2120 Tractor

JOHN DEERE

TECHNICAL MANUAL

2120 Tractor

TM4252 (01Dec70) English

John Deere Werke Mannheim

TM4252 (01Dec70)

LITHO IN U.S.A.
ENGLISH

Model 2120 Tractor

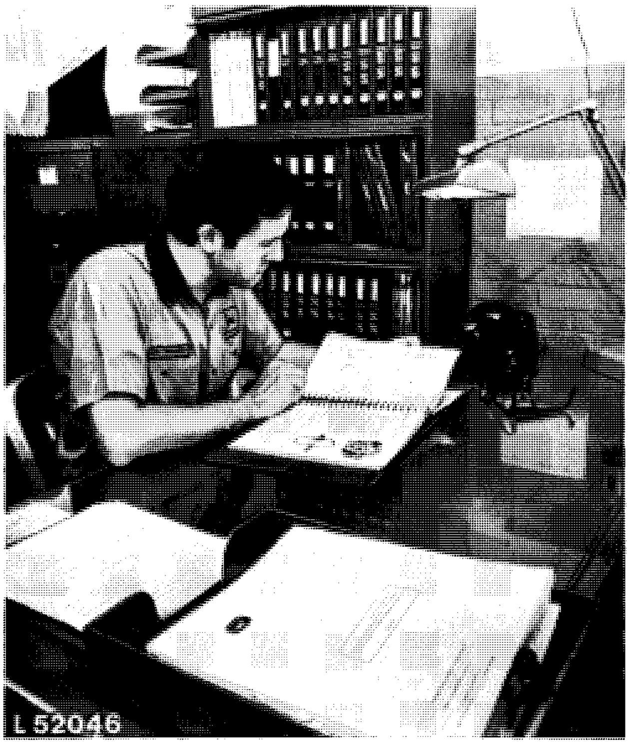
Serial No. 61020 L-up

Technical Manual
TM-4252 (Dec-70)

CONTENTS

Printed in Germany

INTRODUCTION



Use FOS Manuals for Reference

Use Technical Manuals for Actual Service

This technical manual is part of a twin concept of service:

- **FOS Manuals – for reference**
- **Technical Manuals – for actual service**

The two kinds of manuals work as a team to give you both the general background and technical details of shop service.

Fundamentals of Service (FOS) Manuals cover basic theory of operation, *fundamentals* of trouble shooting, *general* maintenance, and *basic types* of failures and their causes. FOS Manuals are for training new men and for reference by experienced men.

Technical Manuals are concise service guides for a specific machine. Technical Manuals are on-the-job guides containing only the vital information needed by a journeyman mechanic.

When a serviceman should refer to a FOS Manual for more information, a FOS symbol like the one at the left is used in the TM to indentify the reference.

Some features of this technical manual:

- *Table of contents at front of whole Manual.*
- *Contents at front of each Section*
- *Specifications at end of each Group*
- *Special tools at end of each Group*

This technical manual was planned and written for you – a journeyman mechanic. Keep it in a permanent binder in the shop where it is handy. Refer to it whenever in doubt about correct service procedures or specifications.

Using the technical manual as a guide will reduce error and costly delay. It will also assure you the best in finished service work.

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Section 10
GENERAL INFORMATION

CONTENTS OF THIS SECTION

Group 5
SPECIFICATIONS

SERIAL NUMBERS

The engine serial number is stamped into the name plate at the lower right of the front cylinder block.

NOTE: If ordering engine parts, indicate all digits of the serial number on the name plate.

The name plate showing the tractor serial number is located on the right-hand side of the front support.

NOTE: If ordering tractor parts, (excluding engine parts), indicate all digits of the serial number on the name plate.

MODEL NUMBERS

The injection pump, injection nozzles, the generator (alternator), starter and the main hydraulic pump have model numbers to facilitate identification of different makes of a given unit.

SPECIFICATIONS

ENGINE

Number of cylinder 4

Cylinder liner bore . . . . . . 4.02 in. (102 mm)

Stroke . . . . 4.33 in. (110 mm)

Displacement . . . . 219 cu.in. (3590 cm^2)

Compression ratio . . . . 16.7 : 1

Maximum torque at
1500 rpm . . . . 170 ft.lbs. (23.5 mkg)

Firing order . . . . 1 - 3 - 4 - 2

Valve clearance (engine hot or cold)
Intake valve 0.014 in. (0.35 mm)
Outlet valve 0.018 in. (0.45 mm)

Fast idle . . . . 2650 rpm

Slow idle . . . . 650 rpm

Working speed range . . . . . 1500 to 2500 rpm

Flywheel horsepower[1] at 2500 rpm
Net . . . . 67 HP (68 PS)
Gross[2] . . . . 71 HP (72 PS)

PTO horsepower[3] . . . . 60 HP (61 PS)
(at 2500 rpm engine speed and
650 or 1210 rpm powershaft speed)

ENGINE CLUTCH

Dual dry disk clutch, foot operated.

Single dry disk clutch with torsion damper (isolator), foot-operated (on tractors with independent PTO)

ELECTRICAL SYSTEM

Batteries . . . . 2 x 12 Volts, 55 Ah

Starter . . . . 12 Volts, 4 HP (4 PS)

Alternator . . . . 12 Volts, 28 A

Generator . . . . 12 Volts, 11 A

Battery terminal grounded . . . . negative

---

1) 1 PS = 1 ch = 0.736 KW; 1 KW = 1,36 PS = 1.36 ch; 1 PS = 0.986 HP; 1 HP = 1.01 PS

2) Less water pump, fan, generator (alternator), air cleaner and muffler.

3) With the engine run in (above 100 hours of operation) and having reached operating temperature (engine and transmission); measured by means of a dynamometer. Permissible variation $\pm$ 5%.

TRANSMISSION

Collar shift transmission with helical cut gears.

This transmission is available in three variations:

8 speed transmission with parking lock, without independent hand brake;
8 speed transmission without parking lock and with independent hand brake;
8 speed transmission without parking lock, with blocked 8th gear and independent hand brake.

With this transmission 8 or 7 forward and 4 reverse speeds are available.

HIGH-LOW SHIFT UNIT

Hydraulically controlled reduction gear which can be shifted under load, with "wet" multiple disk clutch and "wet" multiple disk brake. Allows reduction of the individual gear speeds by 26%.

DIFFERENTIAL AND FINAL DRIVES

Planetary reduction gear and differential with spiral bevel gears.

DIFFERENTIAL LOCK

Hand or foot operated; spring-loaded out of engagement.

POWER SHAFTS

Continuous Running Power Shafts

The power shafts are independent of the transmission if the tractor is equipped with a dual stage engine clutch.

Independent Power Shafts

Independent of transmission, can be engaged and disengaged under load.

The independent power shaft is engaged by a hydraulically operated disc clutch. Disengaging the clutch is achieved by operating the hydraulically actuated band type brake.

Power Shaft Speeds (in rpm)

Engine Speed in rpm	540 rpm shaft	1000 rpm shaft
650	169	315
2067	538	1000
2075	540	1004
2500	650	1210
2650	689	1283

HYDRAULIC SYSTEM

Closed center, constant pressure system; also includes rockshaft, power steering and selective control valves.

System pressure . . . . 2220 to 2280 psi (156 to 160 kg/cm²)

Pump . . . . 4 or 8-piston pump driven by the engine

POWER STEERING

The steering system is a "closed center" type incorporated by the hydraulic system and supplied with oil by the main hydraulic pump. It is connected to the front wheels by means of a steering linkage.

MANUAL STEERING

The manual steering is a recirculating ball bearing, worm and nut type. A number of steel balls between ball nut and steering wheel shaft provide for positive engagement of steering wheel and steering linkage.

HYDRAULIC BRAKES

The disk brakes run in an oil bath and are hydraulically controlled.

HANDBRAKE

Band-type locking brake acting on differential.

CAPACITIES

	Imp. Gals.	US Gals.	Liters
Fuel tank	16.25	19.5	73.8
Cooling system	2.5	3.0	11.4
Engine crankcase incl. filter	1.25	1.5	5.7
Transmission-hydraulic system			
Dry system	7.9	9.5	36.0
At service intervals . . .	6.5	7.4	28.0
Oil-bath air cleaner	0.22	0.26	1.0
Belt pulley	0.25	0.30	1.1

TRAVEL SPEEDS

See Operator's Manual

FRONT AND REAR WHEELS

For tire sizes, treads, inflation pressure and weights see Operator's Manual.

DIMENSIONS AND WEIGHTS

See Operator's Manual.

Group 10

PREDELIVERY, DELIVERY AND AFTER-SALES INSPECTIONS

PREDELIVERY INSPECTION

Every new JOHN DEERE Tractor leaves the factory in such a condition that it can be delivered to the customer after a minimum of service.

To promote complete customer satisfaction, proper predelivery service including mending of possible shipping damage and giving the finishing touches to the tractor, are of prime importance to the dealer.

A tag pointing out the factory-recommended procedure for predelivery service is attached to every new tractor before it leaves the factory. The reverse side of this tag is filled in by the factory after the tractor has undergone a thorough inspection prior to shipping.

After completing the factory-recommended dealer checks and services listed on the predelivery tag, remove the tag from the tractor and file it with the shop order for the job. The tag will then serve as a basis for certifying that the unit has received the proper predelivery service.

TEMPORARY TRACTOR STORAGE

Service	Specifications	Reference
Check radiator for coolant loss and antifreeze protection (gravity of anti-freeze and rust inhibitor mixture)	Coolant level should be midway between radiator core and bottom edge of filler neck	Operator's manual
CAUTION: On tractors equipped with a generator and shipped with dry-charged batteries or without batteries which are to be started by means of a slave battery, do not remove insulating tape on terminal of cable to starter under any circumstances. Also, do not remove – contrary to earlier statements – wire between terminals D+ of regulator and D+ of generator. If this advice is disregarded, damage to generator and regulator may result. **CAUTION: On tractors equipped with an alternator, do not remove or disconnect the bridge piece which connects D+, DF and D-terminals.**	. . . .	. . . .
Remove batteries.	Store at room temperature	. . . .
Reduce shipping pressure of tires	. . . .	Operator's manual
Cover tractor and tires for protection and cleanliness	. . . .	. . . .

BEFORE DELIVERING TRACTOR

Service	Specifications	Reference
COOLING SYSTEM		
Check radiator for coolant loss	Coolant level should be midway between radiator core and bottom edge of filler neck.	Operator's manual
Check gravity of antifreeze and rust inhibitor mixture	. . . .	Operator's manual
ELECTRICAL SYSTEM		
CAUTION: On tractors equipped with a generator which are to be started by means of a slave battery, do not remove insulating tape on terminal of cable to starter under any circumstances. Also, do not remove - contrary to earlier statements - wire between terminals D+ of regulator and D+ of generator. If this advice is disregarded, damage to generator and regulator may result.	. . . .	Section 40, group 10
If the batteries are to be installed in the tractor, remove insulating tape on terminal of battery cable. This is to be done if the tractor was shipped with dry- charged batteries or without batteries, on tractors supplied with a generator.		
CAUTION: If a tractor equipped with alternator is to be started by means of a slave battery,do not remove bridging wire connecting alternator terminals D+, DF and D- under any circumstances. Removing this wire will result in immediate destruction of diodes.	. . . .	Section 40, group 10
If the batteries are to be installed in the tractor, proceed as follows: Remove bridging wire from terminals D+, DF and D- and connect wires to alternator.	. . . .	Section 40, group 10

BEFORE DELIVERING TRACTOR - Continued

Service	Specifications	Reference
Fill batteries with electrolyte, charge batteries and install in tractor.	. . . .	"Fundamentals of Service, Electrical Systems" manual under "Batteries"
First connect positive (+) and then negative (-) wire of each battery. Only then start tractor engine.	. . . .	Section 40, group 10
TIRES AND WHEELS		
Check tire inflation pressure	. . . .	Operator's manual
Retighten wheel bolts and ball nuts	. . . .	Section 80, group 15 and Operator's manual
LUBRICATION		
Check crankcase oil level	Top mark on dip stick	Operator's manual
Check transmission-hydraulic system oil level	. . . .	Operator's manual
Lubricate all lubrication points on the tractor	. . . .	Operator's manual
ENGINE		
Check oil bath air cleaner	Fill with oil to "Full"	Operator's manual
Check dry type air cleaner	. . . .	Operator's manual
Fill fuel tank and start engine	Capacity: 16.25 Imp. (19.5 US) Gals = 73.8 lit.	Operator's manual
Check lighting system, indicator lights and instruments for proper operation	. . . .	Operator's manual
Check if speed control linkage moves easily	. . . .	Section 20, group 40
Check engine idle speeds	. . . .	Section 20, group 40
Check injection timing	. . . .	Section 30, group 15
TESTING OPERATION		
Check clutch pedal adjustment	Approx. 1 in. (25 mm) clutch pedal free travel	Section 50, group 5
Check operation of HIGH-LOW shift	. . . .	Section 50, group 10
Shift transmission through all speeds	. . . .	Operator's manual
Check differential lock operation	. . . .	Operator's manual
Check power shaft operation	. . . .	Operator's manual
Check 3-point hitch operation	. . . .	Operator's manual
Check hydraulic system operation	. . . .	Section 70, group 5
Check brake system	. . . .	Section 60, group 15

BEFORE DELIVERING TRACTOR - Continued

Service	Specifications	Reference
Check steering operation	. . . .	Section 60, group 10
Check seat adjustment	. . . .	Operator's manual
Check operation of remote hydraulic cylinder (if equipped)	. . . .	Section 70, group 5
GENERAL INFORMATION		
Tighten accessible nuts and attaching screws	. . . .	Section 10, group 20
Attach roll guard	Tighten nuts and bolts to 94 ft.lbs. (13 mkg)	Section 80, group 25
Clean tractor and touch up paint	. . . .	. . . .

DELIVERY INSPECTION

A thorough discussion of the operation and service of the tractor at the time of its delivery helps to assure complete customer satisfaction.

Proper delivery should be an important phase of the dealer's program.

It is a well-known fact that many complaints have arisen simply because the owner was not shown how to operate and service his new tractor properly. Therefore, enough time should be devoted, at the customer's convenience, to introducing him to his new tractor and explaining to him how to operate and service it.

Using the tractor operator's manual as a guide, be sure that the owner understands the following points properly.

1. Adjusting the seat
2. Operation of control levers and instruments
3. Starting and shutting off the engine
4. The importance of the tractor break-in period
5. Use of counterweights and proper inflation pressure as well as filling of tires with water and magnesium chloride, if required.
6. Operating the complete hydraulic system
7. Operating the power shaft and belt pulley (if equipped)
8. The importance of the safety rules
9. The importance of lubrication and periodic service

AFTER-SALES INSPECTION

In the interest of the purchaser and the dealer an after-sales inspection should be carried out by the dealer after the first 100 hours of using a new John Deere tractor.

The purpose of this inspection is to make sure that the customer is receiving satisfactory performance from his tractor. At the same time, the inspection should reveal whether or not the tractor is being operated, lubricated and serviced properly.

Through this inspection a needless volume of service work can be eliminated by preventing minor difficulties from developing into serious problems later on. It also will promote stronger dealer-customer relations and give the customer an opportunity to ask questions that may have arisen during the first few days of use.

Thereby the dealer has the further opportunity of promoting the possible sale of other new equipment.

The following inspection program is recommended:

AFTER-SALES INSPECTION

Service	Specifications	Reference
COOLING SYSTEM		
Check coolant level	Coolant level should be midway between radiator core and bottom edge of filler neck	Operator's manual
Clean exterior of radiator	. . . .	. . . .
Check hose connections	. . . .	. . . .
FUEL SYSTEM		
Check sediment bowls and elements of fuel filter for water or sediment and clean transfer pump screen	. . . .	Operator's manual
Check line connections	. . . .	. . . .
ELECTRICAL SYSTEM		
Check gravity of battery electrolyte	Gravity should be 1.260 at an electrolyte temperature of 80°F (27°C)	
Check electrolyte level of batteries	To bottom of filler neck in each cell	Operator's manual
Check tension of fan belt	3/4 in. (19 mm) deflection with a 20 lbs (9 kg) force	Operator's manual and section 20, group 35
Start engine and check operation of lights, indicator lamps and instruments	. . . .	Operator's manual
LUBRICATION		
Check crankcase oil level	Top mark on dip stick	Operator's manual
Check transmission oil level	. . . .	Operator's manual
Check oil level of manual steering gear housing	Add oil up to filler hole	Operator's manual
Check oil level of belt pulley housing	Add oil up to filler hole	Operator's manual
Lubricate clutch throw-out bearing	. . . .	Operator's manual
Lubricate 3-point hitch	. . . .	Operator's manual

AFTER-SALES INSPECTION

Service	Specifications	Reference
ENGINE		
Check oil level in oil-bath air cleaner	Fill with oil to level mark	Operator's manual
Check dry-type air cleaner	. . . .	Operator's manual
Check valve clearance	Intake valve: 0.014 in. (0.35 mm) Exhaust valve: 0.018 in. (0.45 mm)	Section 20, group 10
Check engine speed under load as well as fast and slow idle speed	. . . .	Section 20, group 40
Check engine performance	. . . .	Section 10, group 20
GENERAL INFORMATION		
Check clutch pedal adjustment	Approx. 1 in. (25 mm) free travel	Section 50, group 5
Check operation of HIGH-LOW shift unit	. . . .	Section 50, group 10
Shift transmission through all speeds	. . . .	Operator's manual
Check operation of power shaft	. . . .	Operator's manual
Check differential lock	. . . .	Operator's manual
Check operation of hydraulic system	. . . .	Section 70, group 5
Check steering system	. . . .	Section 60, group 10
Check brakes	. . . .	Section 60, group 15
Tighten accessible nuts and cap screws	. . . .	Section 10, group 20
Tighten roll guard attaching screws and nuts	94 ft.lbs. (13 mkg)	Section 80, group 25
Tighten accessible hydraulic lines	. . . .	. . . .
Visual inspection of tractor	Damaged paint, loose connections, proper positioning of hoses and lines, leaks, operation of all mechanical parts	. . . .

Group 15

LUBRICATION AND PERIODIC SERVICE

For brands of oil and lubricants to be used as well as for lubricating and servicing the model 2120 tractor, see operator's manual.

Group 20
ENGINE AND TRACTOR TUNE-UP

GENERAL INFORMATION

Before tuning up the engine, determine whether a tune-up will restore operating efficiency. If there is doubt, the following preliminary tests will help to determine if the engine can be tuned up.

PRELIMINARY ENGINE TESTING

Service	Specifications	Reference
Checking air intake system by means of vacuum gauge	14 to 25 in. (355-635 mm) water head; engine running at fast idle speed	"Fundamentals of Service, Engine" manual under "Diagnosis and Testing"
Check radiator for air bubbles or oil film	. . . .	. . . .
Measure blow-by at crankcase vent tube *	436 Imp.gals./h. 524 US.gals./h. 1982 liters/h.	
Check compression which should be at least (using special tool No. 19.58-90.578)	300 psi (21 kg/cm^2)	"Fundamentals of Service, Engine" manual under "Diagnosis and Testing"
Measure engine horsepower at powershaft (using a dynamometer)	Record measured performance and compare with performance measured after carrying out "Engine Tune-up"	. . . .

* *Measure with a standard gas gauge, placing hose over end of crankcase vent tube. The engine must be tested at 2500 rpm, normal running temperature and should be run in (at least 100 hours). Measure over a period of 5 minutes and multiply measured value by 12 (for hourly rate). Compare with values quoted above.*

There is no undue wear on piston rings and cylinder liners if the measured value is lower than that quoted above. Should a further test be desired, carry out a compression test. If the "blow-by" reading is more than that quoted above, the decline in performance is due to excessive wear and the engine should be overhauled.

ENGINE TUNE-UP-Continued

Service	Specifications	Reference
AIR INTAKE SYSTEM		
Oil-bath air cleaner - clean oil cup and fill with fresh engine oil to "Full" mark	. . . .	Operator's manual and "Fundamentals of Service, Engine" manual.
Dry-type air cleaner - clean filter element and dust unloading valve	. . . .	Operator's manual and "Fundamentals of Service, Engine" manual
Check crankcase vent tube for foreign particles (restriction)	. . . .	. . . .
Tighten cylinder head cap screws	110 ft.lbs. (15 mkg)	Section 20, group 10
Check and adjust valve clearance	Intake valve 0.014 in. (0.35 mm) Outlet valve 0.018 in. (0.45 mm)	Section 20, group 10
BATTERIES		
Thoroughly clean wires, connections and batteries	. . . .	. . . .
Tighten cable clamp screws	. . . .	. . . .
Liberally coat battery terminals and cable connectors with petroleum jelly	. . . .	. . . .
Check electrolyte level of battery	. . . .	Operator's manual
Check specific gravity of electrolyte	. . . .	Operator's manual
GENERATOR (ALTERNATOR)		
Check fan belt tension	3/4 in. (19 mm) deflection with 20 lbs (9 kg) force	Section 20, group 35
FUEL SYSTEM		
Check fuel tank and lines for leaks or restriction	. . . .	. . . .
Clean screen of fuel transfer pump	. . . .	Operator's manual
Check first stage filter element and replace, if necessary	. . . .	Section 30, group 10
Check injection timing and adjust, if necessary	. . . .	Section 30, group 15
Bleed fuel system	. . . .	Section 30, group 15
Check engine speeds and adjust speed control linkage, if necessary	. . . .	Section 20, group 40

ENGINE TUNE-UP - Continued

Service	Specifications	Reference
ENGINE LUBRICATION SYSTEM		
Check engine oil pressure	50 to 60 psi (3.5 to 4.2 kg/cm^2) at 2500 rpm	Section 20, group 30
COOLING SYSTEM		
Clean and flush cooling system	. . . .	"Fundamentals of Service, Engine" manual
Check radiator hoses for damage and leaks	. . . .	. . . .
Clear radiator core of restrictions	. . . .	. . . .

CHECKING ENGINE PERFORMANCE

After the engine has been tuned up as explained above, determine powershaft horsepower by means of a dynamometer, see "Fundamentals of Service, Engine" manual.

Compare measured performance in HP with output measured before carrying out "Engine tune-up".

TRACTOR TUNE-UP

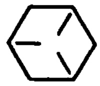
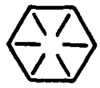
After carrying out engine tune-up, make the following adjustments on the tractor:

Service	Specifications	Reference
ENGINE CLUTCH		
Adjust clutch pedal free travel	Approx. 1 in. (25 mm)	Section 50, group 5
FRONT WHEELS		
Clean and lubricate front wheel bearings	. . . .	Section 80, group 15
Adjust front wheel bearings	. . . .	Section 80, group 15
Check toe-in	1/8 to 1/4 in. (3 to 6.5 mm)	Section 60, group 5
Check torque of front wheel bolts	87 ft.lbs (12 mkg)	. . . .
HYDRAULIC BRAKES		
Bleed brake system	. . . .	Section 60, group 15

TRACTOR TUNE-UP - Continued

Service	Specifications	Reference
HYDRAULIC SYSTEM		
Check stand-by pressure of hydraulic pump	156 to 160 kg/cm^2 (2220 to 2280 psi)	Section 70, group 5
Check rockshaft lift cycle time at 2500 rpm engine speed	1.8 sec. to 2.3 sec.	Section 70, group 5
Check time required for extending or retracting remote cylinder at 2100 rpm engine speed	2 sec.	Section 70, group 5
Check operating pressure of HIGH-LOW shift unit:	. . . .	. . . .
on tractors without independent power shaft	95-105 psi (6.7 to 7.3 kg/cm^2)	Section 50, group 10
on tractors with independent power shaft	140-160 psi (9.8 to 11.2 kg/cm^2)	Section 50, group 10
Check operating pressure of power shaft clutch and brake	140 to 160 psi (9.8 to 11.2 kg/cm^2)	Section 50, group 35
TIRES		
Check tire inflation pressure	. . . .	Operator's manual
TORQUES		
Check all accessible cap screws and nuts of tractor for proper torque	. . . .	Torque chart

STANDARD TORQUES

Recommended torques in ft. lbs. and mkg for UNC and UNF cap screws						
Head marking (identifying strength)	 or 6.8 (6. S)*		 or 10.9 (10 K)**		 or 12.9 (12 K)***	
Thread-O.D. (in.)	ft.lbs.	mkg	ft.lbs.	mkg	ft.lbs.	mkg
1/4	7	1	10	1,5	14	2
5/16	14	2	20	3	30	4
3/8	21	3	35	5	50	7
7/16	35	5	55	8	80	11
1/2	55	8	85	12	130	18
9/16	75	10	130	18	185	26
5/8	105	15	170	23,5	250	34,5
3/4	185	25,5	300	41,5	420	58
7/8	160****	22****	445	61,5	670	92,5
1	250	34,5	670	92,5	1000	138.5

NOTE: A variation of ± 10% is permissible for all torques indicated in this chart.

Torque figures indicated above and in the Specifications sections of this manual are valid for non-greased or non-oiled threads and heads unless otherwise specified. Therefore, do not grease or oil bolts or cap screws unless otherwise specified in this manual.

*	Regular bolts and cap screws
**	Tempered steel high strength bolts and cap screws
***	Tempered steel extra high strength bolts and cap screws
****	Bolts and screws 7/8 in. and larger are often formed hot rather than cold, which accounts for the lower torque.

SPECIAL TOOLS

Part No. if ordered through JD Parts Depot	Manufacturer	Description	Use
19.58-90-578		Special adapter	Checking compression pressure
19.58-90-260*		Special tool	Checking oil pressure

* Details see section 70, group 5

Group 25
SEPARATING ASSEMBLIES

SEPARATING BETWEEN ENGINE AND TRACTOR FRONT END

REMOVAL

For safety disconnect ground strap (cable) from battery.

Remove front end weights (if equipped).

Remove radiator and fuel tank caps. Remove radiator side grilles and hood. Install radiator and fuel tank caps.

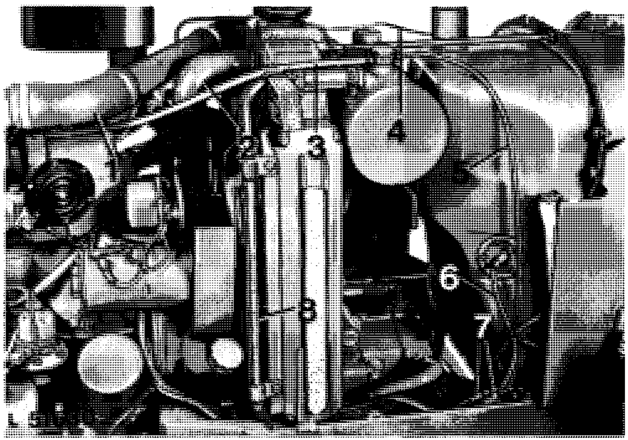


Fig. 1 — Separating between Tractor Front End and Engine

1 Air intake hose
2 Upper water hose
3 Leak-off and vent line
4 Fuel return line
5 Leak-off and vent line
6 Cable of fuel gauge sending unit
7 Distributor
8 Hydraulic line (on tractors without oil cooler)

Disconnect air intake hose (see 1, fig. 1) at engine intake manifold and air cleaner.

Disconnect leak-off and vent lines 3 and 5 at hydraulic oil reservoir.

Remove support rod at top of radiator. Disconnect fuel return line 4 at fuel tank.

Disconnect headlight wires at distributors 7.

Drain coolant and disconnect upper and lower water hoses at radiator.

Only on tractors without oil cooler: Disconnect hydraulic oil line (see 8, fig. 1) at top and bottom hose and remove.

Only on tractors equipped with oil cooler: Remove hose elbow between hydraulic oil reservoir and oil cooler at oil cooler end. Disconnect return oil line at bottom of oil cooler.

NOTE: Plug lines and openings immediately with plugs or caps to prevent loss of oil and entering of dirt into the system.

Remove screws securing fan shroud to radiator and slide over fan to the rear.

Remove screws securing radiator to front axle support and lift out radiator to the left of tractor.

Close fuel shut-off valve at bottom of fuel tank.

Disconnect fuel inlet line at fuel tank and fuel transfer pump. Remove transfer pump and fuel inlet line.

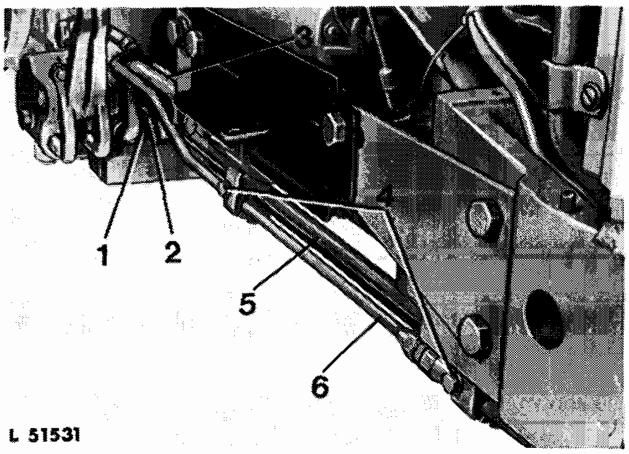


Fig. 2 — Disconnecting Hydraulic Lines

1 Retainer
2 Cap screw
3 Return line to transmission case
4 Pipe clamps
5 Hydraulic pump inlet line
6 Hydraulic pump pressure line

Remove side frames.

Remove pipe clamps (see 4, fig. 2).

Unscrew cap screw 2 and remove retainer 1 which supports the hydraulic pump inlet line 5 and return line 3 of oil cooler (oil reservoir if not equipped with oil cooler).

On tractors not equipped with HIGH-LOW transmission: Take care that the check valve installed in hydraulic pump inlet line 5 is not lost when the inlet line is removed.

Disconnect pressure line 6 at connector situated at front of engine.

Disconnect drag link at bell crank.

Remove securing screw of hydraulic pump drive shaft.

Securely support rear of tractor under clutch housing by placing assembly stand 19.58-90.619 under transmission case.

Insert wooden blocks between front axle and front support to prevent the latter from slipping sideways.

Suspend front of tractor to a suitable hoist or support with assembly stand 19.58-90.618.

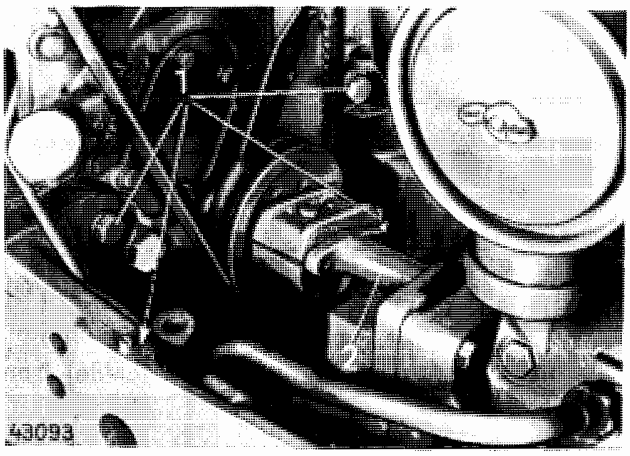


Fig. 3 — Attaching Points of Tractor Front End

1 Attaching screws of front axle support
2 Hydraulic pump drive shaft

Remove cap screws (see 1, fig. 3) of front support and separate front end from engine. Take measures to prevent front of tractor from tipping forwards. (Drain fuel tank if it contains too much fuel or support front end of tractor).

INSTALLATION

Make sure woodruff key is installed in shaft of hydraulic pump.

Move front of tractor towards engine.

Engage pump shaft in hydraulic pump drive shaft and at the same time connect return line of oil cooler (reservoir if not equipped with oil cooler). Slide hydraulic pump inlet line into clutch housing and tighten both lines (see fig. 2). Tighten cap screw (see 2, fig. 2) securing retainer 1 to the specified torque.

CAUTION: On tractors not equipped with HIGH-LOW transmission: Ensure check valve is inserted in hydraulic pump inlet line before it is installed.

Attach front end of tractor to engine, using cap screws (see 1, fig. 3). Tighten cap screws to specified torque. Tighten hydraulic pump drive shaft cap screw to specified torque.

NOTE: Do not tighten securing screw of hydraulic pump drive shaft until tractor front end is secured to engine.

Install fuel transfer pump and connect fuel lines.

Make sure transfer pump inlet line is behind and below fuel pressure line.

Open fuel shut-off valve.

Connect cable to fuel gauge sending unit.

Connect headlight cables to junctions.

Lift and slide radiator into location from the left side of tractor. Slide fan shroud forward over radiator, insert and tighten set screws. Secure radiator to front axle support. Install upper and lower water hoses.

Only on tractors not equipped with oil cooler: Connect oil line to oil reservoir and tighten both hose clamps (see fig. 1).

Only on tractors equipped with oil cooler: Connect hose elbow between hydraulic oil reservoir and oil cooler at top of oil cooler and return line at bottom of oil cooler.

Connect air vent lines to hydraulic reservoir.

Connect hydraulic pump pressure line and install line clamps (see fig. 1).

Connect air intake pipe at manifold and air filter.

Attach drag link to bell crank and tighten castellated nut to specified torque.

Install hood and radiator side grilles.

Fill radiator with clear, soft water, adding an anti-freeze-rust inhibitor mixture (see operators manual).

Connect ground strap to battery.

CAUTION: Always connect ground strap to negative(-)pole of battery.

Start engine and check fuel lines, hydraulic lines and water hoses for leaks.

REMOVING AND INSTALLING ENGINE

NOTE: For most engine service operations the engine need not be removed. However, if the crankshaft has to be removed or in case of major overhaul, remove engine.

REMOVAL

For safety disconnect ground strap (cable) from battery.

Separate front of tractor from engine, as explained previously.

On tractors equipped with power steering: Disconnect power steering pressure line at steering housing and hydraulic pump pressure line.

On tractors equipped with an alternator: Disconnect cable between alternator and regulator by removing plug at alternator. Immediately connect terminals D+, D and DF with bridge piece supplied with the tractor. Disconnect terminal B+ at alternator.

On tractors equipped with a generator: Disconnect cable to starter and generator indicator lamp at regulator.

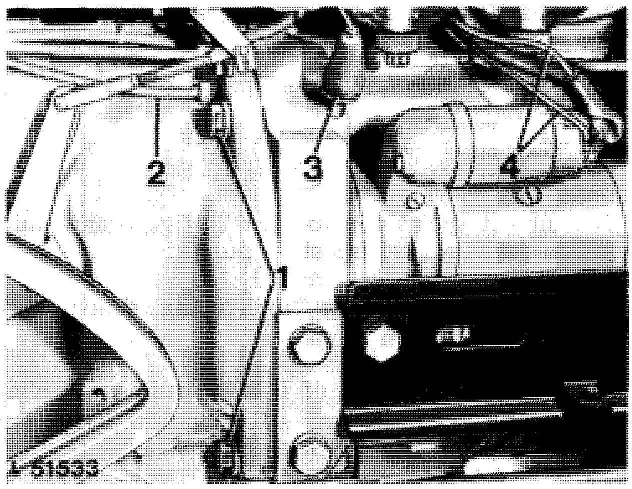


Fig. 4 — Separating between Engine and Clutch Housing, R.H. Side

1 Engine attaching screws
2 Flexible shaft of tractormeter
3 Oil pressure switch
4 Starter cable

Disconnect all cables at starter (see fig. 4). Disconnect oil pressure switch cable 3 and cable at signal horn.

Disconnect flexible shaft of tractormeter 2 at clutch housing and camshaft. If necessary, renew gasket.

On tractors equipped with starting fluid adapter: Disconnect starting fluid line at intake manifold.

On tractors equipped with Thermostart aid: Disconnect cable at heater of intake manifold.

Disconnect air vent line of hydraulic oil reservoir at cylinder head cover.

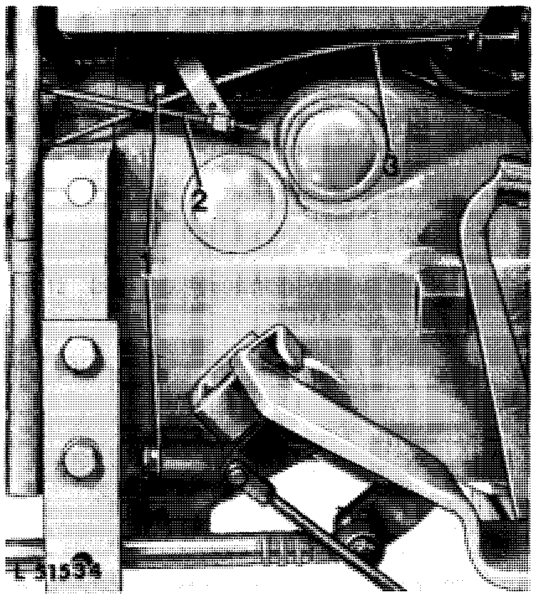


Fig. 5 — Separating between Engine and Clutch Housing, L.H. Side

1 Engine attaching screws
2 Speed control rod
3 Shut-off cable

Disconnect speed control rod 2 (fig. 5) and shut-off cables 3 at fuel injection pump.

On tractors with muffler facing downwards: Remove muffler.

Screw retaining screw of flexible tube of coolant temperature gauge out of cylinder head and withdraw from cylinder head.

Remove left dash panel as well as both batteries.

Remove cap screws attaching dashboard to flywheel housing.

Attach JD 244-1 and 244-2 engine lifting eyes to cylinder head and attach engine to a suitable hoist.

Remove cap screws 1 (figs. 4 and 5) attaching flywheel housing to clutch housing and both cap screws securing oil pan to clutch housing.

Lift engine out to the front by means of the hoist.

CAUTION: Move engine properly in line with drive shaft and hollow drive shaft until these shafts come loose of the driven disks of the engine dual-stage clutch, or free of driven disk and torsion damper if tractor is equipped with a single-stage clutch.

INSTALLATION

Align engine properly with drive shaft and hollow drive shaft. Move engine towards rear of tractor. Align splines of both shafts with internal splines of driven disks (tractor with dual-stage clutch), or (if equipped with a single-stage clutch) with splines of driven disk and torsion damper. Align screw holes of flywheel housing with holes in clutch housing. Slide engine evenly towards clutch housing. Engage two dowels of flywheel housing in bores of clutch housing until engine is in full contact with clutch housing.

CAUTION: Make sure flywheel housing is flush against clutch housing before tightening cap screws to specified torque.

Secure oil pan to clutch housing, tightening both cap screws to the specified torque.

Attach dashboard to flywheel housing.

Connect speed control rod and shut-off cable to fuel injection pump.

Insert flexible tube of coolant temperature gauge in cylinder head and tighten retaining screw.

On tractors equipped with an alternator: Disconnect bridge piece from terminals D+, D- and DF and connect harness plug to terminals. Connect cable from starter to terminal B+ on alternator.

On tractors equipped with a generator: Connect cables from starter and generator indicator lamp to regulator.

Connect cables to starter.

Connect cables to signal horn and oil pressure warning switch.

Install both batteries.

CAUTION: Connect battery cable to positive poles of batteries.

Lubricate rubber seal of tractormeter flexible shaft and attach shaft to clutch housing (see 2, fig. 4). Make sure driving tab of flexible shaft engages in slot of camshaft. Do not tighten excessively to avoid damage to the seal resulting in leakage.

On tractors equipped with starting fluid adapter: Connect starting fluid line to intake manifold.

On tractors equipped with Thermostart aid: Connect Thermostart aid wire to heater in intake manifold.

On tractors equipped with muffler facing downward: Install muffler.

Secure oil reservoir bleed line to cylinder head cover.

Attach front of tractor to engine.

CAUTION: Connect ground strap of batteries to negative (-) poles.

NOTE: If engine has been overhauled, tune up engines as explained in group 20.

REMOVAL AND INSTALLATION OF CLUTCH HOUSING

NOTE: Separating and attaching of engine and clutch housing as well as of clutch housing and transmission case is explained below. Where the tractor is to be separated depends on the individual repair operation. If, e.g., repair work has to be carried out on the transmission, separation between the clutch housing and the transmission case will be sufficient.

REMOVAL

Disconnect battery ground strap.

Drain transmission oil.

Separate engine from clutch housing as explained under "REMOVING ENGINE", the tractor front end may remain attached to the engine.

Disconnect drag link at steering arm.

Disconnect hydraulic oil reservoir vent line (see 5, fig. 6) at connector on gear shift cover.

Remove pipe clamps (see 4, fig. 2), screws 2 and retainer 1 which secure suction line 5 of hydraulic pump and return line 3 of oil cooler (oil reservoir if not equipped with oil cooler) to front side of clutch housing.

On tractors not equipped with HIGH-LOW transmission and independent PTO: Take care not to lose check valve installed in hydraulic pump pressure line when latter is removed.

On tractors equipped with power steering: Disconnect power steering pressure line at connectors.

Remove clamp (see 6, fig. 6) and hydraulic pump pressure line 3.

Insert wooden blocks between front axle and front support to prevent front support from tipping sideways.

Suspend tractor front end and engine to a suitable hoist or support under the engine by means of assembly stand 19.58-90.618. Similarly the rear of tractor should be suspended to a suitable hoist or be supported under the transmission case by means of assembly stand 19.58-90.619.

Roll engine and tractor front end away from clutch housing.

CAUTION: Move engine properly in line with drive shaft until these shafts come loose of the driven disks of the engine dual-stage clutch, or on tractors with single-stage clutch, free of driven disk and torsion damper.

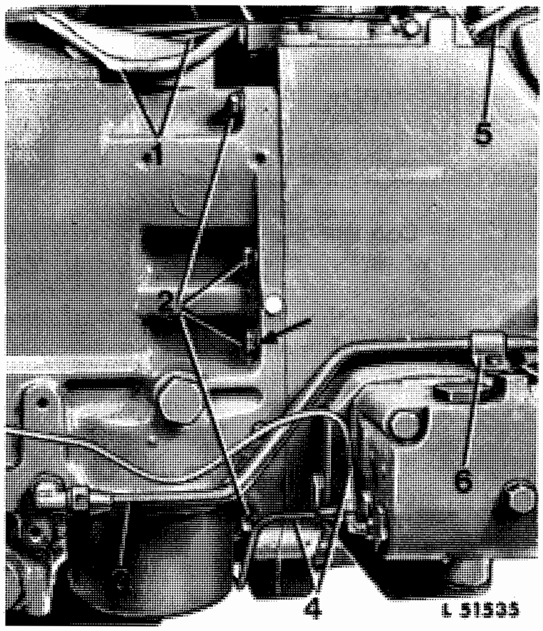


Fig. 6 — Separating between Clutch Housing and Transmission Case, R.H. Side

1 Wiring harness
2 Attaching screws
3 Hydraulic pump pressure line
4 Brake lines
5 Hydraulic oil reservoir vent line
6 Line clamp

Disconnect brake line (see 4, fig. 6) at master cylinder.

Remove transmission cover.

Disconnect both harnesses to rear fenders at connectors. Disconnect cable at starter safety switch and cables at stop light switch.

On tractors equipped with HIGH-LOW transmission: Remove screws (see 3, fig. 7). Disconnect connecting rod from lever shaft and remove cover 4 complete with lever shaft and control arm.

On tractors equipped with independent PTO: Before removing cover (see 4, fig. 7), move PTO shift lever in engaged position. After cover 4 has been removed, do not move PTO shift lever otherwise lock balls and springs will drop out of cover.

Remove screws attaching transmission shift cover to clutch housing. Remove gear shift cover complete with shift levers.

Remove transmission oil filter.

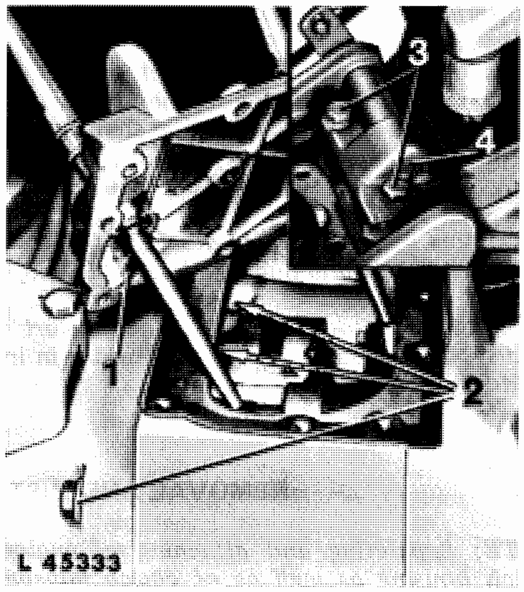


Fig. 7 — Removing Gear Shift Cover

1 Shift cover
2 Clutch housing attaching points
3 Attaching screws
4 Cover

Remove cap screws 2 (figs. 6 and 7) securing clutch housing to transmission case, and separate clutch housing from transmission case.

Discard seal rings provided between the two housings.

On tractors with continuous-running PTO: Be sure ball and spring provided on some PTO shaft types do not get lost (see section 50, group 30).

INSTALLATION

Install new seal rings in clutch housing front facing transmission case.

Slide clutch housing against transmission case.

Slide PTO drive shaft into needle bearing sleeve of front PTO shaft or, if front PTO is not provided, into needle bearing sleeve of bearing cover.

On tractors with continuous-running PTO: Make sure, spring and ball provided on some powershaft types are installed in PTO drive shaft, bearing housing or front powershaft. Align clutch housing with centerline of PTO drive shaft and slide against transmission case. Mesh powershaft gears with splines of hollow PTO drive shaft.

Make sure clutch housing is flush against transmission case before tightening cap screws to the specified torque.

NOTE: Before inserting the third retaining screw in clutch housing (see arrow, fig. 6) coat it with a film of oil-resistant sealant.

NOTE: If clutch housing has also been separated from engine, assemble as explained under "Installation of Engine."

Insert hydraulic pump inlet line (see 5, fig. 2) and oil cooler return line 3* in bore of clutch housing and secure by means of screw and retainer. Tighten screw to correct torque.
* Oil reservoir when not equipped with oil cooler.

On tractors not equipped with HIGH-LOW Shift unit: Ensure check valve is installed in feed line to hydraulic pump before connecting.

Connect hydraulic pump pressure line.

On tractors equipped with power steering: Connect power steering pressure line.

As regards further installation operations reverse removal procedure.

CAUTION: Connect ground cable of batteries to negative(-)poles.

REMOVAL AND INSTALLATION OF FINAL DRIVES

REMOVAL

NOTE: The removal of both final drives is explained below. If only one final drive is to be removed, remove only one wheel, wiring harness etc.

For safety disconnect ground strap at batteries.

Lift up rear of tractor by means of a suitable jack or hoist and remove rear wheels.

CAUTION: Support transmission safely to prevent tipping of tractor.

Disconnect both rear wiring harnesses at connectors.

Remove rear fenders and roll-over guard.

Disconnect cables at stop light switch located in left-hand rear axle housing.

Disconnect brake lines on both brake housings.

On tractors equipped with selective control valve(s): Disconnect hydraulic lines and remove two screws securing the bracket* or hydraulic manifold** onto the right-hand final drive assembly.

Cover connections and exposed openings with plastic plugs or caps to prevent particles of dirt from entering the system.

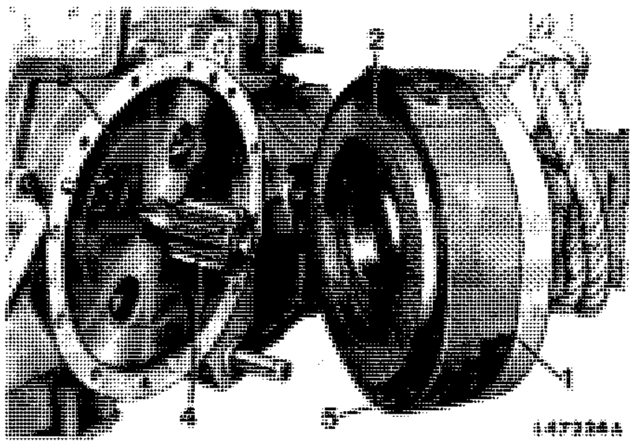


Fig. 8 — Removing Final Drive

1 Final drive housing
2 Pressure ring
3 Brake disk
4 Final drive shaft
5 Brake housing

Remove selective control valve(s).

* On earlier tractors
** On later tractors

Attach final drive to hoist. Remove final drive attaching screws. Separate final drive housing together with brake housing from transmission case. Withdraw housing evenly until final drive shaft gear is no longer in mesh with planetary gears of final drive.

CAUTION: Take care that the brake housing does not fall down (DANGER OF ACCIDENTS).

INSTALLATION

NOTE: If the brake disk and the "floating" facing were removed, install bonded two-layer facing so that the brass-interwoven upper layer faces the brake surface of the transmission case.

Position new gaskets between final drive housing and brake housing as well as between transmission case and brake housing.

Attach final drive to transmission case by means of a suitable hoist. Make sure final drive shaft gear engages with planetary gears and that the dowels are guided into their respective bores.

Tighten final drive attaching screws to the specified torque.

On tractors with selective control valve(s): Attach control valves with bracket* or manifold** onto the right hand final drive housing. Connect hydraulic lines.

Connect brake lines and bleed brakes, as explained in section 60, group 15.

Install rear fenders and roll-over guard. Tighten hex. nuts to specified torque.

Connect lines of wiring harnesses to connectors.

Connect cable to brake warning switch.

Install rear wheels and tighten to the specified torque.

CAUTION: Tighten ground strap to negative (-) poles of batteries.

REMOVAL AND INSTALLATION OF ROCKSHAFT

REMOVAL

IMPORTANT: Work on the hydraulic system requires extreme care and cleanliness. Minute dirt or foreign particles, scratches, nicks or burrs may put the hydraulic system out of function. Before removing the rockshaft, check hydraulic system for leaks.

For safety, disconnect ground cable from batteries.

Remove transmission shield. Disconnect line 1 (fig. 9) of starter safety switch.

Remove operator's seat. Disconnect both lift links at lift arms.

Disconnect oil return line (see 2, fig. 9) of selective control valve (if equipped) at elbow on rockshaft.

Disconnect lines of rear quick couplers (if equipped) at selective control valves.

Free both rear wiring harnesses.

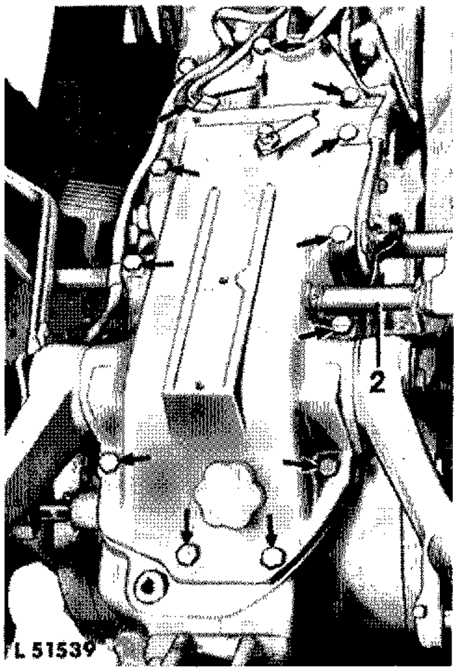


Fig. 9 — Rockshaft, Installed

1 Line of safety starter switch
2 Oil return line

* On earlier tractors
** On later tractors

Move selector lever in position "L" (load control) so that the control linkage roller slides along the cam of the control arm when removing the rockshaft.

Attach engine lifting eye No. JD 244-2 to top of rockshaft housing.

Remove rockshaft attaching screws (see arrows in fig. 9). Lift rockshaft assembly off transmission case by means of a hoist.

Take care not to damage two rear harnesses.

NOTE: After removing rockshaft, cover transmission case to prevent foreign particles from falling into the transmission.

INSTALLATION

Use a new gasket between transmission case and rockshaft. Make sure dowels in transmission case and seal ring of oil inlet passage are installed.

Move selector lever in position "L" so that the control linkage with roller can be slid over the cam.

Lift rockshaft on transmission case, using a suitable hoist.

If equipped: connect oil return line 2 (fig. 9) of selective control valve to rockshaft housing.

Connect lines to quick couplers.

Tighten rockshaft attaching screws to the specified torque.

Connect cable of starter safety switch.

Connect both rear wire harnesses to rockshaft. Install transmission shield on transmission case.

Attach lift links to lift arms. Install operator's seat.

For adjustment of rockshaft see section 70, group 20.

CAUTION: Tighten ground strap to negative (-) poles of batteries.

TORQUES FOR HARDWARE

Front support to engine, cap screws	170 ft.lbs.	23,5 mkg
Hydraulic pump drive shaft, cap screw	32 ft.lbs.	4.4 mkg
Drag link to bell crank or steering arm, castellated nut*	55 ft.lbs.	7.7 mkg
Clutch housing to engine, cap screws	170 ft.lbs.	23.5 mkg
Oil pan to clutch housing, cap screws	170 ft.lbs.	23.5 mkg
Clutch housing to transmission, cap screws	85 ft.lbs.	11.7 mkg
Securing bracket, hydraulic lines to clutch housing, cap screw	32 ft.lbs.	4.5 mkg
Final drive housings to transmission case, cap screws	85 ft.lbs.	11.7 mkg
Roll-over guard to final drive housings,. securing bracket, cap screws	94 ft.lbs.	13 mkg

* *NOTE: If cotter pin cannot be inserted when tightening to the specified torque, turn nut to next slot and secure with cotter pin.*

TORQUES FOR HARDWARE (Continued)

Rockshaft housing to transmission case, cap screws	85 ft.lbs.	11,7 mkg
Rear wheels to rear axle, ball nuts (on rear wheels with steel disks)	195 ft.lbs.	27 mkg
Rear wheels to rear axle, wheel securing bolts (on rear wheels with cast disks)	130 ft.lbs.	18 mkg
Wheel disk to hub (on tractors equipped with rack-and-pinion axle), wheel securing bolts	300 ft.lbs.	41.5 mkg

SPECIAL TOOLS

Part No. when ordering from JD Parts Depot	Manufacturer	Description	Use
L 48524	JD 244-1*	Lifting eye, straight	Removing and installing assemblies
L 48525	JD 244-2*	Lifting eye, bent	Ditto
19.58-90.618		Assembly stand	Separating tractor front end and engine.
19.58-90.619		Assembly stand	Ditto

* SERVICE TOOLS INC., 1901 INDIANA AVENUE, ILLINOIS 60616, USA

Section 20
ENGINE

CONTENTS OF THIS SECTION

Group 5

GENERAL INFORMATION, DIAGNOSING MALFUNCTIONS

GENERAL INFORMATION

The tractor is equipped with a 4-cylinder vertical in-line, valve-in-head, 4-cycle Diesel engine with direct fuel injection. The engine is our own design. The "wet" cylinder liners can be replaced one at a time. The pistons are of forged aluminium alloy and cam-ground. Each piston has two single, cast-iron compression rings and one oil control ring. All ring grooves are above the piston pin. The case-hardened piston pins are full floating and are held in place by two snap rings each.

The crankshaft is a one-piece, heat-treated, steel forging. It is supported in five replaceable two-piece main bearings machined to close tolerances.

The connecting rods are provided with a bronze bushing and a two-piece, replaceable bearing cap each.

A camshaft supported in the cylinder block controls the valves and drives the fuel transfer pump.

The intake and outlet valves are supported in the cylinder head. The valve stems slide in bores in the cylinder head. The rocker arm shaft assembly is fitted on top of the cylinder head.

The engine is supplied with lubricating oil by a gear pump. The lubricating oil passes through a full-flow oil filter in the main oil circuit. To ensure engine lubrication, the oil filter is provided with a by-pass valve which opens when the filter element is clogged.

The engine has a pressure cooling system consisting of the radiator, water pump, multi-blade fan and thermostat.

DIAGNOSING MALFUNCTIONS

ENGINE WILL NOT CRANK

Dead batteries

Bad battery connections

Defective main switch or starter safety switch

Starter solenoid defective

Starter defective

ENGINE HARD TO START OR WILL NOT START

Loose or corroded battery connections
Low battery output

Excessive resistance in starter circuit

Too high viscosity crankcase oil

Water, dirt or air in fuel system

Fuel filter clogged

Stuck shut-off knob

Dirty or faulty fuel injectors

Defective injection pump

Defective fuel transfer pump

Shut-off valve at fuel tank closed

Injection pump out of time

ENGINE RUNS IRREGULARLY OR STALLS FREQUENTLY

Coolant temperature too low

Insufficient fuel supply

Injector tips defective or leaking

Fuel filter or fuel lines clogged

Defective fuel transfer pump

Incorrect engine timing

Improper valve clearance

Cylinder head gasket leaking

Worn or broken compression rings

Valves stuck or burnt

Excessive back pressure

Engine compression too low

Engine overheated

Defective fuel injection pump

ENGINE MISSES

Water in fuel

Mixture of petrol (gasoline) and Diesel fuel

Air in fuel system

Defective fuel injectors

Defective fuel injection pump

Fuel injectors improperly installed

Leaking fuel injector seals

Engine overheated

Cams of camshaft worn

Worn valve springs

Worn or defective fuel transfer pump

Engine backfiring

Incorrect engine timing

Engine compression too low

Improper valve clearance

Burnt, damaged or stuck valves

LACK OF ENGINE POWER

Air cleaner clogged or dirty

Excessive resistance in air intake system

Fuel filter clogged

Defective fuel transfer pump

Defective fuel injection pump

Defective fuel injectors

Improper crankcase oil

Engine overheated

Engine clutch drags

Defective cylinder head gasket

Cams of camshaft worn

Improper valve clearance

Improper valve timing*

Burnt, damaged or stuck valves*

Worn valve springs*

Incorrect engine timing

Piston rings and cylinder liners excessively worn

Engine compression too low*

Improper coolant temperature

ENGINE OVERHEATS

Lack of coolant in cooling system

Radiator core and/or side grille screens dirty

Loose or defective fan belt

Defective thermostat

Cooling system limed up

Engine overloaded

Injection pump delivers too much fuel

Damaged cylinder head gasket

* Measure blow-by at crankcase vent tube or carry out cylinder compression test. See section 10, group 20.

Incorrect engine timing

Defective water pump

Too low crankcase oil level

Defective radiator cap

HIGH OIL CONSUMPTION

Oil control rings worn or broken

Scored cylinder liners or pistons

Excessive resistance in air intake system

Oil passages restrict free oil flow

Worn valve guides or stems

Too low viscosity crankcase oil

Excessive oil pressure

Piston ring grooves excessively worn

Piston rings sticking in ring grooves

Insufficient piston ring tension

Piston ring gaps not staggered

Excessive main or connecting rod bearing clearance

Crankcase oil level too high

External oil leaks

Front and rear crankshaft oil seal faulty

LOW OIL PRESSURE

Low crankcase oil level

Leakage at internal oil passages

Defective oil pump

Excessive main and connecting rod bearing clearance

Improper regulating valve adjustment

Improper crankcase oil

Defective oil pressure warning switch or indicator lamp

HIGH OIL PRESSURE

Stuck or improperly adjusted regulating valve

Stuck or damaged filter by-pass valve

EXCESSIVE FUEL CONSUMPTION

Engine overloaded

Compression too low

Leaks in fuel system

Air cleaner restricted or dirty

Fuel injectors dirty or faulty

Injection pump defective (delivers too much fuel)

Incorrect engine timing

BLACK OR GREY EXHAUST SMOKE

Excess fuel

Engine overloaded

Air cleaner restricted or dirty

Defective muffler (causing back-pressure)

Fuel injectors dirty or faulty

Incorrect engine timing

WHITE EXHAUST SMOKE

Engine compression too low

Defective fuel injectors

Incorrect engine timing

Thermostat defective

COOLANT IN CRANKCASE

Cylinder head gasket defective

Cylinder head or block cracked

Cylinder liner seals leaking

ABNORMAL ENGINE NOISE

Incorrect engine timing

Worn main or connecting rod bearings

Excessive crankshaft end play

Loose main bearing caps

Foreign material in combustion chamber

Worn piston pin bushings and pins

Scored pistons

Worn timing gears

Excessive valve clearance

Worn cam followers

Bent push rods

Worn camshaft

Worn rocker arm shaft

Insufficient engine lubrication

DETONATION OR PRE-IGNITION

Oil picked up by intake air stream (intake manifold)

Dirty or faulty fuel injectors

Improper engine timing

Injector tip holes enlarged

Injector tips broken

Carbon build-up in compression chamber

FOS

NOTE: Overall and detailed information on engine troubles and repair see also "Fundamentals of Service, Engines" manual.

Group 10

CYLINDER HEAD, CAMSHAFT AND BALANCER SHAFTS

GENERAL INFORMATION

The intake and exhaust valves are set in the cylinder head. The valve guides are integral with the head. The valve seats are ground directly into the cylinder head. Between each valve stem and the rocker arm is a hardened stem cap.

The camshaft is driven at half engine speed by the upper idler gear of the timing drives. It is supported by three pressure lubricated bores, integral with the cylinder block.

The camshaft has an eccentric lobe to actuate the fuel transfer pump and an axial, pressed-in lug to drive the tractormeter.

Both balancer shafts are arranged in the lower half of the cylinder block. They are driven at double engine speed in opposite direction to each other, revolving in three replaceable, pressure-lubricated bushings. The right-hand balancer shaft is driven by the lower idler gear and the left by the oil pump gear.

DIAGNOSING MALFUNCTIONS

For diagnosing malfunctions see group 5.

FOS

NOTE: For comprehensive and detailed repair instructions see "Fundamentals of Service, Engines" manual.

CYLINDER HEAD

REMOVAL

NOTE: It is not necessary to remove the engine in order to work on the cylinder head, valves and associated parts.

Immediately cover or plug holes of all removed or exposed fuel pipes with plastic caps or plugs.

Remove injection nozzles (nozzle points are protruding from cylinder head sealing face and might be damaged).

Disconnect both battery ground straps.

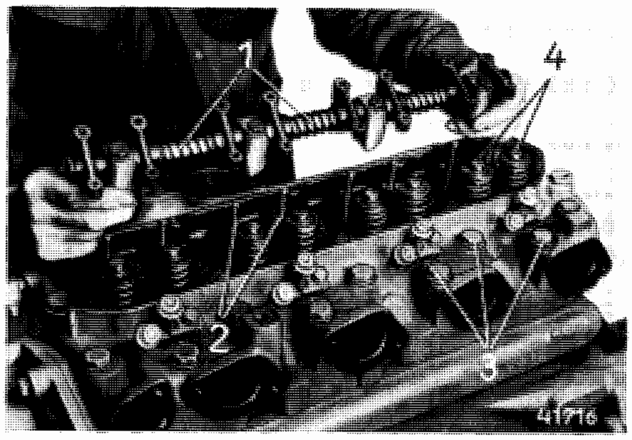


Fig. 1 - Removal of Rocker Arm Shaft Assembly

1 Rocker arm shaft
2 Push rods
3 Cylinder head cap screws
4 Valve stem caps

When removing, identify parts to facilitate reinstallation.

Do not turn crankshaft after removal of cylinder head, before all liners are secured with screws and washers.

REPAIR

DISASSEMBLY

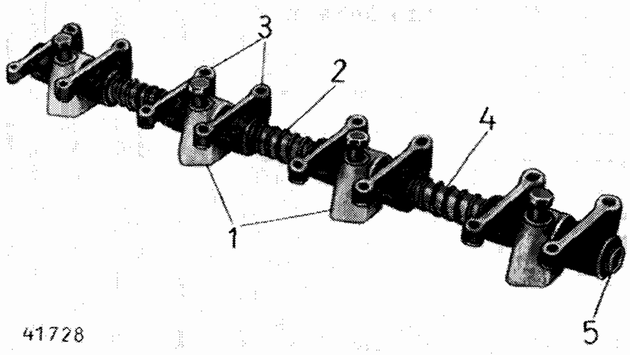


Fig. 2 - Rocker Arm Shaft Assembly

1 Rocker arm support
2 Springs
3 Rocker arms
4 Rocker arm shaft
5 Plug

Remove plug from one end of rocker arm shaft and slide all parts off the shaft (see fig. 2). Identify parts for correct reinstallation.

When several valves are being removed, identify each to facilitate replacement in its original position.

Compress valve spring with commercial tool and remove both retainer locks from the spring cap. Release spring and remove spring cap and spring. Pull valves out of the cylinder head.

INSPECTION

Check all parts for wear or damage.

Valve Seats

Measure diameter of valve guides. Replace valves, if necessary and ream the cylinder head bores. Beside standard sized valves, there are valves with oversize stems available. Check if new valves move freely in the cylinder head.

Reface valve seats in cylinder head with commercial tools, if necessary, observing specified measurements.

Replace valve stem caps, if necessary.

Valve Springs

Valve springs may have different free lengths, however, they must have the same length when compressed at the specified load. Check valve spring tension.

Rocker Arm Shaft Assembly

Make sure that all oil bores in the rocker arm shaft, rocker arms and the adjusting screws are clear. Thoroughly clean cavities of rocker arm supports. This is especially important for the rear support through which the oil passes to the rocker arm shaft. Check all rocker arms for excessive wear and tear on points of rocker arm contact. Check spring tension.

If a valve is replaced, the accompanying rocker arm and push rod should be replaced at the same time.

Injection Nozzle Bores

Remove carbon deposits from bores, using special tool No. JDE 39. CAUTION: Always turn the tool clockwise as turning it counterclockwise will dull the tool.

ASSEMBLY

Rocker Arm Shaft Assembly

Assemble the individual parts, according to fig. 3 finally placing the plug on the shaft end. Make sure rocker arms are installed in their original positions.

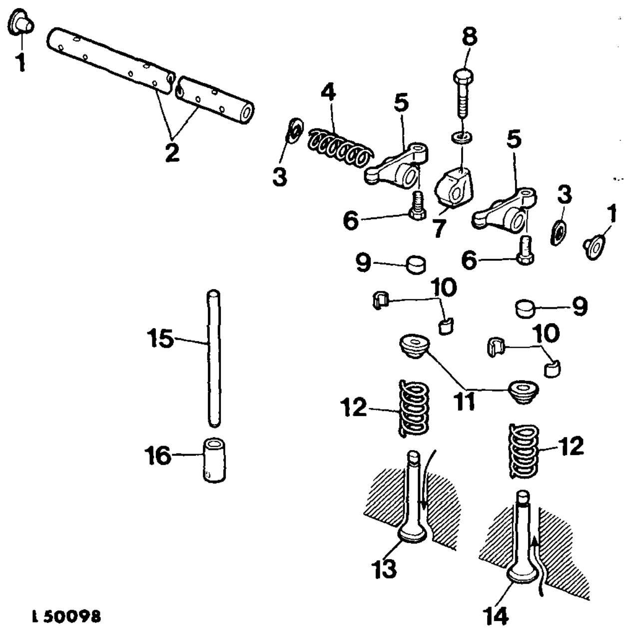


Fig. 3 - Rocker Arm Shaft Assembly and Valves —Exploded View

1 Plug	9 Valve stem cap
2 Rocker arm shaft	10 Keepers
3 Special washers	11 Valve spring cap
4 Spring	12 Valve spring
5 Rocker arm	13 Intake valve
6 Adjusting screw	14 Exhaust valve
7 Rocker arm support	15 Cam follower
8 Cap screw	16 Push rod

IMPORTANT: Make sure that oil bore in rocker arm shaft is at the side of the flywheel and facing down when assembly is installed on cylinder head.

Lubricate all rocker arms liberally with oil and see that they move freely.

Cylinder Head

Apply clean oil to valve stems and install the valves in the same guide ports from which they were removed. Move valves up and down several times to ascertain that they slide freely and are properly seated.

When assembling observe the following:

1. Always use new keepers.
2. When replacing valve springs, make sure that the end contacting the cylinder head is properly seated.
3. After the valves are installed, give the stems two or three taps with a rubber or nylon hammer, so that the parts will seat properly, resp. to ensure the proper positioning of the keepers.

INSTALLATION

CYLINDER HEAD

Use a new cylinder head gasket, coated with a uniform thin layer of "PERMATEX Type 3", "TEROSON – Atmosit", "COLLEX-Aviation'", or "HERMETIC-Hermalex" on both sides and place it on the cylinder block.

CAUTION: Use hardened flat steel washers under all cylinder head cap screws.

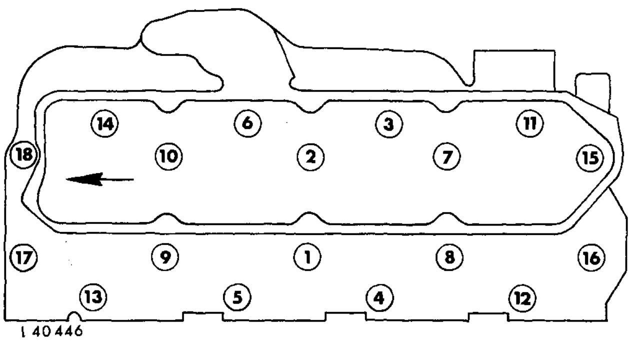


Fig. 4 - Correct Sequence for Tightening Cylinder Head Cap Screws

Gradually tighten cylinder head cap screws evenly, following the sequence outlined in fig. 4 and finally tighten to specified torque. Install push rods into their original bores according to the marks made on removal. Place a valve cap on each stem and make certain that they turn freely.

ROCKER ARM SHAFT ASSEMBLY

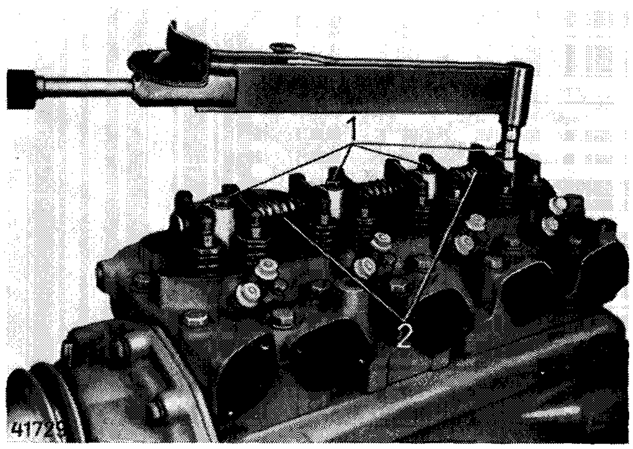


Fig. 5 - Tightening Rocker Arm Shaft Assembly

1 Cap screws 2 Rocker arm shaft assembly

Install rocker arm shaft assembly on cylinder head so that the lubrication holes are at the flywheel end. Turn the rocker arm shaft so that these holes are facing down. Tighten cap screws to specified torque (see fig. 5).

ADJUSTING VALVE CLEARANCE

The valve clearance can be adjusted with the engine cold or warm.

Turn crankshaft to the right (seen from the radiator) until the No. 1 piston (front) reaches top dead center (TDC) of its compression stroke; CAUTION: not the exhaust stroke.

Insert timing screw into the flywheel housing hole. Rock the flywheel until screw slides into hole in flywheel rim (flywheel will then be exactly in TDC position).

Adjust clearance of the exhaust valves of cylinders Nos. 1 and 3, and the intake valves of cylinders Nos. 1 and 2.

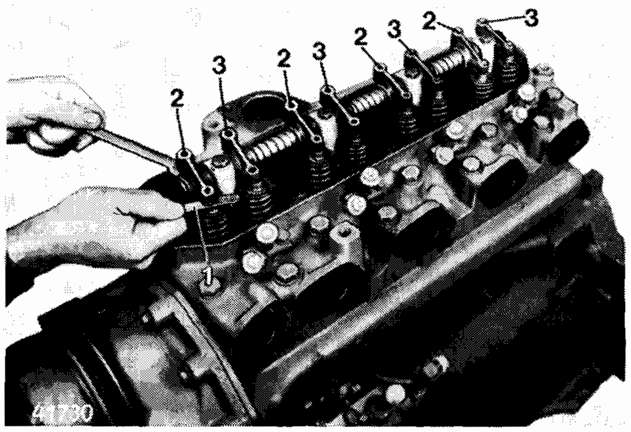


Fig. 6 Adjusting Clearance of the Intake Valve of Cylinder No. 1

1 Feeler gauge
2 Adjusting screw of intake valve
3 Adjusting screw of exhaust valve

Adjust the valve clearance, using a feeler gauge (see fig. 6 and Specifications).

Pull timing screw out of flywheel bore, turn crankshaft one complete revolution (=360°) and insert timing screw again into flywheel bore.

Adjust clearance of exhaust valves of cylinders Nos. 2 and 4 and inlet valves of cylinders Nos. 3 and 4 (see Specifications).

NOTE: After the engine has run for some time on a specified load (see Specifications), tighten cylinder head screws to specified torque. Check clearance of all valves and readjust, if necessary.

CAMSHAFT

REMOVAL

To remove the camshaft and related parts it is not necessary to remove the engine. However, the front of the tractor must be separated to get access to the front of engine (see section 10, group 25).

Disconnect both battery ground straps.

Remove cylinder head, timing gear housing and fuel transfer pump.

Remove all push rods and cam followers and identify them to facilitate replacement in their original bores.

NOTE: Be careful that cams do not damage the bearing surfaces in bores.

REPAIR

Measure each of the three bearing journals of the camshaft as well as the corresponding bores in two opposing planes.

Measure thickness of thrust plate since this thrust plate determines camshaft end play.

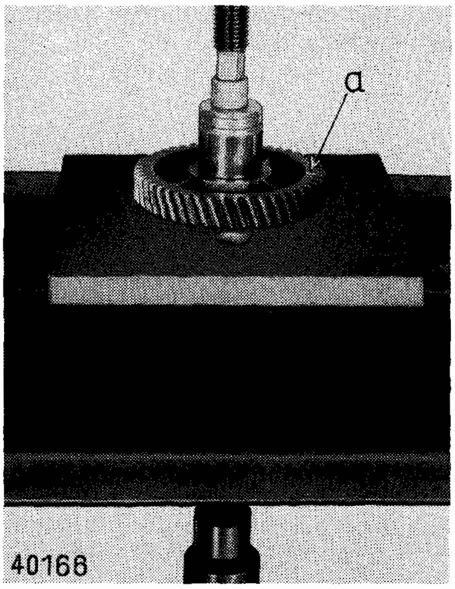


Fig. 7 - Pressing Gear on Camshaft

a Timing mark up

Replace gear of camshaft, if necessary. Position the new gear on camshaft so that timing mark "a" (fig. 7) faces away from camshaft.

CAUTION: Support camshaft behind the front bearing journal, when pressing on gear.

Press on gear until it is tight against the shoulder of camshaft.

Replace tractormeter drive lug, if necessary.

Install new drive lug in camshaft so that its slot faces away from the camshaft. Support camshaft at rear journal.

ALWAYS replace cam followers when installing a new camshaft.

INSTALLATION

Install camshaft, observing the following:

1. Coat camshaft with light, clean engine oil.
2. When installing, make sure that cam lobes do not damage bearing bores in block.
3. Rotate camshaft until cap screws attaching thrust plate can be installed and tighten them to specified torque.
4. Check camshaft end play (a new camshaft and a new thrust plate should add up to the proper end play).
5. With crankshaft at TDC and piston No. 1 (front) on compression stroke, adjust camshaft for valve timing.

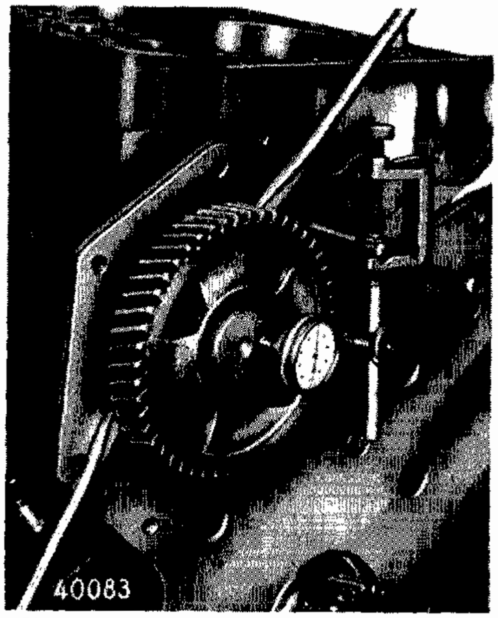


Fig. 8 - Measuring Camshaft End Play

Use special tool No. JD 254 to align timing mark "b" on the camshaft gear (fig. 9) between centers of crankshaft and camshaft by rotating the camshaft.

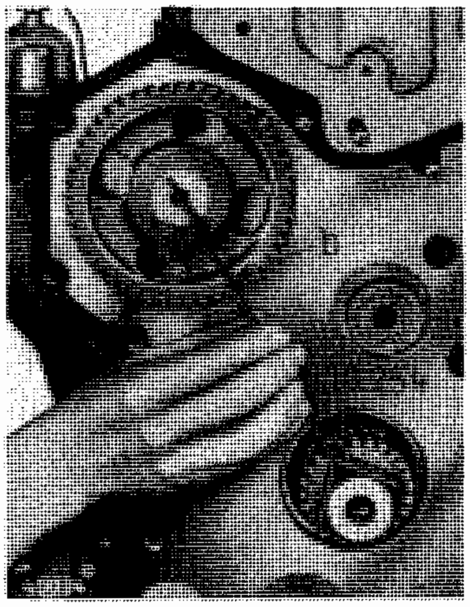


Fig. 9 - Timing Camshaft Gear by means of Special Tool No. JD 254
b Timing mark

6. With camshaft gear in this position, install upper idler gear and tighten cap screw to specified torque.

Install cam followers, cylinder head, timing gear cover and fuel transfer pump.

Run engine for some time at a specified load (see Specifications) and then retighten cylinder head cap screws to specified torque. Check valve clearance and readjust, if necessary.

BALANCER SHAFTS

REMOVAL

NOTE: It is not necessary to remove the engine, when removing the balancer shafts. However, the front end of tractor must be removed to obtain access to front of engine (see section 10, group 25).

Disconnect ground strap at negative pole of each battery.

Drain engine oil and remove oil pan.

Remove timing gear cover.

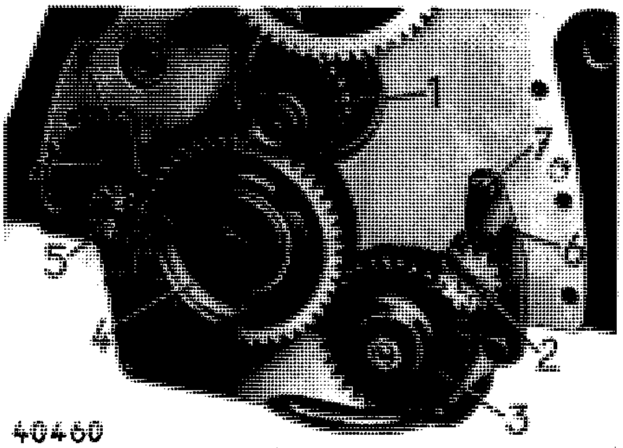


Fig. 10 — Balancer Shafts, Installed

1 Crankshaft gear
2 Left-hand balancer shaft
3 Oil pump gear
4 Lower idler gear
5 Right-hand balancer shaft gear
6 Thrust plate
7 Cap screws

NOTE: To facilitate reassembly, mark on each balancer shaft and thrust plate from which side of the engine they have been removed (right or left-hand).

REMOVAL OF RIGHT-HAND BALANCER SHAFT

Remove lower idler gear 4 (fig. 10) (see group 25). Remove both cap screws 7 and thrust plate 6. Pull balancer shaft out of block.

REMOVAL OF LEFT-HAND BALANCER SHAFT

If still necessary, remove lower idler gear 4 (fig. 10). Remove oil pump gear 3 (see group 25).

Remove both cap screws 7 and thrust plate 6. Pull balancer shaft out of cylinder block.

CAUTION: Take care when pulling out balancer shaft that neither the journals nor bushings located in cylinder head are damaged.

REPAIR

Measure twice each of the balancer shaft journals and bushing bores at right-angles to each other.

Measure thickness of each balancer shaft thrust plate, this plate determining the end play of each shaft.

REPLACING A BALANCER SHAFT GEAR

With the aid of a commercial press or puller, remove gear from balancer shaft.

Set replacement gear onto shaft with the installation mark (see "c", fig. 11) facing upward. Press gear onto shaft until it is, within a tolerance (see Specifications), flush with face of balancer shaft. It is recommended that this tolerance be checked as it affects the end play of the balancer shaft.

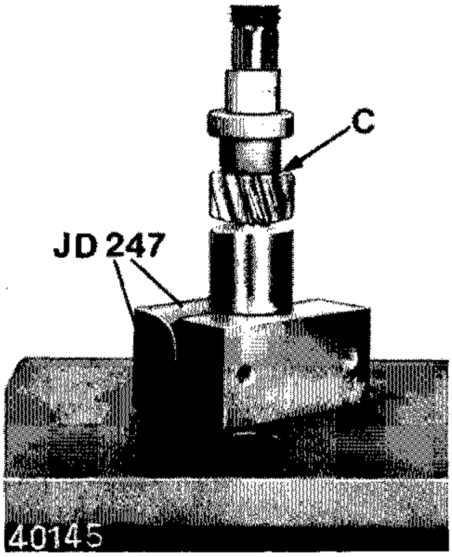


Fig. 11 — Pressing Gear on Balancer Shaft by means of Special Tool No. JD 247

c Installation mark

REPLACING BALANCER SHAFT BUSHINGS

NOTE: The front and centre bushings can be replaced with the engine in position. It is necessary to separate engine and clutch housing, when replacing the rear bushing.

Using driver JD 249, drive out old bushings from cylinder block.

From the timing gear side, drive in new bushings with the aid of driver JD 249, insuring that face of bushings does not protrude over countersunk part of cylinder block bores.

CAUTION: Install each bushing so that its oil bore "h" (fig. 14) is aligned with cylinder block oil bore "i" on cylinder head side and that the bushing recess, in which ball "k" of special tool JD 255 engages, corresponds with oil channel "g".

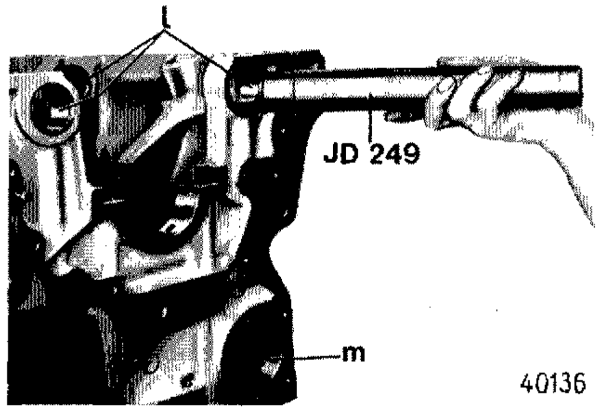


Fig. 12 — Drift JD 249 to Remove and Install Balancer Shaft Bushings

l Bushings   m Cam shaft bore

After driving in new bushings, secure as follows with the aid of special tool No. JD 255.

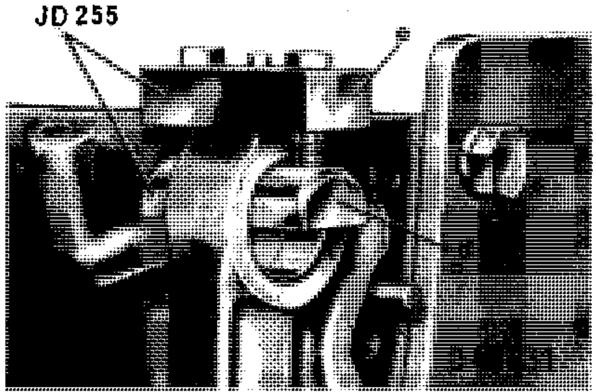


Fig. 13 — Securing a Balancer Shaft Bushing in Cylinder Block with the Aid of Special Tool No. JD 255

e, d Special Tool No. JD 255

NOTE: The half-round part "d" (figs. 13 and 14) of special tool No. JD 255 is, with regard to ball "k", unsymmetrical, fitting properly only in one position into the bushing bore (see fig. 14).

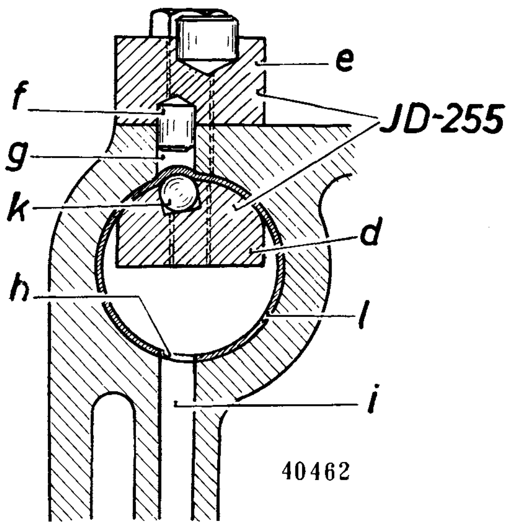


Fig. 14 — Securing a Balancer Shaft Bushing, Using Special Tool No. JD 255 (Sectional View)

d Half-round part of special tool
e Top part of tool
f Pin of part "e"
g Oil channel
h Oil bore
i Oil channel
k Ball
l Bushing

Remove both cap screws of special tool No. JD 255. Turn part "e" of tool so that pin "f" fitting in oil channel "g" is directed towards the bushing and set up on cylinder block as shown in figs. 13 and 14. Insert part "d" of special tool in bushing "l" so that its rounded surface has the same radial distance from the bushing. At the same time, ball "k" should be vertically under pin "f" of part "e". The ball then lies in the bushing recess. Place both cap screws through part "e" as shown in fig. 13 and screw into part "d" evenly and finger tight so that both parts of the tool are parallel to each other, making sure that the ball is still in its correct position. Now tighten both cap screws gradually and evenly until the rounded part "d" of tool lies against the bushing "l". In this way ball "i" has made a small bulge in the wall of the bushing, pressing the material in the oil channel "g" so that the bushing cannot move sideways or revolve.

INSTALLATION

Coat each shaft with light, clean engine oil and from the timing gear side, guide shaft into cylinder block bushings.

CAUTION: Take care when doing this that the journals and bushings are not damaged.

Tighten thrust plate cap screws to the specified torque (see Torques for Hardware).

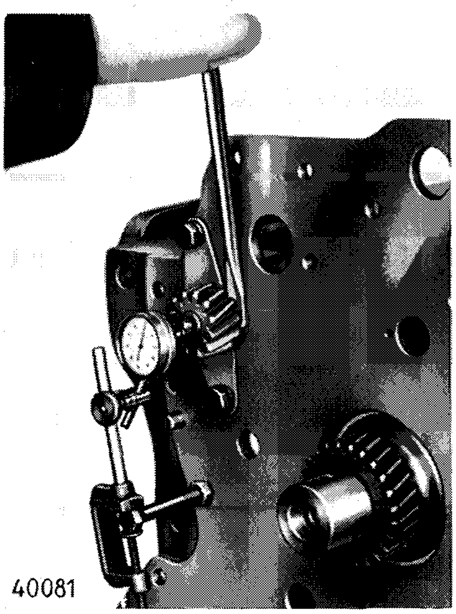


Fig. 15 — Measuring Balancer Shaft "End Play"

As shown in fig. 15, check that actual end play does not exceed maximum distance quoted in the Specifications.

CAUTION: If the balancer shaft end play is too great, although the thrust plate is within tolerance, check whether balancer shaft gear and end face of shaft are within the tolerance quoted in Specifications.

After installing one or both balancer shafts and before installing idler gear, align marks on balancer shaft gears with centre of crankshaft (see group 25 for details).

IMPORTANT! Make sure that the keyway of each balancer shaft gear is vertical to the cylinder head. If this is not the case, both shafts have been mixed up and must be reinstalled in the opposite bores.

Install all engine and tractor parts removed to facilitate removal of balancer shafts (see removal).

SPECIFICATIONS

	Dimensions of New Parts	Wear Tolerance
CYLINDER HEAD		
Valve stem dia. (standard)	0.3715 to 0.3725 in 9.43 to 9.46 mm	
Bore for valve stem	0.3745 to 0.3755 in 9.51 to 9.53 mm	0.001 in 0.025 mm
Clearance between bore and valve stem	0.002 to 0.004 in 0.05 to 0.10 mm	0.006 in 0.152 mm
Valve stem oversizes, stem dia. larger than standard by	0.003; 0.015; 0.030 in 0.076; 0.381; 0.762 mm	
Valve seat angle	.45°	
Angle of valve faces	.43.5°	
Concentricity tolerance of valve seat (max.)		0.002 in 0.05 mm
Valve seat width	0.057 to 0.073 in 1.45 to 1.85 mm	
Valve head dia., intake valve	1.767 to 1.777 in 44.88 to 45.13 mm	
Valve head dia., exhaust valve	1.570 to 1.580 in 38.88 to 40.13 mm	
Valve length	5.144 to 5.169 in 130.66 to 131.29 mm	0.005 in 0.13 mm
Valve clearance		
Intake valve	0.014 in 0.35 mm	
Exhaust valve	0.018 in 0.45 mm	

CYLINDER HEAD - Continued

	Dimensions of New Parts	Wear Tolerance
Valve lift (clearance adjusted)		
Intake valve	0.460 to 0.490 in 11.7 to 12.5 mm	0.430 in 10.9 mm
Exhaust valve	0.456 to 0.482 in 11.6 to 12.2 mm	0.426 in 10.8 mm
Rocker arm shaft dia.	0.7869 to 0.7879 in 19.987 to 20.013 mm	0.002 in 0.05 mm
Rocker arm bore dia.	0.790 to 0.792 in 20.066 to 20.117 mm	0.002 in 0.05 mm
Rocker arm shaft spring Spring tension at a length of 1.813 in (46 mm)	4 to 6 lbs 1.8 to 2.7 kg	
Valve springs Spring free length	2.125 in approx. 54 mm	
Spring tension at a length of 1.813 in (= 46 mm) Valves closed	54 to 62 lbs 24.2 to 27.8 kg	
Spring tension at a length of 1.359 in (= 34.5 mm) Valves opened	133 to 153 lbs 60.5 to 69.5 kg	

Retightening cylinder head cap screws — Run engine for half an hour at rated speed = 2500 rpm.
Loosen screws by 5° to 10° and tighten to the specified torque.

CAMSHAFT

	Dimensions of New Parts	Wear Tolerance
Dia. of camshaft bearing journal	2.1997 to 2.2007 in 55.872 to 55.898 mm	0.001 in 0.025 mm
Dia. of camshaft bearing bores in cylinder block	2.2042 to 2.2052 in 55.987 to 56.012 mm	
Clearance	0.0035 to 0.0055 in 0.09 to 0.14 mm	0.007 in 0.178 mm
End play	0.0025 to 0.0085 in 0.06 to 0.22 mm	0.015 in 0.381 mm
Thickness of thrust plate	0.156 to 0.158 in 3.96 to 4.01 mm	0.005 in 0.13 mm

BALANCER SHAFTS	Dimensions of new parts	Wear Tolerance
Diameter of balancer shaft bearing journals	1.4995 to 1.5005 in. 38.087 to 38.113 mm	
Diameter of bushing bores	1.5020 to 1.5040 in. 38.150 to 38.201 mm	
Clearance	0.0015 to 0.0045 in. 0.04 to 0.12 mm	0.006 in. 0.15 mm
Diameter of cylinder block bores for bushings	1.6245 to 1.6255 in. 41.262 to 41.288 mm	
Thickness of pressure plate	0.117 to 0.119 in. 2.97 to 3.02 mm	
Press on gear flush with face of balancer shaft, within a tolerance of	±0.0005 in. ±0.013 mm	
End play	0.002 to 0.008 in. 0.05 to 0.2 mm	0.015 in. 0.38 mm

TORQUES FOR HARDWARE

Rocker arm shaft to cylinder head, cap screws	35 ft.lbs.	4.8 mkg
Cylinder head to cylinder block, cap screws	110 ft.lbs.	15 mkg
Injection nozzles to cylinder head, cap screws	20 ft.lbs.	2.8 mkg
Fan to V-belt pulley of water pump	20 ft.lbs.	2.8 mkg
Intake manifold, cap screws	35 ft.lbs.	4.8 mkg
Exhaust manifold, cap screws	35 ft.lbs.	4.8 mkg
Camshaft thrust plate to cylinder block, cap screws	35 ft.lbs.	4.8 mkg
Upper idler gear to cylinder block, cap screws	65 ft.lbs.	9 mkg
Timing gear cover to cylinder block, cap screws	35 ft.lbs.	4.8 mkg
Rocker arm cover to cylinder head, cap screws	2 ft.lbs.	0.28 mkg
Balancer shaft pressure plate to cylinder block, cap screws	35 ft.lbs.	4.8 mkg

SPECIAL TOOLS

Part numbers when ordering from JD Parts Depot	Manufacturer	Description	Use
L 48545	JDE 39*	Cleaning tool	Cleaning cylinder head nozzle bores
L 48542	JD 254*	Feeler gauge	Adjusting camshaft gear
L 48528	JD 249*	Driver	Removing and installing balancer shaft bushings
L 48543	JD 255*	Special tool	Securing balancer shaft bushings

* SERVICE TOOLS INC., 1901 INDIANA AVENUE, CHICAGO, ILLINOIS 60616, USA

Group 15

CYLINDER BLOCK, LINERS, PISTONS AND CONNECTING RODS

GENERAL

The cylinder block is a one-piece casting comprising cylinders and crankcase. Inside the cylinder block are the bearings for the crankshaft, camshaft and balancer shafts. The cylinder block also contains bores for the cylinder liners, the valve tappets, various oil channels, coolant passages etc.

The cylinder block is equipped with individual liners of the wet-sleeve, replaceable type. A rubber ring packing of square section fits on a shoulder of the cylinder liner. Together with two O-rings located in cylinder block grooves it forms the lower seal of each liner against the cylinder block. The top of the liner is sealed by means of the cylinder head gasket.

The pistons are forged aluminium alloy. The outer surface of the pistons is camground. The piston crown has a cut-out swirl cup with a truncated cone in the center. Every piston is equipped with two compression rings and an oil control ring.

The connecting rods have a bronze bushing serving as bearing surface for the piston pins. The replaceable steel-backed bearing insert halves are aluminium-lined and tin-plated.

DIAGNOSING MALFUNCTIONS

For diagnosing malfunctions, see group 5.

REMOVAL

Pistons, connecting rods and cylinder liners may be removed even with the engine installed.

With the cylinder head removed, do not rotate crankshaft until all cylinder liners have been secured by means of screws and washers.

Secure cylinder liners before removing the pistons. Carefully remove any carbon from cylinder liners.

Keep bearing inserts with their respective rods and covers.

Each connecting rod and piston should be installed in their original bore. Therefore mark connecting rod, piston and rod cover for identification. Observe the "FRONT" mark stamped into every piston crown and connecting rod. After installation, this mark should face the radiator side of the cylinder block.

Before removing the cylinder liners, while they are still secured by washers and screws, measure the amount by which each liner protrudes above the sealing surface of the block (see Specifications).

REPAIR

FOS *NOTE: Complete and detailed repair instructions see manual: "Fundamentals of Service, Engines".*

PISTONS

Place pistons in a cleaning solvent to allow carbon deposits to soak. Then clean, flush and dry pistons. Do not use a steel brush to clean piston rings and piston crown.

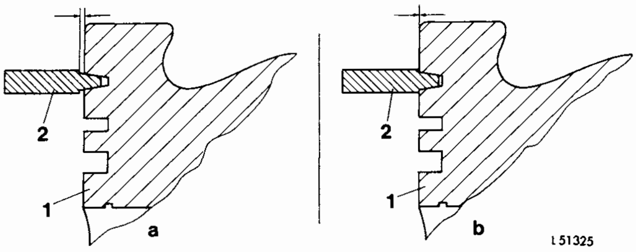


Fig. 1 — Checking Top Piston Groove for Wear

1 Piston
2 Feeler gauge No. 19.58-90.281
a Piston can be used again
b Discard piston and replace

Check piston ring grooves for wear as follows: Clean piston ring grooves carefully. Using feeler gauge 19.58-90.281 (see 2, fig. 1) check the groove of the top compression ring (trapezoidal-shaped) for excessive wear. As long as there is a gap between the shoulder of the feeler gauge and the piston (see a, fig. 1) the piston can be used again. If shoulder of feeler gauge comes into contact with the piston (see b, fig. 1), wear is excessive and the piston must be replaced. When checking the center piston ring groove, insert a new piston ring. Measure clearance between ring and groove at several points around the ring, using a feeler gauge.

Using a micrometer, measure all piston diameters at a 90° angle from piston pin. The pistons are cam ground with the largest diameter at right angles to the piston pin (see Specifications).

Check piston pins and replace them, if excessively worn (see Specifications).

Always use new piston pins when installing new pistons.

CONNECTING RODS AND BEARINGS

Replace connecting rod bearings and piston pin bushings at every major engine overhaul.

Connecting rods and rod caps are only available as matched sets. Connecting rod bearing insert halves are available in standard sizes and several undersizes (see Specifications).

Insert bearing insert halves, install rod cap and tighten rod screws to the specified torque. Measure each bearing bore and its respective crankshaft journal at several places. The difference between the two measurements is the bearing clearance (see Specifications).

Check piston pin bushing and replace, if necessary.

NOTE: Always install a new bushing when installing a new piston pin. Press in new bushing and ream until the respective piston pin can be inserted by "thumb-press fit".

CYLINDER BLOCK

Remove all gaskets and scrape off any residual deposits. Remove O-rings sealing liners from cylinder block grooves and discard.

Thoroughly clean the block outside and particularly inside with cleaning solvent or by pressure steam cleaning. Make sure all passages and orifices are free from sludge, rust and grease and remove all scale or lime deposits.

OIL PASSAGES AND VALVE SEAT BUSHING OF OIL PRESSURE REGULATING VALVE

Valve Seat Bushing of Oil Pressure Regulating Valve

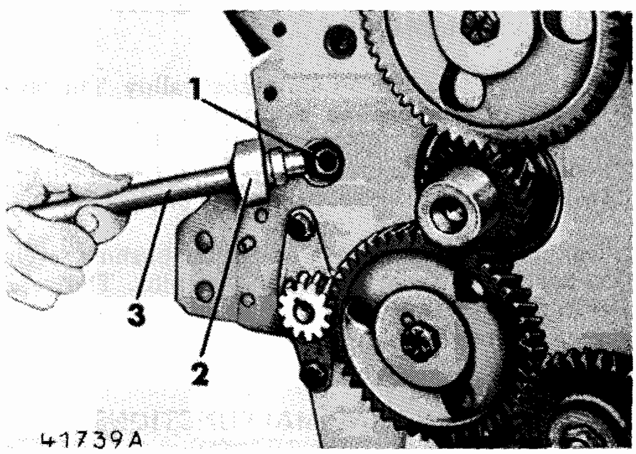


Fig. 2 — Driving in Valve Seat Bushing of Oil Pressure Regulating Valve

1 Valve seat bushing
2 Special tool No. JD 248
3 Special tool (driver) No. 813

Check the bushing with sealing edge for lubricating oil pressure regulating valve located in the front cylinder block for serviceability. If necessary, remove unserviceable bushing from cylinder block and drive in a new bushing until driver contacts cylinder block, using special tools JD 248 and 813 (see fig. 2).

CAUTION: Do not use other unsuitable tools. Above all do not press tool against the slightly protruding inner edge of the bushing since it is a delicate sealing face.

Dowel Pins, Plugs and Studs

Check these parts for tight fit or proper sealing in cylinder block, If necessary, replace by new parts. Coat part to be inserted in cylinder block with a suitable sealant resistant to oil and water.

Threaded Bushing for Dip Stick

If the threaded bushing for the dip stick has to be replaced, coat threaded end of new bushing with an oil-resistant sealant. Thread into cylinder block as indicated under Specifications.

Fitting for Lubricating Oil Filter

If fitting has to be replaced, press in new fitting so that it is flush with the cylinder block. The threaded end should face away from the cylinder block.

CYLINDER LINERS

Measure each cylinder liner as explained below, using a suitable gauge (see specifications):

1. Measure cylinder liner bores at upper piston ring - end of stroke.

2. Measure cylinder liner bores at lower piston ring - end of stroke.

3. Measure cylinder liner bores at right angles from piston pin and at the end of stroke of the upper piston ring.

4. Also measure cylinder liner bores at the end of stroke of the lower piston ring.

A comparison of these measurements will show if, and to what extent, the cylinder liner is worn out-of-round or tapered.

If a cylinder liner is excessively worn (see Specifications), the piston, too, may be so worn that it needs replacement.

Deglazing Cylinder Liner Bores

NOTE: Remove cylinder liners and place in a suitable clamping device or in an old cylinder block for deglazing.

For deglazing cylinder liners 15 to 35 micro-in. (0.0004 to 0.0009 mm), use 180 grit emery cloth or honing stone.

When deglazing, move the tool up and down 10 to 12 times and adapted to driving speed of tool, guide the latter so that a 45° criss-cross hone pattern shown in fig. 3 is produced.

Fig. 3 — Deglazing (Removing Hardened Shining Spots) a Cylinder Liner Bore, Using Special Tool

Clean cylinders thoroughly. Wipe out cylinder liners with a cloth until a clean white rag shows no discoloration when wiped through cylinder bore.

ASSEMBLY

CONNECTING RODS, PISTONS AND PISTON RINGS

Make sure that the marks for identifying matched pistons and connecting rods, applied prior to Disassembly, do tally.

Apply a coat of clean, thin engine oil to the piston pin and insert in piston bore and through connecting rod bushing. A properly fitting piston pin can be positioned by thumb pressure.

Installing Piston Rings

NOTE: New piston rings are furnished with the correct end gap. This should not be altered.

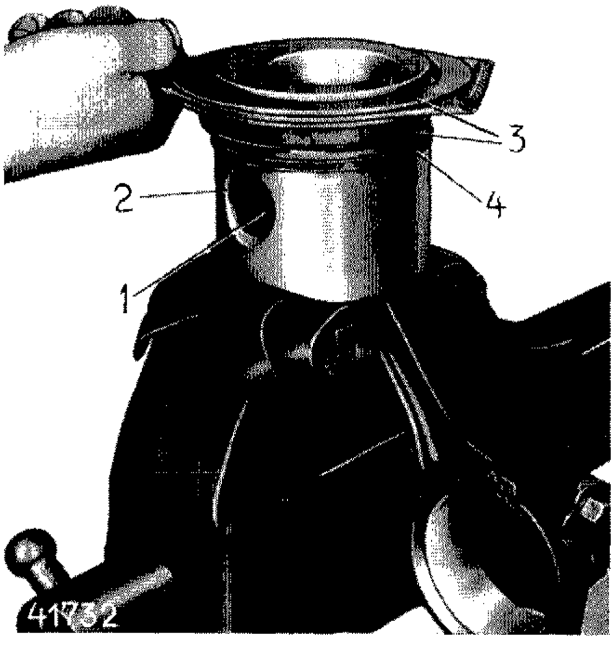


Fig. 4 - Installing Piston Rings

Piston pin
Snap ring
3 Compression rings
4 Oil control ring

Coat exterior of piston and all piston rings with a film of clean engine oil. Insert piston rings, using a commercial piston ring expander.

1. Install the expander ring in groove of oil control ring so that its gap is over a piston pin bore.

CAUTION: Make sure fixed end of guide wire is inserted at least four threads in the expander ring and is properly seated. The other, free end should move freely inside the expander ring. Then install oil control ring in ring groove with the gap opposite the expander gap.

2. Install second compression ring in center groove with "TOP" mark facing upward and with its gap shifted 120° from expander ring gap.

3. Then install upper compression ring with the side marked with a dot facing upwards and with its gap shifted 120° from the gap of the second compression ring.

INSTALLATION

CYLINDER LINERS

Make sure cylinder block is completely clean and that the O-rings are removed from cylinder block grooves.

Install cylinder liner WITHOUT the square-section packing and secure by means of a washer and cap screw.

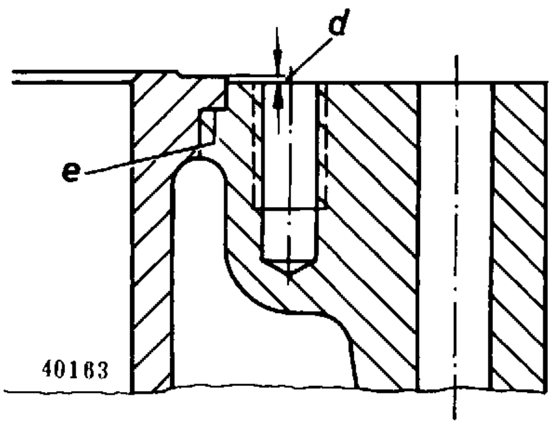


Fig. 5 — Upper Fit and Sealing Face of Cylinder Liner in Cylinder Block

d Check dimension
e Seating area

Measure dimension "d" (see Specifications) shown in fig. 5 by which the sealing face of the cylinder liner protrudes over the cylinder block sealing face. Measure at several places around the circumference and compare measurements to make sure sealing face of cylinder liner is parallel to sealing face of cylinder block.

If the protrusion of the cylinder liner sealing face over the cylinder block sealing face is less than specified, remove liner and install one shim R 46906 (for proper thickness see Specifications) between liner and cylinder block.

Re-install liner with shim but WITHOUT packing in cylinder block. Again measure dimension "d" (fig. 5) and record. Remove cylinder liner and shim.

NOTE: Do not soak packings and O-rings in oil before installing them as they would swell up and could get damaged when installing the cylinder liners.

Carefully slide new, **dry** packing 1 (fig. 6) over liner until it contacts liner shoulder. Be sure packing is not twisted or crimped. Also make sure inner flank of packing contacts liner face when packing is installed.

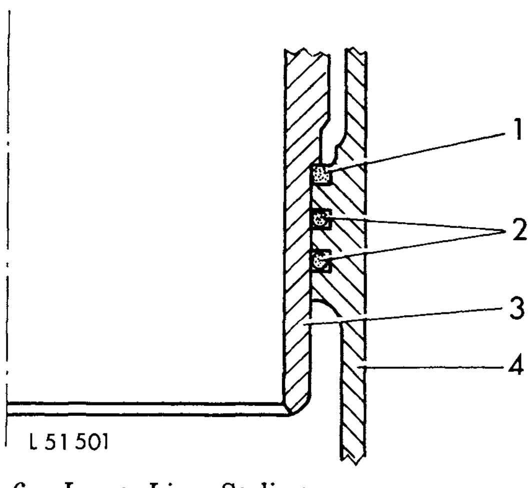


Fig. 6 — Lower Liner Sealing

1 Square-section packing
2 O-rings
3 Cylinder liner
4 Cylinder block

Install two new, **dry** O-rings in grooves of cylinder block.

Before installing liner, make sure O-rings are properly seated in cylinder block grooves. If part of an O-ring projects into bore for liner, the O-ring could be pressed onto groove edge, thus getting damaged without the serviceman noticing it.

Coat packing and O-rings with a film of oil and immediately slide liner with shim into its bore in cylinder block. Observe the mark applied during disassembly to identify the liner and its corresponding bore in the block. Work the liner gently in by hand. Finally use a block of hardwood to drive the liner into its proper position by tapping lightly with a hammer.

CAUTION: Do not yet compress packing.

The cylinder liner will now protrude over the sealing surface of the block by slightly more than dimension "d" (see fig. 5).

Measure protrusion and record. Subtract dimension "d" (with shim, but without packings) measured above from amount of protrusion. The difference indicates how much the liner packings will be compressed. The minimum dimension is given under "Specifications".

If this dimension is not attained, the check must be repeated with another cylinder liner.

If the minimum dimension can still not be attained, replace the cylinder block. Do not place more than one shim between liner and cylinder block under any circumstances.

PISTON WITH CONNECTING ROD

Retain all cylinder liners in the block, using large washers and cap screws.

Coat pistons and cylinder liners with a film of thin engine oil.

NOTE: Observe the identification marks which were applied to the pistons and connecting rods during removal and insert them into the liners from which they were removed.

Make sure that the mark "FRONT" which is stamped into the head of each piston and into the shaft of each connecting rod faces toward the radiator before installing them.

Be sure piston rings and oil control ring are still in the original position.

Apply a film of thin engine oil to bore of special tool No. 19.58-90.616.

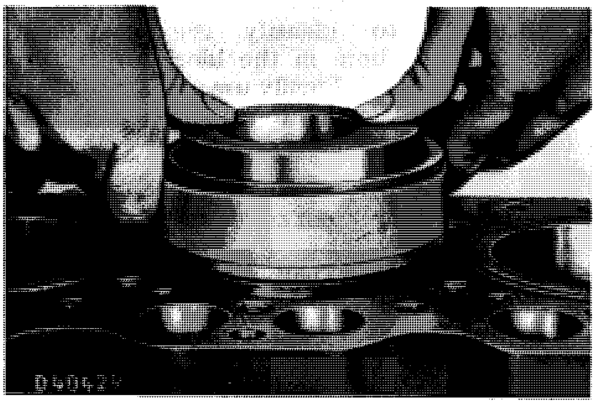


Fig. 7 — Installing Piston, Using Special Tool 19.58-90.616

Position special tool No. JD 19.58-90.616 exactly in the middle of the cylinder bore. Insert connecting rod and piston through this tool until piston rings touch the tool. Then press or tap piston downward until all piston rings are in the cylinder liner. Remove the special tool.

Apply a film of clean, thin engine oil to the bearing inserts and crankshaft rod journals. Install bearing inserts (if used bearings are reinstalled, observe the identification marks applied during removal). Make sure the small tangs on each half of the bearing shell fit correctly into slots in the rod and cap.

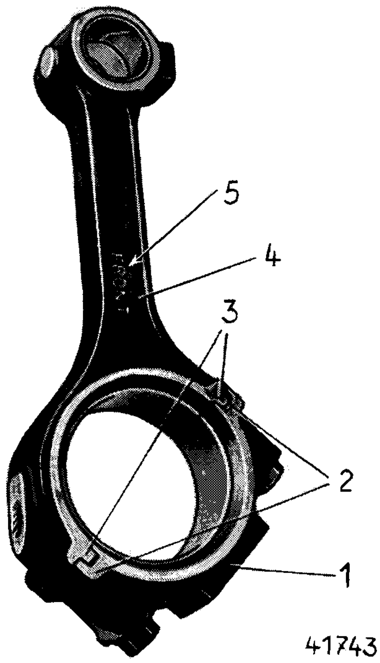


Fig. 8 — Installing Connecting Rod Caps

1 Connecting rod cap
2 Slots
3 Tangs
4 Connecting rod
5 "FRONT" mark

Install the bearing cap with the large tang in the rod fitting into the large slot in the cap. Install the cap screws, coated with a film of oil. First tighten them alternately, and finally to specified torque.

Rotate the crankshaft several revolutions to make sure there is no binding of parts or unusual resistance.

Install oil pan and cylinder head. Fill crankcase with oil of proper viscosity. Fill cooling system with clean soft water or with antifreeze solution (see Operator's Manual).

SPECIFICATIONS

	Dimensions of New Parts	Wear Tolerance
CYLINDER BLOCK		
Camshaft bearing bores	2.2042 to 2.2052 in. 55.987 to 56.012 mm	
Bores for crankshaft bearings	3.3250 to 3.3260 in. 84.455 to 84.480 mm	
Dimension from center of dipstick bushing nipple end to base of cylinder block	6.0 in. 152.5 mm	
Lower bore for seating liners	4.3730 to 4.3750 in. 111.075 to 111.125 in.	
CYLINDER LINERS		
Outer diameter of liner at lower bore	4.3680 to 4.3720 in. 110.950 to 111.050 mm	
Clearance between liner and cylinder block at lower bore	0.0010 to 0.0070 in. 0.025 to 0.175 mm	
Cylinder liner bore	4.0150 to 4.0164 in. 101.982 to 102.018 mm	
Max. permissible wear or taper		0.005 in. 0.13 mm
Protrusion over cylinder block sealing face (see dimension "d", fig. 5, cylinder liner installed without packing)	0.000 to 0.004 in. 0.000 to 0.102 mm	
Thickness of shim R 46906	0.004 in. 0.1 mm	
Minimum dimension for proper compression of liner packing	0.0126 in. 0.32 mm	
Desired cylinder liner wall finish	15 to 35 micro-inch 0.0004 to 0.0009 mm	
PISTONS		
Piston dia. below oil control ring, measured at right angles from piston pin	4.0053 to 4.0065 in. 101.735 to 101.765 mm	
Play between piston and cylinder liner, measured below oil control ring	0.0085 to 0.011 in. 0.217 to 0.283 mm	0.016 in. 0.406 mm
Play between piston and cylinder liner, measured at open piston end	0.0011 to 0.0044 in. 0.027 to 0.113 mm	0.0094 in. 0.249 mm
Piston diameter at open end, measured at right angles to piston pin	4.0121 to 4.0140 in. 101.905 to 101.955 mm	

	Dimensions of New Parts	Wear Tolerances
Bore for piston pins	1.1880 to 1.1883 in. 30.175 to 30.182 mm	0.001 in. 0.025 mm
Piston ring side clearance (centre ring)	0.0035 to 0.0053 in. 0.09 to 0.13 mm	0.008 in. 0.2 mm
PISTON PINS		
Piston pin diameter	1.1875 to 1.1879 in. 30.163 to 30.173 mm	0.0005 in. 0.013 mm
Length of piston pin	3.3410 to 3.3510 in. 84.861 to 85.115 mm	0.005 in. 0.13 mm
Piston pin clearance in piston	0.0003 to 0.0008 in. 0.007 to 0.020 mm	0.0015 in. 0.038 mm
CONNECTING RODS AND BEARINGS		
Connecting rod bearing clearance	0.0012 to 0.0042 in. 0.030 to 0.106 mm	0.0062 in. 0.16 mm
Little end bushing bore	1.1886 to 1.1896 in. 30.190 to 30.215 mm	0.002 in. 0.05 mm
Piston pin clearance in little end	0.0007 to 0.0021 in. 0.017 to 0.053 mm	0.0041 in. 0.104 mm
Connecting rod bearing bores	2.7502 to 2.7522 in. 69.855 to 69.905 mm	no wear permissible
Connecting rod bearing undersizes, smaller than standard sizes by	0.002; 0.010; 0.020 and 0.030 in. 0.051; 0.254; 0.508 and 0.762 mm	

TORQUES FOR HARDWARE

Connecting rod cap screws (dip in oil)	60 to 70 ft.lbs.	8.3 to 9.7 mkg
Rocker arm shaft to cylinder head, cap screws	35 ft.lbs.	4,8 mkg
Cylinder head to cylinder block, cap screws	110 ft.lbs.	15 mkg
Rocker arm cover to cylinder head, cap screws	2 ft.lbs.	0.28 mkg
Oil pan to cylinder block and timing gear cover	35 ft.lbs.	4.8 mkg
Oil pan to clutch housing, cap screws	170 ft.lbs.	23.5 mkg
Intake manifold, cap screws	35 ft.lbs.	4.8 mkg
Exhaust manifold, cap screws	35 ft.lbs.	4.8 mkg
Fan to V-belt pulley (securing plate) of waterpump	20 ft.lbs.	2.75 mkg
Injection nozzles to cylinder head, cap screws	20 ft.lbs.	2.75 mkg

ENGINE BREAK-IN

On an overhauled engine proceed as follows to safeguard proper break-in of new parts.

1. Operate engine for approx. 5 minutes at 1500 rpm idle speed.

2. Check engine oil pressure; with engine running at 2500 rpm and oil of operating temperature, oil pressure should be 50 to 60 psi (3.5 to 4.2 kg/cm^2).

3. Run engine for approx. 25 minutes at 2000 rpm and half load.

4. Run engine for approx. 30 minutes at 2500 rpm and three quarter load.

NOTE: Use a dynamometer to put load on the tractor. If a dynamometer is not available, use another suitable device to put load on the tractor.

5. Tighten cylinder head cap screws: first loosen them by 5 to 10°, then tighten to the specified torque. Check valve clearance and adjust, if necessary.

NOTE: Explain to the operator that the engine should be operated under normal load during the first 100 hours of operation. Light loads and unnecessarily long idle operation should be avoided. Replace engine oil and filter after100 hours of operation. For subsequent oil change and proper oil viscosity see Operator's Manual.

SPECIFICATIONS

Compression if driven through starter (engine, starter and batteries must be in good condition), minimum	300 psi	21 kg/cm^2

The most important single factor regarding engine compression is the pressure differential among the individual cylinders. Pressure should be approx. identical in all cylinders; the pressure differential should be no more than 50 psi (3.5 kg/cm^2).

Engine oil pressure at 2500 rpm	50 to 60 psi	3.5 to 4.2 kg/cm^2

SPECIAL TOOLS

Part No. if ordered through JD Parts Service	Manufacturer	Description	Use
L 48527	JD 248*	Driver	Driving in fitting of oil pressure regulating valve
L 48521	813*	Driving pin	To be used in conjunction with JD 248
19.58-90.281	JDE 62*	Feeler gauge	Checking the first compression ring groove (trapezoidal shaped)
19.58-90.616		Piston ring compressor	Installing pistons
	JD 970-M*	Washers	Securing cylinder liners in block
19H 432		Cap screws	ditto
		Washers DIN 9021	ditto

* SERVICE TOOLS INC., 1901 INDIANA AVENUE, CHICAGO, ILLINOIS 60616, USA

Group 20

CRANKSHAFT, MAIN BEARINGS AND FLYWHEEL

GENERAL INFORMATION

The crankshaft is a steel forging supported by five, replaceable aluminium, steel-backed, tinplated, main bearings.

The rear main bearing has a flange on each side to support the crankshaft thrust and to limit end play.

The crankshaft is drilled for pressure lubrication to all bearings.

The flywheel ring gear engaged by the starter is shrunk-fit to the front of the flywheel. The flywheel has a bore for setting top dead center if the engine timing is to be adjusted.

DIAGNOSING MALFUNCTIONS

See group 5 for diagnosing malfunctions.

REMOVAL

For removal of engine, see section 10, group 25.

NOTE: It is recommended to check crankshaft end play be means of a dial indicator prior to removal. If end play is excessive, reduce play by installing a new pilot bearing.

REPAIR

FOS

NOTE: Overall and detailed information on repair see "Fundamentals of Service, Engines" manual.

DISASSEMBLY

Remove starting motor.

Remove engine clutch, flywheel and flywheel housing. Place engine on assembly stand.

Remove cylinder head (see group 10).

Remove oil pan and oil pump (see group 30).

Remove pistons and connecting rods (see group 15).

NOTE: As a rule, pistons and connecting rods will have to be removed. However, removal is not required if only the crankshaft is to be lifted out of the cylinder block.

Remove timing gear cover and gears as well as cylinder block front plate (see group 25).

Remove oil slinger from front of crankshaft.

Remove crankshaft.

CHECKING FLYWHEEL AND HOUSING

Inspect flywheel ring gear for serviceability and tight fit on flywheel. Check if flywheel seat, dowel bore and ball bearing are in proper condition. Inspect flywheel friction face contacting driven disk for heat cracks and rough spots.

If ring gear has to be replaced, heat gear evenly and lift away from flywheel. Also heat new gear evenly and install with chamfered edge of teeth facing away from flywheel.

Check flywheel pilot bearing for wear and replace, if necessary. Install new bearing, with sealed side facing clutch, in flywheel bore so that it is flush with crankshaft face of flywheel. Pack ball bearing with heat-resistant grease.

Check flywheel housing and tachometer drive shaft for damage. Check tachometer drive seal for serviceability.

Check oil seal ring of flywheel housing, especially sealing lip, for proper condition; replace, if necessary. Press unserviceable oil seal ring out of flywheel housing, using a suitable tool. Support housing securely in bore area to avoid damage.

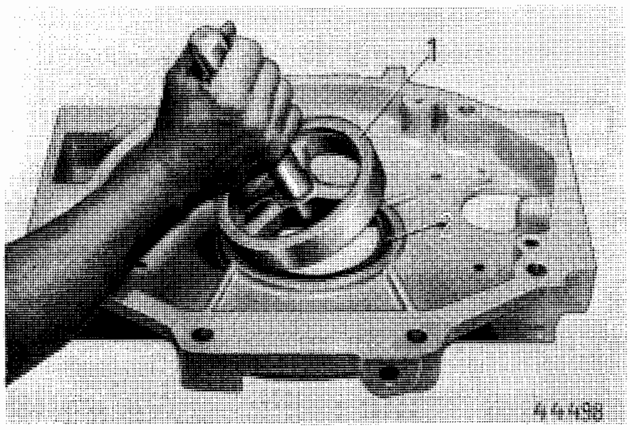


Fig. 1 - Driving in Oil Seal Ring of Flywheel Cover, Using Special Tool No. JDE 2

1 Driver No. JDE 2
2 Oil seal ring

Use a suitable tube section or similar tool, or, if available, driver No. JDE 2 to drive in a new oil seal ring. Drive oil seal ring into flywheel housing, with sealing lip facing away from driver, until metal cover of seal ring is flush with machined face of housing.

When driving or pressing in oil seal ring, support flywheel housing squarely in bore area so it will not be damaged.

CHECKING CRANKSHAFT

Clean crankshaft thoroughly, especially oil passages from crankshaft bearings to connecting rod bearings.

Check all crankshaft journals thoroughly. Make sure bearing faces are not damaged or excessively worn. If scores are not deep, carefully dress journals by means of fine emery cloth or polishing cloth.

CAUTION: Especially check both shoulders of pilot bearing journal for scores or unevenness which might damage the lateral thrust faces of the pilot bearing.

Measure each journal at several places by means of a micrometer to determine out-of-roundness and/or taper due to wear (see Specifications).

The flywheel end of the crankshaft has an axial bore receiving a plug. This plug receives the thrust exerted by the shaft. If the plug is worn or damaged, pull out old plug and insert a new plug in crankshaft bore.

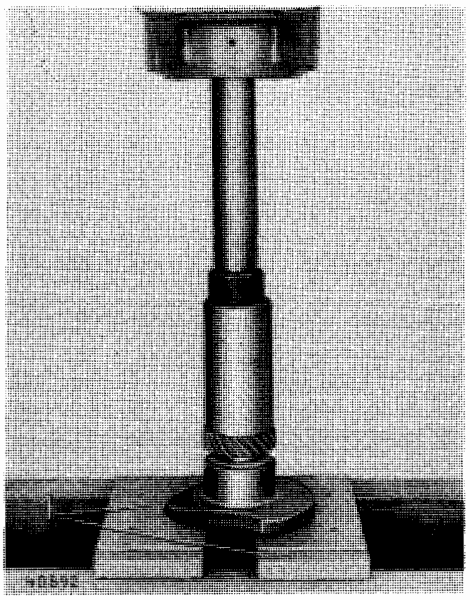


Fig. 2 - Pressing Gear on Crankshaft

1 Block for supporting crankshaft under front throw

Check teeth for excessive wear and damage. Remove unserviceable gear by means of a commercial puller.

If a press is used for pressing on a new gear, support crankshaft under front throw as shown in fig. 2.

Insert new Woodruff key in crankshaft keyway. Press gear on crankshaft so that it is flush against crankshaft shoulder. To facilitate installation, the gear may be heated to 350° F (180° C).

INSPECTING CRANKSHAFT MAIN BEARINGS

If one main bearing half needs replacement, always replace both halves. In such a case check condition of sliding surfaces and clearance of all crankshaft bearings. Damage in a bearing may be due to excessive wear of another bearing. If an inspection shows that other bearings, though heavily worn, are still within the wearing tolerance, do not hesitate to replace these bearings. All crankshaft bearings should be replaced at every major engine overhaul.

If the bearing inserts are to be used again, it will be useful to mark them for proper reinstallation.

Remove all bearing inserts from cylinder block and bearing caps. Check all bearings for excessive wear, scores, chipping in which case they have to be replaced. Above all, thoroughly check lateral thrust faces of pilot bearing. Wear of this bearing is also indicated by increased crankshaft end play.

Measure crankshaft bearing clearance: Bearing clearance is the difference between bearing bore and crankshaft diameter (see Specifications). If the permissible maximum clearance is exceeded, install undersize bearings.

NOTE: Make sure you use the proper undersize bearing. If undersize bearings are too tight and clearance is not within specifications, the journal and bearing will be wiped clean of the oil film, resulting in premature wear.

MEASURING CRANKSHAFT END PLAY

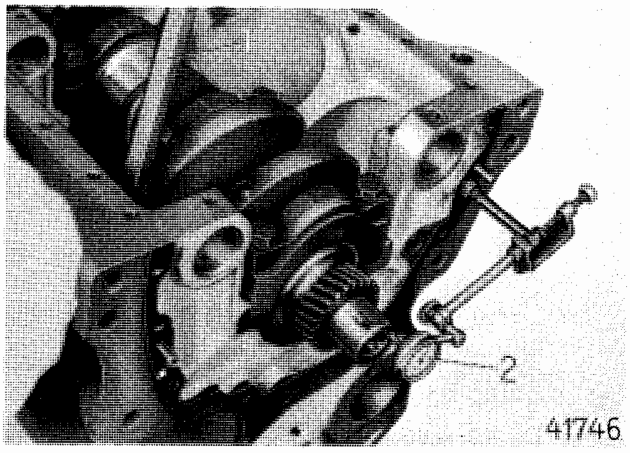


Fig. 3 - Measuring Crankshaft End Play with Dial Indicator

1 Mounting bar
2 Dial indicator

Fasten dial indicator to cylinder block as shown in fig. 3 or in a similar way and position on crankshaft face.

Move crankshaft back and forth, using a bar or similar tool and measure amount of clearance on dial gauge (see Specifications).

CAUTION: Do not apply too much pressure with bar as this could damage new bearing inserts.

CRANKSHAFT WEAR RING FOR REAR OIL SEAL

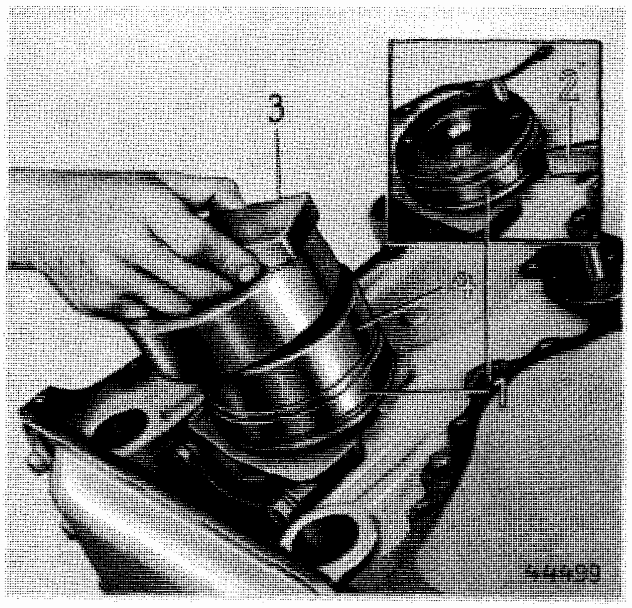


Fig. 4 - Removing Old Wear Ring-Pressing on New Wear Ring, Using Special Tools No. JD 251 and JD 251-3

1 Wear ring
2 Dull chisel
3 Special tool No. JD 251
4 Pilot ring No. JD 251-3

Removing Old Wear Ring

Score wear ring with a dull chisel at several places of its circumference. This will stretch the material so that the wear ring gets loose on the crankshaft and can be removed without using force (see fig. 4).

CAUTION: Do not score wear ring too deeply as crankshaft surface may be damaged.

Pressing on New Wear Ring

Position pilot ring 4 (fig. 4) - special tool No. JD 251-3- against center of rear crankshaft face. Slide new wear ring (rounded edge of ring outward) over pilot ring and start wear ring onto crankshaft by hand. Avoid "cocking" or forcing the ring (use no force).

Place special tool 3 (fig. 4) - No. JD 251 - (as shown in fig. 4) over pilot ring until it contacts wear ring. Tap JD 251 driver lightly to drive wear ring on crankshaft until flat bar of driver 3 bottoms on pilot ring 4. When pressing on wear ring, turn driver No. JD 251 repeatedly (to prevent "cocking" of wear ring).

CAUTION: When assembling, be careful not to nick or damage polished wear ring surface (sealing face for oil seal ring in flywheel housing).

INSTALLATION

INSTALLING CRANKSHAFT AND BEARINGS

NOTE: New crankshaft bearings, except for the pilot bearing, may be installed at random. Used bearings should be installed at the same location from which they were removed. Observe the marks applied on removal.

Place bearing inserts in their bores in the cylinder block, observing the marks applied during removal of the crankshaft. Make sure tangs properly engage slots of cylinder block and that oil hole of bearing insert is aligned with oil bore of cylinder block.

Coat all bearing inserts and crankshaft journals with a film of oil. Carefully install crankshaft in cylinder block.

Place bearing inserts in bearing caps, making sure tangs are properly engaged. Coat bearing insert surfaces with a film of oil. Replace all bearing caps according to the marks so that the tangs of both bearing halves are on the same side (see fig. 5).

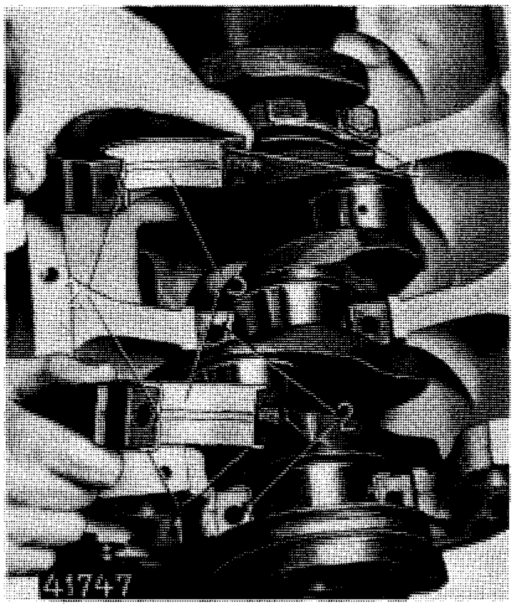


Fig. 5 - Installing Crankshaft Bearing Caps and Inserts

1 Thrust face of pilot bearing
2 Tangs in slots
3 Bearing inserts
4 Bearing caps

Turn all cap screws into cylinder block, but tighten only finger-tight. Align pilot bearing halves before tightening bearing cap screws:

Force crankshaft from radiator side to flywheel side and then back from flywheel side to radiator side. Tighten all cap screws to the specified torque. Check crankshaft end play as explained under "Measuring Crankshaft End Play" (see fig. 3).

INSTALLING FLYWHEEL HOUSING

Make sure sealing faces of cylinder block and flywheel are thoroughly clean and both dowels are provided on cylinder block side.

Coat both sides of new gasket with a film of oil (do not stick on) and place on cylinder block.

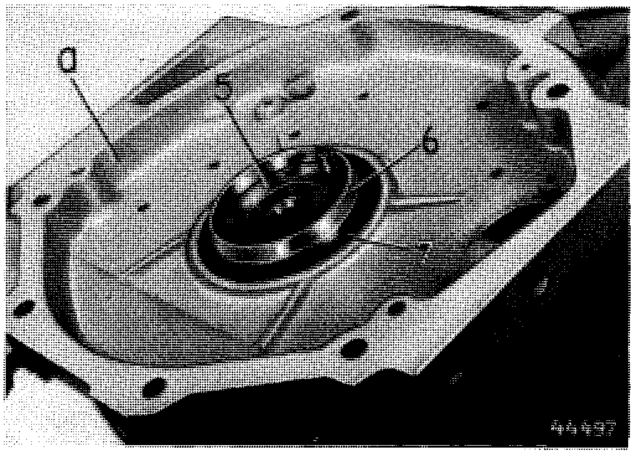


Fig. 6 - Installing Flywheel Housing

a Flywheel housing
5 Crankshaft
6 No. JD 251-4 Seal Protector
7 Oil seal ring

Slide seal protector 6 (fig. 6) - special tool No. JD 251-4 - on rear end of crankshaft. Coat seal protector and crankshaft wear ring with a film of clean engine oil.

Install flywheel housing, sliding oil seal ring (as shown in fig. 6) over seal protector onto crankshaft wear ring. When installing seal ring, make sure sealing lip of ring is not damaged or turned over.

INSTALLING FLYWHEEL

Make sure seats of flywheel and crankshaft are clean and show no burrs or unevenness.

NOTE: To facilitate installation of flywheel, screw two pilot pins into crankshaft.

Slide flywheel over dowel of crankshaft and press onto crankshaft. Tighten cap screws crosswise to the specified torque, taking several steps.

FINAL INSTALLATION

Slide oil slinger onto crankshaft, with the flanged edge facing away from engine.

Installation of front crankshaft seal ring, see group 25.

Install pistons and connecting rods (see group 15).

Install oil pan and oil pump (see group 30).

Install cylinder head (see group 10).

Install engine (see section 10, group 25).

Fill crankcase with oil and fill cooling system with coolant (see Operator's Manual).

SPECIFICATIONS

	Dimensions of New Parts	Wear Tolerance
Crankshaft end play	0.002 to 0.008 in. 0.051 to 0.203 mm	0.015 in. 0.381 mm
Dia. of crankshaft journals (standard size)	3.1235 to 3.1245 in. 79.337 to 79.362 mm	
Dia. of connecting rod journals (standard size)	2.7480 to 2.7490 in. 69.799 to 69.824 mm	
Journal taper for each inch (25.4 mm) of journal length		0.001 in. 0.025 mm
Journal out-of-roundness		0.003 in. 0.076 mm
Crankshaft bearing bore (standard size)	3.1256 to 3.1276 in. 79.390 to 79.441 mm	0.002 in. 0.05 mm
Crankshaft bearing clearance	0.001 to 0.0041 in. 0.028 to 0.104 mm	0.006 in. 0.152 mm
Connecting rod bearing bore, installed (standard size)	2.7502 to 2.7522 in. 69.855 to 69.905 mm	
Connecting rod bearing clearance	0.0012 to 0.0042 in. 0.030 to 0.106 mm	0.062 in. 0.16 mm
Crankshaft bearing undersizes, smaller than standard by	0.002; 0.010; 0.020 and 0.030 in. 0.051; 0.254; 0.508 and 0.762 mm	
Crankshaft bearing bores in cylinder block	3.3250 to 3.3260 in. 84.455 to 84.480 mm	

TORQUES FOR HARDWARE

Crankshaft bearing cap-to-cylinder block, cap screws	85 ft.lbs.	11.7 mkg
Flywheel housing-to-cylinder block, 1st stage	22 ft.lbs	3.0 mkg
Flywheel housing-to-cylinder block, 2nd stage	35 ft.lbs	4.8 mkg
Flywheel-to-crankshaft, cap screws	85 ft.lbs	11.7 mkg
V-belt pulley on crankshaft, cap screw	85 ft.lbs	11.7 mkg

SPECIAL TOOLS

Part No. if ordered through JD-Parts Depot	Manufacturer	Description	Use
	JDE 2*	Driver	Installing oil seal ring in flywheel housing
L 48539	JD 251*	Driver	Driving wear ring on crankshaft
L 48585	JD 251-3*	Pilot ring	Pilots JD 251 driver
L 48586	JD 251-4*	Seal protector	Protects oil seal ring during installation of flywheel housing

* SERVICE TOOLS INC., 1901 INDIANA AVENUE, CHICAGO, ILLINOIS 60616, USA

Group 25
TIMING GEAR TRAIN

GENERAL INFORMATION

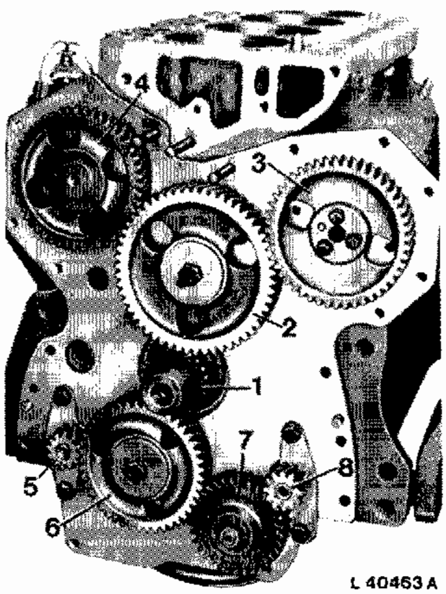


Fig. 1 — Timing Gear Train - Cover Removed

1 Crankshaft gear
2 Upper idler gear
3 Injection pump gear
4 Camshaft drive gear
5 Right-hand balancer shaft gear
6 Lower idler gear
7 Oil pump gear
8 Left-hand balancer shaft gear

The helical timing gear train consists of gears 1 to 8 (fig. 1), the gear train being driven by crankshaft gear 1. The upper idler gear 2 drives camshaft gear 4 and injection pump gear 3 while lower idler gear 6 drives oil pump gear 7 and right-hand balancer shaft gear 5. The left-hand balancer shaft gear 8 is driven by oil pump gear 7.

Due to the number of teeth of these gears, camshaft and injection pump shaft rotate at half the crankshaft speed, whereas both balancer shafts run at double the crankshaft speed.

The crankshaft gear, camshaft gear and both balancer shaft gears are pressed on and keyed to their respective shafts. The oil pump gear is pressed on its taper seat and secured to the shaft by a retaining nut. The injection pump gear is secured to the pump shaft with three cap screws. The upper and lower idler gears with bronze bushings rotate on stationary shafts pressed into the cylinder block front plate.

The camshaft gear, injection pump gear and both balancer shaft gears have timing marks which must be aligned with the center of the crankshaft when No. 1 piston is at "top dead center" of its compression stroke. With the other gears no timing is required.

DIAGNOSING MALFUNCTIONS

See group 5 for diagnosing malfunctions.

REMOVAL

Removal of the timing gear cover, the timing gears or the cylinder block front plate does not require removal of the engine. However, split the tractor and remove front end to get access to the front of the engine (see section 10, group 25).

If engine has to be removed, see section 10, group 25.

Whenever engine has to be overhauled or crankshaft has to be removed, also remove timing gear train as follows:

1. Remove timing gear cover.

2. Back hex. nut off oil pump shaft and remove cap screws of upper and lower idler gears.

3. Remove upper and lower idler gear. Pull oil pump gear off the tapered pump shaft, using a commercial puller. DO NOT PRY GEAR OFF THE SHAFT BY MEANS OF MOUNTING BARS ETC.

4. Remove oil pump (see group 30).

5. Remove injection pump with gear (see section 30).

6. Remove camshaft and balancer shafts (see group 10).

REPAIR

NOTE: Overall and detailed information on repair see "Fundamentals of Service, Engines" manual.

Inspection, repair and replacement of gear of

camshaft and balancer shafts see group 10,

crankshaft see group 20,

lube oil pump see group 30,

injection pump see section 30, group 15.

Prior to replacing the crankshaft gear, camshaft gear or balancer shaft gears, remove the respective shaft (see above groups).

CHECKING TIMING GEAR BACKLASH

As a matter of experience unusual gear train noise indicates excessive backlash or damaged teeth.

Check backlash between individual gear pairs and replace gears, if necessary (see Specifications).

IDLER GEARS

Measure I.D. of bushing in idler gear and O.D. of shaft; clearance see Specifications. If bushing has to be replaced, press in new bushing by means of tool JD 252 so that it is flush with either side of gear.

If there are signs of insufficient lubrication, make sure that oil passage of cylinder block for lubricating the upper idler gear as well as longitudinal and vertical oil bores of shaft are open.

The lower idler gear is splash-lubricated.

FRONT PLATE AND TIMING GEAR COVER

Make sure front plate is not warped or otherwise damaged which would jeopardize safe sealing against cylinder block and timing gear.

Do not pry or press against timing gear cover with excessive force. The cover is cast aluminium alloy which might be sprung or warped.

If timing cover seal ring leaks, especially if this is indicated by oil spots on the timing cover, remove seal ring from cover.

CAUTION: Support timing cover squarely to prevent distortion.

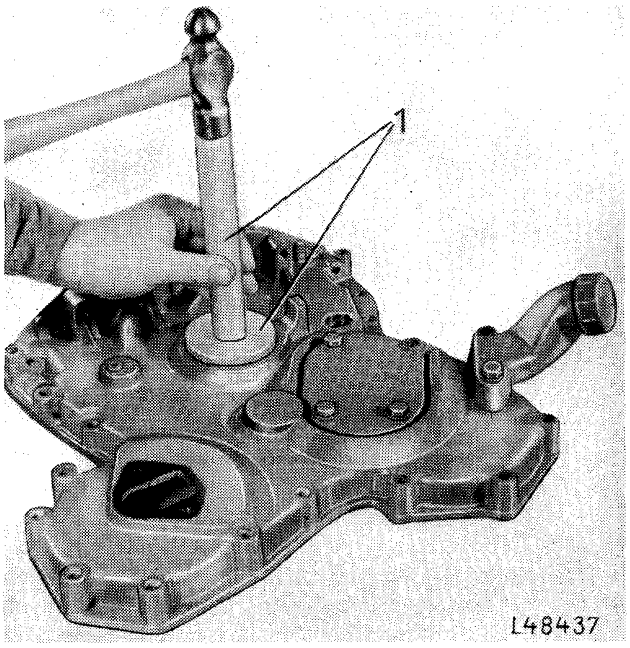


Fig. 2 - Front Crankshaft Oil Seal in Timing Cover and Oil Seal Driver

1 Special tool No. JD 250 and driving pin No. 815

Prior to installing new oil seal, coat outer surface of seal with an oil-resistant sealing compound. Press in oil seal until it bottoms in bore. The spring-loaded lip of the seal should face the timing gears. Use special tools No. 815 and JD 250.

CAUTION: When installing oil seal, support timing cover to prevent distortion.

INSTALLATION

NOTE: If engine has been completely disassembled, install crankshaft before installing cylinder block front plate.

Coat front plate seal facing cylinder block with a film of "PERMATEX Type 3", "TEROSON Atmosit", "COLLEX Aviation" or "HERMETIC HERMALEX".

CAUTION: Cut off protruding edge of gasket only when timing cover has been tightened. Tighten front plate attaching screws to the specified torque (see Torques for Hardware).

INSTALLATION AND ADJUSTMENT OF TIMING GEAR TRAIN

Align timing marks of camshaft, balancer shaft and injection pump gears with center of crankshaft after having installed them. Install and adjust timing gears as follows:

1. Install camshaft and balancer shafts (see group 10).

2. Rotate crankshaft clockwise (seen from radiator) until piston No. 1 (radiator side) is immediately before TDC of its compression stroke. Insert timing screw in bore of flywheel housing and flywheel when the latter is exactly in its TDC position.

NOTE: With the engine disassembled, rotate crankshaft so that piston No. 1 bearing journal is in its top position facing the cylinder head. In this position the keyway of the crankshaft gear faces exactly upward (cylinder head side).

CAUTION: Do not rotate crankshaft after having adjusted TDC.

3. Install oil pump and oil pump gear (see group 30).

NOTE: Tighten hex. nut of pump shaft only after timing gears have been adjusted and lower idler gear has been installed so that the gear pair can be blocked by means of a clean rag.

4. Install fuel injection pump with gear (see section 30).

5. With the crankshaft set at TDC as indicated in item 2, align mark "b" stamped onto camshaft gear (see fig. 3) with line drawn through center of crankshaft and camshaft as shown in fig. 3, using timing tool No. JD 254 and rotating the camshaft.

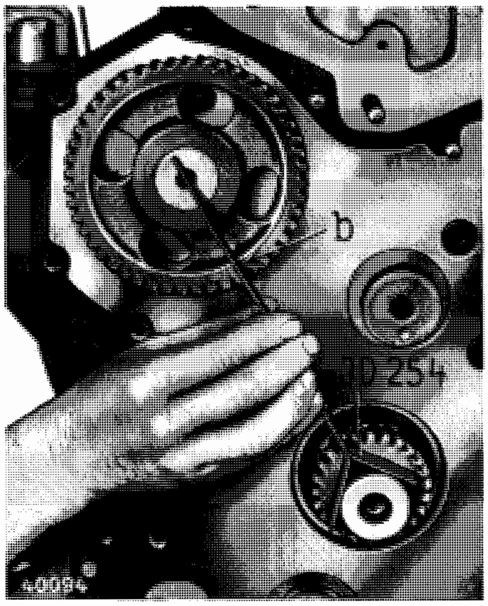


Fig. 3 - Timing Camshaft Gear by means of Timing Tool No. JD 254

b Timing mark

6. With the crankshaft set in TDC position as indicated in item 2, align mark "c" (fig. 4) stamped onto injection pump gear with line drawn through center of crankshaft and pump shaft as shown in fig. 4, using timing tool No. JD 254 and rotating the injection pump shaft. CAUTION: Use timing mark indicating number of cylinders on respective engine.

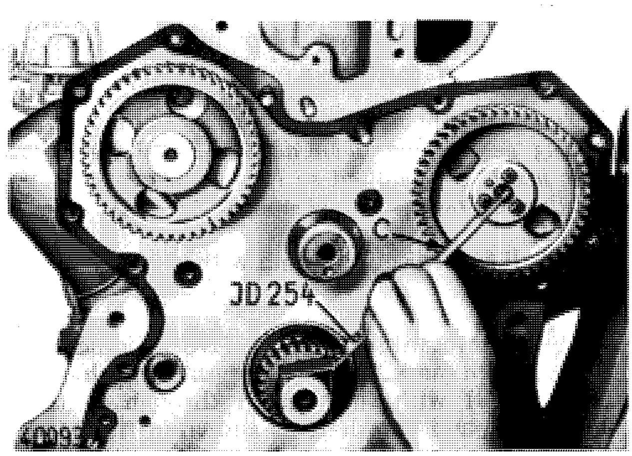


Fig. 4 - Timing Injection Pump Gear, Using Timing Tool No. JD 254

c Timing mark

7. After having timed the camshaft and injection pump gear, carefully slide upper idler gear on shaft, simultaneously engaging the gear in crankshaft, camshaft and injection pump gears with a rotating motion. Use special care not to rotate the previously timed gears.

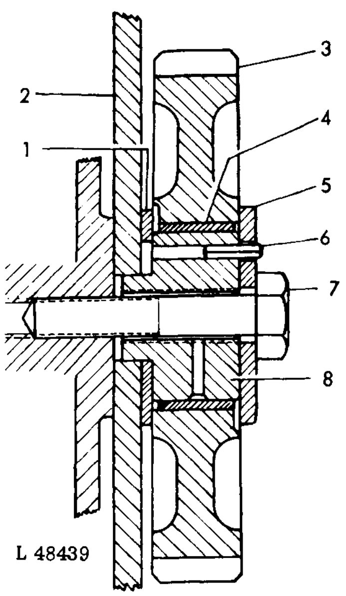


Fig. 5 - Upper Idler Gear and Support - Sectional View

1 Rear thrust washer
2 Cylinder block front plate
3 Idler gear
4 Idler gear bushing
5 Front thrust washer
6 Spring pin
7 Cap screw
8 Shaft

Make sure that the rear thrust washer 1 (fig. 5) is installed.

If a new shaft is installed, first drive spring pin 6 (fig. 5) in shaft so that it protrudes from the front face of the shaft by a specified dimension (see Specifications). Install front thrust washer 5 and cap screw 7, secure gears against rotation and tighten screw to the specified torque (see Torques for Hardware).

8. While the crankshaft is set in its TDC position in accordance with paragraph 2, align both balancer shaft gears with the aid of timing tool No. JD 254. Rotating the balancer shafts, set the balancer gear markings (see "d" and "e", fig. 6) so that they are in alignment with the centre of the crankshaft and balancer shaft (see fig. 6).

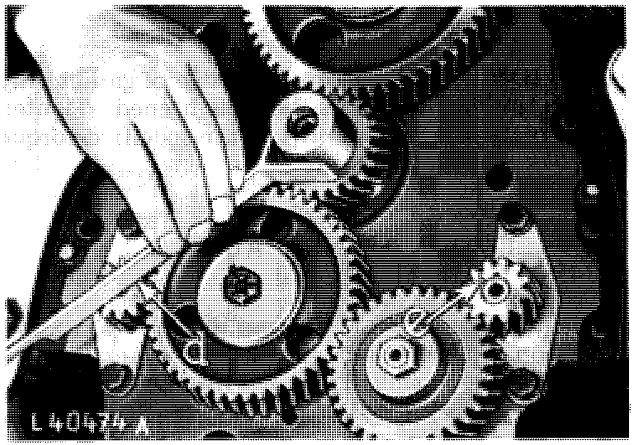


Fig. 6 — Timing Balancer Shaft Gear by means of Timing Tool No. JD 254

d Timing mark on right-hand balancer shaft gear
e Timing mark on left-hand balancer shaft gear

9. After having timed the balancer shaft gears, carefully slide the lower idler gear onto the shaft, simultaneously engaging the gear in the crankshaft, lubricating oil pump and right-hand balancer shaft gears with a rotating motion. Take extra care not to rotate the previously timed gears. Make sure that rear thrust washer 1 (fig. 7) has been installed.

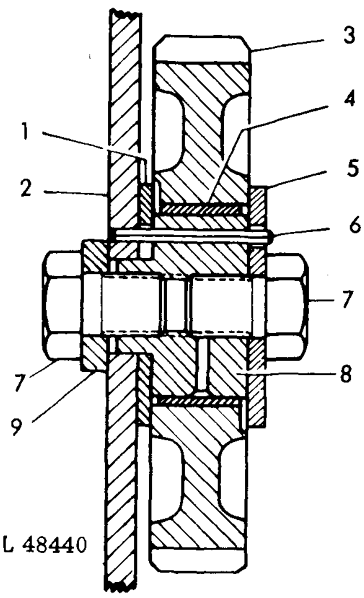


Fig. 7 — Lower Idler Gear and Its Support - Sectional View

1 Rear thrust washer	5 Front thrust washer
2 Cylinder block front plate	6 Spring pin
3 Idler gear	7 Cap screws
4 Idler gear bushing	8 Shaft
	9 Special steel washer

If a new shaft is installed for the lower idler gear, drive spring pin 6 (fig. 7) in shaft so that it protrudes from front face of shaft by a specified value. Slide rear thrust washer 1 on shaft journal and spring pin. Drive in shaft until thrust washer is fully seated. Secure shaft with special steel washer 9 and cap screw 7. Tighten screw to specified torque (see Torques for Hardware).

Install front thrust washer 5 over the spring pin 6, screwing the second cap screw 7 (see fig. 7) into the shaft. Secure gears against rotation and tighten screw to specified torque (see Torques for Hardware).

After final installation of all shafts and gears, check timing of the individual gears as explained above, using timing tool JD 254.

Then withdraw timing pin from flywheel and flywheel housing and attach protective cover to flywheel housing.

FINAL ASSEMBLY

Install oil slinger on crankshaft with flange facing away from engine.

Coat spring-loaded lip of timing cover oil seal with a film of high-temperature grease. Slide timing cover over crankshaft. However, be careful not to damage or turn over lip of oil seal. Install nuts and screws of timing cover and tighten to the specified torque.

Cut off protruding edge of gasket between front plate and cylinder block or between front plate and timing cover so that it is flush with the oil pan sealing face.

Install all parts of oil pressure regulating valve (see group 30). Install all engine or tractor parts removed to facilitate removal of parts dealt with in this group.

SPECIFICATIONS

	Dimensions of new parts	Wear tolerance
Timing gear backlash between		
upper idler gear and crankshaft gear	0.0027 to 0.0116 in. 0.069 to 0.295 mm	0.0166 in. 0.422 mm
upper idler gear and camshaft gear	0.0028 to 0.0135 in. 0.071 to 0.343 mm	0.0185 in. 0.470 mm
upper idler gear and injection pump gear	0.0028 to 0.0135 in. 0.071 to 0.343 mm	0.0185 in. 0.470 mm
lower idler gear and crankshaft gear	0.0027 to 0.0137 in. 0.069 to 0.348 mm	0.0187 in. 0.475 mm
lower idler gear and balancer shaft gear	0.0018 to 0.0156 in. 0.046 to 0.396 mm	0.0206 in. 0.523 mm

	Dimensions of new parts	Wear tolerance
lower idler gear and oil pump gear	0.0016 to 0.0147 in. 0.041 to 0.374 mm	0.0157 in. 0.400 mm
oil pump gear and balancer shaft gear	0.0020 to 0.0140 in. 0.051 to 0.356 mm	0.0190 in. 0.483 mm
Dia. of an idler gear shaft	1,7495 to 1,7505 in. 44,436 to 44,462 mm	0.0010 in. 0.025 mm
Dia. of idler gear bushing bore	1,7515 to 1,7535 in. 44,487 to 44,538 mm	0.0010 in. 0.025 mm
End play of an idler gear	0.001 to 0.007 in. 0.02 to 0.17 mm	0.015 in. 0.38 mm
Hub width of an idler gear	0.865 to 0.867 in. 21,97 to 22,02 mm	0.002 in. 0.05 mm
Width of shaft	0.868 to 0.872 in. 22.05 to 22.15 mm	0.002 in. 0.05 mm
Spring pins protruding from shaft:		
on lower idler gear by	0.197 to 0.275 in. 5 to 7 mm	
on upper idler gear by	0.138 to 0.177 in. 3.5 to 4.5 mm	

TORQUES FOR HARDWARE

Front plate to cylinder block	25 ft.lbs	3.5 mkg
Drive gear on oil pump shaft, hex. nut (staked)	35 ft.lbs.	4.8 mkg
Cap screw of upper idler gear	65 ft.lbs.	9 mkg
Cap screw of lower idler gear	95 ft.lbs.	13 mkg
Timing gear cover to cylinder block and front plate	35 ft.lbs.	4.8 mkg

SPECIAL TOOLS

Part No. if ordered from JD Parts Depot	Manufacturer	Description	Use
L 48540	JD 252*	Driver	Driving in idler gear bushings
L 48529	JD 250*	Special tool	Driving crankshaft front oil seal in timing gear cover
L 48522	815*	Driving pin	To be used in conjunction with tools JD 252 and JD 250
L 48542	JD 254*	Timing tool	Timing gears of timing train

* SERVICE TOOLS INC., 1901 INDIANA AVENUE, CHICAGO, ILLINOIS 60616, USA

Group 30

OIL PUMP, OIL PRESSURE REGULATING VALVE AND OIL FILTER

GENERAL INFORMATION

LUBRICATION SYSTEM

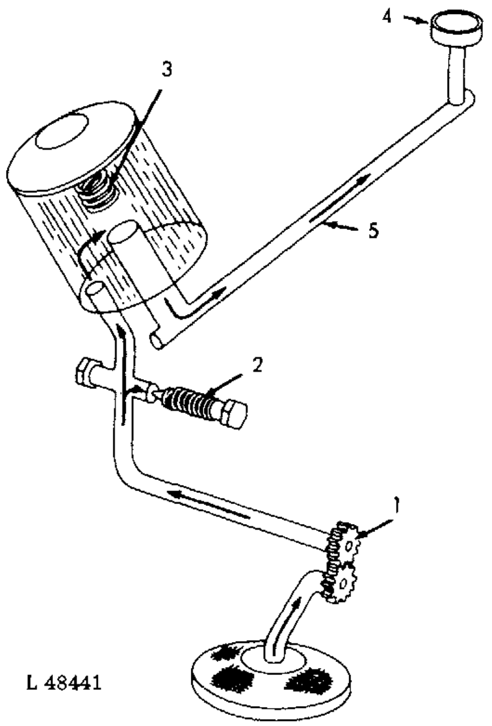


Fig. 1 — Engine Lubrication System

1 Oil pump
2 Oil pressure regulating valve
3 By-pass valve
4 Oil pressure sending unit
5 Main oil gallery

The engine has a pressure lubrication system. In the main it consists of the gear pump, filter strainer in the suction pipe, full flow oil filter, adjustable oil pressure regulating valve and the electrical oil pressure warning switch in the flywheel housing.

OIL PUMP AND OIL PRESSURE REGULATING VALVE

The pump draws the lubricating oil from the oil pan through a strainer and a suction line and pumps it through a pressure line to the oil filter and to the main oil gallery of the cylinder block. The pressure regulating valve is located at the front of the cylinder block. It is situated at the end of the gallery branching off the cylinder bore leading to the oil filter. It controls oil pressure before the oil enters the filter and it provides constant pressure in the main gallery and in the entire lubrication system.

The cone of the pressure regulating valve is pressed by a spring onto the replaceable valve seat in the cylinder block. This pressure spring is retained by means of a plug turned into the timing gear cover. The oil pressure can be adjusted by changing the number of shims between spring and plug. If oil pressure exceeds spring pressure, the cone is lifted from its seat and part of the oil may return to the oil pan via the timing case to maintain constant pressure.

OIL FILTER

The lubricating oil filter is located on the right-hand side of the cylinder block. As it is of the full-flow type, oil for lubricating the points connected with the main gallery flows through the filter. The element is integral with the filter housing and for this reason the entire filter must always be replaced. When the oil filter element no longer permits sufficient oil flow, the pressure relief valve opens, allowing oil to flow through (unfiltered). Thus excessive pressure build-up is avoided and lubrication of the engine is maintained.

DIAGNOSING MALFUNCTIONS

For diagnosing malfunctions, see group 5.

REMOVAL

OIL PUMP

Drain engine oil and remove oil pan.

Place a clean cloth between the teeth of the lower idler gear and the teeth of the oil pump gear.

Remove hex. nut which is secured by three center punch marks. Pull pump gear off the tapered seat on the pump shaft.

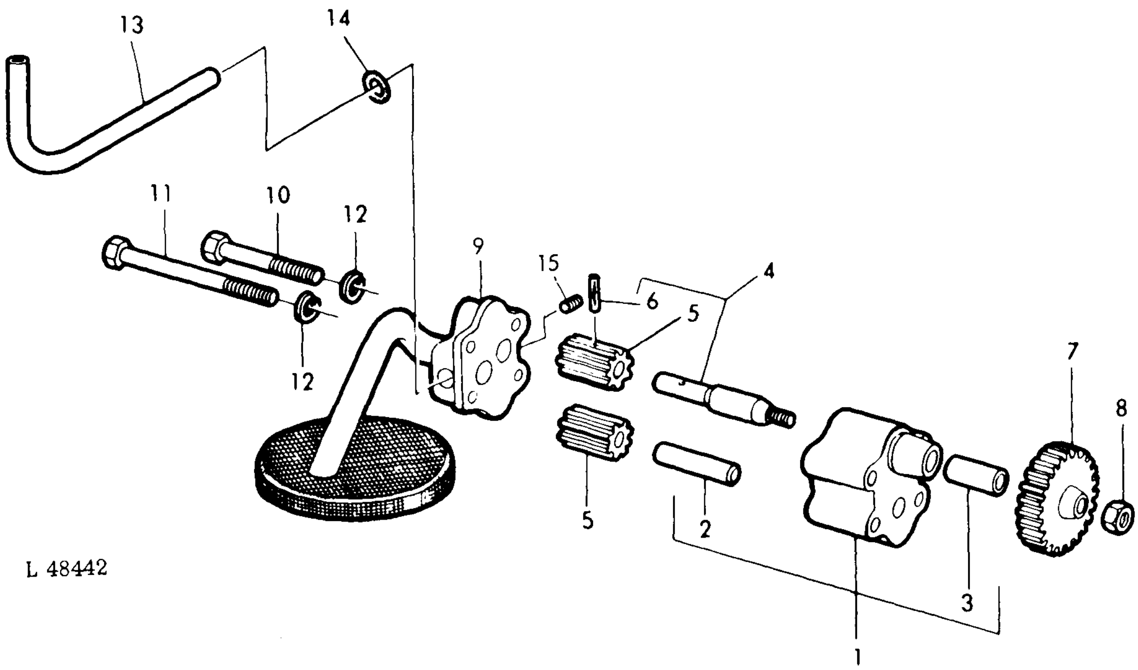


Fig. 2 — Oil Pump Assembly

1 Pump housing
2 Shaft for driven gear
3 Bearing bushing for pump shaft
4 Pump drive shaft
5 Pump gears
6 Groove pin
7 Gear on pump shaft
8 Hex. nut
9 Pump cover with suction pipe and strainer
10 Cap screw (3 used)
11 Cap screw
12 Spring washers
13 Pressure pipe
14 O-Ring
15 Plug

REPAIR

FOS

NOTE: For overall and detailed information on repair of the engine lubrication system see "Fundamentals of Service, Engines" manual.

DISASSEMBLY OF THE OIL PUMP

Pull drive shaft with gear out of pump housing.

Remove driven gear from shaft. Support pump housing by means of a pipe section and press shaft of driven gear out of the housing.

INSPECTION

Pump Housing and Shaft for Driven Gear

Check pump housing 1 (fig. 2) for distortion or cracks. Especially check sealing surface to which pump cover 9 attaches. Measure diameter of bearing bushing 3. Replace bushing if worn, or if not absolutely perfect. Drive in new bushing with special tools No. JD 253 and 813 so that it is flush with inside face of housing.

Check shaft 2 for serviceability; determine wear by measuring shaft diameter. Drive new shaft from cover side into pump housing 1 so that the shaft face is flush with sealing face of pump housing.

Pump Cover

Make sure that inner sealing face of pump cover 9 (fig. 2) is completely level, smooth and undamaged. This is important since the cover is not provided with any gaskets. The metal-to-metal sealing is achieved by means of the precision-machined sealing surfaces. For that reason these surfaces should be absolutely perfect.

Replace O-ring on outlet side. Make sure suction pipe is free of foreign matter and that the filter strainer is not blocked or damaged.

Pump Drive Shaft

Measure diameter of bearing area of pump drive shaft 4 (fig. 2).

NOTE: The pump drive shaft is only available as an assembly with the drive gear and the groove pin.

Pump Gears

Measure width of both pump gears 5 (fig. 2).

Install drive shaft with gear and driven gear. Measure clearance between gears and housing with a feeler gauge. Excessive clearance can only be corrected by replacing the components. Always replace gears 5 in pairs.

With both gears installed, place an exact straight edge on sealing face of housing and measure the clearance between faces of both gears and the straight edge with feeler gauge.

This dimension is equal to the end play of the gears in the pump housing (see Specifications).

Oil Pressure Regulating Valve

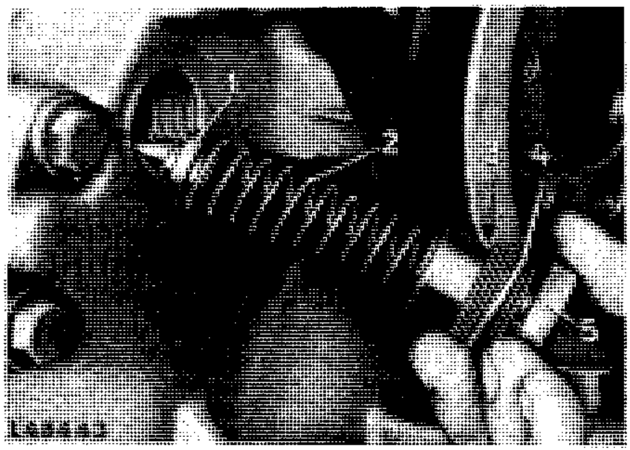


Fig. 3 — Oil Pressure Regulating Valve, Removed

1 Valve cone
2 Pressure spring
3 Shims
4 Aluminium washer
5 Plug

Turn plug 5 (fig. 3) out of timing gear housing and remove with all parts shown above.

Check valve cone 1 for excessive wear and damaged sealing face.

Check valve seat bushing in cylinder block for damage, especially the slightly protruding edge (sealing face) of the bushing.

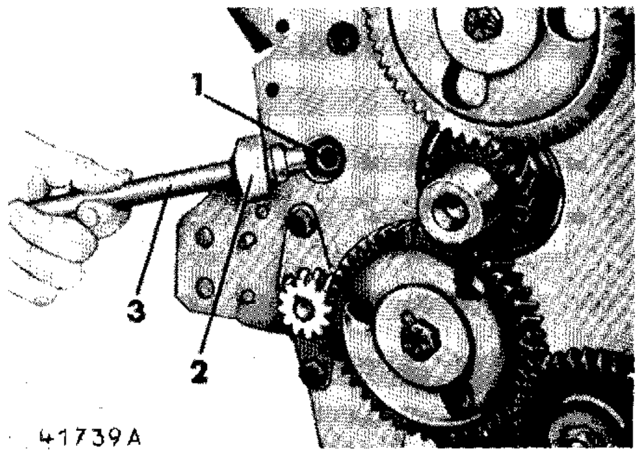


Fig. 4 — Driving in Valve Seat Bushing of Oil Pressure Regulating Valve

1 Bushing
2 Special tool No. JD 248
3 Special tool No. 813

Drive in a new bushing, using special tools No. JD 248 and No. 813 until driver contacts cylinder block.

CAUTION: Do not use other unsuitable means for this job and above all do not damage the slightly protruding edge of the bushing as it is a sealing surface.

Check condition and tension of valve spring (see Specifications).

Oil Filter

When in doubt regarding the effectiveness of the oil filter installed because of unusually dirty oil, replace oil filter.

Check that there is no foreign matter in the oil galleries of the cylinder block.

For replacing the oil filter fitting, see group 15.

ASSEMBLY OF OIL PUMP

Install pump shaft 4 with driving gear 5 in pump housing 1 as shown in fig. 2 and slide driven gear 5 on shaft 2. Turn the pump shaft to make sure that shaft and both gears move absolutely free in the housing.

Place a new O-ring 14 in oil outlet opening in pump cover 9.

INSTALLATION

OIL PUMP

Insert pump housing with gears and shaft installed through the bore of cylinder block front plate. Insert pressure pipe, attached to the pump cover, into the oil gallery of the cylinder block. Make sure that all sealing faces and the faces of both pump gears are perfectly clean. Place the pump cover on the housing by pivoting the pressure pipe in the cylinder block. Attach pump to cylinder block front plate, using cap screws. However, do not firmly tighten yet. Rotate pump shaft to make sure that shaft and gears move freely. If necessary, adjust by lightly tapping the housing. Tighten the four cap screws crosswise to the specified torque.

Install pump driving gear and tighten hex.nut to the specified torque. Secure nut by applying three center punch marks.

OIL PRESSURE REGULATING VALVE

Install all parts shown in fig. 3. As a preliminary adjustment, place the number of shims 3 found on disassembly between spring 2 and plug 5. Slide an aluminium washer 4 on the plug and tighten plug to the specified torque.

If necessary, add or remove shims when checking oil pressure (see Adjusting Engine Oil Pressure).

OIL FILTER
Install new oil filter (see Specifications)

After final installation, check oil filter connection for leakage with engine running. If necessary, retighten filter, but do not overtighten.

IMPORTANT: The full flow filter has a special by-pass valve (see fig. 1) to protect the engine when the filter element is blocked. Therefore, use only genuine John Deere filters.

ADJUSTING ENGINE OIL PRESSURE

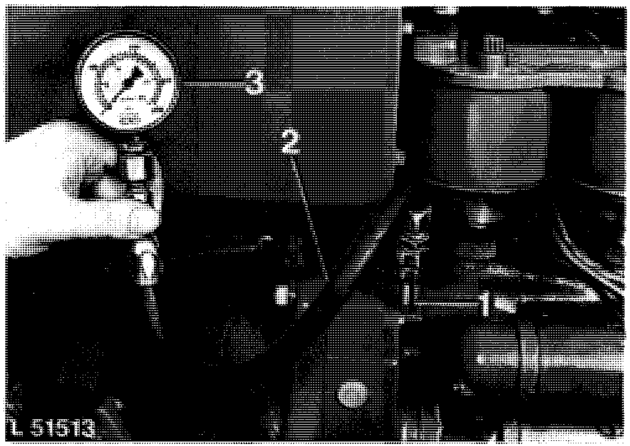


Fig. 5 — Checking Oil Pressure by Means of Pressure Gauge

1 Special adapter Nr. 19.58-90.267 of special tool No. 19.58-90.260
2 Pressure hose of special tool No. 19.58-90.260
3 Pressure gauge No. 19.58-90.268 of special tool No. 19.58-90.260

Adjust oil pressure as follows:

Check oil pressure by means of special tool 19.58-90.260. Connect pressure gauge instead of oil pressure warning switch to flywheel housing (see fig. 5).

Operate starter: the oil pressure warning lamp on the instrument panel will now light up. It will only go out when the engine has started and a minimum oil pressure has built up.

CAUTION: If the warning light is still on when the engine has run for 10 seconds, stop engine at once and check if shims have been installed between spring and plug of oil pressure regulating valve and if the plug has been provided with an aluminium washer.

Before checking the pressure, warm up engine to allow the lubricating oil to reach normal operating temperature.

At the rated engine speed the gauge should indicate the specified oil pressure (see Tune-Up Data).

To increase oil pressure, place as many shims between plug and spring of oil pressure regulating valve as are required to attain the required pressure.

CAUTION: However, do not use more than four shims.

To reduce the oil pressure, remove part or all of the shims located between plug and spring. Turn in plug with aluminium washer and measure pressure. If pressure is still too high, add a second washer.

SPECIFICATIONS

	Dimensions of new parts	Wear tolerance
OIL PUMP		
Bore for the drive shaft in pump housing (with bushing installed)	0.6315 bis 0.6335 in. 16.040 to 16.091 mm	0.0030 in. 0.08 mm
Diameter of the idler shaft	0.4850 to 0.4856 in. 12.319 to 12.334 mm	0.0005 in. 0.013 mm
Diameter of drive shaft journal	0.6295 to 0.6305 in. 15.989 to 16.015 mm	0.0010 in. 0.025 mm
Radial clearance between gears and pump housing	0.0010 to 0.0040 in. 0.025 to 0.1 mm	0.0050 in. 0.13 mm
Gear width	1.4163 to 1.4183 in. 35.974 to 36.025 mm	0.0020 in. 0.05 mm
Axial clearance between gears and pump cover	0.001 to 0.006 in. 0.025 to 0.15 mm	0.008 in. 0.2 mm

OIL FILTER

Screw filter onto fitting by hand until the rubber gasket just touches the cylinder block without compression. Then tighten filter another 1-1/2 turns for proper sealing.

OIL PRESSURE REGULATING VALVE

Spring of oil pressure regulating valve

Free length of spring	approx. 4.7 in. 119 mm
Spring pressure at a length of 1.68 in. (42.5 mm)	13.5 to 16.5 lbs. (6.1 to 7.5 kg)

TORQUES FOR HARDWARE

Oil pump assembly to cylinder block front plate	35 ft.lbs	4.8 mkg
Driving gear on oil pump shaft (nut secured by center punch marks)	35 ft.lbs	4.8 mkg
Oil pan to cylinder block and timing gear housing	35 ft.lbs	4.8 mkg
Oil pan to clutch housing, cap screws	170 ft.lbs	23.5 mkg
Plug of oil pressure regulating valve in timing gear housing	80 ft.lbs	11 mkg

TUNE-UP DATA

Oil pressure at 2500 rpm and normal operating temperature of engine and lubricating oil	50 to 60 psi	3.5 to 4.2 kg/cm^2

SPECIAL TOOLS

Part No. if ordered from JD Parts Depot	Manufacturer	Description	Use
L 48541	JD 253*	Driver	Driving in bearing bushing of lubricating oil pump
L 48527	JD 248*	Driver	Driving in bushing of oil pressure regulating valve
L 48521	813*	Driving pin	Sliding on the above tools
19.58-90.260**		Special tool	Measuring oil pressure

* SERVICE TOOLS INC., 1901 INDIANA AVENUE, CHICAGO, ILLINOIS 60616, USA
** Details see section 70, group 5.

Group 35
ENGINE COOLING SYSTEM

GENERAL INFORMATION

COOLING SYSTEM

The pressure cooling system includes mainly the radiator, the water pump, the multi-blade fan and the thermostat.

The pump sucks cooled water from the radiator and pumps it through a passage integral with the pump housing to the cylinder block. After the coolant has passed the cylinder liners, it flows through the cylinder head to the thermostat housing where the thermostat is located. With the engine hot, the thermostat is open and the coolant returns to the radiator. If the engine has not yet reached operating temperature, the thermostat remains closed; the coolant flows from the manifold through a by-pass hose back into the water pump (suction side). In this case it only circulates through the engine and the pump. This way the coolant temperature is automatically regulated by the thermostat. For observing the coolant temperature, a temperature gauge is provided on the dashboard.

RADIATOR

The radiator is of the conventional design with cooling tubes through which the coolant passes and with soldered exterior cores.

The filler neck of the radiator is provided with a filler cap with built-in relief valve.

THERMOSTAT

The thermostat is located in a housing attached to the cylinder head and is available in several types to suit different operating conditions. These thermostats open at varying temperatures of the coolant (see Specifications).

WATER PUMP

The coolant is circulated by means of a centrifugal-type pump which is mounted on the front of the cylinder block. The pump is driven by the V-belt which also drives the generator and the fan, from the crankshaft. The pump shaft runs in a pre-lubricated special bearing. The pump housing is sealed against the bearing with a seal ring. If this seal ring leaks, water escapes through a bore in the pump housing (see "c", fig. 1).

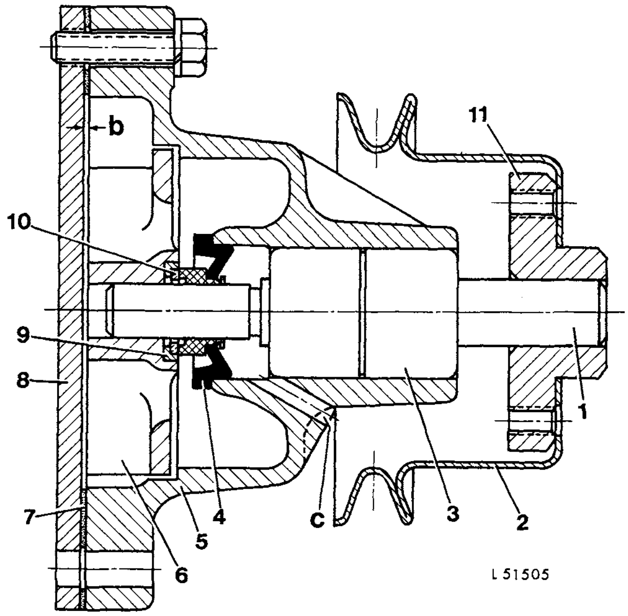


Fig. 1 — Water Pump, Sectional View

1 Pump shaft
2 V-belt pulley
3 Pump shaft bearing
4 Seal ring
5 Pump housing
6 Impeller
7 Seal
8 Cover
9 Rubber cap
10 Ceramic washer
11 Fan securing plate
b Clearance
c Drain hole

DIAGNOSING MALFUNCTIONS

ENGINE OVERHEATED

Causes see group 5.

WATER PUMP LEAKING

Seal ring or pump shaft worn

COOLANT TEMPERATURE BELOW NORMAL

Thermostat defective

Coolant temperature gauge defective.

ENGINE VIBRATING

Fan blades bent

Pump shaft worn

REPAIR

RADIATOR

Radiator repairs should only be made in specialised repair shops. If radiator leaks and source of leak cannot be determined visually, proceed as follows:

Install radiator cap and plug top hose connection. Attach pressure air hose to bottom radiator inlet. Submerge radiator in clean tank filled with clear water. Put radiator under pressure (see Specifications). Check radiator pressure cap, especially gasket and spring, if still usable. The seal must fit tightly and feel soft. Replace unserviceable radiator cap.

ADJUSTING FAN BELT

For specified flex with a given amount of pull on the fan belt, see Specifications.

WATER PUMP

Drain coolant and remove radiator. Remove fan, V-belt pulley and water pump.

Disassembly of Water Pump

Remove rear cover 8 (fig. 1) and gasket 7. Discard gasket.

Remove fan securing plate 11 with a standard puller from the pump shaft.

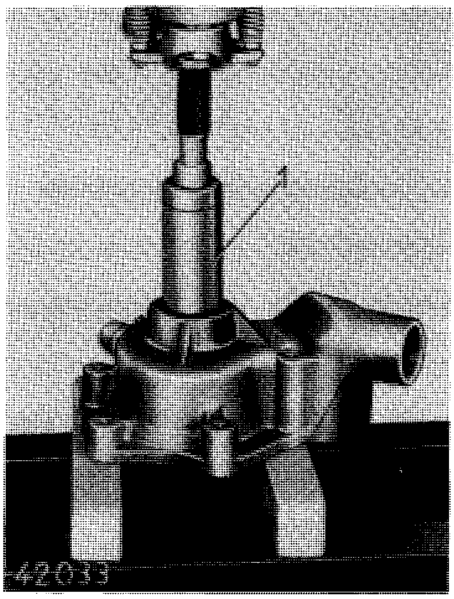


Fig. 2 — Driving Out Ball Bearing With Pump Shaft, Seal Ring and Impeller, Using Special Tool No. JD 262

1 Special Tool No. JD 262

Support pump housing under a press, allowing sufficient clearance for impeller. Using special tool No. JD 262, press bearing assembly together with pump shaft, seal ring and impeller from pump housing (see fig. 2).

NOTE: Instead of the special tool No. JD 262 a suitable tube section can be used which contacts only the bushing-shaped race of the bearing.

Press pump shaft with special support bearing and seal ring out of impeller, using a press and a suitable tool. Pull seal ring off the shaft.

NOTE: Remove ceramic washer (see 10, fig. 1) from the impeller bore, and also remove rubber cap 9.

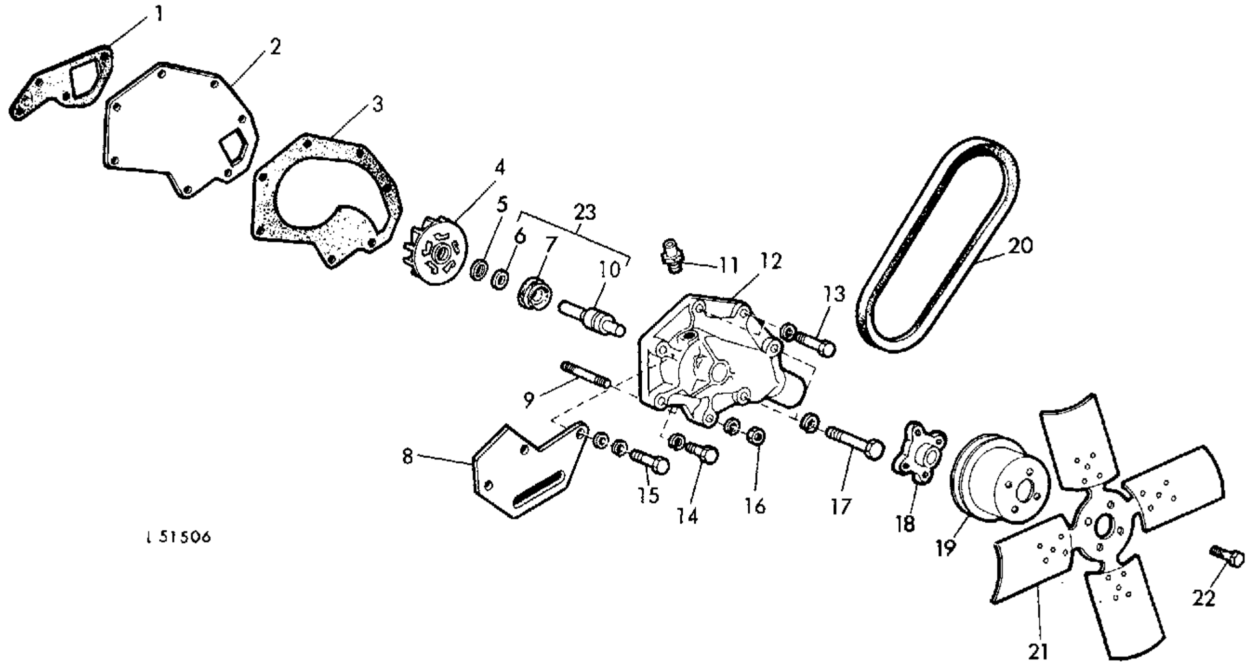


Fig. 3 — Water Pump Assembly

1 Gasket
2 Rear cover
3 Gasket
4 Impeller
5 Rubber cap
6 Ceramic washer
7 Special seal ring
8 Adjusting strap
9 Stud
10 Pump shaft with bearing
11 Elbow
12 Pump housing
13 Cap screw (2 used)
14 Cap screw
15 Cap screw
16 Hex. nut
17 Cap screw (2 used)
18 Fan securing plate
19 V-belt pulley
20 Fan belt
21 Fan
22 Cap screw (4 used)
23 Repair set

Checking the Water Pump

If coolant drains from bore "c" during operation (see fig. 1), this generally indicates a faulty seal ring 4 (fig. 1).

Check all parts for wear and replace, if necessary.

Apart from the various spare parts (see fig. 3), a repair set is available (see 23, fig. 3), consisting of ceramic washer 6, special seal ring 7, and pump shaft 10 with bearing.

Check rubber cap 5 and replace, if necessary.

Assembly of Water Pump

Place pump housing (open side first) on a press and drive bearing assembly with pump shaft into pump housing until bearing face is flush with the hub face.

CAUTION: To do this, use special tool No. JD 262 or a suitable tube section that contacts only the bushing-shaped race of the bearing (see fig. 2).

Install special seal 7 (fig. 3) in pump housing, open side facing upward (see fig. 1).

Install ceramic washer in rubber cap so that unpolished side of washer provided with a V-groove faces the rubber cap. Make sure that all parts are dry and clean.

Dip rubber cap and ceramic washer in oil and insert in impeller bore (rubber cap should bottom on bore). The ceramic washer should be flush with the impeller face.

After installation in the impeller, the folded portion of the rubber cap should equally surround the ceramic washer.

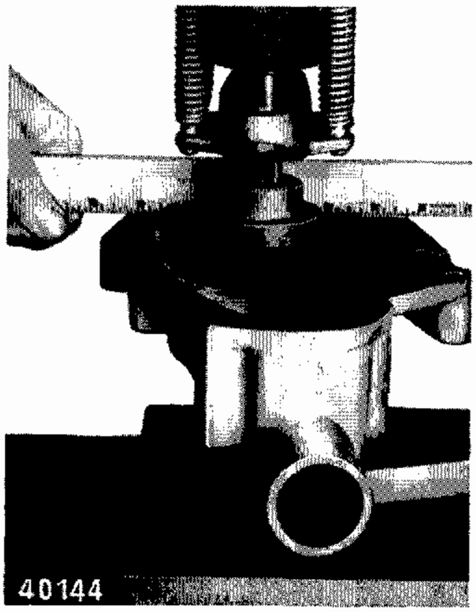


Fig. 4 — Pressing Impeller on Pump Shaft and Checking Clearance from Housing Sealing Face.

Place pump housing with shaft installed under a press and support on pump shaft.

Press impeller on pump shaft until clearance "b" (fig. 1), within a given tolerance, is flush with the pump housing face (see Specifications).

Check this clearance by means of a perfect straight edge (see fig. 4).

Place water pump under a press so that the thrust from pressing on the fan securing plate 18 (fig. 3) is received only by the pump shaft face.

Place fan securing plate on pump shaft with the plate hub facing the press. Press on to shaft until shaft face is flush with hub face (see fig. 1).

Attach pump cover to pump housing, using a new gasket, and tighten cap screws to the specified torque. Install water pump, placing a new gasket between pump cover and cylinder block. Tighten screws to the specified torque.

Install radiator.

INSPECTING THERMOSTAT

If the engine remains too cool (possibly due to the thermostat not closing properly or leaking) or gets too hot (due to the thermostat not opening), check thermostat thoroughly. If no exterior damage or defects can be found, place thermostat in hot water of suitable temperature (see opening temperatures, Specifications) and observe whether the valve starts to open properly.

CAUTION: The opening value applies to normal altitude. In higher altitudes this temperature is correspondingly lower. After the thermostat has cooled off, the valve should close again. If necessary, check against a new thermostat. If in doubt, do not hesitate to replace the thermostat.

SPECIFICATIONS

RADIATOR

Capacity of cooling system	2.3 Imp. (2.75 US) gals	10.5 lit.
Relief valve of radiator filler cap opens at a pressure of	6.25 to 7.5 psi	0.44 to 0.53 kg/cm^2
Radiator test pressure	7 psi	0.5 kg/cm^2

THERMOSTAT

Thermostat for hot climate or permanent full load operation opens at	180° F	82° C
Thermostat for normal operation opens at	194° F	90° C
Thermostat for light operating conditions opens at	205° F	96° C

WATER PUMP

Clearance between impeller and cover (see fig. 1, dim. "b")	±0.005 in.	±0.12 mm

FAN BELT

The fan belt should have 0.75 in. (19 mm) flex with 20 lbs (9 kg) pull midway between crankshaft and generator or water pump (use a spring scale).

TORQUES FOR HARDWARE

Flanged cover to thermostat housing	20 ft.lbs.	2.75 mkg
Cover to water pump housing	35 ft.lbs.	4.8 mkg
Fan to securing plate	20 ft.lbs.	2.75 mkg

SPECIAL TOOLS

Part number if ordered from JD Parts Depot	Manufacturer	Description	Use
L 48535	JD 262*	Special tool	Installation and removal of pumpshaft bearing

* SERVICE TOOLS INC., 1901 INDIANA AVENUE, CHICAGO, ILLINOIS 60616, USA

Group 40
SPEED CONTROL LINKAGE

GENERAL INFORMATION

The desired speed is selected by means of the hand or foot throttle. The position of these levers controls — through the governor on the injection pump — the amount of fuel being injected into the cylinders.

The hand throttle shaft is self-locking: two spring-loaded friction disks keep the hand lever in the position selected.

With engine running at slow idle speed, the stop 4 (fig. 1) of the hand throttle contacts the dashboard. When turning the hand throttle in a clockwise direction to its stop, stop screw 2 contacts the dashboard, and engine speed is increased to maximum rpm.

The engine is stopped by means of a shut-off cable. One end of the cable is connected to the injection pump stop lever, the other to a knob in the dashboard.

CAUTION: Never stop engine by turning off the fuel shut-off valve. Otherwise injection pump will run dry and the internal parts will be damaged.

REMOVAL AND DISASSEMBLY

HAND THROTTLE ASSEMBLY

Remove right-hand cowl.

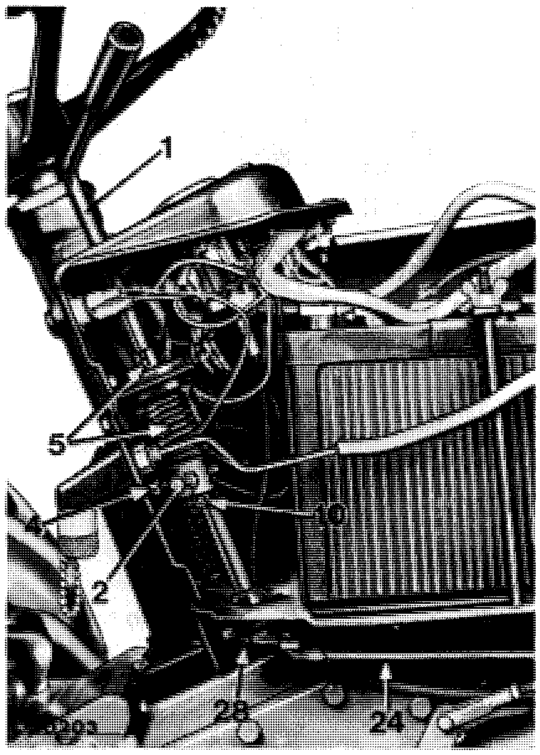


Fig. 1 — Removing Hand Throttle Assembly

1 Hand throttle
2 Fast idle stop screw
4 Slow idle stop screw
5 Groove pins
10 Groove pin
24 Connecting rod
28 Spring pin

NOTE: Numbers behind parts in the following text refer to figs. 1 and 2.

Disconnect *rod* 24 from arm 27 and speed control arm 22.

Drive out spring pin 28 securing arm 27 to hand throttle 1 and remove arm.

Drive groove pin 10 out of stop 12 and hand throttle. Push down stop 12 and spring 7 and drive both groove pins 5 out of hand throttle.

Lift hand throttle out of dashboard and remove all parts located on throttle.

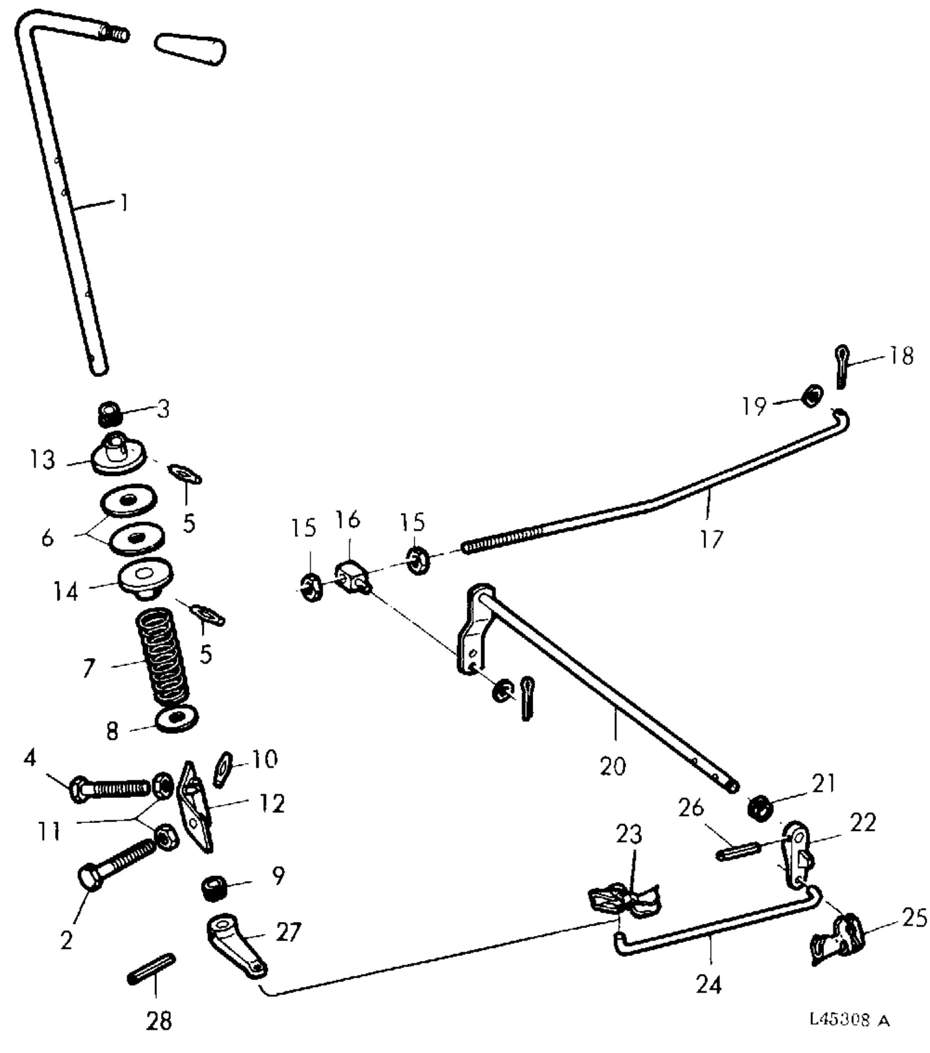


Fig. 2 — Parts of Hand Throttle Assembly

1 Hand throttle	8 Washer	15 Hex. nuts	22 Speed control arm
2 Fast idle stop screw	9 Bushing	16 Swivel	23 Retainer
3 Bushing	10 Groove pin	17 Speed control rod	24 Connecting rod
4 Slow idle stop screw	11 Jam nuts	18 Cotter pin	25 Clip
5 Groove pins	12 Stop	19 Washer	26 Spring pin
6 Friction disks	13 Upper disk	20 Shaft	27 Arm
7 Spring	14 Lower disk	21 Bushing (2 used)	28 Spring pin

FOOT THROTTLE

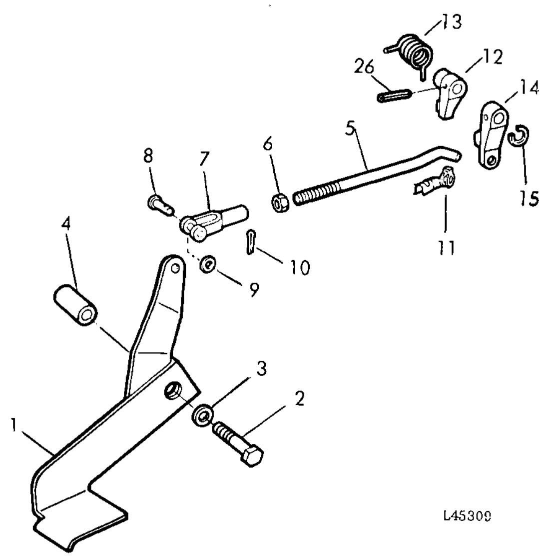


Fig. 3 — Parts of Foot Throttle Assembly

1 Foot throttle
2 Cap screw
3 Washer
4 Spacer
5 Rod
6 Jam nut
7 Yoke
8 Headed pin
9 Washer
10 Cotter pin
11 Clevis
12 Speed control arm
13 Return spring
14 Speed control arm
15 Snap ring
26 Spring pin

Remove parts of foot throttle as shown in fig. 3.

SHAFT WITH ARM 20 AND SPEED CONTROL ROD 17 (Fig. 2)

NOTE: On tractors with foot throttle, the speed control arm 12 (fig. 3) is connected by means of spring pin 26.

On tractors without foot throttle, the speed control arm 22 (fig. 2) is attached to the shaft with arm 20 by means of the spring pin 26.

Disconnect linkage, remove lever and arm from shaft and withdraw shaft from its two bushings on left-hand side of tractor.

SHUT-OFF CABLE

Disconnect shut-off cable from injection pump and dashboard. Remove shut-off cable.

REPAIR

Inspect rods and levers of speed control linkage for cracks or distortion. Check linkage for binding, excessive play or any damage which could result in insufficient engine performance.

ASSEMBLY AND INSTALLATION

For assembly and installation of speed control linkage, reverse removal procedure as shown in fig. 1 through 3.

ADJUSTING SPEED CONTROL LINKAGE

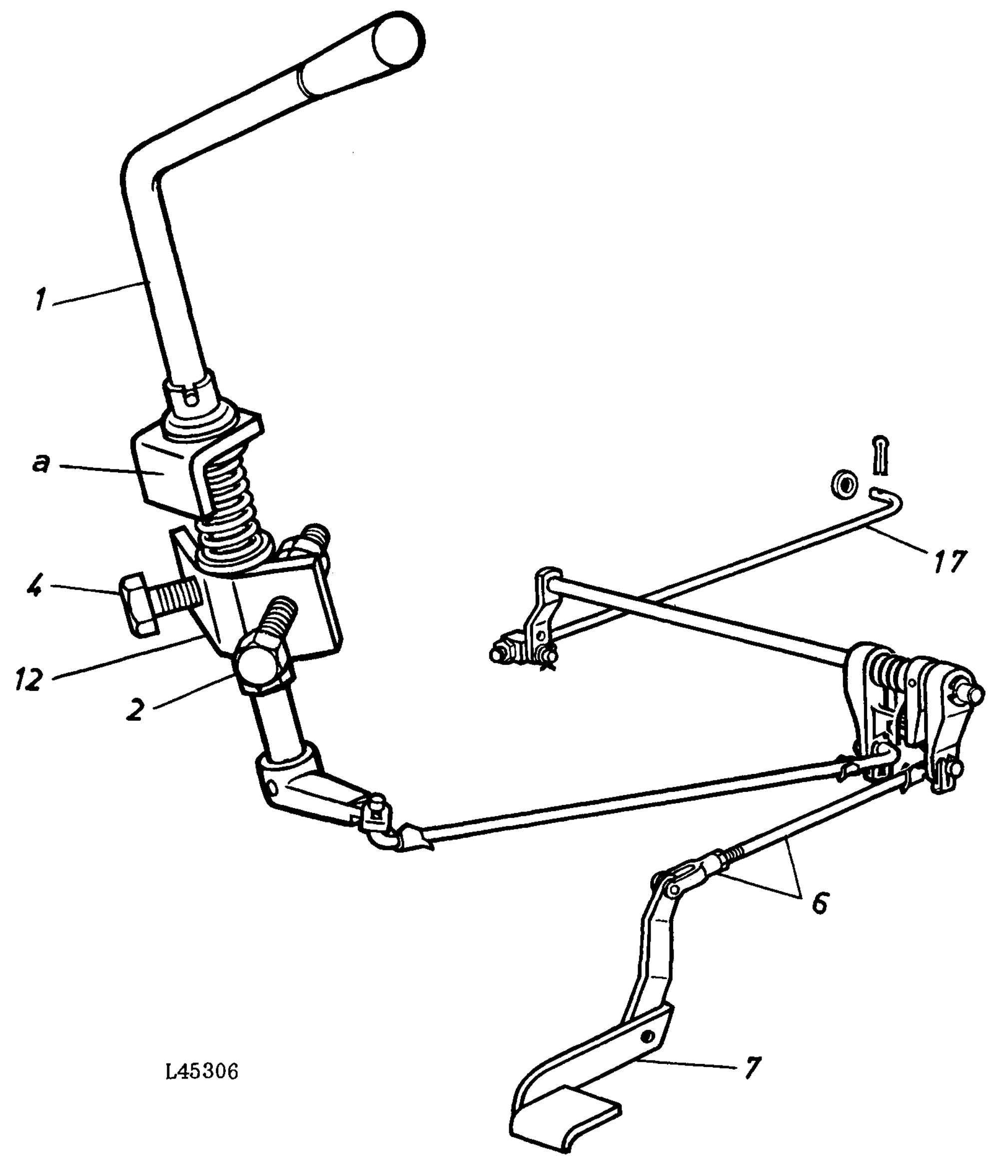


Fig. 4 — Speed Control Linkage

a Angle (welded onto dashboard)
1 Hand throttle
2 Fast idle stop screw
4 Slow idle stop screw
6 Rod of foot throttle
7 Foot throttle
12 Stop
17 Speed control rod

NOTE: Before adjusting engine speed, make sure engine has reached its normal operating temperature. The engine speed at any one moment will be shown on the tractor tachometer. For a more accurate examination it is recommanded to determine powershaft speeds by means of a commercial master gauge. The respective engine speeds are indicated in section 10, group 5.

All speeds indicated apply to an engine not under load. The maximum permissible speed variation is ±20 rpm.

Make all speed adjustments in the order shown below.

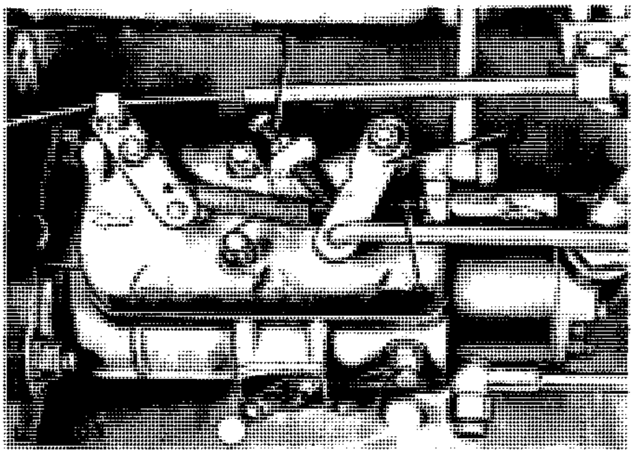


Fig. 5 — ROTO DIESEL Injection Pump, Installed

1 Slow idle stop screw
2 Fast idle stop screw
3 Pump throttle lever

1. Disconnect speed control rod at injection pump.

2. Move pump throttle lever 3 (fig. 5) against pump stop screw 2 for fast idle.

Now engine speed should be 2650 rpm.

If this is not the case, adjust pump stop screw 2 for fast idle and lead-seal screw.

3. Move pump throttle lever in slow idle position against the stop screw. Engine speed should now be 650 rpm. If not, adjust pump stop screw 1 for slow idle accordingly.

Adjusting Hand Throttle

4. Make sure speed control rod is still disconnected from pump throttle lever. Move speed control lever first clockwise and then counterclockwise to the stop. Now adjust speed control rod, if necessary, so that it can easily be attached to the pump throttle lever when the latter is in that position where the engine just starts to pick up speed. Then increase effective length of speed control rod by backing off the rear hex. nut two full turns. In this position, tighten front hex. nut and attach speed control rod to pump throttle lever.

5. Move hand throttle clockwise to the stop (fast idle speed). The engine speed should now be 2650 rpm.

If this is not the case, adjust fast idle stop screw 2 (fig. 4) located in stop 12 (fig. 4) of dashboard accordingly.

Adjusting Foot Throttle

6. Depress foot throttle until it contacts the footrest. Engine speed should now be 2650 rpm.

If this is not the case, adjust effective length of foot throttle rod 6 (fig. 4) accordingly.

Adjusting Shut-Off Cable

7. Completely push in shut-off knob and make sure there is no gap between shut-off lever of pump and its stop. If shut-off lever is not in contact, disconnect steel cable at injection pump and pull slightly rearward so there will be a gap between the knob and the retainer fastened to the dashboard.

Push pump shut-off lever by hand against the stop and attach steel cable. To check, run engine until hot. Pull out shut-off knob as far as possible and make sure engine stops quickly.

SPECIFICATIONS

Low idle speed	'650 rpm.
Fast idle speed	2650 rpm.

Section 30
FUEL SYSTEM

CONTENTS OF THIS SECTION

Printed in Germany

Group 5

DIAGNOSING MALFUNCTIONS

FUEL NOT REACHING INJECTION NOZZLES

Fuel filters clogged
Fuel line clogged or restricted
Fuel transfer pump pressure too low
Air in fuel system
Fuel tank shut-off valve closed
Fuel return line restricted

ENGINE STARTS HARD OR WON'T START

Water, dirt or air in fuel system
Fuel filters clogged
Shut-off knob stuck
Fuel lines clogged or restricted
Injection nozzles dirty or faulty
Injection pump faulty
Fuel transfer pump faulty
Fuel tank shut-off valve closed
Incorrect timing

ENGINE STARTS AND STOPS

Water in fuel
Filters clogged
Air in fuel system
Fuel lines clogged or restricted
Injection pump fuel return line damaged

ERRATIC ENGINE OPERATION

Filters clogged
Air in fuel system
Injection nozzles faulty or dirty
Fuel lines clogged or restricted
Incorrect timing
Water in fuel
Injection pump fuel return line restricted
Injection nozzle return line clogged

ENGINE IDLES POORLY

Air leak in fuel system
Injection nozzles dirty or faulty
Incorrect timing
Automatic advance or injection pump faulty or not operating
Fuel lines clogged or restricted
Water in fuel
Injection pump return line restricted
Injection nozzle return line clogged

ENGINE DOES NOT DEVELOP FULL POWER

Air cleaner restricted
Incorrect timing
Automatic advance of injection pump faulty or not operating
Fuel filters clogged
Injection nozzle return line clogged
Injection nozzles faulty or sticking
Injection pump return line restricted
Injection pump housing is not full of fuel
Water in fuel

ENGINE SMOKES BLACK OR GREY

Injection nozzles faulty or sticking
Incorrect timing
Automatic advance of injection pump faulty or not operating
Air cleaner element clogged or dirty

ENGINE SMOKES BLUE OR WHITE

Cranking speed too low
Incorrect timing
Automatic advance of injection pump faulty or not operating
Injection nozzles faulty or sticking
Excessive wear in liners and/or stuck piston rings
Engine does not get hot

Group 10
FUEL TANK, TRANSFER PUMP, FUEL FILTERS

FUEL TANK

GENERAL INFORMATION

The fuel tank is located in front of the radiator, between the front plate and the two side grille screens. The fuel gauge sending unit is attached to the right-hand side of the tank. The fuel shut-off valve is located at the bottom of the tank. The fuel tank filler cap is vented for safety.

REMOVAL

Remove both radiator grilles and hood.

Disconnect line at fuel gauge sending unit (see 8, fig. 1).

Remove air cleaner and hydraulic oil reservoir 7.

Close fuel shut-off valve.

Disconnect fuel inlet line as well as return line 1 at tank.

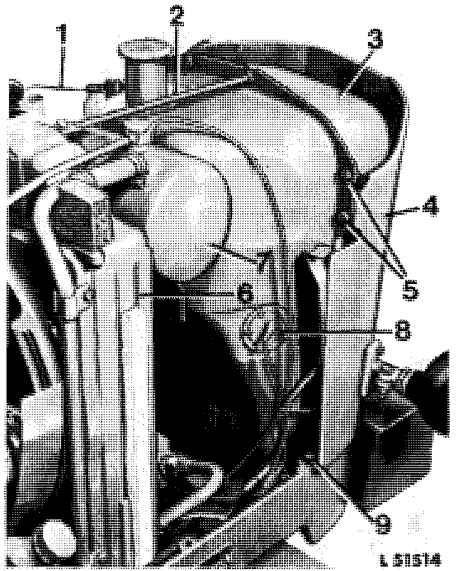


Fig. 1 — Installed Fuel Tank

1 Fuel return line
2 Rod
3 Fuel tank
4 Front cover
5 Cap crews
6 Radiator
7 Hydraulic oil reservoir
8 Fuel gauge sending unit
9 Cap screws

Disconnect rod (see 2, fig. 1) at fuel tank. Loosen rod screws on radiator and swing rod away. Remove cap screws 5 on both sides. Loosen both cap screws 9, slide stops backward and lift fuel tank off tractor.

REPAIR

Inspect seal rings and other tank parts for serviceability. When removing fuel gauge sending unit, take care of the float.

If filler cap is unserviceable, replace only with a genuine JOHN DEERE filler cap.

CAUTION: Cleaning and repairing a fuel tank is very dangerous. Do not smoke or permit live sparks or fire of any nature in the vicinity while cleaning or repairing a tank.

When installing the sending unit, make sure float can freely move up and down vertically.

FOS *NOTE: Description of fuel tank repair operations see "Fundamentals of Service - Engines" manual.*

INSTALLATION

When installing the fuel tank, reverse removal procedure. After filling the tank with fuel, bleed the fuel system.

NOTE: After installing fuel tank and tightening the four cap screws (see 5, fig. 1), press both fuel tank stops against tank flange. Tank must then be flush against front axle support. Hold stops in this position and tighten cap screw 9.

TRANSFER PUMP

GENERAL INFORMATION

The fuel transfer pump is a diaphragm-type pump driven by the engine camshaft and attached to the right-hand side of the engine.

The pump can be operated manually, e.g. for bleeding the fuel system. Fuel is fed from the fuel tank through a line. The pump transfers the fuel through the dual filter to the injection pump.

DIAGNOSING MALFUNCTIONS

NO FUEL, OR ONLY A LITTLE, FLOWS

Pump primer lever on upper end of stroke

Leaking pump bowl seal ring

Plugged fuel screen inside pump fuel bowl

Clogged fuel inlet line

Fuel line loose or damaged

Loose cover screws on pump

If correction of the above troubles does not produce a satisfactory flow, the pump is defective and must be replaced or overhauled.

REMOVAL

Close fuel shut-off valve at tank. Disconnect fuel lines. Remove both cap screws and take away complete transfer pump. Plug opening on cylinder block to protect it from foreign matter.

REPAIR

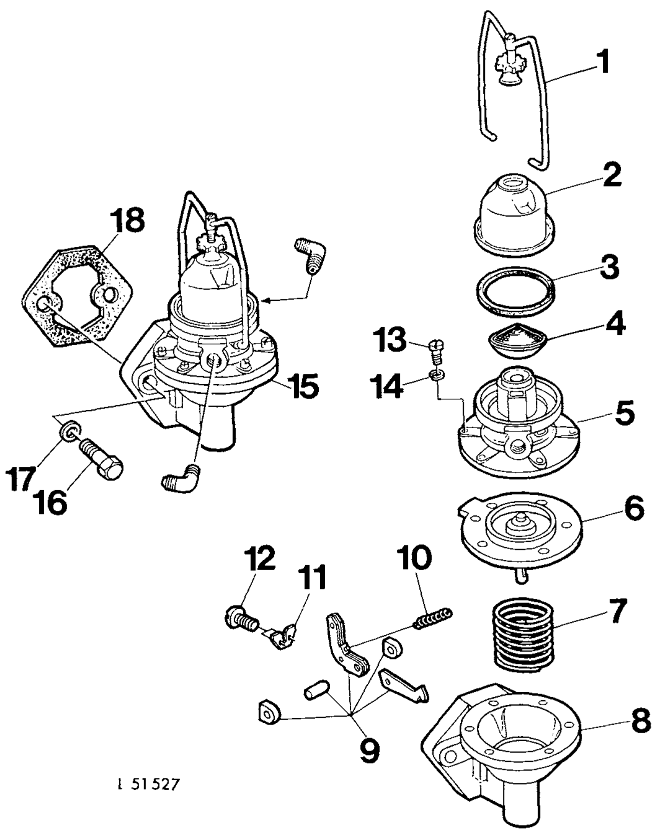


Fig. 2 — Fuel Transfer Pump - Exploded View

1 Bail
2 Bowl
3 Seal ring
4 Screen
5 Pump cover
6 Diaphragm
7 Diaphragm spring
8 Pump body
9 Rocker arm and bearing parts
10 Spring
11 Retainer
12 Button-head screw (2 used)
13 Machine screw (6 used)
14 Spring washer (6 used)
15 Complete pump
16 Cap screw (2 used)
17 Washer (2 used)
18 Gasket

Disassemble transfer pump as shown in fig. 2. When disassembling, mark pump cover 5 and pump body 8 for easier reassembly.

Test all parts for serviceability and replace, if necessary.

Apart from various parts (see fig. 2) three repair sets are available:

1. A repair set consisting of parts 3, 6, 7, 10 and 18 (see fig. 2).

2. A repair set for replacing the rocker arm and bearing parts (see 9, fig. 2).

3. A repair set for overhauling the pump, consisting of parts 1 through 14 (see fig. 2), equivalent to the complete pump 15.

Assemble transfer pump as shown in fig. 2, observing the following:

1. Make sure diaphragm is engaged in rocker arm.

2. Before installing the pump cover, position diaphragm so that it is level by moving rocker arm. Hold lever in this position.

3. Install pump cover and cover screws. However, turn in screws so that they just contact the lock washers. Operate rocker arm several times, then release with a snap to make sure that diaphragm will not be overstretched when in use. Tighten cover screws crosswise.

INSTALLATION

Using a new gasket, attach transfer pump to cylinder block. Connect lines and open fuel shut-off valve. Bleed fuel system.

FILTERS

ROTO-DIESEL FUEL FILTER

GENERAL INFORMATION

The ROTO-DIESEL dual-stage fuel filter has a 1st and 2nd stage which are connected in series. The 1st stage is provided with a screen for removing coarse dirt. Both filters have a paper cell filter element each to retain fine dirt. The fuel flow is indicated by arrows in fig. 3.

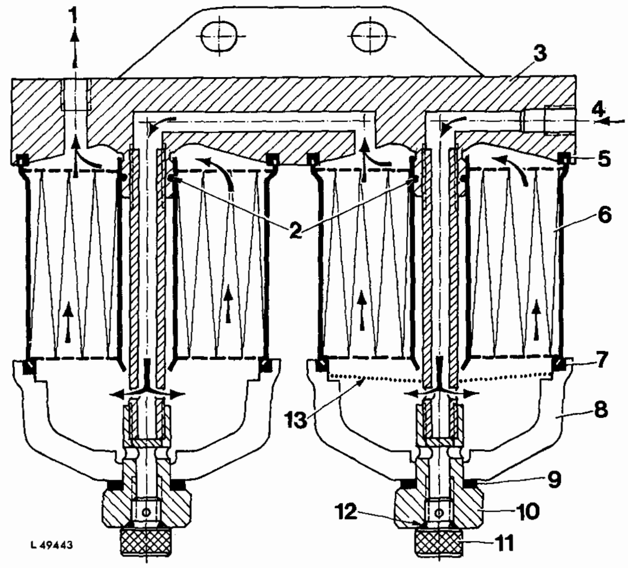


Fig. 3 — ROTO-DIESEL Dual Stage Fuel Filter - Sectional View

1 Fuel outlet	5 Seal ring	9 Seal ring
2 O-Rings	6 Filter element	10 Stud screw
3 Filter cover	7 Seal ring	11 Drain plug
4 Fuel inlet	8 Sediment bowl	12 O-ring (3 used)
		13 Screen

REPAIR

NOTE: For proper servicing of dual-stage fuel filter see Operator's Manual.

Replace filter elements or complete cartridges at the specified service intervals (see Operator's Manual).

If the cartridge of the 1st stage filter with element 6 (fig. 3) is replaced, clean screen 13 and sediment bowl 8 carefully. New seal rings 5 and 7 will be supplied with the cartridge. Replace O-rings 2 of filter cover, if required. Check all other parts for serviceability and replace, if necessary. Before installing a filter cartridge, tighten stud screw 10 fingertight. Check for leakage before starting operation.

Bleed fuel system.

Dry-type Air Cleaner

GENERAL INFORMATION

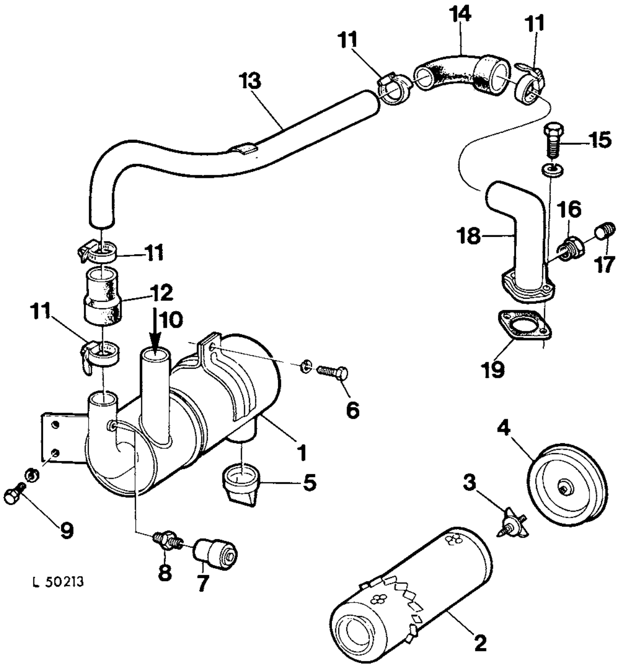


Fig. 4 — Dry-type Air Cleaner

1 Air cleaner housing
2 Filter element
3 Wing nut
4 Filter cover
5 Dust unloading valve
6 Cap screw
7 Restriction indicator
8 Connector
9 Cap screw (2 used)
10 Air intake neck
11 Hose clamps
12 Hose section
13 Pipe
14 Hose section
15 Cap screw (2 used)
16 Adapter
17 Plug
18 Intake manifold
19 Gasket

Under the influence of the suction generated by the engine, the intake air flows through intake pipe 10 (fig. 4) into the filter, past the fins of filter element 2. The filter element fins collect coarse dirt which is then stored in dust unloading valve 5. The intake air now passes through filter element 2 where fine dirt is retained, and is finally sucked in by the engine.

A restriction indicator 7 located in the outlet manifold indicates the degree of pollution by means of a red warning signal (see Operator's Manual).

FOS D *NOTE: For a detailed explanation of the dry-type air cleaner see "Fundamentals of Service — Engines" manual.*

REPAIR

FOS D *NOTE: For servicing and cleaning of dry-type air cleaner see Operator's Manual and "Fundamentals of Service—Engines" manual.*

Check air intake line, especially hoses between air cleaner and intake manifold for proper condition and tight connections.

CAUTION: Do not operate engine without filter element or dust unloading valve.

INSPECTING THE AIR INTAKE SYSTEM

After the filter element has been cleaned, check system for restrictions which could inhibit the free flow of air. Use a commercial vacuum gauge with a range of up to 40 in. (1000 mm) water head.

Proceed as follows:

Remove starting aid adapter or plug from intake manifold and connect vacuum gauge.

Operate engine at fast idle.

If the air cleaner is not restricted, the gauge should show a vacuum of approx. 14 in. (355 mm) water head. However, it should not exceed 25 in. (635 mm). If this happens, the free flow of air is restricted. Find and remove the cause of restriction.

OIL-BATH AIR CLEANER

GENERAL INFORMATION

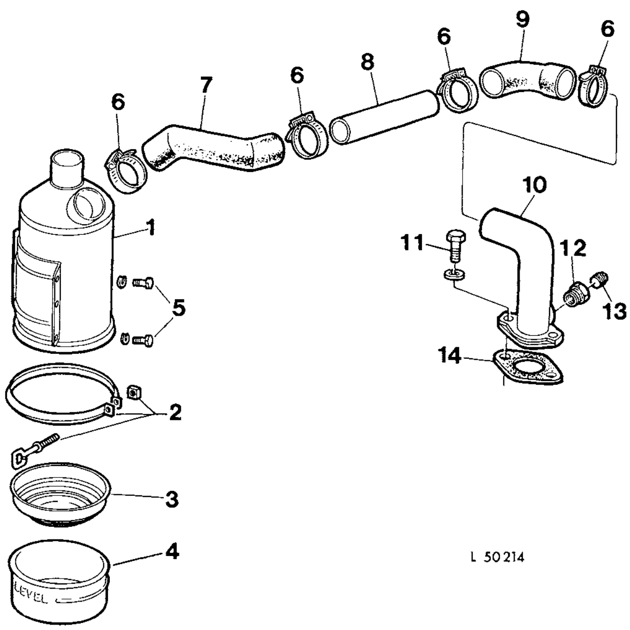


Fig. 5 — Oil-Bath Air Cleaner — Exploded View

1	Oil bath air cleaner	8	Pipe
2	Clamp	9	Hose section
3	Element	10	Intake manifold
4	Oil cup	11	Cap screw (2 used)
5	Cap screws (3 used)	12	Connector
6	Hose clamps	13	Plug
7	Hose bend	14	Gasket

The oil-bath air cleaner consists essentially of the filter body with intake and outlet tubes, the wiremesh filter element and the removable oil cup with the oil bath.

Dusty air passes through the center tube into the oil cup where most of the heavier particles are deposited, forming the sludge. The direction of the air flow is then reversed, carrying along smaller particles and oil droplets. Both are trapped in the oil-saturated wire filtering element.

FOS *NOTE: For a detailed explanation of oil-bath air cleaner operation see "Fundamentals of Service — Engines" manual.*

CAUTION: Open oil-bath air cleaner only with the engine stopped!

REPAIR

FOS *NOTE: For servicing and cleaning of oil-bath air cleaner see Operator's Manual and "Fundamentals of Service — Engines" manual.*

Inspect air intake line, especially hose sections between air cleaner and intake manifold for proper condition and air-tight connections.

CAUTION: Do not operate engine with the air cleaner oil cup loose or removed.

CHECKING AIR INTAKE SYSTEM

See "Dry-type Air Cleaner".

Group 15
ROTO-DIESEL FUEL INJECTION PUMP

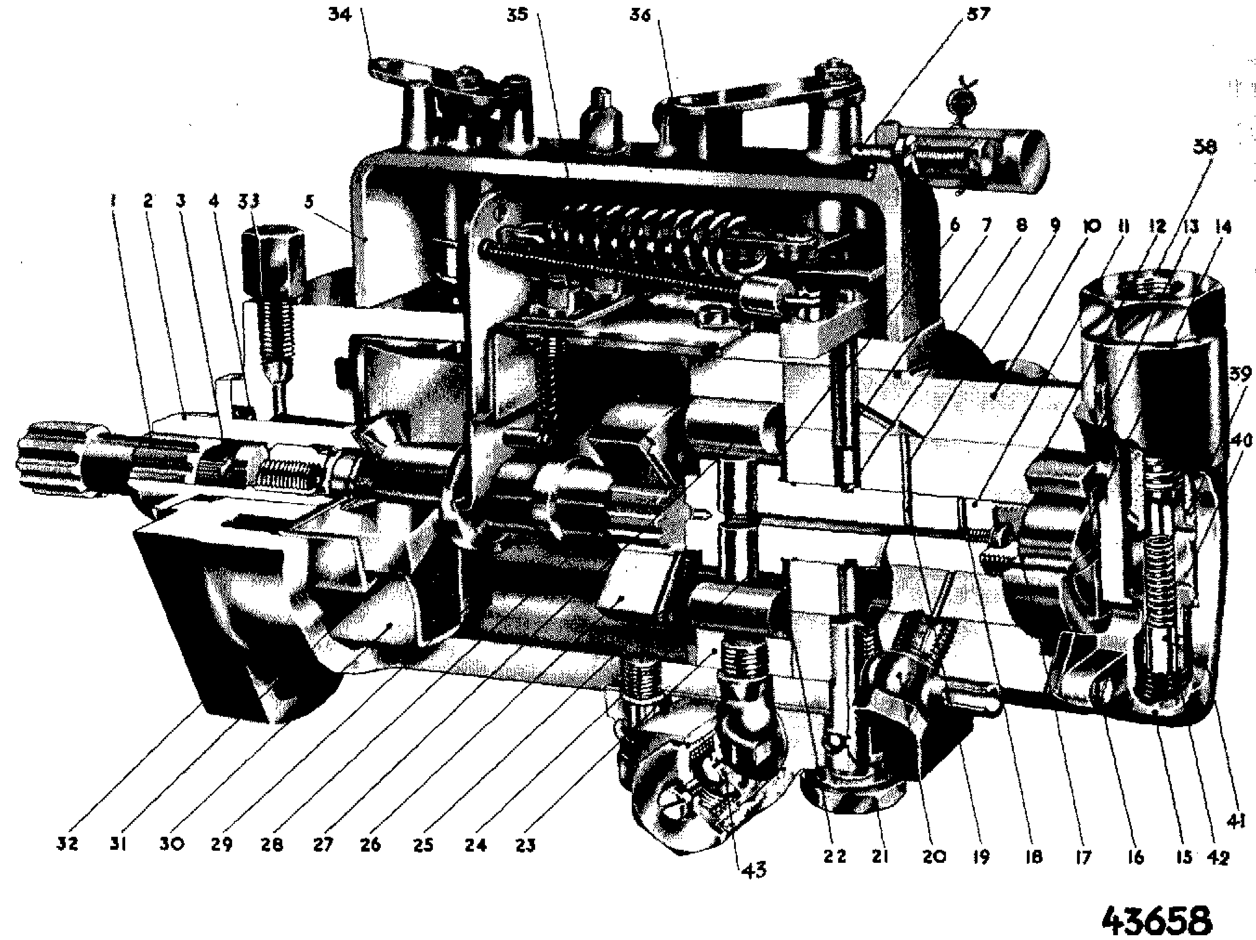


Fig. 1 — ROTO DIESEL Injection Pump — Sectional View

1 Connecting shaft
2 Drive hub
3 Spring washer
4 Seal ring
5 Governor housing
6 Seal
7 Metering valve
8 Metering valve chamber
9 Metering channel
10 Pump head
11 Pump and distributor rotor
12 Eccentric sleeve of displacement pump
13 Seal
14 Rotor of displacement pump
15 End plate
16 Cap screw
17 Sliding blades of displacement pump
18 Distributor channel
19 Radial bore (quantity depending on number of cylinders)
20 Pressure connectors*
21 Hollow screw
22 Race
23 Cam ring
24 Pump piston
25 Rear adjusting plate
26 Front adjusting plate
27 Cam roller
28 Pump shaft
29 Internal chamber of pump housing
30 Governor cage
31 Flyweights
32 Pump housing
33 Leak-off connector
34 Shut-off lever
35 Governor spring
36 Speed control lever
37 Adjusting screw for upper idle speed
38 Fuel inlet
39 Filter
40 Pressure regulating valve sleeve
41 Pressure regulating valve piston
42 Bleed spring
43 Automatic hydraulic speed advance

* In contrast to the above illustration, the pressure connectors of fuel injection pumps installed in John Deere engines are of the pressure valve type (see fig. 5).

GENERAL

The ROTO-DIESEL fuel injection pump is a horizontally installed distributor pump with mechanical governor and automatic hydraulic speed advance. The moving parts of the pump are simultaneously lubricated and cooled by the Diesel fuel flowing through the pump. No lubricant is required.

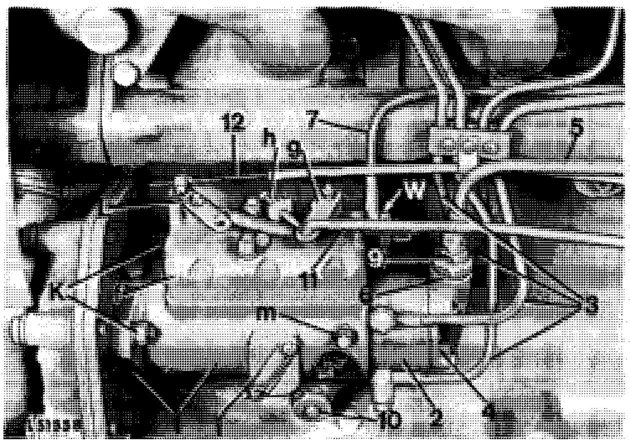


Fig. 2 — Fuel Injection Pump Installed

1 Pump housing with mounting flange
2 Pump head
3 Fuel pressure lines
4 Pump cover
5 Fuel supply line
6 Fuel inlet screen
7 Bleed and fuel return line to tank
9 Connector
10 Hydraulic, automatic speed advance
11 Speed control rod
12 Shut-off cable
f Governor housing
g Speed control lever
h Adjusting screw for slow idle speed
i Timing hole cover
k Hex. nuts for attaching the pump
l Shut-off lever
m Bleed plug
w Bleed line fitting

Fuel Pump and Flow Regulation

The diesel fuel for injection is fed to the cylinders — regardless of their number — by a single unit. Its pump and distributor rotor is fitted with two opposed pistons controlled by a cam ring. The distribution to the individual cylinders is done by the rotor in conjunction with the pump head (see fig. 3). This design assures an equal quantity of fuel being injected into each cylinder at any moment.

On the other end of the rotor, opposite the two pump pistons, there is a displacement pump which delivers the Diesel fuel, sucked from the fuel filter, through the metering valve into inlet bore "a", (see fig. 3) in the pump head, at a pressure which varies with engine speed.

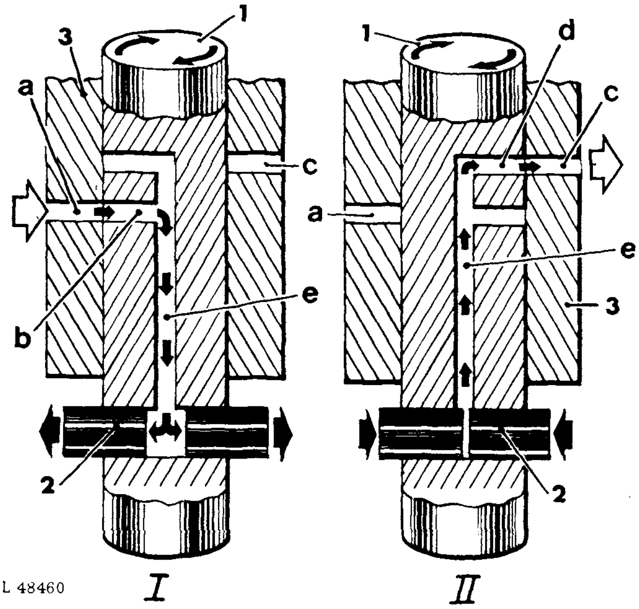


Fig. 3 — Diagram of Fuel Distribution by Rotor Action

I Filling the rotor with the fuel quantity adjusted to load requirements
II Fuel supply to cylinder, adjusted to load requirements
1 Pump and distributor rotor
2 Pump piston
3 Pump head
a Inlet bore in pump head
b Inlet bore in pump- and distributor rotor
c Outlet bore in pump head
d Distributor bore in pump- and distributor rotor
e Longitudinal bore in pump- and distributor rotor

Filling Process (see I, (fig. 3): As rotor 1 rotates, the inlet bore "a" in pump head 3 aligns with the inlet bore "b" in the rotor. The fuel coming from the displacement pump reaches the pump piston chamber through bores "a" and "e" (the flow being regulated by the metering valve) and forces the two pistons 2 apart.

Pumping and Delivery Process (see II, fig. 3): During further rotation of the rotor 1 the inlet bore "a" in the pump head 3 is closed and the distributor bore "d" in the rotor eventually aligns with one of the 4 outlet bores "c" in the pump head. Meanwhile the two pump pistons 2 have reached the cam so that they move towards each other. The trapped, metered fuel is forced, under high pressure, through the bores "e" and "d" in the rotor and the outlet opening "c" in the pump head, through the pressure valve and the connected pressure line, to the fuel injection nozzle and into the appropriate cylinder.

A pressure valve is located at each outlet in the pump head (as on in-line type injection pumps) where the pressure line leading to the injection nozzle is connected. After injection, the pressure valve closes again and with its small relief piston sucks a quantity of fuel from the pressure line. The resulting relief in the pressure line causes a quick and firm shutting of the nozzle needle thus preventing fuel from leaking into the combustion chamber.

The quantity of fuel which is needed at any given moment for each cylinder and combustion cycle is regulated by a metering valve which is controlled, over speed control rod 11 (fig. 2) and the control lever "g", by the governor inside the injection pump housing "f".

In the "engine shut-off" position the metering valve completely cuts the supply of fuel from the displacement pump to the rotor (for further details about speed control and engine shut-off, see section 20, group 40). The unused fuel flows through the pressure regulating valve back to the suction side of the displacement pump.

At idling speed or under load, the transfer pump feeds more fuel to the metering valve than is needed for injection.

The excess fuel flows through the pressure regulating valve back to the suction side of the displacement pump. A very small amount of this surplus fuel escapes through the top of the governor housing "f" (fig. 2) and, together with any air bubbles the fuel may contain, flows through the bleed and return line 7 back into the fuel tank. This ensures both a constant bleeding of all injection pump fuel channels and a certain amount of cooling.

Automatic Adjustment of the Injection Timing (Speed Advance)

To facilitate starting and to obtain the best possible engine performance over the entire speed range, the injection pump is fitted with an automatic, hydraulically operated, speed advance, (see 10, fig. 2). It is pre-set at the factory.

The speed advance adjusts the timing of the injection in relation to engine speed and load. Due to the varying pressure of the fuel fed from the displacement pump to the working pump piston, the cam ring rotates in the pump head. The power required for rotating the cam is provided by a piston at the base of the pump housing (see 10, fig. 2). The piston is coupled to the cam ring by a bolt. A pre-stressed helical spring in the timing control operates contrary to the hydraulic movement of the adjusting piston. When the engine is started, this spring sets the cam for "retarded" injection; with increasing engine speed the cam ring is rotated hydraulically toward "advance". The final position of the cam ring is reached at a certain engine speed given by the setting of the adjusting screw. When the engine is at a standstill, the spring returns the cam ring to its starting position.

REMOVAL

NOTES:

Before removing, clean off any dirt from all oil lines, the injection pump and its surrounding area. Each fuel pressure line must fit the injection pump and nozzle easily, without stress. Take care not to bend the lines when removing them as this may reduce their working life. Remove all fuel pressure lines before removing the injection pump.

CAUTION: Never pour cold water onto a warm injection pump. This might cause corrosion of the moving parts of the pump. Never clean the pump with a steam cleaner.

The complete injection pump can be removed and installed with the engine in the tractor.

In order to preserve the correct position for the installation of the injection pump, do not change the position of the timing gears after removing the injection pump.

REMOVAL

1. Remove the hood (see Operator's Manual).

2. Turn the crankshaft clockwise, as seen from the radiator, until No. 1 piston is just before the top dead center (TDC) of its compression stroke.

CAUTION: Do not mistake exhaust stroke for compression stroke.

Put the adjusting screw through the bore in the flywheel housing (see fig. 7) and into the flywheel bore, as soon as the flywheel has reached the "TDC" position. In case the crankshaft was turned beyond "TDC", it should be turned to the left at least 1/4 of a revolution and then back to the "TDC" position. This must be done to eliminate timing gear backlash.

3. Remove cover "i" (fig. 2) from the timing hole in the injection pump (the cover is lead-sealed and fitted with a gasket).

Make sure that the timing mark "p" (fig. 4) on the snap ring "o" is directly opposite the mark "q" on the driven disk "n" of the rotor; the mark "q" has the identification letter "A".

CAUTION: There are other letters on the driven disk which have no significance.

4. Close the fuel shut-off valve at the tank.

5. Remove all fuel lines and disconnect speed control rod as well as stop cable at injection pump.

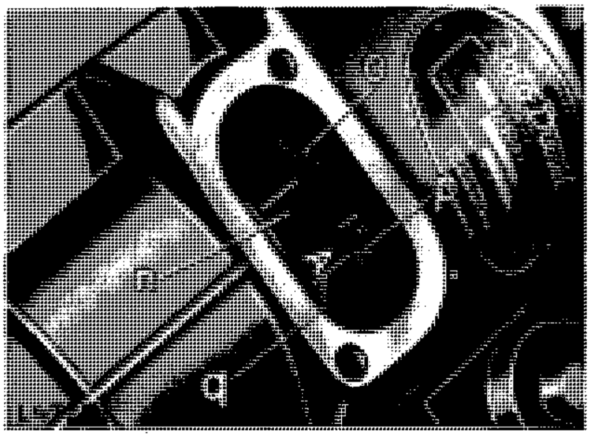


Fig. 4 — Timing Marks of the ROTO DIESEL Injection Pump for Adjusting the Injection Timing

n Driven disk of the rotor
o Snap ring in pump housing
p Timing mark on snap ring
q Timing mark with identification letters on driven disk

IMPORTANT: When loosening the union nut of a fuel pressure line, make sure to hold the injection nozzle (see fig. 8).

Plug all open connections on pump, injection nozzles and fuel lines, preferably with plastic caps and plugs. Do not use fibrous material.

6. Remove cover from mounting hole in timing gear cover.

7. Remove the three cap screws which secure the injection pump drive gear to the pump shaft (take care of the spring washers!).
Remove the three hex. nuts "k" (fig. 2) and pull the complete injection pump backward from the three studs.

DISASSEMBLY

FUEL INJECTION PUMP

NOTE: Certain external parts which can be easily replaced are available as spare parts; (see parts list).

Do not disassemble the ROTO DIESEL injection pump further than necessary for installing available parts, not even for cleaning. Therefore, it is advisable to keep a replacement pump available.

PRESSURE VALVES

NOTE: Pressure valves (see fig. 5) are only available as an assembly. Therefore, disassemble a pressure valve only for cleaning.

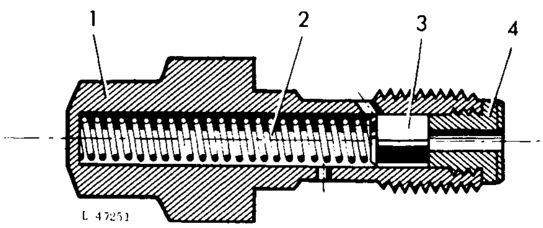


Fig. 5 — Pressure Valve — Sectional View

1 Valve body
2 Pressure spring
3 Valve piston
4 Plug

Remove pressure valve assembly from injection pump head.

Turn plug 4 (fig. 5) out of valve body 1. Remove piston 3 and spring 2.

REPAIR

INJECTION PUMP

Proper checking of the injection pump, especially as regards deliveries in various load ranges and the operation of the governor, is only possible if a special test stand and the appropriate specifications are available. Therefore, do not attempt to disassemble or repair injection pumps, but send them to the dealer's specialized service shop.

PRESSURE VALVE ASSEMBLY

If leakage occurs at the connection of pressure valve and fuel pressure line on pump head, remove pressure valve from pump head and replace both copper ring gaskets.

Remove any defective pressure valves as an assembly. Tighten pressure valves and thus also fuel pressure lines in the pump head to the specified torque.

INSTALLATION AND ADJUSTMENT

INSTALLING THE INJECTION PUMP

NOTES:

The outlets for the connection of the fuel pressure lines are marked on the pump head with letters "V", "U", "X" and "W" relating to cylinder No. 1, 3, 4 and 2 in firing order.

The timing gear housing is provided with a boss (indicator) and an adjusting mark. A mark "O" identifying the TDC is located on the circumference of the crankshaft pulley (see fig. 6).

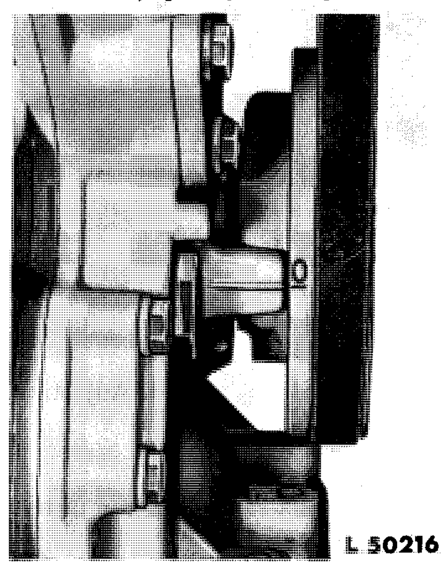


Fig. 6 — Indicator on Timing Gear Housing and Adjusting Marks on Crankshaft Pulley.

o Adjusting mark on crankshaft pulley

Installing the Injection Pump with the Pump Drive Gear still in the Position of Removal (see "Removal").

1. Remove cover "i" (see fig. 2) on the injection pump. Turn the drive shaft of the injection pump until the adjusting mark "q" on the driven disk "n" (see fig. 4) lines up with the mark "p" on snap ring "o" (see fig. 4).

IMPORTANT: The driven disk has several adjusting marks identified by different letters. However, only the mark "q" identified by letter "A" (see fig. 4) is applicable.

2. Make sure that No. 1 piston is still on its compression stroke at TDC and that the pump gear has the corresponding position (check the position of the dowel against position of slot in hub of pump drive shaft).

Insert adjusting screw 1 (fig. 7) through flywheel housing and into flywheel bore.

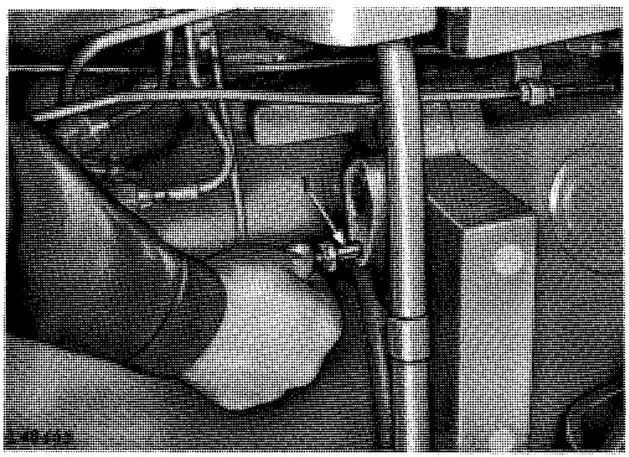


Fig. 7 — Using Timing Screw for Adjusting TDC
1 Timing Screw

3. Fit a new gasket onto the pump housing and slide the housing onto the three studs. Fit pump shaft hub into drive gear and make sure that the dowel fits into bore in pump shaft hub (can be judged by means of the three screw holes). Insert pump housing into bore in cylinder block front plate. Screw the gear onto pump shaft and tighten three cap screws to the specified torque. Finally screw the three hex. nuts onto the studs and tighten only finger-tight.

4. Set the injection timing accurately (by pivoting the pump housing) (see "Timing the injection pump"). Then tighten the mounting nuts to the specified torque.

5. Install timing cover on injection pump hole and tighten screws to the specified torque. Install mounting hole cover on timing gear cover and tighten securely.

6. Install and connect all fuel lines, the speed control linkage and the stop cable. Bleed the fuel system (see below).

Installing Injection Pump with Pump Drive Gear Removed

1. Mount the injection pump and secure it with the three nuts (the position of the rotor is of no significance).

2. Mount the drive gear onto the pump shaft hub and make sure that the dowel fits into the groove in the shaft hub. At the same time adjust the gear to the injection timing (see section 20, group 25). Tighten the cap screws to the specified torque.

NOTE: By adjusting the gear to the injection timing, the rotor of the injection pump is also turned into the correct position with regard to injection timing.

3. Adjust (see below) and completely install fuel injection pump (see items 4-6 above).

ADJUSTING FUEL INJECTION PUMP

NOTE: After having installed the injection pump, accurately determine the injection timing. For adjusting, use the marks on the snap ring in the pump housing and on the driven disk of the rotor. Use the latter mark in conjunction with an identification letter referring to No. 1 cylinder.

1. Only if required:

Turn crankshaft — seen from radiator side — clockwise until No. 1 piston is just before top dead center of its compression stroke (TDC), i.e. both valves closed. **CAUTION: Do not mistake exhaust stroke for compression stroke.** Insert the adjusting screw 1 (see fig. 7) through the flywheel housing and into flywheel bore as soon as flywheel

has reached the *exact* TDC position. If the crankshaft was turned beyond TDC, it must be turned back by at least 1/4 turn and then forward again to the TDC position. This is necessary to eliminate timing gear backlash.
Remove cover from the pump housing timing hole.

2. Loosen attaching nuts of injection pump and pivot pump housing first away from cylinder block as far as the slots allow. Then pivot it back again, but only far enough to place mark "A" on the driven disk "n" (see fig. 4) exactly opposite the mark "p" on the snap ring "o". Re-tighten the three pump attaching nuts to the specified torque.

3. *To check the adjustment of the injection timing* remove timing screw and rotate crankshaft clockwise two complete turns as seen from the radiator until No. 1 piston (radiator side) is near the TDC of its compression stroke. Insert timing screw into flywheel bore. Then check position of driven disk in relation to snap ring (see item 2).

NOTE: When rotating the crankshaft, take care not to turn it beyond TDC. However, if this should happen, turn crankshaft in opposite direction by at least 1/4 turn and then back to TDC. This eliminates timing gear backlash.

If necessary, correct the timing by pivoting pump housing in relation to cylinder block. Always pivot pump housing first in opposite direction before moving it back in direction for correct adjustment to eliminate timing gear backlash (see item 2).

4. Re-install and secure cover on injection pump timing hole. Tighten screws to specified torque.

5. Bleed fuel system and injection pump thoroughly (see below).

INSTALLING FUEL LINES, SPEED CONTROL ROD AND STOP CABLE

After adjusting and checking the injection timing, connect the speed control rod to the speed control lever and the stop cable to the shut-off lever.
Reinstall all fuel pressure lines and tighten to injection pump head by means of pressure valves (see fig. 5). Tighten pressure valves and thus lines to the specified torque.

When tightening injector line nuts, use one hand and two wrenches, holding the injector pressure screw (see fig. 8). Tighten union nuts just enough to prevent leaks with the engine running.

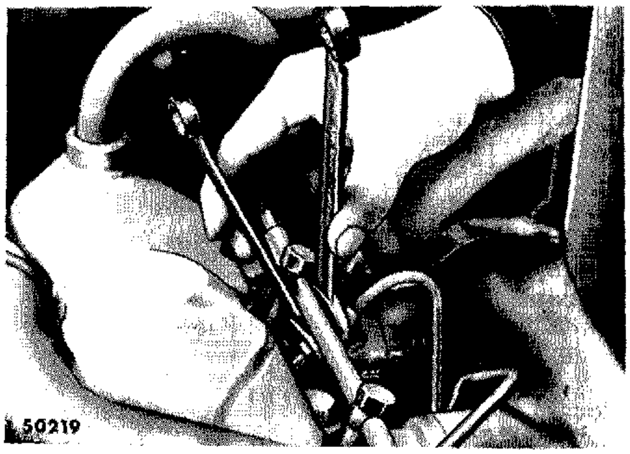


Fig. 8 — Proper Tightening of Injector Line Nut

Tighten hollow screw "w" (fig. 2) of fuel return line at injection pump to the specified torque.

BLEEDING INJECTION PUMP AND FUEL SYSTEM

Always bleed the entire fuel system after installing the injection pump.

NOTE: A new or spare injection pump is not yet filled with fuel. This is done by operating the priming lever of the fuel transfer pump.

Loosen the bleed plug on the front (first stage) fuel filter; operate the fuel pump by hand and pump fuel through the filter until a solid stream of fuel without air bubbles is obtained. Tighten bleed plug again.

NOTE: If the fuel pump does not deliver and no resistance is felt in the top position of the lever, turn the crankshaft a little with the starter to find a more suitable position for the camshaft.

Loosen bleed plug of 2nd stage filter. Bleed filter and tighten bleed plug.

Loosen bleed plug "m" (fig. 2) on injection pump, bleed and retighten to the specified torque.

Loosen hollow screw "w" of the bleed and return line 7 at the pump and after bleeding, re-tighten to the specified torque.

After bleeding, keep the hand lever of the fuel pump in the lowest position.

Loosen the union nut of the pressure line on at least two injection nozzles by one turn and turn the crankshaft with the starter until sufficient fuel without air issues from the connections. **CAUTION: Do not loosen the line more than one turn. Tighten injector line nut just enough to prevent leaks with the engine running. When tightening the union nut, do not forget to hold the injector pressure screw as explained above.**

CHECKING THE ENGINE SPEED

After bleeding the fuel system, check the slow and the fast idle speed; for details see section 20, group 40. If necessary, re-adjust the speed control device.

ADJUSTING FUEL DELIVERY TO DIFFERENT ALTITUDES

At high altitudes a Diesel engine draws in less oxygen than at sea level. If injected fuel quantities remain the same as at sea level, the engine gets too much fuel with incomplete combustion resulting. As a result the engine emits too much smoke.

Stamp the percentage by which fuel delivery should be reduced into the name plate.

EXAMPLE: DPA 34 42 410
Code — 12%

CAUTION: Fuel delivery may only be modified by a ROTO DIESEL dealer.

The following chart shows the percentage by which fuel delivery should be reduced at a given altitude.

Percentage	at an altitude of
0%	0 to 1500 ft. (0-450 m)
3%	1500 to 2500 ft. (450-750 m)
6%	2500 to 3500 ft. (750-1050 m)
9%	3500 to 4500 ft. (1050-1350 m)
12%	4500 to 5500 ft. (1350-1650 m)

TORQUES FOR HARDWARE

Pump drive gear-to-pump shaft, cap screws	18 ft.lbs.	2.5 mkg
Injection pump-to-cylinder block front plate, hex. nuts	18 ft.lbs.	2.5 mkg
Bleed and fuel return line, hollow screw	9.2 ft.lbs.	1.3 mkg
Fuel pressure lines, pressure valve	21.5 ft.lbs.	3 mkg
Fuel supply line, connector	21 ft.lbs.	2.9 mkg
Adjusting screw for slow idle speed, hex. nut	3.3 ft.lbs.	0.45 mkg
Timing hole cover on injection pump, cap screws	2.5 ft.lbs.	0.35 mkg
Bleed plug	2.5 ft.lbs.	0.35 mkg

Group 20

ROOSA MASTER FUEL INJECTION NOZZLES

GENERAL INFORMATION

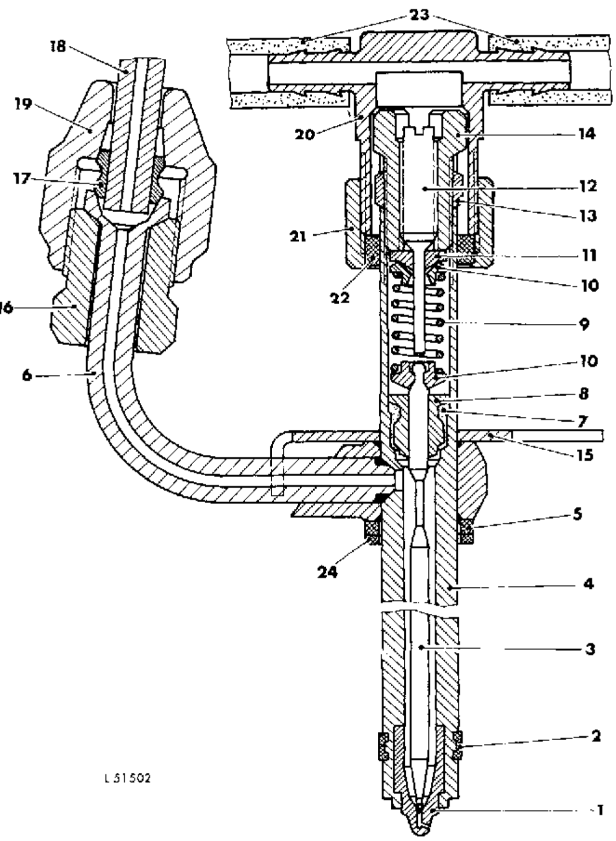


Fig. 1 — ROOSA MASTER Injection Nozzle - Sectional View

1 Spray tip
2 Carbon stop seal
3 Nozzle valve
4 Nozzle body
5 Plastic seal
6 Connection for injection line
7 Seal ring of nozzle valve guide
8 Nozzle valve guide
9 Adjustable pressure spring
10 Spring seat
11 Ball washer
12 Lift adjusting screw
13 Lock nut
14 Pressure adjusting screw
15 Location clamp
16 Pipe union (male)
17 Nipple
18 Fuel pressure line
19 Pipe union (female)
20 Fuel leak-off boot
21 Knurled nut
22 Plastic ring
23 Leak-off line
24 Plastic seal

NOTE: The numbers listed below refer to fig. 1, unless reference is made to another figure.

The ROOSA MASTER fuel injection nozzle has several orifices.

The nozzle (see 1, fig. 1) forms an integral unit with nozzle body 4 from which it cannot be separated. The injection nozzle is secured in the cylinder head by three superimposed spring clamps (see 28, fig. 2) which press on clamp 15, and a cap screw 25; the contact pressure is limited by spacer ring 26 and spacer washer 27. The nozzle is sealed in the cylinder head at its lower end with a carbon stop seal 2. The top end is sealed with plastic seals 5 and 24. Clamp 15 ensures correct position of the complete injection nozzle in the cylinder head. The leak-off line is connected by fuel leak-off boot 20, which is fitted on the nozzle body and secured with plastic ring 22 and knurled nut 21.

The Roosa Master injection nozzle works basically in the same way as a normal spray type nozzle. Its opening pressure is adjusted by the pressure adjusting screw 14. Valve lift is adjusted by screw 12 located in pressure adjusting screw 14.

The carbon stop seal 2 prevents carbon from collecting around the nozzle in the cylinder head. The injection nozzles have five orifices of a specified diameter (see Specifications).

REMOVAL

REMOVING ONE OR SEVERAL INJECTION NOZZLES

IMPORTANT NOTES

Before removal, carefully remove all dirt from the cylinder head around injection nozzles and blow off with compressed air in order to prevent any dirt entering the cylinders or valve seats. Plug the bore in the cylinder head after injection nozzle has been removed. Cap fuel line openings as soon as they are removed.

Fit protecting caps immediately over the nozzle tip and the line connection to avoid damage to the nozzle when handling it.

Do not bend the fuel pressure lines, as this may affect their durability and breakdowns may occur. When loosening the fuel pressure line, hold pressure union of nozzle.

1. Remove hood (see Operator's Manual).

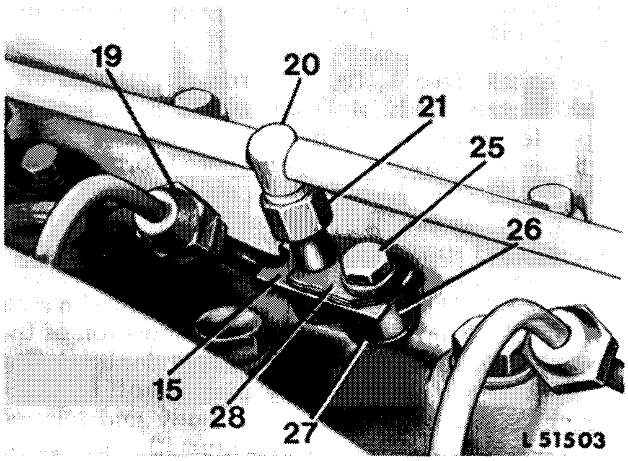


Fig. 2 — Injection Nozzle Installed

15 Locating clamp
19 Pipe union (female)
20 Fuel leak-off boot
21 Hex.nut
25 Cap screw
26 Spacer ring
27 Spacer washer
28 Spring clamps

2. Withdraw leak-off hoses from leak-off boots 20 (fig. 2) of injection nozzles to be removed. Turn knurled nut 21 off boot 20. Remove boot and withdraw knurled nut 21 with plastic ring 22 (see fig. 1) from nozzle.

3. Unscrew union 19 (figs. 1 and 2) from pressure union 16, holding the latter firmly with a wrench.

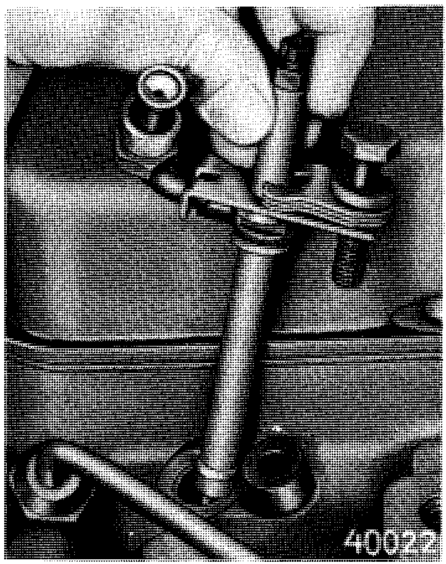


Fig. 3 — Removal of Injection Nozzle by Hand

4. Remove cap screw 25 (fig. 2) from cylinder head and pull complete injection nozzle from cylinder head by hand (see fig. 3). Should this not be possible because the nozzle is "set" in the cylinder head with carbon deposits, then use special puller No. JDE 38 (see fig. 4).

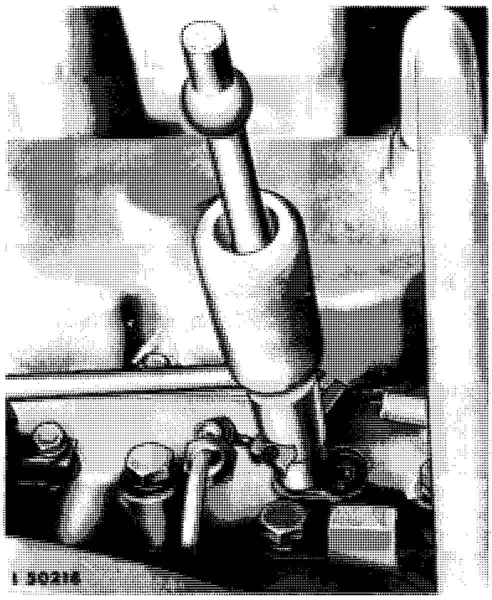


Fig. 4 — Removal of Injection Nozzle with Special Puller No. JDE 38

CAUTION: Do not use screw drivers or similar tools for this as they might damage the injection nozzle irreparably.

As long as the carbon stop seal is in good condition, no carbon deposits will form in the cylinder head bore and the injection nozzle can therefore be removed without using a tool.

REMOVAL OF THE FUEL PRESSURE LINES

NOTES

Carefully clean fuel pressure lines, injection nozzles and injection pump before removing lines to prevent dirt entering the nozzles and pump through the exposed openings. Plug the openings immediately with caps or plugs. Each fuel pressure line is fit to the injection pump and nozzles. Consequently, do not bend lines when removing them, as this reduces their durability. Before removing one or all fuel pressure lines, remove the two clamps.

IMPORTANT: When loosening the pipe union of the fuel pressure line, hold nozzle union firmly.

TESTING

TESTING INJECTION NOZZLE IN ENGINE

Allow the engine to run at high speed under no load. Loosen the fuel pressure line at one of the injection nozzles (so that the fuel escapes at the line connection and is not forced through the nozzle). If there is no change in the engine's speed, it is a sign that this particular nozzle is not in order. Repeat test consecutively at each of the remaining nozzles.

Remove faulty nozzle assembly and check thoroughly by means of a nozzle tester.

EXTERNAL CLEANING OF AN INJECTION NOZZLE

NOTE: Before testing an injection nozzle with a nozzle tester, remove both sealing rings and thoroughly clean the outside of the injection nozzle.

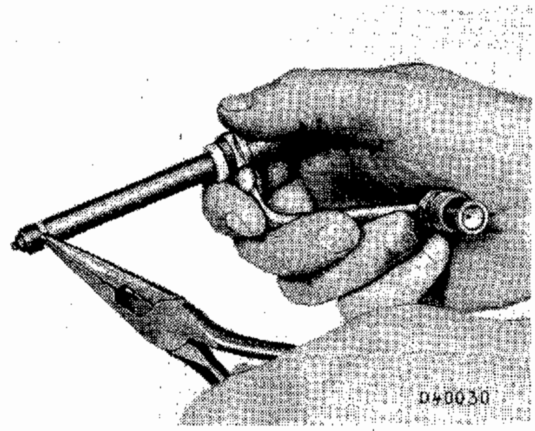


Fig. 5 — Removal of Carbon Stop Seal

Remove carbon stop seal from the groove in the nozzle body, using suitable pliers (see fig. 5). Pull upper seal from the nozzle body and discard both seals.

Place the injection nozzle in solvent or clean Diesel fuel until the accumulated deposits are saturated. Clean the body and tip in particular, up to the groove for the carbon stop seal, with brass wire brush No. 16488 provided with special injection nozzle cleaning kit, using ample Diesel fuel or solvent. NEVER USE A STEEL WIRE BRUSH OR A SCRAPER FOR THIS PURPOSE.

CAUTION: When removing the sealing rings and when cleaning the nozzle, take care not to damage the Teflon coating of the nozzle body above the groove for the sealing ring.

TESTING INJECTION NOZZLE WITH NOZZLE TESTER

NOTES:

Testing the performance of a nozzle while the engine is running (see above) is just a rough test. To obtain a true check of nozzle performance, use a nozzle tester, such as - Robert Bosch, part. No. EFEP 60 A (see fig. 6) (or from Messrs. Bacharach, see part No. 65-030 D). To connect a nozzle to the BOSCH tester, use special tool (fuel pressure line) No. 19-58-90.577. For connection to the BACHARACH nozzle tester use special tool (connecting piece) No. 16492.

Use only carefully filtered Diesel fuel for testing the injection nozzles, since dirty fuel will severely damage the precision parts of a nozzle.

CAUTION: The nozzle tip must always point away from the operator. The fuel issuing from an orifice can penetrate clothes and skin and thus cause severe infection. It is therefore advisable to direct the jet of atomised fuel into a transparent container (see fig. 6).

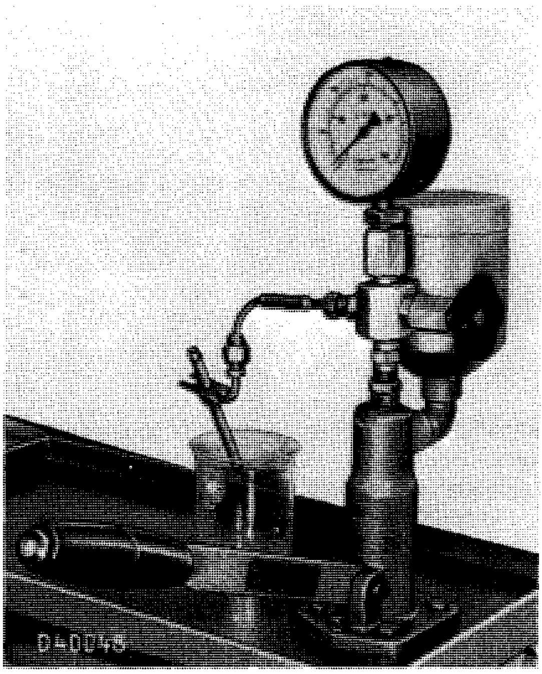


Fig. 6 — ROOSA MASTER Injection Nozzle Connected to BOSCH Tester

Connect the injection nozzle to the tester as shown in fig. 6 so that the axis of the injection nozzle forms an angle of approx. 30° to the vertical, and the spray of fuel is directed downwards and all of it is collected in the container underneath. Make sure that all connections are leakproof to avoid false results when testing.

Close the gauge shut-off valve and flush (bleed) the nozzle by operating test pump rapidly. Thus, the nozzle valve, too, will seat.

SPRAY PATTERN TEST

Close gauge shut-off valve and operate the pump lever at 60 strokes per minute. If the injection nozzle is working properly, the fuel should issue through all nozzle orifices in a fine, evenly shaped spray cone. This spray cone is inclined from the centerline of the nozzle body, but should be evenly distributed. For a better check, place a piece of paper or cardboard at a suitable distance below the nozzle and check the appearance of the damp circular spots made by the fuel. Deviations from the regular spray pattern or angle may be due to the complete or partial clogging of a nozzle orifice. In this case the fuel issues in a jet rather than in a fine spray.

CHATTER TEST

Make sure nozzle orifices are free. When working pump of injection nozzle tester at 60 strokes per minute (gauge shut-off valve closed), a definite characteristic "chatter" should be heard. If this is not the case, the nozzle needle may be bent, or tight in its guide because of the laquer deposits which have accumulated. This can be corrected only by disassembling the nozzle.

TESTING OPENING PRESSURE

NOTE: Absolute opening pressure is less important than equal opening pressure of all nozzles. Max. permissible variation see Specifications.

Close gauge shut-off valve and actuate the pump several times to allow the nozzle needle to seat properly. Open gauge shut-off valve. Pump the pressure up to the point where the pressure gauge needle falls rapidly. This point (take reading) is the nozzle valve opening pressure (minimum pressure see "Specifications").

If spray pattern, leakage test, and valve wear test (see below) are good but the opening pressure test is unsatisfactory, adjust opening pressure as described under "Adjustment".

CHECKING VALVE SEAT

Connect the nozzle to tester in horizontal position. Operate the pump lever rapidly to bleed the nozzle and allow the needle to seat. Dry the tip of the nozzle thoroughly. Now operate the pump lever slowly until the indicated pressure is approx. 2400 psi (= 169 kg/cm^2). Keep watching the nozzle. For 10 seconds no drops should form on the nozzle tip, although a trace of moisture is permissible. Work the pump lever quickly several times in succession, to make the nozzle spray in the normal way. After the last stroke of the pump, observe again. If the nozzle is not quite leakproof, disassemble for servicing.

CHECKING VALVE STEM AND GUIDE WEAR

Connect injection nozzle to the nozzle tester with the tip raised a little higher than its opposite end. Cover the tip and pump the pressure to 1500 psi (105 kg/cm^2). Keep the pressure constant and observe how much fuel leaks out of the nozzle return end. After the first drop has formed, count the drops for 30 seconds, there should be 4 to 8 drops.

NOTE: If all tests prove that the nozzle performs properly, no further service is necessary and the nozzle can be reinstalled (see under "Installation"). An injection nozzle which is not operating properly must be disassembled for cleaning and/or reconditioning, as far as possible.

FUEL PRESSURE LINES

Defects cause irregular running of the engine or leaks. If in doubt, replace the line.

DISASSEMBLY

NOTE: Disassemble the injection nozzle only when necessary, due to faulty operation or as a result of tests on the injection nozzle tester.

It is not advisable to disassemble a Roosa Master injection nozzle if the special tools for cleaning and repair are not available.

Disassemble the nozzle only in a clean working area. Dirt is the worst enemy of injection nozzles.

Place all parts of the injection nozzle immediately into a bowl of well-filtered Diesel fuel and leave there till required for assembly. Just before assembling, rinse all nozzle parts in another pan of clean Diesel fuel.

CAUTION: Never use a steel wire brush for cleaning the nozzle components. They must not be scratched.

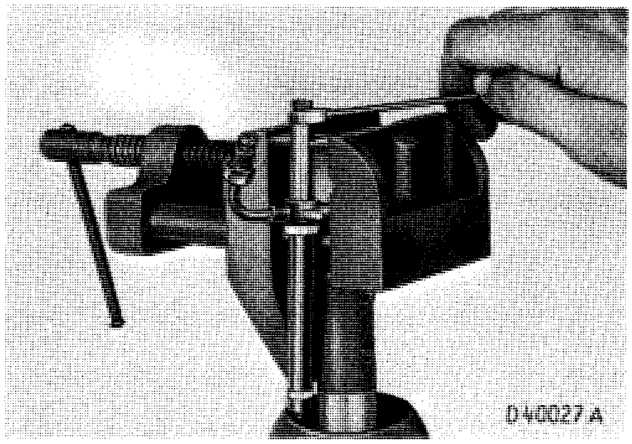


Fig. 7 — Loosening Lock Nut, Using Holding Fixture

Place the injection nozzle in a vise, using holding fixture No. 16475 which is supplied with the special injection nozzle tool kit. Loosen lock nut 13 on the adjusting screws (see fig. 1).

Unscrew and remove spring pressure adjusting screw 14 and lift adjusting screw 12 from nozzle body 4. Unclamp nozzle and remove clamp 15. Invert nozzle and catch in your cupped hand the parts which will now fall out: ball washer 11, upper spring seat 10, pressure spring 9 and lower spring seat 10. If nozzle needle 3 also slips out, hold it carefully by its stem (see fig. 8) and not by the end with the nozzle needle seat. Do not bend needle.

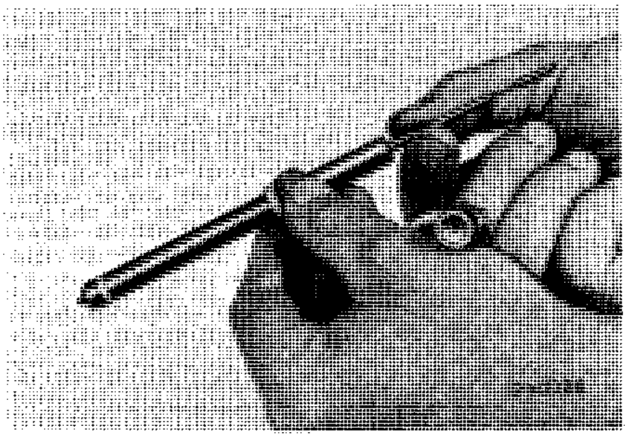


Fig. 8 — Correct Handling of Nozzle Needle

IMPORTANT: If several injection nozzles are disassembled at the same time, make sure that the nozzle needles and nozzle bodies are not mixed up. When assembling, the nozzle needle must be installed into the same nozzle body from which it was taken.

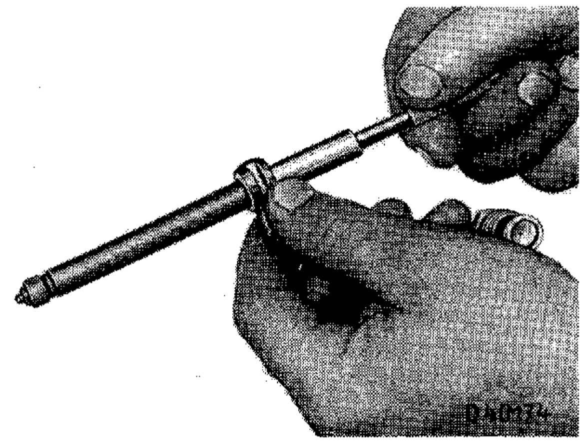


Fig. 9 — Removal of Nozzle Needle Using Special Tool No. 16481

If the nozzle needle does not slide freely from the nozzle body when the injection nozzle has been turned over, use special tool No. 16481 as shown in fig. 9. Should the needle no longer be in its deepest position in the nozzle body, first push it completely into the nozzle body with the aid of the special tool (clamp holder) to avoid bending the needle when the tool is applied. Turn the nut clockwise, slide the tool as far as possible onto the needle so that the gripping device gets a hold of it, then turn the knurled nut to the left to secure the nozzle needle. Remove the needle from the nozzle body by carefully pulling the tool.

Completely unscrew stroke adjusting screw 12 from spring pressure adjusting screw 14 with small screw driver No.16504 which is provided with the special nozzle tool kit.

REPAIR

CLEANING INJECTION NOZZLE PARTS

Injection Nozzle Body

Carefully remove all carbon deposits from the nozzle tip and the groove for the lower sealing ring with solvent or clean Diesel fuel and brass wire brush No. 16488 which is supplied with the special nozzle tool kit. **Never use a steel wire brush for this purpose.**

Check the tip of the nozzle with magnifying glass No. 16487, supplied with the special nozzle tool kit, for cracks, and check the nozzle orifices for chipped edges.

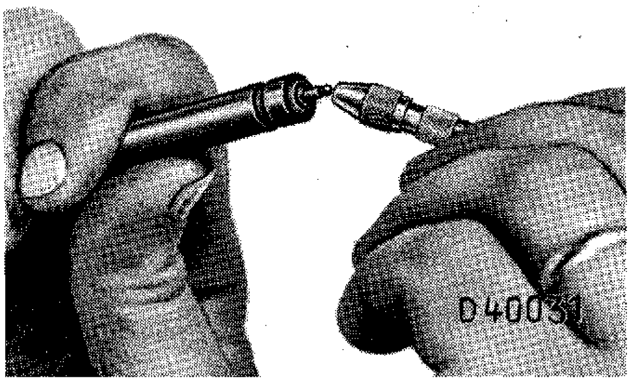


Fig. 10 — Cleaning Nozzle Orifices

Clamp one of the 0.008 in. (= 0.20 mm) diameter nozzle cleaning needles No. 16484, supplied with the special tool kit, into clamping holder No. 16483, also supplied with the tool kit, allowing only about 0.03 in (= 0.8 mm) to protrude.

CAUTION: If the needle protrudes further, it might break off and get stuck in the nozzle orifice from which it is very difficult to remove.

Remove, by grinding on emery stone No. 16490, any burr which may have formed on the cleaning needle when it was cut. Stoning the wire to provide a flat surface is helpful for removing carbon deposits from a clogged orifice.

Insert the cleaning needle into each of the nozzle orifices and remove carbon deposits by turning the holder.

CAUTION: Each nozzle bore forms a different angle to the longitudinal axis of the nozzle. When this cleaning needle moves freely through all orifices, repeat the process with wedge-shaped bevelled needle No. 16485 of 0.010 in. (= 0.25 mm) diameter. Use magnifying glass No. 16487, supplied with the tool kit, for this cleaning operation.

Rinse the nozzle body and check nozzle tip for damage and wear. If only one of the nozzle orifices is chipped or corroded, the spray pattern will be affected. Replace complete injection nozzle.

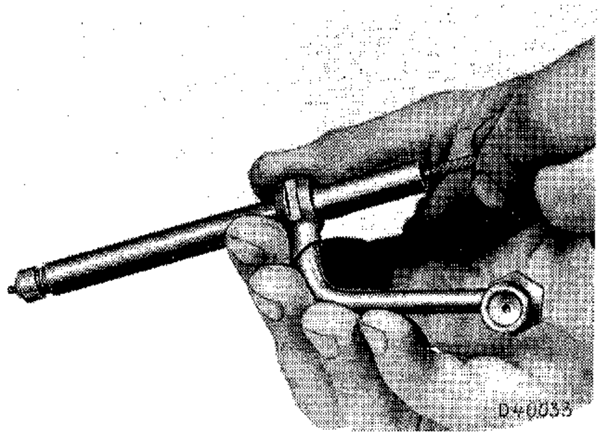


Fig. 11 — Cleaning Nozzle Needle Seat in Nozzle Body with Special Tool No. 16482

Insert special tool (scraper) No. 16482, supplied with the tool kit up to the needle seat and rotate it several times in order to remove carbon deposits which may stick near the seat.

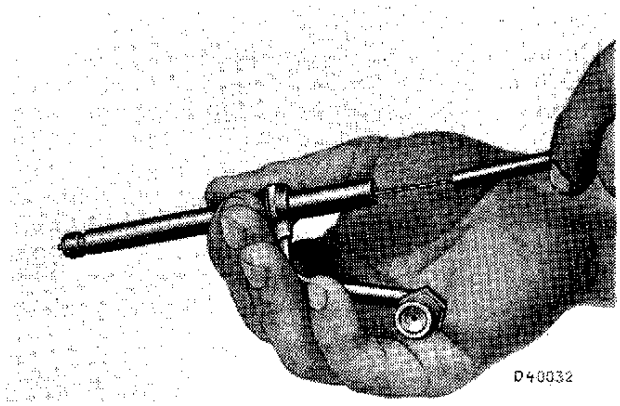


Fig. 12 — Cleaning the Sac Hole in Nozzle Body with Special Tool No. 16476

Insert tool with drill No. 16476, supplied with the tool kit into the sac hole in the nozzle body, and rotate the tool several times to remove any carbon deposits which may be adhering. Clean all nozzle orifices as described above.

Nozzle Needle and Seat

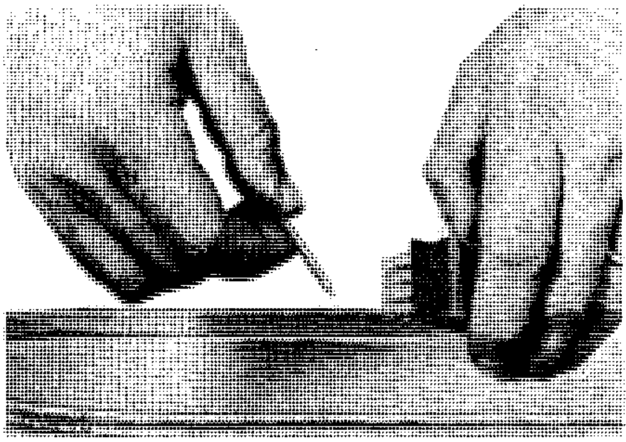


Fig. 13 — Cleaning Nozzle Valve Tip with Brass Wire Brush No. 16488

In order to remove the carbon deposits from the nozzle valve tip and its vicinity, clean the nozzle valve tip with brass wire brush No. 16488 (see fig. 13) supplied with the tool kit. Rub off varnish deposits with felt pad No. 16544, using plenty of solvent or Diesel fuel.

CAUTION: Do not clamp the nozzle needle into a motor driven device.

Examine the surface of the needle where it fits into the nozzle body for scratches which would cause sticking. This part of the needle is usually polished on one side during operation. Visible marks are normal. If an injection nozzle produces spotty chatter while it is being tested or if there is evidence that the needle is sticking in its guide and if there is too little fuel leakage while testing the wear of the needle stem (see above), the nozzle can be corrected by polishing the valve guide area as follows:

1. Apply a small quantity of No. 16489 special polishing paste, supplied with the injection nozzle tool kit, to that part only of the nozzle needle coming into contact with nozzle valve guide 8. Do not use any other compound for this purpose.

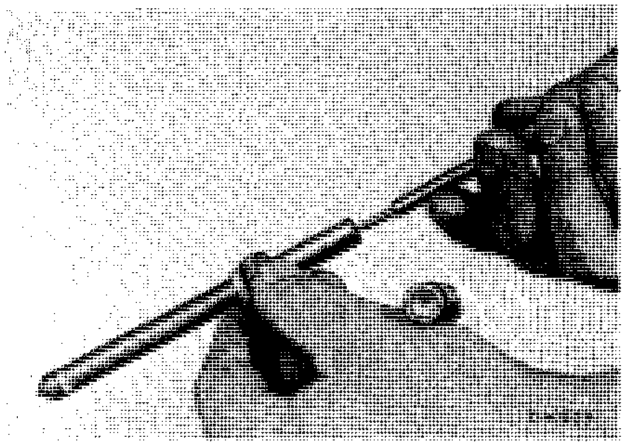


Fig. 14 — Polishing Valve Guide Area

2. Insert needle into the body. When the long part of the needle slides through the nozzle valve guide, it might rub a little. However, this will not affect the correct operation of the nozzle. Hold the needle with special tool No. 16481 (see fig. 9) and rotate it in the nozzle body by turning the tool by hand. After every three or four turns raise the tool and the needle a little (see fig. 14). This lapping may be completed after 10 to 20 turns.

CAUTION: Never use a motor driven chuck for this operation.

3. Before reassembly, wash the nozzle needle and body thoroughly in Diesel fuel.

Seat leakage may be caused by several factors such as: dirt, carbon deposits or a resinous laquer-like coating in the seat area; stoppage in the movement of the needle because it is bent or is sticking in the guide.

If it is evident that the leakage from the nozzle is not due to the above defects, examine the surface of the needle for fine scratches or damage. If evident, they may be removed by using No. 16489 special polishing compound provided in the tool kit. Apply a small amount of No. 16489 special paste to the tip (seat) of the nozzle needle and insert the needle into the body. Fix special tool No. 16481 to the needle (see fig. 9) and lap the needle by hand with a rotary movement of the tool. A very slight polishing (three to five turns by hand) is enough to lap the seat surface.

CAUTION: Too much lapping will cause an undesirable extension of the effective sealing surface between nozzle and body. This prevents the normal "chattering" and results in uneven spraying.

VALVE ADJUSTING MECHANISM

Make sure the stroke adjusting screw 12 is not bent. A bent or otherwise damaged adjusting screw must be replaced with a new part. Also check that spring pressure adjusting screw 14 is still usable. Replace if necessary. Check if the remaining components - both spring seats 10, pressure spring 9, ball washer 11, lock nut 13 and clamp 15 - are still usable; if necessary, replace them.

ASSEMBLY

STEP 1

Slip locating clamp 15 over nozzle body with bent ends down. Rinse the needle in well-filtered Diesel fuel and insert it into the body.

CAUTION: Use greatest care when handling needle.

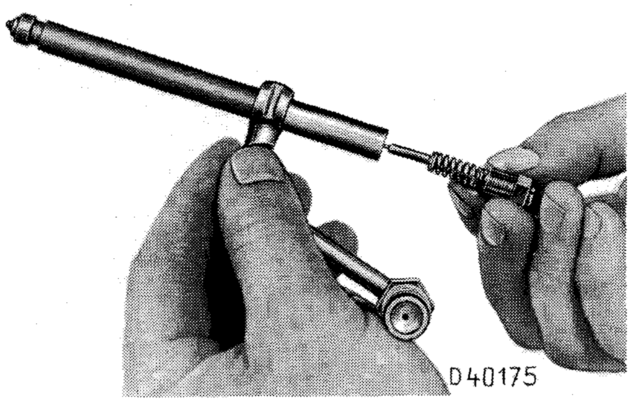


Fig. 15 — Assembly of Injection Nozzle

Screw lift adjusting screw 12 into spring pressure adjusting screw 14 until slotted end of screw is roughly flush with hex. head of spring pressure adjusting screw. Screw lock nut 13 completely onto spring pressure adjusting screw 14. Hold both screws in such a way that the pointed end of the lift adjusting screw faces upward and insert in succession, as per fig. 1, ball washer 11, upper spring seat 10, pressure spring 9 and lower spring seat 10. Tilt nozzle body, as shown in fig. 15 (CAUTION: Do not allow the needle to slide out), and screw the adjusting screw 14, together with the internal parts completely into the body (normally 10 complete turns). Use care not to dislodge the spring seats and spring.

ADJUSTMENT

PREPARATIONS

Clamp the injection nozzle in a vise, using tool No. 16475 provided with the nozzle tool kit and loosen lock nut 13 on the adjusting screw (see fig. 7).

Loosen lift adjusting screw 12 by at least two turns (counterclockwise).

Connect the injection nozzle to the tester (as shown in fig. 6) so that its centerline forms an angle of approx. 30° with the vertical. Make sure that the connections do no leak.

Close gauge shut-off valve and operate the pump several times quickly, thus flushing the nozzle thoroughly (bleeding). This will seat the needle.

CAUTION: The nozzle tip must always face away from the person operating the tester. The fuel issuing from an orifice can penetrate clothes and skin, causing serious infection. It is, therefore, advisable to direct the spray into a transparent container (see fig. 6).

ADJUSTING OPENING PRESSURE

NOTE: When setting nozzle opening pressure, it is desirable to adjust opening pressure toward the high rather than the low limit.

Repeat measuring process to obtain proper result.

Open the gauge shut-off valve on the tester, and, while operating the pump, turn pressure adjusting screw 14 in or out until correct pressure is obtained (see Specifications).

To increase pressure, turn the spring pressure adjusting screw in. If less pressure is required, turn it out. Close shut-off valve of tester and operate pump lever several times quickly, thus opening and closing the nozzle needle repeatedly. Open the shut-off valve again and check the opening pressure; correct if necessary.

ADJUSTING VALVE LIFT

Carefully insert lift adjusting screw 12 into spring pressure adjusting screw 14 until screw 12 bottoms on needle 3. Test bottoming as follows: Raise pump pressure above opening pressure. There should be no valve action. Turn adjusting screw 12 counter-clockwise by 1/2 turn for proper valve lift. (see Specifications). Tighten lock nut 13, while holding spring pressure adjusting screw 14 in position. Then recheck the opening pressure and correct, if necessary.

NOTE: If the nozzle does not produce the characteristic chatter sound, after carrying out the cleaning and repair operations, the valve parts may not be properly aligned.

To correct this, screw spring pressure adjusting screw 14 in and out several times. Then reset needle lift as described above.

Repeat check on the "chatter sound".

Remove nozzle from tester, clamp it in a vise, with No. 16475 special tool (see fig. 7) and tighten lock nut 13 to the specified torque. Install torque wrench adapter No. 16478, provided with special tool kit, in torque wrench and use for this operation. When tightening lock nut 13, hold spring pressure adjusting screw 14. To prevent damage, protect the nozzle with a cap.

ASSEMBLY

STEP 2

IMPORTANT: Each time an injection nozzle is removed from the cylinder head, replace carbon stop seal 2 (fig. 1), with a new one, otherwise carbon deposits may settle in the cylinder head bore, making it considerably more difficult to extract the injection nozzle.

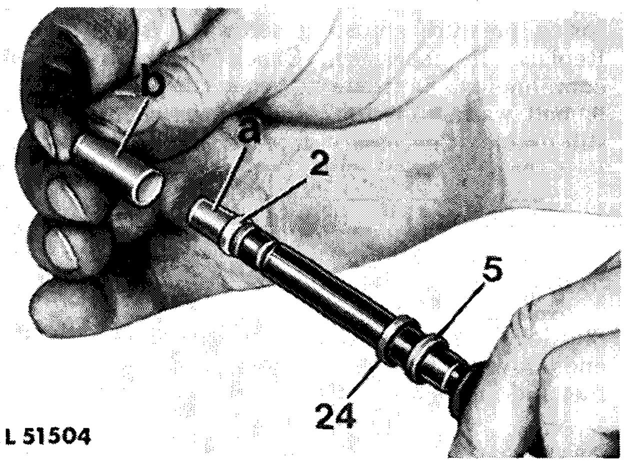


Fig. 16 — Installing Carbon Stop Seal and Sealing Washer

2 Carbon stop seal
5 Top plastic seal
24 Sealing washer
a Pilot tool No. 16477
b Nozzle cap

Slide top plastic seal 5 followed by sealing washer 24 onto nozzle body (see fig. 16). Place No. 16477 pilot tool provided with special nozzle tool kit, on tip of nozzle and slide new carbon seal 2 over nozzle body until it fits properly into the groove.

NOTE: If a No. 16477 pilot tool is not available, a nozzle cap (fitted to every new nozzle) will do, while the carbon stop seal is being fitted.

INSTALLATION

INSTALLING ONE OR SEVERAL INJECTION NOZZLES

NOTE: If the injection nozzle cannot be removed by hand from the cylinder head, it is likely that carbon deposits have formed in the cylinder head bore. To clean, remove the cylinder head (see section 20). Remove oil carbon from cylinder head bore with special tool No. JDE 39.

CAUTION: Always turn the tool clockwise through the bore even when pulling back, otherwise tool will get dull.

Then blow out bore with compressed air.

Make sure that the sealing surface of the cylinder head, on which the seal washer 24 will be resting, is smooth and free of damage or dirt which could prevent proper sealing. Dirt and roughness could cause distortion to nozzle when the attaching screw is tightened, making the valve stick.

CAUTION: Before installing the injection nozzle, make sure nozzle is clean and free from oil or grease. Do not grease or oil the nozzles.

Remove plug from cylinder head bore and insert nozzle into the cylinder head with a twisting motion. Fit the forked end of clamp 15 over the nozzle connecting piece and place spacer washer 27 and spacer ring 26 (see fig. 2) on the cylinder head. Slide washer and three spring clips over cap screw 25 and screw the cap screw into the cylinder head, (see fig. 2), but only finger tight. Connect the fuel pressure line and lightly tighten union for bleeding; tighten cap screw 25 to the specified torque.

When all injection nozzles are installed, slide knurled nuts 21 and seal washers 22 (see fig. 1) over nozzle bodies. Screw T-boots 20 into knurled nuts and tighten. Connect leak-off hoses to boots (see figs. 1 and 2).

INSTALLING THE FUEL PRESSURE LINES

NOTE: When installing one or all fuel pressure lines, reverse removal procedure (see "Removal").

Blow compressed air through new lines before installation. Insure that each line fits easily to the pump body and the appropriate injection nozzle. If it does not, adjust the line very carefully. Tighten pipe union on each pressure line with one hand, using two wrenches. Hold male union with a wrench, see fig. 17. Do not tighten more than necessary to stop fuel leaks.

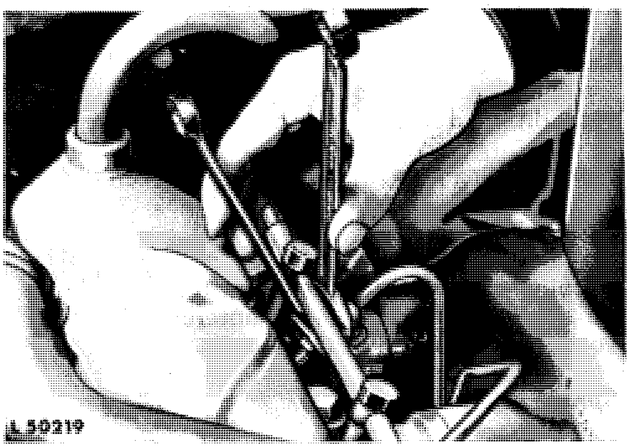


Fig. 17 — Tightening Pressure Lines

Bleeding the Fuel System (see also Operator's Manual): Set the hand throttle to medium speed. Turn crankshaft with starter until fuel lines to the injection nozzles are bled.

Only when air bubbles stop issuing from the loose line connections, and not before, tighten pipe union on each pressure line as described above.

Start up engine and check for leaks.

SPECIFICATIONS

Number of nozzle tip orifices	5	
Diameter of nozzle tip orifice	0.012 in.	0.25 mm
Sac hole diameter	0.042 in.	1.067 mm

Opening pressure

Opening pressure of a new or reconditioned nozzle with a new spring	2950-3050 psi	206-214 kg/cm^2
Opening pressure of a used nozzle which is to be checked, minimum	2750 psi	193 kg/cm^2
Opening pressure to be adjusted on a reconditioned nozzle (adjust to higher value)	2750-2850 psi	193-200 kg/cm^2
Max. opening pressure difference between cylinders	100 psi	7 kg/cm^2

Nozzle Valve Lift

Turning valve lift adjusting screw (based on zero valve lift) 1/2 turn counterclockwise corresponds to a valve lift of	0.009 in.	0.229 mm

Spray Pattern Test

With the gauge shut-off valve closed, work pump lever at 60 strokes per minute

Chatter Test

If the nozzle tester pump is worked at 60 strokes per minute, with the shut-off valve closed, a characteristic chatter should be heard.

Checking Nozzle Valve Seat for Leakage

Operate pump lever slowly until gauge indicates a pressure of 2400 psi (169 kg/cm^2). Observe nozzle: no drop should form on the nozzle tip within 10 seconds.

Checking Valve Stem and Guide Wear (Fuel Leakage)

Pump the pressure to 1500 psi (105 kg/cm^2) and maintain. Count drops for 30 seconds after first drop has formed at rear end of nozzle; there should be from 4 to 8 drops.

TORQUES FOR HARDWARE

Lock nuts of adjusting screws	70-75 in.lbs.	80-85 cmkg
Injection nozzle to cylinder head, cap screw	20 ft.lbs.	2.8 mkg

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SPECIAL TOOLS

Part No. if ordered from JD Parts Depot	Manufacturer	Description	Use
....	65-030 D** ...	BACHARACH nozzle tester......	Testing injection nozzles
....	EFEP 60 A ...	BOSCH nozzle tester	Testing injection nozzles
1958-90.577		Pressure line	Injection nozzle to BOSCH tester
L 48544.....	JDE 38*	Sliding hammer puller	Removing nozzles
L 48545.....	JD 39*.......	Cleaning tool	Cleaning cylinder head bores for nozzles
L 48546.....	16494*	1 set of tools	Servicing nozzles
L 48554.....	16487*	Magnifying glass	Checking nozzle parts
L 48555.....	16475*	Special holding fixture	Clamping complete nozzle in a vise
L 48556.....	16484*	5 nozzle cleaning wires.......... (0.008 in. = 0.20 mm dia.)	Cleaning nozzles
L 48557.....	16485*	5 nozzle cleaning wires.......... (0.01 in. = 0.25 mm dia.)	Cleaning nozzles
L 48568.....	16476*	2 Sac hole drills	Cleaning nozzle sac hole bore
L 48569.....	16482*	Scraper......................	Cleaning nozzle valve seat
L 48570.....	16490*	Honing stone	Flattening nozzle valves
....	16544*	Felt cleaning pad (not available individually)	Cleaning nozzle valves
L 48571.....	16483*	Pin vise	Holding nozzle cleaning wires
L 48572.....	16504*	Screwdriver	Adjusting needle stroke
L 48573.....	16488*	Brass wire brush	Cleaning nozzle parts
L 48574.....	16481*	Valve retractor	Pulling nozzle valve
L 48576.....	16478*	Special adapter for torque wrench	Tightening lock nuts of adjusting screws
L 48577.....	16492*	Connector	Injection nozzle to BACHARACH tester
L 48578.....	16489*	1 can of special polishing compound	Lapping nozzle valve in nozzle body
L 48531.....	16477*		
	JD 258*	Pilot tool	Installing carbon stop seal
....	16493*	Tool kit case (not available individually)	Tool storage

* SERVICE TOOLS INC., 1901 INDIANA AVENUE, CHICAGO, ILLINOIS 60616, USA
** BACHARACH INDUSTRIAL INSTRUMENT CO., 200 NO. BRADDOCK Ave., PITTSBURGH 8, PA., USA

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Group 25
COLD WEATHER STARTING AIDS

STARTING FLUID ADAPTER

GENERAL INFORMATION

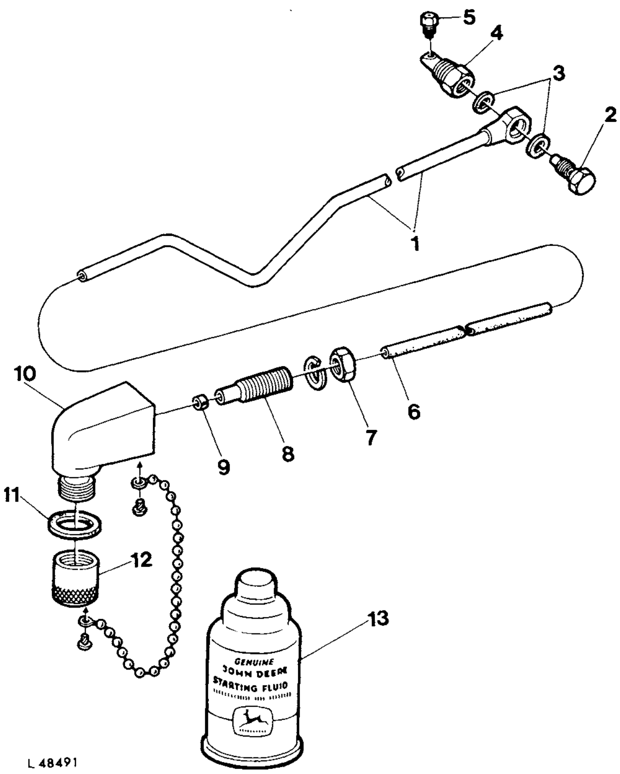

Fig. 1 — Parts of Starting Fluid Adapter

1 Pressure line
2 Hollow screw
3 Seal rings
4 Nozzle holder
5 Spray nozzle
6 Hose section
7 Hex. nut
8 Connector
9 Seal ring
10 Adapter
11 Seal
12 Cap
13 Pressure can with spray fluid

To facilitate engine starting in cold weather, the tractor can be equipped with an adapter for injecting starting fluid (from a pressure can).

When starting the engine, this adapter is used for injecting a volatile starting fluid from pressure can 13 (fig. 1) into the intake manifold and thus into the combustion chamber of the cylinders.

To use the starting aid, unscrew adapter cap 12 and press the head of the spray can into the bore of adapter 10 of the pressure line.

CAUTION: Do not run engine if cap 12 is not in position.

REPAIR

Take off right-hand cowl; remove all starting aid parts as shown in fig. 1.

Check all parts for serviceability.

When cleaning the spray nozzle 5, make sure that the bore is not enlarged or damaged.

Install all starting aid components as shown in fig. 1. Install nozzle holder 4 so that the spray nozzle 5 points upward (see fig. 1). An arrow stamped into one of the hexagonal faces of the nozzle holder will indicate the position.

NOTE: Threads on spray nozzle and nozzle holder are self-sealing; use no sealing compound or seal.

THERMOSTART AID

GENERAL INFORMATION

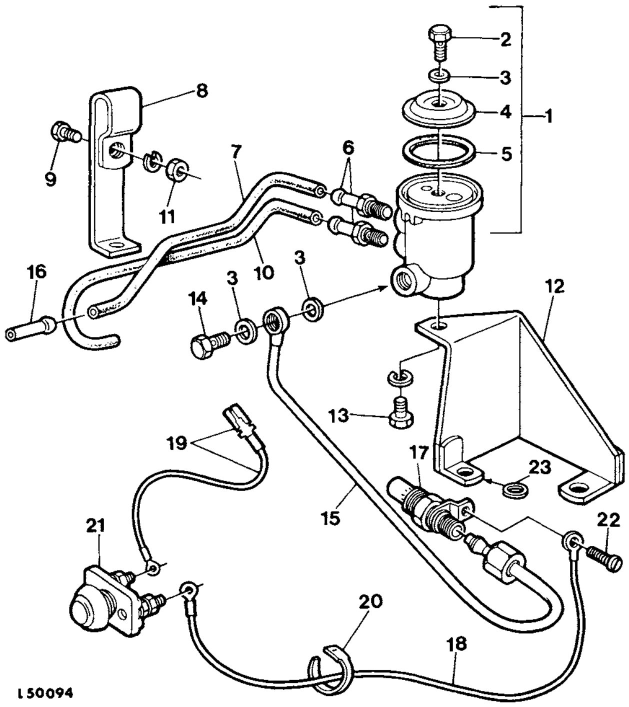

Fig. 2 — "Thermostart" - Exploded View

1 Fuel reservoir	14 Hollow screw
2 Hollow screw	15 Fuel line to burner
3 Sealing washers	16 Hose nipple
4 Cover	17 Burner
5 Gasket	18 Wire from push button switch to burner
6 Hose connections	19 Wire from main switch to push button switch
7 Fuel hose to reservoir	20 Wire clamp
8 Clamp	21 Push button switch
9 Cap screw	22 Button-head screw
10 Fuel return hose to tank	23 Washer
11 Hex. nut	
12 Bracket	
13 Cap screw	

This is how the "Thermostart" device works: Fuel from the leak-off line is fed to the fuel reservoir 1 (fig. 2), located above the cylinder head. This reservoir is constantly kept full; surplus fuel returns to the fuel tank. To operate, push switch 21. Current then flows through leads 19 and 18 to a filament inside the burner 17, located in the intake manifold. As the filament heats up, a heat-sensitive valve (also installed in the burner) opens, allowing fuel to enter the burner through fuel line 15.

The hot filament ignites the fuel which heats the air in the intake manifold, thus providing the engine with preheated intake air for easy starting.

REPAIR

Remove hood and cowl side panel.

Remove parts of Thermostart aid as shown in fig. 2.

When removing push button switch 21, disconnect ground cable from negative (-) pole of batteries.

Check all parts for serviceability and replace, if necessary.

Install all parts as shown in fig. 2. When installing Thermostart burner 17, coat threads of burner with a suitable sealant and tighten burner to the specified torque.

CAUTION: Before operating Thermostart aid for the first time after installation, make sure fuel reservoir is filled to prevent damage to the Thermostart aid.

TORQUES FOR HARDWARE

Thermostart burner
in intake manifold . . . . . 14.5 ft.lbs 2 mkg

Section 40
ELECTRICAL SYSTEM

CONTENTS OF THIS SECTION

Group 5
DIAGNOSING MALFUNCTIONS

1

BATTERIES

LOW OUTPUT

Terminals loose or corroded; cables defective

Low electrolyte level

Low gravity of electrolyte

Defective regulator

Defective alternator (generator)

BATTERIES USE TOO MUCH WATER

Defective regulator

Battery case cracked

BATTERIES ARE NOT CHARGED

Terminals loose or corroded

Fan belt slack or damaged

Sulfated or worn batteries

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ALTERNATOR

TESTS AND DIAGNOSIS ON TRACTOR

Almost every trouble in the alternator will be revealed by the alternator indicator light or by battery behaviour. Therefore, locate cause of trouble as follows:

NOTE: AI = Alternator indicator light, TL = Test lamp, 2 Watt

Trouble indicated with main switch turned ob	Test	Cause
1. Alternator indicator light does not light with the engine shut off	TL between alternator terminals B+ and D+ lights clearly	Bulb blown or test lamp circuit to D+ of alternator interrupted
	TL between alternator terminals B+ and D+ does not light up TL between D+ and ground lights clearly; AI fails	Positive diode in alternator shorted. Disconnect charging wire B+ immediately or switch off main switch, otherwise batteries will be discharged.
	TL between D+ and ground glows; AI glows, too: Withdraw regulator plug, ammeter between B+ and DF indicates an exciting current of 0 amp	Brushes worn, slip rings corroded, rotor windings have an open circuit
	exciting current of 2-3 amps	Regulator or wires between alternator and regulator open-circuited
2. Alternator indicator light lights clearly with the engine running or shut off	Pull out regulator plug with the engine shut off: AI stays on	Alternator wire D+ grounded
	AI fades out: Insert regulator plug and connect ammeter between alternator terminals B+ and D+: less than 2-3 amps	Regulator defective (open circuit) Circuit between alternator diodes and brush holder interrupted
	more than 2-3 amps	Wire DF or rotor field windings grounded
3. With the engine shut off, alternator indicator light lights clearly, but grows dark or glows when the engine is running	With the engine running, TL between B+ and D+: faded out:	Excessive resistance in charging circuit or current flow to alternator indicator light
	glowing:	Regulator defective (battery overcharged or alternator defective (insufficient battery charge)
	With the engine shut off, connect new regulator TL with the engine running: faded out:	Removed regulator defective
	glowing:	Alternator defective

ALTERNATOR DOES NOT CHARGE

Alternator-fan belt slipping

Open circuit or excessive resistance in charging circuit

Worn or defective brushes

Regulator operating improperly

Open circuit in rotor field windings

LOW OR IRREGULAR CHARGING SYSTEM OUTPUT

Fan belt slipping

Open circuit or excessive resistance in charging circuit

Brushes insufficiently supported; worn or defective brushes

Defective regulator

Shorted or defective rectifier diodes

Rotor windings shorted or grounded

Stator windings open, shorted or grounded

EXCESSIVE CHARGING SYSTEM VOLTAGE

Alternator or regulator terminals loose

Regulator operating improperly

NOISY ALTERNATOR

Defective or heavily worn fan belt

Fan belt or pulley not aligned

Pulley loose

Worn bearings

Shorted rectifier diodes

GENERATOR

GENERATOR DOES NOT CHARGE

Generator-fan belt slipping

Regulator or generator connections loose or corroded or wires chafed through (grounded); battery cable loose or corroded

Worn or defective brushes

Brushes stuck in holder (do not bear fully)

Regulator not operating

Armature and/or field windings defective

LOW OR IRREGULAR CHARGING SYSTEM OUTPUT

Fan belt slipping

Regulator or generator connections loose or corroded or wires chafed through (grounded)

Brushes insufficiently supported; worn or defective brushes

Defective regulator

Grounded or shorted windings or open armature or field windings

EXCESSIVE CHARGING SYSTEM VOLTAGE

Connections or wires between regulator and generator loose or corroded or wires chafed through

Regulator operating improperly

NOISY GENERATOR

Defective or heavily worn fan belt

Generator (pulley) not aligned

Pulley loose

Worn bearings

CONTROLS

GENERATOR (ALTERNATOR) INDICATOR LIGHT

Tractors equipped with alternator

Diagnosing Malfunctions see "Alternator"

Tractors equipped with generator

Glows dim or flickers on and off

Excessive resistance in generator

Generator defective

FUEL GAUGE

Always shows "empty"

Open circuit

Poor ground connection between dashboard and fuel gauge

Wire between sending unit and fuel gauge grounded

Float leaking

Sending unit and/or fuel gauge defective

Always shows "full"

Excessive resistance in wire between sending unit and fuel gauge or defective wire

Poor ground contact on sending unit

Sending unit and/or fuel gauge defective

ENGINE OIL PRESSURE INDICATOR LIGHT

Does not light up

Bulb blown

Excessive resistance or ground circuit in wire

Indicator lamp damaged

Oil pressure warning switch defective

Does not fade out

Low engine oil pressure

Indicator lamp damaged

Wire to oil pressure warning switch grounded

Oil pressure warning switch defective

STARTER

SLUGGISH STARTER OPERATION

Low battery output

Terminals loose or corroded; cable defective

Starter defective

Excessive engine drag

Crankcase oil too heavy

DOES NOT OPERATE

Starter safety switch not closed

Batteries discharged

Terminals loose or corroded; cables or wires damaged

Starter defective

Main switch defective

Start safety switch improperly adjusted or defective

SOLENOID SWITCH "CHATTERS"

Low battery output

Terminals loose or corroded; cables or wires defective

HEAD LIGHTS

DIM LIGHT

Poor contact at cable connections or poor ground contact on head lights

Low battery output

Main switch defective

CIGAR LIGHTER

DOES NOT OPERATE

Circuit breaker has interrupted circuit

Lighter filament or sleeve defective

Defective wire

NOTE: For overall and detailed information on inspection and repair of the electrical system and its components e.g. starter, generator and batteries, see "Fundamentals of Service — Electrical Systems" manual.

Group 10
COMPONENTS AND WIRING DIAGRAMS

IMPORTANT NOTES

TRACTORS EQUIPPED WITH AN ALTERNATOR

1. CAUTION: With the engine running, do not disconnect battery terminals or wires between regulator, alternator and battery. Interrupting the circuit for even less than a second will immediately destroy the rectifier diodes in the alternator.

2. With the engine running, do not short or ground (even momentarily) alternator and regulator terminals.

3. If the tractor is to be operated without battery (using a slave battery for starting), remove plug at alternator and connect terminals D+, DF and D- together with bridge piece supplied with the tractor. The alternator will then generate no electricity.

4. Connect batteries or battery chargers in the proper polarity. If they are improperly connected, the rectifier diodes will be immediately destroyed.

5. Before carrying out electric welding jobs on the tractor, disconnect plug and terminal B+ at alternator. Connect terminals D+, DF and D- together with bridge piece supplied with the tractor. Connect ground terminal of welding apparatus directly to the part being welded.

TRACTORS EQUIPPED WITH A GENERATOR

1. When starting the engine by means of a slave battery and thereafter, make sure battery clamp of cable to starter is properly insulated. Damage to generator and regulator can be avoided only by following this recommendation.

2. Never start engine by means of a slave battery when wires between regulator and generator are disconnected.

BATTERIES

The tractor is equipped with two 12-volt batteries connected in parallel. They are located in front of the cowl and are accessible through a hinged door.

The negative pole of the left-hand battery is grounded by means of the ground strap attached to the cowl. The negative pole of the right-hand battery is connected to the negative pole of the left-hand battery by means of a ground cable.

The positive pole of the left-hand battery is connected to the positive pole of the right-hand battery by means of a cable.

The battery cable to the starter is connected to the positive pole of the right-hand battery.

The cable to the main switch is connected to the positive pole of the left-hand battery.

FOS

NOTE: For detailed battery description and service see "Fundamentals of Service — Electrical Systems" manual.

STARTER

GENERAL INFORMATION

The BOSCH 12-Volt helical-spline sliding gear starter is located on the right side of the tractor. It is seated in a flywheel bore and is attached by means of a stud screw and a cap screw.

A solenoid moves the pinion forward. When the engine starts, the pinion is pulled back by a coil spring installed in the solenoid.

FOS

NOTE: For a detailed explanation of starter design and operation see "Fundamentals of Service — Electrical Systems" manual.

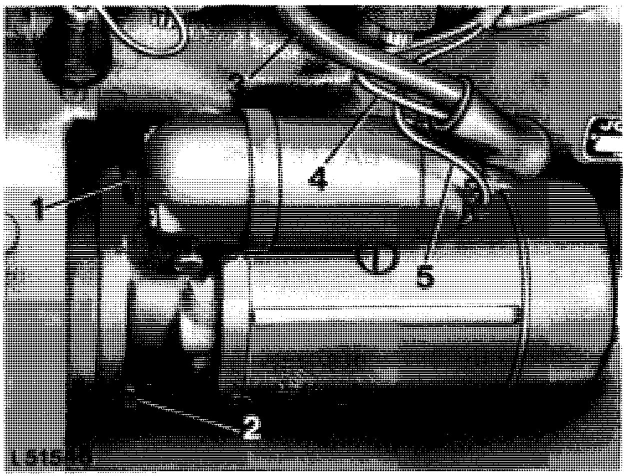


Fig. 1 — Starter Installed

1 Hex.nut
2 Cap screw
3 Starter cable of batteries
4 Wire to generator* or regulator**
5 Wire from starter button

* On tractors equipped with alternator
** On tractors equipped with generator

REPAIR

Disconnect ground strap and cable at negative pole of each battery. Then disconnect wires 4 and 5 (see fig. 1) as well as cable 3 at starter. Remove cap screw 2 and hex.nut 1 and remove starter.

FOS

NOTE: For a detailed explanation of starter repair operations see "Fundamentals of Service — Electrical Systems" manual. Necessary specifications are indicated at the end of this group.

When installing the starter, first slide cable 3 (fig. 1) over starter connecting pin, then wire 4. Connect wire 5 from starter button (see wiring diagram).

ALTERNATOR

GENERAL INFORMATION

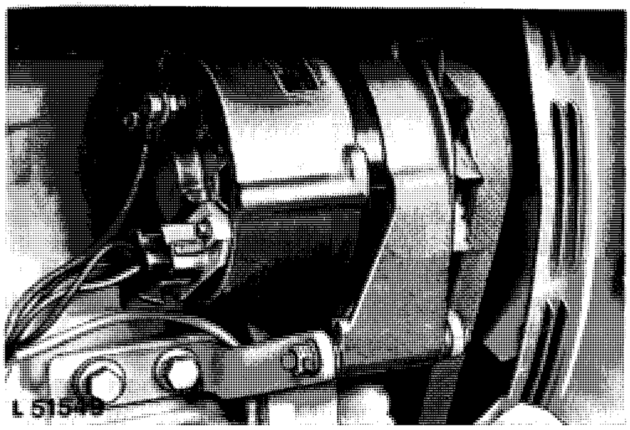


Fig. 2 — Alternator Installed

The BOSCH 14-Volt alternator is a 12-pole self-induced synchronous generator. The current coil is located in the stator, and the exciting coil in the rotor. The exciting current is supplied by the rectifier (terminal D+) through the regulator, two brushes and slip rings to the exciting coil in the rotor.

The alternator is driven by the fan belt off the crankshaft. The rotor is supported by two pre-lubricated bearings.

The alternator generates alternating current which is then transformed into direct current by the rectifier diodes 4 (see fig. 3).

The alternating windings are Y-connected. The coil ends U, V and W (see fig. 3) are connected to the rectifier diodes. The current flows through the diode and terminal B+ directly to the positive pole of the battery. Due to this arrangement the main current no longer flows through the regulator.

Alternating current is generated in each stator coil 3 of the alternator. During one revolution of the rotor, voltage in the stator coil rises from 0 to the positive maximum, drops to 0, rises to the negative maximum and again drops to 0. Then the process is repeated.

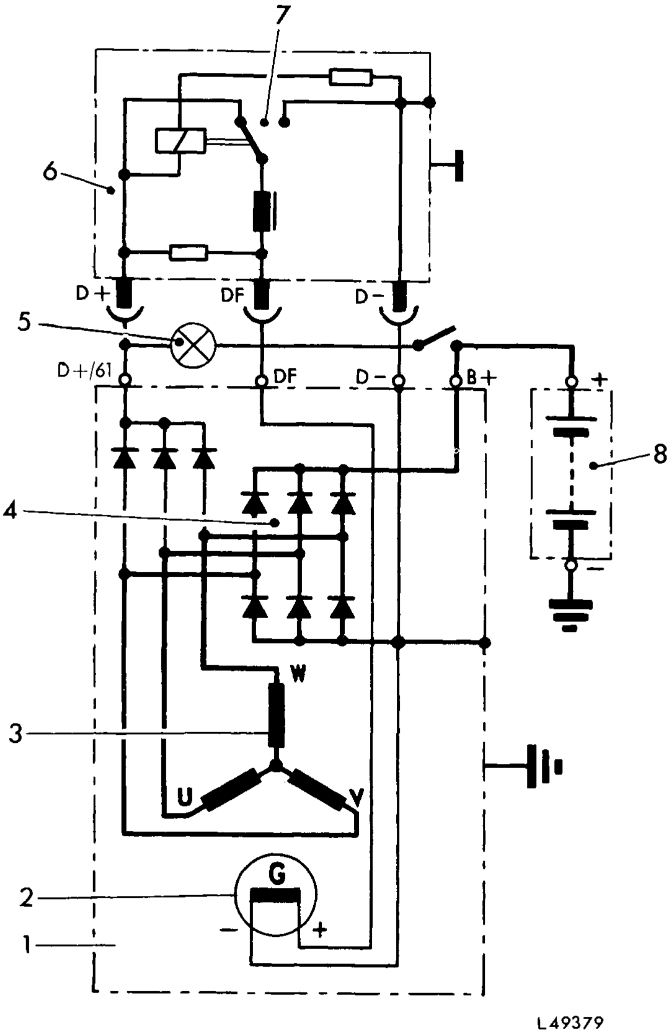


Fig. 3 — Wiring Diagram of an Alternator with Regulator

1 Alternator
2 Exciting coil (rotor)
3 Current coil (stator)
4 Rectifier
5 Alternator indicator light
6 Single unit, 2-terminal regulator
7 Regulator terminals
8 Battery

As the stator coils are Y-connected, a three-phase or alternating current is generated. The individual phases are shifted by 120°.

FOS

NOTE: For a detailed explanation of alternator design and operation see "Fundamentals of Service — Electrical Systems" manual.

REPAIR

With the engine shut off, disconnect plug at alternator. Disconnect terminal B+ at alternator.

Remove alternator attaching screws and lift out alternator.

CAUTION: Replace alternator bearings and brushes after every 2000 hours of operation. The life of the brushes is adjusted to that of the bearings so that the alternator will fail when the bearings have to be replaced. Therefore always replace bearings together with brushes. If bearings are not replaced, the rotor will run unevenly, rubbing against the alternator stator. This will result in severe damage to the alternator.

Replacing brushes

Remove brush holder plate with brushes from rear of alternator. Unsolder brushes and replace. Make sure solder (use only colophony tin solder) does not flow into copper strands (minimum length of brushes see Specifications).

Check if brushes can be moved easily after installation.

Replacing ball bearings

Loosen attaching screws in drive bearing and pull rotor together with drive bearing carefully out of stator. Push rotor out of drive bearing, using a press and suitable support. Remove ball bearing from drive bearing and press in new bearing with closed side facing downward. Attach holder plate.

Push bearing facing slip ring from rotor, using a press, or pull off by means of an extractor. Press on new bearing.

Press drive bearing with ball bearing on rotor, using a press. Make sure that support is clean so that no dirt can enter the bearing.

NOTE: For detailed explanation of alternator repair operations see "Fundamentals of Service—Electrical Systems" manual as well as "Repair Instructions" of manufacturer. Necessary specifications are indicated at the end of this group.

When installing the alternator, reverse removal procedure.

For checking and adjusting fan belt tension see section 20, group 35.

GENERATOR

GENERAL INFORMATION

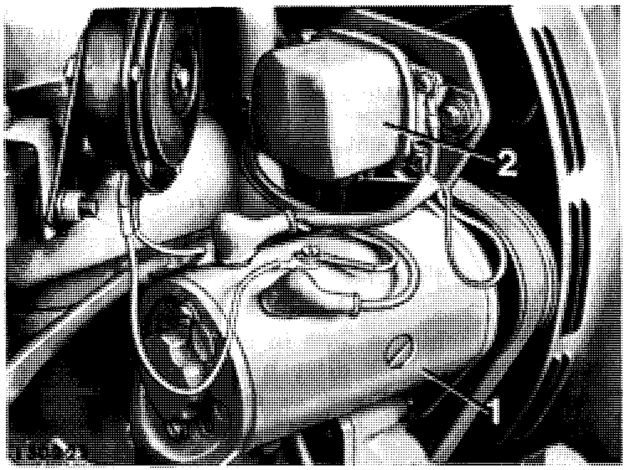


Fig. 4 — Generator and Regulator, Installed

1 Generator 2 Regulator

The Bosch 12-volt generator is V-belt driven by the crankshaft. The armature is supported by two pre-lubricated bearings. The generator is completely enclosed. The carbon brushes can be reached only after removing the rear bearing cover.

NOTE: For a detailed explanation of generator design and operation see "Fundamentals of Service—Electrical Systems" manual.

REPAIR

Disconnect generator wires. Remove cap screws and spacer. Take out generator.

IMPORTANT: If the generator fails to function properly and is removed for inspection, the regulator should also be removed and tested. When installing a new or reconditioned generator, have the regulator checked, too. Failing to do so may cause damage to the new or reconditioned generator.

NOTE: For detailed explanation of generator repair operations see "Fundamentals of Service—Electrical Systems" manual. Necessary specifications are indicated at the end of this group.

When installing the generator, reverse removal procedure. Make sure that wires and cables are not mixed up (see Wiring Diagrams).

For checking and adjusting fan belt tension see section 20, group 35.

REGULATOR

GENERAL INFORMATION

Tractors equipped with Alternator

A single unit, 2-terminal regulator is used for regulating the alternator voltage. The 2-terminal regulator limits the alternator voltage to approx. 14 Volts. No current regulation is required as the alternator current curve rises to its maximum value and then flattens out at maximum alternator speed.

The regulator is located in the tractor dashboard. To remove the regulator, detach right-hand side panel of cowl.

CAUTION: Disconnect cable plug only with the engine shut-off.

NOTE: For a detailed explanation of alternator-regulator design and operation see "Fundamentals of Service— Electrical Systems" manual.

Tractors equipped with Generator

The regulator is rubber-mounted above the generator (see fig. 4).

IMPORTANT: Do not replace the regulator without having the generator carefully checked by a specialist. Always have regulator and generator inspected together; both parts rely on and influence each other.

When installing the regulator, be absolutely sure not to mix up wires (see wiring diagrams).

NOTE: For a detailed explanation of generator-regulator design and operation see "Fundamentals of Service — Electrical Systems" manual.

GENERATOR (ALTERNATOR) INDICATOR LIGHT

The generator (alternator) indicator light is located in the dashboard (see 4, fig. 5). When switching on the main switch, this light goes on. It fades out as soon as the engine is running.

If all components of the electrical system, including the indicator light, are functioning properly and the indicator light fades out, the batteries are being charged by the generator (alternator). However, if the indicator light stays or goes on when the engine is running, this indicates a fault which should be remedied immediately (see group 5).

CONTROLS AND INSTRUMENTS

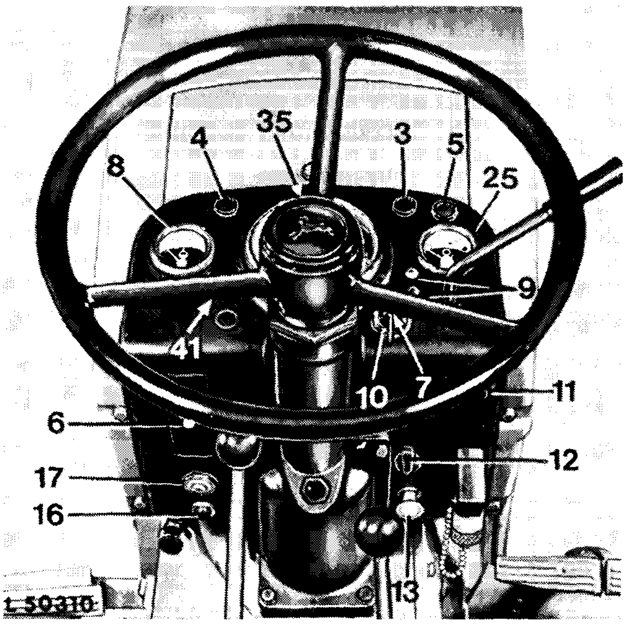


Fig. 5 — Dashboard, Controls and Instruments

3 Engine oil pressure light
4 Generator (Alternator) indicator light
5 Full-beam indicator light
6 Fuse box
7 Tractor turn signal indicator light
8 Coolant temperature gauge
9 Trailer turn signal indicator lights
10 Turn signal light switch
11 Horn button
12 Socket for handlamp
13 Cigar lighter
16 Starter button
17 Main switch
25 Fuel gauge
35 Tractormeter
41 Flashing warning light switch*

* On tractors equipped with flashing warning lights.

Most of the controls and instruments are located in the dashboard (see fig. 5).

Other controls are located as follows: Engine oil pressure warning switch in the flywheel housing, fuel gauge sending unit in the fuel tank, start safety switch in the rockshaft housing and the stop light switch in the left-hand brake line.

CABLES AND WIRES

The components of the electrical system are connected by cables and wires which are partly arranged in harnesses, as shown in the wiring diagram:

Wiring Harness	Connects the following Components of the Wiring System
"A"	Dashboard — Engine
"B"	Dashboard — Stop light switch, start safety switch, connectors, right and left-hand
"C"	Connector, right-hand — Turn and parking light, right-hand, 7-terminal socket
"D"	Main switch — Fuse box
"E"	Connector, left-hand — Turn and parking light, left-hand, stop and turn light, and tail light, left-hand
"F"	Generator (Alternator) — Regulator
"G"	Flasher — Turn light switch and turn light indicator lights
"H"	Wire distributor — Head light, right-hand
"J"	Wire distributor — Head light, left-hand
"K"	7-terminal socket — Stop and turn light, and tail light, right-hand
"L"	Flashing warning light switch — Turn light switch and fuse box

GROUND STRAP AND GROUND CABLE

A ground cable connects the negative pole of the right-hand battery to the negative pole of the left-hand battery. A ground strap connects the negative pole of the left-hand battery to the cowl.

* On tractors equipped with flashing warning lights.

WIRING DIAGRAM

The individual components of the wiring system are identified by the following numbers:

1 Head lights
2 Turn-signal and parking lights
3 Engine oil pressure indicator light
4 Generator (alternator) indicator light
5 Full-beam indicator light
6 Fuse box
7 Tractor turn-signal indicator light
8 Coolant temperature gauge with lamp
9 Trailer turn-signal indicator lights
10 Turn-light switch
11 Horn button
12 Socket (for handlamp)
13 Cigar lighter
14 Start safety switch
15 Starter button
17 Main switch
18 Flasher
19 Horn
20 Engine oil pressure warning switch
21 Regulator
22 Alternator
22a Generator
23 Starter
24 Fuel gauge sending unit
25 Fuel gauge with lamp
26 Batteries
27 Rear work light
28 Connector, right-hand
29 7-terminal socket
32 Stop light switch
33 Stop and turn light, and tail light, right-hand
34 Stop and turn light, and tail light, left-hand
35 Tractormeter with lamp
36 Connector, left-hand
37 Wire distributor
38 Wire distributor
39 Thermostart button
40 Burner of Thermostart aid
41 Flashing warning light switch*

Cables and wires have different colours to facilitate identification. Each component and wire in the wiring diagram is identified by a number. From these numbers which are indicated below it is possible to establish the colour, size and purpose of each wire or cable.

No.	Cable or wire mm^2	Colour	from Component	from No.	from Terminal No.	to Component	to No.	to Terminal No.
42	Ground strap		L.H. battery	26	"-"	Dashboard		
43	25	black	R.H. battery	26	"-"	L.H. battery	26	"-"
44	25	black	L.H. battery	26	"+"	R.H. battery	26	"+"
45	25	black	R.H. battery	26	"+"	Starter	23	30
46	2.5	black	Starter	23	50	Starter button	16	
47	2.5	black	Starter button	16		Start safety switch	14	
48	6	red	Starter	23	30	Alternator or Regulator**	22 21	B+
51	1 or 1.5	green light blue**	Generator	22 or 22a**	DF	Regulator	21	DF
52	1 or 1.5**	brown	Generator	22 or 22a**	D-	Regulator	21	D-
53	1 or 6	light blue red**	Generator	22 or 22a**	D+	Regulator	21	D+
55	1	green	Oil pressure warning switch	20		Oil pressure indicator light	3	
57	1	blue/white	Fuel gauge sending unit	24		Fuel gauge	25	G
59	1	light blue	Regulator	21	D+ or 61**	Generator (alternator) indicator light	4	
60	6	red	Battery, L.H.	26	"+"	Main switch	17	30
62	1	black/yellow	Horn button	11		Signal horn	19	
63	1	brown	Horn		19		6	Ground
64	1	grey	Coolant temperature gauge lamp	8		Fuse box (fuse 6)	6	58

* On tractors equipped with flashing warning lights

** On tractors equipped with generator

Cables and wires No.	mm^2	Colour	from Component	No.	Terminal No.	to Component	No.	Terminal No.
65	1	white	Wire distributor	37		Fuse box (fuse 8)	6	56a
66	1	yellow	Wire distributor	38		Fuse box (fuse 7)	6	56b
67	1	white	Headlight, L.H.	1	56a	Wire distributor	37	
68	1	white	Full-beam indicator light	5		Fuse box (fuse 8)	6	56a
69	1	yellow	Headlight, L.H.	1	56b	Wire distributor	38	
70	1	grey/ black	Fuse box (fuse 4)	6	58	Connector	36	
71	1	grey/ black	Fuse box (fuse 4)	6	58	Connector	28	
72	1	grey/ red	Fuse box (fuse 5)	6	58	Connector	28	
73	1	black	Stop light switch	32		Fuse box (fuse 3)	6	15
74		black	Flasher	18	49	Fuse box (fuse 2)	6	15
74*	1	green/yellow	Flasher	18	49	Warning light switch	41	49
75	1	black	Fuel gauge	25	"+"	Fuse box (fuse 2)	6	15
76	1	red	Socket (hand lamp)	12		Fuse box (fuse 1)	6	30
77	1	red	Horn button	11		Socket	12	
78	1	red	Fuse box (fuse 1)	6	30	Cigar lighter	13	
79	1	white	Main switch	17	56a	Fuse box (fuse 8)	6	56a
80	1	yellow	Main switch	17	56b	Fuse box (fuse 7)	6	56b
81	1	grey	Main switch	17	58	Fuse box (fuse 5)	6	58
82	1	black	Main switch	17	15	Fuse box (fuse 2)	6	15
83	1	red	Main switch	17	30	Fuse box (fuse 1)	6	30
84	1	black	Main switch	17	15	Generator (alternator) indicator light	4	
85	2.5	black	Main switch	17	15	Start safety switch	14	
86	1	brown	Full-beam indicator light	5		Fuel gauge	25	
87	1	white	Full-beam indicator light	5		Fuse box (fuse 8)	6	56a
88	1	brown	Fuel gauge	25	Ground	Turn signal light switch	10	Ground
89	1	black	Turn signal light switch	10	54 F	Stop light switch	32	
89*	1	light blue/ white	Turn signal light switch	10	R	Connector	28	

* On tractors equipped with flashing warning lights

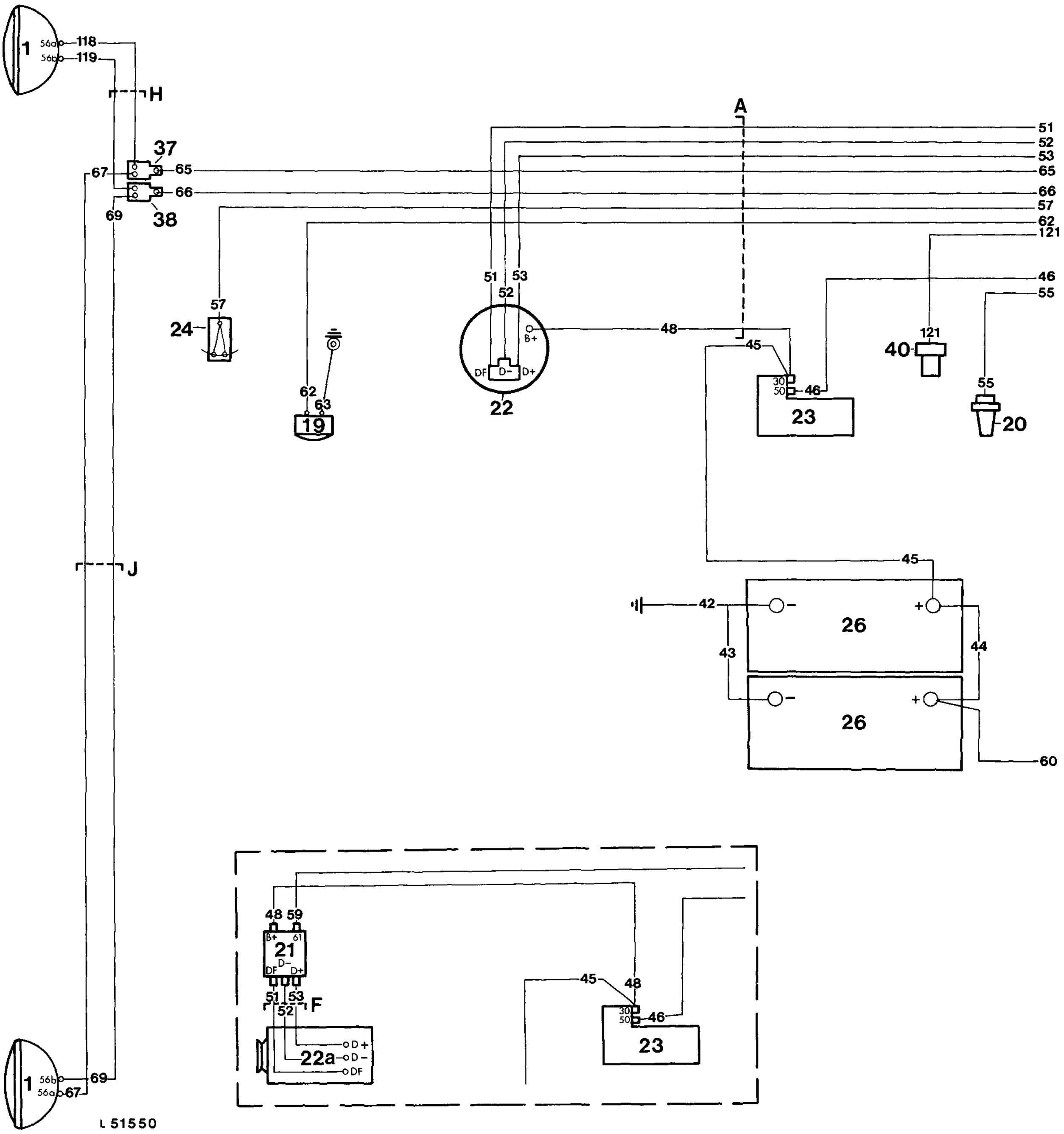
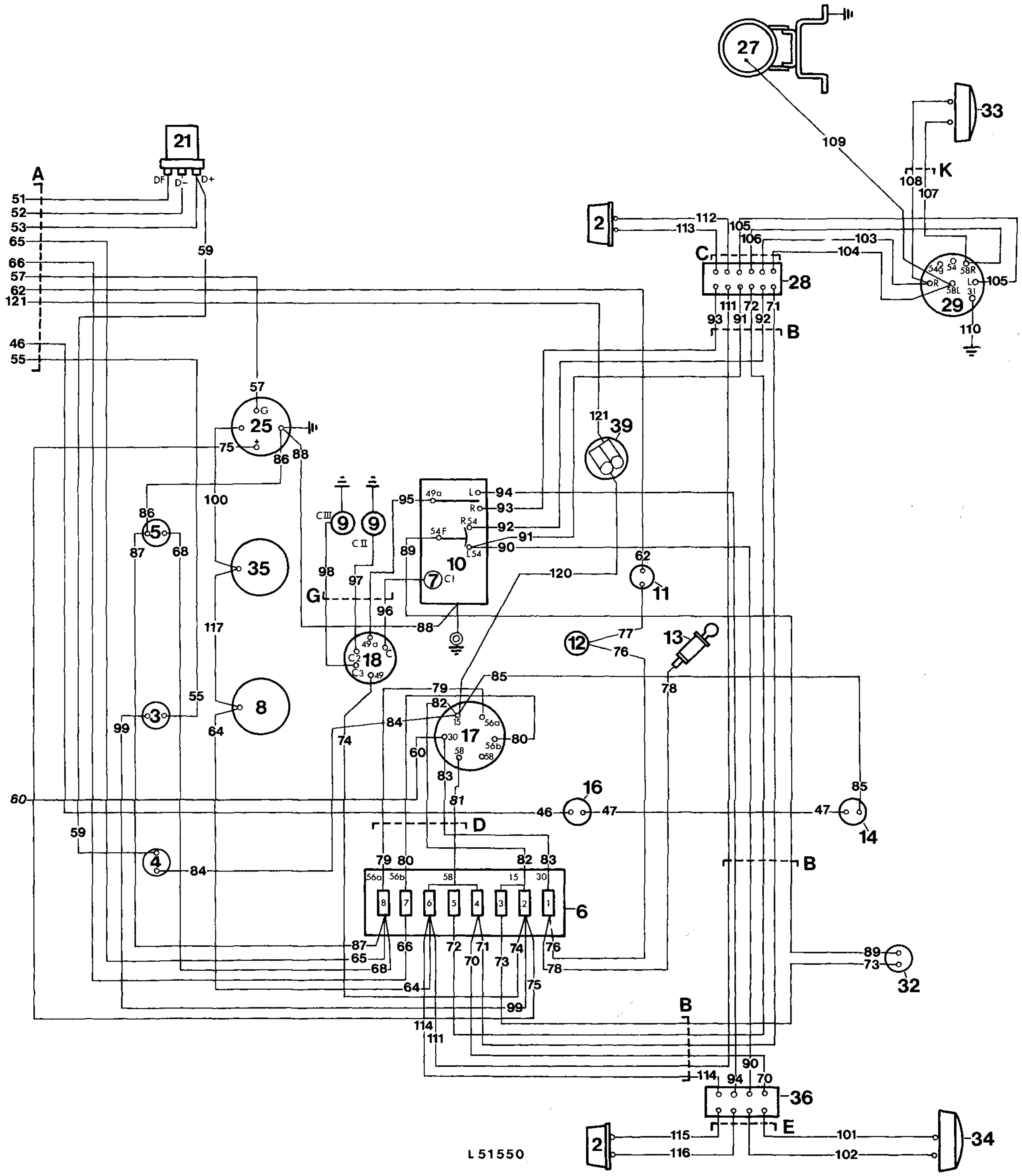


Fig. 6 — Wiring Diagram on Tractors without Flashing Warning Lights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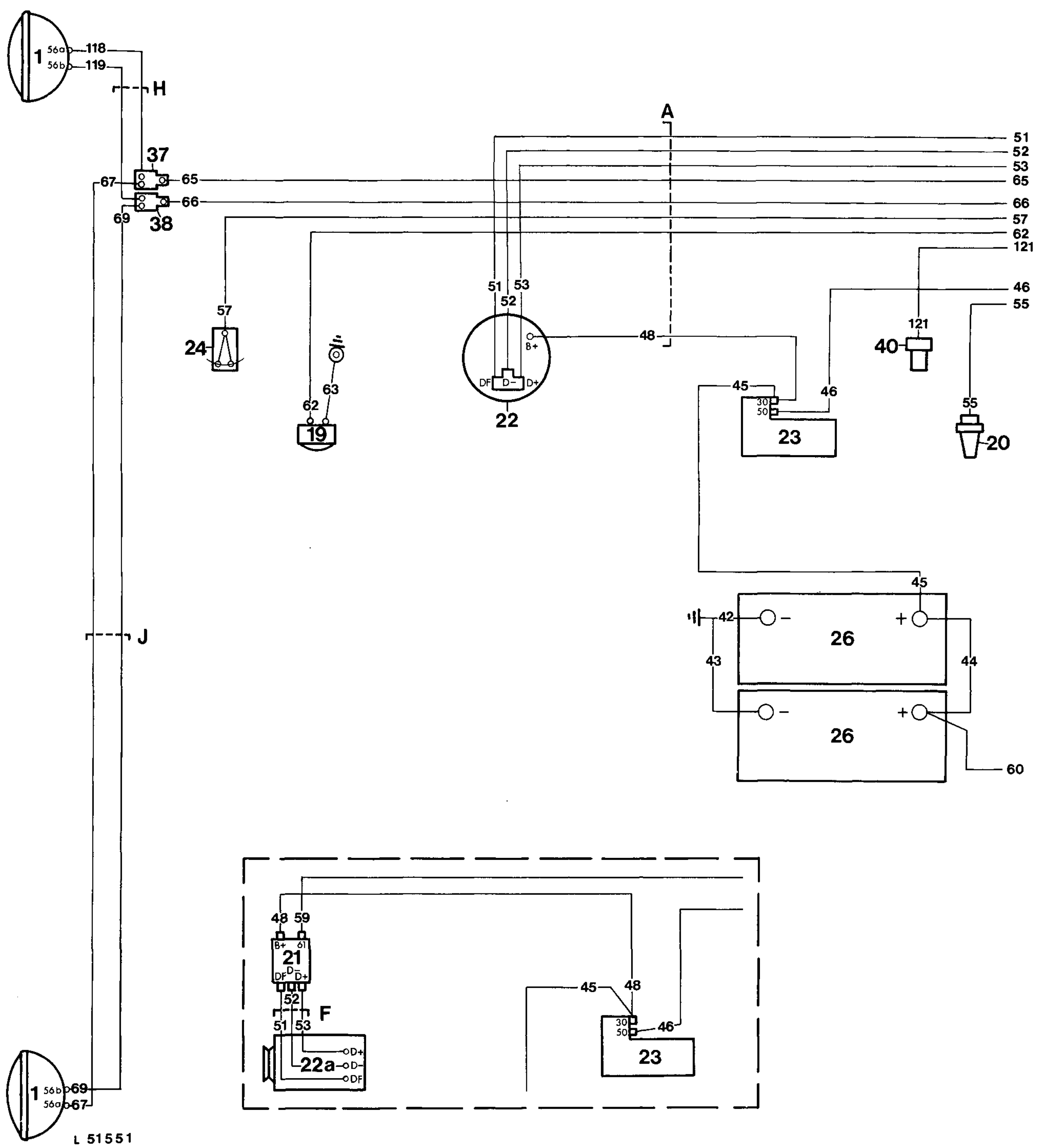
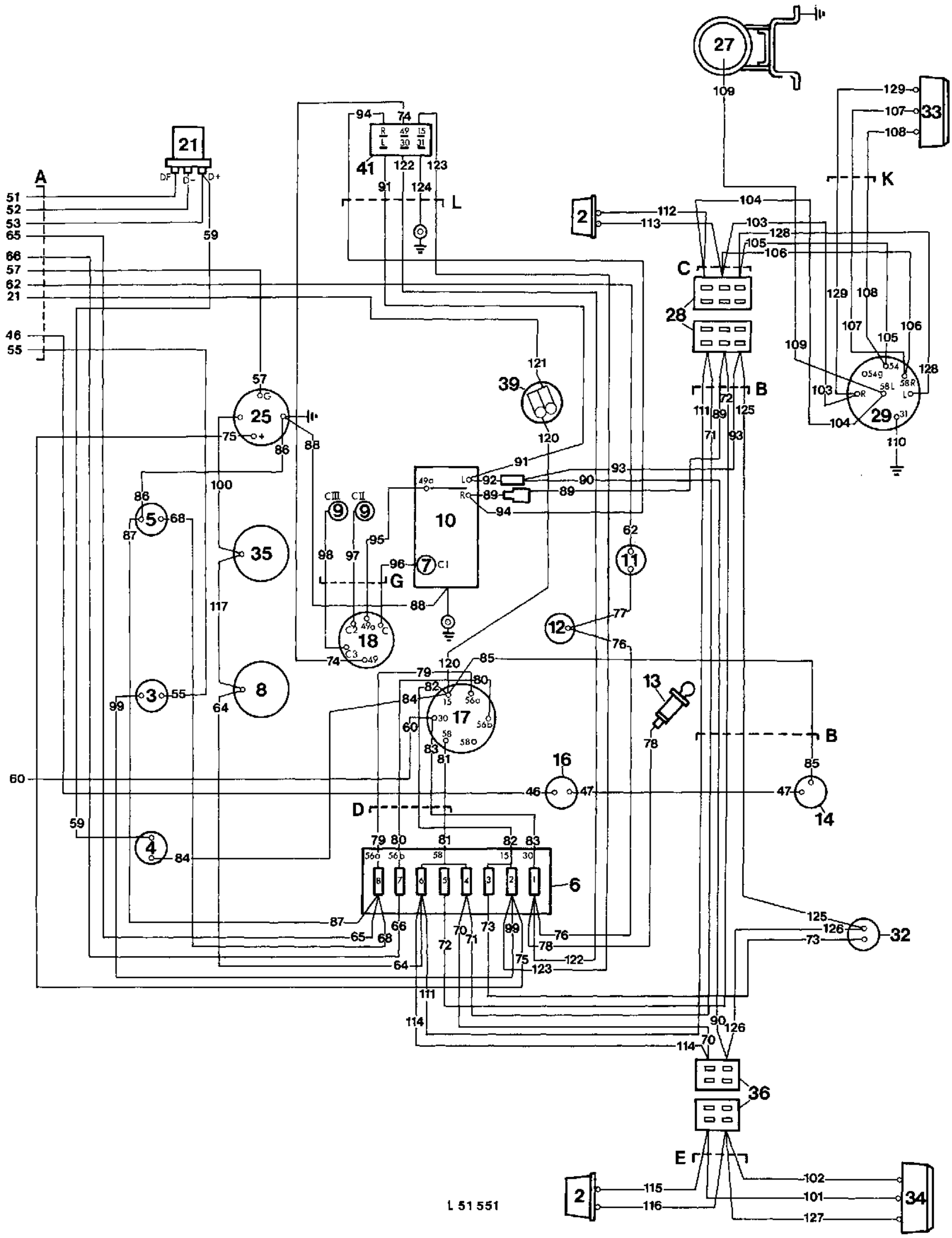


Fig. 7 — Wiring Diagram on Tractors Equipped with Flashing Warning Lights



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Cables and wires No.	mm²	Colour	from Component	from No.	Terminal No.	to Component	to No.	Terminal No.
90	1	black/red	Turn-light switch	10	L 54	Connector	36	
90*	1	black/white	Wire	92		Connector	36	
91	1	black/red	Turn-light switch	10	L 54	Connector	28	
91*	1	black/white	Flashing warning light switch	41	L	Turn-light switch	10	
92	1	black/green	Turn-light switch	10	R 54	Connector	28	
92*	1	black/white	Turn-light switch	10	L	Wire	90	
93	1	light blue/ white	Turn light switch	10	R	Connector	28	
93*	1	black/white	Wire	92		Connector	28	
94	1	black/white	Turn-light switch	10	L	Connector	36	
94*	1	black/green	Flashing warning light switch	41	R	Turn-light switch	10	R
95	1	black/green white	Turn-light switch	10	49a	Flasher	18	49a
96	1	black/ yellow	Flasher	18	C	Turn-light indicator light	7	CI
97	1	black	Flasher	18	C 2	Turn-light indicator light	9	CII
98	1	black/white	Flasher	18	C 3	Turn-light indicator light	9	CIII
99	1	green	Engine oil pressure indicator light	3		Fuse box (fuse 2)	6	15
100	1	grey	Tractormeter (lamp)	35		Fuel gauge (lamp)	25	
101	1	grey/black	Connector	36		Tail light, L.H.	34	
102	1	black/red	Connector	36		Stop and turn-signal light, L.H. or stop light, L.H.*	34	
103	1	black/green or light blue/white*	Connector	28		Socket	29	R
104	1	grey/black	Connector	28		Socket	29	58 L
105	1	black/red	Connector	28		Socket	29	L or 54*
106	1	grey/red	Connector	28		Socket	29	58 R
107	1	grey/red	Socket	29	58R	Tail light, R.H.	33	
108	1	black/green	Socket	29	R	Stop and turn-signal light, R.H.	33	
108*	1	black/green	Socket	29	54	Stop light, R.H.	33	
109	1	grey/red	Socket	29	58L	Rear work light	27	
110	1	brown	Socket	29	31			Ground
111	1	grey	Fuse box (fuse 6)	6	58	Connector	28	
112	1	grey	Connector	28		Parking light, R.H.	2	
113	1	light blue/ white	Connector	28		Turn signal light, R.H.	2	
114	1	grey	Fuse box (fuse 6)	6	58	Connector	36	

* On tractors equipped with flashing warning lights (see wiring diagram, fig. 7)

No.	Cables and wires mm^2	Colour	Component (from)	from No.	Terminal No.	Component (to)	to No.	Terminal No.
115	1	grey	Connector	36		Parking light, L.H.	2	
116	1	black/white	Connector	36		Turn-signal light, L.H.	2	
117	1	grey	Coolant temperature gauge lamp	8		Tractormeter (lamp)	35	
118	1	white	Wire distributor	37		Head light, R.H.	1	56a
119	1	yellow	Wire distributor	38		Head light, R.H.	1	56b
120	1	black	Main switch	17	15	Button of Thermostart aid	39	
121	1	black	Button of Thermostart aid	39		Burner of Thermostart aid	40	
122*	1	red	Fuse box (fuse 1)	6	30	Flashing warning light switch	41	30
123*	1	black	Fuse box (fuse 2)	6	15	Flashing warning light switch	41	15
124*	1	brown	Flashing warning light switch	41	31			Ground
125*	1	black/red	Stop light switch	32		Connector	28	
126*	1	black/red	Stop light switch	32		Connector	36	
127*	1	blach/white	Turn light	34		Connector	36	
128*	1	black/white	Socket	29		Connector	28	
129*	1	black/white	Turn light	33		Socket	29	R

ELECTRICAL SYSTEM WITHOUT TURN-SIGNAL LIGHTS

On tractors without turn-signal lights, wires No. 88 to 94 (see fig. 6, wiring diagram) are not connected to the turn light switch, but to a terminal plate. In addition, the following parts shown in the wiring diagram are not provided:

2 Turn signal lights**, R.H. and L.H.
7 Turn-signal indicator light
9 Turn-signal indicator lights for trailer
10 Turn-signal switch
18 Flasher

wire 74 as well as wires 95 to 98.

REPAIR

GENERAL INFORMATION

Various faults may occur in the electrical system. Apart from the occasional burning out of a bulb and blowing of fuses, bad connections and accidental grounding of wires may be the cause of difficulties.

Connections or terminal screws can become loose; it is, therefore, advisable to check all connections and screws during major inspection. Accidental grounding can be largely reduced by using plastic insulated cables and holding groups of cables in cable clamps.

CAUTION: Before removing parts of the electrical system, check whether the fault is caused by loose connections or bad ground connections.

* On tractors equipped with flashing warning lights (see wiring diagram. fig. 7)
** Parking lights are provided, but no turn-signal lights

MAIN SWITCH

When checking the main switch, ensure that the connected circuits are in good condition (see wiring diagram).

NOTE: The switch key can be removed only in positions "0" and "1".

Switch Key Position (see fig. 8)	Equipment Receiving Current
Key in position "O", pulled out	No current, except for horn, socket for handlamp, cigar lighter and flashing warning lights (if equipped)
Key in position "O", pressed in	Horn, socket for handlamp, cigar lighter, flashing warning lights (if equipped), fuel gauge, engine oil pressure indicator light and generator (alternator) indicator light, start safety switch and button, turn-light switch, flasher, tractor and trailer turn lights, tractor and trailer turn-signal indicator lights, stop light switch and stop lights
Key turned clockwise to position "1", (first notch)	As in position "O", key pressed in; in addition: coolant temperature gauge (lamp), fuel gauge (lamp), tractormeter (lamp); both parking lights, both tail lights of tractor and trailer; rear work light
Key turned clockwise to position "1" (first notch) and removed	Horn, socket, cigar lighter, flashing warning lights (if equipped), coolant temperature gauge (lamp), fuel gauge (lamp), tractormeter (lamp), both parking lights, both tail lights of tractor and trailer, rear work light
Key turned clockwise to position "2" (second notch)	As in position "O", key pressed in; in addition: temperature gauge (lamp), fuel gauge (lamp), tractormeter (lamp); both parking lights, both tail lights of tractor and trailer; dimmed headlights; rear work light
Key turned clockwise to position "3" (third notch)	As in position "2", the only difference: headlights switched to full beam, and full-beam indicator light on

NOTE: If switch terminals are faulty (e.g. lights are weak or flicker on and off), install a new main switch.

FUSES

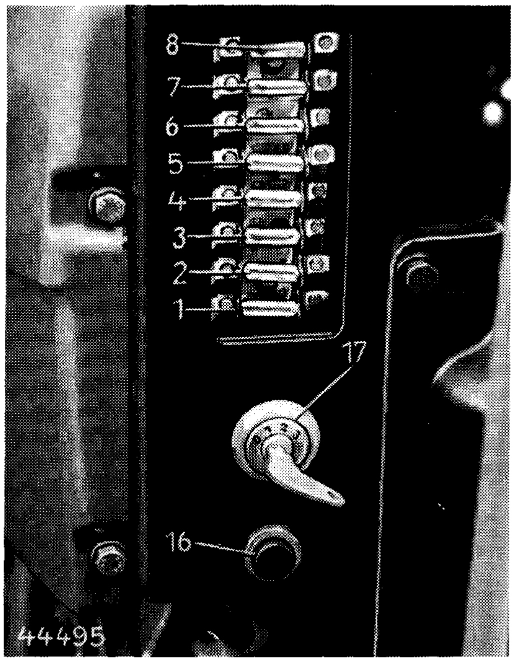

Fig. 8 — Fuse Box with Fuses, Main Switch and Starter Button Installed

16 Starter button 17 Main switch

The fuses 1 to 8 shown in fig. 8 refer to the following circuits:

1 Horn, socket for handlamp, cigar lighter and flashing warning lights (if equipped)

2 Engine oil pressure indicator light, flasher and fuel gauge

3 Stop light switch

4 Left tail light of tractor and trailer and rear work light

5 Right tail light of tractor and trailer

6 Parking and turn lights, lamps of coolant temperature gauge, fuel gauge and tractormeter

7 Dimmed headlights

8 Headlights, full beam and blue indicator light

Fuses of 8 ampere are used for all these circuits. If fuses keep blowing in one circuit, check where the circuit is overloaded (usually through faulty wires causing short circuit to ground).

Quick Check: Disconnect suspected wire at both ends; connect new length of wire to both terminals, install fuse, switch on circuit, and watch fuse for a few minutes. If it lasts, install the new cable which should have at least the same cross section as the original one (s. details of wiring diagram), using the necessary insulation and cable holders. Remove possible corrosion from fuse box contacts or replace fuse box.

Fuses with corroded ends should be replaced.

ENGINE OIL PRESSURE WARNING SWITCH

If the engine oil pressure indicator light does not light up although oil pressure is present and bulb is in order, a faulty pressure switch may be the cause (spring worn or broken, faulty contacts). Check circuit by installing a new warning switch. If this proves that the old switch was defective, replace it.

CAUTION: The thread is conical and seals itself; no sealant needed.

FUEL GAUGE SENDING UNIT

The main operating parts of the sending unit are subject to wear. As a defective or improperly operating fuel gauge may be due to other causes than a faulty sending unit, it is recommended to check the circuit by installing a new or properly operating sending unit. Replace sending unit, if defective.

STOP LIGHT SWITCH

In neutral position, i.e. if the foot brake is not being operated, the stop light switch is open and the circuit interrupted. When depressing the brake pedal, the switch closes the circuit and the stop lights light up. If lights do not light up, the switch may be defective.

Quick Check: Bridge both switch terminals with a piece of wire to close the circuit. If switch is faulty, both stop lights of the tractor and of the trailer (if hitched), should light up. If the lights fail to light up, the fault must be traced elsewhere.

START SAFETY SWITCH

If the starter does not work although the key is pressed in and the range shift lever is in neutral or park position, check the start safety switch by installing a new switch and check circuit. Ensure that the switch is set correctly (see "Adjustment").

NOTE: The start safety switch can be checked in the same manner as the stop light switch (see above).

HEAD LIGHTS, PARK AND TURN SIGNAL LIGHTS, STOP AND TURN SIGNAL LIGHTS AND TAIL LIGHTS

Apart from bulbs blowing, faults on these lights are normally caused by bad connections. This applies especially to ground connections.

Check ground connections as follows:

Connect a length of wire to a bare metal area of the light housing and to bare spot on the tractor frame. Bulb should light brighter if cause was poor ground connection. The trouble may also be due to weak spring contacts exerting insufficient pressure on light bulbs. Re-bend contacts, if necessary. Corroded contacts in bulb sockets or on bulbs can also cause lighting trouble. Clean connections.

ADJUSTMENT

START SAFETY SWITCH

Adjust start safety switch by installing as many shims between rockshaft housing and switch as needed to make contact on starter when the range shift lever is in neutral position, but not if it is in range I or II.

CAUTION: Do not overtighten switch when installing it in the rockshaft housing. For maximum torque see Specifications.

HEAD LIGHTS

For adjusting the head lights, use a commercial head light testing device. Test each head light individually. Make the required corrections by turning the head light in its pivoting mounting.

SPECIFICATIONS

STARTER

ELECTRICAL TEST

NOTE: The test period should be as short as possible; batteries installed in the test stand should be well charged and function properly (battery capacity: 135 Ah). Test starter at room temperature (approx. 20°C = 68°F). On a defective starter the electrical test values differ considerably from specifications given on the next page! If in doubt, check field and armature windings for breaks, ground or winding short-circuits.

No-load test (including solenoid)

Volts	Min. Ampere	Max. Ampere	Min. Speed	Max. Speed
11,5	90	110	6000 rpm	8000 rpm

Load test (including solenoid)

Volts	Min. Ampere	Max. Ampere	Min. Speed	Max. Speed
9	775	805	1300 rpm	1600 rpm

Minumum voltage of solenoid . . . . 8 Volts

CHECKING STARTER SPECIFICATIONS

Minimum dia. of commutator (when re-turning: CAUTION! Centerings of armature shaft are out of center) . . . . 1.555 in. — 39.5 mm

Commutator out-of-roundness, max. . . . . 0.0012 in. — 0.03 mm

Out-of-roundness of stack of armature plates, max. . . . . 0.002 in. — 0.05 mm

Undercutting insulation after re-turning commutator by approx. (then finish-turn) . . . . 0.02 to 0.03 in. — 0.5 to 0.8 mm

Brush pressure (check by means of a spring scale) . . . . 2.2 to 2.9 lbs. — 1.0 to 1.3 kg

Gear backlash . . . . 0.0138 to 0.0236 in. — 0.35 to 0.6 mm

Ring gear clearance (see dimension "a", fig. 9) . . . . 1.98 to 2.03 in. — 50.5 to 51.5 mm

Pinion protruding from housing by (see dimension "c", fig. 9) . . . . 1.89 to 1.91 in. — 48.0 to 48.5 mm

Gap between pinion face and ring gear with starter disengaged; not adjustable (see dimension "b", fig. 9) . . . . 0.1 to 0.12 in. — 2.5 to 3.0 mm

Adjusting dimension for solenoid, drawn in (see dimension "d", fig. 10) . . . . 1.039 to 1.055 in. — 26.4 to 26.8 mm

Armature end play . . . . 0.004 to 0.012 in. — 0.1 to 0.3 mm

Armature braking torque . . . . 4.0 to 6.6 in.lbs. — 4.5 to 7.5 cmkg

Overrunning torque . . . . 1.0 to 2.8 in.lbs. — 1.2 to 3.2 cmkg

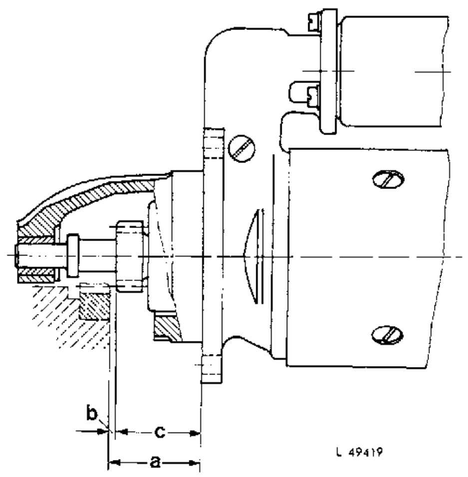

Fig. 9 — Ring Gear and Pinion Clearance, Pinion Protrusion

a Ring gear clearance
b Pinion clearance
c Pinion protrusion

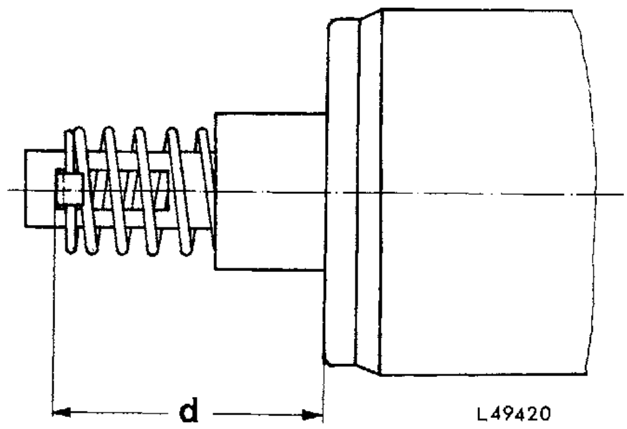

Fig. 10 — Adjusting Measurement of Solenoid

d Adjusting measurement (When retracted)

ALTERNATOR

GENERAL INFORMATION FOR INSPECTION AND REPAIR

Observe the following recommendations closely before starting inspection:

1. The wires between alternator and regulator and/or test stand must be properly connected. Do not make provisional connections. If a provisionally connected cable comes loose during the test, peak voltages will be generated in the alternator which may destroy the diodes.
2. Use only D.C. voltages of up to 24 Volts maximum for testing the diodes. Higher voltages will destroy them.
3. Check high-voltage windings for opens or grounds only after diodes have been disconnected.
4. With the alternator running, do not disconnect battery cable as peak voltages will destroy the diodes.
5. Operate the alternator only by means of the fan belt pulley.
6. To facilitate current flow to the exciting coil, be sure to connect an indicator lamp between terminals B+ and D+. This lamp should have a capacity of 2 watt. It will be most suitable to connect the indicator lamp to a battery post and to alternator terminal D+. The indicator lamp should now light up.

TESTING ALTERNATOR OUTPUT

Connect battery.

Connect voltmeter to alternator terminal B+ and to ground.

Connect resistor pile.

Adjust alternator speed to specified rpm and increase load to value specified in the following chart.

Watch indicator lamp closely; it should completely fade out in any case.

Connect voltmeter to terminal D+. Voltage differential between terminals B+ and D+ should not exceed 0.5 volt.

Adjusting Load Amps.	Maximum Speed * RPM	Resistance Ohms+ 10% Stator**	Rotor
10 18 28	1500 2500 6000	0,4	4,0

* Warm alternator (60° C = 140° F) with regulator
** Between phase leads

TESTING ALTERNATOR IF SPECIFIED OUTPUT IS NOT ACHIEVED

NOTE: Since diodes can only be checked for shorts (with the alternator assembled), the indicator lamp should not light up during the following tests.

1. *Testing exciting diodes*

   Connect positive (+) test prong to terminal D+ and negative (-) test prong to a connecting point (solder point or screw),

2. *Testing positive diodes*

   Connect positive (+) test prong to terminal B+ and negative (-) test prong to a connecting point (solder point or screw)

3. *Testing negative diodes*

   Connect positive (+) test prong to phase connecting point or terminal "W" and negative test prong to terminal D-.

   NOTE: If indicator lamp does not light up during tests 1 to 3, one or more diodes of the tested group will be defective due to a short circuit.

4. *Testing exciting coil in rotor*

   Connect test prongs to terminals DF and D-. When turning the rotor slowly, the indicator lamp should light darker than when placing test prongs directly on rotor. If lamp lights brightly or does not light at all or if it lights intermittently, the exciting coil or the brushes will be defective.

CHECKING ALTERNATOR SPECIFICATIONS

Minimum length of brushes	0.55 in.	14 mm
Brush spring pressure	0.66 to 0.88 lbs.	0.3 to 0.4 kg
Minimum diameter of slip rings	1.24 in.	31.5 mm
Out-of-roundness of slip rings (maximum)	0.0012 in.	0.03 mm

TESTING ALTERNATOR SPECIFICATIONS (CONT.)

Out-of-roundness of rotor, maximum . . . . 0.002 in. 0.05 mm

Isolation gap to alternator housing, minimum . . . . 0.12 in. 3 mm

GENERATOR

ELECTRICAL TEST

NOTES: When testing generator and regulator, check for proper connection and polarity of regulator.

When testing generator without regulator, no-load speed at rated voltage and output speed (cold and hot) can be measured. To do so, first connect terminal "DF" directly to terminal "D-" (thus only regulator failure can be eliminated when testing). Make sure output speed is not exceeded considerably at generator voltage as this would damage the exciting coil.
When putting the generator to an endurance test, it is recommended to use the regulator, too. This will avoid a voltage surge. Do not test the generator in an endurance test at double output speed without using the regulator. When generator failure is evident, always check the regulator.

1. Operate generator as a motor for a short time. To do this, separate generator from drive motor of test bench. Connect battery directly to terminal "D+". The generator should now run as a motor in its normal direction of rotation.

2. No-load speed at rated voltage (see chart)
   Connect voltmeter to terminal "D+" and ground (using an insulated ground wire) to "D-". Increase speed slowly. With no-load speed at rated voltage, the generator voltage should be reached ("cold").

   Speed when testing output "cold"; Ambient temperature should be approx. 68° F (20° C).

   Speed when testing output "warm"; Housing temperature should be approx. 140° F (60° C).

3. Adjusting load
   Adjusting load always corresponds to 2/3 of maximum amperage. When testing output, increase ohm value of resistor installed in test bench until load amperage is obtained (see chart). Record relative speed and compare to actual speed.

No-load speed at rated voltage	Speed when testing output cold	hot	Load amperage	Resistance
1250 to 1450 rpm	1700 to 1900 rpm	1850 to 2000 rpm	7.5 Amperes	3.5 Ohms + 10 %

CHECKING GENERATOR SPECIFICATIONS

Minimum dia. of commutator (when re-turning: CAUTION! Centerings of armature shaft are out of center) . . . . 1.22 in. 31 mm

Commutator out-of-roundness, max. . . . . 0.0012 in. 0.03 mm

Out-of-roundness of stack of armature plates, max. . . . . 0.002 in. 0.05 mm

Undercutting insulation after re-turning commutator by approx. (then finish-turn) . . . . 0.02 to 0.03 in. 0.5 to 0.8 mm

Brush pressure (check by means of a spring scale) . . . . 1.0 to 1.3 lbs. 0.45 to 0.6 kg

Armature end play . . . . 0.004 to 0.012 in. 0.1 to 0.3 mm

TORQUES FOR HARDWARE

Start safety switch in rockshaft housing, max. . . . . 35 ft.lbs. 4.8 mkg

Pulley to generator . . . . 29 ft.lbs. 4 mkg

Section 50

POWER TRAIN

CONTENTS OF THIS SECTION

Printed in Germany

Group 5

ENGINE CLUTCHES AND CLUTCH LINKAGE

DIAGNOSING MALFUNCTIONS

CLUTCH SLIPS

Worn or burned clutch facings

Oil or grease on clutch facings

Insufficient clutch pedal free travel

Release levers out of adjustment

Operator riding clutch pedal

CLUTCH GRABS OR CHATTERS

Facings loose, gummed, worn or glazed, clutch disk(s) bent or warped

Clutch disk(s) loose at hub (loose rivets or insufficiently pre-stressed springs)

Clutch disk hub tight on shaft (does not slide freely)

Tight or binding clutch fork shaft

Cracked or broken pressure plate(s)

Pressure plates sticking

Defective diaphragm spring

Excessive transmission backlash

Clutch throw-out bearing damaged, dirty, worn or improperly lubricated

Clutch release levers out of adjustment

CLUTCH NOISE (when engaged)

Splines of drive shaft(s) or hub(s) of driven disk(s) worn

Clutch disk loose at hub rivets

Torsion damper defective

Flywheel loose on crankshaft flange

CLUTCH DRAG

Clutch shaft splines and/or clutch disk hub distorted or rough

Clutch disk hub tight on clutch shaft

Clutch disk facings loose or oil-soaked

Clutch disk(s) warped or bent

High spots on clutch disk(s)

Defective diaphragm spring

Clutch parts worn

Excessive clutch pedal free travel

Excessive clutch face run-out (flywheel not seated properly)

CLUTCH PEDAL PULSATION

Broken or missing clutch pedal return spring

Clutch release levers out of adjustment

Flywheel not seated properly

Distorted crankshaft flywheel flange

CLUTCH LINKAGE

GENERAL INFORMATION

When depressing the clutch pedal (see 1, fig. 1), motion is transmitted through clutch rod 8/10, clutch shaft 16 and clutch fork 18 to the throw-out bearing carrier and bearing 19. The latter will be pressed against the clutch release levers, thus disengaging the clutch.

Power is transmitted from the clutch pedal 1 to the yoke rod 8/10 through pedal arm 3 which is attached to the clutch pedal by means of cap screw 6. The cap screw is seated in a slotted hole in the pedal arm. On machines equipped with a dual clutch this design allows two pedal positions. When cap screw contacts rear of slot, only the front (engine) clutch can be engaged or disengaged (see "Adjustment" and Operator's Manual). On machines equipped with single clutch only, the clutch pedal can be adjusted to suit operator's height by means of slotted hole in the pedal arm (see "Adjustment").

REPAIR

CLUTCH LINKAGE (fig. 1)

Separate tractor between engine and clutch housing (see section 10, group 25).

Remove clutch linkage parts.

Check bushing (see 17, fig. 1) of clutch shaft 16 in left-hand bore of clutch housing for wear or damage. If necessary, drive in new bushing so that it is flush with face of clutch housing.

Check clutch shaft 16, bearing pin 14 and bushing 13 of clutch pedal 1 for wear or damage. If necessary, drive new bearing pin into clutch housing so that its face protrudes from the housing by a specified dimension (see Specifications).

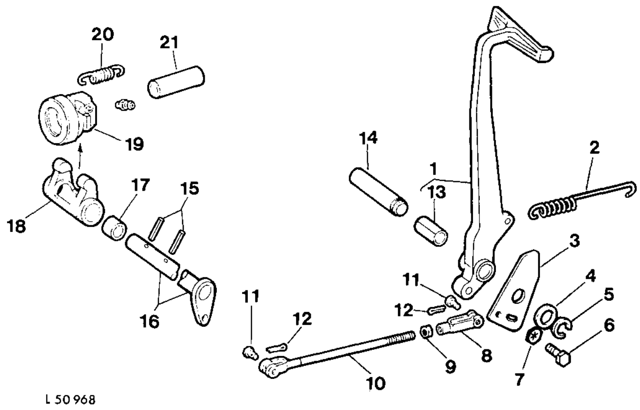

Fig. 1 — Clutch Linkage, Exploded View

1 Clutch pedal
2 Return spring
3 Arm
4 Washer
5 Snap ring
6 Cap screw
7 Toothed lock washer
8 Yoke
9 Lock nut
10 Clutch rod
11 Clevis pin
12 Cotter pin
13 Bushing
14 Bearing pin
15 Spring pins
16 Clutch shaft
17 Bushing
18 Fork
19 Throw-out bearing with carrier
20 Return spring
21 Sleeve for throw-out bearing carrier

Throw-out bearing, carrier and bushing

CAUTION: Do not soak throw-out bearing in solvent as it is packed with grease. Wipe clean with cloth dampened in solvent. The bearing can be filled with grease externally (see Operator's Manual). Do not oil the throw-out bearing.

Check throw-out bearing for evidence of overheating (blue discoloration of surface). If bearing has been overheated or runs rough, it must be replaced complete with carrier (throw-out bearing and carrier are only supplied assembled). Inspect bearing carrier for excessive wear in bore and on lugs. Also check for pitting, cracks or other damage. Make sure bearing carrier slides freely on the sleeve. If necessary, replace the complete assembly (throw-out bearing and carrier).

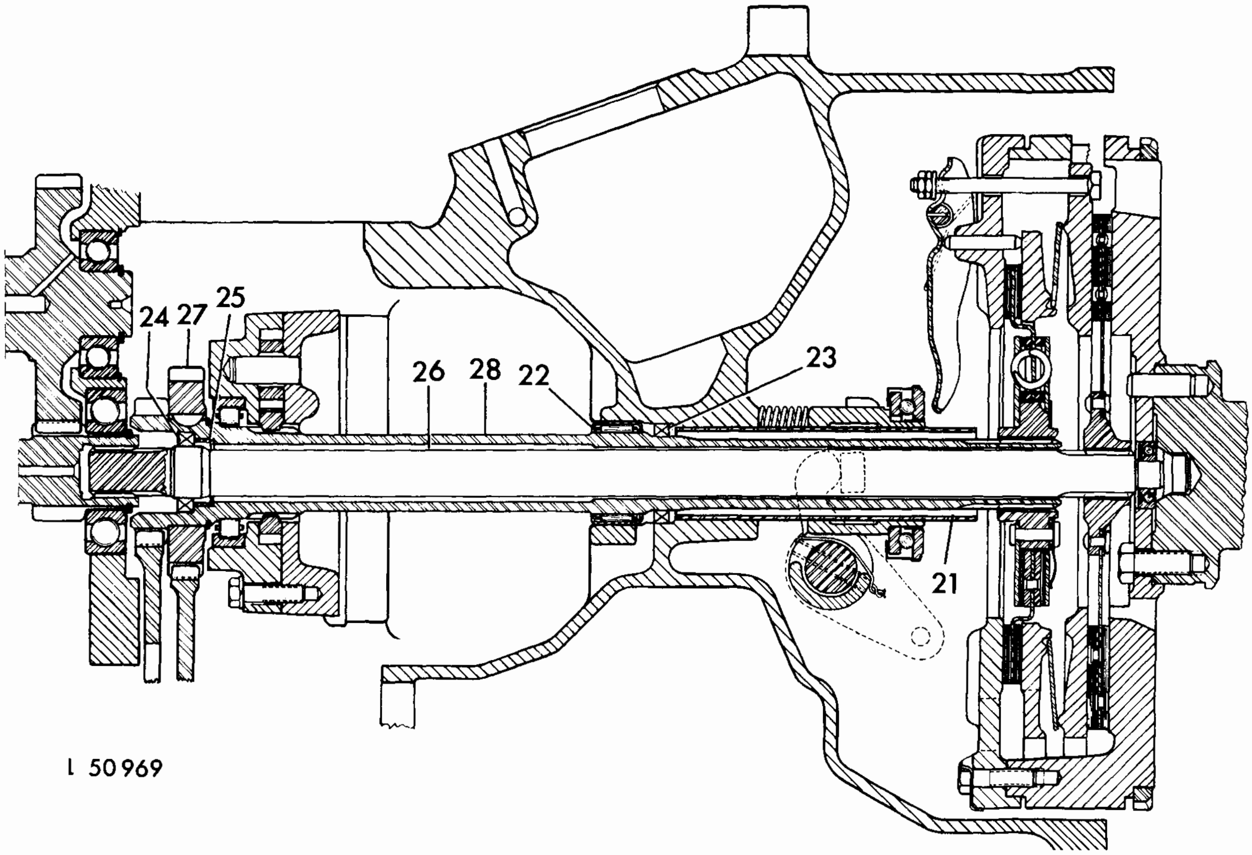

Fig. 2 — Drive Shaft and Hollow PTO Drive Shaft Installed
(Tractor without High-Low Unit Shown)

21 Sleeve
22 Needle bearing
23 Oil seal
24 Oil seal
25 Guide
26 Drive shaft
27 PTO drive gear
28 Hollow PTO drive shaft

Inspect carrier sleeve 21 for wear or damage and replace, if necessary. Drive new sleeve into clutch housing so that its face protrudes from the housing by a specified dimension (see Specifications).

Check clutch fork 18 for wear, cracks or other damage and replace, if necessary.

CLUTCH HOUSING

If there is oil in the clutch compartment of the clutch housing which is not due to oil leakage through the rear crankshaft seal, inspect oil seal (see 23, fig. 2) located between clutch housing and hollow PTO drive shaft 28.

If necessary, separate tractor between transmission and clutch housing.

Only on tractors without HIGH-LOW unit

If it is necessary to renew oil seal (see 23, fig. 2) located in clutch housing, remove both drive shafts (26 and 28). Remove complete transmission oil pump followed by needle bearing 22 and unserviceable oil seal.

Fill space between lips of new oil seal with multi-purpose grease. Press oil seal into bore of clutch housing with sealing lip facing driver so that face of seal is a specified distance from clutch housing face (see Specifications).

Check needle bearing for excessive wear, roughness or damage. Press new needle bearing into clutch housing bore so that its face is flush with shoulder of bore.

Only on tractors with HIGH-LOW unit

If it is necessary to renew oil seal located in clutch housing, remove complete HIGH-LOW unit (see group 10). Remove thrust washer, bushing and unserviceable oil seal from clutch housing.

Fill space between lips of new oil seal with multi-purpose grease. Press seal into bore of clutch housing with sealing lip facing driver so that face of seal is a specified distance from clutch housing face (see Specifications).

Check HIGH-LOW unit bushing for wear and replace, if necessary. Press new bushing into clutch housing so that the lubrication holes in bushing corresponds with those in the clutch housing. Coat bore of bushing with a film of oil.

HOLLOW PTO DRIVE SHAFT

Only on tractors without HIGH-LOW unit

Check hollow PTO drive shaft (see 28, fig. 2) for excessive wear, scores or damage on bearing surface for needle bearing and roller bearing, on sliding surface for oil seal, on splines for clutch disk and torsion damper as well as on slots for woodruff key and oil pump gear. Check seat of gear 27 on shaft. Replace shaft if unserviceable.

Only on tractors with HIGH-LOW unit

The hollow PTO drive shaft is part of the HIGH-LOW unit. Therefore, when checking this shaft it is necessary to remove and disassemble the HIGH-LOW unit.

See group 10 for details.

DRIVE SHAFT

Only on tractors without HIGH-LOW unit

Check drive shaft for excessive wear, scores or damage on sliding surface for oil seal. Check splines on both shaft ends for excessive wear or damage. Check drive shaft for distortion. Inspect guide bearing seat on shaft and replace shaft, if unserviceable.

Only *on tractors with HIGH-LOW unit*

The drive shaft is part of the HIGH-LOW unit. Therefore it is necessary to remove and disassemble the HIGH-LOW unit when the drive shaft is checked.

See group 10 for details.

INSTALLATION

For installation of clutch linkage, reverse removal procedure.

When installing, observe the following details:

Coat sliding face of sleeve, bore and both faces of bearing carrier which contact clutch fork, using MOLYKOTE BR 2 grease. Fill grease compartment of bearing carrier with multi-purpose grease.

Install two spring pins (see 15, fig. 1) flush with clutch fork and secure with wire.

When installing drive shafts, take care not to damage oil seals.

ADJUSTMENT

Normal adjustment of clutch pedal on tractors equipped with dual-stage clutch

With this adjustment, both (engine and PTO) clutches are operated one after the other. Adjust as follows: Loosen cap screw (see 6, fig. 3) and move clutch pedal to the rear until cap screw 6 contacts front of slot in pedal arm 3. Then tighten screw.

Adjusting clutch pedal for operation of engine clutch only on tractors with dual-stage clutch

Loosen cap screw (see 6, fig. 3) and move clutch pedal forward until cap screw contacts rear of slot in pedal arm. Then tighten cap screw.

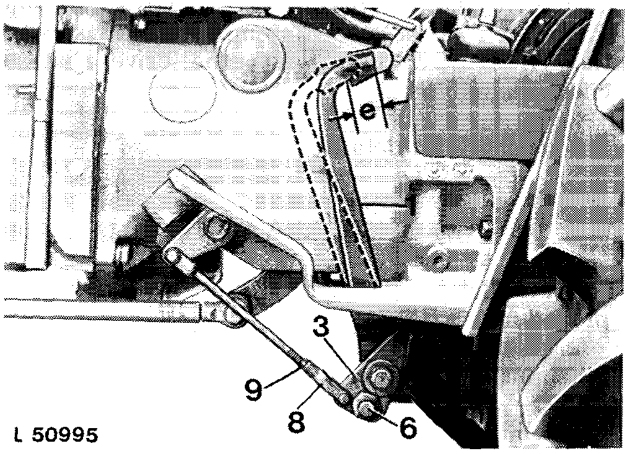

Fig. 3 — Adjusting Clutch Pedal, Pedal Arm and Free Travel on Tractors Equipped with Dual-Stage Clutch

1 Clutch pedal
3 Pedal arm
6 Cap screw
8 Yoke
9 Lock nut
e Free travel

Adjusting clutch pedal free travel on tractors equipped with dual-stage clutch

Remove clevis pin from yoke (see 8, fig. 3) and arm 3. Loosen lock nut 9. Thread yoke 8 on clutch rod until clutch pedal shows specified free travel (see "e", fig. 3 and Specifications).

Reinstall clevis pin through yoke 8 and arm 3 and secure with cotter pin. Tighten lock nut 9.

Adjusting clutch pedal and free travel on tractors equipped with single-stage clutch.

Normal Adjustment: Loosen cap screw 6 (fig. 4) and move clutch pedal to the rear until cap screw contacts front end of slot in arm. Tighten cap screw.

Remove clevis pin from yoke 8 and arm 3. Loosen lock nut 9. Thread yoke on clutch rod until clutch pedal shows specified free travel (see "e", fig. 4). Make sure clutch is completely disengaged before clutch pedal comes against stop bracket "b".

Reinstall clevis pin through yoke 8 and arm 3, securing with cotter pins. Tighten lock nut 9.

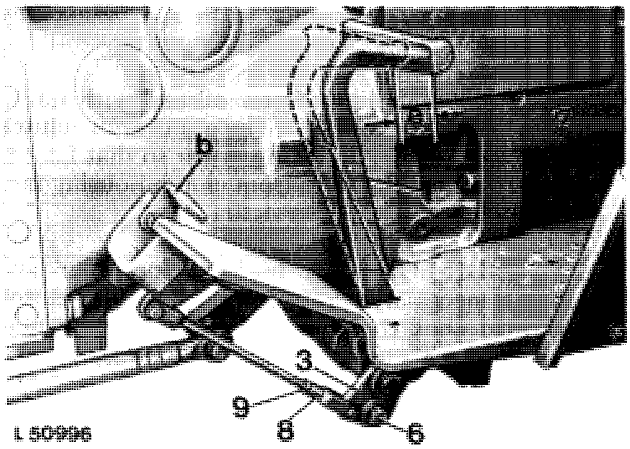

Fig. 4 — Adjusting Clutch Pedal and Free Travel on Tractors Equipped with Single-Stage Clutch

1 Clutch pedal
3 Clutch arm
6 Cap screw
8 Yoke
9 Lock nut
b Stop bracket
e Free travel

Adjustment for tall operators: In this case loosen cap screw 6 and push clutch pedal (see 1, fig. 4) forward until cap screw contacts rear of slot in arm 3. Tighten cap screw.

Remove clevis pin from yoke 8 and arm 3. Loosen lock nut 9. Thread yoke on clutch rod until clutch pedal shows specified free travel, measured from foot rest (see "e", fig. 4 and Specifications). Remove stop bracket "b" when making this adjustment thus ensuring that the engine clutch can be fully disengaged. In this case the foot rest acts as a stop, ensuring that no damage occurs to the clutch linkage.

Reinstall clevis pin through yoke 8 and arm 3 and secure with cotter pins. Tighten lock nut 9.

On both clutch types

CAUTION: If clutch pedal free travel is less than specified minimum (see Specifications), do not start engine until correct free travel has been set.

ENGINE DUAL-STAGE CLUTCH

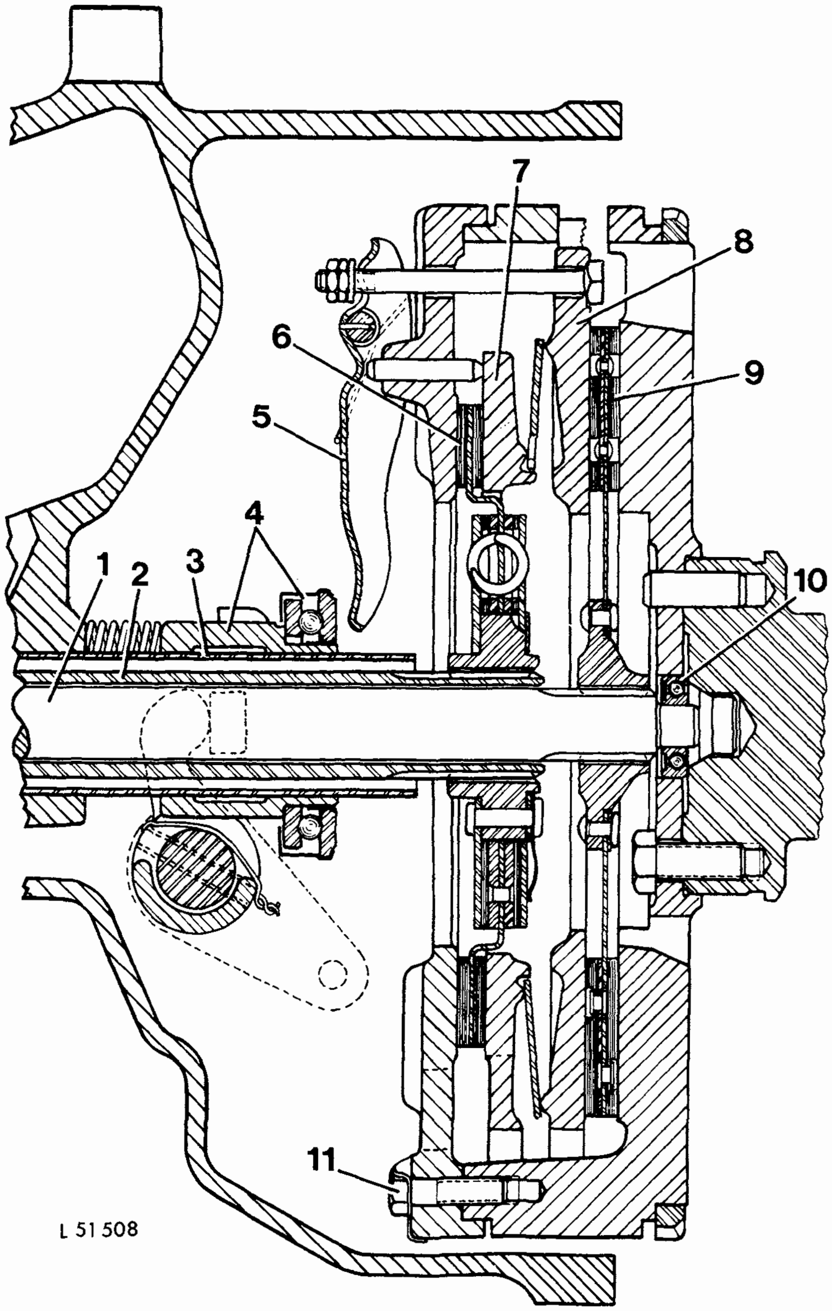

Fig. 5 — Engine Dual-Stage Clutch, Sectional View

1 Drive shaft
2 Hollow PTO drive shaft
3 Sleeve
4 Clutch throw-out bearing and carrier
5 Release lever (3 used)
6 Rear driven disk (PTO clutch)
7 Rear pressure plate
8 Front pressure plate
9 Front driven disk (engine clutch)
10 Pilot bearing
11 Cap screw (6 used)

GENERAL INFORMATION

The dual-stage clutch combines the functions of two single-disk clutches. The dual-stage clutch has two driven disks of different sizes. The front disk (see 9, fig. 5) is splined to drive shaft 1 and the rear disk 6 is splined to hollow PTO drive shaft 2. Driven disk 9 transfers power to the transmission whereas driven disk 6 transmits power to the PTO shafts.

REMOVAL

Separate tractor between engine and clutch housing, see section 10, group 25.

Remove cap screws (see 11, fig. 5) and lift out clutch assembly, taking care of engine clutch disk 9 which comes free.

CAUTION: Prevent oil or grease from getting on the engine clutch disk 9.

DISASSEMBLY

NOTE: The clutch assembly is balanced. Therefore, mark the individual parts before disassembly to facilitate proper reassembly.

Back hex.nuts (see 18, fig. 6) off operating bolts 16 and remove spacers 17.

Remove both snap rings 12 from each release lever 10 and unhook loop spring 11 from pivot pin 13. Drive spring pins 14 out of release levers 10 and pivot pins 13. Push pivot pins out of base plate 7 and release levers. Remove release levers and base plate, taking care not to lose release pins 8.

Remove gear driven disk 6 (PTO clutch), rear pressure plate 5, diaphragm spring 4, front pressure plate 3 and operating bolts 16.

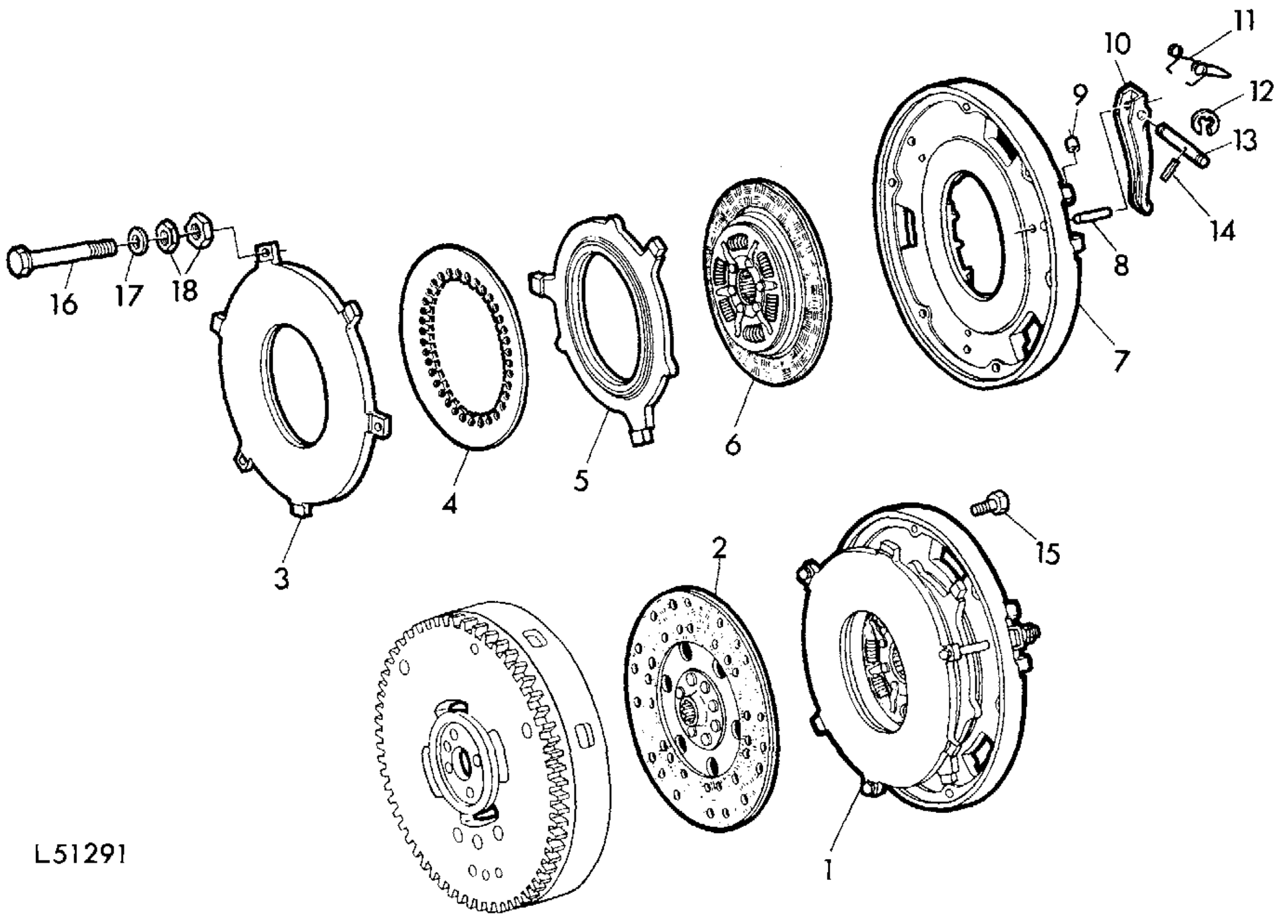

Fig. 6 — Exploded View of Engine Dual-Stage Clutch

1 Clutch assembly
2 Front driven disk (engine clutch)
3 Front pressure plate
4 Diaphragm spring
5 Rear pressure plate
6 Rear driven disk (PTO clutch)
7 Base plate
8 Release pin (3 used)
9 Bushing (6 used)
10 Release lever (3 used)
11 Loop spring (3 used)
12 Snap ring (6 used)
13 Pivot pin (3 used)
14 Spring pin (3 used)
15 Cap screw (6 used)
16 Operating bolt (3 used)
17 Spacer (3 used)
18 Hex.nut (6 used)

REPAIR

DRIVEN DISKS

Check all rivets and facings on driven disks for serviceability. Facings should be smooth, even and free of grease and oil, nor should they be glazed.

If any rivets or facings are loose or if facings are excessively worn (see Specifications), replace defective disk. Check each disk for distortion. Inspect disk splines for wear and damage.

PRESSURE PLATES AND BASE PLATE

Check friction faces of pressure plates and base plate for wear and flatness by means of a feeler gauge and a true square (see Specifications for wear tolerance). Replace pressure plates or base plate if scored or otherwise damaged.

FLYWHEEL AND PILOT BEARING

See section 20, group 20 for checking and repair of flywheel and pilot bearing.

DIAPHRAGM SPRING

Check diaphragm spring for heat cracks or distortion. Do not hesitate to renew spring if operation is doubtful.

RELEASE PINS AND OPERATING BOLTS

Check release pins and operating bolts for wear on contact faces. Check threads of operating bolts for wear.

RELEASE LEVERS

Check contact faces of release levers for wear and pitting.

LOOP SPRINGS

Inspect loop springs for rusty spots, fatigue and distortion. Replace, if necessary.

ASSEMBLY

When assembling, observe the following:

Coat the indicated faces and bores of the following parts with MOLYKOTE BR 2 grease:

The sides of the three lugs of front pressure plate (see 3, fig. 6) and rear pressure plate 5, the sides of the three longidutinal flywheel grooves, the bores of base plate 7 for seating the three release pins 8 and the three operating bolts 16 as well as the bores of the six bushings 9, the faces of diaphragm spring 4 which contact front and rear pressure plates, surfaces of three release pins 8 and bearing surfaces of the three pivot pins 13.

The clutch assembly is balanced. Therefore, when reassembling observe the marks made during disassembly.

Install front driven disk (see 2, fig. 6) in flywheel with long part of hub facing toward flywheel. Align with pilot bearing by means of centering tool No. 19.58-90.486.

To facilitate assembly, the heads of the three operating bolts should be flush against front pressure plate. For this purpose, place a suitable spacer between each operating bolt and flywheel.

Place diaphragm spring 4 with cupped face on front pressure plate 3.

When placing rear pressure plate 5 on diaphragm spring, move diaphragm spring so that it aligns properly with pressure plate, if required.

Position rear driven disk 6 on rear pressure plate 5 with long hub end facing away from flywheel.

When base plate 7 and release pins 8 have been installed, align front driven disk 2 and rear driven disk 6 with pilot bearing in flywheel by means of centering tool No. 19.58-90.486 (see fig. 7). This applies especially to rear driven disk 6, which, if misaligned, will impede assembly of engine to clutch housing.

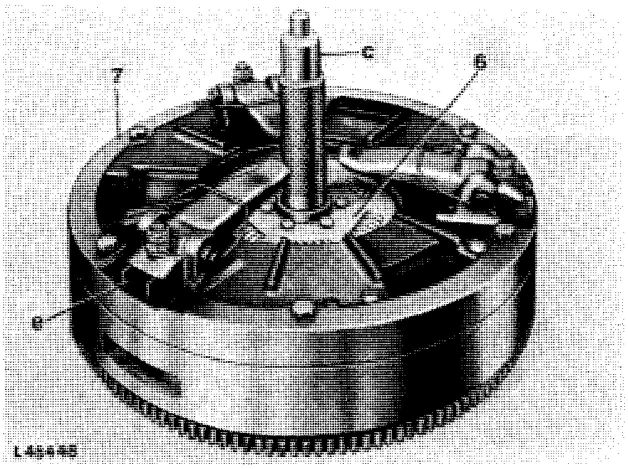

Fig. 7 — Driven Disks Aligned with Pilot Bearing of Flywheel

c Centering tool No. 19.58-90.486
e Spacer
6 Rear driven disk
7 Base plate

After having properly tightened clutch assembly to flywheel (for specified torque see Torques for Hardware), withdraw centering tool.

Thread second hex.nut (see 18, fig. 6) on each operating bolt and tighten only after release levers have been adjusted.

ADJUSTMENT

Whenever the clutch has been disassembled or a new front driven disk or flywheel has been installed, do not forget to adjust the release levers.

The clutch release levers can be adjusted by means of a separate flywheel or the flywheel attached to the engine. The adjusting dimension "a" shown in figure 8 and under "Specifications" applies only if both driven disks are new.

Measure distance "a" between pressure face of each release lever and hub face of rear driven disk by means of a depth gauge (see 2, fig. 8). See "Specifications" for adjusting dimensions.

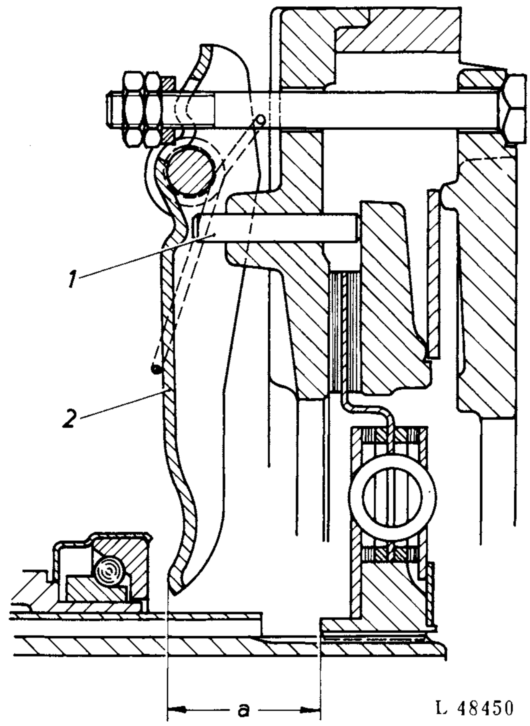

Fig. 8 — Dimension for Adjusting Engine Dual-Stage Clutch

a Distance between clutch release levers and hub face of rear driven disk
1 Release pin
2 Release lever

NOTE: Be sure all three release levers are evenly adjusted.

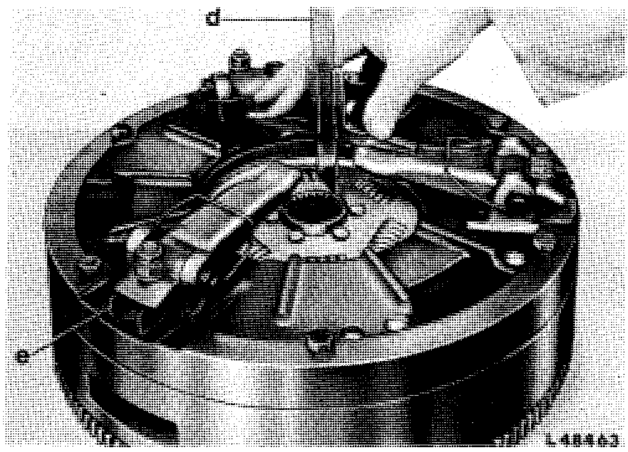

Fig. 9 — Determining Clearance "a" with Depth Gauge

d Depth gauge
e Spacer

If assembly or adjustment is not made with engine flywheel installed, place a suitable spacer (see "e" figs. 7 and 9) between each release lever and base plate.

INSTALLATION

Install flywheel (if necessary). Tighten attaching screws crosswise to the specified torque.

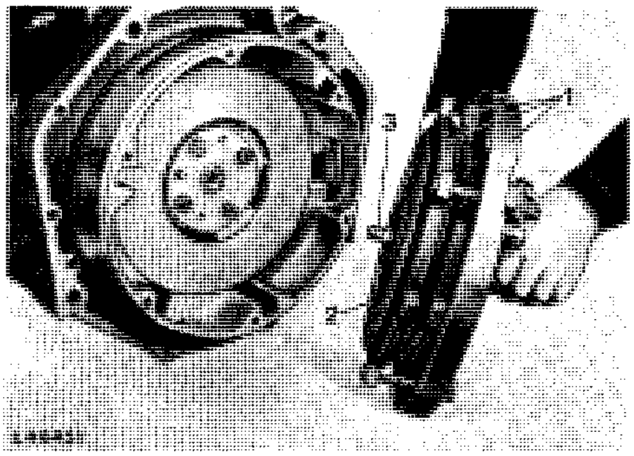

Fig. 10 — Installing Engine Dual-Stage Clutch

1 Clutch assembly
2 Front driven disk
3 Centering tool

Insert centering tool No. 19.58-90.486 (see 3, fig. 10) in clutch assembly. Slide front clutch disk 2 on tool with long hub end facing away from clutch assembly.

Align lugs of pressure plates with slots of flywheel. Install clutch assembly in flywheel. Insert pilot of centering tool in pilot bearing of flywheel. Attach clutch assembly to flywheel. Tighten cap screws crosswise to the specified torque (see Specifications).

Re-install all parts of engine and/or tractor removed or separated to facilitate removal of parts explained in this group (see section 10, group 25).

ADJUSTING ENGINE DUAL-STAGE CLUTCH EXTERNALLY

Disconnect linkage of clutch pedal

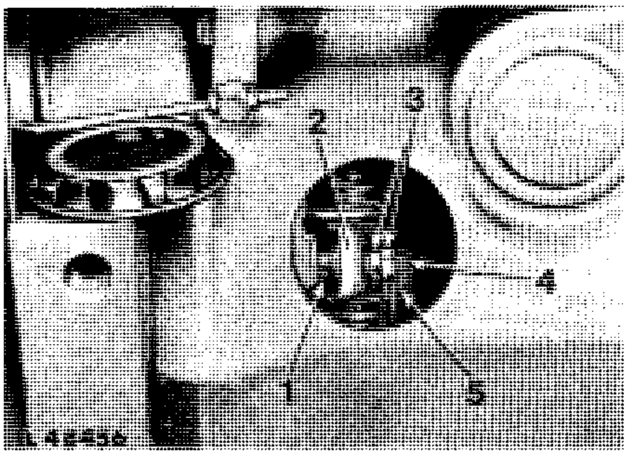

Fig. 11 — Adjusting Engine Dual-stage Clutch Externally

1 Release pin
2 Release lever
3 Hex.nuts
4 Operating bolt
5 Throw-out bearing

Loosen two hex.nuts (see 3, fig. 11) of each operating bolt 4 until release lever 2 contacts relative release pin 1.

NOTE: Rotate flywheel so that hex.nuts of each operating bolt consecutively become accessible through opening of clutch housing.

Tighten inner nut 3 of an operating bolt 2-1/2 turns. Attach linkage of clutch pedal and adjust so that throw-out bearing 3 contacts adjusted release lever 2.

Adjust remaining two release levers with the aid of operating bolt hex.nuts so that they just touch throw-out bearing. Then tighten lock nuts of each operating bolt.

Adjust clutch pedal free travel.

ENGINE SINGLE-STAGE CLUTCH

(Tractors with Independent PTO)

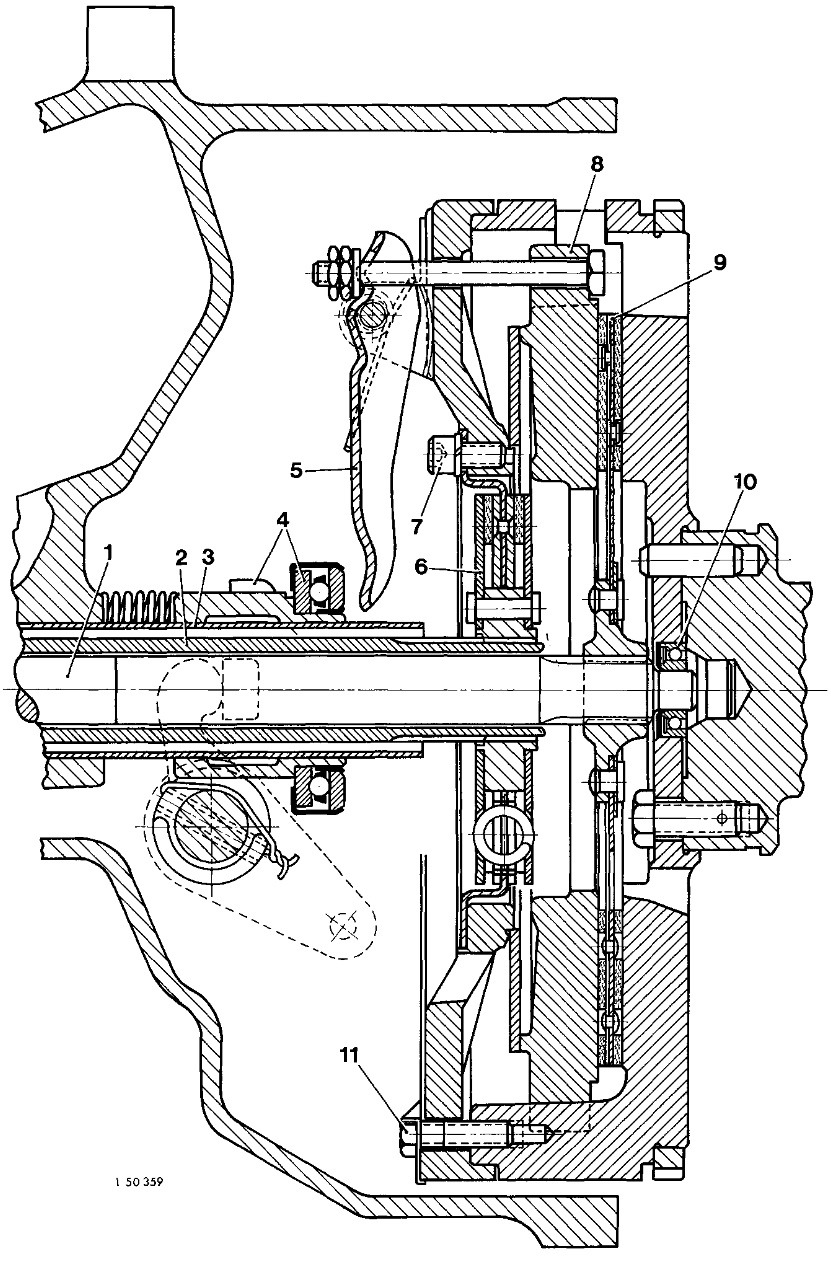

Fig. 12 — Engine Single-Stage Clutch, Sectional View

1 Drive shaft
2 Hollow PTO drive shaft
3 Sleeve
4 Throw-out bearing and carrier
5 Release lever (3 used)
6 Torsion damper
7 Hex.socket screw (6 used)
8 Pressure plate
9 Clutch disk
10 Pilot bearing
11 Cap screw (6 used)

The engine single-stage clutch is a single dry-disk type. It consists essentially of the pressure plate assembly complete with diaphragm spring, and a torsion damper (see 6, fig. 12) secured to the base plate.

The clutch disk (see 9, fig. 12) is splined to the drive shaft 1 and torsion damper 6 is splined to the hollow drive shaft.

The clutch disk transfers power to the transmission whereas the torsion damper transfers power to the PTO shaft.

REMOVAL

Separate tractor between engine and clutch housing, see section 10, group 25.

Remove cap screws (see 11, fig. 12) which secure the clutch assembly to the flywheel. Lift out clutch assembly, taking care of clutch disk 9 which comes free.

CAUTION: Prevent oil or grease from getting on the engine clutch disk.

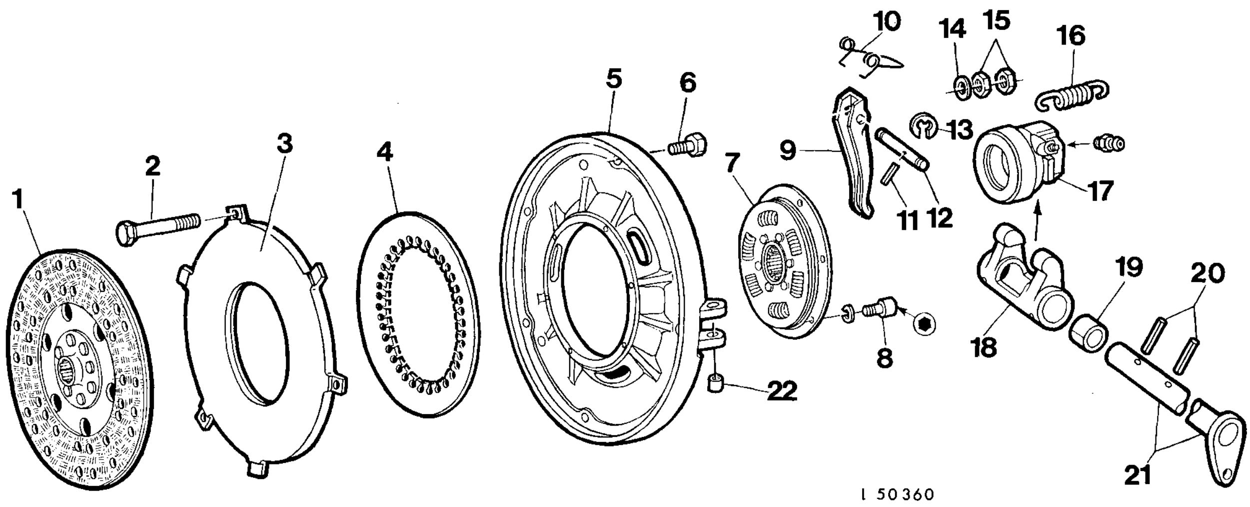

Fig. 13 — Engine Single-Stage Clutch, Exploded View

1 Clutch disk
2 Operating bolt (3 used)
3 Pressure plate
4 Diaphragm spring
5 Base plate
6 Cap screw (6 used)
7 Torsion damper
8 Hex.socket screw (6 used)
9 Release lever (3 used)
10 Loop spring (3 used)
11 Spring pin (3 used)
12 Pivot pin (3 used)
13 Snap ring (6 used)
14 Washer (3 used)
15 Hex.nut (6 used)
16 Return spring
17 Throw-out bearing with carrier
18 Clutch fork
19 Bushing
20 Spring pin (2 used)
21 Clutch shaft
22 Bushing for pivot pin (6 used)

DISASSEMBLY

Back hex.nuts (see 15, fig. 13) off operating bolts 2 and remove washers 14. Remove both snap rings 13 from each release lever 9. Unhook loop springs 10 from pivot pins 12. Drive spring pins 11 out of release levers 9 and pivot pins 12. Push pivot pins 12 out of base plate 5 and release levers 9. Remove release levers.

Take out base plate complete with torsion damper 7 and separate by removing the six hex. socket screws 8.

Remove diaphragm spring and operating bolts 2 from pressure plate 3.

REPAIR

CLUTCH DISK

Check all rivets and facings on clutch disk (see 1, fig. 13) for serviceability. Facings should be smooth, even and free of grease and oil, nor should they be glazed.

If any rivets or facings are loose or if facings are excessively worn (see Specifications), replace clutch disk.

Check clutch disk for distortion.

Inspect clutch disk splines for wear and damage.

PRESSURE PLATE AND FLYWHEEL

Check friction face of pressure plate (see 3, fig. 13) and flywheel for wear and flatness by means of a feeler gauge and a true square (see Specifications for wear tolerance). Replace if scored or otherwise damaged.

DIAPHRAGM SPRING

Check diaphragm spring 4 for heat cracks or distortion. Do not hesitate to renew, if operation is doubtful.

OPERATING BOLTS

Check operating bolts 2 for wear on contact faces and proper condition of threads.

RELEASE LEVERS

Check contact faces of release levers 9 for wear and pitting.

PIVOT PINS AND BUSHINGS

Check pivot pins 12 and bushings 22 for wear or scoring. Replace if necessary.

LOOP SPRINGS

Inspect loop springs 10 for rusty spots, fatigue and distortion. Replace if necessary.

TORSION DAMPER

Check all rivets on the torsion damper. Replace, if any rivets are loose. Check torsion damper splines for wear or damage. Check damper springs for serviceability.

PILOT BEARING

Check flywheel pilot bearing for roughness and excessive wear. Make sure bearing is seated correctly in flywheel bore. See section 20, group 20 for renewal of pilot bearing.

ASSEMBLY

NOTE: The clutch assembly is balanced. Therefore, when reassembling observe the marks made during disassembly.

Coat the indicated faces and bores of the following parts with MOLYKOTE BR 2 grease: The sides of the three lugs of front pressure plate 3 (fig. 13) and the corresponding three grooves in the flywheel, the bores of base plate 5 for seating operating bolts 2, the faces of diaphragm spring 4 which contact pressure plate 3 and base plate 5, the surface of pivot pins 12 and the bores of bushings 22.

Insert the three operating bolts (see 2, fig. 13) in bores of pressure plate (from friction side). Place pressure plate on work bench.

Place diaphragm spring 4 (in alignment) on pressure plate with cupped face toward pressure plate.

Secure torsion damper (see 7, fig. 13) to base plate 5, tightening hex. socket screws 8 to specified torque (see Torques for Hardware).

Guide pre-assembled base plate over the three operating bolts 2 and place on diaphragm spring 4. If necessary, shift diaphragm spring so that it is properly seated around the shoulder of the base plate.

Place the three release levers 9 over the three operating bolts 2. Push pivot pins 12 into bushings 22 located in base plate 5 and into release levers 9. Make sure bore in each pivot pin (for installing spring pin 11) is in line with bore in release levers. Drive in spring pins flush with release levers.

Place loop springs 10 on release levers 9. Press springs (to obtain necessary tension) downward and push over the end of pivot pins 12. Finally secure springs in position with two snap rings 13.

Slide washer 14 over each operating bolt 2, thread hex. nut 15 on each bolt and tighten. Do not install second hex. nut (lock nut) until adjustment of release levers has been completed.

INSTALLATION

Install flywheel (if necessary). Tighten attaching screws crosswise to the specified torque.

Insert centering tool No. 19.58-90.486 (see 1, fig. 14) in clutch assembly. Slide clutch disk 2 on tool with long hub end facing away from clutch assembly.

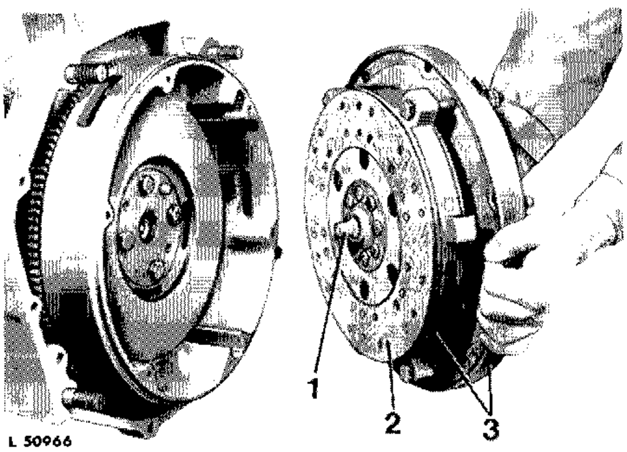

Fig. 14 — Installing Engine Single-Stage Clutch

1 Centering tool
2 Clutch disk
3 Clutch assembly

Align lugs of pressure plate with slots of flywheel. Install clutch assembly in flywheel. Insert pilot of centering tool in pilot bearing of flywheel.

Attach clutch assembly to flywheel. Tighten cap screws crosswise, gradually (with this the diaphragm spring is tightened) to the specified torque (see Torques for Hardware).

Remove centering tool.

ADJUSTMENT

NOTE: The engine clutch can be adjusted in conjunction with its flywheel only.

Whenever the clutch has been disassembled or a new clutch disk or flywheel has been installed, do not forget to adjust the release levers.

Measure clearance between pressure face of each release lever (see 2, fig. 15) and torsion damper hub splines by means of a depth gauge as shown in fig. 15 (see "Specifications" for adjustment dimensions).

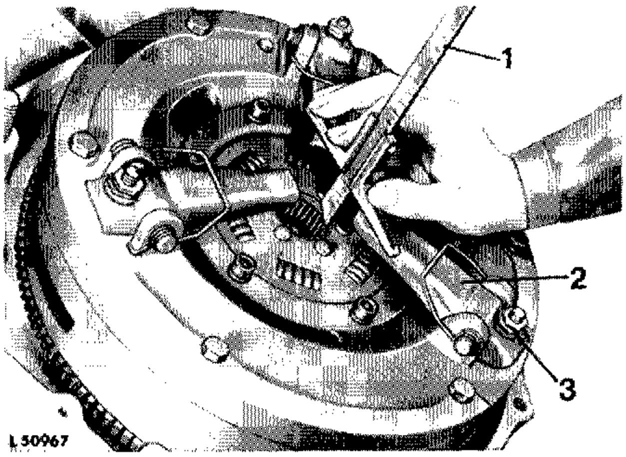

Fig. 15 — Adjusting Release Levers with Depth Gauge

1 Depth gauge
2 Release lever
3 Adjusting nut

If measured clearance is larger than that quoted in Specifications, slacken hex. nut 3 accordingly. If the clearance is less, the nut must be tightened until the correct clearance has been obtained. When adjustment is completed, tighten lock nuts.

IMPORTANT: To safeguard proper operation of engine clutch, difference in height of release levers should not exceed specified measurement (see Specifications).

Reassemble tractor between clutch housing and engine, see section 10, group 25.

SPECIFICATIONS

CLUTCH LINKAGE	Dimensions of New Parts	Wear Tolerance
Dia. of hollow PTO drive shaft seat for roller bearing	1.9651 to 1.9657 in. 49.913 to 49.929 mm	
Dia. of drive shaft seat for pilot bearing	0.5895 to 0.5901 in. 14.973 to 14.989 mm	
Dia. of needle bearing bore of clutch housing	2.1245 to 2.1255 in. 53.962 to 53.988 mm	
Clearance between oil seal face and clutch housing face	1.3 in. 33.3 mm	
Bearing pin of clutch pedal protrudes from clutch housing by	2.5 in. 63.5 mm	
Dia. of clutch pedal bearing pin	0.9975 to 0.9985 in. 25.336 to 25.362 mm	
Inner dia. of clutch pedal bushing (installed)	1.0030 to 1.0075 in. 25.48 to 25.59 mm	
Clearance between bushing face and clutch housing face	2.8 in. 71.5 mm	
Dia. of clutch shaft in clutch housing	1.122 to 1.128 in. 28.50 to 28.66 mm	
Inner dia. of clutch shaft bushing (installed)	1.128 to 1.132 in. 28.65 to 28.75 mm	
ENGINE DUAL-STAGE CLUTCH		
Thickness of a new engine clutch disk	0.366 to 0.390 in. 9.3 to 9.9 mm	0.238 in. 6.3 mm
Thickness of a new PTO clutch disk	0.303 to 0.327 in. 7.7 to 8.3 mm	0.185 in. 4.7 mm
Maximum permissible wear or roughness of pressure plate, base plate and flywheel		0.006 in. 0.15 mm

	Dimensions of New Parts	Wear Tolerance
Adjustments		
Clearance of clutch levers from hub face of rear clutch disk	1.466 to 1.474 in. 37 to 37.6 mm	
Clutch pedal free travel	approx. 1 in. 25 mm	approx. 0.5 in. 13 mm
ENGINE SINGLE-STAGE CLUTCH		
Thickness of a new clutch disk	0.366 to 0.390 in. 9.3 to 9.9 mm	0.238 in. 6.3 mm
Maximum permissible wear or roughness of pressure plate and flywheel		0.006 in. 0.15 mm
Adjustments		
Clearance between release levers and torsion damper hub splines (see fig. 15)	1.791 to 1.811 in. 45.5 to 46.0 mm	
Maximum permissible difference in height of release levers	0.01 in. 0.25 mm	
Clutch pedal free travel	approx. 1 in. 25 mm	approx. 0.5 in. 13 mm

TORQUES FOR HARDWARE

ENGINE DUAL-STAGE CLUTCH		
Flywheel to crankshaft, cap screws	85 ft.lbs.	11.7 mkg
Clutch assembly to flywheel, cap screws	33 to 40 ft.lbs.	4.5 to 5.5 mkg
ENGINE SINGLE-STAGE CLUTCH		
Flywheel to crankshaft, cap screws	85 ft.lbs.	11.7 mkg
Clutch assembly to flywheel, cap screws	33 to 40 ft.lbs.	4.5 to 5.5 mkg
Torsion damper to base plate, hex.socket screws	14 to 20 ft.lbs.	2.0 to 2.5 mkg

SPECIAL TOOLS

Part No. if ordered from JD Parts Depot	Manufacturer	Description	Use
19.58-90.486		Centering tool	Installing engine clutch

Group 10
HIGH-LOW SHIFT UNIT

GENERAL INFORMATION

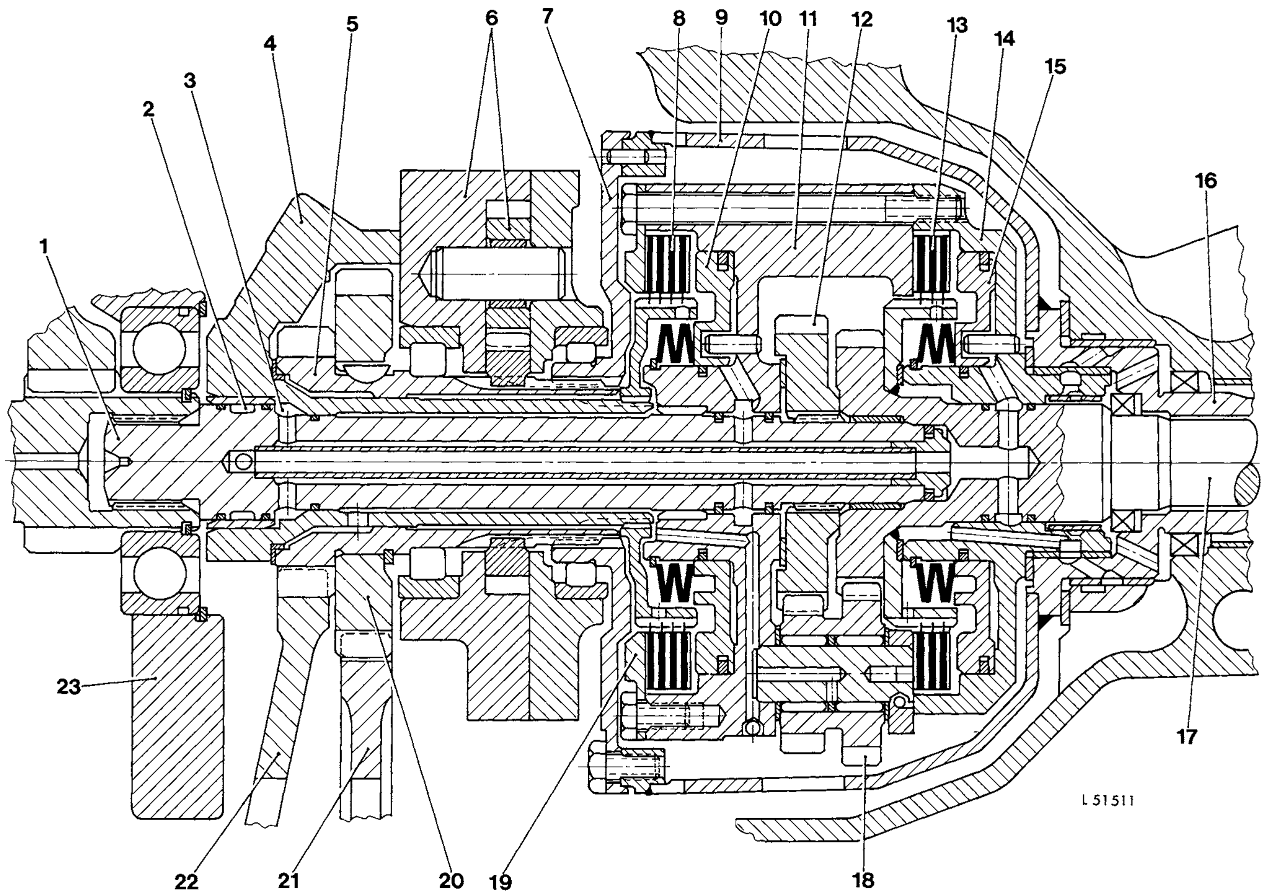

Fig. 1 — HIGH-LOW Shift Assembly, Sectional View

1 Transmission input shaft
2 Oil inlet from control valve to HIGH clutch
3 Oil inlet from control valve to LOW brake
4 Oil manifold
5 Hollow gear shaft (for driving transmission oil pump and PTO shaft)
6 Transmission oil pump
7 HIGH-LOW cover
8 LOW brake
9 HIGH-LOW housing
10 LOW brake piston
11 Planet pinion carrier
12 Planet sun gear
13 HIGH clutch for normal travel speed
14 HIGH clutch drum
15 HIGH clutch piston
16 Hollow drive shaft (integral with HIGH-LOW housing 9)
17 Drive shaft
18 Planet gear (3 used)
19 Backing plate
20 Drive gear for 1000 rpm PTO (tractors with dual PTO)
21 Driven gear for 1000 rpm PTO
22 Driven gear for 540 rpm PTO (tractors with continuous running PTO)
23 Front plate of transmission case

The HIGH-LOW shift unit (see fig. 1) is a hydraulic gear reduction unit which can be shifted under load. This unit allows the operator to shift to a lower range in any transmission gear while "on the go" and without declutching.

Shifting from HIGH to LOW decreases the travel speed by 26% and boosts torque to the tractor rear axle by 35% (LOW brake see item 8, fig. 1). Shifting back to HIGH deactivates the reduction part of the HIGH-LOW unit and the tractor resumes the speed selected by the transmission.

The HIGH-LOW shift unit is located in front of the transmission and contained in the clutch housing. It consists essentially of a control valve assembly located in the transmission shift cover, a HIGH hydraulic clutch for normal travel speed, a LOW hydraulic brake for reduced travel speed (both of the multiple-disk type) and a planetary assembly (see fig. 1).

OIL SUPPLY

Pressure oil to operate the HIGH-LOW shift unit is supplied by the transmission oil pump located directly behind the HIGH-LOW shift unit (see item 6, fig. 1).

Oil from the transmission oil pump passes through transmission oil filter to the control valve unit in the transmission shift cover.

A pressure regulating valve located in the control valve unit (see item 1, fig. 2) maintains the oil pressure required for clutch or brake pack operation (see Specifications). As little oil only is required for operating the disk packs, the main oil stream flows past the pressure regulating valve 1, through by-pass 6 to the relief valve in the right-hand side of the clutch housing.

This relief valve senses pressure to and from the main hydraulic pump, preventing the build-up of excessive pressure due to restriction (see section 70).

The return oil from the oil cooler serves to lubricate the HIGH-LOW shift unit.

CONTROL VALVE ASSEMBLY

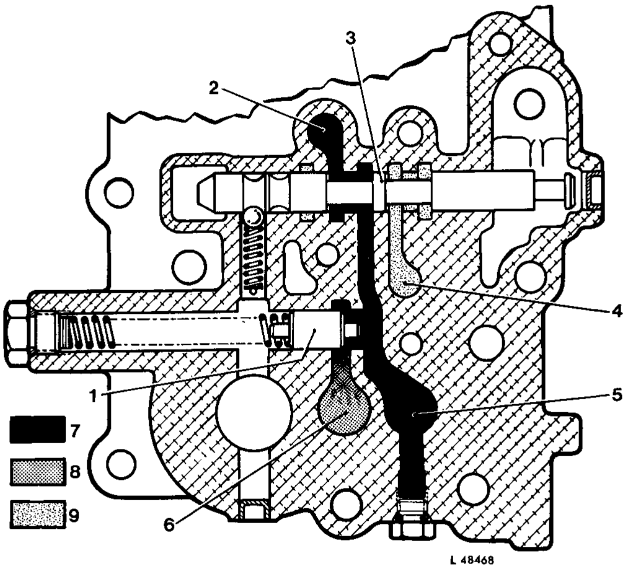

Fig. 2 — Operation of HIGH-LOW Control Valve Assembly

1 Pressure regulating valve
2 To oil manifold and HIGH clutch
3 Control valve
4 To oil manifold and LOW brake
5 Passage for pressure oil from transmission oil pump
6 Passage for oil flowing to main hydraulic pump
7 Pressure oil (100 psi = 7 kg/cm^2)*
8 Pressure oil (50 psi = 3.5 kg/cm^2)
9 Pressure-free oil

The control valve assembly in the transmission shift cover (see fig. 2) contains a control valve 3 and a pressure regulating valve 1.

The control valve 3 is a spool-type valve shifted by the HIGH-LOW control lever. It directs oil to engage the HIGH clutch and the LOW brake and returns oil from the opposite unit. The valve has two detented positions, HIGH and LOW. There is no neutral position.

* Oil pressure on tractors equipped with independent PTO = 150 psi (10.5 kg/cm^2)

The pressure regulating valve 1 is adjustable by shims to maintain the oil pressure required for HIGH clutch or LOW brake engagement (see Specifications).

HYDRAULIC FUNCTION OF HIGH-LOW UNIT

Power flow in HIGH drive

At the input end, drive shaft 17 (fig. 1) is driven at engine speed by the engine clutch disk (the shaft is splined to the disk). The HIGH clutch hub is welded to the drive shaft. The bronze disks (3 used) are splined to the hub and the separator plates (4 used) are tanged to the HIGH clutch drum 14.

With control lever in HIGH position, pressure oil from the control valve causes the piston 15 to engage the HIGH clutch disks and plates, forming a solid unit.

Now the planet pinion carrier, attached to the HIGH clutch drum, rotates with the clutch shaft.

Since the larger planet pinion gear is in mesh with the clutch shaft gear, it is locked to the planet pinion carrier. Therefore, the rotating force of the carrier is transmitted to the planet sun gear through the smaller planet pinion gear while the planet pinions are stationary.

The power flow continues from the planet sun gear through the transmission input shaft 1 onto the transmission.

Power flow in LOW drive

The hub of LOW brake 8 (fig. 1) is splined to the shaft of clutch oil manifold 4. The LOW brake disks (4 used) are splined to the hub and the separator plates (4 used) are tanged to the planet pinion carrier.

With control lever in LOW position, pressure oil from the control valve causes the piston 10 to engage the LOW brake disks and plates, forming a solid unit. Thus rotation of planet pinion carrier 11 will be prevented.

Now the pinions function as countershafts, transmitting power from the clutch shaft gear to the planet sun gear. The different gear ratios cause the reduction in speed for LOW drive. The sun gear transmits power over the input shaft 1 to the transmission.

Both the clutch and brake packs are disengaged by spring washers acting on the piston. Any time one pack is engaged, the other one is disengaged.

PTO power flow

Engine power is transmitted through the rear driven disk of PTO clutch* or torsion damper** of engine clutch, splined to the hollow drive shaft (see 16, fig. 1) and thus to HIGH-LOW housing 9 welded to the hollow drive shaft. From here power is transferred through HIGH-LOW housing cover 7, attached to HIGH-LOW housing to the hollow gear shaft which is splined to the HIGH-LOW housing cover. The hollow gear shaft is provided with the PTO drive gear (540 rpm) for continuous-running or independent PTO. The shaft and gear are machined as an integral assembly. On tractors equipped with dual speed continuous-running PTO the gear is keyed to the hollow shaft (see 20, fig. 1) and drives the 1000 rpm PTO. The shaft also drives the large transmission oil pump gear (see fig. 1).

* Tractors equipped with engine dual-clutch (Tractors with continuous-running PTO)
** Tractors equipped with engine single-stage clutch (Tractors with independent PTO)

CHECKING OPERATING PRESSURE

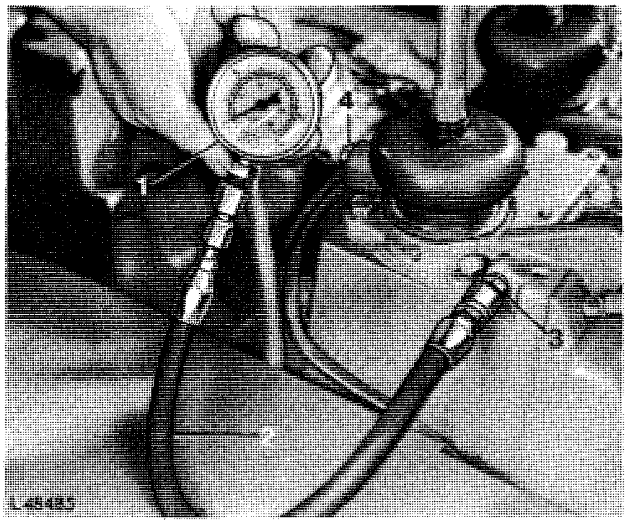

Fig. 3 — Checking Operating Pressure at Pressure Regulating Valve

1 Low pressure gauge No. 19.58-90.268
2 High pressure hose of special tool No. 19.58-90.260
3 Special adapter 19.58-90.266
4 Plug

Remove plug on right side of transmission shift cover and connect gauge No. 19.58-90.268 (measuring range from 0 to 355 psi = 0 to 25 kg/cm^2) with the aid of pressure hose assembly and adapter No. 19.58-90.266 of special tool No. 19.58-90.260 (see fig. 3).

Move range shift lever in park position or apply hand brake and move gear shift lever in neutral position. Run engine at specified speed (see Specifications).

Actuate HIGH-LOW control lever to warm oil to normal operating temperature and observe gauge (operating pressure see Specifications).

If operating pressure is not within specified range, remove plug 4 (fig. 3) of pressure regulating valve in control valve assembly. Adjust to proper operating pressure by adding or removing shims located between plug and valve spring.

DIAGNOSING MALFUNCTIONS

If adjusting pressure does not correct trouble, carry out the following checks:

CHECKING FOR CLOGGED TRANSMISSION OIL FILTER

A clogged filter is very difficult to detect from the outside. When the filter is almost clogged, the oil flow to the HIGH-LOW pressure regulating valve and the main hydraulic pump charging circuit will be very small. Since only a small volume is required to operate the HIGH-LOW disk packs, there will be hardly an indication of disk pack slippage. As the hydraulic system has an auxiliary oil reservoir, operation of most hydraulic units will appear regular.

The function of the tractor hydraulic system that will be most affected by this reduced oil flow is that of transmission and HIGH-LOW unit lubrication. Prolonged operation with a clogged filter element could cause a HIGH-LOW unit failure due to lack of lubrication.

CHECKING TRANSMISSION PUMP OUTPUT

Operate rockshaft or selective control valve lever continuously with remote cylinder connected. Since each of these two units requires a specified oil quantity for normal operation, and since this volume of oil is returned to the transmission case, rockshaft or remote cylinder operation will be affected by the transmission oil pump output.

If transmission oil pump output is low, rockshaft or remote cylinder will operate very slowly when the auxiliary hydraulic oil reservoir of tractor is empty.

A broken transmission filter relief valve spring could also cause the low flow in the system.

However, if rockshaft or remote cylinder operate properly, all the components in the main hydraulic pump charge circuit can be considered in good condition and the problem is in the HIGH-LOW circuit.

Check for a broken pressure regulating valve spring or a sticking pressure regulating valve.

CHECKING OPERATION OF HIGH-LOW SHIFT UNIT

Operate tractor in both HIGH and LOW ranges, carefully observing both operations. Use the brakes to simulate a load condition on the tractor. Low oil pressure in the HIGH-LOW control valve assembly will be indicated by equal disk pack slippage in both ranges. If operation is normal in one range and not in the other, a mechanical failure in the HIGH-LOW shift unit is probably the cause.

Always check operating pressure before disassembling the HIGH-LOW shift unit.

NOTE: Speed of shifting on HIGH-LOW unit is not adjustable. However, the unit should shift instantly when the control lever is moved. The correct pressure adjustment assures oil for fast engagement of HIGH-LOW disk packs.

CHECKING OPERATION OF INDEPENDENT PTO (if equipped)

On tractors equipped with independent PTO, connect a manometer No. 19.58-90.260 of special tool No. 19.58-90-260 to pressure oil channel of PTO clutch and one to pressure oil channel of PTO brake (see group 35). Connect a further manometer No. 19.58-90.268 to pressure regulating valve (see fig. 3).

Start engine. Fully engage and disengage PTO by means of control lever. The manometer connected to pressure channel of pressure regulating valve and one of the two manometers connected to PTO pressure oil channels (depending on position of PTO control lever) should show a pressure of 140-160 psi (9.8-11.2 kg/cm^2).

When this pressure is not reached, slowly move PTO control lever until both manometers connected to PTO pressure oil channels show no pressure. Now oil flow to PTO clutch and brake is interrupted and the pressure regulating valve isolated. The operating pressure at pressure regulating valve should now read 140-160 psi (9.8-11.2 kg/cm^2).

If, with the PTO engaged or disengaged, the operating pressure is too low but not with isolated pressure regulating valve, a leak in the PTO oil system will be the cause (see group 35).

If operating pressure is too low both with engaged or disengaged PTO and with isolated pressure regulating valve, the fault will not be found at the independent PTO.

REMOVAL

Separate tractor between transmission case and clutch housing, see section 10, group 25.

Pull transmission input shaft (see 8, fig. 4) out of HIGH-LOW housing.

Remove retainer holding oil lines. On tractors equipped with independent PTO, remove PTO oil distributor secured to oil manifold and housing of oil transmission pump complete with retainer and two short pressure lines leading to disk packs of HIGH-LOW shift unit.

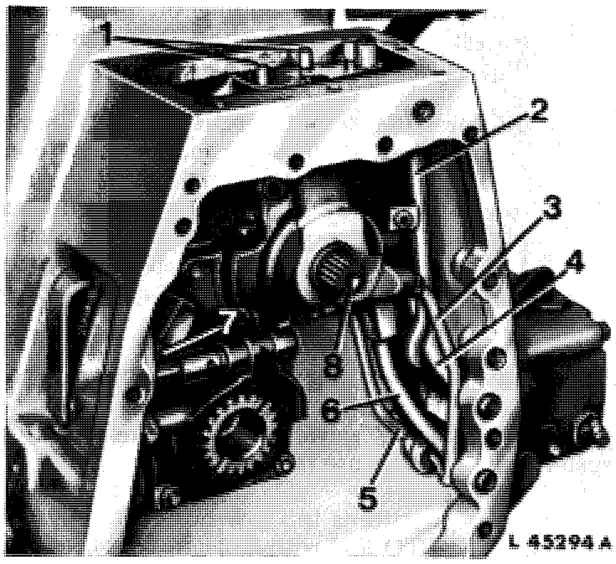

Fig. 4 — Removing Oil Lines

1 Pressure lines to disk packs
2 Pressure line to main hydraulic pump
3 Lube oil line to LOW disk brake
4 Pressure line from transmission oil filter to HIGH-LOW control valve assembly and PTO clutch control valve assembly (if independent PTO is equipped)
5 Lube oil line to HIGH disk clutch
6 Pressure line of transmission oil pump
7 Suction line of transmission oil pump
8 Transmission input shaft

Remove suction line 7 (fig. 4) and pressure line 6 of transmission oil pump.

Remove both pressure lines 1* to disk packs of HIGH-LOW shift assembly through top of clutch housing. Remove pressure lines 2 and 4.

Remove lube oil line 3 to LOW disk brake and lube oil line 5 to HIGH disk clutch from clutch housing.

NOTE: Take care of 0-rings located at the end of each oil line.

If installed, remove both independent PTO oil lines.

If installed, remove front PTO shaft (see group 30).

Remove cap screws attaching oil manifold and transmission oil pump to clutch housing. Remove oil manifold with hollow gear shaft and transmission oil pump as shown in fig. 5.

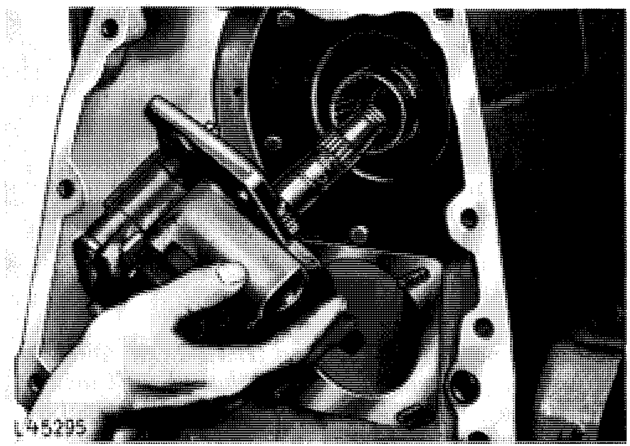

Fig. 5 — Removing Oil Manifold with Transmission Oil Pump

Pull HIGH-LOW shift assembly out of clutch housing, taking care of thrust washer located between HIGH-LOW housing and clutch housing.

* Not on tractors equipped with independent PTO

DISASSEMBLY

Remove cover from HIGH-LOW housing and pull HIGH-LOW shift assembly out of housing, taking care of the thrust washer located between housing and clutch drum.

Remove three short cap screws (see 26, fig. 7) and three long cap screws 25 from cover plate 27. Remove cover plate as well as planet pinion carrier.

Store disks in installation sequence.

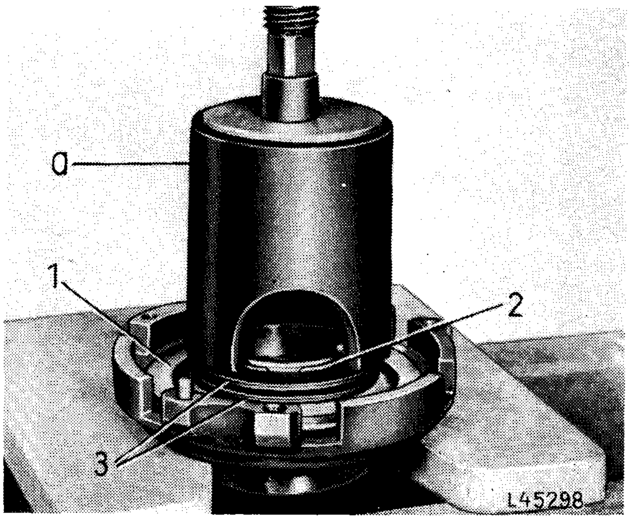

Fig. 6 — Removing Annular Piston of HIGH Disk Clutch

a Special tool No. 19.58-90.617
1 Annular piston
2 Snap ring
3 Spring washers

To facilitate removal of annular piston (see 1, fig. 6) from planet pinion carrier or HIGH clutch drum, first remove snap ring 2 retaining spring washers 3 in planet pinion carrier or clutch drum.

Position special tool No. 19.58-90.617 (see item "a", fig. 6) on spring washers and press washers down so that the snap ring can be removed.

CAUTION: Make sure special tool is centered over spring washer pack. After snap ring is removed, release pressure slowly and keep fingers away.

Remove spring washers and annular piston.

The planet pinions rotate in a carrier on shafts (see 45, fig. 7) and are supported by two sets of needle bearings 42 which are separated by spacer 44.

Prior to removal, rotate planet pinions until "V" marks match the "V" marks on sun gear. Then identify planet pinions and sun gear so that marks on pinions exactly match the SAME marks on sun gear when reassembling.

NOTE: Identification is necessary only if old planet pinions are to be installed again.

To remove planet pinions, pull bearing pins slightly out of planet pinion carrier by means of a 1/4 in. cap screw and remove detent ball at end of each bearing pin. Be careful not to lose the balls.

Pull bearing pins completely out of carrier and remove planet pinions, needle bearings, spacers and thrust washers.

NOTE: Be careful not to lose the needle bearings. There are 44 needles in each planet pinion or a total of 132 needles for the pinion set.

Remove sun gear and thrust washer from planet pinion carrier.

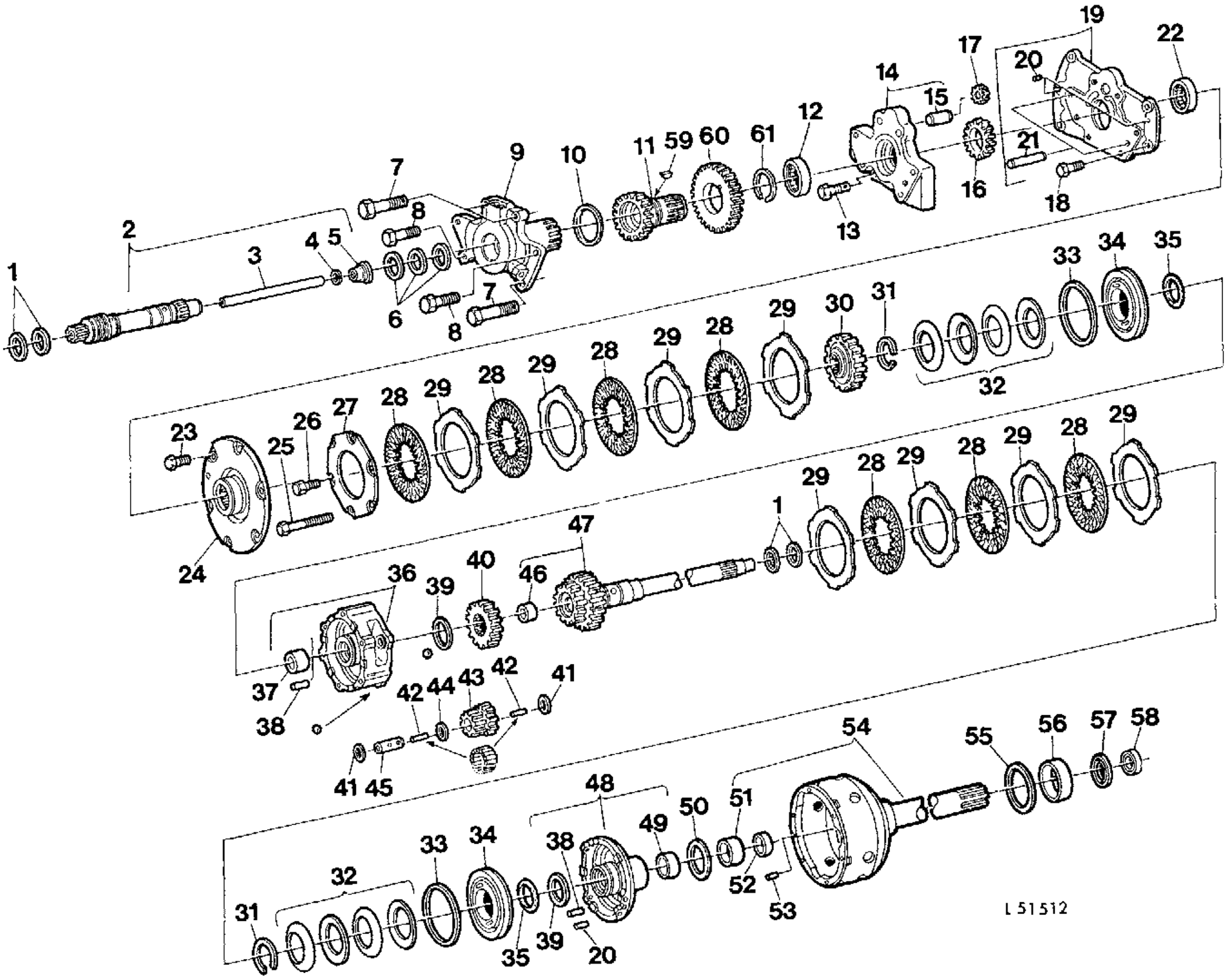

Fig. 7 — HIGH-LOW Shift Assembly, Exploded View

1 Sealing rings
2 Transmission input shaft
3 Oil tube
4 Sealing ring
5 Retainer
6 Sealing rings
7 Cap screw (3 used)
8 Cap screw (2 used)
9 Oil manifold with bushing
10 Thrust washer
11 Hollow gear shaft
12 Roller bearing
13 Cap screw
14 Transmission oil pump housing
15 Bearing pin
16 Pump drive gear
17 Pump driven gear
18 Cap screw (4 used)
19 Transmission oil pump cover
20 Dowel (4 used)
21 Dowel (2 used)
22 Roller bearing
23 Cap screw (6 used)
24 HIGH-LOW housing cover
25 Cap screw (3 used)
26 Cap screw (3 used)
27 Cover plate of disk brake
28 Bronze disks
29 Separator plates
30 Brake hub
31 Snap rings
32 Spring washers
33 Sealing rings
34 Annular piston
35 O-rings
36 Planet pinion carrier
37 Bushing
38 Dowels
39 Thrust washers
40 Sun gear
41 Thrust washers (6 used)
42 Bearing needles (44 used per pinion)
43 Planet pinion (3 used)
44 Spacer (3 used)
45 Planet pinion bearing pin (3 used)
46 Bushing
47 Drive shaft
48 Drum of disk clutch
49 Bushing
50 Thrust washer
51 Bushing
52 Oil seal ring
53 Dowel
54 HIGH-LOW housing and hollow drive shaft
55 Thrust washer
56 Bushing
57 Oil seal ring
58 Pilot bearing (flywheel)
59 Woodruff key
60 Drive gear for 1000 rpm PTO
61 Snap ring

59–61: only on tractors equipped with dual continuous-running PTO

REPAIR

CONTROL VALVE ASSEMBLY

NOTE: Numbers behind parts in the following text refer to fig. 8.

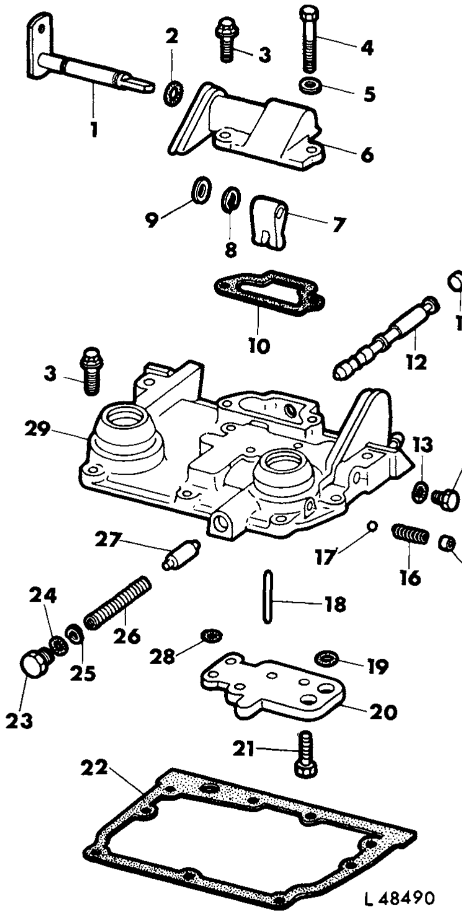

Fig. 8 —Transmission Shift Cover and Control Valve Assembly, Exploded View

1 Control valve shaft
2 O-ring
3 Special screw (6 used)
4 Cap screw
5 Washer
6 Cover
7 Control valve arm
8 Retaining ring
9 Washer
10 Gasket
11 Plug
12 Control valve spool
13 O-ring
14 Plug (pressure test)
15 Plug*
16 Detent spring
17 Detent ball
18 Bearing needle*
19 O-ring
20 Control valve plate
21 Cap screw (2 used)
22 Gasket
23 Plug of pressure regulating valve
24 O-ring
25 Special shim (use as required)
26 Pressure regulating valve spring
27 Valve body
28 O-ring
29 Transmission shift cover

* Not provided on tractors equipped with independent PTO

Check control arm 7 and shaft for wear or damage and replace, if necessary.

To remove valve spool 12, pull off rubber boot and snap ring of gear shift lever (R.H. lever). Withdraw gear shift lever with retaining ring from transmission shift cover.

Remove control valve plate 20 on bottom of transmission shift cover; also remove bearing needle 18 (on tractors not equipped with independent PTO).

Remove spring 16 and ball 17 from transmission shift cover.

Push valve spool 12 and plug 11 out of transmission shift cover. Inspect valve spool for scores or burrs and replace, if necessary.

Remove plug 23 of pressure regulating valve, special shims 25, spring 26 and valve body 27 from cover bore.

Check detent spring 16 and pressure regulating spring 26 for damaged or broken coils. Check spring resilience (see Specifications).

Only on tractors not equipped with independent PTO: When installing parts, start with detent ball 17. Then insert detent spring 16 in bore and compress until bearing needle 18 for securing spring 16 can be inserted.

Only on tractors equipped with independent PTO: When installing parts, first insert detent spring 16 and detent ball 17 into transmission shift cover and press into bore by means of a suitable tool.

Insert valve spool 12, with pointed end first, in bore of transmission shift cover. Install all other parts in sequence shown in fig. 8.

HIGH-LOW SHIFT UNIT

NOTE: Numbers behind parts in the following text refer to fig. 7. For repair of transmission oil pump see section 70, group 15.

Check transmission oil pump cover 19 for wear and damage, especially sliding face of gears 16 and 17 of transmission oil pump. Replace cover, if necessary.

Check annular piston 34 of disk brake and clutch for wear or damage. Replace seal rings 33 and 35.

Check spring washers 32 for damage or flattening: place each washer on a flat support with cupped side down and measure height of washer (see Specifications).

Check disks 28 and separator plates 29 for wear. Make sure grooved pattern of disk facings is not worn or rubbed off. Otherwise replace disk. Check disk splines for broken teeth. For thickness of an individual disk as well as total stacked height of a new disk pack see Specifications.

Check planet pinion carrier 26 for cracks or other damage and replace, if necessary.

Inspect brake hub 30, gear and hub of drive shaft 47, sun gear 40 and planet pinions 43 for chipped or worn teeth. Replace parts, if necessary.

NOTE: If one or two planet pinions must be replaced, install a complete set (3) of pinions as they are matched and are available only as a complete set.

Check bearing needles 42 supporting planet pinions for worn spots. A total of 132 bearing needles are used.

Check transmission input shaft 2 for wear and damage and replace, if necessary. Replace sealing rings 1,4 and 6 on input shaft. When replacing sealing ring 4, first remove retaining ring 5 from input shaft.

Now, if necessary, pull oil tube 3 out of input shaft. Press new oil tube in retaining ring 5. Slide sealing ring 4 on retaining ring and push oil tube with retaining ring and sealing ring in transmission input shaft.

Examine drive shaft 47 for wear or damage. If bushing 46 is damaged, remove it from shaft and press in new bushing with open ends of oil grooves facing outward. Replace sealing rings 1 on drive shaft.

Inspect oil manifold 9 and its bushing for damage. Replace complete oil manifold, if necessary.

Check HIGH-LOW housing and hollow drive shaft 54 (forming an integral unit) for damage. Check oil seal ring 52 and bushing 51 for serviceability. Press in new oil seal ring with numbered side facing driver.

If necessary, remove unserviceable bushing 51 from HIGH-LOW housing. Press in new bushing by means of driver No. 19.58-90.613 and drift No. 815 until drift is flush against HIGH-LOW housing.

CLUTCH HOUSING

Check oil seal ring (see 57, fig. 7) and bushing 56 of clutch housing for serviceability. Press new oil seal ring in clutch housing bore so that its sealing lip faces driving tool and ring is within clutch housing face by a specified dimension (see Specifications).

Remove unserviceable bushing 56 and install new bushing by means of driving tool No. 19.58-90.273 in clutch housing so that lube oil bores of bushing match housing bores. Coat bore of bushing with a film of oil.

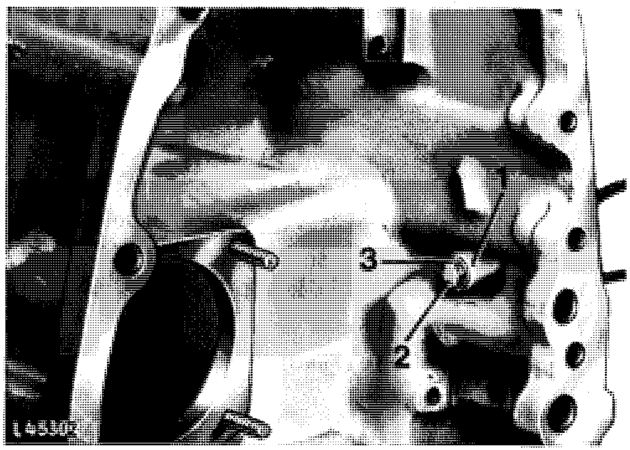

Fig. 9 — Installing Hydraulic Pump Pressure Line Adapter

1 Adapter
2 Cap screw
3 Washer

Check adapter (see 1, fig. 9) for pressure line to main hydraulic pump, situated at the rear and to the right in the clutch housing.

If necessary, remove unserviceable adapter and replace as follows: Remove master cylinder. Drive adapter inwards out of clutch housing. Slide new adapter onto cap screw and washer (see 2 and 3, fig. 9). Place against bore in clutch housing. Screw on hex. nut and tighten, so forcing adapter into location in clutch housing (see fig. 9).

ASSEMBLY

NOTE: Numbers behind parts in the following text refer to fig. 7.

When assembling, principally reverse disassembly procedure. Observe the following:
When installing annular pistons, make sure sealing rings are not inverted or damaged when pistons are pressed into clutch drum or planet pinion carrier.

Install spring washers of disk brake as follows: Place a spring washer 32 on piston with cupped side facing away from piston. Then place second spring washer on first washer with cupped side facing outward. Install third washer with cupped side facing second washer etc. (see fig. 1).

Compress spring washers as shown in fig. 6 until snap ring 31 can be inserted in groove, using a press and special tool No. 19.58-90.617. **CAUTION: Be careful when compressing washers.**

Install a spacer and 44 bearing needles into each planet gear.

Install planet pinions 43 as follows: Insert planet pinions with bearing needles in planet pinion carrier with large gear facing front of carrier and "V" mark of each pinion matching one of the three "V" marks on the sun gear.

NOTE: If old pinions are to be installed again, observe marks made before removal. When reinstalling planet pinions, they should mesh sun gear as before removal, i.e. "V" mark of each planet pinion should match SAME "V" mark on sun gear as before removal.

Insert a thrust washer 41 on each side of planet pinion. Then install bearing pin 45 with threaded end facing forward. As a first step, push in pin sufficiently to allow access to detent ball bore. Install ball in bore and push in pin completely so that it is flush with front face of planet pinion carrier. Install remaining two pinions in the same way.

IMPORTANT: Make sure "V" mark on each planet pinion matches corresponding "V" mark on sun gear.

Install drive shaft 47 in planet pinion carrier with gear first and mesh gear of shaft with planet pinions.

Slide a steel plate 29 on clutch hub welded to drive shaft 47. First slide a bronze disk, then a steel plate etc. on shaft, totaling four steel plates and three bronze disks.

Slide second thrust washer 39 on drive shaft. Place clutch drum 48 with spring washers 32 and annular piston 34 on front side of planet pinion carrier 36.

Slide brake hub 30 over spring washers 32 of disk brake. First install a steel plate 29 on brake hub, then follow with a bronze disk, a steel plate etc., totaling four steel plates and four bronze disks.

Install cover plate 27 and tighten screws to the specified torque.

Insert disk clutch, disk brake and planetary gear in HIGH-LOW housing 54, making sure thrust washer 50 is installed between HIGH-LOW housing and clutch drum. Attach HIGH-LOW cover 24 to housing 54 and tighten cap screws to the specified torque.

INSTALLATION

Install HIGH-LOW shift assembly in clutch housing, making sure thrust washer (see 55, fig. 7) is installed in clutch housing.

If equipped, install front PTO (see group 30).

Install oil manifold and transmission oil pump (see fig. 5)

NOTE: Make sure thrust washer is installed between hollow gear shaft and oil manifold.

Tighten four cap screws attaching transmission oil pump cover to clutch housing as well as oil manifold and transmission oil pump attaching screws to the specified torque.

Insert transmission input shaft in HIGH-LOW shift unit through bore of oil manifold. Be careful not to damage sealing rings of transmission input shaft.

Install lube oil lines (see 3 and 5, fig. 4) of disk packs, taking care of the O-rings.

On tractors equipped with independent PTO: Install both PTO oil lines and oil distributor to oil manifold of HIGH-LOW shift unit and housing of transmission oil pump. Tighten hex. nut securing oil distributor to bracket on oil manifold to specified torque (see Specifications). Before tightening cap screws and nuts, install the two short pressure lines leading to disk packs of HIGH-LOW shift unit between oil distributor and oil manifold. Enter both oil lines into oil distributor.

Enter both pressure lines (see 1*, fig. 4) of HIGH-LOW disk packs in bores of oil manifold. Install pressure line 4 from transmission oil filter and pressure line 2 leading to hydraulic pump. Slide retainer over oil lines and secure on oil manifold. Install suction and pressure lines of transmission oil pump.

Join tractor between clutch housing and transmission case as explained in section 10, group 25.

Check operating pressure of HIGH-LOW shift unit as explained previously and adjust pressure regulating valve of control valve assembly, if necessary.

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* Only installed on tractors not equipped with independent PTO

SPECIFICATIONS

	Dimensions of New Parts	
I.D. of oil manifold bushing	1.3750 to 1.3760 in.	34.925 to 34.951 mm
Dia. of hollow gear shaft bearing seat	1.9651 to 1.9657 in.	49.913 to 49.929 mm
TRANSMISSION INPUT SHAFT		
O.D. of shaft in planet pinion carrier bushing	1.1235 to 1.1245 in.	28.537 to 28.563 mm
O.D. of shaft in drive shaft bushing	0.9330 to 0.9340 in.	23.698 to 23.724 mm
DRIVE SHAFT		
I.D. of bushing in gear end	0.9360 to 0.9390 in.	23.774 to 23.852 mm
Dia. of bushing bore	1.0620 to 1.0630 in.	26.975 to 27.000 mm

	Dimensions of New Parts	
Dia. of shaft in clutch drum bushing	1.3580 to 1.3590 in.	34.493 to 34.519 mm
Dia. of shaft at oil seal location	1.1240 to 1.1260 in.	28.555 to 28.605 mm
Dia. of pilot bearing seat	0.5895 to 0.5901 in.	14.973 to 14.989 mm

CLUTCH DRUM

I.D. of bushing	1.3620 to 1.3650 in.	34.595 to 34.671 mm
Dia. of bushing bore	1.4995 to 1.5005 in.	38.087 to 38.113 mm
Dia. of drum hub in HIGH-LOW housing bushing	2.0610 to 2.0630 in.	52.349 to 52.400 mm

HIGH-LOW HOUSING AND HOLLOW DRIVE SHAFT

I.D. of bushing	2.0675 to 2.0695 in.	52.515 to 52.565 mm
Dia. of bushing bore	2.1870 to 2.1880 in.	55.550 to 55.575 mm
Dia. of oil seal bore	1.6230 to 1.6250 in.	41.235 to 41.275 mm
Dia. of housing at clutch housing oil seal location	1.6240 to 1.6260 in.	41.255 to 41.305 mm
Dia. of housing in clutch housing bushing	2.6860 to 2.6880 in.	68.225 to 68.275 mm

PLANETARY GEAR

I.D. of planet pinion carrier bushing	1.1275 to 1.1295 in.	28.639 to 28.689 mm
Dia. of planet carrier bushing bore	1.3120 to 1.3130 in.	33.325 to 33.351 mm
Dia. of planet carrier bearing bore	1.1250 to 1.1260 in.	28.575 to 28.601 mm
Dia. of bearing pin bores of planet carrier	0.6606 to 0.6616 in.	16.779 to 16.805 mm
Dia. of planet pinion bearing pin	0.6602 to 0.6606 in.	16.771 6o 16.779 mm
Dia. of planet pinion bore	0.8797 to 0.8803 in.	22.344 to 22.360 mm
Width of a planet pinion	1.217 to 1.223 in.	30.92 to 31.08 mm
I.D. of bearing needle spacer	0.669 to 0.679 in.	16.99 to 17.25 mm
Thickness of a spacer	0.084 to 0.090 in.	2.13 to 2.29 mm
Width of sun gear (between butting faces)	0.615 to 0.625 in.	15.62 to 15.88 mm

		Dimensions of New Parts
THRUST WASHERS		
Thickness of a thrust washer between planet pinion and planet pinion carrier	0.036 in.	0.88 mm
Total width of thrust washer between oil manifold and hollow drive shaft	0.13 to 0.18 in.	3.92 to 4.05 mm
Thickness of remaining thrust washers	0.056 to 0.068 in.	1.42 to 1.73 mm
DISK CLUTCH AND BRAKE		
Thickness of a separator plate	0.060 to 0.077 in.	1.52 to 1.96 mm
Thickness of a clutch disk	0.033 to 0.037 in.	0.84 to 0.94 mm
Height of a spring washer	0.139 in.	3.53 mm
Total stacked height of clutch disk pack(3 bronze disks and 4 separator plates)	0.281 to 0.397 in.	8.14 to 10.08 mm
Total stacked height of brake plate pack (4 bronze disks and 4 separator plates)	0.375 to 0.458 in.	9.53 to 11.63 mm
SPRINGS		
Control valve detent spring Resilience at a length of 0.7 in. (17.5 mm)	13 to 16 lbs.	6 to 7.3 kg
Pressure regulating valve spring Resilience at a length of 2.5 in. (63.5 mm)	26.5 to 32.3 lbs	12 to 14.7 kg
CLUTCH HOUSING		
I.D. of clutch housing bushing	2.6910 to 2.6950 in.	68.350 to 68.450 mm
Dia. of bushing bore	2.811 to 2.813 in.	71.40 to 71.44 mm
Clearance between clutch housing front face and oil seal front face	1.3 in.	33.5 mm
OPERATING PRESSURE		
Adjusting pressure of pressure regulating valve (Engine speed — 2100 rpm) On tractors without independent PTO	95 to 105 psi	6.7 to 7.3 kg/cm^2
On tractors equipped with independent PTO	150 to 160 psi	9.8 to 11.2 kg/cm^2

TORQUES FOR HARDWARE

Cover plate to planet pinion carrier or to clutch drum, cap screws	23 ft.lbs.	3.2 mkg
HIGH-LOW cover to HIGH-LOW housing, cap screws	23 ft.lbs.	3.2 mkg
Transmission oil pump cover to clutch housing, cap screws	35 ft.lbs.	4.8 mkg
Oil manifold and pump housing to pump cover, cap screws	35 ft.lbs.	4.8 mkg
Oil distributor to oil manifold bracket, hex. nut (tractors with independent PTO)	20 ft.lbs.	2.8 mkg
Clutch housing to transmission case, cap screws	85 ft.lbs.	11.7 mkg

SPECIAL TOOLS

Part No. if ordered from JD Parts Depot	Part No. if ordered from Manufacturer	Description	Use
19.58 - 90.260*		Special tool	Checking oil pressure
19.58 - 90.617		Special tool	Installing and removing spring washers
19.58 - 90.613		Driver	Driving in HIGH-LOW housing bushing
19.58 - 90.273		Driver	Driving in clutch housing bushing
L 48522	815**	Drift	ditto

* For details see section 70, group 5
** SERVICE TOOLS INC., 1901 INDIANA AVENUE, CHICAGO, ILLINOIS 60616, USA

Group 15

COLLAR-SHIFT TRANSMISSION

GENERAL INFORMATION

The collar-shift transmission is available in three versions:

8-speed transmission without parking lock, with blocked 8th gear and independent secondary brake (hand brake)
8-speed transmission without parking lock, with independent secondary brake (hand brake) and
8-speed transmission with parking lock, without independent secondary brake.

The transmission has helical gears. Its two shift levers are installed on top of the clutch housing.

The range shift lever operates range I and II and the reverse speeds. The gear shift lever selects four speeds in each range except for the transmission version with blocked 8th gear which has only three speeds in range II. Thus the collar-shift transmission provides a choice of 7 or 8 forward speeds and four reverse speeds. The parking lock (if equipped) can also be engaged by means of the range shift lever.

The gearshift mechanism is contained in the front compartment of the transmission case. The transmission case also serves as main oil reservoir for the transmission as well as for the hydraulic system. A transmission oil pump forces oil under pressure through horizontal and vertical bores in the transmission shafts to lubricate the gear train. In addition, there is an oil cup reservoir which gravity-feeds oil to the differential drive shaft when the tractor is being towed.

The transmission gears are carried on three shafts: the transmission drive shaft, the differential drive shaft and the countershaft (see fig. 1).

TRANSMISSION DRIVE SHAFT

The transmission drive shaft is located in the upper half of the transmission compartment. The four gears are integral with the shaft. The gears transmit power at various speeds through the countershaft to the differential drive shaft if range I or reverse is engaged or directly to the differential drive shaft if range II is engaged.

DIFFERENTIAL DRIVE SHAFT

The differential drive shaft is supported on two taper roller bearings below the drive shaft in the transmission case. Four gears are provided on the shaft. They are positively engaged to the differential drive shaft by means of shift collars and sleeves. Power is transmitted to the differential assembly through the bevel pinion of the differential drive shaft.

COUNTERSHAFT

The countershaft is located to the left and below the transmission drive shaft. It carries the range pinions for range I and for reverse. Input power is transmitted through the transmission drive gear located between transmission input shaft and transmission drive shaft to the countershaft.

GEAR SHIFT CONTROLS

Transmission gears are selected manually by two levers. The range shift lever (left-hand lever) is used to select low (range I), high (range II) and reverse ranges. If the tractor is not equipped with an independent second brake(hand brake), the range shift lever is also used to engage the parking lock.

The gear shift lever (right-hand lever) is used to select 1st, 2nd, 3rd and 4th gears when range shift lever is in low position (I). It is used to select 5th, 6th, 7th and 8th gears unless 8th gear is blocked (depending on transmission type; see above) when range shift lever is in high position (II). When range shift lever is in reverse position, the four reverse gears can be selected.

A starter safety switch is provided to protect the operator. Therefore, the range shift lever must be moved in neutral or in park position before the engine can be started.

PARKING THE TRACTOR

Only on tractors provided with parking lock

Move the gear shift lever into any gear position. Then move the range shift lever to park (P) position. In this position the transmission is blocked and acts as a brake directly on the rear axle.

CAUTION: The parking lock can be engaged only after the gear shift lever has been moved into any gear position. Engaging of a gear is not sufficient, particularly on tractors equipped with a HIGH-LOW shift unit. With the engine shut off, clutch disks are disengaged, disconnecting drive between engine and rear axle.

Only on tractors with independent second brake (hand brake)

Apply hand brake.

TOWING THE TRACTOR

When towing the tractor, move both shift levers in neutral position.

CAUTION: When towing tractor, do not exceed maximum permissible speed of tractor.

TOWING TRACTOR FOR STARTING

On tractors not equipped with HIGH-LOW shift unit

When towing the tractor for starting, do not tow it at a speed greater than normal for the gear in which the tractor is being towed. Tow the tractor for starting only in 6th, 7th, or 8th gear.

Only on tractors equipped with HIGH-LOW shift unit

It is not possible to tow or push a tractor equipped with HIGH-LOW shift unit for starting. To do so would damage the transmission.

GROUND SPEEDS

For information on tractor ground speeds, considering the various tire sizes, see Operator's Manual.

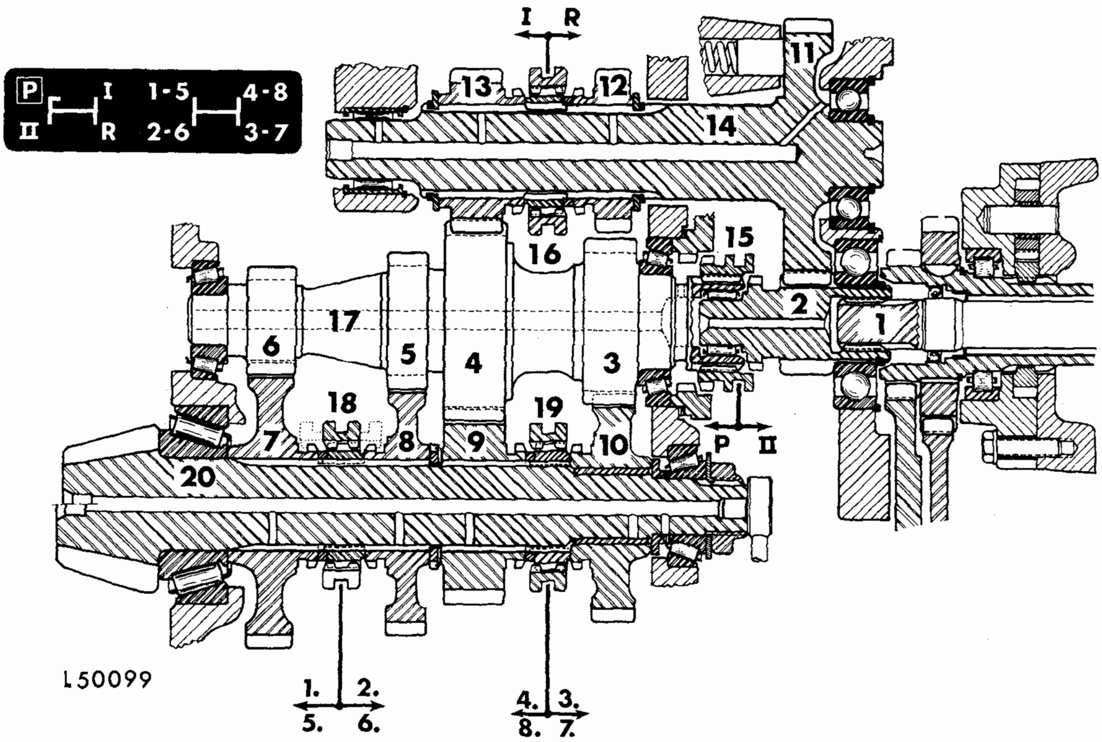

Fig. 1 — Collar-shift Transmission Assembly

1 Transmission input shaft
2 Drive gear of transmission drive shaft
3 Drive gear for 3rd and 7th speed
4 Drive gear for 4th and 8th speed
5 Drive gear for 2nd and 6th speed
6 Drive gear for 1st and 5th speed
7 Driven gear for 1st and 5th gear
8 Driven gear for 2nd and 6th gear
9 Driven gear for 4th and 8th speed
10 Driven gear for 3rd and 7th speed
11 Countershaft drive gear
12 Reverse range pinion
13 Low (I) range gear
14 Countershaft
15 Shift collar for high (II) range and parking lock
16 Shift collar for low (I) and reverse ranges
17 Transmission drive shaft
18 Shift collar for 1st, 2nd, 5th and 6th speeds
19 Shift collar for 3rd, 4th, 7th and 8th speeds
20 Differential drive shaft

POWER FLOW

Power flow in the individual speeds is shown in the following chart in conjunction with fig. 1. Drive gears and driven gears in the following chart have the same numbers as in fig. 1. The numbers are indicated in the sequence of power flow.

Speed	Power Flow (see fig. 1)								
Forward									
1	1,	2,	11,	13,	4,	6,	7,	20,	
2	1,	2,	11,	13,	4,	5,	8,	20,	
3	1,	2,	11,	13,	4,	3,	10,	20,	
4	1,	2,	11,	13,	4,	9,	20		
5	1,	2,	6,	7,	20				
6	1,	2,	5,	8,	20				
7	1,	2,	3,	10,	20				
8	1,	2,	4,	9,	20				
Reverse									
1	1,	2,	11,	12,	10,	3,	6,	7,	20
2	1,	2,	11,	12,	10,	3,	5,	8,	20
3	1,	2,	11,	12,	10,	20			
4	1,	2,	11,	12,	10,	3,	4,	9,	20

DIAGNOSING MALFUNCTIONS

NOISY SHIFTING

Improper shifting or declutching
  Details see Operator's Manual

Parts of shifting mechnism worn or broken
  Replace parts

Engine clutch slips
  Adjust clutch pedal (see group 5)

Gears still rotate when clutch pedal is depressed
  Transmission brake not installed or defective

EXCESSIVE OPERATING NOISE

Transmission parts worn or damaged
  Overhaul transmission

Little transmission oil
  Add oil of proper viscosity and quality (see Operator's Manual)

Transmission oil pump defective
  Check pump and repair (see section 70, group 15)

SHIFTING MECHANISM

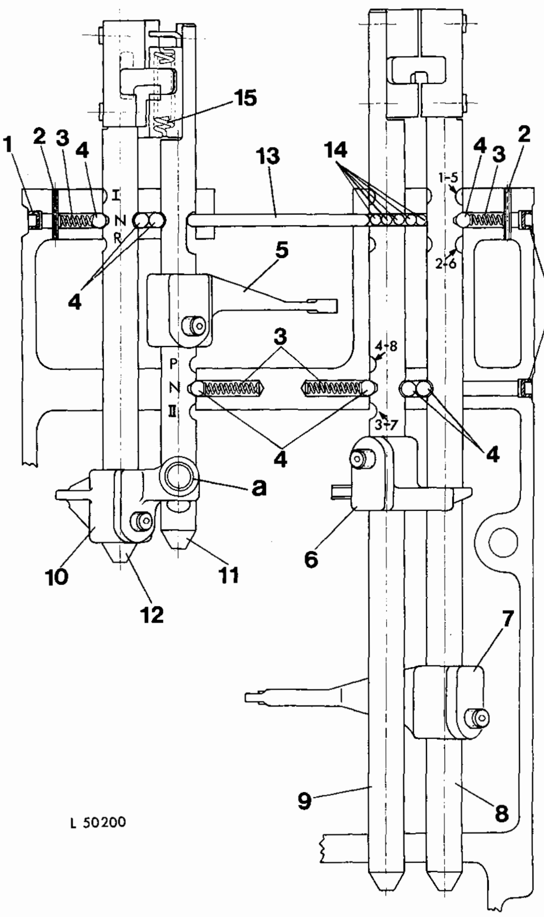

Fig. 2 — Shifting Mechanism for 8-Speed Transmission with Parking Lock

a Pin of starter safety switch
1 Caps
2 Spring pins
3 Detent springs
4 Detent and lock balls
5 Shifter fork of range II and parking lock
6 Shifter forks for 3rd and 7th, 4th and 8th speed
7 Shifter forks for 1st and 5th, 2nd and 6th speed
8 Shifter shaft for 1st and 5th, 2nd and 6th speed
9 Shifter shaft for 3rd and 7th, 4th and 8th speed
10 Shifter fork of range I and reverse range
11 Shifter shaft of range II and parking lock
12 Shifter shaft of range I and reverse range
13 Lock pin
14 Lock balls
15 Spring
(13–15) not provided on tractors with 8-speed transmission, without parking lock

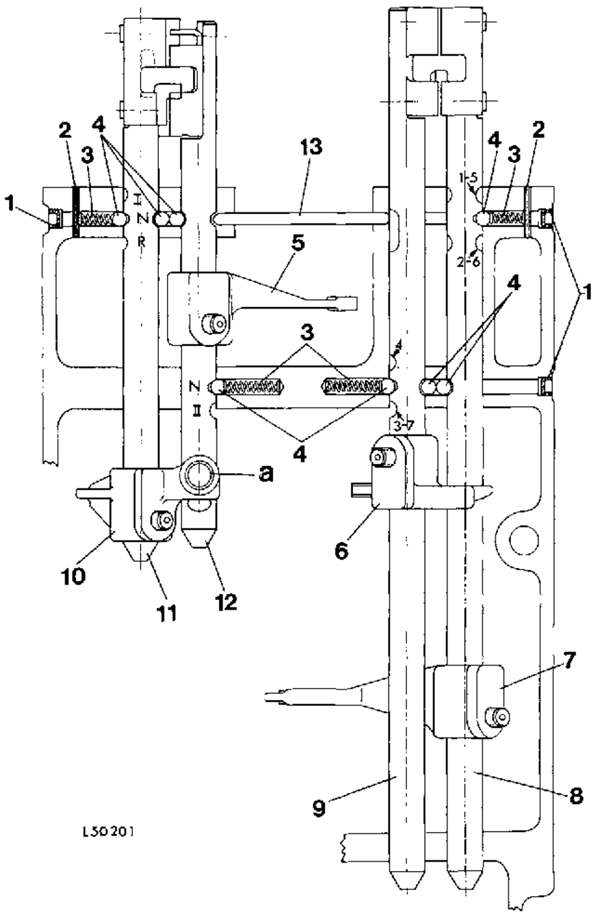

Fig. 3 — Shift Mechanism for 8-Speed Transmission with Blocked 8th. Gear

a Pin of starter safety switch
1 Caps
2 Spring pins
3 Detent springs
4 Detent and lock balls
5 Shifter fork of range II
6 Shifter fork for 3rd, 7th and 4th speed
7 Shifter fork for 1st, 5th, 2nd and 6th speed
8 Shifter shaft for 1st, 5th, 2nd and 6th speed
9 Shifter shaft for 3rd, 7th and 4th speed
10 Shifter fork of range I and reverse range
11 Shifter shaft of range II
12 Shifter shaft of range I and reverse range
13 Lock pin

REPAIR

Separate tractor between clutch housing and transmission case, see section 10, group 25.

Remove rockshaft, see section 10, group 25.

Remove pin "a" (figs. 2 and 3) of starter safety switch from shifter fork of range I and reverse range.

Remove self-locking set screws attaching shifter forks to shifter shafts.

CAUTION: When removing, do not turn shifter shafts as spring-loaded detent balls may slip into the set screw holes in the shifter shafts, causing them to be locked in their guides.

Move both range shifter shafts 10 and 11 (figs. 2 and 3) in neutral position. Then pull shifter shaft 10 out of transmission case bore.

CAUTION: Do not lose two lock balls 4 and detent ball 4 or spring 3 of shifter shaft 10.

Only on 8-speed transmission with parking lock: Before removing shifter shaft 11 (fig. 2), move shifter shaft 9 for 3rd and 7th, 4th and 8th speed so that a gear is engaged (for releasing lock pin 13).

Then, on all transmission types, pull shifter shaft 11 of range II out of bore in transmission case.

CAUTION: Do not lose lock ball 4 and spring 3 of this shifter shaft.

On tractors provided with parking lock unhook tension spring 15 (fig. 2) of range shifter shaft 11 from its pawl, if necessary.

Remove shifter forks of range I and reverse range as well as that of range II.

NOTE: The shift collar of range II can only be removed when the front transmission shield has been detached (see below).

Pull inner shifter shaft 9 (fig. 2) sufficiently out of transmission case so that, on tractors provided with parking lock, the three lock balls 14 can be removed from the shifter shaft. Then pull shifter shaft completely out of bore.

CAUTION: Do not lose lock balls 4 located between both shifter shafts as well as detent ball 4 and spring 3 of shifter shaft 9.

Remove the two lock balls 14 arranged between the two shifter shafts (on tractors provided with parking lock).

Withdraw outer shifter shaft 8 from transmission case, taking care of detent ball 4 and spring 3.

Remove shifter forks from shifter collars.

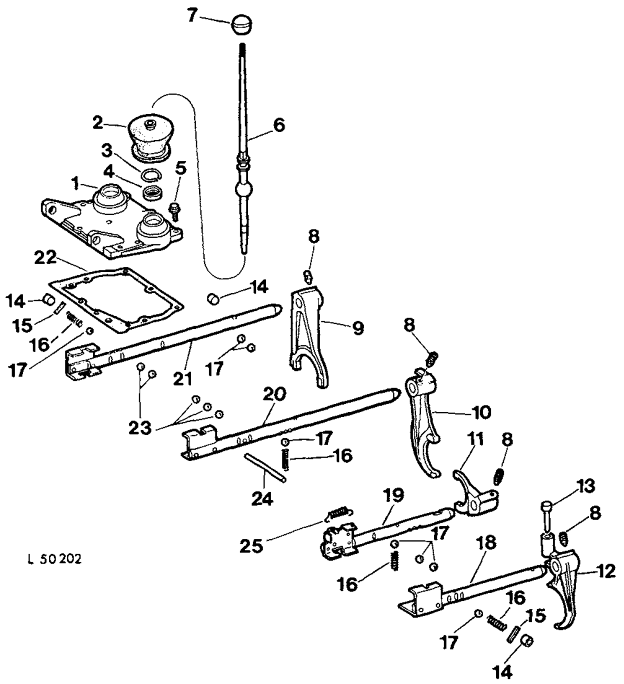

Fig. 4 — Exploded View of Shifter Mechanism

1 Shift cover
2 Boot
3 Snap ring
4 Retaining ring
5 Cap screw
6 Shift lever
7 Knob
8 Self-locking set screws
9 Shifter fork for 1st and 5th, 2nd and 6th speed
10 Shifter fork for 3rd and 7th, 4th and 8th speed
11 Shifter fork of range II and parking lock
12 Shifter fork of range I and reverse range
13 Pin of starter safety switch
14 Caps
15 Spring pins
16 Detent springs
17 Lock and detent balls
18 Shifter shaft of range I and reverse range
19 Shifter shaft of range II and parking lock
20 Shifter shaft for 3rd and 7th, 4th and 8th speed
21 Shifter shaft for 1st and 5th, 2nd and 6th speed
22 Gasket
23 Lock balls (only on tractors with parking lock)
24 Lock pin (not provided on tractors with 8-speed transmission, but without parking lock)
25 Tension spring (only on tractors with parking lock)

Checking shifter forks

Examine shifter forks for excessive wear or distortion. Replace, if necessary.

Checking shifter shafts

Make sure shifter shafts are not distorted. Check faces around pawls and bores of shifter shafts for wear; also check sliding faces of shafts and shaft bearing bores of transmission case.

Checking interlock pin, balls and springs

NOTE: The interlock pin is not provided on 8-speed transmission without parking lock.

Check if springs are still in proper condition (rusty spots, resilience). If necessary, replace spring.

Check ball surfaces for flat spots which could prevent them from rolling freely. Check interlock pin for serviceability.

NOTE: If the interlock pin has to be replaced, drive spring pin 2 (fig. 2) out of transmission case, using a suitable spring pin. Then pull spring pin used as tool sufficiently out of case to withdraw interlock pin. When a new interlock pin is installed, coat new cap with a film of oil-resistant sealant and drive into bore of transmission case.

For installation of shifter mechanism reverse removal sequence, observing figs. 2 through 4.

Install rockshaft unit, see section 10, group 25.

Attach transmission case to clutch housing, see section 10, group 25.

Check operation of transmission by shifting through all ranges and speeds.

TRANSMISSION SHAFTS AND GEARS

REMOVAL

Separate tractor between clutch housing and transmission case, see section 10, group 25.

Remove rockshaft, see section 10, group 25.

Remove transmission shifter mechanism.

On tractors equipped with continuous-running PTO: Remove PTO drive gears from front of transmission case.

On tractors equipped with independent PTO: Remove PTO clutch and brake of the independent PTO (see group 35).

Remove transmission oil cup and rear lube line of transmission.

Removing the Countershaft

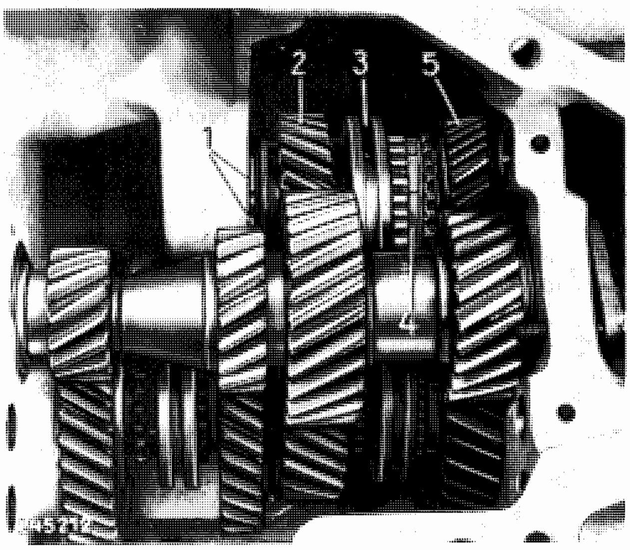

Fig. 5 — Removing Countershaft

1 Snap ring
2 Low range (I) pinion
3 Shift collar
4 Thrust washer
5 Reverse range pinion

Remove cap screws securing front bearing support to transmission case.

Lift snap ring 1 (fig. 5) out of the groove at the end of the countershaft and push it back. Push back pinion 2, sleeve and collar 3. Rotate thrust washer 4 until splines in washer index with countershaft splines. Then push the thrust washer back.

Pry front bearing support carefully off the dowels in the transmission case. As bearing support with countershaft, and transmission drive shaft gear is pulled forward, the snap ring 1, the gears, the shifter collar, sleeve and the thrust washers will slide off the countershaft. Place hand unter these parts and lift them out of the transmission case.

Removing the Transmission Drive Shaft

Remove front bearing support assembly with the countershaft and the transmission drive gear (see above). Slide the shifter collar for range II off the drive shaft.

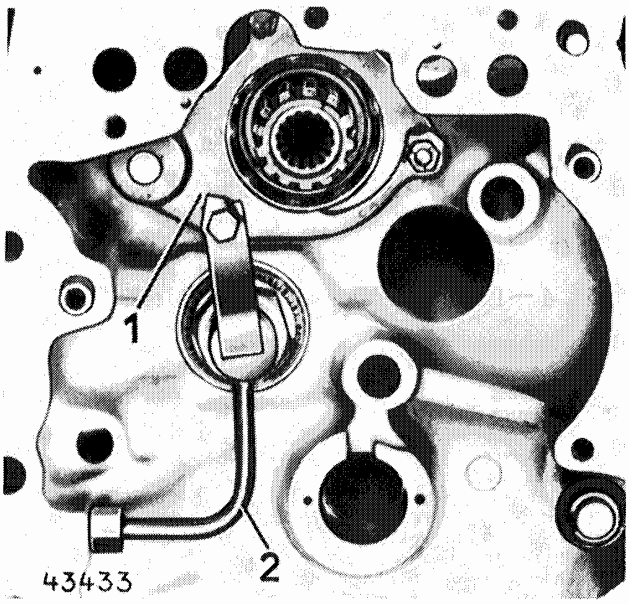

Fig. 6 — Transmission Drive Shaft Quill

1 Quill
2 Oil line

Straighten out the corners of the lock plates and remove the screws. Remove the drive shaft quill 1 (fig. 6) and the shims, and detach front oil line 2 from differential drive shaft.

Tap transmission drive shaft forward to free front bearing cup from case and rear bearing cone from cup.

Move transmission drive shaft forward, lift the rear end of the shaft and lift the shaft diagonally out of the transmission case.

Removing the Differential Drive Shaft

Block up the transmission case and remove both final drives, see section 10, group 25.

Remove differential assembly, see group 20. Remove countershaft and transmission drive shaft (see previous page).

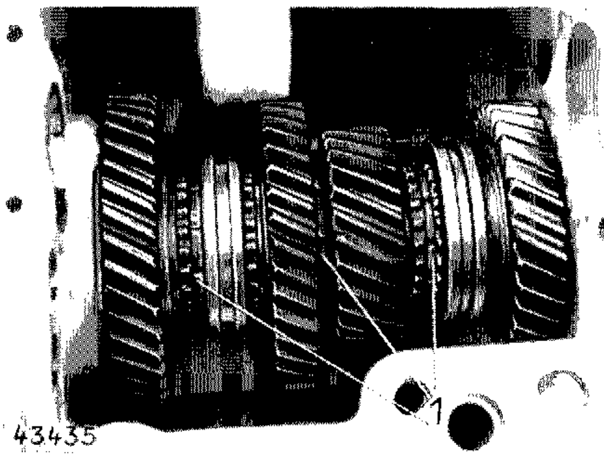

Fig. 7 — Removing Differential Drive Shaft

1 Locking thrust washers

Remove hex. nut from the differential drive shaft. Tap differential drive shaft to the rear until a resistance is felt. Remove bearing cone, shims and spacer. Unlock the three locking thrust washers (see 1, fig. 7) as follows: Press front shifter collar forward until front locking thrust washer is free to be rotated. Hold shifter collar in this position and rotate the thrust washer with a screwdriver to align the washer lugs with the shaft splines. Slide the thrust washer forward on shaft.

Then unlock the central locking thrust washer which is secured by a lock plate. To unlock, press the second (large) gear forward and slide the lock plate forward to disengage it from the locking thrust washer. Hold the lock plate in position and rotate the thrust washer until its splines index with the shaft splines. Then slide the thrust washer forward on the shaft.

Now unlock the rear locking thrust washer in the same way as the front thrust washer.

Pull the drive shaft carefully toward the rear until it can be lifted out of the differential compartment. As the shaft is pulled back, the gears, the shifter collar sleeves, the shifter collars and the locking thrust washers slide off the shaft. Place one hand under these parts and slide them off the shaft.

Should one of the locking thrust washers become locked while the shaft is pulled off, unlock it again as described above.

REPAIR

Differential drive shaft

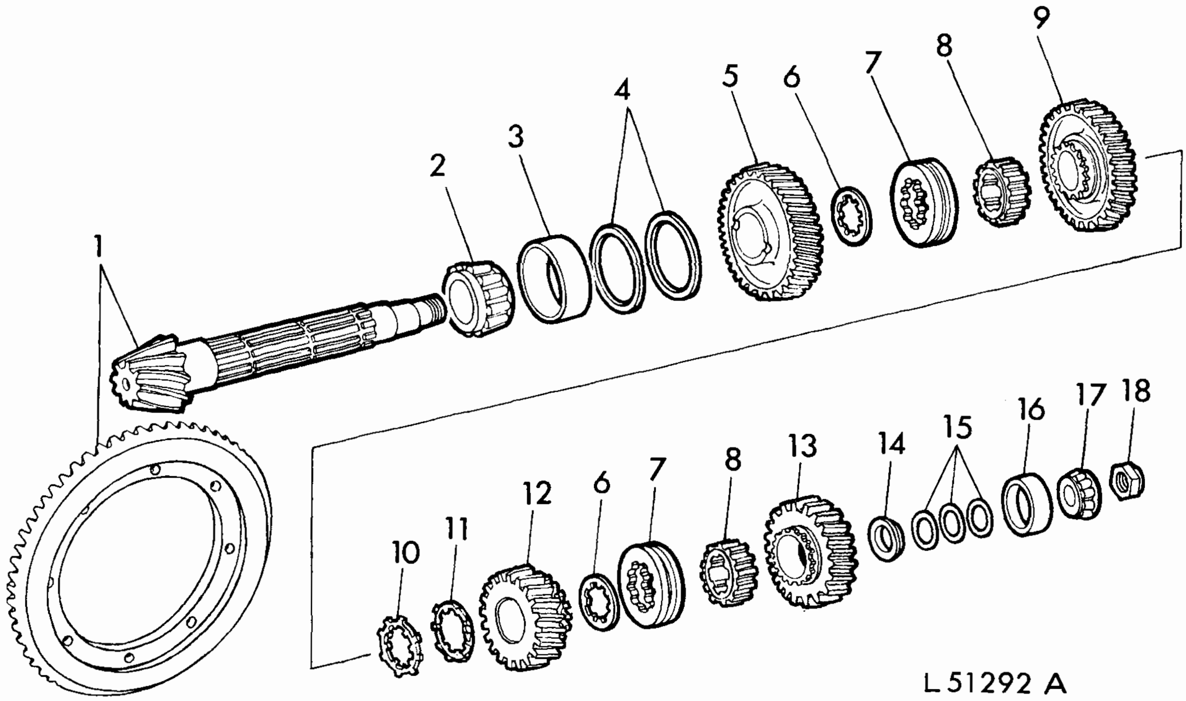

Fig. 8 — Exploded View of Differential Drive Shaft

1 Ring gear and differential shaft
2 Taper roller bearing cone
3 Taper roller bearing cup
4 Shims (2 used)
5 Driven gear for first and fifth speed
6 Locking thrust washers
7 Collars
8 Sleeves
9 Driven gear for second and sixth speed
10 Locking thrust washer with outer tangs
11 Locking washer
12 Driven gear for fourth and eighth speed
13 Driven gear for third and seventh speed
14 Spacer
15 Shims (use as required)
16 Taper roller bearing cup
17 Taper roller bearing cone
18 Hex. nut

Check gears, shifter collars and sleeves of differential drive shaft for damage.

Examine taper roller bearing cones for wear or damage. Replace, if necessary. Make sure splines of shaft are free of burrs and are not excessively worn.

IMPORTANT: If differential drive shaft has to be replaced, also replace differential ring gear as explained in group 20. These parts are a matched set and are therefore available only as an assembly.

NOTE: If transmission case, taper roller bearings of differential drive shaft, the shaft itself and the differential ring gear have been replaced, check and adjust, if necessary, preload of differential drive shaft bearings as explained below and cone point adjustment, see group 20.

Transmission drive shaft

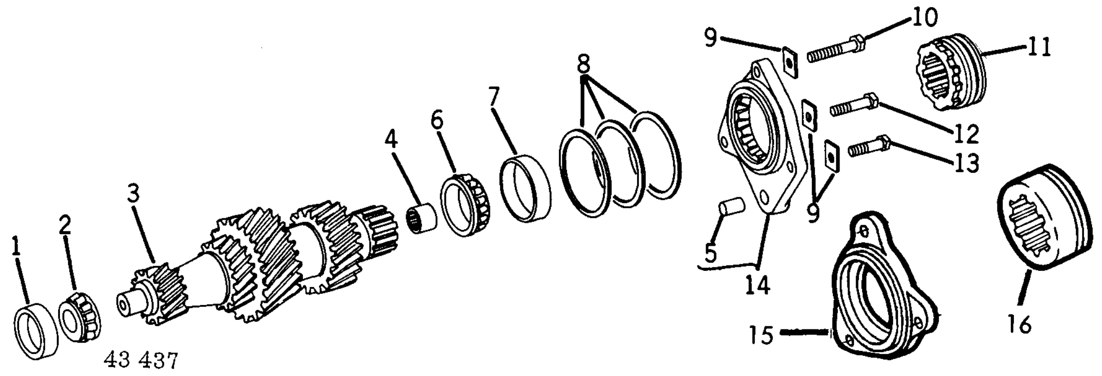

Fig. 9 — Exploded View of Transmission Drive Shaft

1 Taper roller bearing cup
2 Taper roller bearing cone
3 Transmission drive shaft
4 Needle bearing
5 Dowel pin
6 Bearing cone
7 Bearing cup
8 Shims
9 Tab washers
10 Cap screw
11 Range II shifter collar (transmission with parking lock)
12 Cap screw
13 Cap screw
14 Quill (transmission with parking lock)
15 Quill (transmission without parking lock)
16 Range II shifter collar (transmission without parking lock)

Examine transmission drive shaft, expecially its gears, for damage and excessive wear.

Countershaft

Inspect countershaft gears as well as shifter collar and sleeve for proper condition. Replace parts, if necessary.

Examine front bearing support assembly with countershaft and transmission drive gear as well as splines of countershaft and its gear for damage. Check taper roller bearings of countershaft as well as needle bearing for serviceability. Replace damaged parts.

Only on tractors equipped with independent PTO: If necessary, remove piston from PTO brake assembly (see 29, fig. 11) out of front bearing support and check for serviceability. Replace parts, if necessary. Replace O-rings 28 and 30.

If the front bearing support, the countershaft, the transmission drive gear or the ball bearings have to be replaced, remove the snap rings (see 1, fig. 10) securing bearings to support and shafts. Press both shafts out of the bearing support or the bearings as shown in fig. 10.

Check taper roller bearings of shaft, needle bearing, quill, shifter collar of range II, tab washers, and shims for serviceability. Replace parts, if necessary.

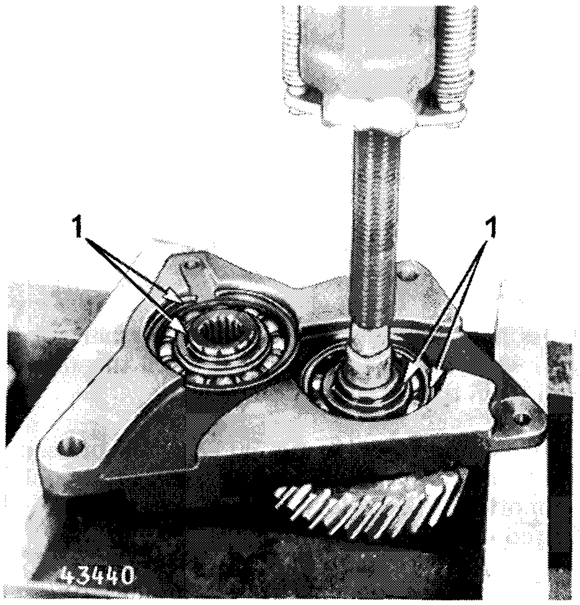

Fig. 10 — Pressing Countershaft and Transmission Drive Gear from Bearing Support

1 Snap rings

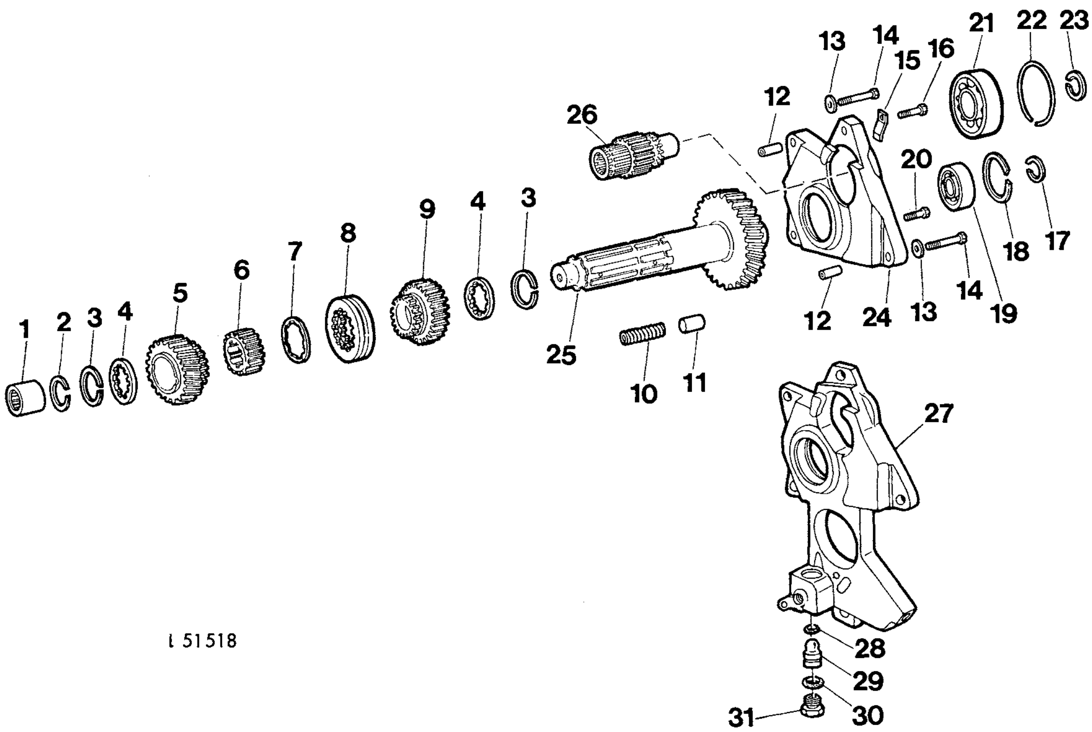

Fig. 11 — Exploded View of Countershaft

1	Needle bearing	12	Hollow dowels	24	Front bearing support (tractors without independent PTO)
2	Snap ring	13	Washers	25	Countershaft
3	Snap rings	14	Cap screws	26	Transmission drive gear
4	Thrust washers	15	Lock tab	27	Front bearing support (tractors with independent PTO)
5	Low range (I) pinion	16	Cap screw	28	O-ring
6	Shifter collar sleeve	17	Snap ring	29	PTO brake piston (tractors with independent PTO)
7	Thrust washer	18	Snap ring	30	O-ring
8	Shift collar	19	Ball bearing	31	Plug
9	Reverse range pinion	20	Cap screw		
10	Spring (2 used)	21	Ball bearing		
11	Friction pin (2 used)	22	Snap ring		
		23	Snap ring		

NOTE: The transmission drive gear must be removed before the countershaft can be removed.

Press the ball bearings and countershaft or drive gear into the bearing support until the snap rings will fit in their proper grooves.

Ball bearing (see 19, fig. 11) can be pressed into the bore only from the outside of the bearing support 24. Therefore, install bearing first — then the countershaft.

Check the friction pins 11 and springs 10 (fig. 11) for damage and wear. Check resilience of springs (see Specifications).

Transmission Lubrication System

Inspect all lubricating oil lines for damage or bent condition, make sure the oil lines are not plugged, especially the small oil bores along the bottom of the oil line above the transmission drive shaft, and the small bore facing the differential.

Inspect the oil cup for damage. If replacement becomes necessary, replace complete oil cup as well as O-ring located on bottom of ball seat bore.

Remove oil sump cover at the bottom of the transmission case. Clean reservoir at bottom of case and replace cover.

Transmission case

Carefully clean transmission case and check for cracks or other damage.

Check oil dipstick and tube for damage and replace, if necessary. If tube has been damaged, press in new tube so that face of tube protrudes by a specified dimension from top machined surface of transmission case (see Specifications).

INSTALLATION

Differential drive shaft

1. Cone Point Adjustment

Adjust cone point by installing shims between transmission case and rear taper roller bearing cup of differential drive shaft.

If the rear bearing cup of the differential drive shaft and the two shims were removed, install two shims of 0.01 in. (0.25 mm) each between case and bearing cup to adjust cone point.

2. Installing the Differential Drive Shaft

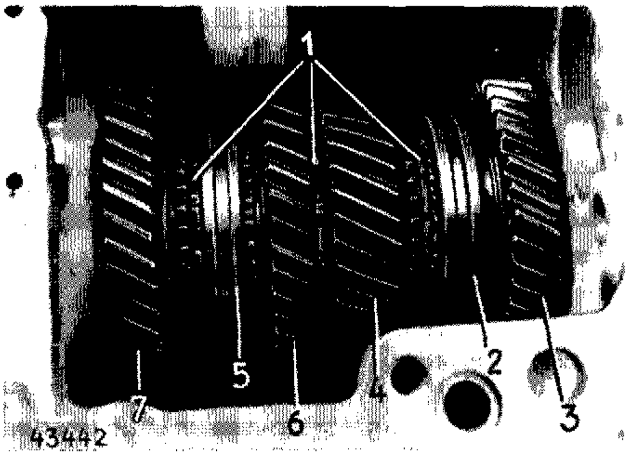

Fig. 12 — Differential Drive Shaft Installed

1 Locking thrust washers
2 Collar
3 Gear for 3rd and 7th speed
4 Gear for 4th and 8th speed (if not locked)
5 Collar
6 Gear for 2nd and 6th speed
7 Gear for 1st and 5th speed

Insert the differential drive shaft with the rear bearing assembled from the differential side and slide shaft forward about half its length into the transmission compartment. First, install gear 7 (fig. 12) for the first and fifth speed with the teeth for collar facing forward. Then slide one of the two locking thrust washers 1 with internal lugs onto the shaft. Install collar 5 and sleeve, with tangs for securing the locking thrust washers facing forward.

Inch differential drive shaft forward and install gear 6 for second and sixth speed, with the teeth for the collar facing toward the rear. Then install the center locking thrust washer with both internal and external tangs and the lock plate with the tangs facing toward the rear.

Move differential drive shaft further forward and slide gear 4 for fourth and eigth speed onto the shaft, with the teeth for the collar facing forward. Then install the third locking thrust washer 1 and collar 2, with sleeve, making sure that tangs for securing the locking thrust washer face forward.

Install gear 3 for third and seventh speed with the hub into the bore in the transmission case (tangs for collar facing towards the rear). Move differential drive shaft forward until the rear bearing cone 3 is seated in bearing cup. At the same time slide the differential drive shaft into gear 3.

Slide gear 7 and the rear locking thrust washer back until the washer fits the appropriate groove cut in shaft. Using a screw driver, rotate the locking thrust washer until the washer splines lock with the shaft splines. Then mesh the locking tangs of the collar sleeve with the thrust washer splines.

Push gear 6 and the center locking thrust washer back until the washer fits into the proper groove cut in the shaft. Rotate this thrust washer in the same way as the rear locking thrust washer and slide the lock plate over the center locking thrust washer to prevent rotation.

Slide back gear 4 and the front locking thrust washer. Mesh washer with the front collar sleeve in the same way as the rear locking thrust washer.

Slide spacer 14 (fig. 8) on the differential drive shaft with the smooth side facing toward the gear. Before proceeding further, make preload adjustments explained on the next page.

3. Adjusting Preload of Differential Drive Shaft Bearings

The differential drive shaft should have a specified preload corresponding to a specified rolling drag torque (see Specifications). Preload or rolling drag torque is adjusted by means of shims 15 (fig. 8) between spacer 14 and front bearing cone 17 of differential drive shaft. Adjust preload and rolling drag torque as follows:

Since preload cannot be measured, first set end play. Therefore, add shims 15 between bearing cone 17 (fig. 8) and spacer 14 until measurable end play is obtained. For correct preload adjustment of differential drive shaft, end play should not exceed a specified dimension (see Specifications). Install bearing cone on shaft and secure by means of hex. nut. Tighten hex. nut to the specified torque (see Torques for Hardware).

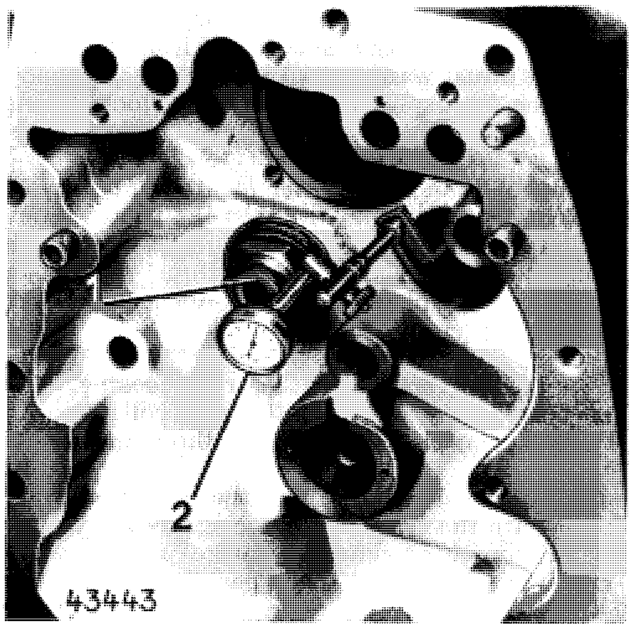

Fig. 13 — Measuring Differential Drive Shaft End Play

1 Differential drive shaft 2 Dial indicator

Attach a dial indicator to front of transmission case as shown in fig. 13 and place the feeler rod against shaft. Move differential drive shaft to and fro and read off shaft end play.

Record end play shown on dial indicator. Again remove nut and bearing cone from shaft. Slide all shims off shaft. Add a specified dimension to recorded end play (see Specifications) and remove thickness of shims corresponding to the calculated dimension. By installing the *remaining* shims, specified preload of differential drive shaft bearings will be obtained.

Install determined thickness of shims as well as bearing cone. Thread on hex. nut and tighten to the specified torque. Stake hex. nut to secure it.

NOTE: Remove differential drive shaft before checking and adjusting the differential assembly bearing preload (see group 20). Take care not to damage or lose the shim pack needed for preloading the differential drive shaft bearings.

Install the differential assembly as explained in group 20. Be sure to check bearing preload and differential backlash at this time. Adjust if necessary.

Install final drives, see section 10, group 25.

Installing transmission drive shaft

Insert transmission drive shaft diagonally in front bore of transmission case. Level shaft, install rear bearing cone of transmission drive in bearing cup. Install front bearing cup.

Adjusting Transmission Drive Shaft End Play

Adjust transmission drive shaft end play (see Specifications) by placing shims between front bearing quill 1 (fig. 14) and transmission case.

Install quill with shim pack. Tighten quill screws to the specified torque (see Specifications). Rotate shaft to make sure it does not bind and that taper roller bearings are properly seated.

Measure and record end play as shown in fig. 14. Remove shims from or add to shim pack located under bearing cap to obtain the specified end play (see Specifications). After having tightened quill screws to the specified torque, again check end play.

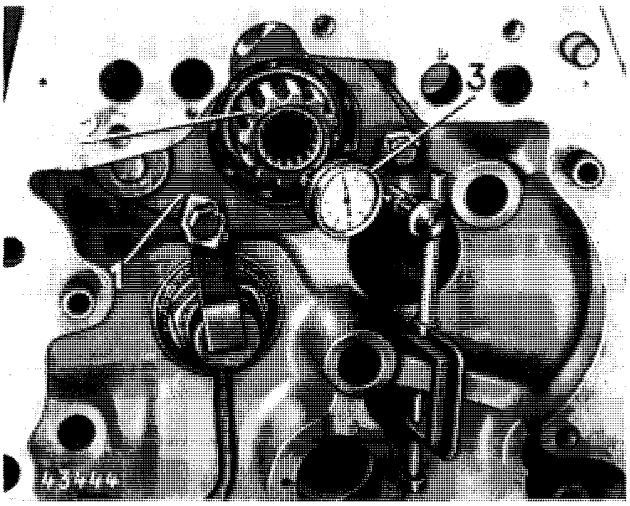

Fig. 14 — Measuring Transmission Drive Shaft End Play

1 Quill
2 Transmission drive shaft
3 Dial indicator

Install front oil line for lubricating differential drive shaft.

Slide collar for high range (II) on front splines of the transmission drive shaft with the annular groove for the shifter fork facing away from shaft.

Installing the Countershaft

NOTE: Before installing the countershaft, make sure that the shifter collar for high range (II) is installed.

Install springs 10 (fig. 11), and friction pins 11 into the two bores in the front of the transmission case, with the grooved thrust surface of the friction pins facing the gear.

With countershaft and transmission drive gear assembled to bearing support, position support on front of transmission. Insert countershaft through bore in transmission case and install snap ring 3 (fig. 11), thrust washer 4 and reverse range pinion 9 with teeth for collar facing toward rear of transmission. Then slide locking thrust washer 7 on shaft; next install shifter sleeve 6, with tangs facing forward, and shifter collar 8. Move countershaft further toward rear of transmission and slide low range pinion 5, with its teeth facing toward the front, the rear thrust washer 4 and the second snap ring 3 on countershaft.

Using a screw driver, rotate locking thrust washer 7 until tangs on shifter collar sleeve engage with locking washer. Slide low range pinion 5 and rear thrust washer 4 further and snap second ring 3 in groove of shaft.

Secure the transmission front cover to the transmission case.

On tractors equipped with independent PTO, make sure that the piston (see 29, fig. 11) of the PTO brake is installed in the front transmission cover.

CAUTION: If necessary rotate the snap ring until lock plate 15 (fig. 11) is seated in its gap.

Install transmission oil cup and rear oil lines. Tighten oil cup attaching screws to the specified torque (see Specifications).

To safeguard proper lubrication of final drives, lube oil lines should protrude into final drives or should be flush with inner edge of final drive housing. Thus oil will be supplied directly to final drives. Bend lines manually, if required.

Makre sure lines do not interfere with shafts. Also be sure nozzle-type oil line ends properly engage shaft bore.

On tractors equipped with continuous-running PTO: Install PTO gears at transmission front face.

On tractors equipped with independent PTO: Install PTO brake and PTO clutch (see group 35).

Install shifter mechanism.

FINAL ASSEMBLY OF TRACTOR

Install rockshaft housing on transmission case, see section 10, group 25.

Join tractor between transmission case and clutch housing, see section 10, group 25.

SPECIFICATIONS

TRANSMISSION CASE		
Distance between front of oil dipstick tube and machined top face of transmission case	7.78 in.	197.5 mm
DIFFERENTIAL DRIVE SHAFT		
To adjust cone point, install two shims between transmission case and rear bearing cup of differential drive shaft, total thickness	0.02 in.	0.5 mm
Max. permissible end play of differential drive shaft before adjusting taper roller bearing preload	0.002 in.	0.05 mm
Dimension to be added to measured end play of differential drive shaft	0.006 in.	0.15 mm
Preload of taper roller bearings	0.006 in.	0.15 mm
Rolling drag torque with proper preload	5 to 15 in.lbs.	5.7 to 17.2 cmkg
Backlash between ring gear and differential drive shaft pinion	0.012 in.	0.30 mm

NOTE: The backlash of 0.012 in. (0.30 mm) should be adjusted as accurately as possible. At no point of the ring gear's circumference should the backlash be less than 0.008 in. (0.20 mm) or more than 0.016 in. (0.40 mm).

TRANSMISSION DRIVE SHAFT		
End play	0.004 bis 0.006 in.	0.10 bis 0.15 mm
COUNTERSHAFT		
Spring of friction pin,		
spring length, unstressed	1.87 in.	approx. 47.5 mm
resilience at a spring length of 1.51 in. (38.5 mm)	63 to 77 lbs.	28.5 to 35 kg

TORQUES FOR HARDWARE

Clutch housing to transmission case	85 ft.lbs.	11.7 mkg
Final drives to transmission case	85 ft.lbs.	11.7 mkg
Rockshaft housing to transmission case	85 ft.lbs.	11.7 mkg
Hex. nut of differential drive shaft	160 ft.lbs.	22 mkg
Quill of transmission drive shaft, cap screws	35 ft.lbs.	4.8 mkg
Front bearing support to transmission case, cap screws	35 ft.lbs.	4.8 mkg
Transmission oil cup to transmission case, cap screws	20 ft.lbs.	2.8 mkg
Rear lube oil line, cap screw	20 ft.lbs.	2.8 mkg
Differential housing cover to differential housing, cap screws	35 ft.lbs.	4.8 mkg
Differential bearing housing to transmission case, cap screws	35 ft.lbs.	4.8 mkg

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Group 20
DIFFERENTIAL

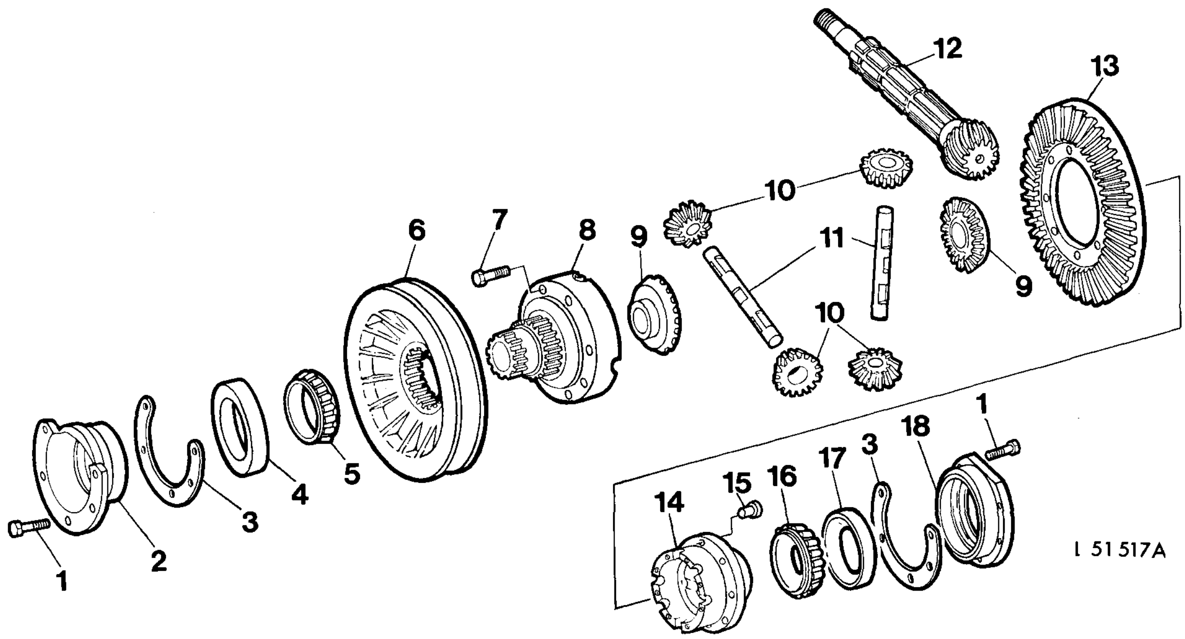

Fig. 1 — Differential Assembly

1 Cap screw (10 used)
2 Bearing housing, l.h.
3 Shims
4 Bearing cup
5 Bearing cone
6 Brake disk and hub (only on tractors with handbrake)
7 Cap screw (8 used)
8 Differential housing cover
9 Bevel gears
10 Bevel pinions
11 Bevel pinion shafts
12 Differential drive shaft
13 Ring gear
14 Differential housing
15 Rivet (8 used)
16 Bearing cone
17 Bearing cup
18 Bearing housing, r.h.

GENERAL INFORMATION

The differential rotates on two adjustable taper roller bearings. It is equipped with four bevel pinions, two bevel gears and two bevel pinion shafts. The ring gear is in mesh with the differential drive shaft bevel gear.

The backlash of this bevel gear is adjusted by shims. These shims also serve for adjusting the preload of the differential taper roller bearings. A differential lock is located at the left-hand side of the differential.

DIAGNOSING MALFUNCTIONS

OIL LEAKAGE

Too much or improper oil (see operator's manual)

Loose transmission oil drain plug

Transmission case broken

Damaged seals

Screws not tightened to the specified torque

EXCESSIVE NOISE

(Continuous)

Worn bearings

Damaged or worn bevel gears or pinions

Loss of lubricant

(Under Load)

Differential drive shaft bevel gear and ring gear adjustment too tight.

(Under No Load)

Worn bearings

Differential drive shaft bevel gear and ring gear adjustment too loose.

REPAIR

Remove rockshaft housing and both final drive assemblies, see section 10, group 25.

DIFFERENTIAL LOCK

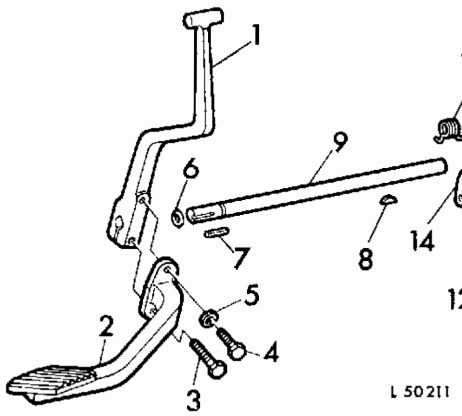

Fig. 2 — Differential Lock Assembly

1 Hand lever
2 Pedal
3 Cap screw
4 Cap screw
5 Lock washer
6 O-Ring
7 Key
8 Woodruff key
9 Shaft
10 Spring
11 Plug
12 Shoes
13 Collar
14 Yoke

Remove cap screws 3 and 4 (fig. 2), remove pedal and drive lever off the shaft. Remove key 7 from shaft.

Hold yoke 14 in place and drive shaft out toward rear of tractor.

Before shaft is fully driven out, remove plug 11 and Woodruff key 8. Discard O-ring 6.

Check splines of differential lock collar and of differential housing cover for excessive wear and damage. Check yoke and shaft for damage and replace, if necessary.

Check spring for worn or broken windings and replace, if necessary.

DIFFERENTIAL

Remove transmission oil cup and rear oil line.

Remove rockshaft control arm and cam from transmission case.

NOTE: If the tractor is equipped with a hand brake, remove this brake as described in section 60, group 15.

Lift up on differential assembly to relieve weight on bearing quills and remove cap screws securing bearing quills to transmission case. Remove differential from transmission case.

Remove differential housing cover from differential housing.

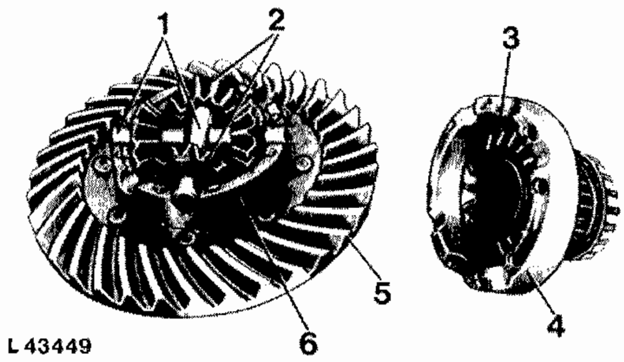

Fig. 3 — Removing Bevel Gears and Bevel Pinions.

1 Bevel pinion shafts
2 Bevel pinions
3 Bevel gears (2 used)
4 Differential housing cover
5 Ring gear
6 Differential housing

Remove bevel gears 3 (fig. 3) and bevel pinion shafts 1 with bevel pinions 2 from the differential housing.

Examine the thrust and bearing surfaces of both bevel gears. If the bevel gears are worn or damaged, the bores in the differential housing and cover may also be damaged.

Check bevel pinions and bevel pinion shafts for excessive wear. If these parts are damaged or excessively worn, also replace parts they are in mesh with, or they are sliding on.

Check ring gear for wear or damage. If the ring gear is no longer serviceable, separate from differential housing by removing rivets and replace.

IMPORTANT! If the ring gear is replaced, also replace the differential drive shaft. These parts are furnished as matched sets and are not available individually for replacement.

The number of teeth of the differential drive shaft pinion and of the ring gear can be determined from without. These figures are stamped into the transmission case, to the left of the rockshaft housing.

Check taper roller bearings if still serviceable.

NOTE: On tractors equipped with hand-brake, push the brake hub and disk 6 on the splines of the bearing cover, before pressing the roller bearing cone on the differential housing cover 8 (fig. 1).

Coat bevel gears, bevel pinions and bevel pinion shafts with transmission oil, before installing them. Install differential housing cover on differential housing and tighten screws to specified torque.

ADJUSTMENT

PRELOAD ADJUSTMENT OF DIFFERENTIAL BEARINGS

Install both bearing housings. Place a number of shims 3 behind the right-hand housing 14 (fig. 1). Check the end play of the differential assembly with a dial indicator. If necessary, add more shims under right-hand bearing housing until measurable end play is obtained.

NOTE: To obtain accurate preload adjustment, differential end play must not exceed specified dimension (see Specifications).

Record end play shown on the dial indicator and add a specified value (see Specifications) to the recorded end play. Then remove enough shims from the shim pack on the right bearing housing to equal the calculated measurement. Install the remaining shims to obtain the correct bearing preload.

ADJUSTING BACKLASH OF DIFFERENTIAL

After adjusting the preload, mount the dial indicator as shown in fig. 4 and check the backlash between the differential drive shaft pinion and the ring gear at several points.

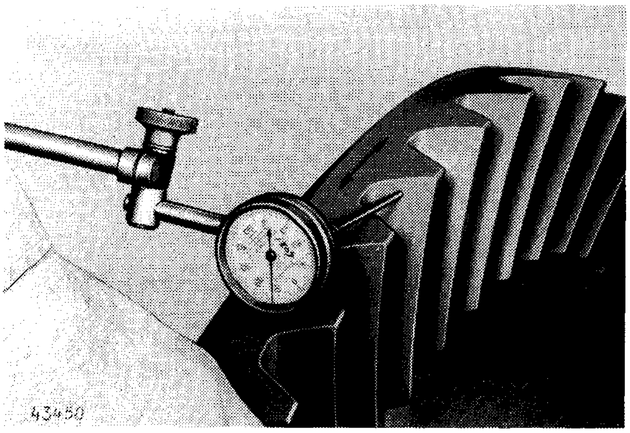

Fig. 4 — Measuring Backlash

Adjust backlash by transferring differential bearing housing shims from one side of the case to the other.

CAUTION! The total thickness of the shims must be maintained so that the correct preload of the roller bearings is not altered.

To increase backlash, move shims from left to right. To decrease backlash, move shims from right to left. See Specifications for correct backlash measurement.

INSTALLATION

With bearing preload and gear backlash properly adjusted, tighten the differential bearing housing cap screws to specified torque.

NOTE: When installing differential lock, use new O-ring.

Install hand brake (if equipped), see section 60, group 15.

Install both final drive assemblies, see section 10, group 25.

Install rockshaft control arm and cam.

Install rockshaft housing, see section 10, group 25.

SPECIFICATIONS

	Dimensions of new parts	
Dia. of bevel pinion bore	0.8585 to 0.8615 in.	21.804 to 21.884 mm
Dia. of bevel pinion shaft	0.8545 to 0.8555 in.	21.704 to 21.730 mm
O.D. of bevel gear hub	2.0467 to 2.0477 in.	51.986 to 52.012 mm
Bore dia. of differential housing, or differential housing cover for bevel gear hub	2.0497 to 2.0517 in.	52.063 to 52.113 mm
O.D. of a bearing housing	5.035 to 5.039 in.	127.89 to 127.99 mm
Bearing bore dia. of l.h. housing for bearing cup	3.810 to 3.812 in.	96.77 to 96.82 mm
Bearing bore dia. of r.h. housing for bearing cup	4.3282 to 4.3302 in.	109.94 to 109.99 mm
Bearing seat dia. of differential housing cover for bearing cone	2.2510 to 2.2526 in.	57.176 to 57.216 mm
Bearing seat dia. of differential housing for bearing cone	2.6885 to 2.6901 in.	68.288 to 68.328 mm
Max. differential end play before preload adjustment of taper roller bearing	0.002 in.	0.05 mm
Value to be added to differential end play	0.003 in.	0.076 mm
Taper roller bearing preload	0.002 to 0.005 in.	0.05 to 0.13 mm
Backlash between ring gear and differential drive shaft pinion	0.012 in.	0.30 mm

NOTE: The backlash of 0.012 in. (0.30 mm) should be adjusted as accurately as possible. At no point of the ring gear's circumference should the backlash be less than 0.008 in. (0.20 mm) or more than 0.016 in. (0.40 mm).

TORQUES FOR HARDWARE

Differential housing cover to differential housing, cap screws	35 ft.lbs.	4.8 mkg
Differential bearing housing to transmission case, cap screws	35 ft.lbs.	4.8 mkg
Cap screw of rear lube oil line and transmission oil cup	20 ft.lbs.	2.8 mkg
Final drives to transmission case, cap screws	85 ft.lbs.	11.7 mkg
Rockshaft housing to transmission case, cap screws	85 ft.lbs.	11.7 mkg

Group 25
FINAL DRIVES

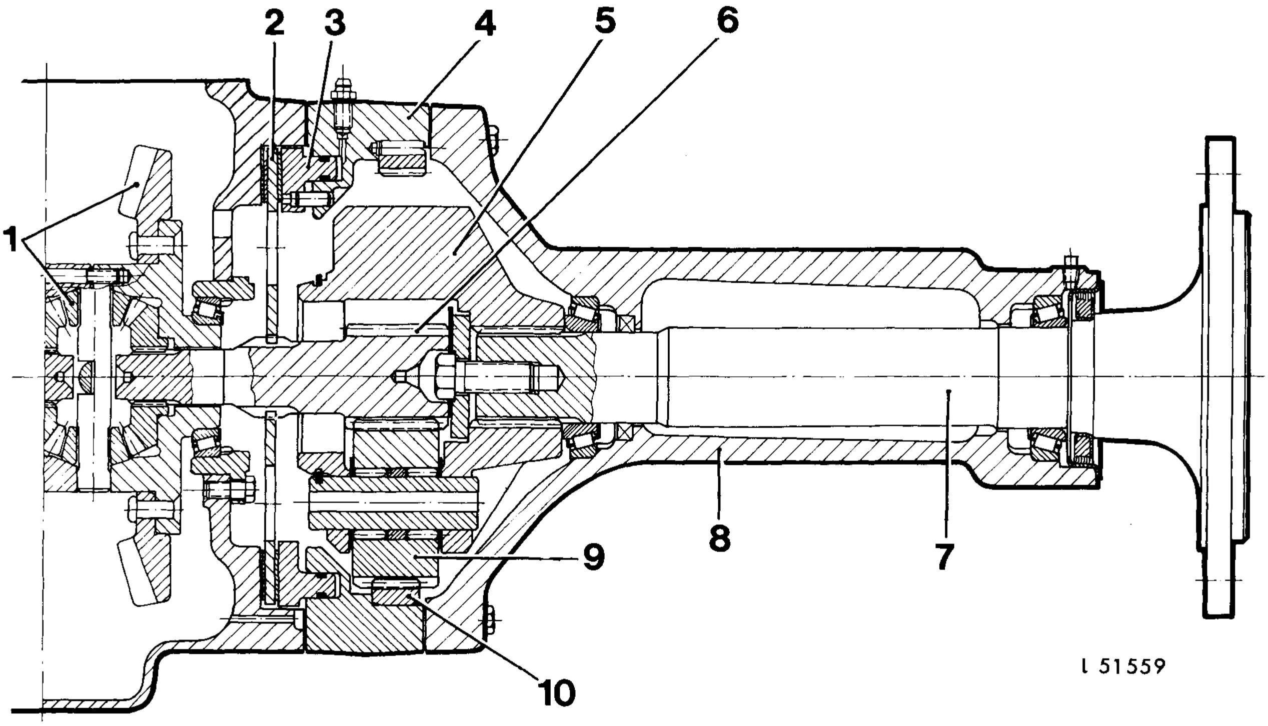

Fig. 1 — Final Drive Assembly, Sectional View

1 Differential
2 Brake disk
3 Brake pressure ring
4 Brake housing with ring gear
5 Planet pinion carrier
6 Final drive shaft (sun pinion)
7 Flanged axle
8 Final drive housing
9 Planet pinion (3 used)
10 Ring gear

GENERAL INFORMATION

Each final drive unit contains a rear axle mounted on two taper roller bearings with oil seals and a planetary gear system which provides the final speed reduction.

DIAGNOSING MALFUNCTIONS

LOSS OF LUBRICANT

Too much or improper lubricant used (see operator's manual).

Worn or damaged oil seals.

UNUSUAL RUNNING NOISE

Ring gear, gear (sun pinion) of final drive shaft or planet pinions worn or damaged.

Worn planet pinion bearing rollers.

Worn or rough bearing surfaces of the rear axle taper roller bearings.

Insufficient or improper type of lubricant used (see operator's manual).

REMOVAL

For removal of final drives see section 10, group 25.

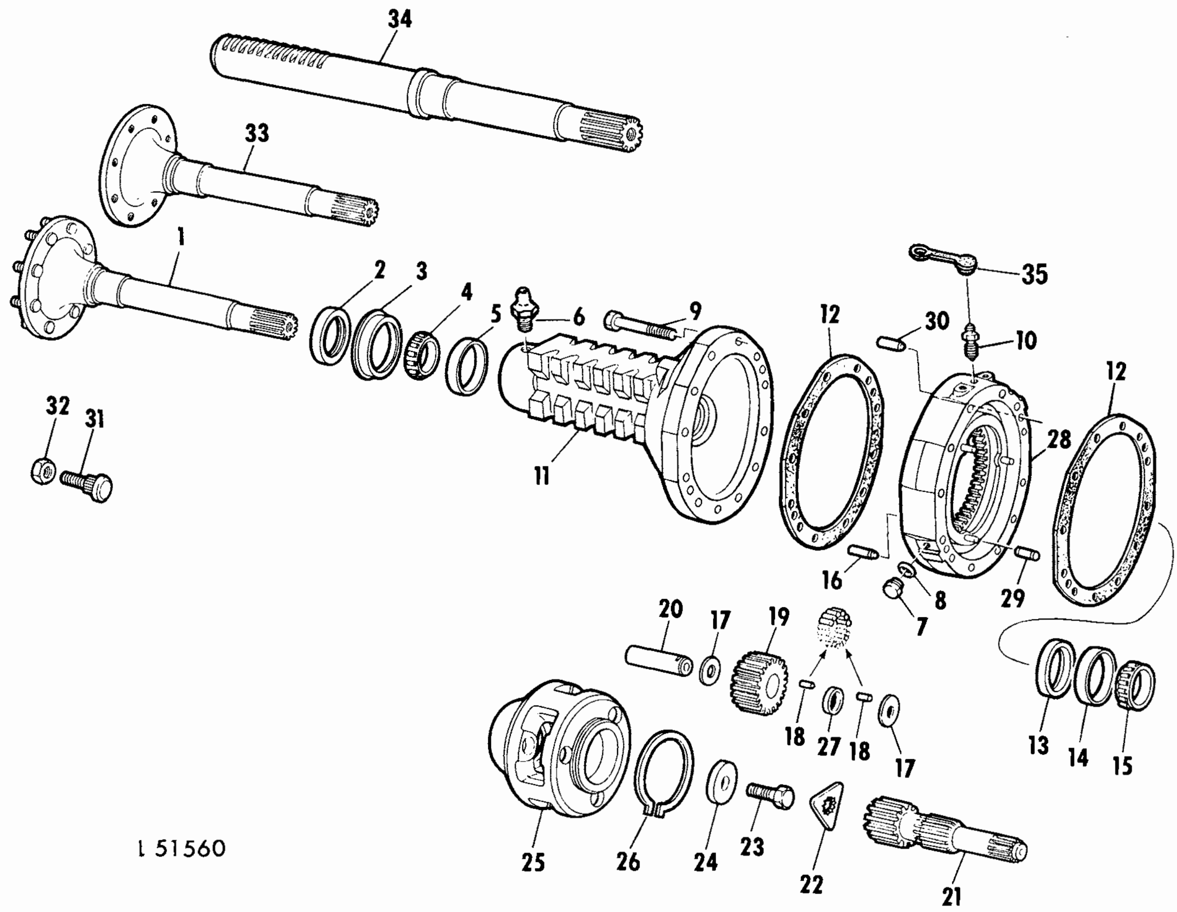

Fig. 2 — Final Drive Assembly - Exploded View

1 Flanged axle*
2 Oil seal
3 Oil seal cup
4 Taper roller bearing cone
5 Taper roller bearing cup
6 Grease nipple
7 Plug
8 O-ring
9 Cap screw (12 used)
10 Bleed screw
11 Rear axle housing
12 Gaskets
13 Oil seal
14 Taper roller bearing cup
15 Taper roller bearing cone
16 Dowel pin (3 used)
17 Thrust washers (6 used)
18 Bearing rollers (120 used)
19 Planet pinion (3 used)
20 Planet pinion shaft (3 used)
21 Final drive shaft
22 Lock plate
23 Cap screw
24 Washer
25 Planet pinion carrier
26 Snap ring
27 Spacer (3 used)
28 Brake housing with ring gear
29 Dowel pin (3 used)
30 Dowel pin (2 used)
31 Wheel bolt* (8 used)
32 Ball nut* (8 used)
33 Flanged axle**
34 Rack-and-pinion axle
35 Dust cap

REPAIR

Be sure to remove lock plate 22 (fig. 2) before attempting to remove cap screws 23.

Push brake housing with ring gear off dowel pins and remove.

Be careful not to lose any of the 40 bearing rollers 18 located in each planet pinion. If some of them have to be replaced, always replace all rollers.

When the ring gear of the brake housing is worn or damaged, replace housing with ring gear.

Do not heat taper roller cones beyond 300° F (150° C) when installing.

* For rear wheels with steel disks
** For rear wheels with cast disks

ADJUSTMENT

First measure the drag torque with the planet carrier assembled in place, but with end play in bearings (see fig. 3). Provide sufficient end play so as not to exceed a certain drag torque. Then tighten the cap screws 23 until final drag torque on rear axle is obtained (for adjusting values see Specifications).

INSTALLATION

Slide final drive shaft in differential assembly. Install assembled final drive as explained in section 10, group 25.

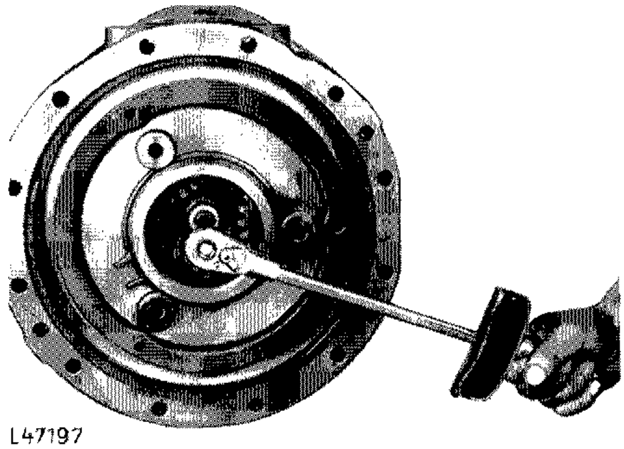
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Fig. 3 — Adjusting the Rear Axle Taper Roller Bearings

SPECIFICATIONS

	Dimensions of new parts	
Dia. of rear axle at outer bearing	2.6885 to 2.6895 in.	68.287 to 68.313 mm
Dia. of rear axle at inner bearing	2.4385 to 2.4395 in.	61.938 to 61.964 mm
Dia. of a planet pinion bore	1.8501 to 1.8515 in.	46.992 to 47.028mm
Width of a planet pinion	2.235 to 2.245 in.	56.77 to 57.03 mm
Dia. of planet pinion bearing rollers (measured at center)	0.2498 to 0.2500 in.	6.344 to 6.349 mm
Thickness of a thrust washer	0.04 in.	1.00 mm
Thickness of a spacer	0.449 to 0.469 in.	11.41 to 11.91 mm
Dia. of planet pinion carrier bores for planet pinion shafts	1.350 to 1.352 in.	34.29 to 34.34 mm
O. D. of planet pinion shaft	1.3491 to 1.3496 in.	34.267 to 34.280 mm
Rear axle drag torque with end play in bearings, max.	48 in.lbs.	55 cm/kg
Rear axle drag torque with preloaded bearings	96 to 144 in.lbs.	110 to 165 cm/kg

TORQUES FOR HARDWARE

Final drives to transmission case, cap screws	85 ft.lbs.	11.7 mkg

Group 30
CONTINUOUS-RUNNING PTO SHAFTS

GENERAL INFORMATION

The PTO shafts located in the lower part of the transmission case are independent of the transmission. They can operate only if the PTO clutch of the engine dual-stage clutch is engaged (see group 5).

The tractor may be equipped with a single rear 540 rpm or a dual rear 540 and 1000 rpm PTO shaft.

The dual PTO shaft can be converted from 540 to 1000 rpm and vice versa by exchanging the stub shaft. In addition, the tractor may be equipped with a mid 1000 rpm PTO shaft.

For operating the PTO shafts see operator's manual.

SINGLE REAR 540 RPM PTO SHAFT

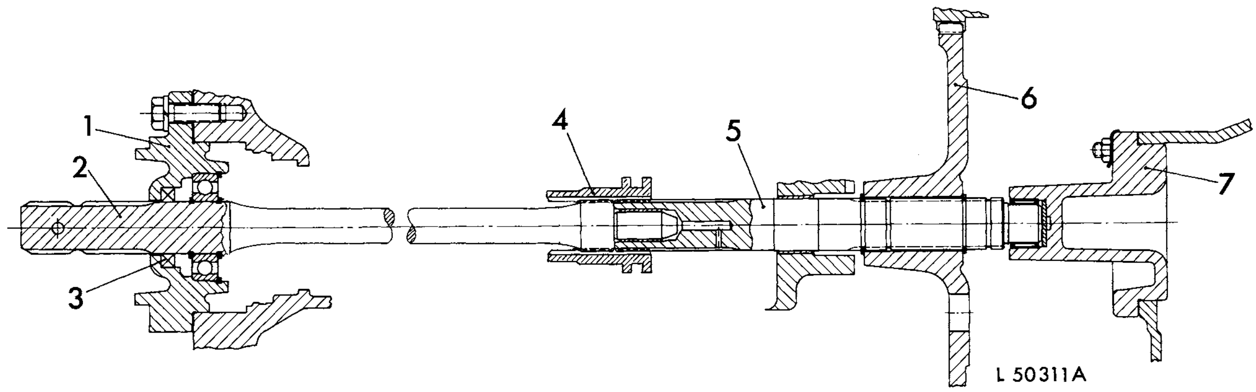

Fig. 1 — Single Rear 540 rpm PTO Shaft

1 Rear quill
2 PTO shaft
3 Oil seal
4 Shifter collar
5 PTO drive shaft
6 PTO gear
7 Front quill

REMOVAL

Before starting work on the PTO shaft, drain transmission oil.

REMOVING PTO SHAFT

Operate PTO shifter mechanism to disengage PTO shaft. This will prevent the collar of the PTO shifter mechanism from dropping into the transmission case when removing PTO shaft.

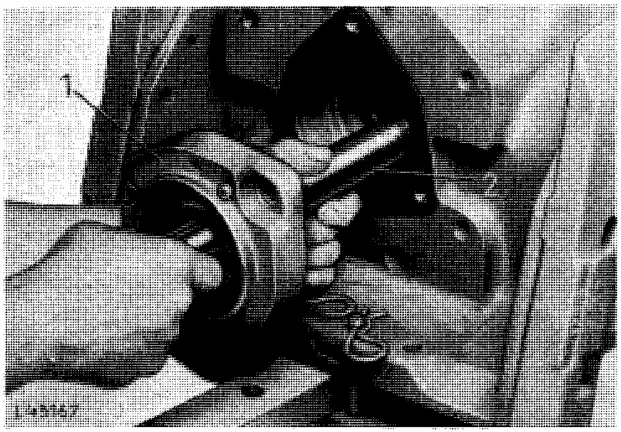

Fig. 2 — Removing Single Rear PTO Shaft

1 Rear quill 2 PTO shaft

Remove cap screws attaching quill 1 (fig. 2) to transmission case. Pull PTO shaft 2 with quill 1 out of transmission case.

REMOVING PTO DRIVE SHAFT AND GEAR

Separate tractor between transmission case and clutch housing, see section 10, group 25.

Remove snap ring and push PTO gear off PTO drive shaft.

Re-install PTO shaft 2 (figs. 1 and 2), if removed. Operate shifter mechanism of rear PTO shaft to prevent shift collar from dropping into transmission case when removing PTO drive shaft.

Pull PTO drive shaft forward out of transmission case.

REMOVING PTO SHIFTER MECHANISM

Remove rockshaft, see section 10, group 25.

NOTE: Prior to removing the PTO shifter mechanism, the transmission countershaft and the range shifter shafts must be removed, see group 15.

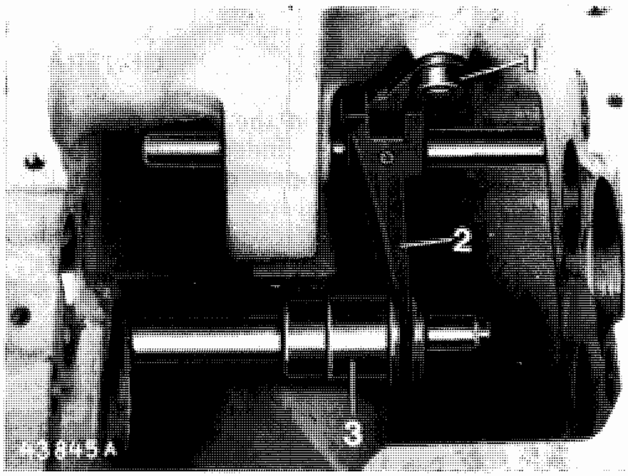

Fig. 3 — Removing PTO Shifter Mechanism

1 Shifter arm 3 Shifter collar
2 Shifter

Remove PTO shifter shaft lock on left side of transmission case.

Remove PTO drive shaft from transmission (if still installed) and remove shifter collar.

Remove parts of shifter mechanism.

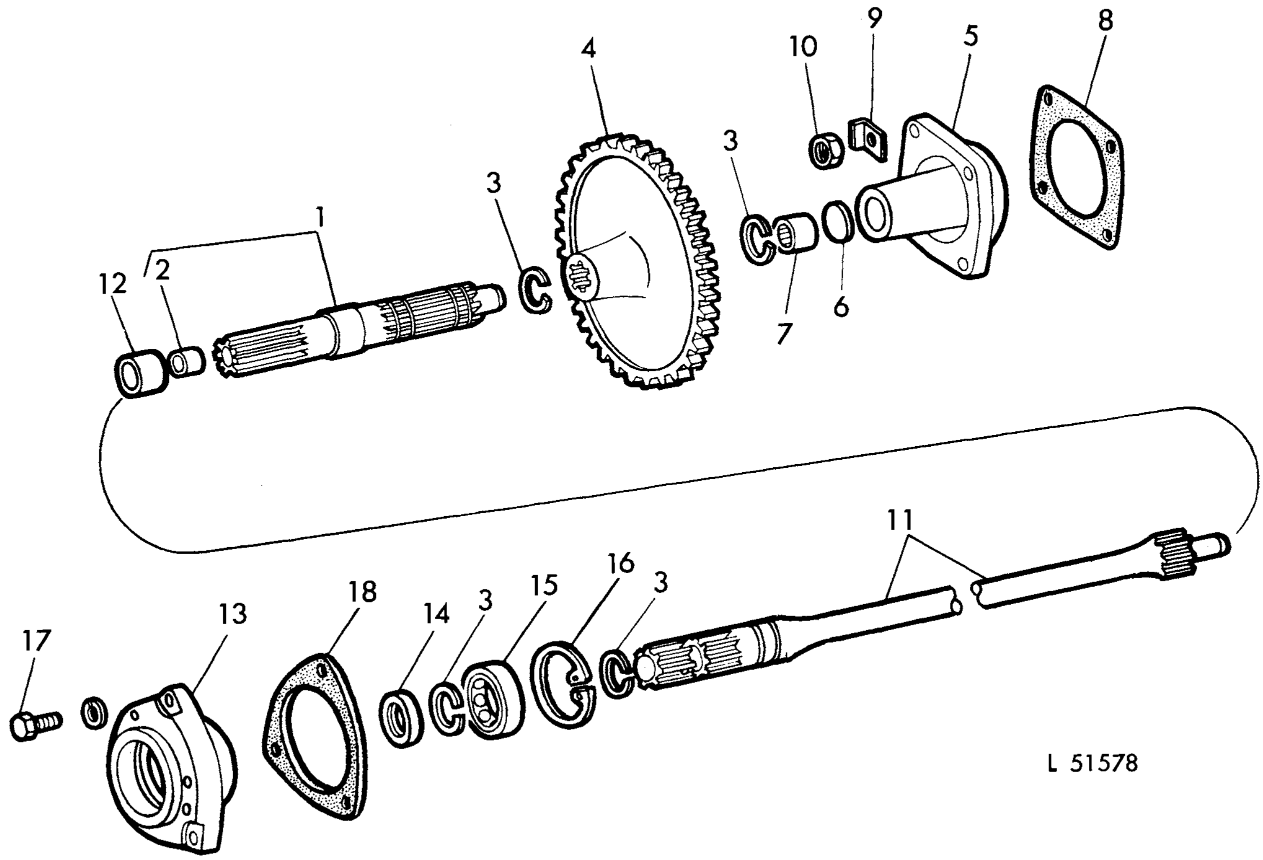

Fig. 4 — Exploded View of Single Rear PTO Shaft

1 PTO drive shaft
2 Bushing
3 Snap rings
4 Gear
5 Front quill
6 Thrust washer
7 Needle bearing
8 Gasket
9 Lock plate (4 used)
10 Hex.nut (4 used)
11 PTO shaft
12 Bushing (seated in transmission case)
13 Rear quill
14 Oil seal
15 Ball bearing
16 Snap ring
17 Cap screw (3 used)
18 Gasket

REPAIR

REPAIR OF PTO SHAFT

Check PTO shaft and quill bearing for wear or damage. To replace PTO shaft or ball bearing, remove snap ring of quill. Push PTO shaft and bearing out of quill. Remove both snap rings of PTO shaft and press bearing off shaft. Press new bearing on shaft so that snap rings in front and behind ball bearing fit into grooves of PTO shaft.

Check quill for damage.

Use new oil seal and drive into quill bore until flush, with sealing lip facing driver.

Press PTO shaft with ball bearing into quill and install snap ring in groove of quill.

REPAIR OF PTO DRIVE SHAFT AND GEAR

Check PTO gear and drive shaft for wear or damage. Check bushing in bore of PTO drive shaft and PTO drive shaft bushing seated in transmission case for wear. Replace, if necessary.

Inspect needle bearing and thrust washer of front quill and replace, if necessary.

REPAIR OF PTO SHIFTER MECHANISM

Check shifter shaft, shifter and splines of shifter collar for wear and replace parts, if necessary.

Check detent spring for serviceability.

INSTALLATION

INSTALLING PTO SHIFTER MECHANISM

When installing, reverse removal procedure.

INSTALLING PTO SHAFT

Install PTO shaft with ball bearing and quill in transmission case. Attach quill to transmission case.

INSTALLING PTO DRIVE SHAFT AND GEAR

Slide PTO drive shaft, with splined end in front, into transmission case and introduce in shifter collar. Slide gear onto drive shaft, with long hub end facing transmission case, and install snap ring.

Attach front PTO quill to clutch housing (if removed) and attach clutch housing to transmission case (see section 10, group 25). Tighten screws to the specified torque.

Fill transmission case with proper oil (see operator's manual).

MID PTO SHAFT

REMOVAL

Drain transmission case.

Separate tractor between transmission case and clutch housing, see section 10, group 25.

REMOVING PTO SHAFT SHIFTER MECHANISM

Drive spring pin 11 (fig. 5) out of coupling 10 and control lever shaft. Withdraw control lever from clutch housing. Drive inner spring pin 8 out of shifter fork and shifter shaft 9. Withdraw shifter shaft and coupling from shifter fork.

When removing shifter fork, make sure detent ball and spring do not get lost.

REMOVING PTO SHAFT

Drive PTO shaft out of quill, using slight taps.

Remove quill.

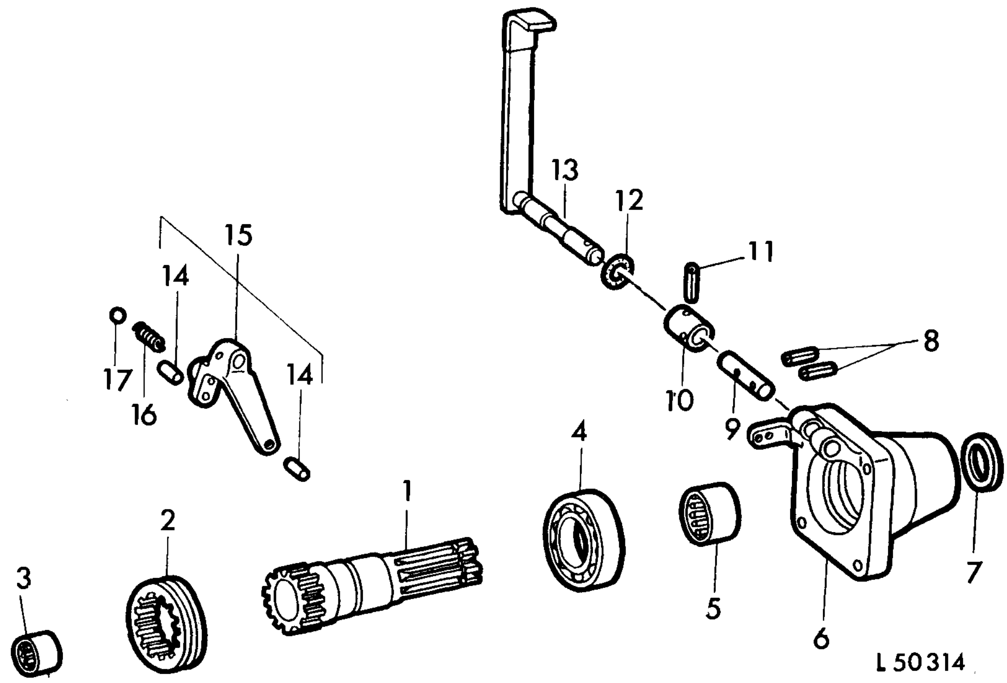

Fig. 5 — Exploded View of Mid PTO Shaft

1 PTO shaft
2 Shifter collar
3 Needle bearing
4 Ball bearing
5 Needle bearing
6 Quill
7 Oil seal
8 Spring pins
9 Shifter shaft
10 Coupling
11 Spring pin
12 O-ring
13 Control lever
14 Dowel pins
15 Shifter fork
16 Detent spring
17 Detent ball

REPAIR

REPAIR OF PTO SHAFT

Check splines of PTO shaft and teeth of drive gear for wear or damage. Inspect ball bearing on PTO shaft and needle bearing in bore of PTO shaft for damage and replace, if necessary. Check needle bearing of quill for wear or rough spots. Check oil seal of quill for damage and replace, if necessary.

REPAIR OF PTO SHIFTER MECHANISM

Check shifter collar, shifter fork and control lever for wear or damage and replace, if necessary. Check detent spring for serviceability.

Check driven gear (1000 rpm) at front of transmission for wear or chipped teeth. Inspect bushings of gear for wear and replace gear, if necessary.

INSTALLATION

When installing PTO shaft and shifter mechanism, reverse removal procedure.

When installing quill, use a new oil seal and when installing PTO control lever, use a new O-ring.

Attach clutch housing to transmission case and tighten screws to the specified torque (see section 10, group 25).

Fill transmission case with proper oil (see operator's manual).

DUAL REAR 540 RPM AND 1000 RPM PTO SHAFT

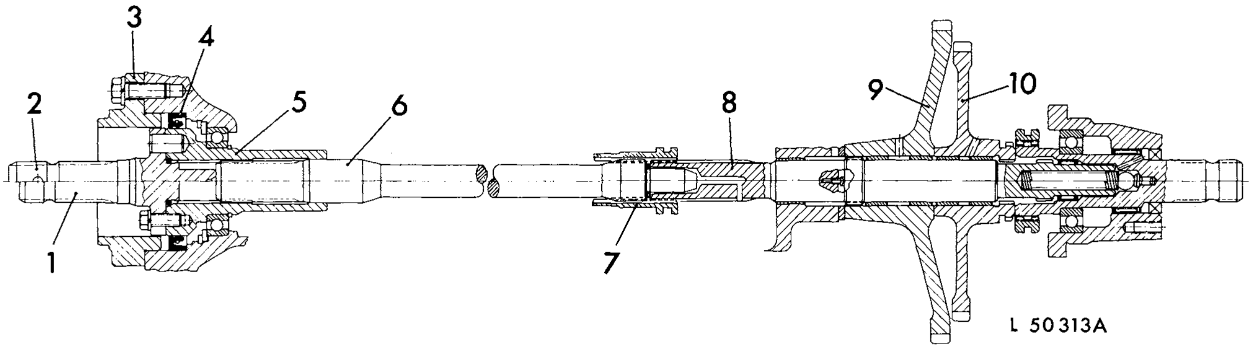

Fig. 6 — Dual Rear 540 rpm and 1000 rpm PTO Shaft, Shown with Mid 1000 rpm PTO Shaft

1 Stub shaft for 1000 rpm
2 Stub shaft for 540 rpm
3 Quill
4 Oil seal
5 PTO pilot
6 PTO shaft
7 Shifter collar
8 PTO driven shaft
9 540 rpm gear
10 1000 rpm gear

NOTE: This PTO shaft can be combined with a mid 1000 rpm PTO shaft (see fig. 6).

For details on mid PTO shaft see page 4.

For rear PTO shifter mechanism see "Single rear 540 rpm PTO shaft" (page 1).

REMOVAL

Before starting work on the PTO shaft, drain transmission case.

REMOVING PTO SHAFT

Operate rear PTO shifter mechanism to disengage PTO shaft. This will prevent the collar of the shifter mechanism from dropping into transmission case when removing PTO shaft.

Remove cap screws attaching rear quill to transmission case. Pull quill out of transmission case.

Remove oil seal 3 (fig. 7) from bore of transmission case.

CAUTION: Take care not to damage bore when removing oil seal. When assembling, install new oil seal.

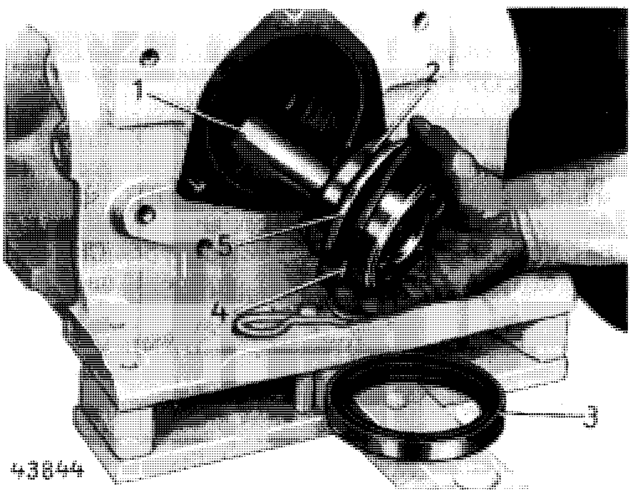

Fig. 7 — Removing PTO Shaft Pilot

1 PTO shaft pilot
2 Ball bearing
3 Oil seal
4 Snap ring
5 Special washer

Remove snap ring 4 (fig. 7). Pull PTO shaft pilot out of transmission case. Remove PTO shaft.

CAUTION: When removing PTO shaft, make sure thrust washer 16 (fig. 8) located between PTO shaft and PTO drive shaft does not drop into transmission case.

REMOVING PTO DRIVE SHAFT AND GEARS

Separate tractor between transmission case and clutch housing, see section 10, group 25.

Push PTO shaft gears off PTO drive shaft.

Re-install PTO shaft and PTO shaft pilot or rear PTO shaft assembly (if removed). Operate PTO shifter mechanism to engage PTO shaft. This will prevent collar of shifter mechanism from dropping into transmission case when removing PTO drive shaft.

Pull PTO drive shaft forward out of transmission case.

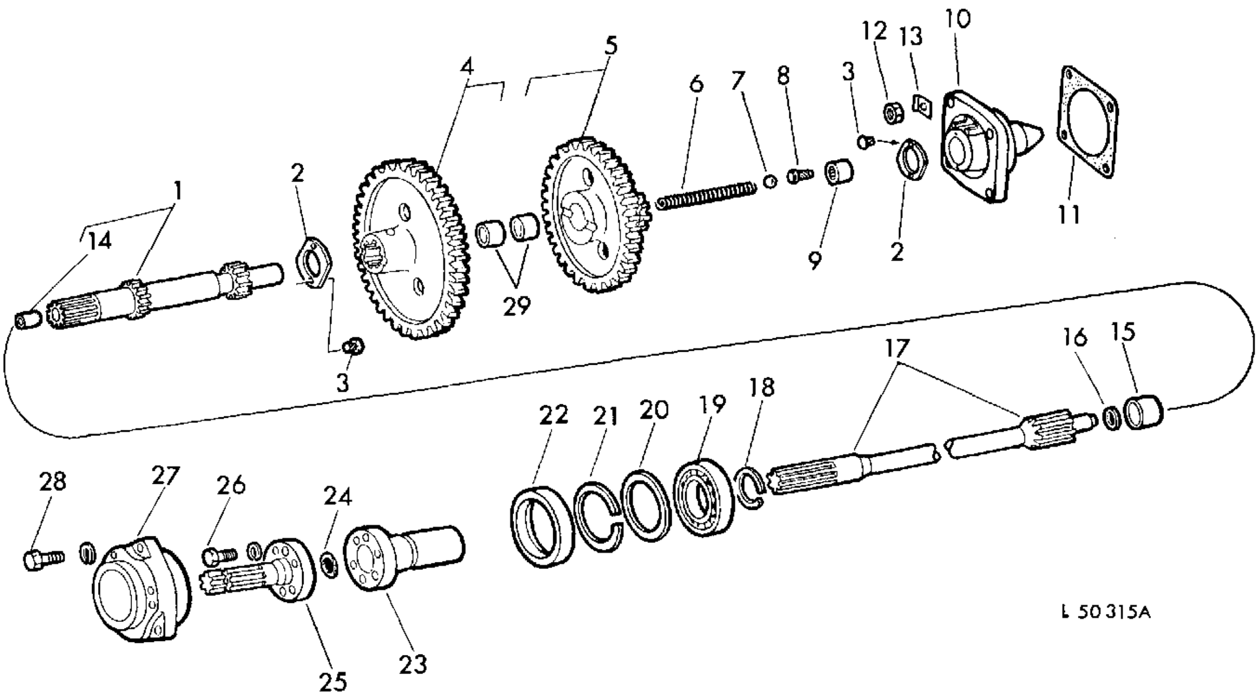

Fig. 8 — Exploded View of Dual Rear 540 and 1000 rpm PTO Shaft

1 PTO drive shaft
2 Thrust washers
3 Drive screw (4 used)
4 Gear (540 rpm)
5 Gear (1000 rpm)
6 Spring
7 Ball
8 Drive screw
9 Needle bearing
10 Front quill
11 Gasket
12 Hex.nut (4 used)
13 Lock plate (4 used)
14 Bushing
15 Bushing (seated in transmission case)
16 Thrust washer
17 PTO shaft
18 Snap ring
19 Ball bearing
20 Special washer
21 Snap ring
22 Oil seal
23 PTO shaft pilot
24 O-ring
25 PTO stub shaft (540 or 1000 rpm)
26 Cap screw (4 used)
27 Rear quill
28 Cap screw (3 used)
29 Bushing of PTO shaft gears (4 used)

REPAIR

REPAIRING PTO SHAFT

Check PTO shaft, PTO shaft pilot, stub shaft and rear quill for damage. Replace, if necessary.

Check ball bearing of PTO shaft pilot for damage. If required, remove snap ring and drive ball bearing off pilot. Press new bearing onto pilot until snap ring fits in groove.

REPAIRING PTO DRIVE SHAFT AND GEARS

Check PTO shaft gears and drive shaft for wear or damage. Inspect bushing in bore of PTO drive shaft for wear and replace, if necessary.

Check bushing of PTO drive shaft in front transmission case for wear and replace, if necessary.

Check spring of PTO drive shaft for damaged or broken coils and replace, if necessary.

INSTALLATION

INSTALLING PTO SHAFT

When installing the PTO shaft, reverse removal procedure.

Make sure thrust washer 16 (fig. 8) is installed between PTO drive shaft 1 and PTO shaft 17.

NOTE: When installing PTO stub shaft, use a new O-ring.

INSTALLING PTO DRIVE SHAFT

Slide PTO drive shaft into transmission case, with splined end first, and insert in shifter collar. Slide large 540 rpm PTO gear with long hub end facing transmission case as well as small 1000 rpm gear with long hub end facing away from transmission case onto drive shaft.

Attach front PTO quill to clutch housing (if removed). If tractor is equipped with mid PTO shaft, install shaft (see page 5).

Attach clutch housing to transmission case and tighten screws to the specified torque (see section 10, group 25).

Fill transmission case with proper oil (see operator's manual).

REAR 540 RPM AND MID 1000 PTO SHAFTS

This PTO shaft is a combination of the "Single Rear PTO Shaft" (see page 1), the "Dual Rear 540 and 1000 rpm PTO Shaft" (see page 6) and the "Mid PTO Shaft" (see page 4).

CAUTION: Contrary to the single rear PTO shaft, on the above shaft a thrust washer 20 is located between PTO shaft 21 (fig. 10) and PTO drive shaft 18.

When removing PTO shaft 21, take care that thrust washer 20 does not drop into transmission case.

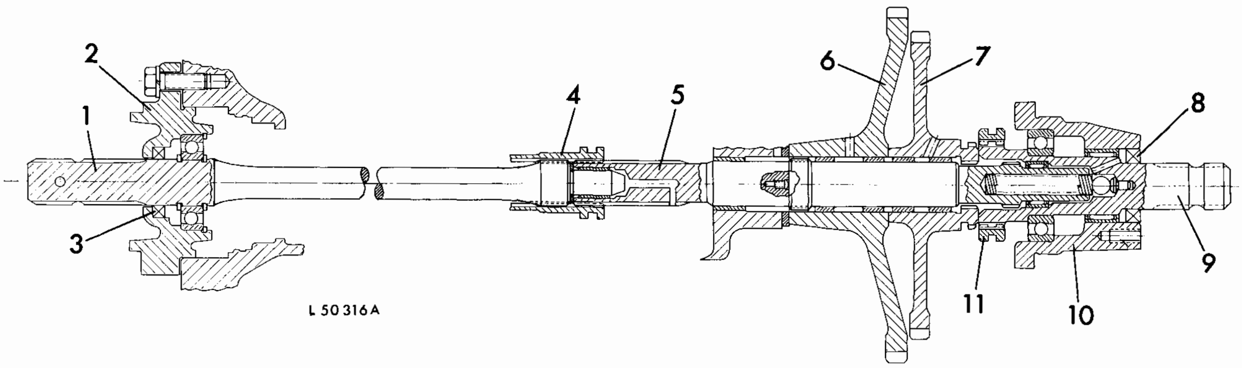

Fig. 9 — Rear 540 rpm and Mid 1000 rpm PTO Shafts

1 PTO shaft
2 Quill
3 Oil seal
4 Shifter collar
5 PTO drive shaft
6 540 rpm gear
7 1000 rpm gear
8 Oil seal
9 Mid PTO shaft
10 Front quill
11 Shifter collar

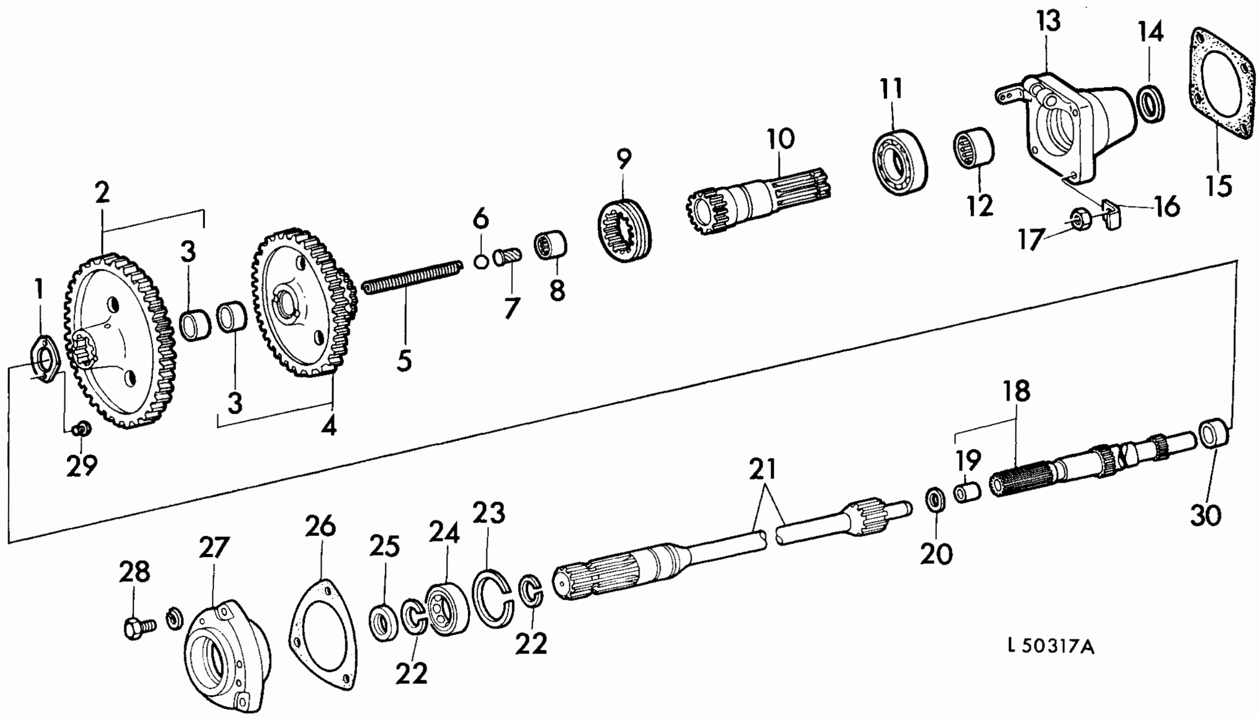

Fig. 10 — Exploded View of Rear 540 rpm and Mid 1000 rpm PTO Shafts

1 Thrust washer
2 540 rpm gear
3 Bushings (4 used)
4 1000 rpm gear
5 Spring
6 Ball
7 Drive screw
8 Needle bearing
9 Shifter collar
10 Mid PTO shaft
11 Ball bearing
12 Needle bearing
13 Front quill
14 Oil seal
15 Seal ring
16 Lock plate (4 used)
17 Hex.nut (4 used)
18 PTO drive shaft
19 Bushing
20 Thrust washer
21 Rear PTO shaft
22 Snap rings
23 Snap ring
24 Ball bearing
25 Oil seal
26 Gasket
27 Rear quill
28 Cap screw (3 used)
29 Drive screw (2 used)
30 Bushing

SPECIFICATIONS

SINGLE REAR 540 RPM PTO SHAFT	Dimensions of New Parts	
Dia. of PTO drive shaft seat for needle bearing	0.9979 to 0.9989 in.	25.351 to 25.367 mm
Dia. of front quill bore for seating needle bearing	1.3115 to 1.3125 in.	33.312 to 33.338 mm
Inner dia. of bushing seated in transmission case	1.3760 to 1.3790 in.	34.949 to 35.029 mm
Dia. of PTO drive shaft bearing journal for bushing	1.3730 to 1.3740 in.	34.874 to 34.900 mm
Dia. of PTO drive shaft bore for seating bushing	0.8120 to 0.8130 in.	20.625 to 20.651 mm
Inner dia. of bushing in PTO drive shaft	0.7515 to 0.7545 in.	19.086 to 19.166 mm
Dia. of PTO shaft journal	0.7495 to 0.7505 in.	19.037 to 19.063 mm
Dia. of PTO shaft seat for ball bearing	1.3779 to 1.3785 in.	34.998 to 35.014 mm
Dia. of ball bearing seat in rear quill	2.8343 to 2.8353 in.	71.991 to 72.017 mm
MID PTO SHAFT		
Dia. of PTO shaft seat for ball bearing	1.7716 to 1.7722 in.	44.958 to 45.014 mm
Dia. of ball bearing seat in quill	3.3464 to 3.3474 in.	84.998 to 85.024 mm
Dia. of quill bore for needle bearing	2.1245 to 2.1255 in.	53.962 to 53.988 mm
Dia. of mid PTO shaft seat for needle bearing	1.7494 to 1.7500 in.	44.434 to 44.450 mm
Dia. of mid PTO shaft bore for needle bearing	1.3115 to 1.3125 in.	33.312 to 33.338 mm

DUAL REAR 540 AND 1000 RPM PTO SHAFT

	Dimensions of New Parts	
Dia. of PTO drive shaft seat for needle bearing	0.9979 to 0.9989 in.	25.351 to 25.367 mm
Dia. of front quill bore for needle bearing	1.3115 to 1.3125 in.	33.312 to 33.338 mm
Inner dia. of bushing seated in transmission case	1.3760 to 1.3790 in.	34.949 to 35.029 mm
Dia. of PTO drive shaft bearing seat for bushing	1.3730 to 1.3740 in.	34.874 to 34.900 mm
Dia. of PTO drive shaft bore for seating bushing	0.8120 to 0.8130 in.	20.625 to 20.651 mm
Inner dia. of bushing seated in PTO drive shaft	0.7515 to 0.7545 in.	19.086 to 19.166 mm
Dia. of PTO shaft journal	0.7495 to 0.7505 in.	19.037 to 19.063 mm
Dia. of ball bearing seat of PTO shaft pilot	2.1653 to 2.1659 in.	54.998 to 55.014 mm
Dia. of PTO gear bushing bore	1.3760 to 1.3790 in.	34.949 to 35.029 mm
Dia. of PTO drive shaft bushing seats	1.3730 to 1.3740 in.	34.874 to 34.900 mm

REAR 540 RPM AND MID 1000 RPM PTO SHAFTS

This PTO shaft is a combination of the "Single Rear 540 rpm PTO Shaft", the "Dual Rear 540 and 1000 rpm PTO Shaft" and the "Mid PTO Shaft". Specifications see above PTO shafts.

Group 35

INDEPENDENT PTO SHAFTS

GENERAL INFORMATION

The tractor can be equipped with a single, independent, rear 540 rpm PTO shaft or with a dual, independent, rear 540/1000 rpm PTO. Conversion from 540 rpm to 1000 rpm is made by exchanging the stub shaft engaged in a reduction gear at the rear of the transmission case.

Tractors with a dual, rear PTO can also be equipped with a mid 1000 rpm PTO.

In this case two selector levers are located on the left-hand side of the tractor, making it possible to engage or disengage the mid or rear PTO mechanically when independent operation of one of the shafts is required. Then the PTO is hydraulically operated, being engaged or disengaged by means of the control lever located on the clutch housing.

For this reason, the rear PTO also has a shifter collar (see 2, fig. 3), whereas on machines without a mid PTO only a connecting sleeve is installed (see 2, fig. 2).

The PTO gear train is located in the lower portion of the transmission case.

When engaging the PTO by means of the lever located on the clutch housing, oil pressure is relieved from the PTO brake and immediately engages the PTO multi-disk clutch.

When disengaging the PTO, oil pressure is relieved from the PTO multiple-disk clutch. The PTO shaft is then immediately brought to a standstill by the hydraulically operated brake band.

The number of PTO clutch disks varies for the single, rear 540 rpm PTO and the dual, rear 540 and 1000 rpm PTO. The differences are as follows:

Single, rear 540 rpm PTO

10 internally splined disk plates
10 externally splined separator plates

Dual, rear 540 and 1000 rpm PTO

6 internally splined disk plates
6 externally splined separator plates

The clutch drums for the single, rear PTO and the dual, rear PTO vary in width (see Specifications).

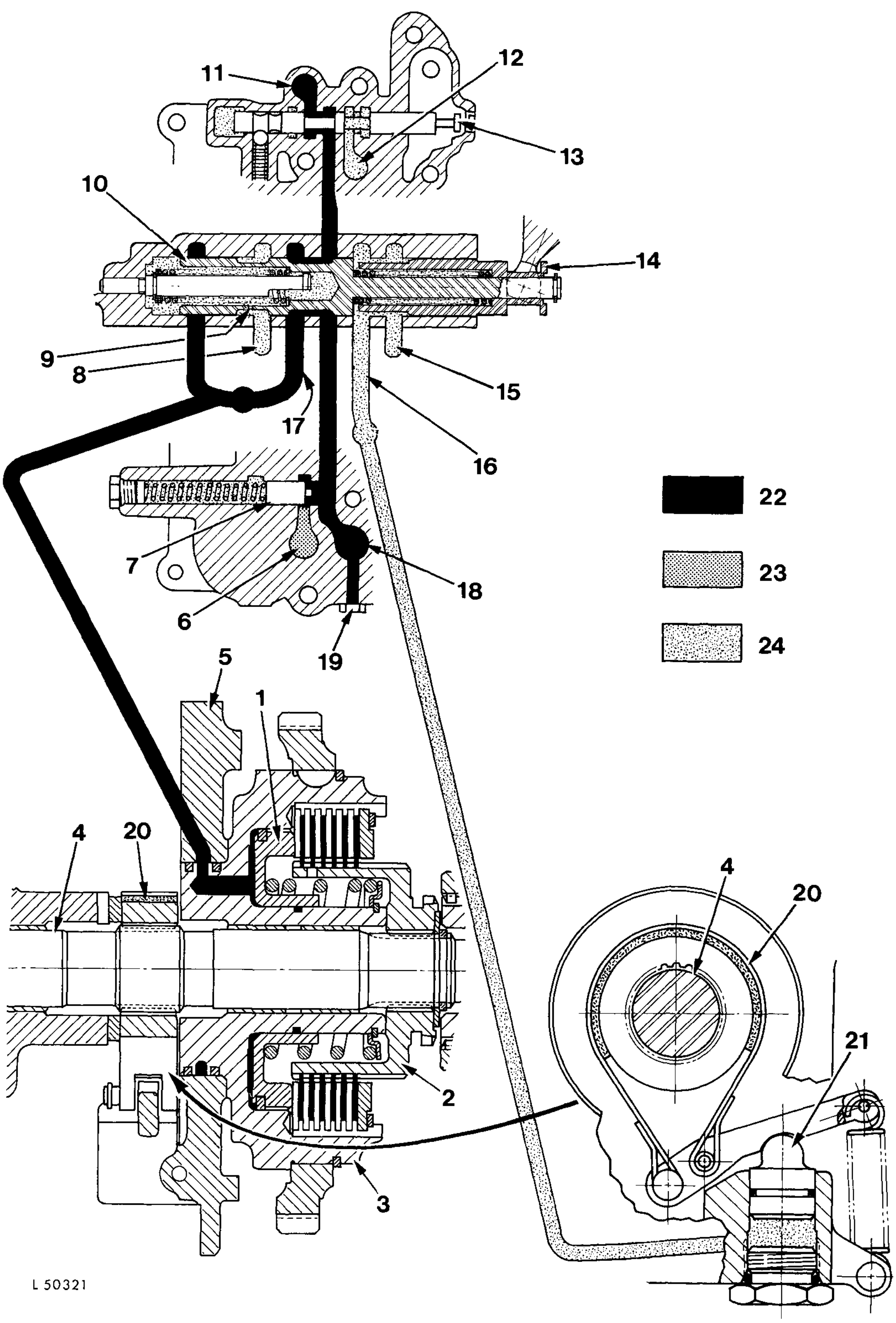

Fig. 1 — Hydraulic Circuit Flow Diagram of Independent PTO

1 PTO clutch piston
2 Disk hub
3 Clutch drum
4 PTO clutch shaft
5 Front transmission cover
6 Passage for oil flowing to hydraulic pump
7 Pressure regulating valve
8 Oil passage to transmission case (return oil from PTO clutch)
9 Oil orifice
10 Spool of PTO control valve
11 Oil flow to manifold and HIGH disk clutch
12 Oil flow to manifold and LOW disk brake
13 Spool of HIGH-LOW control valve
14 PTO clutch valve actuator (engaged position)
15 Oil passage to transmission case (return oil from PTO brake)
16 Pressure oil passage to PTO brake
17 Pressure oil passage to PTO clutch
18 Oil passage from transmission oil pump
19 Port for checking regulating valve pressure
20 Brake band
21 Brake piston
22 Pressure oil (approx. 142 psi = 10 kg/cm^2)
23 Intermediate pressure oil (approx. 71 psi = 5 kg/cm^2)
24 Pressure-free oil

OPERATION

HYDRAULIC FUNCTION

When the PTO control lever is moved forward, spool 10 (fig. 1) with the aid of a lever, a spring and actuator 14, is pushed into housing of gear shift lever.

By this means pressure oil passage 18 is connected to pressure oil passage 17 leading to the PTO clutch. At the same time oil flows under pressure into the passage behind spool 10 until it is completely closed (see fig. 1). During the engaging operation, pressure oil from behind the spool drains off through metering bore 9 thus counteracting the engaging movement until the PTO clutch is completely engaged. In this way an abrupt engagement of the PTO is prevented and a smooth engagement guaranteed.

To disengage the PTO, the spool is moved in the opposite direction. First pressure oil passage 17 is closed and return oil passage 8 opened so that oil from the PTO clutch can flow into the transmission case. Afterwards the spool opens pressure oil passage 16 and at the same time pressure oil passage 17 is opened fully so that pressure oil can flow from there to the PTO brake.

Oil flowing through passage 16 to the PTO brake gets behind brake piston 21, which operates brake band 20 with the aid of a brake arm. The brake band stops shaft 4 and PTO shaft through a hub splined and thus positively engaged onto shaft 4 of PTO clutch.

When the PTO is engaged again, pressure oil from behind the piston is drained and a tension spring releases the brake band (see fig. 1).

The control lever and spool are locked in both end positions, ("engaged" and "disengaged"), by means of two detent balls and springs.

The oil pressure required for operating the PTO clutch and brake is maintained by a pressure regulating valve located in the transmission shift cover. This valve is similar to that installed on tractors equipped with HIGH-LOW unit (see group 10).

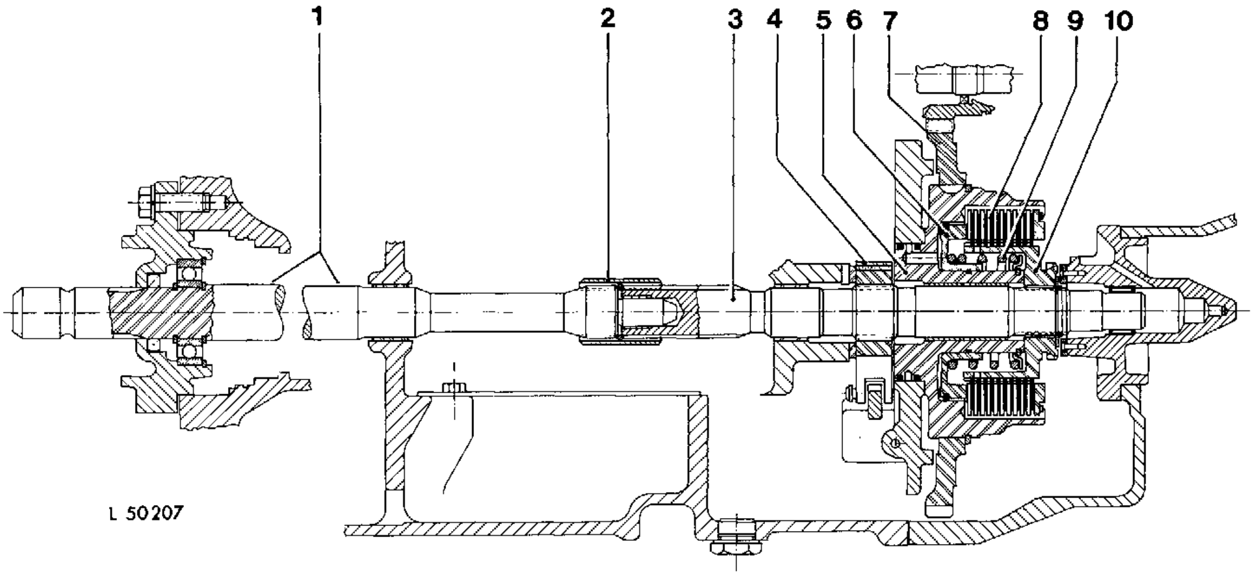

Fig. 2 — Independent, Single, Rear 540 rpm PTO Shaft — Sectional View

1 PTO shaft for 540 rpm
2 Connecting sleeve
3 PTO clutch shaft
4 PTO brake
5 Clutch drum
6 Piston of multiple disk-clutch
7 Drive gear
8 Disk pack
9 Pressure spring
10 Disk hub

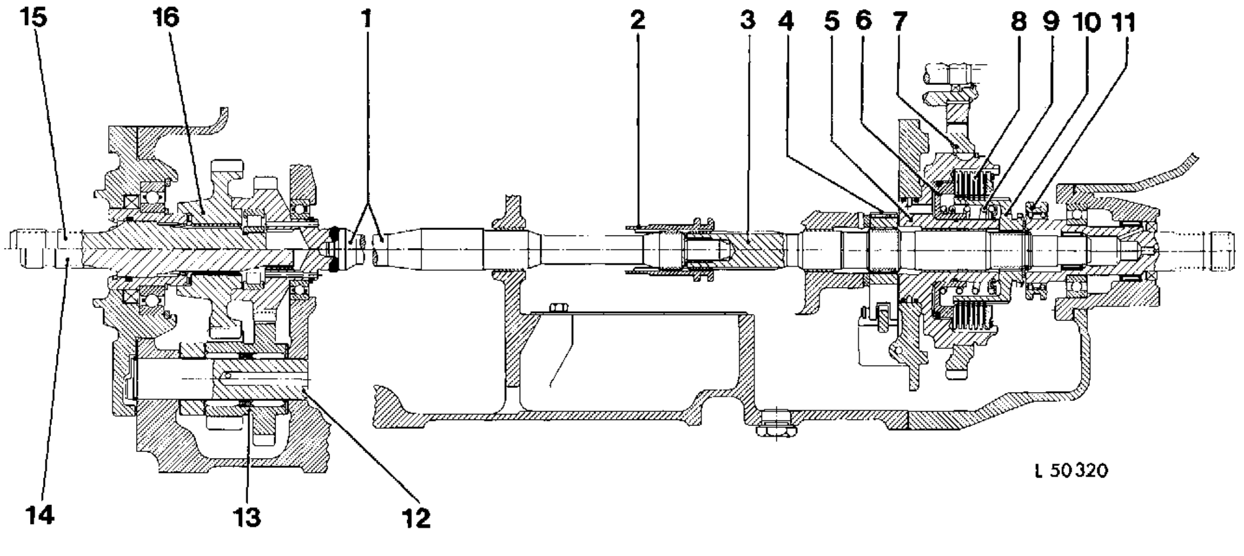

Fig. 3 — Independent, Dual, Rear 540 rpm PTO and Front 1000 rpm PTO — Sectional View

1 PTO shaft with gear
2 Shifter collar
3 PTO clutch shaft
4 PTO brake
5 Clutch drum
6 Piston of multiple-disk clutch
7 Drive gear
8 Disk pack
9 Pressure spring
10 Disk hub
11 Shifter collar (front PTO)
12 Countershaft
13 Double gear
14 1000 rpm stub shaft
15 540 rpm stub shaft
16 Gear

OPERATION

Power is transmitted from the hollow gear shaft of the transmission oil pump to gear 7 (figs. 2 and 3), which is positively engaged to clutch drum 5 by means of a spring washer.

When the clutch disk assembly 8 is compressed through oil pressure by means of piston 6, power is transmitted from clutch drum 5 through disk assembly 8 to hub 10 and thus to shaft 3 (see figs. 2 and 3).

If the 540 rpm stub shaft 15 (fig. 3) is installed, power flows from gear of powershaft end 1 through double gear 13 and gear 16 of countershaft into the stub shaft.

If the 1000 rpm stub shaft 14 is installed, power flows from gear of power shaft end 1 directly into the stub shaft which is splined to the powershaft end (see fig. 3). Meanwhile, double gear 13 and gear 16 of the countershaft are running idle.

TESTING OIL PRESSURE

Testing operating pressure of PTO clutch and brake

Remove plug 1 (fig. 4) when checking the operating pressure of PTO brake. Remove plug 2 when checking the operating pressure of the PTO clutch.

Connect gauge No. 19.58-90.268 (range 0-355 psi = 0-25 kg/cm^2) with the aid of pressure hose assembly and adapter No. 19.58-90.266 of special tool No. 19.58-90.260. When testing operating pressure of PTO brake, a special elbow is required.

Start engine and run at 2100 rpm. Warm up oil to normal running temperature by actuating PTO control lever, engaging and disengaging the PTO. The operating pressure in both final positions of the control lever should be the same. See Specifications for correct operating pressure.

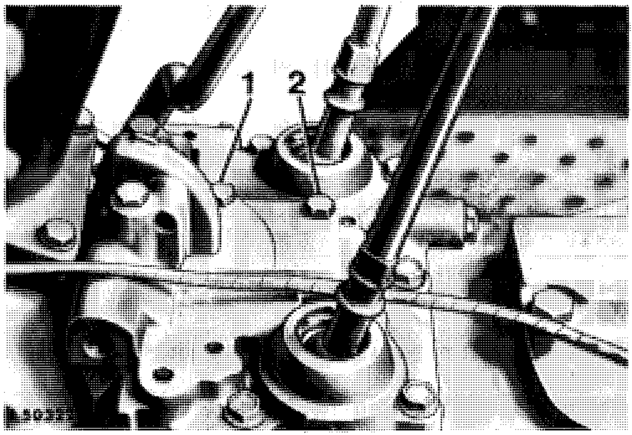

Fig. 4 — Connecting Points for Checking Operating Pressure

1 Plug (checking operating pressure of PTO brake)
2 Plug (checking operating pressure of PTO clutch)

When the pressure reading is less than specified or the PTO shaft turns with the control lever in the disengaged position, do not place PTO shaft under load until the fault has been rectified.

Testing operation of spool in control valve assembly

Remove plugs 1 and 2 (fig. 4) and connect two pressure gauges.

Start engine again and run at 2100 rpm. Observe both pressure gauges.

When the PTO control lever is moved slowly from engaged to disengaged position, one gauge must read zero before the other gauge shows any pressure.

No pressure overlap should be experienced when shifting the lever slowly between the engaged and disengaged positions.

DIAGNOSING MALFUNCTIONS

TOO LITTLE OR NO OIL PRESSURE

Transmission oil pump defective (see section 70, group 15)

Pressure regulating valve incorrectly adjusted (see section 50, group 10)

Clogged transmission oil filter

Broken pressure regulating valve spring

Transmission filter relief valve defective

PTO control valve assembly damaged

OIL PRESSURE OVERLAPS

Control valve spool and/or control valve housing lands damaged

PTO FAILS TO OPERATE

Transmission oil pump defective

Clutch facings worn or burned

Control valve defective

PTO selector levers (if equipped) disengaged

Engine clutch pressure plate defective

PTO countershaft damaged

PTO WILL NOT STOP

Control valve spool defective

Clutch pack defective - will not release

PTO brake worn or defective

PTO IS NOISY

Bearings failed or worn

Countershaft worn or damaged

Insufficient delivery of transmission oil pump

Engine slow idle below specified rpm

REAR PTO SHAFT ASSEMBLY

REMOVAL

REMOVAL ON TRACTORS EQUIPPED WITH SINGLE, REAR 540 RPM PTO SHAFT

Drain transmission oil. Remove complete rockshaft assembly (see section 10, group 25). When removing the rear PTO shaft, press connecting sleeve 2 (fig. 2) against PTO clutch shaft 3 by means of a long, thin screwdriver to prevent the sleeve from falling into the transmission case. Remove attaching screws from rear bearing cover and take bearing cover together with PTO shaft out of the transmission case.

REMOVAL ON TRACTORS EQUIPPED WITH DUAL REAR 540 AND 1000 RPM PTO SHAFT

Drain transmission oil and remove rear bearing cover complete with PTO stub shaft.

Remove gear 16 (fig. 3).

Remove rear PTO shaft 1 as follows:

On tractors not equipped with a mid-PTO: Before pulling out PTO shaft 1 (fig. 3), remove rockshaft assembly and with the aid of a long, thin screwdriver hold connecting sleeve onto the PTO clutch shaft 3.

On tractors equipped with a mid-PTO: Shift rear PTO selector lever, located on side of transmission case, to the rear in the disengaged position before pulling rear PTO shaft out of transmission case. Doing this keeps connecting sleeve 2 (fig. 3) on shaft 3 so that it cannot fall into the transmission case.

Remove countershaft 12 (fig. 3) and gear 13 of countershaft assembly.

INSPECTION AND REPAIR

Remove oil seal from rear bearing cover and discard. Drive new seal into housing so that sealing lip faces driving tool and the oil seal bottoms shoulder of cover. Coat sealing lip with grease.

Check ball bearings and roller bearings (if equipped) for serviceability.

Check countershaft 12 (fig. 3) for scores or wear.

Check bearing needles of gear 13 and spacer. Always replace a complete set (24) of needles if any have to be replaced.

Check PTO shaft bushing in transmission case.

ASSEMBLY

When installing, reverse removal sequence.

When assembling the countershaft 12 (fig. 3), make sure that the thrust washer, all needle bearings and spacer of double gear 13 are installed (see fig. 3).

PTO-CLUTCH

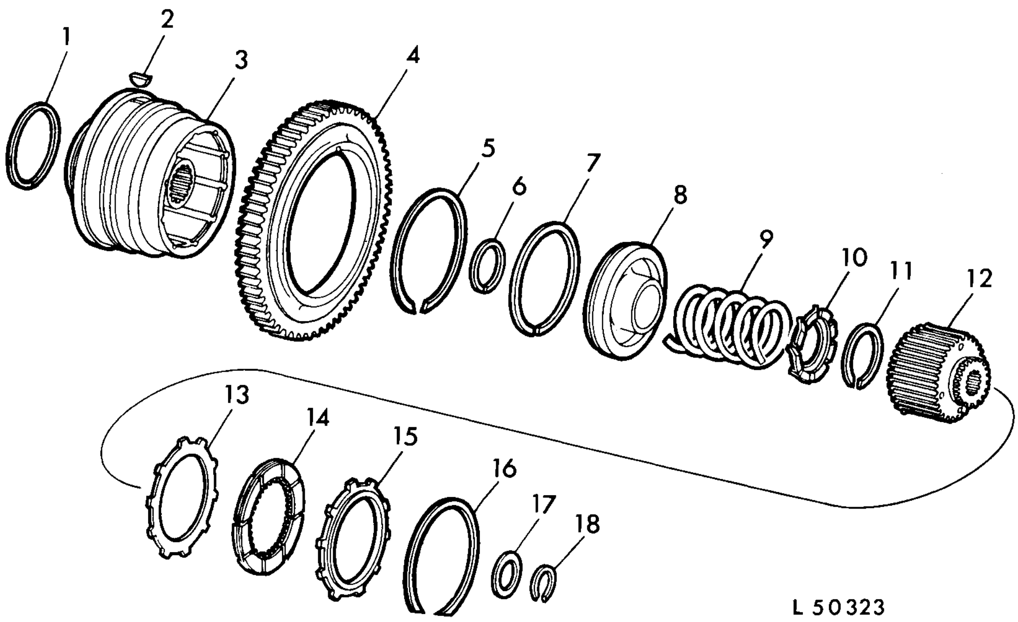

Fig. 5 — PTO Clutch, Exploded View

1 Sealing ring (2 used)
2 Woodruff key
3 Clutch drum
4 Clutch gear
5 Snap ring
6 Packing
7 Sealing ring
8 Piston
9 Pressure spring
10 Retainer
11 Snap ring
12 Clutch hub
13 Separator plate (externally splined) (6 or 10 used)
14 Clutch disk (internally splined) (6 or 10 used)
15 Plate
16 Snap ring
17 Thrust washer
18 Snap ring

REMOVAL

Separate tractor between transmission case and clutch housing, as explained in section 10, group 25.

CAUTION: Before removing shift lever assembly, place shift lever forward in the engaged position. Remove shift lever complete with cover. When removed, do not move shift lever otherwise detent balls and springs will fall out.

Install rear PTO shaft (if removed).

Remove clutch assembly as follows:

On tractors equipped with mid-PTO, shift rear PTO selector lever, located on side of transmission case forward, to the engaged position. This will prevent the disconnect collar from falling into the transmission case when removing the PTO drive shaft and clutch assembly. Pull disk clutch assembly together with shaft out of transmission case.

On tractors not equipped with mid-PTO, remove front snap ring 18 (fig. 5) from clutch shaft. Push disk clutch off shaft, at the same time pushing against the shaft so that it stays in the transmission case, so preventing the connecting sleeve from sliding off the rear PTO shaft.

DISASSEMBLY

Remove snap ring 16 (fig. 5) from the clutch drum. Take out clutch hub 12 with plate 15 and clutch pack, lining up the external splines of clutch disks and plate with the splines in the clutch drum. To facilitate reassembling, make a note of the number of clutch disks and separator plates.

Compress pressure spring 9 and remove snap ring 11 from clutch drum. Remove retainer 10, spring 9 and piston 8. Remove and discard packing 6.

INSPECTION AND REPAIR

Check all parts of clutch disk assembly for wear and damage, watching the following points:

Check clutch hub 12 (fig. 5) for worn or damaged splines.

Check the internally splined disks 14 and externally splined separator plates 13 for wear, making sure that the grooved pattern of the disk facings is not worn or rubbed off. If so, renew disks. Check the internal splines for damage. For thickness of a clutch disk, see Specifications.

Check piston 8 and clutch drum 3 for cracks or any other damage, and replace if necessary. Check piston sealing ring 7 and both clutch drum sealing rings 1 for serviceability.

Check bushings of clutch drum and bushing of PTO clutch shaft seated in transmission case.

If clutch drum gear 4 has to be replaced, heat new gear in an oil bath to 360°F (180°C) before pressing on.

NOTE: On tractors equipped with HIGH-LOW unit, install gear with offset toward large end of drum and on machines not equipped with HIGH-LOW unit towards small end of drum.

Check spring 9 (fig. 5) for damaged or broken coils. Check resilience of spring (see Specifications).

ASSEMBLY

When assembling, reverse disassembly procedure, watching the following points:

Install new packing 6 in clutch drum 3 (fig. 5).

Install retainer 10 so that the fins face away from piston.

Install the correct number of clutch disks 14 and separator plates 13 alternately on hub 12 so that a separator plate is on the piston side and a clutch disk on the side of plate 15.

INSTALLATION

When installing, reverse removal procedure.

NOTE: If the PTO drive shaft was removed on machines not equipped with mid-PTO, ensure that connecting sleeve 2 (fig. 2) is installed on the rear PTO shaft. If this is not the case, insert a screwdriver or similar tool through the square opening of the transmission case and push the connecting sleeve on the PTO shaft.

PTO SHAFT BRAKE

REMOVAL

Separate tractor between transmission case and clutch housing and remove PTO clutch.

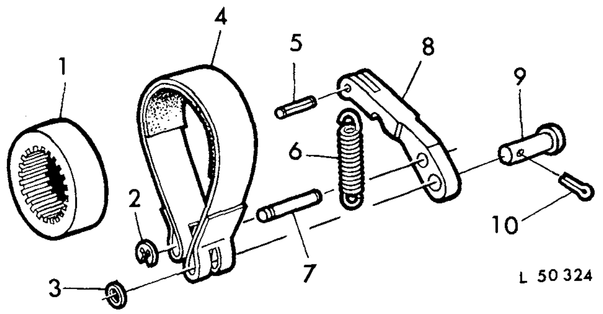

Fig. 6 — PTO Shaft Brake - Exploded View

1 Brake hub
2 Snap ring
3 Washer
4 Brake band
5 Spring pin
6 Tension spring
7 Guide pin
8 Lever
9 Clevis pin
10 Cotter pin

Disconnect tension spring 6 (fig. 6). Drive guide pin 7 out of front transmission cover, and pull out of lever 8 and brake band 4. Remove brake band with lever 8.

NOTE: When removing brake piston 21 (fig. 1), it is necessary to remove the front transmission cover, see section 50, group 15.

REPAIR

Check all parts for wear and damage. Test spring resilience (see Specifications).

INSTALLATION

BRAKE BAND

Remove snap ring 2 (fig. 6) out of groove of guide pin and drive pin (groove first) into front transmission cover until it is flush with outside edge of cover. Guide lever 8 and brake band 4 through bore of transmission cover 1. Install brake band around the hub and push lever 8 and the lugs of brake band 4 onto guide pin 7. Replace snap ring in pin groove.

Reconnect spring 6.

CONTROL VALVE ASSEMBLY

Before removing control lever assembly, push control lever forward into engaged position. Remove control lever complete with cover.

Do not move control lever after assembly has been removed, otherwise detent balls and springs will fall out.

Remove transmission shift cover.

Remove plug 14 (fig. 7) and actuator 22 complete with spring 18, shims 17 and spool 21 from transmission shift cover. Then remove special pin 20 complete with washer 19, second spring 18, shims 17 and retaining ring 16.

DISASSEMBLY

Remove retaining rings 16 (fig. 7) of spool 21 and special pin 20.

CAUTION: Do not mix up springs 18 and shims 17 of special pin and spool.

INSPECTION AND REPAIR

Check spool 21 (fig. 7) and transmission shift cover 6 for damaged lands.

Check resilience of springs 18 (see Specifications).

ASSEMBLY

Assemble special pin and spool of control valve assembly as follows and check resilience of springs:

1. Install washer 19 (fig. 7), spring 18, three shims 17 and retaining ring 16 onto special pin 20. Place special pin (small end first) on spring scales. Press down with your finger on spring of special pin. The spring should break free from headed end of special pin at a determined load (see Specifications).

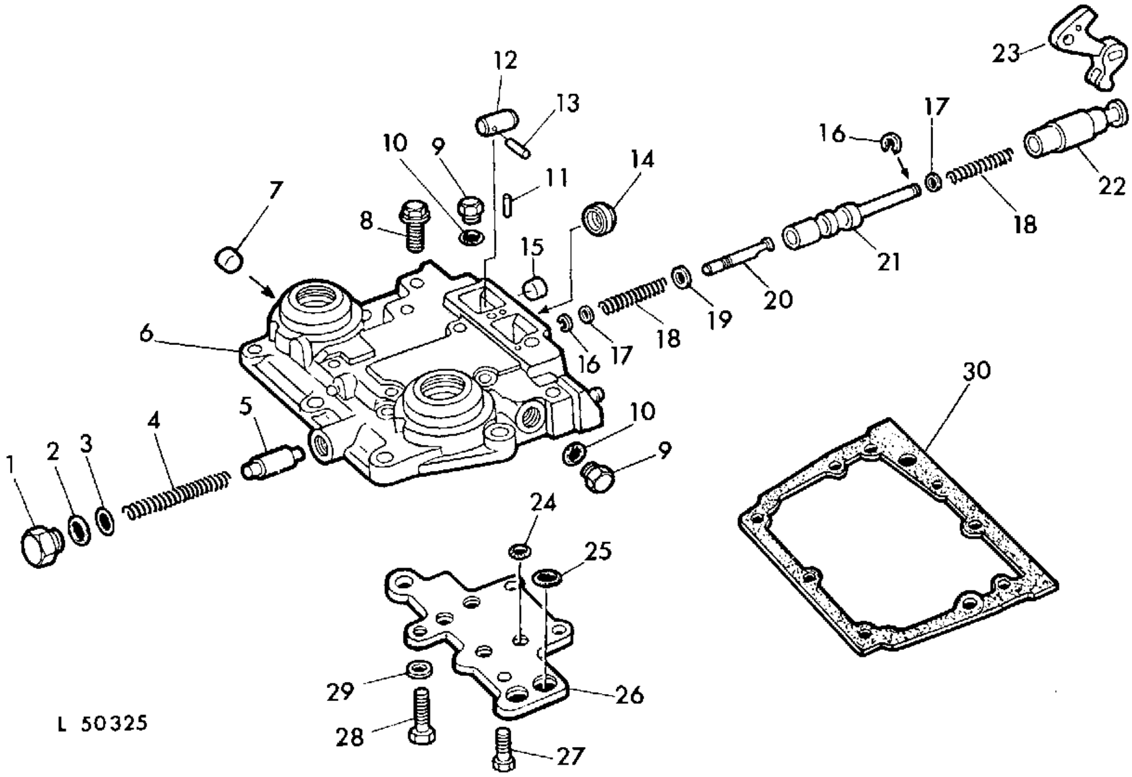

Fig. 7 — Control Valve Assembly and Pressure Regulating Valve, Exploded View

1 Plug
2 O-ring
3 Shim (use as required)
4 Spring
5 Pressure regulating valve
6 Treansmission shift cover
7 Plug
8 Cap screw (5 used)
9 Plug (3 used)
10 O-ring (3 used)
11 Dowel pin (2 used)
12 Plug (on machines without HIGH-LOW unit)
13 Spring pin (on machines without HIGH-LOW unit)
14 Cap
15 Plug
16 Retaining rings
17 Shims (6 used)
18 Springs
19 Washer
20 Special pin
21 Spool
22 Actuator
23 Control lever arm
24 O-ring (2 used)
25 O-ring (2 used)
26 Plate
27 Cap screw (4 used)
28 Cap screw
29 Washer
30 Gasket

If necessary, add or deduct shims until correct spring tension is obtained.

CAUTION: There should always be a minimum of one washer.

2. Install three shims 17 (fig. 7), spring 18, actuator 22 and retaining ring 16 on spool 21.

Place spool end on scales and press with fingers on actuator. If actuator does not break free from snap ring end of spool at the required load, add or deduct washers until correct tension is obtained (see Specifications).

ADJUSTING INTERLOCK MECHANISM OF PTO CONTROL LEVER

Coat both cap screws with sealing compound and screw flush into transmission cover, that is until springs are fully compressed. After that unscrew both cap screws two turns.

MID-PTO SHAFT AND SHIFTER MECHANISM

See group 30 for details regarding mid-PTO and PTO shaft shifter mechanism.

SPECIFICATIONS

CONTROL VALVE ASSEMBLY	Dimensions of new parts	
Clutch and brake oil pressure at 2100 engine rpm	140 to 160 psi	9.8 to 11.2 kg/cm^2
Pressure regulating valve adjustment at 2100 rpm	140 to 160 psi	9.8 to 11.2 kg/cm^2
Spring load of special pin spring (approx. 3 washers)	6.9 to 7.1 lbs.	2.7 to 3.7 kg
Spring load of valve spool spring (approx. 3 washers)	12.5 to 13.5 lbs.	5.7 to 6.1 kg
Control valve assembly spring		
Free length	1.91 in.	48.5 mm
Resilience at a spring length of 1.33 in. (33.8 mm)	20 to 24.5 mm	9 to 11 kg
Detent springs of control lever		
Free length	0.62 in.	15.8 mm
Resilience at a spring length of 0.43 in. (10.9 mm)	4.5 to 5.5 lbs.	2.0 to 2.5 kg
PTO COUNTERSHAFT ASSEMBLY		
Thickness of countershaft gear thrust washer	0.0900 in.	2.25 mm
Thickness of countershaft gear spacer	0.8680 to 0.8720 in.	22.05 to 22.15 mm
Thickness of countershaft needle bearing spacer	0.3660 to 0.3670 in.	9.30 to 9.40 mm
O.D. of countershaft	1.4580 to 1.4586 in.	37.033 to 37.049 mm
I.D. of countershaft gear	1.8972 to 1.8982 in.	48.189 to 48.215 mm
Width of countershaft gear	2.8799 to 2.8800 in.	72.89 to 73.15 mm
Free height of drive gear spring washer	0.19 in.	4.8 mm
O.D. of a needle bearing	0.2186 to 0.2188 in.	5.552 to 5.558 mm
Total number of countershaft gear needle bearings	48	
POWERSHAFT AND DRIVE SHAFT		
O.D. of PTO shaft and drive shaft at bearing area	1.3720 to 1.3740 in.	34.874 to 34.900 mm
I.D. of PTO shaft bushings (in transmission case)	1.3760 to 1.3790 in.	34.949 to 35.029 mm

SPECIFICATIONS (Cont.)

	Dimensions of new parts	
Diameter of bores for bushings in transmission case	1.4995 to 1.5005 in.	38.087 to 38.113 mm
I.D. of bushing located in drive shaft	0.7515 to 0.7545 in.	19.086 to 19.166 mm
Diameter of PTO shaft journal	0.7495 to 0.7505 in.	19.037 to 19.063 mm
PTO CLUTCH ASSEMBLY		
Thickness of externally splined separator plates	0.09 in.	2.3 mm
Thickness of internally splined clutch disks	0.060 to 0.065 in.	1.5 to 1.6 mm
Thickness of clutch hub thrust washer	0.0580 to 0.0620 in.	1.47 to 1.57 mm
O.D. of piston	4.850 to 4.860 in.	123.32 to 123.45 mm
I.D. of piston	2.2490 to 2.2510 in.	57.125 to 57.175 mm
Width of piston	0.732 to 0.742 in.	18.59 to 18.85 mm
Width of clutch drum		
on dual, rear PTO	3.573 to 3.593 in.	90.75 to 91.25 mm
on single, rear PTO	4.203 to 4.223 in.	106.75 to 107.25 mm
I.D. of clutch drum for installing piston	4.8745 to 4.8755 in.	123.812 to 123.838 mm
Diameter of bearing seat on clutch drum hub	2.2440 to 2.2460 in.	56.995 to 57.045 mm
I.D. of bushings located in hub of clutch drum	1.4270 to 1.4280 in.	36.246 to 36.272 mm
Pressure spring of disk clutch piston		
Free length	3.88 in.	98.5 mm
Resilience at a spring length of 1.79 in. (45.5 mm)	117 to 143 lbs.	54 to 66 kg
PTO BRAKE		
O.D. of brake drum	2.3570 to 2.3670 in.	59.87 to 60.13 mm
Thickness of brake band with lining	0.1420 to 0.1580 in.	3.60 to 4.00 mm
Operating lever return spring		
Free length	1.03 in.	51.6 mm
Resilience at a spring length of 3.38 in. (85.8 mm)	4.2 to 5.2 lbs.	1.9 to 2.4 kg

Section 60

FRONT AXLE, STEERING SYSTEM AND BRAKES

CONTENTS OF THIS SECTION

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Group 5
FRONT AXLE

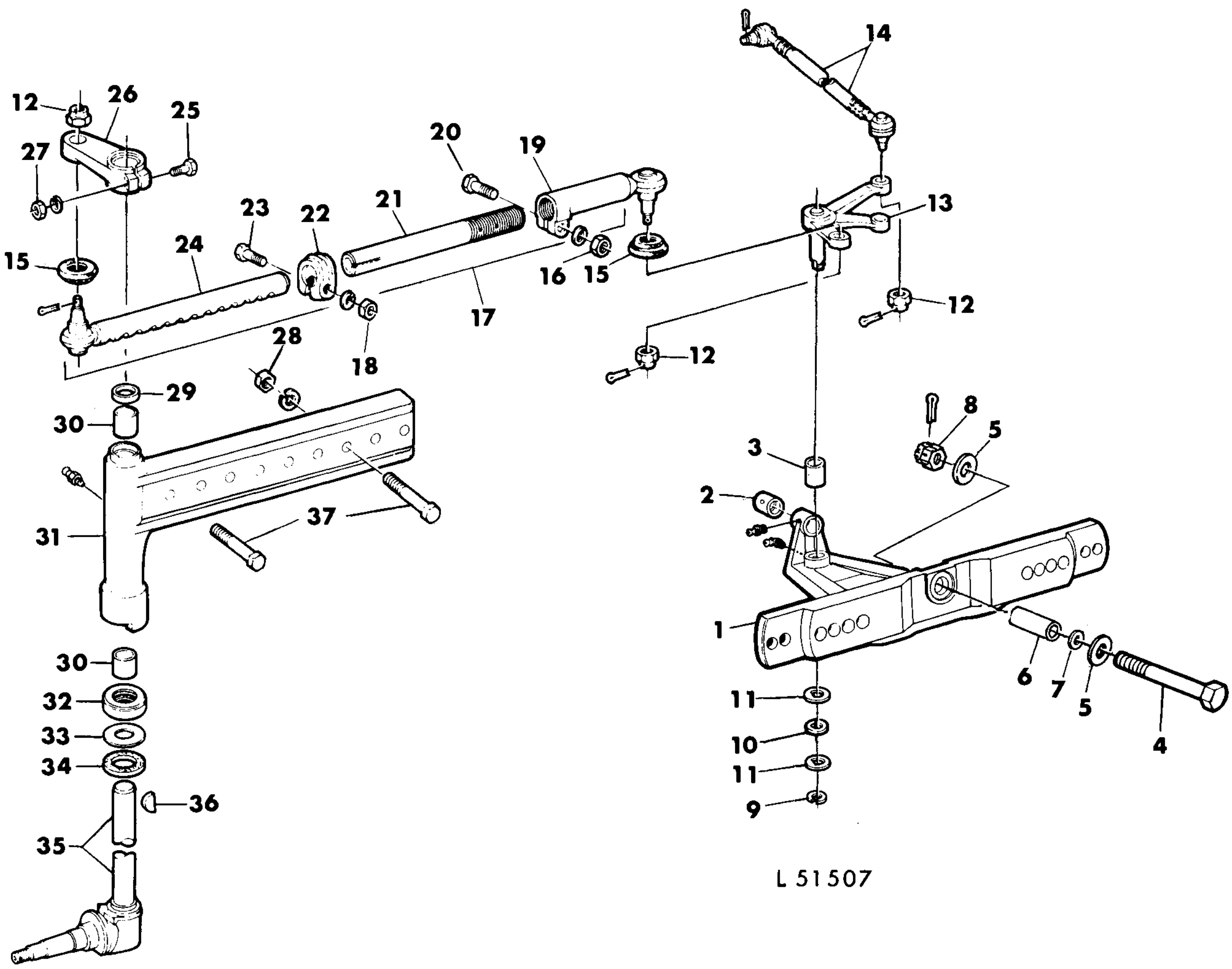


Fig. 1 — Parts of Front Axle Assembly (Standard Version)

1 Axle center
2 Bushing
3 Bushings (2 used)*
4 Special cap screw
5 Washers
6 Tube
7 Shim (use as required)
8 Castellated nut
9 Snap ring
10 Shim (use as required)
11 Special washers
12 Castellated nuts
13 Bell crank
14 Drag link
15 Dust seal
16 Hex. nut
17 Tie rod assembly
18 Hex. nut
19 Tube
20 Cap screw
21 Tube
22 Clamp
23 Cap screw
24 Outer tie rod end
25 Cap screw
26 Steering arm
27 Hex. nut
28 Hex. nut
29 Seal ring
30 Bushings
31 Axle knee
32 Thrust bearing
33 Washer
34 Seal ring
35 Knuckle and spindle assembly
36 Woodruff key
37 Cap screws

* *Later units have two needle bearings installed in place of the two bushings*

GENERAL INFORMATION

The tractor is equipped with an adjustable front axle (standard or heavy-duty). The rotation of the steering wheel is transmitted to the front axle and thus to the front wheels through a steering linkage consisting of a drag link, a bell crank, the tie rods and the steering arms.

REMOVAL

Attach a suitable hoist to the front end support.

Disconnect drag link 14 (fig. 2) at bell crank 13. Support the front axle, using a jack.

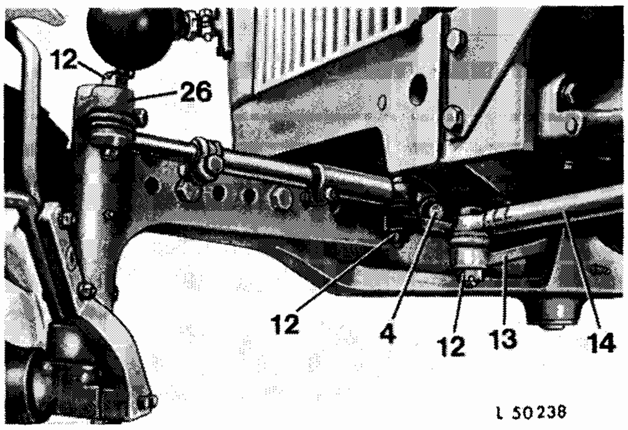


Fig. 2 — Removal of Front Axle Assembly (Standard Axle Shown)

4 Special cap screw
12 Castellated nuts
13 Bell crank
14 Drag link
26 Steering arm

Remove special cap screw 4 (fig. 2) and slotted nut 8 (fig. 1 or 3) together with shims 10. Slide the complete front axle rearward while tube 6 comes free of front support and axle comes free of front support bearing pin. Pull out complete front axle from under tractor.

REPAIR

Disassemble complete front axle and check parts for cracks, wear or damage. Repair or replace, if necessary.

Check seal rings 29 and 34 (fig. 1 or 3) for serviceability.

Inspect thrust bearings 32 for pitting and scoring and replace, if necessary.

Only on earlier units: Check bushing 2 and bushings 3 for wear. Press new bushings 3 into axle center so that front face of each bushing is flush with bottom of chamfer in bore. Align grease hole of upper bushing with grease bore in axle center.

Only on later units: Check bushing 2 and both bell crank needle bearings for wear. Press new needle bearings into axle center so that the front, inscribed, side of each sleeve faces towards installation tool and is flush with bottom of chamfer in bore.

If required, press new bushing 2 in eye of axle center so that its face is flush with bottom of chamfer in bore and with grease holes aligned.

If necessary, press new spindle bushings 30 (fig. 1 or 3) in axle knees so that their front faces are flush with bottom of chamfer in bore.

If tube 6 is excessively worn or damaged, install new tube in front bearing bore of axle center so that it is flush with rear face of axle.

Assemble front axle, observing the following:

When installing bell crank 13 (fig. 1 or 3), adjust end play by adding or removing shims 10 so that bell crank is free to turn easily. However, do not exceed specified end play (see Specifications).

Slide thrust bearings 32 on spindles so that the numbered side faces away from knuckle.

On tractors equipped with a standard front axle: Adjust end play of spindles by means of steering arm 26 (fig. 1) so that spindles are free to turn easily. However, do not exceed the specified end play (see Specifications). Tighten cap screws 25 to specified torque (see Torques for Hardware).

On tractors equipped with a heavy-duty axle: Adjust end play of spindles by means of shims 28 (fig. 3) so that spindles are free to turn easily. However, do not exceed the specified end play (see Specifications). Tighten cap screws to the specified torque. Using a suitable hammer, strike several blows on boss of steering arm 26 and tighten cap screws to the same torque (see Torques for Hardware).

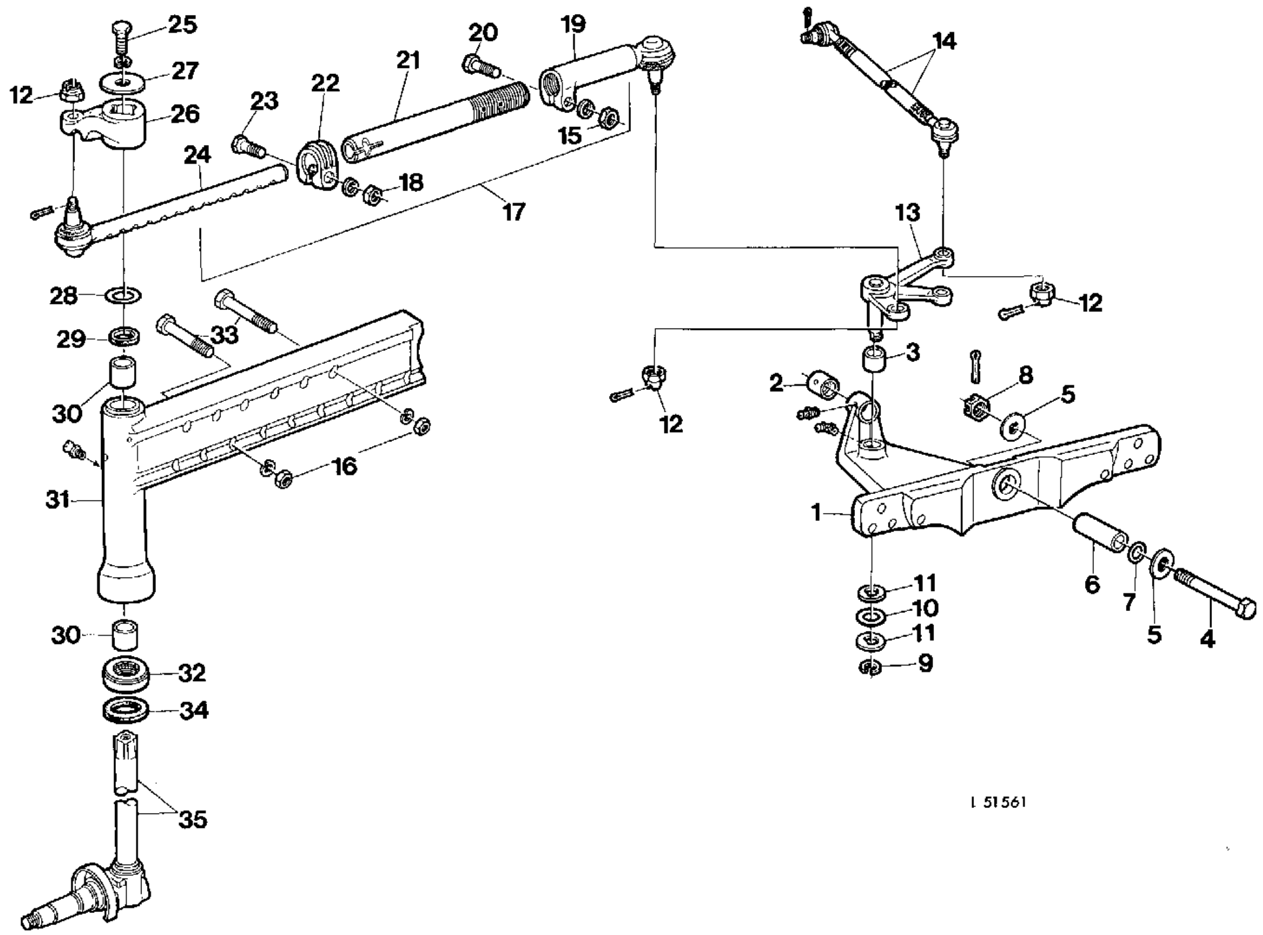


Fig. 3 — Parts of Front Axle Assembly (Heavy-Duty Version)

1 Axle center
2 Bushing
3 Bushing * (2 used)
4 Special cap screw
5 Washers
6 Tube
7 Shim (use as required)
8 Castellated nut
9 Snap ring
10 Shim (use as required)
11 Special washers
12 Castellated nuts
13 Bell crank
14 Drag link
15 Hex. nut
16 Hex. nuts
17 Tie rod assembly
18 Hex. nut
19 Tube
20 Cap screw
21 Tube
22 Clamp
23 Cap screw
24 Outer tie rod end
25 Cap screw
26 Steering arm
27 Washer
28 Shim (use as required)
29 Seal ring
30 Bushings
31 Axle knee
32 Thrust bearing
33 Cap screws
34 Seal ring
35 Knuckle and spindle assembly

* Later units have two needle bearings installed in place of the two bushings

Tighten screws attaching axle knees 31 to axle center 1 to the specified torque.

Tighten castellated nuts 12 (fig. 2) for attaching tie rods to steering arm 26 or to bell crank 13 to the specified torque.

INSTALLATION AND ADJUSTMENT

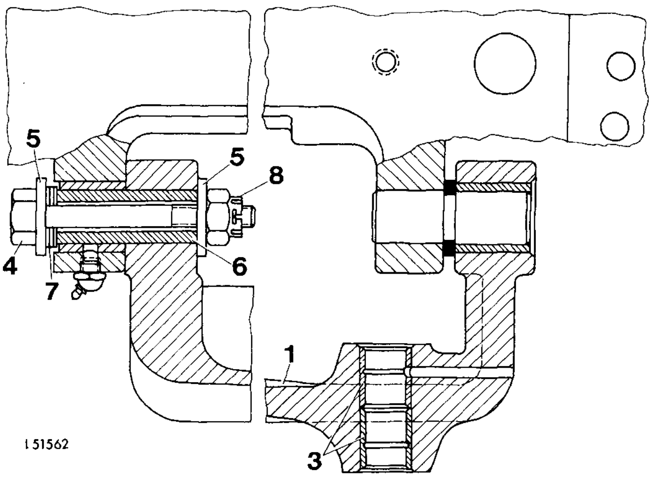


Fig. 4 — Axle Center Installed

1 Axle center
3 Bushings*
4 Special cap screw
5 Washer
6 Tube
7 Shims
8 Castellated nut

Position front axle assembly for installation. Slide axle center 1 (fig. 4) upon its rear support, simultaneously inserting tube 6 of front axle in bore of front support.

Slide a number of shims 7 on special cap screw 4 (see fig. 4). Install screw 4 and tighten castellated nut 8 to the specified torque. Then check for specified end play. If required, adjust for proper end play by adding or removing shims 7. For maximum permissible end play see Specifications.

* Later units have two needle bearings installed in place of the two bushings.

CHECKING AND ADJUSTING TOE-IN

Checking

With front wheels in straight-ahead position, center bell crank. Measure tread at center line of rim at front and rear of front wheels. Front wheel toe-in is correct if measurement at front center line is by a certain amount less than at rear (see Specifications).

Adjustment

Remove cap screw 23 (fig. 1 or 3) of each tie rod and loosen cap screw 20 sufficiently. Turn tube 21 an equal amount clockwise or counterclockwise on both tie rods to obtain proper toe-in (see Specifications). Install cap screw 23, making sure it is placed in same notch in tie rod end 24 from which it was removed. Tighten cap screws 23 and 20 to the specified torque.

Secure drag link 14 (fig. 2) to bell crank 13 and tighten castellated nut 12 to the specified torque.

Turn front wheels from full left to full right.

On tractors with manual steering the stops on knuckles should contact the stops on knees when the wheels are turned full left or right. If necessary, adjust tie rods so stops on axle knuckles contact stops on axle knees equally on both sides (see Group 10).

On tractors with power steering the stops should **not** contact when the wheels are turned full left or right. If necessary, adjust tie rods so there is an equal amount of clearance between stops of knuckles and knees on both sides (see Group 10).

SPECIFICATIONS

	Dimensions of New Parts	
Inner dia. of bushing pressed into axle center	1.5777 to 1.5827 in.	40,077 to 40.197 mm
Inner dia. of bushing pressed into front end support	1.2500 to 1.2550 in.	31.754 to 31.874 mm
Dia. of bore in axle center for seating tube	1.2405 to 1.2425 in.	31.509 to 31.559 mm
Dia. of bearing tube	1.2440 to 1.2450 in.	31.597 to 31.623 mm
Dia. of bore in front end support for seating front axle bearing pin	1.5696 to 1.5705 in.	39.853 to 39.903 mm
Dia. of front axle bearing pin	1.5720 to 1.5730 in.	39.927 to 39.953 mm
Inner dia. of bushing pressed into axle center for seating bell crank (only on earlier units)	1.2500 to 1.2550 in.	31.754 to 31.874 mm
Dia. of bell crank pin	1.2490 to 1.2495 in.	31.725 to 31.738 mm
Thrust bearing seat of knuckle, dia. with standard front axle	1.3735 to 1.3741 in.	34.886 to 34.902 mm
with heavy-duty front axle	1.4985 to 1.4991 in.	38.062 to 38.078 mm
Dia. of front axle knee bore for knuckle bushings with standard front axle	1.4990 to 1.5010 in.	38.075 to 38.125 mm
with heavy-duty front axle	1.6240 to 1.6260 in.	41.245 to 41.295 mm
Inner dia. of knuckle bushing pressed into front axle knee with standard front axle	1.3755 to 1.3795 in.	34.938 to 35.038 mm
with heavy-duty front axle	1.5005 to 1.5045 in.	38.114 to 38.214 mm
Maximum permissible end play of bell crank	0.004 in.	0.10 mm
Maximum permissible end play of knuckles in front axle knee	0.03 in.	0.76 mm
Maximum permissible end play of front axle	0 to 0.015 in.	0 to 0.4 mm
Front wheel toe-in	0.125 to 0.25 in.	3 to 6.5 mm

TORQUES FOR HARDWARE

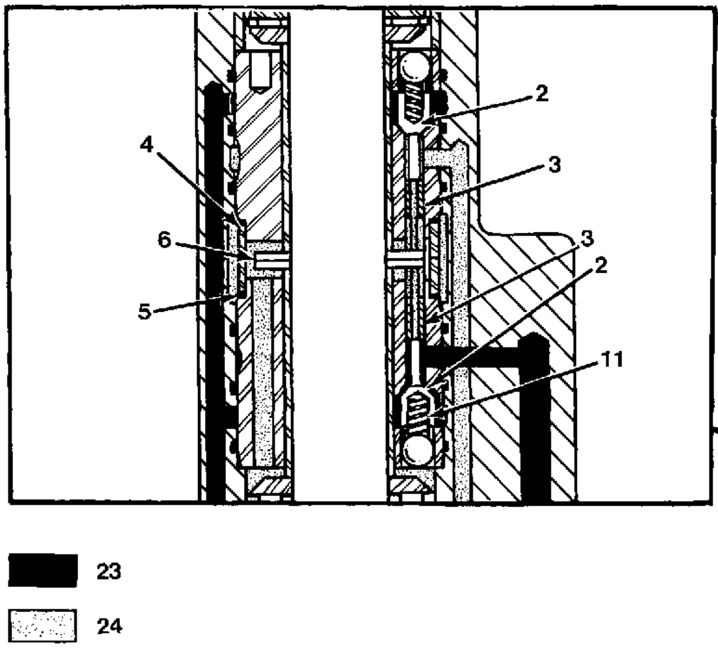
Axle knees-to-axle center, cap screws	300 ft.lbs.	41.5 mkg
Steering arm-to-knuckle, cap screws (with standard front axle)	85 ft.lbs.	12 mkg
Steering arm-to-knuckle, cap screws (with heavy-duty front axle)	170 ft.lbs.	23.5 mkg

TORQUES FOR HARDWARE (Cont'd)

Tie rods-to-bell crank and steering arm, castellated nuts*	55 ft.lbs.	7.7 mkg
Drag link-to-bell crank and steering arm of steering shaft, castellated nuts*	55 ft.lbs.	7.7 mkg
Clamps of tie rods, cap screws	54 ft.lbs.	7.5 mkg
Inner clamping screws of tie rods	32 ft.lbs.	4.5 mkg
Axle center-to-front support, castellated nut*	220 ft.lbs.	30,5 mkg

* *NOTE: If cotter pin cannot be inserted in castellated nut with the specified torque, turn nut to next slot and secure with cotter pin.*

Group 10
STEERING SYSTEM
POWER STEERING



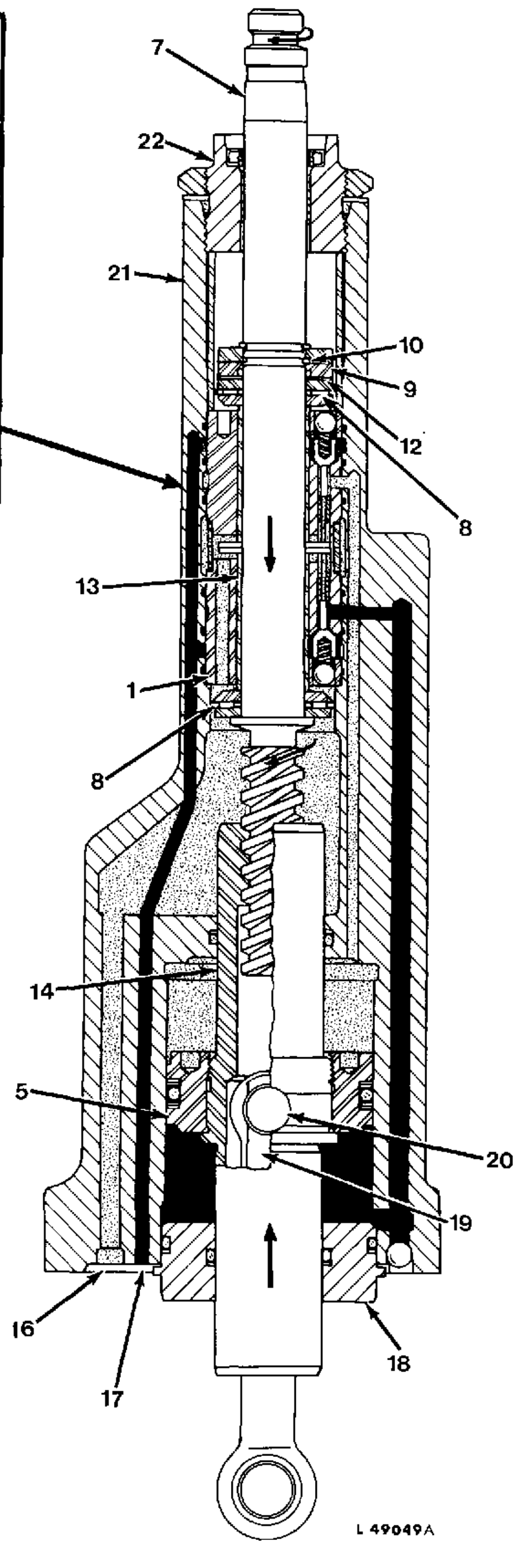


Fig. 1 — Oil Flow in Steering Valve Housing at Right-hand Turn

1 Steering valve body
2 Steering valves
3 Steering valve sleeves
4 Spacers
5 Shims
6 Special washers
7 Steering wheel shaft
8 Needle thrust bearing
9 Special washers
10 Snap rings
11 Springs
12 Shims
13 Operating sleeves
14 Steering piston rod
15 Piston
16 Return passage to transmission sump
17 Pressure oil passage
18 Piston rod guide
19 Connecting rod
20 Pin
21 Steering housing
22 Adjuster
23 Pressure oil
24 Pressure - free oil

INFORMATION

Power steering consists essentially of the power steering valve assembly, the steering linkage and the pressure control valve, located at the right side of the transmission case.

Oil is supplied to the power steering by the main hydraulic pump. Power steering is given first priority on tractor hydraulic oil by the pressure control valve (see section 70, group 10). The steering operates on the closed-enter system.

OPERATION

NOTE: Numbers behind parts in the following text refer to fig. 1 if not otherwise indicated.

Pressure oil from the main hydraulic pump is supplied to the steering valve body through drilled passage 17 in the steering valve assembly housing. When valves 2 are in neutral position (steering wheel motion stopped), the valves are held on their seats by hydraulic pressure and pressure of springs 11 so there is no oil flow to either side of the steering piston 15. (Hence the term "closed center" system).

A mechanical force from the steering linkage can move the steering piston, but a resultant hydraulic force will counteract any piston movement beyond 0.004 in. (= 0.1 mm).

OIL FLOW AT RIGHT-HAND TURN (Fig. 1)

Right-hand rotation of the steering wheel causes the steering wheel shaft 7 to thread into the piston rod 14. The special washers 9, secured to the steering wheel shaft, move downward, taking along the lower operating valve sleeves 13 and special washers 6. These washers push down the lower valve sleeve 3, lifting valve 2 off its seat. This allows pressure oil to flow to the bottom side of piston 15, pushing the piston upward. This motion, transferred to the front wheels through the steering linkage, causes the tractor to turn right.

Oil above the piston is forced to return to the sump through upper valve sleeve 3, drilled passage in housing 1 and passage 16.

When steering wheel rotation is stopped, piston 15 will continue to move up very slightly, thus releasing lower valve sleeve 3 and allowing this valve to seat (neutral position). If steering wheel rotation is continued to the end of its range of travel, the piston 15 will bottom in upper part of cylinder, holding the steering wheel shaft up, thus not allowing the lower valve 2 to go in neutral position. The valve remains open. However, as there is no piston movement, there is no oil flow and the main hydraulic pump goes out of stroke.

The return oil flow through the steering valve housing provides lubrication for the valve housing components and for the parts located in the steering and yoke shaft compartment in the clutch housing. The return oil flows through an overflow passage in the steering and yoke shaft compartment to the sump. The overflow is on the top surface of the compartment; the oil level is, therefore, always above the components located in the compartment. Proper lubrication is thus ensured.

OIL FLOW AT LEFT-HAND TURN

Left-hand rotation of the steering wheel causes the steering wheel shaft to thread out of the piston rod. The special washers 9, the thrust bearings 8 and the operating sleeves 13 move upward together with the steering wheel shaft. The upward sleeve movement lifts the upper valve 2 off its seat, allowing pressure oil to flow to the top side of piston 15. This pushes the piston downward, causing the tractor to turn left. Oil below piston 15 is forced to return to the sump through the passage in the steering valve housing, the lower valve sleeve 3 to return passage 16.

A slight downward motion of piston 15 will permit valve 2 to return to neutral position after steering wheel rotation is stopped. When turning the steering wheel to its end of travel range, piston 15 will bottom on piston rod guide 18 and upper steering valve 2 remains open. But with no piston movement there will be no oil flow and the main hydraulic pump will go out of stroke.

MANUAL STEERING

Manual steering is possible when engine is not running or when there is a malfunction in the hydraulic system. The steering wheel shaft and piston rod provide sufficient mechanical advantage to steer the tractor.

Turning the steering wheel will actuate the special washers, valve sleeves and steering valves the same as for a power turn. The vertical thrust is taken up by the needle bearings and valve bodies rather than the special washers and operating sleeves.

As the steering wheel shaft continues to turn, the piston rod will move causing the piston to push oil out of the steering cylinder, allowing the front wheels to turn. The mechanical stops are the same as in power steering operation.

CHECKING THE STEERING SYSTEM

NOTE: Numbers behind parts in the following text refer to fig. 4 unless otherwise indicated.

Should trouble on the power steering occur, always check main hydraulic pump and pressure control valve first for proper operation, as described in section 70, group 5. If main hydraulic pump and pressure control valve operate properly, use testing procedure as follows.

Shut off engine. Jack up front wheels and steer manually. Turn steering wheel left and right to steering limits. There should be no binding and no extreme hard spots in steering. If hard turning exists, check the mechanical linkage.

Start engine and steer in both directions to the travel limits. Steering effort and response should be the same in both directions. Slow steering or excessive steering effort in one direction may indicate faulty operation of the valve body assembly (19 or 19a, fig. 3) that controls pressure oil for that steering direction. Steering trouble in both directions indicates a fault in both valve body assemblies 19 and 19a.

Check for front wheel steering drift when tractor is moving, when it is standing still and with its front wheels jacked up. Drift is usually caused by steering valve or O-ring leakage in the circuit of the steering direction affected.

Steering valve leakage can be caused by a worn or distorted seat or dirt on valve seat, or improper adjustment of valve body shims "b" (see figs. 4 and 5).

NOTE: The number and thickness of shims "b" (fig. 4) and thus the clearance between special washers "c" and valve sleeves "d" has been determined at the factory. Do not attempt to readjust. When removing and disassembling valve body assemblies 19 and 19a, be extremely careful not to change the shim pack adjustment or to mix up the other components of the valve body assemblies.

A large volume of oil leakage past seal 7 in adjuster nut 9 indicates a restricted or blocked return oil passage. This can be caused by improper installation of the thrust washers 15 and 17 of the lower thrust bearing. If the large chamfer of thrust washer 17 does not face the lower valve body 19a (fig. 3), the return passage will be restricted.

The return oil passage in the clutch housing may be blocked by improper installation of gasket 27 between steering housing and clutch housing.

CAUTION: The gasket used on the manual steering will block this passage.

DIAGNOSING MALFUNCTIONS

SLUGGISH STEERING

O-ring of steering piston or O-rings of piston rod guide leaking.

O-rings of valve body assemblies defective.

Internal leakage in valve body assemblies due to wear of parts
Replace both valve body assemblies

Transmission oil filter clogged
Replace filter element

Steering valves do not bottom on their seats (thus leaking)
Factory-adjusted shim packs have been mixed up

Excessive steering wheel play
Adjust pre-load of steering wheel shaft

INSUFFICIENT STEERING OPERATION

Insufficient oil supply to steering valve housing assembly
Transmission oil pump operates improperly or does not operate at all (clutch disengaged)

Priority in oil supply is given to other hydraulic units of tractor
Adjust pressure control valve of power steering unit

Transmission oil filter clogged
Replace filter element

Hydraulic pump does not operate or has been shut off by means of the pump shut-off screw (if equipped)
Repair hydraulic pump or back off shut-off screw

SLUGGISH STEERING IN ONE DIRECTION

Steering valve leaking due to contamination, deformation or valve seat wear

Replace relevant direction steering valve body assembly

CHATTER OF STEERING VALVE HOUSING COMPONENTS

O-rings of valve body assemblies defective

REMOVAL

Remove power steering unit as follows:

Pull off steering wheel by means of a puller. Remove drain plug 8 (fig. 2) and drain oil. Remove transmission shield 1.

Disconnect pressure line 6 at elbow on steering valve housing.

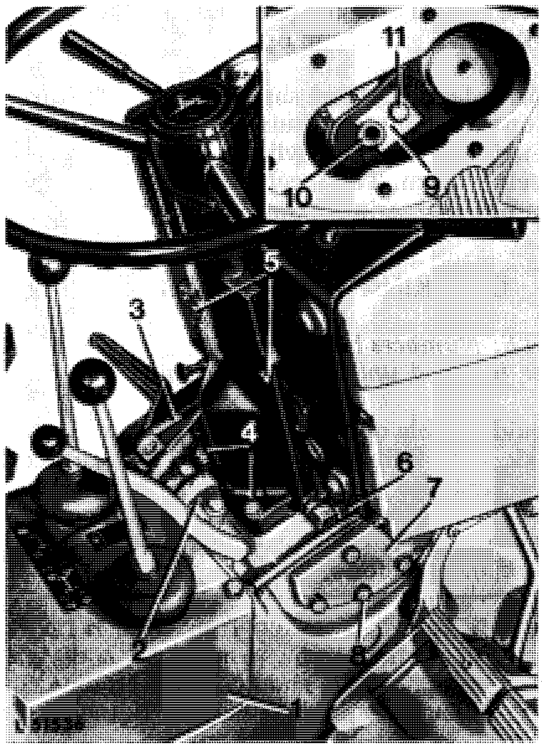


Fig. 2 — Steering Valve Housing Assembly, Installed

1 Transmission shield
2 Shift cover (on tractors with HIGH-LOW unit and/or independent PTO)
3 Linkage of HIGH-LOW control lever
4 Cap screws (4 used)
5 Cap screws (2 used)
6 Pressure line
7 Bearing cover of steering shaft
8 Drain plug
9 Lock plate
10 Pin
11 Cap screw
R Mark (only with mechanical steering)

On tractors with HIGH-LOW unit, disconnect HIGH-LOW control linkage 3 (fig. 2) at lever of shift cover 2.

On tractors with HIGH-LOW unit and/or independent PTO, remove shift cover 2.

CAUTION: Before removing shift cover, place control lever of independent PTO in forward (engaged) position. After removal of complete shift cover, do not move control lever otherwise detent ball and springs will fall out.

Remove cap screw securing foot throttle to clutch housing and place foot throttle on running board.

Remove bearing cover 7 of steering shaft.

Remove one side of dash panel. Remove both hex.nuts of attaching screws 5 (fig. 2) and four screws 4 securing valve housing assembly.

Turn yoke of steering shaft in position shown in figure 2 and remove cap screw 11 and lock plate 9. Pull pin 10 out of steering shaft yoke and linkage by means of a cap screw (3/8 in. thread).

Install steering wheel on steering wheel shaft and turn left and right to the stop so pressing oil out of steering cylinder, collecting oil in a suitable container.

Remove steering valve housing assembly.

Remove steering linkage. **CAUTION: When pulling out steering shaft, make sure oil seal of clutch housing is not damaged.**

REPAIR

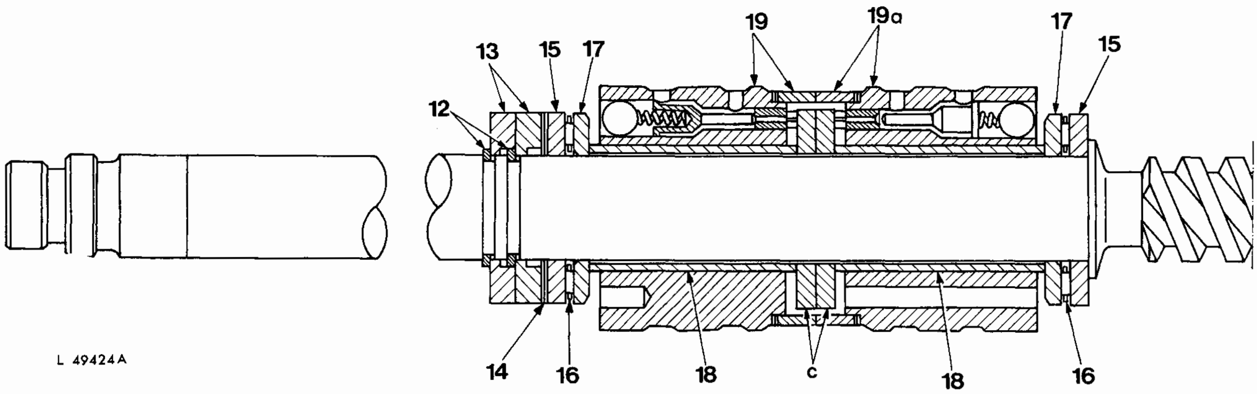


Fig. 3 — Steering Wheel Shaft and Valve Housing Assemblies

12 Snap rings
13 Special washers
14 Shims
15 Thrust washers
16 Thrust bearing
17 Thrust washers
18 Upper and lower operating sleeve
19 Upper valve body with spacer, shims and steering valve
19a Lower valve body with spacer, shims and steering valve
c Special washers

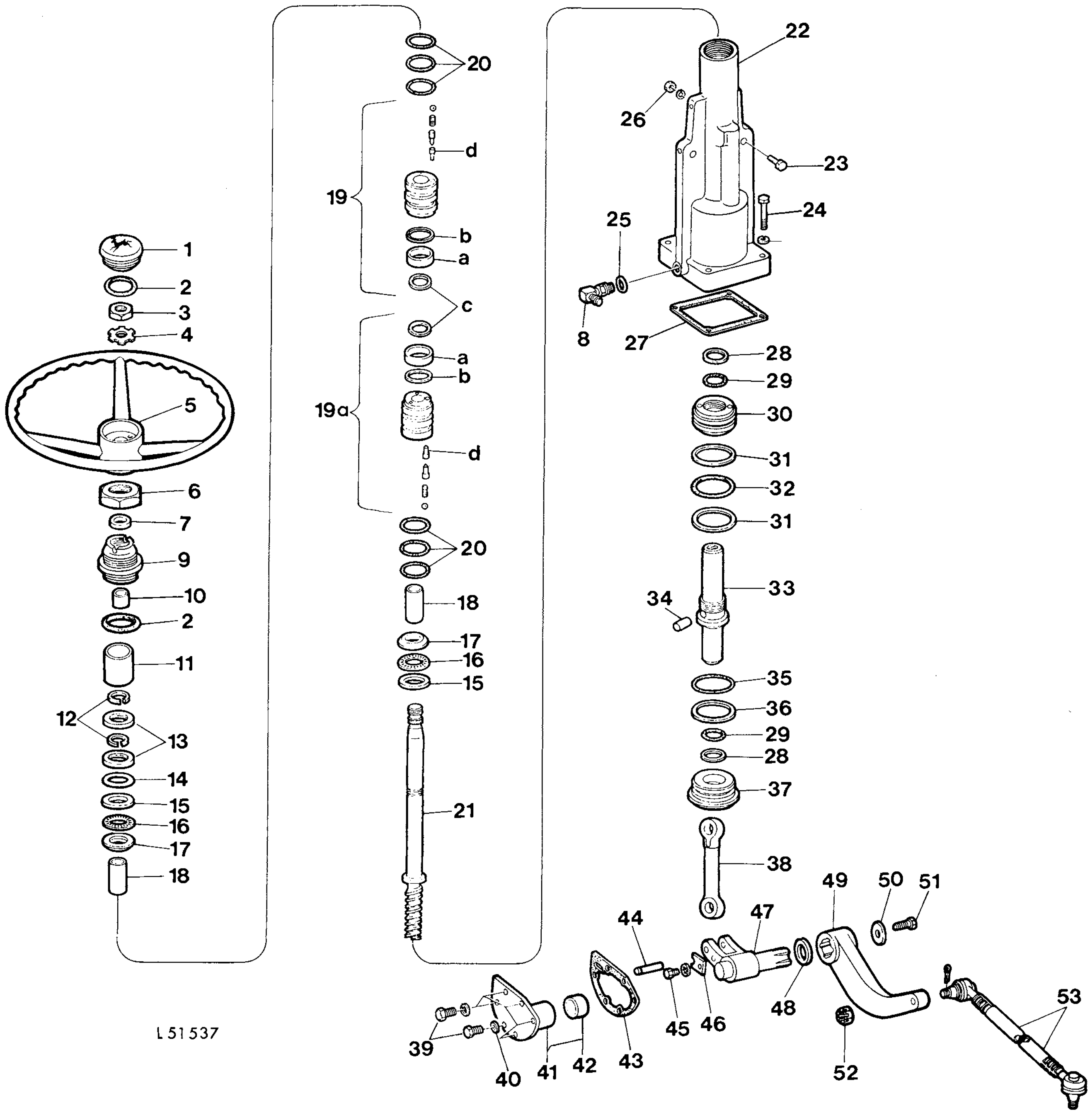


Fig. 4 — Parts of Steering Valve Housing Assembly and Steering Linkage

a Spacers
b Shims (as required)
c Special washers
d Steering valve sleeves
1 Steering wheel emblem
2 O-rings
3 Hex.nut
4 Special lock washer
5 Steering wheel
6 Jam nut
7 Oil seal
8 Elbow
9 Steering wheel shaft adjuster
10 Bushing
11 Spacer
12 Snap rings
13 Special washers
14 Steel shims (as required)
15 Special thrust washers
16 Thrust bearing
17 Special thrust washers
18 Operating sleeves
19 Upper valve body assembly
19a Lower valve body assembly
20 O-rings
21 Steering wheel shaft
22 Steering valve housing
23 Cap screw (2 used)
24 Cap screw (4 used)
25 O-ring
26 Hex.nut (2 used)
27 Gasket
28 Back-up rings
29 O-rings
30 Steering piston
31 Back-up rings
32 O-ring
33 Steering piston rod
34 Pin
35 O-ring
36 Back-up ring
37 Piston rod guide
38 Steering connecting rod
39 Cap screws (6 used)
40 Seal ring
41 Steering shaft and yoke cover
42 Bushing
43 Gasket
44 Steering shaft pin
45 Cap screw
46 Retaining plate
47 Steering and yoke shaft
48 Oil seal
49 Steering shaft arm
50 Special washer
51 Cap screw
52 Castellated nut
53 Drag link

STEERING VALVE HOUSING ASSEMBLY (Fig. 4)

Disassembly

Remove jam nut 6.

Turn steering wheel shaft adjuster 9 out of steering valve housing, using a pronged wrench. Pull spacer 11 out of steering valve housing.

Turn steering wheel shaft 21 clockwise until piston contacts upper end of cylinder. Hold connecting rod 38 and turn steering wheel shaft 21 counter-clockwise until it is completely free of piston rod 33.

Remove piston, piston rod, connecting rod and rod guide from steering valve housing.

Pull steering wheel shaft with the two valve body assemblies, the thrust washers and thrust bearings carefully out of steering valve housing.

Remove the following parts in the order indicated below from the steering wheel shaft (see figs. 3 to 5): first snap ring 12, first special washer 13, second snap ring 12, second special washer 13, shims 14, upper thrust washer 15, upper thrust bearing 16 and upper thrust washer 17; upper valve body assembly 19 (including spacer "a", shims "b" and special washer "c") with upper valve sleeve 18, lower valve body assembly 19a (including spacer "a", shims "b" and special washer "c") with lower sleeve 18; lower thrust washer 17, lower thrust bearing 16 and lower thrust washer 15.

CAUTION: The upper valve body assembly 19, as well as lower valve body assembly 19a are assembled individually, at the factory, being accurately adjusted by means of shims "b". Therefore, special care should be taken to keep spacer "a", shims "b" and special washer "c" of upper valve body assembly 19 apart from corresponding components of the lower valve body assembly 19a. If any parts of the two valve body assemblies are mixed up, malfunction of the steering system could result.

Screw piston 30 off piston rod 33 by means of a pronged wrench. Press pin 34 of connecting rod 38 out of piston rod 33 and lift connecting rod out of piston rod.

Inspection

Inspect oil seal 7 (fig. 4) in adjuster 9 for damage or wear. If necessary, remove bushing 10 and drive in new bushing so that its face is flush with bottom of chamfer in top side of the adjuster. Drive new oil seal 7 to bottom of adjuster 9 with sealing lips facing inward.

Inspect spacer 11, thrust washers 15 and 17 as well as thrust bearing 16 for wear or damage and replace, if necessary.

Examine valve sleeves "d" and special washers "c" of both valve body assemblies 19 and 19a for distortion or wear.

IMPORTANT: If replacement is necessary, replace complete valve body assembly.

Check operating sleeves 18 for wear and damage.

Inspect steering wheel shaft 21 for damage. Check acme thread of steering wheel shaft for wear or scores. Replace if necessary.

Inspect steering piston 30 for damage or wear and replace, if necessary.

Replace back-up rings 31 and O-rings 32 on steering piston.

Examine piston rod 33 for damage, especially its inside thread; replace if necessary.

Inspect piston rod guide 37 for damage or wear, especially in area of piston rod hole. Replace if necessary.

Check connecting rod 38 for wear or damage and replace, if necessary.

Thoroughly clean steering valve housing 22, especially inside. Make sure that all oil bores are perfectly clean. Use compressed air to clean and dry housing. Inspect housing for damage or cracks.

STEERING LINKAGE (Fig. 4)

Inspection

Check steering shaft 47 for damage and replace, if necessary. Examine oil seal 48 on steering shaft 46 (located on left side of clutch housing) and replace, if necessary. Install new oil seal, with lips facing inside, flush with bottom of chamfer in bore. Use tool No. JD 252.

Check cover 41 for damage and replace, if necessary. Inspect bushing 42 of cover and bushing located opposite for seating the steering shaft in the clutch housing and replace, if necessary.

Drive in new bushing so its face is flush with chamfer in cover bore, using No. JD 252 driver.

Check remaining steering linkage for serviceability.

ASSEMBLY

IMPORTANT: Replace all O-rings and backup rings prior to assembly. Before installing, dip all internal parts of steering valve housing in oil.

Insert connecting rod 38 (fig. 4) (small end first) in piston rod 33 and secure with pin 34. Pin should be flush with outside face of piston rod.

Thread piston 30 onto piston rod 33 so dowel holes in piston face top of power steering valve. Tighten to specified torque (see Specifications). Install O-ring 32 in groove of piston 30. Position one back-up ring 31 on either side of the O-ring.

NOTE: Before installing parts located between lower thrust bearing 16 and lower snap ring 12 (see figs. 3 and 5) in steering valve housing, determine proper number of shims 14 (between lower special washer 13 and upper thrust washer 15).

Slide parts on steering wheel shaft to determine number of shims required.

Slide parts on steering wheel shaft in the following order:

1. Slide lower thrust washer 15, thrust bearing 16 and lower thrust washer 17 over steering wheel shaft.

IMPORTANT: Install thrust washer 17 so large chamfered surface will face away from thrust bearing.

2. Install lower operating sleeve 18 and lower valve body 19a with shims "b", spacer "a" and lower special washer "c".

NOTE: The body of lower valve assembly 19a, apart from the steering valve bore, is provided with two other bores serving as return oil passages. However, the body of upper valve assembly 19 does not have these through bores (see figs. 1 and 3). Do not mix up valve bodies when installing parts.

3. Place upper special washer "c", upper operating sleeve 18, upper spacer "a" and shims "b" on shaft. Then install upper valve body.

CAUTION: The upper valve body assembly 19, as well as lower valve body assembly 19a are assembled individually at the factory, being accurately adjusted by means of shims "b". Therefore, special care should be taken to keep spacer "a", shims "b" and special washer "c" of upper valve body assembly 19 apart from the corresponding components of the lower valve body assembly. If any parts of the two valve body assemblies are mixed up, malfunction of the steering system could result.

4. Slide on upper thrust bearing 16 with thrust washers 15 and 17.

IMPORTANT: Slide thrust washer 17 on steering wheel shaft so that its large chamfer faces the upper valve body.

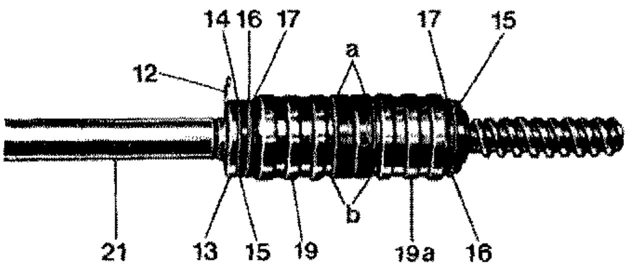


Fig. 5 — Determining Thickness of Shim Pack between Thrust Washer and Special Washer

a Spacers	16 Thrust bearings
b Shims	17 Thrust washers
12 Snap ring	19 Upper valve body assy.
13 Special washer	19a Lower valve body assy.
14 Shims	21 Steering wheel shaft
15 Thrust washers	

5. Position some shims 14 (figs. 3 to 5) on thrust washer 15. Then place one of the two special washers 13 on the shims with the recess facing downward. Adjust total thickness of shims so that snap ring 12 just fits into groove of steering wheel shaft 21. At this moment it is not necessary that the snap ring is fully seated in its groove. However, at any rate make sure that the snap ring really fits in the groove.

Add as many shims 14 as are required to obtain the specified pre-load (see Specifications).

Insert lower snap ring 12 in its groove. Install second special washer 13 on steering wheel shaft with the recess facing downward and fit upper snap ring 12.

If required, insert one O-ring (fig. 4) and one back-up ring 28 each in bore of piston rod guide 37 and in bore of steering valve housing 22. Install O-ring 35 and back-up ring 36 in groove of guide 37.

Slide guide 37 over piston rod 33 and insert piston rod with piston, guide and connecting rod in steering valve housing.

Carefully install pre-assembled steering wheel shaft in steering valve housing and screw shaft into piston rod. Insert spacer 11 in steering valve housing.

Insert O-ring 2 in groove of adjuster 9 pre-assembled with oil seal 7 and bushing 10. Coat lip of oil seal ring 7 with grease. When sliding adjuster 9 on steering wheel shaft, protect sealing against damage by means of a suitable sleeve etc.

Screw adjuster into steering valve housing 8 by means of a pronged wrench and tighten to the specified torque (see "Torques for hardware"). Turn jam nut 6 on adjuster 9 and tighten to the specified torque, holding the adjuster with the pronged wrench.

INSTALLATION AND ADJUSTMENT

For installation, reverse sequence of removal.

Install new gasket between steering valve housing and clutch housing. Tighten screws of steering valve housing assembly to the specified torque (see "Torques for hardware").

Tighten cap screw of steering shaft lock plate (see 11, fig. 2) to the specified torque (see "Torques for hardware").

Install steering shaft bearing cover before tightening cap screw of steering arm. Use a new gasket between bearing cover and clutch housing.

NOTE: Install cap screw provided with seal ring 40 (fig. 4) in bottom bore of bearing cover.

Tighten steering arm cap screw to specified torque (see "Torques for hardware"). Tap the steering arm with a hammer and re-tighten screw to the specified torque.

Install all tractor parts which had to be detached for removal of the steering unit and connect all connections which had been separated (see "Removal").

CHECKING FRONT WHEEL STEERING TRAVEL

Install steering wheel and turn from stop to stop, counting number of turns. Turn steering wheel back half this number of turns. Pull steering wheel and re-position so that a spoke points toward back of tractor.

Tighten steering wheel hex. nut to the specified torque. Bend two tabs of lock plate upward and one tab downward.

With steering wheel centered and front wheels in straight-ahead position, drag link should fit into steering arm. If required, adjust tie rods.

Tighten castellated nuts of drag link to the specified torque (see "Torques for hardware").

NOTE: First turn steering wheel fully to the right-hand stop and then likewise to the left. When doing this, the cast-on stop on spindle knuckle of inner wheel should not come into contact with stop on relative axle knee. If necessary, adjust tie-rods and front wheel toe-in.

MANUAL STEERING

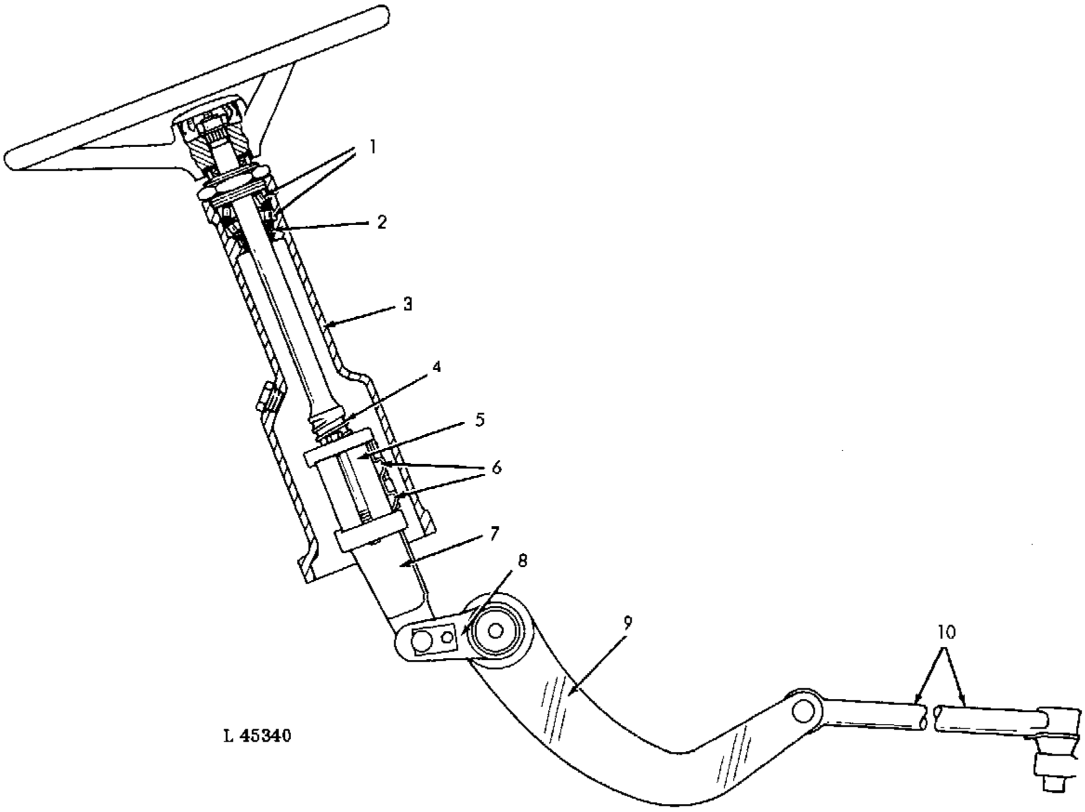


Fig. 6 — Sectional View of Steering System

1 Barrel bearing
2 Oil seal ring
3 Steering housing
4 Steering wheel shaft
5 Ball nut
6 Ball guides
7 Yoke
8 Steering shaft
9 Steering arm
10 Drag link

GENERAL INFORMATION

The manual steering (see fig. 6) is of the recirculating ball bearing, worm and nut type. The ball nut 5 is threaded over the worm portion of the shaft.

The bore of the nut has helical grooves corresponding to grooves in the shaft worm. These grooves within the ball nut are filled with steel balls, making up two separate circuits of recirculating balls. To complete each circuit and to keep the balls from running out at the ends, the ball nut is provided with ball guides 6. Each guide deflects the balls from their helical path when they reach the end of the ball nut, thus returning the balls to the helical path in the ball nut at the start of a circuit.

The steering motion is transmitted by the steering wheel shaft and the ball nut to the steering shaft 11 which is connected to the steering linkage leading to the front wheels.

The steering wheel shaft is supported on the upper end by two barrel-type bearings 1. An adjuster threaded into the steering housing controls the preload on the barrel bearings.

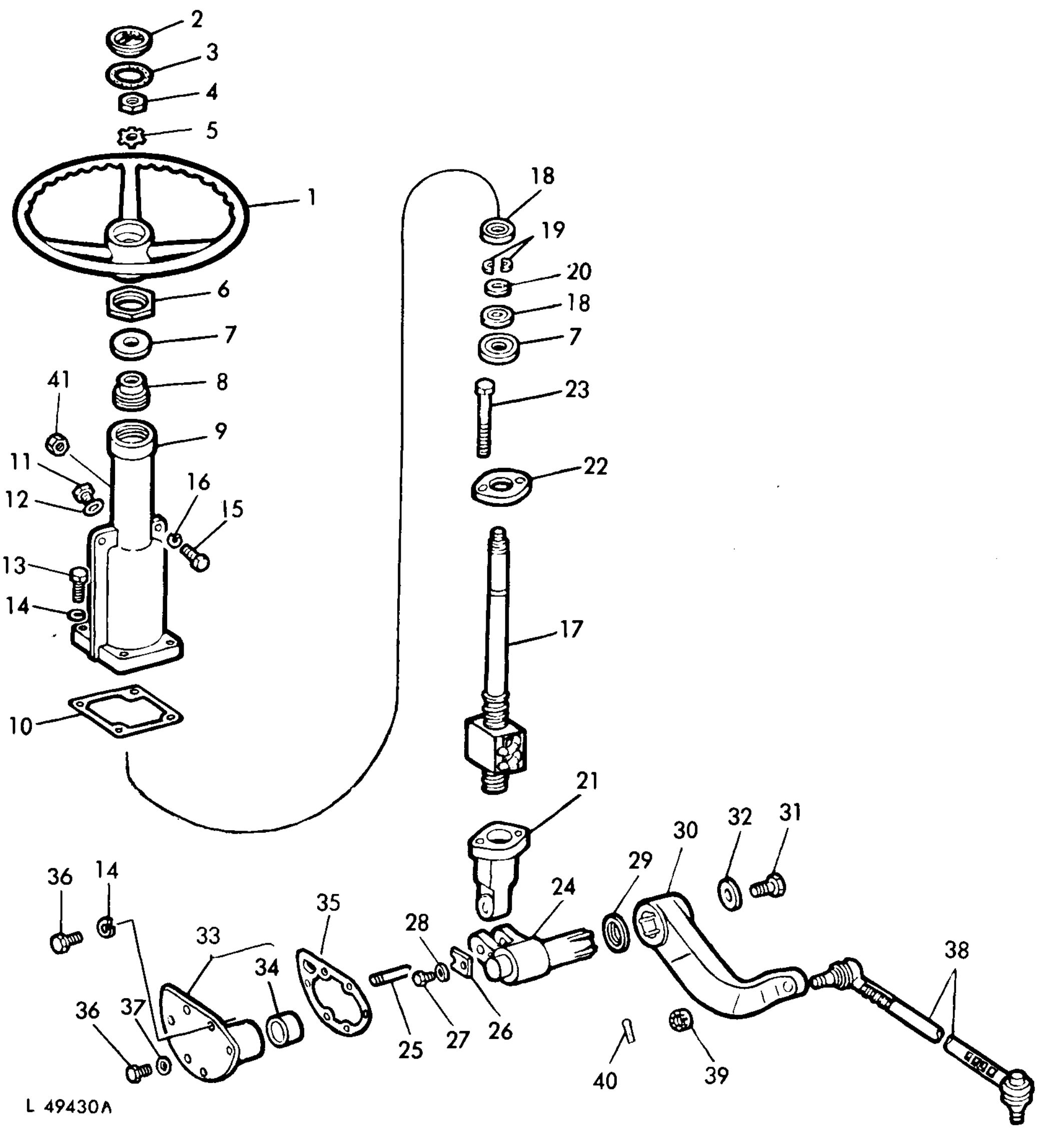


Fig. 7 — Parts of Steering Housing Assembly and Steering Linkage

1 Steering wheel
2 Steering wheel emblem
3 O-ring
4 Hex. nut
5 Lock plate
6 Adjusting nut
7 Oil seal rings
8 Sleeve for adjusting preload of barrel bearing
9 Steering housing
10 Gasket
11 Plug
12 O-ring
13 Cap screw (4 used)
14 Lock washer (9 used)
15 Cap screw (2 used)
16 Lock washer (2 used)
17 Steering wheel shaft and ball nut
18 Barrel bearing
19 Thrust washer halves
20 Retainer
21 Yoke
22 Flange
23 Cap screw (2 used)
24 Steering shaft
25 Pin
26 Lock plate
27 Cap screw
28 Tooth washer
29 Oil seal ring
30 Steering shaft arm
31 Cap screw
32 Washer
33 Steering shaft cover
34 Bushing
35 Gasket
36 Cap screw (6 used)
37 Seal ring
38 Drag link
39 Castellated nut
40 Cotter pin
41 Hex. nut (2 used)

REMOVAL

For removal of manual steering see section on removal of power steering. Removal operations are identical or similar.

REPAIR

STEERING HOUSING ASSEMBLY (Fig. 7)

Disassembly

Remove adjusting nut 6 and screw sleeve 8 out of housing by means of a pronged wrench.

Pull up on steering wheel shaft and remove upper barrel bearing, retainer and both thrust washers. Slide lower barrel bearing off steering wheel shaft.

Pull steering wheel shaft, ball nut and yoke downward out of steering housing. Separate yoke from ball nut.

Inspection

Check adjuster sleeve 8 and its oil seal ring 7 for serviceability. If necessary, press new seal ring in sleeve so that its sealing lip faces the driver (metal side bottoms in bore).

Check steering housing 9 for cracks or other damage. Check oil seal 7 in steering housing. If necessary, install a new oil seal 7 with its sealing lip facing the driver (metal face bottoming in bore).

Inspect barrel bearing 18; bearing rollers should be smooth, polished and free to turn.

Check both thrust washer halves 19 for damage and replace, if necessary.

Check steering wheel shaft and ball nut 17 for damage. Inspect shaft worm for wear or breakage. Check if ball nut moves freely. If necessary, replace steering wheel shaft and ball nut as an assembly.

STEERING LINKAGE (Fig. 7)

Inspection

Check steering wheel shaft 24 for damage and replace, if necessary. Remove oil seal ring 29 of steering shaft from clutch housing, if necessary. Install a new seal ring, using No. JD 252 driver, with lips facing bottom of bore and opposite side flush with lower chamfered edge of bore.

Inspect bearing cover 33 for damage and replace, if necessary. Check bushing 34 of bearing cover and opposite steering shaft bushing in clutch housing and replace, if necessary. Drive in new bushing so that its face is flush with chamfer of bearing bore, using driving tool No. JD 252.

Check remaining steering linkage for serviceability.

ASSEMBLY

When attaching yoke 4 (fig. 8) to ball nut, make sure that closed side of yoke faces ball tracks of ball nut (see fig. 8);

Tighten screws 1 attaching flange to ball nut and to yoke, to the specified torque.

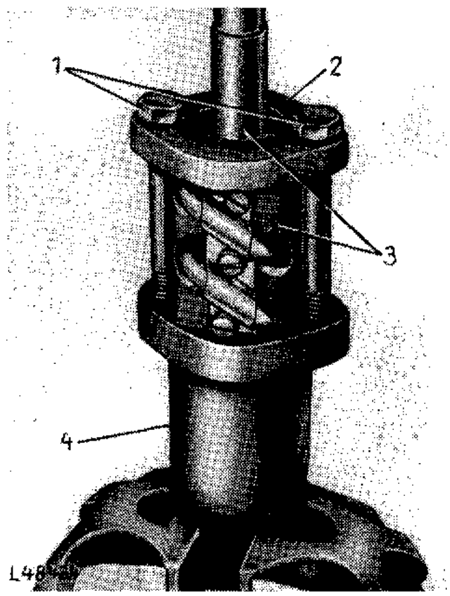


Fig. 8 — Ball Nut and Yoke Assembled

1 Cap screws
2 Flange
3 Steering wheel shaft and ball nut
4 Yoke

Turn steering wheel shaft counterclockwise out of ball nut, as far as possible.

Install steering wheel shaft assembly (take care of steering housing oil seal) so that tracks of ball nut face front side of steering housing. Pack one of the two barrel bearings with grease and install on steering wheel shaft with bearing cone facing upward. Insert both thrust washer halves and secure by means of retainer.

Push steering wheel shaft into housing until barrel bearing is seated on ridge in housing. Pack bearings and thrust washers liberally with grease. Then slide second barrel bearing on steering wheel shaft so that cone bottoms on thrust washers (position opposite that of first barrel bearing).

Make sure that all parts are well greased and screw adjuster sleeve in steering gear housing.

ADJUSTMENT

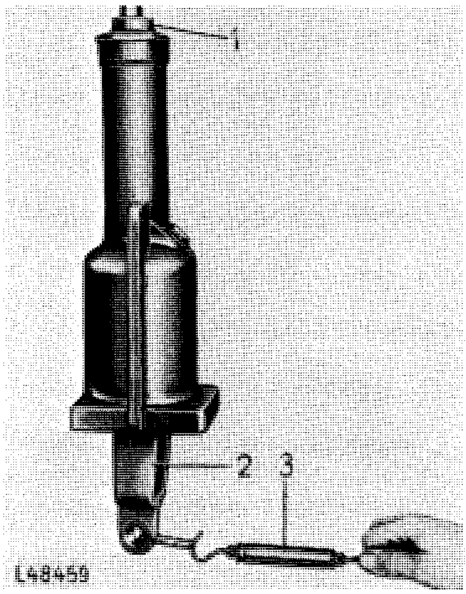


Fig. 9 — Adjusting Preload of Barrel Bearings

1 Adjuster 2 Yoke 3 Spring scale

Turn ball nut so that it is at the bottom of the steering wheel shaft worm. Hook spring scale into bore of yoke as shown in fig. 9 and tighten adjuster 1 (fig. 9) until a specified force is required to move the yoke (see Specifications).

Tighten adjusting nut to specified torque. Hold adjuster while tightening.

INSTALLATION

For installation, reverse removal procedure.

Use new gasket between steering gear housing and clutch housing.

CAUTION: Make sure large tab of gasket is located under left rear corner of steering gear housing (if installed).

Tighten attaching screws of steering gear housing to the specified torque (see "Torques for hardware").

Tighten cap screw of steering shaft lock plate to the specified torque (see "Torques for hardware").

NOTE: Make sure side marked "R" of yoke is on the right-hand side (see fig. 2).

Install bearing cover of steering shaft before tightening cap screw of steering shaft arm. Use a new gasket between bearing cover and clutch housing.

NOTE: Install cap screw with seal ring 37 (fig. 7) in lowest bore of bearing cover.

Tighten cap screw of steering shaft arm to the specified torque (see "Torques for hardware"). Strike arm with a hammer and retighten screw to above torque.

Install all tractor parts which had to be removed to facilitate removal of steering unit and remake all connections (see Removal).

Fill up with oil (see Operator's Manual).

CHECKING FRONT WHEEL STEERING TRAVEL

Install steering wheel. Turn steering wheel from left stop to right stop, counting number of turns needed to turn the wheel from stop to stop. Turn wheel back half the number of turns obtained above. Remove steering wheel and reposition so that a spoke points toward back of tractor, seen in the direction of forward travel.

Attach steering wheel, tightening hex. nut to specified torque. Bend up two tabs of lock plate; bend down the other tab.

With tractor front wheels in straight-ahead position and steering gear centered, drag link should just fit into hole in steering shaft arm. If this is not the case, adjust tie rods to suit.

Tighten castellated nuts on drag link to specified torque (see "Torques for hardware").

NOTE: First turn steering wheel fully to the right-hand stop and then likewise to the left. When doing this, the cast-on stop on spindle knuckle of the relative inner wheel should contact the stop on relative axle knee. If necessary, adjust tie-rods and front wheel toe-in.

SPECIFICATIONS

MANUAL STEERING AND POWER STEERING	Dimensions of new parts	
Inner dia. of bearing cover and clutch housing bushing (bushing installed)	1.7514 to 1.7550 in.	44.485 to 44.545 mm
Dia. of steering shaft journals	1.7495 to 1.7505 in.	44.437 to 44.463 mm
Dia. of bearing cover bore	1.8640 to 1.8654 in.	47.345 to 47.381 mm
POWER STEERING		
Dia. of steering wheel shaft bearing seat	0.8740 to 0.8760 in.	22.200 to 22.250 mm
Preload in steering wheel shaft bearings	0.001 to 0.003 in.	0.02 to 0.08 mm
MANUAL STEERING		
Dia. of barrel bearing bore in steering shaft housing	2.1895 to 2.1905 in.	55.613 to 55.639 mm
Dia. of steering wheel shaft bearing seat	0.8730 to 0.8760 in.	22.172 to 22.252 mm
Preload of barrel bearings, determined with a spring scale at end of yoke	15 to 17 lbs	6.8 to 7.7 kg

TORQUES FOR HARDWARE

MANUAL STEERING AND POWER STEERING

Steering gear housing assembly-to-clutch housing, cap screws	36 ft.lbs.	5 mkg
Lock plate-to-steering shaft, cap screw	8 ft.lbs.	1.1 mkg
Steering shaft bearing cover-to-clutch housing, cap screws	36 ft.lbs.	5 mkg
Steering shaft arm-to-steering shaft, cap screw	170 ft.lbs.	23.5 mkg
Steering wheel-to-steering wheel shaft, hex. nut	50 ft.lbs.	7 mkg
Drag link-to-steering shaft arm and bell crank, castellated nuts*	55 ft.lbs.	7.7 mkg

POWER STEERING

Steering piston-to-piston rod	250 ft.lbs.	34 mkg
Adjuster in steering valve housing	50 ft.lbs.	7 mkg
Hex. nut on adjuster	30 ft.lbs.	4.3 mkg

MANUAL STEERING

Flange-to-ball nut and yoke, cap screws	85 ft.lbs.	11.7 mkg
Adjusting nut on sleeve	75 ft.lbs.	10.5 mkg

* *NOTE: If cotter pin can not be inserted in castellated nut when tightening to the specified torque, turn nut to next slot and secure with cotter pin.*

SPECIAL TOOLS

Part No. if ordered from JD Parts Depot	Part No. if ordered from Manufacturer	Description	Use
L 48540	JD 252**	Driving tool	Driving in oil seal ring of steering shaft in clutch housing and driving bushings in bearing cover and clutch housing

** SERVICE TOOLS INC., 1901 INDIANA AVENUE, CHICAGO, ILLINOIS 60616, USA

Group 15
BRAKES

HYDRAULIC BRAKES

DIAGNOSING MALFUNCTIONS

EXCESSIVE PEDAL LEAK-DOWN

Brakes not adjusted.

O-rings of brake valve pistons leaking.

Leakage past pressure ring packings in brake housings and/or leaking brake oil lines.

Equalizing valves of brake valve and cylinder and reservoir check valves defective.

NOTE: Isolate difficulty in either a defective reservoir check valve or equalizing valve as follows:

1. Isolate brake valve and parts in brake housings and check for pedal leak-down. If leak-down stops, difficulty is in individual brake assembly in brake housings.

2. If after brake valve isolation difficulty continues, depress brake pedals separately, then simultaneously. If leak-down occurs in each case, defective reservoir check valves are indicated. If leak-down occurs on individual and not simultaneous pedal operation, faulty equalizing valves are indicated.

EXCESSIVE BRAKE CHATTER

Improper or contaminated oil in hydraulic system.

GENERAL INFORMATION

The brake pedals allow simultaneous (acting on both wheels) or individual (steering brakes acting on individual wheels) operation of the hydraulic brakes. Couple brake pedals by means of a latch for simultaneous operation.

The brake valve reservoir is filled with return oil from the transmission oil pump lube circuit. Hydraulic braking is assured as long as there is sufficient oil in the hydraulic reservoir.

The operation of hydraulic brakes is explained in the manual "Fundamentals of Service — Hydraulics".

BRAKE VALVE AND CYLINDER

REMOVAL

Disconnect brake lines 3 (fig. 1) at valve and immediately plug lines and fittings. Remove both cap screws 2 attaching brake valve and cylinder to clutch housing, and lift off brake valve and cylinder. Discard gasket installed between brake valve and clutch housing. Remove one of the snap rings 1 and remove pin and brake pedal.

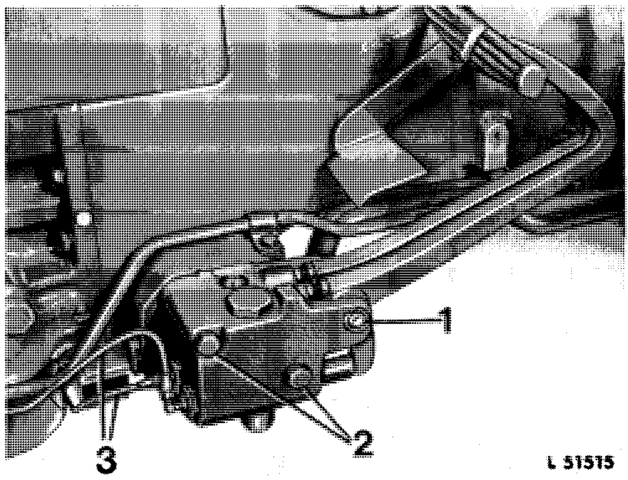


Fig. 1 — Brake Valve and Cylinder, Installed

1 Snap ring (2 used)
2 Cap screws
3 Brake lines

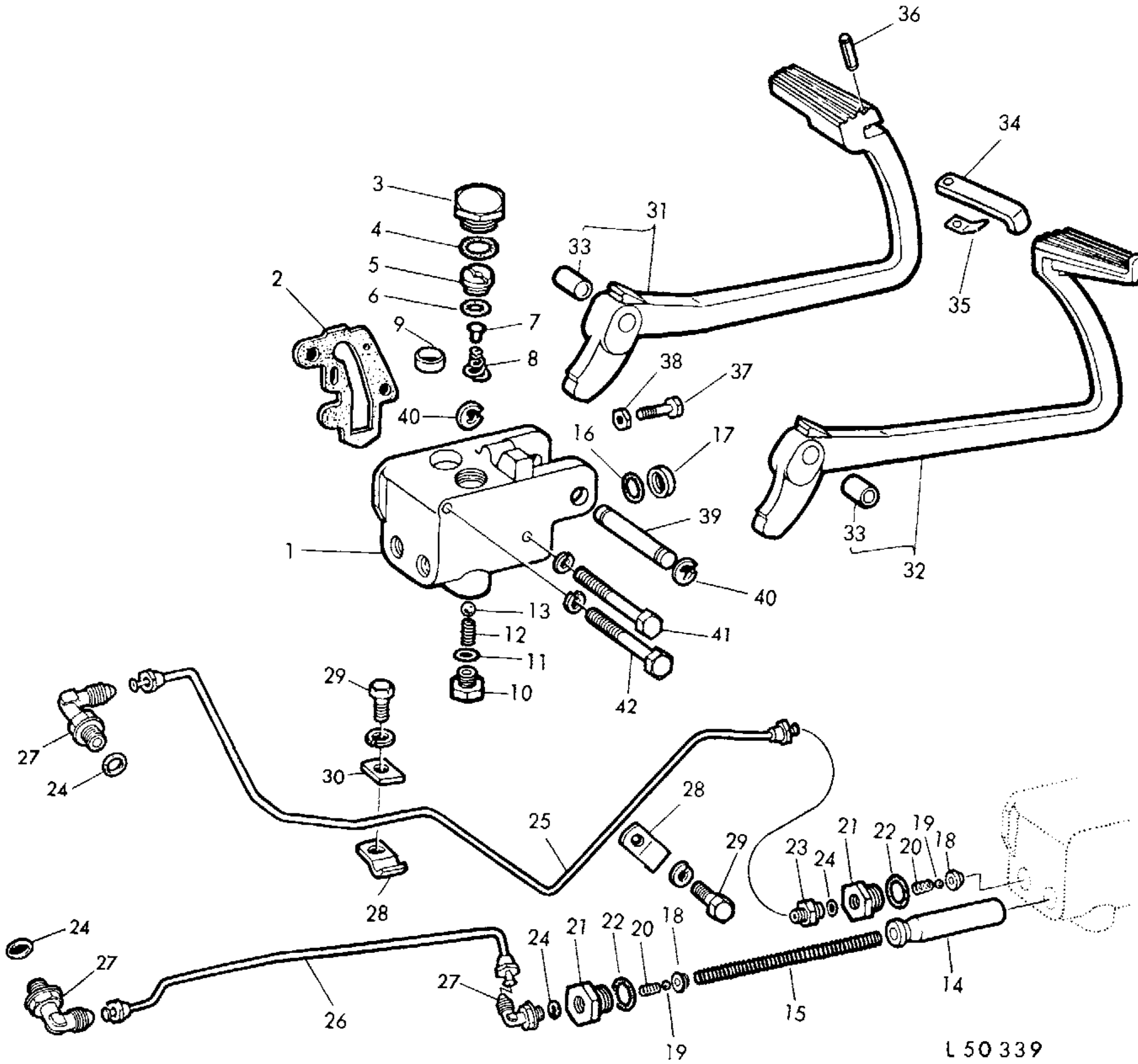


Fig. 2 — Parts of Brake Valve and Cylinder

1 Brake valve and cylinder housing
2 Gasket
3 Plug
4 O-ring
5 Seat of check valves (2 used)
6 O-ring (2 used)
7 Check valve (2 used)
8 Spring (2 used)
9 Plug
10 Plug (2 used)
11 O-ring (2 used)
12 Spring (2 used)
13 Ball (2 used)
14 Brake piston (2 used)
15 Spring (2 used)
16 O-ring (2 used)
17 Seal ring (2 used)
18 Retainer
19 Balls
20 Springs
21 Valve seats for balls
22 O-rings
23 Adapter
24 O-rings
25 Left-hand brake line
26 Right-hand brake line
27 Elbows
28 Pipe clamps
29 Cap screws
30 Plate
31 Left-hand brake pedal
32 Right-hand brake pedal
33 Bushings
34 Latch
35 Leaf spring
36 Spring pin
37 Cap screw
38 Hex. nut
39 Brake pedal shaft
40 Snap rings
41 Cap screw
42 Cap screw

REPAIR

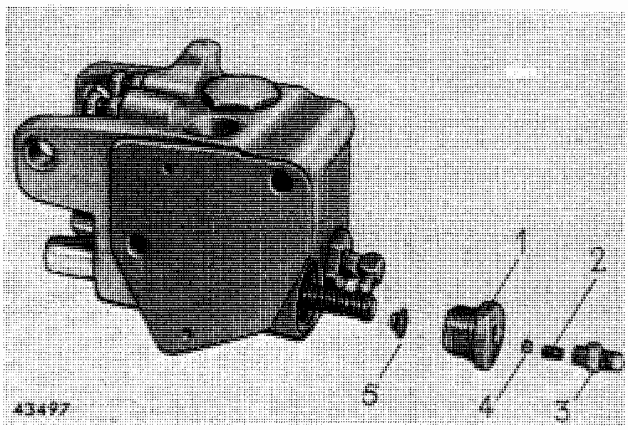


Fig. 3 — Removing Balls, Valve Seats, Springs and Retainers of Brake Valve and Cylinder

1 Valve seat
2 Spring
3 Adapter
4 Ball
5 Retainer

Screw adapter elbow 3 (fig. 3) and elbow out of valve seats 1 and remove balls 4 and springs 2 which are now relw released. Screw valve seats 1 out of brake valve and cylinder and remove retainers 5. Withdraw pistons and springs from brake valve and cylinder.

Remove plugs on top of brake valve as well as check valves.

Turn out both plugs 10 (fig. 2) on bottom of brake valve and remove springs and balls of equalizing valves.

Check all parts for wear, scoring, cracks or other damage and replace, if necessary.

Check tension of springs.

Inspect check valves 7 (fig. 2) for wear or damage, especially in area contacting brake pistons when brake pedals are released.

If pedal bushings 33 (fig. 2) have to be replaced, press in new bushings so that they are flush with outside edge of pedals.

Pre-assemble check valves (spring 8, valve 7, valve seat 5) and install in brake valve and cylinder.

Coat brake pistons 14 with transmission oil and slide into bores of brake valve housing (small diameter first).

NOTE: When assembling, always use fresh oil seal rings and O-rings.

INSTALLATION

Using a new gasket, attach brake valve assembly to clutch housing. connect brake lines. Run engine for about 2 minutes at 2100 rpm with the clutch engaged to allow the transmission lubrication system to fill brake valve reservoir.

NOTE: If it is not desirable to run tractor engine at this time, screw out plug 3 (fig. 2) and fill brake valve reservoir manually with transmission oil.

ADJUSTMENT AND BLEEDING

BLEEDING AIR FROM BRAKE SYSTEM

Attach a plastic bleed tube to the brake bleed screw located on top of brake housing and insert other end of tube in transmission filler hole. Turn out bleed screw by a 3/4 turn, *slowly* depress brake pedal on brake being bled and then allow it to return *slowly*. Continue operating pedal until oil in tube is free of air bubbles.

CAUTION: Never allow brake pedal to return sharply before brakes are completely adjusted. By permitting brake valve piston to release quickly, damage may occur to valve as piston travel is not yet closely adjusted.

Close bleed screw securely while brake pedal is depressed. Remove plastic bleed tube and repeat bleeding operation on other brake. Then adjust brakes.

ADJUSTING BRAKE PEDALS

IMPORTANT: This adjustment must be made any time the brake valve is disassembled. Failure to adjust pedal stop screws will allow the brake pistons to knock against the reservoir check valves, causing damage or undue wear on valve parts.

Make this adjustment after the brake system has been bled.

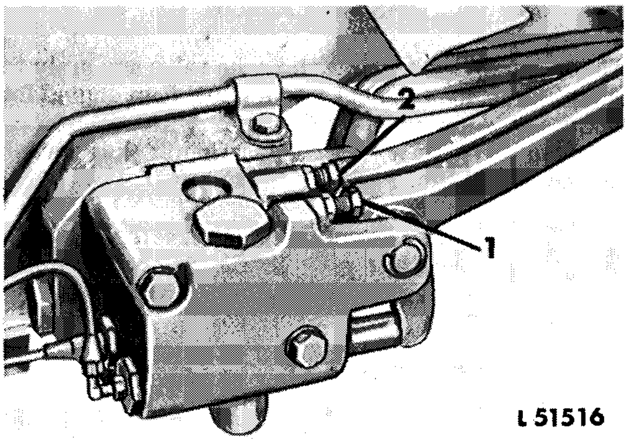


Fig. 4 — Adjusting Brake Pedals

1 Stop screw of right-hand brake pedal
2 Stop screw of left-hand brake pedal

Adjust stop screw (1 or 2, fig. 4) of brake pedal to be adjusted so that brake piston is fully extended from the housing and the brake pedal arm is just touching the piston.

In this position turn out stop screw by 1/3 turn.

When adjusting the right-hand brake pedal, apply a specified force to the left-hand brake pedal (see Specifications).

When adjusting the left-hand brake pedal, apply a force to the right-hand brake pedal.

When the loaded brake pedal starts to settle, turn out stop screw of pedal to be adjusted by another 1/3 turn. The loaded brake pedal should now stop settling. If it does not, this indicates a leak (see "Diagnosing Malfunctions").

When both brake pedals have been adjusted, align them by turning the stop screw on the higher pedal in or out.

CHECKING BRAKE PEDAL ADJUSTMENT

Apply a specified force (see Specifications) to each brake pedal for one minute. The loaded pedal should not settle by more than the specified value (see Specifications).

NOTE: Do not check both brake pedals simultaneously, but each separately.

PRESSURE RINGS AND BRAKE DISKS

REMOVAL

Removal of final drives see section 10, group 25.

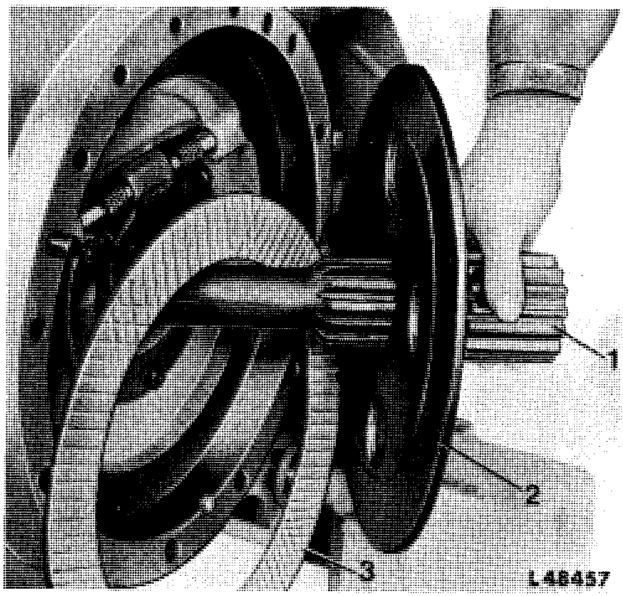


Fig. 5 — Removing Brake Disk and Inner Facing

1 Final drive shaft
2 Brake disk
3 Facing

Remove final drive shaft and brake disk.

Lift pressure ring with the two packings from the brake housing.

REPAIR

Check inner facings 3 (fig. 5) as well as internal splines of brake disks 2 for excessive wear. If necessary, replace brake disks or inner facings.

Check facing on pressure rings for excessive wear and inspect pressure rings for scoring or other damage. Replace pressure rings, if necessary.

Discard packings of pressure rings and replace.

INSTALLATION

Install the "floating" facing made up of two bonded layers in transmission case so that the thick layer interwoven with brass faces the transmission brake face.

Slide brake disk on final drive shaft.

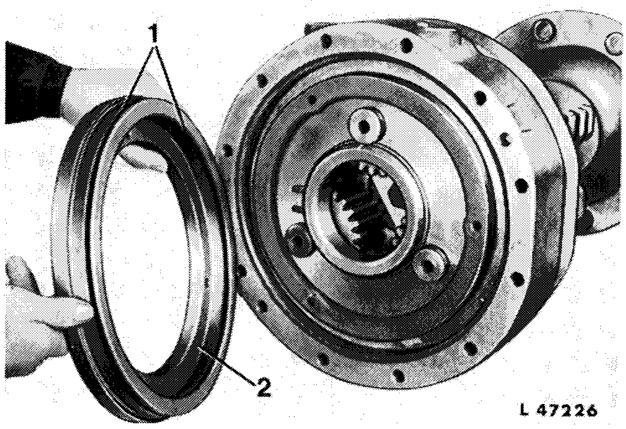


Fig. 6 — Installing Pressure Ring with Packings

1 Packings
2 Pressure ring with facing

Install pressure ring in annular bore of brake housing, aligning pressure ring with dowels.

Make sure pressure ring is seated on bottom of bore and that the packings have not been damaged or turned over during installation.

Install final drives as explained in section 10, group 25. Bleed brake system (see above).

HAND BRAKE

GENERAL INFORMATION

The main components of the hand brake are the brake disk which is splined to the differential housing, the brake band engaging the brake disk, the hand brake lever with toothed quadrant, and the components transmitting the movement of the hand brake lever to the brake band. The hand brake acts through the differential and the final drives on the rear axle, and thus on the rear wheels of the tractor. The brake disks and the brake band are partly submerged in transmission oil and are thus sufficiently cooled.

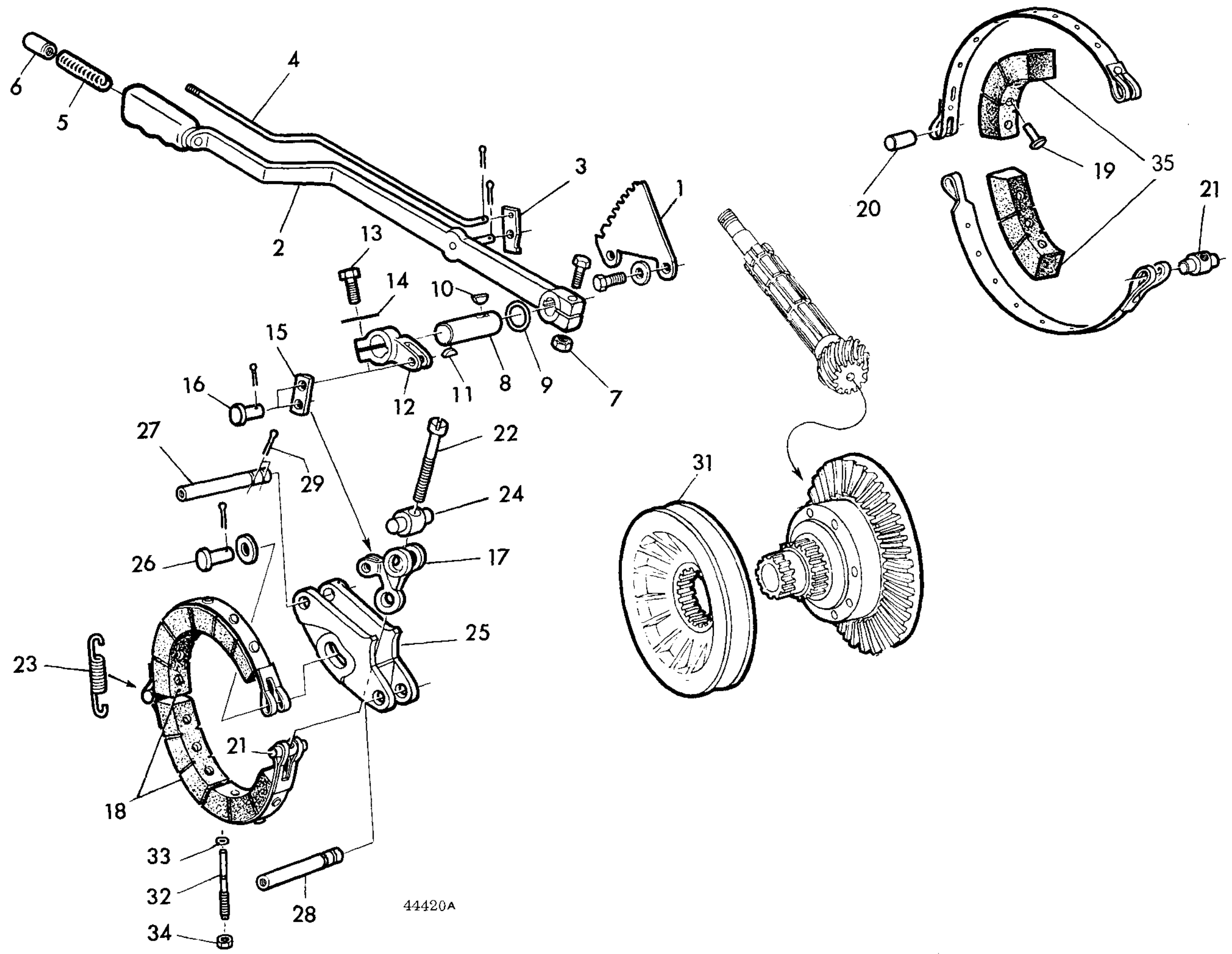


Fig. 7 — Parts of Hand Brake

1 Toothed quadrant
2 Hand brake lever
3 Latch
4 Release rod
5 Pressure spring
6 Push button
7 Hex. nut
8 Brake shaft
9 O-ring
10 Woodruff key
11 Woodruff key
12 Lever
13 Cap screw
14 Lock plate
15 Link
16 Pin (2 used)
17 Brake band arm
18 Brake band assembly
19 Special rivet (12 used)
20 Pin
21 Toggle
22 Brake band adjusting screw
23 Tension spring
24 Toggle
25 Anchor
26 Pin
27 Upper anchor pin
28 Lower anchor pin
29 Cotter pin (2 used)
31 Brake disk
32 Brake band support screw
33 O-ring
34 Hex. nut
35 Facings (4 used)

REMOVAL

Drain transmission oil and remove rockshaft (see section 10, group 25).

Remove hand brake parts as shown in fig. 7.

Before removing brake disk 31, remove differential unit (see section 50, group 20).

REPAIR

Check all hand brake parts for serviceability and repair or replace, if necessary.

BRAKE FACINGS

If facings are loose or so much worn that grooves on sides of facings are no longer visible, replace facings. When fitting a new facing, insert rivets from inside and peen on the outside.

BRAKE DISK

Check brake faces and carefully smoothen rough spots. Replace brake disk, if badly worn or scored.

TENSION SPRING

Tension spring 23 (fig. 7) should have a specified resilience at a given spring length (see Specifications).

INSTALLATION

Install the components, reversing the sequence observed for removal (as shown in fig. 7).

NOTE: Hook in tension spring 23 with the brake band still removed.

ADJUSTMENT

After having installed all hand brake parts, tighten brake band adjusting screw 22 (fig. 7) until brake band fully contacts brake disk. Then back off screw by one turn.

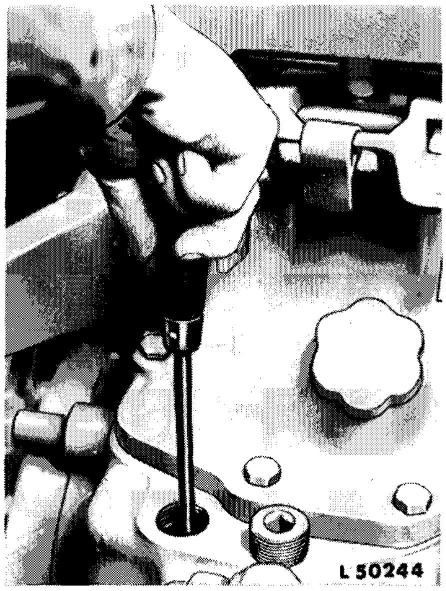


Fig. 8 — Adjusting Hand Brake

Tighten brake band support screw 32 (fig. 7) at bottom of transmission case finger-tight. Then back off 2 turns and secure by means of hex. nut 34.

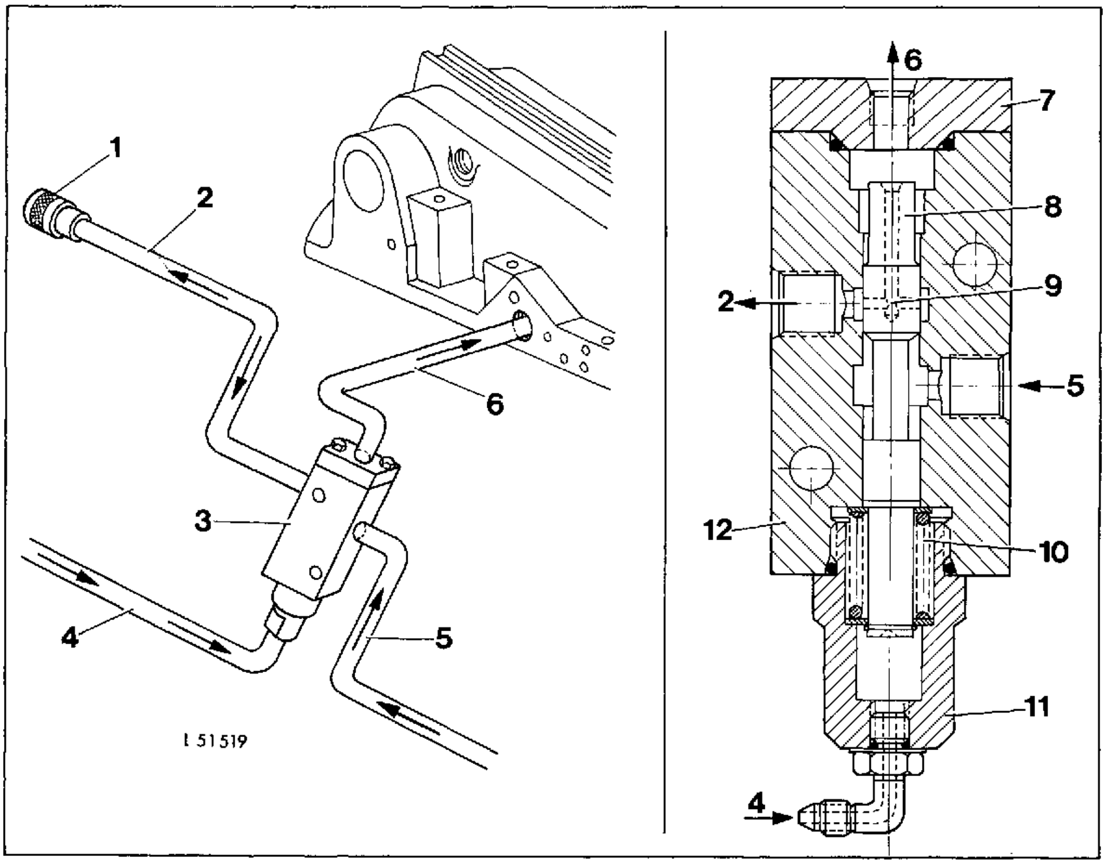


Fig. 9 — Operation of the Brake Valve

1 Quick disconnect coupler
2 Pressure line to coupler
3 Brake valve
4 Control line from final drive
5 Pressure line from hydraulic pump
6 Return and leak-off line
7 Valve cap
8 Spool
9 Spool return and leak-off orifice
10 Pressure spring
11 Spring cap
12 Valve body

OPERATION

With the engine running, oil under system pressure from the tractor hydraulic pump, is forced through pressure line 5 (fig. 9), into body 12 of brake valve 3, where it is blocked by spool 8 which is in neutral position (fig. 9).

If the hydraulic brakes of the tractor are operated, oil from the pressure oil circuit of the foot brakes passes s through control line 4 to the bottom of spool 8, pushing the spool upwards after overcoming pressure of spring 10. The return and leak-off orifice 9 is now closed while the oil passage leading to pressure oil line 2 of the quick disconnect coupler is opened. Oil under pressure in the valve body can now pass through pressure line 2 and quick disconnect coupler 1 to the hydraulic trailer brakes.

When the braking operation is completed, pressure oil flows no longer through control line 4 to overcome spring pressure. Spring 10 moves the spool downwards into the neutral position. Thereby, the return and leak-off orifice 9 is again connected to the passage in the valve body leading to pressure oil line 2. Oil can now return into the rockshaft housing, and thus into the transmission case via pressure line 2, spool 8 and return and leak-off line 6.

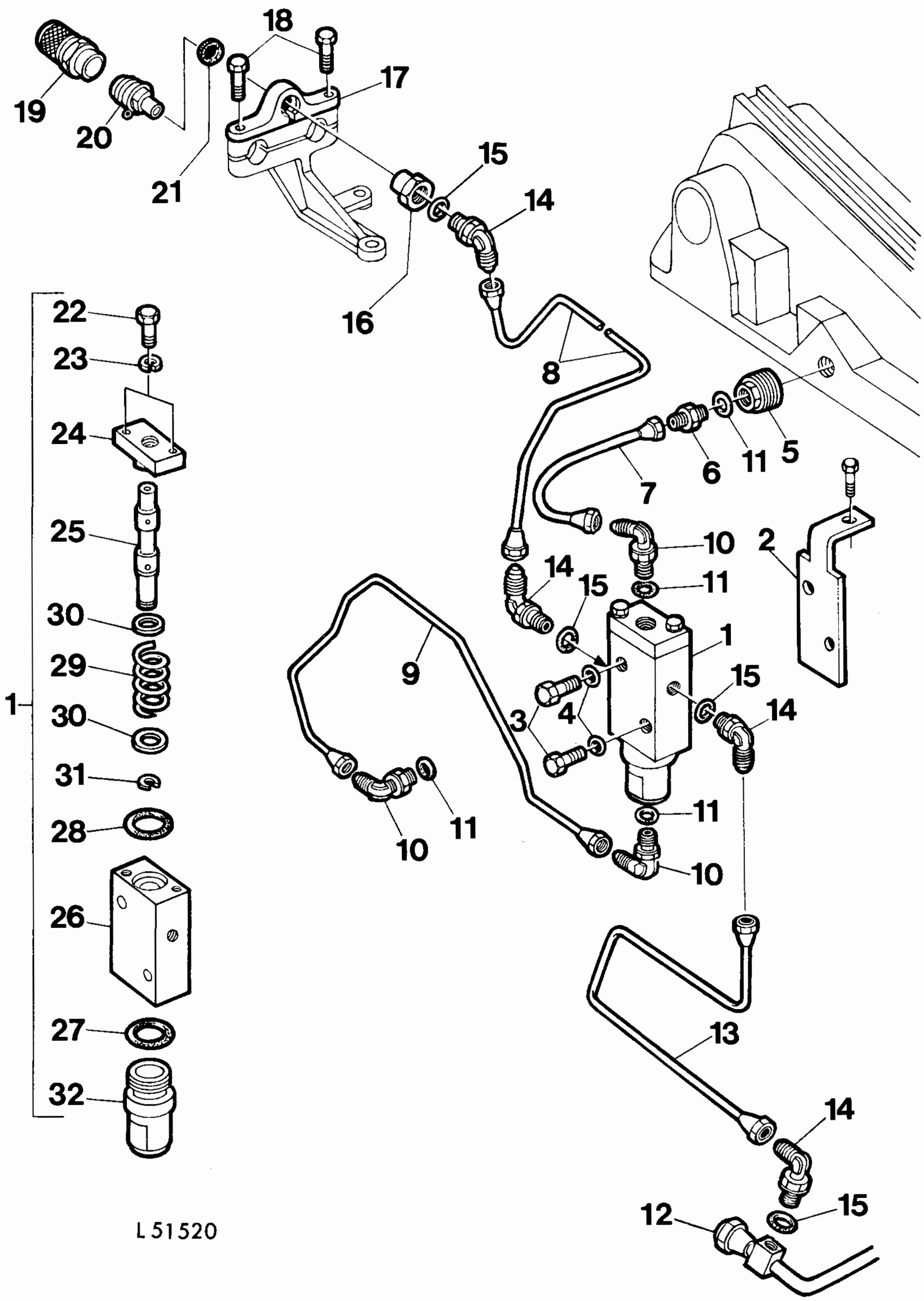


Fig. 10 — Parts for Hydraulic Trailer Brakes

1 Brake valve, complete
2 Securing bracket
3 Cap screws
4 O-rings
5 Special plug
6 Adapter
7 Return line
8 Pressure line to quick-disconnect coupler
9 Control line (from final drive)
10 Elbow connectors (90 deg.)
11 O-rings
12 Pressure line (hydr. pump)
13 Pressure line to brake valve
14 Elbow connectors (90 deg.)
15 O-rings
16 Special connector
17 Clamp
18 Cap screws
19 Quick disconnect coupler
20 Quick disconnect coupler
21 Seal
22 Cap screws (2 used)
23 Spring washer (2 used)
24 Valve cover
25 Spool
26 Valve body
27 O-ring
28 O-ring
29 Pressure spring
30 Washers
31 Retainer
32 Spring cap

REPAIR

REMOVAL OF BRAKE VALVE

Disconnect all lines at elbow connectors of brake valve.

Unscrew both cap screws 3 (Fig. 10) attaching brake valve 1 to bracket 2. Remove brake valve and discard O-rings 4.

DISASSEMBLY OF BRAKE VALVE

Turn spring cap 32 (fig. 10) out of valve body 26. Pull spool 25 with spring 29, washers 30 and retaining ring 31 out of valve body.

Remove retaining ring 31, spring 29 and both washers 30 from spool.

Unscrew both cap screws 22 from valve body 26 and remove valve cover 24.

INSPECTION

Check spool and valve body for scoring or other damage.

The spool and valve body are not separately replaceable. Because they are selectively fitted at the factory. If either needs replacement, the complete control valve assembly must be replaced.

Check all other parts and replace where necessary.

Discard O-rings and replace with new ones.

Check tension of pressure spring 29 (fig. 10). See specifications.

ASSEMBLY AND INSTALLATION

When assembling and installing brake valve, reverse disassembly procedure and refer to figures 9 and 10.

BLEEDING

Loosen hex. nut of elbow connector 10 screwed into spring cap 32 (fig. 10).

Operate right-hand brake pedal to bleed control line 9 and brake valve 1.

Tighten spring cap 32 and hex. nut of elbow connector.

TESTING

1. Use an adapter to connect a pressure gauge (measuring range 0-2550 psi = 0-250 kg/cm^2) to coupler plug 20 (fig. 10).

2. Start engine. Pressure gauge should not register any pressure.

3. Press down right-hand brake pedal with approximately 55 lbs. (25 kg) force. The gauge should immediately show a pressure of approximately 2130 psi (150 kg/cm^2). Within a period of 10 seconds the brake pedal should neither sag nor should a back pressure be observed.

SPECIFICATIONS

HYDRAULIC FOOT BRAKES	Dimensions of New Parts	Wear Tolerance
Inner dia. of bushings pressed into brake pedals	0.688 to 0.692 in. 17.48 to 17.58 mm	0.705 in. 17.91 mm
Dia. of brake pedal shafts	0.685 to 0.688 in. 17.40 to 17.48 mm	0.681 in. 17.30 mm
Dia. of a brake piston	0.8715 to 0.8733 in. 22.136 to 22.182 mm	
Dia. of piston bearing bores in brake valve and cylinder housing	0.874 to 0.875 in. 22.199 to 22.225 mm	
Brake piston springs		
Free length of spring	7.5 in. 190 mm	
Spring tension at a length of 5.75 in. (145 mm)	20 lbs. 9 kg	
Springs of valve balls for regulating return oil		
Free length of spring	0.42 in. 10.7 mm	
Spring tension at a length of 0.24 in. (6 mm)	0.17 to 0.20 lbs. 76 to 93 g	
Springs of check valves		
Free length	0.89 in. 22.6 mm	
Spring tension at a length of 0.33 in. (8.4 mm)	0.09 to 0.13 lbs. 40 to 60 g	
Springs of equalizing valves		
Free length	0.79 in. 20 mm	
Spring tension at a length of 0.28 in. (7 mm)	0.13 to 0.17 lbs. 60 to 76 g	
Load on a brake pedal during adjustment	10 lbs. 4.5 kg	
To check brake adjustment, apply a force of for one minute	60 lbs. 27 kg	
Maximum pedal settling within 1 minute at a load of 60 lbs. (27 kg)	approx. 1 in. 25 mm	
HAND BRAKE		
Tension spring of brake band		
Free length	4.8 in. 122 mm	
Spring tension at a length of 5.16 in. (131 mm)	62 to 71 lbs. 28 to 32 kg	

SPECIFICATIONS (Cont.)

	Dimensions of New Parts	Wear Tolerance
PARTS FOR HYDRAULIC TRAILER BRAKE		
Brake valve		
Diameter of control valve spool at helical edges	0.4728 to 0.4737 in. 12.020 to 12.043 mm	
Diameter of bore for bearing in valve housing	0.4729 to 0.4738 in. 12.023 to 12.046 mm	
Valve housing and control valve spool are matched pairs with a specified clearance of	0.00012 to 0.00024 in. 0.003 to 0.006 mm	
Pressure spring of control valve spool Free length	approx. 1.04 in. 26.5 mm	
Spring tension at a length of 0.57 in. (14.5 mm)	48 to 58 lbs. 21.5 to 26.5 kg	
Operating test		
Load right-hand foot pedal with	approx. 55 lbs. 25 kg	
Operating pressure with this load*	approx. 2130 psi. 150 kg/cm^2	

* *During a period of approx. 10 secs. there should be no back pressure or sinking of clutch pedal.*

Section 70

HYDRAULIC SYSTEM

CONTENTS OF THIS SECTION

Group 5

GENERAL INFORMATION, DIAGNOSING MALFUNCTIONS, AND PRESSURE TESTS

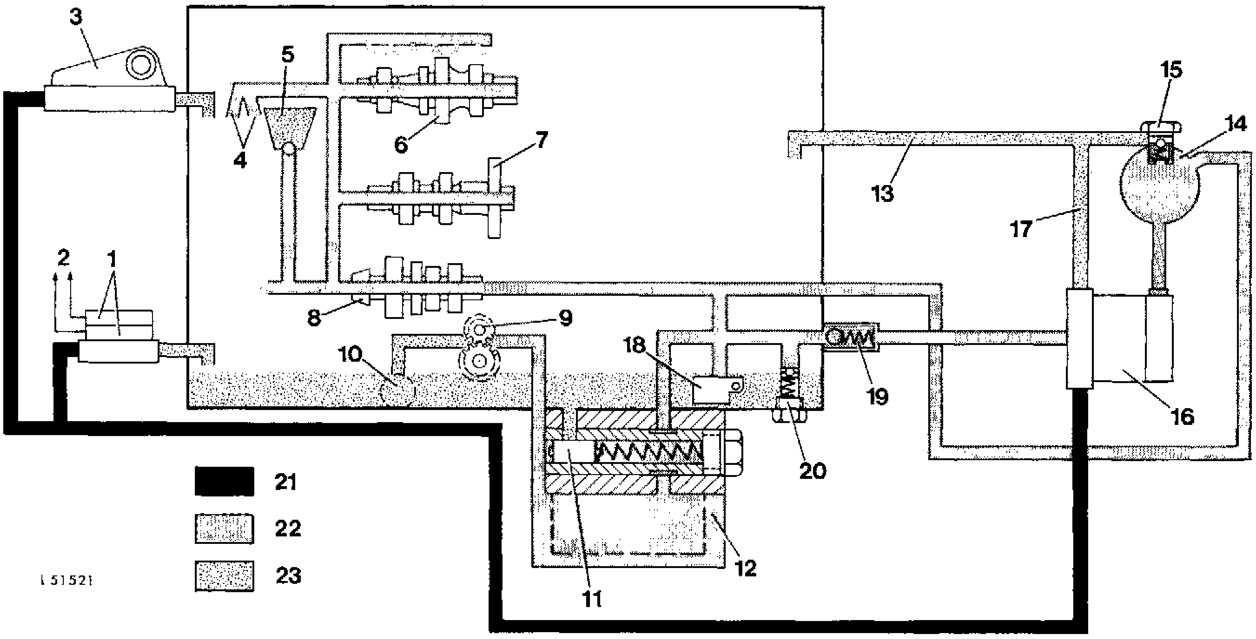


Fig. 1 — Complete Hydraulic System (Tractor Without HIGH-LOW Shift Unit, Independent PTO and Power Steering)

1 Selective control valves
2 To quick couplers
3 Rockshaft
4 Lube oil to final drives
5 Transmission oil cup
6 Transmission drive shaft
7 Countershaft
8 Differential drive shaft
9 Transmission oil pump
10 Suction screen
11 By-pass valve of transmission oil filter
12 Transmission oil filter
13 Bleed line
14 Hydraulic oil reservoir
15 Check valve
16 Hydraulic pump
17 Leak-off and bleed line
18 Main brake cylinder
19 Check valve (inlet line to hydraulic pump)
20 Relief valve
21 Pressure oil (2050 to 2280 psi = 144 to 160 kg/cm2)
22 Intermediate pressure oil (50 psi = 3,5 kg/cm2)
23 Pressure-free oil

GENERAL INFORMATION

The hydraulic system of the tractor includes main oil reservoir (transmission case), hydraulic pump, transmission oil pump, various valves, oil lines, filter, power steering* with flow control valve, hydraulic oil reservoir, oil cooler*, HIGH-LOW shift unit*, independent PTO*, rockshaft and one or several selective control valves*.

The hydraulic system (see figs. 1 and 2) is a closed-center, constant pressure type system.

"Closed system" means that no oil flows through hydraulic unit control valves when the latter are in neutral position.

"Constant pressure" means that high pressure is constantly maintained in the hydraulic system while engine and hydraulic pump are operating, as long as none of the hydraulic units requires oil (see "stand-by pressure", Specifications).

For a detailed explanation of operation and repair of power steering and hydraulic brakes see section 60.

NOTE: Detailed explanation of design and operation of the individual hydraulic units see "Fundamentals of Service - Hydraulics" manual.

* If equipped

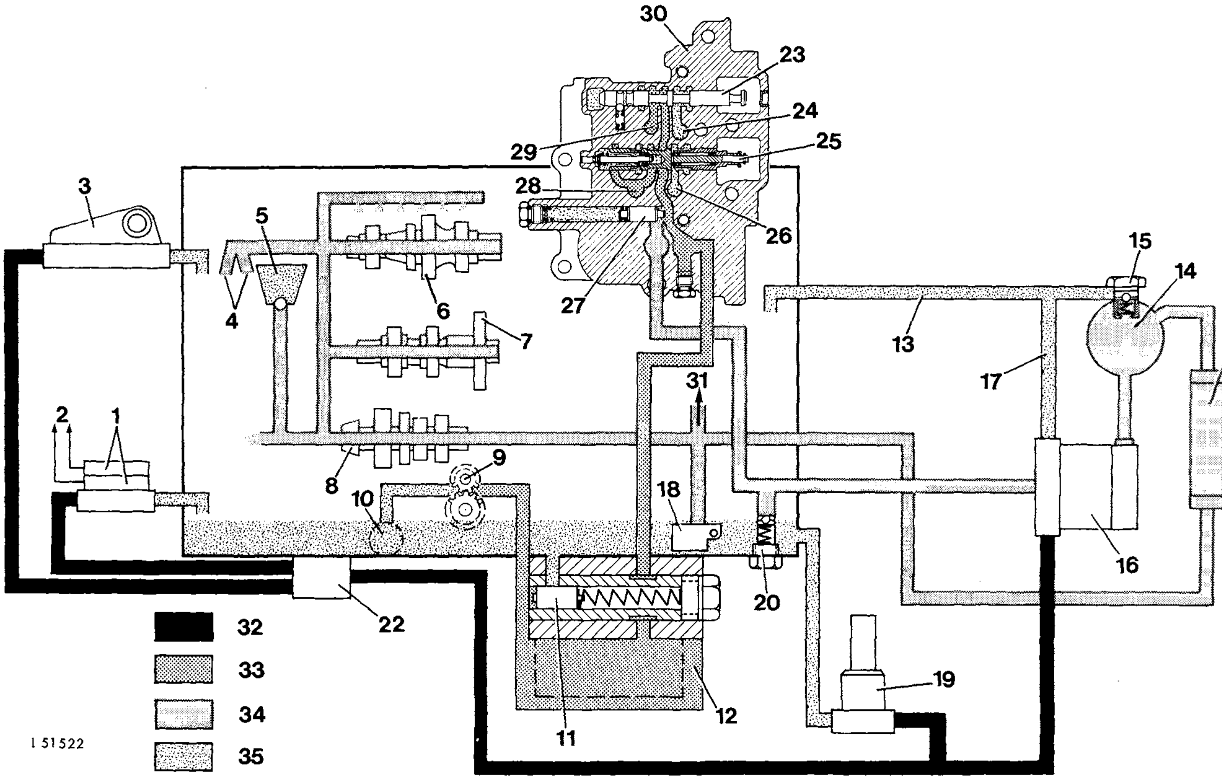


Fig. 2 — Complete Hydraulic System (Tractor With HIGH-LOW Shift Unit, Oil Cooler, Independent PTO and Power Steering)

1 Selective control valves
2 To quick couplers
3 Rockshaft
4 Lube oil to final drives
5 Transmission oil cup
6 Transmission drive shaft
7 Countershaft
8 Differential drive shaft
9 Transmission oil pump
10 Suction screen
11 By-pass valve of transmission oil filter
12 Transmission oil filter
13 Bleed line
14 Hydraulic oil reservoir
15 Check valve
16 Hydraulic pump
17 Leak-off and bleed line
18 Main brake cylinder
19 Power steering
20 Relief valve
21 Oil cooler
22 Flow control valve of power steering
23 HIGH-LOW control valve assy.
24 To disk brake of HIGH-LOW unit
25 Control valve of independent PTO
26 To PTO brake
27 Pressure regulating valve
28 To PTO clutch
29 To disk clutch of HIGH-LOW unit
30 Transmission shift cover
31 To HIGH-LOW unit (lubrication)
32 Pressure oil (2050 to 2280 psi = 144 to 160 kg/cm2)
33 Pressure oil (100 psi = 7 kg/cm2)*
34 Pressure oil (50 psi = 3.5 kg/cm2)
35 Pressure-free oil

OPERATION

Transmission oil pump 9 (see figs. 1 and 2) sucks oil from the main oil reservoir (transmission case) through suction screen 10 and pushes it through transmission oil filter 12.

The transmission oil filter 12 is provided with a by-pass valve 11 located between inlet and outlet of the filter. This by-pass valve causes the oil sucked in by the oil pump to be returned to the main oil reservoir if a specified pressure differential is reached between inlet and outlet of transmission oil filter due to filter restriction (see Specifications).

On tractors not equipped with HIGH-LOW unit or independent PTO, oil passes from transmission oil filter directly to the hydraulic pump. These machines have a check valve 19 (fig. 1) installed in the inlet line to the hydraulic pump, ensuring that when the engine is stopped or engine clutch is disengaged (transmission oil pump is then not operating), oil does not flow back. On tractors equipped with HIGH-LOW shift unit or independent PTO the operation of the check valve is carried out by the pressure regulating valve 27 located in the transmission shift cover 30 (fig. 2).

* On tractors equipped with independent PTO 150 psi (10.5 kg/cm).

On tractors equipped with HIGH-LOW shift unit, independent PTO or both, oil flows from transmission oil filter first to pressure regulating valve (adjusted by shims) located in gear shift cover 30 (fig. 2). The pressure regulating valve 27 regulates the oil to a given pressure for engaging the HIGH-LOW multi-disk clutch, PTO multi-disk clutch and for operating the PTO brake (see Specifications).

Then oil reaches HIGH-LOW control valve 23, or independent PTO control valve 25, or both, whatever is required. Only a small amount of oil is required by the HIGH-LOW unit and independent PTO, the rest flowing to the hydraulic pump.

NOTE: For a detailed explanation of design and operation of the HIGH-LOW unit and independent PTO see section 50.

Relief valve 20 (fig. 1 or 2) located in the clutch housing protects the system from excessive pressure which may be due to excessive resistance in the system.

Oil not required by hydraulic pump 16 (pump in stand-by position) flows through the hydraulic reservoir to oil cooler 21 (if equipped).

If the tractor is equipped with a power steering unit 19 (fig. 2), oil is supplied from the hydraulic pump. Flow control valve 22 installed in the hydraulic system gives priority in oil supply to power steering.

Pressure oil from the hydraulic pump also flows to the rear for operating rockshaft 3, selective control valves 1 and attached implements. Return oil from the rockshaft and attached implements flows directly into the main oil reservoir (transmission case).

On tractors equipped with an oil cooler, oil flows back into the clutch housing, fills the reservoir of main brake cylinder 18, lubricates and cools the HIGH-LOW disk packs 31 (fig. 2) and lubricates the transmission gears and shafts. Then it flows back again into the main oil reservoir.

On tractors not equipped with an oil cooler, the oil flows from the oil reservoir to the clutch housing, filling the reservoir of main brake cylinder and lubricating transmission gears and shafts.

DIAGNOSING MALFUNCTIONS

HYDRAULIC SYSTEM

SLOW OPERATION

Hydraulic system responds slowly
    Increase engine speed

Oil does not reach hydraulic pump
    Clutch pedal depressed
    Transmission oil pump faulty
    Transmission oil filter clogged

Improper transmission/hydraulic system oil
    Drain oil and fill hydraulic system with oil of proper viscosity and quality

Pressure regulating valve of hydraulic pump improperly adjusted
    Check valve seat for foreign particles or damage
    Adjust pressure regulating valve

Internal leakage
    Check hydraulic system

Hydraulic pump operating improperly
    Check hydraulic pump

NO OIL PRESSURE

No oil or improper oil in hydraulic system
    Fill in oil of proper quality and viscosity

Hydraulic pump does not deliver
    With the engine running, check pump shut-off screw (if equipped)

Transmission oil pump does not operate
    Check pump

Oil lines leaking
    Tighten lines or replace

Hydraulic pump worn or damaged
    Check pump

OIL OVERHEATING

Oil of improper viscosity in system
Use proper oil

Oil cooler malfunction
Clean and repair oil cooler

Pressure regulating valve of hydraulic pump sticking
Repair valve

Crankcase outlet valve of hydraulic pump sticking in open position
Check valve for foreign particles

OIL IN SYSTEM FOAMING

Too little oil in system
Add oil, check system for leakage

Water in oil
Drain oil and refill

Improper oil viscosity
Use oil of proper viscosity

Oil lines bent or dented
Replace lines

Air leak in hydraulic pump inlet line
Tighten line connections or replace lines

HYDRAULIC PUMP

NO PUMP OUTLET

Check pump shut-off screw

Adjust pressure regulating valve of pump

Pressure regulating valve of pump stuck open

Pump shaft broken

ERRATIC PUMP OPERATION

Pressure regulating valve not seating properly
Check valve seat for damage or foreign particles

Leaking inlet or outlet valves, defective O-rings
Repair valves, replace O-rings of valve plugs

Piston springs not balanced
Check springs for broken coils or unequal resilience

Pump pistons stuck
Check pistons for burrs or dirt
If required, replace parts

PUMP NOISE OR SQUEAL

Spring guide of pressure regulating valve binding
Smoothen sharp edge on lower end of spring guide. Adjust system pressure

Loose pump drive coupler parts
Tighten screws and nuts to the specified torque

Air bubble in pressure regulating valve chamber
Bleed valve chamber by backing off adjusting screw of pressure regulating valve until spring pressure is relieved. Air will escape through threads. Then adjust pressure regulating screw

PUMP OPERATES SLOWLY

Pump shaft seal groove in pump housing worn
Replace pump housing and seal ring

POWER STEERING

Diagnosing malfunctions see section 60

HYDRAULIC BRAKES

Diagnosing malfunctions see section 60

ROCKSHAFT

FAILS TO RISE OR RISES SLOWLY

No pressure in system
  Check operation of hydraulic pump

Rate-of-drop valve stuck open
  Turn in rate-of-drop screw completely. If lift arms rise, check valve for foreign particles. Check O-rings and back-up rings of valve plugs for proper condition

Return spring of valve operating lever unhooked or weak
  Remove plug on right side of rockshaft housing and watch valve linkage. If linkage moves with the engine shut off, spring will be unhooked or damaged. Hook in spring or replace.

O-ring of rockshaft piston damaged or worn
  Replace O-ring and back-up ring

Clutch pedal depressed
  Release clutch pedal so that transmission oil pump can operate again

Low pump output
  Check and adjust hydraulic pump

Adjusting screw of load control arm improperly adjusted

Adjusting screw of cam follower improperly adjusted (improper reaction in load control)

Dump valve defective

Transmission oil filter contaminated or plugged

ERRATIC OPERATION OF ROCKSHAFT CONTROL VALVES

Insufficient valve play (both control valves remaining open)
  Adjust valve play (neutral range of control lever)

O-ring of rockshaft piston damaged or worn
  Replace O-ring and back-up ring

Thermal relief valve defective
  Replace valve

Rate-of-drop valve leaking
  Check valve for foreign particles or damaged plug, back-up ring and O-rings

ROCKSHAFT FAILS TO LOWER OR LOWERS SLOWLY

Rate-of-drop screw completely turned in

Valve linkage damaged or disconnected

ROCKSHAFT RISES QUICKLY

Dump valve improperly adjusted
  Remove shims to reduce oil flow

ROCKSHAFT LOWERS QUICKLY

Rate-of-drop screw backed off excessively

ROCKSHAFT FAILS TO RISE UNDER LOAD

Excessive load on hitch

Insufficient delivery of hydraulic pump
  Check and adjust hydraulic pump

Adjusting screw of load control arm improperly adjusted

O-ring of rockshaft piston damaged or worn
  Replace O-ring and back-up ring

Seal between rockshaft cylinder and valve housing and rockshaft housing or between rockshaft housing and transmission case leaking
Replace gasket and seals

Thermal relief valve defective
Replace relief valve

INSUFFICIENT RISE IN DEPTH CONTROL

Control lever improperly adjusted

EXCESSIVE SETTLING UNDER LOAD

Rate-of-drop valve leaking
To check rate-of-drop screw, turn it in completely. Now lift arms should stop to settle. If this is not the case, check valve for foreign particles or leaking valve plug.

Rockshaft cylinder check valve leaking
Replace check valve ball and rework valve seat

Plug at rockshaft cylinder end leaking
Tighten plug

Rockshaft cylinder valve housing porous or damaged
Replace housing

INSUFFICIENT LOAD RESPONSE

Selector lever in depth (D) or load-and-depth (LD) position
Move selector lever in load (L) control position

Excessive valve play
Adjust valve play

Control valves stuck
Check valves for worn springs or foreign particles

Load control shaft or bushings worn

Negative stop screw of load control arm excessively turned in.

EXCESSIVE HITCH RESPONSE

Selector lever in load control position (L)
Move selector lever in load-and-depth position (LD)

OIL HEATING - BY-PASSING OF OIL

Insufficient valve play (both control valves remaining open)
Adjust valve play

Control valves leaking
Check valves for foreign particles and replace valve plugs, O-rings and back-up rings.

Thermal relief valve defective or worn
Replace valve

O-rings of one or both valves leaking
Replace O-rings and back-up rings

REMOTE CYLINDER

CYLINDER WILL NOT EXTEND

Cylinder overloaded

Insufficient oil pressure
Check hydraulic pump

Air in cylinder
Bleed cylinder

O-ring of piston damaged
Replace O-rings and back-up rings

CYLINDER WILL NOT RETRACT

Air in cylinder
Bleed cylinder

Remote cylinder stop valve stuck
Clean and repair valve

Piston rod stop improperly adjusted
Adjust stop properly

CYLINDER SETTLES UNDER LOAD

Piston O-ring damaged
Replace O-ring and back-up rings

CYLINDER OPERATES SLOWLY

Insufficient oil or insufficient pressure
Check hydraulic pump

Air in cylinder
Bleed cylinder

Remote cylinder stop valve stuck
Clean and repair valve

PRESSURE TESTS

Before making the following tests, check oil level in main oil reservoir (transmission case) and viscosity of oil. Check all lines and connections for leaks or damage.

NOTE: Operate tractor to warm hydraulic oil to approx. 120° F (50° C) before testing hydraulic system in the order given below.

TESTING PUMP STAND-BY PRESSURE

Remove cap screw 5 (fig. 3) or front plug (3/8 in.) on right side of rockshaft housing below flow control valve plug. Connect gauge No. 19.58-90.269 (measuring range of 0 to 3550 psi = 0 to 250 kg/cm^2) to rockshaft housing (see fig. 3) by means of special adapter No. 19.58-90.266 and pressure hose assembly of special tool No. 19.58-90.260.

Move range shift lever in park position or in neutral position, adjusting hand brake. Start engine, engage engine clutch and increase engine speed to 2500 rpm (upper idling speed).

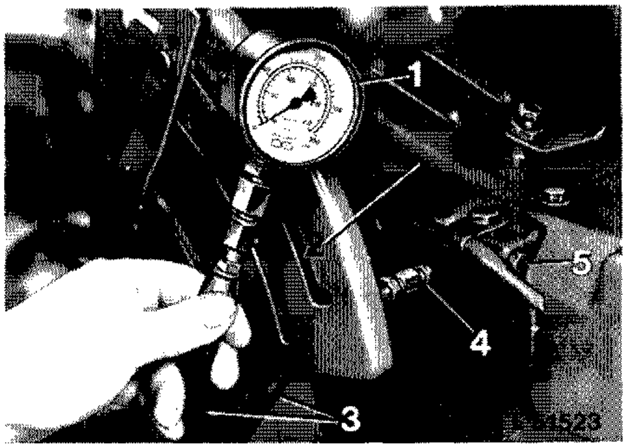


Fig. 3 — Pressure Gauge Connected to Rockshaft Housing

1 Pressure gauge No. 19.58-90.269 of special tool No. 19.58-90.260
2 Rockshaft housing
3 Pressure hose assembly of special tool No. 19.58-90.260
4 Special adapter No. 19.58-90.266 of special tool No. 19.58-90.260
5 Cap screw (3/8 in.)

Record gauge reading. If gauge does not show specified system pressure (see Specifications), adjust pressure regulating valve of hydraulic pump so that specified system pressure will be reached, as explained in group 15 of this section.

TESTING ADJUSTING PRESSURE OF POWER STEERING FLOW CONTROL VALVE

Remove plug located in front of pump pressure regulating valve or pump shut-off screw (if equipped). Install adapter No. 19.58-90.271 (see 4, fig. 4). provided with O-ring.

Screw elbow No. 19.58-90.270 (see 3, fig. 4), provided with O-ring, in adapter. Connect pressure gauge No. 19.58-90.269 to elbow 3 (see fig. 4) and thus to hydraulic pump by means of pressure hose of special tool No. 19.58-90.260.

Test pump stand-by pressure (see Specifications) and check hydraulic components for proper operation.

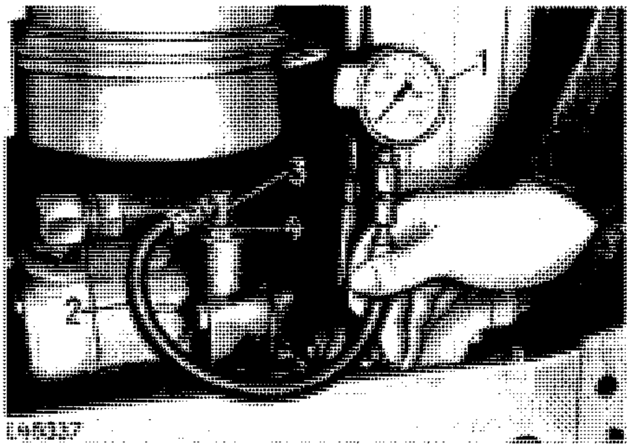


Fig. 4 — Pressure Gauge Connected to Hydraulic Pump

1 Pressure gauge No. 19.58-90.269 of special tool No. 19.58-90.260
2 Pressure hose assembly of special tool No. 19.58-90.260
3 Elbow No. 19.58-90.270 of special tool No. 19.58-90.260
4 Adapter No. 19.58-90.271 of special tool No. 19.58-90.260

Adjust pump pressure regulating valve to 1500 psi (105 kg/cm^2).

Actuate control lever of one of the hydraulic components which do not have priority in oil supply (rockshaft or selective control valve); it should not operate. If component operates, this indicates a malfunction of the flow control valve (contaminated valve or broken valve spring). Determine cause of trouble and remove (see group 10 of this section) before continuing the test.

Carry out any of the following two operations:

1. Move rockshaft control lever fully forward so that lift arms are completely lowered. Then move control lever backward until lift arms have completely risen.

2. Completely retract remote cylinder. Then move selective control lever in "fast extend" position.

Turn adjusting screw of pump pressure regulating valve so as to increase system pressure. Record gauge reading when actuated hydraulic component starts to operate normally. This value indicates flow control valve adjustment. For proper flow control valve adjusting pressure see Specifications.

If adjusting pressure is not correct, add or remove shims between valve spring and throttle (see group 10 of this section). One shim will change pressure by 35 to 40 psi (2.5 to 2.8 kg/cm^2).

To adjust the flow control valve, disconnect pressure line of hydraulic pump at adapter. Remove adapter from valve housing (see group 10). Pull spool out of valve housing bore and install proper number of shims between throttle plate and spring.

Adjust pressure control valve of hydraulic pump so that correct system stand-by pressure is obtained.

TESTING LIFT CYCLES

ROCKSHAFT

Run engine at 2100 rpm.

Lift arms should be in their lowest position. Move rockshaft control lever backward until lift arms are in top position. Rising of lift arms in top position should require a specified period (see Specifications).

REMOTE CYLINDER

Run engine at 2100 rpm and actuate selective control lever to extend remote cylinder piston. Remote cylinder should be completely extended in specified period (see Specifications). If extending or retracting cylinder requires more or less time, turn out adjusting screws to selective control valve to reduce lift cycle. Turn in screws to extend lift cycle (see group 35).

SPECIFICATIONS

HYDRAULIC PUMP

Delivery per pump shaft revolution		
4-piston pump	0.69 cu.in.	11.3 cm^3
8-piston pump	1.38 cu.in.	22.6 cm^3
Delivery at 2500 rpm engine speed and a system pressure of 2050 psi (144 kg/cm^2)		
4-piston pump	5.4 Imp.gals./min. 6.5 U.S. gals./min.	24.6 lit./min.
8-piston pump	10.8 Imp.gals./min. 13 US. gals./min.	49 lit./min.
Pump stand-by pressure	2220 to 2280 psi	156 to 160 kg/cm^2

TRANSMISSION OIL PUMP

Delivery at 2500 rpm engine speed	6.6 Imp.gals./min. 8 US gals./min.	30.3 lit/min

FLOW CONTROL VALVE OF POWER STEERING

Adjusting pressure of flow control valve	1700 to 1800 psi	118 to 125 kg/cm^2
One shim changes pressure by	35 to 40 psi	2.5 to 2.8 kg/cm^2

ROCKSHAFT

Complete lift cycle at 2100 rpm engine speed	1.8 to 2.3 sec.

REMOTE CYLINDER

Period for extending or retracting cylinder at 2100 rpm engine speed	2 sec.

SPECIAL TOOLS

Part No. when ordering from JD Parts Depot	Part No. when ordering from Manufacturer	Description	Use
19.58-90.260*		Special tool	Testing oil pressure

* This special tool includes

2 seal rings	19.58-90.261
1 fitting	19.58-90.262
1 pressure hose with connecting parts	19.58-90.263
1 tool kit	19.58-90.264
1 adapter 3/8 in. - 24 UNF	19.58-90.266
1 adapter	19.58-90.267
1 pressure gauge, measuring range 0-355 psi (0-25 kg/cm^2)	19.58-90.268
1 pressure gauge, measuring range 0-3550 psi (0-250 kg/cm^2)	19.58-90.269
1 elbow	19.58-90.270
1 adapter	19.58-90.271
2 O-rings	R 26287 R
2 O-rings	R 26375 R

Group 10

OIL RESERVOIR, FILTER, VALVES AND OIL COOLER

MAIN OIL RESERVOIR, TRANSMISSION OIL FILTER AND SUCTION SCREEN

GENERAL INFORMATION

The transmission case is also the main oil reservoir for the hydraulic system. The oil level dipstick is located to the right of the transmission case. The oil filler hole is at the rear of the rockshaft housing.

The transmission and hydraulic system drain plugs are located underneath the transmission case.

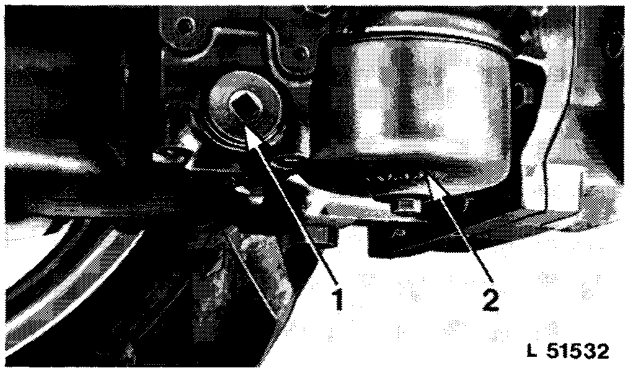


Fig. 1 — Transmission Oil Filter and Oil Intake Screen, Installed

1 Plug
2 Transmission oil filter

The full flow transmission oil filter is located underneath and to the right of the transmission case (see 2, fig. 1). It has a disposable paper filter element.

The transmission oil intake screen is located to the rear, right, behind plug 1 (fig. 1). This intake screen should be removed and cleaned any time the transmission oil is drained and replaced.

REPAIR

Transmission Oil Filter

Remove filter cover and take out O-ring and filter element.

NOTE: It is not necessary to drain transmission oil when replacing transmission oil filter element.

Install new O-ring in transmission case groove, making sure that it is properly seated. Replace filter cover together with new filter element and tighten filter screw firmly, but do not overtighten.

Intake Screen

Remove plug 1 (fig. 1) and intake screen from transmission case. Clean screen in diesel fuel. Install screen and tighten plug.

Fill transmission case with oil, run engine at idling speed for at least three minutes and then check oil level. Do not screw in dipstick, just rest it on top of threads. Add oil as necessary.

BY-PASS VALVE OF TRANSMISSION OIL FILTER

GENERAL INFORMATION

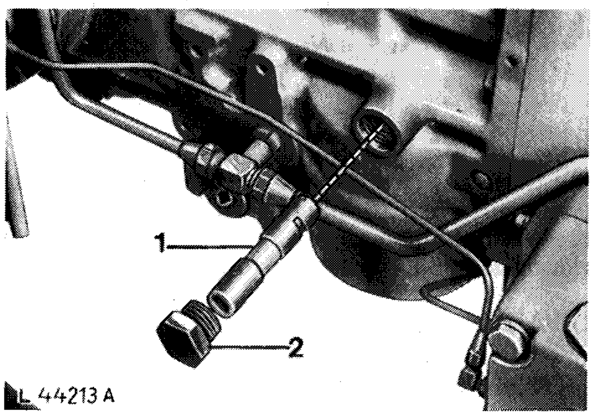


Fig. 2 — By-pass Valve of Transmission Oil Filter

1 By-pass valve   2 Plug

A by-pass valve insures that oil drawn by the transmission pump and delivered to the filter is diverted straight to the main oil reservoir, (transmission case) whenever the filter is clogged or when the oil is still heavy during the warm-up period.

REPAIR

Remove plug 2 (fig. 2) of by-pass valve and withdraw valve sleeve with spring and valve body from transmission case bore.

Drive out spring pin retaining valve body in sleeve. Slide spring and valve body out of sleeve.

Check resilience of valve spring (see Specifications).

Check valve sleeve and body for burrs, scoring or wear and replace, if necessary.

Install spring and valve body in valve sleeve and insert sleeve in transmission case bore. Slide a new O-ring on valve plug and install plug in transmission case. Tighten plug.

RELIEF (SAFETY) VALVE IN CLUTCH HOUSING

GENERAL INFORMATION

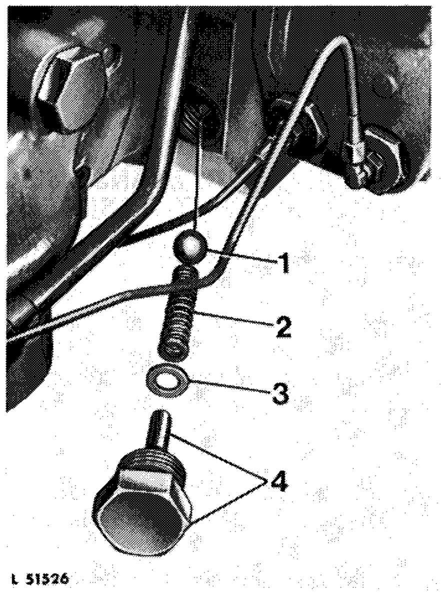


Fig. 3 — Relief (Safety) Valve in Clutch Housing

1 Ball   3 Washer
2 Spring   4 Plug with pin

The relief valve located at the right-hand side of the clutch housing (see fig. 3) serves as a safety valve. It opens and diverts oil to the main oil reservoir (transmission case) whenever the pressure in the clutch housing oil passage leading to the hydraulic pump inlet line exceeds a specified value (see Specifications).

REPAIR

Turn plug 4 (fig. 3) out of clutch housing and remove washer 3, spring 2 and ball 1. If relief valve seat pressed into housing bore is damaged and must be replaced, remove old valve seat and press in new seat with chamfered end first.

Examine valve pin of plug for damage or wear and replace, if required. Bottom new valve pin in plug bore.

Check resilience of valve spring 2 (see Specifications).

When installing, provide plug with a new O-ring.

CHECK VALVE IN INLET LINE OF HYDRAULIC PUMP
(Tractors without HIGH-LOW unit)

GENERAL INFORMATION

A check valve 1 (fig. 4) is installed in the end of the hydraulic pump inlet line, connected to the flywheel housing. This check valve prevents oil from returning to transmission case from the pump and inlet line when transmission oil pump is not working. By this means an immediate oil supply is guaranteed to the hydraulic pump under almost all conditions.

REPAIR

Remove clamp securing hydraulic pump inlet line and return line to clutch housing and pull out inlet line from bore in clutch housing. Disconnect inlet line at hydraulic pump and push forward. Remove check valve assembly from inlet line (see fig. 4).

Check valve spring for cracks and broken or compressed coils and replace, if necessary. Check resilience of valve spring (see Specifications).

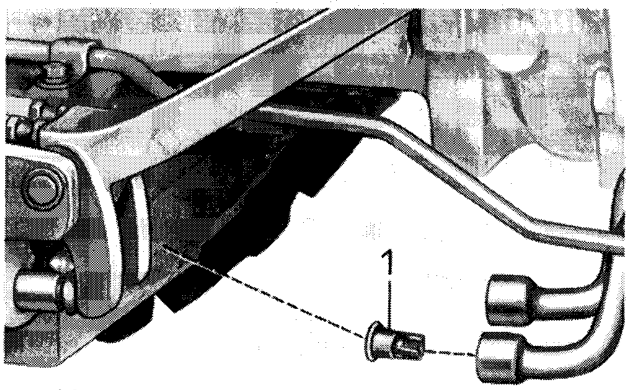


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Fig. 4 — Check Valve in Hydraulic Pump Inlet Line

1 Check valve assembly

Check seat of check valve and spring guide for wear and damage and replace, if necessary.

Assemble, reversing disassembly sequence.

FLOW CONTROL VALVE
(Tractors Equipped with Power Steering)

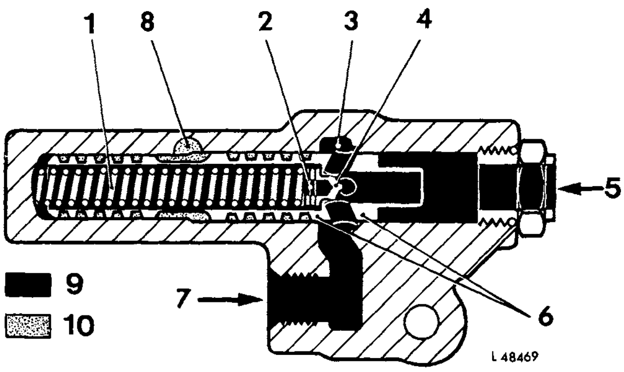

Fig. 5 — Oil Flow in Flow Control Valve at a Pressure Above 1800 psi (125 kg/cm^2)

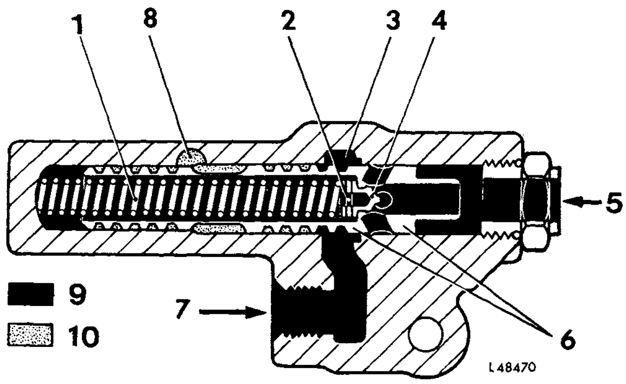

Fig. 6 — Oil Flow in Flow Control Valve at a Pressure Below 1800 psi (125 kg/cm^2)

1 Valve spring
2 Shims
3 To rockshaft
4 Throttle disk
5 From hydraulic pump
6 Valve spool
7 To selective control valve
8 Relief bore to transmission case
9 Pressure oil
10 Pressure-free oil

GENERAL

The flow control valve is located on the lower right of the transmission case.

This valve assures priority in oil supply from the main hydraulic pump to power steering, making sure that there is always sufficient pressure for the steering system.

The control valve spool 6 in the valve housing (figs. 5 and 6) controls the oil flow to the other hydraulic components dependent on power steering demand for oil.

A movable throttle 4 connects the valve spool cavity behind and in front of the throttle, regulating the oil pressure.

The rear of valve spool 6 has a smaller dia. than the front part of it, consequently the oil pressure in front of the valve spool is larger than in the rear of it.

The resulting pressure differential will move the valve spool rearward once the oil pressure exceeds 1800 psi (125 kg/cm^2). At a lower pressure the spring pressure will prevent such a movement.

A bypass bore 8 leading to the transmission case prevents hydraulic blocking of the valve spool due to leak-off oil in the flow control valve.

FOS

NOTE: For a more detailed explanation of design and operation see "Hydraulic Valves" in "Fundamentals of Service — Hydraulics" manual.

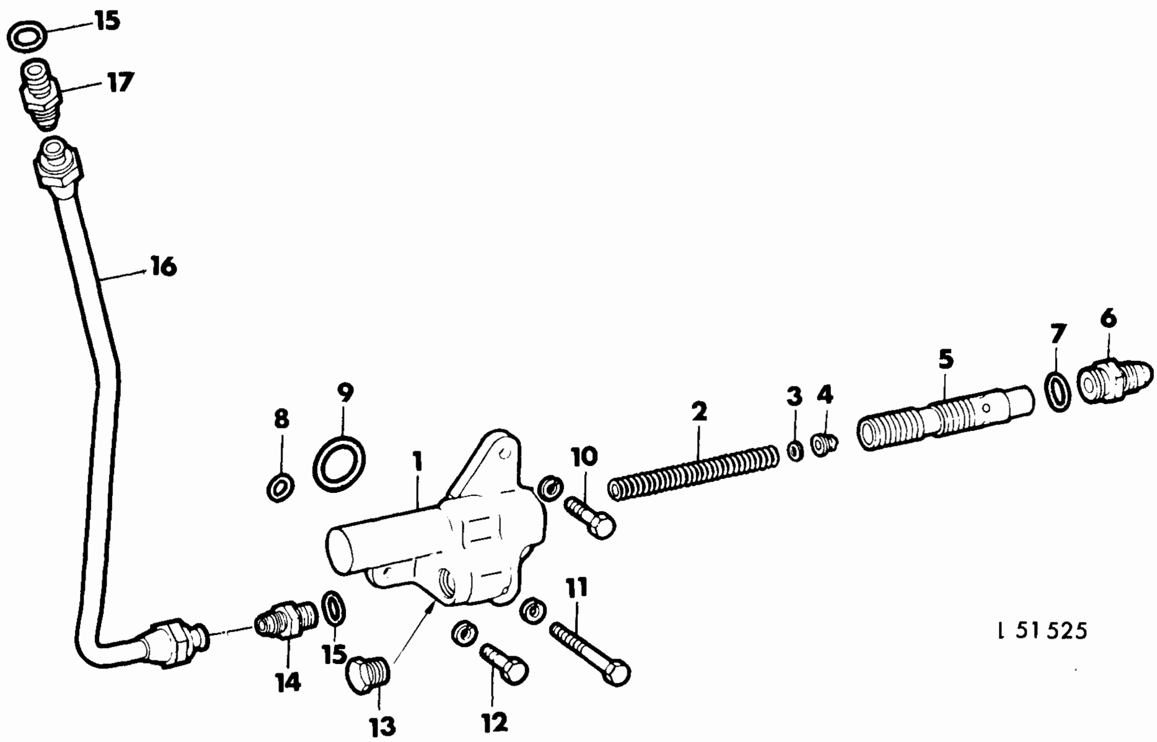

Fig. 7 — Exploded View of Flow Control Valve

1 Valve housing
2 Spring
3 Shim (use as required)
4 Throttle disk
5 Valve spool
6 Adapter
7 O-ring
8 O-ring
9 O-ring
10 Cap screw
11 Cap screw
12 Cap screw
13 Plug (tractors without selective control valve)
14 Adapter (tractor with selective control valve)
15 O-rings
16 Pressure line for selective control valve
17 Adapter

REPAIR

Disconnect main hydraulic pump pressure line as well as pressure line leading to selective control valve (if equipped) at flow control valve.

Remove cap screws securing flow control valve to transmission case and take valve away.

Turn adapter 6 (fig. 7) out of valve housing and withdraw valve spool 5, throttle disk 4, shims 3 and spring 2 from housing.

Check valve spool and housing for serviceability.

Check resilience of pressure spring (see Specifications).

Check throttle 4 for wear and replace, if necessary.

ASSEMBLY

Use same number of shims between spring and throttle disk as installed before removal. Adding shims will increase pressure, removing shims will reduce pressure.

Assemble flow control valve as shown in fig. 7.

Install flow control valve and test as explained in group 5.

HYDRAULIC OIL RESERVOIR

GENERAL INFORMATION

The auxiliary hydraulic oil reservoir 1 (fig. 8) provides an additional supply of oil whenever the transmission oil pump is unable to meet oil demands.

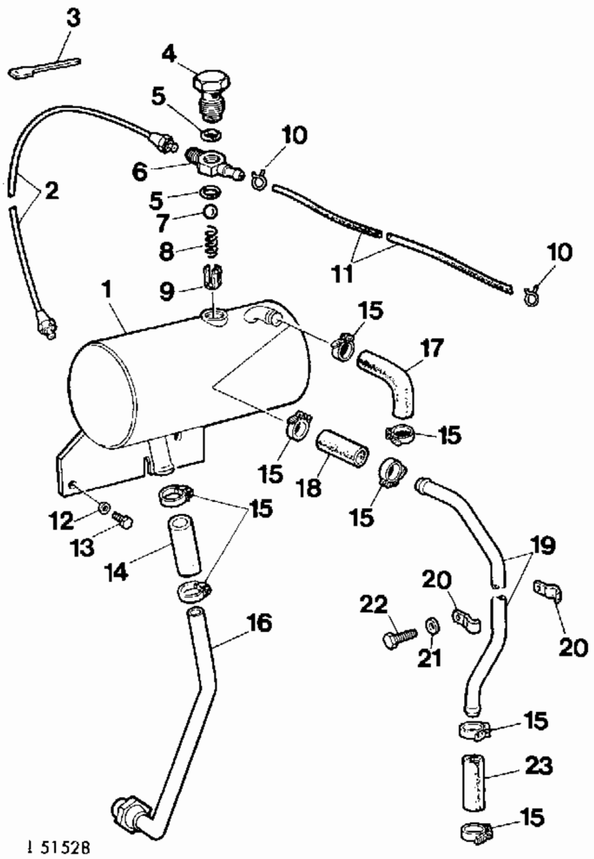

Fig. 8 — Exploded View of Hydraulic Oil Reservoir

1 Hydraulic oil reservoir
2 Leak-off and bleed line
3 Clamping band
4 Hollow screw
5 O-rings
6 Hose adapter
7 Ball
8 Spring
9 Spring guide
10 Hose clip
11 Leak-off and bleed line
12 Washer (3 used)
13 Cap screw (3 used)
14 Hose
15 Hose clamps
16 Oil line
17 Hose (tractors equipped with oil cooler)
18 Hose
19 Oil line
20 Hose clamps
21 Washer
22 Cap screw
23 Hose

(18–23: Tractors not equipped with oil cooler)

REPAIR

Remove check valve (ball 7 and spring 8) together with hollow screw 4 and hose adapter 6. Take care not to knock check valve spring guide 9 against the wall of its bore since this would dislodge it from the assembly so that it could fall, with its ball and spring, into the reservoir.

If the reservoir was removed, carefully clean and rinse out reservoir. Check for leaks and broken seams and replace, if necessary.

OIL COOLER

GENERAL INFORMATION

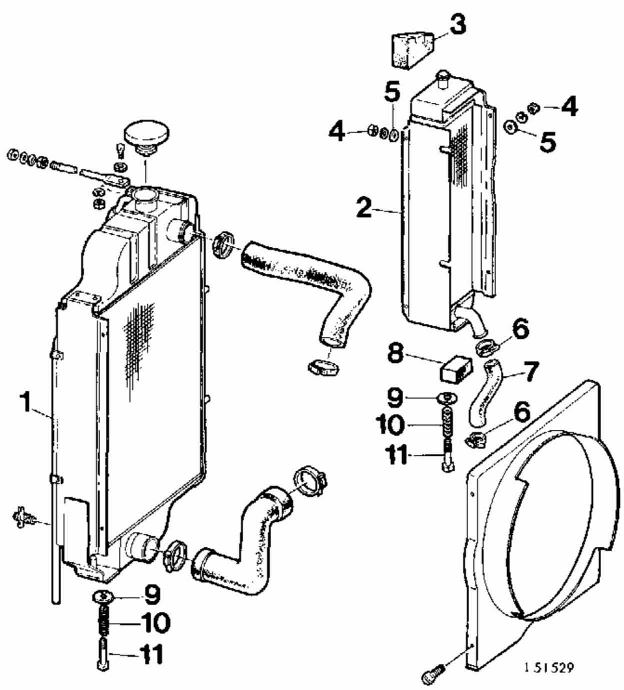

Fig. 9 — Oil Cooler

1 Radiator
2 Oil cooler
3 Foam rubber block
4 Hex.nuts (4 used)
5 Washers (4 used)
6 Hose clamps
7 Hose
8 Foam rubber block
9 Rubber washers
10 Springs
11 Cap screws

The oil cooler prevents heating of oil in the hydraulic system.

FOS

NOTE: For cleaning the oil cooler, follow procedure for cleaning the radiator. See "Fundamentals of Service — Engines" manual.

SPECIFICATIONS

		Dimensions of New Parts
BY-PASS VALVE OF TRANSMISSION OIL FILTER		
Dia. of valve sleeve bore for valve body	0.4995 to 0.5005 in.	12.687 to 12.713 mm
Dia. of valve body	0.4977 to 0.4983 in.	12.440 to 12.557 mm
Valve opens at a pressure differential of	50 psi	3.5 kg/cm^2
Spring of by-pass valve		
Free length	2.56 in.	65 mm
Resilience at a spring length of 1.3 in (33.5 mm)	9.5 to 11.5 lbs.	4.3 to 5.2 kg
RELIEF (SAFETY) VALVE IN CLUTCH HOUSING		
Valve opens at a pressure of	100 to 140 psi.	7 to 10 kg/cm^2
Spring of pressure relief valve		
Free length	1.88 in.	approx. 48 mm
Resilience at a spring length of 1.12 in. (28.5 mm)	30.5 to 37.5 lbs.	13.8 to 17 kg
CHECK VALVE IN INLET LINE TO HYDRAULIC PUMP (Tractors without HIGH-LOW shift unit)		
Spring of check valve		
Free length	0.51 in.	approx. 13 mm
Resilience at a spring length of 0.21 in. (5.3 mm)	0.48 to 0.60 lbs.	0.21 to 0.27 kg
FLOW CONTROL VALVE OF POWER STEERING		
Adjusting pressure of valve	1700 to 1800 psi	118 to 125 kg/cm^2
Dia. of valve spool		
front	0.7497 to 0.7503 in.	19.042 to 19.057 mm
rear	0.7257 to 0.7263 in.	18.433 to 18.477 mm
Spring of flow control valve		
Free length	4.62 in.	approx. 117.5 mm
Resilience at a spring length of 3.5 in. (89 mm)	45 to 55 lbs.	20.5 to 25 kg

Group 15

HYDRAULIC PUMP AND TRANSMISSION OIL PUMP

HYDRAULIC PUMP

(0.69 cu.in. = 11.3 cm^3 and 1.38 cu.in. = 22.6 cm^3)

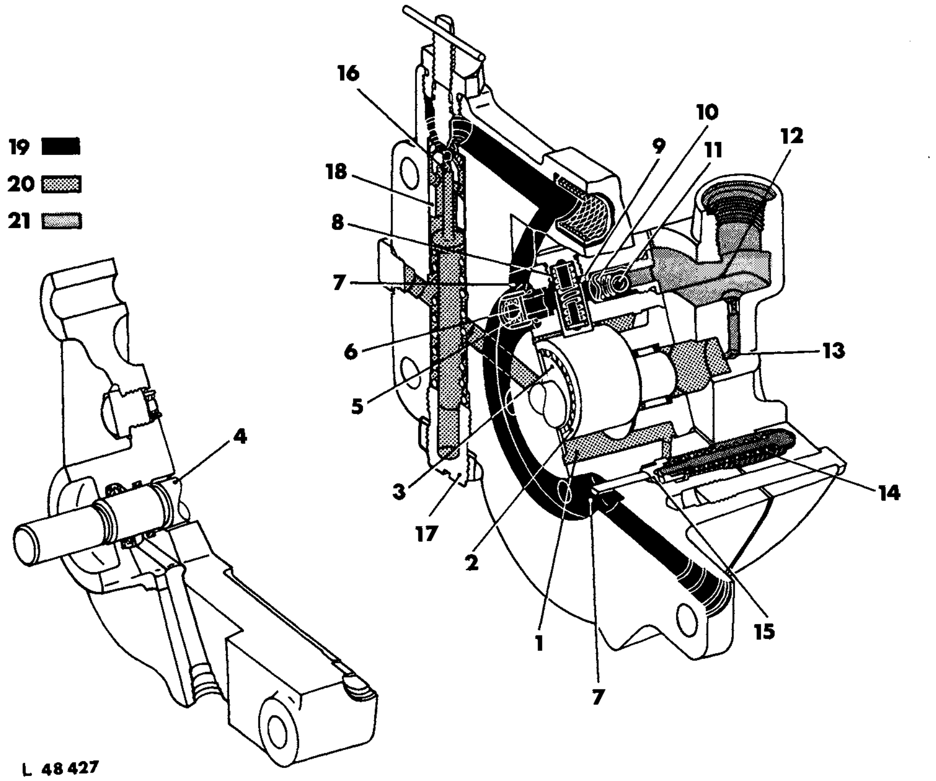

Fig. 1 — Oil Flow in Hydraulic Pump

1 Pump crankcase
2 Race
3 Cam
4 Pump shaft
5 Exhaust valve spring (8 used)*
6 Exhaust valve (8 used)*
7 Pressure outlet gallery
8 Piston spring (8 used)*
9 Piston (8 used)*
10 Intake valve spring (8 used)*
11 Intake valve (8 used)*
12 Intake gallery
13 Bleed hole
14 Crankcase outlet valve spring
15 Crankcase outlet valve
16 Stroke control valve guide
17 Stroke control valve adjusting screw
18 Stroke control valve
19 High pressure oil
20 Medium pressure oil
21 Low pressure oil

* Only 4 used on the = 0.69 cu.in. (11.3 cm^3) pump

GENERAL INFORMATION

The hydraulic pump is a piston type, constant pressure pump with variable displacement, mounted ahead of the radiator and driven by the engine crankshaft through a coupling and drive shaft.

The tractor can be equipped with a 0.69 cu.in. (= 11.3 cm^3) pump (4-piston type), or with a 1.38 cu.in. (= 22.6 cm^3) pump (8-piston type).

The pump shaft has a cam machined as an integral part. A race mounted on bearing needles is positioned around the cam for actuating pistons, located radially around the race.

The pump has a stroke control valve with adjusting screw for setting proper system pressure.

For a detailed description of the pump and its operation see "Fundamentals of Service — Hydraulics" manual under "RADIAL PISTON PUMPS".

PUMP TESTS AND DIAGNOSING MALFUNCTIONS

See group 5 for diagnosing malfunctions, as well as for testing of the hydraulic pump before removal.

REPAIR

REMOVAL AND DISASSEMBLY

NOTE: Servicing is identical for both the 0.69 cu.in. (11.3 cm^3) pump (4-piston type) and the 1.38 cu.in. (22.6 cm^3) pump (8-piston type).

Individual parts of both pump types, except for the pump housing, are the same, the difference being in the quantity of various parts.

Disconnect oil lines from pump and remove pump.

Before disassembling the pump, check pumpshaft end play by means of a dial indicator. Excessive shaft end play may be an indication of worn thrust washers.

When disassembling pump, proceed as follows:

1. Remove cover from pump housing. Remove seat and spring from crankcase outlet valve, (see fig. 4). Using a magnetic pick-up tool, remove valve stop and pin from outlet valve bore in housing.

2. While holding pumpshaft race in place, pull shaft from pump housing.

IMPORTANT! The race is supported by 33 bearing needles. They will fall free when shaft is removed — do not lose them.

Keep pistons, springs, spring seats, valves and plugs in good order so that they can be reinstalled in the bores from which they were removed.

3. Remove the piston bore plugs. Slip piston springs, spring seats and pistons from bores.

Remove race and inner thrust washer.

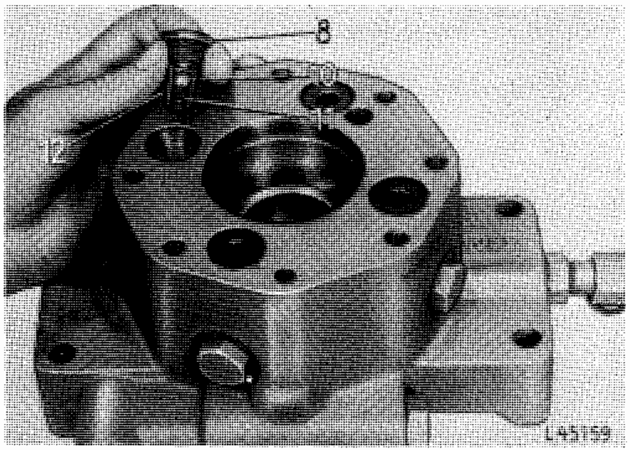

Fig. 2 — Removing Intake Valve Assemblies (0.69 cu.in. = 11.3 cm^3 pump shown)

8 Valve seat
10 Ball
11 Spring
12 Valve guide

4. Remove intake valve assemblies (see fig. 2).

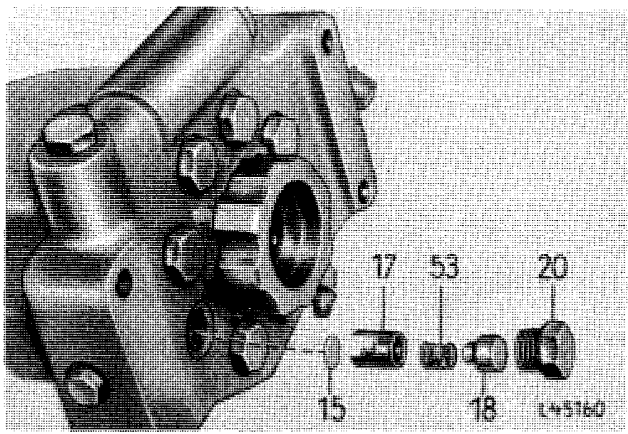

Fig. 3 — Removing Exhaust Valves

15 Valve disk
17 Valve guide
18 Valve stop
20 Plug
53 Valve spring

5. Turn pump housing over (see fig. 3). Remove exhaust valve plugs 20 and exhaust valve assemblies.

6. Remove plug of stroke control valve and slide filter screen from pump housing. Remove stroke control valve adjusting screw, spring, spring seat, and valve stop from housing bore (see fig. 4).

INSPECTION

Pump Housing (Fig. 4)

1. Check clearance between finished face of pump housing and shoulder of cam and race bore. Wear at this point will give pump shaft excessive end play.

2. Check needle sleeve in pump housing for wear or damage. When replacing it, take care that finished face of pump housing will not be damaged. Drive in needle sleeve by means of driver No. 19.58-90.272 so that its face is 0.02 in. (0.5 mm) inside face of pump housing.

3. Measure pump housing bore at groove for pump shaft packing 25. Wear at this point may cause crankcase oil leaks, slowing down the reaction of the pump. Replace packing 25 whenever pump shaft is removed. Check piston bores in housing for scores.

Pistons and Springs (Fig. 4).

1. Check pistons 46 for scoring or pitted faces.

2. Replace O-rings 9 of plugs 20 on piston bores each time the plugs are removed from housing.

3. All piston springs should be matched within certain tolerances (see specifications at the end of this group).

Valves (Fig. 4)

Inspect intake valves for damaged springs 11, valve guides 12, balls 10 and valve seats 8. Replace O-rings 9 of valve seats.

Check exhaust valve disks 15 for wear or damage and check their diameter. Examine valve guides 17, springs 53 and valve stops 18 for damage and replace, if necessary. Replace O-rings 9 of plugs.

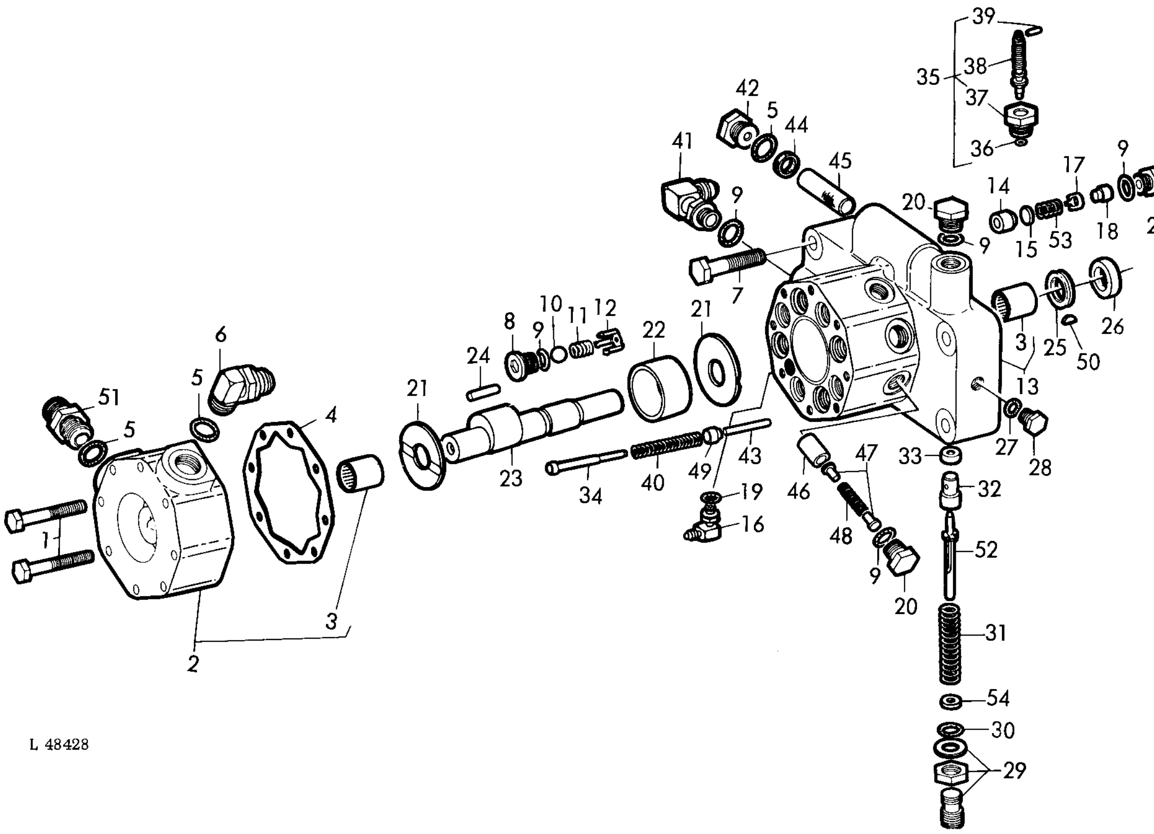

Fig. 4 — Parts of Hydraulic Pump (1.38 cu.in. = 22.6 cm^3 pump shown)

1 Cap screw (8 used)
2 Pump cover
3 Needle sleeves
4 Gasket
5 O-Rings
6 Elbow
7 Cap screw
8 Intake valve seat (8 used)*
9 O-Rings (26 or 18 used)
10 Ball (8 used)*
11 Intake valve spring (8 used)*
12 Valve guide (8 used)*
13 Pump housing
14 Exhaust valve seat (8 used)*
15 Valve disk (8 used)*
16 Elbow
17 Valve guide (8 used)*
18 Valve body (8 used)*
19 O-Ring
20 Plugs (17 or 13 used)
21 Thrust washer
22 Race
23 Pump shaft
24 Bearing needle (33 used)
25 Packing
26 Seal
27 O-Ring
28 Plug
29 Stroke control valve adjusting screw
30 O-Ring
31 Stroke control valve spring
32 Stroke control valve stop
33 Stroke control valve seat
34 Crankcase outlet valve spring seat
35 Hydraulic pump shut-off parts
36 O-Ring
37 Threaded bushing
38 Shut-off screw
39 Spring pin
40 Crankcase outlet valve spring
41 Elbow
42 Plug
43 Crankcase outlet valve pin
44 Seal ring (2 used)
45 Filter element
46 Piston (8 used)*
47 Piston spring seats (16 or 8 used)
48 Piston spring (8 used)*
49 Crankcase outlet valve stop
50 Woodruff key
51 Connector
52 Stroke control valve guide
53 Exhaust valve spring (8 used)*
54 Washer

* Only 4 used on the 0.69 cu.in. (= 11.3 cm^3) pump

Check condition of valve seats 14 pressed into exhaust valve bores. If necessary, drive in new seats with shoulder facing driver (see fig. 5) so that the face of valve seat is 1.171 in. (29.75 mm) below housing bore recess (see fig. 5, item 1). When driving in valve seats, use a driver which exerts pressure only on valve seat shoulder.

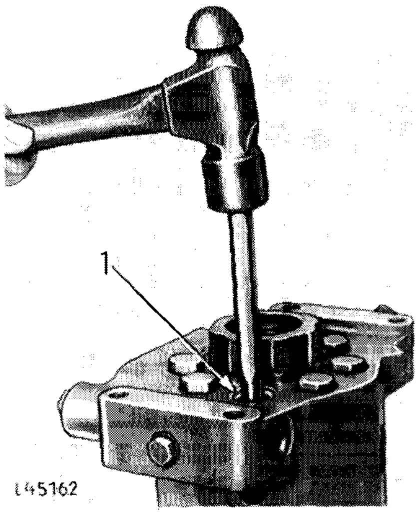

Fig. 5 — Installing Outlet Valve Seat

1 Recess of outlet valve bore

Check tension of intake and exhaust valve springs (see specifications).

Inspect stroke control valve stop 32 for damage or rough spots which might prevent valve from sealing properly. Clean valve stops with a polishing cloth. Do not use lapping agent.

Check spring 31 for damage or insufficient tension. (see specifications).

Check stroke control valve seat 33 for damage or wear and replace, if necessary. Drive in new seat with chamfered end first until it bottoms in valve bore.

Clean stroke control valve filter element 45 thoroughly. Replace seal rings 44 on each end of filter element whenever the pump is disassembled.

Check crankcase outlet valve stop 49, valve pin 43, spring seat 34 and spring 40 for damage. Check spring tension (see specifications).

Pump Shaft (Fig. 4)

Inspect pump shaft for pitting or scoring.

Inspect bearing needles 24 for wear or scores. Worn thrust washers will give pump drive shaft excessive end play. Check the thickness of a thrust washer (see specifications).

Pump Cover (Fig. 4)

Inspect needle sleeve 3 in pump cover 2 for wear or damage. Drive in new needle sleeve by means of driver No.19.58 - 90.272 so that its face is 0.02 in (0.5 mm) inside face of pump cover.

Inspect pump cover for cracks or other damage.

Pump Drive Assembly (Fig.6).

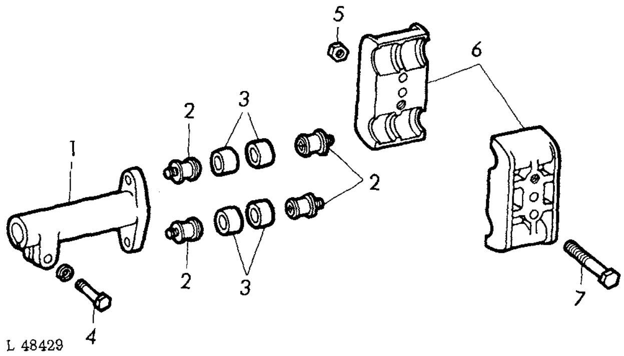

Fig. 6 — Pump Drive Parts

1 Pump drive shaft
2 Special screws
3 Rubber grommets
4 Cap screw
5 Hex. nut (2 used)
6 Coupler halves
7 Cap screw (2 used)

Remove the coupler halves 6 and check the rubber grommets 3 for wear or damage.

ASSEMBLY AND INSTALLATION (Fig.4)

NOTE: Install new O-rings and seal rings. Dip all O-rings, oil seals, valves, guides and bearing needles into clean transmission oil (as used for tractor), before assembly.

Install pump shaft seal 25 into housing. Drive in oil seal 26 with suitable driver (printed side outward). Use driver which contacts outer metal rim of seal only and drive to bottom of chamfer in oil seal groove.

Place a thrust washer 21 in pump housing with oil grooves facing housing. Install bearing race on top of washer.

Install bearing needles 24 around inner surface of race 22 - grease needles to hold them in place. Install pump shaft 23 with grooved end (for seating Woodruff key) first in pump housing.

NOTE: Make sure all 33 needles are installed in race.

Install pistons 46, piston spring seats 47, piston springs 48 and plugs 20. Tighten plugs to recommended torque.

Install O-rings 9 on top of intake valve seats 8. Assemble valve seat 8, ball 10, spring 11 and valve guide 12 of each intake valve. Screw valve assemblies into pump housing bores and tighten securely.

Slip crankcase outlet valve pin 43 into outlet valve bore in housing. Install crankcase outlet valve stop 49 (closed side first), spring 40 and spring seat 34 in outlet valve bore. Install second thrust washer 21 with oil grooves facing outside.

Place new gasket 4 on pump housing and install pump cover 2. Simultaneously insert protruding end of crankcase outlet valve assembly into mating hole of pump cover.

Dip attaching screws 1 of pump cover in oil and tighten first crosswise to a given torque, then to the final torque (see specifications).

Make sure exhaust valve seats 14 are pressed into mating holes of pump housing. Assemble valve disk 15, spring 53, exhaust valve stop 18 and guide 17 of each outlet valve. Install exhaust valve assemblies in bores. Tighten exhaust valve plugs 20 securely. Install stroke control valve filter element 45. Make sure seal rings 44 are in place on ends of filter element.

Insert stroke control valve stop 32 (small diameter first) in valve bore. Install valve guide 52 (small end first) in valve 32. Place spring 31 over valve guide 52. Install stroke control adjusting screw 29 with O-ring 30.

Pump Drive Installation (Fig.6)

Use some drops of Loctite Sealant on threads of both special screws 2, install special screws in crankshaft pulley and tighten to recommended torque. Slip rubber bushes 3 on special screws. Slip the 2 remaining rubber bushes 3 on the two other special screws 2. Use some drops of Loctite Sealant on threads and turn both screws into hydraulic pump drive shaft 1. Tighten to the recommended torque.

Secure pump drive shaft 1 to crankshaft pulley, using coupler halves 6, two cap screws 7 and self locking hex. nuts 5. Tighten two coupler screws 7 only after hydraulic pump has been installed (the two coupler halves should rest loosely on the special screws 2).

Installing Hydraulic Pump

Place Woodruff key in pump shaft groove and insert pump shaft in drive shaft assembly.

Fasten pump to front support and tighten four cap screws to recommended torque.

With pump secured to front support, arrange pump drive coupler halves so that they only contact the rubber bushes, but not the special screws.

Tighten two cap screws 7 (fig. 6) of coupler halves 6 alternately to specified torque — then re-tighten alternately to specified torque. Tighten two lock nuts 5 to the specified torque. Then tighten cap screw 4 of pump drive shaft 1 to specified torque.

Connect oil lines to hydraulic pump.

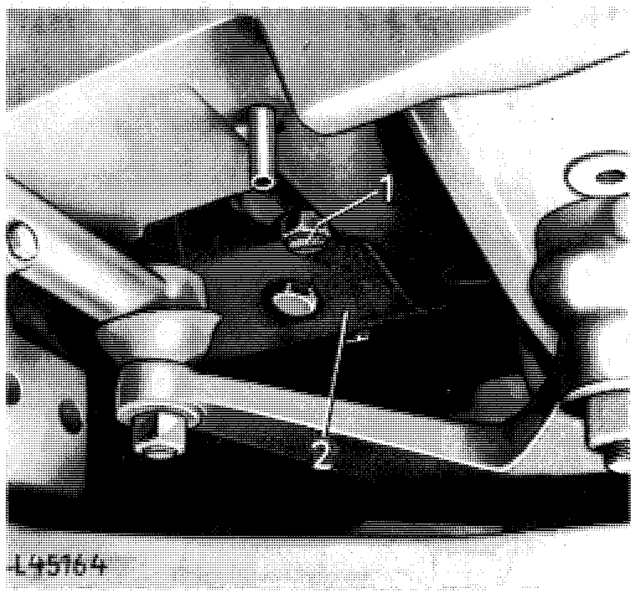

Fig. 7 — Stroke Control Valve Adjusting Screw

1 Adjusting screw
2 Hydraulic pump

ADJUSTMENT

Install a high pressure gauge as explained in group 5.

Set all hydraulic controls in neutral and place the transmission range shift lever in park or neutral position. Apply the handbrake. Start the engine and run at the rated speed.

Back off stroke control valve adjusting screw 1 (fig. 7) until spring pressure on screw is completely relieved. Then turn adjusting screw in until pressure gauge shows specified stand-by pressure (see specifications). Hold adjusting screw and tighten lock nut.

Run engine for approx. 5 - 10 minutes, then recheck adjustment.

TRANSMISSION OIL PUMP

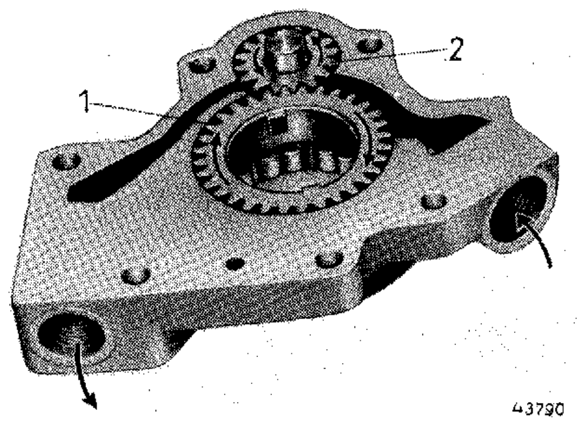

Fig. 8 — Transmission Oil Pump, Pump Housing and Gears

1 Drive gear 2 Driven gear

GENERAL INFORMATION

The transmission oil pump is a gear-type pump. It is mounted on the rear wall of the clutch housing and is driven at engine speed by the hollow power drive shaft.

The pump supplies oil to the HIGH-LOW unit (if equipped), independent PTO (if equipped), and the hydraulic pump. It also delivers oil for lubricating the HIGH-LOW unit and shift transmission.

FOS *For a detailed description of the pump and its operation see "Fundamentals of Service — Hydraulics" manual under "GEAR PUMPS".*

DIAGNOSING MALFUNCTIONS

See group 5 for diagnosing malfunctions.

REMOVAL

Separate transmission from clutch housing (see section 10, group 25).

On machines equipped with HIGH-LOW unit: Remove oil distributor and oil lines of HIGH-LOW unit (see section 50, group 10).

On machines equipped with independent PTO: Remove oil manifold and lines of independent PTO (see section 50, group 10).

Remove transmission oil pump suction and pressure lines and remove pump with pump cover.

REPAIR

Separate cover from pump housing and take out pump gears. Check all parts for wear or scoring. Check the grooves of the hollow power drive shaft which engage the keys of the pump drive gear. Check roller bearing.

Install gears in pump housing. Insert drive gear, with recess on driving lugs of gear in front, into pump housing. Attach cover to pump housing. Do not tighten bolts yet.

INSTALLATION

Install transmission oil pump with cover and tighten four cap screws securing pump cover to clutch housing, to the specified torque.

On machines equipped with HIGH-LOW unit: Install oil distributor and all oil lines of HIGH-LOW unit (see section 50, group 10).

On machines equipped with independent PTO: Install oil manifold and all oil lines of PTO (see section 50, group 10).

Tighten cap screws securing transmission oil pump housing, HIGH-LOW unit oil distributor (if installed) and oil manifold of independent PTO (if installed) to pump cover, to the specified torque.

SPECIFICATIONS

	Dimensions of new parts	
HYDRAULIC PUMP		
Finished housing face to bottom of crankcase bore (where cam and race move)	2.660 - 2.666 in	67.564 - 67.736 mm
Dia. of pump housing bore at groove for pump shaft packing	1.011 - 1.013 in	25.675 - 25.725 mm
Dia. of pump housing bore for pump shaft seal ring	1.498 - 1.500 in	38.05 - 38.10 mm
Dia. of pump shaft bearing bore in pump housing and cover (where needle sleeves are located)	1.3120 - 1.3130 in	33.325 - 33.350 mm
Dia. of piston bores in housing	0.6802 - 0.6808 in	17.277 - 17.292 mm
O.D. of pistons	0.6795 - 0.6799 in	17.259 - 17.269 mm
Bore dia. for exhaust valves	0.624 - 0.626 in	15.85 - 15.90 mm
O.D. of exhaust valve seat	0.6275 - 0.6285 in	15.938 - 15.964 mm
Dia. of exhaust valve disk	0.609 - 0.611 in	15.47 - 15.52 mm
Intake valve springs Tension at a length of 0.31 in (7.8 mm)	0.31 - 0.39 lbs.	150 - 178 g
Exhaust valve springs Tension at a length of 0.30 in (7.6 mm)	2.54 - 3.14 lbs.	1.2 - 1.4 kg
Bore dia. for crankcase outlet valve stop	0.4990 - 0.5010 in	12.675 - 12.725 mm
O.D. of crankcase outlet valve stop	0.4978 - 0.4988 in	12.644 - 12.670 mm
Crankcase outlet valve spring Tension at a length of 2.06 in (52.4 mm)	44 - 54 lbs.	20 - 24,5 kg
Diameter of pump shaft cam	1.4870 - 1.4875 in	37.770 - 37.783 mm
I.D. of cam race	1.8004 - 1.8010 in	45.730 - 45.745 mm
O.D. of cam race	2.235 - 2.245 in	56.769 - 57.023 mm
Thickness of thrust washer	0.087 - 0.091 in	2.21 - 2.31 mm
O.D. of stroke control valve seat	0.7045 - 0.7055 in.	17.894 - 17.920 mm

HYDRAULIC PUMP-Continued

		Dimensions of new parts
Bore dia. for stroke control valve seat	0.7015 - 0.7025 in	17.818 - 17.844 mm
O.D. of stroke control valve stop	0.743 - 0.745 in	18.87 - 18.92 mm
Bore dia. for stroke control valve stop	0.750 - 0.752 in	19.05 - 19.10 mm
Stroke control valve spring Tension at a length of 2.5 in (63.5 mm)	158 - 192 lbs.	72 - 87 kg
Piston springs Spring tension tolerance allowed at a length of 1.25 in (31.8 mm)	0.15 lbs.	68 g
Pump shaft end play	0.004 - 0.038 in	0.1 - 0.9 mm

TRANSMISSION OIL PUMP

Dia. of driven gear shaft	0.6240 - 0.6250 in	15.850 - 15.875 mm
O.D. of driven gear	1.6940 - 1.6950 in	43.027 - 43.053 mm
I.D. of driven gear bushing	0.6265 - 0.6275 in	15.913 - 15.939 mm
Thickness of driven gear	0.5075 - 0.5095 in	12.891 - 12.941 mm
O.D. of drive gear	3.0288 - 3.0308 in	76.932 - 76.982 mm
Bore dia. of drive gear	1.9965 - 1.9800 in	49.940 - 50.060 mm
Thickness of drive gear	0.5075 - 0.5095 in	12.891 - 12.941 mm
Width of drive gear keys	0.2834 - 0.2934 in	7.19 - 7.45 mm
Play between pump housing and gears	0.004 - 0.008 in	0.1 - 0.2 mm
O.D. of hollow power drive shaft	1.9651 - 1.9657 in.	49.914 - 49.929 mm

TORQUES FOR HARDWARE

HYDRAULIC PUMP		Dimensions of new parts
Piston plugs	100 ft.lbs.	14 mkg
Pump cover to pump housing, cap screws		
1st stage	14.5 ft.lbs.	2 mkg
2nd stage	36 ft.lbs.	5 mkg
Pump to front support, cap screws	85 ft.lbs.	11.7 mkg
Pump drive shaft attaching screw	32 ft.lbs.	4.4 mkg
Special screws for pump drive in crankshaft V-belt pulley	35 ft.lbs.	4.8 mkg
Special screws in pump drive shaft	35 ft.lbs.	4.8 mkg
Pump drive coupler halves, cap screws	25 ft.lbs.	3.4 mkg
Hex. nuts for coupler halves, cap screws	25 ft.lbs.	3.4 mkg
TRANSMISSION OIL PUMP		
Pump cover to clutch housing, cap screws	35 ft.lbs.	4.8 mkg
Oil distributor (on machines with HIGH-LOW unit), oil manifold (on machines with independent PTO) and pump housing to pump cover, cap screws	35 ft.lbs.	4.8 mkg

CAPACITIES

Hydraulic pump capacity per revolution of pump shaft		
4-piston pump	0.69 cu.in.	11.3 cm^3
8-piston pump	1.38 cu.in.	22.6 cm^3
Hydr. pump capacity at 2500 rpm engine speed and 2050 psi (144 kg/cm^2) operating pressure		
4-piston pump	5.4 Imp.gals/min. 6.5 US. gals/min.	24.6 lit./min.
8-piston pump	10.8 Imp.gals/min. 13 US.gals/min	49 lit./min.
Stand-by pressure	2220 - 2280 psi	156 - 160 kg/cm^2
Transmission oil pump capacity at 2500 rpm engine speed	6.6 Imp.gals/min 8 US gals/min	30.3 lit./min

SPECIAL TOOLS

Part number when ordering from JD-Parts Depot	Manufacturer	Description	Use
L 48521	813*	Mandrel	Driving in needle sleeves of hydr. pump
19.58-90.272		Driver	as above
19.58-90.260**		Special tool	Checking oil pressure

* SERVICE TOOLS INC., 1901 INDIANA AVENUE, CHICAGO, ILLINOIS 60616, USA
** For details, see group 5

Group 20
ROCKSHAFT

GENERAL INFORMATION

The rockshaft with three-point hitch serves to raise and lower implements.

The load selector lever (see 12, fig. 1) is located to the right of the tractor seat. It will obtain three types of control: Depth (d), load-and-depth (LD), and load (L) as well as two intermediate positions: one between "D" and "LD", the other between "LD" and "L". This allows optimum adjustment to varying soil conditions. When the system is set for float position, the 3-point hitch will move freely.

When the system is set for depth control (selector lever in position D), the position of the rockshaft is in direct relation to the position of the control lever on the quadrant.

In either load control (L) or load-and-depth control (LD), the rockshaft control valves receive signals from the draft links of the 3-point hitch. The draft links are connected directly to the load control shaft positioned through the bottom rear of the transmission case on tapered bushings. Variation of pull on the draft links deflects the load control shaft. This deflection is picked up by the load control arm and transmitted to the rockshaft valve linkage.

The lowering speed of the rockshaft and implement is regulated by the rate-of-drop screw located on top of the rockshaft housing.

A relief valve in the rockshaft housing relieves thermal expansion of oil in the rockshaft assembly, thus preventing build-up of extreme pressures.

The three-point hitch of the tractor is designed for category II implements. It is available in a standard version or reinforced version, the latter having telescopic draft links. The standard version can be converted to category I implements by installing bushings (see Operator's Manual).

NEUTRAL POSITION

Inset "a" of fig. 1 shows the rockshaft in neutral position.

Pressure oil from the main hydraulic pump, entering through oil passage 1 and flow control valve 16 reaches pressure valve 2. Rockshaft cylinder and discharge valve 3 are filled with oil. Note that check ball 15 retains trapped oil in the cylinder, preventing rockshaft from settling.

RAISING THE ROCKSHAFT (DEPTH CONTROL)

Move load selector lever 12 (fig. 1) to position "D" (depth control). This moves load selector link and roller 5 to the top of cam follower 6. The cam follower in turn rides against the rockshaft cam 7 which is attached to the rockshaft. The rockshaft cam closes pressure valve 2 through valve linkage when the lift arms are raised to top position.

When the rockshaft control lever 13 is moved to the rear, the valve linkage moves pressure valve 2 from valve seat 18, against spring and oil pressure behind damping sleeve 17.

If the lift arms are to be raised only a small amount, move the control lever just enough to "crack" the valve from its seat. Pressure oil flows from pressure valve 2 into a passage connected with the rockshaft cylinder where it unseats check ball 15 and flows into the cylinder. The oil now forces the piston rearward, causing piston rod and crank arm to rotate the rockshaft and lift arms upward.

As the rockshaft rotates, the rockshaft cam 7 moves the cam follower 6 and load selector link and roller 5 forward. This motion is transmitted through the valve linkage, closing the pressure valve 2 and completing the depth cycle.

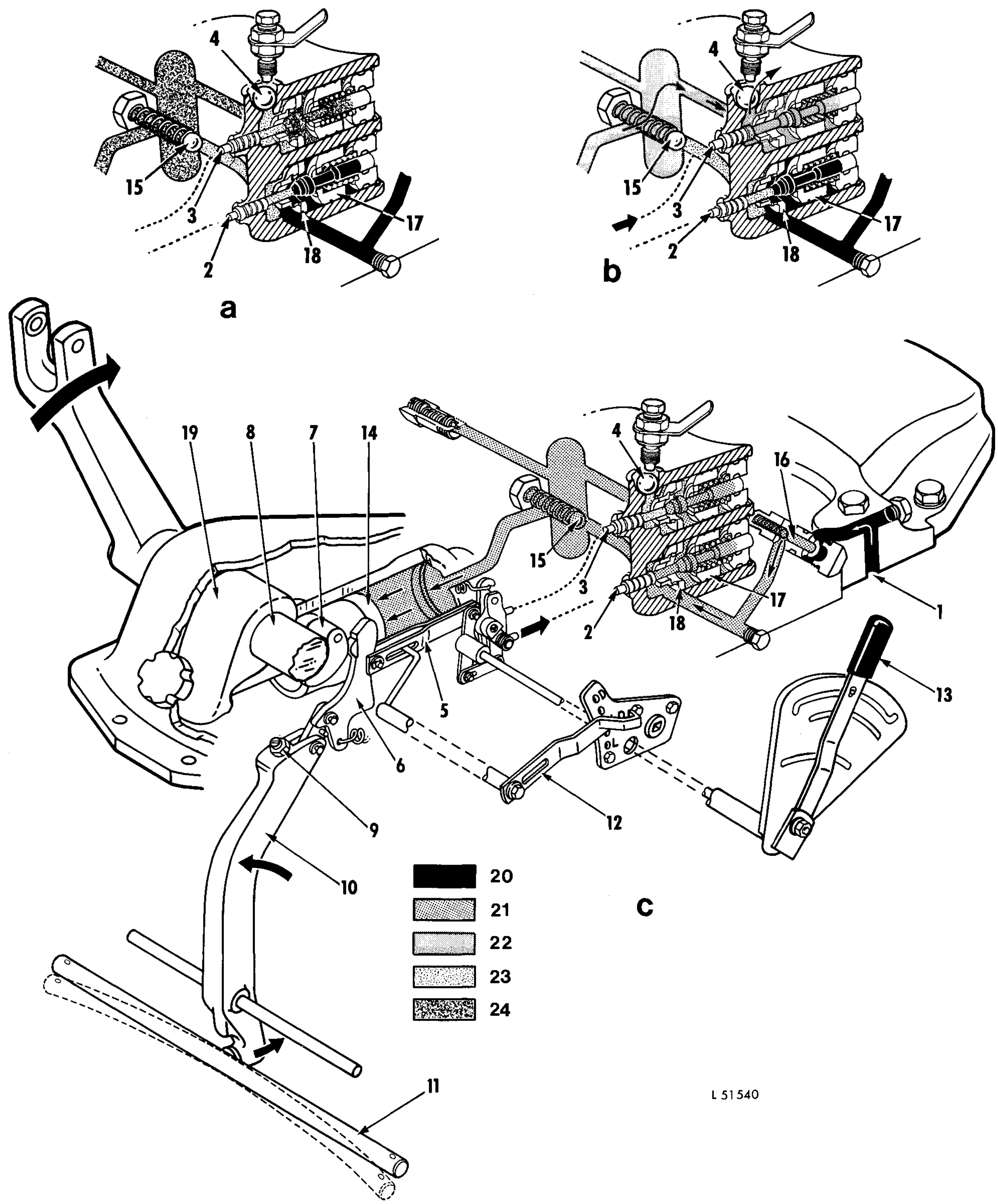

Fig. 1 — Oil Flow in Rockshaft Unit

a Neutral position
b Lowering (depth control)
c Load-and-depth control
1 Oil inlet
2 Pressure valve
3 Discharge valve
4 Rate-of-drop ball
5 Load selector link with roller
6 Cam follower
7 Rockshaft cam
8 Rockshaft
9 Adjusting screw of cam follower
10 Load control arm
11 Load control shaft
12 Selector lever
13 Control lever
14 Rockshaft piston
15 Ball
16 Flow control valve*
17 Damping sleeve
18 Pressure valve seat
19 Rockshaft crank arm
20 Pressure oil
21 Pressure oil (system pressure)
22 Discharge oil
23 Pressure-free oil
24 Trapped oil

* Only if equipped with 1.38 cu.in. (22.6 cm^3) pump

Full upward rockshaft movement is limited by the shut-off rod which closes the pressure valve as soon as the rockshaft crank arm 19 is still a specified distance away from the rockshaft housing (see Specifications).

The pressure valve 2 does not close abruptly because of the pressure differential between the front and rear of damping sleeve 17. As pressure oil flows through an orifice in the sleeve, a gradual buildup occurs at the rear of the sleeve, moving the control valve toward valve seat 18 to the closed position. This controlled pressure buildup behind the sleeve results in smooth, precise rockshaft control.

The discharge valve 3 and check ball 15 trap oil in the rockshaft cylinder to keep the lift arms from lowering when rockshaft control lever is moved to neutral.

LOWERING THE ROCKSHAFT (Depth Control)

Inset "b" of fig. 1 shows lowering the rockshaft.

If the control lever 13 is moved forward, the valve linkage opens discharge valve 3 and the lift arms are lowered, the distance being determined by the control lever.

As the discharge valve is opened, the weight of the implement on the draft links and lift links rotates the rockshaft and crank arm, moving the piston forward. Return oil under slight pressure moves out of the rockshaft cylinder past the discharge valve. The rate of drop is determined by adjusting special cap screw and ball 4.

As the rockshaft rotates and the lift arms are lowered, the spring-loaded cam follower 6 moves rearward, following the rockshaft cam 7. The valve linkage moves away from discharge valve, closing the valve and completing the lowering cycle when the lift arms have reached the point determined by the position of the control lever.

LOAD CONTROL

Move selector lever 12 (fig. 1) in position "L" (load control). This moves load selector link and roller 5 to bottom of the cam follower 6. The rockshaft valve linkage now becomes independent of the rockshaft cam rotation. Linkage signals now come from the implement acting on the draft links, load control shaft 11 and load control arm 10. Moving the control lever 13 forward repositions the valve linkage to open discharge valve 3 and lowers the rockshaft and implement to the desired working position.

If the control lever is moved to a lower position, the working depth will increase and if the control lever is moved to a higher position the working depth will decrease, resulting in higher or lower load, respectively.

NOTE: The horizontal soil resistance which the implement (e.g. plough) has to overcome automatically maintains a constant load via the mechanical and hydraulic controls.

A change in soil resistance simultaneously leads to a change in the force applied to the draft links. Depending on whether this force is increased or decreased, the load control shaft 11 will react differently. Via the load control arm 10 and the load selector link and roller 5, the lift arms will either be raised or lowered until the soil resistance corresponding to the position of the control lever has again been reached.

The pressure valve 2 and discharge valve 3 will now remain closed until the valves receive a signal that is more or less than the established load.

If the soil resistance increases, the signal is picked up by the load selector link and roller 5 which is moved rearward to open pressure valve 2 and raise the lift arms. As the lift arms are rising and draft is decreasing, the deflection of the load control shaft 11 is lessened and the valve linkage moves forward to a neutral position, allowing the pressure valve to close.

If the soil resistance decreases, the draft signals will by less than required to keep working depth constant. Therefore, the load selector link and roller will be moved forward and will open the discharge valve to lower the lift arms. The lowering cycle will continue until the predetermined load is reached, whereupon the valve linkage will be moved rearward to close discharge valve 3.

LOAD-AND-DEPTH CONTROL

Inset "c" of fig. 1 shows the rockshaft in load-and-depth control position.

Move load selector lever 12 (fig. 1) in position "LD" (load-and-depth control). This moves the load selector link and roller 5 to the center of the cam follower 6. In this position both depth control (via rockshaft cam 7) and load control, caused by the draft load and the deflection of load control shaft 11 transmitted to load selector link 5, will be only partly effective (approx. one half each).

This is due to the fact that the movement transmitted by rockshaft cam 7 to cam follower 6 can cause only approx. one half of the longitudinal movement of the load selector link in depth control since the cam follower is supported in the center by the load selector link. On the other hand, the longitudinal movement of the load selector link caused by load control shaft 11 is only approx. one half the movement in load control.

The mechanical and hydraulic control cycles during raising and lowering of the lift arms and implements and the neutral positions between the raising and lowering cycles are principally the same in "load-and-depth control" as in the other two control systems. They differ only in that both systems are simultaneously effective in every raising or lowering cycle.

The load-and-depth position is the best position for most operations requiring load-compensated depth control.

FLOAT POSITION

For float position of the rockshaft, move load selector lever in position "D" and rockshaft control lever to its most forward position.

In float position the mounted implement can move freely upward. The working depth of the implement is controlled by the appropriate cut and angle and/or by supporting wheels or skids.

DIAGNOSING MALFUNCTIONS

For diagnosing malfunctions see group 5.

REPAIR

Remove rockshaft assembly as explained in section 10, group 25.

NOTE: Before lifting rockshaft off transmission case, move selector lever in position "L".

Disconnect control lever from its shaft. Disconnect selector lever from its shaft. Remove cap screws attaching quadrant to rockshaft housing.

Turn rockshaft assembly upside down.

Drive out spring pin securing pivot pin on lever shaft.

Remove remote cylinder adapter from left side of rockshaft housing.

Unhook valve actuating lever return spring from the special pin fitted in the rockshaft housing.

Loosen adjusting screw of shut-off rod.

Remove cap screw at outside front holding rockshaft cylinder and valve housing and also internal locking screws.

Lift rockshaft cylinder and valve housing off rockshaft housing (the piston rod remains attached to the crank arm and pulls away from the piston); at the same time work load selector arm free of slotted load selector link.

CAUTION: Take care not to lose throttle valve ball as it will fall free.

ROCKSHAFT CYLINDER AND VALVE HOUSING

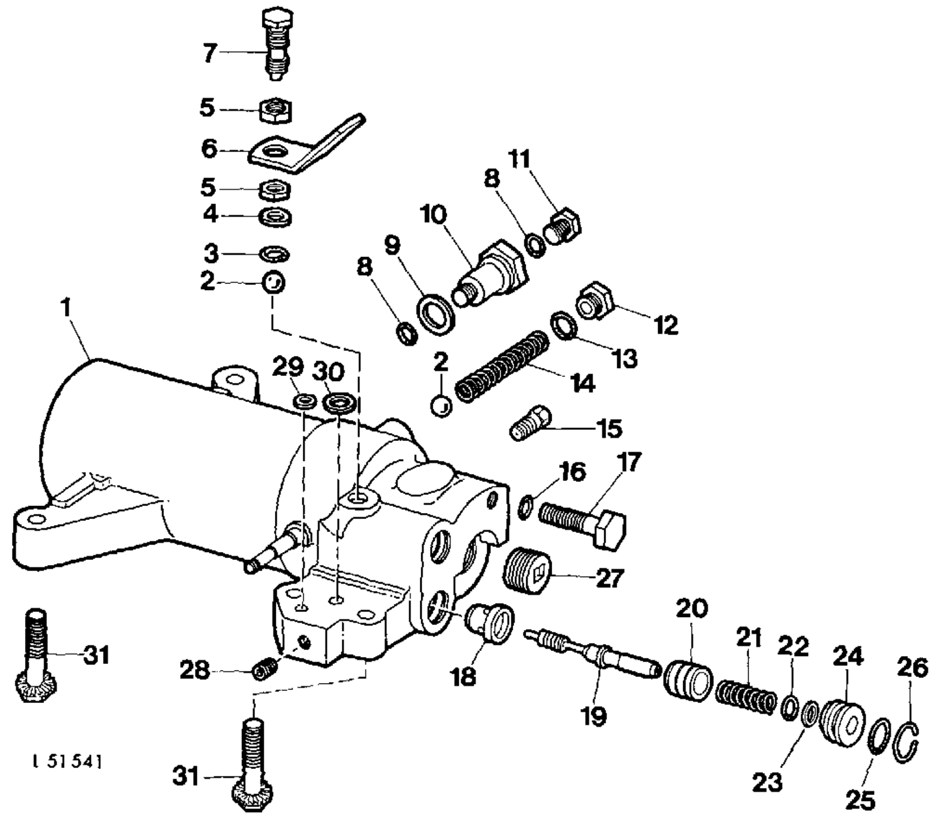

Fig. 2 — Exploded View of Rockshaft Cylinder and Valve Housing

1 Rockshaft cylinder and valve housing
2 Balls
3 O-ring
4 Seal ring
5 Hex. nuts
6 Link
7 Special screw (rate of drop)
8 O-rings
9 Seal
10 Connector for remote hydraulic cylinder
11 Plug
12 Plug
13 O-ring
14 Spring
15 Thermal relief valve
16 Seal ring
17 Cap screw
18 Valve seat (2 used)
19 Valve body (2 used)
20 Damping sleeve (2 used)
21 Valve spring (2 used)
22 O-ring (2 used)
23 Back-up ring (2 used)
24 Plug (2 used)
25 O-ring (2 used)
26 Snap ring (2 used)
27 Plug
28 Plug
29 Seal ring
30 Seal ring
31 Locking screws (4 used)

Pull piston out of rockshaft cylinder.

NOTE: If it is difficult to pull the piston out of cylinder, remove plug 27 (fig. 2) of rockshaft cylinder and drive out piston.

Remove plug 12 (fig. 2) of check valve and take spring 14 as well as ball 2 out of the housing.

Remove relief valve 15.

Remove valve linkage.

Remove snap ring 26 of pressure or discharge valve from groove of valve housing bore. Then take plug 24, spring 21, damping sleeve 20, valve body 19 and valve seat 18 out of housing bore. Remove second valve in the same way.

Store pressure and discharge valve parts separately.

Check rockshaft cylinder and valve housing 1 for cracks and damage as well as piston bore for scoring and wear. Clean all oil channels with compressed air.

Check valve bodies 19 for wear and damage, especially seat face. If discharge valve seat is leaking, lift arms may drop. If pressure valve seat is leaking, lift arms may creep upward.

Check valve seats 18 and damping sleeves 20 for wear and scoring. Replace, if necessary.

Check resilience of valve springs 14 and 21 (see Specifications).

Examine check valve ball 2 for damage and wear. Excessive check ball wear will result in leakage around the ball and thus cause rockshaft settling when engine is shut off.

Check operation of thermal relief valve 15: Connect valve to a nozzle tester with a measuring range up to 5000 psi (350 kg/cm^2) or to a hydraulic hand pump with an appropriate gauge. Raise the pressure slowly. The valve should not open before a pressure of 3500 psi (246 kg/cm^2) has been reached and not after a pressure of 4500 psi (315 kg/cm^2). The valve should close again as soon as pressure has been reduced to 2500 psi (175 kg/cm^2).

Replace all O-rings of plugs. Be sure to replace seal ring of pressure oil inlet bore, too.

ROCKSHAFT CYLINDER AND VALVE HOUSING LINKAGE

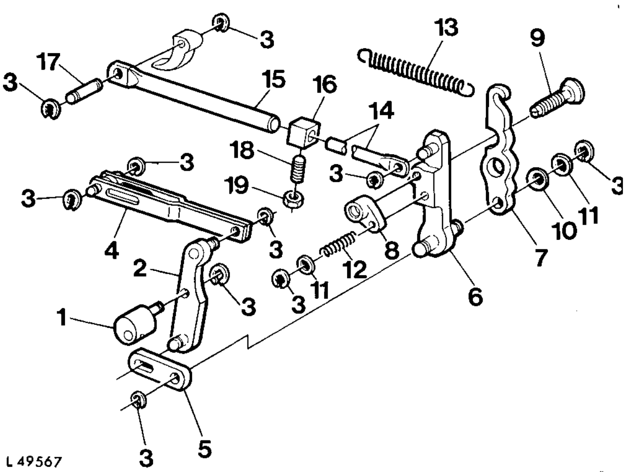

Fig. 3 — Exploded View of Rockshaft Cylinder and Valve Housing Linkage

1 Pivot pin	10 Special washer (convex
2 Arm	11 Washers
3 Snap rings	12 Spring
4 Load selector link with roller	13 Return spring
5 Link	14 Rod
6 Operating link	15 Rod tube
7 Adjusting cam	16 Clamping piece
8 Special nut	17 Pin
9 Special adjusting screw	18 Adjusting screw
	19 Jam nut

Check parts of rockshaft cylinder and valve housing linkage for wear, distortion or deformation.

Check adjusting cam 7 for wear or damage. Wear at cam may make it more difficult to adjust the control lever neutral range. Check all joints for flattened spots or damage.

ROCKSHAFT ASSEMBLY AND LIFT ARMS

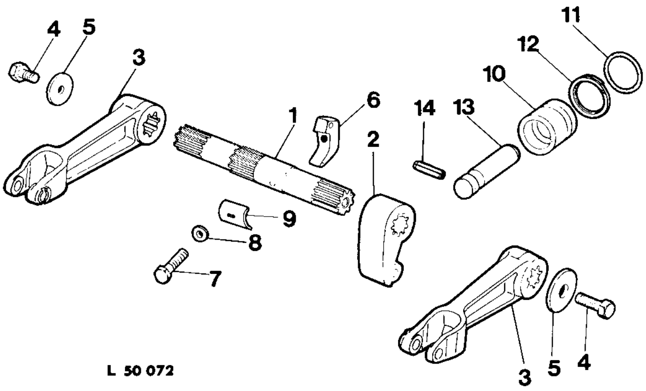

Fig. 4 — Exploded View of Rockshaft Assembly

1 Rockshaft	8 Washer
2 Control arm	9 Spacer plate
3 Lift arms	10 Rockshaft piston
4 Cap screws	11 O-ring
5 Special washers	12 Back-up ring
6 Cam	13 Piston rod
7 Cap screw	14 Spring pin

CAUTION: Before removing the rockshaft, mark position of lift arms 3 (fig. 4) and control arm 2 in relation to rockshaft 1 to facilitate proper reassembly.

Remove lift arms from rockshaft.

Remove cam 6 and spacer 9 from rockshaft. Pull rockshaft out of hydraulic housing. Thereby control arm 2 slides off the rockshaft splines. Remove control arm, rockshaft, back-up rings, O-rings and bushings (see 4, 5 and 6, fig. 5).

Remove spring pin 14 (fig. 4) attaching piston rod 13 to control arm 2 and remove piston rod.

Check rockshaft 1 as well as lift arms 3, especially splines, for wear or other damage and replace, if necessary.

Examine cam 6 and piston rod 13 for damage.

Remove O-ring 11 and back-up ring 12 of piston and discard.

Check piston for scores or excessive wear.

Insert new back-up ring and O-ring in piston groove.

ROCKSHAFT HOUSING ASSEMBLY

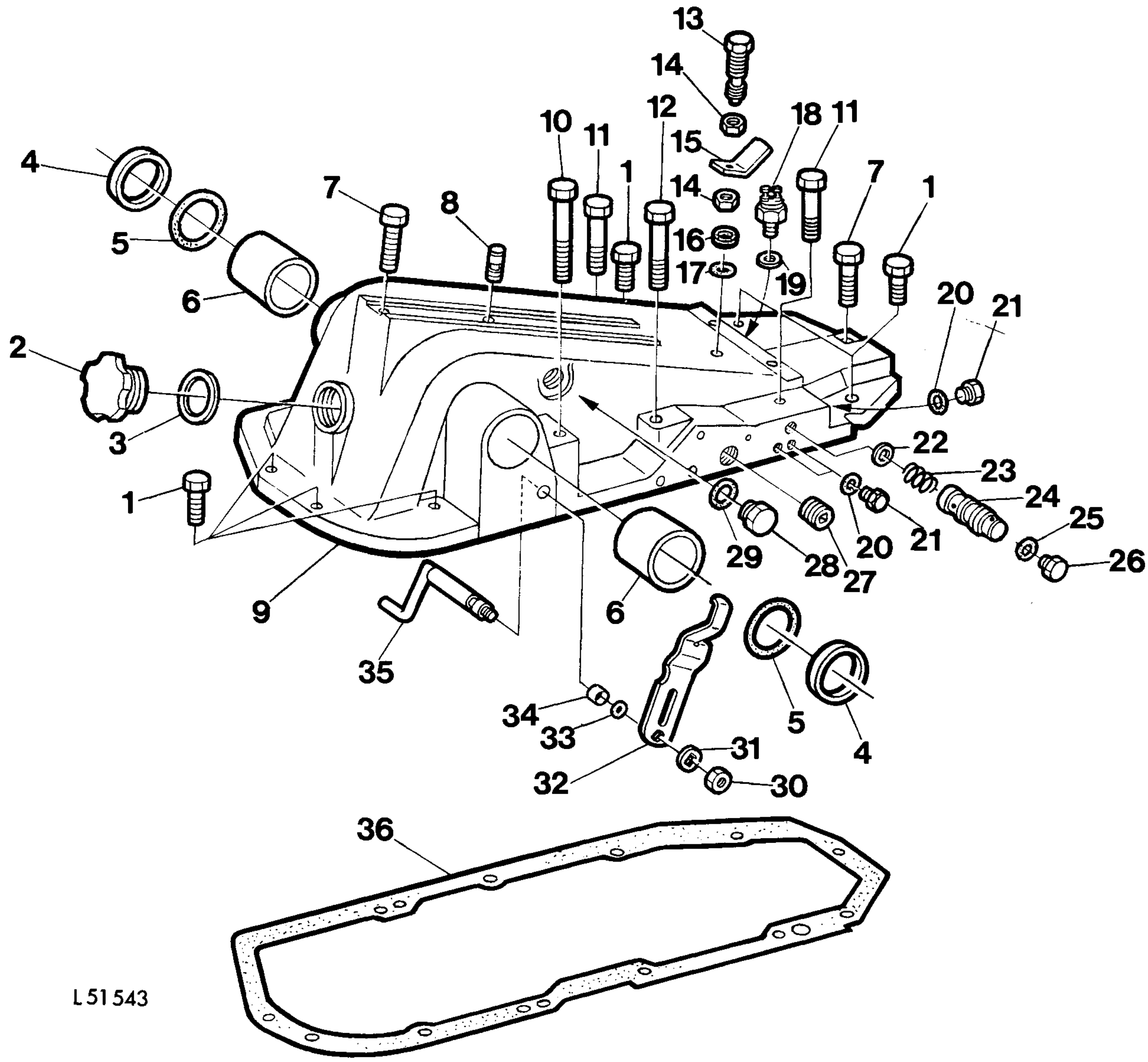

Fig. 5 — Exploded View of Rockshaft Housing

1 Cap screws
2 Oil filler cap
3 Seal ring
4 Back-up rings
5 O-rings
6 Bushings
7 Cap screws
8 Special screw
9 Rockshaft housing
10 Cap screw
11 Cap screws
12 Cap screws
13 Special screw (regulating rate of drop)
14 Lock nuts
15 Clamp
16 Seal ring
17 O-ring
18 Start safety switch
19 Aluminium washer (use as required)
20 O-rings
21 Plugs
22 Shim (use as required)*
23 Spring*
24 Spool of flow control valve*
25 O-ring
26 Plug
27 Plug
28 Plug
29 O-ring
30 Hex. nut
31 Washer
32 Selector lever
33 O-ring
34 Bushing (selector lever shaft)
35 Selector lever shaft
36 Gasket

* Available only if machine is equipped with 1.38 cu.in. (= 22.6 cm^3) hydraulic pump

Check rockshaft housing 9 (fig. 5) for cracks or other damage.

Inspect bushings 6 of rockshaft. If necessary, replace bushings. The new bushings should easily turn in rockshaft housing bores.

Check O-rings 5 of rockshaft. Check if back-up rings 4 are twisted or worn.

Check spool 24 of flow control valve (if equipped) for damage. Renew all O-rings, back-up rings and seal rings.

Check resilience of valve spring 23.

Check bushing 34 of selector lever shaft and replace, if necessary. Press in new bushing so that the end which is not tapered is flush with outer face of rockshaft housing.

ROCKSHAFT CONTROL LEVER AND QUADRANT

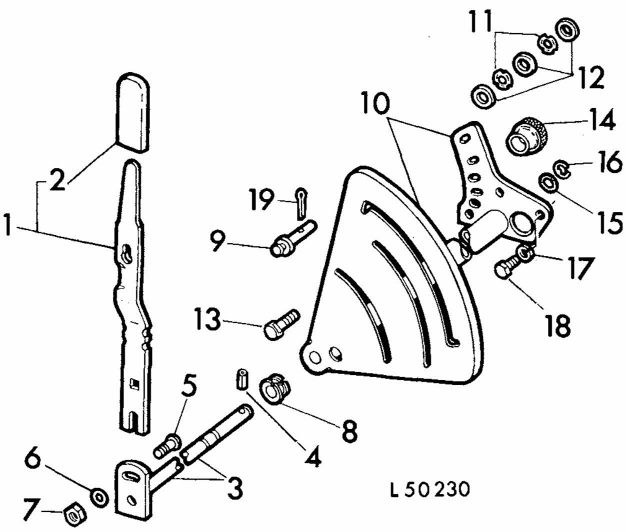

Fig. 6 — Exploded View of Control Lever and Quadrant

1 Control lever
2 Handle
3 Control lever shaft
4 Spring pin
5 Cap screw
6 Washer
7 Hex. nut
8 Bushing
9 Friction pin
10 Quadrant
11 Spring washers
12 Washers
13 Special screw
14 Locking knob
15 O-ring
16 Snap ring
17 Lock washer (3 used)
18 Cap screw (3 used)
19 Cotter pin

Inspect quadrant 10 for damage. If necessary, replace bushing 8. Check control lever shaft 3 for wear. Check serviceability of spring washers 11. If necessary, replace parts.

ASSEMBLY

ROCKSHAFT CYLINDER AND VALVE HOUSING (Fig. 2).

Insert seat 18 of pressure or discharge valve, small end first, in the appropriate valve housing bore. Insert valve body 19, small end first, in its valve seat. Slide damping sleeve 20, tapered end first, and valve spring 21 in bore. Insert O-ring in external groove of plug 24 and install one O-ring and one back-up ring in plug bore. Carefully insert plug 24 in bore of housing, and, at the same time, valve 19 in the plug. Then install snap ring 26.

Install the other valve in the same sequence.

Install back-up ring 12 (fig. 4) and O-ring 11 on rockshaft piston 10.

Coat piston and cylinder with clean transmission oil of the grade used in the tractor and slide piston into cylinder.

Install ball 2 (fig. 2), spring 14 and plug 12 of check valve.

ROCKSHAFT CYLINDER AND VALVE HOUSING LINKAGE (Fig. 3)

Install linkage on bearing pin of rockshaft housing. Make sure linkage moves easily.

ROCKSHAFT ASSEMBLY AND LIFT ARMS (Fig. 4)

IMPORTANT! It is extremely important to observe the marks for identifying the proper position of lift arms and control arm in relation to the rockshaft when assembling.

Guide rockshaft into bushings in the hydraulic housing, pushing the control arm onto the rockshaft splines. Secure cam 6 and spacer plate 9 on rockshaft 1 and piston rod 13 on control arm 2.

CAUTION: Do not tighten cam securing screw 7 until the lift arms have been installed.

Guide new O-rings, covered with grease, over rockshaft and press into grooves in rockshaft housing. Push both back-up rings onto the rockshaft and drive into rockshaft housing, taking care not to damage the O-rings.

Slide lift arms onto rockshaft splines and tighten cap screws to the specified torque.

After installing lift arms and tightening cap screws, slide rockshaft to the left until the right-hand lift arm lies against the rockshaft housing. Then swing control arm 2 to the rear of the rockshaft housing. Position spacer plate 9 so it contacts control arm. Tighten cap screw 7 attaching rockshaft cam and spacer to the specified torque.

INSTALLING ROCKSHAFT CYLINDER AND VALVE HOUSING

Install flow control valve*, using the same number of shims 22 (fig. 5) as removed previously. Insert shims 22 in bore of rockshaft housing. Then install spring 23, valve spool 24 (open end first) and plug 26.

Place seal rings 29 and 30 (fig. 2) on flange of valve housing. Insert seal ring 16 in valve housing bore for front attaching screw 17.

Install rockshaft cylinder and valve housing in rockshaft housing, simultaneously inserting load selector arm in slot of load selector link and piston rod in piston bore.

Install front attaching screw 17 (fig. 2) of valve housing and tighten carefully.

IMPORTANT! Tighten this front attaching screw first, before tightening the four locking screws 31 (fig. 2), to draw rockshaft cylinder and valve housing into proper position in the rockshaft housing.

Tighten rockshaft cylinder and valve housing attaching screw and locking screws to the specified torque.

Hook return spring into special bolt located in rockshaft housing.

Insert rate-of-drop valve ball in rockshaft cylinder bore through tapped hole of rockshaft housing. Install lock nut 5, link 6, second lock nut 5, seal ring 4 and O-ring 3 on special screw 7 as shown in fig. 2. Turn lock nuts sufficiently on special screw 7 so that the O-ring is seated in screw groove.

Turn pre-assembled special screw into rockshaft housing until it is seated on the ball. Turn down lower nut until it starts to compress seal ring 4. Then tighten nut another 1/2 to maximum 1 turn. Place link 6 in extreme right front position and tighten upper nut against link.

Insert control lever shaft 3 (fig. 6) in housing bore and in bore of pivot pin. Secure shaft by means of spring pin 4.

Connect control lever to its shaft.

Connect selector lever to its shaft.

Screw remote cylinder adapter in bore on left side of rockshaft housing.

ADJUSTING UPPER LIFT LIMIT OF LIFT ARMS

Turn rockshaft by moving lift arms until there is a clearance of 0.08 to 0.12 in. (2 to 3 mm) between crank arm and rockshaft housing. Jam a sheet metal strip, 0.08 to 0.12 in. (2-3 mm) thick, between housing and crank arm.

Set valve adjusting cam 7 (fig. 3) with special adjusting screw 9 so that there will be a small gap between one cam and the throttle valve when the pressure valve contacts the other cam, and vice-versa. Lock valve adjusting cam in this position (e. g. by means of a screwdriver inserted between valve housing and cam). Position clamping piece 16 of shut-off rod against tube 15. Tighten adjusting screw 18 and secure with jam nut 19. Remove sheet metal strip inserted between crank arm and housing.

Check adjustment by turning rockshaft so that crank arm moves away from housing, then turn in opposite direction and observe pressure and throttle valves. As soon as clearance between crank arm and housing has narrowed to 0.08-0.12 in. (2-3 mm), the valve adjusting cam must close the pressure valve with the throttle valve just remaining closed.

INSTALLATION

Move selector lever in position "L" (load control). Install rockshaft assembly as explained in section 10, group 25. Tighten screws to the specified torque.

* Only on machines equipped with a 1.38 cu.in. (= 22.6 cm^3) hydraulic pump

ADJUSTMENT

Check oil level before making adjustments on the rockshaft.

Run engine to bring oil to operating temperature.

Check for leaks.

The following is a list of adjustments to be made on the rockshaft after installation on the tractor. They should be made in the order shown below.

1. Load control arm negative stop adjustment
2. Adjustment of rockshaft control lever neutral range
3. Control lever adjustment
4. Load control adjustment
5. Rate-of-drop adjustment

NOTE: Before adjusting rockshaft, make a preliminary adjustment of rate-of-drop valve as follows: Turn down on special adjusting screw so that the ball is pressed on its seat, then back off one turn.

(1) LOAD CONTROL ARM NEGATIVE STOP ADJUSTMENT

If the load control arm negative stop screw has been backed off, adjust load control arm as described below under "Load Control Adjustment".

IMPORTANT: If the load control arm negative stop screw is not adjusted correctly, this will adversely affect the remaining adjustments.

(2) ROCKSHAFT CONTROL LEVER NEUTRAL RANGE ADJUSTMENT

The rockshaft control valve linkage must be adjusted to obtain a clearly defined neutral range for the rockshaft control lever (see Specifications). This is obtained by setting a specified clearance between the valve adjusting cam and the valves.

Adjust as follows:

Remove plug 4 (fig. 8) from rockshaft housing.

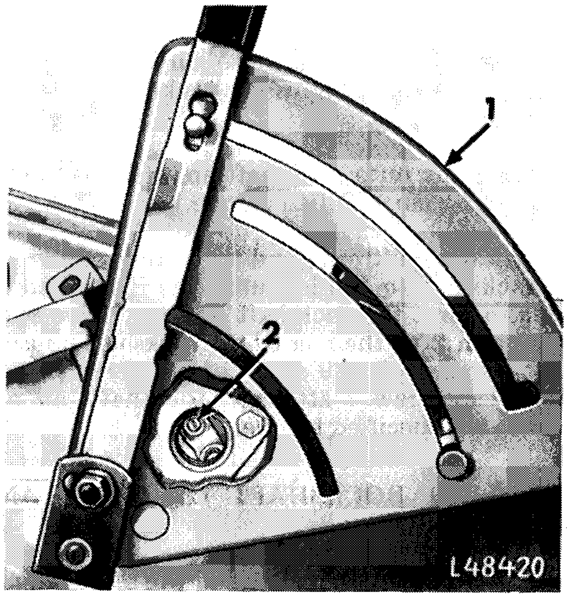

Fig. 7 — Adjusting Valve Linkage and/or Control Lever Neutral Range

1 Upper quadrant rim
2 Adjusting screw

Run engine at 2000 rpm and move load selector lever to position "D". Pull control lever back until lift arms just start to move upward. Mark this position on the upper quadrant rim 1 (fig. 7). Advance control lever until the lift arms just begin to settle. Mark this position, too, on the quadrant rim. The distance between these two marks is the rockshaft control lever neutral range. For proper neutral range see Specifications.

If necessary, reduce control lever neutral range, and consequently valve clearance, by turning adjusting screw *counterclockwise*. Increase valve clearance, and consequently neutral range, by turning adjusting screw *clockwise*.

NOTE: To facilitate adjustment, insert guide tube No. 19.58-90.615 in rockshaft housing bore and slide over adjusting screw.

(3) ADJUSTING ROCKSHAFT CONTROL LEVER

Run engine at 2000 rpm. Place selector lever in position "D" and move rockshaft control lever forward until lift arms have fully dropped. Loosen hex. nut 3 (fig. 8) which secures the control lever to the lever arm. Pull the control lever to the rear until a specified distance is obtained between front end of quadrant slot and control lever friction pin (see "a", fig. 8 and Specifications).

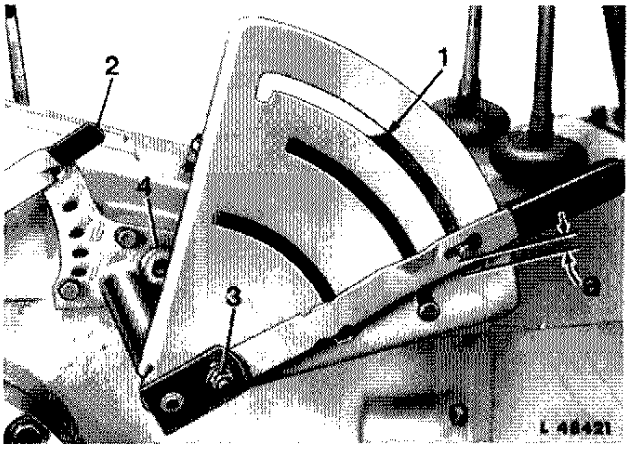

Fig. 8 — Adjusting Control Lever

a Distance between control lever friction pin and front end of quadrant slot
1 Quadrant slot
2 Selector lever in "D" position
3 Hex. nut
4 Plug

Leave control lever fixed in position.

Turn control lever arm slowly to the rear until lift arms just begin to rise. Then re-tighten hex. nut 3.

Pull control lever back fully into lift position. The lift arms should now move to their highest position and at that point there should be a small gap between the rear end of the quadrant slot and the control lever friction pin. Now move rockshaft control lever fully down (lowering position). If dimension "a" (fig. 8) between front end of quadrant slot and control lever friction pin is not as specified (see Specifications), adjust control lever as explained above.

(4) LOAD CONTROL ADJUSTMENT

This adjustment is required to assure proper rockshaft response to varying load conditions.

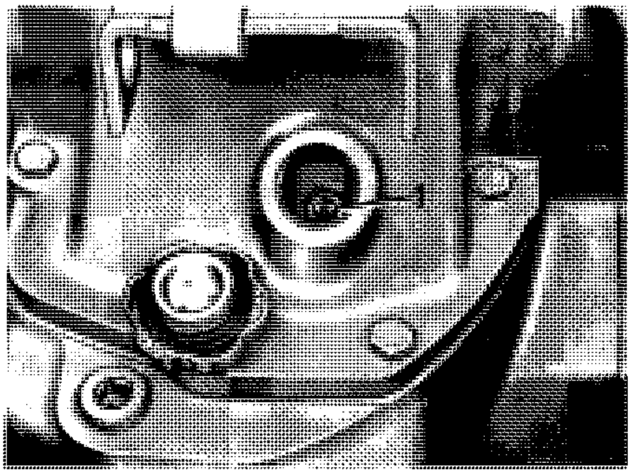

Fig. 9 — Cam Follower Adjusting Screw

1 Adjusting screw

Remove oil filler cap from rockshaft housing. Run engine at 2000 rpm and put load selector lever in bottom position "L". Move rockshaft lever forward to lower the lift arms and then slowly back until clearance between control lever friction pin and rear end of quadrant slot is as specified (see "a", fig. 10 and Specifications).

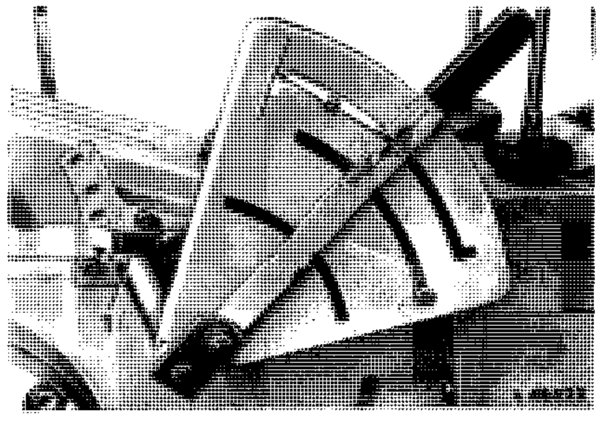
Fig. 10 — Positioning Rockshaft Control Lever for Cam Follower Adjustment

a Distance between control lever friction pin and rear end of quadrant slot
1 Load selector lever in "L" position

Should the lift arms start to rise before this lever position is reached, turn cam adjusting screw 1 (fig. 9) counterclockwise so that the lever can be moved back without the lift arms rising.

With the control lever held in the position shown in fig. 10, turn adjusting screw 1 (fig. 9) clockwise until the lift arms begin to rise. Then tighten adjusting screw lock nut.

NOTE: Use special wrench No. 19.58-90.614 to hold and tighten adjusting screw lock nut.

(5) RATE-OF-DROP ADJUSTMENT

The rate of lift arm and implement drop can be adjusted by the special cap screw located just forward of the operator's seat on the rockshaft housing.

To increase lift arm and implement rate-of-drop, turn the special cap screw counterclockwise. To reduce the rate-of drop, turn clockwise.

LOAD CONTROL MECHANISM

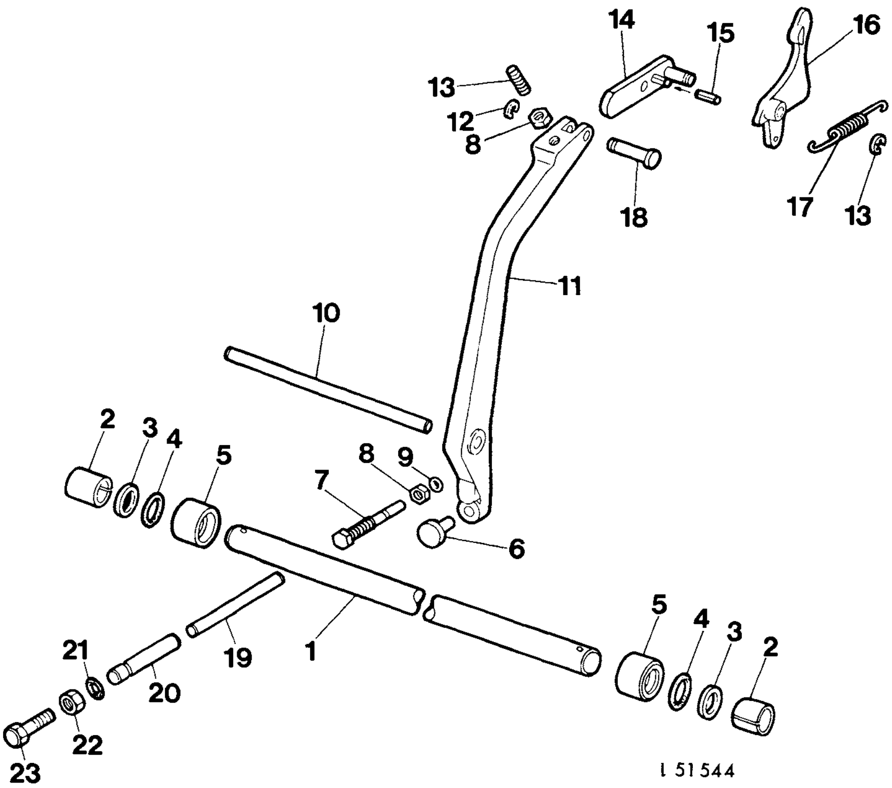

Fig. 11 — Exploded View of Load Control Mechanism

1 Load control shaft
2 Spacers
3 Seal rings
4 O-rings
5 Bushings
6 Special pin
7 Load control arm negative stop screw
8 Lock nuts
9 O-ring
10 Control arm pivot
11 Load control arm
12 Snap rings
13 Cam follower adjusting screw
14 Extension
15 Spring pin
16 Cam follower
17 Return spring
18 Pin
19 Front pin
20 Rear pin
21 O-ring
22 Lock nut
23 Cap screw

(19–23) Only on machines equipped with dual, independent PTO for 540 and 1000 rpm

REPAIR

Remove 3-point hitch.

Remove rockshaft assembly, see section 10, group 25.

Remove left-hand final drive, see section 10, group 25, so that pivot pin 10 (fig. 11) supporting control arm can be withdrawn.

Remove return spring 17 of cam follower.

Withdraw control arm pivot 10 far enough to lift control arm out of transmission case.

Push both spacers 2 from load control shaft. Using a suitable drift, drive load control shaft out of transmission case and bushings.

Remove load control arm negative stop screw from transmission case (see figs. 12 and 13). On machines equipped with dual, independent PTO, also remove pins 19 and 20 (fig. 11) from transmission case.

Check bushings 5 in transmission case for wear or damage. If required, drive old bushings from transmission case (inserting drift through bore of other bushing).

Replace O-rings 4 and sealing rings 3. First insert new O-ring 4 in bushing 5, then compress sealing ring 3 and install so that O-ring 4 seats on the outer circumference of the sealing ring. Drive new bushing 5 complete with new sealing ring 3 and new O-ring 4 into transmission case (chamfer to inside), using a suitable driver. Take care when driving in new bushing not to peen edges of bushing.

Check control arm 11 for wear or damage.

Check special pin 6 for rough spots where in contact with load control shaft. Check extension 14 for wear and smooth off any roughness.

Check to see that load control shaft 1 is undamaged and still perfectly straight, replace if damaged or bent.

Check spacers 2, on which the draft links are carried, for wear and replace as necessary.

Check load control arm negative stop screw 7 or both pins 19 and 20 for wear, especially on end contacting load control arm. Replace O-ring 9 on screw 7 or O-ring 21 on pin 20.

INSTALLATION

Coat control shaft with clean transmission oil, insert in bushings and slide through transmission case.

CAUTION: Do not damage sealing rings.

Push the two spacers on the ends of the load control shaft protruding from the transmission case.

Lift control arm with extension and cam follower into transmission case and insert control arm pivot. Install cam follower return spring.

Before installing the load control arm negative stop screw 7 (fig. 11) or both pins 19 and 20 and cap screw 23, coat O-ring 9 or 21 with clean transmission oil. Take care not to damage the O-ring when installing stop screw 7 or pin 20. Do not turn in screw 7 or 23 fully until final load control arm adjustment has been made.

Install left-hand final drive, see section 10, group 25.

Install rockshaft assembly, see section 10, group 25.

Install 3-point hitch.

Install draft links, placing a bushing over both load control shaft ends. Secure each link with a pin and spring pin.

ADJUSTMENT

IMPORTANT: If control arm negative stop screw is not properly set, this will adversely affect the remaining rockshaft adjustments (see above).

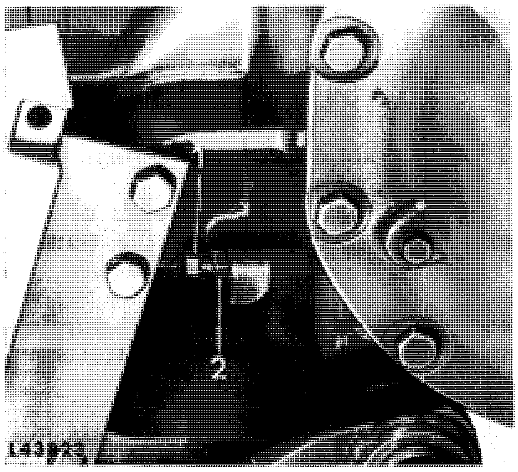

Fig. 12 — Load Control Arm Negative Stop Screw (On Tractors without Dual, Independent PTO)

1 Negative stop screw 2 Lock nut

On tractors without dual, independent PTO: Loosen lock nut 2 (fig. 12) and screw in negative stop screw until it just touches the load control arm. Screw back 1/4 turn and tighten lock nut.

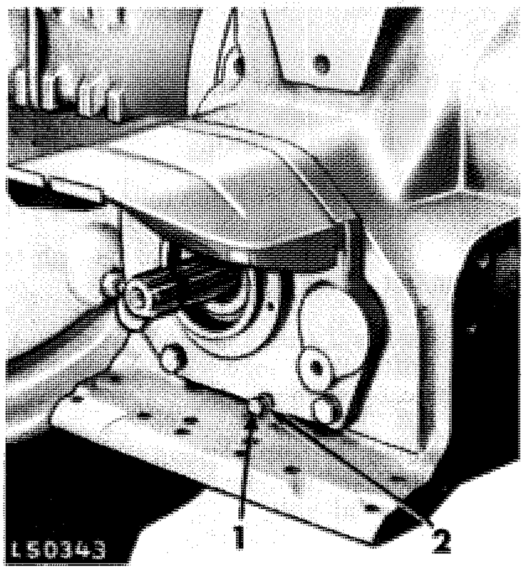

Fig. 13 — Load Control Arm Negative Stop Screw (On Tractors with Dual, Independent PTO)

1 Negative stop screw 2 Lock nut

On Tractors with dual, independent PTO: Loosen lock nut 2 (fig. 13) and screw in negative stop screw until front pin 19 (fig. 11) touches the load control arm. Screw back 1/3 turn and tighten lock nut.

NOTE: Contact between screw and control arm can be felt more easily by inserting a screwdriver into the oil filler hole and holding it against upper end of control arm.

THREE-POINT HITCH

Disassemble and assemble 3-point hitch as shown in figs. 14 and 15.

For adjustment and operation of 3-point hitch, see Operator's Manual.

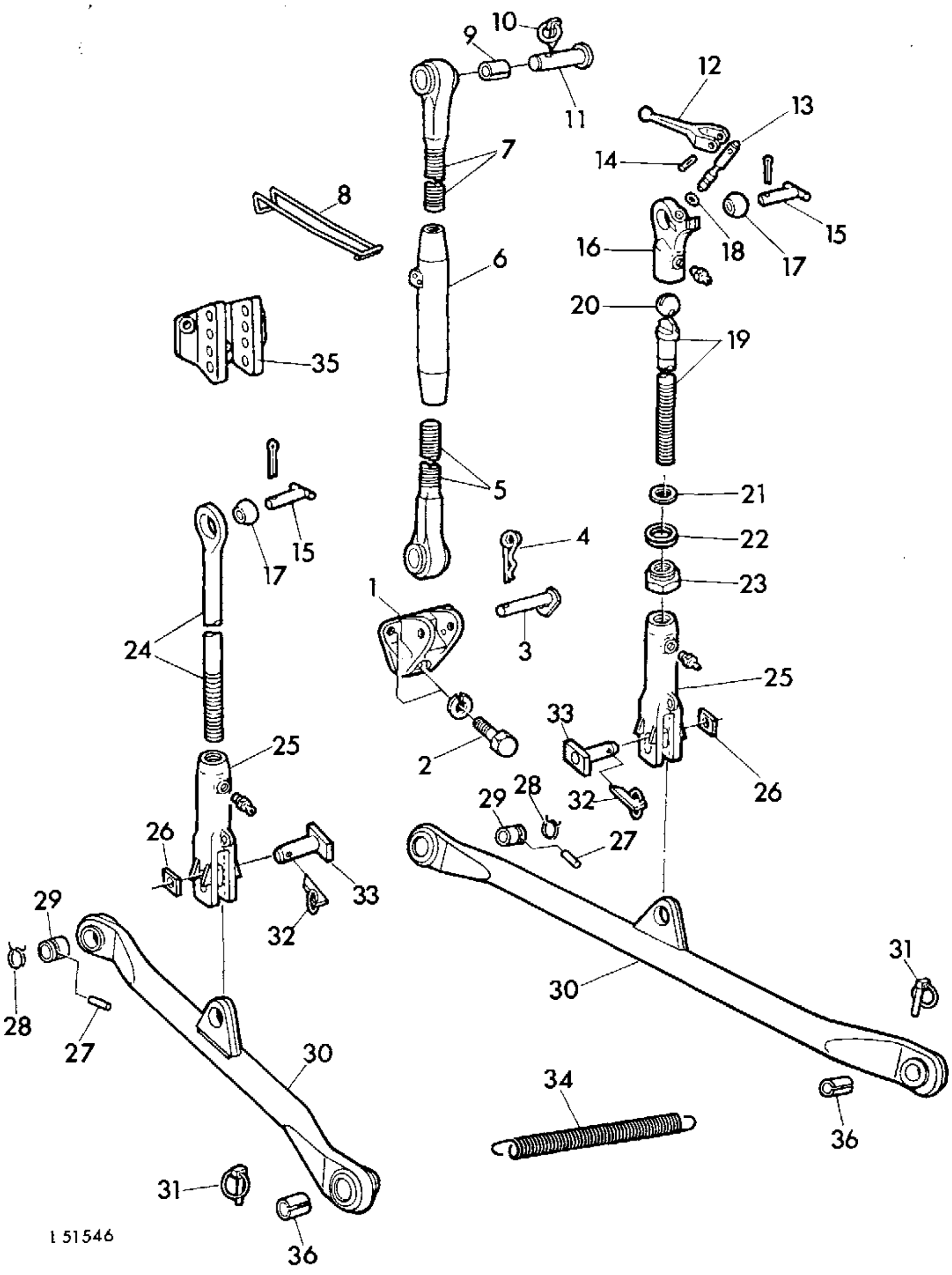

Fig. 14 — Exploded View of 3-Point Hitch (Cat. II)

1 Center link bracket
2 Cap screw
3 Pin
4 Spring pin
5 Center link front end
6 Center link body
7 Center link rear end
8 Handle
9 Bushing
10 Quick-lock pin
11 Headed pin
12 Leveling handle
13 Shaft
14 Groove pin
15 Pin with handle
16 Ball housing
17 Ball joint
18 O-ring
19 R. H. lift link
20 Ball
21 Washer
22 Washer
23 Bushing
24 L. H. lift link
25 Lift link bodies
26 Plates
27 Pins
28 Spring clips
29 Bushings
30 Draft links
31 Quick-lock pins
32 Quick-lock pins
33 Pins
34 Spring
35 Bracket for towing assy.
36 Bushings (for converting to cat. I)

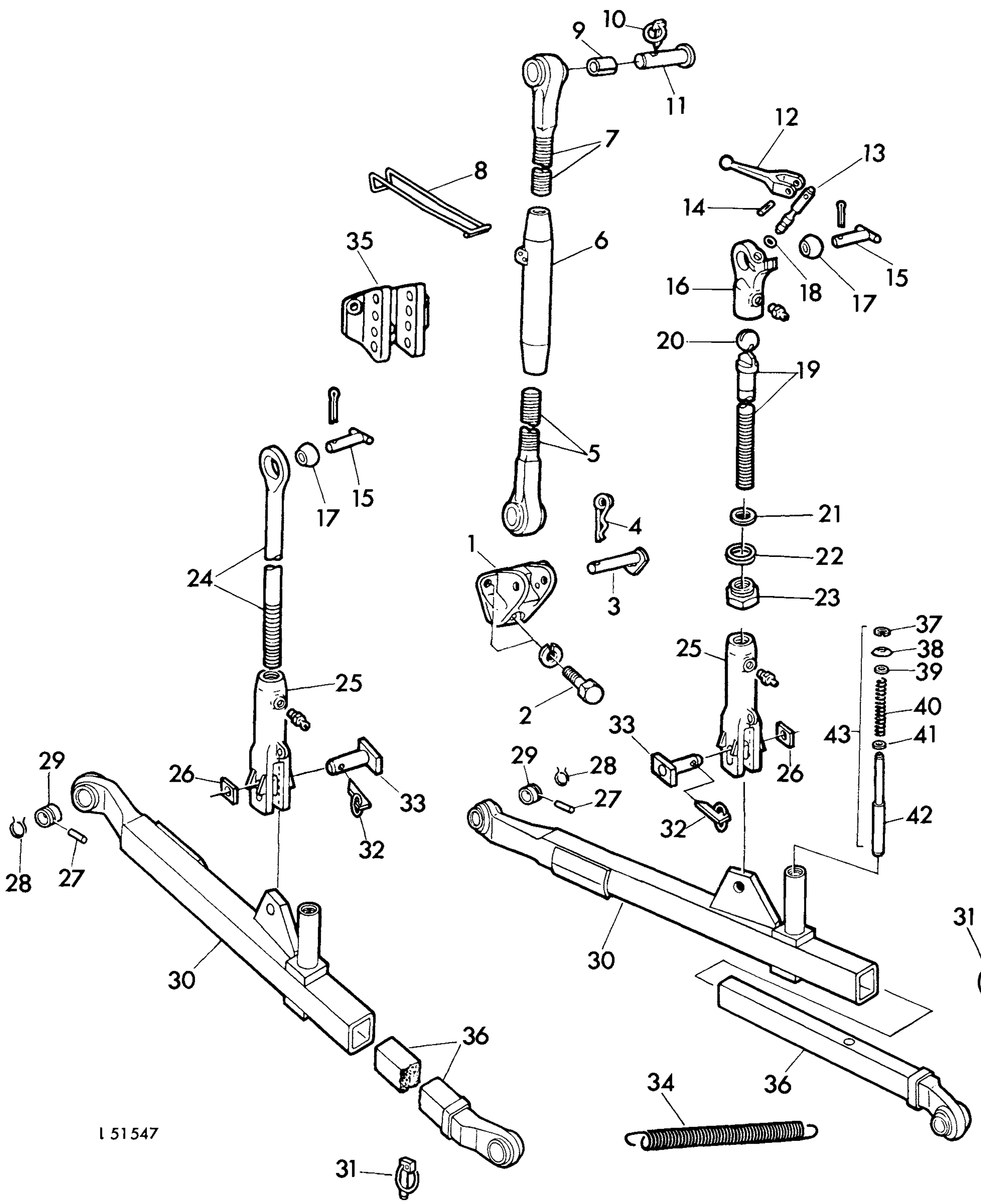

Fig. 15 — Exploded View of 3-Point Hitch with Telescoping Draft Links, Cat. II
(See fig. 14 for text regarding keys 1 to 35)

36 Telescoping draft link
37 Snap ring (2 used)
38 Special washer (2 used)
39 Special washer (2 used)
40 Spring (2 used)
41 Special washer (2 used)
42 Locking pin (2 used)
43 Locking device

SPECIFICATIONS

ROCKSHAFT		Dimensions of New Parts
O.D. of rockshaft piston	3.6120 to 3.6320 in.	91.975 to 92.025 mm
I.D. of rockshaft cylinder	3.6255 to 3.6285 in.	92.086 to 92.166 mm
Springs of pressure and discharge valves Resilience at a spring length of 0.875 in. (22 mm)	11 to 13 lbs.	4.5 to 5.5 kg
Check valve spring Resilience at a spring length of 2.65 in. (65 mm)	12.5 to 15.5 lbs.	5.6 to 7 kg
Spring of flow control valve* Resilience at a spring length of 0.79 in. (20 mm)	11.7 to 14.3 lbs.	5.3 to 6.5 kg
Max. permissible drop of lift arms within 15 minutes, measured between lift arm bores (engine shut-off and rockshaft under full load)	2.5 in.	64 mm
Opening pressure of thermal relief valve	3500 to 4500 psi.	246 to 315 kg/cm^2

ADJUSTMENTS

ADJUSTING CONTROL LEVER NEUTRAL RANGE

Neutral range (Rotating adjusting screw 1/4 turn varies control lever neutral range by 0.156 in. = 4 mm)	0.157 to 0.236 in.	4 to 6 mm

ADJUSTING ROCKSHAFT CONTROL LEVER

Distance between control lever friction pin and front end of quadrant slot (see fig. 8)	0.3 in.	8 mm

ADJUSTING LOAD CONTROL RESPONSE

Distance between control lever friction pin and rear end of quadrant slot (see fig. 10)	3.62 in.	92 mm

* Available only if machine is equipped with 1.38 cu. in. (22.6 cm^3) hydraulic pump

ADJUSTING LOAD CONTROL ARM

Turn in control arm negative stop screw until it contacts arm, then back off on tractors not equipped with dual, independent PTO by	1/4 turn	
on tractors equipped with dual, independent PTO by	1/3 turn	

ADJUSTING UPPER LIFT LIMIT

Pressure valve should close when distance between cam follower and rockshaft housing is	0.08 to 0.12 in.	2 to 3 mm

TORQUES FOR HARDWARE

Rockshaft cylinder and valve housing to rockshaft housing, cap screws	35 ft.lbs.	4.8 mkg
Lift arms to rockshaft, cap screws	85 ft.lbs.	11.7 mkg
Spacer and cam to rockshaft, cap screw	10 ft.lbs.	1.4 mkg
Rockshaft housing to transmission case, cap screws	85 ft.lbs.	11.7 mkg

SPECIAL TOOLS

Part No. when ordering from J D Parts Depot	Part No. when ordering from Manufacturer	Description	Use
19.58-90.615		Guide tube	Adjusting rockshaft unit
19.58-90.614		Special wrench	ditto

Group 25

SELECTIVE CONTROL VALVES

(Spool Type)

GENERAL INFORMATION

The tractor may be equipped with the following selective control valves:

1. One single selective control valve (see fig. 2)
2. Two single selective control valves (see fig. 3)
3. One dual selective control valve (see fig. 4)
4. Two dual selective control valves (see fig. 4)
5. One single selective control valve and one dual selective control valve.

The above combinations are based on two standard control valves made up of identical parts, except for the valve housing. The difference is that in one housing the oil passages are open on both sides (see item 32, figs. 3 and 4) whereas in the other model one side is closed (see item 1, figs. 2 and 4).

In addition, there are two different end plates (see items 15 and 33, figs. 2 and 4).

If the tractor is equipped with a single selective control valve, the latter is provided with the end plate 15 and spacer 29 (see fig. 2). The oil passages of the valve housing are open only on one side.

If the tractor is equipped with two single control valves, the latter are provided with the end plate 33, junction block 29, a pinion shaft 37 and a rack 13 each. The rack splines are facing in the same direction (fig. 3). The oil passages of the lower control valve are open whereas the upper valve is closed on one side.

If the tractor is equipped with a dual selective control valve, the latter is made up of two single valves. However, apart from end plate 15 there is only one pinion shaft 37 located between the two racks whose splines face each other (see figs. 1 and 4). The junction block 29 is not required as the end plate 15 is level with the two valves.

If the tractor is equipped with two dual control valves, there are three valves with open oil passages and one valve closed on one (the top) side. Moreover, there are two end plates 15. No junction block is required (see fig. 4).

If the tractor is equipped with a single and a dual selective control valve, the parts shown in figs. 2 and 4 are provided, with the exception that two valves with open oil passages are used for the dual control valve.

Operation of selective control valves see tractor Operator's Manual.

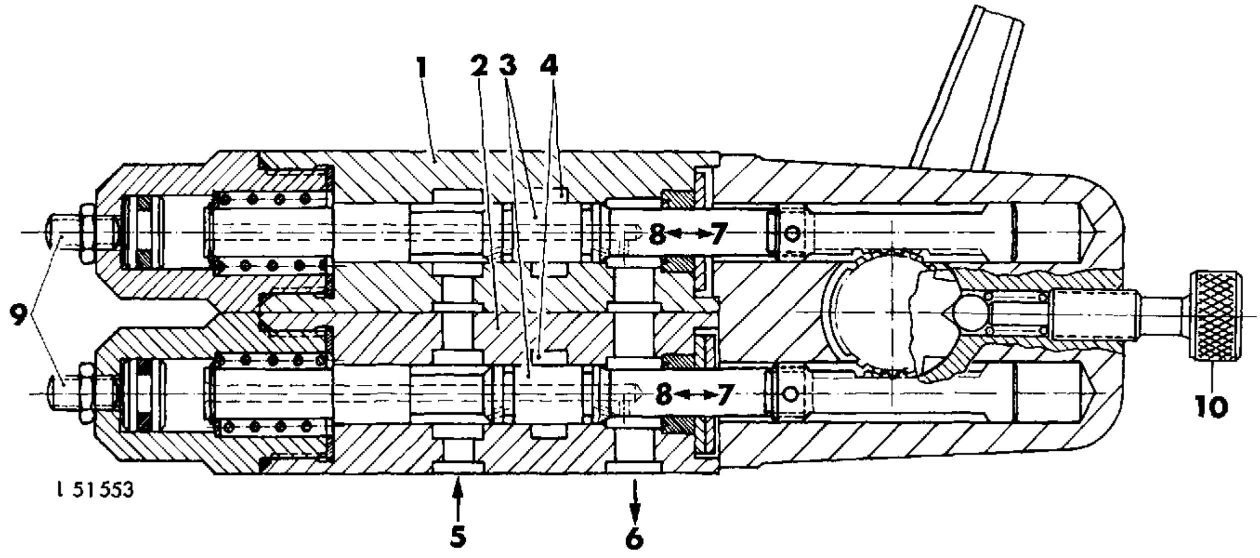

Fig. 1 — Dual Selective Control Valve, Sectional View

1 Valve housing (closed on one side)
2 Valve housing (open on both sides)
3 Valve spool
4 Annular passage for oil flowing to or from quick coupler
5 Pressure oil passage
6 Return oil passage
7 Shifting for "Raising" (pressure oil to annular passage 4 and to quick coupler)
8 Shifting for "Lowering" (return oil from quick coupler and annular passage 5)
9 Screws for adjusting rate of drop (metering return oil flow)
10 Stop screw

OPERATION

In neutral position, oil from the pump is blocked in pressure oil passage 5 by valve spool(s) 3 (fig. 1).

If valve spool 3 is moved in the direction shown by arrow 7, pressure oil flows from passage 5 into annular passage 4 and thus to the quick coupler and the implement connected to it.

If the spool is moved in the direction shown by arrow 8, annular passage 4 will be connected with return oil passage 6. This allows the oil returning from the implement and the quick coupler to flow back into the transmission case.

The bores in spool 3 allow leakage oil to drain off. In this way leakage oil behind the spool cannot cause a blockage and proper operation of the spool is assured.

The position of the valve spool(s) in relation to the return oil passage and thus the rate of drop can be adjusted by means of the adjusting screw(s) 9.

The pressure oil will not be affected by this adjustment.

The valve spools are connected with a rack by means of a cylindrical pin.

The individual control valves are of the single type. The dual valve consists of two single valves provided with only one pinion shaft which is located between the racks. Due to this arrangement, the racks of the two single valves are moved into opposite directions when operating the control lever. In this way the inlet port on one valve and the outlet port on the other valve are opened and vice versa. Thus the two single valves operate as a dual valve (see fig. 1).

REMOVAL

Remove lines leading to quick couplers at elbow adapters of control valves.

Remove both cap screws securing control valve to junction block and lift off control valve assembly.

Take care of seal rings installed between control valves or between bottom valve and junction block.

Remove, only if required, inlet and return line at junction block.

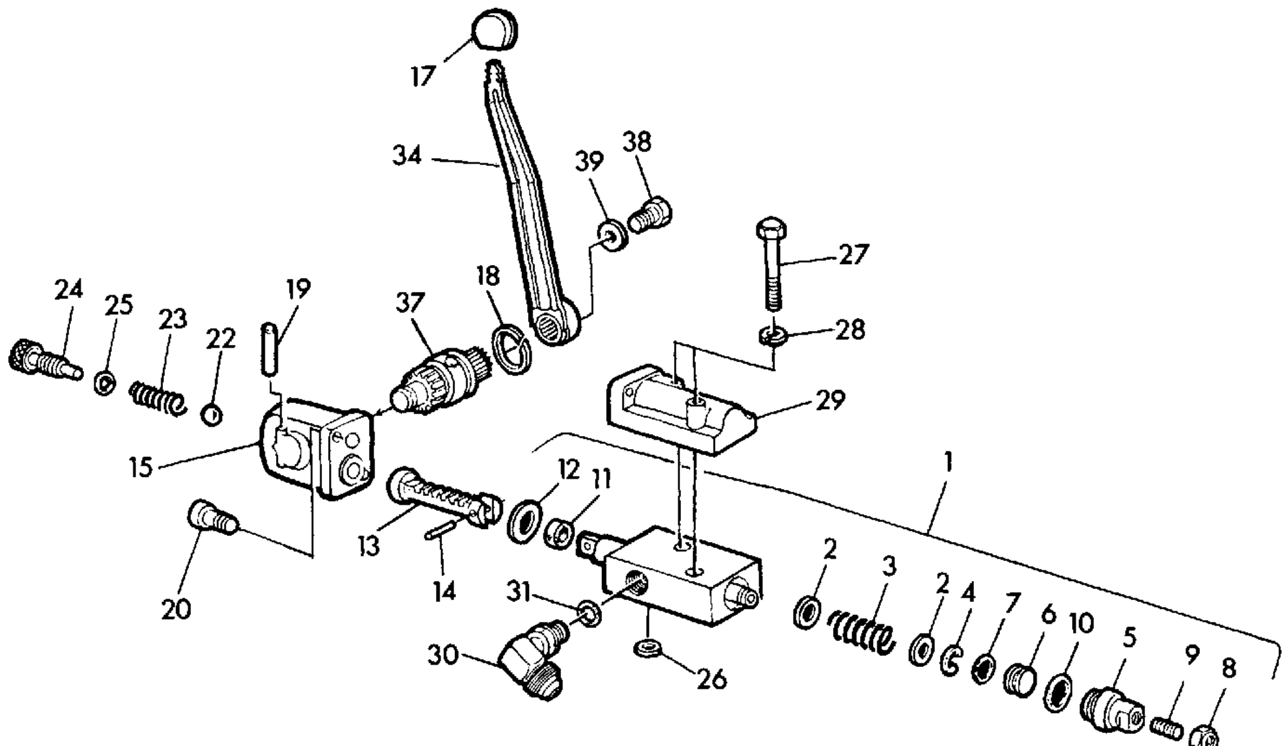

Fig. 2 — Exploded View of a Single Selective Control Valve

1 Valve housing and spool assembly (closed on one side)
2 Washers
3 Pressure spring
4 Snap ring
5 Spring cap
6 Plug
7 O-ring
8 Lock nut
9 Set screw
10 O-ring
11 V-packing
12 Washer
13 Rack
14 Pin
15 End plate
17 Knob
18 Seal ring (Teflon)
19 Pin
20 Hex. socket screw (2 used)
22 Lock ball
23 Locking spring
24 Stop screw
25 O-ring
26 Seal ring (4 used)
27 Cap screw (2 used)
28 Lock washer (2 used)
29 Spacer housing
30 Elbow adapter
31 O-ring
34 Control lever
37 Pinion shaft
38 Cap screw
39 Washer

REPAIR

DISASSEMBLY

Drive pin 19 (fig. 2) out of end plate 15.

Remove stop screw 24, locking spring 23 and locking ball 22.

Pull control lever 34 with pinion shaft 37 out of end plate 15.

Remove control lever from shaft.

Remove both hex. socket screws 20 of end plate and lift end plate 15 as well as spacer housing 29 away.

Drive pin 14 out of rack 13 and valve spool.

Screw spring cap 5 out of valve housing and remove all parts of the valve housing (see fig. 2).

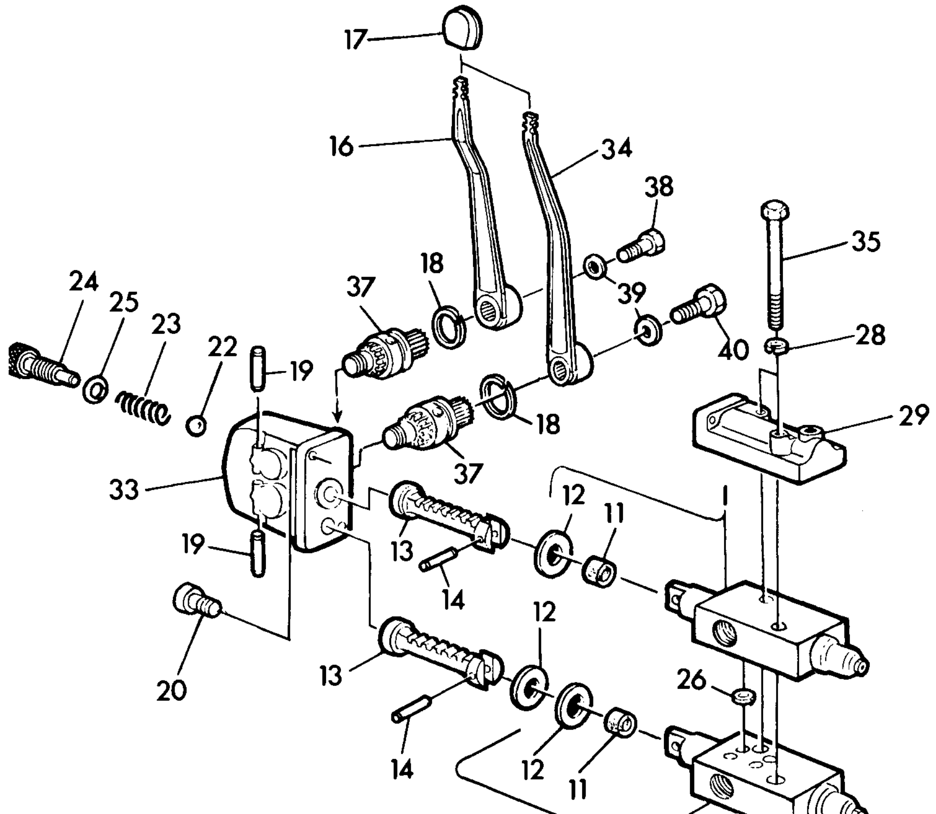

Fig. 3 — Exploded View of Two Single Selective Control Valves

1 Valve housing and spool assembly (closed on one side)
11 V-packings
12 Washers
13 Racks
14 Pins
16 Control lever
17 Knob (2 used)
18 Seal rings (Teflon)
19 Pins
20 Hex. socket screw (2 used)
22 Locking ball (2 used)
23 Locking spring (2 used)
24 Stop screw (2 used)
25 O-ring (2 used)
26 Seal rings (8 used)
28 Lock washer (2 used)
29 Spacer housing
32 Valve housing and spool assembly (open on both sides)
33 End plate
34 Control lever
35 Cap screw (2 used)
37 Pinion shafts
38 Cap screw
39 Washers
40 Cap screw

CAUTION: When disassembling two or more control valves, be absolutely sure not to mix up valve housings and spools as these parts are fitted with very close tolerances. Spools and housings are, therefore, available as matched sets only.

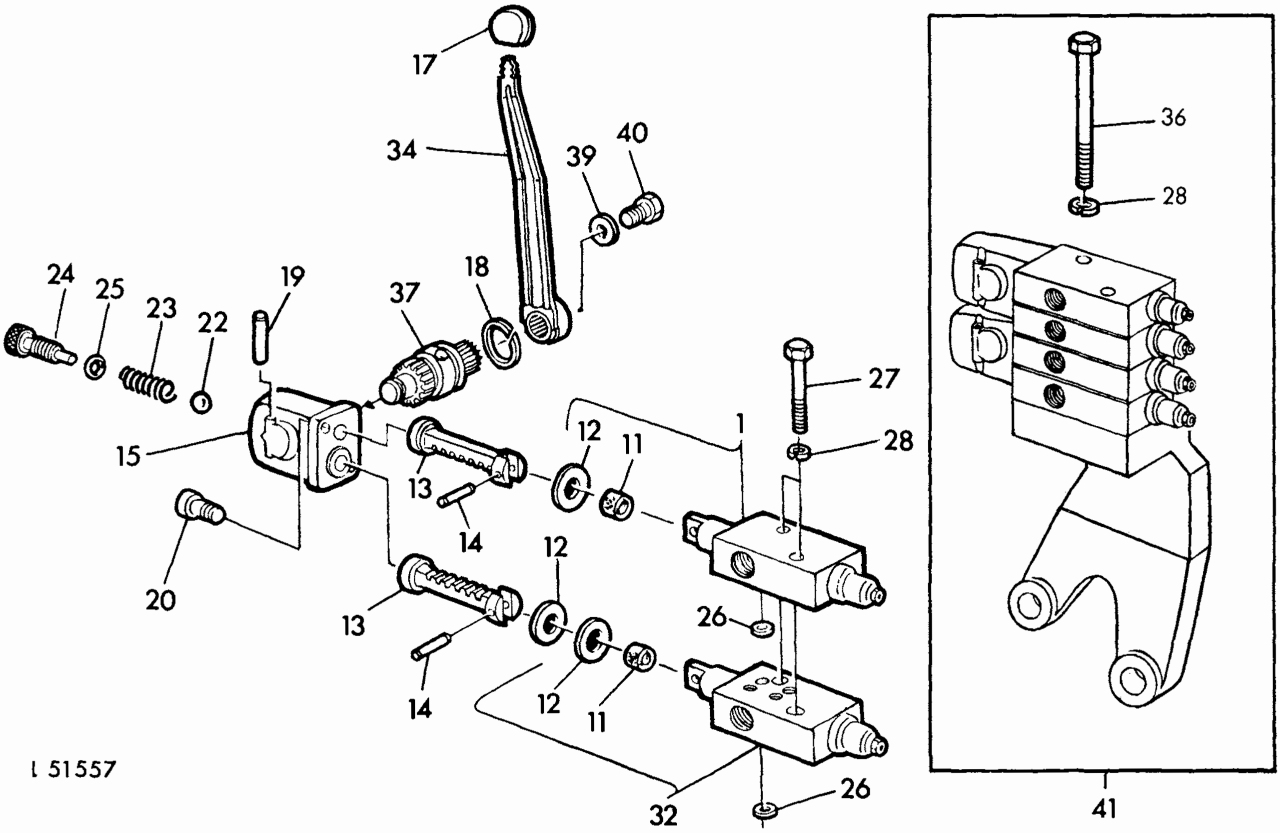

Fig. 4 — Exploded View of a Dual Selective Control Valve

1 Valve housing and spool assembly (closed on one side)
11 V-packings
12 Washers
13 Racks
14 Pins
15 End plate
17 Knob
18 Seal ring (Teflon)
19 Pin
20 Hex. socket screw (2 used)
22 Locking ball
23 Locking spring
24 Stop screw
25 O-ring
26 Seal rings (8 used)
27 Cap screw (2 used)
28 Lock washer (2 used on each valve)
32 Valve housing and spool assembly (open on both sides)
34 Control lever
36 Cap screw (2 used)
37 Pinion shaft
39 Washer
40 Cap screw
41 Two dual selective control valves

INSPECTION

Check valve spool and housing for scores or other damage. If necessary, always replace spool and valve housing as one set. Since they are lapped in, they are available only as a matched set.

Discard V-packings 11 (figs. 2 to 4), seal rings 18 and 26 as well as all O-rings.

Check resilience of spring 3 and locking spring 23 (see Specifications).

Check end plate 15 or 33, racks 13 and pinion shafts 37 for serviceability. Replace parts, if necessary.

ASSEMBLY

Assemble by reversing sequence of steps explained under "Disassembly", as shown in figs. 2, 3 or 4.

Take care not to mix up valve spools or housings if more than one valve has been disassembled.

Install new V-packings 11, new seal rings 18 and new O-rings.

After assembly make sure valve spool moves freely in valve housing.

Install two washers 12 (see fig. 3) in control valve whose rack is located in bore of end plate 15 or 33 which does not have a protrusion.

Install each pinion shaft 37 so that locking ball is engaged in neutral position of valve spool or control lever.

INSTALLATION

When installing control valves, use new seal rings 26 (figs. 2 to 4). If several control valves are installed, mount valves with open sides facing each other. Install valve with closed side on top.

Install oil lines.

ADJUSTMENT

Every selective control valve is provided with a screw (see item 9, figs. 1 and 2) for adjusting return oil flow or rate of drop.

Extending or retracting a remote hydraulic cylinder of 2.5 in. (63,5 mm) piston dia. and a stroke of 8 in. (203 mm) should require at least 2 sec. Faster speeds may cause damage.

If this period is not attained, adjust both screws 9 of dual control valve for proper return oil flow and correct remote cylinder lift cycle.

On single control valves adjust return oil flow and thus rate of drop according to the implement attached. The lift cycle period is indicated in the Operator's Manual of the implement concerned.

To decrease return oil flow and thus rate of drop, turn in adjusting screw. Turn out screw to increase rate of drop.

SPECIFICATIONS

	Dimensions of New Parts	
O.D. of valve spool at lands	0.4728 to 0.4737 in.	12.020 to 12.043 mm
O.D. of valve spool at V-packing location	0.3886 to 0.3900 in.	9.964 to 10.000 mm
I.D. of valve housing bore	0.4729 to 0.4738 in.	12.023 to 12.046 mm
Clearance between valve housing and spool	0.00012 to 0.00024 in.	0.003 to 0.006 mm
Spring of valve spool		
Free length	1.04 in.	26.5 mm
Resilience at a spring length of 0.57 in. (14.5 mm)	48 to 58 lbs.	21.5 to 26.5 kg
Locking spring		
Free length	1.3 in.	33 mm
Resilience at a spring length of 0.71 in. (18 mm)	12.7 to 15.3 lbs.	5.7 to 6.9 kg

TORQUES FOR HARDWARE

Selective control valves to junction block of rockshaft, cap screws	20 ft.lbs.	2.5 mkg
End plate to valve housing, hex. socket screws	11 ft.lbs.	1.5 mkg

Group 30
SELECTIVE CONTROL VALVE
(Poppet Type)

GENERAL INFORMATION

The tractor may be equipped with a single or dual selective control valve for operating one or two remote cylinders. The selective control valves are secured to the right-hand rear axle housing.

Each selective control valve will operate either a single or double-acting remote cylinder, and provides two speeds of operation.

The dual control valve will operate two cylinders independently or simultaneously. A control lever operates each single selective control valve, having four detent positions. They are: (1) Neutral position, (2) fast extend position, (3) fast retract position, (4) float position.

The control lever will remain locked in "fast extend" or "fast retract" position until piston of remote cylinder has completed its stroke. Then it automatically returns to the neutral position. The control lever must be moved back manually from "float" to "neutral" position.

DIAGNOSING MALFUNCTIONS

CYLINDER WILL NOT EXTEND

Insufficient oil flow or oil pressure
  Check oil flow to selective control valve

Spring pin securing operating arm and shaft to rocker sheared.
  Install new spring pin

Leaking top pressure valve or return valve
  Clean valves, recondition valve seats, adjust operating cams

Lower pressure valve or return valve of selective control valve does not open
  Adjust operating cams

Selective control valve housing porous
  Renew housing

Metering valve clogged
  Clean valve

Oil flow from selective control valve to cylinder restricted or clogged
  Check oil line from selective control valve to cylinder for foreign particles

O-ring of remote cylinder piston faulty
  Replace O-ring

CYLINDER WILL NOT RETRACT

Remote cylinder stop valve seized
  Find cause and eliminate

Spring pin securing operating arm and shaft to rocker sheared
  Install new spring pin

Lower pressure valve or return valve of selective control valve leaking
  Clean valves, recondition valve seats and adjust operating cams

Top pressure valve or return valve of selective control valve does not open
  Adjust operating cams

CYLINDER SETTLES UNDER LOAD

Valves of selective control valve leaking
  Clean valves, recondition valve seats and adjust operating cams

O-ring of remote cylinder piston faulty
  Replace O-ring

Selective control valve housing porous
  Renew housing

CONTROL LEVER DOES NOT RETURN TO NEUTRAL POSITION

Control lever bent or seized
  Renew unserviceable parts

Control lever in float position
  Move lever to "neutral" position

Remote cylinder detent piston seized
  Clean piston

Pressure valve springs too weak
Check resilience of springs (see Specifications)

Return valves not seating correctly
Clean valves, recondition valve seats and adjust operating cams

Excessive leakage in remote cylinder

CONTROL LEVER WILL NOT REMAIN IN DETENT POSITION

Rocker detents worn or broken
Replace defective parts

Oil flow rate set too high
Adjust metering valve

Detent piston sticking
Remove foreign material

CYLINDER OPERATING TOO FAST OR TOO SLOW

Metering valve incorrectly adjusted or sticking
Clean and adjust metering valve

Flow control valve sticking
Remove foreign material

Flow control valve spring worn or broken
Replace spring

Pressure or return valves sticking or leaking
Clean valves, recondition valve seats and adjust operating cams

Remote cylinder stop valve sticking
Check for fault and repair

OPERATION

NOTE: The operation of one control valve, used with a double-acting remote cylinder, is explained below.

The selective control valve consists of:

1. A metering valve 10 (fig. 1) which regulates oil flow to the remote cylinder and makes possible, within a certain range, gradual regulation of the oil flow.

2. A flow control valve compensating oil pressure variations and ensuring constant flow of oil.

3. Two return valves 7 provided with sealing cones which control return oil flow from the remote cylinder.

4. Two pressure valves 6 provided with sealing cones which control pressure oil flow to the remote cylinder.

5. A detent piston 4 for locking the selective control valve lever hydraulically in "fast extend" or "fast retract" position.

6. A rocker assembly consisting of two cam plates, four adjusting screws and the rocker itself. The cam plates open the pressure and return valves. The rocker is provided with detents for neutral and the above positions.

NEUTRAL POSITION

In neutral position, oil pressure is equal on both sides of the metering valve. Both pressure valves 6 (fig. 1) and both return valves 7 are closed, trapping oil on both sides of the remote cylinder piston, and retaining the piston in its present position.

FAST EXTEND

Move control lever fully to the rear. This will turn the rocker assembly and open lower return valve as well as lower pressure valve (see fig. 1).

The return valve opens a little earlier than the pressure valve, allowing return oil to flow into the transmission case from one side of the piston before pressure oil flows into remote cylinder from the other side.

Opening the pressure valve causes a pressure drop in the circuit behind the metering valve. At the same time this pressure drop occurs behind detent piston 4, moving it into a detent of the rocker due to the pressure differential.

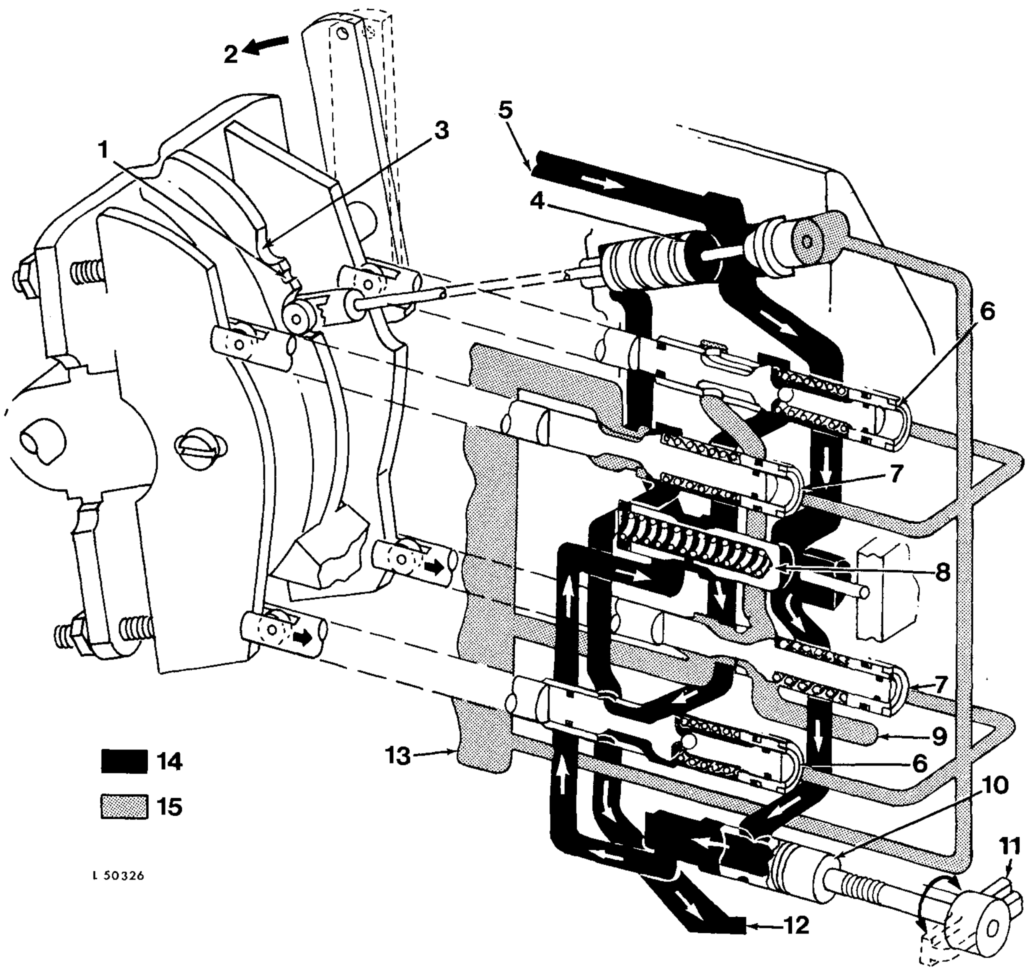

Fig. 1 — Selective Control Valve in "Fast Extend" Position

1 Notch for neutral position
2 Control lever in "fast extend" position
3 Detent for "fast retract" position
4 Detent piston
5 Pressure oil from hydraulic pump
6 Pressure valves
7 Return valves
8 Flow control valve
9 Return line from quick coupler
10 Metering valve
11 Max.quantity of oil
12 Pressure line to quick coupler
13 Transmission case (oil sump)
14 Pressure oil
15 Return oil

As soon as the remote cylinder reaches the end of its stroke, a temporary pressure build-up occurs at the rear of flow control valve 8 and at the rear of the opened pressure valve. This pressure build-up plus spring pressure closes the flow control valve. At the same time pressure is now equal on both sides of the detent piston so that cam plates and rocker are moved, causing the control lever and valves to return to their neutral position.

FAST RETRACT

The operation is similar to that described under "fast extend", with the difference that the control lever is moved forward, opening the other return valve and other pressure valve.

SLOW RETRACT

Move control lever only slightly forward. As the rocker assembly rotates, the top return pressure valves (see fig. 1) are opened. Pressure and return oil from the remote cylinder is metered appropriately and the remote cylinder rod gradually retracts.

In the "slow retract" position the detent follower is held hydraulically between "neutral" and "fast retract" position.

When the control lever is released, the valves close and rocker assembly moves into neutral position. Oil is trapped and the remote cylinder piston held in its position.

SLOW EXTEND

The operation in position "slow extend" is similar to that of "slow retract", the difference being that the control lever is pulled slightly to the rear. Thus both lower valves (see fig. 1) are opened and oil flows in the opposite direction.

FLOAT POSITION

When the control lever is in float position, both return valves are opened by the cam plates and cam followers while the pressure valves remain closed.

Oil can now flow freely through the selective control valve and from one side of the remote cylinder to the other while the piston (together with piston rod) can extend and retract freely (it "floats").

Pressure exerted by the valve springs against pressure valves and operating cams mountains the valves in "float" position until control lever is moved back into neutral position by the operator.

REPAIR

DISASSEMBLY

Disconnect control lever from selective control valve and remove control valve assembly.

NOTE: Identify all parts for assembly.

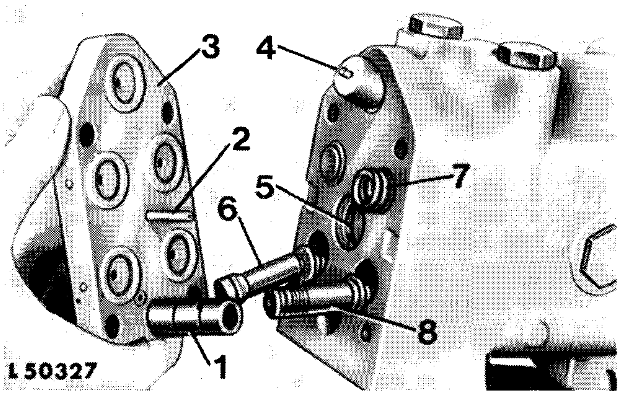

Fig. 2 — Removing Bottom Cover

1 Metering valve
2 Flow control valve stop pin
3 Bottom cover
4 Outer guide of detent piston
5 Flow control valve
6 Pressure valve
7 Pressure valve spring
8 Return valve

Remove bottom cover 3, complete with metering valve 1 and flow control valve stop pin 2 from control valve housing.

NOTE: Remove bottom cover carefully as valve springs are compressed. Removing the cover may release valve guides.

Remove valve guides, valve springs and pressure and return valves from housing (see fig. 2).

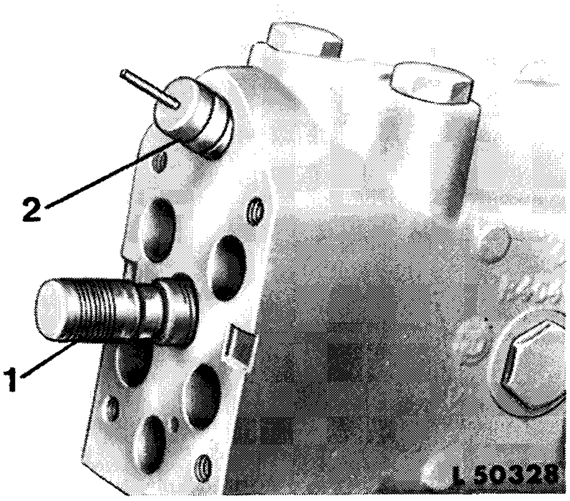

Fig. 3 — Removal of Flow Control Valve and Detent Piston

1 Flow control valve
2 Detent piston

Remove flow control valve and its spring.

Remove snap ring, outer guide of detent piston, back-up ring, O-ring and detent piston (see fig. 3).

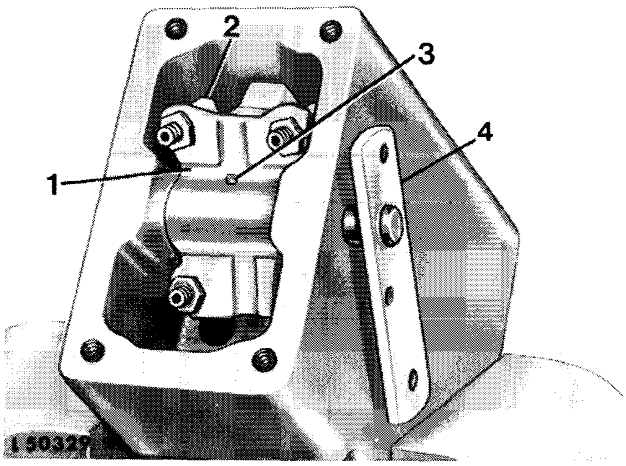

Fig. 4 — Removal of Rocker Assembly

1 Rocker assembly
2 Cam plate
3 Spring pin
4 Control lever arm and shaft

Turn housing so that rocker assembly is at the top (see fig. 4).

Drive out spring pin 3 (fig. 4) which secures control lever arm and shaft 4 to rocker. Pull out arm and shaft.

Remove special screws of cam plates and lift rocker out of housing. Remove cam plates.

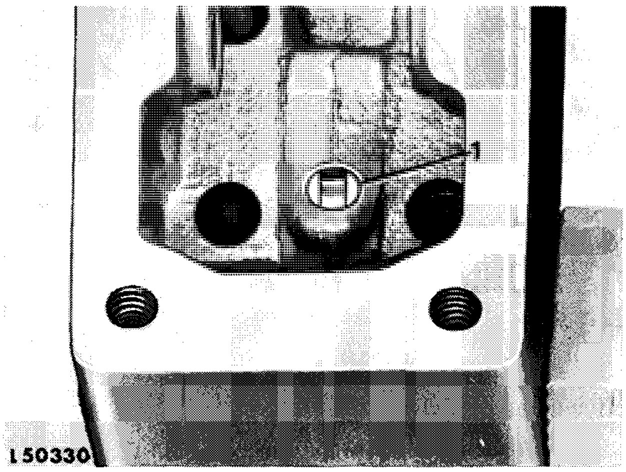

Fig. 5 — Removal of Detent Piston Cam Follower

1 Cam follower

Remove cam follower 1 (fig. 5) of detent piston and drive inner guide of detent piston out of housing with the aid of a brass pin.

INSPECTION

Housing 12 (fig. 6)

Check housing for cracks, scores or burrs.

Remove scores or burrs with a fine file. Replace housing, if cracked or damaged in any other way.

Check valve seats for pitting or wear and re-lap, if worn. Replace O-rings for sealing metering valve and control lever shaft.

Top cover 3, bottom cover 34 and bracket assembly 37 (fig. 6).

Check bottom cover 34 (fig. 6) for cracks or any other damage and replace, if necessary. Replace cover seals 33.

If necessary, replace spring pin 42, which serves as a stop for the flow control valve. When driving in new spring pin, ensure that it protrudes far enough from cover (see Specifications). If the spring pin does not protrude far enough from cover, jerky operation of the flow control valve will be the result. Check side cover 48 for cracks or burrs. Remove any burrs with a fine file and replace cover, if necessary. Renew cover seal rings.

Check top cover 3 for damage and replace, if necessary. Replace seal ring 4.

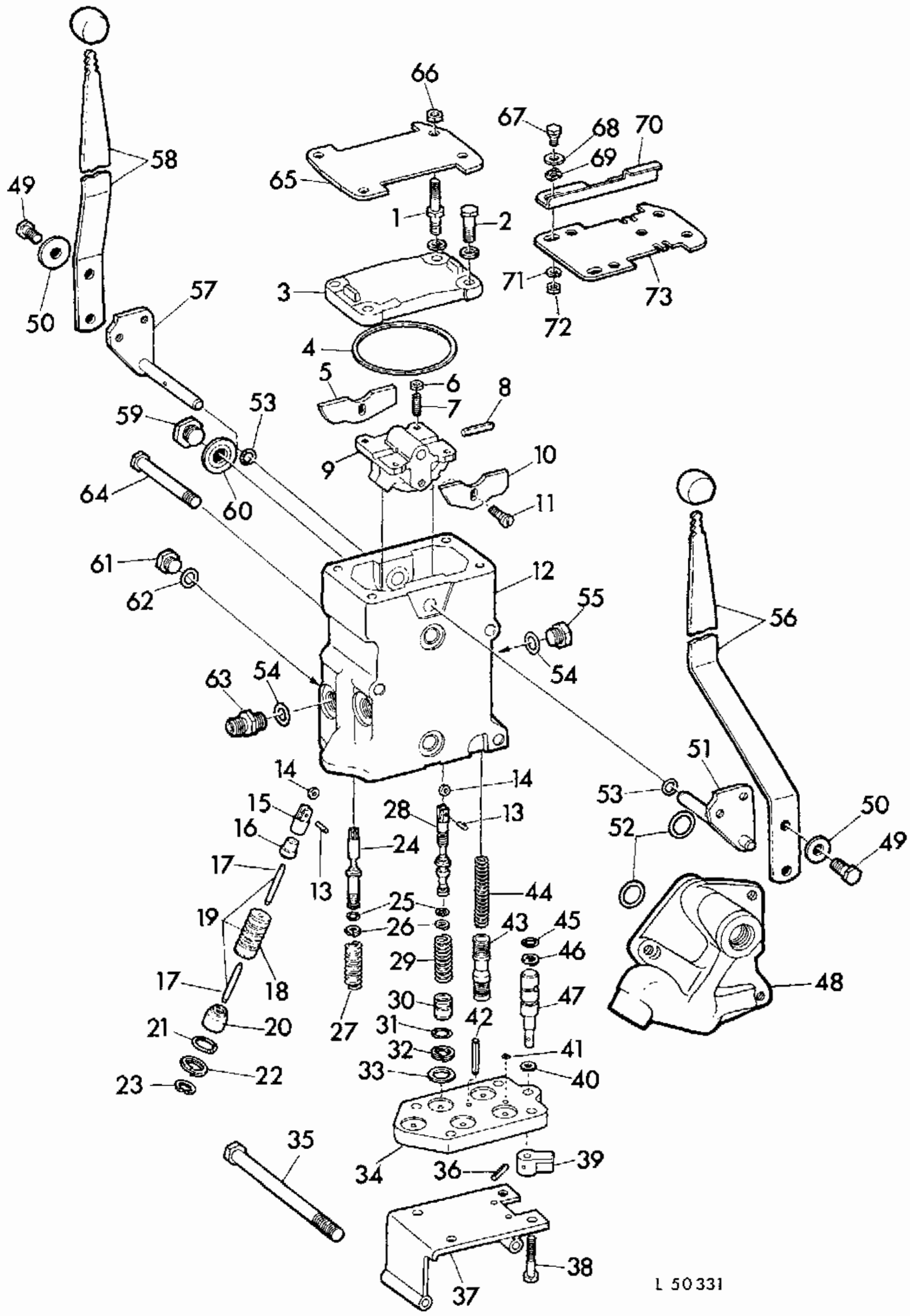

Fig. 6 — Exploded View of Selective Control Valve Assembly

1 Special screw (2 used)
2 Cap screw (2 used)
3 Top cover
4 Seal ring
5 Cam plate
6 Lock nut (4 used)
7 Adjusting screws
8 Spring pin
9 Rocker
10 Cam plate
11 Special screw (2 used)
12 Housing
13 Spring pin (5 used)
14 Cam follower roller (5 used)
15 Cam follower (detent piston)
16 Inner guide
17 Pins
18 Detent piston
19 Detent piston assembly
20 Outer guide
21 O-ring
22 Back-up ring
23 Snap ring
24 Return valve (2 used)
25 O-rings (6 used)
26 Back-up rings (6 used)
27 Spring (return valve-2 used)
28 Pressure valve (2 used)
29 Spring (pressure valve - 2 used)
30 Spring cap (4 used)
31 O-ring (4 used)
32 Back-up ring (4 used)
33 Seal ring (6 used)
34 Bottom cover
35 Cap screw (2 used)
36 Spring pin
37 Bracket assembly
38 Cap screw (4 used)
39 Adjusting arm for metering valve
40 Thrust washer
41 O-ring
42 Spring pin (flow control valve stop)
43 Flow control valve
44 Flow control valve spring
45 O-ring
46 Back-up ring
47 Metering valve
48 Side cover
49 Cap screws
50 Washers
51 Control lever arm and shaft
52 O-rings
53 O-rings
54 O-rings (4 used)
55 Plug (2 used)
56 Control lever
57 Control lever arm and shaft (for 2nd sel. control valve)
58 Control lever (for 2nd sel. control valve)
59 Plug
60 Seal ring
61 Plug
62 O-ring
63 Connector
64 Cap screw (3 used)
65 Stop plate
66 Hex.nuts (2 used)
67 Stop screw
68 Washer
69 Lock washer
70 Lock plate
71 Spring washer
72 Hex. nut
73 Stop plate

Valves (fig. 6)

Check all valves for wear or scoring and replace, if necessary.

Check valve rollers for free movement, flat spots, pitting or wear and replace, if necessary.

Check valve springs for serviceability and proper resilience (see Specifications).

Detent Piston 19 and Cam Follower 15 (fig. 6)

Check detent piston assembly for wear or damage. If piston pin has to be replaced, press new pin to bottom of bore.

If spring pin of cam follower is replaced, drive in new spring pin so that its slot is facing body of cam follower.

Rocker 9, Cam Plates 5 and 10 (fig. 6)

Check rocker detents for wear or damage. Damaged detents can lead to "fast extend" or "fast retract" becoming engaged although control lever is in "slow extend" or "slow retract" position. If necessary, replace rocker.

Check cam plates for wear or damage and replace, if necessary.

ASSEMBLY

Assemble selective control valve by reversing sequence of steps explained under "Disassembly".

Use new O-rings and back-up rings. Dip all parts in clean transmission oil, ensuring that all parts remain thoroughly clean.

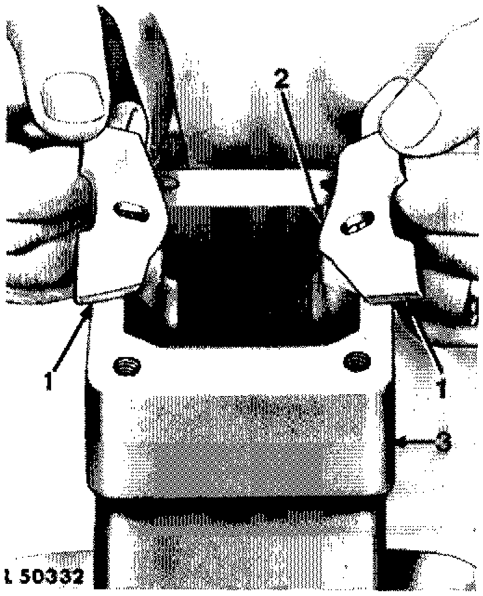

Fig. 7 — Installation of Cam Plates

1 Tapered end of cam plates
2 Cam with pointed lobe
3 Side of housing not numbered

Install cam plates as shown in fig. 7. The tapered end of cam plates must point toward front of valve housing. Install cam plate with pointed lobe in housing on side which is not numbered (see 3, fig. 7).

Install detent piston cam follower in housing. Ensure that cam follower roller lies against rocker.

Install rocker and secure to cam plates by means of special screws. Do not tighten special screws until cam plates have been adjusted. Install control lever arm and shaft in housing and rocker so that the arm faces top side of housing. Drive in spring pin securing shaft to rocker.

Install pressure valves and return valves. Make sure that valve rollers are properly seated on cam plates (see fig. 1). Use the correct spring for each valve (see Specifications).

Install flow control valve spring and flow control valve.

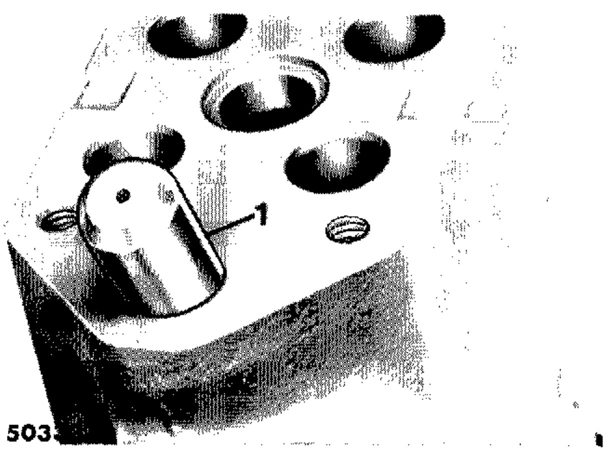

Fig. 8 — Installation of Detent Piston Inner Guide

1 Special tool JDH-28

Using special tool JDH-28, drive inner guide of detent piston into relevant bore in housing (see fig. 8).

Install detent piston, O-ring, back-up ring, outer guide and snap ring.

Seat spring caps onto springs with off-set side of caps facing bottom valve cover.

Secure bottom valve cover with flow control valve stop pin (see Specifications) and metering valve to housing (see fig. 2).

NOTE: If metering valve has been separated from bottom valve cover, secure adjusting arm to metering valve with long part of arm facing to the rear and metering valve slot (valve assembled) facing numbered side of control valve housing.

ADJUSTMENT

ADJUSTING PRESSURE AND RETURN VALVES

The return and pressure valves are adjusted by setting specified distances between curved surfaces of cams and valve rollers while selective control valve is in neutral position. This is to insure that the return valves open before the pressure valves during selective control valve operation.

A special adjusting tool JDH-15C is necessary to make the valve adjustment. The tool's adjusting screws hold the rocker in neutral position and the valves on their seats during the adjustment.

NOTE: Special tool JDH-15C replaces special tool JDH-15 and can be used on earlier model selective control valves, too.

The adjustment is made as follows:

1. Remove bottom cover together with valve guides and springs. Replace cover with special tool JDH-15C and secure, making sure that adjusting screws are not making contact.

2. Place selective control valve housing in a vice with the open end facing upward. Turn the four valve cam adjusting screws 7 (fig. 6) out and leave loose.

3. Loosen cam plate special screws 11 (fig. 6) and let cams rest on valve rollers, leaving the special screws slightly loose.

4. Turn in the two special tool set screws on the lever side of housing so as to hold the pressure and return valves on that side on their seats. Ensure that the valve rollers are riding properly on the cam. The rollers should turn, at the most, 90° before contacting the cam plate.

IMPORTANT! The special tool set screws must be tightened with the hand only. Under no circumstances should a wrench be used.

5. Level the rocker in relation to the top housing edge (see fig. 10). Gradually screw in detent piston set screw until detent piston follower just touches the rocker. Move the rocker slightly until the follower is felt going in the neutral notch. Finger tighten the screw to hold the rocker in neutral.

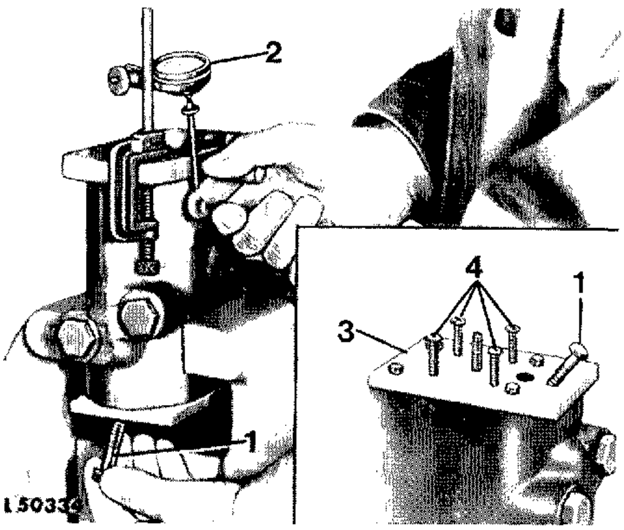

Fig. 9 — Setting Neutral Position

1 Set screw
2 Dial indicator set at "0"
3 Special adjusting tool JDH-15C
4 Set screws

6. With the rocker held in neutral position, install a dial indicator with a minimum travel of 0.14 in. (= 3.6 mm). Seat dial indicator on control lever (see "a", fig. 11) at a distance of 2 in. (= approx. 50 mm) measured from the center of control lever shaft. Align dial indicator so that there is a sufficient distance to measure on both sides. Set dial indicator at zero.

NOTE: It may be necessary to install control lever in reverse position (turned 180°) to mount dial indicator. Therefore, file a small groove in control lever where contacted by indicator feeler point.

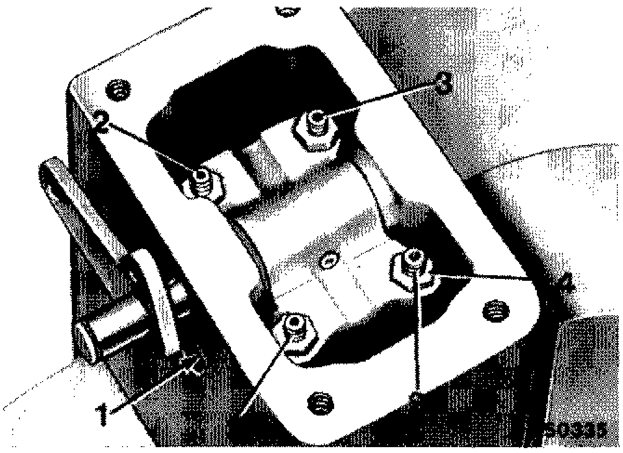

Fig. 10 — Adjusting Cam Plate Set Screws

1 Special screw for securing cam plate
2 Set screws for pressure valves
3 Set screws for return valves
4 Lock nut (4 used)

7. Turn in two cam adjusting screws on lever side of housing evenly until they just touch the cam. Do not apply pressure. If screws appear uneven against cam, reposition cam plate and retighten set screws.

8. As soon as both set screws are contacting the cam plate evenly, back off return valve set screw 1/8 turn and secure with lock nut. Then back off set pressure valve screw 1/4 turn, securing also with lock nut.

NOTE: The valve nearest to the "TOP" mark cast on the valve housing is a pressure valve, the other pressure valve being diagonally across from it (see fig. 10).

9. Tighten special screw securing cam plate to rocker (see 1, fig. 10) and press cam against both set screws.

NOTE: Each time the cam adjusting screws are backed off from the cams (creating a clearance between cam plates and adjusting screws), cams must be pried up against screws without loosening the cam-to-rocker attaching screws.

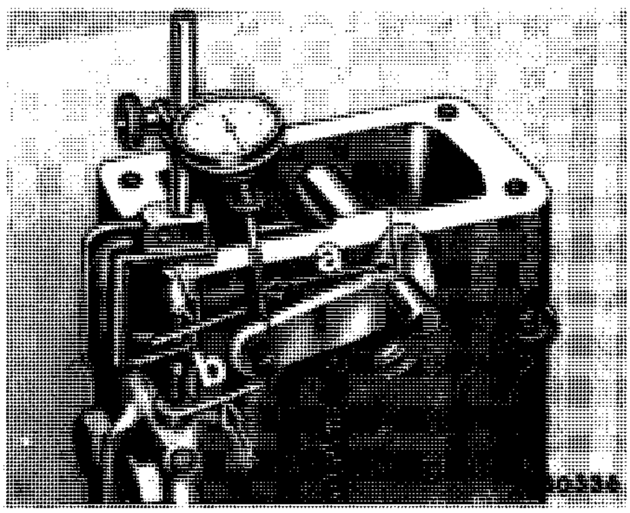

Fig. 11 — Adjusting Valves

a 2 in. (50 mm)

10. Loosen set screw of special adjusting tool for detent piston and rotate rocker in both directions.

As the cam touches the return valve roller, the dial indicator should read 0.01 to 0.016 in. (= 0.25 to 0.40 mm). When the control lever or rocker is moved in the opposite direction, the cam moves against the pressure valve roller. Here the dial indicator should read 0.037 to 0.043 in. (0.94 to 1.1 mm). To decrease play, turn adjusting screw inwards, to increase turn outwards. Tighten lock nuts when valves are adjusted.

11. Check the "0" position on the dial indicator as explained in paragraphs 5 and 6.

12. Back off special adjusting tool set screws from control lever side. Tighten set screws on opposite side to press return valve and pressure valve that have not yet been adjusted against the valve seats. Set dial indicator at zero.

13. Adjust second return valve and pressure valve in the same manner as before. The adjusting dimensions are the same as above.

CAUTION: The pressure valves and return valves are arranged "crosswise" (see fig. 10).

14. After having adjusted these valves, recheck "0" position of dial indicator and adjustment of all four valves. Readjust, if necessary.

15. Reinstall valve springs, valve guides and cover. Do not remove valves unless necessary. Valves must be readjusted, if they are removed and reinstalled.

METERING VALVE ADJUSTMENT

Install selective control valve assembly.

Connect hydraulic tester (as described in section 70, group 5) to selective control valve and check oil flow (see Specifications).

VALVE LEAKAGE CHECK

Check valve leakage by connecting a hose, approx. 2 ft. (70 cm) long, with pressure gauge to quick coupler outlet. With engine running, adjust pressure (operating selective control valve) to 1500 psi. (105 kg/cm^2).

If pressure valves are leaking, pressure will increase. If return valves are leaking, pressure will decrease. See Specifications for maximum permissible leakage.

SPECIFICATIONS

	Dimensions of new parts	
O.D. of pressure or return valves	0.4960 to 0.4970 in.	12.600 to 12.624 mm
O.D. of flow control valve	0.7480 to 0.7490 in.	19.000 to 19.025 mm
O.D. of metering valve	0.6235 to 0.6245 in.	15.837 to 15.862 mm
O.D. of detent piston	0.7450 to 0.7470 in.	18.923 to 18.974 mm
Spring of pressure valve		
Free length	1.812 in.	46 mm
Resilience at a length of 1.25 in. (31.8 mm)	36 to 44 lbs.	17 to 20 kg
Spring of return valve		
Free length	1.562 in.	39.7 mm
Resilience at a length of 1.25 in. (31.8 mm)	19 to 23 lbs.	8.6 to 10.5 kg

SPECIFICATIONS (Cont'd)

		Dimensions of new parts
Spring of flow control valve		
Free length	2.94 in.	74.6 mm
Resilience at a length of 2.12 in. (= 54 mm)	41 to 49 lbs.	18.5 to 22 kg
Stop pin of flow control valve, exposed length	0.937 in.	24 mm

ADJUSTMENTS

Metering valve		
Flow rate at 1500 psi. (105 kg/cm^2) and 2500 rpm engine speed	1.66 Imp.gals./min. 2 US gals./min.	7.5 lit./min.
Metering valve arm in center position	5 to 5.8 Imp.gals./min. 6 to 7 US gals./min.	22.5 to 26.5 lit./min.
Pressure and return valves		
Play between pressure valve and cam (in neutral position)	0.037 to 0.043 in.	0.94 to 1.10 mm
Play between return valve and cam (in neutral position)	0.010 to 0.016 in.	0.25 to 0.40 mm

Valve leakage
Pressure valve (set at 1500 psi. (105 kg/cm^2) . . . . 500 psi (35 kg/cm^2)/min. maximum increase
Return valve (set at 1500 psi. (105 kg/cm^2) . . . . . 500 psi (35 kg/cm^2)/min. maximum decrease

TORQUES FOR HARDWARE

Bottom cover to control valve housing	20 ft.lbs.	2.8 mkg
Top cover to control valve housing	35 ft.lbs.	4.8 mkg

SPECIAL TOOLS

Part No. when ordering from John Deere Parts Depot	Manufacturer	Description	Use
19.58-90.279	JDH-28*	Driver	Installing inner detent guide
19.58-90.280	JDH-15C*	Special setting tool	To set selective control valve

* SERVICE TOOLS, INC., 1901 INDIANA AVENUE, CHICAGO, ILLINOIS 60616, USA

Group 35
REMOTE CYLINDER

GENERAL INFORMATION

The double-acting remote cylinder has a piston of 2.5 in. (63.5 mm) dia. which is 8 in. (203 mm) long. The cylinder serves for operating a wide range of implements. It is provided with an adjustable stop which allows a variable lift range from 0 to 8 in. (0 to 203 mm).

NOTE: For a detailed explanation of remote cylinder design and operation see under "Hydraulic Cylinders" in "Fundamentals of Service—Hydraulics" manual.

For connecting the cylinder to the tractor see Operator's Manual.

DIAGNOSING MALFUNCTIONS

For diagnosing malfunctions see group 5.

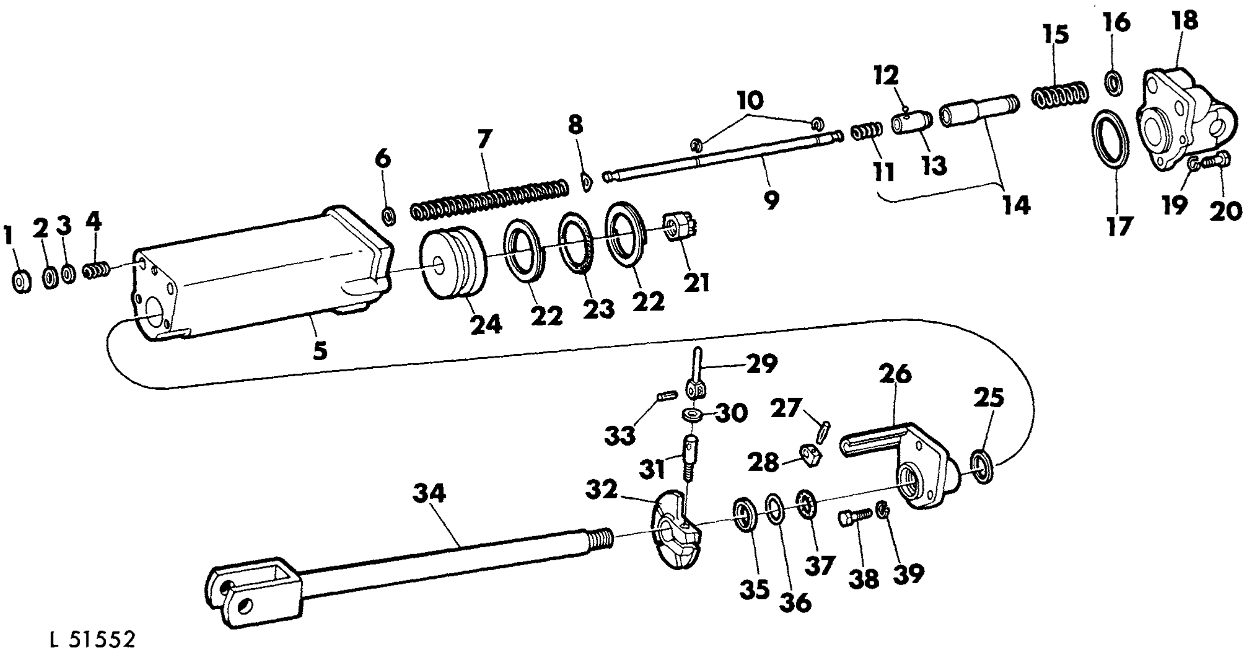

Fig. 1 — Exploded View of Remote Cylinder

1 Packing adapter
2 V-packing (3 used)
3 Packing adapter
4 Spring
5 Remote cylinder
6 Washer
7 Stop rod spring
8 Special washer
9 Stop rod
10 Snap rings
11 Spring
12 Ball
13 Valve
14 Stop valve assembly
15 Stop valve spring
16 Oil passage gasket (2 used)
17 Gasket
18 Remote cylinder cap
19 Lock washer (4 used)
20 Cap screw (4 used)
21 Special nut
22 Back-up rings
23 O-ring
24 Piston
25 Piston rod guide gasket
26 Piston rod guide
27 Groove pin
28 Stop rod arm
29 Stop lever
30 Special washer
31 Stop screw
32 Piston rod stop
33 Roll pin
34 Piston rod with yoke
35 Oil seal
36 Back-up ring
37 O-ring
38 Cap screw (3 used)
39 Lock washer (3 used)

REPAIR

View and description of individual parts see fig. 1.

DISASSEMBLY

Remove end cap 18.

Press rod assembly completely into cylinder and remove stop valve assembly 14. Pull stop valve 14 from valve 13, watching ball 12, which retains valve 13 on rod 9. After removing ball, take valve 13 out of rod 9.

Insert a rod through yoke attaching pin holes of piston rod 34 and unscrew special lock nut 21 from piston rod. Pull piston 24 and rod 34 out of cylinder.

Push stop 32 from piston rod 34 and, if necessary, remove stop lever 29, washer 30 and stop screw 31.

Press rod 9 completely into cylinder so that it does not get bent when groove pin 27 is driven out. Drive groove pin 27 out of stop arm 28 and rod 9.

Remove piston rod guide 26. Rod 9 can be used to drive packing adapters 1 and 3, together with the three packings 2, out of the cylinder.

INSPECTION

Check cylinder and piston for wear, scoring, cracks and other damage.

Replace piston O-ring 23 and back-up rings 22.

Replace piston rod guide seal 25 as well as O-ring 37 and back-up ring 36.

Check rod 9, stop valve 14 and valve 13 for excessive wear or damage and replace, if necessary.

ASSEMBLY

NOTE: When assembling the remote cylinder, always replace O-rings, back-up rings, seals and packings.

Install new O-ring 37 first, then back-up ring 36, to piston rod guide 26.

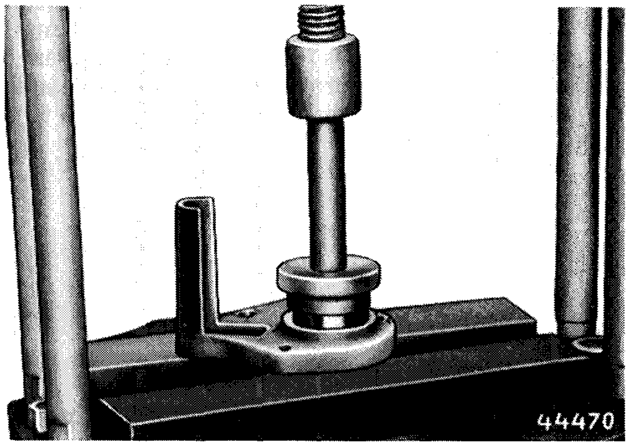

Fig. 2 — Assembly of Piston Rod Oil Seal

Drive or press new oil seal 35, with seal lip facing driver or press, into piston rod guide bore (see fig. 2).

Install packing adapters 1 and 3, and the three packings 2 to stop rod, in the order shown in fig. 1 (the seal edge of each packing facing the cylinder).

Fit piston rod guide 26 and seal 25, but do not yet tighten cap screws 38.

Install stop rod assembly. With the help of stop valve assembly, press stop rod 9 through packing bores. Tighten cap screws 38 of piston rod guide to the specified torque (see Torques for Hardware).

Push stop arm 28 onto stop rod and drive in groove pin 27.

NOTE: Before driving in pin 27, push stop rod 9 completely into cylinder, so that rod does not get bent while the pin is driven in.

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Install stop valve assembly 14, ensuring that ball 12 fits into recess. Press valve assembly into cylinder bore.

Push stop 32, with smooth side away from piston rod yoke end, into piston rod. Insert piston rod 34 into cylinder.

Install O-ring 23 and both back-up rings 22 on piston, O-ring between back-up rings.

Push piston 24 onto piston rod 34 until it contacts rod recess, then fit lock nut 21 and tighten. Fit stop screw 31, special washer 30 and stop lever 29 to stop 32 (if removed) and turn stop 32 on piston rod so that lever 29 is opposite stop arm 28.

Fit seal 17 to end cap 18. Fit both seals 16 to oil passages.

Slide spring 15 over stop valve end 14 and install end cap. Tighten cap screws 20 to the specified torque (see Torques for Hardware).

BLEEDING

After remote cylinder assembly, connect hoses to quick coupler of tractor. The hose near the stop rod side is to be connected to the inner plug of the quick coupler. This ensures that the remote cylinder piston extends when the selective control valve lever is moved backward.

In order to bleed, hold remote cylinder vertical with hose end upward.

Start engine and move selective control valve lever several times into positions "retract" and "extend" so that any trapped air can escape from the cylinder.

SPECIFICATIONS

Period required for extending or retracting the cylinder at 2100 rpm engine speed	2 sec.

TORQUES FOR HARDWARE

Cap screws of piston rod guide	35 ft.lbs.	4.8 mkg
Cap screws of remote cylinder cap	85 ft.lbs.	11.7 mkg

Section 80
MISCELLANEOUS

CONTENTS OF THIS SECTION

Group 5
BELT PULLEY

GENERAL INFORMATION

The belt pulley assembly is driven by the PTO stub shaft at 540 rpm or 1000 rpm respectively. It is a straight bevel gear type unit and is attached to the transmission case.

REMOVAL AND DISASSEMBLY

Drain oil from pulley case by removing filler plug. Remove pulley guard. Remove pulley from shaft, using a puller if necessary.

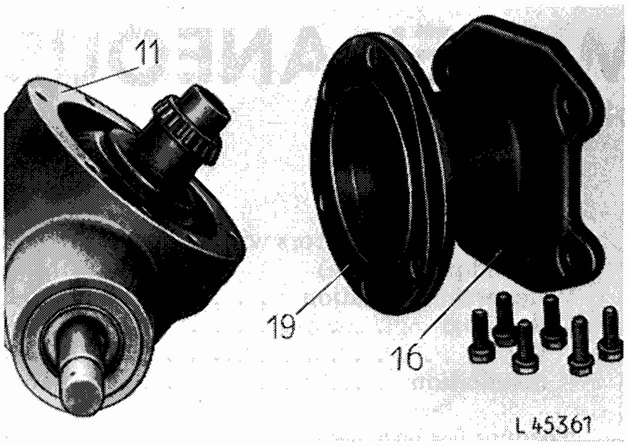


Fig. 1 — Removing Pulley Case from Quill

11 Belt pulley case
16 Quill
19 Shims

Remove pulley case 11 (fig. 1) from quill 16.

CAUTION: Be careful not to damage shims 19 between pulley case and quill.

Remove quill from transmission case.

Lift pulley drive gear hub assembly out of belt pulley case.

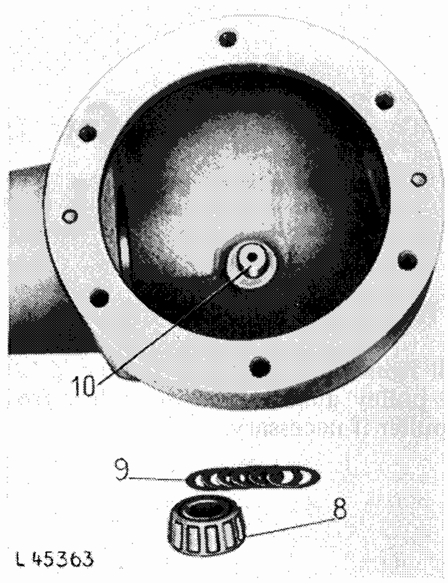


Fig. 2 — Removing Bearing Cone and Shims from Inner Bearing Pin

8 Inner bearing cone
9 Shims
10 Inner bearing pin

Remove bearing cone 8 (fig. 2) and shims 9 from inner bearing pin 10.

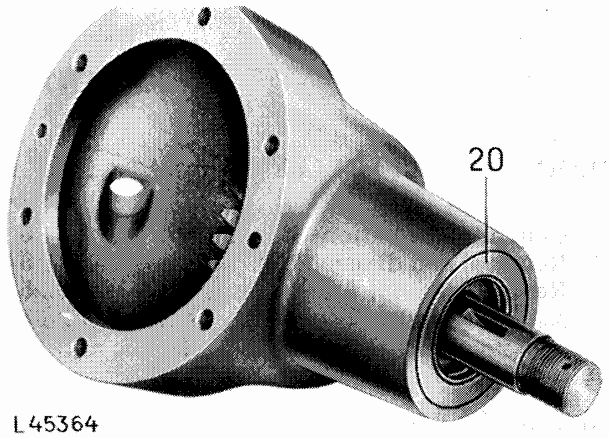


Fig. 3 — Removing Oil Seal from Belt Pulley Case

20 Oil Seal

Remove oil seal 20 (fig. 3) and pull outer bearing cone off shaft.

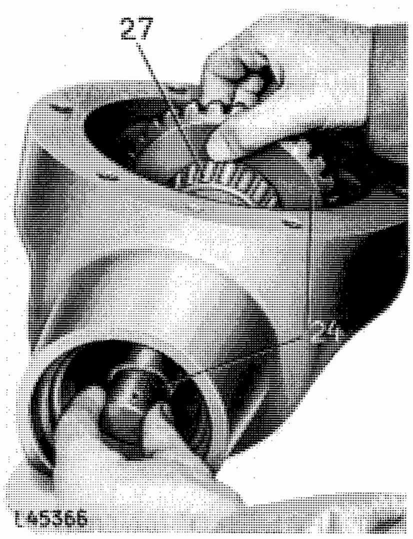


Fig. 4 — Removing Drive Shaft

24 Drive shaft
27 Inner bearing cone

Remove drive shaft 24 (fig. 4) with inner bearing cone 27 from belt pulley case.

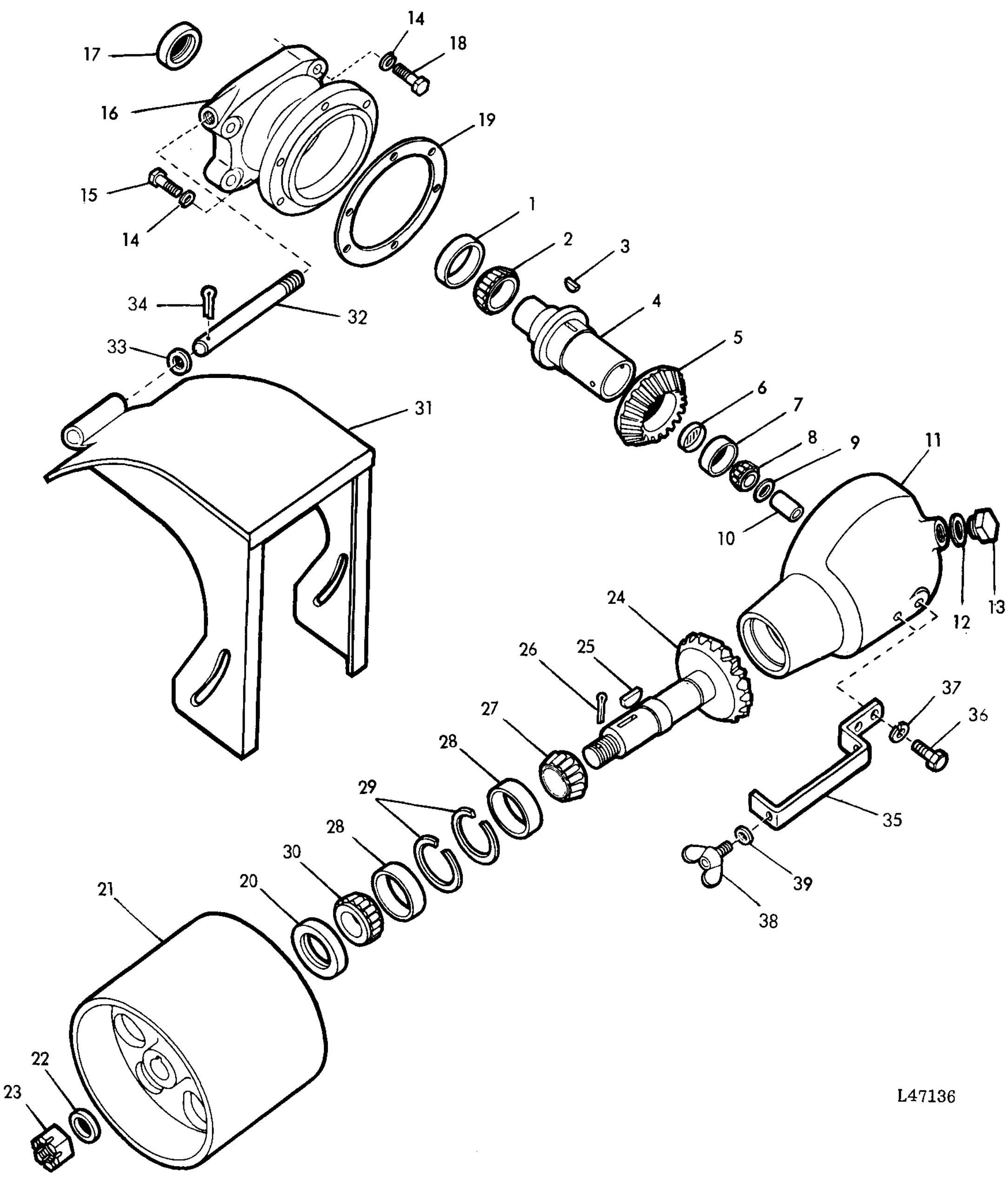


Fig. 5 — Parts of the Belt Pulley Drive Assembly

1	Bearing cup	11	Belt pulley case	21	Belt pulley	31	Pulley guard
2	Bearing cone	12	Aluminium washer	22	Plain washer	32	Pin
3	Woodruff key	13	Filler and drain plug	23	Nut	33	Washer
4	Drive gear hub	14	Lock washer (10 used)	24	Drive shaft	34	Cotter pin
5	Drive gear	15	Cap screw (6 used)	25	Woodruff key	35	Retainer
6	Cup plug	16	Quill	26	Cotter pin	36	Cap screw (2 used)
7	Bearing cup	17	Oil seal	27	Bearing cone	37	Lock washer (2 used)
8	Bearing cone	18	Cap screw (4 used)	28	Bearing cups	38	Wing nut (2 used)
9	Shims	19	Quill shims	29	Snap rings	39	Washer (2 used)
10	Inner bearing pin	20	Oil seal	30	Bearing cone		

REPAIR

Wash all parts in a clean solvent and dry, using compressed air, before inspecting for serviceability.

If it is necessary to replace the inner bearing pin 10, be sure to install the new pin with small bore facing inward (see fig. 2).

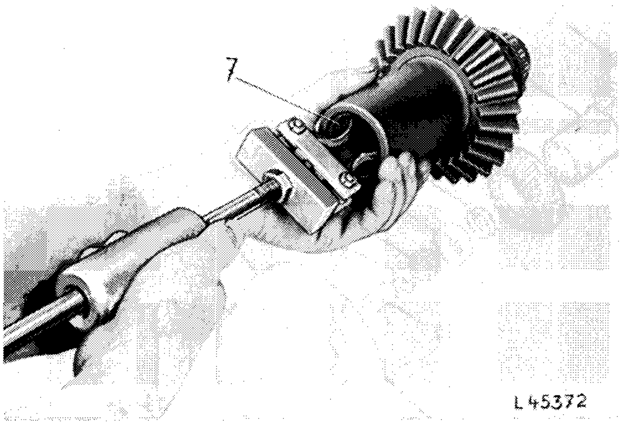


Fig. 6 — Removing Bearing Cup from Drive Gear Hub

7 Bearing cup

If the cup must be replaced, use a puller as shown in fig. 6 to remove the old cup, and press a new cup into place.

If the gear 5 (fig. 5) of hub 4 must be replaced, use a press to remove the old gear. Press a new gear into place, making sure that the Woodruff key is in place and that the new gear is pressed fully onto the hub shoulder.

ASSEMBLY AND ADJUSTMENT

NOTE: For location of parts in assembly refer to fig. 5.

Insert drive shaft 24 with bearing cone 27 into the belt pulley case (see fig. 4).

Install bearing cone 30 onto drive shaft. Install new oil seal 20 in case, metal side out.

As a temporary measure, install a pack of shims 9 of specified thickness (see Specifications) and bearing cone 8 on bearing pin 10. Place drive gear hub assembly on inner bearing cone 8 in belt pulley case.

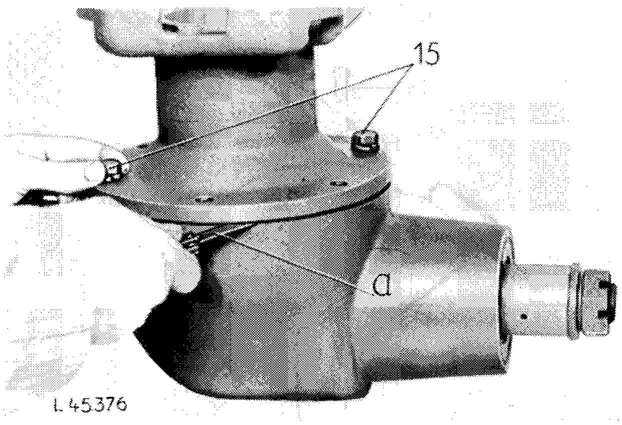


Fig. 7 — Measuring for Shim Requirement

a Feeler gauge 15 Cap Screws

Position quill 16 on belt pulley case, and install two cap screws 15 as shown in fig. 7 finger tight on opposite sides of the quill. Use a feeler gauge to measure clearance between case and quill to determine shim pack required. Install shim pack to the measurement determined above, and secure quill to belt pulley case with cap screws 15.

NOTE: Shim pack is temporary until correct gear backlash and hub assembly end play is adjusted.

MEASURING AND ADJUSTING GEAR BACKLASH

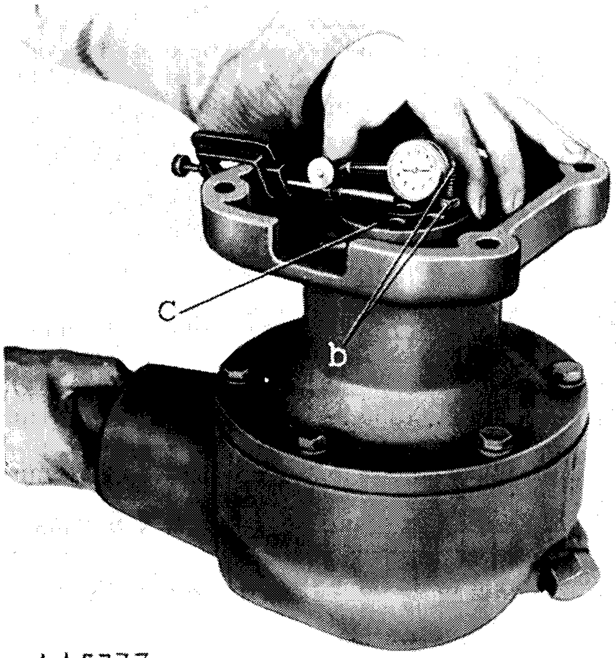


Fig. 8 — Measuring Gear Backlash

b Cap screw and nut
c PTO stub shaft

Use a dial indicator as shown on fig. 8. Prior to measuring, insert a cap screw in PTO stub shaft and secure it with a nut (see "b"). Install 1000 rpm PTO stub shaft (or 540 rpm stub shaft respectively), and tap lightly to insure proper seating. Fasten dial indicator on quill so that its pin touches the cap screw in the stub shaft, then rotate drive shaft slightly to the left and right and take backlash reading.

To establish correct backlash (see Specifications), remove hub assembly and quill. Add or deduct shims beneath inner bearing cone 8 (see fig. 2).

CHECKING AND ADJUSTING END PLAY OF DRIVE GEAR HUB ASSEMBLY

Use a dial indicator to check end play of hub assembly roller bearings. If required, add or remove shims between the quill and belt pulley case to obtain correct end play (see Specifications).

ADJUSTING DRAG TORQUE

Install belt pulley, washer and slotted hex. nut.

Tighten slotted nut to specified roll drag torque (see Specifications).

If slot in nut does not match cotter pin hole in shaft, tighten until next slot matches cotter pin hole. Install cotter pin.

Mount belt pulley drive assembly to transmission case and fill belt pulley case to level of filler hole with recommended oil (see Operator's Manual).

Install pulley guard.

SPECIFICATIONS

	Dimensions of New Parts	
O.D. of inner drive shaft bearing seat	1.7970 to 1.7976 in.	45.643 to 45.659 mm
O.D. of outer drive shaft bearing seat	1.7720 to 1.7726 in.	45.008 to 45.024 mm
O.D. of shaft at pulley location	1.7505 to 1.7511 in.	44.462 to 44.478 mm
I.D. of hub bore for bearing cup	1.9365 to 1.9375 in.	49.187 to 49.213 mm
O.D. of hub bearing seat for bearing cone	1.7822 to 1.7828 in.	45.268 to 45.284 mm
O.D. of hub at drive gear location	2.7530 to 2.7540 in.	69.926 to 69.952 mm
I.D. of drive gear bore	2.750 to 2.752 in.	69.85 to 69.90 mm
Height of shim pack between bearing pin and bearing cone (temporary height)	0.058 in.	1.47 mm
Gear backlash	0.005 to 0.009 in.	0.12 to 0.22 mm
Roll drag torque	15 to 25 in.lbs.	17.2 to 28.7 cmkg
End play of hub assembly roller bearings	0.0004 to 0.003 in.	0.01 to 0.08 mm
Oil capacity (belt pulley case)	0.3 U.S. gals. 0.25 Imp.gals.	1.2 lit.
O.D. of belt pulley	12 in.	305 mm
Face	8.5 in.	215 mm
Belt pulley speed (at 2100 engine rpm)	985 rpm	
Belt speed (at 2100 engine rpm)	3100 ft./min	15.5 m/sec.

Group 10

DE LUXE SEAT

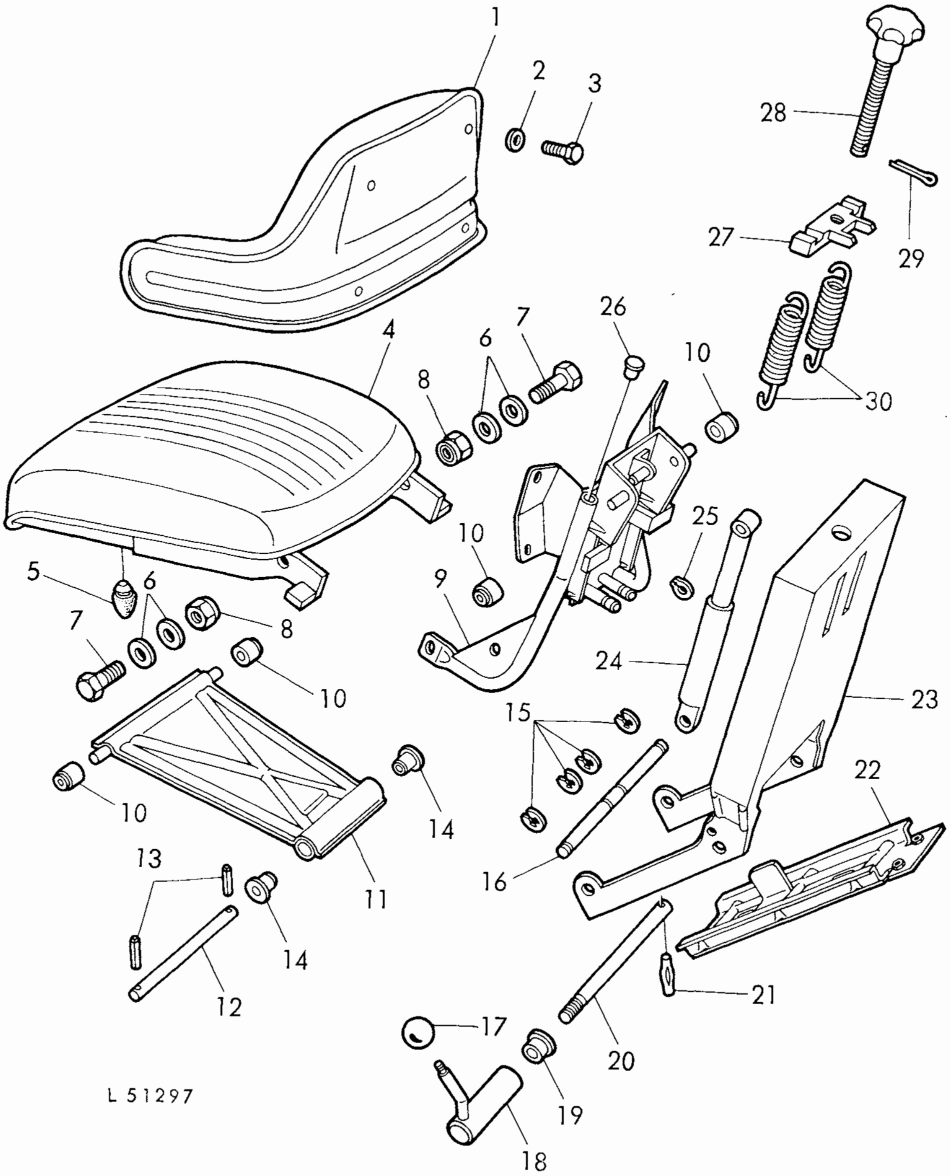


Fig. 1 — Exploded View of DE LUXE Seat

1 Back rest
2 Washer (4 used)
3 Cap screw (4 used)
4 Seat cushion
5 Bumper
6 Washers
7 Cap screws
8 Hex. nuts
9 Seat frame
10 Guide rollers
11 Seat suspension
12 Suspension pin
13 Spring pins
14 Guide bushings
15 Snap rings
16 Shock absorber shaft
17 Knob
18 Locking lever
19 Thrust bushing
20 Adjusting pin
21 Locating pin
22 Adjusting rail
23 Spring housing
24 Shock absorber
25 Snap ring
26 Cap (2 used)
27 Spring suspension bracket
28 Damping screw
29 Cotter pin
30 Tension springs

GENERAL INFORMATION

The DE LUXE seat absorbs field shocks through two adjustable springs and a shock absorber suspension system located on the rear of the seat. The seat is adjustable for operator's height and weight; range of adjustment is from 154 to 265 lbs (70 to 120 kg).

REPAIR

Swing up seat cushion and remove the two cap screws securing the seat to junction block of rockshaft housing. Then lift off complete seat.

Disassemble seat as shown in fig. 1 and check all parts for serviceability.

Check spring 30 for fatigue and broken coils.

Hold shock absorber 24 vertically, with body down (see fig. 1). Press in piston and pull out again. Replace shock absorber if no resistance is offered to both compression and extension.

When assembling seat, reverse disassembly sequence as shown in fig. 1.

For adjusting seat to operator's height and weight, see Operator's Manual.

Group 15

FRONT AND REAR WHEELS

Front Wheels

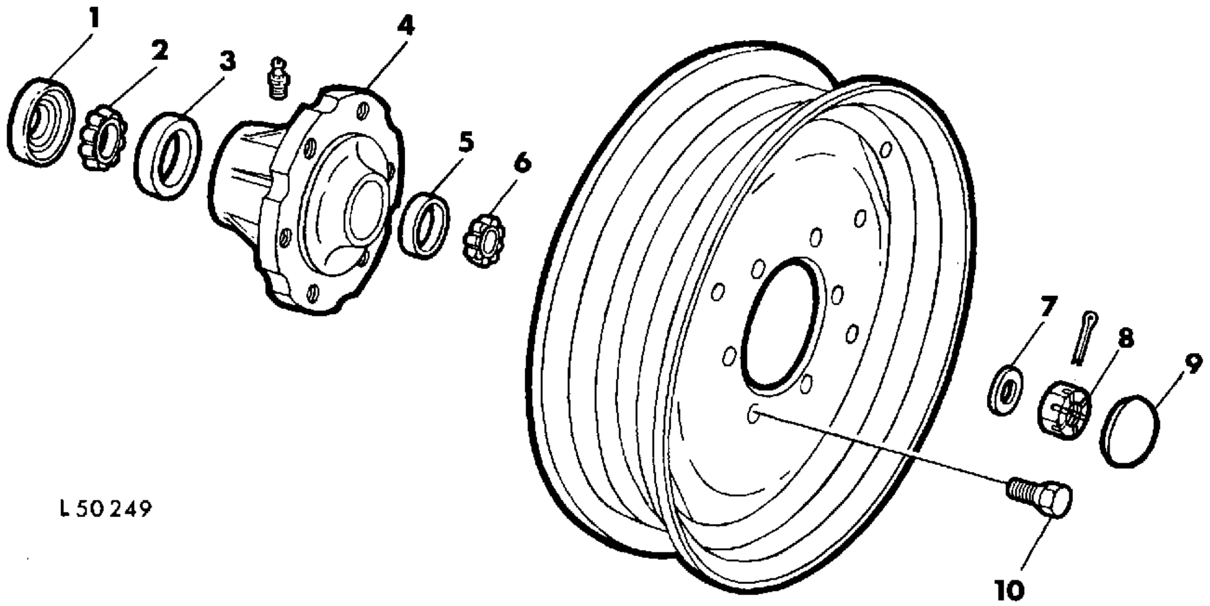


Fig. 1 — Exploded View of Front Wheel (Standard Type)

1 Oil seal
2 Roller bearing cone
3 Roller bearing cup
4 Front wheel hub
5 Roller bearing cup
6 Roller bearing cone
7 Washer
8 Slotted nut
9 Dust cap
10 Wheel bolt (6 used)

STANDARD TYPE

REPAIR

Remove dust cap 9 (fig. 1). Raise front of tractor and support safely.

Remove front wheel and hub.

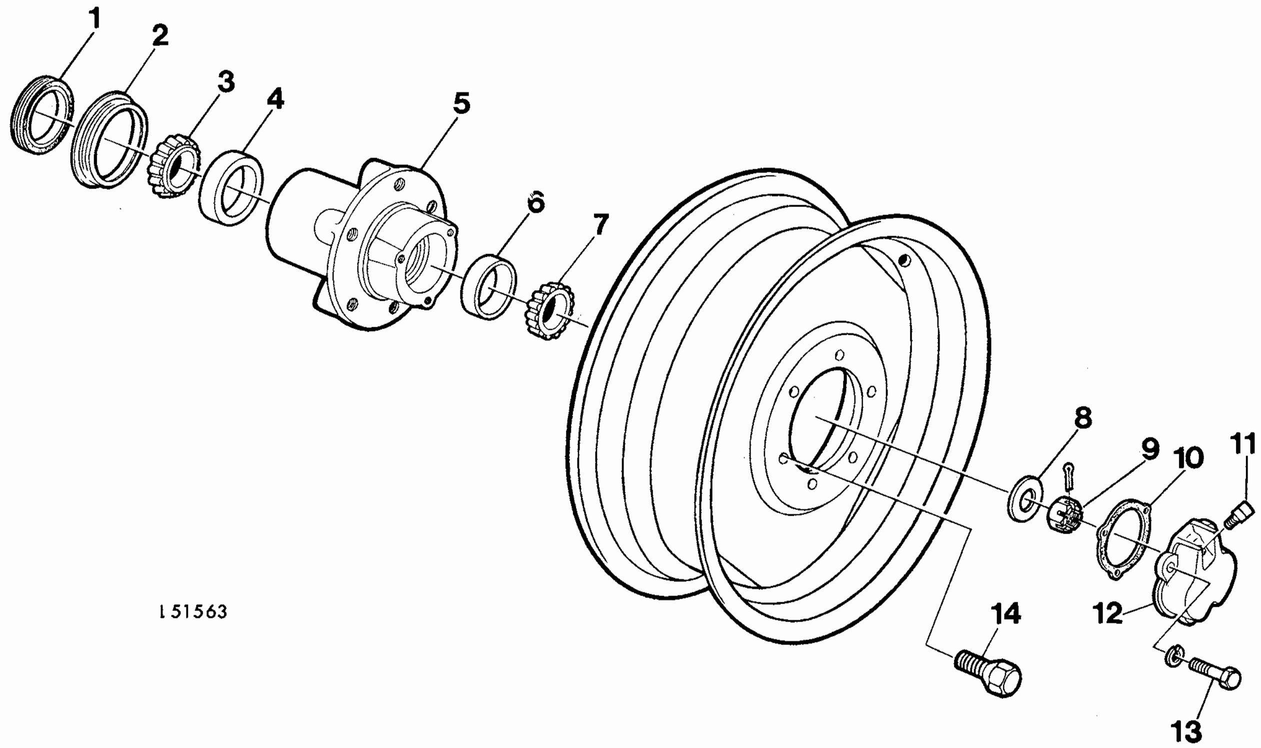
Clean all parts and check bearing cups and cones for damage or excessive wear.

Check oil seal 1 for serviceability and replace, if necessary. Drive new oil seal (with sealing lip facing away from hub) into hub bore by means of a suitable driving tool so that it is 0.3 in. (8 mm) from hub face. When assembling, pack space between lips of oil seal with lithium-saponified multi-purpose grease (or SAE No. 2 multi-purpose grease). Pack roller bearings liberally with bearing grease.

CAUTION: When assembling, keep bearings free from dirt.

Slide front wheel together with hub assembly on axle spindle. Install bearing cone 6 as well as washer 7 and slotted nut 8.

NOTE: Do not use a hammer when assembling front wheel hub bearing assembly. Tighten slotted nut to pull assembly together.



1 Oil seal	5 Hub	9 Castellated nut	12 Hub cap
2 Collar	6 Taper roller bearing cup	10 Gasket	13 Cap screw (3 used)
3 Taper roller bearing cone	7 Taper roller bearing cone	11 Square headed screw	14 Wheel bolt (6 used)
4 Taper roller bearing cup	8 Washer		

HEAVY-DUTY TYPE

REPAIR

Remove hub cap 12 (fig. 2). Raise front of tractor and support safely.

Remove front wheel with hub.

Clean all parts and check bearing cups and cones for damage or excessive wear.

NOTE: The front hubs have slots to facilitate removal of bearing cups.

If oil seal 1 has scored collar 2 or if bearing grease is dirty, drive collar out of hub. Replace collar as well as oil seal.

CAUTION: The seal ring will seal effectively only if sealing face is completely smooth and free of scores.

Drive new oil seal on axle spindle with numbered side of seal facing driving tool.

Pack space between lips of oil seal with lithium-saponified multi-purpose grease (or SAE No. 2 multi-purpose grease). Pack roller bearings liberally with bearing grease.

CAUTION: When assembling, keep bearings free from dirt.

Slide front wheel together with hub assembly on axle spindle. Install bearing cone 7 as well as washer 8 and castellated nut 9.

NOTE: Do not use a hammer when assembling front wheel hub bearing assembly. Tighten slotted nut to pull assembly together.

ADJUSTING FRONT WHEEL BEARINGS

(Both Front Wheel Types)

Tighten slotted nut to the specified torque.

Rotate wheel several times to align bearings and retighten slotted nut to the specified torque. Then back off nut to nearest slot and insert cotter pin.

NOTE: If a slot in the nut just lines up with cotter pin hole in spindle after applying the specified torque, back off nut one slot.

Install dust cap or gasket and hub cap.

Rear Wheels

(on Tractors with Rack-and-Pinion Axle)

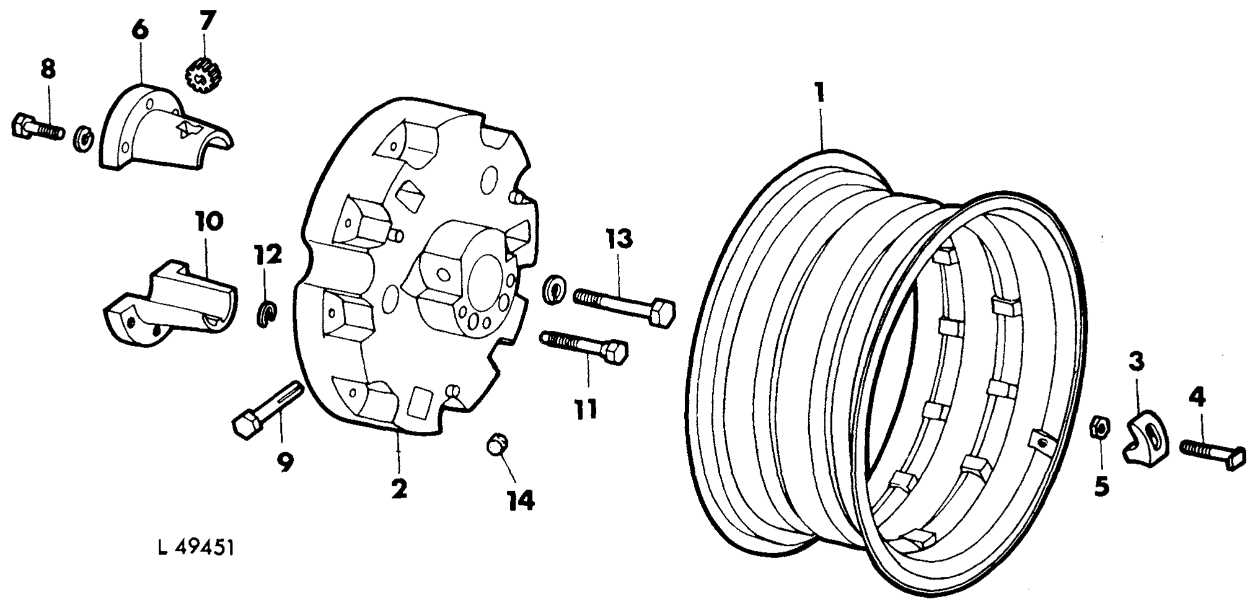


Fig. 3 — Exploded View of Rear Wheel with Rack-and-Pinion Axle

1 Rear wheel rim
2 Wheel disk
3 Clamp (12 used)
4 Square head bolt (12 used)
5 Hex. nut (12 used)
6 Wheel sleeve half
7 Pinion
8 Cap screw (3 used)
9 Pinion shaft
10 Wheel sleeve half
11 Jack screw (2 used)
12 Snap ring (2 used)
13 Cap screw (3 used)
14 Plug

GENERAL INFORMATION

If the tractor is equipped with rack-and-pinion axle, the rear wheels or disks are positively engaged by two wheel sleeve halves each to the relative axle. The wheel disks are pressed onto the tapered seats of the wheel sleeve halves. For infinitely variable tread adjustment, turn pinion shaft 9 (fig. 3). Since a pinion engaging the rack end of the axle is splined onto shaft 9, the relative rear wheel is moved inward or outward on the axle when turning the shaft. (Proper instructions for adjusting tread width see Operator's Manual).

REMOVAL

Loosen wheel bolts 13 (fig. 3) sufficiently. Lift up on right or left rear of tractor, using a floor jack, until relative rear wheel comes off ground. Support tractor safely.

Tighten both jack screws 11 until tapered seat of wheel sleeve half comes free. Then turn pinion shaft 9 and thus pinion until it is disengaged from rack end of rear axle. Remove rear wheel.

REPAIR

Remove plug 14 (fig. 3) from wheel disk 2 and drive shaft 9 out of pinion 7 (see fig. 4).

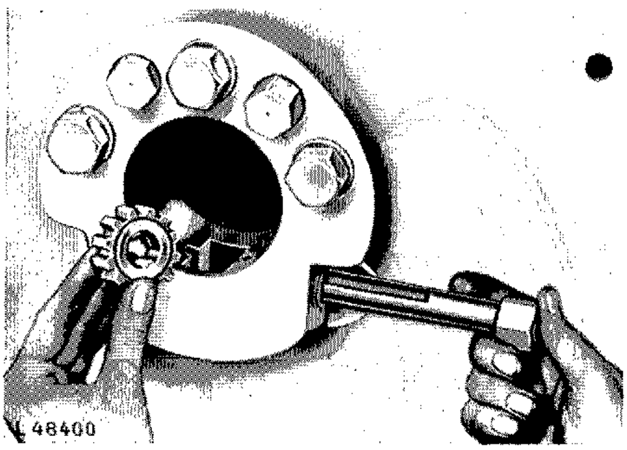


Fig. 4 — Pinion and Shaft Removed

Turn previously loosened attaching screws 13 (fig. 3) out of sleeve half 10. Also remove cap screws 8 of sleeve half 6 provided on rear of wheel disk. Lift off both sleeve halves.

Remove snap rings 12 of the two jack screws 11 and turn jack screws out of wheel disk. Remove wheel disk from rim.

Check rear wheel parts for wear, scores, cracks or other damage.

Attach wheel disk to rear wheel rim and tighten hex. nuts 5 (fig. 3) to the specified torque.

Attach sleeve half 6 to wheel disk. Screw both jack screws 11 into wheel disk and install snap rings 12. Back off jack screws until snap rings are flush against wheel disk.

Turn in attaching screws 13 of sleeve half 10 only a few threads. Position pinion 7 for installation and drive shaft 9 into pinion bore.

INSTALLATION

Slide rear wheel on rack-and-pinion axle until pinion engages with rack end of axle.

NOTE: Take care not to damage pinion teeth.

Adjust desired tread width by means of pinion shaft.

Tighten attaching screws 13 to the specified torque.

TORQUES FOR HARDWARE

FRONT WHEELS		
Slotted nut on axle spindle	35 ft.lbs.	4.8 mkg
Front wheel rim to hub, bolts	87 ft.lbs.	12 mkg
(Tractors with steel wheel disks)		
Rear wheels to rear axle, ball nuts	195 ft.lbs.	27 mkg
Steel disk to rear wheel rim, special bolts	145 ft.lbs.	20 mkg
(Tractors with cast wheel disks)		
Wheel disk to rear axle, wheel bolts	130 ft.lbs.	18 mkg
Cast disk to rear wheel rim, square head bolts	170 ft.lbs.	23.5 mkg
(Tractors with rack-and-pinion axle)		
Wheel disk to hub, wheel bolts	300 ft.lbs.	41.5 mkg
Wheel disk to rear wheel rim, square head bolts	170 ft.lbs.	23.5 mkg

Group 20
HYDRAULIC TRAILER HITCH

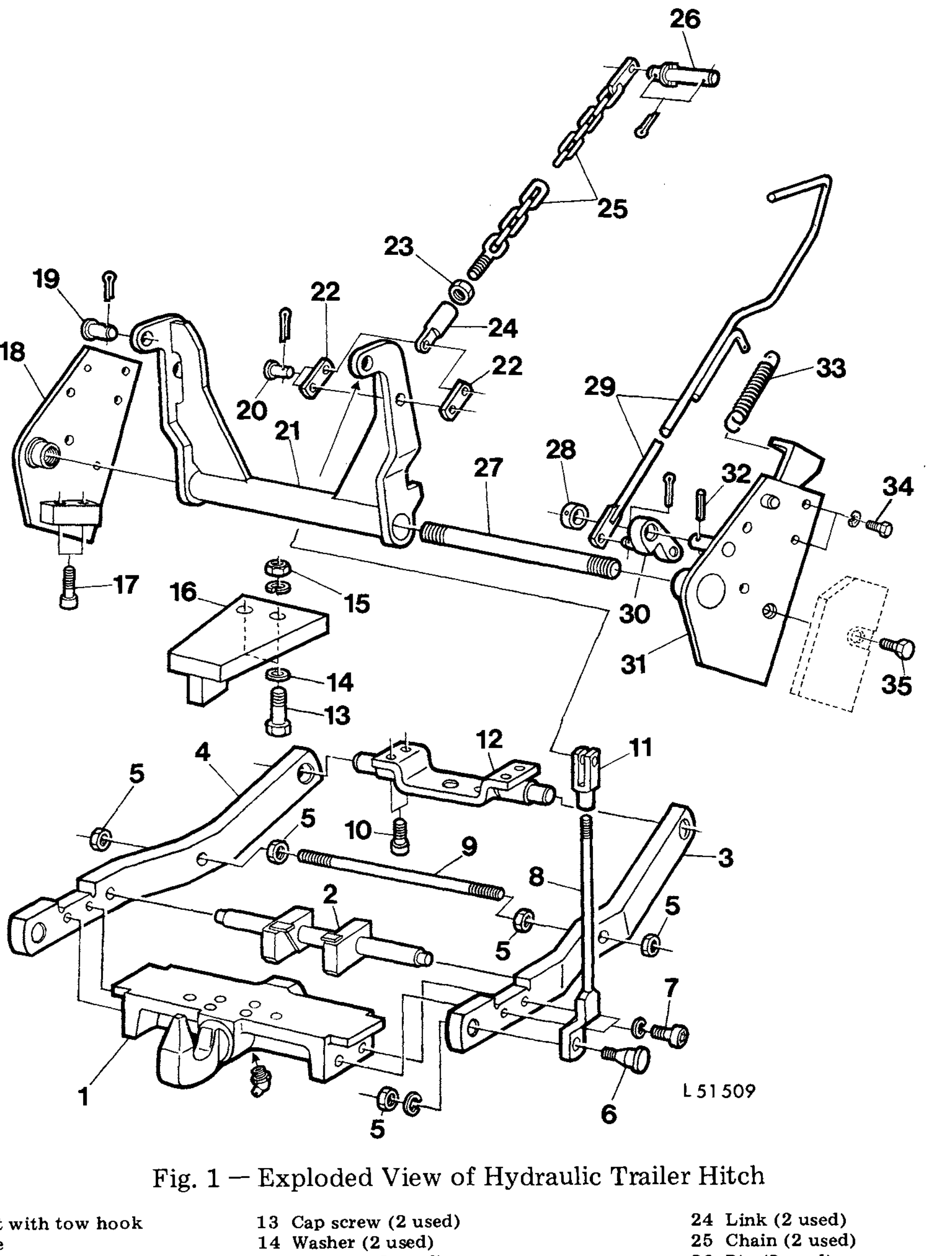


Fig. 1 — Exploded View of Hydraulic Trailer Hitch

1 Bearing support with tow hook
2 Anti-twist brace
3 Stay, right-hand
4 Stay, left-hand
5 Hex.nuts
6 Threaded pin (2 used)
7 Hex.socket screw (4 used)
8 Lifting rod (2 used)
9 Rod
10 Hex.socket screw (4 used)
11 Yoke (2 used)
12 Support
13 Cap screw (2 used)
14 Washer (2 used)
15 Hex.nut (2 used)
16 Stop bracket
17 Hex.socket screw (4 used)
18 Lifting plate, left-hand
19 Pin (2 used)
20 Pin (4 used)
21 Lifting bracket
22 Connecting link (4 used)
23 Hex.nut (2 used)
24 Link (2 used)
25 Chain (2 used)
26 Pin (2 used)
27 Shaft
28 Bushing
29 Release rod
30 Latch
31 Lifting plate, right-hand
32 Spring pin
33 Tension spring
34 Cap screw (4 used)
35 Cap screw (2 used)

GENERAL INFORMATION

The raising and lowering of the towing hitch, with its anti-twist device, is made by operating the rockshaft control lever. To lower the towing hitch, also pull up on release rod (see Operator's Manual).

The towing hitch is secured sideways by lifting plates bolted to the transmission case and underneath the transmission case by means of a support bracket.

REPAIR

Remove cotter pins securing hitch chains to rockshaft lift arms.

Remove four hex.socket screws 10 (fig. 1) securing the support bracket 12.

Also remove the four hex.socket screws 17 which secure the lifting plates 18 and 31 underneath the transmission case. Screw out four cap screws 34 and both cap screws 35 securing the lifting plates at the right and left-hand side of the transmission case.

Remove towing hitch.

The assembly is made up of simple parts which require very little maintenance, apart from regular greasing.

If necessary, all parts can easily be taken apart or replaced after having removed securing bolts, nuts or cotter pins.

Check all parts for cracks, wear, damage or distortion and replace, if necessary.

The assembly and installation of the hydraulic hitch is made by reversing the sequence observed for disassembly and removal.

TORQUES FOR HARDWARE

Lifting plates to transmission case, hex.socket screws	87 ft.lbs.	12 mkg
Support bracket to transmission case, hex.socket screws	87 ft.lbs.	12 mkg
Bearing support with tow hook to right and left-hand stays, hex.socket screws	55 ft.lbs.	7.7 mkg

Group 25
ROLL-OVER GUARD

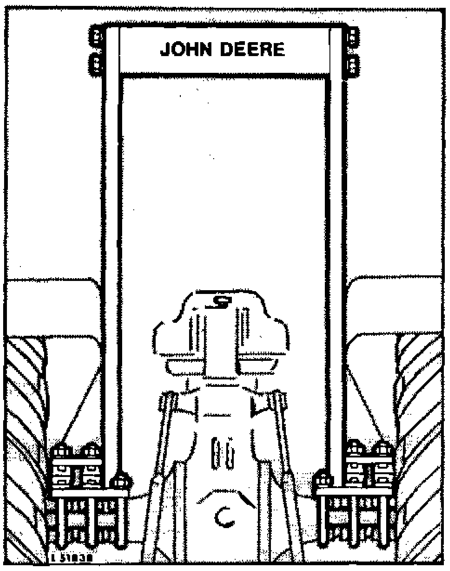


Fig. 1 — Roll-over Guard, Installed

INSTALLATION

Tighten all roll-over guard cap screws and hex. nuts to the specified torque (see fig. 1).

NOTE: Do not tighten securing bracket hex. nuts until crossbeam has been installed. Install crossbeam so that the name "JOHN DEERE" faces to the rear of the machine.

TORQUES FOR HARDWARE

Roll-over guard to rear axle housings, hex. nuts of securing brackets	94 ft.lbs.	13 mkg
Both upright supports to crossbeam, cap screws	94 ft.lbs.	13 mkg