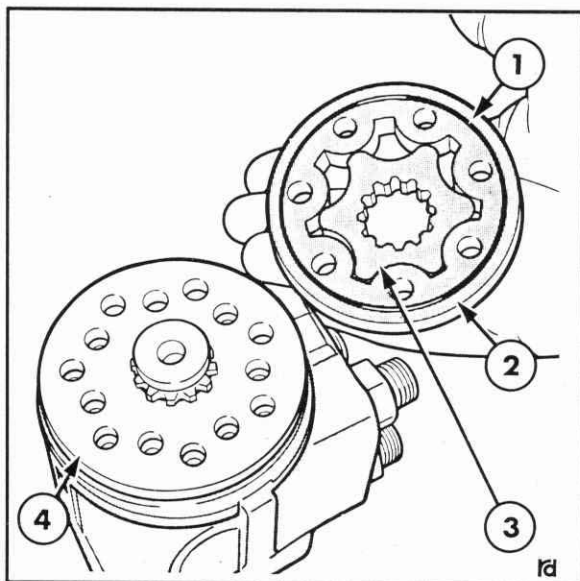


Figure 7-41A
Metering Unit

1. 'O' ring
2. Stator
3. Rotor
4. Manifold plate

17. Assemble the metering unit rotor and stator and install new lightly-greased O rings to either side of the stator, 7-41A.

18. Position the metering unit onto the valve plate with the rotor positioned as in Figure 7-42. Align the holes in the valve plate, stator, and motor housing.

When correctly installed, one rotor lobe will be positioned centered on a stator lobe as shown in Figure 7-42.

19. Install the end plate in position. Align the bolt holes and install the bolts. Note the position of the pin bolt. Tighten the bolts in two steps, first to 8 ft. lbs. (10.8 N·m) and then to 21 ft. lbs. (28.4 N·m) in sequence, as shown in Figure 7-44.

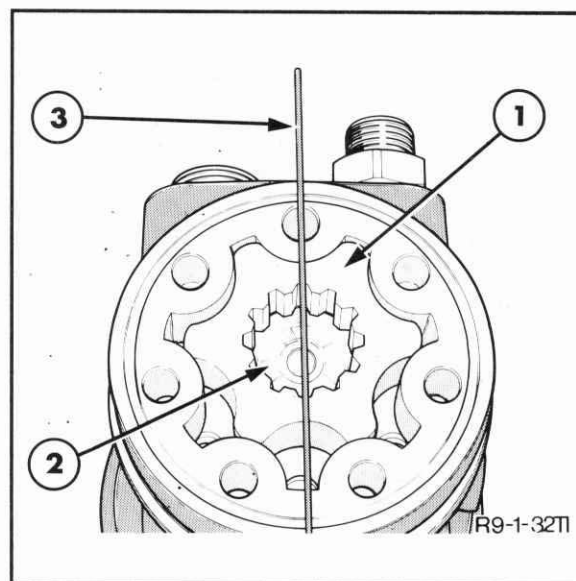


Figure 7-42
Metering Unit Timing

1. Rotor
2. Drive link
3. Position of drive link to rotor

20. Install the relief valve assembly.

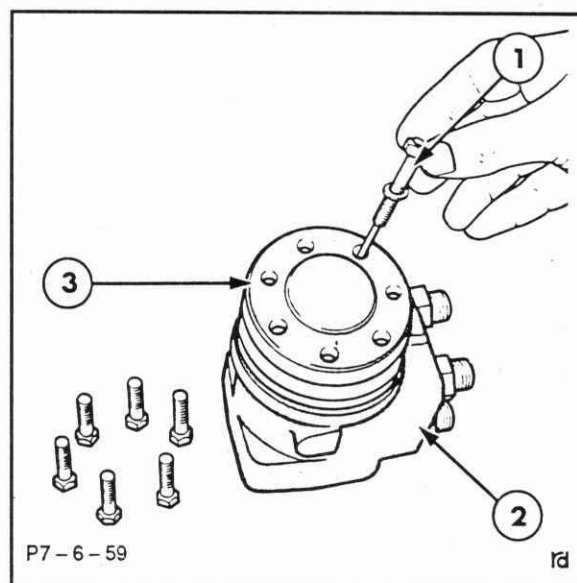


Figure 7-43
End Plate

1. Check valve bolt
2. Housing
3. End plate

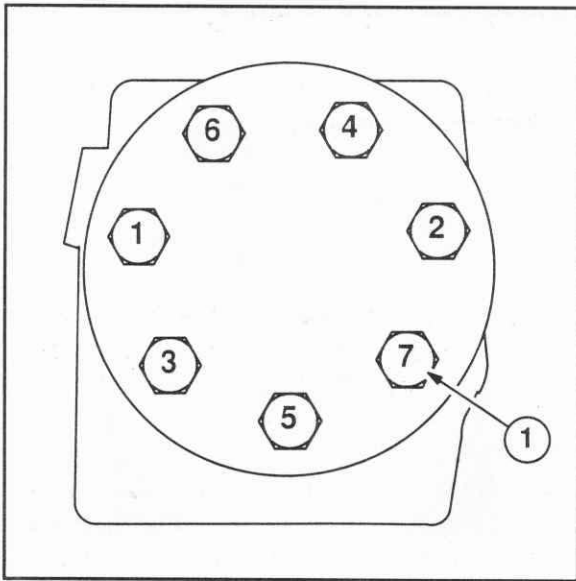


Figure 7-44

Bolt Tightening Sequence

1. Pin bolt

21. Install the steering motor in the tractor and check to ensure the motor turns freely without binding before connecting the tubing and filling with oil. Follow the previously outlined disassembly procedure in reverse order.

22. Purge the air from the system by operating the steering system from lock to lock until the system functions correctly.

23. Check and replenish the hydraulic oil reservoir as necessary.

RESERVOIR FILTER AND HYDRAULIC TUBES

TO RENEW FILTER ELEMENT

1. Hold a suitable container under the pump assembly, then disconnect the pressure and return tubes and allow the oil to drain.
2. Extract the reservoir retaining bolt, ease the reservoir casing away from the pump body, and drain off any remaining oil.
3. Discard the oil filter element.
4. Clean the reservoir casing with a suitable solvent and dry with a lint-free cloth.
5. Inspect the large reservoir sealing ring and retaining bolt sealing washer for damage and replace if necessary.
6. Install a new filter element and replace the reservoir.
7. Reconnect the power-steering pump pressure and return tubes.
8. Fill the reservoir with the correct grade and quantity of oil.
9. Operate the steering from lock-to-lock several times with the engine running to

expel any air from the system and then recheck the oil level.

HYDRAULIC TUBES

Except for replacement of the tubes which pass through the fire wall, no special procedures are required.

Servicing the power-steering tubes which pass through the fire wall can best be accomplished after removing the fuel tank.

When replacing the power-steering tube fire wall grommet, lubricate the grommet with soap to ease installation into the fire walls.

NOTE: Check all tubes and hoses after installation to ensure there is no possibility of chafing or rubbing.

When examining the steering system, check the tubes and hoses as follows:

1. Inspect the hydraulic tubes for leakage at connections. Replace oil seals (where fitted) and tighten loose connections.
2. Check the tubes for signs of fracture and replace if necessary.
3. Examine flexible hoses for cracks or chafing and replace if required.

BLEEDING THE STEERING SYSTEM

1. Fill the reservoir with the correct oil.
2. Start the engine and let it run for approximately 15 seconds, then stop the engine.
3. Add oil to the reservoir as required. Do not let the oil level drop below the pump outlet.
4. With one finger on a spoke of the steering wheel, spin the wheel rapidly to bleed the air in the steering cylinders and lines.
5. As soon as the steering motor valve spool is actuated, add oil to the reservoir to replenish the oil flowing into the circuit.
6. Rotate the steering wheel to keep the valve spool actuated. Do this until the front wheels have reached the stop in one direction. Quickly reverse the steering wheel rotation to actuate the valve spool in the opposite direction.
7. Keep rotating the steering wheel left and right (from stop to stop) to bleed out the air, replenishing the oil as necessary.
8. The air will bleed out only at the reservoir; therefore, the oil must be circulated in both directions repeatedly until the air has bled out. (The oil in the lines to the power cylinder reaches a "dead end" at the piston. The oil in the cylinder does not flow in a circuit. As the piston moves back and forth, the oil moves back and forth in the lines. Therefore, air in these lines and the cylinder may be slow in moving into the steering motor control valve and to the reservoir.)
9. When the oil in the reservoir is clear (not cloudy or creamy), the system is free of air.

NOTE: Do not operate the vehicle until all the air is bled from the hydraulic steering system.

TROUBLESHOOTING AND PRESSURE TESTING

IMPORTANT: When making a repair, the cause of the failure must be corrected to avoid a repeat failure.

PROBLEM	POSSIBLE CAUSES	CORRECTION
No steering or excessive effort to steer.	1. Incorrect oil level in reservoir 2. Air in system 3. Steering system relief valve faulty 4. Worn pump 5. Leaking steering cylinder 6. Broken or damaged steering column flange and insulator assembly 7. Damaged or worn metering unit	1. Fill with the correct grade and quantity of oil. 2. Check for loose connections or damaged tubing. Purge system of air. 3. Check system pressure. 4. Inspect and repair. 5. Inspect and repair. 6. Inspect and replace as required. 7. Inspect and replace as required.
Steering wanders	1. Excessive play in steering linkage joints 2. Leaking steering cylinder 3. Damaged or worn metering unit	1. Inspect and replace as required. 2. Inspect and repair. 3. Inspect and replace as required.
Front wheels surge when steering	1. Leaking steering cylinder 2. Damaged or worn metering unit	1. Inspect and repair. 2. Inspect and replace as required.
Noisy pump	1. Incorrect oil level in reservoir 2. Air in system 3. Water in oil	1. Fill with the correct grade and quantity of oil. 2. Check for loose connections or damaged tubing. Purge system of air. 3. Drain and replace the oil.

POWER-STEERING PUMP - TROUBLESHOOTING AND PRESSURE TESTING

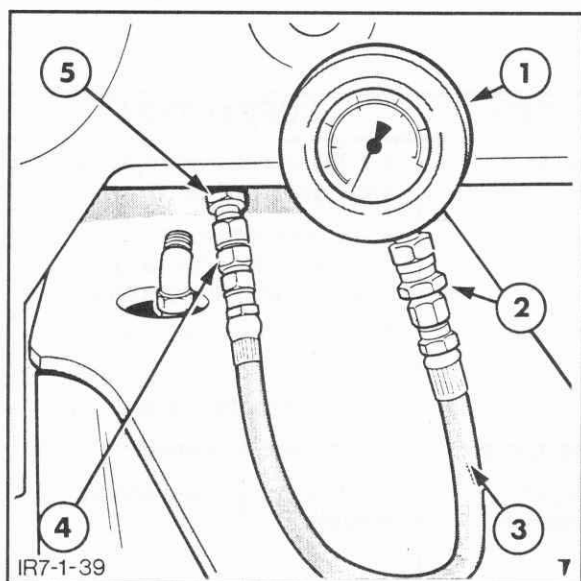


Figure 7-45

Pressure Test Gauge Installation Two Wheel Drive Units On Right-Hand Turn

1. High pressure gauge; tool no. FT.8503A
2. Adaptor; tool no. FT.8503-8
3. Ford hose; part no. E1NN-F493AA
4. Adaptor; tool no. FT.8541
5. Pressure 'IN' steering hose

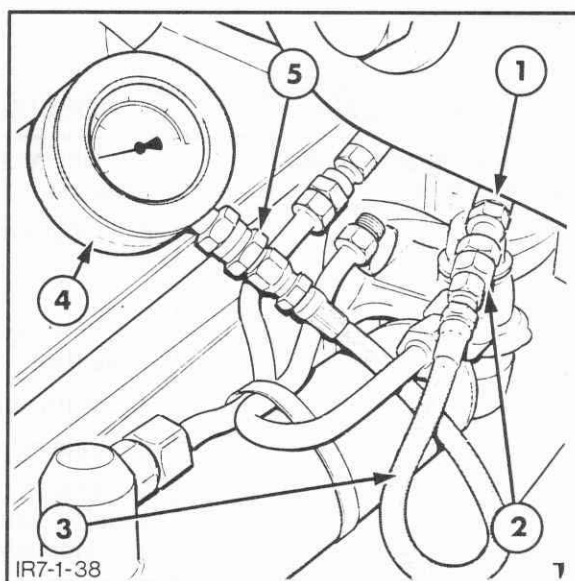


Figure 7-46

Pressure Test Gauge Installation Front Wheel Drive Units on Right-Hand Turn

1. Pressure 'IN' steering hose
2. Adaptor; tool no. FT.8503-8
3. Ford hose; part no. E1NN-493AA
4. Adaptor; tool no. FT.8541
5. High pressure gauge; tool no. FT.85031

1. Turn the steering wheel until the wheels are on a full, right-hand lock.

2. Two-Wheel Drive Tractors

Raise and securely support the front of the tractor to enable the axle to oscillate.

Raise and securely support the left-hand end of the axle to prevent any axle movement and allow easier access to the steering cylinder hose connections.

3. Disconnect the pressure "IN" steering hose connection from the cylinder, and using adaptors from the test kit, FNH00025.

Connect a pressure gauge to the steering hose, Figure 7-45 for 2WD tractors and Figure 7-46 for FWD tractors.

4. Start the engine and operate at 1100 RPM.
5. Turn the steering wheel as for a right turn. Record the gauge reading, then stop the engine.

IMPORTANT: Operate the engine just long enough to obtain an accurate reading. Prolonged operation will cause overheating and damage to the pump.

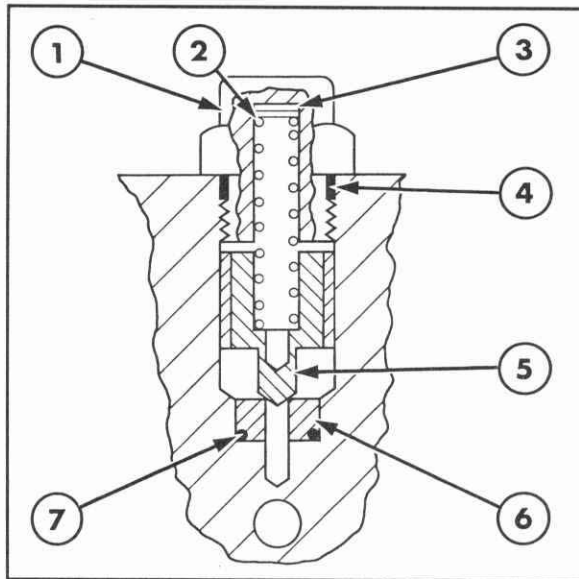


Figure 7-47
Power Steering Pump

1. Plug
2. Spring
3. Shim
4. Seal
5. Relief Valve
6. Relief Valve Seat
7. Seal

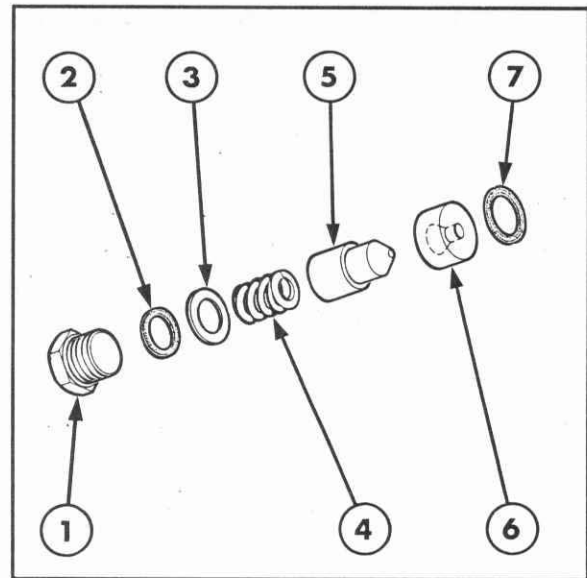


Figure 7-48
Power Steering Relief Valve Assembly

1. Plug
2. Seal
3. Shim
4. Spring
5. Relief valve
6. Relief valve seat
7. Seal

6. Disconnect the pressure testing equipment and repeat the above installation and test procedure for the steering system performing a full left-hand turn.

STEERING PRESSURE ADJUSTMENT (PUMP)

If the pressure readings on both locks are different, it is an indication of concern within the steering motor and the steering motor should be overhauled as detailed in this section. If the pressure readings are similar, but not to specifications, remove the relief valve (when fitted) in the power-steering pump and adjust the shims as follows:

1. With a suitable container held under the pump assembly, disconnect the return pipe and drain the oil.

2. Remove the power-steering pump as previously described.

3. Remove the pressure relief valve, Figure 7-47, from the pump body.

4. Carefully withdraw the pressure relief valve, pin, seal, and spring, and add or subtract shims as required. Refer to Figure 7-48.

NOTE: For every 0.01" (0.25 mm) increase in shim thickness, the pressure relief valve setting is increased by 70 ft. lbs. (4.8 bar, 4.9 kgf/cm²).

5. Reassemble the valve and install into the pump body. Tighten the valve to the correct torque. See Specifications - Chapter 5.

SECTION 7 – STEERING AND FRONT AXLE

6. Fill the power-steering reservoir with the correct grade of oil and purge the air from the system, as previously described in "Bleeding The Steering System."
7. Re-test the relief valve pressure setting as previously described.

STEERING PRESSURE ADJUSTMENT (STEERING MOTOR)

1. When the relief is not fitted in the pump the relief valve in the steering motor can be altered by resetting the adjuster/valve. Figure 7-28 steering motor overhaul.

SPECIFICATIONS AND SPECIAL TOOLS

SPECIFICATIONS

Pump

Oil	Ford M134C/D
Output	4.33 - 5.06 Gall/min (16.39 - 19.15 liters/min)
Flow Control at 2000 ERPM	4.5 Gall/min

Steering Motor

Displacement	6.00 in ³ /Rev (100 cm ³ /Rev)
--------------------	--

Power-steering Motor

Type	Hydrostatic
------------	-------------

Steering Wheel Turns Lock to Lock

Two-Wheel Drive Axle	4.1
Four-Wheel Drive Axle - Left Turn	3.1
Four-Wheel Drive Axle - Right Turn	3.75

Steering Pressure Relief Valve	2000 - 2100 lbf/in ² (140 - 145 bar)
--------------------------------------	---

Cylinder Pressure Relief (Shock Valve)	2800 - 3150 lbf/in ² (200 - 220 bar)
--	---

Power-steering Pump

Type	Gear
------------	------

Pump Output at 1500 RPM	4.3 - 5.0 U.S. gal/min
-------------------------------	------------------------

Relief Valve Pressure	2600 - 2800 lbf/in ² (182 - 196 bar)
-----------------------------	---

Shim Thickness	Pressure Change
0.007 in. (0.25 mm)	5 lbf/in ² (0.34 bar)
0.080 in. (0.38 mm)	60 lbf/in ² (4.08 bar)

Oil Specification

Fill with the correct grade, quantity, and type of oil, as specified in the relevant Operator's Manual.

SECTION 7 – STEERING AND FRONT AXLE

TORQUE SPECIFICATIONS

	ft. lbs.	N·m	kgf.m
Steering Wheel Nut	41.0	55.0	5.6
Steering Motor to Steering Column Bracket	17.0	23.0	2.3
Steering Motor End Cover	22.0	30.0	3.0
Steering Motor Pipe Connections	35.0	45.0	4.5
Steering Motor Pipe Adaptors	40.0	55.0	4.0
Steering Cylinder Ball-joint Clamps	32.0	43.0	4.4
Steering Cylinder Ball-joint Nuts	130.0	176.0	18.0
Steering Cylinder Extension Tube to Cylinder	200.0	271.0	27.5
Steering Pump Body Through Bolts	26.0	35.3	3.6
Steering Pump Drive Gear Nut	31.0	42.0	4.3
Steering Pump to Front Cover Bolt	23.0	31.2	3.2
Steering Pump Reservoir Bolt	12.0	16.3	1.7
Steering Pump Relief Valve	31.0	42.0	4.2
Check Valve Bolt	22.0	30.0	4.0

SPECIAL TOOLS

DESCRIPTION	V.L. CHURCHILL TOOL NO.	NUDAY/O.T.C TOOL NO.	DANFOSS TOOL NO.
Pressure Gauge	FT8503A	2028	--
"Tee" Adaptor	--	0838	--
Reducer	--	0724	--
Hose	FT4100-1	7099	--
Seal Installer	--	--	Danfoss No. SJ.
Pressure Test Kit	--	FNH 00025	150-9000-11 --

TWO-WHEEL DRIVE FRONT AXLE

FRONT AXLE - DESCRIPTION

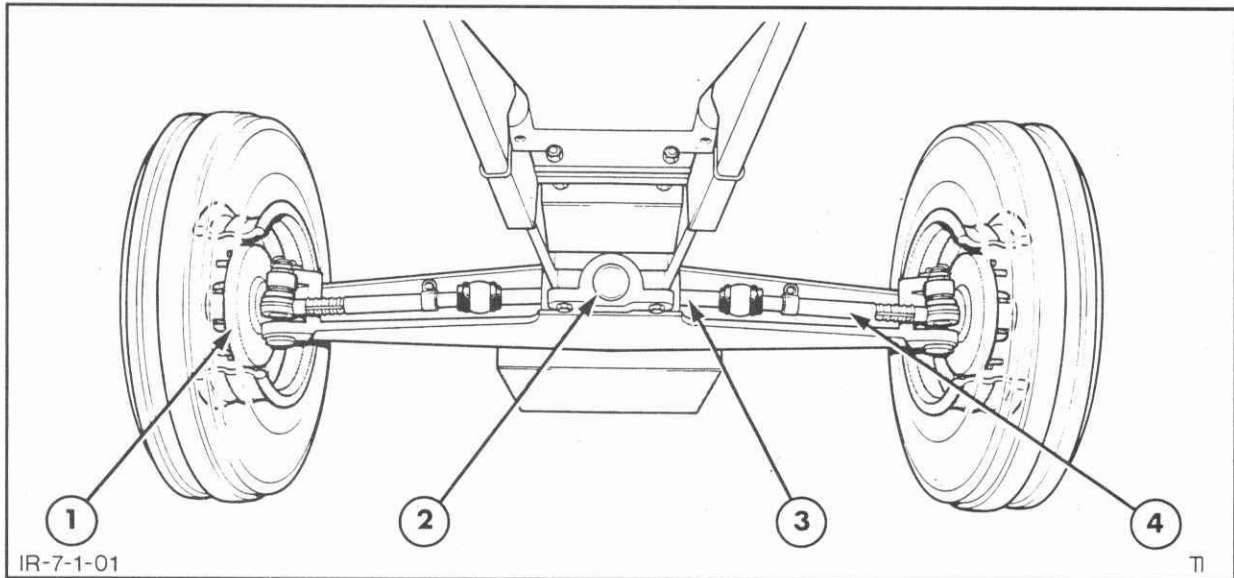


Figure 7-49
Front Axle Assembly

1. Steering cylinder
2. Track control rod

3. Hub and spindle assembly
4. Oscillation bearing support cap

The two-wheel drive front axle, Figure 7-49, is centrally mounted on the front support by two support caps. The support caps locate on the axle trunnion bushings and allow the axle to oscillate when traversing over rough terrain.

The hub and spindle assemblies are attached to the axle by spindle pins which pass through the spindle assembly and locate in machined castings welded on each end of the axle beam. The spindle pin is locked to the spindle by a locking pin, but swivels in greasable bushings housed in the machined axle castings.

The vertical thrust of each spindle is supported by a thrust bearing located

between the top of the spindle and the axle casting.

The steering cylinder is clamped in the center of the axle housing and retained in position by a locking plate and two studs. The track control rod assemblies are connected between the wheel spindle arms and the cylinder piston which protrudes through both ends of the cylinder.

The nonadjustable front wheel track width is 62" (1575 mm) on KF3P models and 70" (1778 mm) on DF0P, DF1Q, LF4P/Q and LF5Q units.

TOE-IN ADJUSTMENT

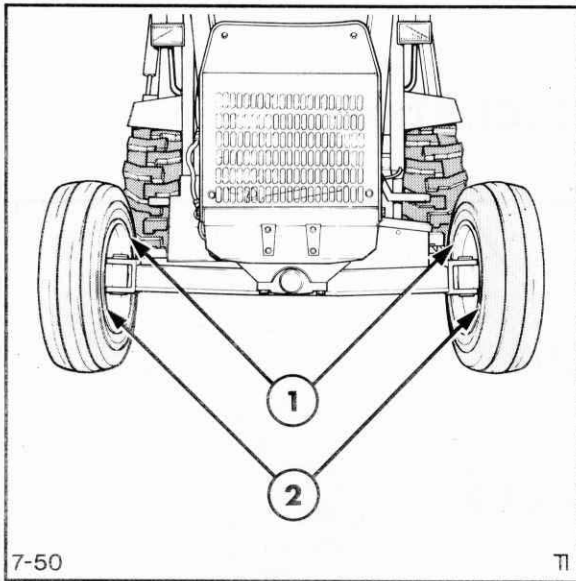


Figure 7-50

Front Wheel Toe-In Measurements

1. Rear track width (dimension B)
2. Front track width (dimension A)

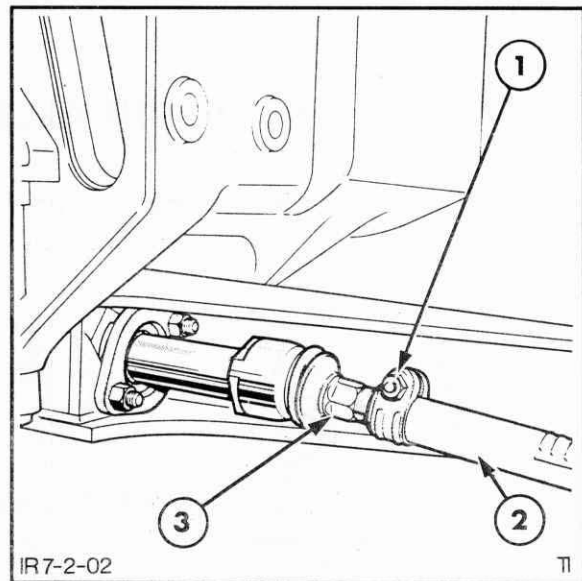


Figure 7-51

Track Control Rod Adjustment

1. Clamp bolt
2. Track control rod
3. Hexagon adjuster

The toe-in for the front wheels is set at the factory. Normally, the front wheels maintain their toe-in adjustment; however, an occasional check of the toe-in should be made after any front axle component overhaul, as follows:

1. On flat level ground, slowly drive the tractor in a straight line for at least 10 feet (2 meters). Stop the unit and be sure that the front wheels remain in the straight-ahead position.
2. Mark the inboard rim of each front wheel towards the front at wheel center height.
3. Measure and note the distance between the two marks, dimension A. Refer to Figure 7-50.
4. Maintain the straight-ahead position and move the unit forward so the wheels

rotate through 180 degrees and the marks on the wheels face the rear at wheel center height.

5. Again, measure and note the distance between the two marks, dimension B.

NOTE: If dimension A is larger, then A-B gives the toe-out. If dimension B is larger, then B-A gives the toe-in.

Specified toe-in is 0-0.25" (0-6 mm).

To ensure accurate results, complete the procedure three times with three different marks equally spaced around each wheel rim and the average dimension for toe-in calculated.

This method minimizes any inaccuracy due to wheel rim runout.

SECTION 7

If the toe-in is not correct, make the adjustments outlined as follows:

this adjustment is carried out equally on both track rods.

1. Loosen the clamp bolt on each track control rod, Figure 7-51.
2. Rotate the hexagon adjuster in order to achieve the specified toe-in. Be sure that
3. After the correct toe-in is obtained, tighten the clamp nuts.
4. Recheck the toe-in, as outlined above, and readjust if necessary.

FRONT WHEEL HUB AND SPINDLE - OVERHAUL

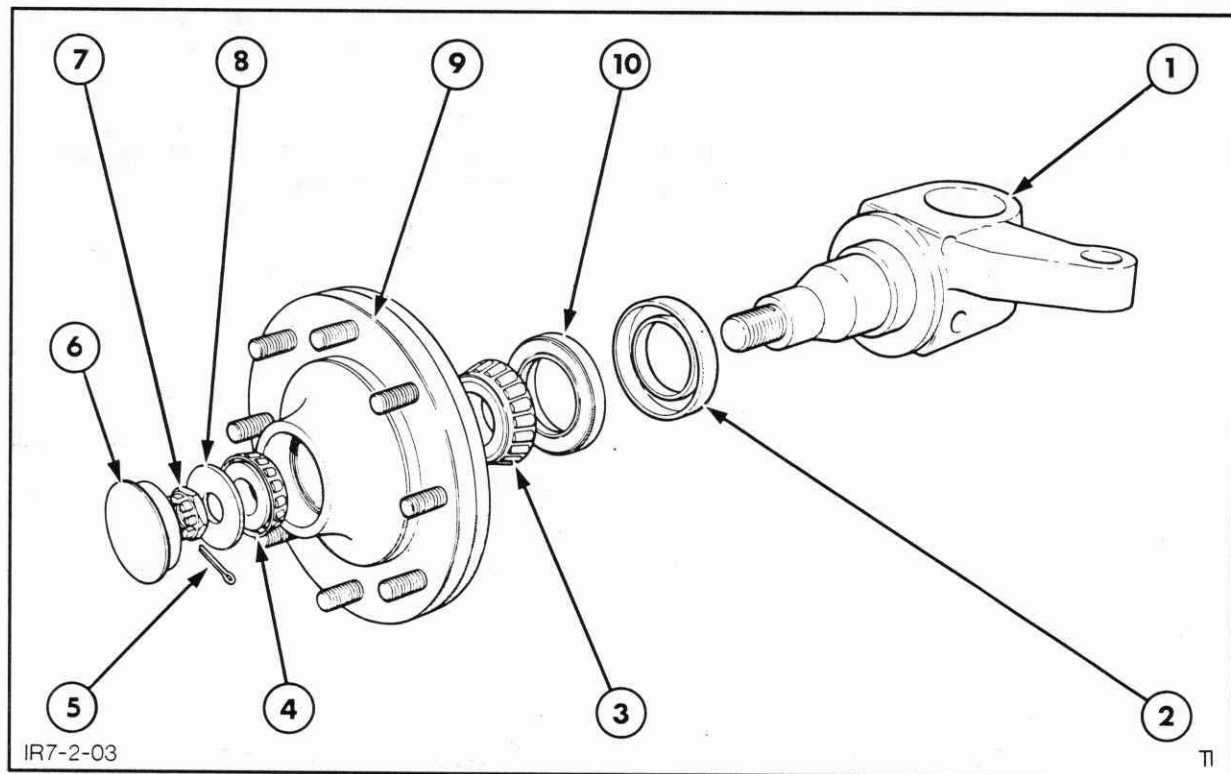


Figure 7-52
Hub and Spindle Assembly

1. Spindle
2. Mud shield
3. Inner bearing
4. Outer bearing
5. Cotter pin

6. Grease retaining cap
7. Castellated nut
8. Washer
9. Hub
10. Grease retainer

REMOVAL FIGURE 7-52

3. Remove the front wheel hub grease retaining cap.

Hub and Bearing Removal

1. Using a suitable jack or hoist, safely support the front end of the unit.

4. Remove the split pin and castellated nut.

2. Remove the front wheel.

5. Pull the hub assembly from the spindle and retrieve the washer and outer bearing.

6. Remove the inner bearing, grease retainer, and mud shield from the spindle.

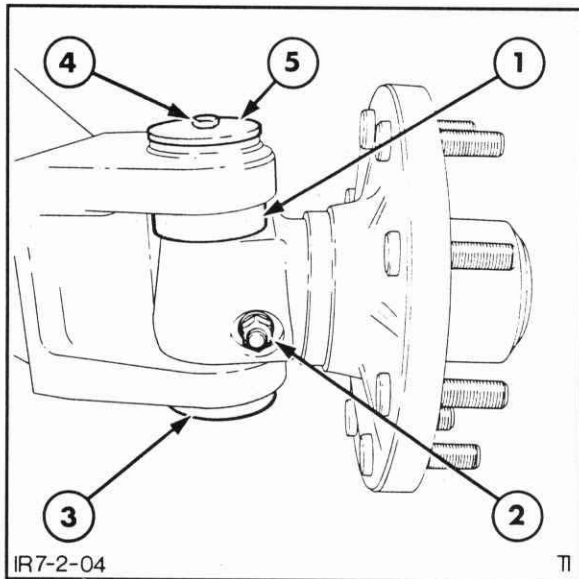


Figure 7-53
Spindle Assembly

1. Thrust bearing
2. Locking pin
3. Dust seal
4. Bolt
5. Dust seal

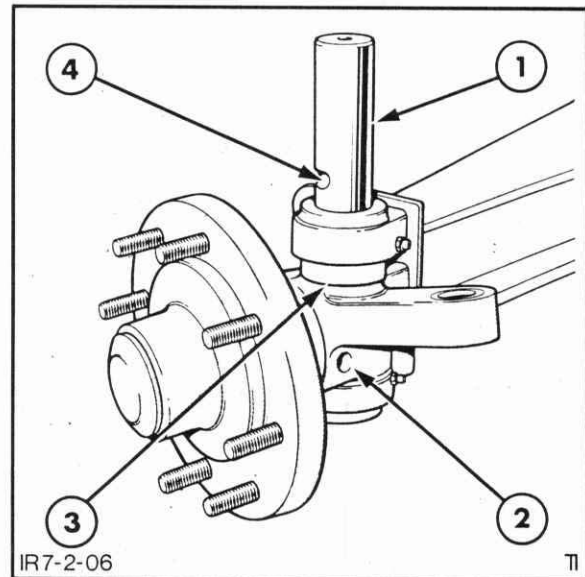


Figure 7-54
Spindle Pin Removal

1. Spindle pin
2. Thrust bearing

SPINDLE REMOVAL

1. Disconnect the track control rod from the spindle arm.
2. Remove the bolts retaining the dust seals on each end of the spindle pin, Figure 7-53.
3. Remove the nut and lock washer from the spindle locking pin and drive out the pin.
4. Drive the spindle pin from the axle housing, refer to Figure 7-54.
5. Remove the spindle assembly and thrust bearing from the axle.
6. Remove and discard the seal located in the bottom of the spindle.

INSPECTION AND REPAIR

1. Clean all components with a suitable solvent and allow to dry.
2. Inspect the inner and outer bearings and cups for wear and damage. Install new parts as necessary. The bearings, if worn, should be replaced as an assembly, and when installing bearing cups in the hub, be sure that they are seated correctly against the shoulder in the bore.
3. Inspect the grease retainer bearing surface in the hub for scoring. If slight marking is evident, polish smooth with a fine abrasive. If scoring is excessive or damage is evident, install a new hub assembly.

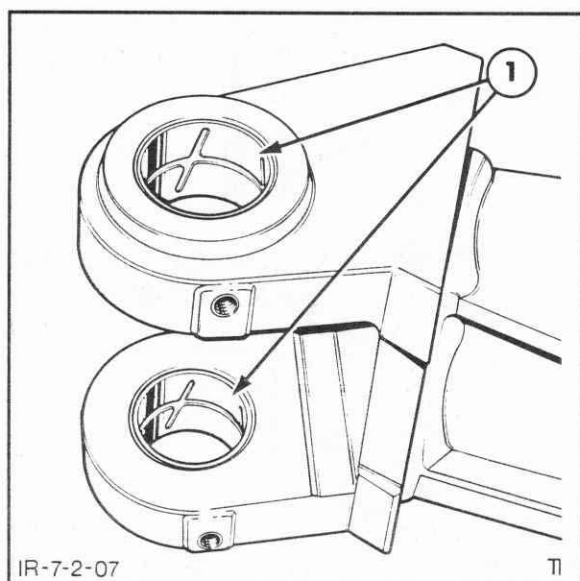


Figure 7-55

Axle Spindle Pin Bushings

1. Bushings

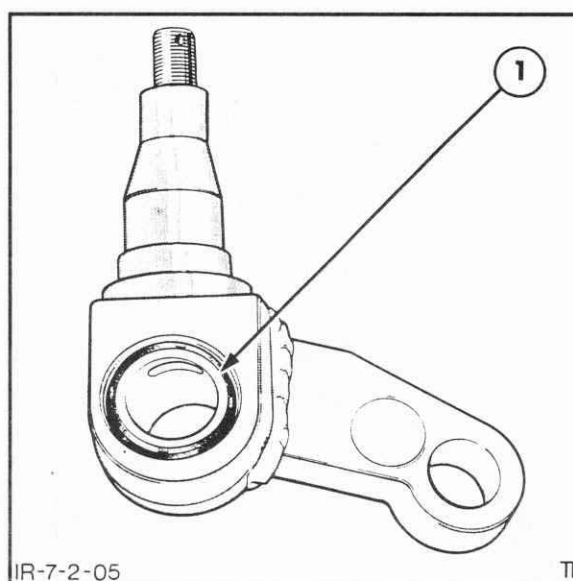


Figure 7-56

Spindle Oil Seal

1. Oil seal

4. Inspect the spindle pin bushes in the axle for wear, cracks, or scoring, Figure 7-55. If the pin fit is poor or any side play was noticed before disassembly, install new bushings. The bushings can be removed and installed with bushing kit, Tool No. 818 or 9514.

NOTE: When installing new bushings, the holes in the bushings must be aligned with the corresponding hole for the grease fitting.

5. Inspect the spindle pin for abnormal wear or scoring. Install a new pin, if necessary.
6. If noisy, thrust bearings were reported or the bearing race is scored or damaged, install a new bearing.

INSTALLATION

1. Press a new seal into the base of the spindle, Figure 7-56.

2. Using a suitable-sized sleeve, install the mud shield and grease retainer on the wheel spindle. Refer to Figure 7-57.

NOTE: The surface of the retainer assembly should be wiped with grease prior to installation and installed with the metal surface facing towards the hub.

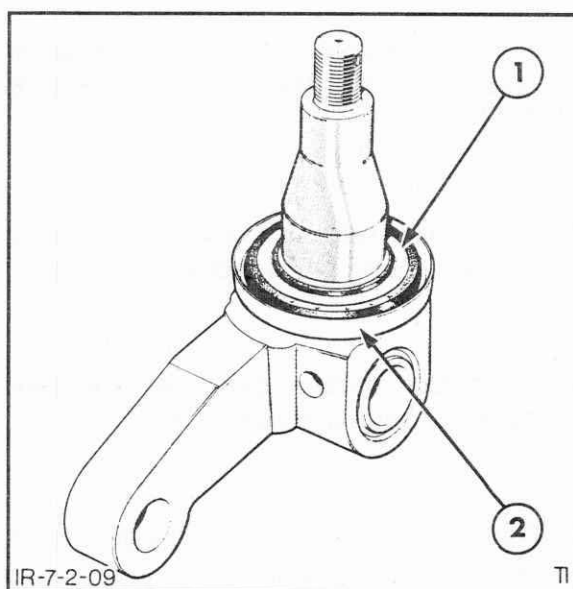


Figure 7-57

Mud Shield and Grease Retainer Installation

1. Grease retainer
2. Mud shield

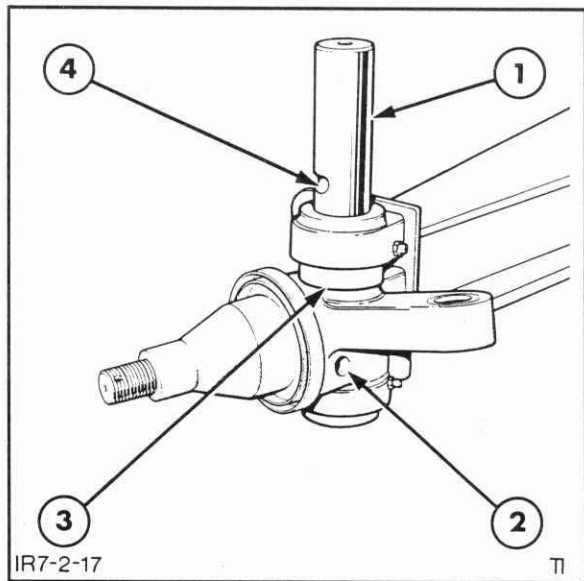


Figure 7-58

Installing Spindle Pin

1. Spindle pin
2. Locking pin bore
3. Thrust bearing
4. Locking pin notch

3. Place the spindle on the axle casting, aligning the spindle bores.

4. Apply grease to the thrust bearing and place the bearing between the axle and spindle pin bores.

5. Install the spindle pin ensuring that the notch in the pin aligns with the locking pin bore in the spindle, Figure 7-58.

NOTE: The locking pin notch in the spindle pin is offset to one end. When installing the pin, be sure that the offset is positioned to the bottom of the spindle to align with the locking pin bore.

6. Drive the pin until it seats and secure with the lock washer and nut. Tighten the nut to 37 lbs. ft. (50 N·m) torque.

7. Position new dust seals on each end of the pin and secure in position with the retaining bolts, tightening the bolts to the 34 ft. lbs. (46 N·m) torque.

8. Reconnect the track control rod to the spindle arm. Tighten the castellated nut to 285 ft. lbs. (385 N·m) torque, then rotate the nut to the next slot to align with the hole in the ball joint stud. Install a new cotter pin to prevent movement of the nut.

9. Install the inner bearing assembly onto the spindle. Where necessary, a suitable sleeve may also be used to install the bearing.

10. Apply the specified grease to the bearing and position the hub onto the spindle.

11. Apply grease to the outer bearing and locate the bearing in the hub. Install the retaining washer and castellated nut. Tighten the nut to a torque of 50 ft. lbs. (6.92 kgm), then slacken off two to three slots to give an end float of 0.002" to 0.010" (0.050 to 0.254 mm). Insert a new cotter pin to locate the nut. Pack the hub grease retaining cap with grease.

12. Install the wheel and lower the tractor to the ground.

STEERING CYLINDER AND TRACK CONTROL ROD - OVERHAUL

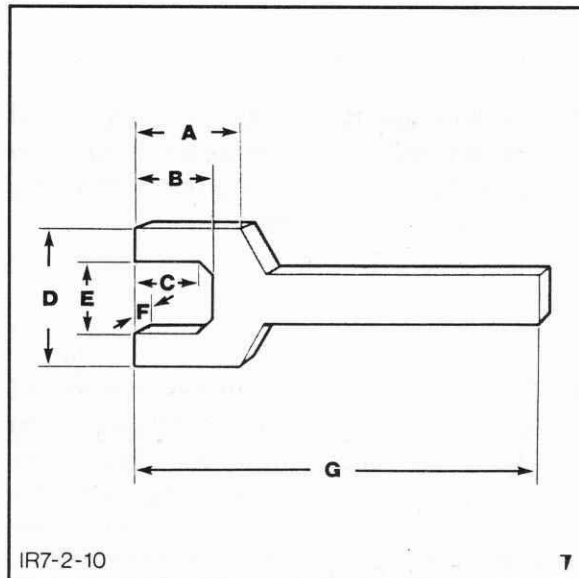


Figure 7-59
Locking Spanner

- A. 80 mm
- B. 60 mm
- C. 50 mm
- D. 90 mm
- E. 55 mm
- F. 10 mm
- G. 250 mm

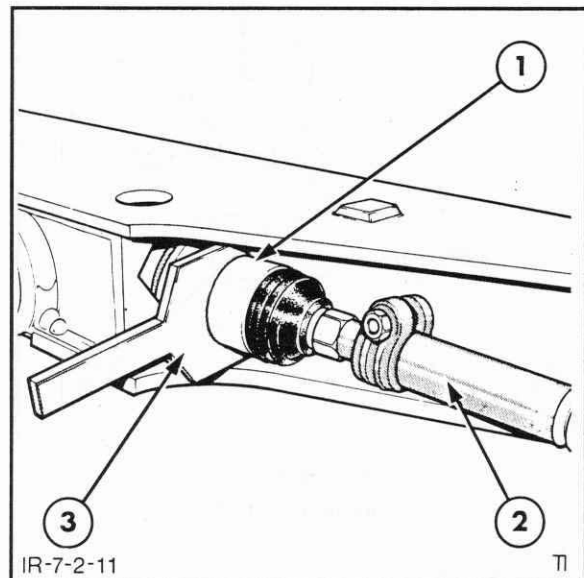


Figure 7-60
Locking Spanner Installed

- 1. Ball joint
- 2. Track control rod
- 3. Locking spanner

REMOVAL

In order to remove the steering cylinder, it is necessary to use a suitable 55 mm open-ended spanner or to manufacture a ball joint locking spanner which will be used when releasing the track control rod ball joint from the steering cylinder piston rod.

If a locking spanner is to be manufactured, it should be made from high carbon steel to the dimensions shown in Figure 7-59 and hardened after machining.

1. Position the tractor on a hard level surface and position the front wheels as for a right-hand turn.

2. Fit the locking spanner over the flats on the right-hand track control rod ball joint, Figure 7-60.

NOTE: The outer edge of the spanner fingers will locate in the channel in the axle and prevent rotation of the joint when releasing the joint on the opposite end of the piston rod.

3. Position a good quality heavy-duty open-ended spanner with leverage capable of withstanding a torque in excess of 340 ft. lbs. (465 N:m) onto the ball joint at the opposite end of the piston rod. Refer to Figure 7-61. Apply leverage to the spanner to unscrew the ball joint.

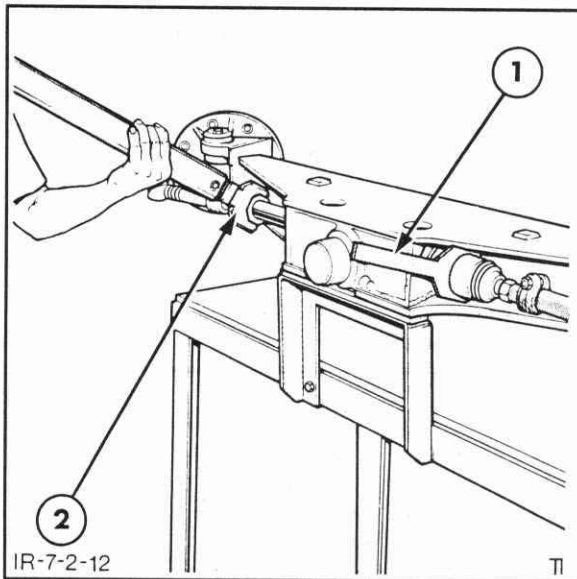


Figure 7-61

Releasing Track Control Rod Ball Joints
(Shown With Axle Removed From
Vehicle for Clarity)

1. Locking spanner
2. Heavy duty open ended spanner

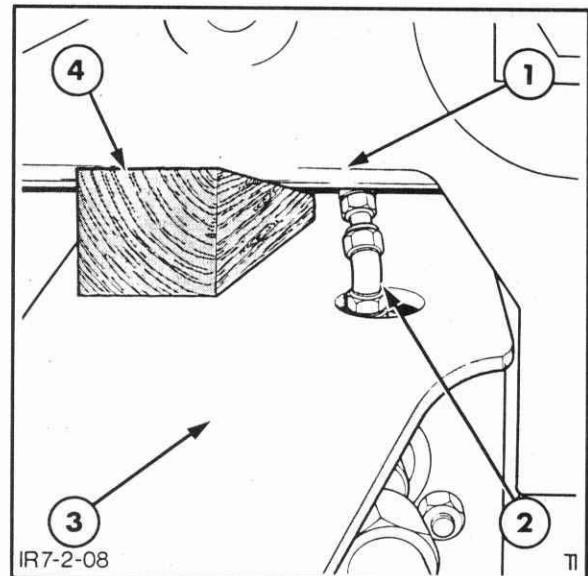


Figure 7-62

Steering Cylinder Hose Connections

1. Front support
2. Steering hose elbow
3. Front axle
4. Wedge

NOTE: The weakest joint will unscrew, and to remove the cylinder from the axle, it is necessary to release the left-hand joint. If the right-hand joint is released, position the locking spanner on the left-hand track control rod ball joint and use a suitable spanner located on the flats machined on the left-hand end of the piston rod to release the joint.

the axle. Then disconnect the steering cylinder hose connection elbow at the steering cylinder, Figure 7-62. Remove the wedge and repeat this procedure to disconnect the elbow on the opposite end of the cylinder.

4. Raise and securely support the front of the tractor to enable the axle to oscillate.
5. Raise one end of the axle and support the raised end with an axle stand to prevent axle movement. For additional safety, insert a wooden wedge between the axle and front support on the lowered side of
6. Disconnect and remove the track control rods from the spindle arms.
7. Remove the two studs which clamp the locking plate to the cylinder and remove the plate, Figure 7-63.
8. Withdraw the cylinder assembly from the right-hand side of the axle.

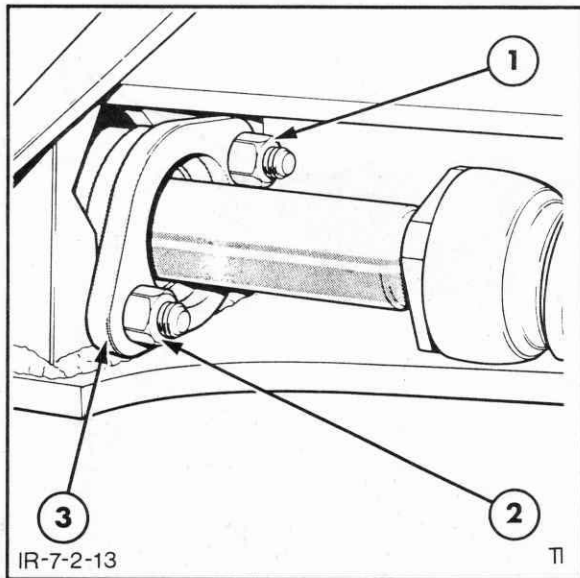


Figure 7-63

Steering Cylinder Locking Plate

1. Stud
2. Stud
3. Locking plate

3. Using special "C" spanner FT.8554 and while pulling the exposed tang of the locking wire, rotate each gland counterclockwise and remove the wire.
4. Pull on the cylinder rod and knock the gland from the end of the cylinder barrel. If necessary, continue to rotate the gland during this operation.
5. Insert the rod back into the cylinder and similarly remove the gland at the opposite end of the barrel.

6. Remove the wear ring, piston seal, and O ring from the piston.
7. Remove the O ring, back-up washer, oil seal, and wiper seal from each of the glands.

STEERING CYLINDER DISASSEMBLY

Figure 7-64

1. Thoroughly drain the cylinder of all oil from both ports. Recap the ports and thoroughly clean the exterior so that the internal parts will not be contaminated.
2. Install suitable fittings into the cylinder ports so that the cylinder may be clamped by the jaws of a vise without gripping on the cylinder barrel.

IMPORTANT: Do NOT clamp directly around the cylinder barrel, as distortion and damage to the barrel will occur.

INSPECTION

1. Wash the cylinder components in a suitable solvent and allow to air dry.
2. Inspect the cylinder rod for damage. Any minor nicks or burrs may be removed using an abrasive stone.
3. Inspect the inside of the cylinder barrel for damage.
4. Inspect the track control rod ball joints for looseness. If any wear is evident, replace the joint.

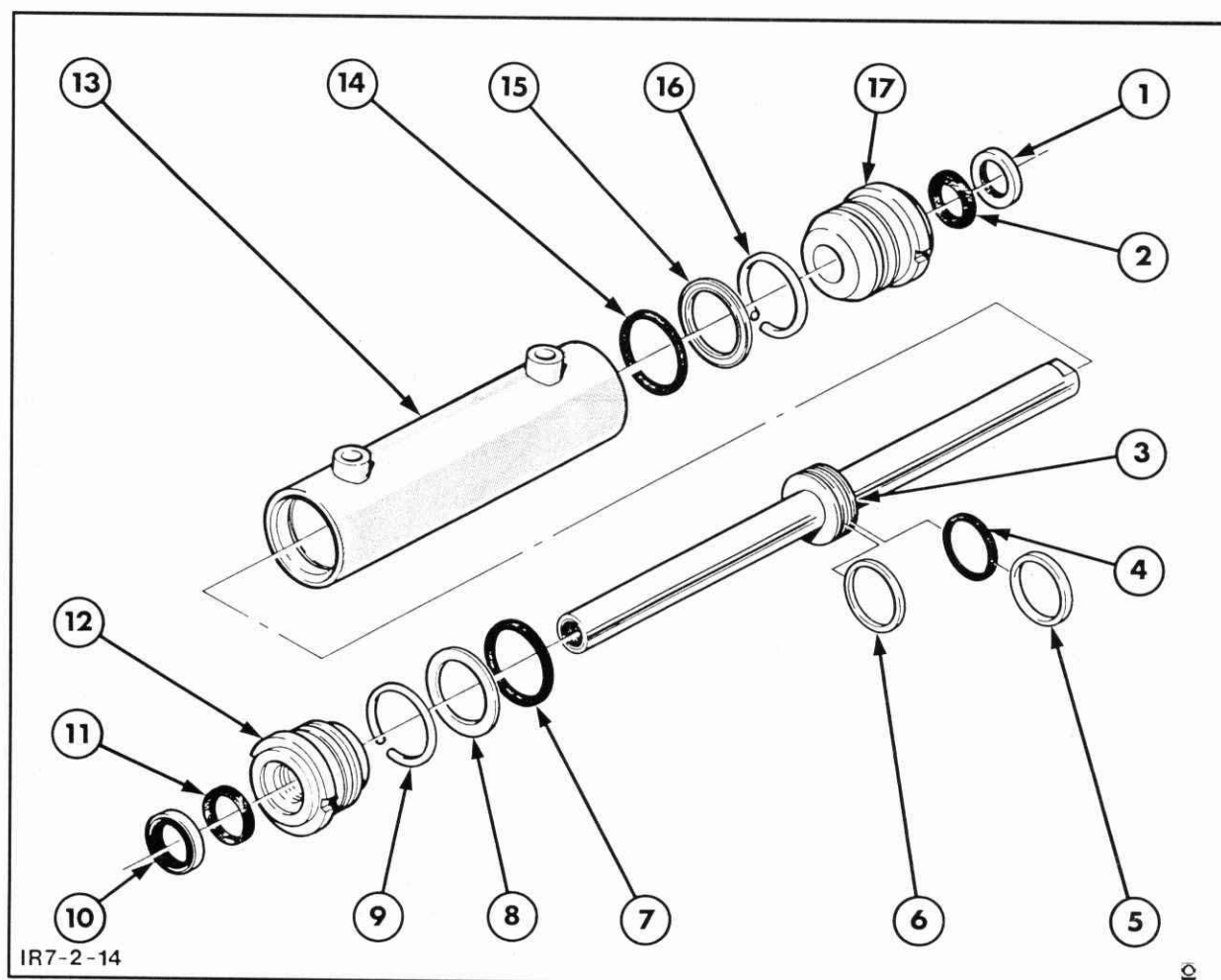


Figure 7-64
Steering Cylinder – Exploded View

1. Wiper seal
2. Oil seal
3. Piston and rod assembly
4. O ring
5. Piston seal
6. Wear ring
7. O ring
8. Back up washer
9. Locking wire

10. Wiper seal
11. Oil seal
12. Gland
13. Cylinder barrel
14. O ring
15. Back up washer
16. Locking wire
17. Gland

REASSEMBLY

Figure 7-64

1. Install new piston seal expander (O ring), piston seal, and wear ring on the piston.
2. Install a new rod seal in the groove in the gland. Be sure that the sealing lip faces towards pressure.
3. Install a new cylinder rod wiper seal into the gland.
4. Install a new O ring and back-up seal onto the outer diameter of the gland. Be sure that the concave face of the back-up ring abuts the O ring and that the O ring is positioned towards the barrel.

SECTION 7 – STEERING AND FRONT AXLE

NOTE: Installation of the piston seal on top of the O ring requires special care. Allow the seal to contract naturally before attempting to install the piston and rod assembly into the cylinder.

9. Install the gland on the opposite end of the barrel, using the same procedure as detailed above.

INSTALLATION

5. Lubricate all seals and slide a gland assembly onto the piston rod.
6. Place the cylinder barrel in a vertical position and insert the piston and rod assembly.
7. Lightly coat the outer surface of the gland and lead-in area of the cylinder barrel with a lithium base high melting point-type grease. Gently tap the gland into the barrel until fully seated. Slowly rotate the gland until the small hole in the locking wire groove aligns with the hole in the side of the barrel.
8. Push the short right-angled bend on the locking wire into the entry hole in the barrel and, using the special "C" spanner FT.8554, rotate the gland clockwise (as if it were threaded) and feed in the wire. The rotation of the gland will become tight when the wire has completely rotated around the barrel. Be sure that at least 0.375" (8 mm) of wire is left exposed for future disassembly. Seal the wire entry hole with a proprietary non-solidifying sealant.
1. Installation of the steering cylinder and track control rods follows the removal procedure in reverse.
2. Be sure that all steering joints and ball joints are tightened to the specified torque. When tightening the track control rod ball joints to the steering cylinder rod, locate the locking spanner on the flats of the right-hand joint and position a suitable good quality torque wrench onto the flats of the left-hand joint. Apply effort to the torque wrench until the specified torque is applied. When this torque is achieved, both joints will have been tightened to the specified value.
3. Fill the steering reservoir with oil and purge the air from the system, as previously described in "Bleeding The Steering System."
4. Adjust and set the front wheel toe-in as previously described.

For overhaul of the hub and spindle assembly, refer to the steps previously outlined in this section.

TWO-WHEEL DRIVE FRONT AXLE - TORQUE SPECIFICATIONS

	Nm	Kgfm	ft. lbs.
Oscillation Bearing Cap Bolts	510	52.0	376
Spindle Locking Pin Nut	50	4.9	37
Spindle Dust Seal Bolts	46	4.7	34
Track Control Rod Ball Joint to Steering Cylinder	465	47.0	340
Track Control Rod Ball Joint Nut to Spindle Arm	385	40.0	285
Steering Cylinder Locking Plate Bolts	145	15.0	105
Front-Wheel Nuts - 2WD	176	17.9	130

FRONT AXLE - OVERHAUL

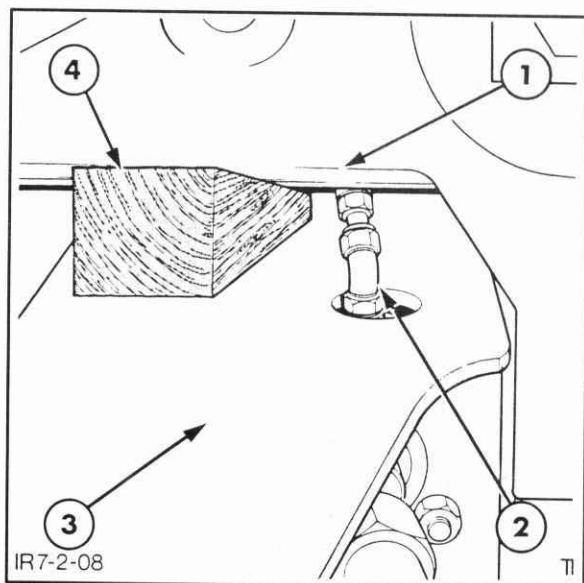


Figure 7-65

Steering Cylinder Hose Connections

1. Front support
2. Hose connection
3. Axle
4. Wooden wedge

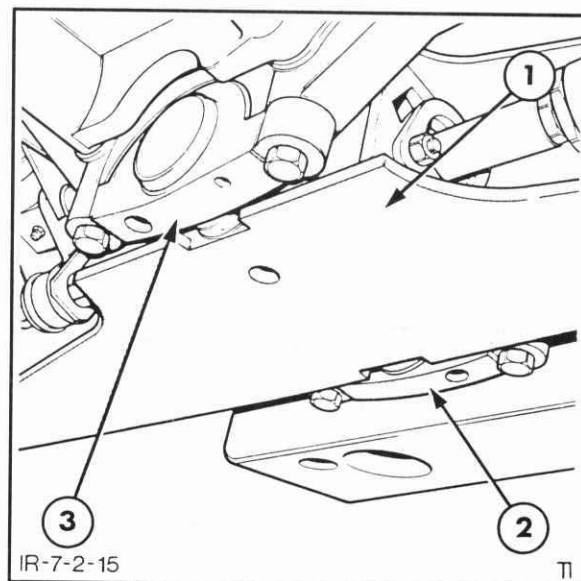


Figure 7-66

Axle Bearing Caps

1. Axle
2. Front oscillation bearing cap
3. Rear oscillation bearing cap

REMOVAL

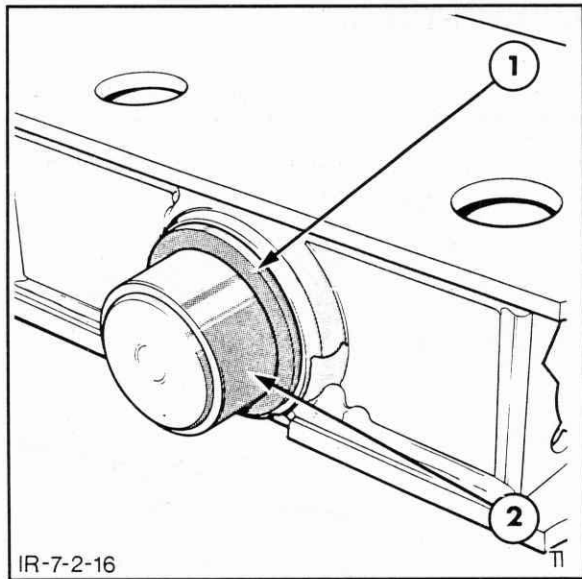
1. Using suitable lifting equipment, raise the front of the unit and place a support in a position clear of the front axle and wheels.
2. Remove the front wheel and tire assemblies.
3. Raise one end of the axle and support the raised end with an axle stand to prevent axle movement. For additional safety, insert a wooden wedge between the axle and front support on the lowered side of the axle. Disconnect the steering cylinder hose connection at the cylinder, Figure 7-65. Remove the wedge and repeat this procedure to disconnect the hose on the opposite end of the cylinder.

4. Support the front axle with suitable lifting equipment and remove the bolts securing the front and rear oscillation bearing caps. Refer to Figure 7-66.

5. Carefully lower the axle from the vehicle and position it on a suitable stand.

INSPECTION AND REPAIR

1. Inspect the bushings on the axle trunnions, Figure 7-67, for excessive wear or distortion and replace if necessary. Similarly inspect the bushes in the oscillation bearing caps and replace if worn.

**Figure 7-67**

Trunnion Bush and Thrust Washer

1. Thrust washer
2. Bush

INSTALLATION

1. Position the thrust washers on both axle trunnions.
 2. Locate the dowels in the front support.
 3. Position the oscillation bearing caps onto the axle trunnions and, using suitable lifting equipment, locate the axle beneath the vehicle. Position the bearing caps onto the locating dowels in the front support and install the retaining bolts. Tighten the bolts to 376 ft. lbs. (510 N·m) torque.
 4. Reconnect the steering hoses using the removal procedure in reverse and tighten the joints.
 5. Attach the wheel and tire assemblies to the wheel spindles and tighten the nuts to 130 ft. lbs. (176 N·m) torque.
 6. Fill the power-steering reservoir with 134C/D hydraulic oil and purge the air from the steering system, as described in "Bleeding The Steering System." Add oil as required to maintain system capacity while bleeding.
2. Inspect the thrust washers for wear and replace if excessively worn. The thickness of the washers when new are 3.85-4.00 mm (0.151" - 0.157").
 3. Examine the oscillation bearing cap locating dowels for damage. During axle removal, the dowels may remain in either the bearing cap or front support.
 4. Inspect the front axle body for cracks or damage. If the axle structure is damaged, it is necessary to install a new axle.

TROUBLESHOOTING - STEERING

PROBLEM	POSSIBLE CAUSES	CORRECTION
No steering or excessive effort required to steer	1. Incorrect oil level in reservoir. 2. Air in system 3. Pump relief valve faulty 4. Worn pump 5. Leaking power cylinder 6. Damaged valve spool 7. Broken or damaged steering column 8. Damaged or worn metering element	1. Fill with the correct grade and quantity of oil 2. Check for loose connections or damaged tubing. Purge system of air 3. Check system pressure 4. Inspect and repair 5. Inspect and repair 6. Inspect and replace 7. Inspect and replace 8. Inspect and replace
Steering wanders	1. Excessive play in steering linkage ball joints 2. Leaking power cylinder 3. Control valve spool sticking or worn 4. Weak or broken torsion bar 5. Incorrect valve spool shim adjustment 6. Damaged or worn metering element	1. Inspect and replace 2. Inspect and repair 3. Inspect and replace 4. Inspect and repair 5. Check and adjust 6. Inspect and replace
Front wheels surge when steering	1. Leaking power cylinder 2. Control valve spool sticking 3. Weak or broken torsion bar 4. Damaged or worn metering element	1. Inspect and repair 2. Inspect and repair 3. Inspect and replace 4. Inspect and replace
Noisy pump	1. Incorrect oil level in reservoir 2. Air in system 3. Water in oil	1. Fill with the correct grade and quantity of oil 2. Check for loose connections or damaged tubing. Purge system of oil 3. Drain and replace the oil

SPECIFICATIONS AND SPECIAL TOOLS - TWO-WHEEL DRIVE FRONT AXLE

DIMENSIONS AND ADJUSTMENTS

Wheel Tread Width (fixed)

KF3P	62 in. (1575 mm)
DF0P, DF1Q, LF4P/Q, LF5Q	70 in. (1778 mm)

Toe-in 0 - 0.25 in. (0 - 6 mm)

GREASE

Grease with the correct grade, as specified in the relevant Operator's Manual.

FRONT TIRE PRESSURES AND PERMISSIBLE LOADS (TWO-WHEEL DRIVE)

The following charts give the carrying capacity of the axle at the tire pressures indicated.

Tire Size	Ply Rating	Inflation Pressures in Bar											
		1.5	1.7	1.9	2.1	2.2	2.4	2.6	2.8	3.0	3.3	3.6	3.9
		Permissible Load Capacity Per Axle (kg)											
9.00 - 16	10	1360	1480	1600	1700	1750	1850	1940	2030	2110	2240	2360	2490
11L - 16	10	1400	1480	1620	1720	1790	1880	2000	2080	2210	2340	2460	--

Tire Size	Ply Rating	Inflation Pressures in lbf/in2											
		22	25	28	30	32	35	38	41	44	48	52	57
		Permissible Load Capacity Per Axle (lb.)											
9.00 - 16	10	2298	3262	3527	3747	3858	4078	4276	4475	4651	4938	5202	5489
11L - 16	10	3086	3262	3527	3791	3946	4144	4409	4585	4872	5158	5423	--

TWO-WHEEL DRIVE FRONT AXLE - TORQUE SPECIFICATIONS

	N·m	kgf.m	ft. lbs.
Oscillation Bearing Cap Bolts	510	52.0	376
Spindle Locking Pin Nut	50	4.9	37
Spindle Dust Seal Bolts	46	4.7	34
Track Control Rod Ball Joint to Steering Cylinder	465	47.0	340
Track Control Rod Ball Joint Nut to Spindle Arm	385	40.0	285
Steering Cylinder Locking Plate Bolts	145	15.0	105
Front-Wheel Nuts - 2WD	176	17.9	130

SPECIAL TOOLS

Bushing Kit	818	9514
Steering Cylinder "C" Spanner	FT.8554	

FRONT-WHEEL DRIVE FRONT AXLE

DESCRIPTION AND OPERATION

The front axle installed on backhoe loaders can be readily identified by the data plate attached to the right-hand side of the axle casting.

The data plate details the axle type, serial number, total gear ratio, reference number, oil capacity and type, and grease type.

When ordering parts, always quote the type, reference, and serial numbers. Refer to later sections for Ford oil and grease specifications.

The axle has a track width measuring 74.2" (1884 mm) and is measured at the wheel-mounting flange. Wheel track adjustment is achieved by using separate wheel rim and disc assemblies.

The axle, Figure 7-68, is pivoted at the center to allow oscillation when traversing rough ground and the drive pinion actually passes through the hollow center of the rear oscillation bushing. This arrangement keeps the drive shaft, connecting the front axle with the transfer case assembly, in a straight plane

through all degrees of oscillation. The drive shaft runs in a single row ball bearing and is connected to the axle pinion and transfer case through sliding splined connections.

Axle shafts are double universally-jointed for constant running and each joint is serviceable.

Final reduction is achieved using three pinion epicyclic gearing housed in a removable hub with a separate oil housing. The reduction hubs are attached to the central housing by swivel pins top and bottom, turning in cone and cup type bearings which are serviceable and greasable to ensure long life.

This axle type features a centrally-mounted differential supported in the axle casing by a separate removable carrier.

With the exception of the differential unit, the axle reduction hubs, wheel hub bearings, axle shafts, and steering cylinder can all be removed and overhauled without removing the axle from the unit.

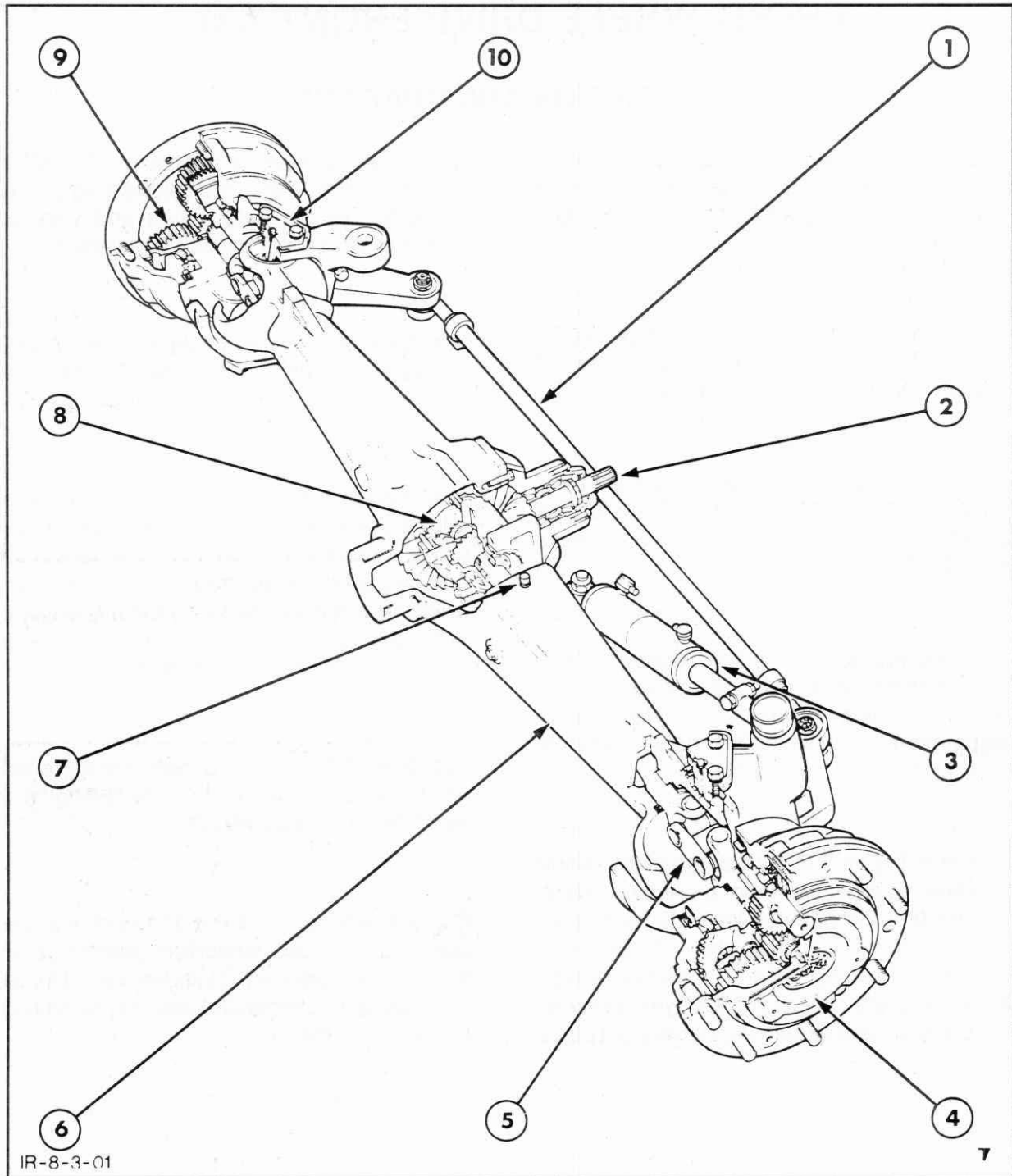


Figure 7-68

Front Axle — Cutaway View

- | | |
|---|--|
| 1. Track rod | 6. Axle center casing |
| 2. Pinion | 7. Center casing breather |
| 3. Steering cylinder | 8. Crown wheel and differential assembly |
| 4. Hub and planetary reduction gear assembly | 9. Planetary reduction gear |
| 5. Axle shaft double universal joint assembly | 10. Swivel pin assembly |

PLANETARY REDUCTION ASSEMBLY AND WHEEL HUBS - OVERHAUL

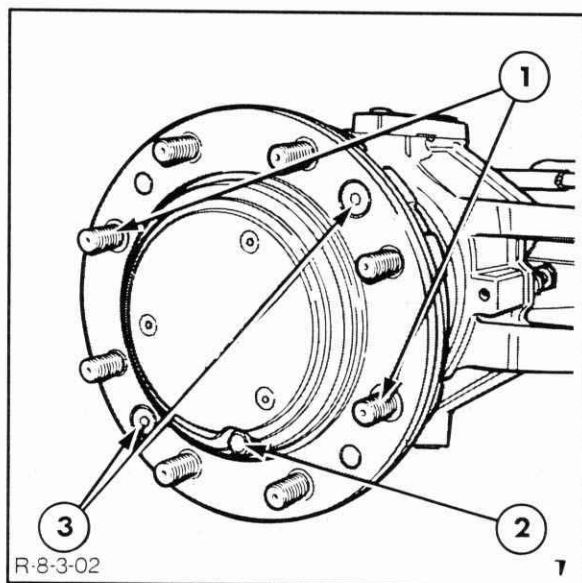


Figure 7-69

Planetary Carrier Retainers

1. Shouldered wheel studs
2. Filler/drain plug
3. Socket screws

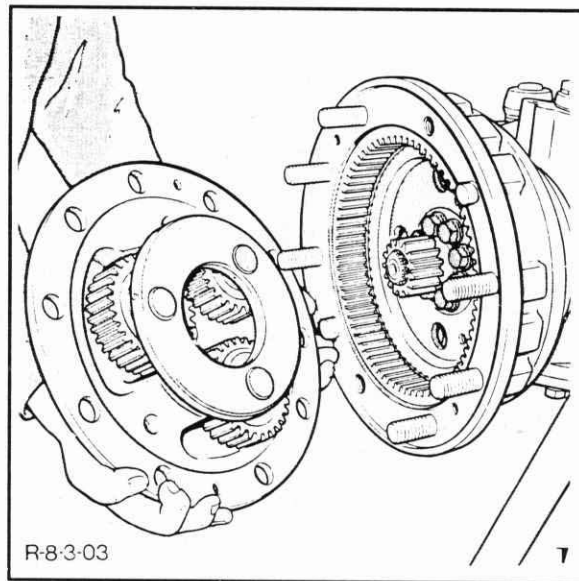


Figure 7-70

Withdrawing Planetary Carrier From Hub Assembly

REMOVAL

1. Position the unit on a hard level surface, lower the loader arms, apply the parking brake, and block the rear wheels. Disconnect the battery.
2. Jack up the front axle and securely support the front of the tractor. Remove the front wheel.
3. Turn the hub so that the filler/drain plug is at its lowest point and drain the hub oil.
4. Remove the two 8 mm socket screws and the two shouldered wheel studs, Figure 7-69, securing the planetary carrier assembly to the hub assembly.

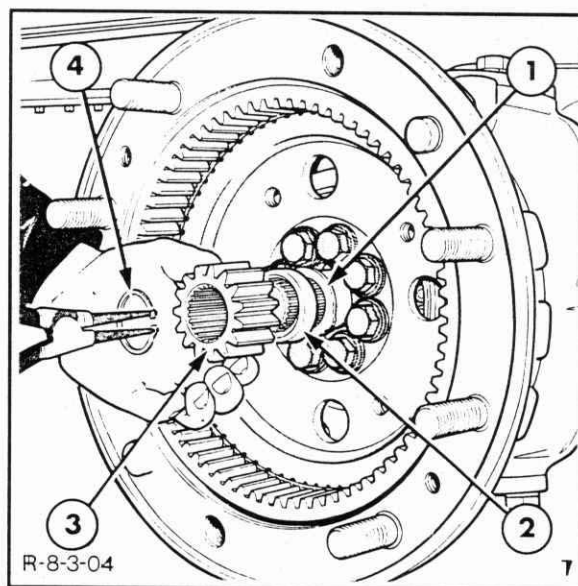


Figure 7-71

Removing Sun Gear Components

1. Thrust washer
2. Spacer
3. Sun gear
4. Snap ring

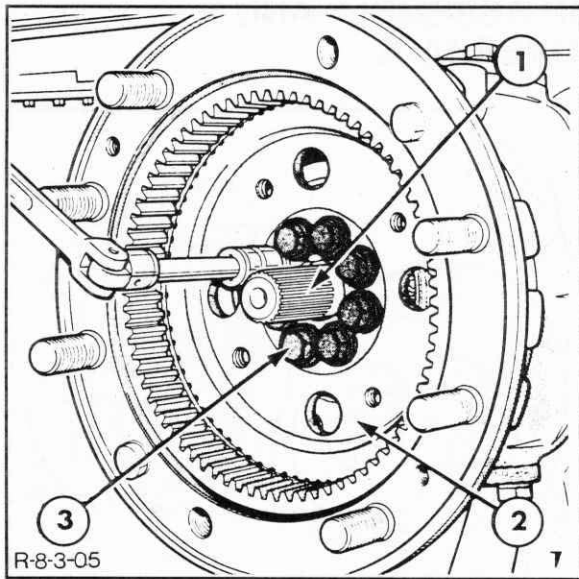


Figure 7-72

Ring Gear and Carrier Retaining Bolts

1. Axle shaft
2. Ring and carrier
3. Retaining bolts

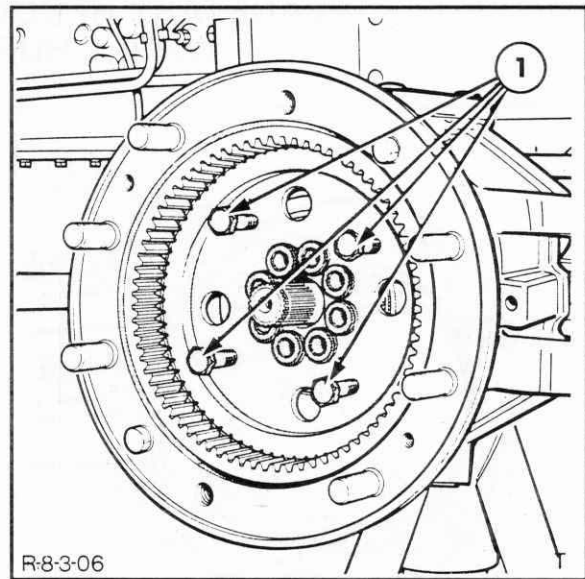


Figure 7-73

Using Jack Bolts To Withdraw Ring Gear and Carrier Assembly

1. Jack bolts

5. Gently tap the planetary carrier with a soft face mallet and, using the slots provided, lever the carrier from the hub.

Carefully withdraw the planetary carrier assembly, Figure 7-70. Take care not to misplace the thrust pad positioned in the center of the carrier.

6. Remove the sun gear retaining snap ring and remove the sun gear from the axle shaft, Figure 7-71, followed by the spacer and thrust washer.
7. Remove the eight ring gear and carrier assembly retaining bolts, Figure 7-72, and remove the assembly by installing 4 of the bolts into the threaded jacking holes in the rear gear. Tighten the bolts evenly to draw off the planetary ring gear, Figure 7-73.

8. Carefully pull off the hub assembly. If necessary, tap the hub using a soft-faced mallet on the rear face at equal spaces around periphery, Figure 7-74.

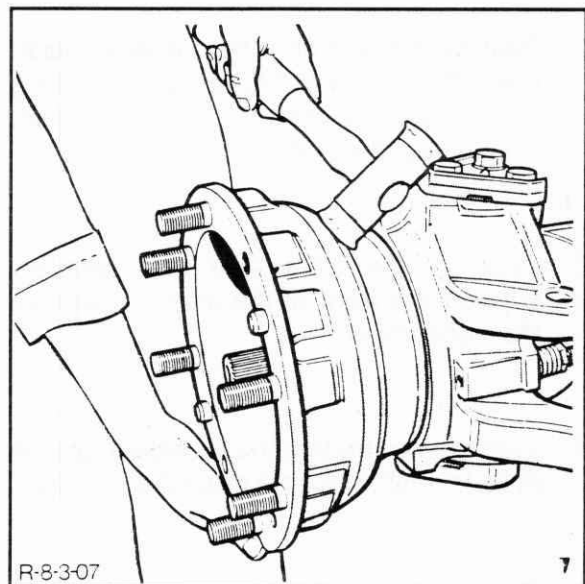


Figure 7-74

Removing Hub Assembly

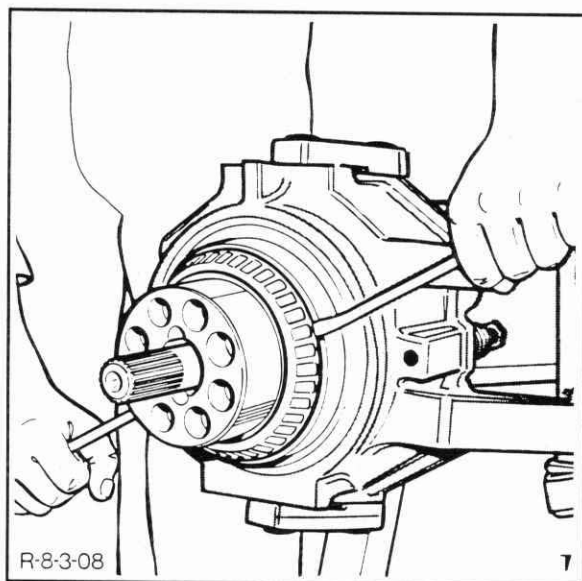


Figure 7-75
Levering Off Hub Inner Bearing

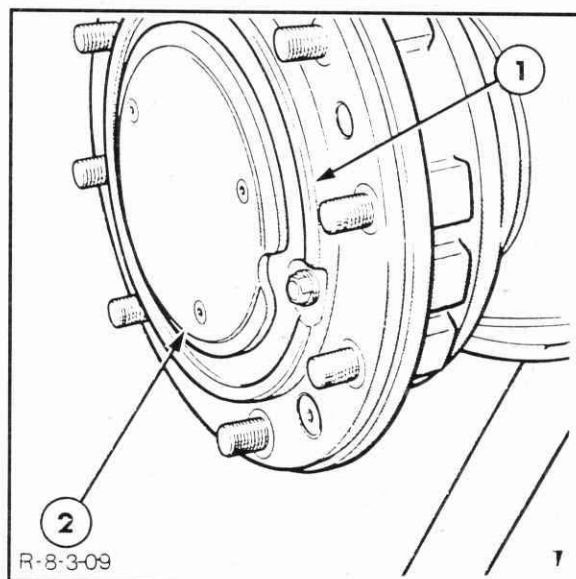


Figure 7-76
Carrier Housing Cover Plate

1. Carrier housing
2. Cover plate

9. Lever off the inner bearing inner track from the swivel casing, Figure 7-75.
10. Remove the oil seal from the inner side of the hub.

DISASSEMBLY

Planetary Carrier Assembly

1. Remove the planetary carrier outer cover plate screws and remove the cover plate, Figure 7-76.
2. Drive out the three roll pins, Figure 7-77, securing each shaft to the carrier. Push each shaft outward, out of the carrier, collecting from each shaft two thrust washers, the planetary gear, and the thirty bearing rollers.

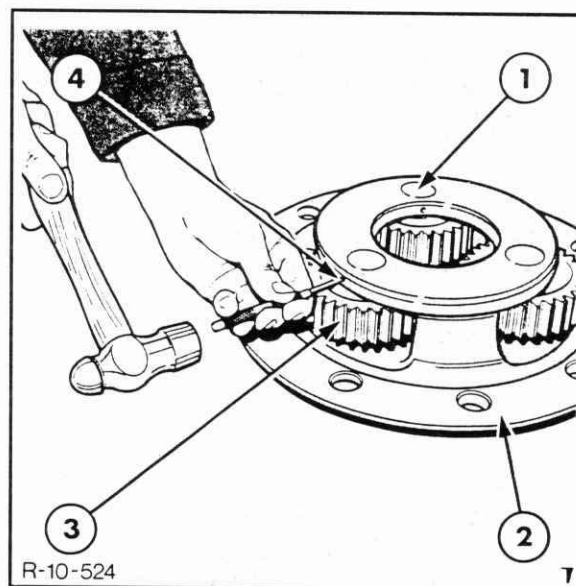


Figure 7-77
Removing Shaft Roll Pins

1. Shaft
2. Housing
3. Planet gear
4. Roll pin

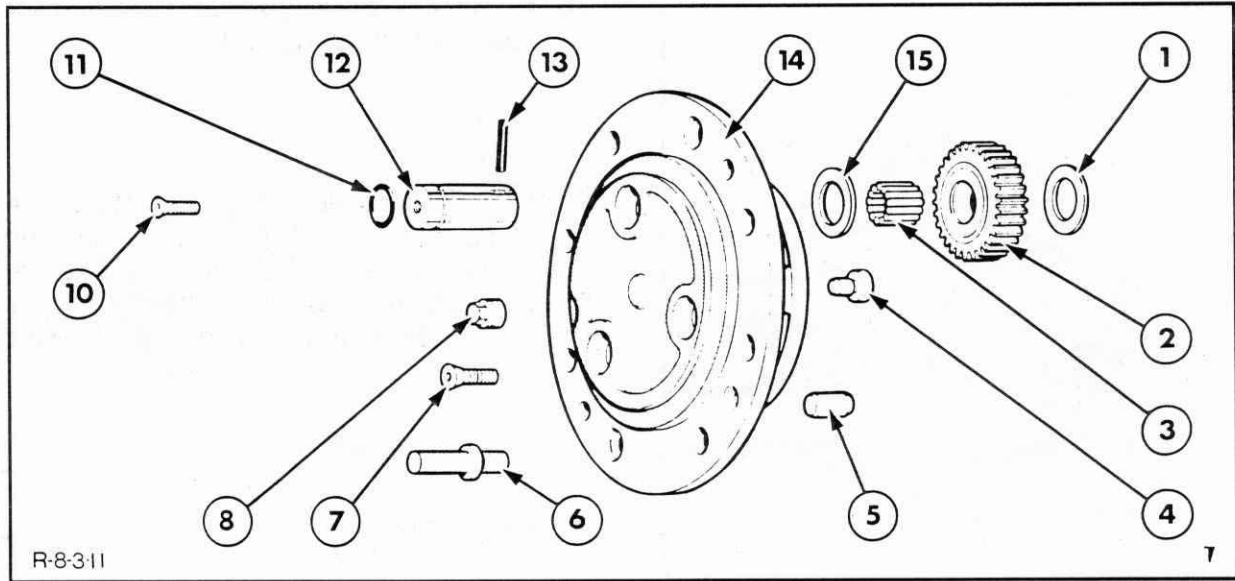


Figure 7-78

Planetary Carrier – Exploded View

- | | |
|---------------------------|-----------------------|
| 1. Thrust washer | 9. Cover plate |
| 2. Planet gear | 10. Retaining screw |
| 3. Needle roller bearings | 11. Shaft O ring seal |
| 4. Thrust pad | 12. Shaft |
| 5. Locating dowel | 13. Roll pin |
| 6. Shouldered wheel stud | 14. Carrier housing |
| 7. Carrier to hub screw | 15. Thrust washer |
| 8. Drain/filler plug | |

INSPECTION AND REPAIR

1. Wash all components in a suitable solvent and allow to air dry.
2. Inspect the hub main bearings - the outer tracks will still be in the hub housing. If these are worn, carefully drive them out of the housing using a suitable drift. Install new bearing outer tracks, carefully pressing in the tracks until they are fully seated.
3. Examine the planet gear bearing rollers and shafts. If wear is found, replace the complete planet gear shaft and bearing set. A worn bearing roller, or one which has picked up, will undoubtedly signify similar wear or damage to the bearing path inside the planet gear and to the planet gear shafts.

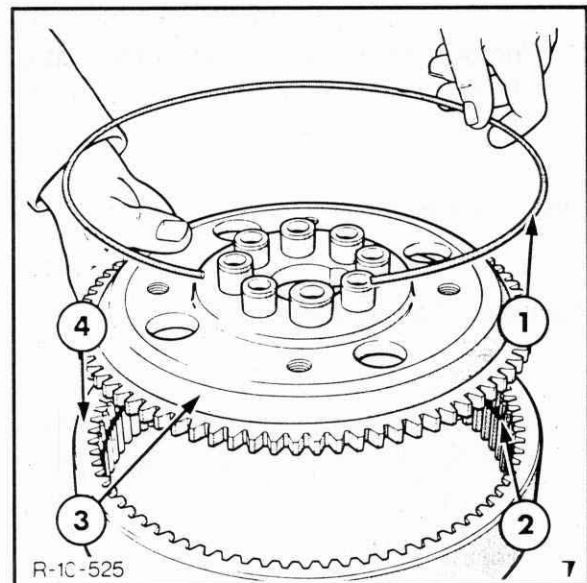


Figure 7-79

Ring Gear and Carrier

1. Retaining ring
2. Retaining ring
3. Carrier
4. Ring gear

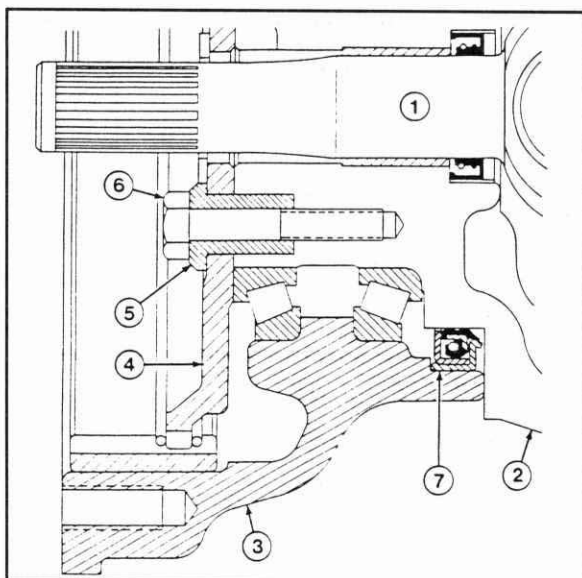


Figure 7-80

Ring Gear and Carrier Retention – Section View

1. Axle shaft
2. Swivel casing
3. Hub
4. Carrier
5. Locating bushing (7 x 20 mm + 1 x 24 mm)
6. Carrier retaining bolt
7. Cassette seal

4. Remove the carrier to ring gear retaining ring and separate the two components, Figure 7-79. Carefully inspect the ring gear teeth for wear.

5. Examine the ring gear carrier to swivel hub locating bushings, Figure 7-80.

Examine these bushes for any damage caused by fretting, particularly if it was noticed that the bolts were below torque during disassembly.

NOTE: On each hub, there are two types: seven bushes have a diameter of 20 mm and one has a diameter of 24 mm. The larger one serves as a master locator, ensuring that the carrier can only be refitted in one position.

6. Examine the sun gear and planet gear teeth for wear or damage.

7. Carefully inspect the planet shaft cover to planet carrier mating surfaces and the planet carrier to hub mating surfaces. Minor nicks or burrs to these surfaces should be removed, using an abrasive stone.

REASSEMBLY

1. Reassemble the planetary carrier following the disassembly procedure in reverse. Ensure thirty bearing rollers are placed in each planet gear and new roll pins are used to secure the shafts to the housing.

2. Note sealant is not specified for the outer planet shaft cover. Sealing is effected by the shaft O rings.

INSTALLATION

1. Assemble the hub inner bearing onto the swivel casting. Carefully install a new oil seal into the hub. Ensure the seal is fully seated and concentric within the hub. A special tool FNH00290 is required for this operation.

2. Apply a slight amount of soapy water with a brush to the inner neoprene part of the seal and to the mating surface on the swivel housing.

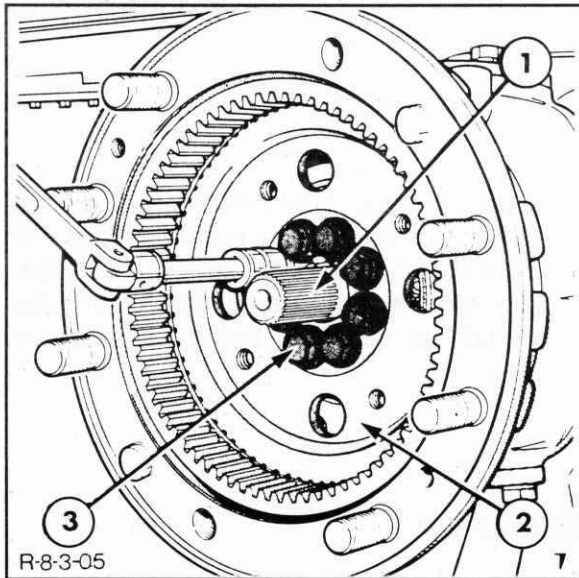
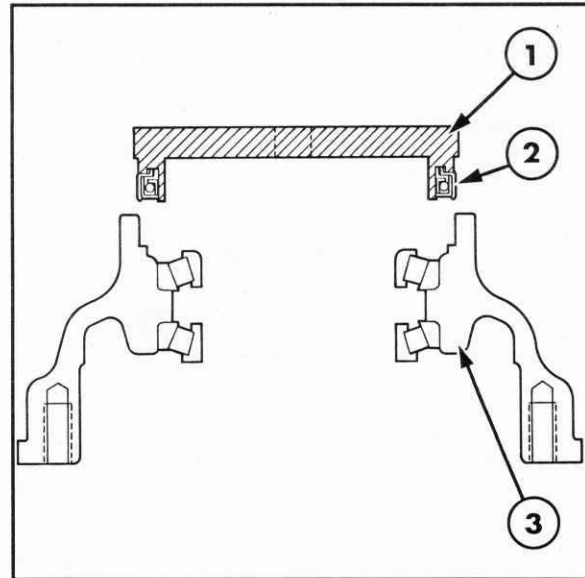


Figure 7-81

Tightening Ring Gear and Carrier Assembly Retaining Bolts

1. Axle shaft
2. Ring gear and carrier
3. Retaining bolts



Cassette Seal Installation

1. Seal installer
2. Cassette seal
3. Hub assembly

NOTE: Do not use oil or the seal will NOT adhere to the swivel housing and a leak will result.

3. Install the inner bearing.
4. Carefully assemble the hub to the swivel assembly.
5. Supporting the hub, slide in the outer bearing, maintain the hub in this position while fitting the ring gear and carrier.

NOTE: The hub bearings and the machining of the hub housing and swivel stub are held to fine limits and bearing preload/rolling resistance adjustment is not necessary.

6. Assemble the ring gear carrier to the ring gear with the wire-type locking rings. Ensure that the rings have not been deformed or damaged during disassembly.
7. Bolt the ring gear and carrier assembly to the swivel casing, Figure 7-84. Tighten the bolts, evenly in three stages, to 184 ft. lbs. (250 N·m) torque. A chart in the specification section outline all the bolt torque values for the FWD axle.
8. Install the sun gear/axle shaft thrust washer, spacer, and sun gear, Figure 7-82. Lock the sun gear to the axle shaft using a new snap ring.
9. Coat the mating surfaces of the planetary carrier and the hub with sealant, ESK-M4G269-A (loctite 518).

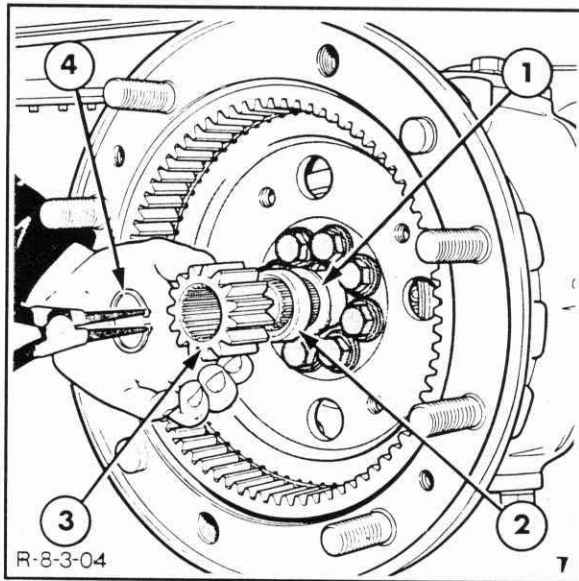


Figure 7-82

Installing Sun Gear Components

1. Thrust washer
2. Spacer
3. Sun gear
4. Snap ring

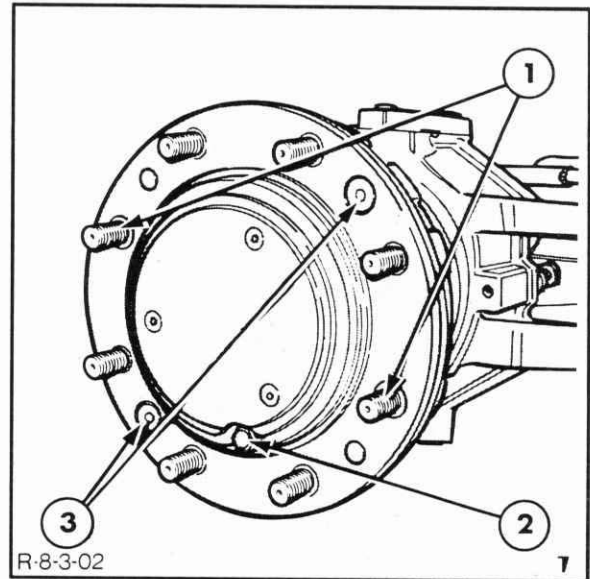


Figure 7-83

Installing Planetary Carrier Retainers

1. Shouldered studs
2. Filler/level plug
3. Socket screws

10. Ensuring that the thrust button is in place in the center of the carrier assembly, position the assembled planetary carrier to the hub and install the two retaining screws and the two special wheel studs, Figure 7-83. Tighten the screw and studs

to the torque specified: screw - 59 ft. lbs. (80 N·m); stud (2) - 51 ft. lbs. (70 N·m).

11. Position the combined filler/level plug on the horizontal plane and refill the hub with oil.

AXLE SHAFTS - OVERHAUL

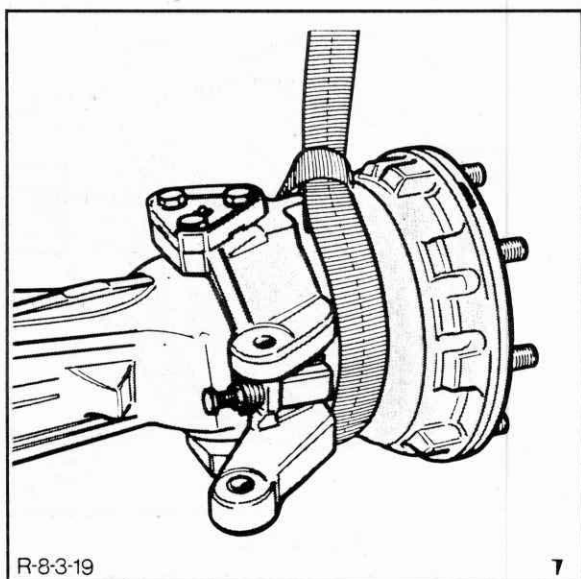


Figure 7-84

Hub and Swivel Assembly Supported By Sling

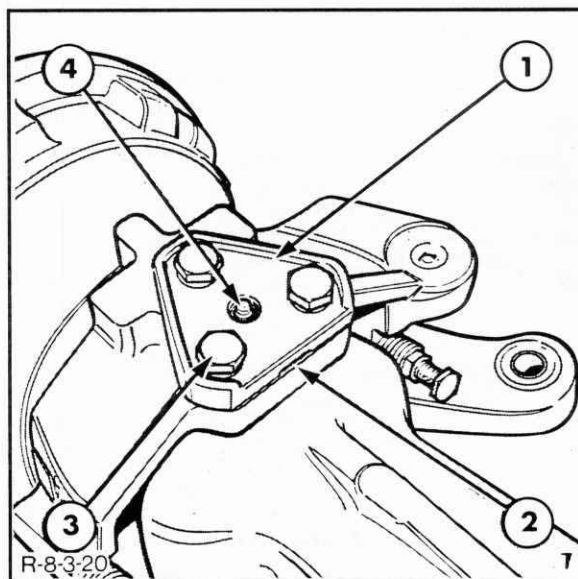


Figure 7-85

Upper Swivel Pin and Retaining Bolts

1. Swivel pin
2. Lever slot
3. Retaining bolts
4. Greaser

REMOVAL

1. Remove the planetary gear carrier assembly, sun gear, spacer and thrust washer as previously described under "Planetary Reduction Assembly And Wheel Hubs" - Overhaul.
2. Position a suitable sling around the hub and swivel casing, Figure 7-84.
3. Disconnect the track rod and steering cylinder, where necessary, from the steering control arm.
4. Remove the upper and lower swivel pin retaining bolts, Figure 7-85, and carefully lever the swivel pins and shims from the casing, noting the position of the shims. Identify the top pin and shims to aid reassembly.

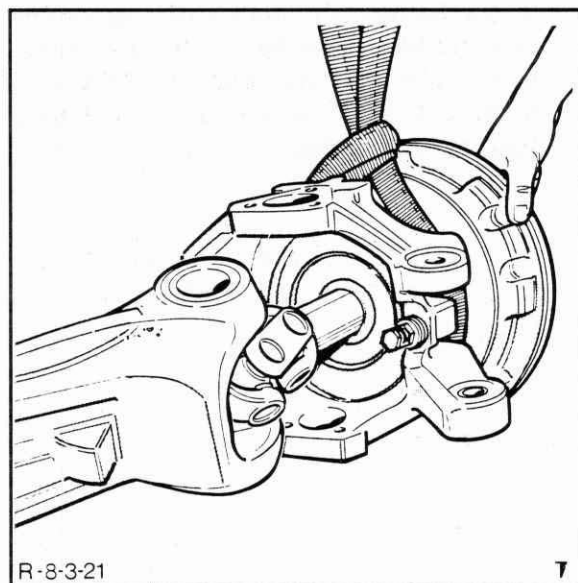


Figure 7-86

Removing Swivel Casing and Hub Assembly

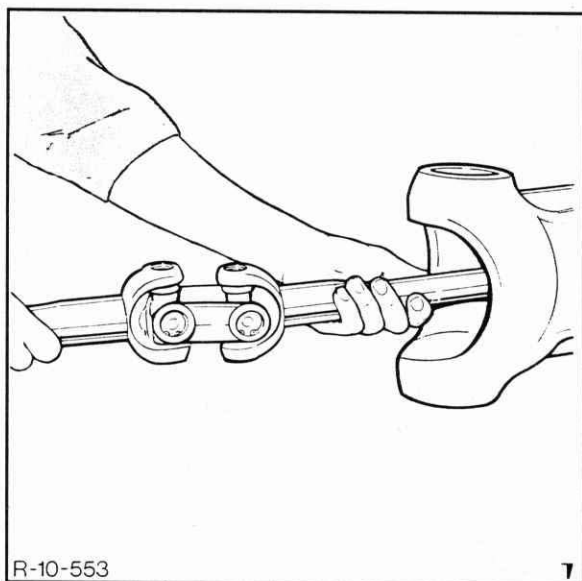


Figure 7-87

Withdrawing Axle Shaft From Axle Casing

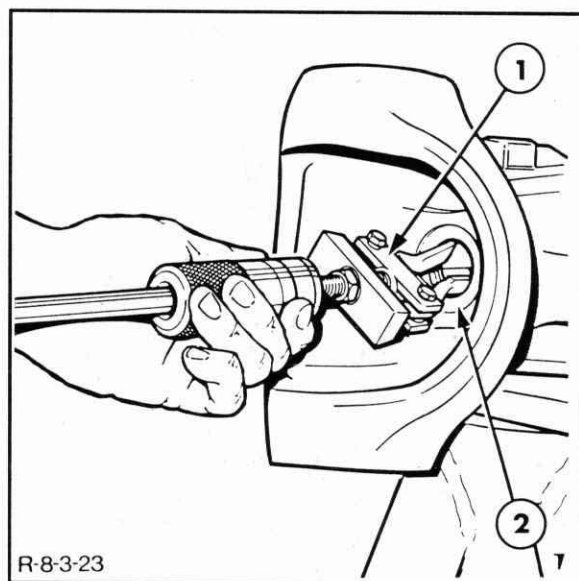


Figure 7-88

Removing Axle Shaft Oil Seal From Axle Casing

1. Puller tool no. 954C or 9508
2. Oil seal

5. Carefully ease the hub and swivel assembly from the axle center casing, Figure 7-86. Do not allow the axle shaft to be pulled from the center casing. As the hub and swivel casing assembly is moved away from the center casing, support the short outer end of the axle shaft as it passes through the seal.

actual joint and that the parent metal of the inner and outer yokes is not worn. Similarly, inspect the splined ends of the shafts for fretting or wear.

6. Very carefully pull the axle shaft from the axle casing, guiding it through the outer oil seal, Figure 7-87.

2. Inspect the bearing and seal journal areas for wear or damage.

DISASSEMBLY

1. Disassembly of the double universally-jointed axle shaft follows conventional practice and requires no special instruction. Before disassembly, read the following "Inspection And Repair" section.

INSPECTION AND REPAIR

1. Carefully inspect the universal joints and determine that wear is confined to the

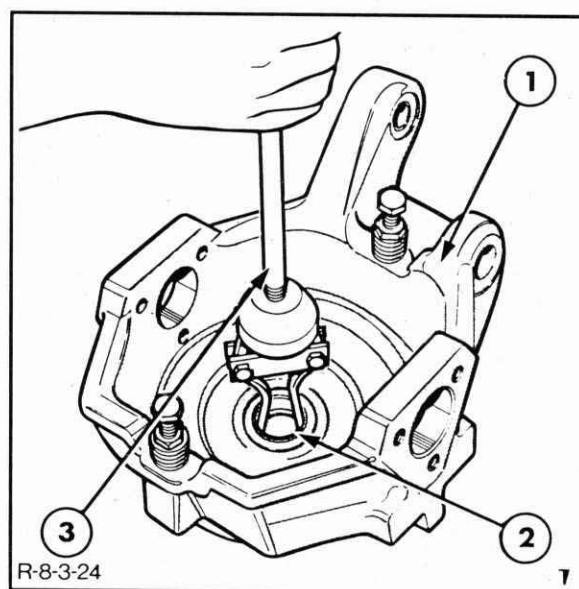


Figure 7-89

Removing Oil Seal From Swivel Casing

1. Swivel casing
2. Oil seal
3. Puller tool no. 954C or 9508

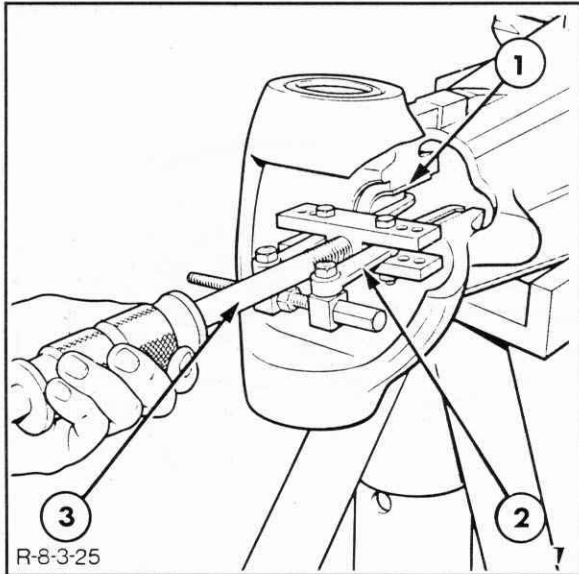


Figure 7-90

Removing Axle Shaft Bushing From Axle Casing

1. Bushing
2. Puller tool no. 943 or 9507
3. Slide hammer tool no. 943S or 9567

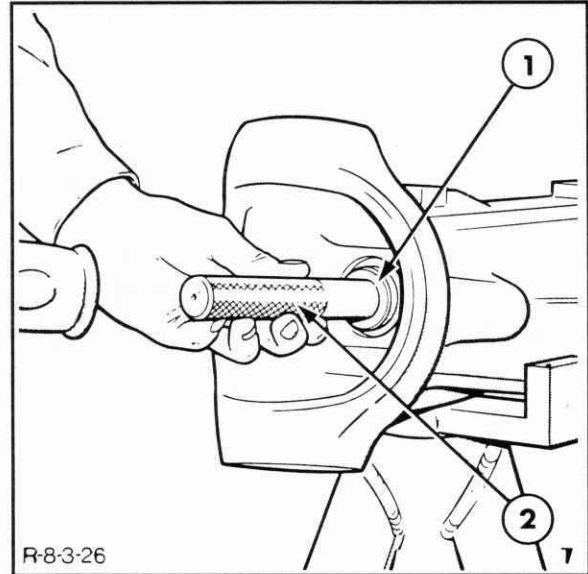


Figure 7-91

Installing Axle Shaft Bushing In Swivel Casing

1. Bushing installed FT. 3164 or 307974
2. Drive handle tool no. 550

3. If yoke parent metal and journals are undamaged and fit for further service, disassemble and universal joints as necessary. If damage is present, consider replacement of the complete axle shaft.
4. Remove the axle shaft oil seals from the axle center casing, Figure 7-88, and the swivel casing assembly, Figure 7-89.
5. Inspect the axle shaft bushings in the swivel casing and the axle center casing. If these bushings are worn or damaged, extract them using Tool No. 943 and 943S (9507 and 9567) or Tool No. 954C (9508), Figure 7-90.
6. Where necessary, drive in new bushings, Figure 7-91, using the following tools with driver handle No. 550:

Swivel Hubs - FT.3164 (307974) Axle Center Casing - FT.3165 (307975)

Ensure the bushings are fully seated.

7. Install new oil seals to the swivel casing and axle center casing using driver handle No. 550 and FT.3162 (307972), Figure 7-92.

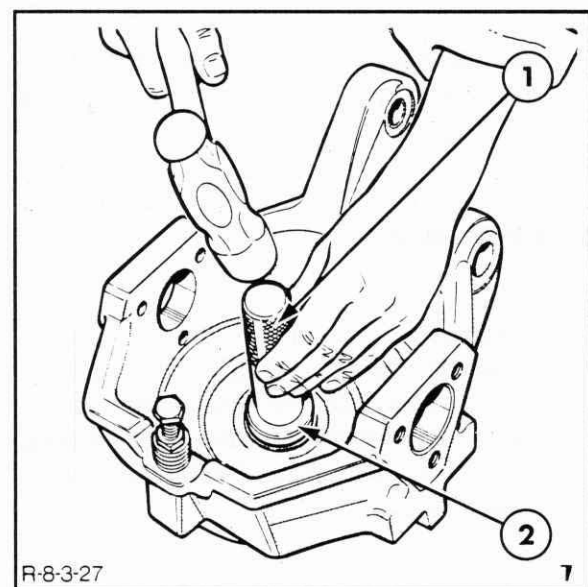


Figure 7-92

Installing Oil Seal in Swivel Casing

1. Driver handle tool no. 550
2. Oil seal installer tool no. FT 3162 or 307972

SECTION 7

Ensure the seals are positioned squarely.

shaft through the center of the casing that the oil seal is not damaged.

REASSEMBLY

1. Reassemble the axle shaft universal joints following established techniques. Take great care that each bearing cup is installed without disturbing the bearing rollers and that the new snap rings can be installed positively in their grooves.
4. Install the swivel pins and shims, ensuring that the same shims removed are replaced in exactly the same location. If any doubt exists as to the correct position, refer to the following heading covering "Steering Swivel Pin Bearings - Overhaul."

INSTALLATION

1. Lubricate the bushing and oil seal in the axle casing and swivel casing using a good quality grease.
2. Carefully pass the axle shaft through the center casing bushing and locate it into the differential side gear. Ensure that the oil seal is not damaged during this operation.
3. Locate the swivel casing onto the axle casing, taking care when passing the axle
5. Tighten the swivel pin retaining bolts to 100 ft. lbs. (137 N·m) torque.
6. Install the sun gear thrust washer, spacer, and sun gear. Lock the sun gear to the axle shaft using a new snap ring. Reassemble the planetary gear carrier to the hub assembly, following the removal procedure in reverse.
7. Fill the hub assembly with oil. Check the differential oil and grease the swivel bearings.

STEERING SWIVEL PIN BEARINGS - OVERHAUL

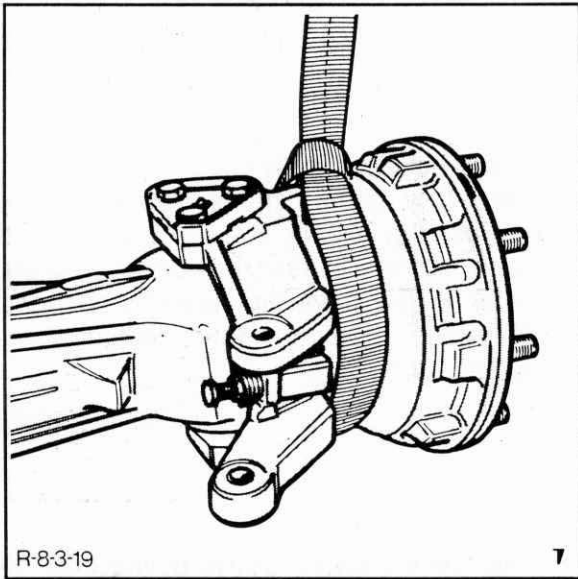


Figure 7-93

Hub And Swivel Assembly Supported By Sling

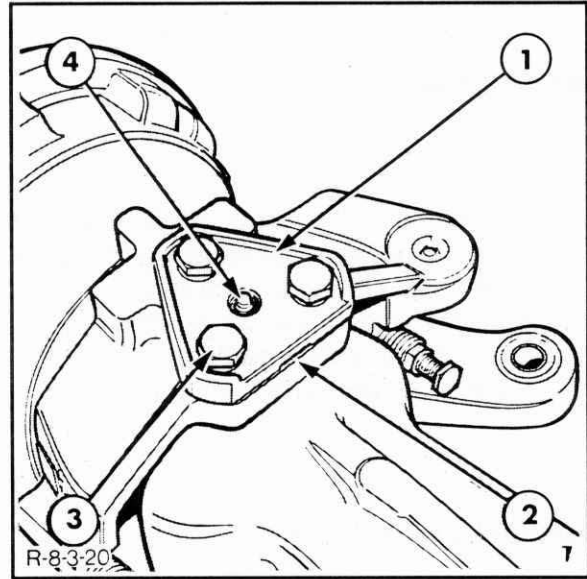


Figure 7-94

Upper Swivel Pin And Retaining Bolts

1. Swivel pin
2. Lever slot
3. Retaining bolts
4. Greaser

REMOVAL

1. Position the tractor on a hard level surface, lower the loader arms, and raise the front wheel. Securely support the tractor in this position and remove the front wheel.
2. Remove the planetary gear carrier assembly, sun gear, spacer, and thrust washer, as previously described under the heading "Planetary Reduction Assembly And Wheel Hubs - Overhaul."
3. Disconnect the steering track rod and steering cylinder, where applicable, from the steering arm.
4. Support the hub and planetary carrier assembly using a crane and sling, Figure 7-93.

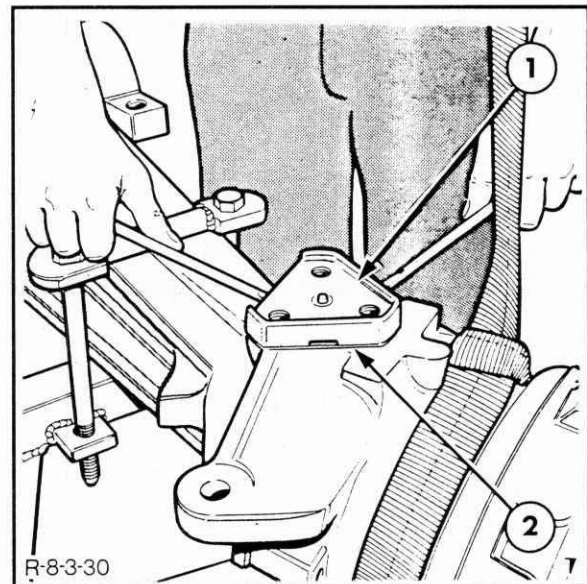


Figure 7-95

Removing Upper Swivel Pin

1. Swivel pin
2. Shim

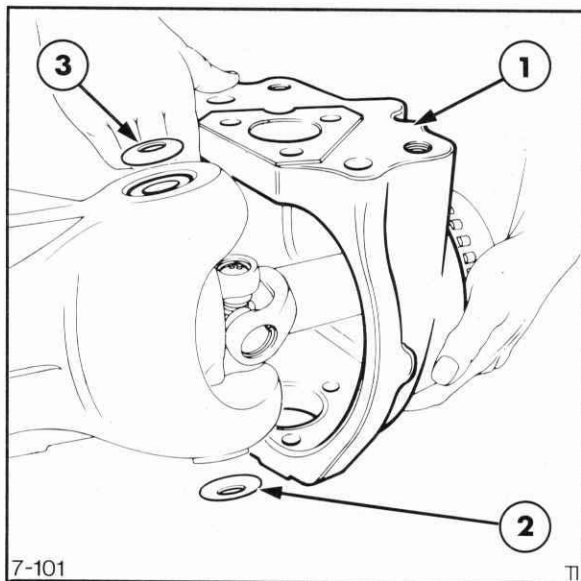


Figure 7-96

Removing Swivel Hub

1. Swivel Hub
2. Belleville Washer, Thin, Where Fitted
3. Belleville Washer, Thick, Where Fitted

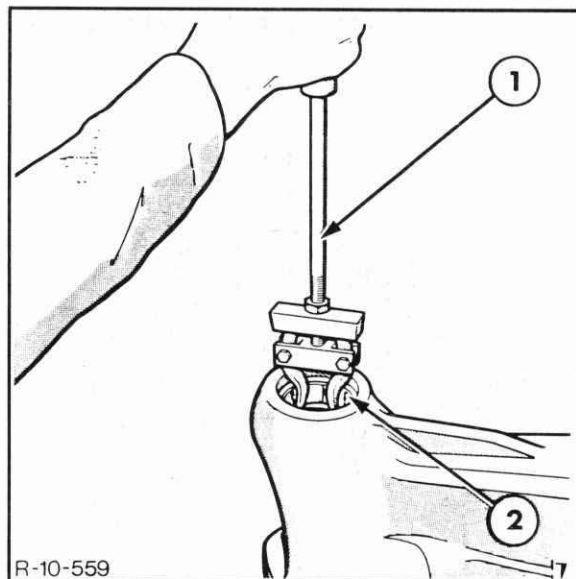


Figure 7-97

Removing Swivel Pin Bearing Outer Cup

1. Slide hammer tool no. 9435 or 9567
2. Outer race

5. Remove the upper and lower swivel pin retaining bolts, Figure 7-94, and carefully level the swivel pins from the casing, noting the position of the shims. Identify the top pin and shims and the bottom pin and shims, Figure 7-95.
6. Carefully ease the hub and swivel casing assembly from the axle center casing, Figure 7-96. Do not allow the axle shaft to be pulled from the center casing.

As the hub and swivel casing assembly is moved away from the center casing, support the short outer end of the axle shaft as it passes through the seal.

DISASSEMBLY

1. Using puller tool No. 943 and 943C (9507 and 9567), or 954C (9508), extract the outer bearing race from the axle center casing, Figure 7-97.

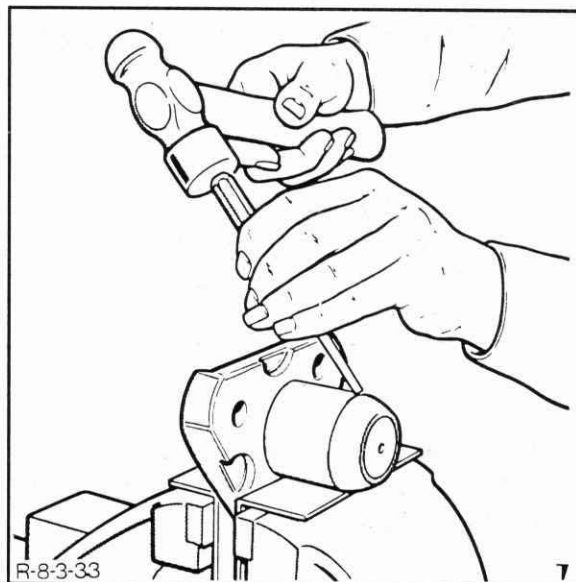


Figure 7-98

Removing Swivel Pin Bearing Cone

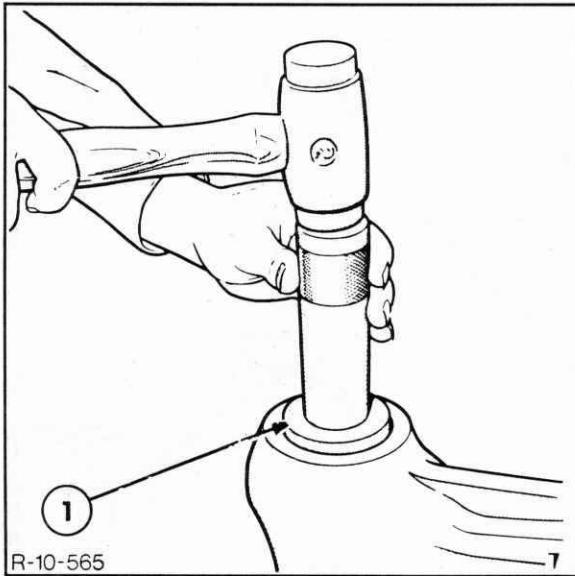


Figure 7-99

Installing Swivel pin Bearing Outer Race

1. Suitable driver tool

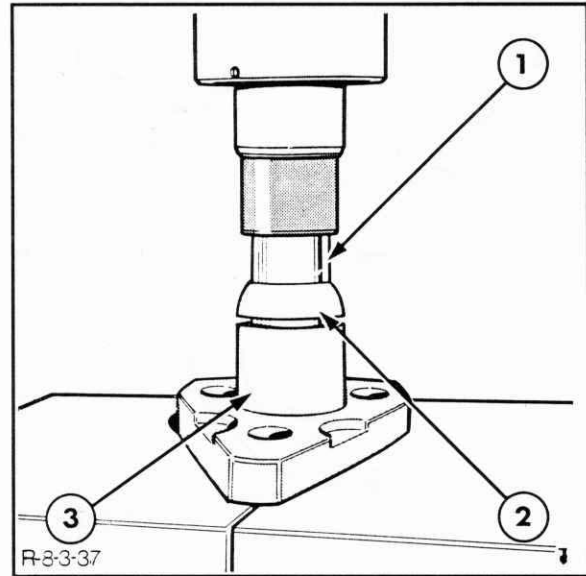


Figure 7-100

Pressing Swivel Pin Bearing Cone Onto Pin

1. Spacer block
2. Bearing cone
3. Swivel pin

2. Using a suitable drift, drive the cone half of the swivel bearing off each pin, Figure 7-98.

INSPECTION

1. Thoroughly clean all parts, including the ends of the axle center casing.
2. Inspect the axle shaft oil seal in the swivel casing. If this was damaged during disassembly or is worn, replace the seal, as described under the heading "Axle Shafts - Inspection And Repair."
3. Be sure that the grease zerks are in good condition and that the grease channels are not blocked.

REASSEMBLY

1. Drive in new bearing outer race to the upper and lower locations on the ends of the axle center casing using a suitable driver, Figure 7-99.

NOTE: It may be necessary to heat the axle casing the chill the bearing to aid installation.

2. Press on new cone halves onto the swivel pins, ensuring that they are fully seated, Figure 7-100.

INSTALLATION

1. Carefully reposition the hub and swivel casing onto the axle shaft and to its location on the axle center casing. Ensure that the axle shaft does not damage the seal as it passes through the swivel casing. Locating the belleville washers during re assembly, Figure 7-101.

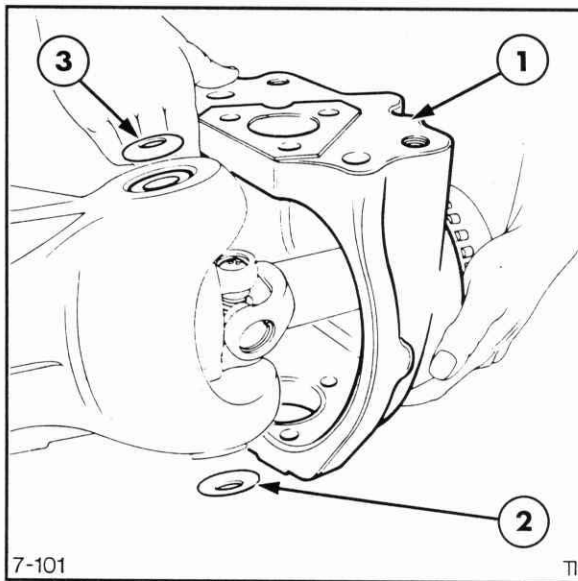


Figure 7-101

Removing Swivel Hub

1. Swivel Hub
2. Belleville Washer, Thin, Where Fitted
3. Belleville Washer, Thick, Where Fitted

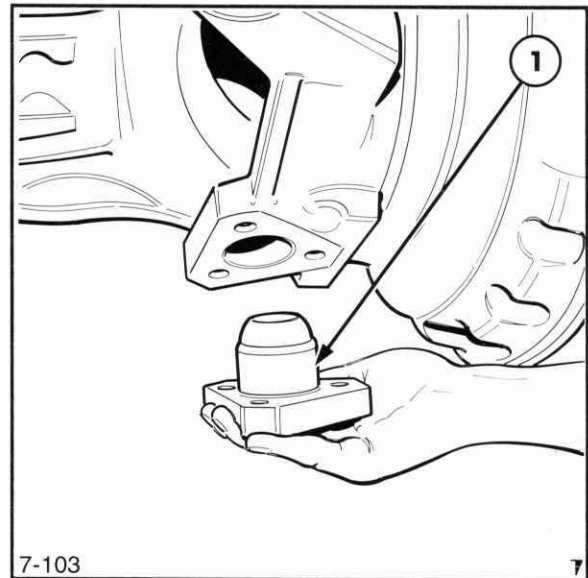


Figure 7-102

Lower Swivel Pin

1. Swivel pin

2. Refit swivel pin and attaching bolts, Figure 7-102.

the hub assembly, following the removal procedure in reverse.

3. Grease the swivel pins with grease.

5. Fill the hub(s) with the specified oil.

4. Reinstall the axle shaft thrust washer spacer and sun gear. Lock the sun gear to the axle shaft, using a new snap ring and reassemble the planetary gear carriage to

6. Reconnect the track rod end to the steering arm and tighten the retaining bolt to 220 ft. lbs. (300 N·m).

STEERING CYLINDER AND TRACK CONTROL ROD - OVERHAUL

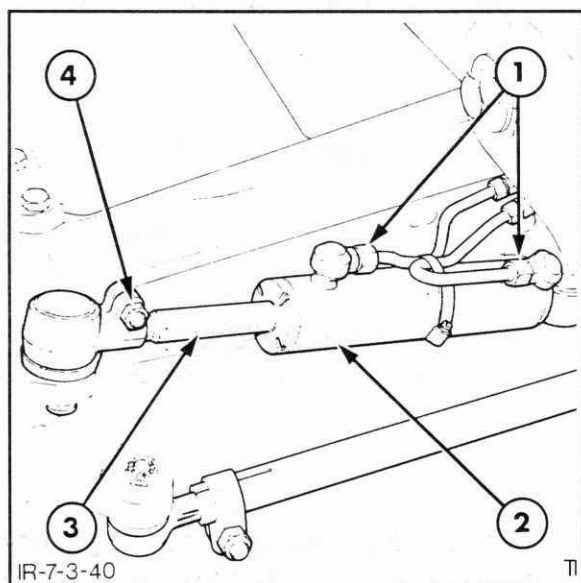


Figure 7-103

Steering Cylinder Installation

1. Hydraulic steering connections
2. Steering cylinder
3. Cylinder rod
4. Ball joint clamp bolt

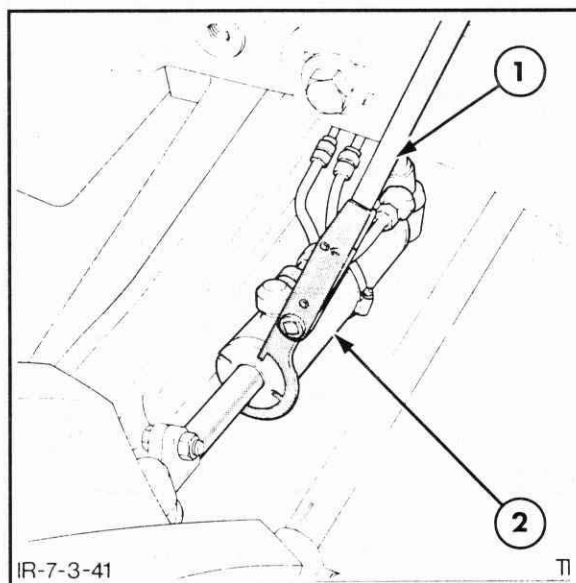


Figure 7-104

Releasing Steering Cylinder Gland

1. Wrench
2. 'C' Spanner tool no. FT 3171
3. Gland

REMOVAL

1. Position the tractor on a hard level surface.
2. Thoroughly clean the area around the cylinder to prevent contamination of the steering system during removal.
3. Disconnect the hydraulic steering connections to the cylinder, Figure 7-103, and cap the open ends of the connections. Remove the hose clip securing the tubes to the cylinder.
4. To aid disassembly of the cylinder after removal from unit, use "C" spanner special tool no. FT3171 and a suitable wrench to release the gland from the cylinder, Figure 7-104.
5. Remove the steering cylinder rod to ball joint clamping bolt and, using a spanner on the flats on the end of the cylinder rod, loosen the ball joint.
6. Disconnect the steering cylinder ball joints from the steering arm and cylinder anchor.
7. Withdraw the steering cylinder assembly from the axle.
8. Where overhaul of the ball joints, on either end of the track control rod connecting the axle swivel hubs, are required. the ball joints are disconnected and removed using established overhaul procedures.

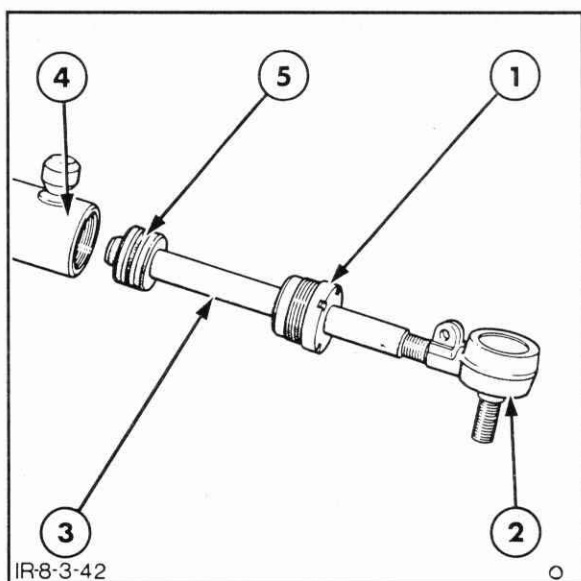


Figure 7-105

Cylinder Rod and Piston Assembly

1. Ball joint
2. Gland
3. Cylinder rod
4. Cylinder
5. Piston

3. Remove the wear rings, piston seal, and O ring from the piston and the O ring, oil seal, and wiper seal from the gland, Figure 7-108.

INSPECTION

1. Wash the cylinder components in a suitable solvent and allow to air dry.
2. Inspect the cylinder rod for damage. Any minor nicks or burrs may be removed using an abrasive stone.
3. Inspect the inside of the cylinder barrel for damage.

DISASSEMBLY

1. Unscrew the gland from the cylinder and withdraw the cylinder rod and piston assembly, Figure 7-105.
2. Unscrew the ball joint from the cylinder rod and withdraw the gland.

NOTE: The cylinder rod and barrel are not serviced as individual components. If either of these parts is damaged, the complete cylinder assembly must be replaced.

4. Inspect the cylinder rod ball joint for looseness. If any wear is evident, replace the joint.

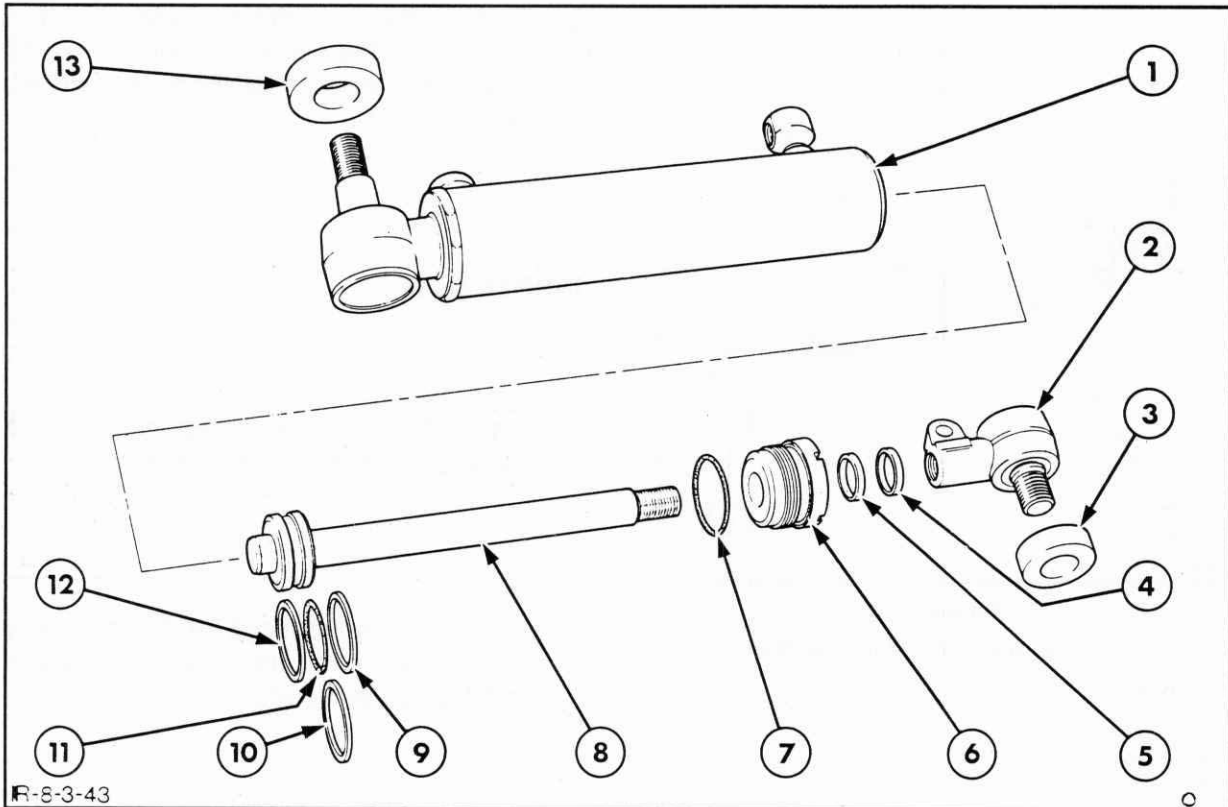


Figure 7-106
Steering Cylinder – Exploded View

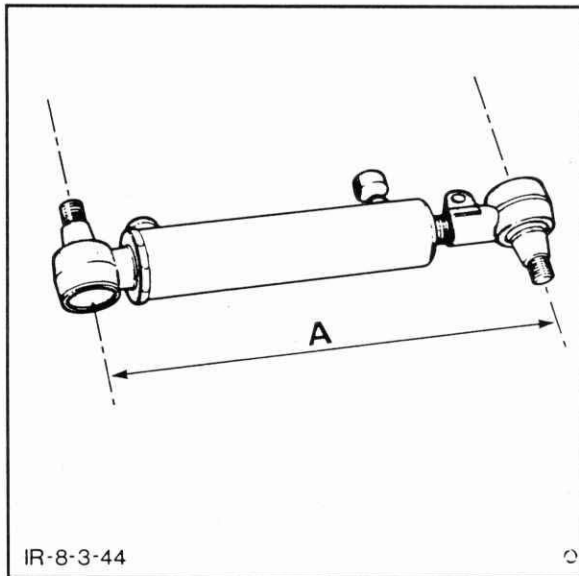
- | | |
|--------------------|--------------------------|
| 1. Cylinder barrel | 8. Cylinder rod |
| 2. Ball joint | 9. Wear ring |
| 3. Dust cover | 10. Seal |
| 4. Wiper | 11. Piston seal expander |
| 5. Rod seal | 12. Wear ring |
| 6. Gland | 13. Dust cover |
| 7. 'O' ring | |

REASSEMBLY

With Reference to Figure 7-106

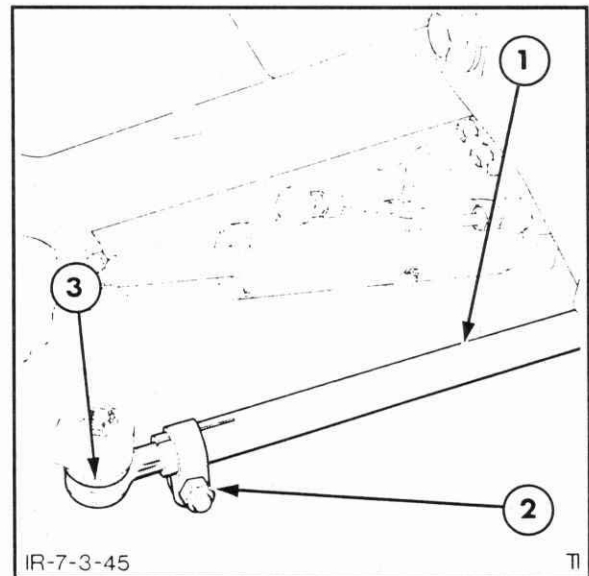
1. Install new piston seal expander (O-ring), piston seal, and wear rings on the piston.
2. Install a new rod seal in the groove in the gland. Be sure that the sealing lip faces towards pressure.
3. Install a new cylinder rod wiper seal and O-ring barrel seal into their respective locations on the gland.
4. Lubricate all seals and the piston and reassemble the piston and rod assembly into the cylinder barrel.

NOTE: Installation of the piston seal on top of the O-ring requires special care. Allow the seal to contract naturally before attempting to install the piston and rod assembly into the cylinder.

**Figure 7-107**

Steering Cylinder Ball Joint Adjustment

A. 15.875 in (403 mm)

**Figure 7-108**

Track Rod Adjustment

1. Track rod
2. Clamp bolt
3. Ball joint

5. To protect the gland seals during reassembly, apply masking tape to the threads of the cylinder rod. Install the gland and tighten using "C" spanner tool no. FT3171 and a suitable torque wrench to 190 ft. lbs. (258 N·m) torque.

Figure 7-107. Tighten the ball joint retaining bolt to 50 ft. lbs. (70 N·m) torque.

INSTALLATION

NOTE: Do not clamp the cylinder barrel when tightening the gland, as this will cause distortion. Instead, clamp the ball joint or tighten the gland after installing the cylinder onto the axle.

6. Remove the masking tape and loosely install the ball joint to the cylinder rod. Push the cylinder rod into the barrel until fully retracted and adjust the position of the ball joint until the specified distance between the centers of the ball joint studs on either end of the cylinder is achieved,
1. Installation of the steering cylinder follows the removal procedure in reverse.
2. Ensure all steering joints and ball joints are tightened to the specified torque.
3. Secure the steering cylinder line to the cylinder using a hose clip.
4. Fill the steering pump reservoir with 134D oil.

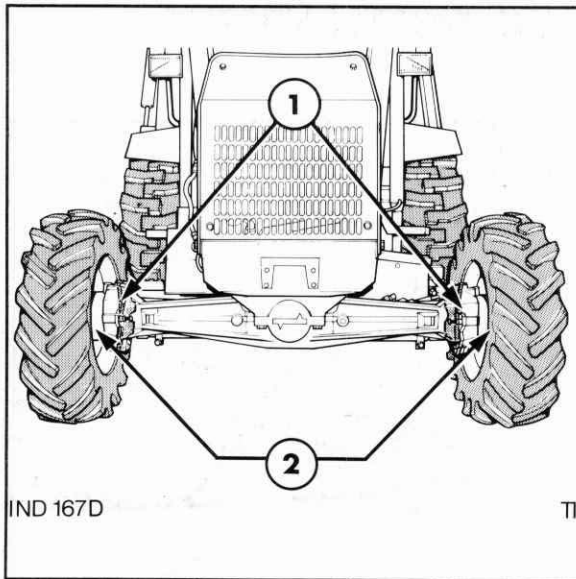


Figure 7-109
Toe-In Measurement

1. Rear measurement
2. Front measurement

5. Remove the air from the steering system. Refer to the previous section on bleeding the steering system.

6. Adjust and set the front wheel toe-in, 0 - 0.16 in. (0 - 4.0 mm), by adjusting the length of the track control rod. To adjust length of track rod, release clamp bolts on either end of rod, Figure 7-108, and turn rod as necessary.

After adjustment, tighten clamp bolts. Be sure that the toe-in measurement is made at the inside of each wheel rim and at hub height, Figure 7-109.

FRONT AXLE - REMOVAL AND INSTALLATION

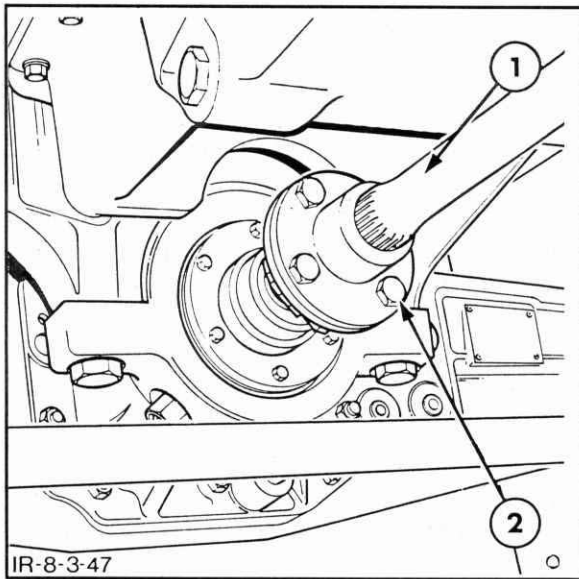


Figure 7-110

Drive Shaft to Axle Pinion Flange

1. Drive shaft
2. Drive flange bolt

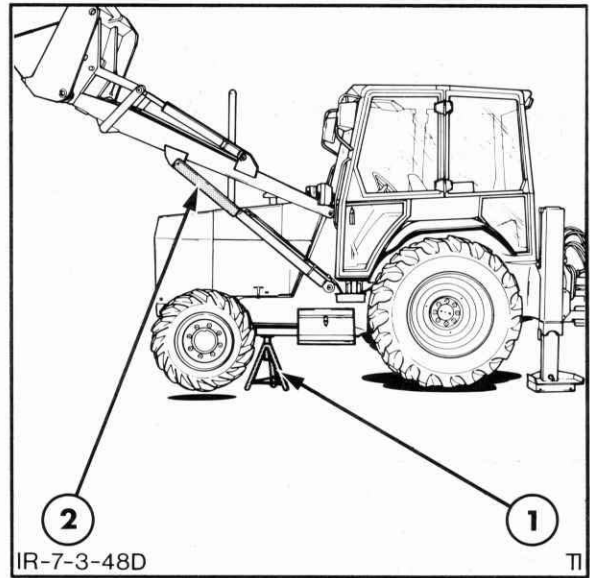


Figure 7-111

Front of Vehicle Supported Prior to Axle Removal

1. Axle stands
2. Safety support

REMOVAL

1. Position the tractor on a hard level surface, apply the parking brake, and block the rear wheels.
2. Remove the drive shaft guard retaining bolts and remove the guard.
3. Disconnect the drive shaft to axle pinion flange bolts, Figure 7-110.
4. Raise the front of the tractor so that both front wheels are clear of the ground and securely support the tractor on the loader subframe in a position clear of the front axle and wheels, Figure 7-111. Be sure

that the method of blocking and supporting the tractor is secure.

IMPORTANT: Be sure that the loader is raised and the safety support is engaged during this operation.

5. Remove the front wheels.
6. Disconnect the steering hydraulic hose connections and cap the ends.
7. Using suitable jacks or lifting equipment, and ensuring that the axle will be stable once the front and rear support pillars are removed, position such equipment to support the weight of the axle.

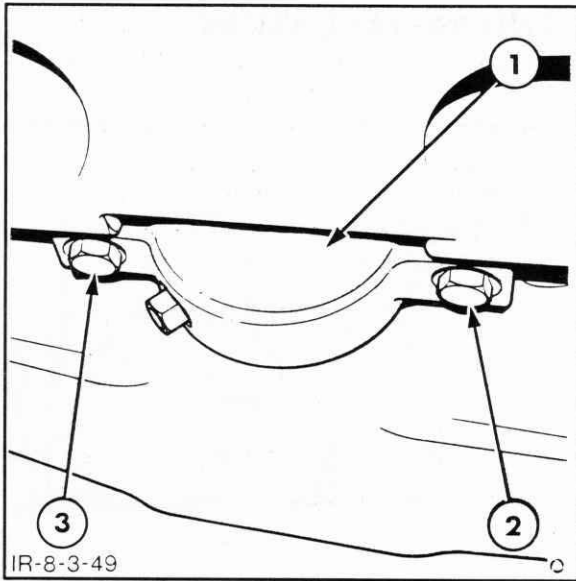


Figure 7-112

Front Support Pillar Retaining Bolts

1. Support pillar
2. Retaining bolt
3. Retaining bolt

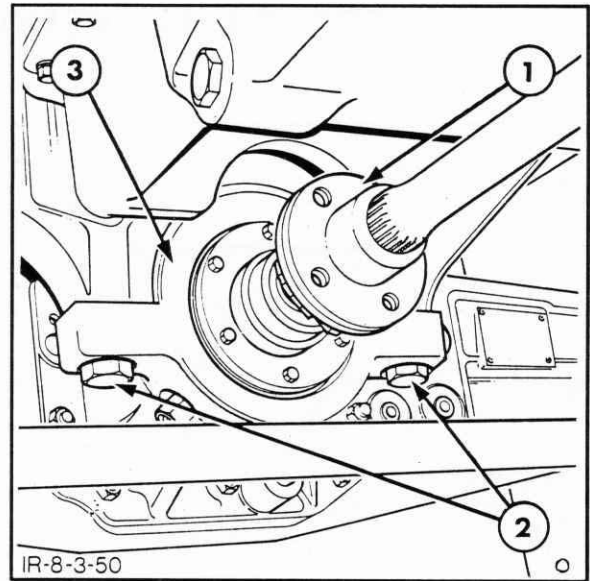


Figure 7-113

Rear Support Pillar Retaining Bolts

1. Pinion drive flange
2. Retaining bolts
3. Support pillar

8. Loosen both the front and rear support pillar retaining bolts, Figures 7-112 and 7-113. Equally and gradually, lower the jacks or lifting equipment, checking that the axle is stable and secure.

9. Remove the front and rear support retaining bolts and lower the axle to the ground.

INSPECTION

1. Remove the front and rear support pillars from the axle trunnions. Inspect the bushings on the front trunnion and the rear support bearing surface on the differential housing trunnion, Figure 7-114.

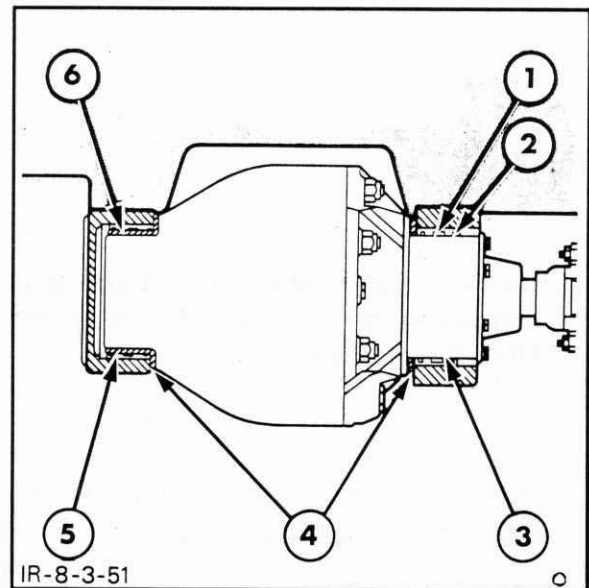


Figure 7-114

Front and Rear Support Pillar Installation

1. Rear support bushing
2. O ring seal
3. Rear support bearing surface
4. Thrust washers
5. Front support bushing
6. Front trunnion bushing

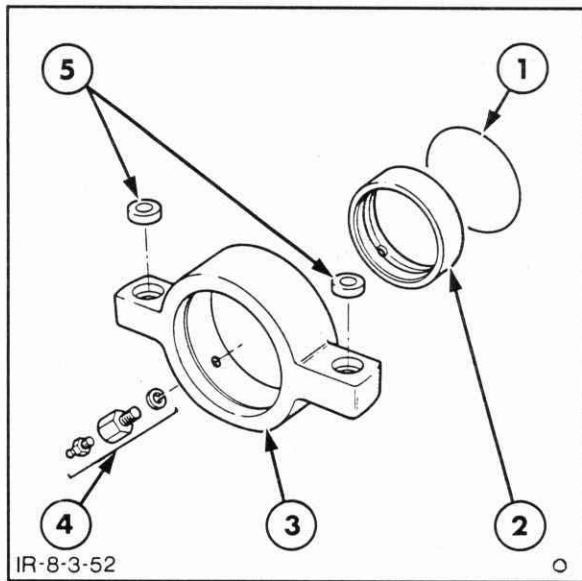


Figure 7-115

Rear Support Pillar Bushing and O Ring Seal

1. O ring seal
2. Bushing
3. Rear support pillar
4. Bushing locator and greaser
5. Locators (dowels)

2. Remove the O-ring seal from the bushing inside the rear support pillar, Figure 7-115. Clean all mating surfaces of the bushings and slide the front and rear supports back onto the front and rear trunnions. Assess the degree of wear by rocking the supports from side to side. If wear is excessive, bushings should be replaced.
3. To remove the bushings from the supports, first remove the locating bolt and greaser assembly. Remove the rear support bushing using a press. The front support bushing may require cutting to ease removal. Install new bushings, ensuring that the grease holes align with the drilling in each support and insert the special locating bolt and greaser assemblies.

4. Where necessary, draw off the bushing on the front axle trunnion. If necessary, cut the bushing longitudinally to ease removal. Install a new thrust washer and bushing by carefully driving the bushing onto the trunnion until it contacts the thrust washer.

INSTALLATION

1. Installation of the axle follows the removal procedure in reverse.
2. Apply thread locking sealant to the front and rear support pillar retaining bolts and tighten to 380 ft. lbs. (515 N·m) torque.
3. Lubricate the support pillar bushings with grease.
4. Tighten the drive shaft to axle pinion flange bolts to 42 ft. lbs. (57 N·m) torque.
5. Fill the steering pump reservoir with the correct type and grade of oil as discussed previously in this section.
6. Cycle the steering from lock to lock to purge any air from the circuit. Re-check the reservoir level.
7. Check and adjust the front wheel toe-in.
8. Check that when the axle is fully oscillated and on full left or right lock, the tires do not touch the sides of the tractor. Where necessary, adjust the steering stops on the swivel casings to limit the turning angle.

DIFFERENTIAL, RING GEAR AND PINION ASSEMBLY - OVERHAUL

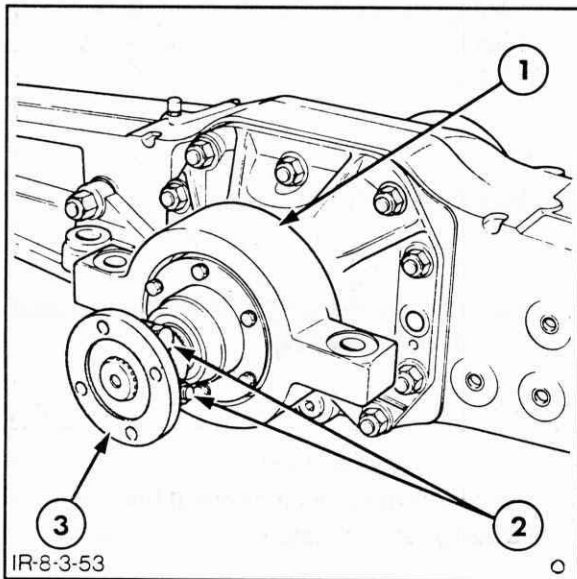


Figure 7-116

Pinion Drive Shaft Coupler

1. Rear support pillar
2. Coupler retaining bolts
3. Drive shaft coupler

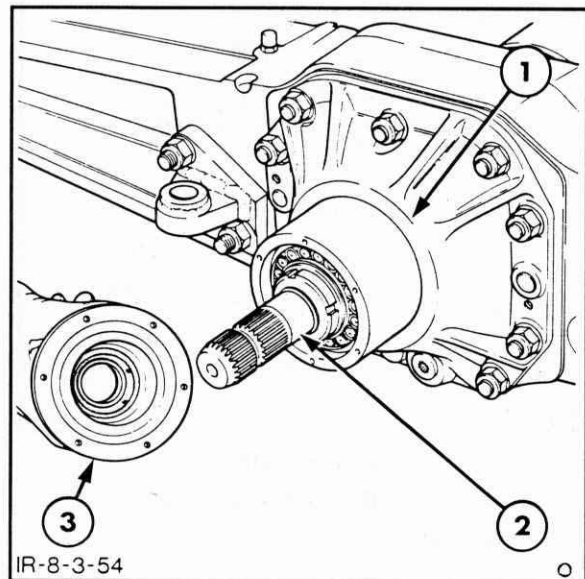


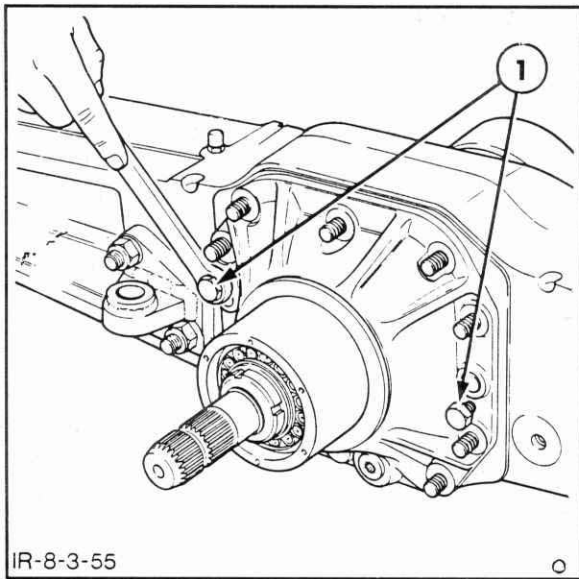
Figure 7-117

Removing Pinion Oil Seal Housing

1. Differential support housing
2. Pinion shaft
3. Pinion oil seal housing

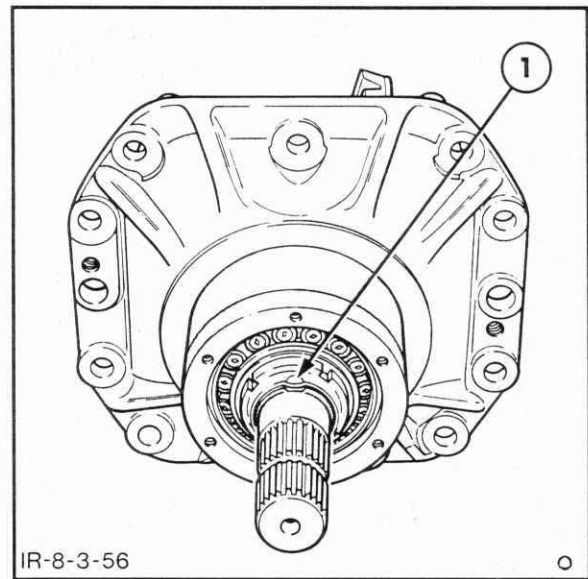
REMOVAL

1. Remove the axle assembly as described in this section and mount on a suitable stand to enable the differential assembly to be removed.
2. Drain the oil from the differential housing.
3. Disconnect and remove the track rod and steering cylinder.
4. Remove the two bolts securing the drive shaft coupler to the pinion shaft, Figure 7-116, and remove the coupler from the shaft.
5. Remove the rear support pillar from the trunnion on the differential support housing.
6. Remove the pinion oil seal housing retaining bolts and withdraw the housing from the pinion shaft, Figure 7-117. Removal of the oil seal housing at this stage improves handling of differential support housing during removal from axle.
7. Remove the swivel casings and axle shafts following the procedure described earlier in this section.
8. Remove the differential support to axle casing retaining bolts.

**Figure 7-118**

Removing Differential Support

1. Jacking bolts

**Figure 7-119**

Pinion and Bearing Retaining Nut

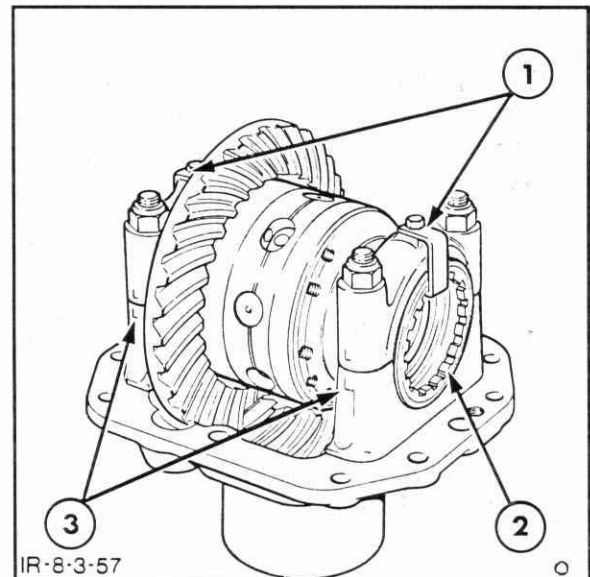
1. Retaining nut deformation

9. Install two M10 x 1.5 x 50 mm bolts in the threaded jacking holes in the differential support. Tighten the bolts evenly to push off the differential support assembly, Figure 7-118. Remove the differential support from the axle casing.

respective bores and to the position of each within its bore. This marking will assist reassembly if new components affecting bearing preload or crown wheel and pinion matching are not required.

DISASSEMBLY

1. Straighten the deformation on the edge of the pinion and bearing retaining nut which locks the nut to the pinion shaft, Figure 7-119.
2. Position a suitable piece of hard wood in mesh with the ring gear and pinion to effectively lock the two gears to facilitate removal of the pinion and bearing retaining nut.
3. Using tool no. FT.3168 (307978), remove the retaining nut and tabbed washer.
4. Carefully mark the bearing adjuster ring nuts, Figure 7-120, relative to their

**Figure 7-120**

Differential Support Assembly

1. Locking plates
2. Bearing adjuster ring nut
3. Bearing cap identification marks

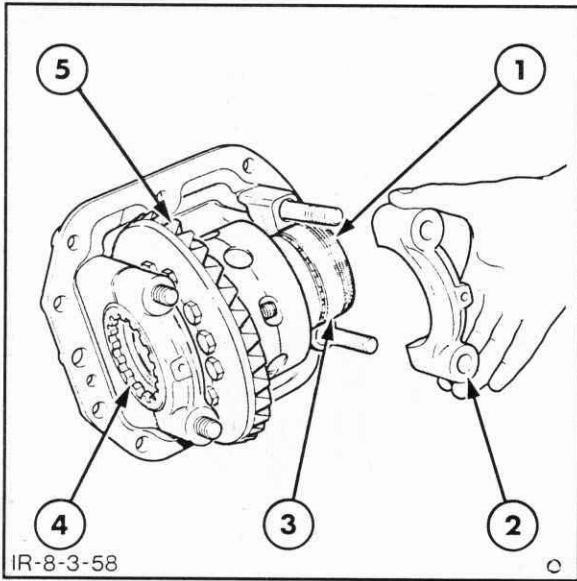


Figure 7-121

Removing Differential Bearing Caps

1. Bearing adjuster ring nut
2. Bearing cap
3. Bearing outer race
4. Bearing adjuster ring nut
5. Ring gear

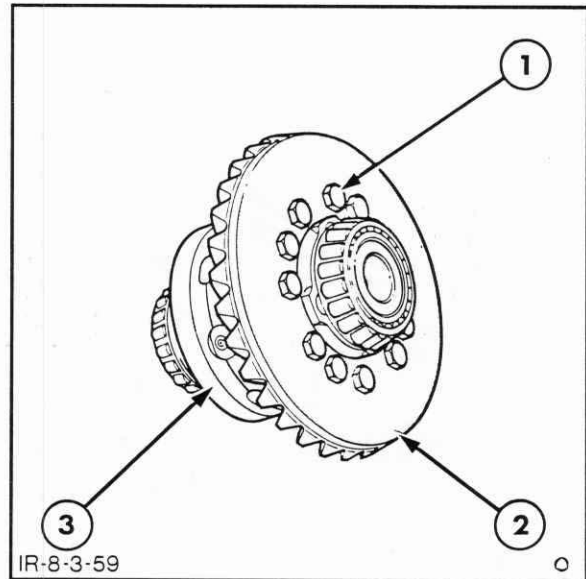


Figure 7-122

Differential and Ring Gear Assembly

1. Ring gear retaining bolts
2. Ring gear
3. Differential housing

5. Mark each bearing end cap in relation to the housing to ensure these are not interchanged during reassembly, Figure 7-120.
6. Remove the differential unit bearing adjuster ring nut locking plates.
7. Remove the bearing cap retaining nuts and caps, Figure 7-121.
8. Lift out the differential and ring gear assembly, Figure 7-122, from the support housing. Collect the bearing outer tracks and adjuster ring nuts. Identify each bearing track to its respective bearing.
9. Mark the two halves of the differential housing to ensure correct alignment on reassembly.
10. Support the differential and remove the ring gear retaining bolts.

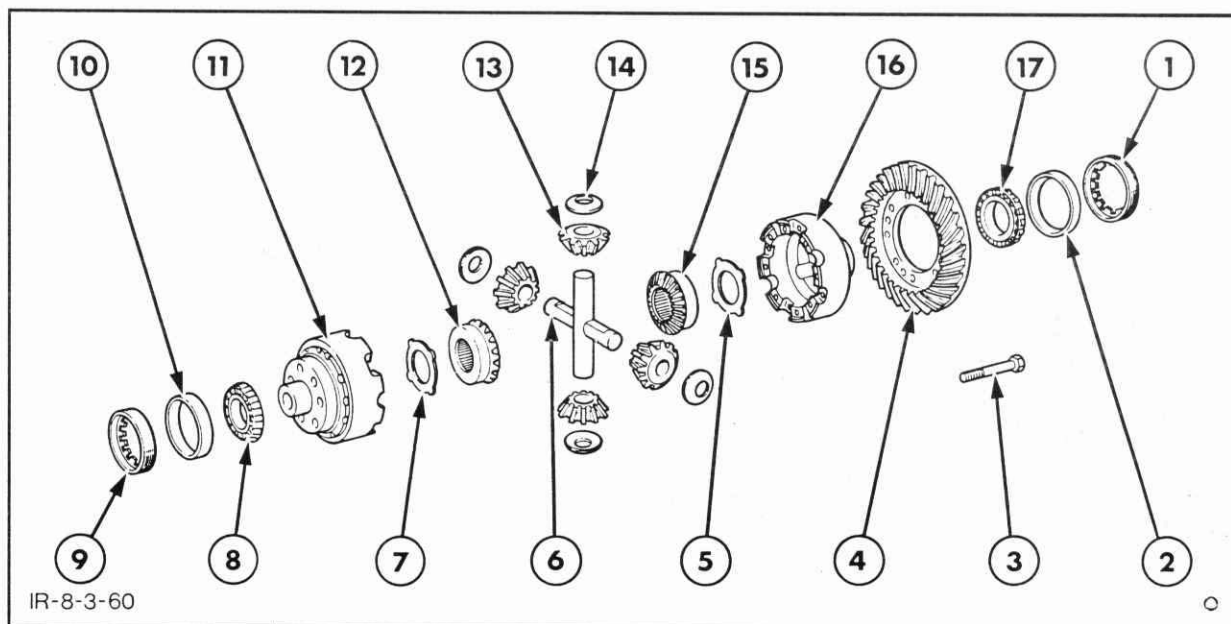


Figure 7-123

Differential and Ring Gear Assembly - Exploded View

- | | | | |
|------------------|-------------------|--------------------------|--------------------------|
| 1. Adjuster ring | 6. Shaft | 11. Differential housing | 16. Differential housing |
| 2. Bearing track | 7. Thrust washer | 12. Side gear | 17. Bearing |
| 3. Bolt | 8. Bearing | 13. Bevel gear | |
| 4. Ring gear | 9. Adjuster ring | 14. Thrust washer | |
| 5. Thrust washer | 10. Bearing track | 15. Side gear | |

11. Remove the crown wheel and separate the two halves of the differential housing. Refer to Figure 7-123.

12. Pry the bevel gear shafts from the separated differential housing and collect the four bevel gears and thrust washers and two side gears and thrust washers.

13. Drive the pinion from the differential support housing and collect the collapsible spacer and outer bearing inner race, Figure 7-124.

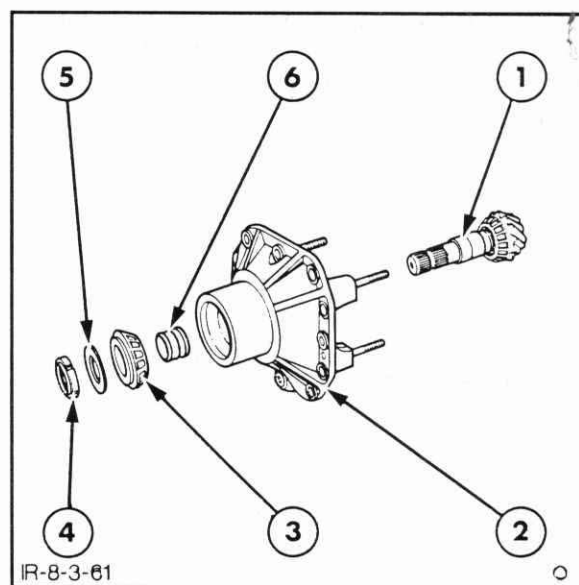


Figure 7-124

Drive Pinion Removed From Differential Support Housing

INSPECTION AND REPAIR

1. Clean all the components in a suitable solvent and allow to air dry.

1. Pinion and bearing
2. Support housing
3. Outer bearing
4. Retaining nut
5. Tabbed washer
6. Collapsible spacer

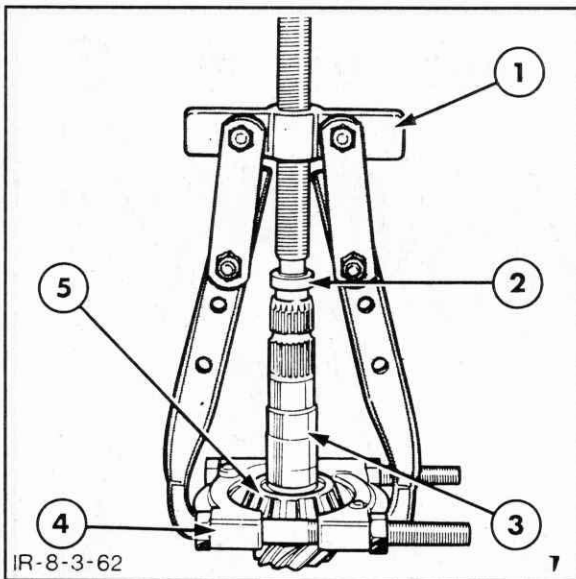


Figure 7-125

Removing Pinion Inner Bearing Race

1. Puller tool no. 1003 or 9516
2. Shaft protector
3. Pinion
4. Pulling attachment tool no. 951 or 9190
5. Bearing inner race

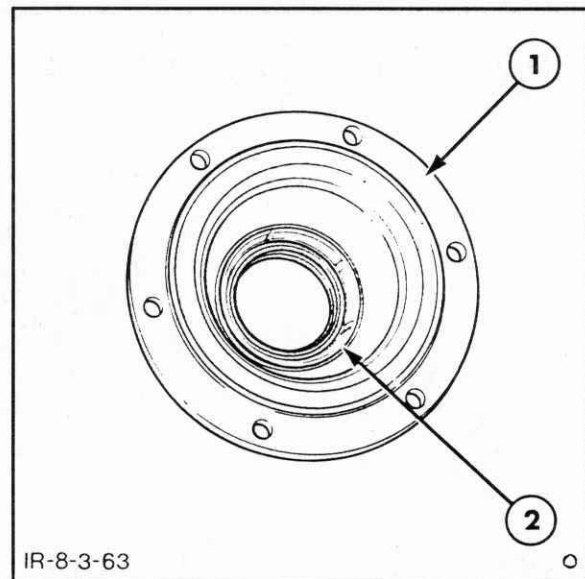


Figure 7-126

Pinion Oil Seal Housing

1. Housing
2. Oil seal

2. Clean all traces of locking compound from the ring gear securing bolts and any locating dowels.

3. Carefully inspect the ring gear and pinion teeth. If worn or damaged, both gears must be replaced. They are only serviced as a matched pair.

4. Inspect the differential side bearings. Where necessary, pull off the inner races using tool no. 1003 (9516) and tool no. 951 (9190).

5. Inspect the pinion bearings. Where necessary, remove the inner bearing inner race using tool nos. 951 and 1003 (9190 and 9516), Figure 7-125. Note that there is a shim positioned between the pinion inner bearing and the head of the

pinion. Drive out the outer race from the differential support housing.

6. Inspect the differential gears, thrust washers, and shaft for wear. Replace any worn or damaged items.

7. Inspect the side gears and the splines within each gear for damage.

8. Examine the thrust washer placed under the head of each side gear for wear and damage and replace if necessary.

9. Visually check the condition of the axle housing, the differential support housing, and the differential gear housing.

10. Remove and replace the oil seal in the pinion oil seal housing, Figure 7-126.

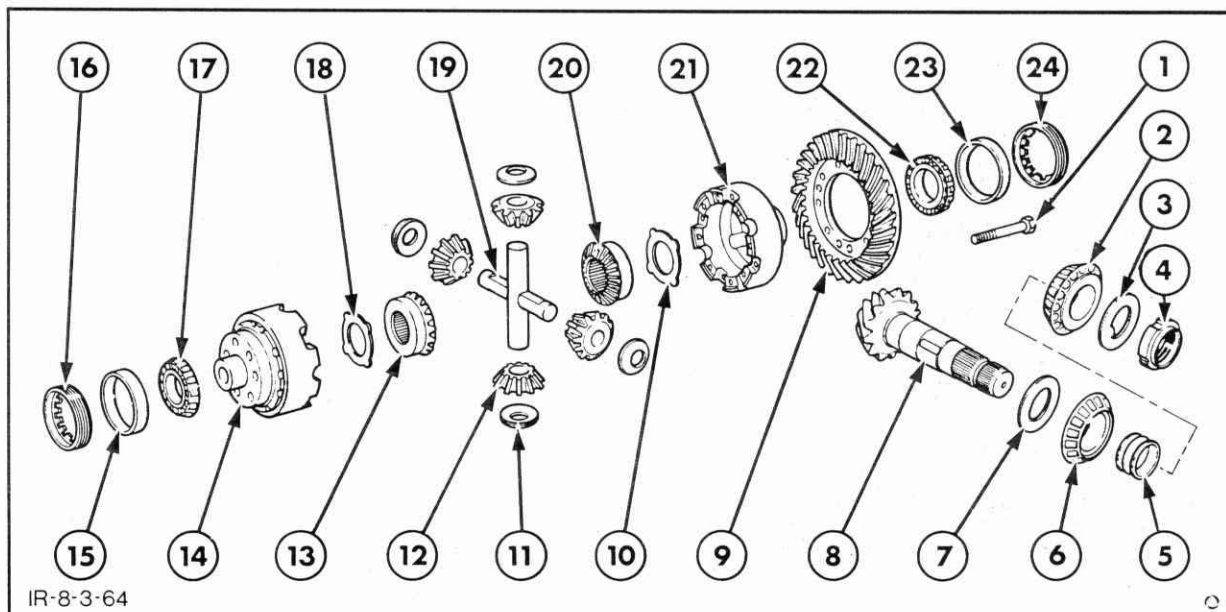


Figure 7-127

Differential, Ring Gear and Pinion Assembly - Exploded View

- | | | |
|-----------------------|--------------------------|--------------------------|
| 1. Bolt | 9. Ring gear | 17. Bearing |
| 2. Bearing | 10. Thrust washer | 18. Thrust washer |
| 3. Tabbed washer | 11. Thrust washer | 19. Shaft |
| 4. Retaining nut | 12. Bevel gear | 20. Side gear |
| 5. Collapsible spacer | 13. Side gear | 21. Differential housing |
| 6. Bearing | 14. Differential housing | 22. Bearing |
| 7. Shim | 15. Bearing track | 23. Bearing track |
| 8. Pinion | 16. Adjuster ring | 24. Adjuster ring |

REASSEMBLY

Calculate the shim thickness as follows:

With Reference to Figure 7-127

1. If the ring gear and pinion assembly or pinion bearings have been replaced or the differential support housing has been changed, it will be necessary to recalculate the thickness of shim placed behind the head of the drive pinion on the pinion shaft (the bevel distance). If all these components are reusable, then the drive pinion may be reinstalled in the differential support housing, using the same shim value as originally fitted.
 - a. Install the pinion bearings in the differential support housing, as shown in Figure 7-128, and lightly clamp the bearings using part of tool no. FT. 3135 (or 4775). Ensure the disc part of the tool with the cut-away side is uppermost. Tighten the clamp so that the bearing cones can just be turned by hand - do not overtighten.
 - b. Install the differential support housing bearing caps (not the bearing races) and tighten the cap retaining nuts to 115 ft. lbs. (156 N·m) torque.

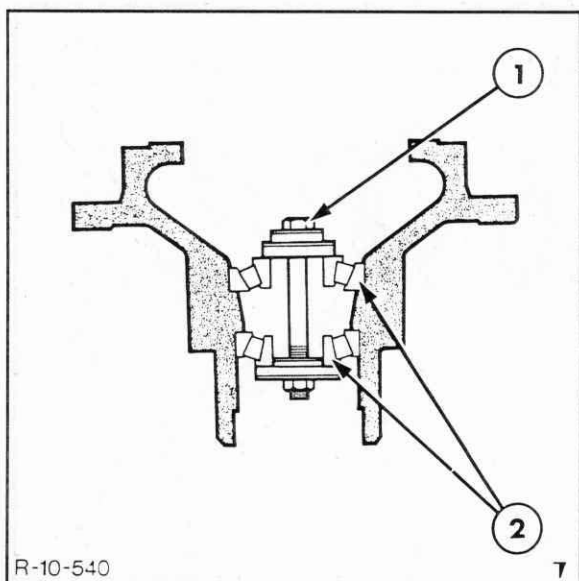


Figure 7-128

Pinion Bearings Clamped in Housing

1. Part of pinion setting gauge tool no. FT.3135 or 4775
2. Pinion bearing assemblies

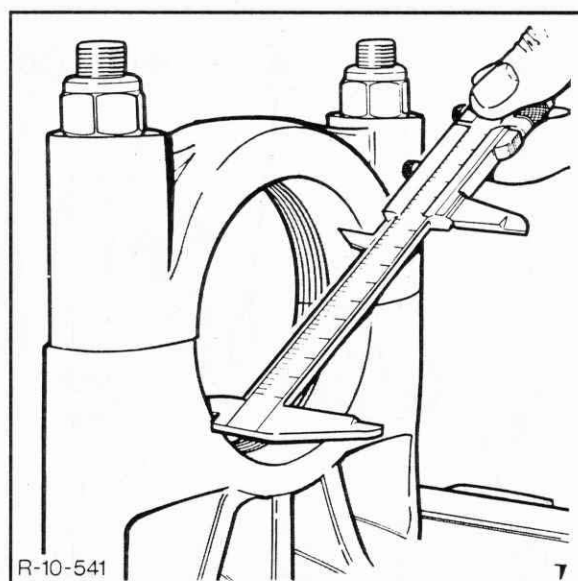


Figure 7-129

Measuring Diameter of Differential Support Housing Bearing Bores

- c. Using an internal micrometer or vernier gauge, measure the side bearing bore dimension, A, shown in Figure 7-129.

Etched on head of pinion is 107.7.

$110.8 - 107.7 = 3.1$ shim thickness required in millimeters.

- d. Locate the circular bar of tool no. FT. 3135 (4775) across the two bearing bores in the support housing, Figure 7-130, and using a depth gauge, measure the dimension, B.

- e. Determine the required thickness of the shim using the following calculation:

a) $C = B - 25.0 \text{ mm (dia. of bar)} + 1/2A$

The actual shim thickness will be the difference between calculation C and the dimension etched on the head of the pinion.

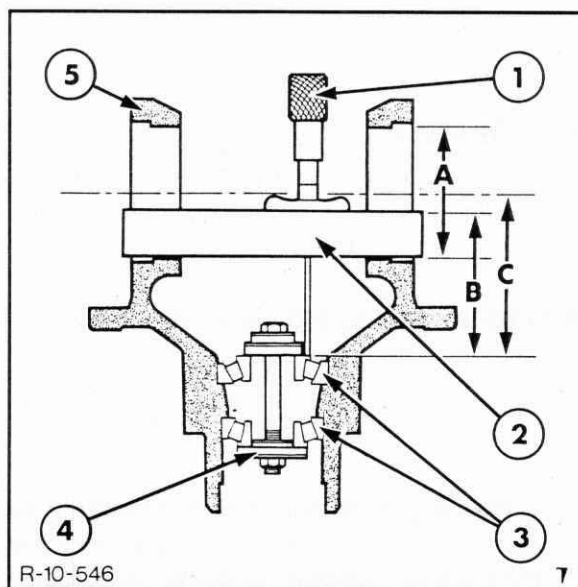


Figure 7-130

Measuring Dimension 'B'

1. Depth gauge
2. Bar gauge - part of tool no. FT.3135 or 4775
3. Pinion shaft bearings
4. Pinion setting gauge tool no. FT.3135 or 4775
5. Differential support housing

Example:

$C = 90.8 - 25 + 1/2(90) = 110.8$

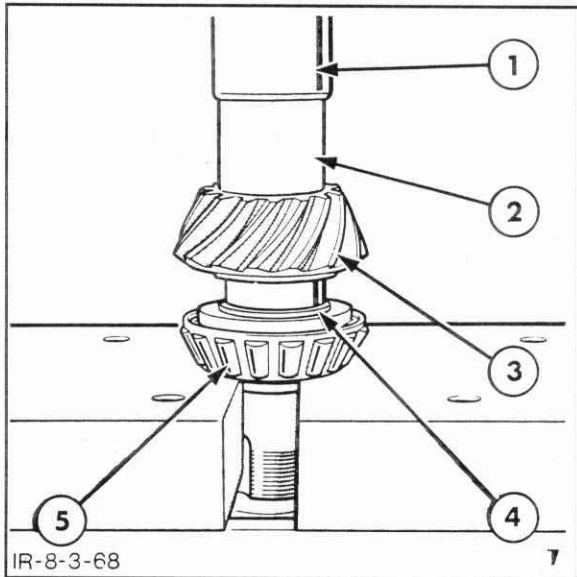


Figure 7-131

Pressing Inner Bearing Onto Pinion

1. Press
2. Shaft protector
3. Pinion
4. Shim
5. Inner bearing

Select the calculated shim thickness from the range available, and install on the pinion shaft with the chamfer adjacent to the pinion gear.

Pinion to ring gear bevel distance - adjustable by shims 2.5 mm - 3.4 mm in steps of 0.1 mm (0.010 in. - 0.136 in. in steps of 0.004 in.).

2. Press the inner bearing onto the pinion shaft, ensuring that it is fully seated, Figure 7-131.

IMPORTANT: Place a new collapsible spacer on the pinion shaft. DO NOT use the old item.

3. Assemble the pinion bearing and spacer assembly into the support housing and install the outer bearing, tabbed washer

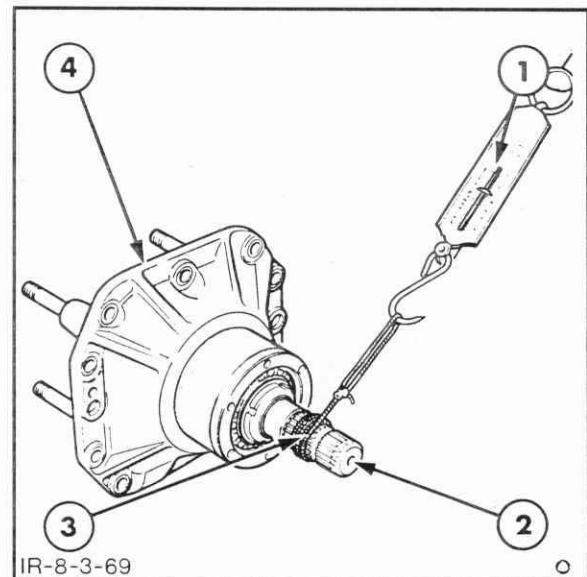


Figure 7-132

Checking Pinion Shaft Bearing Rolling Resistance

1. Spring balance
2. Pinion shaft
3. String
4. Differential support housing

and retaining nut. Ensure the retaining nut is in good condition and, using Tool No. FT.3168 (307978) tighten the nut until the bearings are just supported (no free play exists).

4. Wrap a length of string evenly and without overlapping around the exposed input spline and using a pull scale, measure the force required to rotate the pinion shaft in its bearings, Figure 7-132. The scale should be read during rotation of the pinion. Do not read the scale at the point where rotation starts.
5. Progressively tighten the retaining nut until a rotational pull is between 21 - 31 Lbf (9.5 - 14.0 kgf) on the spring scale.

It may be necessary to temporarily replace the differential and ring gear to prevent rotation of the pinion during tightening of the bearing retaining nut.

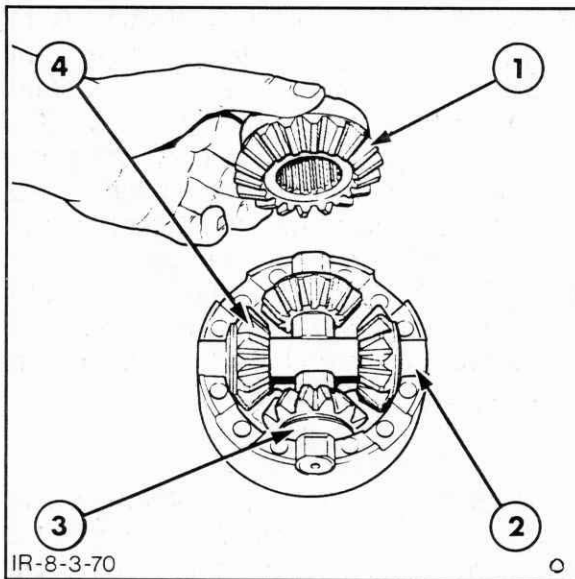


Figure 7-133

Reassembling Differential

1. Side gear
2. Shaft
3. Thrust washer
4. Bevel gear

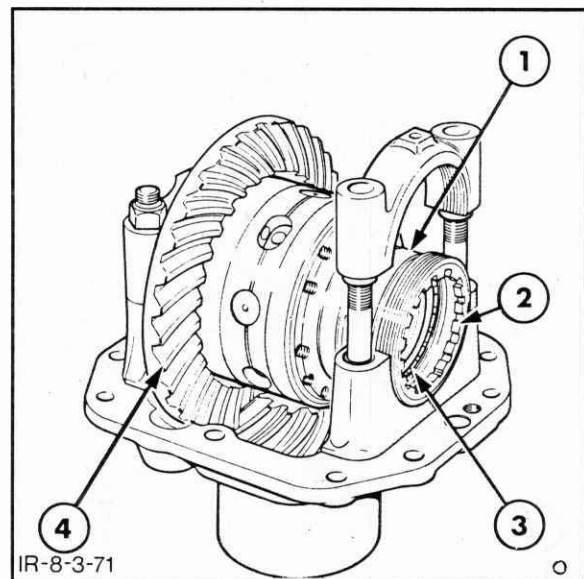


Figure 7-134

Reassembling Differential and Support Housing

1. Bearing track
2. Adjuster ring
3. Bearing
4. Ring gear

6. When the specified pull scale reading is achieved, lock the retaining nut to the shaft by driving the locking sleeve part of the nut into the slot machined on the pinion shaft. Record the reading obtained on the pull scale so that it can be used later when the ring gear bearing preload needs to be set..
7. Position a tabbed thrust washer and side gear into one half of the differential housing.
8. Locate the bevel gears and thrust washers onto the shafts and position the shafts into the differential housing, Figure 7-133. It will be necessary to lightly tap each shaft to ensure they are fully seated in the housing.
9. Position the remaining tabbed thrust washer and side gear into the second half of the differential housing and assemble the two halves of the housing, ensuring

that they align with marks scribed during disassembly.

10. Install the ring gear on the housing. Coat the threads of the retaining bolts with sealant, as specified in "Specifications", and tighten to 51 ft. lbs. (70 N·m) torque.
11. Press the two side bearings onto the housing, ensuring that they are both fully seated.
12. Place the assembled differential housing into the support housing and position the bearing outer tracks, support housing end caps, and bearing adjuster rings in their respective positions, Figure 7-134. Ensure that the centering bushes are in position and that the relationship between the ring gear and pinion is correct. The ring gear should always be to the right of the pinion when viewed from the input side.

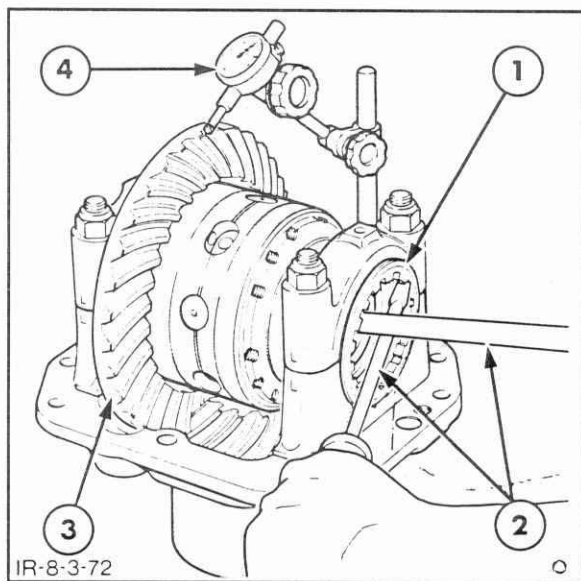


Figure 7-135

Measuring Ring Gear To Pinion Back Lash

1. Adjuster ring
2. Pry bars
3. Ring gear
4. Dial indicator

13. Assemble the bearing cap retaining nuts so that the caps are just pinched and, at the same time, carefully adjust the adjuster rings to ensure that the ring gear is not forced into mesh with the pinion. Take care during this procedure. Tightening the cap nuts and forcing the ring gear against the pinion could seriously damage the gear set.

14. With the bearing cap retaining nuts fully supporting the caps, but not fully tightened, adjust the adjuster rings to remove all free play. Do this by first tightening the ring gear side locking ring, moving the ring gear against the pinion and then tightening the other adjuster until it becomes difficult to move. DO NOT force the adjuster.

15. Measure the backlash between the crown and pinion by placing a dial indicator with its stylus placed at 90 degrees to the crown wheel teeth, Figure 7-135.

16. Turn the adjuster rings equal amounts, to move the ring gear towards or away from the pinion to achieve the specified backlash. Ring gear backlash is 0.006 - 0.010 in. (0.15 - 0.25 mm). During this operation, gently tap each bearing cap with a soft-faced hammer to ensure the cap and bearings remain correctly seated. Repeat the backlash measurement on two more teeth at equidistant around the ring gear and readjust as necessary.

17. To set the preload on the differential side bearings, tighten each adjuster ring by 1/2 to 1 notch and perform the following test to ensure correct adjustment has been achieved:

- a. With the ring gear in mesh with the pinion and the backlash correctly set, rotate the pinion using the string and pull scale and record the effort required to rotate the pinion and the ring gear/differential unit.
- b. From this result, subtract the previously recorded pinion only bearing rolling resistance. Refer to Steps 5 and 6.

Example:

Effort to rotate ring gear and pinion = 15 daN (15.3 kgf, 34 lbf)
 Effort to rotate pinion only = 11 daN (11.2 kgf, 25 lbf)
 Differential bearing rolling resistance = 15-11
 = 4 daN (4.1 kgf, 9 lbf)

- c. Adjust, where necessary, each differential side bearing adjuster ring, by equal amounts, to preserve the backlash adjustment, until the rolling resistance achieved is within the lower band of the specified figure.

SECTION 7 – STEERING AND FRONT AXLE

18. Fully tighten the bearing cap nuts to 115 ft. lbs. (156 N·m) torque.
thoroughly clean. Then coat these surfaces with specified sealant. See "Specifications."
19. Recheck the backlash and then install the adjuster ring lock tabs. Where necessary, tighten the adjuster rings to align the tab with the slot. Recheck the differential bearing rolling resistance. Differential bearing rolling resistance is 7.0 -10.6 lbf (3.2 - 4.7 kgf).
20. Install a new oil seal in the pinion oil seal housing, using driver handle No. 550 and seal installer FT.3162 (307972).
21. Coat the mating surfaces of the pinion oil seal housing and the differential support casing with specified sealant. See "Specifications."
22. Carefully slide the housing over the pinion and install the retaining bolts. Tighten the bolts to 7 ft. lbs. (10 N·m) torque.
2. Carefully assemble the support casing to the axle housing and evenly tighten the retaining bolts to 74 ft. lbs. (100 N·m) torque.
3. Reassemble the axle shafts and swivel hubs to the axle, as described earlier in this section.
4. Install the axle on the tractor, as previously described in this Section.
5. Fill the axle center casing and the hubs with oil type - 134D.

Oil capacities

INSTALLATION

1. Ensure that the differential support casing and axle housing mating faces are

Hub (each) 2.10 pints (1 liter)

Axle Differential 13.6 pints (6.5 liter)

DRIVE SHAFT - OVERHAUL

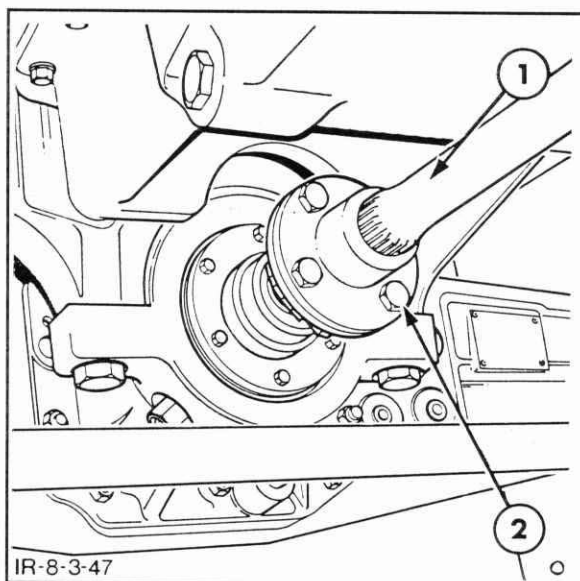


Figure 7-136

Drive Shaft To Axle Pinion Flange

1. Drive shaft
2. Bolt

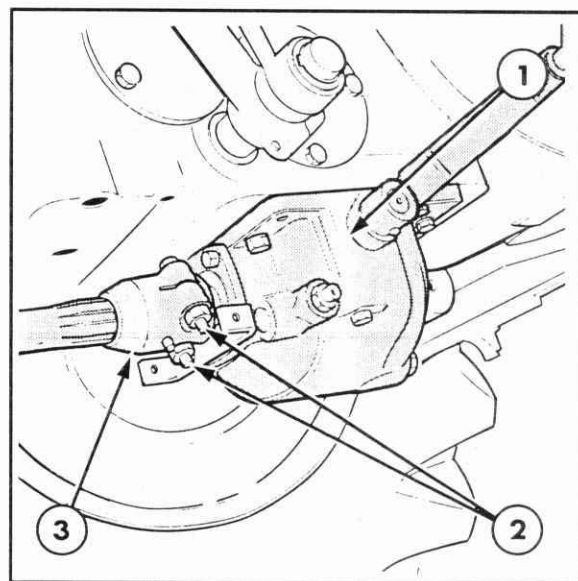


Figure 7-137

Drive Shaft To Transfer Case Coupling

1. Transfer case
2. Connecting bolts
3. Coupling

REMOVAL

1. Position the tractor on a hard-level surface. Apply the parking brake and block the wheels.

2. Remove the drive shaft guard.

3. Support the drive shaft and remove the bolts securing the drive shaft to the axle pinion drive flange, Figure 7-136.

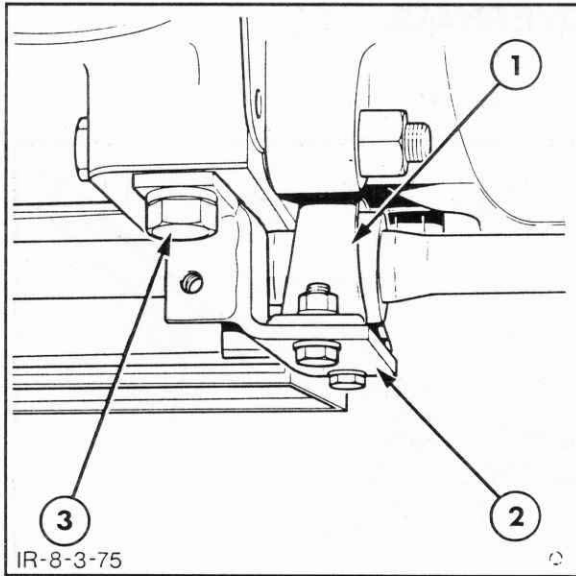
4. Remove the clamping bolts on the sliding coupling connecting the drive shaft to the

transfer case output shaft and disconnect the coupler, Figure 7-137.

5. Remove the bolts securing the bearing support bracket and withdraw the drive shaft from beneath the unit, Figure 7-138.

INSPECTION AND REPAIR

1. Remove the bolts securing the bearing to the support and slide the bearing from the drive shaft.
2. Inspect the drive shaft for wear or damage and replace if necessary.

**Figure 7-138**

Drive Shaft Support Bearing

1. Bearing
2. Support bracket
3. Support retaining bolt

3. Examine the drive shaft for straightness. The drive shaft and bearing must be replaced if the shaft is damaged.

INSTALLATION

Installation follows the removal procedure in reverse. On installation, observe the following requirements:

- Tighten all nuts and bolts to the specified torque. Refer to the axle drawing in the specification portion of this section.
- Grease the bearing and couplings.

TRANSFER GEAR ASSEMBLY

DESCRIPTION AND OPERATION

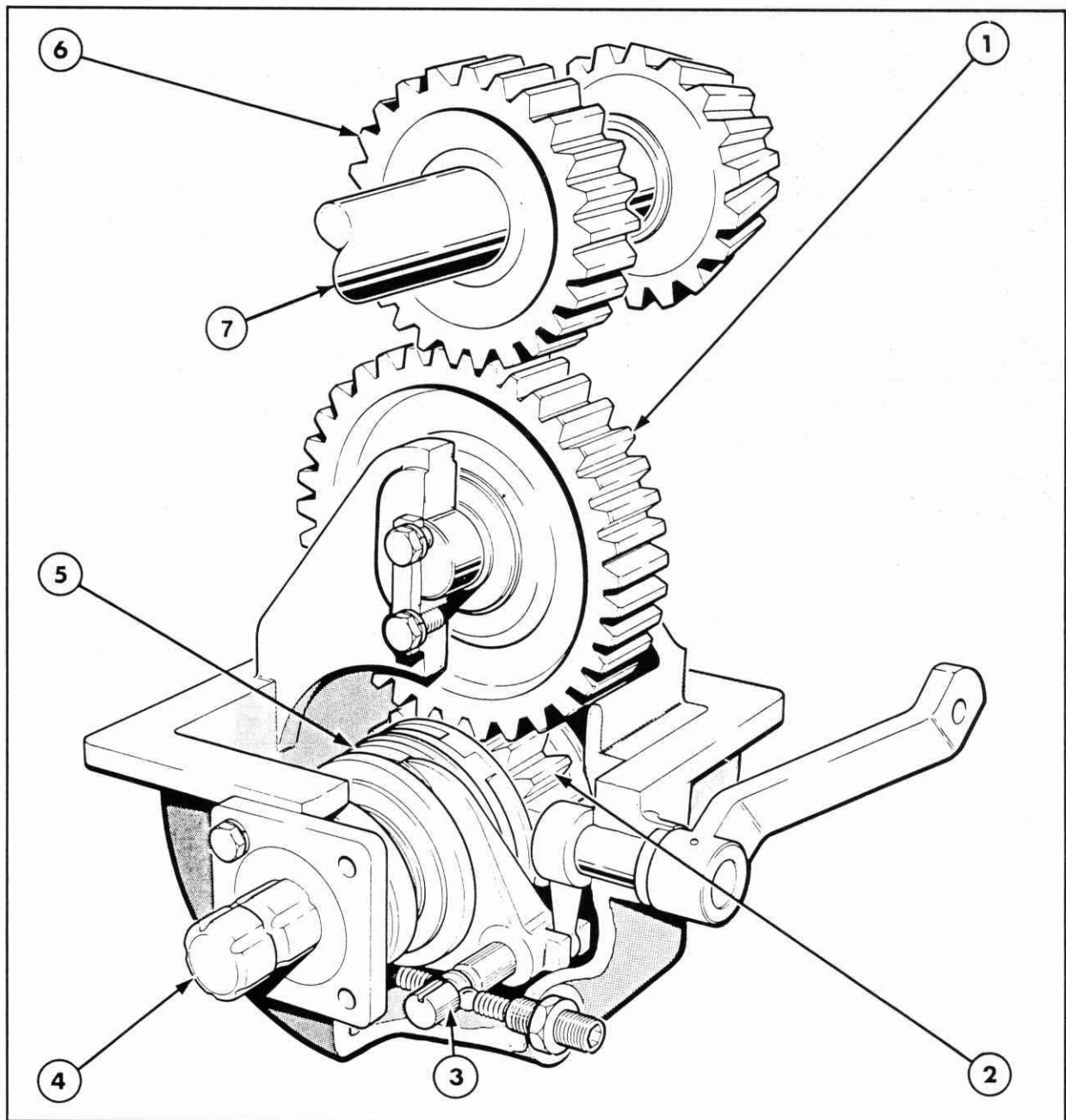


Figure 7-139

Front Wheel Drive Transfer Gear Assembly

- | | |
|---------------------|------------------------------|
| 1. Idler gear | 5. Sliding coupling assembly |
| 2. Driven gear | 6. Pinion drive gear |
| 3. Detent mechanism | 7. Rear axle pinion shaft |
| 4. Output shaft | |

SECTION 7 – STEERING AND FRONT AXLE

The front-wheel drive on the tractors is taken via a transfer gear assembly housed in the transfer case located at the bottom of the rear axle center housing, Figure 7-139.

The transfer case gear train transmits the drive from the pinion shaft to the drive shaft which is located under the tractor and protected by a guard. The drive shaft connects directly to the pinion shaft of the front axle.

A gear on the rear axle pinion drives the train of two gears inside the transfer case. The second gear in the train is connected to the transfer gear output shaft via a sliding dog clutch assembly, actuated by the spring loader selector lever mechanism.

The front-wheel drive can be engaged and disengaged under all normal operating conditions using the selector lever located on the right-hand side of the operator on the side of the instrument console. The front-wheel drive is engaged when the selector lever is in

the "up" position and disengages when the lever is in the "down" position.

Moving the selector lever to engaged position (up) moves the selector fork operating the sliding coupling/dog clutch rearwards. Should a tooth to tooth situation occur on the dog clutch, the rear springs in the sliding coupling will be loaded trying to force the shift gear half of the clutch rearwards. As the driving gear rotates, the dog clutch teeth will move relative to one another and the springs will ensure full engagement takes place.

Moving the selector lever to the disengaged position (down) moves the fork forwards. If there is a large torque difference between the shift gear and driving gear, the dog clutch teeth will not separate.

In this situation, the front springs of the sliding coupling will be loaded, trying to force the shift gear forwards. When the torque equalizes, the dog clutch teeth will separate due to the springs and disengage the front drive.

OVERHAUL

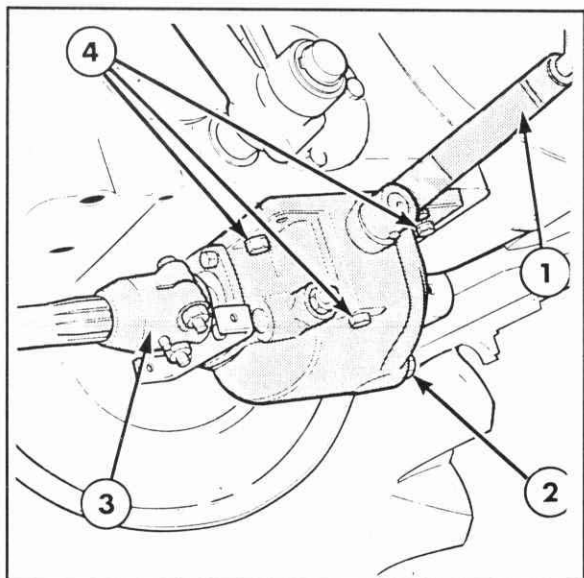


Figure 7-140

Transfer Case Installation

1. Actuating lever
2. Drain plug
3. Drive shaft coupling
4. Transfer case securing bolts

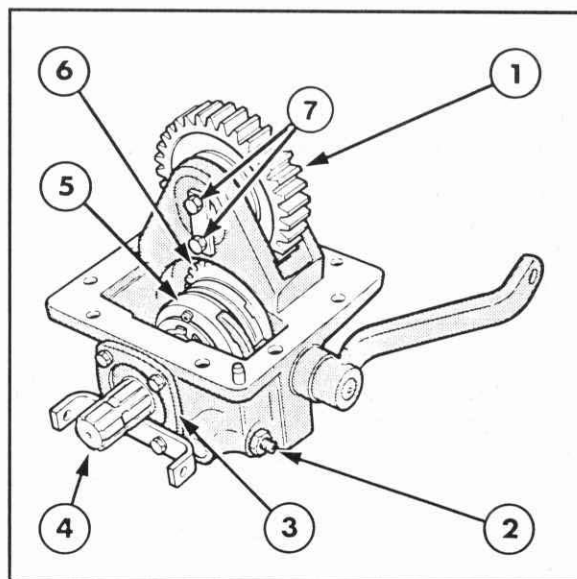


Figure 7-141

Transfer Gear Assembly

1. Idler gear
2. Detent adjuster
3. End cap
4. Output shaft
5. Sliding coupling assembly
6. Driven gear
7. Idler gear retaining bolts

REMOVAL

1. Park the tractor on a hard level surface and block the wheels.

2. Remove the drive shaft guard.

3. Remove the transfer case/rear axle drain plug, Figure 7-140, and allow the oil to drain into a suitable container. Replace the drain plug.

4. Disengage the front-wheel drive and disconnect the selector lever linkage from the actuating lever at the transfer case.

5. Disconnect the drive shaft coupling from the transfer case output shaft. Refer to Figure 7-140.

6. Support the weight of the transfer case on a trolley jack and remove the transfer case to center housing securing bolts. Carefully withdraw the transfer case assembly.

DISASSEMBLY

1. Withdraw the idler gear shaft retainer bolts, Figure 7-141, and remove the retainer.

2. Using a suitable press, remove the idler gear shaft and withdraw the idler gear and bearing assembly.

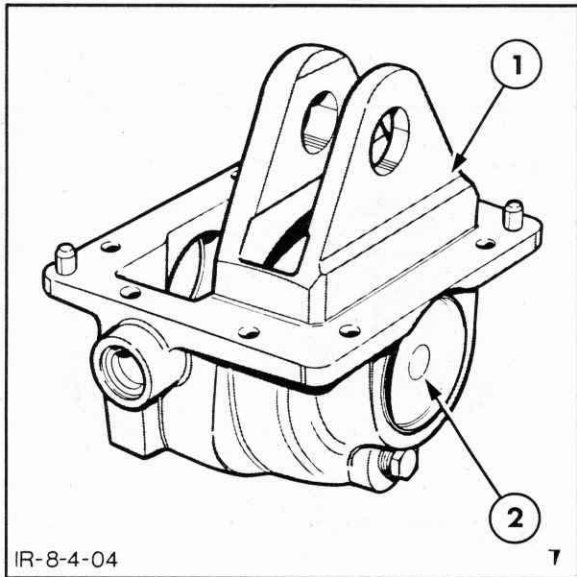


Figure 7-142
Transfer Case

1. Transfer case
2. Blanking plug

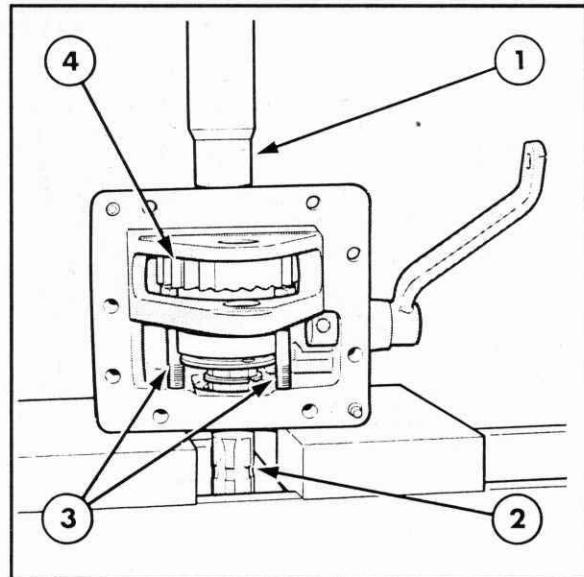


Figure 7-143
Output Shaft Removal

1. Press
2. Output shaft
3. 80 mm bolts
4. Driven gear

3. Remove the output shaft end cap retaining bolts and withdraw the end cap and drive shaft guard retaining bracket.

4. Remove the detent adjusting bolt and withdraw the spring and ball.

5. Remove the blanking plug in the rear of the transfer case, Figure 7-142.

NOTE: The end of the output shaft is situated very close to the face of the blanking plug and care must be taken if drilling a hole in the plug to assist in applying leverage to remove the plug.

6. Position the transfer case assembly on a suitable press and insert two 80 mm long bolts between the driven gear and

transfer casing, Figure 7-143. Press the shaft from the transfer case.

NOTE: The two 80 mm (3") bolts will ensure that the rear bearing remains seated in the casing. Failure to achieve this will make shaft removal difficult.

NOTE: Where the driven gear is a similar diameter to the sliding coupling, it is necessary to reduce the thickness of the bolt heads in order that they can be positioned between the coupling and driven gear to enable shaft removal.

7. Using the transfer gear actuating lever, position the fork to the front of the casing. Remove the sliding coupling assembly and thrust washer. Moving the fork fully forward will also press the detent shaft plug from the casing. Retrieve the plug.

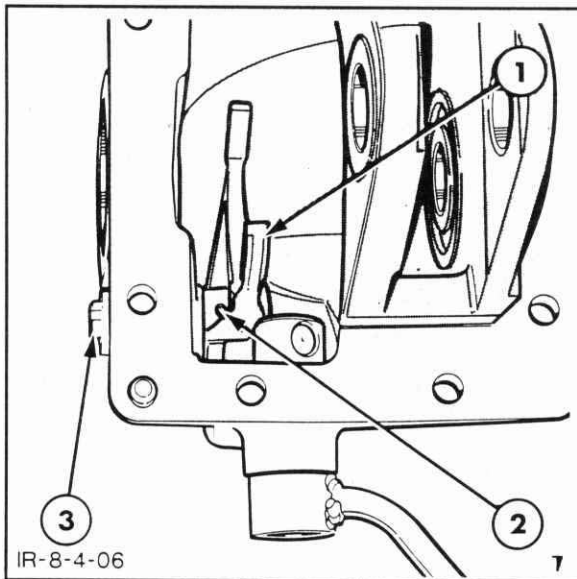


Figure 7-144

Shaft and Fork Installation

1. Fork
2. Pin
3. Detent shaft

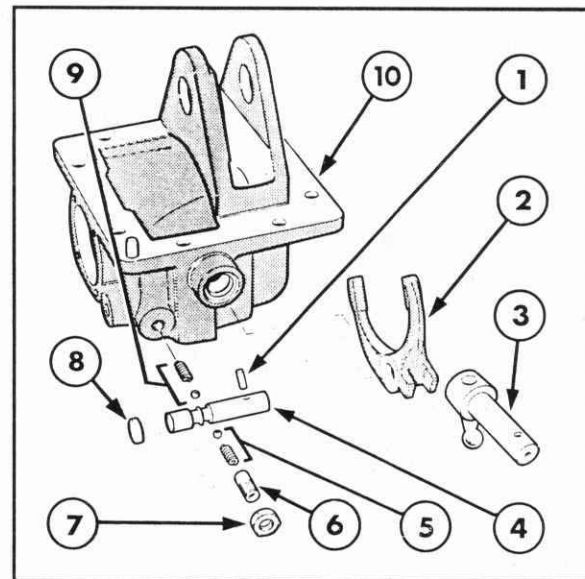


Figure 7-145

Fork and Detent Shaft Assembly

1. Pin
2. Fork
3. Actuating shaft
4. Detent shaft
5. Ball and spring
6. Detent adjuster
7. Locknut
8. Plug
9. Ball and spring
10. Transfer case

8. Remove the driven gear and thrust washer from the casing. To aid removal, twist the gear through 180 degrees so that the dog clutch teeth are facing rearwards.
9. Using a pin punch, knock the pin securing the fork on the detent shaft into the center of the shaft, Figure 7-144.

NOTE: Do not attempt to knock the pin through the shaft, as this will prevent removal of the shaft.

10. Push the detent shaft toward the rear of the housing and remove the fork.

11. Remove detent shaft from casing the knock the pin from the shaft. Retrieve the remaining detent ball and spring. Refer to Figure 7-145.

12. Using a pin punch drive the lever assembly retaining pin from the actuating lever shaft. Remove the lever and shaft from the casing.

13. Remove the rear bearing snap ring, Figure 7-146, and using a suitable press and step plate adaptors, Tool Nos. 630T/14 or 15 or 9211, remove bearing.

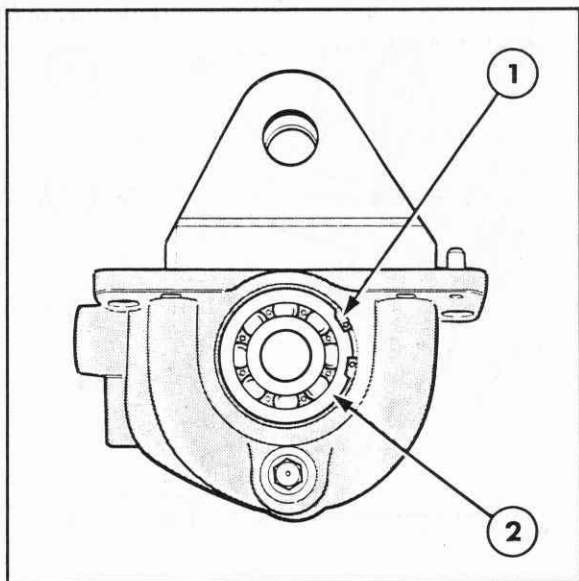


Figure 7-146

Output Shaft Rear Bearing

1. Snap ring
2. Bearing

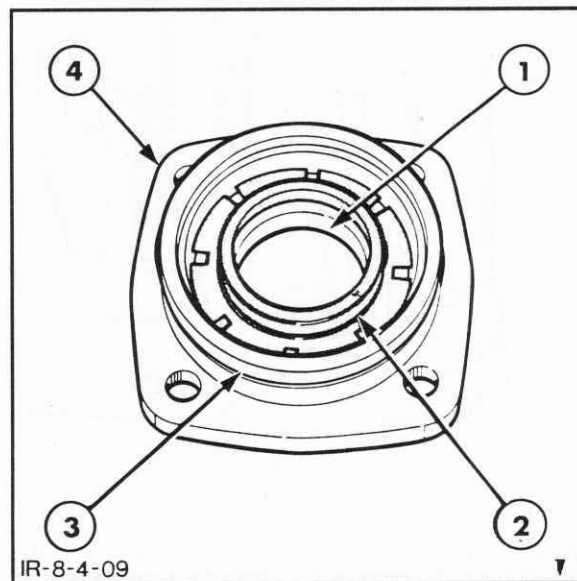


Figure 7-147

End Cap Assembly

1. Dust seal
2. Oil seal
3. Sealing ring
4. End cap

14. Using a suitable press and step plate adaptor, Tool No. 630T or 9211, remove the dust and oil seal from the output shaft end cap, Figure 7-147.

15. Remove the actuating lever oil seal from the transfer case.

16. Remove the snap ring from the sliding coupling assembly and separate the components, Figure 7-148.

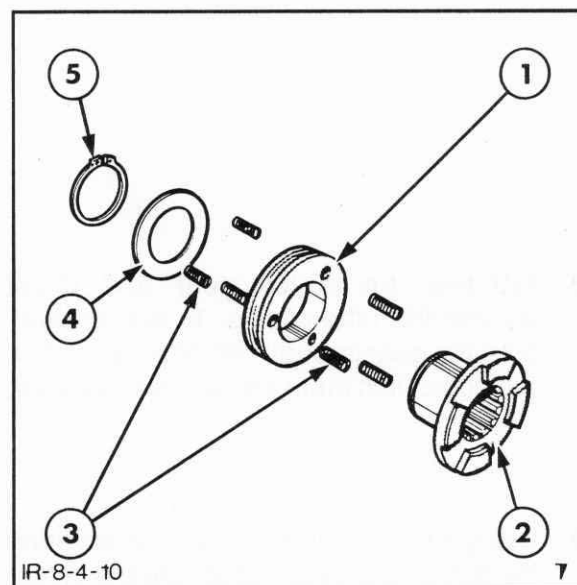


Figure 7-148

Sliding Coupling Assembly

1. Collar
2. Shift gear
3. Springs
4. Retaining ring
5. Snap ring

17. Remove the retaining ring from the idler gear and bearing assembly and separate the components, Figure 7-149.

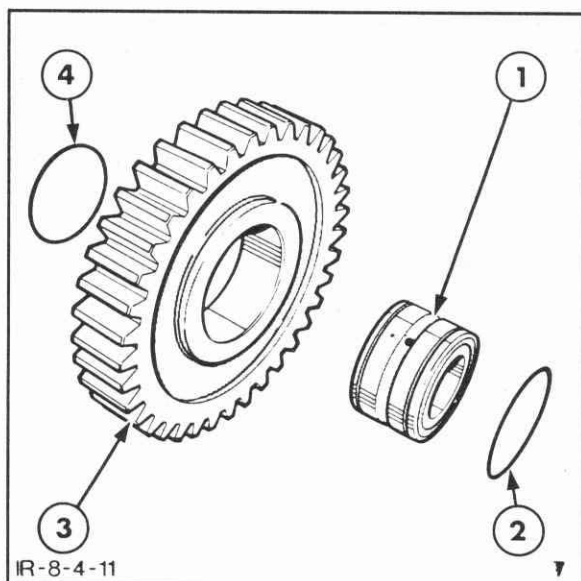


Figure 7-149

Idler Gear Assembly

1. Bearing
2. Retaining ring
3. Idler gear
4. Retaining ring

INSPECTION AND REPAIR

1. Clean all components in a suitable solvent and dry with a lint-free cloth.
2. Inspect all gears for damage and replace if necessary.
3. Inspect all bearings for wear or damage and replace if necessary.
4. Examine the transfer casing for cracks and replace if necessary.
5. Replace the dust seal, oil seal, and sealing ring in the end cap.
6. Replace the actuating lever oil seal.

REASSEMBLY

With reference to Figure 7-150

1. Assemble the actuating lever and shaft to the transfer case.
2. Insert the detent spring and ball into transfer case drilling and install shaft. To ease installation, locate the ball in the machined slot in the shaft, push shaft forward, and then rotate shaft to seat ball.
3. Locate the actuating lever in the gate on the fork and position the fork on detent shaft. Retain fork on shaft with roll pin.
4. Reassemble the sliding coupling assembly.
5. Where front bearing replacement has been necessary, install the bearing onto the output shaft. Ensure the snap ring, which limits travel of the sliding coupling, is also correctly located on the shaft.

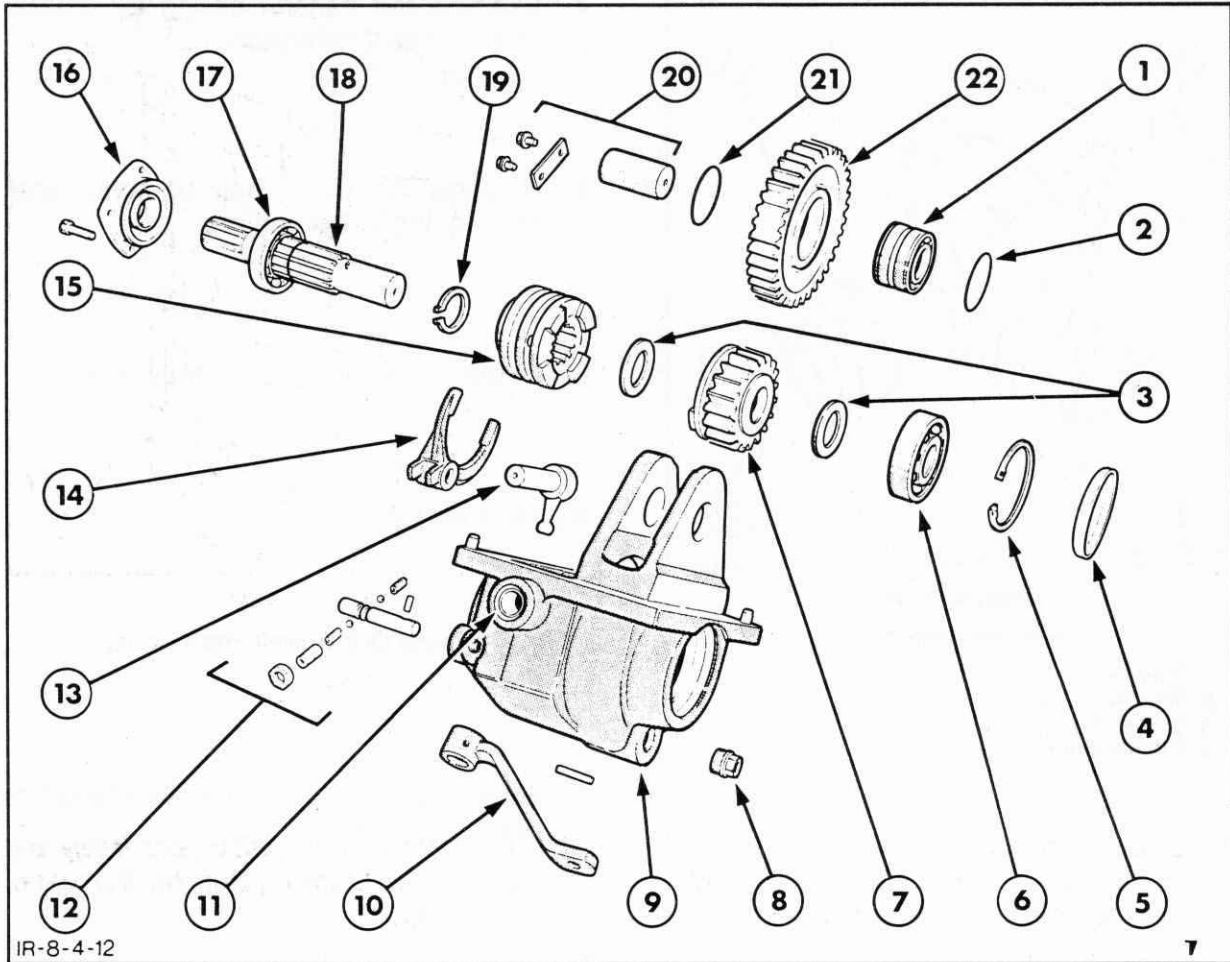


Figure 7-150
Transfer Gear Assembly - Exploded View

- | | |
|-----------------------|-------------------------------|
| 1. Idler gear bearing | 12. Detent shaft components |
| 2. Bearing retainer | 13. Actuating lever shaft |
| 3. Thrust washers | 14. Fork |
| 4. Blanking plug | 15. Sliding coupling assembly |
| 5. Snap ring | 16. End cap assembly |
| 6. Rear bearing | 17. Front bearing |
| 7. Driven gear | 18. Output shaft |
| 8. Drain plug | 19. Snap ring |
| 9. Transfer case | 20. Shaft and retainer |
| 10. Actuating lever | 21. Bearing retainer |
| 11. Oil seal | 22. Idler gear |

6. Position the driven gear in the transfer case. To ease installation, install gear with dog clutch teeth facing rearwards and then turn the gear through 180 degrees to position teeth forwards.

7. Position the sliding coupling on the actuating fork. Pass the output shaft

through the front of the transfer casing, through the coupling and driven gear while, at the same time, positioning the thrust washer to the front of the gear.

8. Using a suitable press and sleeve, press the output shaft and front bearing into the casing, Figure 7-151.

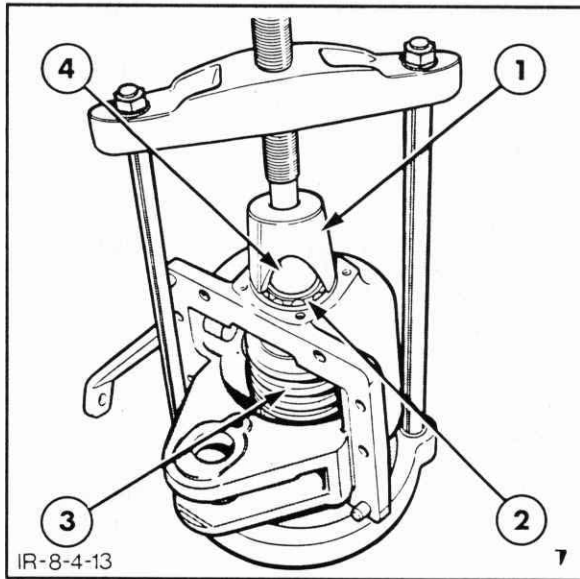


Figure 7-151

Installing Output Shaft Front Bearing

1. Sleeve
2. Bearing
3. Sliding coupling assembly
4. Output shaft

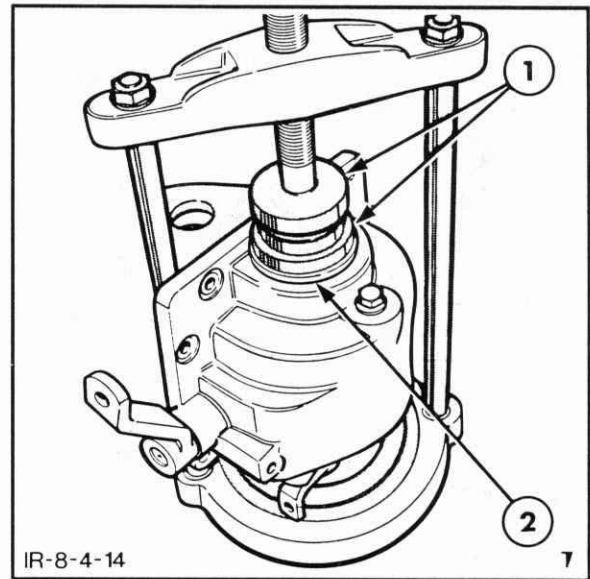


Figure 7-152

Installing Output Shaft Rear Bearing

1. Step plate adaptors
2. Bearing

9. Coat the detent shaft blanking plug with appropriate sealant, and press the plug into the bore in the housing.
10. Install the end cap assembly and drive shaft guard retaining bracket. Tighten the retaining bolts to 17.5 ft. lbs. (24 N·m) torque.
11. Position the driven gear thrust washer over the output shaft and using a suitable press and step plate adaptors, Tool No. 630T or 9211, install the rear bearing, Figure 7-152. The bearing must only be pressed into the bore sufficiently to allow the locating snap ring to be installed. Install the snap ring.
12. Reassemble the idler gear and bearing assembly and install in the casing. Retain the idler gear in position with the retainer, tightening the bolts to 17.5 ft. lbs. (24 N·m) torque.
13. Ensure the output shaft rotates freely and install a new blanking plug into the rear of the casing.
14. Install the drain plug.
15. Install the activating lever onto the shaft and retain with the roll pin.
16. Install detent outer ball and spring. Coat the threads of the adjusting stud with sealant, and adjust detent pressure until a 26 lbf (12 Kgf) is required on the operating lever to activate detent, Figure 7-153.
17. Lock detent adjusting stud in position by tightening the locknut.

INSTALLATION

Installation of the transfer case follows the removal procedure in reverse. On installation, observe the following requirements:

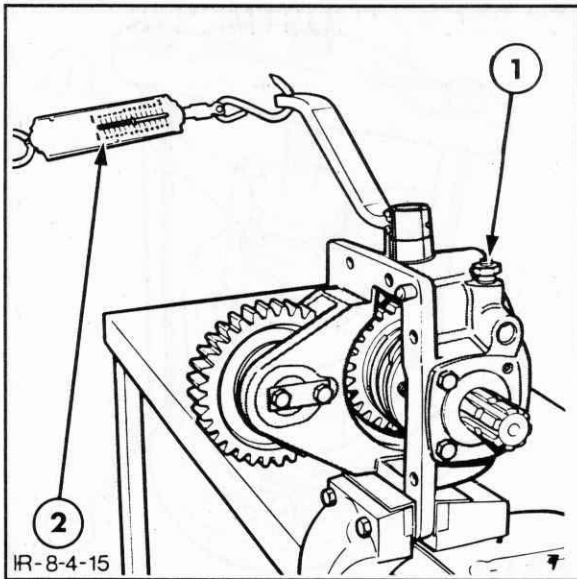


Figure 7-153
Detent Adjuster

1. Detent adjuster
2. Spring balance

- Install a new mounting face gasket.
- Tighten all bolts to 35.5 ft. lbs. ((48 N·m) torque.
- With the unit on level ground, refill the rear axle with new oil.

Rear axle oil

Type	134D hydraulic oil
Capacity	
KF3P -	8.5 gal. (22.0 liters)
DF0P, DF1Q	
LF4P/Q, LF5Q -	10.7 gal. (40.6 liters)

TRANSFER GEAR OPERATING CABLE - ADJUSTMENTS

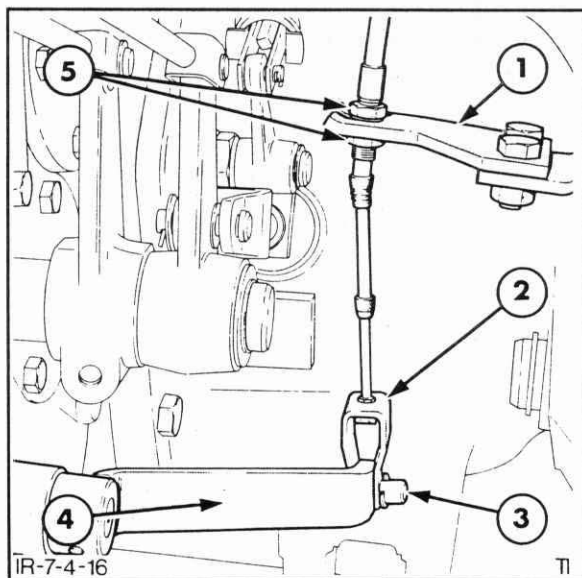


Figure 7-154

Transfer Gear Operating Cable At Transfer Case

1. Retaining bracket
2. Cable clevis
3. Clevis pin
4. Actuating lever
5. Cable locknuts

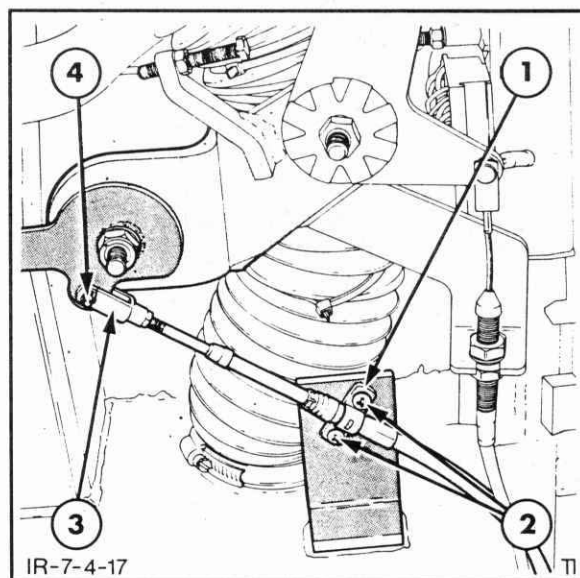


Figure 7-155

Transfer Gear Operating Cable At Side Console

1. Retaining bracket
2. Clamp retaining screw
3. Cable clevis
4. Clevis pin

REMOVAL

1. Disengage the front-wheel drive and disconnect the selector lever linkage from the actuating lever at the transfer case, Figure 7-154.
2. Loosen the cable adjusting nuts at the bracket attached to the loader sub-frame, Figure 7-154.
3. Pull the cable from the bracket.
4. Remove the side console lower panel retaining screws.
5. Remove the front-wheel drive selector lever knob and remove the panel.

6. Disconnect the cable at the selector lever, Figure 7-155. Loosen the cable clamp retaining screws and pull the cable through the clamp.
7. Pull the cable from the tractor from underneath the cab.

INSTALLATION

1. Route the cable up into the cab and through the cable clamp. Secure the clamp retaining screws, Figure 7-155.
2. Connect the cable to the selector lever and retain with the clevis pin and split pin, Figure 7-155.
3. Attach the cable to the transfer case actuating lever and retain with the clevis pin, Figure 7-154.

SECTION 7 – STEERING AND FRONT AXLE

4. Position the cable into the retaining bracket, Figure 7-154, and hand tighten the locking nuts.
5. Install the side console lever panel and tighten the retaining screws. Install the selector lever knob and tighten the retaining screw.
6. Position the selector lever in the disengaged, lower position. Ensure the transfer case actuating lever is in the disengaged position. Adjust the cable locknuts so that when the selector lever is operated the lever does not hit the console lower panel in either the engaged or disengaged position.
7. Tighten the locknuts.

SPECIFICATIONS - FRONT-WHEEL DRIVE AXLE AND TRANSFER GEAR ASSEMBLY

FRONT AXLE TYPE

Heavy-duty, center-driven, double reduction (ring gear and pinion plus planetary hubs)

STEERING TURN ANGLE

(Dependent on track setting) 50 degrees

AXLE OSCILLATION ANGLE 12 degrees

OVERALL WIDTH 1884 MM (74.2 IN)
(WHEEL MOUNTING FLANGE)

FRONT AXLE RATIOS

	KF3P	DF0P, DF1Q, LF4P/Q, LF5Q European	DF0P, DF1Q, LF4P/Q, LF5Q Americas
Overall:	10.33:1	16:1	14.3:1
Ring Gear and Pinion	1.72:1	2.67:1	2.383:1
Planetary Hubs	6:1	6:1	6:1
Matching Transfer Gear Assembly	0.735:1	1.037:1	1.037:1

OIL CAPACITIES

Hub (each			
Liters Imp.	1	1	1
Pints	1.76	1.76	1.76
U.S. Pints	2.10	2.10	2.10
Axle Differential			
Liters	6.5	6.5	6.5
Imp. Pints	11.4	11.4	11.4
U.S. Pints	13.6	13.6	13.6

CLEARANCES AND ADJUSTMENTS

Front Wheel Toe-in	0 - 4.0 mm (0.16 in)
Axle Hub Bearing Rolling Resistance	Non-adjustable, pre-set
Axle Shaft End Float	Non-adjustable, pre-set
Swivel Bearing Pre-Load	0.2 - 0.4 mm (0.008 - 0.016 in) Adjustable by shims of:- 0.10 mm (0.0040 in) 0.19 mm (0.0076 in) 0.35 mm (0.0140 in)
Drive Pinion Bearing Rolling Resistance (see text)	9.2 - 13.7 daN (21 - 31 lbf) (9.5 - 14.0 kgf)
Pinion to Ring Gear Backlash	0.15 - 0.25 mm (0.006 - 0.010 in)
Pinion to Ring Gear Bevel Distance (see text)	Adjustable by shims 2.5 mm - 3.4 mm in steps of 0.1 mm (0.010 in - 0.136 in steps of 0.004 mm)
Differential Bearing Rolling Resistance (see text)	Drive Pinion Bearing Rolling Resistance plus 3.1 - 4.7 daN (7.0 - 10.6 lbf) (3.2 - 4.8 kgf)

LUBRICANTS

Fill with correct grade, quantity, and type of oil, as specified in the relevant Operator's Manual.

GREASE FITTINGS

Grease with the correct grade, as specified in the relevant Operator's Manual.

THREAD SEALANT

To Ford Specification - ESK-M4G247-A2 (Loctite 243 or 542).
Crown wheel retaining bolts, planetary shaft cover screw heads.

To Ford Specification - ESE-M4G203-A2 (Loctite 270/271).
Axle support pillar retaining bolts.

DOWELL FIXATIVE ADHESIVE

To Ford Specification - SPM-2G9120-A (Loctite 638).
Differential support housing to axle casing dowel.

FLANGE SEALANT (FACE-TO-FACE SEALANT)

To Ford Specification ESK-M4G269-A (Loctite Superflex Silicone, Loctite 518 or Silastic 732).

Planetary carrier to hub housing, differential support housing to axle casing and pinion oil seal housing.

WEAR RING RETAINER

To Ford Specification ESK-M4G269-A (Loctite 518).
Hub seal wear ring.

TRANSFER GEAR ASSEMBLY

TYPE

Rear axle centralized mounting with dog-type non-slip clutch. Mechanically engaged and released.

	KF3P	DF0P, DF1Q, LF4P/Q, LF5Q
TRANSFER GEAR ASSEMBLY RATIO	0.735:1	1:037:1
Drive Pinion Teeth	25	28
Idler Gear Teeth	38	33
Driven Gear Teeth	34	27

ACTUATING LEVER DETENT ADJUSTMENT

Adjust until effort required to activate lever when measured with a spring balance is equivalent to 12 kgf (26 lbf).

OIL CAPACITY

Transfer Case Lubricated by Rear Axle Oil.

Increase in Rear Axle Oil Capacity with Transfer Case Installed

Liters	1.0
Imp. Pints	1.7
U.S. Pints	2.1

SEALANT

To Ford Specification SJ-M4G9102-A (Loctite 573).
Detent adjustment screw and detent shaft blanking plug.

TORQUE SPECIFICATIONS
FWD AXLE

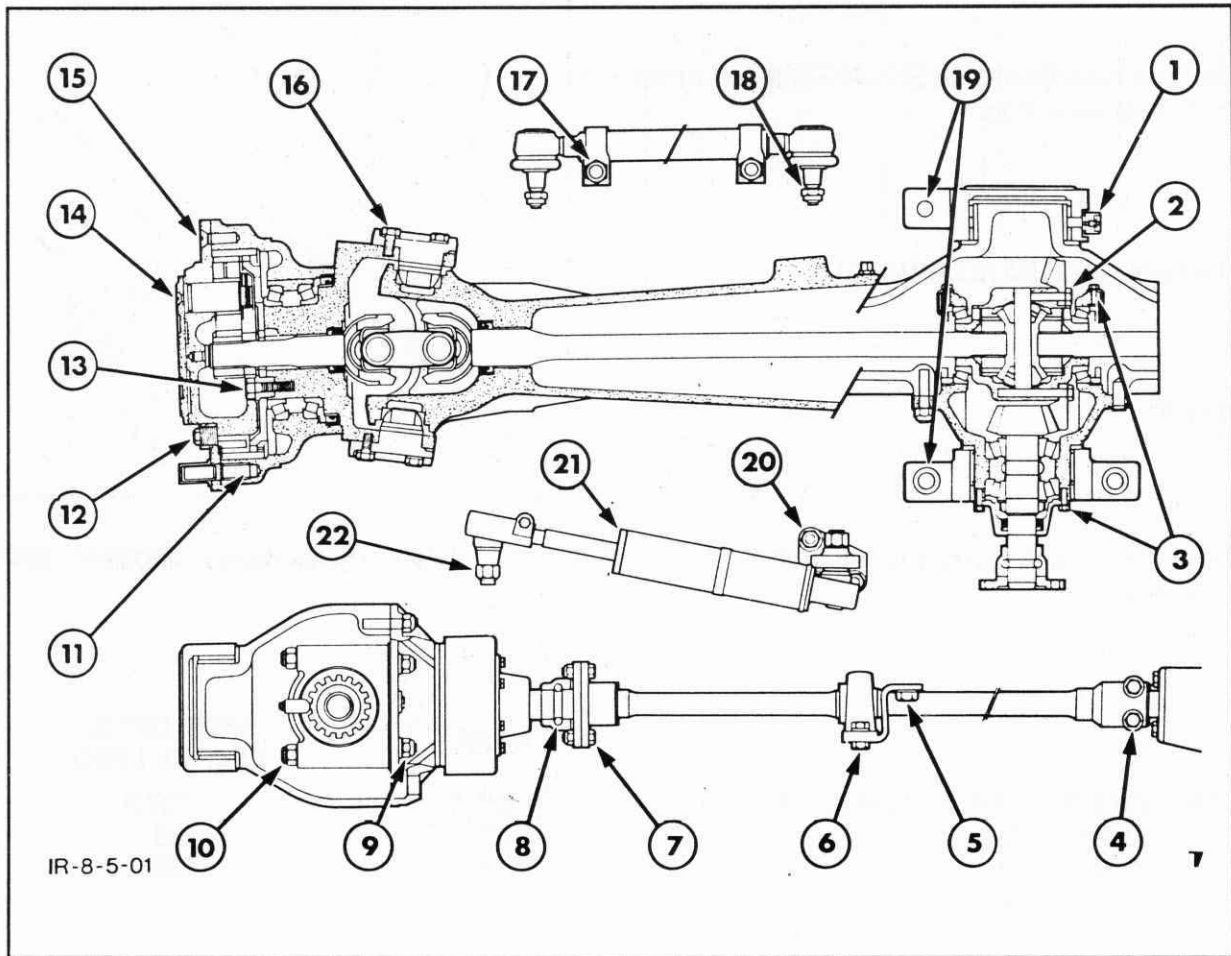


Figure 7-156

Fig. Ref.	N·m	Kgf.m	Lbf. ft
1	70	7	51
2	70	7	51
3	10	1	7
4	57	5.8	42
5	352	35.9	260
6	57	5.8	42
7	57	5.8	42
8	56	5.7	41
9	100	10.2	74
10	156	15.9	115
11	70	7	51
12	40	4.1	30
13	250	25.4	184
14	34	3.5	25
15	80	8.2	59
16	137	13.8	100
17	70	6.9	50
18	140	14.1	102
19	515	53	380
20	240	24	177
21	258	26.3	190
22	300	30.4	220
Front Wheel Nuts - FWD	270	27.5	200

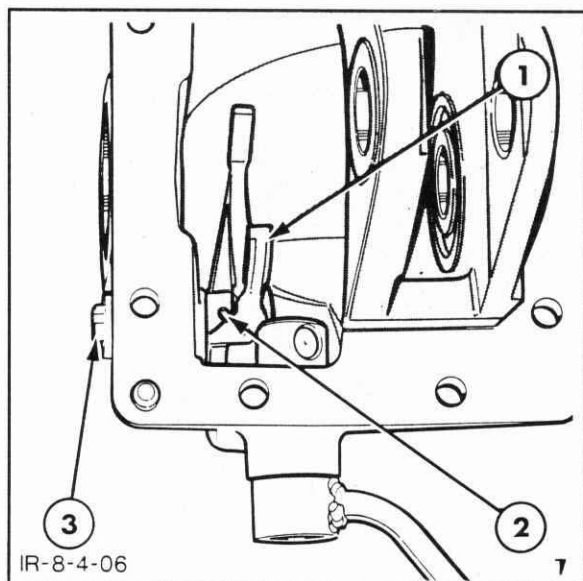


Figure 7-144

Shaft and Fork Installation

1. Fork
2. Pin
3. Detent shaft

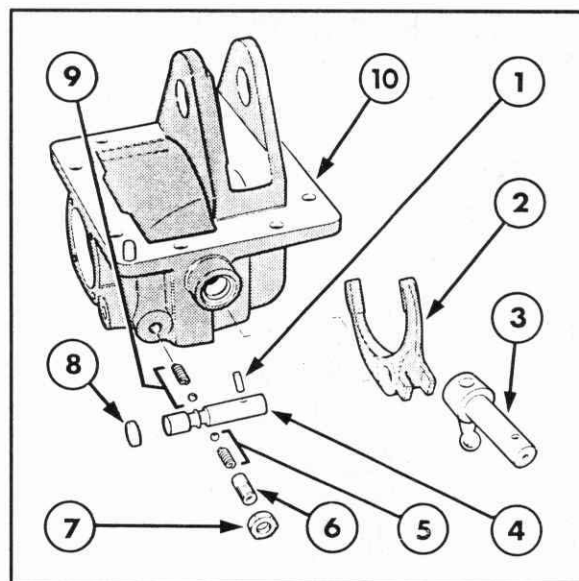


Figure 7-145

Fork and Detent Shaft Assembly

1. Pin
2. Fork
3. Actuating shaft
4. Detent shaft
5. Ball and spring
6. Detent adjuster
7. Locknut
8. Plug
9. Ball and spring
10. Transfer case

8. Remove the driven gear and thrust washer from the casing. To aid removal, twist the gear through 180 degrees so that the dog clutch teeth are facing rearwards.

9. Using a pin punch, knock the pin securing the fork on the detent shaft into the center of the shaft, Figure 7-144.

NOTE: Do not attempt to knock the pin through the shaft, as this will prevent removal of the shaft.

10. Push the detent shaft toward the rear of the housing and remove the fork.

11. Remove detent shaft from casing the knock the pin from the shaft. Retrieve the remaining detent ball and spring. Refer to Figure 7-145.

12. Using a pin punch drive the lever assembly retaining pin from the actuating lever shaft. Remove the lever and shaft from the casing.

13. Remove the rear bearing snap ring, Figure 7-146, and using a suitable press and step plate adaptors, Tool Nos. 630T/14 or 15 or 9211, remove bearing.

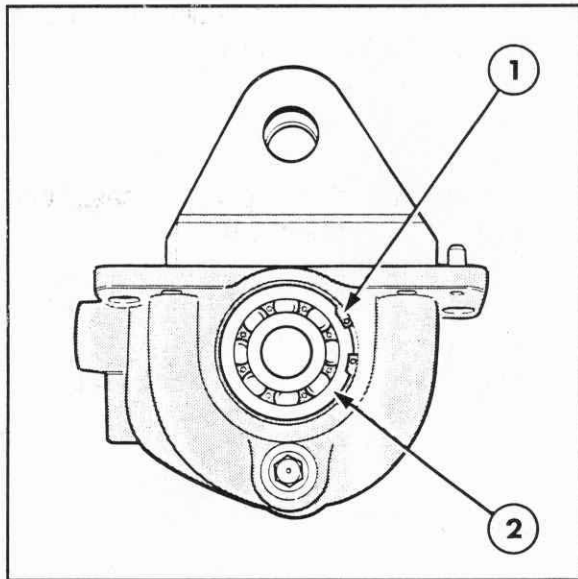


Figure 7-146

Output Shaft Rear Bearing

1. Snap ring
2. Bearing

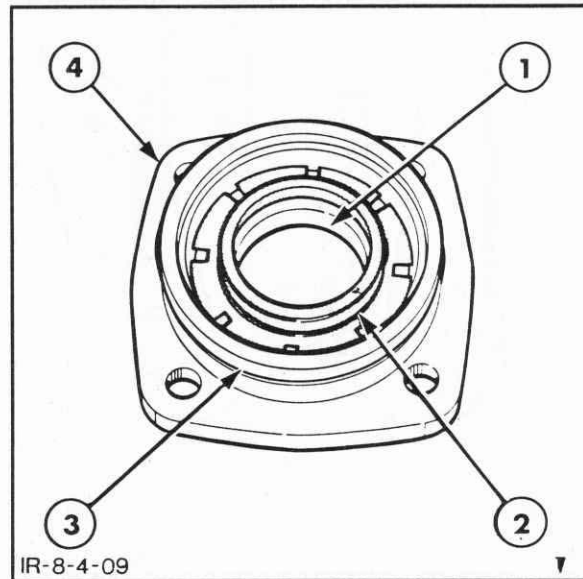


Figure 7-147

End Cap Assembly

1. Dust seal
2. Oil seal
3. Sealing ring
4. End cap

14. Using a suitable press and step plate adaptor, Tool No. 630T or 9211, remove the dust and oil seal from the output shaft end cap, Figure 7-147.

15. Remove the actuating lever oil seal from the transfer case.

16. Remove the snap ring from the sliding coupling assembly and separate the components, Figure 7-148.

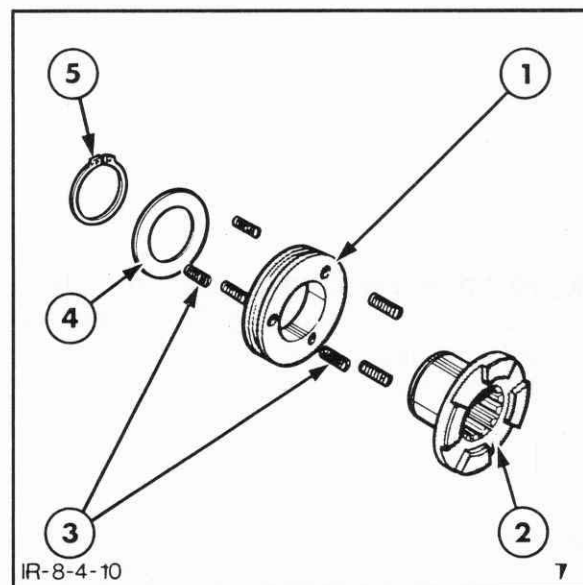


Figure 7-148

Sliding Coupling Assembly

1. Collar
2. Shift gear
3. Springs
4. Retaining ring
5. Snap ring

17. Remove the retaining ring from the idler gear and bearing assembly and separate the components, Figure 7-149.

TRANSFER GEAR OPERATING CABLE - ADJUSTMENTS

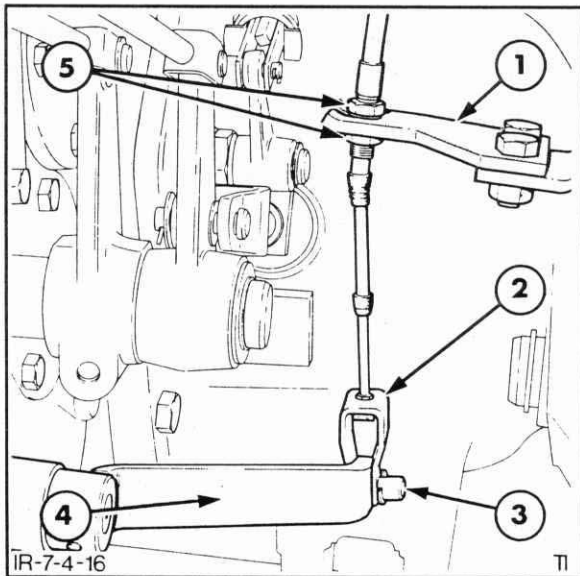


Figure 7-154

Transfer Gear Operating Cable At Transfer Case

1. Retaining bracket
2. Cable clevis
3. Clevis pin
4. Actuating lever
5. Cable locknuts

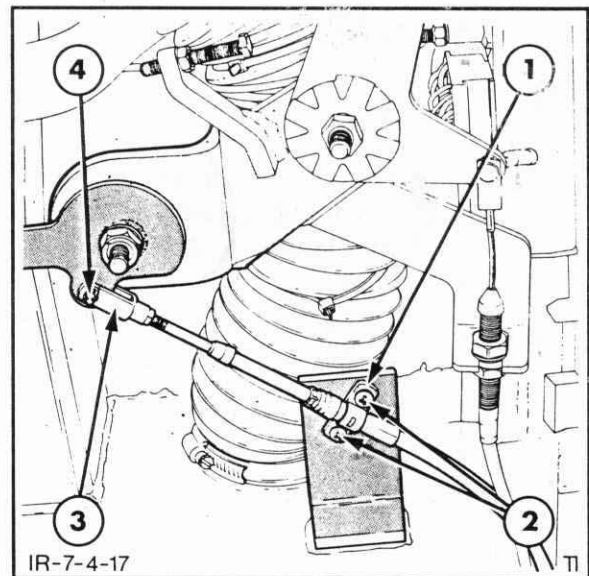


Figure 7-155

Transfer Gear Operating Cable At Side Console

1. Retaining bracket
2. Clamp retaining screw
3. Cable clevis
4. Clevis pin

REMOVAL

1. Disengage the front-wheel drive and disconnect the selector lever linkage from the actuating lever at the transfer case, Figure 7-154.
2. Loosen the cable adjusting nuts at the bracket attached to the loader sub-frame, Figure 7-154.
3. Pull the cable from the bracket.
4. Remove the side console lower panel retaining screws.
5. Remove the front-wheel drive selector lever knob and remove the panel.

6. Disconnect the cable at the selector lever, Figure 7-155. Loosen the cable clamp retaining screws and pull the cable through the clamp.
7. Pull the cable from the tractor from underneath the cab.

INSTALLATION

1. Route the cable up into the cab and through the cable clamp. Secure the clamp retaining screws, Figure 7-155.
2. Connect the cable to the selector lever and retain with the clevis pin and split pin, Figure 7-155.
3. Attach the cable to the transfer case actuating lever and retain with the clevis pin, Figure 7-154.

SECTION 7 – STEERING AND FRONT AXLE

4. Position the cable into the retaining bracket, Figure 7-154, and hand tighten the locking nuts.
5. Install the side console lever panel and tighten the retaining screws. Install the selector lever knob and tighten the retaining screw.
6. Position the selector lever in the disengaged, lower position. Ensure the transfer case actuating lever is in the disengaged position. Adjust the cable locknuts so that when the selector lever is operated the lever does not hit the console lower panel in either the engaged or disengaged position.
7. Tighten the locknuts.

SPECIFICATIONS - FRONT-WHEEL DRIVE AXLE AND TRANSFER GEAR ASSEMBLY

FRONT AXLE TYPE

Heavy-duty, center-driven, double reduction (ring gear and pinion plus planetary hubs)

STEERING TURN ANGLE

(Dependent on track setting) 50 degrees

AXLE OSCILLATION ANGLE 12 degrees

OVERALL WIDTH 1884 MM (74.2 IN)
(WHEEL MOUNTING FLANGE)

FRONT AXLE RATIOS

	KF3P	DF0P, DF1Q, LF4P/Q, LF5Q European	DF0P, DF1Q, LF4P/Q, LF5Q Americas
Overall:	10.33:1	16:1	14.3:1
Ring Gear and Pinion	1.72:1	2.67:1	2.383:1
Planetary Hubs	6:1	6:1	6:1
Matching Transfer Gear Assembly	0.735:1	1.037:1	1.037:1

OIL CAPACITIES

Hub (each			
Liters Imp.	1	1	1
Pints	1.76	1.76	1.76
U.S. Pints	2.10	2.10	2.10
Axle Differential			
Liters	6.5	6.5	6.5
Imp. Pints	11.4	11.4	11.4
U.S. Pints	13.6	13.6	13.6

CLEARANCES AND ADJUSTMENTS

Front Wheel Toe-in	0 - 4.0 mm (0.16 in)
Axle Hub Bearing Rolling Resistance	Non-adjustable, pre-set
Axle Shaft End Float	Non-adjustable, pre-set
Swivel Bearing Pre-Load	0.2 - 0.4 mm (0.008 - 0.016 in) Adjustable by shims of:- 0.10 mm (0.0040 in) 0.19 mm (0.0076 in) 0.35 mm (0.0140 in)
Drive Pinion Bearing Rolling Resistance (see text)	9.2 - 13.7 daN (21 - 31 lbf) (9.5 - 14.0 kgf)
Pinion to Ring Gear Backlash	0.15 - 0.25 mm (0.006 - 0.010 in)
Pinion to Ring Gear Bevel Clearance (see text)	Adjustable by shims 2.5 mm - 3.4 mm in steps of 0.1 mm (0.010 in - 0.136 in steps of 0.004 mm)
Differential Bearing Rolling Resistance (see text)	Drive Pinion Bearing Rolling Resistance plus 3.1 - 4.7 daN (7.0 - 10.6 lbf) (3.2 - 4.8 kgf)

LUBRICANTS

Fill with correct grade, quantity, and type of oil, as specified in the relevant Operator's Manual.

GREASE FITTINGS

Grease with the correct grade, as specified in the relevant Operator's Manual.

THREAD SEALANT

To Ford Specification - ESK-M4G247-A2 (Loctite 243 or 542).
Crown wheel retaining bolts, planetary shaft cover screw heads.

To Ford Specification - ESE-M4G203-A2 (Loctite 270/271).
Axle support pillar retaining bolts.

DOWELL FIXATIVE ADHESIVE

To Ford Specification - SPM-2G9120-A (Loctite 638).
Differential support housing to axle casing dowel.

FLANGE SEALANT (FACE-TO-FACE SEALANT)

To Ford Specification ESK-M4G269-A (Loctite Superflex Silicone, Loctite 518 or Silastic 732).

Planetary carrier to hub housing, differential support housing to axle casing and pinion oil seal housing.

WEAR RING RETAINER

To Ford Specification ESK-M4G269-A (Loctite 518).
Hub seal wear ring.

TRANSFER GEAR ASSEMBLY**TYPE**

Rear axle centralized mounting with dog-type non-slip clutch. Mechanically engaged and released.

	KF3P	DF0P, DF1Q, LF4P/Q, LF5Q
TRANSFER GEAR ASSEMBLY RATIO	0.735:1	1:037:1
Drive Pinion Teeth	25	28
Idler Gear Teeth	38	33
Driven Gear Teeth	34	27

ACTUATING LEVER DETENT ADJUSTMENT

Adjust until effort required to activate lever when measured with a spring balance is equivalent to 12 kgf (26 lbf).

OIL CAPACITY

Transfer Case Lubricated by Rear Axle Oil.

Increase in Rear Axle Oil Capacity with Transfer Case Installed

Liters	1.0
Imp. Pints	1.7
U.S. Pints	2.1

SEALANT

To Ford Specification SJ-M4G9102-A (Loctite 573).
Detent adjustment screw and detent shaft blanking plug.

TORQUE SPECIFICATIONS
FWD AXLE

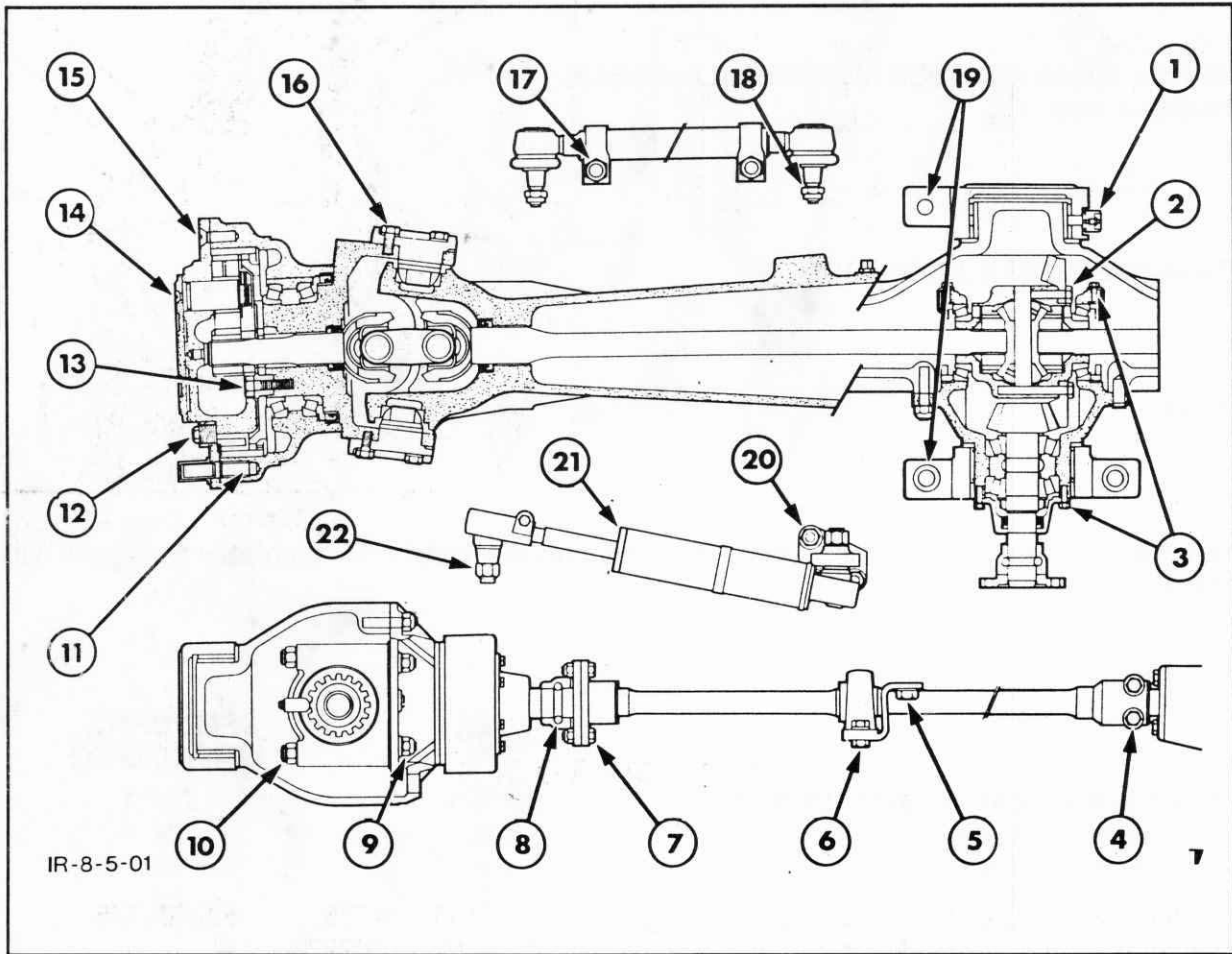


Figure 7-156

Fig. Ref.	N·m	Kgf.m	Lbf. ft
1	70	7	51
2	70	7	51
3	10	1	7
4	57	5.8	42
5	352	35.9	260
6	57	5.8	42
7	57	5.8	42
8	56	5.7	41
9	100	10.2	74
10	156	15.9	115
11	70	7	51
12	40	4.1	30
13	250	25.4	184
14	34	3.5	25
15	80	8.2	59
16	137	13.8	100
17	70	6.9	50
18	140	14.1	102
19	515	53	380
20	240	24	177
21	258	26.3	190
22	300	30.4	220
Front Wheel Nuts - FWD	270	27.5	200

TORQUE SPECIFICATIONS TRANSFER GEAR ASSEMBLY

Fig. Ref.	N·m	Kgf.m	Lbf. ft
1	48	4.9	35.5
2	60	6.0	44.0
3	87	8.8	64.0
4	24	2.4	17.5
5	24	2.4	17.5

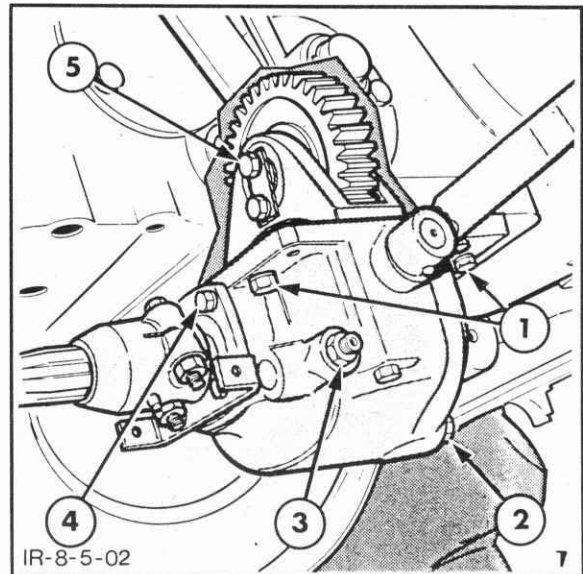


Figure 7-157

SPECIAL TOOLS

Fixture - Ring Gear and Pinion Bevel Setting	FT.3135	4775	FNH04775
Oil Seal Installer - Axle Shaft (Swivel Casing)	FT.3162	307972	--
Oil Seal Installer - Axle Shaft (Center Casing)	FT.3162	307972	--
Oil Seal Installer - Differential Pinion	FT.3162	307972	--
Bushing Installer - Axle Shaft (Swivel Casing)	FT.3164	307974	--
Bushing Installer - Axle Shaft (Center Casing)	FT.3165	307975	--
Wrench - Differential Pinion Bearing Nut	FT.3168	307978	--
Driver Handle	550	--	--
Slide Hammer	943	9507	FNHO9507
Slide Hammer Puller	943S	9567	FNH09567
Puller Attachment	951	9190	FNH09190
Slide Hammer	954C	9508	FNHO9527
Puller	1003	9516	FNH09516



Figure 1

UNITED STATES

State	Area	Population	Capital
Alabama	52,420	2,049,000	Montgomery
Alaska	588,000	267,000	Juneau
Arizona	113,970	1,315,000	Phoenix
Arkansas	53,110	1,244,000	Fayetteville
California	158,330	16,719,000	Sacramento
Colorado	104,140	2,763,000	Denver
Connecticut	5,540	2,580,000	Hartford
Delaware	2,480	554,000	Dover
Florida	57,930	13,990,000	Tallahassee
Georgia	59,720	4,488,000	Atlanta
Hawaii	10,930	1,295,000	Honolulu
Idaho	83,740	1,206,000	Boise
Illinois	143,120	12,812,000	Springfield
Indiana	36,420	6,487,000	Indianapolis
Iowa	71,480	3,191,000	Des Moines
Kansas	81,760	3,401,000	Topeka
Kentucky	40,320	4,046,000	Frankfort
Louisiana	52,430	4,287,000	Baton Rouge
Maine	9,330	1,329,000	Portland
Maryland	12,160	5,774,000	Annapolis
Massachusetts	8,010	6,779,000	Boston
Michigan	96,710	10,077,000	Lansing
Minnesota	86,930	5,426,000	St. Paul
Mississippi	47,820	2,849,000	Jackson
Missouri	69,700	5,994,000	Jefferson City
Montana	147,040	989,000	Helena
Nebraska	77,340	1,934,000	Lincoln
Nevada	110,630	2,050,000	Carson City
New Hampshire	9,330	1,329,000	Manchester
New Jersey	19,210	8,903,000	Trenton
New Mexico	121,710	1,885,000	Santa Fe
New York	54,550	19,045,000	Albany
North Carolina	51,880	7,599,000	Raleigh
North Dakota	70,620	682,000	Bismarck
Ohio	44,820	11,354,000	Columbus
Oklahoma	69,560	3,756,000	Norman
Oregon	98,380	3,437,000	Salem
Pennsylvania	46,080	12,461,000	Harrisburg
Rhode Island	1,540	1,057,000	Providence
South Carolina	32,240	3,401,000	Columbia
South Dakota	77,340	801,000	Sioux Falls
Tennessee	56,270	5,687,000	Nashville
Texas	269,790	20,851,000	Austin
Vermont	9,610	623,000	Montpelier
Virginia	42,770	6,535,000	Richmond
Washington	71,300	5,271,000	Olympia
West Virginia	24,060	1,853,000	Charleston
Wisconsin	65,490	5,791,000	Madison
Wyoming	97,810	562,000	Cheyenne

UNITED STATES

State	Area	Population	Capital
Alabama	52,420	2,049,000	Montgomery
Alaska	588,000	267,000	Juneau
Arizona	113,970	1,315,000	Phoenix
Arkansas	53,110	1,244,000	Fayetteville
California	158,330	16,719,000	Sacramento
Colorado	104,140	2,763,000	Denver
Connecticut	5,540	2,580,000	Hartford
Delaware	2,480	554,000	Dover
Florida	57,930	13,990,000	Tallahassee
Georgia	59,720	4,488,000	Atlanta
Hawaii	10,930	1,295,000	Honolulu
Idaho	83,740	1,206,000	Boise
Illinois	143,120	12,812,000	Springfield
Indiana	36,420	6,487,000	Indianapolis
Iowa	71,480	3,191,000	Des Moines
Kansas	81,760	3,401,000	Topeka
Kentucky	40,320	4,046,000	Frankfort
Louisiana	52,430	4,287,000	Baton Rouge
Maine	9,330	1,329,000	Portland
Maryland	12,160	5,774,000	Annapolis
Massachusetts	8,010	6,779,000	Boston
Michigan	96,710	10,077,000	Lansing
Minnesota	86,930	5,426,000	St. Paul
Mississippi	47,820	2,849,000	Jackson
Missouri	69,700	5,994,000	Jefferson City
Montana	147,040	989,000	Helena
Nebraska	77,340	1,934,000	Lincoln
Nevada	110,630	2,050,000	Carson City
New Hampshire	9,330	1,329,000	Manchester
New Jersey	19,210	8,903,000	Trenton
New Mexico	121,710	1,885,000	Santa Fe
New York	54,550	19,045,000	Albany
North Carolina	51,880	7,599,000	Raleigh
North Dakota	70,620	682,000	Bismarck
Ohio	44,820	11,354,000	Columbus
Oklahoma	69,560	3,756,000	Norman
Oregon	98,380	3,437,000	Salem
Pennsylvania	46,080	12,461,000	Harrisburg
Rhode Island	1,540	1,057,000	Providence
South Carolina	32,240	3,401,000	Columbia
South Dakota	77,340	801,000	Sioux Falls
Tennessee	56,270	5,687,000	Nashville
Texas	269,790	20,851,000	Austin
Vermont	9,610	623,000	Montpelier
Virginia	42,770	6,535,000	Richmond
Washington	71,300	5,271,000	Olympia
West Virginia	24,060	1,853,000	Charleston
Wisconsin	65,490	5,791,000	Madison
Wyoming	97,810	562,000	Cheyenne

SECTION 4 – TRANSMISSION

4 X 4 TRANSMISSION,	4-1
Complete Overhaul,	4-35
Component installation,	4-45
Component removal,	4-35
Gearshift components,	4-35
Installation - countershaft pre-load check,	4-39
Installation - gearshift components,	4-44
Installation - output shaft pre-load check,	4-41
Installation - output shaft, countershaft and rear cover assemblies,	4-43
Output shaft and countershaft gear assemblies,	4-38
Rear cover plate,	4-37
Separating the transmission from the engine and rear axle,	4-35
Component Overhaul,	4-46
Clutch pack clearance check, .	4-54
Countershaft and gear assembly,	4-60
Front input shaft and rear clutch assembly,	4-50
Output shaft and gear assembly,	4-57
Rear input shaft,	4-56
Reverse idler gear assembly, ..	4-56
Solenoid control valve,	4-55
Torque converter,	4-46
Transmission hydraulic pump and oil distributor assembly,	4-47
Discription and Operation,	4-1
Gear ratios,	4-2
Hydraulic clutch assemblies, ..	4-12
Modulator unit,	4-10
Oil cooler,	4-15
Oil distributor,	4-4
Oil flow,	4-13
Power flows,	4-15
Pressure regulating valve and bypass valve,	4-5
Solenoid control valve,	4-6

Control Valve,	4-18
Description and Operation,	4-3
811-Operation hydraulic pump, .	4-5
821-Hydraulic Overhaul,	4-28
Pressure Regulator serviced with Transmission separated from engine,	4-28
Assembly - front input shaft and clutch housing,	4-31
Assembly - torque converter, ..	4-33
Assembly - transmission hydraulic pump and oil distribution housing,	4-32
Connecting the transmission to the engine,	4-33
Disassembly - front input shaft and clutch housing,	4-30
Disassembly - torque converter,	4-28
Disassembly - transmission hydraulic pump and oil distributor housing,	4-29
Separating the transmission from engine,	4-28
Gearshift Lever, Modulator Unit and Solenoid Control Valve - Overhaul,	4-23
Gearshift lever,	4-23
Modulator unit,	4-26
Safety start switches,	4-25
Solenoid control valve,	4-25
Overhauling the Transmission, ...	4-21
General,	4-21
8 X 8 TRANSMISSION,	4-67
Complete Overhaul,	4-104
Component installation,	4-117
Component removal,	4-104
Gearshift components,	4-104
Installation - Countershaft pre-load check,	4-109
Installation - gearshift components,	4-115
Installation - output shaft countershaft and rear cover assemblies,	4-112
Installation - output shaft pre-load check,	4-110

Output shaft and countershaft gear assemblies,	4-107
Rear cover plate,	4-107
Separating the transmission from the engine and rear axle,	4-97
Component Overhaul,	4-97
Clutch pack clearance,	4-100
Countershaft assembly,	4-100
Front input shaft and clutch assembly,	4-100
Output shaft and gear,	4-129
Rear input shaft and gear,	4-128
Reverse idler gear assembly,	4-127
Solenoid control valve and lock-up valve,	4-127
Torque converter,	4-118
Transmission hydraulic pump and oil distributor,	4-119
Description and Operation,	4-67
Hydraulic clutch assemblies, ..	4-80
Lock-up valve,	4-77
Modulator unit,	4-78
Oil cooler,	4-83
Oil distributor,	4-71
Oil flow,	4-82
Power flows,	4-87
Pressure regulating valve and bypass valve,	4-72
Solenoid control valve,	4-73
Synchronized 8x8 transmission,	4-67
Synchronizer,	4-84
Torque converter,	4-70
Transmission hydraulic pump, ..	4-72
Front End Overhaul,	4-97
Assemblies serviced with transmission separated from engine,	4-97
Assembly - front input shaft and clutch housing,	4-100
Assembly - torque converter, ..	4-102
Assembly - transmission pump and oil distributor housing, ..	4-101
Connecting the transmission, ..	4-102
Disassembly - front input shaft and clutch housing,	4-99
Disassembly - torque converter, ..	4-97
Disassembly - transmission pump and oil distributor housing,	4-98

Separating the transmission from the engine,	4-97
Gearshift Lever, Modulator Unit, Lock-up Valve and Solenoid Control Valve - Overhaul,	4-91
Gearshift lever,	4-91
Lock-up valve,	4-95
Modulator unit,	4-95
Safety start switches,	4-93
Solenoid control valve,	4-94
Overhauling the Transmission, ...	4-90
General,	4-90

SPECIFICATIONS,	4-176
Special Tools,	4-180

TRANSMISSION ELECTRICAL	
CONTROL CIRCUIT,	4-134
Basic Control Circuitry	
Description,	4-134
Forward circuit,	4-135
General,	4-134
Neutral circuit,	4-135
Power-up circuit,	4-134
Reverse circuit,	4-136
Torque converter lock-up circuit,	4-137
Transmission Electrical Operation, ..	4-138
Forward circuit,	4-141
Power-up circuit,	4-139
Reverse circuit,	4-143
Torque converter lock-up circuit (8x8 transmission only),	4-145

TROUBLESHOOTING,	4-146
Electrical,	4-146
Dividing the system,	4-147
Harsh or sluggish shift engagement,	4-149
Intermittent electrical problems,	4-151
Modulator control box,	4-149
Performing circuit tests,	4-148
Preliminary checks,	4-146
Test equipment,	4-147
General,	4-146
Hydraulic,	4-169
Control valve check,	4-170
Diagnosis guide,	4-173
Flow test,	4-171
Internal leakage test,	4-169

Line pressure test,	4-169
Oil-to-cooler tests,	4-170
Pressure tests,	4-171
Stall test,	4-172
Troubleshooting guide,	4-175

SECTION 5 - REAR AXLE AND BRAKE

REAR AXLE AND WHEEL

BRAKES,	5-1
Brake Pedal Linkage and Cross-Shaft,	5-24
Description and Operation,	5-1
Differential lock operation,	5-4
Differential and Differential Lock Assembly,	5-17
Disassembly,	5-17
Inspection and repair,	5-18
Installation,	5-19
Reassembly,	5-18
Removal,	5-17
Differential Lock Linkage,	5-25
Drive Pinion Assembly,	5-20
Disassembly,	5-21
Inspection and repair,	5-22
Installation,	5-23
Reassembly,	5-22
Removal,	5-20
Overhaul,	5-5
Disassembly,	5-5
Inspection and repair,	5-6
Installation,	5-11
Reassembly,	5-6
Removal,	5-5
Planetary Gear Assembly,	5-12
Disassembly,	5-12
Inspection and repair,	5-12
Installation,	5-14
Reassembly,	5-13
Removal,	5-12
Rear Wheel Brakes,	5-15
Disassembly,	5-15
Inspection and repair,	5-15
Installation,	5-16
Reassembly,	5-16
Removal,	5-15
Twin Cable Hand Brake Operation,	5-26
Installation,	5-26
Removal,	5-26

SPECIFICATIONS AND

SPECIAL TOOLS,	5-27
----------------------	------

SECTION 6 - POWER TAKE-OFF

TO,	6-1
Overhaul,	6-13
Overhaul,	6-10
Operation,	6-1
.....	6-5
.....	6-20
.....	6-9
..... and Tests, ..	6-7
.....	6-7
.....	6-7
.....	6-17
Spec. Too	6-29
Specifications, ...	6-28
Troubleshooting	6-27

SECTION 7 - STEERING AND FRONT AXLE

FRONT-WHEEL DRIVE FRONT

AXLE,	7-55
Axle Shaft - Overhaul,	7-64
Description and Operation,	7-55
Differential, Ring Gear and Pinion Assembly - Overhaul,	7-80
Drive Shaft - Overhaul,	7-91
Front Axle - Removal and Installation,	7-77
Planetary Reduction Assembly and Wheel Hubs - Overhaul,	7-57
Steering Cylinder and Rack Control Rod - Overhaul,	7-72
Steering Swivel Pin Bearings Overhaul,	7-68

STEERING,	7-1
Bleeding Steering System,	7-32
Hydrostatic Steering - Description and Operation,	7-1
Description,	7-1
Hoses, tubes, and steering cylinders,	7-10
Metering unit - operation,	7-9
Power-steering pump and reservoir,	7-3
Steering column shaft,	7-1
Steering cooler,	7-3
Steering motor,	7-3
Steering motor operation,	7-6

Hydrostatic failure of Motor - Overhaul, fully drained,	7-18
Power-Steering Pump - Troubleshooting and Pressure Testing,	
Power-Steering Reservoir, and Cooler - Overhaul,	7-12
Reservoir Filter and Hydraulic Tubes,	7-31
Specifications and Special Tools, .	7-37
Troubleshooting at Pressure Testing,	7-33
TRANSFER GEAR ASSEMBLY,	7-93
Description and Operation,	7-93
Overhaul,	7-95
Special Tools,	7-109

Specification - Front-Wheel Drive Axle and Transfer Gear Assembly, ...	7-105
Transfer Gear Operating Cable - Adjustments,	7-103

TWO-WHEEL DRIVE FRONT

AXLE,	7-39
Front Axle - Description,	7-39
Front Axle - Overhaul,	7-51
Front Wheel Hub and Spindle - Overhaul,	7-42
Specifications and Special Tools, .	7-54
Steering Cylinder and Track Control Rod - Overhaul,	7-46
Toe-In Adjustment,	7-40
Troubleshooting - Steering,	7-53



NEW HOLLAND

The winning team

FIAT - HITACHI

PART No. 82995387
-FINIS No. 2995387

TNP 12315
ENGLISH 12/93

© 1993 New Holland Ford Limited, Cranes Farm Road, Garsdon, Essex SS14 3AD, England
Printed in England by Valentine Press Ltd, Basildon, Essex

REFILLING TABLE

IMPORTANT: The fluids and lubricants in your machine as delivered in this manual. The mixing of alternative fluids and lubricants with your machine as supplied is not recommended and could result in damage to the machine components. When alternative fluids are to be used as listed, use the system and refill to the appropriate level.

those listed in the manual and lubricants in the manual. Damage to the machine components. the respective

PART TO BE REFILLED	Litres	FIAT Tradename	Temperature of part	Additional information
Cooling system	15.2	PARAFLU	> -35	Mixture of water and antifreeze to be mixed with 50% water. This mixture has anti-oxidizing, anti-corrosive, anti-scale and anti-foaming properties, and cannot freeze above -35°C
Fuel Tank	90.8			ASTM diesel fuel N.2-D TT. Type of good make and quality.
Engine (excluding oil filter Filter)	7.6 0.97	AMBRA SUPER 5W-40 10W-30	-15 + 50 -25 + 20	Engine oil MIL-L-2104 D or "CD" API service
Gear-box CASA ENG 64V4JE	18	TUTELA GI/M TUTELA GI/A		ATF Type A SUFFIX A DEXRON II
Front Axle (twin drive)		TUTELA W90/M D-A		Oil for mechanical transmission MIL-L-2105C or GL5 API service.
Rear Axle (twin drive)	40.6 +1	TUTELA MULTI F		API GL4 OTTO
Hydraulic unit	79.5	IDRAULICAR AP31 (10W) AP51 (10W)	-25 + 10 5 + 50	Hydraulic oil MIL-H-24459 or DIN 51524/51525
Power steering	1.9	TUTELA GI/M TUTELA GI/A		ATF Type A SUFFIX A DEXRON II
Differential housing (twin drive)	6.5	TUTELA W90/M D-A		Oil for mechanical transmission MIL-L-2105C or GL5 API service.
Rear Axle hub (twin drive)	6.5	TUTELA W90/M D-A		Oil for mechanical transmission MIL-L-2105C or GL5 API service.
Rear Wheel Bearings (single drive)	1	TUTELA MR2		N.L.G.I.2
Various grease cup		TUTELA		N.L.G.I.2
Extendible Excavator Arm		MR2		MOLYKOTE 321R