John Deere JD450B Crawler Tractor

JOHN DEERE

TECHNICAL MANUAL

John Deere JD450B
Crawler Tractor

TM1033 (01MAY87) English

John Deere Dubuque Works
TM1033 (01MAY87)

LITHO IN U.S.A.
ENGLISH

JD450-B CRAWLER TRACTORS AND CRAWLER LOADERS

Technical Manual
TM-1033 (May-87)

CONTENTS

The specifications and design information contained in this manual were correct at the time it was printed. It is John Deere's policy to continually improve and update our machines. Therefore, the specifications and design information are subject to change without notice.

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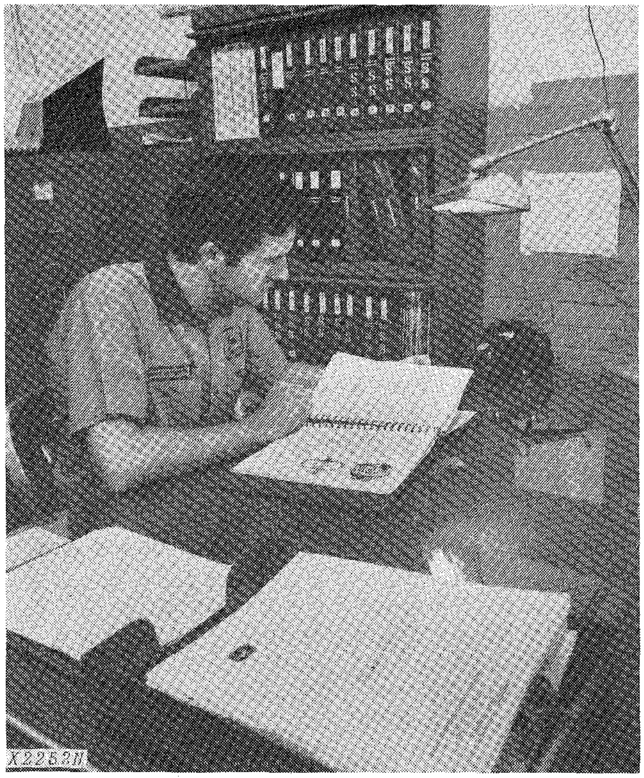
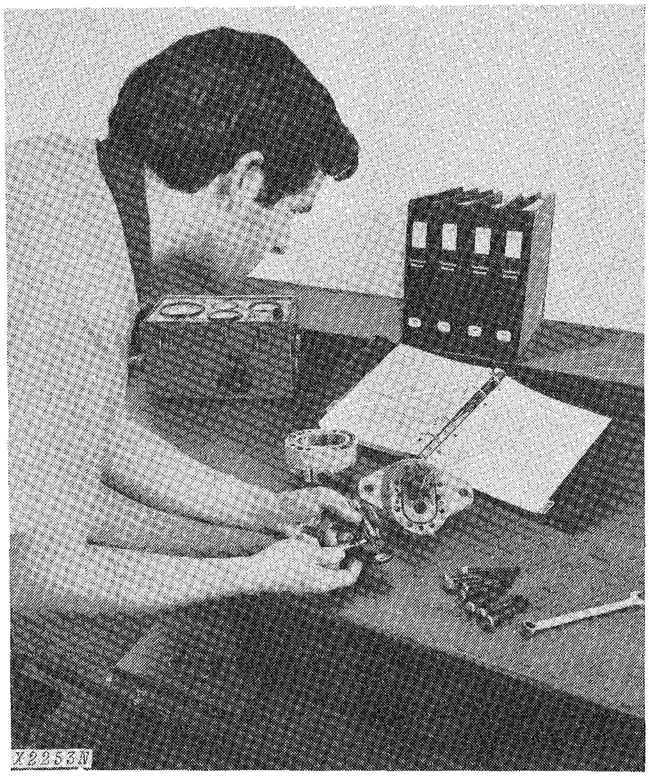
INTRODUCTION



Use FOS Manuals for Reference



Use Technical Manuals for Actual Service

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

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

•FOS Manuals—for reference
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 personnel and for reference by experienced service technicians.

FOS

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

•Technical Manuals—for actual service
Technical Manuals are concise service guides for a *specific* machine. Technical manuals are on-the-job guides containing only the vital information needed by an experienced service technician.

This technical manual was planned and written for you—an experienced service technician. 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.

Some features of this manual:

- *Table of contents at front of manual*
- *Exploded views showing parts relationship*
- *Photos showing service techniques*
- *Specifications grouped for easy reference*

This safety alert symbol identifies important safety messages in this manual. When you see this symbol, be alert to the possibility of personal injury and carefully read the message that follows.

COMPLETE PAGE LISTING WITH LATEST DATE LINES

|	1, 2	(Oct-80)
|	3, 4	(Oct-80)
	10-5-1, 2	(May-73)
|	10-5-3, 4	(Oct-80)
	10-10-1, 2	(May-73)
	10-10-3, 4	(Dec-71)
	10-15-1, 2	(Dec-71)
	10-15-3, 4	(Dec-71)
	10-20-1, 2	(Nov-72)
|	10-25-1, 2	(Oct-80)
	10-25-3, 4	(Feb-74)
|	10-25-5, 6	(Oct-80)
|	10-25-7, 8	(Oct-80)
|	10-25-9, 10	(Oct-80)
|	10-25-11, 12	(Oct-80)
|	20-5-1, 2	(Oct-80)
|	20-10-1, 2	(Oct-80)
|	20-10-3, 4	(Oct-80)
	20-10-5, 6	(Apr-74)
|	20-10-7, 8	(Oct-80)
|	20-10-9, 10	(Oct-80)
|	20-10-11, 12	(Oct-80)
	20-10-13, 14	(Dec-71)
	20-10-15, 16	(Dec-71)
|	20-15-1, 2	(Oct-80)
|	20-15-3, 4	(Oct-80)
|	20-20-1, 2	(Oct-80)
	20-25-1, 2	(May-73)
|	20-25-3, 4	(Oct-80)
|	20-30-1, 2	(Oct-80)
|	20-30-3, 4	(Oct-80)
|	20-30-5, 6	(Oct-80)
|	20-30-7, 8	(Oct-80)
	30-5-1, 2	(Dec-71)
	30-10-1, 2	(Nov-72)
	30-10-3, 4	(Dec-71)
|	30-15-1, 2	(Oct-80)
|	30-15-3, 4	(Oct-80)
|	30-15-5, 6	(Oct-80)
|	30-15-7, 8	(Oct-80)
|	30-20-1, 2	(Oct-80)
|	30-20-3, 4	(Oct-80)
|	30-20-5, 6	(Oct-80)
	40-5-1, 2	(Nov-73)
	40-5-3, 4	(Nov-73)
|	40-5-5, 6	(Oct-80)
	40-5-7, 8	(Nov-73)
|	40-5-9, 10	(Oct-80)
|	40-10-1, 2	(Oct-80)
|	40-10-3, 4	(Oct-80)
	40-10-5, 6	(Feb-74)
	40-10-7, 8	(Aug-73)
	40-10-9, 10	(Apr-74)
|	40-10-11, 12	(Oct-80)
	40-15-1, 2	(May-73)
	40-15-3, 4	(Aug-74)
	40-15-5, 6	(May-73)
	40-15-7, 8	(May-73)
|	40-20-1, 2	(Oct-80)
|	50-5-1,2	(Oct-80)
	50-10-1, 2	(Nov-70)
|	50-10-3, 4	(Oct-80)
|	50-10-5, 6	(Oct-80)
	50-10-7, 8	(Dec-71)
	50-15-1, 2	(Dec-71)
	50-15-3, 4	(Dec-71)
	50-15-5, 6	(Dec-71)
	50-15-7, 8	(Dec-71)
	50-15-9, 10	(Dec-71)
	50-15-11, 12	(Nov-72)
	50-15-13, 14	(Dec-71)
	50-15-15, 16	(Nov-72)
	50-15-17, 18	(Nov-72)
	50-15-19, 20	(Nov-72)
	50-15-21, 22	(Nov-72)
	50-15-23, 24	(Dec-71)
	50-15-25, 26	(Nov-72)
	50-15-27, 28	(Feb-74)
	50-15-29, 30	(Feb-74)
|	50-15-31, 32	(Oct-80)
	50-15-33, 34	(Feb-74)
	50-15-35, 36	(Dec-71)
	50-15-37, 38	(Feb-74)
	50-20-1, 2	(Dec-71)
	50-20-3, 4	(Dec-71)
|	50-25-1, 2	(Oct-80)

| *Vertical lines indicate pages included in this revision.*

	60-5-1, 2	(Nov-72)
	60-5-3, 4	(Dec-71)
	60-10-1, 2	(Feb-73)
	60-10-3, 4	(Nov-70)
	60-15-1, 2	(Nov-70)
|	60-15-3, 4	(Oct-80)
|	60-20-1, 2	(Oct-80)
|	60-20-3, 4	(Oct-80)
|	60-20-5, 6	(Oct-80)
|	60-25-1, 2	(Oct-80)
|	60-25-3, 4	(Oct-80)
|	60-25-5, 6	(Oct-80)
|	60-25-7, 8	(Oct-80)
	70-5-1, 2	(Nov-72)
	70-5-3, 4	(Nov-70)
|	70-5-5, 6	(Oct-80)
	70-5-7, 8	(Nov-70)
|	70-5-9, 10	(Oct-80)
|	70-5-11, 12	(Oct-80)
	70-10-1, 2	(Nov-73)
	70-10-3, 4	(Nov-70)
	70-10-5, 6	(Dec-71)
	70-15-1, 2	(Nov-70)
|	70-15-3, 4	(Oct-80)
	70-20-1, 2	(Nov-70)
	70-20-3, 4	(Nov-70)
	70-20-5, 6	(Aug-74)
|	70-20-7, 8	(Oct-80)
	70-20-9, 10	(Nov-73)
	70-25-1, 2	(Nov-70)
	70-25-3, 4	(Nov-72)
	70-25-5, 6	(Nov-72)
	70-25-7, 8	(Nov-72)
|	70-30-1, 2	(Oct-80)
	70-30-3, 4	(Dec-71)
|	70-30-5, 6	(Oct-80)
	70-35-1, 2	(Feb-74)
	70-35-3, 4	(Feb-74)
	70-35-5, 6	(Feb-74)
|	70-35-7, 8	(Oct-80)
	70-40-1, 2	(Nov-70)
|	70-40-3, 4	(Oct-80)
	70-40-5, 6	(Aug-73)
|	80-5-1, 2	(Oct-80)
	80-5-3, 4	(Dec-71)
|	80-5-5, 6	(Oct-80)
|	80-5-7, 8	(Oct-80)
|	80-5-9, 10	(Oct-80)
|	80-5-11, 12	(Oct-80)
|	80-5-13, 14	(Oct-80)
|	80-5-15, 16	(Oct-80)
	80-10-1, 2	(Nov-70)
|	80-10-3, 4	(Oct-80)
	80-10-5, 6	(May-73)
	80-10-7, 8	(May-73)
	80-10-9, 10	(May-73)
	80-10-11, 12	(May-73)
|	80-10-13, 14	(Oct-80)
	80-15-1, 2	(Nov-70)
|	80-15-3, 4	(Oct-80)
	80-15-5, 6	(Nov-72)
|	80-15-7, 8	(Oct-80)
	80-15-9, 10	(Nov-72)
	80-15-11, 12	(Nov-73)
	80-15-13, 14	(Feb-73)
	80-15-15, 16	(Feb-73)
|	80-15-17, 18	(Oct-80)
	80-20-1, 2	(Nov-70)
|	80-20-3, 4	(Oct-80)
	80-25-1, 2	(Nov-70)
|	80-25-3, 4	(Oct-80)
|	80-30-1, 2	(Oct-80)
	80-35-1, 2	(Nov-70)
	80-40-1, 2	(Aug-73)
	80-40-3, 4	(Feb-74)
	80-40-5, 6	(Feb-74)
|	Index-1, 2	(Oct-80)
|	Index-3, 4	(Oct-80)
	Index-5, 6*	(May-73)

| *Vertical lines indicate pages included in this revision.*
**Remove these pages from Technical Manual.*

Section 10
GENERAL

CONTENTS OF THIS SECTION

Group 5
SPECIFICATIONS

Engine

Type .... 4-cylinder in-line, valve-in-head, 4-stroke cycle diesel

Flywheel horsepower (observed) at 2500 rpm 65
Drawbar horsepower (observed) 48.6
Torque (ft-lbs) max. at 1300 rpm (observed) (nominal) 164.5
Bore and stroke, inches .... 4.02 x 4.33
Displacement, cubic inches 219
Compression ratio 16.2:1
Firing order 1,3,4,2
Governed speed range (rpm) .... 800 - 2650
Engine disconnect clutch ..... 11-inch, single disk, foot-operated

Electrical System

Battery voltage (nominal) .... 12 volts
Ground battery terminal .... Negative

Hydraulic System

Type .... Open-center; includes power steering, brakes, loader, dozer, ripper, backhoe, and rotoboom.

Transmission

Type .... Manual selection, H-L-R with eight forward speeds and four reverse

Travel speeds, mph (no slip, 2500 engine rpm):

Range	High	Low	Reverse
1st	1.8	1.3	1.7
2nd	2.8	2.0	2.7
3rd	4.3	3.0	4.1
4th	6.7	4.7	6.4

Steering-Brakes

Type...... Multiple-disk clutches and contracting band with integral reservoir (early models), hydraulic pump and cylinders.

Power Take-Off

Type.... Transmission-driven, rear, 1000 rpm at 1900 rpm engine speed.

Track and Track Frame

Five rollers non-oscillating, one carrier roller each side. Hydraulic track adjusters. 36 track shoes per side (Dozer). 37 track shoes per side (Loader).

Track Shoes

Type	Size (Inches)
Grouser	14, 16, 18
Rubber	13
Notched Open-Center Grouser	16
Triple Semi-Grouser	13, 14, 16
Open Center Grouser	14, 16, 18

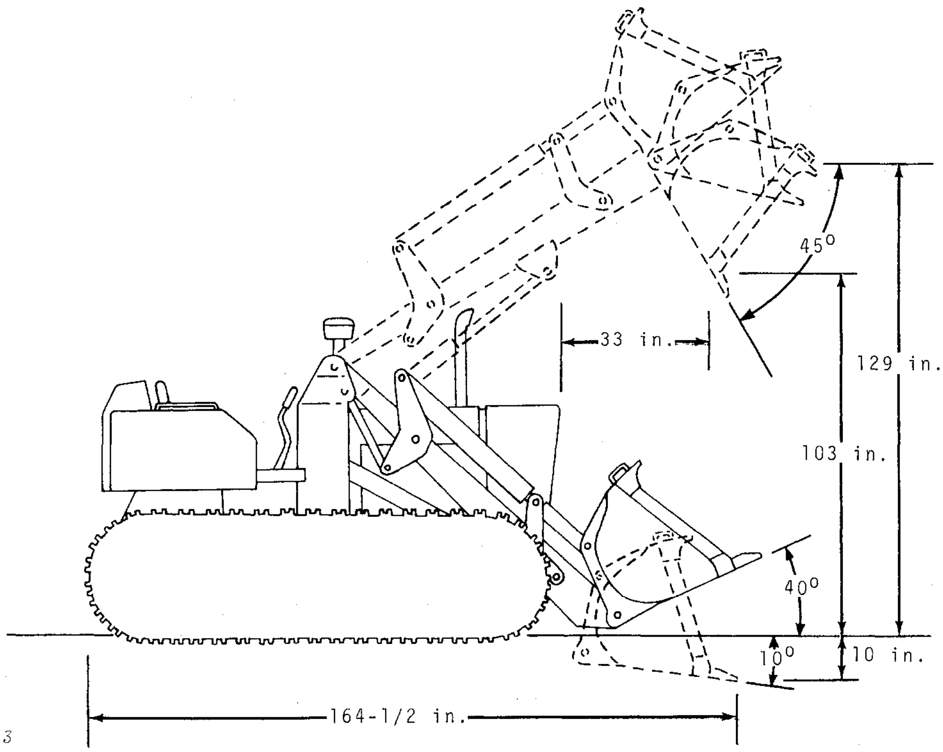
Capacities (U.S. Standard Measures)

Fuel tank .... 31 gal.
Cooling system .... 16 qts.
Engine crankcase (including filter) .... 9 qts.
Transmission case .... 32 qts.
Final drives (each) .... 6.5 qts.
Crawler loader hydraulic system .... 13 gal.
(with fork and single clamp) .... 15 gal.
(with fork and dual clamps) .... 16 gal.
Crawler tractor hydraulic system .... 8 gal.
Winch housing reservoir .... 9 qts.
Winch drum:
(with 1/2-inch cable) .... 195 ft.
(with 5/8-inch cable) .... 125 ft.
(with 3/4-inch cable) .... 100 ft.

Weight Distribution

	Loader	Bulldozers 6405	6410	6415
SAE Operating Weight (lbs.)*	16,700	14,250	14,250	14,500
Ground Contact (Sq. In.)	2,128	2,328	2,328	2,328
Ground Pressure (psi)	7.8	6.1	6.1	6.2
Track on Ground (inches)	76	72.75	72.75	72.75

* *1973 Representative Tractor*
Includes fully serviced tractor, 175 lb. operator, and R.O.P.S.



JD450-B Operating Dimensions

DIMENSIONS (Crawler Tractor)
Height to top of hood .... 57 in.
Over-all height (with exhaust stack) .... 89 in.
Over-all width, minimum (with 14 in. shoes) .... 65-3/4 in.
Over-all length .... 109-1/4 in.
Ground clearance (at rear crossbar) .... 14-1/4 in.
Shipping weight (approx.) .... 11,600 lbs.

DIMENSIONS (Crawler Loader)
Over-all length .... 164-1/4 in.
Over-all height (with exhaust stack) .... 89 in.
Over-all width (minimum) (with 14 in. shoes) .... 72-1/4 in.
Ground clearance (at rear crossbar) .... 14-1/4 in.
Dumping reach (full height) (bucket at 45° angle) .... 33 in.
Dumping clearance (full height) (bucket at 45° angle) .... 103 in.
Maximum lift (bucket at full height) .... 129 in.
Digging depth below ground (10 degrees) .... 4-1/2 in.
Bucket width (1-1/4 yd. bucket) .... 72-1/4 in.
Maximum dump angle
Full height .... 50° from horizontal
Ground level .... 70° from horizontal
Bucket roll-back (ground level) .... 40°
Operating weight, approximate .... 16,390 lbs.
Hydraulic lift capacity (full height) .... 9,000 lbs.
Breakout force .... 14,360 lbs.

Group 10
PREDELIVERY, DELIVERY, AND AFTER-SALES SERVICES

PREDELIVERY SERVICE

Because of the shipping factors involved, plus extra finishing touches that are necessary to promote customer satisfaction, proper predelivery service is of prime importance to the dealer.

A tag pointing out the factory-recommended procedure for predelivery service is attached to each new crawler before it leaves the factory.

After completing the factory-recommended dealer checks and services listed on the predelivery tag, remove the tag from the crawler and file it with the job shop order. The tag will then serve as a basis for certifying that the crawler has received the proper predelivery service when that portion of the customer's John Deere Delivery Receipt is completed.

TEMPORARY CRAWLER STORAGE

Service	Specification	Reference
Check radiator for coolant loss and antifreeze protection.	....	Section 10, Group 15
Fill fuel tank	....	Operator's Manual
Check crankcase oil level.	....	Operator's Manual
Relieve hydraulic pressure.	Stop engine, lower equipment to ground.	....
Cover crawler for protection and cleanliness.	....	....

BEFORE DELIVERING CRAWLER

Service	Specification	Reference
Electrical System		
Inspect electrolyte	....	Operator's Manual
Check alternator belt tension	3/4-inch deflection with 20 lb. force.	Operator's Manual
Clean terminals and check battery cable connections.	....	Operator's Manual
Cooling System		
Inspect radiator for coolant loss.	Midway between core and filler neck.	Operator's Manual
Check antifreeze protection.	....	Operator's Manual
Track		
Check track tension.	....	Section 80
Check front idler, track carrier roller and track roller oil level.	To oil level check hole.	....
Lubrication		
Check crankcase oil level.	Between marks on dipstick.	Operator's Manual
Check transmission oil level.	Between marks on gauge.	Operator's Manual

BEFORE DELIVERING CRAWLER (Continued)

Service	Specification	Reference
Lubrication (Continued)		
Check final drive oil level.	To level of filler holes.	Operator's Manual
Check hydraulic reservoir oil level.	Halfway up on window glass	Operator's Manual
Check winch reservoir oil level.	To level of oil level hole.	Operator's Manual
Lubricate grease fittings.	....	Operator's Manual
Engine		
Check air cleaner.	....	Operator's Manual
Fill fuel tank and start engine.	....	Operator's Manual
Check operation of lights and gauges.	....	Operator's Manual
Check speed control linkage for free operation.	....	Section 20
Check engine idle speeds.	....	Section 20
Operation		
Check engine clutch operation.	....	Section 50
Check brake operation.	....	Section 60
Shift transmission through all ranges.	....	Operator's Manual
Check power take-off operation.	....	Operator's Manual
Check operation of attached equipment.	....	Operator's Manual
Check hydraulic system operation.	....	Operator's Manual
Check steering operation.	....	Section 60
Check bucket level indicator and electrical return-to-dig mechanism (if present).	....	Operator's Manual
General		
Tighten accessible nuts and cap screws.	Standard torque chart.	Section 10
Clean crawler and touch up paint.	....	....

DELIVERY SERVICE

A thorough discussion of the operation and service of a new machine at the time of delivery helps to assure complete customer satisfaction. Proper delivery should be an important phase of a dealer's program. A portion of the John Deere Delivery Receipt emphasizes the importance of proper delivery service.

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 machine properly. Enough time should be devoted, at the customer's convenience, to introducing the owner to his new machine and explaining to him how to operate and service it.

Using the machine operator's manual as a guide, be sure that the owner understands these points thoroughly:

1. Controls and instruments.
2. How to start and stop the engine.
3. The importance of the break-in period.
4. How to use cast-iron ballast.
5. All functions of the hydraulic system.
6. The importance of safety.
7. The importance of lubrication and periodic services.

After explaining and demonstrating the above features, have the owner sign the delivery receipt and give him the operator's manual.

AFTER-SALES SERVICE

The purchaser of a new John Deere machine is entitled to a free inspection at some mutually agreeable time within the warranty period after the equipment has been "run in."

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

If the recommended after-sales service inspection is followed, the dealer can eliminate a needless volume of service work by preventing minor irregularities from developing into service problems later on. This will promote strong dealer-customer relations and give the dealer an opportunity to answer questions that may have arisen during the first few days of operation. During the inspection service, the dealer has the additional opportunity of promoting the possible sales of other new equipment.

The following is a recommended inspection program.

INSPECTION PROCEDURE

Service	Specification	Reference
Cooling System		
Check radiator coolant level.	Midway between core and filler neck	Operator's Manual
Check external surface of radiator core.	....	Operator's Manual
Check hoses and connections for leaks.	....	....
Fuel System		
Remove water and foreign matter from fuel filter sediment bowls.	....	Operator's Manual
Bleed fuel system.	....	Operator's Manual
Tighten loose connections and check entire system for leaks. Correct if necessary	....	....
Check air cleaner cup, element, and unloading valve. Clean element if necessary.	....	Operator's Manual

INSPECTION PROCEDURE—Continued

Service	Specification	Reference
Electrical System		
Check specific gravity of battery.	1.215 to 1.270 at 80°F	Operator's Manual
Check level of battery electrolyte.	To bottom of filler neck above plates.	Operator's Manual
Check alternator belt tension.	3/4-inch deflection with 20-pound force.	Operator's Manual
Start engine and check action of starter, lights and gauges.	. . . .	Operator's Manual
Lubrication		
Check crankcase oil level.	Between marks on dipstick	Operator's Manual
Check transmission oil level.	Between marks on gauge.	Operator's Manual
Check final drive oil level.	To level of filler holes.	Operator's Manual
Check hydraulic reservoir oil level.	Halfway up on window glass.	Operator's Manual
Check winch reservoir oil level.	To level of oil level hole.	Operator's Manual
Lubricate grease fittings.	. . . .	Operator's Manual
Engine		
Check valve clearance.	Intake-0.014 inch Exhaust-0.018 inch	Operator's Manual
Check engine speed under load and horsepower (Dynamometer test).	65 hp at 2500 rpm	FOS-ENGINES
General		
Check clutch pedal free travel.	. . . .	Operator's Manual
Check transmission linkage adjustment.	. . . .	Section 50
Check power take-off operation.	. . . .	Operator's Manual
Check hydraulic system.	. . . .	Section 70
Check steering clutches and brakes.	. . . .	Section 60
Check track tension.	. . . .	Section 80
Check winch operation.	. . . .	Section 80
Tighten accessible nuts and cap screws.	. . . .	Section 10, Group 25

Group 15
TUNE-UP AND ADJUSTMENT

Before tuning up a tractor, determine whether a tune-up will restore operating efficiency. When there is doubt, the following preliminary tests will help to determine if the engine can be tuned up. If the condition is satisfactory, proceed with the tune-up. Choose from the following procedures only those necessary to restore the unit.

PRELIMINARY ENGINE TESTING

Operation	Specification	Reference
Dynamometer Test (at 2500 engine rpm)	Compare with "SPECIFICATIONS"; compare with output after tune-up.	FOS-ENGINES
Compression Test	350 psi. The difference between cylinders should be no more than 50 psi.	FOS-ENGINES
Intake Vacuum Test	11 to 25 inches of water at fast idle	FOS-ENGINES
Engine Coolant Check	No air bubbles or oil film in radiator	FOS-ENGINES

ENGINE TUNE-UP

Operation	Specification		Reference
Air Intake System			
Service air cleaner and check system for leaks			FOS-ENGINES
Check restriction indicator operation	23 to 27 inches of water at 2500 rpm (full load)		FOS-ENGINES
Check crankcase breather for restriction			FOS-ENGINES
Exhaust System			
Check system for leaks			FOS-ENGINES
Check muffler and exhaust pipe for restriction			FOS-ENGINES
Cooling System			
Check radiator for coolant loss	Midway between core and filter neck		
Clean grille, radiator core and oil cooler case			FOS-ENGINES
Check pressure cap	6.25 to 7.50 psi release pressure		FOS-ENGINES
Clean and flush system, check thermostat.	Starts to Open	Fully Open	FOS-ENGINES
180°	177°F. to 184°F.	202°F.	
205°	201°F. to 207°F.	213°F.	

ENGINE TUNE-UP—Continued

Operation	Specification	Reference
Cylinder Head and Valves		
Tighten cylinder head cap screws	110 ft-lbs. torque, in sequence	Section 20, Group 10
Check valve clearance	Intake, 0.014-inch Exhaust, 0.018-inch	Section 20, Group 10
Fuel System		
Check fuel tank sump for water		FOS - ENGINES
Check fuel transfer pump pressure	3-1/2 to 4-1/2 psi at slow idle	FOS - ENGINES
Clean sediment bowls and change filter		FOS - ENGINES
Service injection nozzles		SM-2045
Injection Pump:		
Service and check timing		Section 30, Group 25
Advance		Section 30, Group 25
Adjust throttle linkage	Slow idle (rpm) 800 Fast idle (rpm) 2650	Section 20, Group 20
Lubrication System Check engine oil pressure	45 to 65 psi at 2500 rpm (180°F. to 220°F.)	Section 20, Group 10
Charging System		
Check battery specific gravity		FOS - ELECTRICAL SYSTEMS
Check electrolyte level		FOS - ELECTRICAL SYSTEMS
Check alternator belt tension	3/4-inch belt deflection with 20 lbs. force.	FOS - ELECTRICAL SYSTEMS
Check alternator output	22 amps.	FOS - ELECTRICAL SYSTEMS
Check alternator regulated voltage		FOS - ELECTRICAL SYSTEMS
Starting System		
Check start-safety switch operation		FOS - ELECTRICAL SYSTEMS
Check starter current draw	Approx. 150 amps.	Section 40, Group 15
Check operation of ammeter, oil pressure and air filter restriction indicator		FOS - ELECTRICAL SYSTEMS

FINAL ENGINE TEST

Operation	Specification	Reference
Dynamometer	Compare with previous recorded output. Record for future use.	FOS - ENGINES

CRAWLER ADJUSTMENTS

Operation	Specification	Reference
Engine clutch pedal adjustment		Section 50, Group 10
Steering clutch adjustment		Section 60, Group 25
Steering linkage adjustment		Section 60, Group 25
Brake band adjustment		Section 60, Group 25
Foot brake linkage adjustment		Section 60, Group 25
Track adjustment		Section 80, Group 10
Track alignment		Section 80, Group 10
H-L-R system adjustment		Section 50, Group 20
Winch Adjustments:		
Control lever	1/2-inch between front edge of lever and top edge of lever guard	Section 80, Group 15
Brake band	4-11/16 inches between bottom edge of spring pin and bottom edge of spring anchor	Section 80, Group 15
Loader Adjustments:		
Bucket level indicator		Section 80, Group 25
Electric return-to-dig		Section 70, Group 20
Boom alignment		Section 80, Group 25
Loader hydraulic system		Section 70, Group 5

Group 20
LUBRICATION

GENERAL INFORMATION

Carefully written and illustrated lubrication instructions have been included in the operator's manual furnished with your customer's machine. Remind him to follow these instructions carefully.

For your convenience when servicing the crawler, the following chart shows the capacities and types of lubricant for each of the various components and systems. A definition of the various lubricants follows the chart.

Component	Capacity	Type of Lubricant
Engine crankcase	9 U.S. quarts (includes filter)	See "Engine Lubricating Oil" page 20-2
Transmission	32 U.S. quarts	John Deere Type 303 Special-Purpose Oil or an equivalent
Hydraulic system	13 U.S. gallons (min.)	John Deere Type 303 Special-Purpose Oil or an equivalent
Track adjuster (Track tension)	As required	John Deere Track Idler and Roller Lubricant (Type "O") or an equivalent
Loader boom and bucket cylinder pivot points	2 strokes of grease gun	John Deere Multi-Purpose Lubricant or an equivalent
Winch fairlead	2 strokes of grease gun	John Deere Multi-Purpose Lubricant or an equivalent
Loader control lever	As required	Engine oil
Winch housing reservoir	9 U.S. quarts	Above 32°F.: John Deere Type 303 Special-Purpose Oil. Below 32°F.: SAE 5W-20 Oil. Below 0°F.: Three parts SAE 5W-20, one part Grade No. 1 diesel fuel
Final drives	6-1/2 U.S. quarts (each)	John Deere Type 303 Special-Purpose Oil or an equivalent
Starter	Saturate wicks	SAE 10W engine oil
Engine clutch bearing (early models)	2 strokes of grease gun	High temperature grease

LUBRICANTS

Effective use of lubricating oils and greases is perhaps the most important step towards low upkeep cost, long tractor life, and satisfactory service. Use only lubricants specified in this section; apply them at intervals and according to the instructions in the lubrications and periodic service section.

ENGINE LUBRICATING OILS

X3377

We recommend John Deere Torq-Gard or Torq-Gard Supreme engine oil for use in the engine crankcase. This oil is compounded specifically for use in John Deere engines, and provides superior lubrication under all conditions. NEVER PUT ADDITIVES IN THE CRANKCASE. Torq-Gard oil is formulated to provide all the protection your engine needs. Additives could reduce this protection rather than help it.

If oil other than Torq-Gard or Torq-Gard Supreme is used, it must conform to the following specifications.

SINGLE VISCOSITY OILS

API Service CD/SD
MIL-L-2104C*
Series 3*

MULTI-VISCOSITY OILS

API Service CC/SE, CC/SD or SD

** As further assurance of quality, the oil should be identified as suitable for API Service Designation SD.*

Depending on the expected prevailing temperature for the fill period, use oil of viscosity as shown in the following chart.

		Other Oils	
Air Temperature	John Deere Torq-Gard Oil	Single Viscosity Oil	Multi-Viscosity Oil
Above 32°F.	SAE 30	SAE 30	Not recommended.
−10°F. to 30°F.* *	SAE 10W-20	SAE 10W	SAE 10W-30
Below −10°F.	SAE 5W-20	SAE 5W	SAE 5W-20

** * SAE 5W-20 oil may also be used to insure optimum lubrication at starting, particularly when engine is subjected to −10°F. or lower temperatures for several hours.*

Some increase in oil consumption may be expected when SAE 5W-20 or SAE 5W oils are used. Check oil level more frequently.

TRANSMISSION HYDRAULIC OILS

Use only John Deere Type 303 Special-Purpose Oil or an equivalent in the transmission-hydraulic system. Other types of oil will not give satisfactory service, and may result in eventual damage. This special oil, available from your John Deere dealer, may be used in all weather conditions.

GREASES

Use John Deere Multi-Purpose Lubricant or an equivalent multi-purpose type grease for all grease fittings. Application of grease as instructed in the lubrication section will provide proper lubrication and will keep contamination out of bearings.

Track Idler and Roller Grease

Use John Deere Track Idler and Roller Lubricant or an equivalent multi-purpose grease having a NLGI consisting of No. 0.

STORING LUBRICANTS

Your tractor can operate at top efficiency only if clean lubricants are used. Use clean containers to handle all lubricants. Store them in an area protected from dust, moisture, and other contamination.

Group 25
SEPARATION

REMOVING AND INSTALLING LOADER ENGINE

Removal

Most service procedures on the engine can be accomplished with the engine in the unit. If the crankshaft is to be removed or in event of a general overhaul, remove the engine as follows:

Detach H-L-R oil filter base from inside of grille housing. Remove hood and grille housing.

Disconnect all the necessary wiring, linkage and lines from both sides of the engine.

Disconnect radiator hoses and remove radiator and pump with support as a unit.

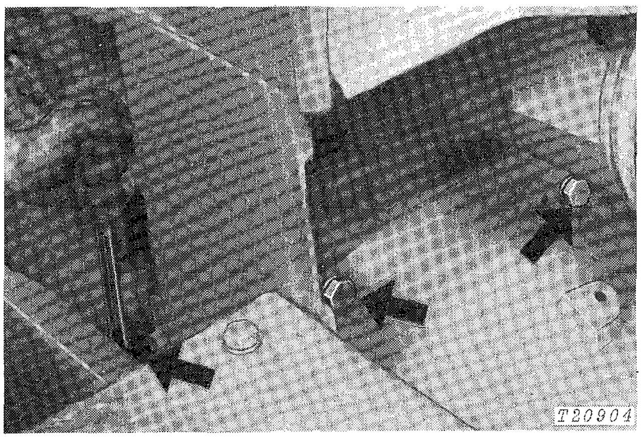


Fig. 1-Engine Attaching Points

Install two JD-244 engine lifting adapters in cylinder head.

Attach JDG-1 sling to lifting adapters.

Remove cap screws securing engine flywheel housing to clutch housing (Fig. 1).

Using hoist, pull engine forward off clutch housing and remove engine from machine.

NOTE: Alternate method would be to remove the engine, radiator and pump with support as one unit.

Installation

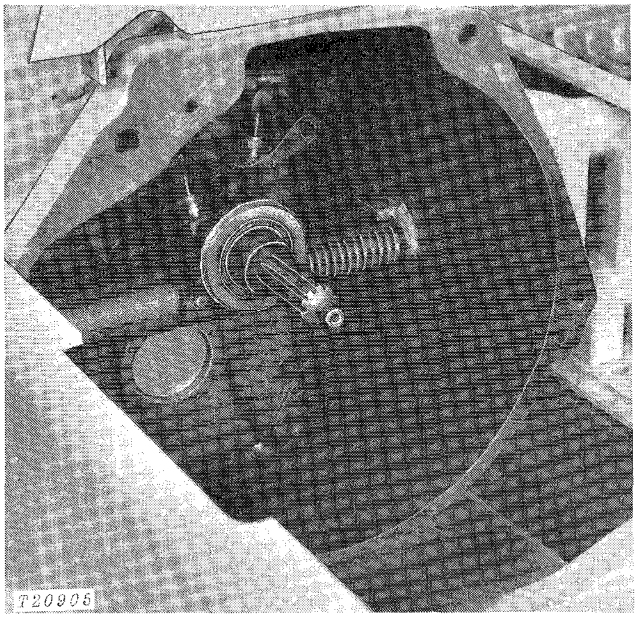


Fig. 2-Transmission-Engine Indexing Point

IMPORTANT: Tighten side frame-to-steering clutch cap screws before tightening side frame to engine clutch housing cap screws.

To install engine correctly, line up cap screw holes of engine with those of clutch housing. Bar engine over, holding it in a horizontal position and exerting a steady pressure on the engine toward the clutch housing until the engine clutch indexes with the transmission input shaft.

Refer to specifications, page 10-25-10 for correct cap screw torque values.

Install radiator and hoses. Attach H-L-R oil filter to inside of grille housing.

Connect all the necessary wiring, linkage and lines to both sides of engine.

Start engine and check for oil or water leaks.

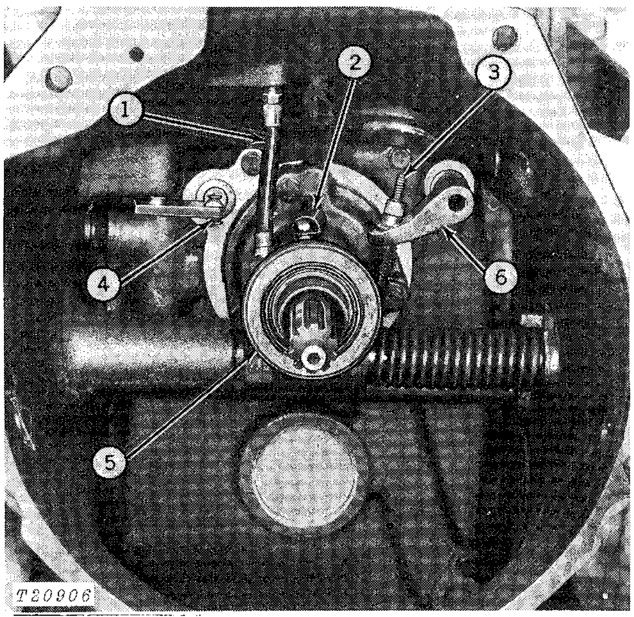
REMOVING AND INSTALLING CLUTCH HOUSING

Removal

NOTE: On crawler-loader units, leave loader and cowl support intact. Remove engine, then drive clutch shaft to right side and remove clutch stop lever. Roll back clutch and brake pedals. Disconnect all wiring and control linkage from clutch housing. Remove cap screws securing clutch housing to cowl support, to side frames, and to transmission. With the aid of a hoist, remove clutch housing by sliding forward off transmission dowels and out under loader and cowl support.

Remove engine from unit as instructed in "Alternate Method" on page 10-25-1.

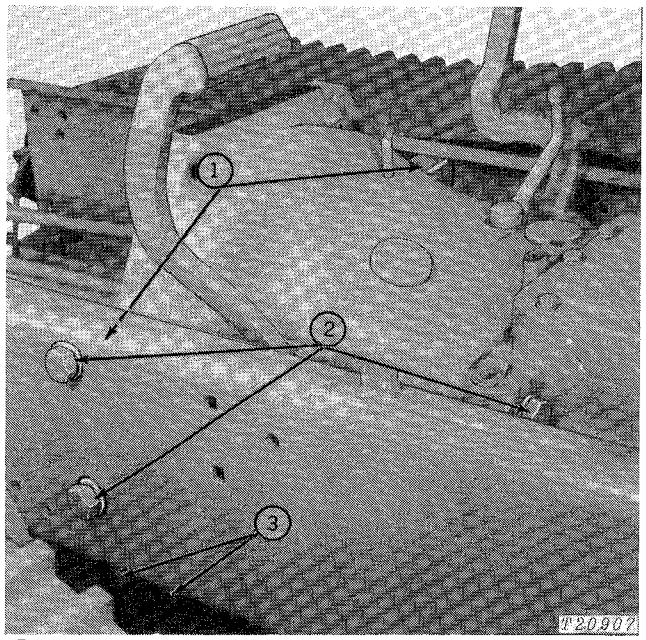
Disconnect all the necessary wiring, linkage and lines from cowl. Remove cap screws securing cowl to clutch housing and with the aid of a chain hoist, lift cowl from unit.



1—Grease Hose (-133850)
2—Return Spring
3—Operating Rod
4—PTO Linkage
5—Throw-Out Bearing
6—H-L-R Operating Arm

Fig. 3-Clutch Control Linkage (-133850)

Disconnect clutch control linkage (Fig. 3). Remove oil cooler line and elbow from right side of clutch housing-to-transmission front cover.



1—Spacer Support
2—Clutch Housing Attaching Points
3—Spacer Support Attaching Points

Fig. 4-Attaching Points

Disconnect clutch pedal return spring and yokes from brake levers.

Remove cap screws securing clutch housing (Fig. 4) and with the aid of a hoist, remove clutch housing from unit.

Installation

IMPORTANT: Tighten side frame-to-steering clutch cap screws before tightening side frame-to-engine clutch housing cap screws.

Install clutch housing by reversing removal procedure. Spacers are used with lower side frame to clutch housing screws.

Tighten all cap screws to specifications (page 10-25-10).

Install cowl and engine to machine.

REMOVING AND INSTALLING FINAL DRIVE

REMOVAL

Raise one side of tractor by placing floor jack securely under front cross member. Start engine and shift transmission into first gear. Pull back on steering lever that controls track not raised off floor (this disengages steering clutch and applies brake to that side). Engage engine clutch, permitting raised track to rotate until master pin has moved around drive sprocket and is approximately 6 inches from floor.

CAUTION: Be sure that track to be rotated is clear of floor and opposite track is locked in position so that tractor does not move.

NOTE: When crawler is equipped with a loader and bottom counterweight, the counterweight must be removed.

Release track tension, remove track master pin and move track assembly clear of drive sprocket.

Remove sprocket shield or sprocket weight from machine.

A special tool used in the removal and installation of crawler sprocket weights may be produced locally. See "Special Tools", page 10-25-11.

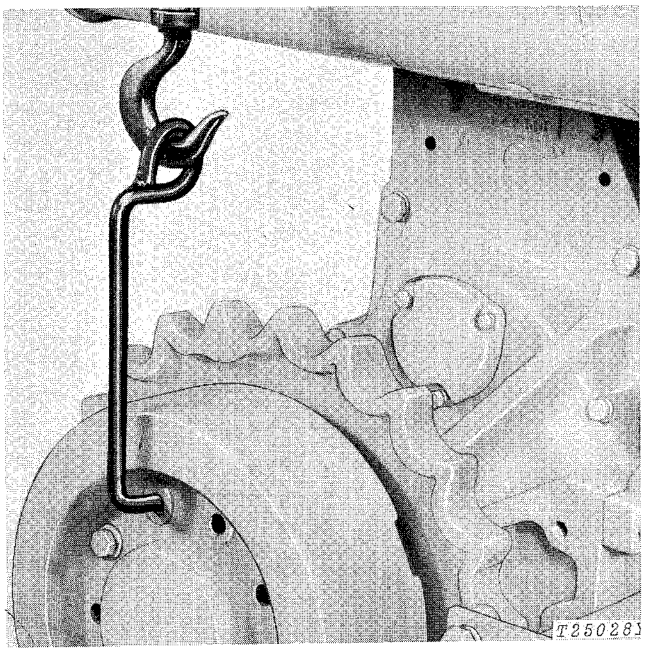
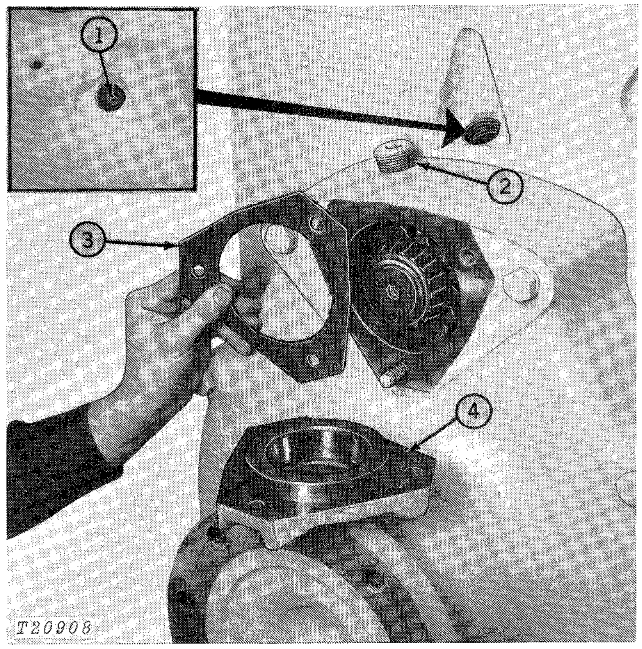


Fig. 5-Removing Sprocket Weight

Position special tool as shown in Fig. 5 to remove or install sprocket weights.

Drain oil from final drive housing and remove track drive sprocket from unit.



1—Set Screw **2—Plug** **3—Shims** **4—Bearing Quill**

Fig. 6-Removing Final Drive Pinion Shaft

Remove final drive bearing quill and plug. Rotate steering clutch until set screw is visible in hole and loosen set screw.

Install suitable puller in threaded center hole of final drive pinion shaft and remove shaft.

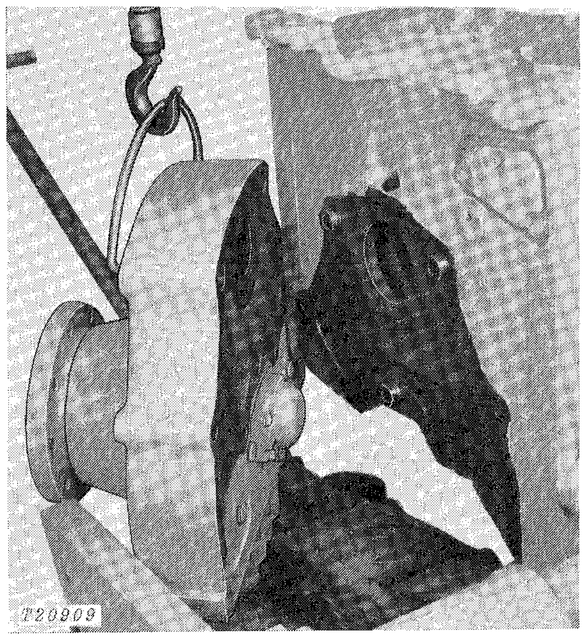


Fig. 7-Removing Final Drive

Under tractor, remove two inner cap screws attaching steering clutch housing to final drive.

Remove cap screws which hold final drive housing to steering clutch housing.

Using a hoist, lift final drive assembly away from steering clutch housing. The special yoke shown in Fig. 7 can be constructed from 1/2-inch round stock and will facilitate removal of the final drive assembly.

Installation

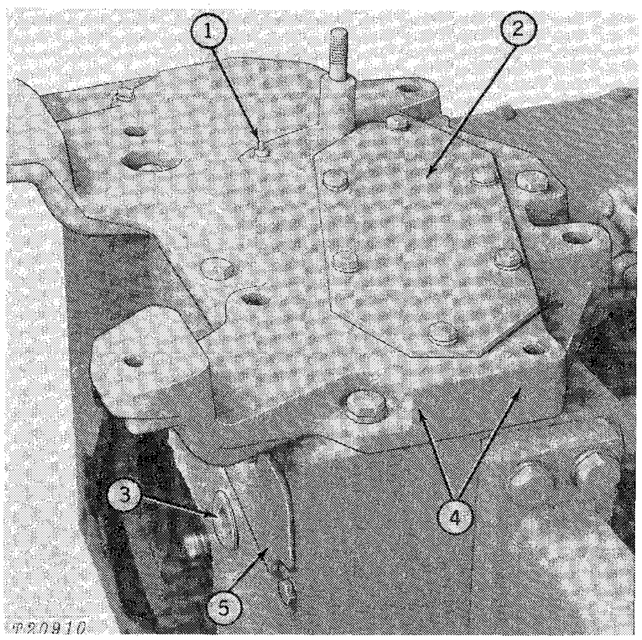
Before installing final drive housing on tractor, install final drive pinion shaft in housing and determine the number of shims necessary behind quill to obtain 0.0000 to 0.0030 inch preload. (See page 60-20-4 for details). Then remove final drive pinion shaft and proceed with installation by reversing removal procedure.

Fill bearing bore in end of final drive pinion shaft half full of high temperature grease and coat pinion and bearing surfaces with oil. Carefully insert pinion shaft through final drive housing and pinion shaft oil seal, and on into steering clutch splines. DO NOT FORCE THE PINION SHAFT into position as forcing the shaft will misalign the bearings and damage the oil seal and inner splines on the steering clutch.

REMOVING AND INSTALLING STEERING CLUTCHES

NOTE: Alternate method of removing steering clutch assembly without removing final drive housing is to disconnect track assembly, remove track drive sprocket, back off final drive pinion shaft set screw, and remove bearing quill and final drive pinion shaft. Steering clutch drive shaft may then be reached through final drive housing. Refer to Fig. 9 and 10 for guide to steering clutch linkage.

Disconnect all the necessary wiring, linkage and lines from rear tank unit (hydraulic reservoir, battery box and fuel tank). Remove cap screws securing rear tank unit support to steering clutch housing and lift rear tank unit from machine.

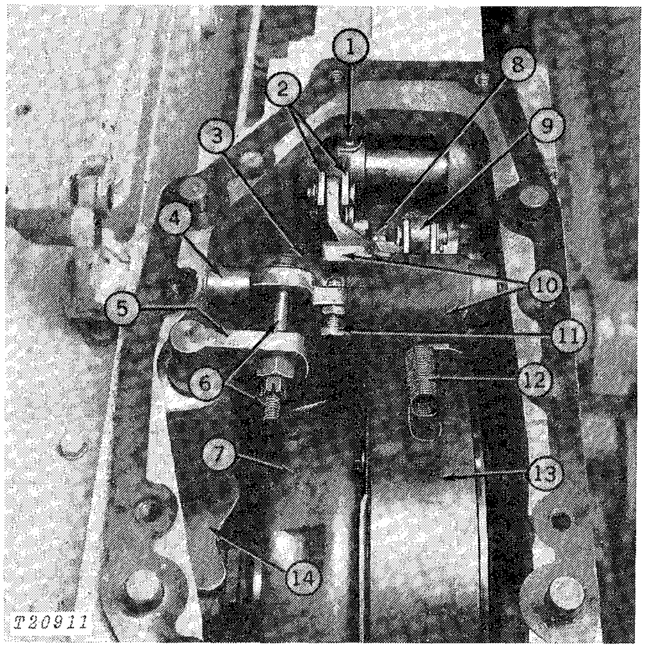


1—Spring Eye Screw	**4—Steering Clutch Cover**
2—Adjusting Cover	**5—Brake Adjusting Screw Cover**
3—Brake Yoke Plug	

Fig. 8-Steering Clutch Housing Covers

Remove final drive housing from steering clutch housing as instructed on page 10-25-3.

Remove steering clutch housing covers (Fig. 8). Reach through adjusting cover to unhook spring from eye screw.



1—Foot Brake	**8—Brake Anchor**
2—Slotted Links	**9—Brake Band Yoke**
3—Steering Arm	**10—Brake Bell Housing**
4—Steering Shaft	**11—Brake Actuator Screw**
5—Throw-Out Shaft	**12—Upper Spring**
6—Clutch Rod	**13—Brake Band**
7—Clutch Assembly	**14—Throw-Out Bearing Fork**

Fig. 9-Steering Clutch and Brake Controls

Refer to Figs. 9 and 10 for removal of the following parts.

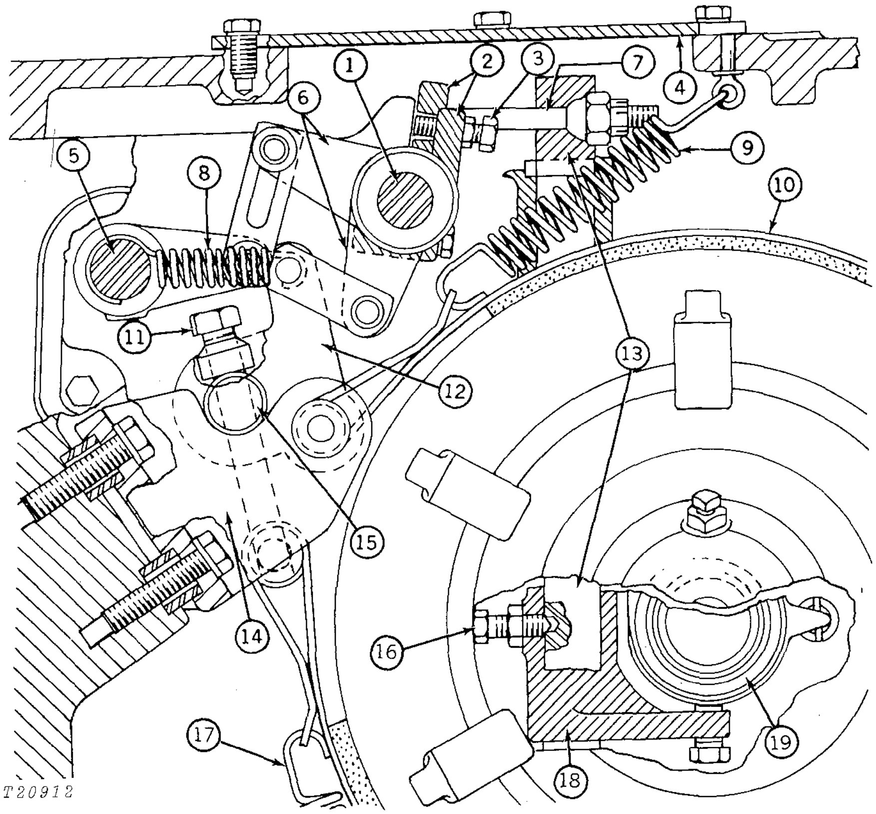
1. Reach through brake adjusting screw cover hole and loosen brake band adjusting screw. Unscrew jam nut and adjusting nut and remove clutch operating rod.

2. Remove return spring between foot brake lever and brake bell crank link. Remove cotter pins and pins and disconnect links from their respective controls.

3. Remove steering arm lock screw.

4. Using a brass drift, drive steering arm toward center of tractor until arm contacts inside wall of steering clutch housing.

5. Holding steering arm against inside wall of steering clutch housing, use a brass drift and drive steering control shaft toward outside of tractor until Woodruff key can be removed from control shaft between steering arm and brake bell crank. Then drive out control shaft and remove steering arm and brake bell crank from steering clutch housing.



1—Steering Shaft
2—Steering Arm
3—Brake Actuator Screw
4—Adjusting Cover
5—Foot Brake Linkage Shaft
6—Brake Bell Crank
7—Clutch Operating Rod
8—Linkage Return Spring
9—Brake Band Return Spring
10—Brake Band
11—Brake Adjusting Screw
12—Brake Band Yoke
13—Throw-Out Shaft
14—Brake Anchor
15—Yoke Pin
16—Set Screw
17—Brake Band Return Spring
18—Throw-Out Bearing Fork
19—Throw-Out Bearing

Fig. 10-Steering Clutch and Brake Controls

6. Remove brake band adjusting screw. Remove brake band yoke pin through plug hole in steering clutch housing. Lift out brake band yoke. Reach down to bottom of clutch housing and unhook lower brake band spring.

7. Loosen jam nut and set screw securing throw-out shaft to throw-out bearing fork. Rotate throw-out shaft until steering clutch assembly can be lifted out.

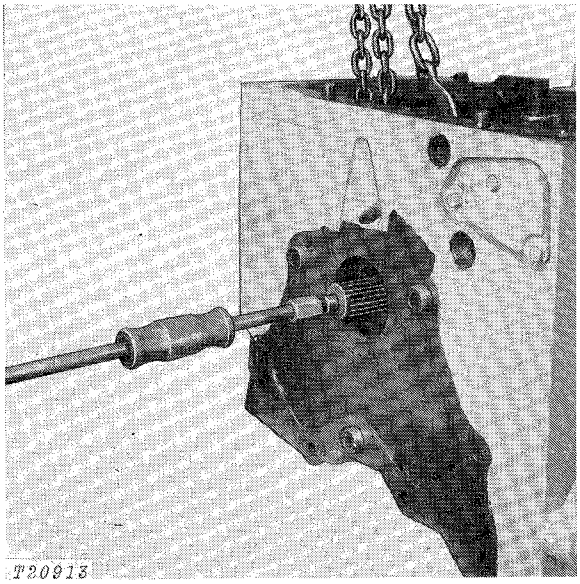


Fig. 11-Removing Steering Clutch Drive Shaft

Support steering clutch assembly. This can be done by rotating brake band around steering clutch drum and securing a chain to brake band ends as shown in Fig. 12.

Install suitable puller in threaded center hole of steering clutch drive shaft and carefully remove shaft (Fig. 11).

Place small chain through holes in band and using a chain hoist, lift out steering clutch assembly (Fig. 12).

Disconnect spring holding clutch throw-out bearing to differential quill.

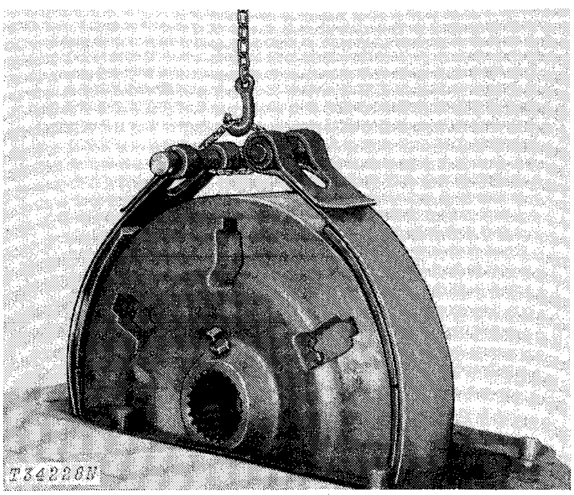


Fig. 12-Removing Steering Clutch Assembly

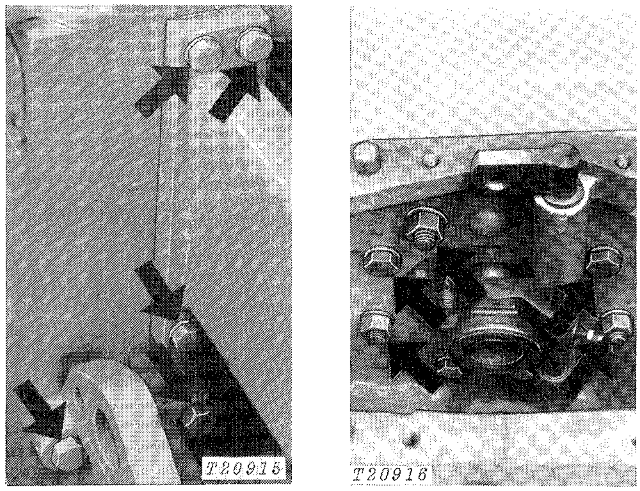


Fig. 13-Attaching Points

Remove cap screws securing steering clutch housing (Fig. 13) and with the aid of a hoist remove housing from transmission case.

Installation

Install steering clutch housing by reversing removal procedure and noting the following:

IMPORTANT: Tighten side frame-to-steering clutch cap screws before tightening side frame-to-engine clutch housing cap screws.

Before installing steering clutch housing, apply non-hardening elastic sealing compound to mounting surfaces on both sides of the housing.

Position dowel cap screws in rear axle brackets in outside lower and inside upper holes.

Adjust steering clutch, steering brake and foot brake as instructed (page 60-25-6).

Install final drives (if removed) as instructed on page 10-25-3.

Tighten all cap screws to specifications (page 10-25-10).

REMOVING AND INSTALLING TRANSMISSION

Removal

Servicing Transmission Range and Speed Change Compartments Only

To gain access to the gears and shafts in the range change and speed change compartments (except for the pinion shaft assembly) the following tractor components must be removed:

1. Remove engine from clutch housing as instructed on page 10-25-1.

2. Remove engine clutch housing from transmission as instructed on page 10-25-2.

Proceed with service of range change and speed change assemblies in front two compartments of transmission case. See Section 50, Group 15.

Servicing Transmission Ring Gear and Pinion

With engine and clutch housing removed, the transmission ring gear and pinion shaft assembly is accessible only when the following tractor components are removed:

1. Disconnect track assembly as instructed on page 10-25-3.

2. Remove track drive sprocket, back off final drive pinion set screw, and remove bearing quill and final drive pinion shaft.

3. Remove steering clutch and brake assembly from steering clutch housing as instructed on page 10-25-4.

NOTE: On crawler-loader tractors, loader does not have to be removed.

4. Remove throw-out bearing and throw-out bearing carrier.

5. Carefully remove both ring gear bearing quills and shims and remove ring gears from transmission case.

Replacing Transmission Case

If transmission case must be replaced, perform all of the preceding steps and continue as follows:

6. Remove final drive housing from steering clutch housing as instructed on page 10-25-3.

7. Using a chain hoist, support transmission case.

8. Remove steering clutch housing from transmission case as instructed on page 10-25-3.

9. Remove transmission case using chain hoist.

Installation

Install transmission by reversing removal procedure.

IMPORTANT: Tighten side frame-to-steering clutch cap screws before tightening side frame-to-engine clutch housing cap screws.

Tighten all cap screws to specifications (page 10-25-10).

REMOVING AND INSTALLING LOADER

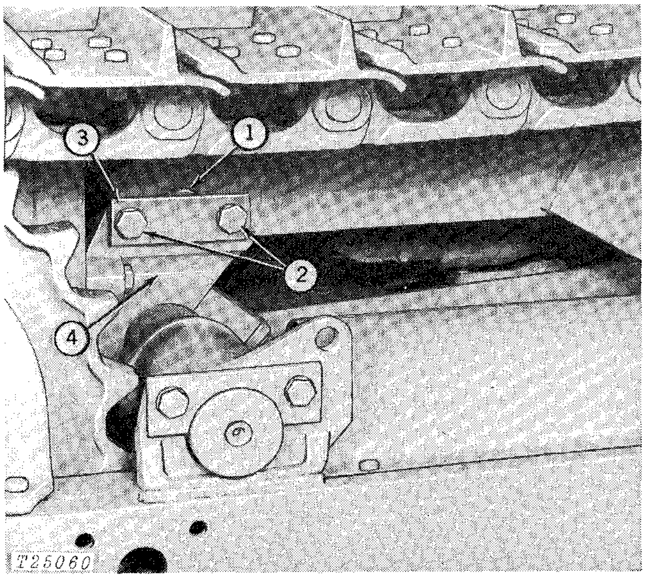
Removal

Drain oil from loader reservoir and disconnect loader hydraulic lines from rear tank unit.

Disconnect all the necessary wiring, linkage and lines between engine and cowl.

Remove air cleaner support and position chains around upper portion of loader frame. Attach chains to hoist.

Position floor jack or dolly with wheels under loader bucket to aid in removal.



1—Mounting Frame Dowel
2—Retaining Cap Screws
3—Outside Retainer
4—Rear Crossbar Bracket

Fig. 14-Loader Rear Mounting Points

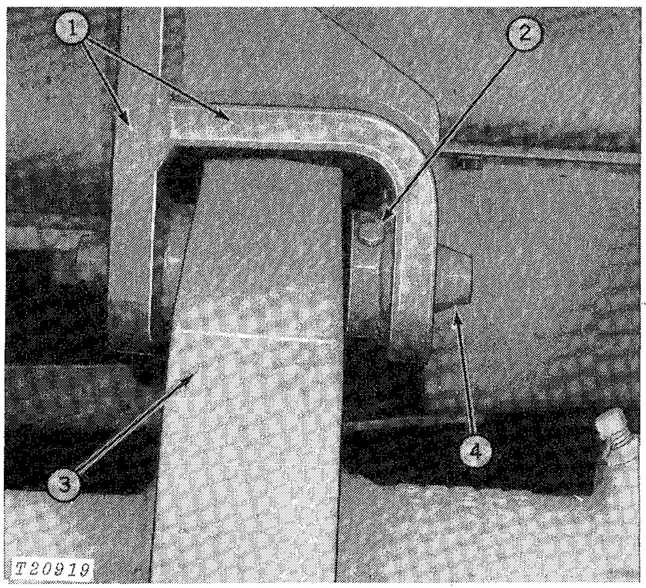
Remove cap screws on both sides of loader securing outside dowel retainer to dowel retainer on inside of loader frame (Fig. 14).

Remove dowels securing loader frame to tractor right and left rear crossbar brackets.

Remove cap screws on both sides of loader securing front mounting pin to loader frame (Fig. 15).

Remove pins securing loader frame to front crossbar.

With the aid of a hoist, raise the loader high enough to clear the tractor and remove the loader.



1—Loader Frame
2—Cap Screw
3—Front Crossbar
4—Mounting Pin

Fig. 15-Loader Front Mounting Points

Installation

Install loader by reversing removal procedure.

SUPPORTING LOADER BOOM

It is desirable, in servicing some of the crawler loader components, to raise the boom to its full height. **CAUTION: Be absolutely certain the boom is then supported before working underneath it. This can be accomplished by three different methods, as follows:**

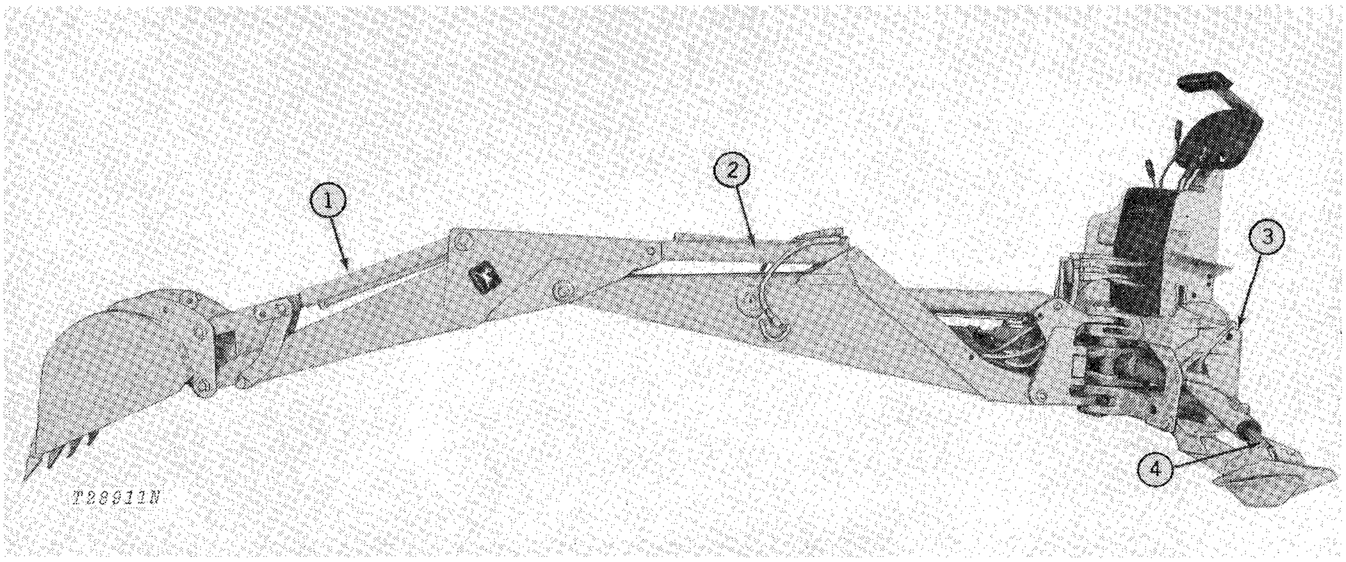
1. Cut a piece of angle iron (4 x 4 inch stock or larger) to a length of 24 inches. Attach it to the boom cylinder piston rod between the rod end and the cylinder barrel, being careful to avoid damaging the piston rod. Be sure the angle iron is large enough to rest against the cylinder barrel and not against the head casting.

NOTE: A boom safety lock bar is available for supporting loader boom. See Page 10-25-11 for component parts.

2. Use prop under cross member to support boom.

3. Chain bucket to hoist or overhead beam.

REMOVING AND INSTALLING 9250 BACKHOES



1—Bucket Cylinder (Retracted)
2—Crowd Cylinder (Retracted)
3—Main Frame (Tipped Slightly Forward)
4—Stabilizer Cylinders (Extended)

Fig. 16-Backhoe in Separation Position

Removal

By using the backhoe hydraulic system, the backhoe can be easily detached to free the crawler for other jobs.

Lower the stabilizers until they are supporting the weight of the backhoe. Retract the bucket and dipperstick and extend boom cylinder until backhoe is fully extended and bucket is resting on the ground. Install swing locking pin in place to prevent tipping.

Remove the cotter pins and mounting pins which hold the top of the backhoe main frame to the crawler frame.

Use stabilizers to raise backhoe frame off the bottom mounting bracket hooks.

Carefully retract the stabilizers until the main frame is resting on the ground tilted slightly forward (Fig. 16).

NOTE: The main frame can be blocked up off the ground by blocking across full width of backhoe main frame.

CAUTION: Shut off the crawler engine before disconnecting the hydraulic lines to the backhoe. If the engine is left running the operator may be sprayed with hot hydraulic oil.

Disconnect the pressure and return hoses from the backhoe main frame at the quick disconnect couplers and connect hoses together.

IMPORTANT: Pressure and return hoses must be connected together at all times when backhoe is removed. DO NOT close the power beyond port in the loader valve or the pressure hose to the backhoe valve.

Wire the hoses to the crawler so they do not drag on the ground during crawler operations.

Carefully drive the crawler from the backhoe.

Installation

Attach the pressure and return hoses to the backhoe main frame at the quick disconnect couplers.

Carefully raise the backhoe main frame with the hydraulic system by extending the stabilizers.

Carefully back the crawler to align the mounting bracket hooks with the lower pins on the backhoe main frame. Retract the stabilizers until the bottom pins rest in the mounting bracket hooks on the crawler.

Secure the top of each side of main frame to crawler with mounting pins and cotter pins.

SPECIFICATIONS

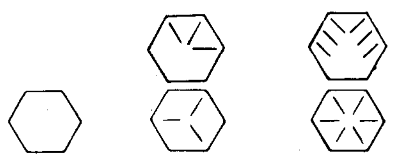
TORQUE VALUES

Item	Torque (ft-lbs)
Loader rear mounting frame dowel retainer	300
Rear crossbar cap to rear bar bracket	250
Rear crossbar bracket to steering clutch housing	300
Front crossbar to track frame (vertical)	240
(horizontal)	425
Front crossbar to side frame (vertical)	425
(horizontal)	240
Side frame to clutch housing	445
Side frame to steering clutch housing	170
Side frame to grille housing	170
Front bottom guard	85
Rear bottom guard	170
Final drive housing to steering clutch housing (5/8 inch)	170
(1/2 inch)	85
Drawbar support	300
Cowl support to clutch housing	85
Drive sprocket to axle shaft	300
Transmission case to clutch housing	300
Flywheel housing to clutch housing (upper)	250
(lower)	170
Bottom guard counterweight to steering clutch housing (F strength with Loctite)	425

TORQUE CHART

RECOMMENDED TORQUE IN FT-LBS
COARSE AND FINE THREADS

B D F



Bolt Diameter	Plain Head	Three Dashes	Six Dashes
1/4	Not used	10	14
5/16	Not used	20	30
3/8	Not used	35	50
7/16	35	55	80
1/2	55	85	120
9/16	75	130	175
5/8	105	170	240
3/4	185	300	425
7/8	160	445	685
1	250	670	1030
1-1/8	330	910	1460
1-1/4	480	1250	2060

T25227

The types of bolts and cap screws are identified by head markings as follows:

Plain Head: (B-strength) regular machine bolts and cap screws.

3-Dash Head: (D-strength) tempered steel high-strength bolts and cap screws.

6-Dash Head: (F-strength) tempered steel extra high-strength bolts and cap screws.

Machine bolts and cap screws 7/8 inch and larger are sometimes formed hot rather than cold, which accounts for the lower torque.

SPECIAL TOOLS

No.	Name	Use
Convenience Tools		
JD244	Lifting Eyes	To Remove Engine
JDG-1 or JDG-23	Sling	To Remove Engine
D-01043AA	Load Positioning Sling	To remove and install engine. Comes with one set of JDG-19 Lifting Brackets
JDG-19	Lifting Bracket	Use with D-01043AA
Fig. 17*	Sprocket Weight Tool	To Remove and Install Sprocket Weights
Fig. 18**	Boom Safety Lock Bar	To Support Boom

Sprocket Weight Tool

A special tool for the removal and installation of crawler sprocket weights may be fabricated locally. Required material is approximately 30 inches of 5/8-inch round bar stock. Bend and weld the bar stock as shown in Fig. 17.

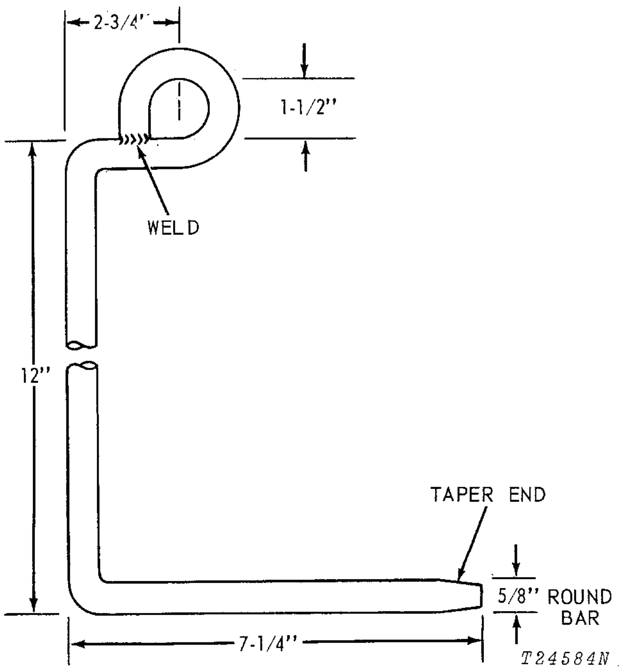
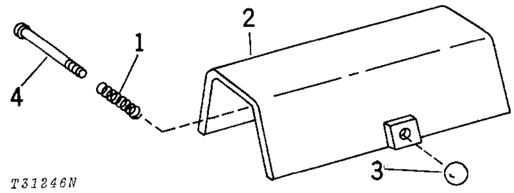


Fig. 17-Sprocket Weight Tool



1—T41597 Spring
2—AT40572 Boom Safety Lock Bar
3—M526 Knob
4—T41596 Pin

Fig. 18-Boom Safety Lock Bar Assembly

**Dealer-Made Tool*
***Order Components From: John Deere Region*

Section 20
ENGINE

CONTENTS OF THIS SECTION

Group 5
DIAGNOSIS

DIAGNOSING ENGINE MALFUNCTIONS

The following is a quick guide for diagnosing engine malfunctions. Each malfunction is elaborated upon further in the section or group in this manual pertaining specifically to the component or system.

Engine Hard To Start, Will Not Start

Check fuel system (Section 30).
Check electrical system (Section 40).
Check air intake system (Section 30).
Low compression (Group 10).

Engine Starts, Won't Continue To Run

Check fuel system (Section 30).
Check ignition (Section 40).
Check air intake system (Section 30).

Engine Loses Power

Check fuel system (Section 30).
Check air intake system (Section 30).
Low compression (Group 10).

Engine Emits Black Or Gray Exhaust Smoke

Check air intake system (Section 30).
Check fuel system (Section 30).
Low compression (Group 10).

Engine Has Low Oil Pressure

Check lubrication system (Group 15).

Engine Speed Is Erratic

Check fuel injection pump (Group 30).
Check speed control linkage (Group 20).

Engine Makes Abnormal Noise

Check timing (Section 30).
Improper fuel (Section 30).
Worn or improperly adjusted engine parts (Group 10).
Plugged injection nozzles (Section 30).

Engine Operates At Abnormal Temperature

Check cooling system (Group 25).
Check fuel injection timing (Section 30).

Engine Consumes Excessive Fuel

Check fuel system (Section 30).
Check air intake system (Section 30).
Low compression (Group 10).

Engine Misses

Low compression (Group 10).
Check fuel system (Section 30).

Group 10
BASIC ENGINE

DIAGNOSING BASIC ENGINE MALFUNCTIONS

Engine Makes Noise (Valve Train)

Improperly adjusted valve clearance.
Worn shaft or rocker arm bore.
Bent push rods.
Worn camshaft or cam followers.

Engine Makes Noise (Piston and Pins)

Worn piston.
Worn piston pin or bushings.
Broken piston.

Engine Makes Noise (Bearings)

Worn connecting rod bearings.
Excessive crankshaft end play.
Excessive main bearing clearance.

Engine Makes Noise (Timing Gear Train)

Worn gears.

Engine Uses Excessive Amount of Oil

Worn valve guides.
Stuck or worn piston rings.
Crankcase oil diluted with fuel.
Engine overloaded.
Clogged breather pipe.

Low Compression

Worn rings.
Burned valves.
Damaged pistons.
Failed head gasket.

Engine Misses

Improperly adjusted valves.
Burned valves.
Weak valve springs.
Low compression on one or more cylinders.
(Also see Fuel System, Section 30).

Engine Lacks Power

Low compression on some or all cylinders.
Improperly adjusted valves.
Burned valves (check compression).
Valves sticking.
(Also see Fuel System, Section 40).

Coolant Leaks into Crankcase

Failure of head gasket.
Cracked head or block.
Leakage at cylinder liner seal.

CYLINDER HEAD, VALVES, AND ROCKER ARMS

REMOVAL

The engine need not be removed from unit to service cylinder head, valves, and related parts.

Plug all open injection lines. Remove injection nozzles from head. (Nozzle tips extend below face of cylinder head and may be accidentally damaged.)

REPAIR

Do not rotate crankshaft with cylinder head removed unless all cylinder liners are bolted down.

Inspecting Cylinder Head

Check valve stem to guide clearance. Valves are available with standard size or oversize stems.

Valve guides must be precision reamed to match oversized valves. Make sure valves fit freely in guides.

Worn valve guides should be reconditioned by knurling. Use knurling tool no. 1002 exactly as recommended by the manufacturer.

Check to determine if cylinder head is flat and smooth. If it is necessary to resurface the bottom deck of the head, remove no more material than absolutely necessary (not to exceed 0.030 inch).

Check distance from the bottom deck of the cylinder head to the valves when seated. The distance for intake valves must be 0.023 to 0.047 inch, the distance for exhaust valves must be 0.038 to 0.072 inch.

Valves

Replace valve stem caps if worn or damaged.

Inspecting Valve Springs

Check compression strength of springs.

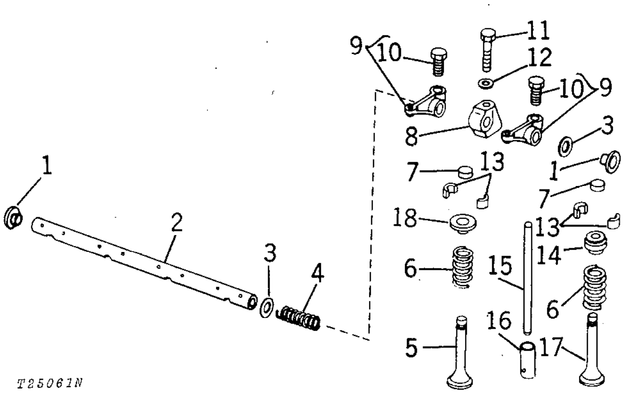
Inspecting Rocker Arm Assembly

Make sure that rocker arm oil holes are not plugged.

If ends of arms are worn, resurface them.

Thoroughly clean holes in rocker arm mounting brackets. This is especially important for the rear bracket, because oil is fed to the rocker arm shaft through this hole.

If a failed valve has been replaced, also replace the rocker arm and push rod for that valve.



1—Plug (2 used)
2—Rocker Arm Shaft
3—Washer (2 used)
4—Spring (3 used)
5—Intake Valve (4 used)
6—Valve Spring (8 used)
7—Valve Stem Cap (8 used)
8—Supports (4 used)
9—Rocker Arm (8 used)
10—Adjusting Screw (8 used)
11—Cap Screw (4 used)
12—Special Washer (4 used)
13—Retainer Lock (16 used)
14—Exhaust Valve Cap (4 used)
15—Push Rod (8 used)
16—Tappet (8 used)
17—Exhaust Valve (4 used)
18—Valve Spring Cap (4 used)

Fig. 1-Exploded View of Rocker Arm Assembly

Assembly

Assemble parts on rocker arm shaft in locations from which they were removed (Fig. 1).

Oil hole in rocker arm shaft-to-shaft support must face downward when assembly is installed on cylinder head.

Apply John Deere Valve Stem Lubricant (AR44402) to valve stems and install valves in valve guides, working them back and forth to make sure they slip through the ports easily and seat properly.

Note also the following:

1. Use new valve keepers.
2. After assembly, "pop" each spring and valve assembly three or four times by tapping the end of each valve stem with a soft mallet.

INSTALLATION

Install head gasket dry.

Distance between cylinder head gasket and cylinder liner must be equal within 0.040 in. around each cylinder liner.

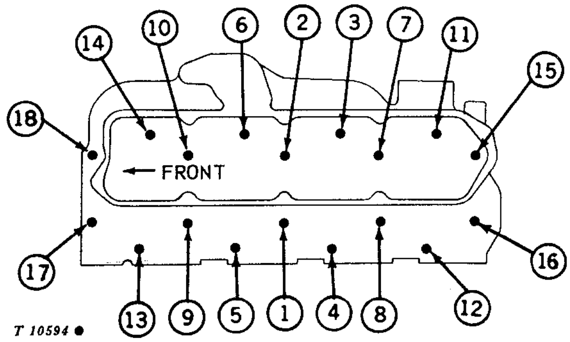


Fig. 2-Proper Sequence for Tightening Cylinder Head Cap Screws

Use specified flat washers under all cap screws. Do not dip cap screws in oil prior to installation. Start cylinder head to cylinder block cap screws by hand and tighten evenly to 110 ft-lbs torque, following sequence in Fig. 2.

Install push rods in location from which they were removed.

Position valve stem caps over ends of valve stems. Make certain the caps rotate freely on the stems.

Install rocker arm and shaft assembly on cylinder head. Tighten cap screws to 35 ft-lbs.

Put JOHN DEERE GASKET MAKER or an equivalent on cap screws before installing intake manifold.

Adjusting Valve Tappet Clearance

The engine may be either hot or cold during valve adjustment.

Position No. 1 cylinder (located at fan end) on TDC. Timing cover screw will enter its hole in flywheel (Fig. 3).

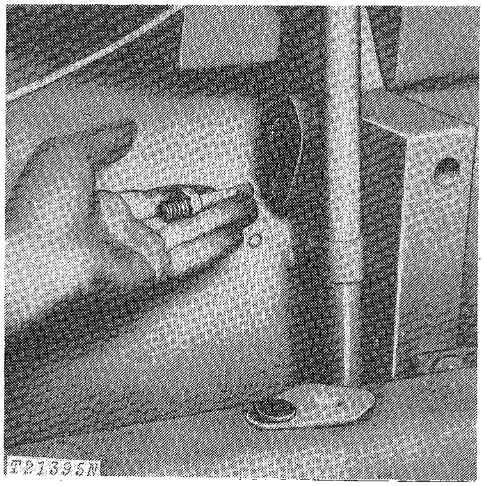


Fig. 3-Timing Screw

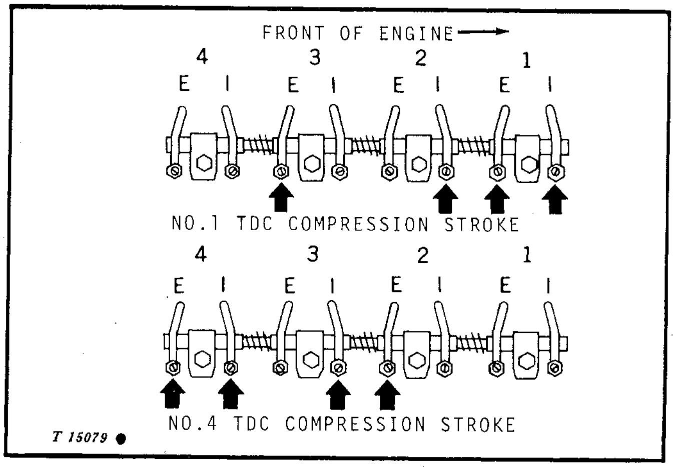


Fig. 4-Adjusting Valve Tappet Clearance

Adjust valve clearance on No. 1 and 3 exhaust valves to 0.018-inch and on No. 1 and 2 intake valves to clearance of 0.014 inch. Using a feeler gauge to measure clearance, turn valve adjusting screw up or down until clearance is correct.

Remove timing screw from flywheel. Rotate engine flywheel 360 degrees and reinsert timing screw into hole on flywheel rim.

Adjust valve clearance on No. 2 and 4 exhaust and No. 3 and 4 intake valves to clearances specified.

Remove timing screw from flywheel and reinstall timing cover.

Retighten cylinder head cap screws and recheck valve clearances after thirty minutes run-in with engine at 1900 to 2200 rpm with 3/4 to full load. See "Engine Break-In Procedure", page 20-30-4.

CYLINDER BLOCK, LINERS, AND RODS

GENERAL INFORMATION

Cylinder block and crankcase are cast in one piece.

Cylinder liners are of the replaceable wet-sleeve type, made of hardened alloy cast iron and are a slip fit in the cylinder block. The flange of each liner rests on a shoulder within the block and is sealed by a square rubber packing. The top edge of the liner is sealed flush with the cylinder block by the compression of the cylinder head and gasket. Two O-rings in the block provide additional sealing.

Pistons are aluminum-alloy, cam-ground and weight-controlled, with two compression rings and one oil control ring.

Connecting rods have a replaceable bronze bushing for the piston pin and a replaceable, steel-backed, aluminum-lined bearing insert.

REMOVAL

Remove the pistons and connecting rods, noting the following:

1. Engine normally need not be removed from unit to service pistons, connecting rods, and cylinder liners. If engine has to be removed, see Section 10.

2. Do not rotate crankshaft with cylinder head removed unless all cylinder liners are bolted down. Bolt down cylinder liners before removing pistons.

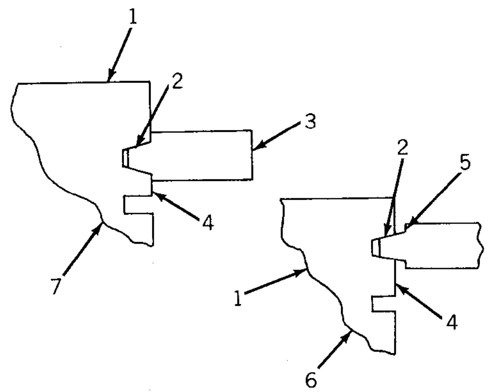
3. Keep rod bearing inserts with their respective rods and caps to assure correct reassembly.

4. Each connecting rod and piston must be reinstalled in the cylinder bore from which it was removed. Observe the word "FRONT" stamped on the head of all pistons and in the rib of the connecting rods. These must face toward the front of the engine at the time of reassembly.

REPAIR

Inspect all parts and compare with "Specifications." Note especially the following:

1. Check Keystone ring grooves for excessive wear by inserting a JDE-62 Ring Groove Wear Gauge in the groove (Fig. 5). If gauge shoulders contact the ring land, the groove is excessively worn.



T27564

1—Piston	**4—Ring Land**
2—Keystone Ring Groove	**5—Gauge Shoulder**
3—Keystone Ring Groove Wear Gauge	**6—Good Ring Groove**
	7—Worn Ring Groove

Fig. 5-Using Ring Groove Wear Gauge

2. Check clearance between piston and cylinder liner bore to determine if replacement is necessary. Measure clearance with a feeler gauge at the bottom of piston skirt 90° to pin bore. To establish taper and out-of-round, check liner 1 inch from bottom and 1 inch from top, lengthwise and crosswise. Wear limits are as follows:

Specifications	Measurement
Liner Taper (maximum)	0.002 in.
Liner Out-of-Round (maximum)	0.002 in.
Clearance Between Liner and Piston at Bottom of Skirt (maximum)	0.008 in.

3. Always replace piston rings whenever they are removed from a piston.

4. Always install new snap rings when new pistons are installed.

5. If piston pins are worn past the point of a snug thumb press fit, they should be replaced.

NOTE: Service blocks are furnished with both piston cooling orifices and plugs to be installed in the tapped holes in the main bearing webs. When replacing block in engine up to and including serial number 248000, install plugs. Starting with serial number 248001, install orifices. Tighten orifices or plugs with 85 to 110 in-lbs.

6. Replace connecting rod bearing inserts at every major overhaul. Inserts are available in standard size or undersizes.

7. Inspect piston pin bushings and replace if excessively worn or damaged.

8. A new piston pin bushing must be reamed after it is pressed into position to provide a "thumb press fit" for pin.

9. Clean block thoroughly with cleaning solvent or by pressure steam cleaning. Make sure all passages and crevices are cleared of sludge, rust, and grease. Be sure all coolant passages are cleaned of lime deposit and scale.

10. Inspect oil pressure regulating valve bushing in fan end of cylinder block. If valve seating area is worn or damaged, remove bushing from block and install a new bushing using the procedure shown on page 20-15-3.

11. If dipstick nipple has been removed, coat threads of nipple with joint sealing compound and install in cylinder block. Measure from block rail vertically to center of nipple end. Measurement should be 8-1/4 inches.

NOTE: If dipstick nipple has an integral O-ring, be sure it is not twisted, sheared or damaged when installing nipple.

12. If filter base nipple is damaged, remove it and press in a new nipple flush with face of bore in block. Position nipple so that threaded boss is away from side of block as far as possible.

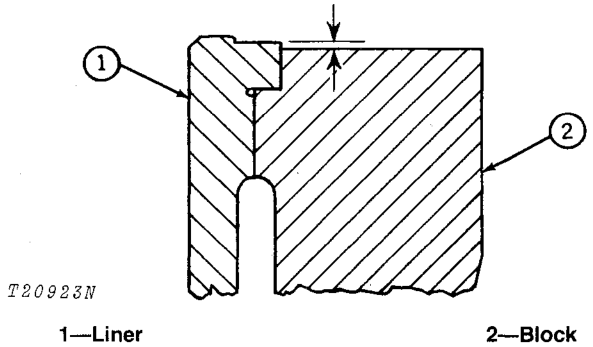


Fig. 6-Location of Liner in Cylinder Block

When installing new cylinder liners in block, use a depth gauge to check the height of the flange on the liner in relation to the cylinder block (Fig. 6). The top of the flange should be no more than 0.0040 inch above the cylinder block with packings removed from the bottom of the liner. Check this several places around the liner to make sure the liner is seated squarely in the bore of the cylinder block.

Be sure to pull cylinder liner and reinstall packing and O-rings before final assembly. Check O-ring groove in block and remove any burrs or sharp edges.

Deglazing Cylinder Liners

The cylinder liners may be deglazed with a deglazing tool or honing stone, but not rebored. When the liner exceeds a 0.002 inch maximum taper or exceeds 0.002 inch out-of-roundness, the liner must be replaced.

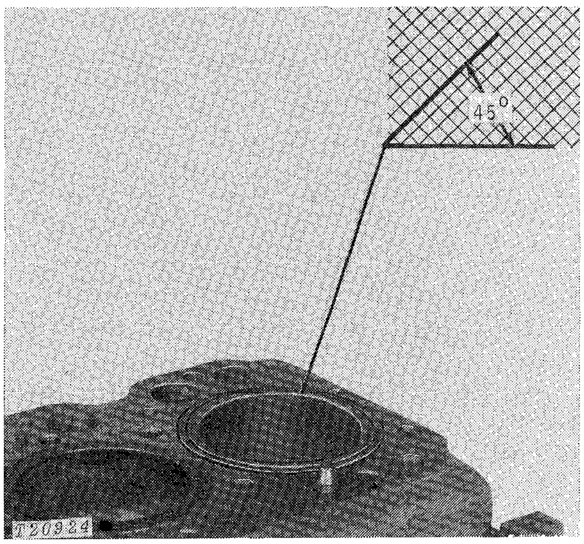


Fig. 7-Deglazing Cylinder Liner

Use a 180-grit honing stone and light pressure to produce the desired 15 to 35 micro-inch R.M.S. cylinder wall finish (Fig. 7).

Immediately after deglazing, clean liner bores with hot water, soap and scrub brush. Rinse cylinder liner bores with clean water until rinse water is clear. Wipe liner dry with clean towels. Wipe bores with clean engine oil.

IMPORTANT: Solvents will not remove honing residue

ASSEMBLY

Assembling Connecting Rod and Piston

Assemble pistons and connecting rods making sure that identification marks on piston and rod are in same relative position as they were at time of disassembly.

NOTE: On later units (187209-) the piston pin diameter has been increased. The new pin also requires the use of a new connecting rod, new piston, and new piston pin snap rings.

On units prior to the above serial number, the new parts can be used; however, replacement must be made for all engine cylinders. New parts cannot be used with old parts.

Each connecting rod and piston must be reinstalled in the cylinder liner from which it was removed. Observe the word "FRONT" stamped on the head of all pistons and in the rib of the connecting rods. All identification marks must face toward the fan end of engine.

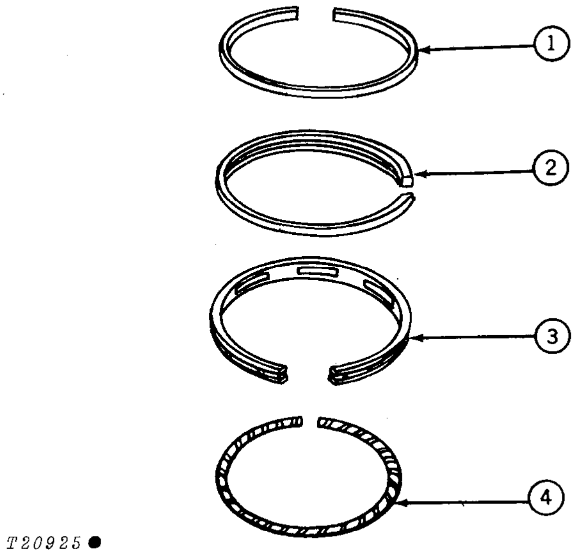
Coat piston pin with a light film of oil and insert into piston pin bore through connecting rod bushings and on into opposite pin bore. A properly fitted piston pin can be pressed into position with the thumb. Install new piston pin snap rings and check that rings are in grooves of piston pin bore.

Installing Piston Rings on Piston

Coat the outside of the pistons and rings with a light film of oil. Use a JDE-45 Ring Expander to install rings in their respective grooves.

IMPORTANT: Use of incorrect size ring expander will damage rings.

1. Install the expander in the oil ring groove. Install the oil ring with dots (or "Top") facing up towards the top of the piston and position oil ring gap opposite expander gap (Fig. 8).
2. Install second compression ring (Fig. 8) with dots (or "Top") facing up towards the top of the piston.



1—1st Comp. Ring
2—2nd Comp. Ring
3—Oil Ring
4—Oil Ring Expander

Fig. 8-Ring Installation

3. Install the first compression ring with dots (or "Top") facing up towards the top of the piston.

NOTE: If rings are not marked, install with either side up.

4. Piston rings should move freely in their grooves.

INSTALLATION

Installing Cylinder Liners

Before installing liners it is important to make sure the counterbore, under the liner flange at top is completely free from dirt or nicks.

Carefully install a new, dry packing over the bottom end of the cylinder liner. Slide packing firmly against the shoulder of the liner, making sure that the packing is not twisted or crimped.

Install cylinder bore O-rings into the grooves in the cylinder block. Install the black O-ring in the bottom groove in the cylinder block and the red O-ring in the top groove. Check that the O-rings are correctly retained in the grooves and are not twisted.

Coat the liner packing, seating area of the liner, and new cylinder bore O-rings with John Deere AR54749 Soap Lubricant.

IMPORTANT: Do not soak the packing or O-rings in oil prior to assembly. Soaking will cause the packings to swell.

NOTE: If you suspect that a packing may have sheared or displaced during lowering into position, the liner and packing assembly should be removed and examined.

Work liners gently in place as far as possible by hand. Finish seating liners by placing a wood block over upper end and tapping block lightly with hammer.

Cylinder liner will protrude over the top of the cylinder block more than normal due to the uncompressed packing.

Clean cylinder liner bores with waterless hand cleaner after installation in block. Wipe dry with clean towels. Coat cylinder liner bores with engine oil just before installing pistons.

Installing Pistons

Use short cap screws and large flat washers to retain liners in position while pistons are installed.

Place top piston ring gap over piston pin and stagger ring gaps before installing pistons in cylinder liners.

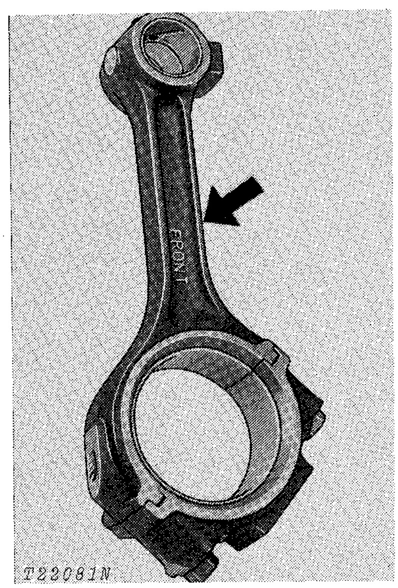


Fig. 9-Installing Connecting Rod

Be sure the word "FRONT" stamped on the head of the pistons faces toward the front of the engine before installing them in liners. On connecting rods, be sure the word "FRONT" faces toward the front (Fig. 9).

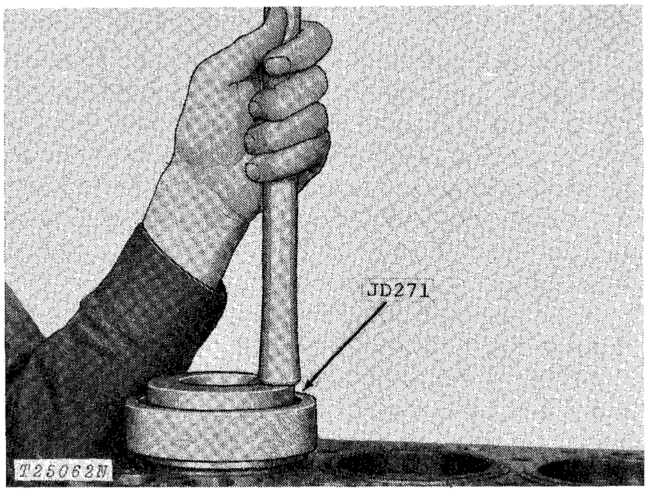


Fig. 10-Installing Pistons

Use Compressor Tool JD271 to install pistons (Fig. 10).

Apply light-weight oil to the bearing inserts and crankshaft rod journals.

Tighten connecting rod cap screws to 52 ft-lbs.

IMPORTANT: Installing or removing connecting rod and main bearing cap screws using pneumatic wrenches generates high frictional heat and can cause cap screw fatigue.

Installing Oil Pan

Apply Permatex No. 3 Sealing Compound to oil pan gasket and cylinder block pan surface. Tighten oil pan-to-cylinder block and timing gear cover cap screws to 35 ft-lbs.

Engine Break-In

Refer to specifications and perform the break-in steps to insure proper run-in of new parts.

CRANKSHAFT, MAIN BEARINGS, AND FLYWHEEL

GENERAL INFORMATION

The crankshaft is a one-piece steel forging, supported on seven main bearings. The bearings are replaceable, steel-backed, tinplated, aluminum-lined inserts. The rear main bearing has a thrust surface.

The crankshaft is drilled for pressure lubrication from the main bearings to the connecting rod bearings.

The ring gear for the starting motor is shrunk in place on the front outer rim of the flywheel. On the front outer rim of the flywheel is a "TDC" (top dead center) bore which is used when timing injection pump, and adjusting valve tappets.

REMOVAL

To service crankshaft, main bearings and flywheel it is necessary to remove engine from unit (Refer to Section 10, Group 25).

Remove oil pan, timing gear cover, starting motor, flywheel, and pistons.

REPAIR

Flywheel

1. To install new ring gear, heat gear evenly all the way around and, while ring is hot, slip it onto flywheel. Install with chamfered edge of teeth toward front of flywheel.

2. To install new pilot bearing, pack with grease and drive in (shielded side out) to bottom of bore.

NOTE: It is recommended that "D" grade cap screws be replaced with "F" grade cap screws and hardened washers.

Install cap screws. Tighten "D" grade cap screws to 85 ft-lb "F" grade cap screws to 120 ft-lb.

Crankshaft

3. Use a knife-edge gear puller to pull crankshaft gear.

CAUTION: Oil fumes or oil can ignite above 380°F. Use a thermometer and do not exceed 360°F. Do not allow a flame or heating element to be in direct contact with the oil. Heat the oil in a well-ventilated area. Plan a safe handling procedure to avoid burns.

4. To install new crankshaft gear, support crankshaft under its first throw while pressing on gear. Gear may be heated in hot oil (300°F) to aid in assembly.

5. Check the thrust surfaces on both sides of the crankshaft rear main bearing.

6. If the crankshaft journals are out-of-round or are tapered, either grind crankshaft and install undersize bearings or replace crankshaft.

Main Bearings

7. If any one main bearing insert needs replacing, always replace both halves. Check clearance and condition of all main bearing inserts at this time. Wear on the damaged insert may have been caused by another being out of specifications. If other inserts are within specifications, but show excessive wear, replace them. New main bearing inserts should be installed at every major overhaul.

8. Determine if main bearing clearance is within 0.0016 inch to 0.0046 inch.

NOTE: If engine has piston cooling orifices in tapped holes on main bearing webs. remove and check for clogging or damage. Clean or replace as necessary. Install orifices and tighten with 85 to 110 in-lbs.

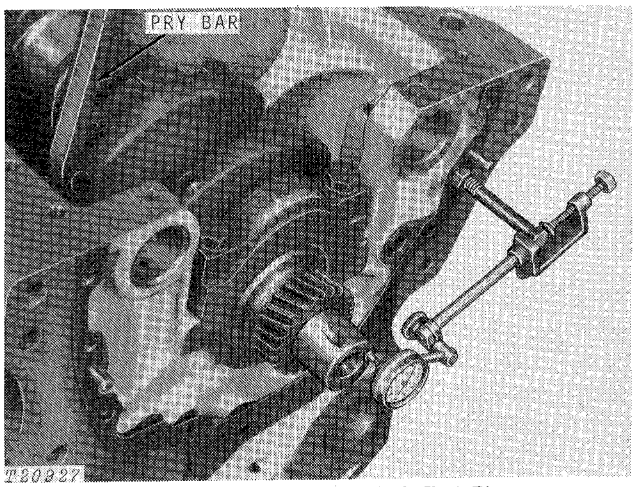


Fig. 11-Checking Crankshaft End Play

9. Measure crankshaft end play and determine if it is within 0.0020 inch to 0.0080 inch.

10. To remove old seal wear ring from crankshaft, scribe lines across wear ring with the aid of a dull chisel until ring can be removed (see inset in Fig. 12).

IMPORTANT: Do not scribe lines too deep in wear ring, as crankshaft wear ring surface may be damaged.

11. Install pilot ring (JD251-3), bevelled edge outward, over rear of crankshaft (Fig. 12). Slide new wear ring (rounded edge of ring outward) over pilot ring and start wear ring onto crankshaft flange by hand (avoid heavy pressure or cocking of wear ring). Place driver (JD251) over pilot ring until it contacts wear ring. Tap driver with a mallet until driver bottoms on pilot ring. Rotate driver while tapping.

Do not nick or damage wear ring oil seal surface. Check crankshaft and wear ring surfaces for nicks and clean up if necessary.

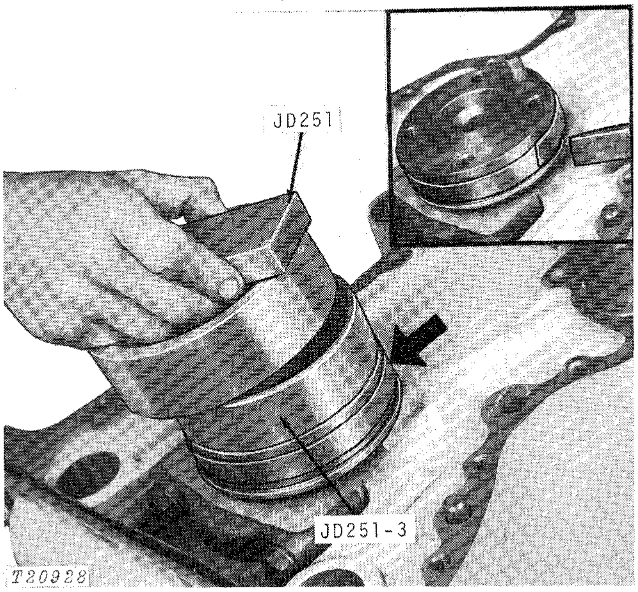


Fig. 12-Installing Crankshaft Seal Wear Ring

12. Remove old oil seal from flywheel housing. Press new seal in rear of flywheel housing (lip inward) using a suitable driver, until seal case is flush with machined face of seal bore in housing. Be sure to support housing around bore while pressing in a new seal.

INSTALLATION

1. Install inserts with thrust faces (Fig. 13) in rear main bearing bore. Install plain inserts in other main bearing bores. Make sure that tangs on all inserts fit the locking grooves in the bores and that the oil holes in inserts line up with oil passages in the block.

2. Make sure bearing caps are installed on the mains from which they were removed by referring to identification marks made at the time of removal. Put oil on main bearing cap screws and washers. Loosely install cap screws in main bearing caps—until finger tight.

3. Align upper and lower thrust flanges on rear main bearing as follows: Tap the crankshaft to the rear to line up the front flanges. Then tap the crankshaft to the front to line up the rear flanges. Tighten main bearing cap screws to 85 ft-lbs.

4. If crankshft end play has not been checked with all repair parts installed, check it by method given in "Repair" in this group and compare measurement to (0.0020 to 0.0080 inch).

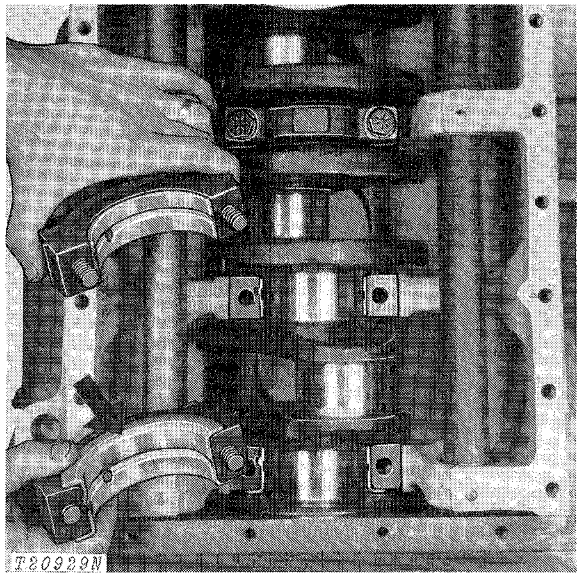
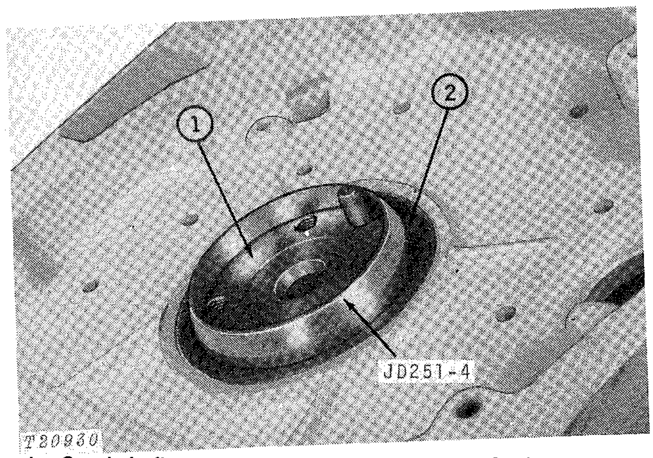


Fig. 13-Installing Main Bearing Caps

5. To facilitate installation of flywheel, screw two pilot studs into flywheel mounting screw holes in crankshaft. Tighten attaching cap screws to 85 ft-lbs.

6. Place crankshaft oil slinger over front end of crankshaft with inside of slinger against front gear on crankshaft.



1—Crankshaft **2—Oil Seal**

Fig. 14-Installing Flywheel Housing

Position JD-251-4 seal protector (Fig. 14) over rear of crankshaft and coat protector and wear ring with engine oil. Install flywheel housing on rear of engine. Be careful not to invert oil seal lip in flywheel housing.

Install all other parts removed.

Install engine (Section 10).

CAMSHAFT

GENERAL INFORMATION

The camshaft is iron alloy with all cams integral. The camshaft has a lobe to actuate the fuel transfer pump.

The camshaft is driven at one-half engine speed by the top idler gear and is supported by four pressure-lubricated bores integral with the cylinder block. Camshaft thrust is taken by a thrust plate fastened to the front of the cylinder block.

VALVE LIFT CHECK

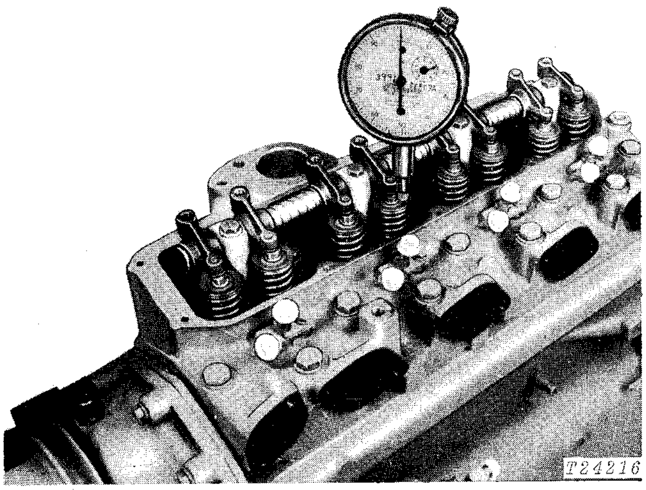


Fig. 15-Checking Valve Lift

Measuring valve lift can give an indication of wear on cam lobes, cam followers, and push rods.

Set exhaust valve clearance of 0.018 inch and intake valve clearance of 0.014 inch.

Place dial indicator on valve rotator or valve spring cap. (Be sure that valve is fully closed and the rocker arm moves freely.) Zero dial indicator.

Manually turn engine in running direction. When rocker arm contacts valve, check indicator travel as the rocker arm moves valve to full open.

Exhaust valve lift should be 0.456 inch to 0.482 inch and intake valve lift should be 0.460 inch to 0.490 inch.

REMOVAL

To service camshaft and related parts, engine normally need not be removed from unit. If engine has to be removed refer to Section 10.

Remove distributor and fuel transfer pump.

Using a wire with a 90-degree bend on the end, reach down through top of cylinder head and raise tappets off camshaft lobes. Secure wires so that tappets will not drag on camshaft during removal.

Remove top idler gear from engine front plate. This will allow camshaft to rotate when lining up camshaft attaching cap screws.

NOTE: If cylinder block is removed from machine and secured on an engine stand upside down, cam followers need not be wired up.

REPAIR

1. Determine if camshaft journals and bores are within 2.1997 inches to 2.2007 inches.

2. Thrust plate must be within 0.1560 inch to 0.1580 inch as the thrust plate determines camshaft end play.

3. Replace camshaft drive gear if necessary by pressing shaft from gear. Press on gear until it is tight against flange on camshaft. Timing mark must face away from camshaft.

Support camshaft under its first bearing while pressing on gear.

4. Whenever a new camshaft is installed, replace the tappets.

5. If replacing tachometer drive, support camshaft and press in new drive with slot located 180° from keyway in opposite end of camshaft.

INSTALLATION

Install the camshaft, noting the following:

1. Coat entire camshaft with a light film of oil.

2. When installing camshaft, do not permit cam lobes to drag on camshaft bores.

3. Turn the camshaft gear until the cap screws and locks which secure the thrust plate can be installed and tightened to 35 ft-lbs.

4. Check camshaft for 0.0025 inch to 0.0085 inch end play (new camshaft and thrust plates should restore this).

5. Before installing idler gear, set flywheel at "TDC" with No. 1 (front) piston on the compression stroke and align the timing mark on the camshaft drive gear with the center of the crankshaft, using timing tool JD254.

6. With timing marks aligned, install top idler gear and secure to front plate with flat washers and cap screw. Tighten cap screw to 65 ft-lbs.

Install all parts removed.

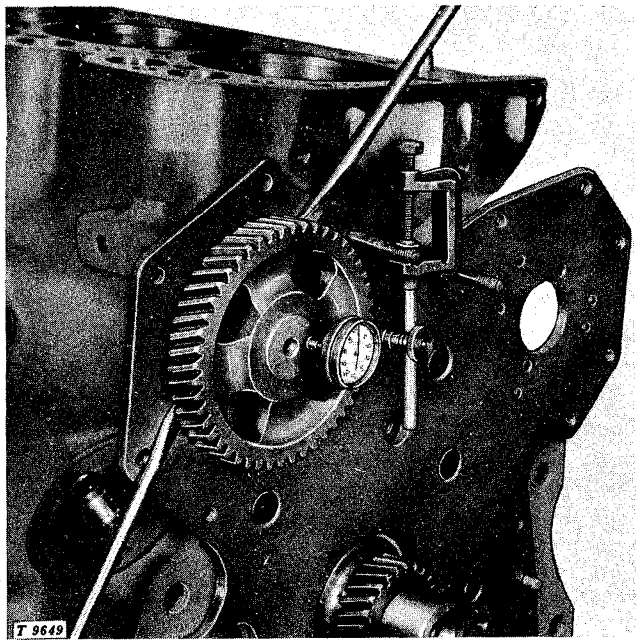


Fig. 16-Checking Camshaft End Play

BALANCER SHAFTS

GENERAL INFORMATION

Two balancer shafts are mounted in the lower half of the cylinder block and each rotates in three pressure-lubricated replaceable bushings.

The balancer shafts rotate in opposite directions to reduce engine vibration. Thrust of the balancer shafts is absorbed by thrust plates fastened to the front of the cylinder block.

REMOVAL

To service balancer shafts and related parts, engine normally need not be removed from unit. If engine has to be removed, refer to Section 10. Then proceed as follows:

1. Remove timing gear cover.

2. Remove oil pump gear.

3. Remove lower idler gear.

4. Remove balancer shafts and identify shafts and thrust plates as "right" and "left."

REPAIR

Measure oil clearance between balancer shaft journals and bushings. Maximum allowable clearance is 0.0058 in.

If oil clearance is too much, install new bushings.

If oil clearance is still too much, install new balancer shaft.

Installing Bushings

The first two bushings can be replaced with the engine in the unit using Tool JD249. To remove the third (rear) bushing, separate the engine from the clutch housing. (Section 10). Press all bushings in from front of engine until flush with bushing bore chamfer in block. (JD249 Tool can also be used to drive out old bushings.)

Be sure that oil hole in each bushing lines up with upper oil lead hole in cylinder block.

Check thickness of thrust plate. These must be within 0.1170 inch to 0.1190 inch as the thrust plate determines balancer shaft end play.

Inspect balancer shaft drive gears for worn, cracked, and broken teeth.

Installing Drive Gear

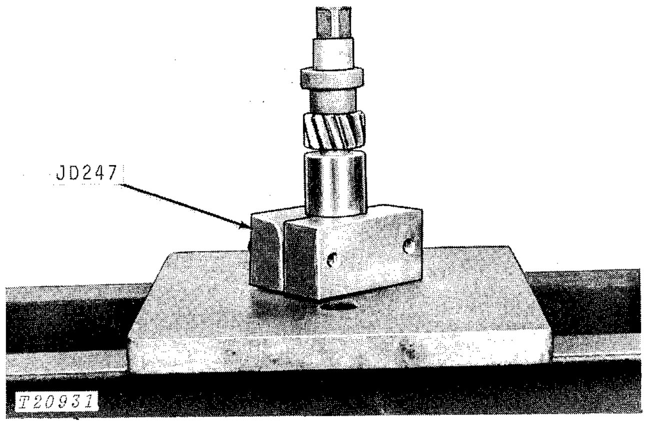


Fig. 17-Replacing Balancer Shaft Gear

Position balancer shaft drive gear on front of balancer shaft so that slot in gear lines up with Woodruff key, and timing mark on front of gear faces away from balancer shaft. Press on gear to flush with end of shaft using JD247 Holding Tool to support shaft as shown in Figure 17. Be sure gear is flush with end of shaft (within 0.0010 inch) as this sets balancer shaft end play.

INSTALLATION

1. Apply a light film of oil to balancer journals and bushings.
2. Secure thrust plates to front plate with hardware and tighten to 35 ft-lbs torque.
3. Check balancer shaft for end play of no more than 0.0080 inch or less than 0.0020 inch.
4. Install oil pump.
5. Before installing lower idler gear, set flywheel at "TDC" with No. 1 piston on compression stroke and align timing mark on balancer shaft drive gears with center of crankshaft using Timing Tool JD254.
6. Install all parts removed.

TIMING GEAR TRAIN

REMOVAL

To service gear train and related parts, with the exception of the crankshaft, engine normally need not be removed. If engine must be removed, see Section 10 of this manual.

Whenever an engine is being completely reconditioned or the crankshaft is being removed, the engine front plate with gear assemblies should be removed from the engine using the following steps:

1. Remove timing gear cover.

2. Remove hex. nuts from the oil pump and injection pump drive gears and cap screws from upper and lower idler gears.

3. Remove upper and lower idler gears from engine front plate. Attach a puller to oil pump gear and pull gear from shaft. NEVER PRY GEAR FROM SHAFT.

4. Remove oil pump (Group 15).

5. Remove fuel injection pump and drive gear (Section 30).

6. Remove camshaft.

REPAIR

For gear inspection and repair, refer to the section and group in the manual covering the assemblies that the gears drive. The camshaft and crankshaft must be removed from the engine to replace their gears.

Checking Gear Train Backlash

If gear train noise is noted at the time of disassembly, it usually indicates excessive gear lash or damaged gear teeth.

During disassembly, measure crankshaft to upper idler (0.0027 to 0.0116 inch), upper idler to camshaft (0.0028 to 0.0135 inch), upper idler to injection pump (0.0028 to 0.0135 inch) crankshaft to lower idler (0.0027 to 0.0137 inch), lower idler to oil pump (0.0016 to 0.0147 inch), lower idler to balancer (0.0018 to 0.0156 inch), and oil pump to balancer (0.0020 to 0.0140 inch) for gear train backlash.

Idler Gears

Be sure that the oil hole in the upper shaft is open. Measure inside diameter of bushing (1.7520 inches to 1.7530 inches) and outside diameter of shaft (1.7495 inches to 1.7505 inches) to determine oil clearance. If bushing replacement is required, press in new bushing to flush with either side of gear using JD252 Driver.

The upper idler gear is pressure-lubricated. If there are signs of oil starvation, make certain that the oil delivery hole in cylinder block is open.

If idler gear shaft replacement is necessary, press in new spring pins to 0.2000 inch to 0.2800 inch above shaft.

Front Plate and Timing Gear Cover

Never pry or press against timing gear cover with excessive force. The cover is cast aluminum alloy and might be sprung or warped.

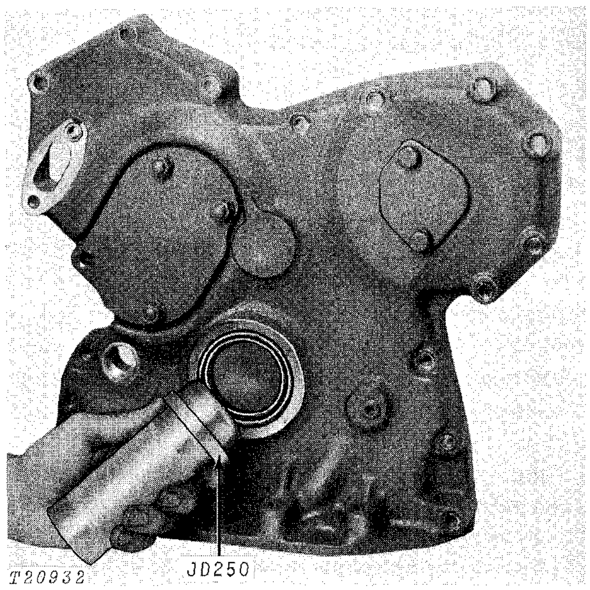
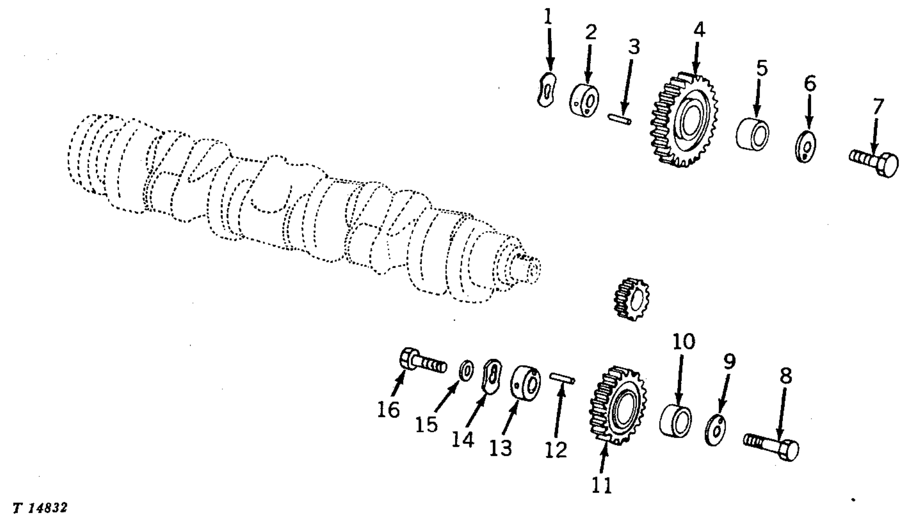


Fig. 18-Installing Oil Seal in Timing Gear Cover

If there is evidence of oil leakage on outside of timing gear cover, replace crankshaft front oil seal.

Coat outer surface of seal with joint sealing compound. Support the oil seal bore area of timing gear cover. Press in oil seal to bottom of bore with spring-loaded lip facing inward using JD250 oil seal driver.



1—Inner Thrust Washer
2—Idler Gear Shaft
3—Spring Pin
4—Upper Idler Gear
5—Bushing
6—Outer Thrust Washer
7—Cap Screw
8—Cap Screw
9—Outer Thrust Washer
10—Bushing
11—Lower Idler Gear
12—Spring Pin
13—Idler Gear Shaft
14—Inner Thrust Washer
15—Washer
16—Special Bolt

Fig. 19-Idler Gears

INSTALLATION

Installing and Timing the Gear Train (Fig. 19)

The camshaft gear and injection pump gear must be timed to the center of the crankshaft when they are installed. Install and time gear assemblies using the following steps:

1. Turn crankshaft until No. 1 piston is at top dead center (TDC) of its compression stroke. Remove timing hold cover and screw on flywheel housing. Reversing the screw, insert the smooth end into the flywheel housing bore. Rock the flywheel until the screw slides into hole in flywheel.

If engine is stripped, position crankshaft so that No. 1 (fan end) connecting rod journal is at its highest point toward the deck of the engine at this time. *The keyway in the crankshaft front gear (not pulley keyway) should now point straight up toward the top of the engine.*

Do not rotate crankshaft after "TDC" setting has been made.

2. Install camshaft.

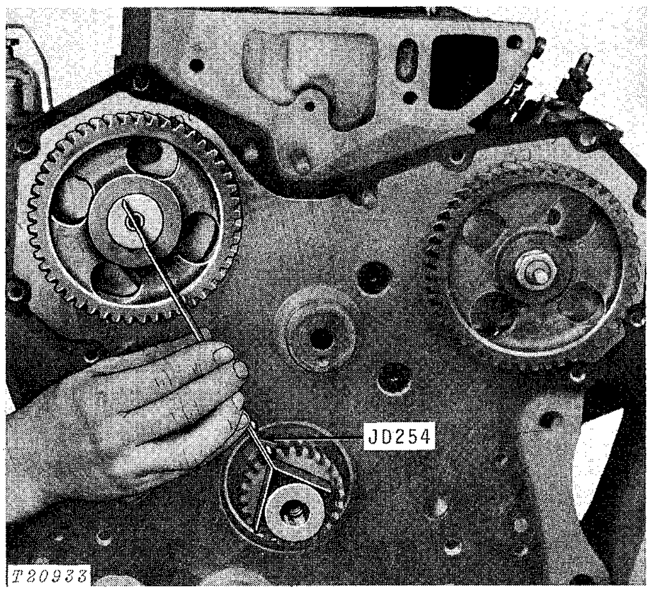


Fig. 20-Timing the Camshaft Gear

With engine at "TDC," use JD254 gear timing tool to align the timing mark on the camshaft gear between centers of the crankshaft and camshaft (Fig. 20).

3. Install fuel injection pump and drive gear (Section 30).

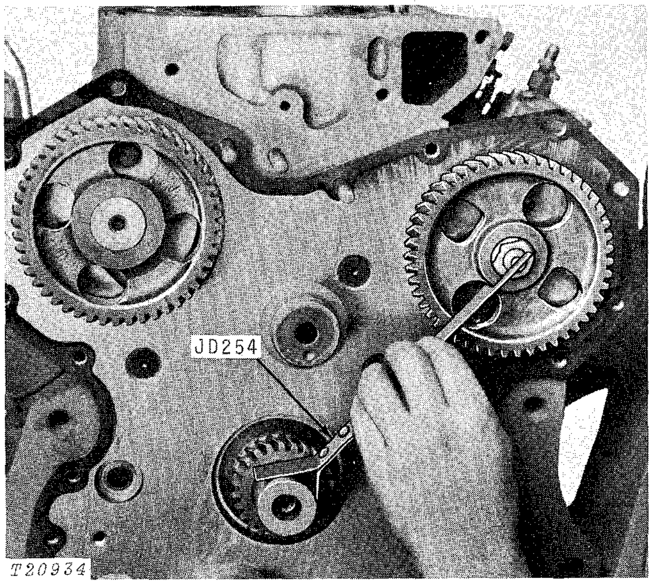


Fig. 21-Timing the Injection Pump Gear

With engine at "TDC," use JD254 gear timing tool to align the timing mark on the injection pump gear between centers of crankshaft and injection pump shaft (Fig. 21)..

Use the timing mark on the injection pump drive gear that indicates the number of cylinders in the engine.

4. With camshaft and injection pump gears installed and timed, carefully install upper idler gear into position using care not to rotate the timing gears. Be sure inner thrust washer and idler gear shaft are in place on rear of idler gear shaft (Fig. 19). Over front of gear, install outer thrust washer and cap screw. Using a screwdriver between gears to prevent rotation, secure upper idler gear to front plate and tighten to 65 ft-lbs.

5. Install balancer shafts.

With engine at "TDC", use tool JD254 to align the timing marks on the balancer shaft drive gears between center of the crankshaft and balancer shaft (Fig. 22).

6. Install oil pump and drive gear (Group 15).

Tighten oil pump gear hex. nut to 35 to 45 ft-lbs after gears have been timed and lower idler gear installed so that gears may be restrained with a screwdriver. Then stake threads on shaft.

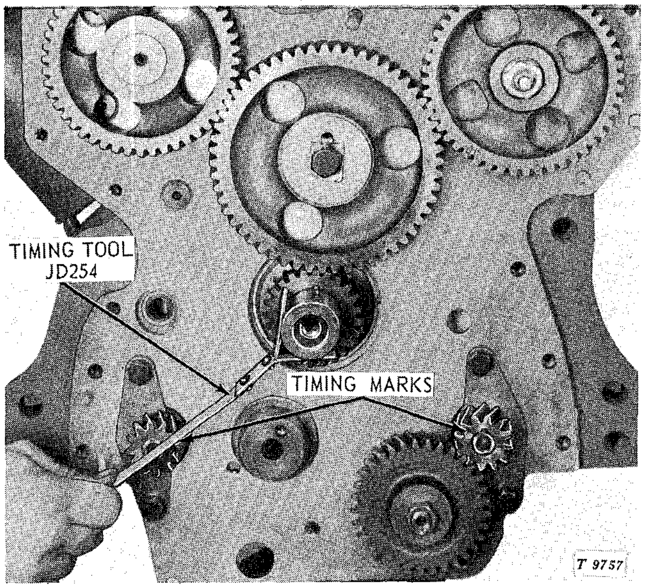


Fig. 22-Timing the Balancer Shaft Gears

7. With balancer shaft and oil pump gear installed, install lower idler gear into position, using care not to rotate any gears. Be sure special bolt, washer, inner thrust washer, and idler gear shaft are in place on rear of idler gear shaft. Over front of gear, install outer thrust washer and cap screw. Tighten cap screw to 95 ft-lbs.

After all gears are locked in place, recheck all timing marks with JD254 gear timing tool, making sure that marks still align between the centers of the respective shafts and the center of the crankshaft with the engine at "TDC." Then remove timing screw from flywheel and install timing hole cover.

Final Installation

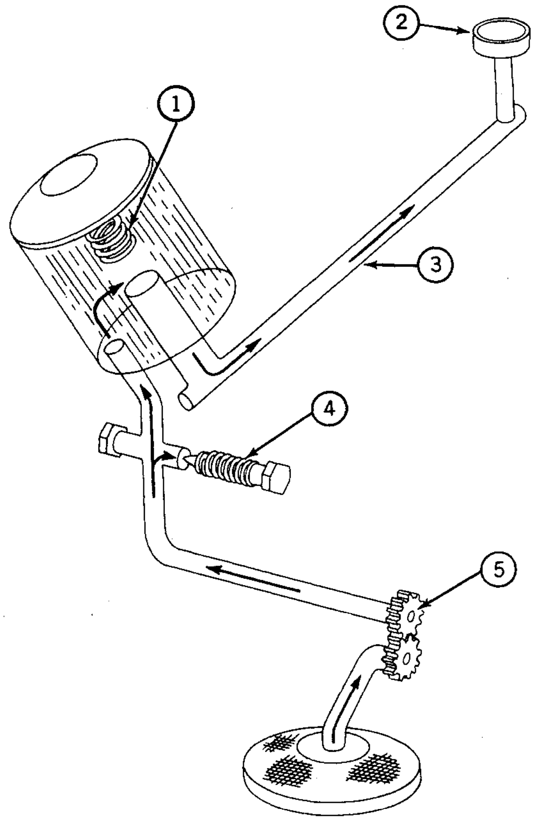
Apply a thin coat of high-temperature grease to the inside lips of the front oil seal and install timing gear cover. Be careful not to invert lips of oil seal while installing cover.

Before installing gear cover on engine be sure that oil slinger is securely positioned over end of crankshaft with inside against gear. Also be sure oil pressure regulating valve and spring are in place under cover.

Group 15

ENGINE LUBRICATION

GENERAL INFORMATION



1—Bypass Valve
2—Sending Unit
3—Oil Gallery
4—Regulating Valve
5—Oil Pump

Fig. 1-Engine Lubrication System

The engine lubrication system has an internal, force-feed, splash-type pump, with an externally adjustable pressure regulating valve and a full-flow oil filter.

Oil Pump

Oil enters the pump from the rear through the pump intake tube and is discharged at the oil outlet hole into an oil tube leading to the oil filter and engine oil gallery.

Regulating Valve

An externally adjustable pressure regulating valve is located at the fan end of the cylinder block in oil gallery.

The valve assembly consists of a valve body held against a seat by a spring and plug. Pressure may be adjusted by changing the number of shims behind the valve plug. When oil pressure is greater than the valve setting, oil is bypassed to the crankcase and desired pressure is maintained.

Oil Filter

The oil filter is mounted on the cylinder block. It is a full-flow type with a spin-on type replaceable element. If the filter clogs, a bypass valve in the element opens to keep a full flow of oil to vital engine parts.

DIAGNOSING MALFUNCTIONS

Checking Engine Oil Pressure

If oil pressure indicator gauge continues to show low oil pressure after engine has been running for 10 seconds, the engine should be stopped and cause of low pressure determined. (See below and Group 10 for further lubrication system diagnosis.) If indicator gauge shows low oil pressure at any time while engine is being operated, the same procedure should be followed immediately.

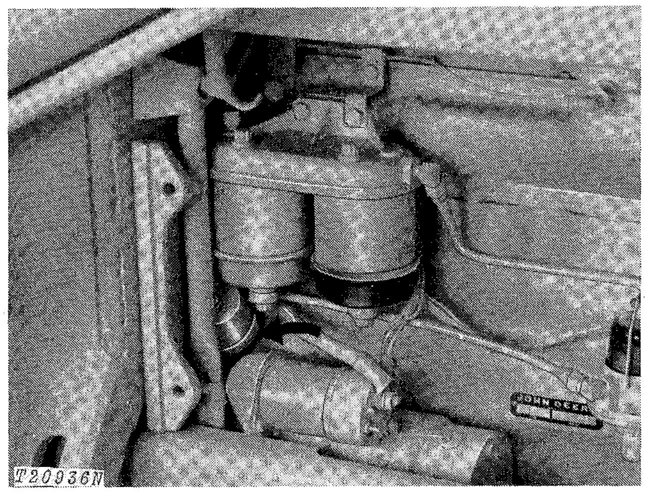


Fig. 2-Oil Pressure Sending Unit

Check oil pressure as follows:

Remove sending unit (Fig. 2) and install master pressure gauge.

With engine warmed up and running at 2500 rpm, oil pressure reading should be 50 ± 15 psi at 180° to 220°F.

If pressure does not register within acceptable range, adjust oil pressure (refer to "Adjusting Oil Pressure," page 15-4, this group).

Further analyze causes of improper oil pressure according to the following:

Engine Oil Pressure Too High

Incorrect oil viscosity.
Engine oil pressure adjustment incorrect.
Pressure gauge inaccurate.

Engine Oil Pressure Too Low

Incorrect oil viscosity.
Engine oil pressure adjustment incorrect.
Worn parts (connecting rod bearings, main bearing, camshaft bushings) allow leakage.
Plugged intake screen.
Oil pressure regulating valve damaged.
Oil pressure regulating valve spring worn or damaged.

Engine Consumes Excessive Amount of Oil

See diagnosis information in Group 10, Basic Engine.

REPAIR

Remove engine oil pan.

NOTE: Before removing oil pump assembly, set engine at TDC and secure left hand balancer shaft to prevent turning during oil pump removal.

Remove oil pump assembly.

To remove idler shaft (11, Fig. 3) from oil pump housing, slide idler gear (12) off shaft; then support housing (10) and press out shaft.

Pump Housing and Idler Shaft

If surface to which cover attaches is rough, burred, or warped, upper body must be replaced.

Pump Cover

Examine pump cover (4 or 20) mounting surface. A damaged cover must be replaced. The seal between cover and pump housing is dependent upon these two surfaces being perfectly flat and smooth.

Examine screen on cover to be sure it is clean and the wire mesh of the screen is not damaged.

Inspect inlet and outlet tubes for clogging.

Pump Drive Shaft

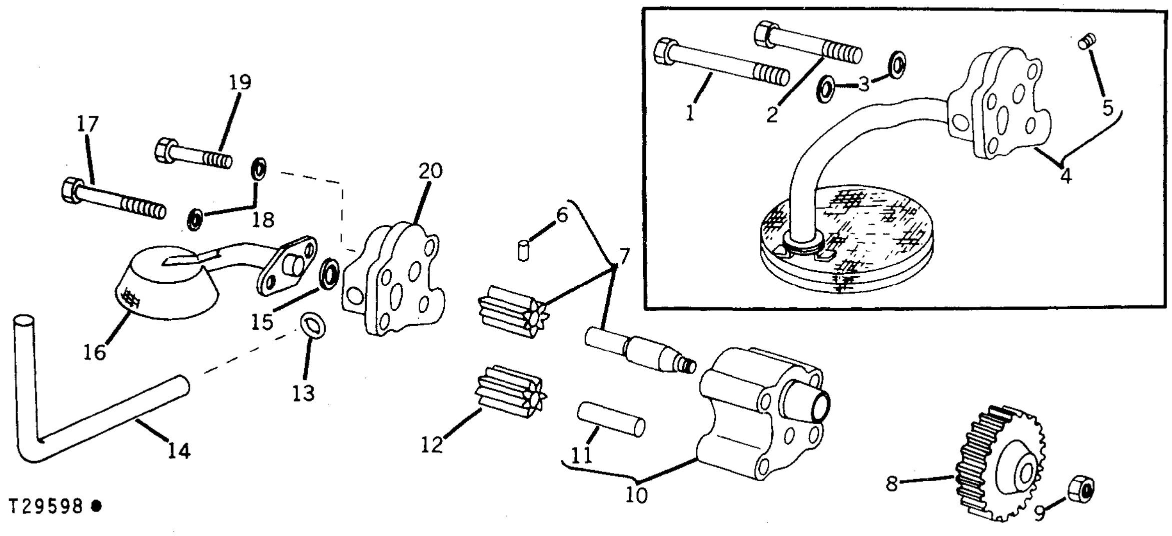
Carefully inspect shaft (7) for wear, especially at points of contact. Check diameter of drive shaft (0.6308 inch to 0.6312 inch) at point where it rides in bore of housing and replace if necessary. (The drive shaft is not available separate from the pump gear and groove pin.)

Pump Gears

Measure width of gears (1.4163 to 1.4183 inches - early units; 1.6203 to 1.6223 inches - later units).

Install gears in housing in running position and measure radial clearance (0.0030 inch to 0.0060 inch) between gear teeth and body. Excessive clearance can be corrected only by replacement of worn parts.

Place a straightedge across top of housing (to represent cover) and measure clearance (0.0012 inch to 0.0062 inch) between gears and straightedge.



1—Cap Screw (-165122)
2—Cap Screw (3 used) (-165122)
3—Lock Washer (4 used) (-165122)
4—Cover Assembly (-165122)
5—Pipe Plug (-165122)
6—Groove Pin
7—Drive Shaft with Gear and Pin
8—Drive Gear
9—Jam Nut
10—Pump Housing
11—Idler Shaft
12—Idler Gear
13—O-Ring
14—Outlet Tube
15—O-Ring (165123-)
16—Intake (165123-)
17—Cap Screw (2 used) (165123-)
18—Lock Washer (4 used) (165123-)
19—Cap Screw (2 used) (165123-)
20—Cover (165123-)

Fig. 3-Oil Pump

Oil Pressure Regulating Valve

Remove oil pressure regulating plug, shims (if used), spring, and valve. Save all shims for correct assembly.

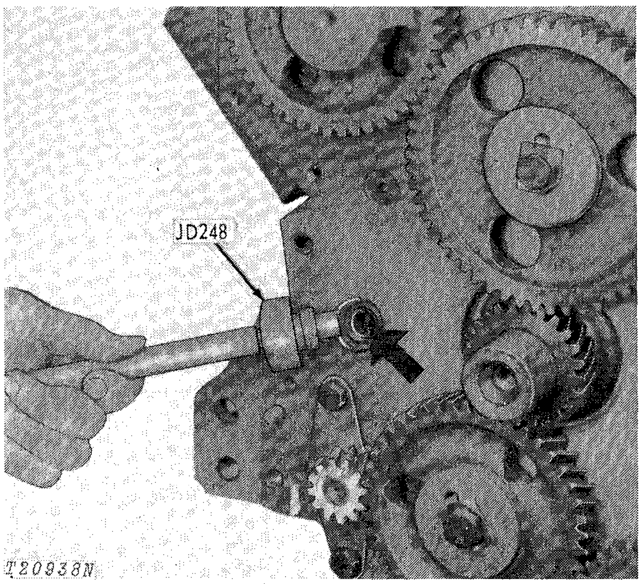


Fig. 4-Installing Pressure Regulating Valve Bushing

Inspect regulating valve seat in front of cylinder block for damage (especially at raised rim of bushing).

Press new bushing into block using JD248 Tool (Fig. 4). Press in bushing until outer recessed edge of bushing is flush with bottom of counterbore in block. Do not press on raised inner rim of bushing; this rim is the regulating valve seat.

Check oil pressure regulating spring. Test length is 1.68 inches at 15 ± 1.5 lbs. pressure.

Check pressure regulating valve plug threads for damage.

IMPORTANT: When the latest oil pressure regulating valve is installed, the latest pressure regulating spring and relief valve plug must also be used.

Oil Filter

Unscrew filter element from engine and discard it. Inspect oil passages at mounting point on cylinder block for obstructions. If filter base nipple in block is damaged, refer to "Basic Engine," Group 10, for replacement details.

ASSEMBLY

Press idler shaft (11, Fig. 3) into pump housing until flush with outer surface of housing.

Place gear and shaft in housing. Install pump idler gear on idler shaft in housing. Check to see that both gears rotate freely in housing.

Install new O-ring (13) in oil outlet opening in oil pump cover.

INSTALLATION

Oil Pump

Place pump housing with gears and drive shaft in position in engine. Set engine at TDC and time left balancer shaft to engine gear train (Group 10). Install drive gear on shaft. Tighten hex. nut to 35 to 45 ft-lbs and then stake nut to shaft.

IMPORTANT: Put oil on gears before assembling oil pump.

NOTE: If left hand balancer shaft has moved, retime balancer shaft to engine gear train (see Group 10).

Position oil pump cover and screen up against pump housing. Install pump outlet oil tube in cover. Fasten cover in place. Tighten to 35 ft-lbs.

Place valve and spring in valve hole in engine timing gear cover. With an aluminum washer on valve plug and same number of shims (if used) in plug counterbore as removed, install plug in timing gear cover. This is a preliminary setting to be used on early units until oil pressure can be checked.

Oil Filter

Install new filter element. Turn element down until sealing ring just contacts mounting pad; then turn down an additional 1-1/2 turns.

Check for leaks around filter element. Retighten if necessary, but do not overtighten.

The filter element has a special bypass valve to protect the engine in case of filter clogging. Advise the operator to replace only with a John Deere filter element supplied by his dealer.

ADJUSTING OIL PRESSURE

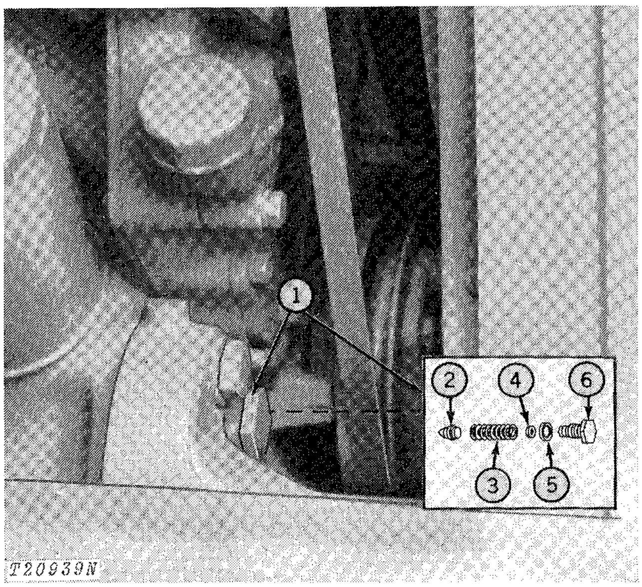
To increase oil pressure do the following:

With the large aluminum washer under head of valve plug, insert the small shims provided in counterbore of plug (not to exceed four) until pressure 50 ± 15 psi at 2500 rpm is reached.

To decrease oil pressure do the following:

Remove the small shims from the counterbore of the valve plug. To further decrease pressure, add a second large aluminum washer under head of plug.

NOTE: Later units may be adjusted in the same manner, but under normal conditions should not require adjustment.

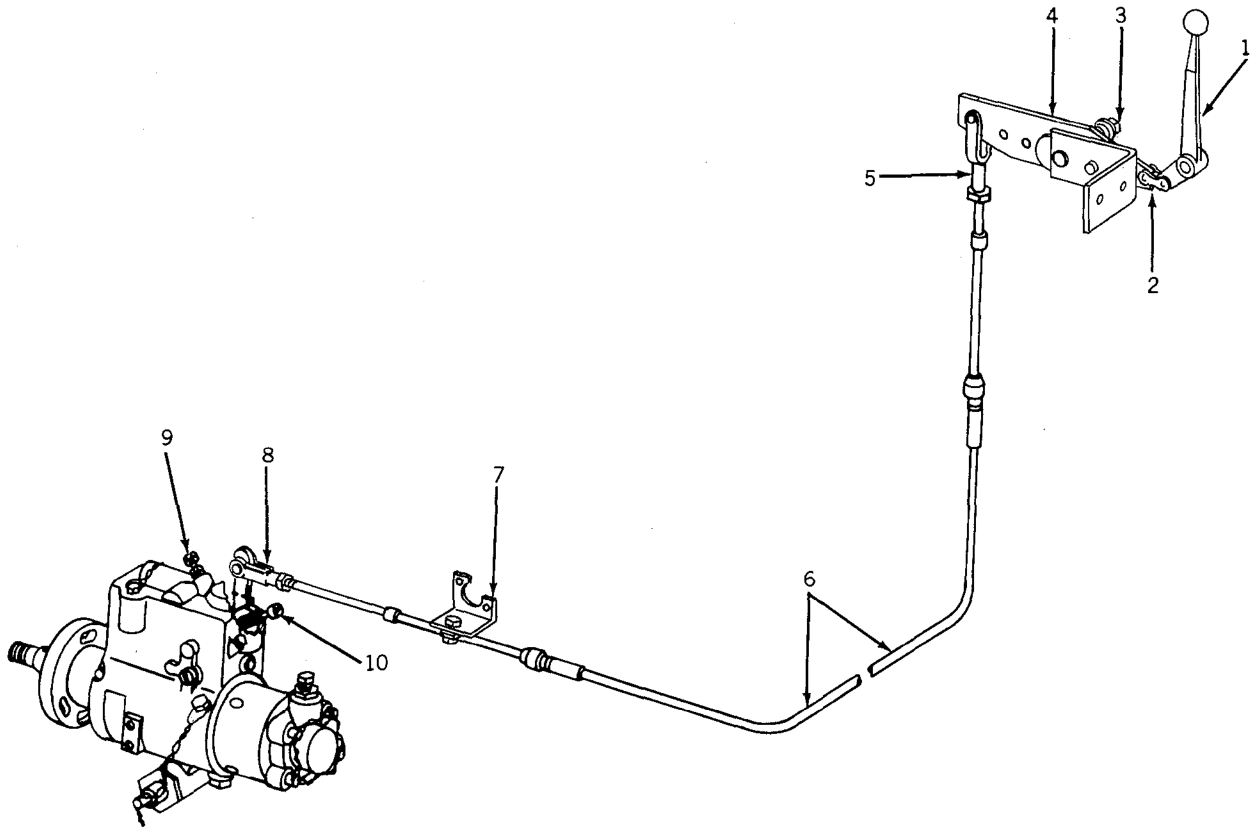


1—Regulating Valve
2—Valve Head
3—Spring
4—Shim
5—Washer
6—Plug

Fig. 5-Regulating Valve (Early Units Shown)

Group 20

SPEED CONTROL LINKAGE



T20940

1—Hand Throttle Lever
2—Lever-to-Bell Crank Link
3—Friction Adjusting Nut
4—Bell Crank
5—Adjustable Yoke
6—Speed Control Cable
7—Bracket
8—Adjustable Yoke
9—Pump Slow-Idle Stop Screw
10—Pump Fast-Idle Stop Screw

Fig. 1-Speed Control Linkage

GENERAL INFORMATION

The speed control linkage, by means of the hand throttle, controls the amount of fuel delivered to the engine by the injection pump, thus regulating engine speed.

To accelerate the engine, push the hand throttle forward. To slow down the engine, pull the hand throttle to the rear. Normal slow idle is full rearward on the throttle. The slow and fast-idle screws are shown in Fig. 1.

IMPORTANT: Do not attempt to stop the engine by turning off the fuel at shut-off valve at fuel tank. This will cause the injection pump to run dry and damage internal parts.

REPAIR

Refer to Fig. 1 for relative position of speed control linkage parts.

Inspect linkage for bent or cracked rods and arms.

Examine linkage for binding, looseness, and any condition that might cause poor engine performance.

SPEED CONTROL ADJUSTMENTS

Make all speed control adjustments in the exact order given here. Refer to Fig. 1 as a guide to adjusting points.

IMPORTANT: Be sure engine is at operating temperature before making speed adjustments. Use a master tachometer. All speeds given are for engine at no load.

1. Disconnect speed control cable from injection pump arm. Loosen cable clamp (7).

2. Run engine and rotate pump throttle arm until fast-idle stop screw (10) contacts its stop. Engine speed should be at fast idle of 2650 ± 25 rpm. If not, adjust pump stop screw (10) to correct. Lock screw with sealing wire.

3. Lightly rotate pump throttle arm to slow-idle position. Engine speed should be at slow idle of 800 + 25 − 0 rpm. If not, adjust slow-idle stop screw (9) on top of injection pump.

4. With speed control cable disconnected, move hand lever forward to the high idle position. Adjust cable yoke (8) to provide for 1/8-inch overtravel of the pump arm. (For more travel, adjust cable at yoke (5) under dash.) Check slow idle.

5. Move hand throttle fully rearward and turn off ignition.

6. Move hand throttle back and forth to check friction on lever. Check for 5 to 11 lbs. drag with a spring scale. Adjust, if necessary, at nut (3).

Group 25
ENGINE COOLING SYSTEM

GENERAL INFORMATION

Radiator

Coolant temperature is controlled by a thermostat. A bypass line from the thermostat housing to the water pump allows fast engine warmup and a uniform cooling temperature throughout the cylinder block. The pressure-type radiator cap is equipped with a pressure valve that permits a pressure build-up in the cooling system.

Water Pump

The centrifugal-type water pump attaches directly to the cylinder block and is driven by the fan belt. A seal assembly is pressed into the pump housing between the pre-lubricated ball bearing and the impeller. If the seal becomes worn or damaged, water will escape through drain hole near the bottom of the pump housing.

Oil Cooler (Later Units)

On later units there is an external engine oil cooler located on the cylinder block.

DIAGNOSING MALFUNCTIONS

Engine Overheats

Oil cooler malfunction.
Low coolant level.
Faulty thermostat.
Leaking head gasket (Group 10).
Plugged radiator.
Pump impeller broken.
Collapsed hoses.
Scored piston(s) (Group 10).

Water Pump Leaks

Worn seal and/or shaft.

Engine Runs Cold

Faulty thermostat.
Defective temperature gauge.

Engine Vibrates

Bent fan blades.
Worn pump shaft.

Oil Mixed With Coolant

Oil cooler damaged.
Defective cylinder liner packings.
Defective cylinder head gasket.

REPAIR

Radiator

Inspect and test radiator pressure cap for damage that might impair its sealing power. Radiator cap relief pressure is 6-1/4 to 7-1/2 psi.

Fan Belt

To replace fan belt, pull pump disconnect lever out and push forward beyond its stop. This will provide an opening in the pump disconnect to remove fan belt.

Water Pump

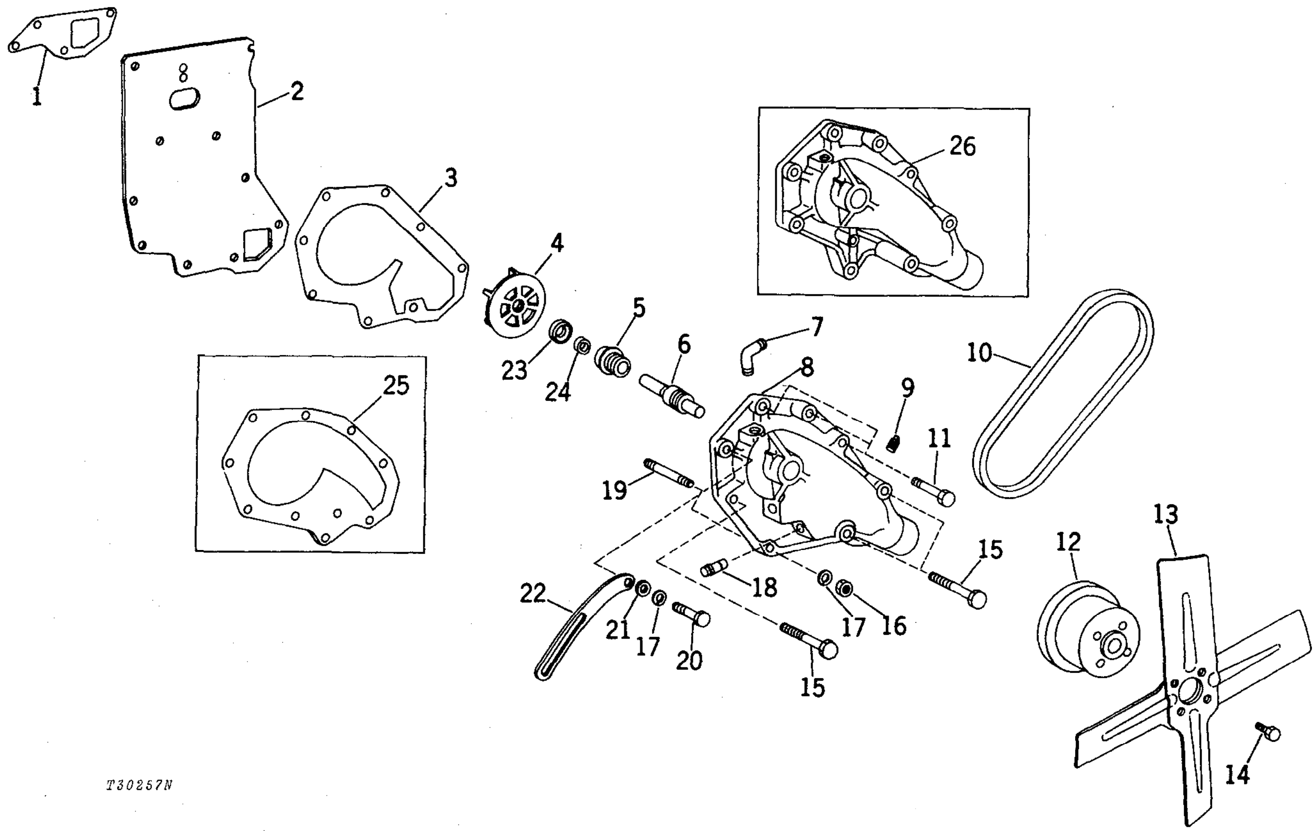
Drain coolant from radiator and engine block and remove radiator and water pump from engine.

Disassembling Water Pump

Remove the rear cover plate and gasket from the pump housing (Fig. 1).

Select a drift that is slightly smaller than the bearing shaft and, supporting fan hub, press hub from water pump.

Support water pump housing and allow sufficient clearance for impeller at center of support. Using a JD262A water pump bearing driver or any tubular-type driver that contacts only the outer race of bearing, press bearing assembly from housing.



1—Gasket	10—Fan Belt	19—Stud
2—Cover	11—Cap Screw (2 used)	20—Cap Screw
3—Gasket (later units)	12—Hub	21—Washer
4—Impeller	13—Fan	22—Adjusting Strap
5—Seal	14—Cap Screw (4 used)	23—Cup
6—Bearing	15—Cap Screw (2 used)	24—Insert
7—Elbow	16—Nut	25—Gasket (early units)
8—Housing (later units)	17—Lock Washer (5 used)	26—Housing (early units)
9—Pipe Plug	18—Tube (2 used) (later units)	

Fig. 1-Water Pump and Related Parts

Support impeller and press out bearing shaft using a drift that is slightly smaller than the bearing shaft. Remove seal from bearing shaft (Fig. 2).

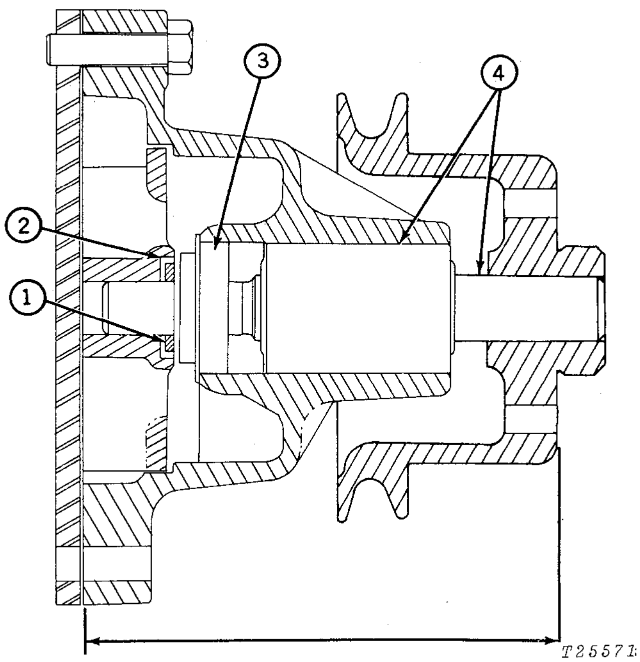
Inspecting Water Pump

Any leakage at the drain hole in bottom of housing generally indicates a leaking seal.

Assembling Pump

Install a new seal in the pump housing. Coat outside pump seal metal retainer with joint sealing compound and wipe off any excess (spring-loaded type seal only). Apply a thin coat of light oil to sealing lip of seal before installing.

If seal is a two-piece type, install by hand. Rubber sealing surface that contacts housing should be clean and dry.



1—Insert
2—Cup
3—Seal
4—Bearing and Shaft

Fig. 2-Cutaway View of Water Pump

If seal is a spring-loaded type, use a tubular type driver that contacts only the outer metal portion of the seal and press new seal (metal side first) into pump housing. Press in until metal flange bottoms on housing.

Using a JD262A water pump bearing driver or any tubular-type driver that contacts only the outer race of bearing, press shaft and bearing assembly into housing until outer metal case is flush with pump housing.

Install impeller insert and cup in impeller. Place insert in cup with "V" groove on insert toward cup. Be sure parts are dry and clean. Dip cup and insert in oil and install in impeller (cup to bottom of counterbore in impeller). Insert should be flat and edge of cup uniform around insert when installed in impeller.

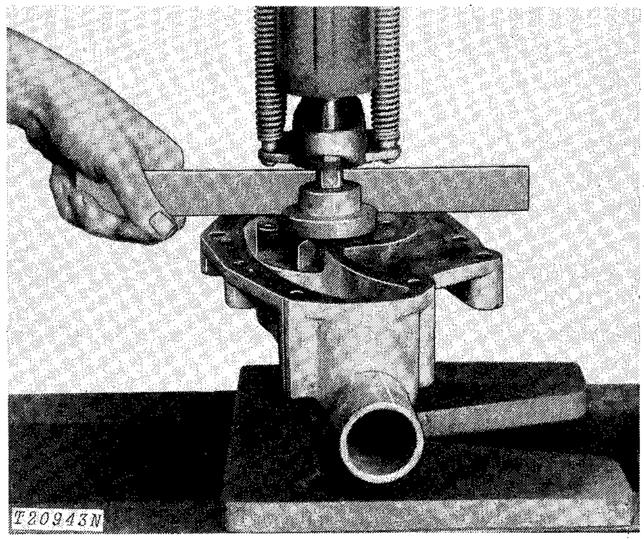


Fig. 3-Installing Impeller

Support pump assembly on end of bearing shaft and press impeller (fins away from housing) into position. Impeller should be pressed in until fins are flush (within 0.005 inch) with metal rim of pump housing. Check with a straightedge and feeler gauge as shown in Fig. 3.

Using a support smaller than the bearing shaft, support impeller end of pump bearing shaft and press fan pulley into position on opposite end of shaft.

Press fan pulley on shaft until flush with end of shaft (see Fig. 2).

Fan pulley should be pressed onto shaft according to specifications. The distance from the fan surface on pulley-to-rear surface of water pump housing (without rear plate or gasket) should be 5-11/16 inches.

Using a new gasket, install pump rear cover on pump assembly. Tighten attaching cap screws to 35 ft-lbs.

Install radiator and water pump.

Inspecting Thermostat

If the engine has been running too cool or too hot, carefully inspect the thermostat for defects. If visual inspection fails to disclose any defects, test the thermostat in hot water to check for proper closing.

Oil Cooler

Drain oil from engine crankcase and coolant from radiator and oil cooler.

Check to see that the cooler is not plugged with lime or other foreign material. Check for tube damage. See Fig. 4 for relationship of cooler parts.

Position packing (14, Fig. 4) on bottom of oil cooler.

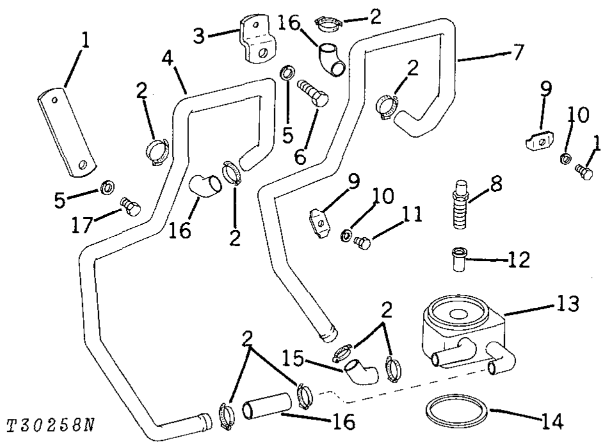
Place oil cooler on cylinder block and install oil cooler nipple (8).

Tighten oil cooler nipple to 20 to 25 ft-lb torque.

Connect coolant hoses to oil cooler.

Install new oil filter.

Fill cooling system with proper coolant.



1—Strap
2—Clamp (8 used)
3—Clamp
4—Upper Water Line
5—Lock Washer (2 used)
6—Cap Screw
7—Lower Water Line
8—Nipple
9—Half Clamp (2 used)
10—Lock Washer (2 used)
11—Screw (2 used)
12—Relief Valve
13—Oil Cooler
14—Packing
15—Hose
16—Hose
17—Cap Screw

Fig. 4-Oil Cooler

Group 30
SPECIFICATIONS AND SPECIAL TOOLS

Basic Engine

SPECIFICATIONS

NOTE: All specifications are in inches unless otherwise noted.

Item	New Part	Wear Tolerance
VALVES AND CYLINDER HEAD		
Valve head diameter (intake)	1.7670 to 1.7770	---
(exhaust)	1.5700 to 1.5800	---
Stem diameter	0.3715 to 0.3725	---
Angle of face	43° 30′ ± 15′	---
Valve length	5.1390 to 5.1740	0.0050
Guide (I.D.)	0.3745 to 0.3755	0.0010
Guide to valve stem clearance	0.0020 to 0.0040	0.0060 (max.)
Springs (valve closed) (lbs @ 1-13/16)	54 to 62	---
Springs (valve open) (lbs @ 1-23/64)	133 to 153	---
Width of seat	1/16	1/64
Angle of seat	45°	---
Concentricity of seat	---	0.0020
Distance bottom of deck to valve		
Intake	0.037 ± 0.007	---
Exhaust	0.057 ± 0.007	---
Maximum amount of material to be removed from head	---	0.030
ROCKER ARMS AND SHAFT		
Shaft O.D.	0.7869 to 0.7879	0.0020
Bore I.D.	0.7900 to 0.7920	0.0020
Springs compressed (lbs @1-13/16)	4 to 6	---
CYLINDER BLOCK		
Balance shaft bearing bore (without bearing)	1.6245 to 1.6255	---
Balancer shaft journal to bushings clearance	---	0.0058
Camshaft bearing bore	2.2042 to 2.2054	---
Main bearing bore (without insert)	3.3250 to 3.3260	---
Dipstick nipple-to-block rail	8-1/4	---
CYLINDER LINER		
Liner taper (maximum)	---	0.0020
Liner out-of-round (maximum)	---	0.0020
Cylinder liner above block	0.0010 to 0.0040	---
MAIN BEARINGS		
Bearings I.D.	3.1256 to 3.1276	0.0020
Bearing to journal clearance	0.0016 to 0.0046	0.0060 (max.)

Basic Engine

SPECIFICATIONS—Continued

Item	New Part	Wear Tolerance
CRANKSHAFT		
Main journal O.D.	3.1230 to 3.1240	Round within 0.0030
Rod journal O.D.	2.7480 to 2.7490	Round within 0.0030
End play	0.0020 to 0.0080	0.0150 (max.)
Journal taper (per inch of journal length)	---	0.0010
Journal out-of-roundness	---	0.0030
PISTON		
Ring Side clearance	0.0015 to 0.0035	0.008 (max.)
Clearance between liner and piston at bottom of skirt (maximum)	---	0.008 in.
Piston pin diameter	1.3750 ± 0.0002 in.	. . . . .
CONNECTING RODS AND BEARINGS		
Bearing insert oil clearance	0.0012 to 0.0042	0.0020
Pin bushing (early units)	1.1886 to 1.1896	0.0020
(later units)	1.376 to 1.377	0.0020
Bore I.D.	2.7502 to 2.7520	None allowed
Pin bushing oil clearance	0.0008 to 0.0022	0.0020
BALANCER SHAFTS		
Bearing bore (without bearing)	1.6245 to 1.6255	0.0030
Bearing-to-journal clearance	0.0015 to 0.0045	0.0058 (max.)
End play	0.0020 to 0.0080	0.0150 (max.)
Thrust plate thickness	0.1170 to 0.1190	0.0050
Drive gear	0.0000 to 0.0010	. . . . .
UPPER AND LOWER IDLER GEARS		
Shaft O.D.	1.7495 to 1.7505	0.0010
Bushing I.D.	1.7520 to 1.7530	0.0010
Oil clearance	0.0015 to 0.0035	0.0060 (max.)
Width of gear at hub	0.8650 to 0.8670	0.0020
Width of shaft	0.8680 to 0.8720	0.0020
End play	0.0010 to 0.0070	0.0150 (max.)
Spring pins above idler shaft	0.2000 to 0.2800	

Basic Engine

SPECIFICATIONS—Continued

Item	New Part	Wear Tolerance
GEAR TRAIN BACKLASH		
Crankshaft-to-upper idler	0.0027 to 0.0116	0.0050
Upper idler-to-camshaft	0.0028 to 0.0135	0.0050
Upper idler-to-injection pump	0.0028 to 0.0135	0.0050
Crankshaft-to-lower idler	0.0027 to 0.0137	0.0050
Lower idler-to-oil pump	0.0016 to 0.0147	0.0050
Lower idler-to-balancer	0.0018 to 0.0156	0.0050
Oil pump-to-balancer	0.0020 to 0.0140	0.0050
CAMSHAFT		
Journal O.D.	2.1997 to 2.2007	0.0010
Journal clearance	0.0035 to 0.0055	0.0090 Max.
End Play	0.0025 to 0.0085	0.0150 Max.
Thrust plate thickness	0.1560 to 0.1580	0.0050

TORQUE VALUES

Item	Torque (ft-lbs) (Unless otherwise noted)
ENGINE	
Balancer shaft thrust plate-to-front plate	35
Camshaft thrust plate-to-block	35
Crankshaft upper idler gear	65
Crankshaft lower idler gear	95
Front plate-to-block	25
Rocker arm-to-head	35
Rocker arm cover-to-cylinder head (hex. head screws)	25 in-lbs
Connecting rod cap screws	52
Main bearing cap screws	85
Flywheel-to-crankshaft	85
Head-to-block	110
Oil pump drive gear	35 to 45
Oil pan-to-block and timing gear cover	35
Fan drive pulley-to-crankshaft	85
Fan assembly-to-fan hub	20
Timing gear cover	35
Thermostat cover	20
Injection pump drive gear (hex. nut)	540 in-lbs
Injection nozzle-to-head	16
Injection line-to-injection pump	35
Piston cooling orifices or plugs	85 to 110 in-lbs
Exhaust manifold cap screws	35
Intake manifold cap screws	35
Flywheel housing to block (3/8 in.)	35
(5/8 in.)	170

ENGINE BREAK-IN

NOTE: Whenever possible, use a dynamometer to provide a more accurate break-in, assuring proper initial seating of new piston rings.

Time	Load*	Engine Speed	Remarks
10 Minutes	No Load	800 + 25 – 0 rpm (Slow Idle)	Check oil
10 Minutes	No Load	1500 to 2000 rpm (1/2 Throttle)	pressure,
20 Minutes	1/4 Load	1900 to 2200 rpm	coolant
30 Minutes	1/2 Load	(3/4 Throttle)	temperature,
30 Minutes	1/2 to 3/4 Load		and leakage.
30 Minutes**	3/4 to Full Load		
100 Hours +	All Loads		Field Only

* *Loads can be simulated in the field by controlled machine operation.*

** *After this run, loosen cylinder head bolts 45 degrees; then retighten bolts one at a time, in sequence (Group 0409), with 95 ft-lb. Loosen rocker arm support cap screws; then retighten with 35 ft-lb. Check and reset valve clearance. Loosen exhaust manifold cap screws and nuts; then retighten to 35 ft-lb.*

\+ *Refer to the operator's manual for proper operation and service. After break-in, drain crankcase oil, and remove filter. Install new filter and fill crankcase with oil of proper viscosity and service classification.*

TUNE-UP DATA

ENGINE

Minimum compression readings*	350 psi	
Valve tests		
At air cleaner	11 to 25 inches water	
Valve clearance		
Exhaust valves	0.018 inch	
Intake valves	0.014 inch	
Valve lift (clearance adjusted)	**New Part**	**Wear Tolerance**
Exhaust valve	0.456 to 0.482 in.	0.4260 in.
Intake valve	0.460 to 0.490 in.	0.4300 in.

* *The most important factor in compression readings is the difference between cylinders. This difference should be no more than 50 psi.*

SPECIAL TOOLS

No.	Name	Use
ESSENTIAL TOOLS		
813 and 815	Mandrels	To be used with bushing and seal drivers.
JDE-45	Limiting Piston Ring Expander	To install piston rings.
JDE-77A	Valve Seat Puller	To remove valve seats.
JDE-88	Bushing Installation and Removal Tool	To remove and install piston pin bushings.
JDE-135	Universal Piston Ring Expander	To install piston rings.
JD271	Piston Ring Compressor	Sleeve-type compressor to install pistons.
JD246	Governor Bushing Driver	To install governor drive shaft bushing in timing gear cover.
JD248	Oil Pressure Relief Valve Bushing Driver	To install relief valve bushing in cylinder block.
JD250	Oil Seal Driver	To install crankshaft front oil seal.
JD251	Driver	To install crankshaft rear oil seal wear ring (used with JD251-3 Pilot Ring).
JD251-3	Pilot Ring	To install crankshat rear oil seal wear ring.
JD251-4	Seal Protector	To protect crankshaft rear oil seal during installation over crankshaft.
JD252	Driver	To install idler gear bushings.
JD254	Gear Timing Tool	To time engine front gear train.
JD255	Staking Tool	To stake balancer shaft bearings.
JD249	Driver	To install balancer shaft bushings.
JD247	Holding Tool	To install balancer shaft drive gear.
970-JD	Puller	To pull cylinder liners from cylinder block.
970-8	Adapter Plate	To adapt 970-JD Puller to cylinder liner.
1002*	Knurling Tool	To knurl engine valve guides.
JDE-62	Keystone Groove Wear Gauge	To check keystone ring grooves for wear.
D-14547-BA	Compression Gauge	To check combustion chamber pressure.
D-14550-BA	Compression Gauge Adapter	To adapt D-14547-BA Gauge to combustion chamber.

* *A No. 1002 knurling tool may be ordered from United Tool Processes Corporation, Box 914, New Canaan, Connecticut 06840.*

Lubricating System

SPECIFICATIONS

NOTE: Unless otherwise indicated, all specifications are in inches.

Item	Measurement	New Part	Wear Tolerance
OIL PUMP			
Idler shaft	O.D.	0.4850 to 0.4856	0.0005
Drive shaft	O.D.	0.6308 to 0.6312	0.0010
Gears-to-housing	Radial clearance	0.0030 to 0.0060	0.0010
Pump gear	Width (early units)	1.4163 to 1.4183	0.0020
	Width (later units)	1.6203 to 1.6223	0.0020
Gears-to-cover	Clearance	0.0012 to 0.0062	0.0020
Oil pressure regulating spring	Test length @ 15 ± 1.5 lbs.	1.68 in.	

OIL FILTER

Turn element down until sealing ring just contacts mounting pad; then turn down an additional 1-1/2 turns.

TORQUE VALUES

Item	Torque (ft-lbs)
Oil pump assembly cap screws	35
Oil pan cap screws	35
Oil pump gear-to-drive shaft nut	35 to 45
Oil pressure regulating valve plug	70

TUNE-UP DATA

Oil pressure (engine at 180 to 220°F and 2500 rpm) .... 50 ± 15 psi

SPECIAL TOOLS

No.	Name	Use
ESSENTIAL TOOLS		
JD248	Driver	Installation of oil pressure regulating valve bushing
----	0-100 psi Pressure Gauge	To check engine oil pressure.

Governor and Speed Control Linkage

SPECIFICATIONS

Fast idle	2650 ± 25 rpm
Slow idle	800 + 25 − 0 rpm

ADJUSTMENTS

Overtravel at throttle lever	1/8 in.
Drag friction on throttle lever	5 to 11 lbs.

TORQUE VALUES

Injection pump slow idle adjusting lock nut	25 in-lbs

SPECIAL TOOL

No.	Name	Use
Essential Tools		
---	Master tachometer or similar device	To test engine rpm.

Cooling System

SPECIFICATIONS

Item	Specification
Radiator	
Coolant capacity	4 U.S. gallons
Radiator cap relief pressure	6-1/4 to 7-1/2 psi
Thermostat	160°
Water Pump	
Impeller fins-to-rim of pump housing	Flush (within 0.005 in.)
Front of pulley-to-rear of pump housing	5-11/16 in.
Fan Belt Tension	
With gauge (initial)	100 to 110 lbs.
(after three minutes of operation)	80 lbs. minimum
Without gauge	3/4-inch flex with 20 lbs. force
Oil Cooler	
Relief valve setting	12 to 15 psi

TORQUE VALUES

Item	Torque (ft-lbs)
Fan	20
Thermostat cover and housing	35
Water pump	35

SPECIAL TOOLS

No.	Name	Use
Convenience Tool JD262A	Driver	Removal and installation of water pump bearing.

Section 30
FUEL SYSTEM

CONTENTS OF THIS SECTION

Group 5
DIAGNOSIS

DIAGNOSING FUEL SYSTEM MALFUNCTIONS

The following is a guide for diagnosing fuel system difficulties. For specific diagnosis of fuel system components, refer to the groups which cover complete servicing.

Engine Starts Hard or Will Not Start

No fuel.
Fuel shut-off valves closed.
Air leak on suction side of fuel system.
  Look for leaks at all connections.
Improper type of fuel.
  See operator's manual for correct fuel.
Water, dirt, or air in fuel system.
  Drain, flush, and refill. Bleed system.
Clogged fuel filter.
  Replace first-stage filter element and bleed system.
Dirty or faulty injection nozzles.
  Service injection nozzles.
Cranking speed too slow.
  Check starting circuit to increase cranking speed.
Incorrect timing.
  See Group 20.
Fuel transfer pump primer lever left on upward end of stroke.
  Move lever to lowest point of stroke.

Engine Knocks

Dirt in air intake system.
  Clean filter.
Injection pump out of time.
  Time injection pump.

Engine Runs Irregularly or Stalls Frequently

Air leak on suction side of fuel system.
  Look for leaking connections.
Improper type of fuel.
  See operator's manual for correct fuel.
Clogged fuel filter.
  Replace first stage filter element and bleed system.
Water, dirt, or air in fuel system.
  Drain, flush, and refill. Bleed system.
Injection nozzle return lines clogged.
  Remove and blow out with filtered air.
Dirty or faulty injection nozzles.
  Service injection nozzles.
Incorrect timing.
  See Group 20.

Lack of Engine Power

Improper type of fuel.
  See operator's manual for correct fuel.
Air leak on suction side of fuel tank.
  Look for leaking connections.
Air intake restriction.
  Clean air cleaner.
Clogged fuel filter.
  Replace first stage filter element and bleed system.
Dirty or faulty injection nozzles.
  Service nozzles.
Injection nozzle return lines clogged.
  Remove and blow out with filtered air.
Water in fuel.
  Drain and refill system. Prime and bleed system.
Injection pump out of time.
  Time injection pump.

High Fuel Consumption

Improper type of fuel.
  See operator's manual for correct fuel.
Clogged or dirty air cleaner.
  Clean air cleaner.
Dirty or faulty injection nozzles.
  Service injection nozzles.
Injection pump out of time.
  Time injection pump.

Engine Emits Black or Gray Smoke

Improper type of fuel (low cetane).
Restriction or leak in air intake system.
  Inspect air intake system.
Restriction in exhaust system.
  Inspect exhaust system.
Dirty or faulty injection nozzles.
  Service injection nozzles.
Injection pump out of time.
  Time injection pump.

Engine Emits White Smoke

Improper type of fuel.
  See operator's manual for correct fuel.
Injection pump out of time.
  Time injection pump.

Group 10

FUEL TANK, TRANSFER PUMP, AND FILTERS

FUEL TANK

GENERAL INFORMATION

The fuel tank is of welded sheet steel construction and mounts directly behind the operator's seat.

A fuel shut-off valve is provided at the tank outlet under the seat. Later units also provide a drain valve under the seat which enables the operator to easily drain condensation from the tank.

REMOVAL

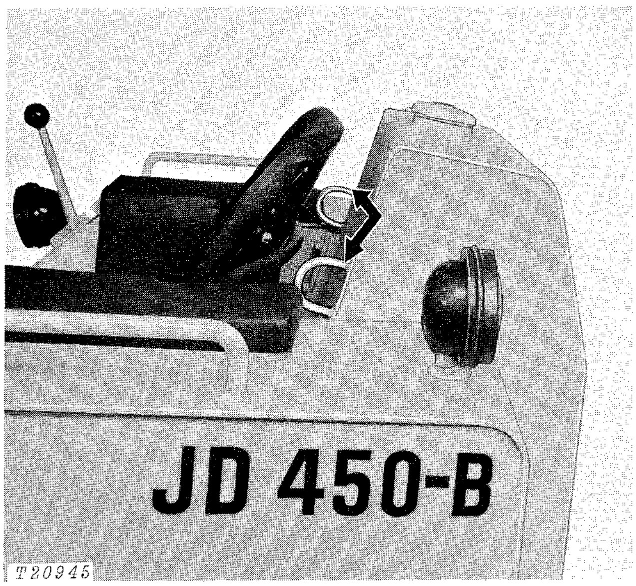


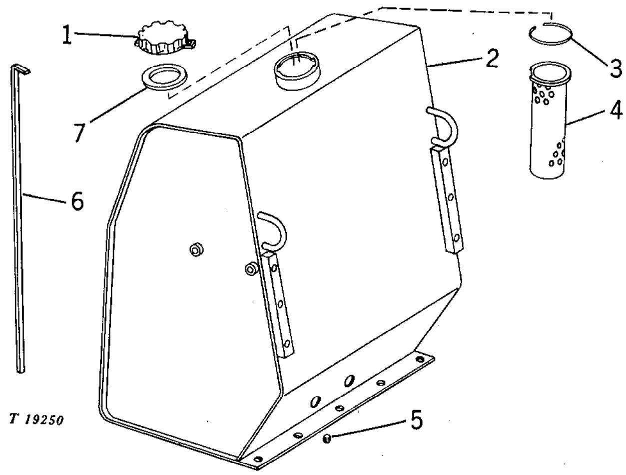
Fig. 1-Fuel Tank Lifting Hooks

Remove operator's seat from tractor. Drain fuel from the tank. Close fuel shut-off valve and detach fuel outlet line and fuel return line. On later units, disconnect drain tube from drain valve.

Attach a chain to tank lifting hooks (Fig. 1). Remove cap screws from lower tank flange and from tank side brackets. Lift tank from unit.

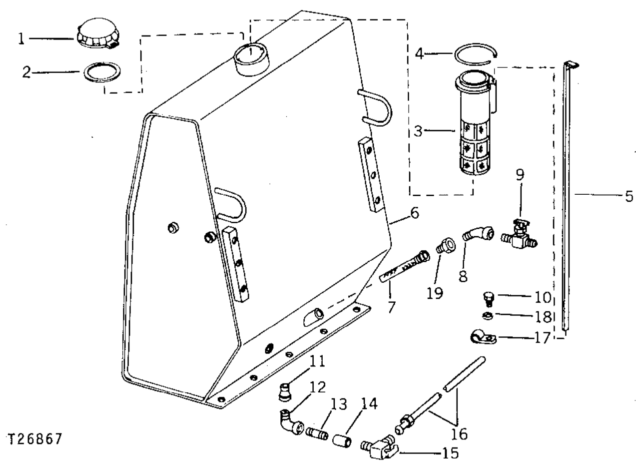
REPAIR

CAUTION: Cleaning and repairing a fuel tank is very dangerous. Live sparks, smoking, or fire of any nature should never be permitted in the vicinity of the cleaning or repairing operation.



1—Cap
2—Fuel Tank
3—Retaining Ring
4—Fuel Strainer
5—Drain Plug
6—Fuel Gauge
7—Gasket

Fig. 2-Fuel Tank (early units)



1—Filler Cap
2—Gasket
3—Fuel Strainer
4—Snap Ring
5—Fuel Gauge
6—Tank
7—Filter
8—Elbow
9—Shut-Off Valve
10—Cap Screw
11—Bushing
12—Elbow
13—Line Nipple
14—Liner Coupler
15—Drain Valve
16—Drain Line
17—Clamp (2 used)
18—Lock Washer (2 used)
19—Bushing

Fig. 3-Fuel Tank (later units)

FOS Refer to FOS-30, ENGINES for detailed information on repair of fuel tanks.

INSTALLATION

Use a chain hoist to lower fuel tank into place on unit. Attach fuel outlet line, fuel return line (diesel) and drain tube (later units) loosely to tank fittings.

Secure tank to lower bar and side flanges with cap screws. Tighten tank line(s) and tube (later units) securely. Open fuel shut-off valve. Install seat.

FUEL TRANSFER PUMP

AC Pump (Early Models)

GENERAL INFORMATION

The AC fuel transfer pump is of the diaphragm type, actuated by an accentric lobe on the engine camshaft.

A hand primer lever on the fuel transfer pump is used as an aid in bleeding the diesel fuel system.

TESTING AND DIAGNOSIS

Fuel Flow Not to Specifications

Primer lever left in upward position.
Plugged fuel screen inside pump sediment bowl.
Clogged fuel line from tank to transfer pump.
Loose fuel line fittings.
Leaking pump bowl gasket.
Loose pump cover screws.

REPAIR

Two parts kits - a pump overhaul kit (diaphragm, gaskets, and springs - 4, 7, 8, 14, and 18, Fig. 4), and a rocker arm parts kit (11) may be used when repair is necessary.

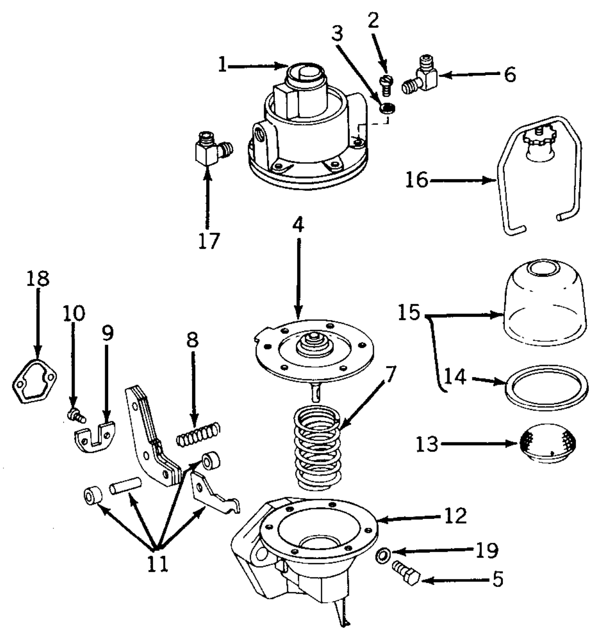
Refer to Fig. 4 and disassemble AC transfer pump. Replace parts as necessary. Use the following as a guide in checking pump parts.

1. Inspect rocker arm for wear.
2. Inspect diaphragm for leaks.
3. Check pull rod for wear.
4. Inspect valve and cage assemblies.
5. Check rocker arm springs.
6. Inspect rocker arm link and pin.

Assembly

Be sure diaphragm pull rod is engaged with link inside body.

Tighten cover-to-body screws evenly to prevent distortion.



T20946

1—Pump Cover*	**10—Screw (2 used)**
2—Screw (6 used)	**11—Rocker Arm Parts Kit**
3—Lock Washer (6 used)	**12—Pump Body***
4—Diaphragm*	**13—Screen**
5—Cap Screw	**14—Gasket**
6—Inlet Elbow	**15—Bowl**
7—Spring	**16—Bail Assembly**
8—Spring	**17—Outlet Elbow**
9—Rocker Arm Bearing Retainer*	**18—Gasket**
	19—Special Washer (2 used)

* *Not available for service.*

Fig. 4-AC Fuel Transfer Pump

Airtex Pump (Later Models)

GENERAL INFORMATION

The Airtex fuel transfer pump is of the diaphragm type, actuated by an eccentric lobe on the engine camshaft.

A hand primer lever on the transfer pump is used as an aid in bleeding the fuel system.

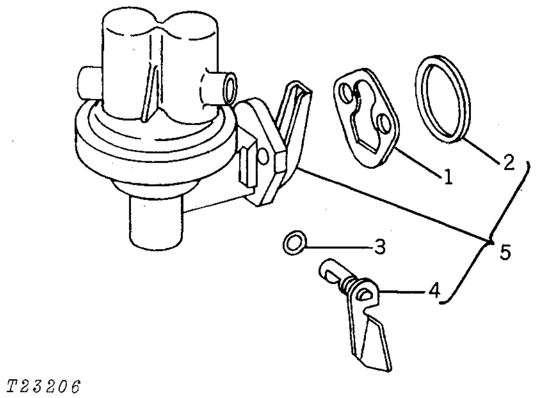
TESTING AND DIAGNOSIS

Fuel Flow Not to Specifications
 Primer lever left in upward position.
 Clogged fuel line from tank to transfer pump.
 Loose fuel line fittings.

REPAIR

Refer to Fig. 5 when disassembling and assembling the Airtex Fuel Pump.

To remove or install primer lever, compress rocker arm lever.



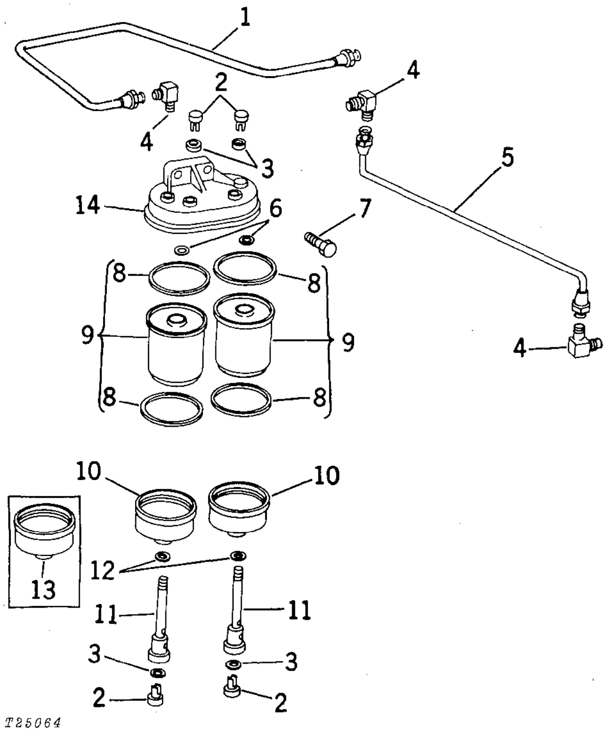
1—Gasket
2—Packing
3—O-Ring (diesel)
4—Primer Lever (diesel)
5—Fuel Pump

Fig. 5-Airtex Fuel Pump

Further breakdown of the Airtex Pump is not possible. If a diagnosis of the system indicates a faulty transfer pump, a new pump (5, Fig. 5) must be ordered.

FUEL FILTERS

GENERAL INFORMATION



1—Filter to Injection Pump Line
2—Plug
3—Seal Washer
4—Elbow
5—Transfer Pump to Filter Line
6—O-ring
7—Cap Screw
8—Gasket
9—Element with Gasket
10—Glass Sediment Bowl
11—Filter Screw
12—Gasket
13—Aluminum Sediment Bowl (early units)
14—Filter Head

Fig. 6-Fuel Filter Assembly

The two stages of fuel filters are located on the right side of the tractor engine. Fuel from the fuel pump enters the fuel filter head at the first stage filter and exits to the injection pump through the filter head at the second stage filter.

On units equipped with an Airtex Pump, a fuel strainer is used to filter fuel before it reaches the transfer pump. This strainer is located between the front fuel line and the transfer pump on early units and in the fuel tank on later units (7, Fig. 3).

DIAGNOSING MALFUNCTIONS

A complete diagnosis of the fuel system should include an inspection of the filters and strainers in the system including the strainer used in the fuel tank (4, Fig. 2 or 3, Fig. 3).

REPAIR

Refer to Fig. 6 during disassembly and assembly of fuel filters.

See Operator's Manual for filter cleaning or replacement information.

The fuel strainer used on early units with Airtex pumps can be cleaned by removing it from the unit and flushing in the opposite direction to normal flow. If strainer will not flush clean, replace it.

The fuel filter used on later units with Airtex pumps (7, Fig. 3) seldom needs cleaning because the sloshing of the fuel tends to wash dirt particles from the filter screen.

SPECIFICATIONS

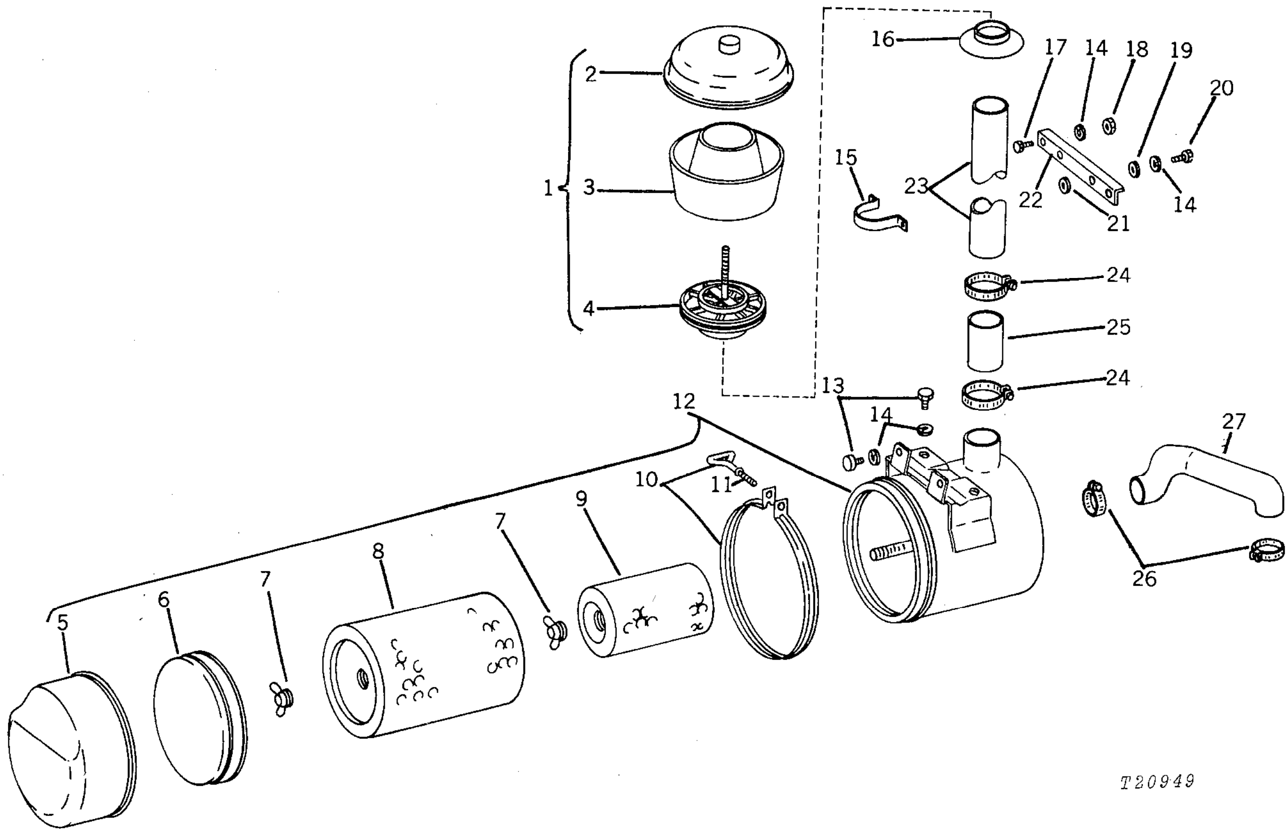
Fuel tank capacity	31 U.S. Gallons
Fuel transfer pump static pressure (AC and Airtex)	3-1/2 psi min. to 4-1/2 psi max. at 16 inches above outlet at 1800 camshaft R.P.M.
Fuel transfer pump flow (A.C.)	approx. 2 quarts per minute at 1800 camshaft rpm with 2 psi fuel outlet pressure.
(Airtex)	approx. 3 quarts per minute at 1600 camshaft rpm with 2 psi fuel outlet pressure.

Group 15

AIR INTAKE SYSTEM

AIR CLEANER

GENERAL INFORMATION



1—Pre-Cleaner	8—Element	15—Clamp*	22—Extension Bracket*
2—Pre-Cleaner Cover	9—Safety Element	16—Seal or Grommet	23—Extension
3—Pre-Cleaner Bowl	10—Clamp	17—Cap Screw (2 used)*	24—Hose Clamp* *
4—Pre-Cleaner Base	11—Bolt	18—Nut (2 used)*	25—Hose * *
5—Cup	12—Cleaner Assembly	19—Washer (6 used)*	26—Hose Clamp
6—Baffle Skirt	13—Cap Screw (4 used)	20—Cap Screw (2 used)*	27—Air Intake Hose
7—Wing Nut	14—Lock Washer (8 used)*	21—Washer (approx. 6 used)*	

* Used only on crawlers without loader
* * Used only on crawlers with loader

Fig. 1-Air Cleaner and Pre-Cleaner (Without Turbocharger)

The JD450-B is equipped with a two stage, dry type air cleaner with a pre-cleaner attachment as standard equipment.

The pre-cleaner collects large particles of dirt before the air enters the cleaner element. This reduces the number of times the cleaner element must be cleaned.

Air from the pre-cleaner enters the inlet of the air cleaner assembly. Dirt is removed from the air as it passes through the cleaner element and safety element. Clean air then flows out the end of the filter assembly to the engine.

Air Restriction Indicator

The air restriction indicator is located on the air intake manifold. Its purpose is to warn the operator whenever excessive restriction is present in the air cleaner.

TESTING

Components of the air intake system can be tested using D-05022ST Water Vaccum Gauge.

REPAIR

Refer to the operator's manual for air cleaner service instructions.

Replace filter element and safety element (1) if damaged, (2) after one year of service, or (3) if element is not responding to cleaning, indicated by excessive smoke or loss of power.

TURBOCHARGER

GENERAL INFORMATION

The turbocharger (Fig. 4) consists of a radial inward-flow turbine (2), centrifugal impeller (14), center housing (7), turbine housing (1), and compressor housing (17).

During engine operation, exhaust gases pass through the turbine housing, rotating the turbine wheel. The compressor wheel (mounted on same shaft as the turbine) rotates with the turbine. The compressor draws in ambient air, compresses the air, and delivers it to the intake manifold. As the power output of the engine increases, the flow of exhaust gases increases, and the speed and output of the rotating assembly increase proportionately.

Engine oil under pressure from the engine lubrication system is pumped through passages in the center housing and directed to bearings and thrust washers through passages in the center housing and thrust plate. Oil is sealed from the compressor and turbine by seals at both ends of the center housing.

Discharge oil drains by gravity from the center housing to the engine crankcase.

FOS Refer to "Intake and Exhaust Systems" in FOS Manual-ENGINES for more information on turbochargers.

DIAGNOSING MALFUNCTIONS

Noise or Vibrations

(Do not confuse the whine heard during rundown with noise which indicates a bearing failure.)

Bearings not lubricated.
Insufficient oil pressure (see "SPECIFICATIONS").
Clean or replace oil line.
Replace engine oil filter.

Leak in engine intake or exhaust manifold.
Tighten loose connections or replace manifold gaskets if necessary.

Improper clearance between turbine wheel and turbine housing.
Check axial bearing end play (see "SPECIFICATIONS").

Engine Will Not Deliver Rated Power

Clogged manifold system.
Clean air intake ducting.

Foreign material lodged in compressor, impeller, or turbine.
Disassemble and clean.

Excessive dirt build-up in compressor.
Thoroughly clean compressor assembly.
Clean air cleaner and check for leakage.

Leak in engine intake or exhaust manifold.
Tighten loose connections or replace manifold gaskets as necessary.

Rotating assembly bearing seizure.
Repair turbocharger.

Oil On Compressor Wheel Or In Compressor Housing

Oil being pushed or pulled through center housing.
Excessive back pressure-blocked exhaust.
Air intake restriction.
Clogged air cleaner element or collapsed inlet line.

Oil In Manifolds Or Dripping From Housing

Seal failure.
Damaged or worn journal bearings.
(a) Unbalance of rotating assembly.
Damage to turbine or compressor wheel or blade. Dirt or carbon build-up on wheel or wheels.
(b) Bearing wear.
Oil starvation or insufficient lubrication.

Drag In Turbine Wheel

Carbon build-up behind turbine wheel.
Coked oil or combustion deposits.

Dirt build-up behind compressor wheel.
Air intake leaks.

Bearing seizure, dirty or worn bearings.
Excessive temperatures, unbalanced wheel, dirty oil, oil starvation, insufficient lubrication, or normal wear.

Oil drain restriction.
See "SPECIFICATIONS."

TESTING

Radial Bearing Test

Perform this test to determine whether it is necessary to replace or repair the thrust bearing, radial bearing, and/or rotating assembly of the housing assembly. The radial bearing check should be made with the turbocharger removed from the engine.

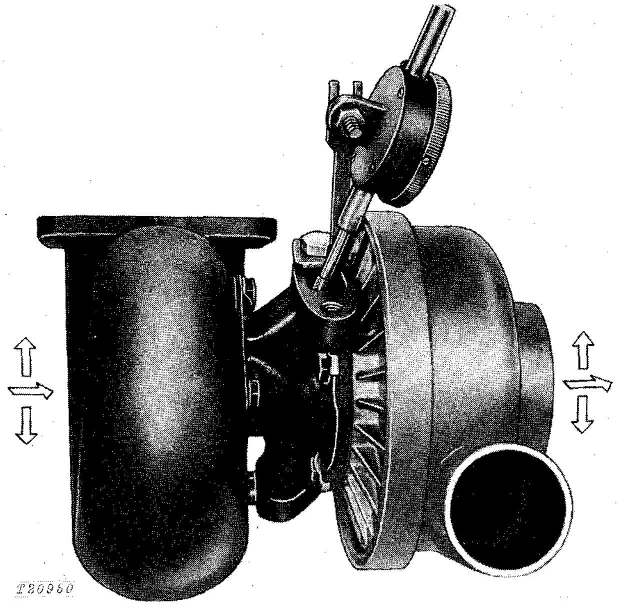


Fig. 2-Radial Bearing Check

Fasten dial indicator (plunger type with one inch travel) using a mounting adapter and two inch indicator extension rod to the turbocharger oil drain mounting flange (Fig. 2). The mounting plate and indicator can be secured with the bolts removed from the oil drain hole. (See "TOOLS" for dial indicator adapter.)

Move the rotating shaft forward (toward compressor) and then away from the indicator (Fig. 2) using care to move the shaft in the same direction as the dial indicator travels.

Equal pressures should be applied to the shaft at both ends simultaneously. The total dial indicator movement should be as specified (see "SPECIFICATIONS"). Any deviation from specifications is cause for repair.

Axial End Play Bearing Test

Perform this test to determine if the rotating assembly must be repaired or replaced.

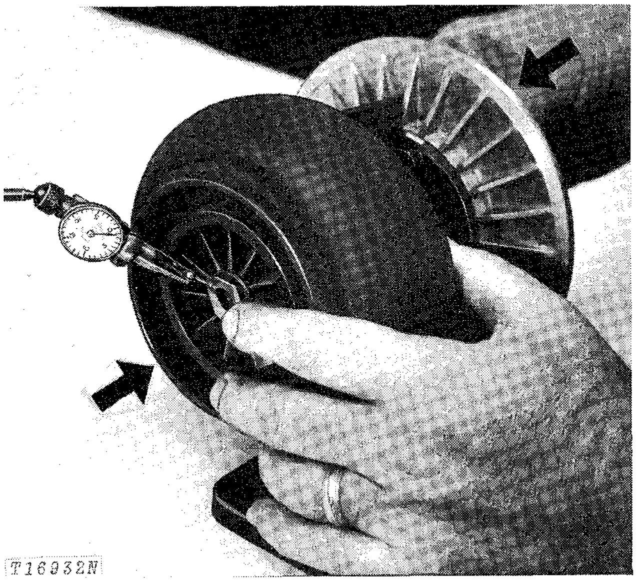


Fig. 3-End Play Bearing Test

Fasten a dial indicator to the backplate so that the indicator tip rests on the end of the shaft (Fig. 3).

Move the shaft axially back and forth by hand. If the total indicator reading is more or less than specified, the rotating assembly must be repaired or replaced.

Intake Manifold Pressure Test

Remove plug from the air inlet which is mounted on the intake manifold and install an air pressure gauge. Run engine and note pressure reading (see "SPECIFICATIONS").

REPAIR

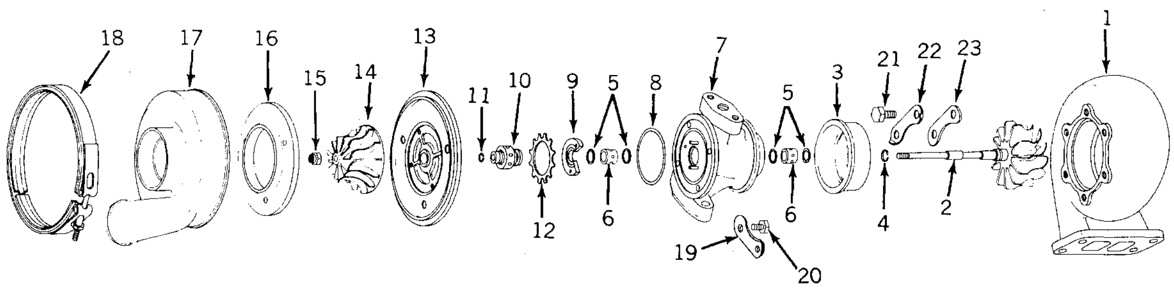
Disassembly

Clean the exterior with a pressure spray of cleaning solvent before disassembly. As each part is removed, place it in a clean protective container.

Remove the clamps and lock plates which hold the compressor (17, Fig. 4) and turbine (1) housings to the center housing group. Tap with a soft hammer if force is needed for removal.

NOTE: Use caution when removing housings to prevent damage to compressor or turbine wheel.

Place the center housing group in a suitable fixture which will prevent the turbine wheel from turning (see "SPECIAL TOOLS").



U 7480

1—Turbine Housing
2—Turbine Wheel with Shaft
3—Wheel Shroud
4—Piston Ring
5—Retaining Ring (4 used)
6—Bearing (2 used)
7—Center Housing
8—Seal Ring
9—Thrust Bearing
10—Thrust Collar
11—Piston Ring
12—Thrust Spring
13—Back Plate
14—Impeller
15—Lock Nut
16—Diffuser
17—Compressor Housing
18—Clamp
19—Lock Plate (2 used)
20—Bolt (4 used)
21—Bolt (6 used)
22—Lock Plate (3 used)
23—Clamp (3 used)

Fig. 4-Turbocharger Assembly

Use a double universal joint when removing the wheel nut to avoid possible bending of the shaft.

Remove the compressor wheel from the shaft. Remove shaft wheel from center housing, keeping it centered with bearings until clear of center housing.

Remove bolts from back plate.

Tap back plate with soft mallet to remove from recess in center housing.

Remove thrust collar and thrust bearing from center housing.

Remove bearings and retainers from center housing. Discard seal ring.

The turbine wheel shroud is not retained to the center housing and will fall free when the shaft wheel is removed.

Cleaning

Before cleaning, inspect all parts for signs of rubbing, burning, or other damage which might not be evident after cleaning.

Soak all parts in a clean carbon solvent. After soaking use a stiff bristle brush and remove all dirt particles. Dry parts thoroughly.

Normally a light accumulation of carbon deposits will not affect turbine operation.

Inspection

General

Parts must not show signs of damage, corrosion, or deterioration. Threads must not be nicked, crossed, or stripped.

Shaft Wheel

Turbine wheel must show no signs of rubbing and vanes must not be torn or worn to a feather edge. Shaft must show no signs of scoring, scratches, or seizure with the bearings.

Impeller

Impeller must show no signs of rubbing or damage from foreign material. It must be completely free of dirt or other foreign material. Impeller bore must not be galled.

Seal Parts

Seals must show no signs of rubbing or scoring of the running faces.

Housing

Housing must show no signs of contact with rotating parts. Oil and air passages must be clean and free of obstructions.

Repair or Replacement

Burnish or polish out minor surface damage. Use silicone carbide abrasive cloth for aluminum parts and crocus abrasive cloth for the steel parts.

If removed, replace the following parts: (Fig. 4) seal ring (8), lock nut (15), lock plate (19 and 22), piston rings (4 and 11), bearings (6), retaining rings (5), and bolts (21).

Thrust bearing (9) and thrust collar piston ring groove showing signs of nicks, scoring, shellac deposits, or foreign material inbedments must be replaced.

ASSEMBLY

Refer to Fig. 4 for assembly.

Check each part for cleanliness before installation.

Install inboard bearing retaining rings using special snap ring pliers. Lubricate bearings with clean engine oil and insert in place. Install turbine side and compressor side bearing retaining rings.

Place turbine wheel uptight. Guide shaft through center housing shroud and bearing. Place thrust washer over rear section of thrust collar.

Install piston ring on thrust collar and place thrust collar over shaft, and flat against the center housing, engaging the pins in the back of the thrust washer.

Install seal ring in groove in center housing.

Be sure that thrust spring is installed in back plate. Align mounting holes of center housing and back plate and install over shaft and thrust collar. Use care not to break piston ring when engaging seal into back plate bore. Back plate is easily installed if open end of piston ring is engaged into back plate bore first.

Install thrust plate bolts and lock plates. Tighten as specified and secure lock tabs.

Install impeller and tighten nut (see "SPECIFICATIONS" and "ASSEMBLY NOTES"). Tighten nut using double universal joint to avoid side load which may cause shaft to bend. Check axial end play and radial movements. (See "SPECIFICATIONS").

Check clearance between wheel shroud and turbine wheel. Orient compressor housing to center housing and install V-band coupling. Tighten to specifications.

Orient turbine housing to center housing. Coat bolt threads with a high temperature, anti-seizing compound. Install bolts, clamps, and lock tabs. Tighten bolts as specified.

After assembly, push the rotating assembly as far as possible from the turbine end and check for binding. Repeat check, pushing from the compressor end.

INSTALLATION

Just prior to mounting the turbocharger, prime the turbocharger lubrication system. Fill the center housing with new engine oil through the oil drain hole. Turn the rotating assembly by hand to lubricate the bearings and thrust washer.

When installing turbocharger exhaust adapter and exhaust elbow be certain that the installation does not apply a force on the turbine housing. The exhaust adapter must have 1/32-inch minimum end play and rotate freely.

Align air intake pipe with the air intake manifold and turbocharger outlet before tightening clamps on either hose. Tighten clamps to 70 ± 5 in-lbs.

Use Permatex No. 1 on the threads of the turbocharger oil inlet line-to-oil inlet line adapter. Threads must be free of any oil film to assure an effective seal.

When starting engine with a new or repaired turbocharger, disconnect the injection pump electrical solenoid shut-off wire and crank the engine with the starter until the engine oil pressure gauge pointer moves off left index mark.

SPECIFICATIONS

Item	Specifications
AIR RESTRICTION INDICATOR	
Restriction required to activate	25.0 ± 2.3 in. of water
TURBOCHARGER	
Radial Bearing Movement	0.003 in. to 0.007 in.
Axial end play	0.001 in. to 0.004 in.
Intake manifold pressure	4-1/2 to 7 psi at 2500 rpm at full load
Minimum oil flow at 2200 rpm engine speed	1/2 gpm

TORQUE VALUES

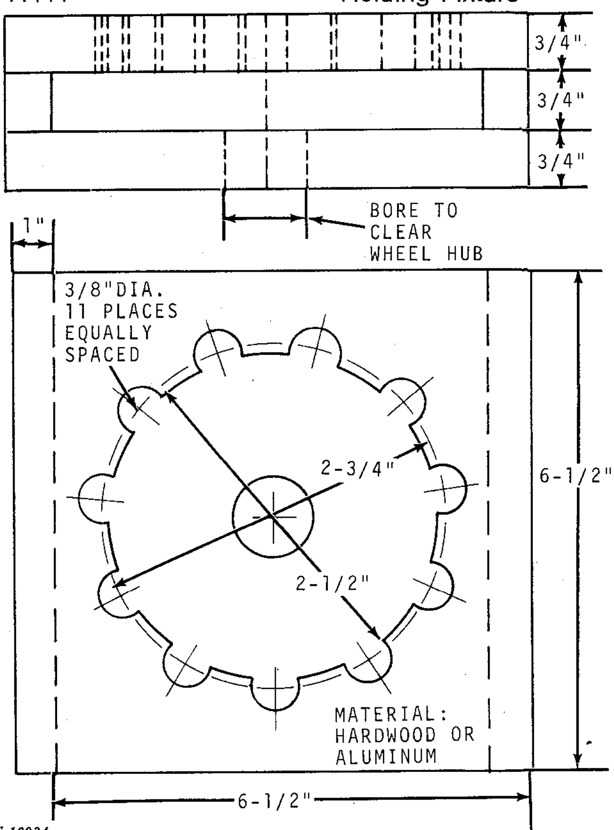
Item	Torque (in-lbs)
V-band coupling	40-80
Turbine housing to center housing	100-130
Thrust plate bolts	40-60
Impeller nut	18-20
Intake hose to turbocharger compressor housing clamp	70 ± 5

ASSEMBLY NOTES

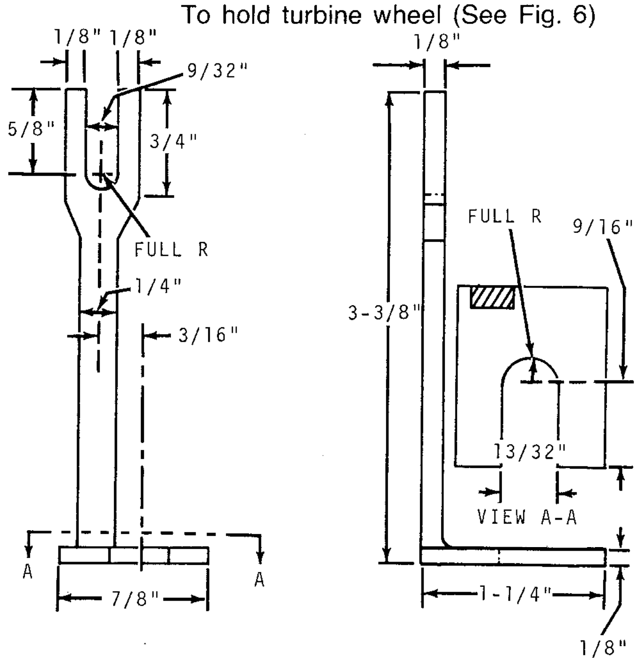
After installing impeller nut and tightening to 18 to 20 in-lbs, continue to tighten through an angle of 90 degrees.

SPECIAL TOOLS

No.	Name	Use
ESSENTIAL TOOLS		
JD501	Waldes Truarc Snap Ring Pliers	Installing retaining rings
CONVENIENCE TOOLS		
JDST-11	Water Vacuum Gauge and Fittings	Check air intake system
AR45035	Cleaning Gun	Clean dry air cleaner element
......	Dial Indicator Adapter	Radial bearing check (See Fig. 7)
......	Holding Fixture	To hold turbine wheel (See Fig. 6)



T 16934 *Fig. 5-Turbine Wheel Holding Fixture*

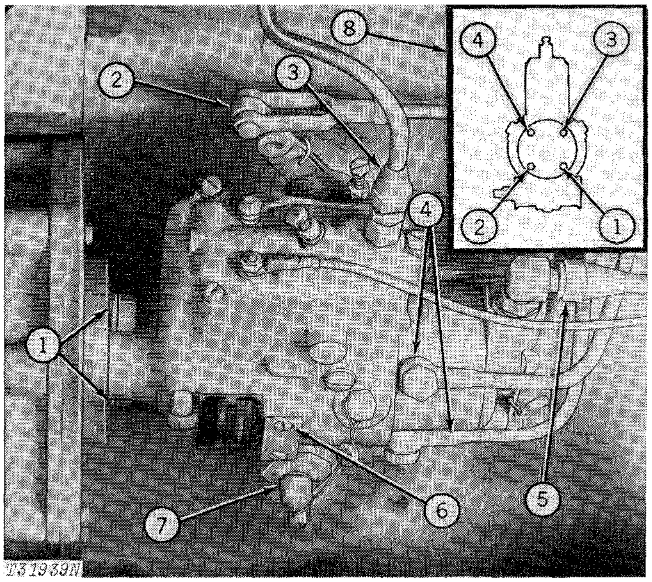


T 18230 *Fig. 6-Dial Indicator Adapter (Radial Bearing Check)*

Group 20
FUEL INJECTION PUMPS

ROOSA-MASTER MODEL DB PUMPS

GENERAL INFORMATION



1—Attaching Points	5—Fuel Inlet
2—Throttle Linkage	6—Timing Hole Cover
3—Fuel Return	7—Cam Advance Mechanism
4—Injection Lines	8—Injection Delivery Sequence (View from end plate)

Fig. 1-Fuel Injection Pump

The fuel injection pump is mounted horizontally on the left side of the engine front plate (Fig. 1). The pump model and characteristics are shown in code form on the pump name plate.

The pump is a speed advance, single cylinder, opposed plunger, inlet metering, distributor type.

DIAGNOSING MALFUNCTIONS

If fuel system diagnosis has isolated the malfunctions to the fuel injection pump, the following guide may be used to determine pump malfunctions without removing the injection pump from the engine.

Modification or alteration of the injection pump timing, or the fuel injection nozzles in ways not recommended by the manufacturer will terminate the warranty obligation to the purchaser.

Fuel

Pump inlet line clogged or restricted.
Blow out line with filtered air, replace line if damaged.
Pump inlet line or fittings leaking.
Tighten to specifications. Replace if damaged.
Pump housing not full of fuel.
Operate engine for approximately 5 minutes until pump fills with fuel.
Injection lines connected to wrong cylinder.
Relocate lines for correct firing sequence.
Injection lines leaking.
Tighten to specifications.
Washer not used in assembly.
One or more injection lines connector screws obstructed.
Clean or replace.
Fuel not reaching injection pump.
Inlet strainer clogged.
Fuel return line clogged or restricted.
Blow out return line with filtered air.
Fuel leaks at fittings in hydraulic head or housing.
Tighten fittings to specifications.

Electrical

Electrical system failure or low voltage at solenoid shut-off.
Test solenoid circuit.
Solenoid failure.
Test solenoid (See SM-2045).

Mechanical

Pump timed incorrectly to engine.
Correct timing, tighten pump mounting nuts to specifications.
Throttle arm travel not sufficient.
Check installation and adjust linkage (Section 20, Group 20).
Automatic advance faulty or not operating.
Check advance, tighten lock nut.
Slow and fast idle adjustment incorrect.
Adjust to specifications; tighten lock nuts.

REMOVAL

Before removing fuel injection pump, thoroughly clean the pump, fittings, and all connections to be disconnected.

IMPORTANT: Never spray cold water on or steam clean a warm injection pump.

The fuel injection pump and engine should be static timed before the injection pump is removed (see "Installation").

Removing Injection Pump From Drive Shaft

Disconnect fuel supply, fuel return, and the injection lines from the pump (Fig. 1). Plug all openings.

Disconnect the throttle linkage and wire throttle lever in wide open position before removal of pump to prevent loosening of internal parts.

Remove the pump mounting nuts and slide the pump in a straight line away from the engine.

The pump drive gear and shaft will remain on the engine front plate.

Removing Injection Pump, Drive Shaft, and Gear

NOTE: The injection pump drive shaft can be removed without removing the timing gear cover. Loosen the nut on the end of the shaft and drive gear off shaft from the rear using a brass drift. Install by placing the shaft in the gear and tightening the attaching nut drawing the shaft through the gear. Tighten nut to specifications.

If it is desired to remove the pump drive gear and shaft from the engine with the pump, the timing gear cover must be removed (see Section 20, Group 10).

Clean the injection pump and lines. Align the timing marks on the pump and insert the timing screw in flywheel.

With timing gear cover removed, check to see that the injection pump gear is properly timed to the crankshaft (see Section 20, Group 10).

Remove the upper idler gear.

Remove injection pump drive gear and shaft.

Remove pump mounting hex. nuts and lift pump from engine.

REPAIR

For detailed information and specifications refer to John Deere Service Manual SM-2045, "Testing and Servicing Fuel Injection Pumps and Nozzles."

Drive Shaft and Gear

Remove thrust spring and pin from gear end of shaft.
Loosen nut until flush with end of shaft.
Remove nut and gear from shaft.
Inspect gear for wear or chipped teeth.
Inspect tang on drive shaft (see "Specifications").
Inspect wear surfaces on drive shaft.

Check seals on drive shaft for hardness or cracked condition. Examine seal grooves on shaft for smooth finish. Any roughness at these points will cause seal failure.

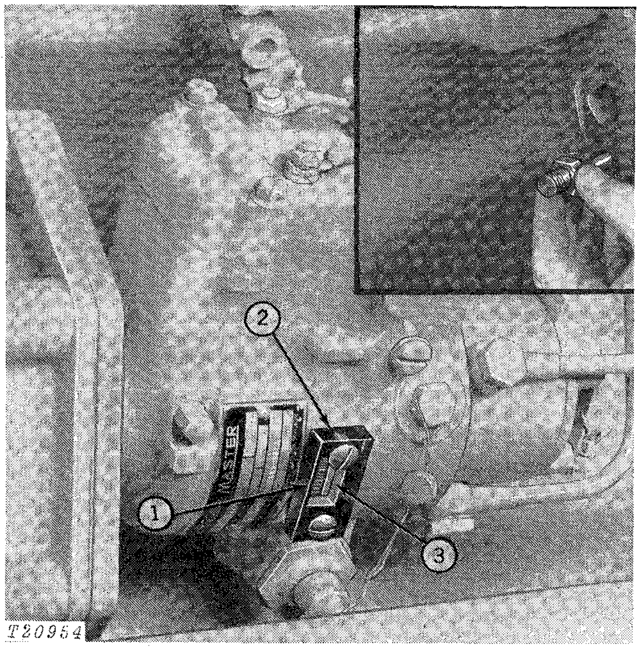
Apply a generous coat of Lubriplate to the drive shaft seals and slide seals into grooves using drive shaft seal installation tool (see "SPECIAL TOOLS"). The seals must face in the opposite directions. Apply Lubriplate liberally around the shaft between the seals.

Install gear on drive shaft using key and keyway to locate gear on shaft. Tighten hex. nut to specifications.

INSTALLATION AND TIMING

If removed, install injection pump gear and shaft on engine front plate. See Section 20, Group 10 for timing injection pump gear.

Install engine timing gear cover (if removed).



1—Governor Weight Retainer Timing Line
2—Timing Window
3—Cam Timing Line

Fig. 2-Timing Lines

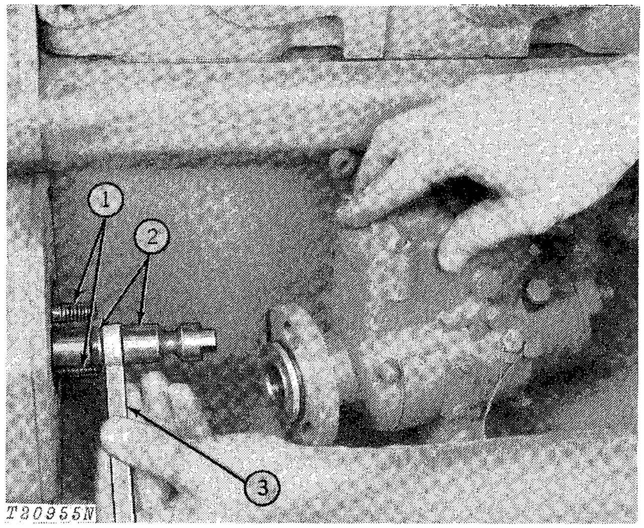
With timing window (JD259 (13366)) in place, check to be sure that timing line on governor weight retainer hub registers with the line on the cam (Fig. 2).

If engine has not been set on "top dead center" (No. 1 cylinder on compression stroke) rotate engine in direction of rotation (counterclockwise as viewed from flywheel end) until No. 1 cylinder is on compression stroke. Insert timing pin in flywheel as the flywheel is rotated and comes in registry (inset, Fig. 2). Engine is now set at "top dead center."

Install pump over shaft, making sure that reference mark on drive shaft tang aligns with mark on the slot end of the distributor rotor in the pump.

Incorrect assembly of shaft into pump will result in timing error of 180 degrees.

Using drive shaft seal compressing tool (JD256 (13371)), compress seal on shaft and slide pump in place (Fig. 3). Install hex. nuts and tighten finger tight. Rotate pump first in the direction of rotation and then in the opposite direction and again register timing lines to take up all backlash. Tighten mounting nuts securely.



1—Mounting Studs
2—Seals
3—Seal Compressing Tool

Fig. 3-Compressing Drive Shaft Seal

Do not turn drive shaft seal over while installing. If resistance is felt, stop and check position of seal. If seal has been forced back, replace seal.

Recheck pump timing.

Connect injection lines using new washers. Tighten connections with 420 in-lbs.

Connect fuel supply and return lines. Tighten only enough to keep lines from leaking.

Connect throttle linkage.

Remove timing window and install timing window cover.

Bleed fuel system (see Operator's Manual).

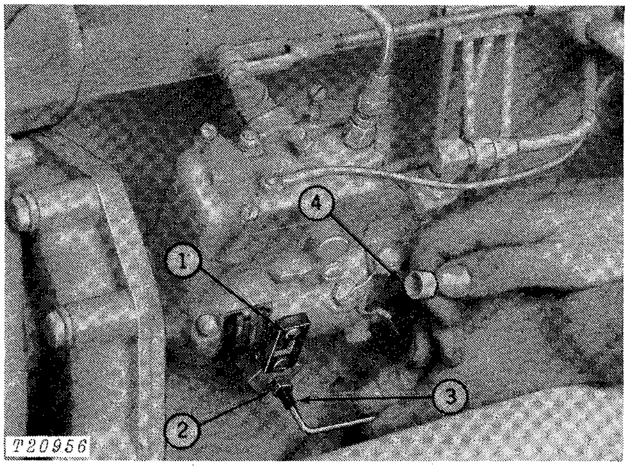
ADJUSTMENT

Speed Control Linkage

See Section 20, Group 20.

Cam Advance

1. Be sure that injection pump is static timed to engine.
2. Install timing window.



1—Timing Window **3—Advance Trimmer Screw**
2—Lock Nut **4—Seal Cap**

Fig. 4-Adjusting Cam Advance

Note the location of the cam timing line. Due to slight variations in windows and hole locations, cam line may not be exactly behind window line. Adjust timing window to get best possible line-up.

3. Bring engine to operating temperature.

4. See "Specifications" for engine speeds and cam advance position.

NOTE: Marks on timing window are two pump degrees apart.

5. Adjust cam advance by loosening lock nut and turning advance trimmer screw (Fig. 4).

Turn screw in to retard timing, turn screw out to advance timing.

6. Secure trimmer screw with lock nut and install seal cap.

SPECIFICATIONS

TUNE-UP DATA

Model JDB 431AL2475 (early units without turbocharger)
- A. Total advance movement .... 8 ± 1/2°
- B. Advance at 1200 rpm (no load).......... 4°

Model JDB 435AL2442 or JDB 435MD2802 (with turbocharger and later units without turbocharger)
- A. Total advance movement .... 7 + 1 or − 0°
- B. Advance at 1100 rpm (no load).......... 4°

WEAR LIMITS

Drive shaft tang thickness .... 0.305 in. min.

TESTS

Electric Solenoid Shut Off
- Voltage required to energize.......... 8 to 12 volts

TORQUE VALUES

Item	Torque (in-lbs)
Fuel inlet and outlet fitting screws	240
Fuel line connectors	420
Advance screw hole plug	40-50
Drive shaft hex. nut	540
Throttle control lock screw	35-40
Timing plate screws	15-20

SPECIAL TOOLS

No.	Name	Use
ESSENTIAL TOOLS		
JD259 (13366)	Timing Window	Adjust Cam Advance
JD256 (13371)	Compressing Tool	Compress Drive Shaft Seal
13369	Installation Tool	Install Drive Shaft Seal
D05022ST	Water Vacuum Gauge	Test Air Intake System

Section 40
ELECTRICAL SYSTEM

CONTENTS OF THIS SECTION

Group 5
DESCRIPTION AND ELECTRICAL SCHEMATIC

GENERAL INFORMATION

The unit is equipped with a 12-volt, negative-grounded electrical system. It includes either one 12-volt battery or two in parallel, a 22-ampere alternator, a voltage regulator, a 12-volt starter, and wiring harnesses.

Precautions

Certain precautions should be followed when testing or servicing the electrical system. See Group 10 for those precautions concerning the charging system.

CAUTION: Keep all sparks or flames away from the batteries. The gas from the electrolyte is highly flammable.

Avoid sparks when connecting booster batteries or battery chargers. When possible, make the last connection at a point away from the battery.

CAUTION: Use care to prevent personal injury or damage from the sulfuric acid in the electrolyte.

The grounded cable should always be the first one disconnected and the last one connected.

When possible, disconnect the battery ground when working on or around the electrical system. Severe damage or burns can be caused by an accidental ground or short circuit. This will also prevent inadvertent starter operation.

John Deere battery chargers can be used as a booster to start the engine.

IMPORTANT: A battery charger should not be used as a booster if a battery has a very low charge (1.150 specific gravity reading or lower). A low charged battery greatly increases the possibility of mistakenly connecting the charger to the battery in reverse, and it is possible to reverse the charge on a battery. If this is done the alternator diodes or the wire harness may be damaged.

If the battery has a specific gravity reading of 1.150 or lower, disconnect battery cables and charge it until the specific gravity reading is 1.150 or above before using a battery charger as a booster.

Polarity Precautions

Never polarize the alternator or regulator. Never ground a terminal. If either the alternator or regulator is disconnected, be sure it is reconnected before connecting the batteries. Always check the wiring before connecting batteries. With ignition and light switches "OFF" and the positive (+) terminals of the batteries connected, momentarily tap the negative battery cable to the negative battery terminal. No arcing should occur. If arcing does occur, do not make connections. Recheck entire wiring system, make corrections, and repeat the same test.

Disconnect positive battery terminals when charging batteries. Disconnect negative battery ground cable when arc-welding on the unit.

Circuit Breaker

The electrical system is protected by a 20-amp circuit breaker located under the cowl beside the key switch. A 40-amp current should trip the breaker within one minute. The circuit breaker will reset itself in one minute after turning off the key switch.

WIRING DIAGRAMS

Refer to Fig. 3 to trouble-shoot the electrical system. Note that all harness connections and junction blocks are not indicated; for testing the circuit at a connector or replacing individual wires, refer to Fig. 4.

To use the electrical schematic, you must think of the electrical current as flowing from the positive (+) terminal of the battery through the various circuits and components to ground, and from ground back to the negative (−) terminal of the battery.

The circuit can be checked by one of two ways; you may start at some point in the circuit and work either toward the positive source or toward ground.

When using the vehicle battery as the tester power supply, remember that the portion of the circuit between the test connection and ground is not being tested, and that all switches must be closed between the battery and the test point for an indication of current or voltage reading.

REMOVING BODY CONNECTORS FROM WIRES

To remove the body connectors is a very simple job. DO NOT attempt to jerk the wires out of the body connector. Use the following procedure.

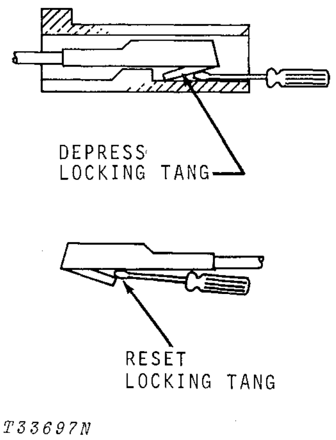


Fig. 1-Removing Female Connector

Insert a small screw driver or paper clip into the body connector and press the locking tang down as shown in Fig. 1. Remove wire from connector.

Be sure to bend the locking tang back up when installing new body connector.

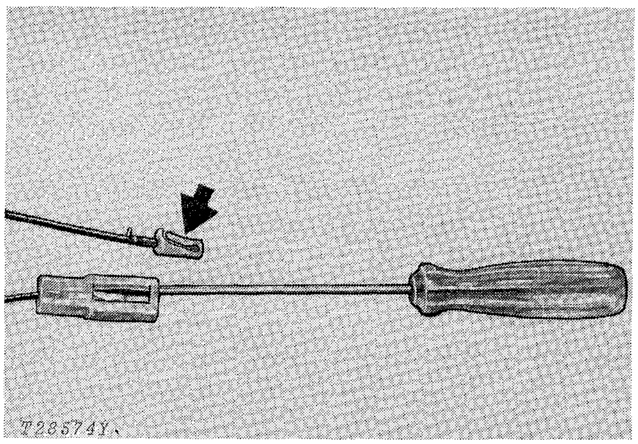


Fig. 2-Removing Male Connector

Using a knife or a screw driver, bend the locking tang in as shown in Fig. 2. Remove wire from connector.

Be sure to bend the locking tang out when assembling new body connector.

DIAGNOSING MALFUNCTIONS

Make the following circuit tests with switches closed where necessary to provide a complete circuit. Use a voltmeter to take voltage checks and an electrical test probe containing a neon bulb to check circuit continuity.

Engine Will Not Crank

1) Use a jumper cable between T.P. 1 (Test Point 1) and T.P. 2 on the starter solenoid (3, Fig. 3). If starter will not crank or cranks slowly, check voltage at T.P. 1. If the voltage reading is low, check the battery charge and connections. If the voltage is normal, remove and repair the starter (Group 15). If the starter cranks normally, proceed to step 2.

2) If the hour meter runs and the fuel shut-off solenoid engages ("clicks"), the circuit is complete through the ignition switch. Using electrical test probe, check terminals of the start safety switch (4). If probe lights on only one terminal, either 1) the transmission is not in neutral, 2) the connection is loose, or 3) the start safety switch is faulty. If probe does not light at either terminal, remove the instrument panel and check the circuit between T.P. 3 and the start switch (5).

3) If the hour meter does not run and the fuel shut-off solenoid fails to engage, use the test probe and check the circuit between T.P.'s 1 and 4 and T.P.'s 2 and 4. If the cigar lighter works, then the circuit is OK up to T.P. 5 and needs to be checked between T.P. 5 and T.P. 4.

4) Refer to Section 20, "Diagnosing Malfunctions."

Engine Cranks, But Will Not Start

1) If engine cranks slowly, refer to step 1 of "ENGINE WILL NOT CRANK."

2) Check for a defective fuel shut-off solenoid (7, Fig. 3).

3) Refer to Sections 20 and 30, "Diagnosing Malfunctions."

Engine Starts, But Will Not Run

1) Refer to step 2 of "ENGINE CRANKS, BUT WILL NOT START."

2) Refer to Sections 20 and 30, "Diagnosing Malfunctions."

Return-to-Dig Mechanism Fails

1) If lamps will light, check for voltage at bucket switch (11, Fig. 3), spool switch (12), and spool solenoid (13). Refer to Section 70 and check that bucket switch is properly adjusted.

2) If lamps will not light, check for voltage at T.P. 6 on ignition switch (6).

Lamp Will Not Light

1) If all lamps will not light, check for voltage at light switch (15, Fig. 3).

2) If individual lamp will not light, check lamp ground before replacing lamp.

Gauge Will Not Function

1) If gauges operate only while engine is running, check for voltage at T.P. 6 on ignition switch (6, Fig. 3).

2) If the engine oil pressure, coolant temperature and/or transmission oil temperature gauges operate while the engine is running, but not with the ignition switch in the "ACC" position, or vice versa, check wiring and connections between gauges.

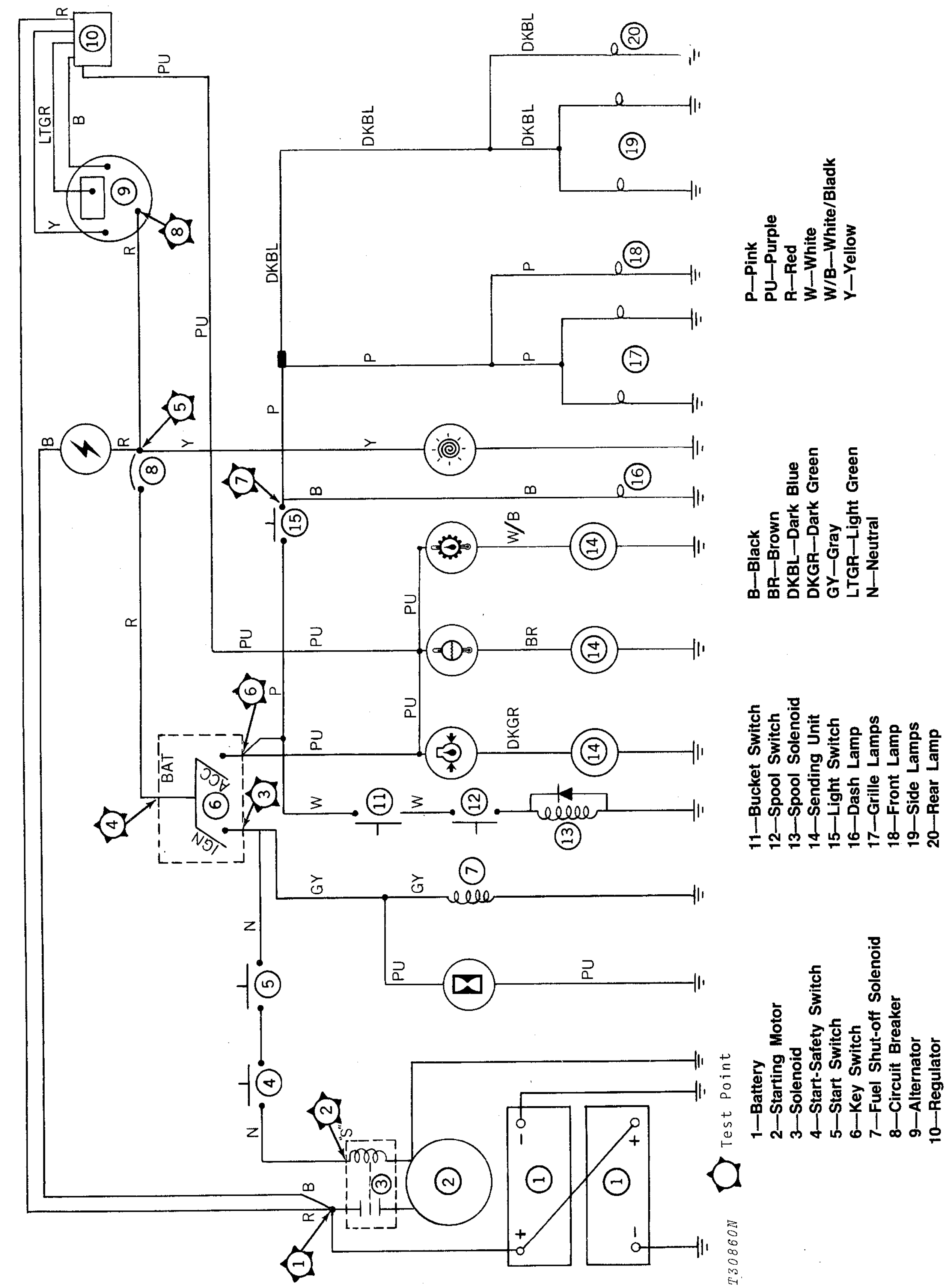


Fig. 3-Electrical Schematic

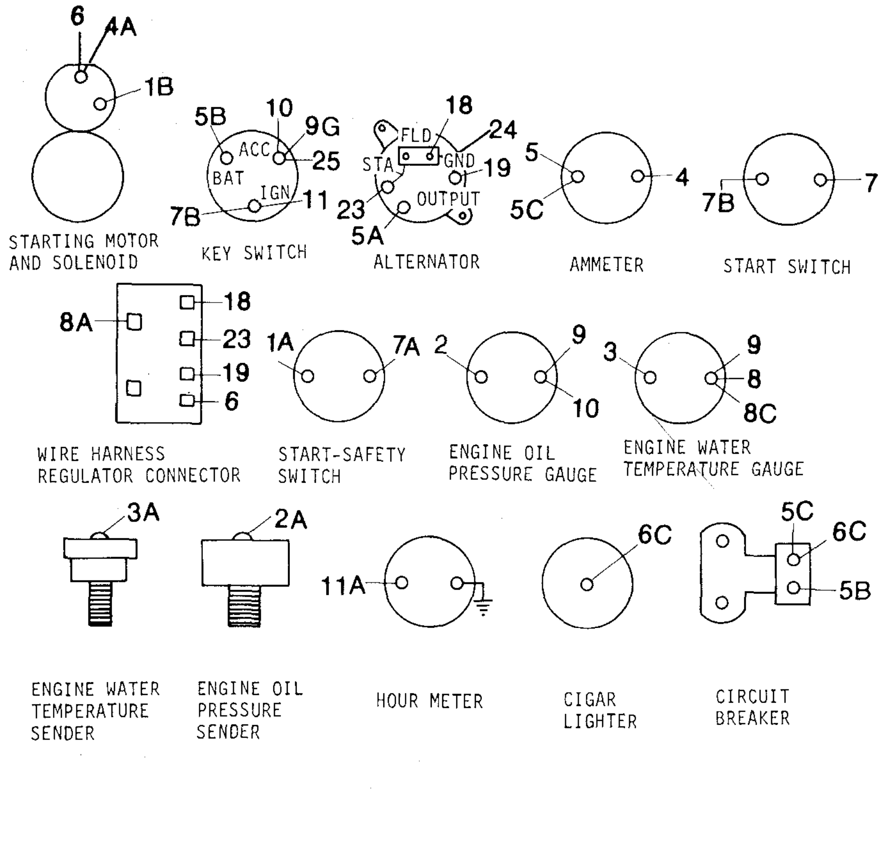


Fig. 4-Component Wire Routing (Part I)

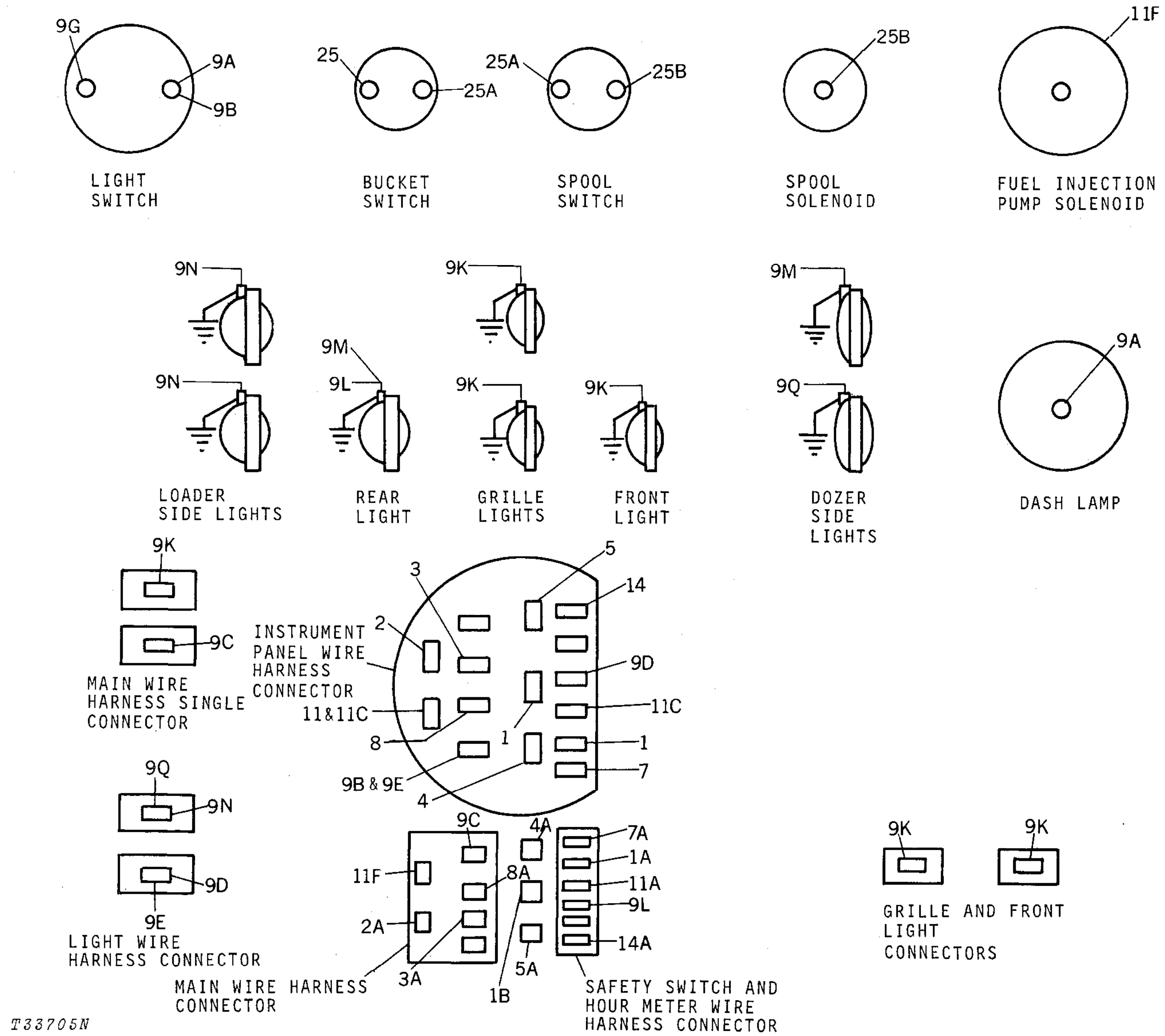


Fig. 5-Component Wire Routing (Part II)

The following is an explanation of Figs. 4 and 5 - Component Wire Routing:

No.	Color	Routing
1	Neutral	Instrument panel wire harness connector to instrument panel wire harness connector.
1A	Neutral	Safety switch and hour meter wire harness connector to start-safety switch.
1B	Neutral	Main wire harness single connector to solenoid "S" terminal.
2	Dark Green	Instrument panel wire harness connector to engine oil pressure gauge.
2A	Dark Green	Main wire harness connector to engine oil pressure sender.
3	Brown	Engine temperature gauge to instrument panel wire harness connector.
3A	Brown	Main wire harness connector to engine coolant temperature sender.
4	Black	Ammeter to instrument panel wire harness connector.
4A	Black	Main wire harness single connector to starting motor solenoid "BAT" terminal.
5	Red	Ammeter to instrument panel wire harness connector.
5A	Red	Main wire harness connector to alternator output terminal.
5B	Red	Circuit breaker to key switch "BAT" terminal.
5C	Red	Ammeter to circuit breaker.
6	Red	Starting motor solenoid "BAT" terminal to wire harness regulator connector.
6C	Yellow	Circuit breaker to cigar lighter.
7	Neutral	Start switch to instrument panel wire harness connector.
7A	Neutral	Safety switch and hour meter wire harness connector to start-safety switch.
7B	Neutral	Start switch to key switch "IGN" terminal.
8	Purple	Engine temperature gauge to instrument panel wire harness connector.
8A	Purple	Main wire harness connector to wire harness regulator connector.
8C	Purple	Engine temperature gauge to transmission temperature gauge.
9	Purple	Engine oil pressure gauge to engine temperature gauge.
9A	Black	Light switch to dash lamp.
9B	Pink	Light switch to instrument panel wire harness connector.
9C	Pink	Main wire harness connector to main wire harness single connector.

The following is a continuation of the explanation of Figs. 4 and 5 - Component Wire Routing:

No.	Color	Routing
9D	Dark Blue	Instrument panel wire harness connector to light wire harness connector.
9E	Dark Blue	Instrument panel wire harness connector to light wire harness connector.
9G	Pink	Light switch to key switch "ACC" terminal.
9K	Pink	Main wire harness single connector to grille and front light connector.
9L	Dark Blue	Safety switch and hour meter wire harness connector to rear light.
9M	Dark Blue	Rear light to dozer left hand side light.
9N	Dark Blue	Light wire harness connector to loader side lights.
9Q	Dark Blue	Light wire harness connector to dozer right hand side light.
10	Purple	Key switch "ACC" terminal to engine oil pressure gauge.
11	Gray	Key switch "IGN" terminal to instrument panel wire harness connector.
11A	Purple	Safety switch and hour meter wire harness connector to hour meter.

No.	Color	Routing
11C	Purple	Instrument panel wire harness connector to instrument panel wire harness connector.
11F	Gray	Main wire harness connector to fuel injection pump solenoid.
14	White with Black Stripes	Transmission temperature gauge to instrument panel wire harness connector.
14A	Neutral with Black Stripes	Safety switch and hour meter wire harness connector to transmission temperature sender.
18	Light Green	Wire harness regulator connector to alternator "FLD" terminal.
19	Black	Wire harness regulator connector to alternator "GND" terminal.
23	Yellow	Wire harness regulator connector to alternator "STA" terminal.
24	Black	Alternator "FLD" terminal to alternator "GND" terminal. **IMPORTANT: Voltage regulators with part numbers AT63382, AT42450, AT29078,and AT21816 must have the alternator field wire connected to the alternat or GND terminal. Regulators with part number AT41069 must have the alternator field wire connected to the alternator STA terminal.**
25	White	Key switch"IGN"terminal to bucket switch.
25A	White	Bucket switch to spool switch.
25B	White	Spool switch to spool solenoid.

SPECIFICATIONS

Circuit Breaker

20 amp, breaker maximum trip time for 40 amp current .... 1 min.
Circuit breaker reset time .... 1 min.

Test Values*

Test Point	Voltage/Resistance
T.P. 1	13 volts
T.P. 2	10.2 volts/4.5 ohms
T.P. 3	12.8 volts
T.P. 4	12.8 volts
T.P. 5	12.8 volts
T.P. 6	12.8 volts
T.P. 7	12.8 volts 12.4 volts (lamps lighted)
T.P. 8	13.5 to 13.75 volts (engine running)

Gauge	Wire Color/Voltage	Resistance
Engine Coolant Temperature	PR/12.8 volts BR/10.2 volts	100 ohms
Engine Oil Pressure	PR/12.8 volts DGR/8.6 volts	80 ohms
Transmission Oil Temperature	PR/12.8 volts W/B/10.2 volts	100 ohms
Hourmeter	PR/12.6 volts	20 ohms
Ammeter	B/12.8 volts R/12.8 volts	0.0 ohms

* *Values are typical; unit batteries are power source, except where noted.*

Group 10
CHARGING SYSTEM

GENERAL INFORMATION

The charging system consists of an enclosed-type alternator, solid-state regulator, circuit wiring and one or two batteries connected in parallel. This is a 12-volt, negative-ground system.

Refer to Fundamentals of Service Manual - FOS ELECTRICAL SYSTEMS - to learn how an alternator charging circuit works and to identify components.

TEST AND DIAGNOSIS

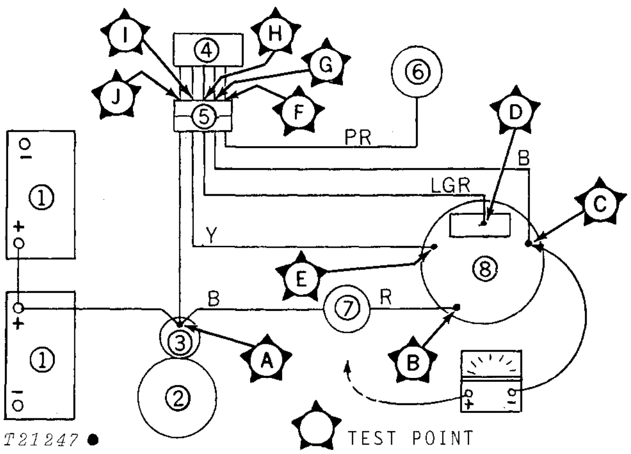
The following tests are designed to isolate individual circuits and check their operation.

Refer to FOS Manual, Electrical Systems Chapter 4, for additional diagnosis and tests.

Battery Tests

Make battery specific gravity test and compare with "Specifications."

If specific gravity reading is O.K. and battery has been overcharging, check charging system per Test No. 4. (Battery overcharging is normally detected by excessive battery gassing, high water consumption, and continuous charging as indicated by the panel ammeter).



1—Battery
2—Starting Motor
3—Solenoid
4—Regulator
5—Plug Connection
6—Key Switch
7—Ammeter
8—Alternator

Fig. 1-Electrical Test Points

If specific gravity is low, the voltage may also be low or the fan belt may be loose. Check for poor connections at the battery, starter, alternator, and regulator. Check charging system per Test Nos. 1, 2, and 3.

WIRING AND COMPONENT TESTS

(Serial No. -186586)
(See Fig. 1 for all test points)

IMPORTANT: Voltage regulators with part numbers AT63382, AT42450, AT29078 and AT21816 must have the alternator field wire connected to the alternator GND terminal. Regulators with part number AT41069 must have the alternator field wire connected to the alternator STA terminal.

IMPORTANT: The charging system should be tested by the following tests prior to replacement of components. Premature replacement can result in failure by the new component, particularly regulators.

Test No. 1 - Key Off

(A) Connect voltmeter negative lead to alternator ground terminal (test point C). Connect voltmeter positive lead to alternator output terminal (test point B). Voltmeter should indicate battery voltage; if below battery voltage, check battery connections, ammeter leads, etc.

(B) Connect voltmeter positive lead to alternator field terminal (test point D). Voltmeter should indicate zero. If voltmeter indicates above zero, one of the alternator positive diodes, the regulator circuit switch or the ignition switch is shorted.

IMPORTANT: Never ground the field circuit as the regulator will be damaged.

Positive Diode Check

(C) Connect voltmeter positive lead to alternator stator terminal (test point E). Voltmeter should indicate zero volts. If voltmeter indicates above zero, one of the positive diodes is shorted. Check and replace defective alternator diodes.

Ignition Switch Check

(D) Disconnect regulator plug from tractor harness plug and connect voltmeter positive lead to purple tractor harness lead (test point F). Voltmeter should indicate zero. If voltmeter indicates above zero, ignition switch is shorted. Replace ignition switch.

Regulator Check

If both readings in the two previous checks were zero, the regulator circuit switch is shorted. Replace the regulator.

Test No. 2 - Key On

Connect voltmeter positive lead to alternator field terminal (test point D). Voltmeter should indicate 2.0 to 4.0 volts.

(1) ***If voltage is below 2.0 volts,*** check voltage with voltmeter positive lead at the purple tractor harness lead. Voltage should be within 0.5 volt of battery voltage. If voltage is O.K.; the regulator is defective or the alternator field circuit is shorted.

Remove green field lead from alternator field terminal (test point D) and check voltage at green lead.

(a) If voltage is within 4.0 volts of battery voltage, check alternator field circuit for shorts.

If voltage is not within 4.0 volts of battery voltage, replace regulator. Connect green field lead to alternator field terminal.

(2) ***If voltage is above 4.0 volts,*** check alternator field circuit for an open circuit (stuck or worn brushes, dirty slip rings, or an open alternator rotor).

Turn on lights and check panel ammeter for a discharge condition. If ammeter does not indicate discharge, replace ammeter. Turn off lights.

Test No. 3 - Key On, Engine Running

With the lights on, slowly increase engine speed; alternator should charge as indicated by an increasing charge rate on the panel ammeter. If alternator fails to charge as indicated by the ammeter, perform the following checks.

Connect voltmeter positive lead on alternator stator terminal (test point E). The voltmeter should indicate above 2.0 volts; if not, the alternator contains a defective stator, diodes, or broken leads. If the voltmeter indicates below 2.0 volts, the regulator is defective or high resistance connections exist in the charging system.

Using voltmeter, check wiring connections shown in Fig. 1 and compare readings with chart below. If all voltages are O.K., replace regulator.

Wiring Resistance Test Chart

Test Points (Fig. 1)	Max. Voltage
A-B	0.3 volt
C-G	0.1 volt
D-H	0.1 volt
E-I	0.1 volt
B-J	0.1 volt
F-B	0.5 volt

Test No. 4 - Key On, Engine Running (Overcharging Condition)

Run engine at high idle for minimum of 10 minutes to stabilize temperatures. Using a voltmeter, check battery voltage against values listed under "Alternator Output" chart.

ALTERNATOR OUTPUT
TEMPERATURE CORRECTION CHART

Temperature*	Voltage
40°F.	14.3 to 15.1 volts
60°F.	14.1 to 14.9 volts
80°F.	14.0 to 14.8 volts
100°F.	13.8 to 14.6 volts
120°F.	13.7 to 14.5 volts
140°F.	13.6 to 14.3 volts

* *Measured 1 inch from regulator case.*

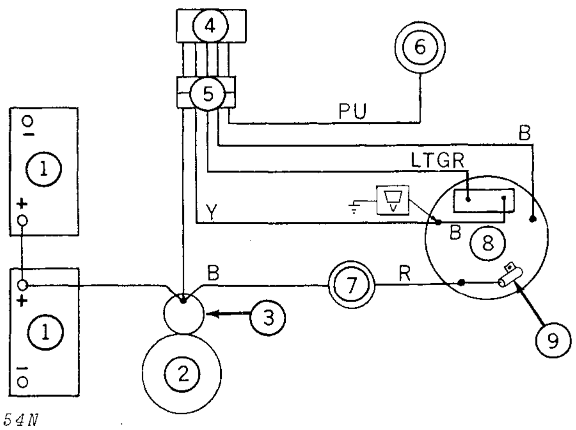
If voltage is within specifications, the battery is defective and should be replaced.

If voltage is above specifications, a high resistance connection exists in the regulator red or black leads or the regulator is defective. Check lead resistance between test points and compare with chart above. If voltage is O.K., replace regulator.

WIRING AND COMPONENT TESTS (Serial No. 186587-)

IMPORTANT: Voltage regulators with part numbers AT63382, AT42450, AT29078 and AT21816 must have the alternator field wire connected to the alternator ground terminal. Regulators with part number AT41069 must have the alternator field wire connected to the alternator STA terminal.

Test No. 1



T30854N

1—Battery
2—Starting Motor
3—Solenoid
4—Regulator
5—Plug Connection
6—Key Switch
7—Ammeter
8—Alternator
9—Capacitor

Fig. 2-Voltmeter Connected to Starter Terminal

With key switch off, connect voltmeter to alternator stator terminal (Fig. 2). Voltage reading should be 0 volts.

If 12 volts is indicated one or more of the positive diodes is shorted. If the reading is approximately 2 volts, the key switch contacts are not opening.

Test No. 2

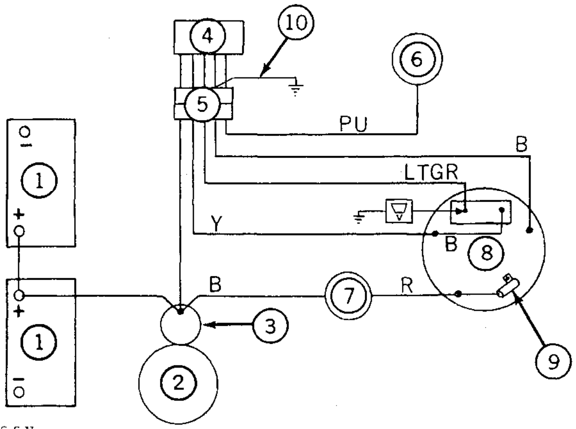
With key switch on and engine not running, connect voltmeter to stator terminal (Fig. 2). The reading should be approximately 2 volts.

If no voltage is indicated, the cause is either an open in the wiring to the regulator or short to ground in the field circuit.

To isolate, check voltage on the purple lead terminal in the regulator connector. It should be 12 volts. If voltage is at regulator connector, remove black wire from stator-to-field terminal. Now if voltage goes to 12 volts at the stator terminal, check brushes and rotor for a short to ground condition.

If you get a 12 volt reading, the field circuit is open, either in the alternator or in the regulator. To isolate proceed to Test No. 3.

Test No. 3



T30855N

1—Battery
2—Starting Motor
3—Solenoid
4—Regulator
5—Plug Connection
6—Key Switch
7—Ammeter
8—Alternator
9—Capacitor
10—Jumper Wire

Fig. 3-Voltmeter Connected to Alternator Field Terminal

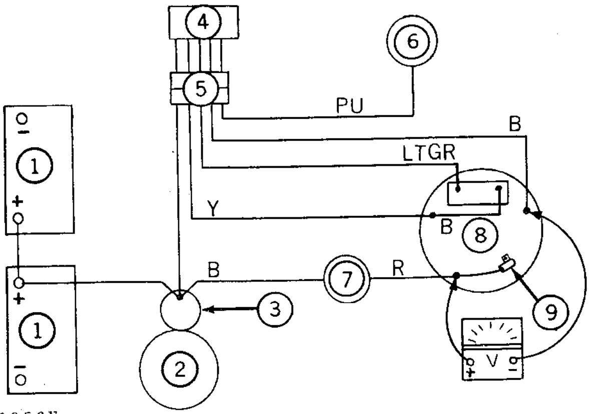
With key switch on and engine not running, connect voltmeter to field terminal with the green wire (Fig. 3).

If you get a 12 volt reading, the regulator field circuit or ground circuit is open.

To isolate connect a jumper wire (10) to black lead in regulator connector and to ground as shown in Fig. 3. If you get a 2 volt reading at the stator terminal you know the ground circuit is open. Check black lead to alternator. If a 12 volt reading is still obtained, replace regulator.

If reading is 0 volts is indicated the alternator field circuit is open. Check the brushes and rotor.

Test No. 4



T30856N

1—Battery	**5—Plug Connection**
2—Starting Motor	**6—Key Switch**
3—Solenoid	**7—Ammeter**
4—Regulator	**8—Alternator**
	9—Capacitor

Fig. 4-Output Test Connections

With ignition switch on, engine running at fast idle, connect voltmeter and ammeter to the output terminal (Fig. 4).

Initially the ammeter reading should be 20 amps. or more and the voltmeter should read approximately 13.0 volts in a fully charged battery.

After a few minutes of operation the voltage reading should start to rise. When the reading is approximately 14.2 volts, the ammeter indicator should start to decrease. The voltage should continue to rise slowly to approximately 14.4 volts and then level off.

The ammeter should also drop to approximately 10 to 15 amps.

Since temperature does affect the controlled voltage level, Test No. 4 should be run at approximately 70°F ambient temperature.

With a cold ambient temperature the voltage will go up and with a hot ambient temperature the voltage will go down. See chart.

Temperature*	Voltage
40°F	14.4 - 14.9 volts
60°F	14.3 - 14.7 volts
80°F	14.2 - 14.6 volts
100°F	14.0 - 14.4 volts
120°F	13.8 - 14.3 volts
140°F	13.6 - 14.1 volts

* *Measured 1 inch from regulator.*

If the alternator output current is low the probable causes are in the alternator, open positive diodes, shorted negative diodes, or a defective stator.

If the voltage does not level off and the current level remains high, the voltage regulator is faulty and should be replaced.

Since these are only probable causes, always check the alternator output voltage whenever you have a low ammeter reading. You could have a sulfated battery causing high resistance to current flow, or a high resistance connection in the charging circuit which would cause a rise in system voltage to 14.4 volts and consequently the regulator would reduce the alternator output.

In summary, the solution to most problems in the charging circuit can be obtained if you can accurately answer these questions:

1. Is system voltage being blocked in the key off condition?

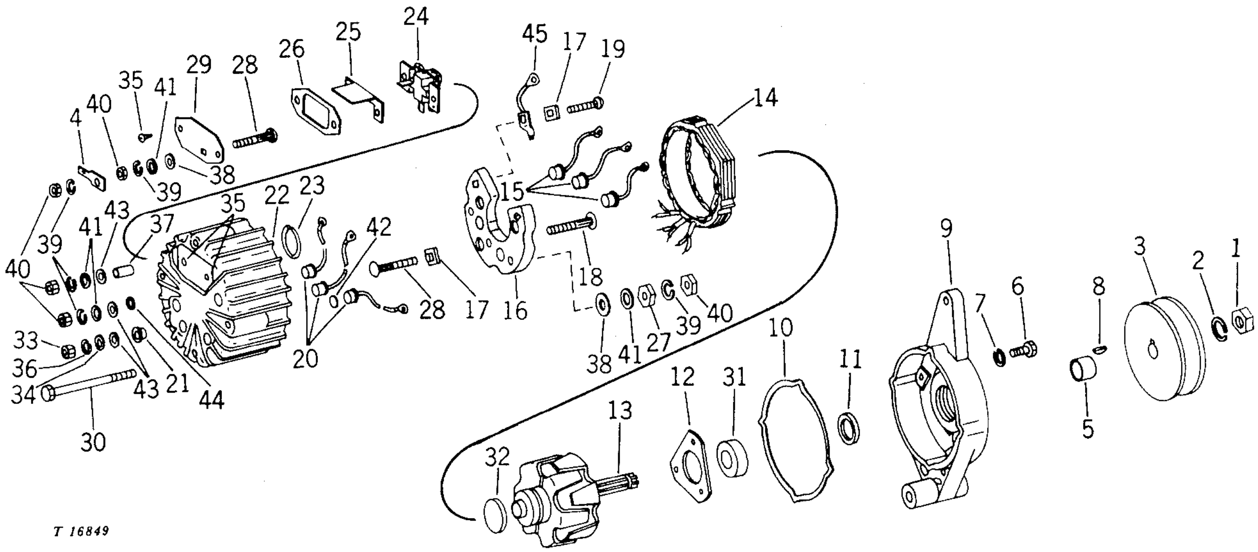
2. Is there excitation voltage to the alternator field in the key on condition?

3. Is the field current functional?

4. What is the alternator output with full field?

5. At what voltage does the regulator limit alternator output?

REPAIR



1—5/8″ Nut
2—5/8″ Lock Washer
3—Pulley
4—Field Terminal
5—Spacer
6—No. 8 x 3/8″ Mach. Screw (3 used)
7—No. 8 Lock Washer (3 used)
8—Woodruff Key
9—Front Housing
10—Gasket
11—Front Bearing Seal
12—Front Bearing Retainer
13—Rotor
14—Stator
15—Positive Rectifying Diode (3 used)
16—Positive Diode Plate
17—Insulator (5 used)
18—Output Terminal Bolt
19—Ground and Auxiliary Terminal Bolts (2 used)
20—Negative Rectifying Diode (3 used)
21—Output Terminal Insulator
22—Rear Housing
23—Rear Bearing Retainer
24—Brush and Holder
25—Brush Insulator
26—Brush Cover Gasket
27—No. 10 Nut (3 used)
28—Diode-to-Diode Plate Bolt (4 used)
29—Brush Cover
30—Through Bolts (4 used)
31—Front Ball Bearing
32—Rear Ball Bearing
33—1/4″ Nut
34—17/64″ x 7/16″ x 0.060″ Washer
35—No. 8 x 1/2″ Self Tapping Screw
36—1/4″ Lock Washer
37—Stator Terminal Insulator Sleeve
38—Insulating Washer (4 used)
39—No. 10 Lock Washer (7 used)
40—No. 10 Nut (7 used)
41—7/32″ x 1/2″ x 0.048″ Wahser (6 used)
42—Diode to Rear Cover Insulator (3 used)
43—Insulator Washer (3 used)
44—Insulator Washer
45—Jumper Cable

Fig. 5-Alternator
(Serial No. -186586)

Remove the pulley by clamping it in a vise, using an old oversized belt for protection from vise jaws.

Remove front nut and washer from shaft and pull alternator from pulley. A slight rocking of the alternator body will loosen a tight pulley.

Brushes and Slip Rings

NOTE: It is not necessary to remove the alternator from the unit to clean the brushes.

Remove the two screws holding outer brush cover and swing cover open. Remove two screws holding brush assembly and carefully remove assembly and insulator (Fig. 6).

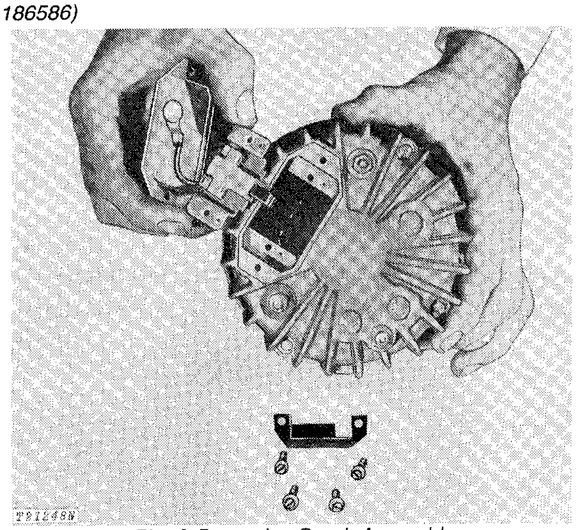
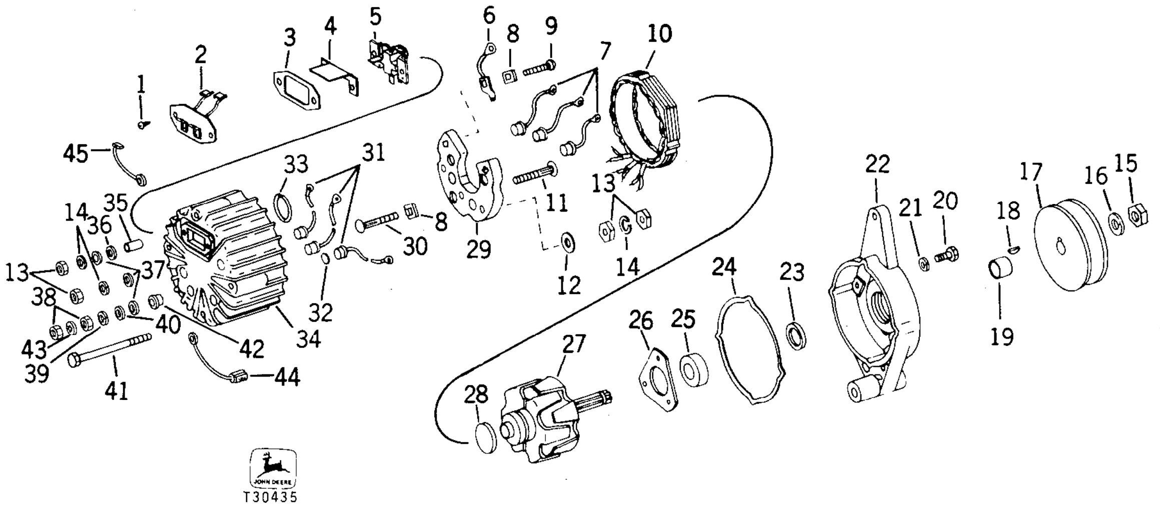


Fig. 6-Removing Brush Assembly



1—Drive Screw (2 used)
2—Brush Cover
3—Brush Cover Gasket
4—Brush Insulator
5—Brush and Holder
6—Jumper Cable
7—Rectifying Positive Diode (3 used)
8—Insulator (5 used)
9—Bolt (2 used)
10—Stator
11—Bolt
12—Washer (3 used)
13—Nut (10 used)
14—Lock Washer (9 used)
15—Nut
16—Lock Washer
17—Pulley
18—Key
19—Spacer
20—Screw (3 used)
21—Lock Washer (3 used)
22—Front Housing
23—Special Washer
24—Gasket
25—Ball Bearing
26—Bearing Retainer
27—Rotor
28—Ball Bearing
29—Positive Diode Plate
30—Special Bolt (3 used)
31—Negative Rectifying Diode (3 used)
32—Insulator (3 used)
33—Bearing Retainer
34—Rear Housing
35—Sleeve
36—Washer (2 used)
37—Washer
38—Nut
39—Lock Washer
40—Washer
41—Bolt (4 used)
42—Insulator
43—Lock Washer
44—Capacitor
45—Lead Wire

Fig. 7-Alternator
(Serial No. 186587-)

Replace brush assembly if brushes extend less than 1/4-inch beyond the holder.

IMPORTANT: If in the process of brush removal the brush cover gasket should become damaged or torn, it must be replaced and positioned properly.

If the insulator, which prevents the brush lead from shorting on the rear housing and grounding the field, should become damaged or torn, it must be replaced.

If the brushes are clogged with dust or dirt, clean them with compressed air. Avoid using any type of liquid as this increases the possibility of dust or dirt hardening in the brush cavity and hindering the movement of the brush.

If slip rings are contaminated, clean with a nonpetroleum base cleaning solvent. If solvent does not clean the slip rings, use crocus cloth.

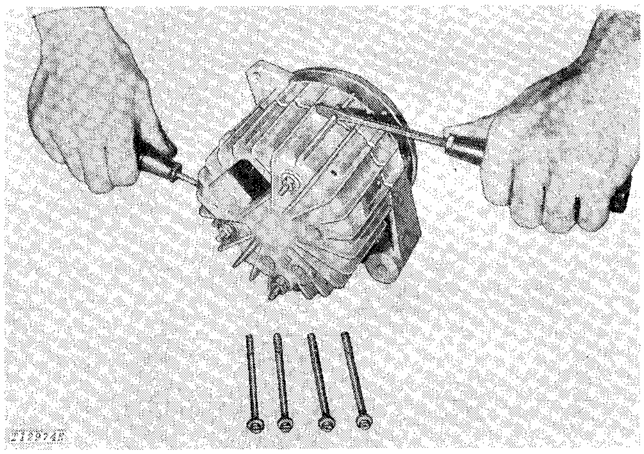


Fig. 8-Separating Front and Rear Housings

Remove the four through bolts retaining the front and rear housings. Using two screwdrivers (Fig. 8), apply equal pressure to release the rear housing from the front. Care should be taken that the stator stays with the rear housing.

IMPORTANT: If housing gasket is damaged, replace it at time of assembly.

Stator

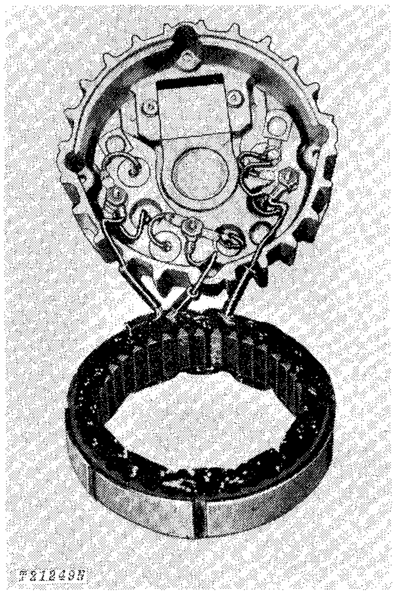


Fig. 9-Removing Stator from Rear Housing

Grasping the stator, apply pressure to separate stator from housing (Fig. 9).

Remove the stator wires from the terminals. Note wire connections for assembly.

Diodes

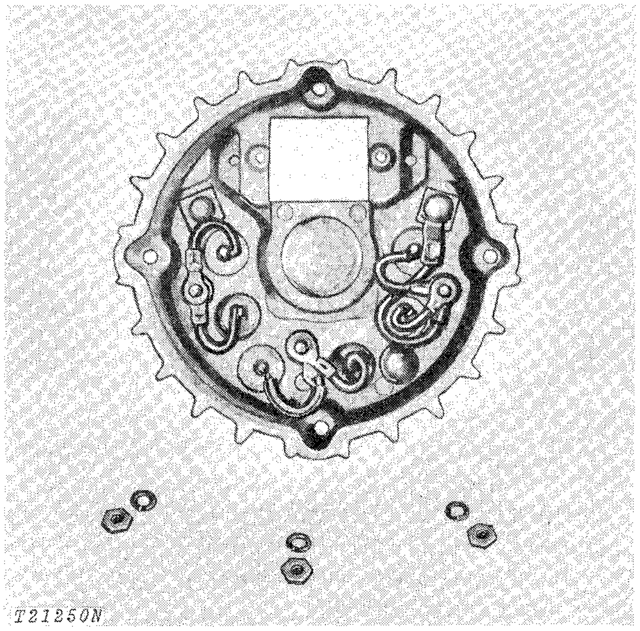


Fig. 10-Removing Diode Heat Sink

Remove the three black leads (Fig. 10) from the heat sink screws and push heat sink out of housing.

NOTE: Three mica insulators are set against the inside of the rear housing and insulate the positive heat sink from the housing.

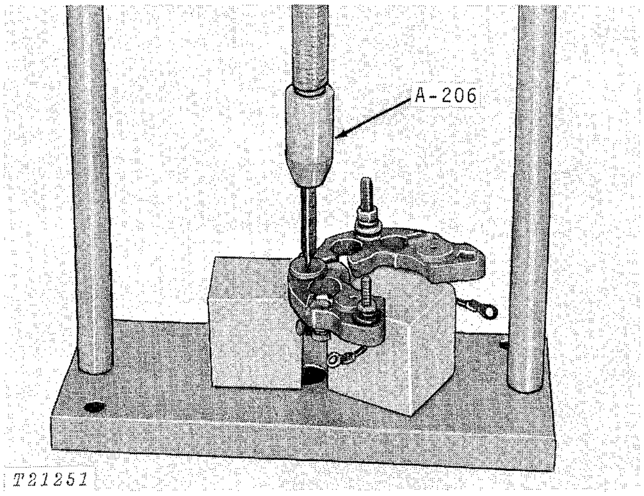


Fig. 11-Removing Defective Positive Diode

Using a small punch and A-206 tool (Fig. 11), press defective positive diodes out of heat sink.

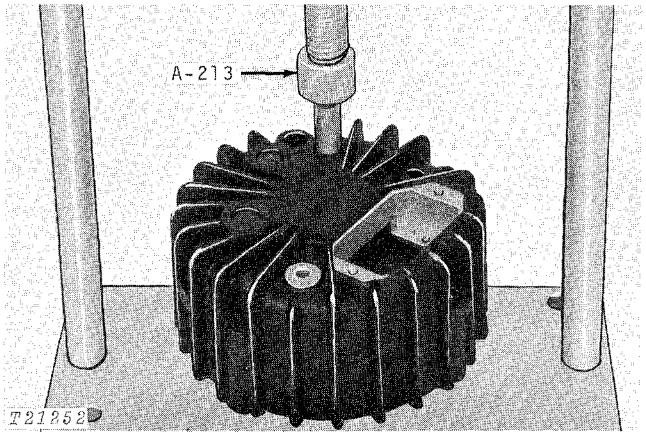


Fig. 12-Removing Defective Negative Diode

Using A-213 tool (Fig. 12), press defective negative diodes out of the rear housing.

IMPORTANT: The rectifying diodes used in this application have welded rather than soldered leads. Do not attempt to use replacement diodes with soldered leads.

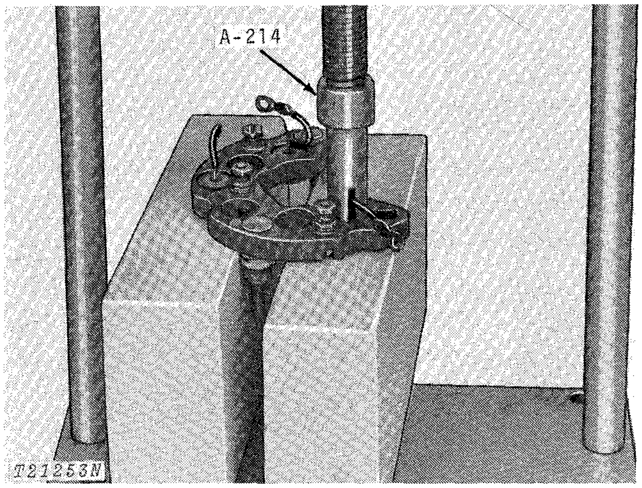


Fig. 13-Installing Positive Diode

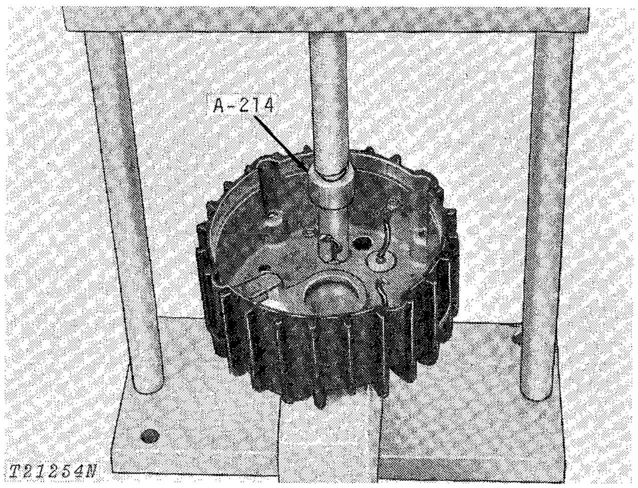


Fig. 14-Installing Negative Diode

Place a new diode in diode hole. Rotate diode so serrations on new diode do not line up with the serrations made by original diode; this provides a more efficient transfer of heat from the diode. Press diode fully into hole using A-214 tool (Fig. 13 or 14).

Rotor

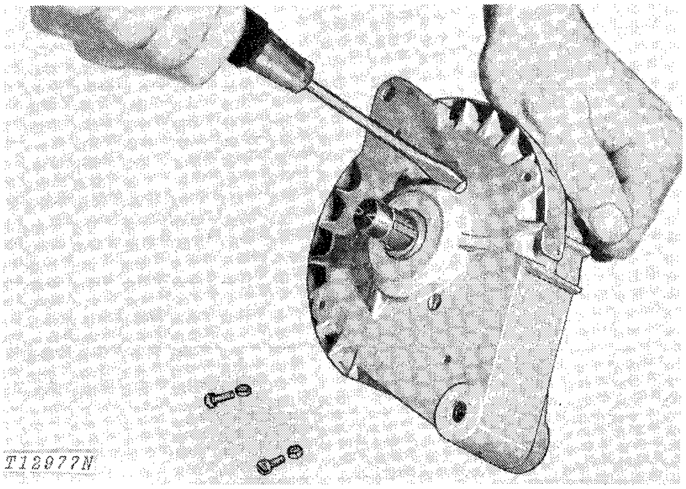


Fig. 15-Removing Rotor Retaining Hardware

Remove the three screws and lock washers from the front housing (Fig. 15). If not already removed, remove Woodruff key on rotor shaft.

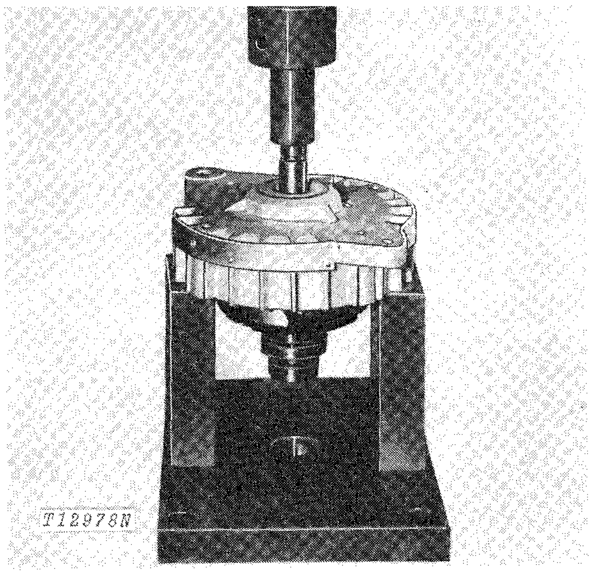


Fig. 16-Pressing Rotor Out of Housing

Using a press (Fig. 16), press rotor out of front housing.

Bearings are sealed and cannot be lubricated. Remove the bearings using A-216 puller (Fig. 17) and adapter.

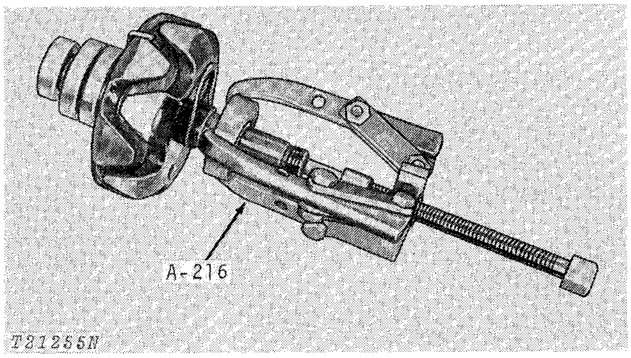


Fig. 17-Removing Rotor Bearings

ALTERNATOR COMPONENT TESTS

Make the following appropriate tests to locate faulty components prior to assembly.

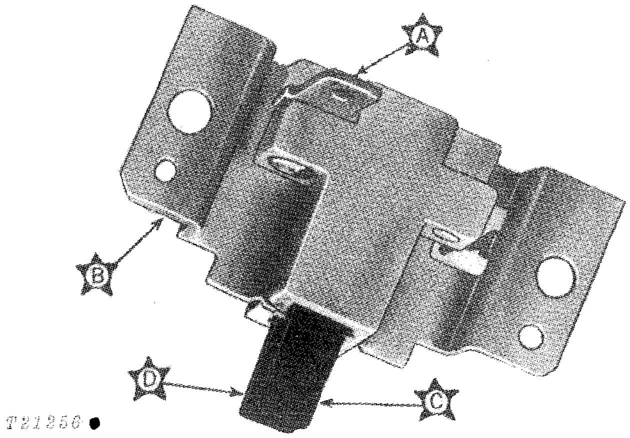


Fig. 18-Brush Assembly Test Points

Brush Assembly Insulation Test

1) Insulation Test: Connect ohmmeter or a test lamp (12 volts) to field terminal and bracket (test points A and B, as shown in Fig. 18).

Resistance should be high (infinite) or test lamp should not light. If resistance is low, or test lamp lights, brush assembly is shorted and must be replaced.

2) Continuity Test: Connect an ohmmeter or a test lamp to field terminal and brush (test points A and C). Use an alligator clip to assure good contact to brush. **IMPORTANT: Do not chip brush.** Resistance reading should be zero or test light should light. Move brush and brush lead wire to make certain that the brush lead wire connections are not intermittent. Resistance reading should not vary when brush and lead wire are being moved around.

3) Connect ohmmeter or test light to bracket and grounded brush (test points B and D). Resistance reading should be zero or test light should light. Repeat same test on brush lead wire as described in step 2.

Rectifier Diode Test

If a commercial alternator rectifier diode tester is available, follow manufacturer's instructions to test all diodes. **Do not use 120-volt AC test lamp.**

A 12-volt battery-operated test lamp may be used if a commercial tester is not available. Connect one test lead to diode heat sink, the other to each diode wire terminal, then repeat with tests leads reversed. Lamp should light with leads in one position, but should not light with test leads reversed. All diodes in heat sink or rear housing should show the same results.

If lamp lights, regardless of how test leads are switched, the diode is shorted. If lamp fails to light in either test, the diode is open. Replace defective diodes; observe correct polarity by color of stamping used to list part number on diode.

Stator Tests

1) An ohmmeter or test lamp may be used to test for opens.

Connect ohmmeter or test lamp probe to one of the stator leads and connect the other test probe to each remaining lead.

Continuity should be indicated or test lamp should light. If continuity is not indicated or test lamp does not light, there is an open in the stator windings. Replace stator.

2) To test for shorts, connect one ohmmeter or test lamp probe to the stator windings and the other test probe to the stator case. Continuity should not be indicated or test lamp should not light. If test lamp lights or there is continuity, a short exists in the stator. Replace stator.

Rotor Test

This test checks the field coil for leakage or shorts to rotor poles. An ohmmeter or test lamp (12-volt) may be used.

Connect ohmmeter or test lamp test probes to one of the slip rings, and to rotor shaft. Ohmmeter resistance should be infinite and test lamp should not light. If resistance is not infinite or test lamp lights, leakage or a short exists between the field coil and rotor.

ASSEMBLY

Bearings

Installing Front Bearing

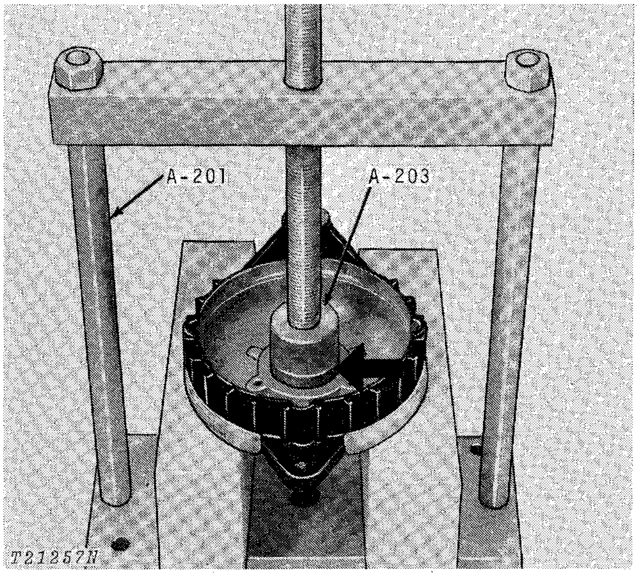


Fig. 19-Installing Bearing in Front Housing

Check that bearing cavity in front housing is clean and that felt dust seal is installed in recess. Press bearing into housing using A-203 tool (Fig. 19). Apply even pressure only to the outside race of the bearing. Install bearing retainer and secure with screws and lock washers.

Installing Rotor

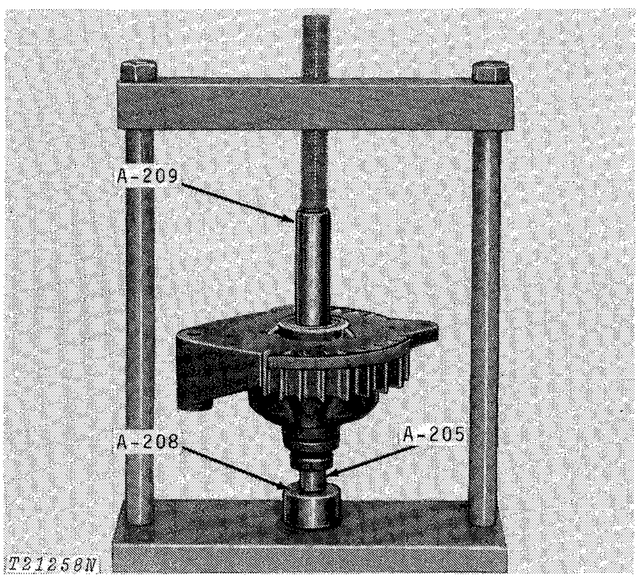


Fig. 20-Installing Rotor

Press assembled front housing onto rotor assembly using A-209 tool (Fig. 20). Support end of rotor shaft with A-205 tool inside of A-208 tool as illustrated.

Installing Rear Bearing

Support front housing in press using A-208 tool. Using A-206 bearing driver, press bearing on rotor shaft up to shoulder.

Install new rear bearing retainer in rear housing.

Installing Diode Heat Sink

Coat the three mica insulators with a thin coat of silicon grease or petrolatum. Make certain that all insulating washers are properly positioned. Secure heat sink to housing with terminal bolts.

Attach diode leads and stator leads to heat sink.

Assembling Stator To Rear Housing

Check that rear bearing retainer is properly seated in rear housing. Place stator in rear housing, with leads extended toward heat sink. Assemble leads to diode terminal screws. Each screw should hold a black negative diode lead, a red positive diode lead, and a lead from the stator. The terminal screw nearest the stator terminal will also hold the stator tap lead wire.

Arrange all leads to prevent accidental contact with surfaces, through bolts, or the rotor. Align stator slots with through bolt holes.

Assembling Front and Rear Housing

Place front housing, with rotor assembled, in a vise with the drive end down. Place sealing gasket over top edge of front housing. Place rear housing and heat sink assembly over top end of rotor, align bearing cavity, and press housings together.

Position gasket to align with through bolts and tighten to specifications. Spin rotor by hand to check that diode wires are not rubbing against rotor.

Installing Brush Assembly

Place insulator over brush assembly. Slide assembly into brush cavity and position with alignment pins. Secure insulator and brush assembly to rear housing and tighten screws to specified torque.

Installing Pulley

Place pulley spacer over rotor shaft and install Woodruff key in slot. Place pulley on shaft and tighten nut to specified torque. Spin rotor by hand to check that fan does not rub on housing.

SPECIFICATIONS

Item	Measurement
Alternator output (max.)	22 amp.
Alternator brushes	1/4-inch beyond holder (minimum)
System voltage	12 volt
Ground	Negative

Batteries

Specific gravity (corrected for 80°F. electrode temperature)	1.215 to 1.270
Maximum variation between cells	0.050 volts or 0.050 specific gravity

When replacing the battery, use the John Deere battery or its equivalent shown in the following chart:

Volts	John Deere Part Number	BCI Group	Cold Cranking AMPS 0°F.	Cold Cranking AMPS −20°F.	Reserve Capacity (Minutes at 25 amps)
12	AT29159	30H	475	395	150
12	AT29160	30H	570	450	180

Fan Belt Tension

With gauge (initial)	100 to 110 lbs.
(after three minutes of operation)	80 lbs. minimum
Without gauge	3/4-inch flex with 20 lbs. force

ALTERNATOR AND REGULATOR TEST SPECIFICATIONS

(Serial No. —186586)

Circuit Tests	Reading
Test No. 1 - Key Off	A) Battery voltage B) 0.0 volt C) 0.0 volt D) 0.0 volt
Test No. 2 - Key On	2.0 to 4.0 volts 1) Battery voltage ± 0.5 volt a) Battery voltage ± 4.0 volts
Test No. 3 - Key On, Engine Running	+2.0 volts
Test No. 4 - Key On, Engine Running	Battery voltage (Alternator Output)

(Serial No. 186587—)

(1) Switch off	0 volts
(2) Key on, engine stopped	2 volts
Regulator connector (purple wire)	12 volts
(3) Key on, engine stopped	
(regulator field or ground circuit open)	12 volts
(alternator field circuit open)	0 volts
(4) Engine running (initially)	20 amps at 13.0 volts approx.
(after a few minutes operation)	10 to 15 amps at 14.4 volts approx.

SPECIFICATIONS—Continued

ALTERNATOR OUTPUT TEMPERATURE CORRECTION CHART

Temperature*	Voltage
40°F.	14.3 to 15.1 volts
60°F.	14.1 to 14.9 volts
80°F.	14.0 to 14.8 volts
100°F.	13.8 to 14.6 volts
120°F.	13.7 to 14.5 volts
140°F.	13.6 to 14.3 volts

* *Measured 1 inch from regulator case.*

Wiring Resistance Test Chart

Test Points (Fig. 1)	Max. Voltage
A-B	0.3 volt
C-G	0.1 volt
D-H	0.1 volt
E-I	0.1 volt
B-J	0.1 volt
F-B	0.5 volt

TORQUE VALUES

Item	Torque
Pulley Nut	40 to 50 ft-lbs
Through Bolts	50 to 60 in-lbs
Brush Mounting Screws	16 to 20 in-lbs
Diode Mounting Nuts	20 to 30 in-lbs

SPECIAL TOOLS

No.	Name	Use
ESSENTIAL TOOLS		
A200JD	Alternator service tool set	Disassembly and Assembly of Alternator
A-201*	Press Assembly	
A-203*	Drive End Bearing Installation Tool	
A-205*	Shaft Protector	
A-206*	Slip Ring End Bearing Installation Tool	
A-207*	Drive End Housing Support Tool	
A-208*	Rotor Holder	
A-209*	Bearing Removal and Pulley Installation Tool	
A-213*	Diode Removal Tool	
A-214*	Diode Installation Tool	
A-216*	Alternator Housing and Bearing Puller	

**List of Tools in A200JD Alternator Service Tool Set*

Group 15
STARTING MOTOR

GENERAL INFORMATION

The starting motor has a totally enclosed shift lever and solenoid plunger to seal out dirt, icing conditions, and splash. Positive lubrication to the bushings is provided by oil saturated wicks.

An overrunning clutch is used with the starting motor.

When making tests, the battery voltage should not drop below 9 volts. Never run the starting motor more than twenty seconds at a time or overheating will result. Allow motor to cool at least two minutes before running it again.

FOS

Refer to "Starting Circuits" in FOS Manual - ELECTRICAL SYSTEMS for additional starting motor information.

DIAGNOSIS AND TESTS

Place the H-L-R lever in neutral and engage neutral lock lever. Turn key switch on and press start button.

Solenoid Switch Chatters
- Low battery
- Poor connection
- Open in solenoid hold-in circuit

Sluggish Starter Operation
- Low battery
- High resistance in circuit
- Excessive engine drag
- Defective starter

If starter does not operate, connect a voltmeter to the solenoid "S" terminal and a good ground.

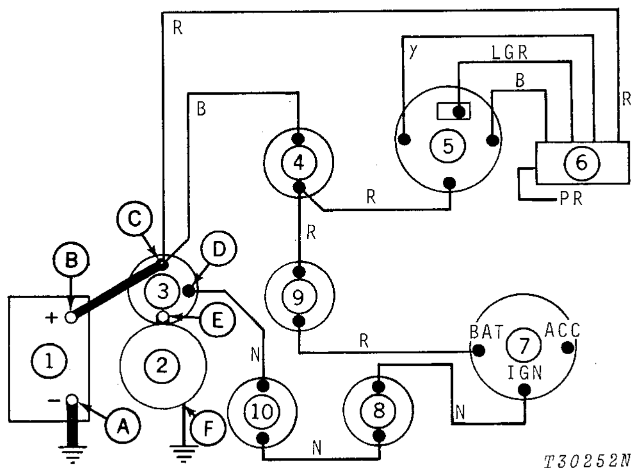
Voltmeter Indicates Battery Voltage
- Defective starter
- Defective starter solenoid switch

Voltmeter Does Not Indicate Battery Voltage
- Defective key switch
- Defective start button
- Defective start-safety switch
- Maladjusted start-safety switch
- Defective wiring between battery and solenoid "S" terminal

High Resistance Test

Disconnect wire from injection pump solenoid shut-off terminal.

Connect voltmeter to ground and to solenoid battery terminal. Operate starter and compare voltage with a similar reading at battery. Always use a pin connector at battery post. If difference is more than 0.8 volt, make the tests indicated in Fig. 1. Check for defective wires or faulty connections.



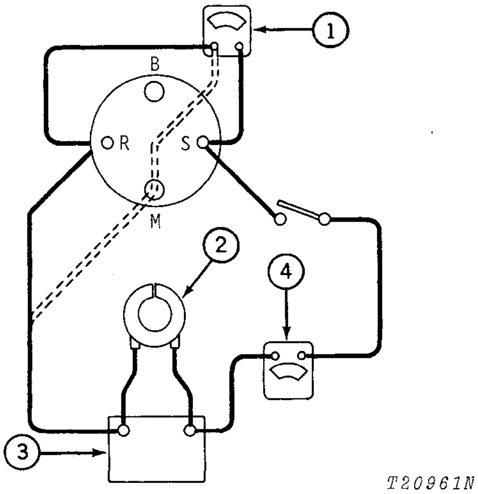
1—Battery	6—Regulator
2—Starter	7—Key Switch
3—Solenoid	8—Start Button
4—Ammeter	9—Circuit Breaker
5—Alternator	10—Start Safety-Switch

Fig. 1-Resistance Test

Make connections shown in Fig. 1 and check readings with chart below.

Test Points	Maximum Voltmeter Reading
A-F	0.2
B-C	0.2
C-D	1.0
C-E	0.2

Solenoid Tests (Starter Removed)



1—Voltmeter
2—Carbon Pile
3—Battery
4—Ammeter

Fig. 2-Solenoid Test Points

Testing Pull-In Windings

Disconnect field connector from solenoid motor terminal. Connect ammeter in series with a carbon pile resistor to terminal "S" and to battery. Connect voltmeter to terminal "S" and to solenoid motor terminal. With carbon pile in the off position, connect other battery post to solenoid motor terminal. Quickly adjust the carbon pile to obtain 10 volts. The ammeter reading should be 26.5 to 30.5 amps.

Testing Hold-In Windings

Disconnect solenoid. Connect ammeter in series with a switch to terminal "S" and to battery. Connect voltmeter to terminal "S" and to solenoid ground. Connect carbon pile resistor across the battery. Connect other battery post to solenoid ground. Close the switch and adjust carbon pile to obtain 10 volts. The ammeter reading should be 14.5 to 16.5 amps.

High Ammeter Reading

Windings are grounded or short circuited

Low Ammeter Reading

Excessive resistance is present (usually in a connection)

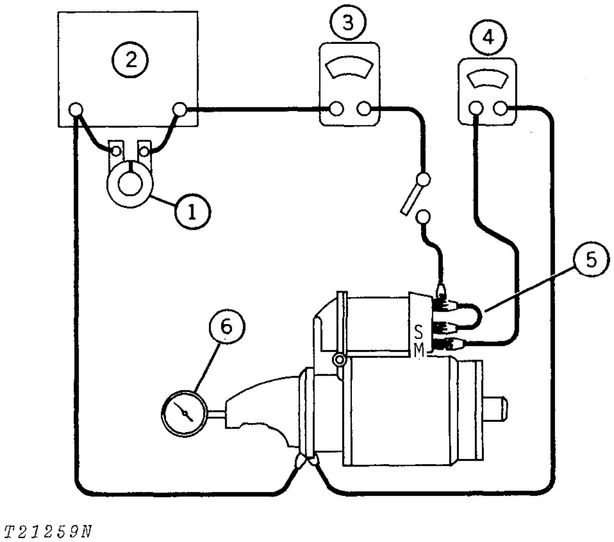
No Ammeter Reading

Windings are open circuited

To prevent overheating, do not energize the pull-in winding longer than fifteen seconds. Current draw will decrease as the winding temperature increases.

If the fault cannot be repaired and the solenoid performance is questionable, replace the windings.

Starter No-Load Test



1—Carbon Pile
2—Battery
3—Ammeter
4—Voltmeter
5—Jumper Lead
6—Tachometer

Fig. 3-No-Load Test Hook-Up

Make the hook-up as shown in Fig. 3. Do not run the motor more than fifteen seconds at a time or overheating will result. Allow motor to cool at least two minutes before running it again. Close switch to operate starter and adjust carbon pile to obtain specified voltage. Current draw and rpm should be a s follows:

Motor No.	Test Volts	Min. Amps	Max. Amps	Min. RPM	Max. RPM
1107871	10.6	105*	200*	6500	14000

* *Includes solenoid*

Fails to Operate, No Current Draw

Open circuited field circuit
Open armature coils
Defective brush contact with commutator

Fails to Operate, High Current Draw

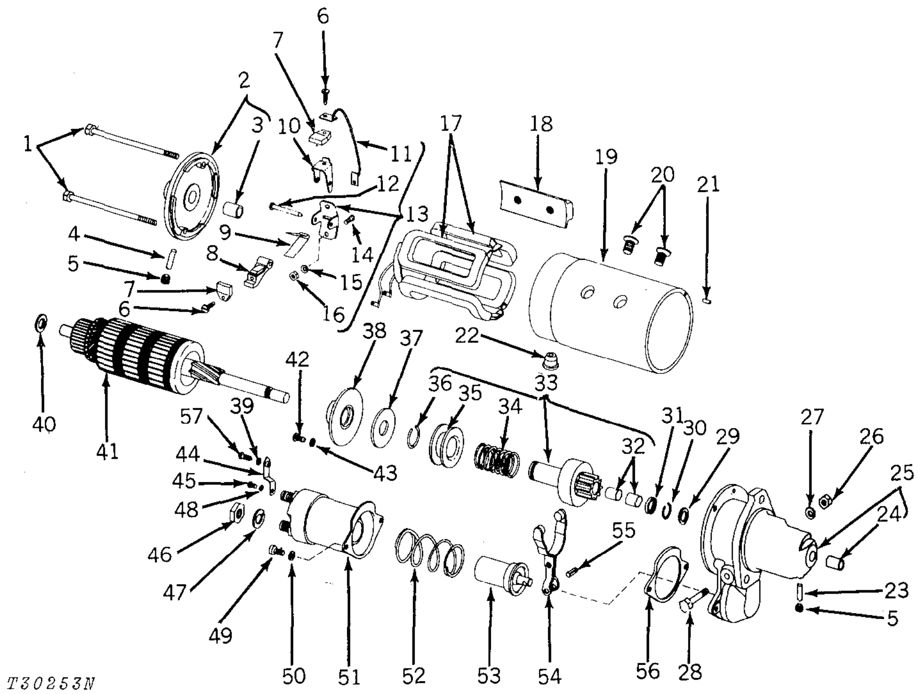
Grounded terminal or fields
Seized bearings

Low Speed, Low Current Draw
High internal resistance
Defective brush contact with commutator
Open armature coil

High Speed, High Current Draw
Shorted field coils

Low Speed, High Current Draw
Excessive friction caused by bad bearings, bent armature, or loose pole shoes
Shorted armature
Grounded armature or fields

REPAIR



1—Through Bolt (2 used)
2—Commutator End Frame
3—Commutator Bushing
4—Commutator End Wick
5—1/8″ Pipe Plug (2 used)
6—No. 8 x 3/4″ Drive Screw (4 used)
7—Brush (4 used)
8—Insulated Brush Holder (2 used)
9—Brush Spring (4 used)
10—Ground Brush Holder (2 used)
11—Lead Assembly (2 used)
12—Brush Pin (2 used)
13—Brush Support Package
14—No. 10 x 1/2″ Machine Screw (4 used)
15—No. 10 Lock Washer (4 used)
16—No. 10 Nut (4 used)
17—Field Coil Assembly
18—Pole Shoe (4 used)
19—Frame
20—Pole Shoe Screw (8 used)
21—Dowel Pin
22—Grommet
23—Drive End Wick
24—Drive End Bushing
25—Drive Housing
26—5/16″ Jam Nut
27—5/16″ Lock Washer
28—Shift Lever Screw
29—Drive End Thrust Collar
30—Retaining Ring
31—Pinion Stop
32—Clutch Bushing (2 used)
33—Motor Drive
34—Spring
35—Clutch Collar
36—Locking Wire
37—Brake Washer
38—Center Bearing Plate
39—No. 10 Lock Washer
40—Commutator End Spacer Washer
41—Armature
42—Center Bearing Screw
43—Lock Washer
44—Connector
45—No. 10 x 7/16″ Machine Screw
46—3/8″ Nut
47—3/8″ Lock Washer
48—No. 10 Internal Tooth Lock Washer
49—1/4″ x 1/2″ Machine Screw (2 used)
50—1/4″ Lock Washer (2 used)
51—Solenoid Switch Assembly
52—Plunger Return Spring
53—Solenoid Switch Plunger
54—Shift Lever
55—3/16″ x 13/16″ Spring Pin
56—Solenoid Gasket
57—No. 10 x 7/16″ Machine Screw

Fig. 4-Starting Motor

Disassemble motor only as far as necessary to make repairs (Fig. 4).

Mark position of commutator end frame with regard to main frame to aid in alignment during reassembly.

Disconnect field coil connector from solenoid motor terminal and remove solenoid mounting screws.

Remove commutator end frame. Remove field frame and solenoid from drive housing. Separate armature and clutch assembly from drive housing.

Remove snap ring retainer and pinion stop from armature shaft.

Do not clean any parts in grease-dissolving solvents. Wipe the drive with a clean cloth.

The commutator may be cleaned with No. 00 sandpaper. *Do not use emery cloth.*

If the commutator is worn, dirty, out of round, or has high insulation, it can be turned down in a lathe and the insulation undercut.

Checking Armature

Check the armature for opens, short circuits, and grounds. Shorts between bars are sometimes produced by brush dust or copper between the bars. These shorts can be eliminated by cleaning out the slots.

Check armature for straightness. If necessary, turn commutator and under cut the insulation to 1/32-inch depth.

Checking Brushes

Inspect brushes. If they are oil soaked or are worn to approximately 5/16 inch, replace them.

To remove brush holders, slide pivot pins out. When installing brushes, the long side of brush is toward the end frame. Tighten brushes after assembling starter.

Checking Field Coils

FOS

Test the field coil windings for grounds, opens and short circuits. Refer to "Starting Circuits" in FOS Manual-ELECTRICAL SYSTEMS for details.

If field coils are defective remove coils from frame using a pole shoe screwdriver. Use a pole shoe spreader to prevent distorting field frame.

IMPORTANT: Be careful when installing field coils to prevent shorting or grounding the coils as the pole shoes are tightened. Where the pole shoe has a long lip on one side and a short lip on the other, assemble the long lip in direction of armature rotation.

Repairing Overrunning Clutch Assembly

The pinion should turn smoothly with a slight drag in the overrunning direction and lock up in the opposite direction. If not, the entire clutch and pinion assembly must be replaced as the assembly cannot be repaired except for the spring and collar.

FOS

See Chapter 5 of FOS Manual 20—ELECTRICAL SYSTEMS for overrunning clutch service information.

Bushings

Pre-Lubricated Bushings

When install pre-lubricated bushings in the overrunning clutch, use an arbor (see "Special Tools") to prevent bearing collapse. After installation, check bushing size. Burnish bushing to size if necessary.

Wick-Lubricated Bushings

Remove pipe plugs, expansion plugs and oil wicks from housings. Press out old bushing. Press new bushing in to same depth as old bushing. Carefully drill bushing through oil wick hole using same size drill as oil wick hole.

After drilling, ream bushing to maintain proper oil clearance between shaft and bushing.

Soak new wicks in SAE 10 engine oil. Install wicks, expansion plugs and pipe plugs.

Bushing, Overrunning Clutch

I.D.	0.562-0.563 in.
Wear tolerance	0.574 in.

Bushing, Drive Housing

I.D.	0.499-0.501 in.
Wear tolerance	0.511 in.
Oil clearance	0.002-0.005 in.
Wear tolerance	0.017 in.

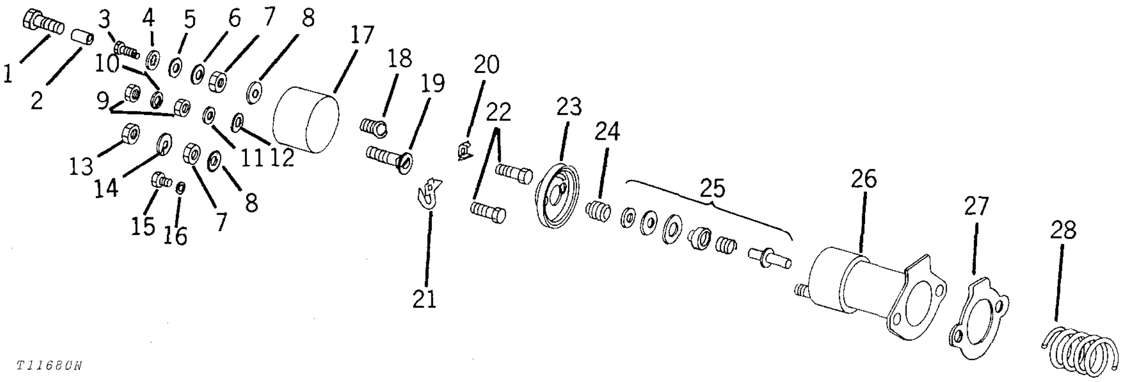
Bushing, Commutator End Frame

I.D.	0.5625-0.5635 in.
Wear tolerance	0.573 in.
Oil clearance	0.002-0.005 in.
Wear tolerance	0.016 in.

Bushing, Center Bearing

I.D.	0.760-0.762 in.
Wear tolerance	0.772 in.
Oil clearance	0.010-0.015 in.
Wear tolerance	0.025 in.

Solenoid Switch



1—Terminal Screw
2—Connector
3—Machine Screw
4—Lock Washer
5—Washer
6—Washer
7—Jam Nut (2 used)
8—Sealing Washer (2 used)
9—Nut (4 used)
10—Lock Washer (2 used)
11—Washer
12—Washer
13—Jam Nut
14—Lock Washer
15—Machine Screw (2 used)
16—Washer
17—Cover
18—Motor Terminal Stud
19—Battery Terminal Stud
20—Switch Terminal Clip
21—Contact
22—Switch and Resistor Terminal Stud (2 used)
23—Gasket
24—Return Spring
25—Contact Assembly
26—Case and Coil
27—Gasket
28—Return Spring

Fig. 5-Solenoid Switch

Remove nuts and sealing washers from solenoid motor and "S" terminals when removing switch cover.

Replacement "S" terminal clips and motor terminal studs are soldered to winding leads. Use new sealing washers when assembling the solenoid.

ASSEMBLY

To assemble starter, reverse the disassembly procedures.

Lubricate splines and drive end of armature shaft with SAE 10 engine oil. Heavier oil may cause failure to mesh at low temperature. Lubricate the bearing surfaces of the center bearing, drive end frame, and commutator end frame with Delco-Remy lubricant No. 1960954.

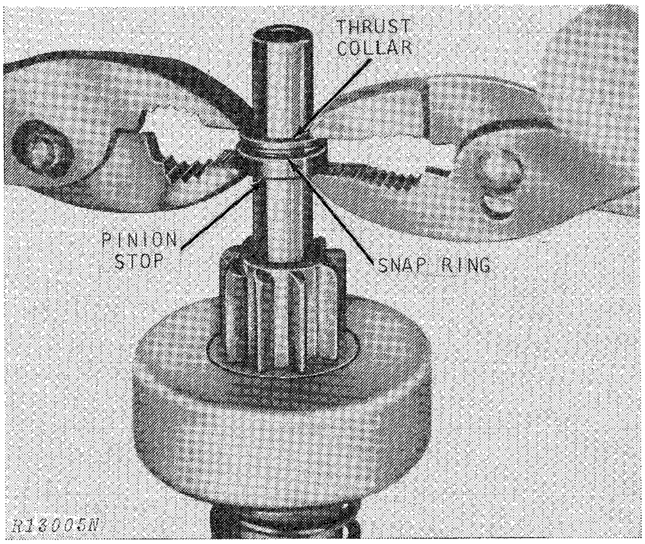


Fig. 6-Forcing Pinion Stop Over Snap Ring

With overrunning clutch in place, install pinion stop with cupped side out. Squeeze snap ring in its groove and force pinion stop over snap ring (Fig. 6).

Use Permatex No. 2 sealing compound between solenoid flange and starter field frame.

Carefully install field frame so that brush holders are not broken. Align brushes with commutator and tighten brushes.

If it is necessary to seat brushes, use No. 00 sandpaper. Clean all dust from starter.

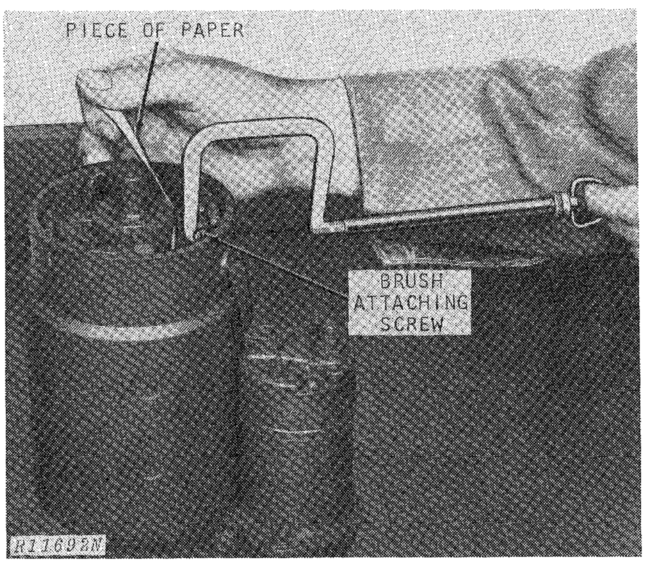
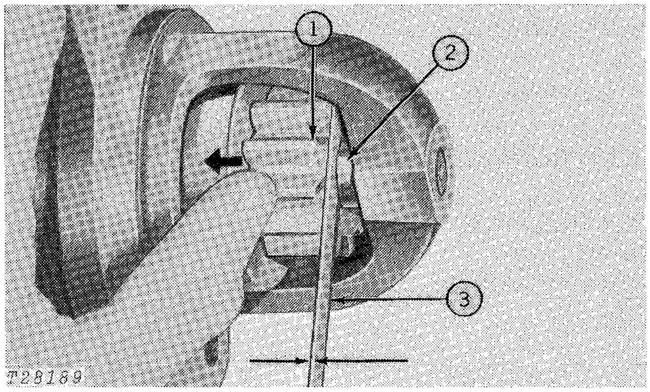


Fig. 7-Testing Brush Spring Tension

Brush spring tension should be 35 ounces or more (Fig. 7). Bend the springs to adjust tension.



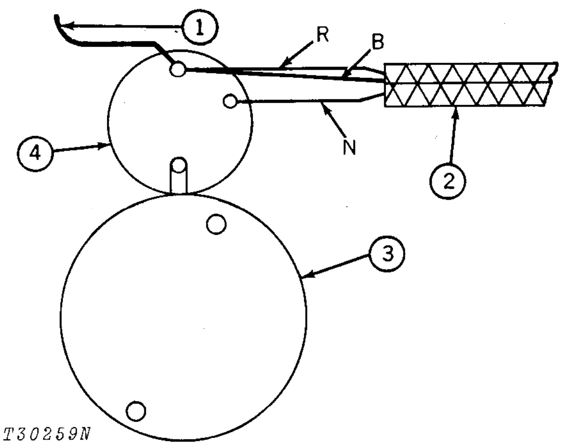
1—Pinion
2—Pinion Stop
3—Feeler Gauge

Fig. 8-Checking Pinion Clearance

To check pinion clearance, disconnect field coil from solenoid motor terminal. Connect battery to solenoid frame and "S" terminal. Momentarily connect a jumper wire between solenoid frame and motor terminal to pull solenoid plunger in. Clearance between pinion and pinion stop should be 0.010 to 0.140 inch, when pressing clutch toward commutator (Fig. 8).

Armature end play should be 0.050 to 0.060 inch.

INSTALLATION



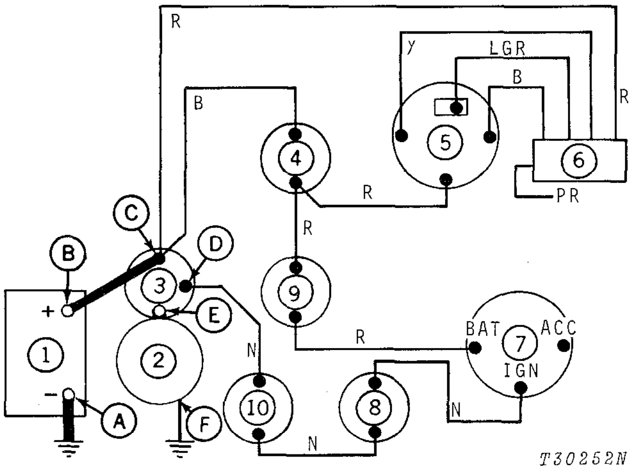
1—Positive Starter Cable
2—Wiring Harness
3—Starter
4—Solenoid Switch

Fig. 9-Starter Connections

Install starter. Connect wiring harness and positive battery cable. (Fig. 9).

SPECIFICATIONS

High Resistance Test



1—Battery
2—Starter
3—Solenoid
4—Ammeter
5—Alternator
6—Regulator
7—Key Switch
8—Start Button
9—Circuit Breaker
10—Start Safety-Switch

Fig. 10-Resistance Test Points

RESISTANCE TEST

Test Points	Maximum Voltmeter Reading
A-F	0.2
B-C	0.2
C-D	1.0
C-E	0.2

Maximum difference between starter voltage and battery voltage . . . . 0.8 volt

Item	Measurement	Specification	Wear Tolerance
Solenoid Model No. 114356			
Windings, Pull In	Current Draw	26.5 to 30.5 amps at 10 volts	------
Windings, Hold In	Current Draw	14.5 to 16.5 amps at 10 volts	------
Starter Model No. 1107871			
Bushing, Overrunning Clutch	I.D.	0.562-0.563 in.	0.574 in.
Bushing, Drive Housing	I.D.	0.499-0.501 in.	0.511 in.
Bushing, Drive Housing	Oil Clearance	0.002-0.005 in.	0.017 in.
Bushing, Commutator End Frame	I.D.	0.5625-0.5635 in.	0.573 in.
Bushing, Commutator End Frame	Oil Clearance	0.002-0.005 in.	0.016 in.
Bushing, Center Bearing	I.D.	0.760-0.762 in.	0.772 in.
Bushing, Center Bearing	Oil Clearance	0.010-0.015 in.	0.025 in.
Brush	Offset Direction	To commutator end frame	------
Brush	Minimum Length	5/16 in.	------
Spring, Brush	Minimum Tension	35 oz.	------
Commutator	Undercut Depth	1/32 in.	------
Armature	End Play	0.050 in.	0.060 in.
Pinion	Clearance	0.010-0.140 in.	------

SPECIFICATIONS—Continued

Starter No-Load Test

Motor No.	Test Volts	Min. Amps	Max. Amps	Min. RPM	Max. RPM
1107871	10.0	105*	200*	6500	14000

* *Includes solenoid.*

SPECIAL TOOLS

No.	Name	Use
Convenience Tools		
. . . .	Pole shoe screw driver	To remove field coils
. . . .	Pole shoe spreader	To install field coils
. . . .	Commutator turning tool	To turn and undercut commutator
. . . .	Armature tester	To check armature for shorts, grounds or opens
. . . .	Spring tension gauge	To check brush spring tension
. . . .	Pre-lubricated bearing arbor	Install overrunning clutch bushings

Make an arbor to the dimensions shown in Fig. 11 for installation of pre-lubricated bushings.

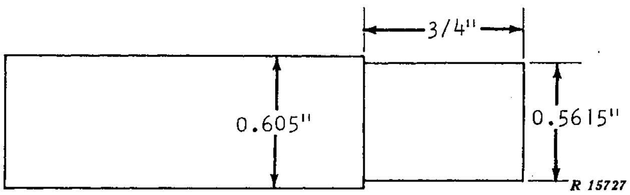


Fig. 11-Pre-Lubricated Bearing Arbor

Group 20
GAUGES AND SWITCHES

GENERAL INFORMATION

The tractor has both mechanical and electrical gauges and sending units. The tachometer gauge is mechanical. The engine coolant temperature and oil pressure gauges, transmission oil temperature gauge, hour meter, senders, and ammeter are electrical.

TESTS

For circuit tests of components, refer to Group 5.

A potentiometer or rheostat (approximately 0 to 200 ohms) and an ohmmeter are required to check electrical gauges and senders.

Checking Electrical Gauges

Set potentiometer or rheostat with ohmmeter at nominal sender resistance for value given in "Specifications."

Remove lead from sender and connect rheostat between sender lead and loader ground. If gauge reads correctly, sender could be faulty.

Check gauge with engine running to maintain proper voltage.

Checking Electrical Sending Units

Remove sender and install in a system with a known accurate gauge with numbered face dial.

Connect ohmmeter across sender (to sender lead terminal and base of sender). Adjust pressure or temperature to value given in "Specifications" and check resistance on ohmmeter.

Cigar Lighter

When installing cigar lighter lead, use two spacer nuts to position lead away from cigar lighter housing.

SPECIFICATIONS

Item	Mark	Specification Value
GAUGES		
Engine coolant temperature	1st	140°F.
	2nd	190°F.
	Orange	222°F.
	3rd	270°F.
Engine oil pressure	1st	0 psi
	2nd	18 psi
	3rd	40 psi
	4th	80 psi
Transmission oil temperature	1st	140°F.
	2nd	190°F.
	Orange	222°F.
	3rd	270°F.
SENDING UNITS		
Engine coolant temperature		200°F. at 122 ± 10% ohms
Engine oil pressure		40 psi at 103 ohms
Transmission temperature		200°F. at 122 ± 10%
START SAFETY SWITCH		
Spring (flush with housing) pressure		6 ± 1 lb.

	Replacement Number	Value
LAMPS		
Dash lamp	GE-631	12VDC, 0.63 amp.
Operating lamps (all)	GE-4406	12VDC, 35 watt

Section 50

POWER TRAIN

CONTENTS OF THIS SECTION

Group 5
DIAGNOSIS

DIAGNOSING SYSTEM MALFUNCTIONS

Crawler Fails to Move

Clutch (Group 10)
- Clutch linkage improperly adjusted.
- Clutch slips.
- Clutch levers out of adjustment.
- Throw-out bearing shaft or fork damaged.
- Throw-out bearing not releasing fully.
- Clutch levers loose on bracket.

H-L-R Transmission (Group 15)
- Front input shaft broken.
- Shifter forks or shafts damaged.
- Transmission shaft or gear failure.
- Transmission shifter collars damaged.
- Improper valve adjustment.
- Low oil level or oil pressure.

Crawler Makes Excessive Noise When Moving

Clutch (Group 10)
- Clutch disk loose from plate.
- Flywheel loose.

H-L-R Transmission (Group 15)
- Transmission parts worn or damaged.
- Transmission oil level low.
- Shifter forks and shafts worn.
- Oil pump worn.
- Valves out of adjustment.
- Mechanical failure within clutch pack.

Excessive Vibration

Clutch (Group 10)
- Incorrect assembly.
- Flywheel loose.

H-L-R Transmission (Group 15)
- Bent or damaged shafts.
- Improper shaft adjustment.
- Improper transmission assembly.
- Mechanical failure within clutch pack.

Group 10
CLUTCH ASSEMBLY

GENERAL INFORMATION

The clutch mechanism is located on the rear of the engine flywheel and is enclosed by the clutch housing (Fig. 1). A pedal mechanically controls the clutch throw-out bearing which engages or disengages the driven disk by means of a spring-loaded pressure plate. An 11-inch driven disk is used.

Partially depressing the clutch pedal stops tractor motion but does not stop powershaft rotation. Thus "live power" is available at all times for PTO or winch drive operations.

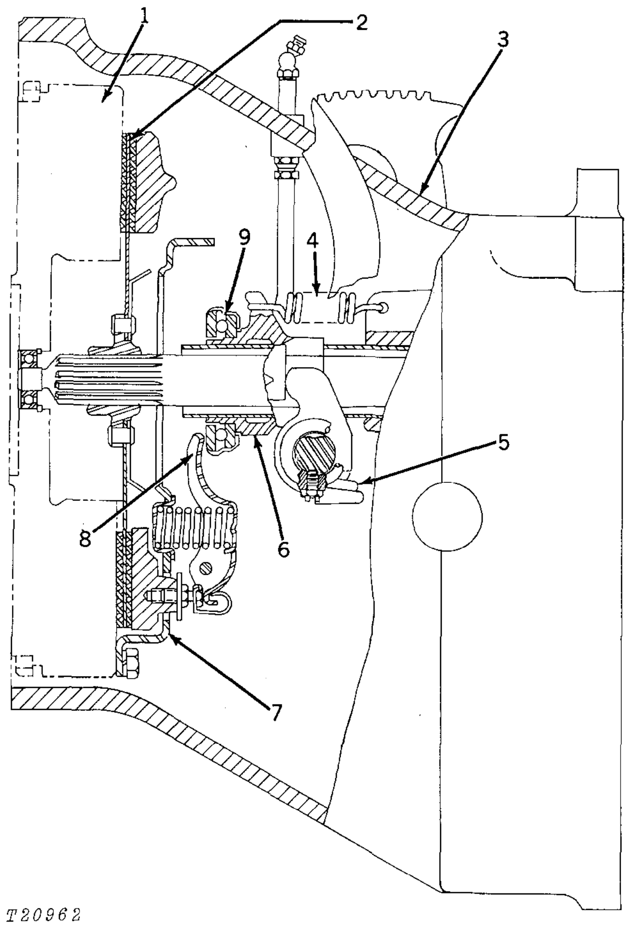
When the clutch pedal is depressed, clamping action of the pressure plate is released, allowing the clutch driven disk to stop rotating with the pressure plate and flywheel. This is the disengaged position.

When the clutch pedal is released, coil springs within the pressure plate mechanism act against the pressure plate disk and clamp the friction surfaces of the driven disk between the pressure plate and the clutch surface of the flywheel. This causes the clutch driven disk to rotate with the pressure plate assembly and flywheel, thereby transmitting engine power to the transmission. This is the engaged position.

Clutch and clutch control linkages have been so designed that minor adjustment of the clutch is made externally, thereby eliminating disassembly of the clutch except at time of major overhauls (Fig. 1).

Clutch controls and pedal shaft are mounted in center portion of the clutch housing. Movement of the clutch pedal is transmitted through the clutch linkage to the throw-out bearing.

The front input shaft transmits engine power from the flywheel through the splined hub of the clutch driven disk directly to the transmission. The front end of the front input shaft is supported by the clutch pilot bearing located in the flywheel.



1—Flywheel
2—Clutch Driven Disk
3—Clutch Housing
4—Carrier Return Spring
5—Clutch Pedal Return Spring
6—Throw-Out Bearing Carrier
7—Clutch Pressure Plate
8—Clutch Lever
9—Clutch Throw-Out Bearing

Fig. 1-Clutch and Control Linkage

The clutch also serves as the PTO or winch drive clutch. The powershaft drive gear, splined to the input shaft under the front cover, drives the PTO driven gear and shaft or the winch drive shaft. Power is transmitted only when the engine is running and the clutch is engaged. The H-L-R transmission "live power" operation is provided by partially depressing the clutch, stopping tractor motion but not stopping power to the powershaft.

DIAGNOSING CLUTCH MALFUNCTIONS

Clutch Slips

Worn or burned clutch disk facings.
Replace clutch disk. Check pressure plate.

Oil or grease on clutch disk facing.
Clean or replace disk.

No clutch free travel.
Adjust pedal linkage.

Clutch levers out of adjustment.
Adjust clutch levers.

Weak clutch springs.
Check springs to specifications.

Clutch Chatters.

Loose clutch disk facings.
Replace clutch disk.

Clutch disk loose at hub.
Repair disk.

Cracked or broken pressure plate.
Replace pressure plate.

Worn clutch throw-out bearing.
Replace and lubricate periodically.

Clutch Makes Noise (While Engaged)
Clutch shaft or disk splines worn.
Replace shaft and disk.

Clutch disk loose at hub rivets.
Replace disk.

Flywheel loose on crankshaft.

Clutch Drags (While Disengaged)

Excessive pedal free travel.
Adjust pedal linkage.

Distorted or rough clutch shaft splines.
Repair or replace shaft and disk.

Disk hub tight on clutch shaft.
Repair or replace shaft and disk.

Disk facing broken.
Replace clutch disk.

Clutch disk warped or bent.
Replace clutch disk.

High spots on disk.
Replace clutch disk.

Excessive clutch face run-out (flywheel not seated properly).
Remove flywheel and seat correctly.

Clutch disk frozen to flywheel.
Clean or replace disk.

Clutch Pedal Pulsates

Broken or missing clutch pedal spring.
Replace spring.

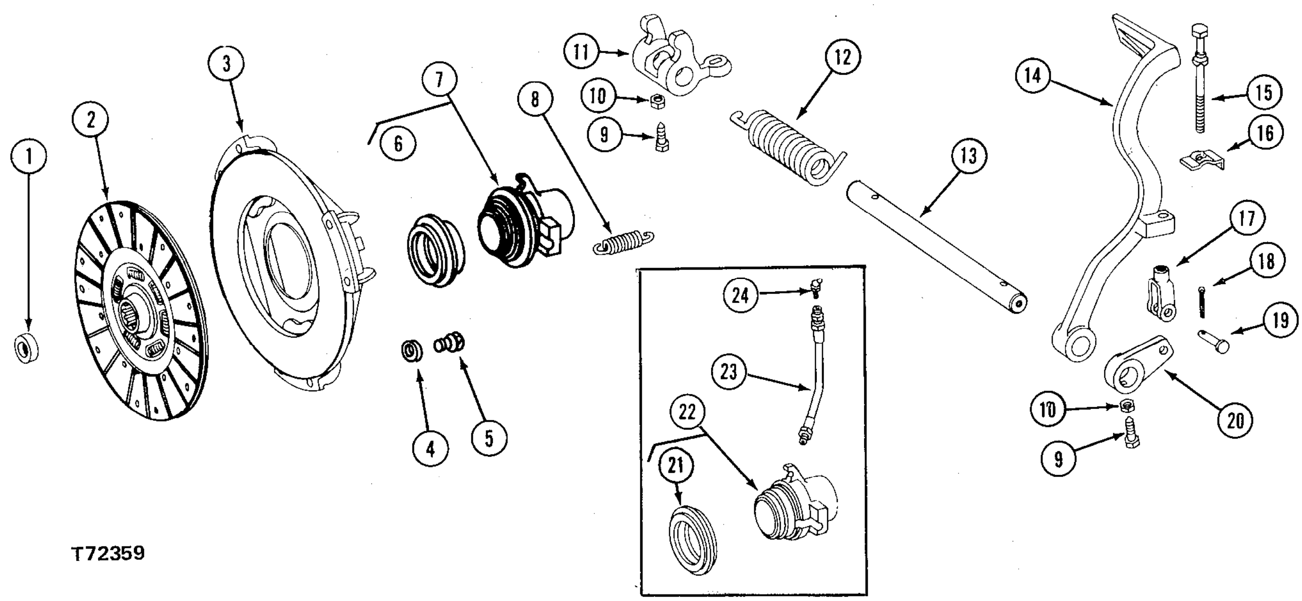
Clutch levers out of adjustment.
Adjust levers.

Flywheel not seated correctly.
Remove flywheel and seat correctly.

Bent crankshaft flywheel flange.
Replace crankshaft.

Bent clutch shaft.
Replace shaft and disk.

REPAIR



1—Pilot Bearing
2—Driven Disk
3—Pressure Plate
4—Lock Washer (6 used)
5—Special Cap Screw (6 used)
6—Throw-Out Bearing (133851-)
7—Throw-Out Bearing Carrier (133851-)
8—Spring
9—Special Set Screw (2 used)
10—Nut (2 used)
11—Fork
12—Return Spring
13—Shaft
14—Clutch Pedal
15—Clutch Adjusting Bolt
16—Detent Seat
17—Yoke
18—Cotter Pin
19—Pin
20—Clutch Adjusting Lever
21—Throw-Out Bearing (-133850)
22—Throw-Out Bearing Carrier (-133850)
23—Grease Tube (-133850)
24—Grease Fitting (-133850)

Fig. 2-Clutch Assembly

Separate tractor between engine and clutch housing (Section 10, Group 25).

Remove pressure plate attaching cap screws and lift pressure plate and driven disk from flywheel.

Remove all grease and dirt from the clutch operating parts.

IMPORTANT: Do not immerse clutch drive facings in any type of cleaning solution as it will tend to glaze them.

PRESSURE PLATE

Refer to Fig. 1 for identification of parts.

Disassemble the pressure plate by depressing the inner ends of the clutch levers as far as possible without forcing against bracket.

With an open end wrench, loosen lock nuts. Back out the three adjusting screws from pressure plate and remove return clips.

Release assembly by gradually releasing load on springs. The clutch may then be disassembled for inspection. To separate clutch levers from bracket, first remove pivot pins.

Check pressure plate for cracks, warped condition, and excessive wear. Check pressure springs in the assembly for damaged, weak, or rusty coils. Each part should be carefully inspected for wear and replaced if there is any question of its serviceability. (See "SPECIFICATIONS", page 50-25-1).

Clutch levers, bracket, and pivot pins should be replaced if any wear is found on these parts. Note carefully the condition of return clips and replace as necessary.

CLUTCH DRIVEN DISK

Examine clutch facings. If there is evidence of excessive wear, greasy condition, or glazing, replace the facing. Normally clutch facings should be replaced at the time of every major engine overhaul.

FLYWHEEL AND CLUTCH PILOT BEARING

Check pilot bearing for excessive wear or tight spots by rotating inner bearing race with finger.

Replace bearing if defective. Pack new bearing with high-temperature grease. Drive in new bearing (shielded side out) to bottom of counterbore with a driver which will contact only the outer bearing race.

PRESSURE PLATE ASSEMBLY

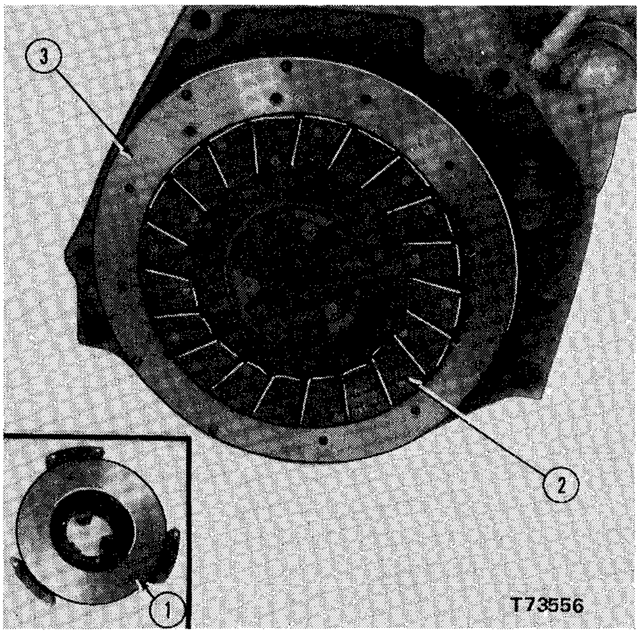
Assemble clutch levers and bracket with new pivot pins. Secure pins in position and install pressure springs into their recesses.

Assemble bracket, spring, and clutch lever subassembly over pressure plate making certain slots in bracket align with pressure plate drive lugs. Lubriplate sides of drive lugs to assure free operation of clutch assembly.

Place this assembly on hydraulic press and apply pressure on the lever directly above the pressure spring while forcing the spring into position in bracket.

Assemble return clips under adjusting screws in pressure plate. Make certain return clips are in proper position, and then tighten lock nuts.

INSTALLATION

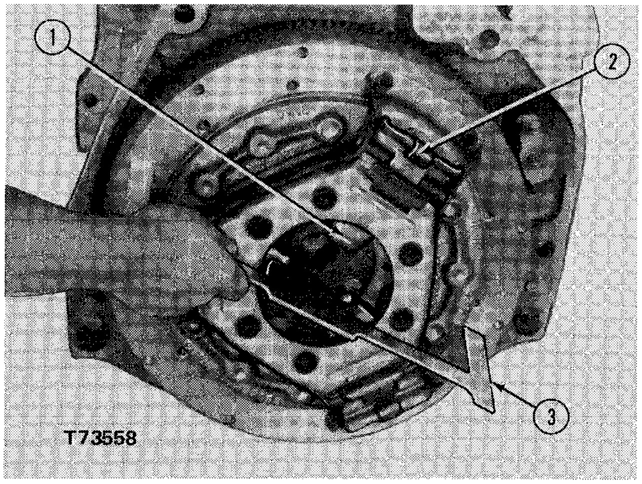


1—Pressure Plate Assembly 3—Flywheel
2—Driven Disk

Fig. 3-Installing Clutch Assembly on Engine Flywheel

Using either a clutch disk centering shaft (JDE-52) or a clutch shaft, position clutch pressure plate assembly and driven disk over end of shaft and into place on rear of flywheel. Bolt the pressure plate to flywheel. Refer to Fig. 3.

ADJUSTMENT



1—Clutch Release Levers 2—Lever Adjustment
3—JD227

Fig. 4-Adjusting Clutch Levers

Adjust the setting of the clutch levers using gauge (JD-227) as follows.

Place the gauge over the pressure plate with the gauge legs resting on the flywheel and notched area over a clutch lever. Move the adjusting screw in or out to place clutch levers at the proper level (2.000 ± 0.03 inch). Repeat the above procedure on remaining clutch levers. Refer to Fig. 4.

After the release levers are adjusted and lock nuts tightened, exercise the clutch levers several times. Recheck adjustment and change if necessary. If the levers dropped excessively, this process should be repeated until the setting is permanent.

IMPORTANT: To insure proper clutch functioning, the variation in adjusted height of release levers should not exceed 0.010 inch.

CLUTCH CONTROLS AND CLUTCH HOUSING REPAIR

Refer to Figs. 5 and 6, page 50-10-5 and perform the following steps:

1. Remove cotter pin and pin attaching PTO control lever to shifter shaft.

2. Remove grease tube from housing and throw-out bearing carrier (-133850).

3. Remove the stop nut fastening valve operating arm to link. Rotate arm upward to free from threaded bolt. Be careful not to lose spacer and spring.

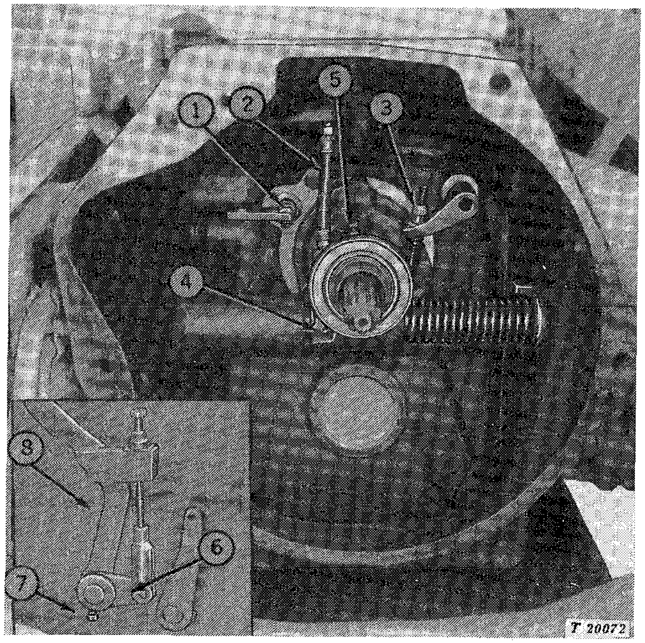


Fig. 5-Clutch Control Linkage (-133851)

4. Remove jam nut and set screw fastening throw-out bearing fork to clutch pedal shaft.

5. Unhook return spring from throw-out bearing carrier and slide bearing on carrier from tube on transmission front cover.

6. Disconnect fork from clutch adjusting lever.

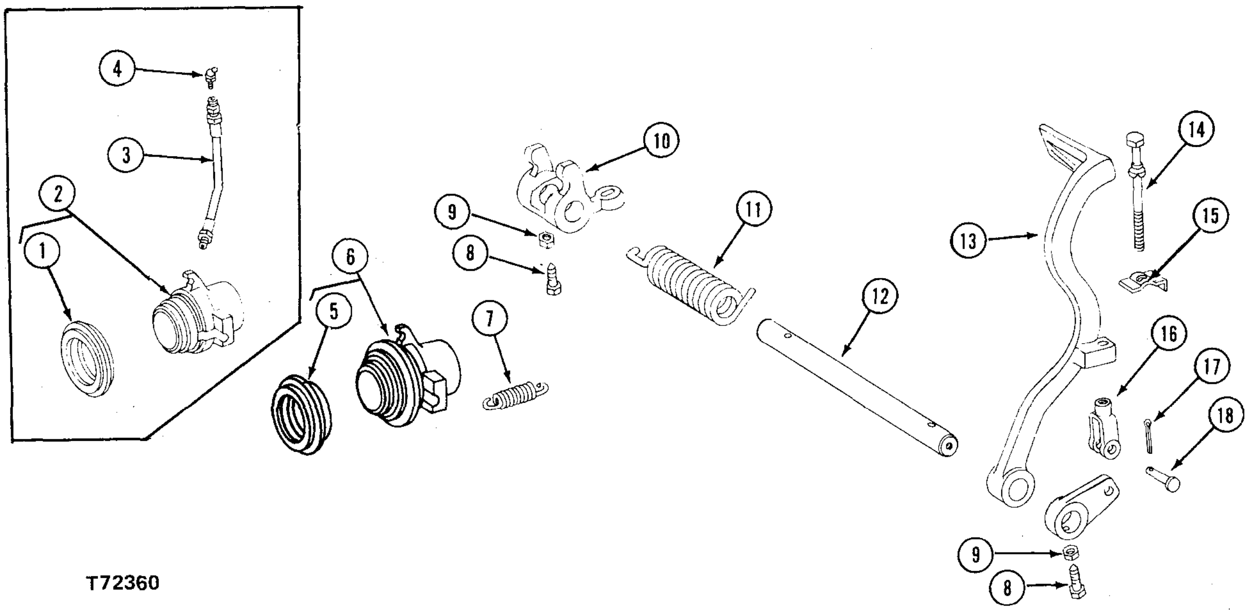
7. Loosen jam nut and set screw and remove clutch adjusting lever.

8. Slide off clutch pedal.

NOTE: If clutch housing, clutch pedal shaft, clutch pedal return spring or throw-out bearing fork are damaged and must be replaced, clutch housing must be removed from tractor (Section 10, Group 25). Inspect parts and replace as necessary. Clutch housing-to-transmission case cap screws must be tightened to 300 ft-lbs.

CLUTCH HOUSING

Inspect housing for cracks or other damage. Replace if necessary. Examine bushings in pedal shaft bores. Install left bushing until flush with outside edge of housing. Drive in other bushing until flush with inside edge of bore in housing.



1—Throw-Out Bearing (-133850)
2—Throw-Out Bearing Carrier (-133850)
3—Grease Tube (-133850)
4—Grease Fitting (-133850)
5—Throw-Out Bearing (133851-   )
6—Throw-Out Bearing Carrier (133851-   )
7—Spring
8—Set Screw (2 used)
9—Nut (2 used)
10—Fork
11—Return Spring
12—Shaft
13—Clutch Pedal
14—Adjusting Bolt
15—Detent Seat
16—Yoke
17—Cotter Pin
18—Pin

Fig. 6-Clutch Control Linkage

CLUTCH CONTROLS REPAIR

Clutch Throw-Out Bearing and Bearing Carrier

Check throw-out bearing for evidence of overheating (blue discoloration of surface). If bearing appears to have been overheated or is rough, replace bearing (-133850) or replace clutch throw-out bearing carrier (133851-   ).

IMPORTANT: Throw-out bearing should not be soaked in solvent as it is pre-packed with grease. Wipe clean with cloth dampened in solvent. No attempt should be made to oil bearing.

The throw-out bearing is a vital part of the power train for the tractor. If there is any doubt at all about the condition of this bearing, replace it with a new one. If replacement is necessary, use an arbor press to remove old bearing from carrier (-133850).

Inspect bearing carrier for evidence of excessive wear, cracks, or other damage. Test carrier on carrier tube to be sure it slides freely.

If bearing needs replacing press new bearing onto carrier with the highly polished surface out and scribe mark aligned with notch in carrier (-133850).

IMPORTANT: To prevent damage to bearing balls, insert a block of wood between bearing and arbor or use some similar means to rotate bearing while installing (-133850). Do not use excessive pressure.

Clutch Pedal, Shaft, Adjusting Lever, and Bolt

Inspect shaft for evidence of wear, especially at points of contact. Inspect clutch pedal and adjusting lever for cracks or other damage. Examine adjusting bolt and detent seat for damage. Replace as necessary.

Clutch Throw-Out Yoke and Springs

Inspect clutch throw-out bearing fork for cracks or worn portions (especially at point where fork contacts throw-out bearing carrier). Examine large pedal return spring for damaged or set coils.

Inspect all remaining parts of clutch control linkage for wear or damage and replace as necessary.

NOTE: See Fig. 6, page 50-10-5 for correct location of parts.

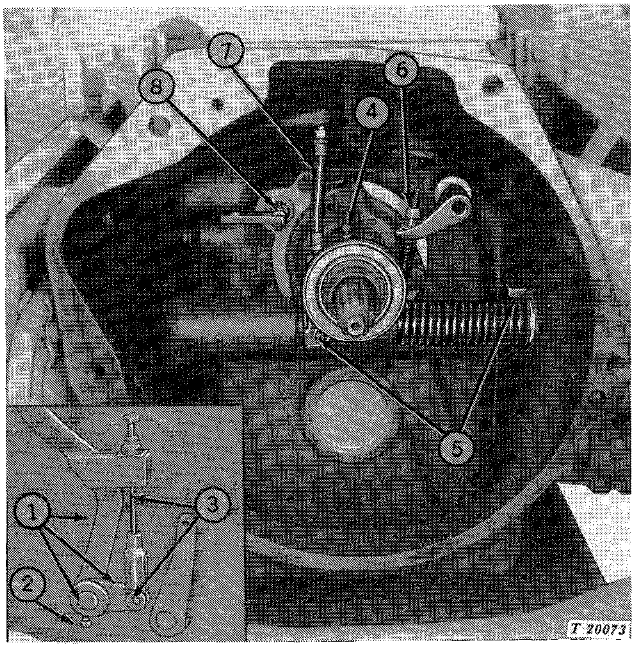


Fig. 7-Clutch Coltrol Linkage (-133850)

Refer to Fig. 7 and perform the following steps:

1. If clutch pedal shaft, throw-out bearing fork and pedal return spring were removed they must be installed before clutch housing is joined to transmission. Inset clutch pedal shaft through left wall of clutch, and reaching inside of housing, position yoke and spring. Push shaft on into right wall of housing. Install pedal and adjusting lever. Join clutch housing to transmission case.

2. Fasten adjusting lever with set screw and jam nut. Tighten jam nut to 35 ft-lbs.

3. Install adjusting bolt and detent seat in pedal. Attach fork to bolt and adjusting lever.

4. Slide throw-out bearing and carrier onto tube and connect carrier return spring.

5. Make sure pedal return spring is hooked behind tab on left side of clutch housing. Pushing yoke to rear against force of spring, index holes in fork and shaft. Install set screw and jam nut. Tighten set screw and jam nut to 35 ft-lbs.

6. Insert threaded link with spring in operating arm. Install spacer, washer and lock nut. Turn lock nut approximately five turns. Refer to H-L-R clutch valve adjustment for final adjustment of stop nut.

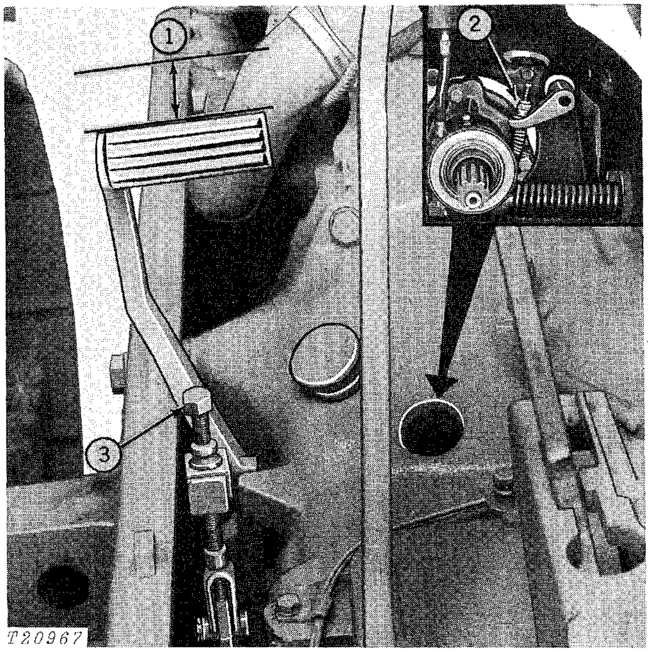
7. Install grease tube or throw-out bearing carrier. (If grease fitting on clutch housing was removed, install it so that it points to rear of tractor (-133850).

8. Connect PTO control lever to shifter shaft using pin and cotter pin.

JOINING THE TRACTOR

Install engine using procedure outlined on page 10-25-1.

ENGINE CLUTCH AND H-L-R CLUTCH VALVE ADJUSTMENT



1—Free Travel
2—H-L-R Linkage Stop Nut
3—Pedal Detent Adjusting Screw

Fig. 8-Adjusting H-L-R Linkage

Whenever the clutch and H-L-R linkage have been removed, or clutch pedal free travel becomes less than 3.250 inch or whenever H-L-R shifts from high to reverse too aggressively, the linkage must be readjusted. Be sure to make both adjustments in the sequence given below.

First adjust clutch pedal free travel to 3.750 inch at the clutch pad as follows: Remove left footrest from tractor. Observe detent set screw on clutch pedal arm on left side of clutch housing (Fig. 8). Loosen detent screw to increase free travel or tighten screw to decrease free travel. Always end up with screw in the detent (locked position).

Refer to "Testing" on page 50-15-10 and install pressure gauge as instructed. Turn H-L-R clutch valve stop nut down until clutch pedal starts to pull away from stop, then back it out five turns.

With the foot brakes on, start the engine. Place the speed selector lever in a neutral position and the H-L-R range selector in neutral. Slowly release the clutch pedal and set the engine speed at slow idle. Record pressure reading.

While observing the pressure, turn down (clockwise) the H-L-R linkage stop nut at a slow rate. As the nut is turned the pressure at the gauge will increase to a maximum and then drop as the nut is turned further. From the point where a 5-10 psi pressure drop occurs, continue to turn the nut one complete turn clockwise.

When properly adjusted, pressure at the gauge should rise 5 to 10 psi when clutch pedal is depressed 1/2 to 3/4 inch. If more than 3/4 inch pedal travel is required to get 5 to 10 psi rise, turn stop nut counterclockwise. If less than 1/2 inch pedal travel is required, turn stop nut clockwise.

CHECK H-L-R LINKAGE FOR WEAR

With H-L-R valve in neutral detent, H-L-R lever has some movement before linkage moves valve arm out of neutral detent. This movement increases as pivot points in linkage wear or yoke nut is not tight.

1. Place H-L-R lever in neutral position.

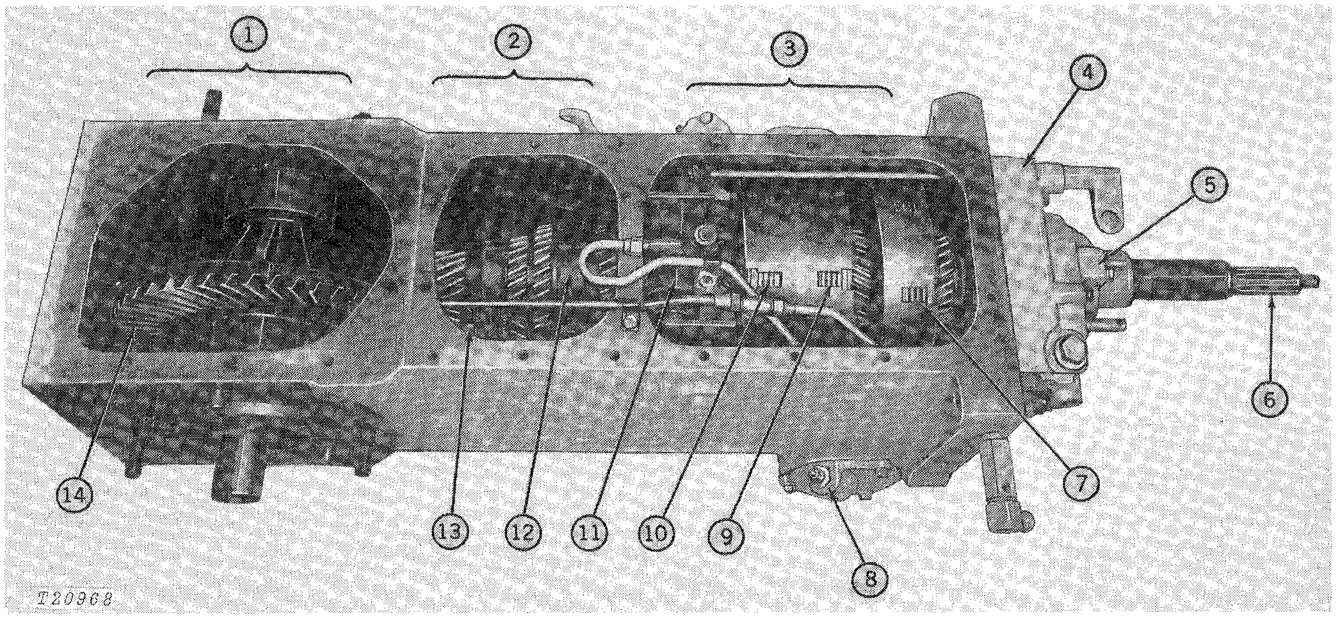
2. Apple slight amount of rearward pressure on lever holding it against detent. Mark location of lever on quadrant. Apply slight amount of forward pressure on lever holding it against opposite side of detent. Mark location of lever on quadrant. Use same spot on lever for both markings. Measure distance between the two marks. If distance is less than 0.5 in., linkage wear is not a problem.

3. If distance is 0.5 in. or more, inspect control rod pivot pin, control rod yoke, and pivot pin for wear. One or more of these wear points must be repaired to bring control linkage free travel under 0.5 in. Be sure jam nut is tight.

Group 15

H-L-R TRANSMISSION

GENERAL INFORMATION



1—Ring Gear and Hub Compartment
2—Speed Change Compartment
3—Range Change Compartment
4—Transmission Front Cover
5—H-L-R Oil Pump
6—Front Drive Shaft
7—High Clutch
8—Reservoir Filter Screen Cover
9—Reverse Clutch
10—Low Clutch
11—Clutch Control Unit
12—Rear Drive Shaft
13—Pinion Shaft Assembly
14—Ring Gear Assembly

Fig. 1-Transmission Case and Components (Early Unit)

The H-L-R transmission is basically a collar shift transmission plus a hydraulic reverser and underdrive unit. The two features work as follows:

Manual Shifting of Gears. Shift lever beside operator's seat is used to select one of four shift stations by manual shifting of collars on gears in the speed change compartment.

Shifting "On the Go." Reverser lever on platform (-142199) or battery box (142200-) is used to reverse the gear train or to shift from high to low gear under load without clutching by means of hydraulic clutches in the range change compartment.

The reverser lever can select a high, low or reverse gear for any of the four shift stations, making available eight forward gears and four reverse gears.

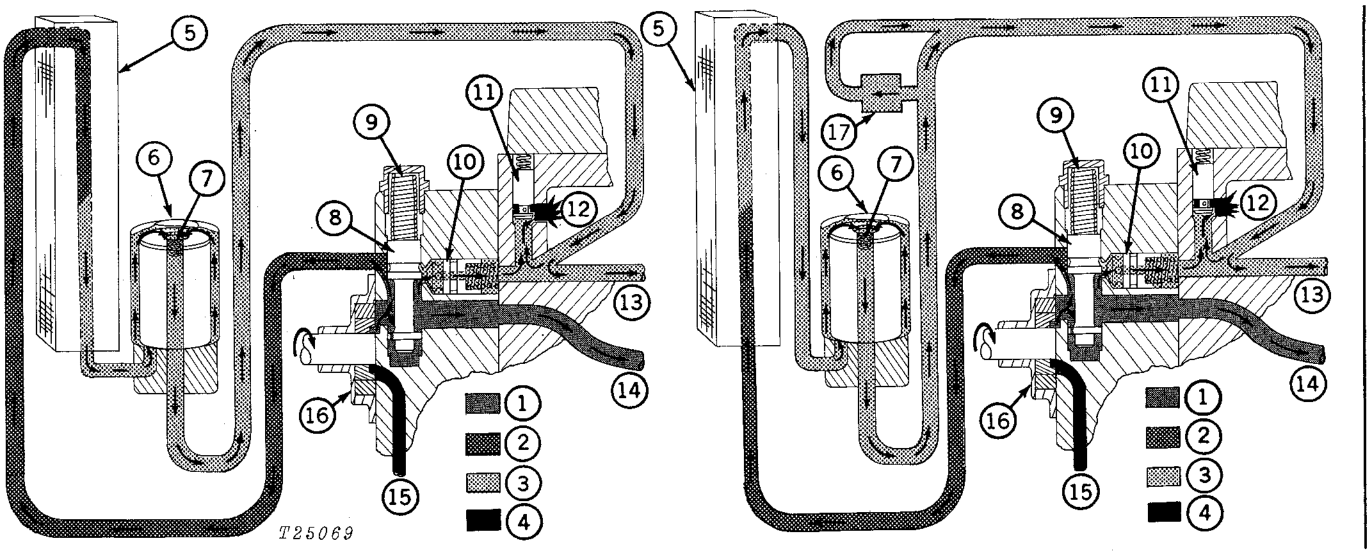
TRANSMISSION CASE UNITS

The transmission case (Fig. 1) contains three separate compartments. From front to rear they are:

Range Change Compartment (3). A control valve unit operates the three hydraulic clutches—high, low, and reverse—mounted on the clutch shaft. The transmission front drive shaft and two countershafts transmit rotation to the clutch shaft.

Speed Change Compartment (2). The rear drive shaft carries four gears which mesh with gears on the pinion shaft. The pinion shaft carries the shifters, shifter collars, and driven gears which transmit a specific speed through the pinion to the ring gear.

Ring Gear and Hub Compartment (1). This compartment houses the ring gear and hub which receive rotation from the pinion and transmit it to the final drives.



1—Pressure Oil
2—Intermediate Pressure Oil
3—Low Pressure Oil
4—Pressure Free Oil
5—Oil Cooler
6—Oil Filter
7—Protective Filter Bypass
8—Pressure Regulating Valve
9—Shims
10—Cooler Bypass Valve
11—Clutch Lubricating Bypass Valve
12—Excess Oil to Reservoir
13—Lub. Oil to Clutches and Output Shaft
14—Engaging Oil to Clutches
15—Oil From Reservoir
16—Clutch Oil Pump
17—Power Steering System

Fig. 2-Transmission Oil Supply System

OPERATION OF TRANSMISSION OIL SUPPLY SYSTEM

The transmission oil supply system cools and filters the oil and delivers it as needed for all functions of the transmission. Flow of oil in the system is shown in Fig. 2.

Oil is sucked from transmission case reservoir by the clutch oil pump and constantly delivered to the pressure regulating valve. This valve sends the oil "on demand" to the H-L-R clutches for engagement or to the oil cooler to be cooled and filtered and returned for clutch lubrication.

During clutch engagement, pressure oil from the pump is sent to the engaging clutch pack. As the clutch engages and oil is no longer demanded, back-up pressure further opens the regulating valve and diverts excess incoming oil to the cooler. If the pressure differential between oil cooler inlet oil and clutch lubricating oil rises above 80 to 100 psi, the oil cooler bypass valve opens and diverts excess oil to the clutch lubricating oil circuit. Excess lubricating oil is in turn relieved as the clutch lubricating oil bypass valve opens and dumps it to the reservoir.

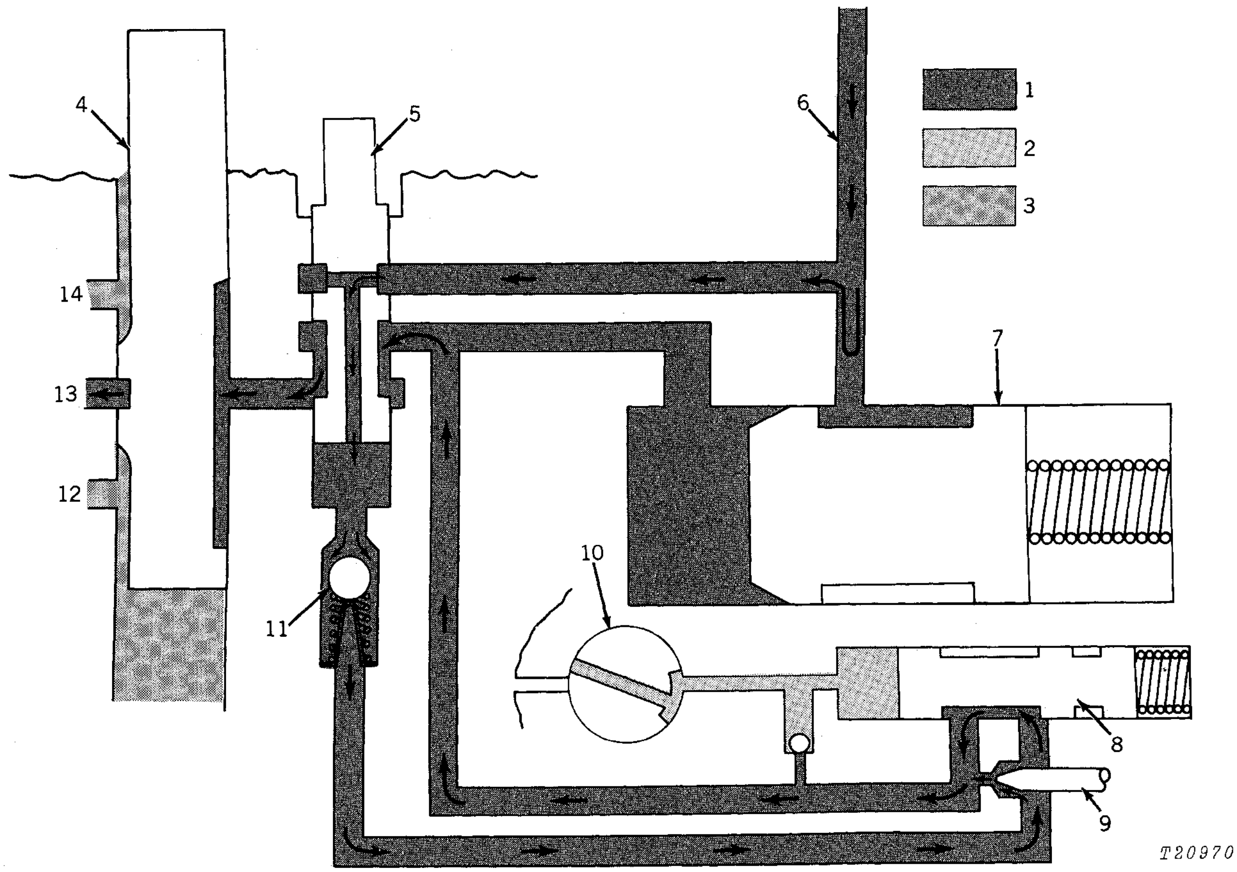
Initial oil pressure for the oil supply circuit is set by the pressure regulating valve, adjustable by shims. The other valves work in series to regulate oil pressure.

If the oil filter clogs, the protective relief valve opens, allowing oil to bypass the filter and return directly to the clutch lubricating circuit.

OPERATION OF CLUTCH CONTROL UNIT

The clutch control unit receives pressure oil from the supply system and regulates it by means of a valve circuit to engage and disengage the clutch packs during various shift cycles. The control unit mounts over the clutch shaft in the rear of the range change box of the transmission (Fig. 1). The valves located in the clutch control unit are: the shift valve, linked to the reverser lever, which directs engaging oil to the selected clutch pack; the pilot valve, also linked to the reverser lever, which controls the by-pass valve; the bypass valve, which opens to give full flow to the clutch pack after engagement and stays open during a rapid hi-low shift; the needle valve, which is an adjustable orifice to regulate the speed of clutch engagement; the check valve, which keeps pressure oil in the accumulator circuit during neutral for use in the next shift; the accumulator piston, which "surges" oil to fill the engaging clutch for a smoother shift; and the clutch valve, linked to the clutch pedal, which finally engages or neutralizes the whole valve circuit.

The action of the valves in the clutch control unit during each shift cycle is explained on this and the following pages.



1—Pressure Oil
2—Trapped Oil
3—Pressure-Free Oil
4—Shift Valve
5—Clutch Valve
6—Supply Oil From Pump
7—Accumulator
8—Bypass Valve
9—Needle Valve
10—Pilot Valve
11—Check Valve
12—Reverse (To Clutches)
13—High (To Clutches)
14—Low (To Clutches)

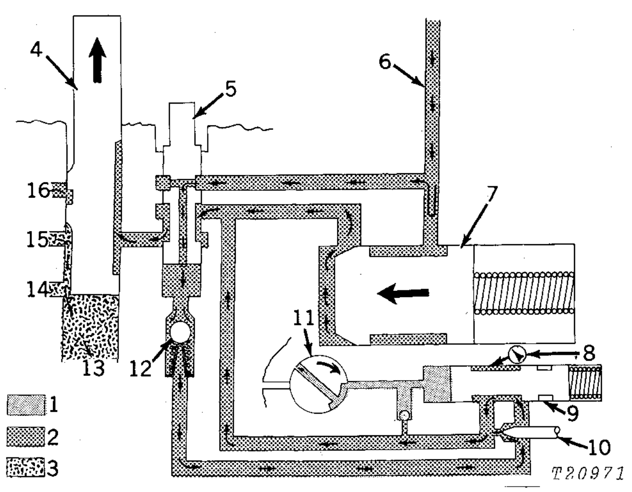
Fig. 3-Clutch Control Unit Operating in High Gear

Operating in High Gear

Pressure oil from the supply system flows around accumulator, goes through clutch valve, and holds the check valve open. Oil has full flow around bypass valve, which is held open by oil pressure. Pressure oil flows on around clutch valve and across to slot in shift valve. This slot engages the high clutch passage and keeps pressure oil against the clutch to hold it engaged.

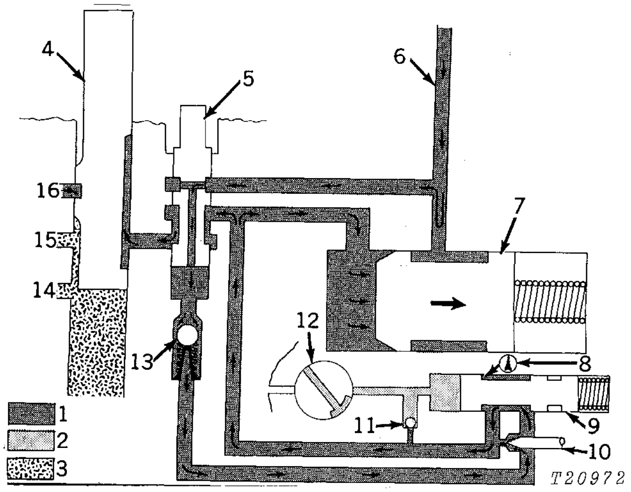
Additional oil is fed into the unit only on "demand" to make up for leakage and keep pressure oil against the engaged clutch.

The accumulator has reloaded with oil for the next shift.



1—Trapped Oil
2—Low Pressure Oil
3—Return Oil
4—Shift Valve
5—Clutch Valve
6—Supply Oil From Pump
7—Accumulator
8—Pressure Check Point
9—Bypass Valve
10—Needle Valve
11—Pilot Valve
12—Check Valve
13—To Reservoir
14—Reverse (To Clutch)
15—High (To Clutch)
16—Low (To Clutch)

Fig. 4-Cycle 1-Unit Shifting High to Low Gear



1—Pressure Oil
2—Trapped Oil
3—Pressure Free Oil
4—Shift Valve
5—Clutch Valve
6—Supply Oil From Pump
7—Accumulator
8—Pressure Check Point
9—Bypass Valve
10—Needle Valve
11—Check Ball
12—Pilot Valve
13—Check Valve
14—Reverse (To Clutch)
15—High (To Clutch)
16—Low (To Clutch)

Fig. 5-Cycle 2-Unit Shifting High to Low Gear

Shifting From High to Low Gear (a "Rapid Shift")

This is a rapid shift and can be divided into two cycles.

Cycle 1 (Fig. 4)

Shifting the reverser lever from High to Low gear moves both the shift and pilot valves, because they are linked together mechanically. The following interaction occurs:

The pilot valve rotates but no oil is dumped as orifice has been bypassed between low and high.

The shift valve is lifted, dumping oil from the high clutch to disengage it, and engaging the low clutch. Now pressure oil rushes into the low clutch, via the orifice bypass valve, completing engagement very rapidly.

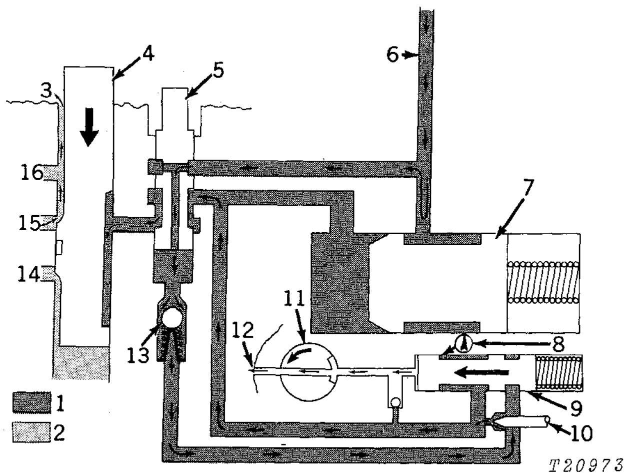
Pressure at "Check Point" should drop rapidly from pressure oil to low pressure oil when accumulator discharges.

Cycle 2 (Fig. 5)

The pressure oil also reloads the accumulator for the next shift.

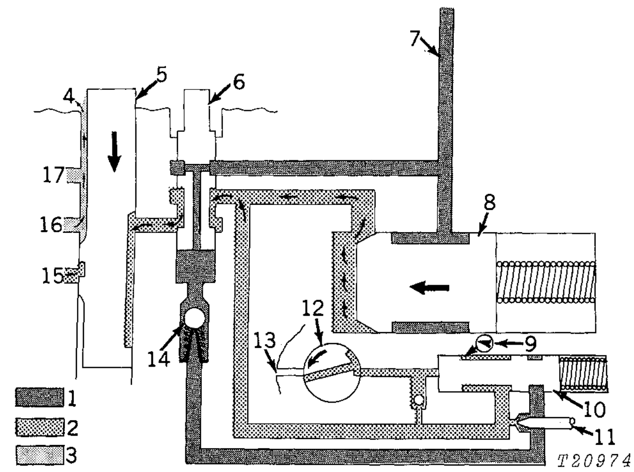
Pressure at "Check Point" for this final cycle should show at fast rise from low pressure oil to pressure oil after start of shift.

NOTE: Shifting from Low to High gear is accomplished in the same manner as described except that the shift valve engaging slot moves from Low to High.



1—Pressure Oil
2—Pressure Free Oil
3—To Reservoir
4—Shift Valve
5—Clutch Valve
6—Supply Oil From Pump
7—Accumulator
8—Pressure Check Point
9—Bypass Valve
10—Needle Valve
11—Pilot Valve
12—Neutral Passage
13—Check Valve
14—Reverse (To Clutch)
15—High (To Clutch)
16—Low (To Clutch)

Fig. 6-Unit Shifting High to Reverse Gear (Step 1)



1—Pressure Oil
2—Low Pressure Oil
3—Pressure Free Oil
4—To Reservoir
5—Shift Valve
6—Clutch Valve
7—Supply Oil From Filter
8—Accumulator
9—Pressure Check Point
10—Bypass Valve
11—Needle Valve
12—Pilot Valve
13—Neutral Passage
14—Check Valve
15—Reverse (To Clutch)
16—High (To Clutch)
17—Low (To Clutch)

Fig. 7-Unit Shifting High to Reverse Gear (Step 2)

Shifting From High to Reverse Gear

This is a "cushion" shift and can be divided into five steps.

Step 1 (Fig. 6)

The reverser lever is shifted from high toward reverse gear.

The pilot valve has started to turn and engages a "neutral" passage. Oil escapes, allowing bypass valve to close.

The shift valve starts to lower, dumping oil from the engaged high clutch.

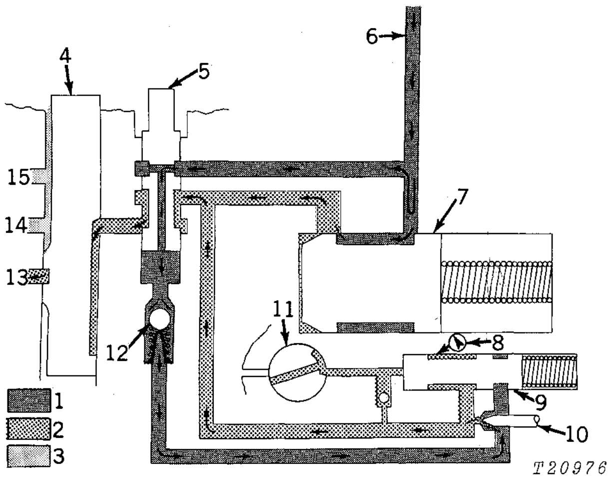
Pressure oil in the control unit, however, remains constant at this moment.

Step 2 (Fig. 7)

The pilot valve has now turned to seal off the "neutral" passage.

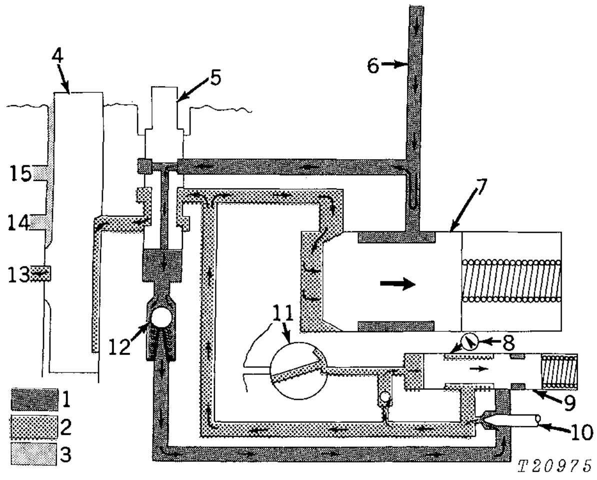
At the same moment, the shift valve slot engages the reverse clutch passage. Now pressure oil rushes into the reverse clutch, reducing pressure in the control unit.

This pressure drop allows the spring-loaded accumulator to discharge and "surge" oil in to help fill the reverse clutch cavities. This "surge" does not engage the reverse clutch but it does take up slack volume to assure a smooth engagement. As the accumulator discharges, pressure in the control unit beyond the orifice at the needle valve should drop rapidly to low pressure after start of shift.



1—Pressure Oil
2—Low Pressure Oil
3—Pressure Free Oil
4—Shift Valve
5—Clutch Valve
6—Supply Oil From Pump
7—Accumulator
8—Pressure Check Point
9—Bypass Valve
10—Needle Valve
11—Pilot Valve
12—Check Valve
13—Reverse (To Clutch)
14—High (To Clutch)
15—Low (To Clutch)

Fig. 8-Unit Shifting High to Reverse Gear (Step 3)



1—Pressure Oil
2—Low Pressure Oil
3—Pressure Free Oil
4—Shift Valve
5—Clutch Valve
6—Supply Oil From Pump
7—Accumulator
8—Pressure Check Point
9—Bypass Valve
10—Needle Valve
11—Pilot Valve
12—Check Valve
13—Reverse (To Clutch)
14—High (To Clutch)
15—Low (To Clutch)

Fig. 9-Unit Shifting High to Reverse Gear (Step 4)

Step 3 (Fig. 8)

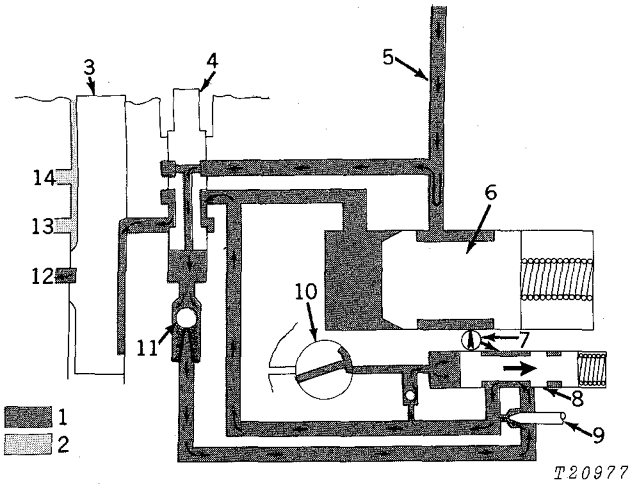
The accumulator stays in discharge position and allows some oil entering unit to flow directly around its shoulder to reverse clutch.

Other oil entering unit follows the usual route past valves but must then flow through orifice at needle valve, since bypass valve is closed. The accumulator, in the discharged position, feeds oil past the land on its piston until the engaged clutch is filled. When pressure in the clutch reaches the low pressure setting, the accumulator starts to recharge, closing the land and forcing all oil to go through the orifice. Pressure should remain at low pressure momentarily after start of shift.

Step 4 (Fig. 9)

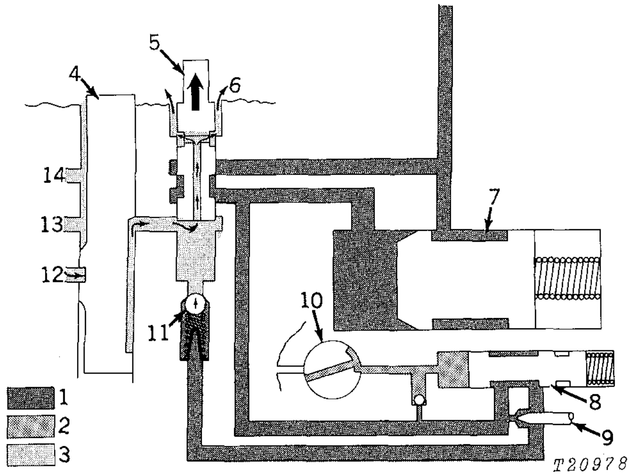
Oil coming through the needle valve orifice recharges the accumulator, slowly building up pressure in the clutch to give a cushioned engagement.

Pressure oil from the accumulator also enters the bypass valve through an orifice as the accumulator recharges and moves back against the spring to the open position. The speed at which the accumulator recharges is adjusted by means of the needle valve.



1—Pressure Oil
2—Pressure Free Oil
3—Shift Valve
4—Clutch Valve
5—Supply Oil From Pump
6—Accumulator
7—Pressure Check Point
8—Bypass Valve
9—Needle Valve
10—Pilot Valve
11—Check Valve
12—Reverse (To Clutch)
13—High (To Clutch)
14—Low (To Clutch)

Fig. 10-Unit Shifting High to Reverse Gear (Step 5)



1—Pressure Oil
2—Trapped Oil
3—Pressure Free Oil
4—Shift Valve
5—Clutch Valve
6—To Reservoir
7—Accumulator
8—Bypass Valve
9—Needle Valve
10—Pilot Valve
11—Check Valve
12—Reverse (To Clutch)
13—High (To Clutch)
14—Low (To Clutch)

Fig. 11-Unit When Clutch Pedal is Depressed

Step 5 (Fig. 10)

As the pressure continues to rise, the bypass valve opens suddenly and admits a full flow of oil to completely engage and hold the reverse clutch. This should cause an instant rise to pressure oil. Pressure on engaged clutch should remain constant until a new shift is made.

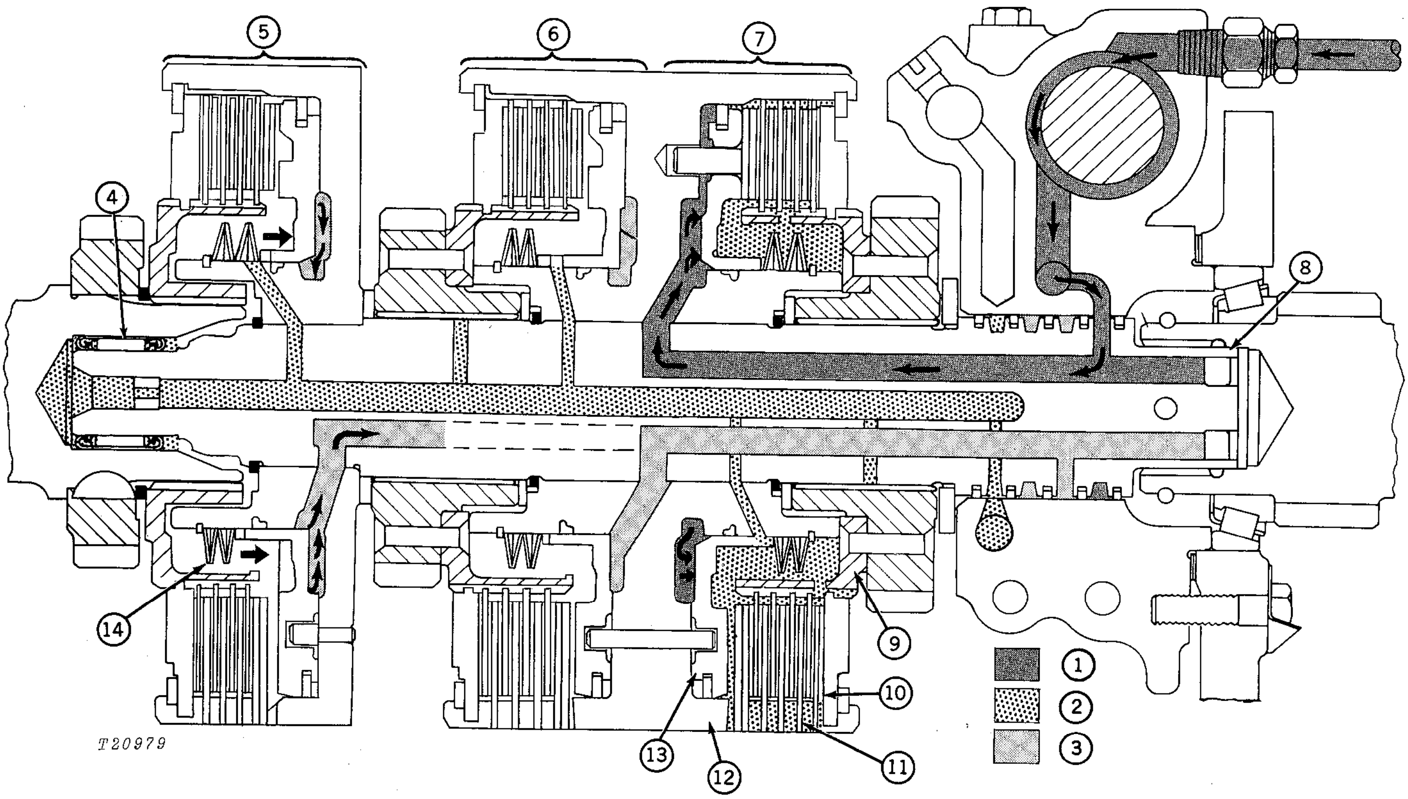
Neutral

The neutral cycle is the same as "Step 1" on page 50-15-5. Oil flow is shown in Fig. 6. The pilot valve dumps oil, allowing the bypass valve to close. This seals off the full flow passage to the clutches. At the same time, the shift valve dumps oil from the engaged clutch and the pressure slot in the shift valve is closed off.

Depressing Clutch Pedal (Fig. 11)

When the clutch pedal is depressed, the clutch valve lifts, dumping oil from the engaged clutch. The same motion in the clutch valve seals off passages in the valve housing, retaining oil supply in valves and in front of accumulator. The check valve ball also closes and holds pressure at other end of the circuit.

When the clutch pedal is released again, the clutch valve drops and oil retained in the valving goes to work again with only a slight delay.



1—Pressure Oil
2—Low Pressure Oil
3—Return Oil
4—Needle Bearing
5—High Clutch
6—Reverse Clutch
7—Low Clutch
8—Clutch Shaft
9—Clutch Hub
10—Disk
11—Plate
12—Clutch Drum
13—Piston
14—Release Spring Pack

Fig. 12-Clutch Engagement (Shifting High to Low Gear)

FUNCTION OF H-L-R CLUTCHES

Each of the three hydraulic clutches— high, low, and reverse — is operated by a pack of alternating disks and plates (Fig. 12). When these parts are clamped together by a hydraulic piston, the clutch is engaged. When they are released by spring action, the clutch is disengaged. Any time one clutch is engaged, the other two clutches are disengaged.

Clutch Engagement (Fig. 12)

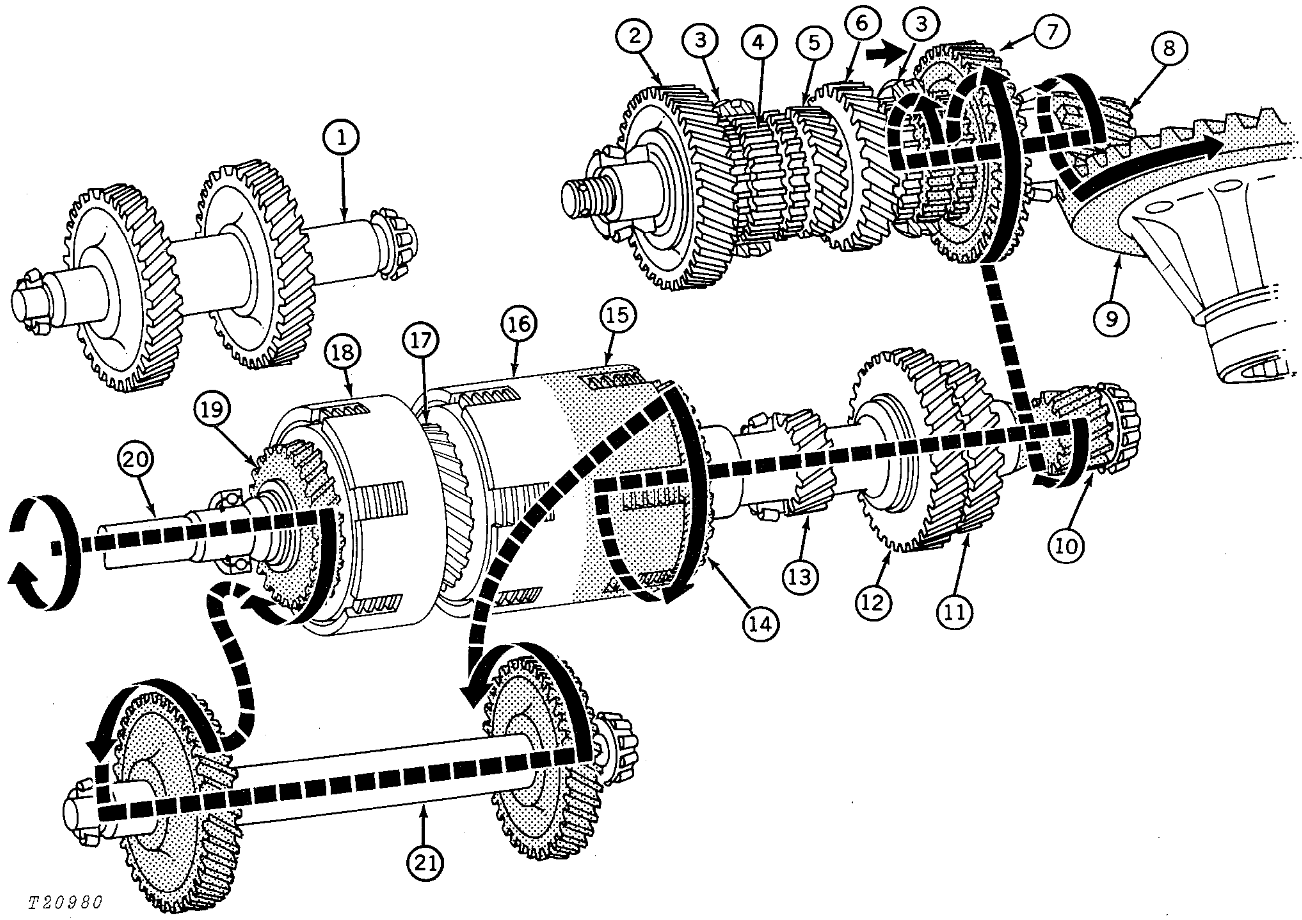
When the reverser lever is shifted from high to low gear, the shift valve directs pressure oil to the rear oil ring on the clutch shaft. This oil flows down a drilled passage inside the clutch shaft and out to a compartment in front of the low clutch piston. Oil pressure expands this compartment and moves the piston against the clutch pack. Now the disks and plates are clamped together, rotating as a unit.

Power is transmitted by this engagement as follows: The disks constantly rotate with the clutch hub, driven by the underdrive countershaft. The plates mesh with the clutch drum, which is keyed to the clutch shaft. However, until a clutch is engaged, the clutch shaft is idle. When the low clutch is engaged, the power from the countershaft is passed through the clamped disks and plates to the clutch shaft. This shaft sends the proper rotation and speed to the rear input.

At the same time pressure oil is fed into the low clutch, oil is escaping from the high clutch. This allows a spring to release the disks and plates, disengaging the clutch. The reverse clutch is already disengaged. Engagement of high or reverse clutches is similar.

Lubrication of Clutches

Lubricating oil (low pressure oil) flows constantly out the engaged clutch hub to flush and cool the disks and plates. This oil flows down a fourth drilled passage in the clutch shaft. The needle bearing on the front of the clutch shaft and the clutch hub bushings are also lubricated by this oil.



1—Reverse Countershaft
2—Second Speed Gear
3—Shifter Collar (2 used)
4—Shifter Gear (2 used)
5—Fourth Speed Gear
6—Third Speed Gear
7—First Speed Gear
8—Pinion
9—Ring Gear
10—1st Speed Driving Gear
11—3rd Speed Driving Gear
12—4th Speed Driving Gear
13—2nd Speed Driving Gear
14—Low Clutch Pinion
15—Low Clutch Drum
16—Reverse Clutch Drum
17—Reverse Clutch Pinion
18—High Clutch Drum
19—Front Input Gear
20—Front Input Shaft
21—Underdrive Countershaft

Fig. 13-Power Flow in First Shift Station—Low Range Illustrated

POWER FLOW

The above illustrates the H-L-R transmission parts. Gear combinations to obtain first shift station—low range (forward) are also shown.

Use the chart and Fig. 13 to trace power flow through the transmission when diagnosing problems in a particular operating station. The drive gears and driven gears are listed by component numbers (see Key to Fig. 13) in the sequence of power flow.

Shift Station	Range	Power Flow (Fig. 13)
1	Low	20, 19, 21, 15, 14, 10, 7, 4, 8, 9
2	Low	20, 19, 21, 15, 14, 13, 2, 4, 8, 9
3	Low	20, 19, 21, 15, 14, 11, 6, 4, 8, 9
4	Low	20, 19, 21, 15, 14, 12, 5, 4, 8, 9
1	High	20, 18, 19, 10, 7, 4, 8, 9
2	High	20, 18, 19, 13, 2, 4, 8, 9
3	High	20, 18, 19, 11, 6, 4, 8, 9
4	High	20, 18, 19, 12, 5, 4, 8, 9
1	Reverse	20, 19, 21, 1, 16, 17, 10, 7, 4, 8, 9
2	Reverse	20, 19, 21, 1, 16, 17, 13, 2, 4, 8, 9
3	Reverse	20, 19, 21, 1, 16, 17, 11, 6, 4, 8, 9
4	Reverse	20, 19, 21, 1, 16, 17, 12, 5, 4, 8, 9
1	Neutral	20, 19, 21, 1, 17, 14

TESTING

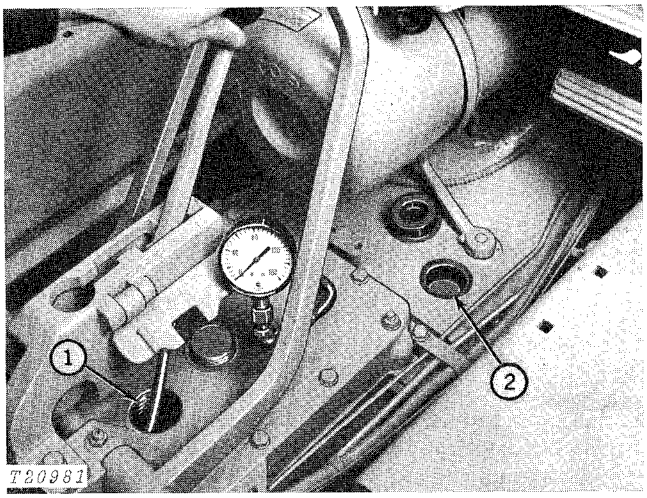
Start engine, warm it up to normal operating temperature and set engine speed to fast idle. Warm up H-L-R oil to normal temperature by cycling reverser lever.

H-L-R SHIFTING

First adjust clutch pedal free travel and H-L-R linkage (refer to page 50-10-7).

H-L-R OIL PRESSURE

Remove large drum plug from transmission top cover (Fig. 14). Remove small pipe plug from top of accumulator housing and attach a pressure gauge in the hole as shown.



1—Drum Plug Location **2—Rubber Plug**

Fig. 14-Checking Oil Pressure

Run engine at 1800 rpm and record oil pressure. Correct engaging oil pressure to H-L-R clutches is 170 to 180 psi with oil at 150-180° F.

When shifting from reverse to high or high to reverse, the oil pressure at the by-pass valve in the accumulator housing should drop from and return to engaging oil pressure in 1.5 seconds average. If deviation from this time is observed, readjust clutch oil manifold needle valve. Always check clutch adjustment before attempting to readjust the needle valve.

When shifting from high to low or low to high, the oil pressure at the by-pass valve in the accumulator housing should be 170 to 180 psi in 1 second maximum time after start of shift.

Adjust pressure if necessary as follows. Remove rubber plug from top right side of the clutch housing (Fig. 14). Then remove large plug from transmission front cover and add or subtract shims inside plug. (Grease may be used to retain shims.)

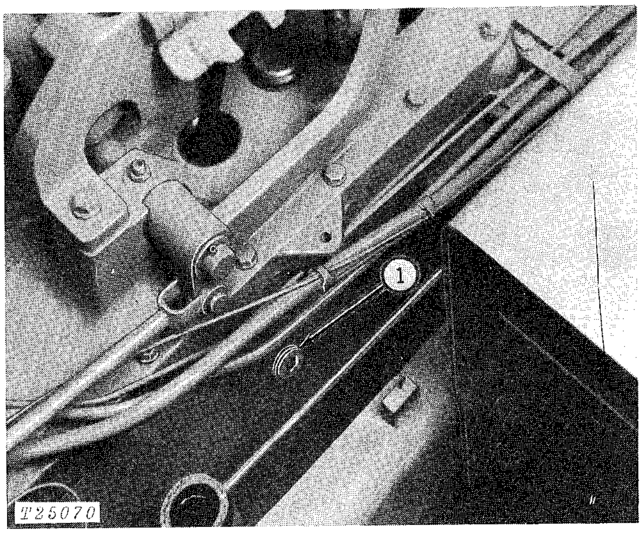
Read oil pressure on gauge. When pressure is correct, reinstall plugs.

SPEED OF SHIFT ADJUSTMENT

NOTE: Needle valve should not need adjusting unless manifold is replaced. Always check engine clutch and H-L-R clutch valve adjustment before making this adjustment.

To make speed of shift adjustment, remove needle valve access plug from right wall of transmission case (Fig. 15).

NOTE: Needle valve should not need adjusting unless manifold has been changed.



1—Needle Valve Access Plug

Fig. 15-Adjusting Time Span of Shifting

Loosen jam nut and screw in on needle valve until shuttle shifting becomes sluggish. (If this cannot be done, recheck clutch pedal and shifter linkage adjustment, page 50-10-7.)

Screw out needle valve gradually until shuttle shifting is as rapid as desired, without jerking (1.5 second average).

NOTE: If needle valve has no effect on rate of shift, stop engine and turn clutch valve stop nut in until pedal moves away from stop. If unit responds to adjustments, clutch valve was not adjusted properly. If unit still does not respond to needle valve adjustment, remove transmission cover and check bypass valve, accumulator, and pilot orifices and screen for plugging.

Hold needle valve in place and lock with jam nut. Reinstall plug in case.

IMPORTANT: Do not allow shuttle shifting to become sluggish. If shift is too slow, excessive heat will be generated while clutch is slipping, and clutch friction disks will become glazed. As a result, the clutch may slip under load and tractor will lose power. Keep clutches adjusted for a snappy shift.

If correct shift time cannot be obtained, recheck linkage adjustments.

TESTING OIL COOLER BYPASS VALVE AND CLUTCH LUBRICATING BYPASS VALVE

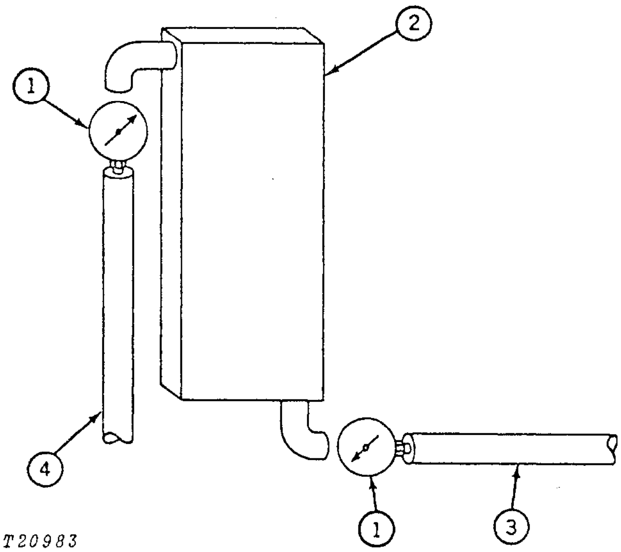
Detach the cooler inlet line and return line at cooler elbows. Attach a pressure gauge to both the inlet line and return lines.

Run transmission at 1800 rpm and the range change (H-L-R) in gear position.

Pressure at the gauge on the cooler return line (Fig. 16) should be 58-72 psi. The differential between gauges in the cooler inlet line and the cooler return line should be 80-100 psi. If deviation from these pressures is observed, check the valves and springs.

Run engine at 2500 rpm. Engage clutch with the H-L-R in neutral position. Flow through the cooler should be 10 gpm minimum.

Remove gauges and reinstall inlet and return lines after this portion of the test.



1—Pressure Gauge
2—Oil Cooler
3—Return Line (Early Units) Inlet Line (Later Units)
4—Inlet Line (Early Units) Return Line (Later Units)

Fig. 16-Testing Bypass Valves

DIAGNOSING MALFUNCTIONS

Transmission Continually Runs Hot

Obstruction in cooler lines or cooler.
Check lines for mushy or collapsed condition and cooler restriction.

Cooler fins filled with trash.
Clean and straighten fins.

Oil level too high.
Check level.

Drag or interference caused by failed bearings.
Replace worn or damaged transmission parts.

Low oil pump capacity.
Inspect pump for damaged or worn parts.
Low flow through cooler; check cooler flow.

Weak cooler relief valve spring.
Replace spring and adjust system pressure.

Shuttle Shift Too Abrupt

Check clutch valve adjustment.

Shifts Too Slow

Adjust clutch and H-L-R shifter linkage.
Adjust needle valve orifice.
Check bypass valve for broken spring or valve in backwards.
Check screen or pilot valve orifice for clogging.

Clutches Slip or Fail to Take Hold

Check clutch pressure.

Pressure gradually decreases as pedal is depressed.
Adjust clutch pedal and shifter linkage.

Pedal moves away from its stop.
Replace clutch pedal return spring.

Excessive Gear Clash When Shifting

Disconnect clutch out of adjustment or clutch pedal not depressed far enough.

Excessive Transmission Noise

Transmission parts worn or damaged.
Overhaul and repair transmission.

Transmission low on oil.
Fill to proper level.

REPAIR

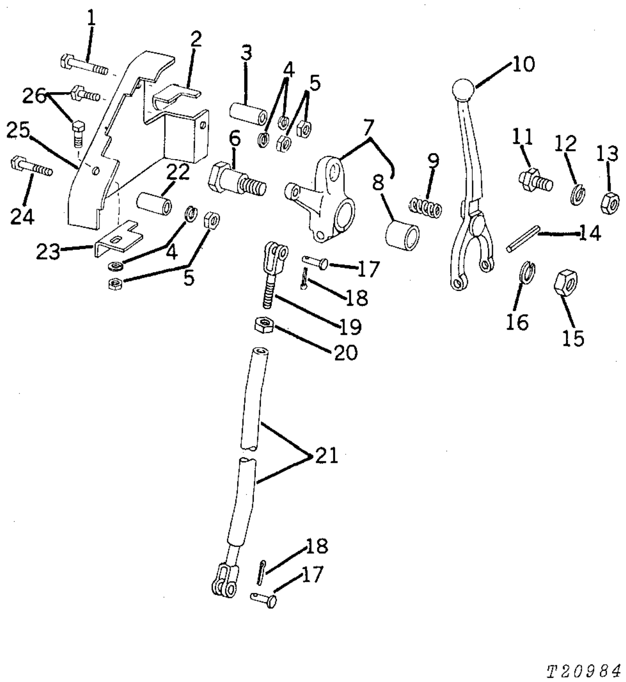
SHIFT LEVER (Fig. 17)
(-142199)

Remove seat cushion and take out cap screws, spacers, and hex. nuts fastening shift lever cover to left side tank.

Disconnect speed change rod from shift lever pivot.

Remove hex. nut and lock washer from pivot bolt (6) and remove shift lever assembly. Do not lose spring. Drive out spring pin (14) attaching pivot to shift lever.

Unscrew hex. nut from lever position pin (11) and remove pin.



1—Cap Screw	**14—Spring Pin**
2—Upper Stop	**15—Nut**
3—Spacer	**16—Lock Washer**
4—Lock Washer (4 used)	**17—Pin (2 used)**
5—Nut (4 used)	**18—Cotter Pin (2 used)**
6—Pivot Bolt	**19—Yoke**
7—Pivot	**20—Nut**
8—Bushing	**21—Link**
9—Spring	**22—Lower Cover Spacer**
10—Gear Shift Lever	**23—Lower Stop**
11—Lever Position Pin	**24—Cap Screw**
12—Lock Washer	**25—Gear Shift Lever Cover**
13—Nut	**26—Cap Screw (2 used)**

Fig. 17-Shift Lever Assembly

Examine shift lever pivot (7) for cracks or wear and replace if necessary.

Inspect pivot bushing (8) for damage or excessive wear.

If necessary, press new bushing into lever pivot to flush with chamfered end of bore.

Inspect link (21) for bent condition.

Inspect lever position pin (11) for wear or damage.

Examine shift lever stops (2 and 23) for wear. Replace if necessary.

Assembly

Assemble shift lever to pivot using spring pin. Be sure spring (9) is installed properly between pivot and lever.

Install shift lever and pivot on left side tank using special pivot bolt (6).

Install lever position pin (11).

Attach speed change rod to lever pivot.

NOTE: Do not install cover until adjustments have been completed.

Move gear shift lever (10) to second gear (3 detents from lower position on transmission shifter arm). Adjust shifter lever to a position where there is approximately 1/16-inch from lever position pin (11) to lower edge of gear shift lever. Shift to third gear and check on high side of gear shift lever for the same measurement. If not, remove pin from yoke (19) and adjust until measurement is equal. Install pin in yoke and arm.

Attach the lower stop (23) to the shift lever cover. Do not tighten this stop now. Fasten the shift lever cover to the battery box.

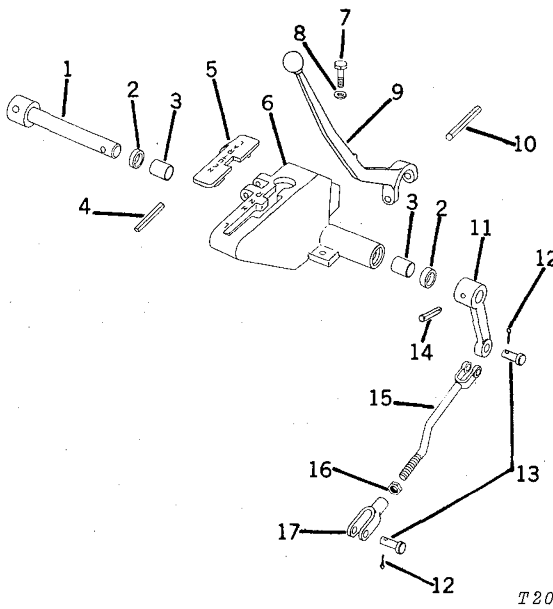
Secure the cover at the lower hole first. The upper cap screw goes through the cover, then through the upper stop, spacer, and battery box. Do not tighten the upper cap screw.

Shift transmission into the first gear detent position (rear detent). Position upper shift lever stop flush against the gear shift lever. Then tighten cap screw and nut securing shift cover and upper stop to battery box.

Shift transmission into the fourth gear detent position. Position lower shift lever stop flush against the gear shift lever. Then tighten the cap screw and nut securing the lower stop to the cover.

REVERSER LEVER (Fig. 18) (-142199)

Disconnect battery ground straps for safety. Remove seat frame and front seat panel. Remove both footrests.



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1—Reverser Lever Shaft	**10—Spring Pin**
2—Oil Seal (2 used)	**11—Reverser Lever Shaft Arm**
3—Bushing (2 used)	**12—Cotter Pin (2 used)**
4—Spring Pin	**13—Pin (2 used)**
5—Reverser Lever Lock	**14—Special Pin**
6—Quadrant	**15—Speed Range Shifter Rod**
7—Cap Screw (2 used)	**16—Jam Nut**
8—Lock Washer (2 used)	**17—Yoke**
9—Reverser Lever	

Fig. 18-Reverser Lever Assembly

Disconnect steering control rods from steering levers. Drive out spring pins attaching levers to shaft and remove levers.

Disconnect speed range shifter rod (15) from reverser lever shaft arm.

Remove transmission oil filler cap and dipstick and take out all cap screws securing transmission top cover. Remove cover with reverser lever from transmission case.

With assembly on bench, remove cap screws from reverser quadrant (6) and separate from top cover.

Drive out spring pin at reverser lever pivot.

Drive out pin holding reverser lever shaft arm to shaft.

Using a brass drift, drive out reverser lever shaft (1).

Inspect shaft (1) for wear or damage. File down any nick or burrs on shaft. Replace if necessary.

Examine reverser lever shaft arm (11) and speed range shifter rod (15) for damage. Repair or replace as required.

Inspect bushing (3) in reverser lever quadrant for wear. If necessary, remove oil seals and old bushings and drive in new bushings until flush with bottom of chamfers in shaft bores.

Inspect oil seals (2) in reverser lever quadrant for damage. If seal were removed or are damaged in any way, replace them. Position new oil seals with lips inward and press in flush with end of quadrant.

Assembly

With transmission top cover on bench, refer to Fig. 18 and assemble reverser lever.

Pack high temperature grease into shaft bore of reverser lever quadrant.

Install reverser lever shaft. Be careful with oil seal lips.

Install reverser lever shaft arm on reverser lever shaft.

Position reverser lever in quadrant and fasten to reverser lever shaft with spring pin.

Install quadrant on transmission top cover.

Use Loctite plastic gasket to seal transmission to covers. Tighten cover cap screws to 50 ft-lbs front and 35 ft-lbs rear.

Connect speed range shifter rod to reverser lever shaft arm.

Install steering control levers and connect steering control rods.

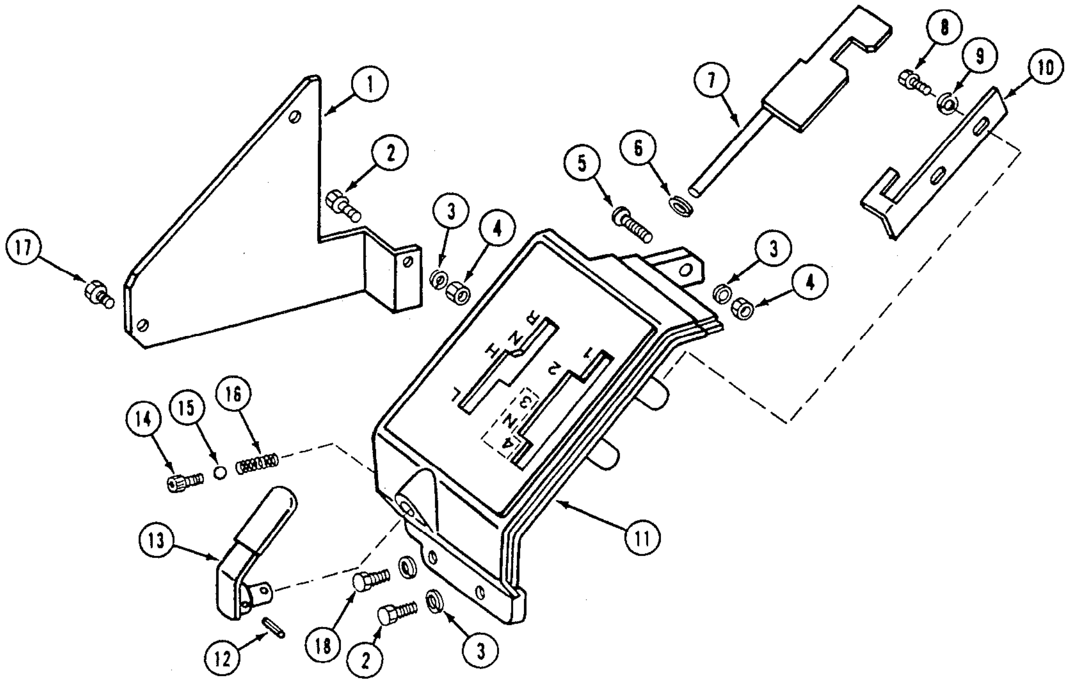
Install front seat panel, seat and footrests.

Connect batteries.

IMPORTANT: Batteries are NEGATIVE ground only. Always connect battery ground strap (−) to negative (−) post of battery. Connect battery cable (+) to positive (+) post of battery. NEVER ATTEMPT TO POLARIZE THE ALTERNATOR.

With range change arm in the center position (detents can be felt when arm is rotated) and reverser lever in high ("H") position on quadrant, adjust range shifter rod until it is in line with hole in range change shifter arm. Install pin and cotter pin.

GEAR SHIFT AND H-L-R LEVERS QUADRANT (142200-)



1—Cover	5—Bolt (2 used)	9—Washer	14—Set Screw
2—Cap Screw (3 used)	6—Washer	10—Lever Stop	15—Steel Ball
3—Lock Washer (5 used)	7—Neutral Lock	11—Quadrant	16—Spring
4—Nut (3 used)	8—Cap Screw (2 used)	12—Spring Pin	17—Cap Screw (2 used)
		13—Lock Lever	18—Cap Screw

Fig. 19-Gear Shift and H-L-R Levers Quandrant

Refer to Fig. 19 for identification and location of parts.

Remove seat cushion and take out cap screws and hex. nuts fastening cover (1) to side of battery box.

Remove knobs (10, Fig. 20, page 50-15-16) from gear shift and H-L-R levers.

Lift quadrant assembly from mounting and place on bench for further disassembly if needed.

When disassembling the quadrant (11, Fig. 19), be careful not to lose steel ball (15).

Inspect parts and replace as needed.

Assemble quadrant before installing to battery box.

Do not tighten cap screws (8) until adjustments to the H-L-R have been completed.

Refer to Fig. 20, page 50-15-16 for location of parts during disassembly and assembly.

Remove cotter keys and pins from H-L-R lever rod (17) and gear shift speed change link (19).

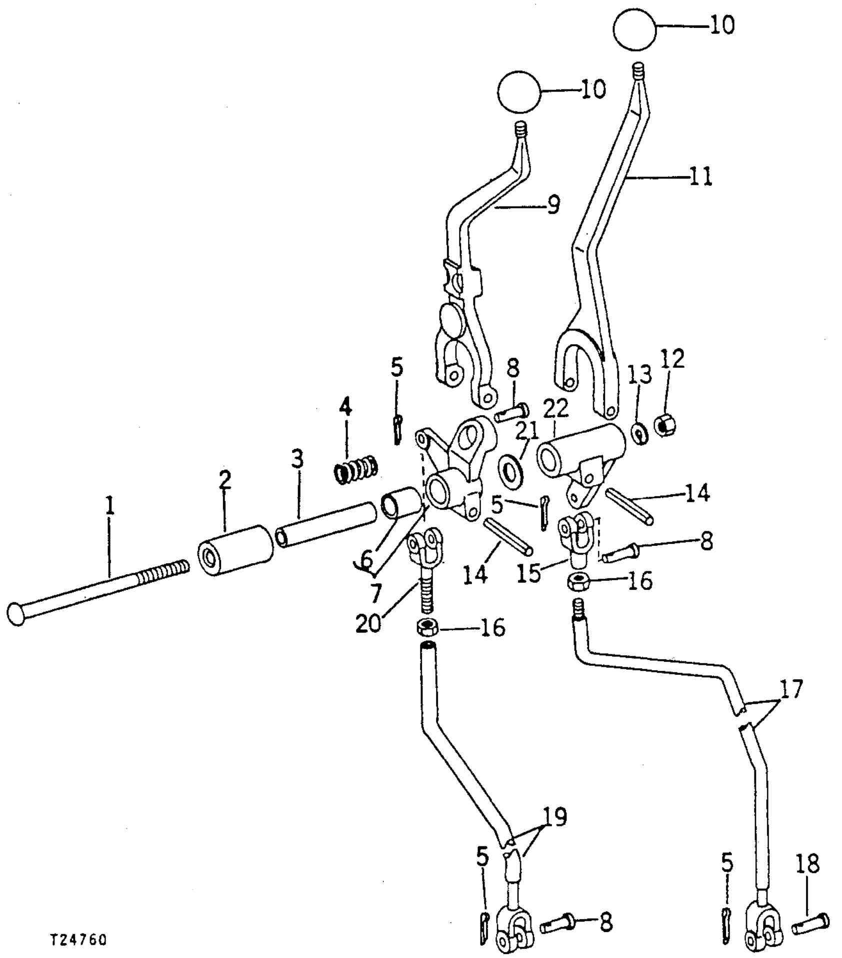
Remove bolt (1), spacer, lock washer and nut.

Examine pivot (7) for cracks or wear and replace if necessary.

Inspect pivot bushing (6) for damage or excessive wear. If necessary, press in new bushing flush to edge of pivot.

Inspect H-L-R lever rod (17) and gear shift speed change link (19) for bent condition.

GEAR SHIFT AND H-L-R LEVERS AND LINKAGE (142200-)



1—Bolt	6—Bushing	11—H-L-R Lever	17—H-L-R Lever Rod
2—Spacer	7—Pivot	12—Nut	18—Pin
3—Spacer	8—Pin (3 used)	13—Lock Washer	19—Link
4—Spring	9—Gear Shift Lever	14—Spring Pin (2 used)	20—Yoke
5—Cotter Pin (4 used)	10—Knob (2 used)	15—Yoke	21—Washer
		16—Nut (2 used)	22—H-L-R Lever Pivot

Fig. 20-Gear Shift and H-L-R Levers and Linkage

Assembly

Assemble levers to pivots using spring pins. Be sure spring pins are installed properly between pivots and levers.

Position pivot and lever assemblies in battery box. Check to be sure spring (4) is properly positioned in recess.

Connect linkage previously removed.

Position shift and H-L-R levers quadrant (11, Fig. 19, page 50-15-15).

Shift Lever Stop Adjustment

Adjust adjustable yoke (20, Fig. 20) to position gear shift lever (9) 0.060 inch distance between gear shift lever and front of quadrant when shift lever is in neutral detent position.

Install pin and cotter pin. Tighten the yoke jam nut.

Shift transmission to fourth gear detent position. Linkage must be in detent position before shift lever contacts end of shift quadrant. If not, linkage components are excessively worn. Replace necessary components and do lever adjustment.

H-L-R Lever Adjustment

Shift H-L-R lever (11, Fig. 20) in neutral detent (between high and reverse).

Hold H-L-R lever against back edge of slot in neutral lock (7, Fig. 19). Apply pressure to take play out of neutral lock.

Starting with the H-L-R rod yoke (15, Fig. 20) adjust long. Shorten the H-L-R rod yoke until pin (8) slips through the yoke and pivot arm (22). Turn yoke 1/2 additional turn but not so short that the pin will not slide freely into yoke and pivot arm.

Install pin and cotter pin. Tighten the yoke jam nut.

TESTING THE ADJUSTMENT

1. With the H-L-R control lever locked in neutral and the speed selector lever in the 4th speed position, depress the clutch pedal and start the engine.

2. Make certain the area around the crawler is cleared to allow some travel of the machine.

3. Adjust the engine throttle lever to obtain an engine speed of approximately 1900 rpm.

4. While holding the foot brake firmly and with the clutch fully depressed, lift the H-L-R neutral lock and shift the lever to reverse.

5. With the brake pedal firmly depressed, slowly release the clutch pedal to such a degree that the engine starts to load in reverse.

6. Again fully depress the clutch pedal and move the H-L-R control lever toward neutral just far enough that the neutral lock can be placed over the lever in the locked position. Now slowly release the clutch pedal to its maximum engaged position.

NOTE: If the crawler begins rearward movement while releasing the clutch pedal, shut the engine off, recheck the adjustment of the linkage and if necessary, adjust the linkage yoke an additional 1/2 turn clockwise. Retest as outlined in steps 1 through 6 of the testing procedure.

7. After establishing that the unit will not operate rearward with the lever locked in neutral, repeat the testing procedure (steps 1 through 6) from the high to neutral position and readjust as required until no movement of the crawler can occur in either direction with the H-L-R lever locked in neutral.

TRANSMISSION FRONT COVER

Remove large plug from top of front cover and pull pressure regulating valve assembly from bore. Save all shims under plug.

Pull oil cooler bypass valve and spring from rear bore of front cover.

Pull clutch lubrication bypass valve and spring from bore in top front of transmission case.

Wash all valve parts in solvent and dry with compressed air.

Flush out valve bores in front cover and case. Examine valve bores for scoring or burrs using a pinpoint flashlight.

Try valves in bores; lightly hone any rough spots using emery cloth. Lap valves to seats if pitted. After lapping, flush out bores thoroughly. Replace any badly damaged parts.

Examine springs for worn or broken coils. Replace if there is any doubt of their strength.

Insert oil pressure regulating valve in vertical bore of transmission front cover. Place spring over valve, then install plug, using same number of shims as removed.

IMPORTANT: Be sure regulating valve is installed in bore with double spool end outward.

Insert oil cooler bypass valve and spring in top rear bore of front cover.

Slide clutch lubricating bypass valve and spring into right front bore in top of transmission case (refer to Fig. 52, page 50-15-37).

CLUTCH OIL PUMP

Remove cap screws from clutch oil pump cover. Pull cover from front input. Remove pump rotors.

Clean all parts in solvent and dry with compressed air.

Examine pump rotors for broken splines or lobes. Remove any nicks, burrs, or sharp edges using emery cloth. Check gear faces and mating surfaces for excessive wear or scoring. Replace any damaged parts. (Rotors are replaced as matched sets.)

Inspect parts in pump cover for damage. If tube is damaged, remove it and press in a new tube 7.28 inch above rear gasket surface of pump cover.

If oil seal in cover is damaged, remove retaining ring and roller bearing to gain access to oil seal. Press in new seal from rear. Front of seal to machined face of cover must be 2.72 inches. Lips of seal should face driver.

Examine roller bearing for wear or scoring. If damaged, install a new bearing in its bore. Position retaining ring. Assemble the inner and outer rotors and sealing ring into pump cover.

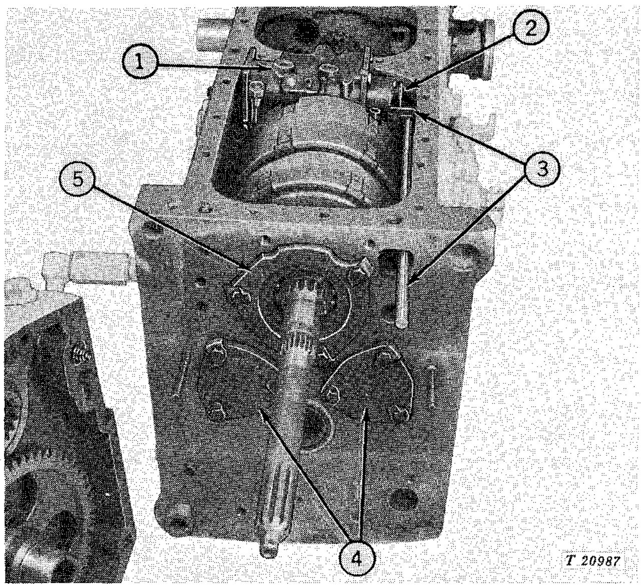
SHAFTS AND GEARS

Remove drain plug from transmission case and drain the entire case.

Remove engine from clutch housing as instructed on page 10-25-1.

Separate engine clutch housing from transmission (page 10-25-2).

Remove transmission top cover by disconnecting rods from shifter arm and from steering levers. Remove cap screws and lift top cover from transmission case.



1—Accumulator Housing
2—Retainer Ring
3—Clutch Valve Operating Shaft
4—Countershaft Quills
5—Front Drive Shaft Quill

Fig. 21-Removing Operating Linkage and Countershaft

NOTE: Removal of transmission is required only when the transmission case is damaged and must be replaced. If transmission must be removed, see procedure on page 10-25-7.

To remove transmission front cover, drive out roll pin and tap arm from shaft.

Remove cap screws and hex. nuts and carefully pull front cover from case.

Range Change Compartment Subassemblies

Detach oil lines from tee and clamp. Remove lines and tee from case (refer to Fig. 22).

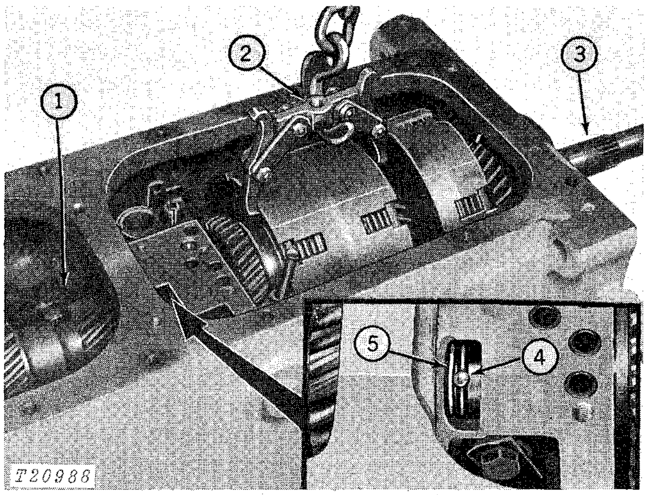
Remove two cap screws from accumulator housing.

Remove retainer ring and free link from shift valve arm.

Remove accumulator housing and shift valve by lifting straight up.

Drive out roll pin and pull clutch valve operating shaft.

Check rear drive shaft bearing setting before removal. If they are within "Specifications" they will not have to be reset when reassembling.



1—Cap Screws
2—Lifting Device
3—Clutch Shaft
4—Pin
5—Retainer Ring

Fig. 22-Attaching Lifting Device to H-L-R Clutches and Control Unit

Remove countershaft quills and shim packs and identify with shafts for assembly.

Remove cap screws from front drive shaft quill but do not remove quill at this time.

Attach jaws of a gear puller or similar device under rims of dual clutch drum as shown. Hook a chain hoist to the puller.

Remove cap screws holding control valve housing to rear wall of case. Remove lock plate and washers.

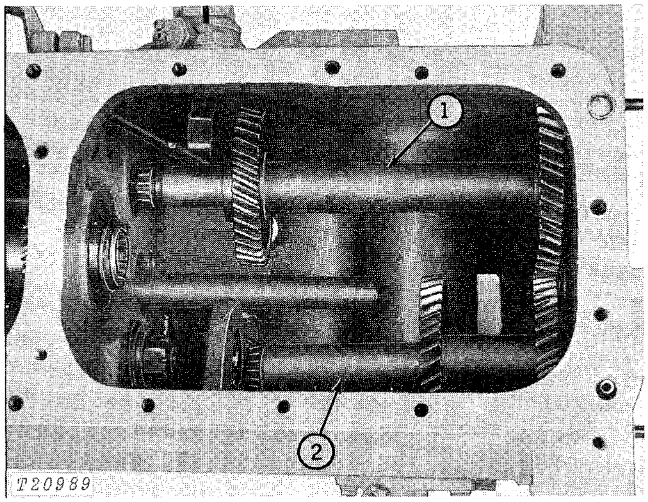
Reach through slot in valve housing and move retainer ring to rear out of rear drive shaft groove.

Tap out pin clutch shaft. Let it drop into case.

Take up slack in lifting chain until puller jaws support clutch unit. Remove front drive shaft and quill. Work clutches, control unit, and countershafts slowly forward.

When rear of clutch shaft clears, tilt up rear of clutch unit as shown and carefully lift unit from case.

NOTE: Be careful with shim pack on rear of clutch valve unit. Remove and save all shims for correct reassembly.



1—Underdrive Countershaft **2—Reverse Countershaft**

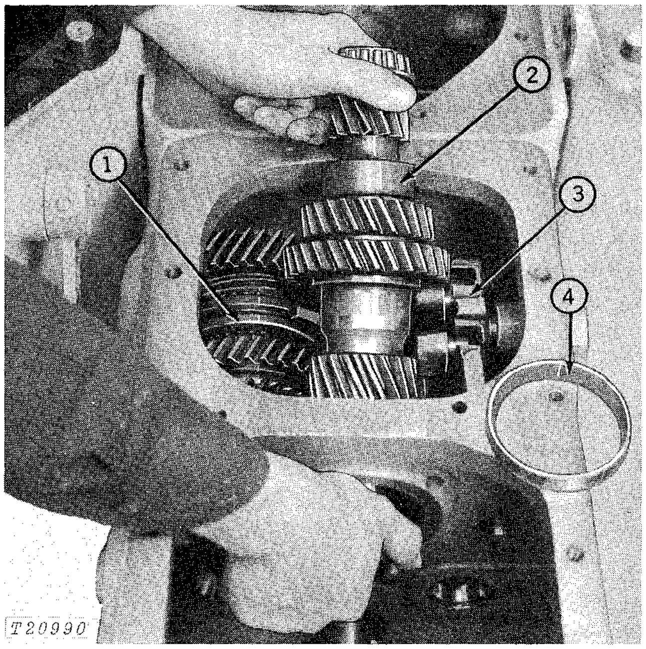
Fig. 23-Removing Countershafts

Remove countershafts from case.

Remove clutch shaft pin and any other loose parts from bottom of case.

Speed Change Compartment and Ring Gear Compartment Subassemblies

Refer to page 10-25-7 for instructions on removing tractor components to gain access to the speed change and ring gear compartments.



1—Pinion Shaft Assembly **3—Shifter Cam**
2—Rear Drive Shaft **4—Front Bearing Cup**

Fig. 24-Removing Rear Drive Shaft

Carefully drive rear drive shaft front bearing cup from its bore. Continue to drive front bearing cone off shaft. Lift shaft subassembly from compartment. Refer to Fig. 24.

Remove output shaft oil line.

Remove cotter pin, nut, snap ring and bearing, and shim pack from front of pinion shaft.

Remove the ring gear quill attaching screws. Insert two of the cap screws in the quill threaded holes and tighten evenly, forcing quill from case. Carefully remove both ring gear quills and shims. Lift ring gear and housing from compartment.

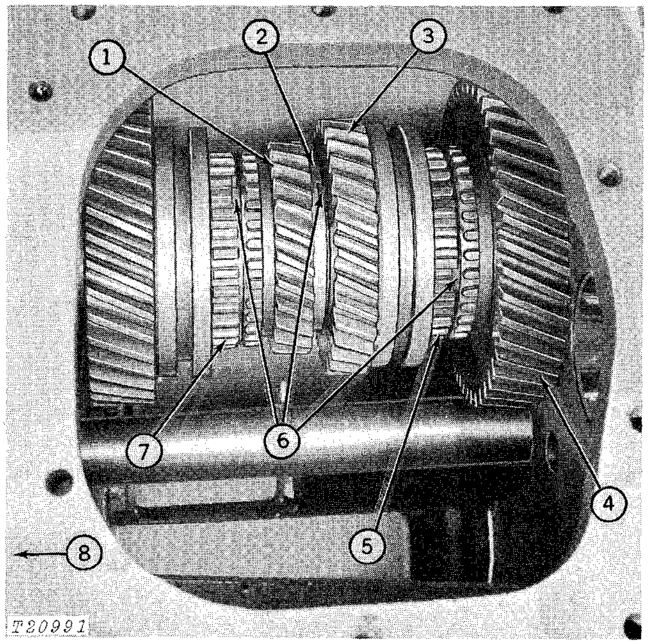
Remove shifter spring retainer, washer, shifter spring, detent ball retainer, and detent ball from port in transmission case.

Slide shifter forks shaft forward into range change compartment and lift shifter forks from speed change compartment.

Remove speed shifter arm and Woodruff key from shifter shaft on outside of transmission case and remove shifter cam and shaft.

NOTE: Shifter cam and shaft may also be removed by removing the self-locking nut fastening cam to shaft and lifting cam out of case. Camshaft and shifter arm can then be removed from outside of case.

Remove pinion shaft as follows (refer to Fig. 26).

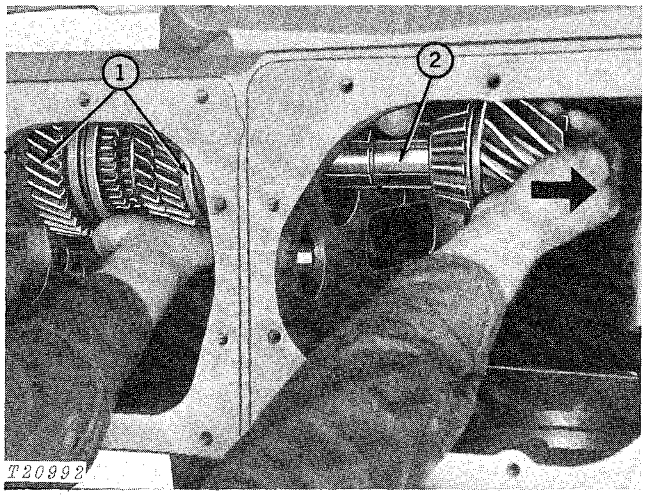


1—4th Speed Gear
2—Thrust Plate
3—3rd Speed Gear
4—1st Speed Gear
5—Rear Shifter Gear
6—Locking Thrust Washers
7—Front Shifter Gear
8—Front of Tractor

Fig. 25-Unlocking Thrust Washers on Pinion Shaft

With cotter pin, hex. nut, bearing, shim pack, and spacer removed from front of pinion shaft, locate the three locking thrust washers on the pinion shaft (Fig. 25). From front of tractor to rear they are positioned as follows: The first thrust washer is between the front shifter gear and the 4th speed gear; the second washer is located between the thrust plate and the 3rd speed gear; the third washer is positioned between the rear shifter gear and the 1st speed gear.

To unlock the thrust washers, use a screw driver to rotate the washers in their grooves until the splines on the shaft and washers index (Fig. 25). Slide the washers to the front (see arrows). Now the pinion shaft can be removed.

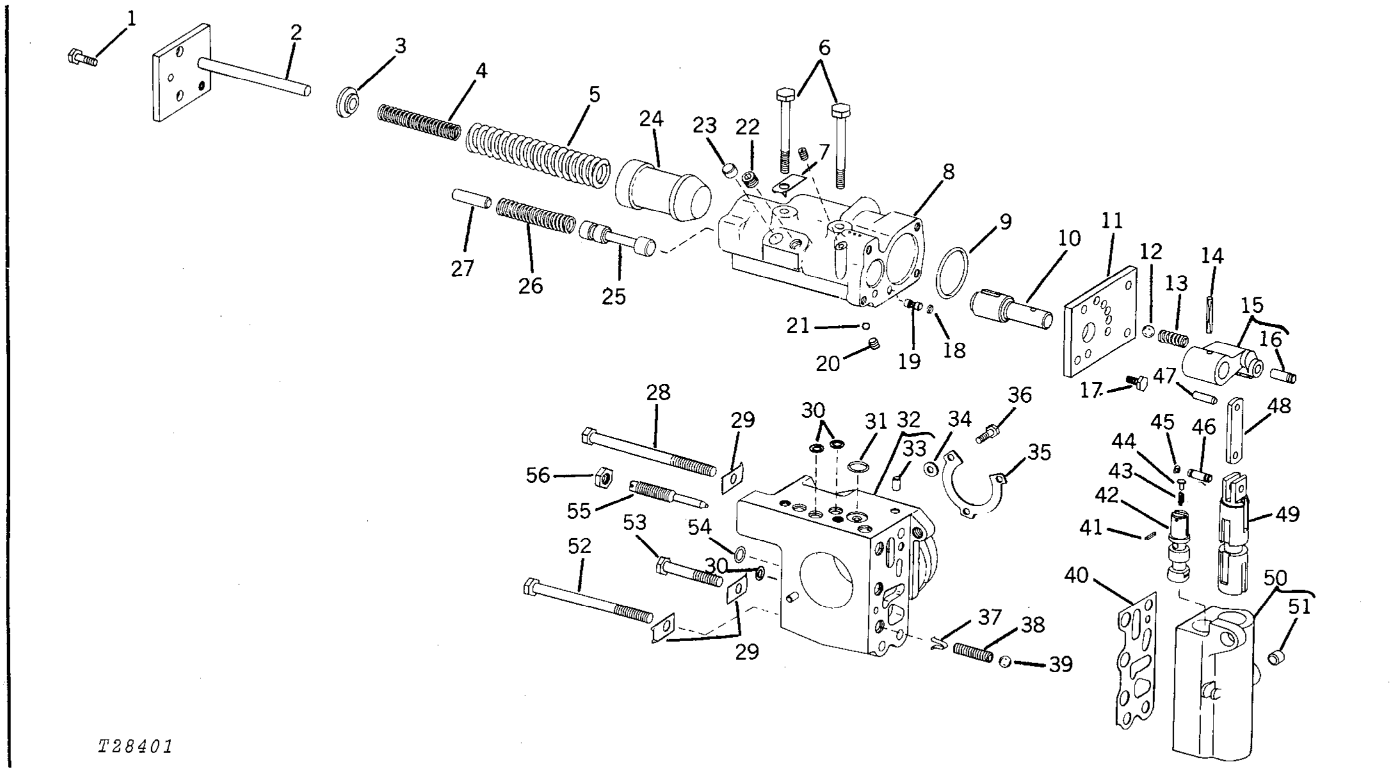


1—Gears and Collars 2—Pinion Shaft

Fig. 26-Removing Pinion Shaft, Gears, and Collars

Carefully pull pinion shaft to the rear until it can be lifted from the differential compartment (Fig. 26). As shaft is withdrawn, the gears and shifter collars will slide off front of shaft. Place one hand under the parts during shaft removal and lift them from speed change compartment, keeping them in order to aid in reassembly. If a thrust washer should become locked when removing the shaft, repeat unlocking procedure described above.

Rebuild Subassemblies



1—Special Cap Screw (2 used)
2—Bypass Valve Cover
3—Special Spring Spacer
4—Inner Accumulator Piston Spring
5—Outer Accumulator Piston Spring
6—Cap Screw (2 used)
7—Lock Plate
8—Accumulator Housing
9—O-Ring
10—Pilot Valve
11—Detent Plate
12—Steel Ball
13—Detent Spring
14—Spring Pin
15—Pilot Valve Arm
16—Pin
17—Special Cap Screw (4 used)
18—O-Ring
19—Cap with Screen
20—Orifice
21—Steel Ball
22—Pipe Plug
23—Dowel
24—Accumulator Piston
25—Bypass Valve
26—Bypass Spring
27—Valve Stop Pin
28—Cap Screw
29—Lock Washer (3 used)
30—O-Ring (7 used)
31—O-Ring
32—Clutch Oil Manifold
33—Dowel Pin
34—Washer (6 used)
35—Lock Plate
36—Cap Screw (3 used)
37—Check Valve Stop
38—Accumulator Check Valve Spring
39—Steel Ball
40—Gasket
41—Spring Pin
42—Clutch Control Valve
43—Spring
44—Pin
45—Retaining Ring (2 used)
46—Pin
47—Pin
48—Link
49—Shift Valve (-125927)
Shift Valve (125928-)
50—Shift Valve Housing (-125927)
Shift Valve Housing (125928-)
51—Dowel Pin
52—Cap Screw
53—Cap Screw
54—O-Ring
55—Needle Valve
56—Jam Nut

Fig. 27-Clutch Control Unit

Clutch Control Unit (Fig. 27)

NOTE: These are precision hydraulic parts. Use care to keep them clean and free from damage. The smallest nick, burr or particle of dirt can cause a failure.

Drive out spring pin (14) securing pilot valve arm to shaft. Pull pilot valve arm (15), being careful to catch detent ball and spring. Pull pin and remove shift valve from link.

Remove detent plate (11) and pull pilot valve (10). Tip housing until small ball rolls out of bore. Carefully pull filter screen (19) from bore using piece of wire.

Remove bypass valve cover with stop. Pull accumulator piston and bypass valve assemblies.

Remove three cap screws and separate shift valve housing (50) from manifold. Catch check valve ball as parts are separated. Remove spring and stop from bore. Screw out needle valve. Lift clutch valve from bore.

Inspect control housings for damage or cracks. Remove plugs and flush out all passages with cleaning solvent; then dry with compressed air only. See that all passages are open and clean. Inspect valve bores and accumulator cylinder for scoring.

Press shift valve housing oil lead hole dowel pin (51) flush with face of housing.

Inspect restrictors in pilot valve dumping orifices (Fig. 27, page 50-15-21). Pin holes must be clean and perfectly round. Also check orifices for clogging. Use a pinpoint flashlight to make these checks.

Inspect filter screen. Wash carefully in solvent. Do not crush. Replace if damaged.

Replace all O-rings and gaskets.

Wash all parts in solvent and dry. Clean any dirt from valve grooves or slots. Inspect ground surfaces of valves for any nicks or burrs. Hone lightly if necessary. Try valves in their bores; they should slide freely. The clutch valve (42), with light oil on its lands, must fall freely to bottom of bore in valve housing by its own weight. Examine valve balls for pitting. Try in seats. If rough, lap them to seats; then wash parts. Check springs for worn or broken coils.

Examine needle valve (55). If point is worn or deeply grooved, replace needle valve.

Press accumulator housing dowel pin (accumulator housing oil lead hole) flush with face of housing.

Press bypass valve pressure orifice (20) in accumulator housing to bottom of 0.248 diameter with chamfered end in.

Install needle valve in bore. Screw down until finger tight, and back off three turns. This is a preliminary setting. Tighten jam nut (refer to Fig. 27, page 50-15-21 for parts identification).

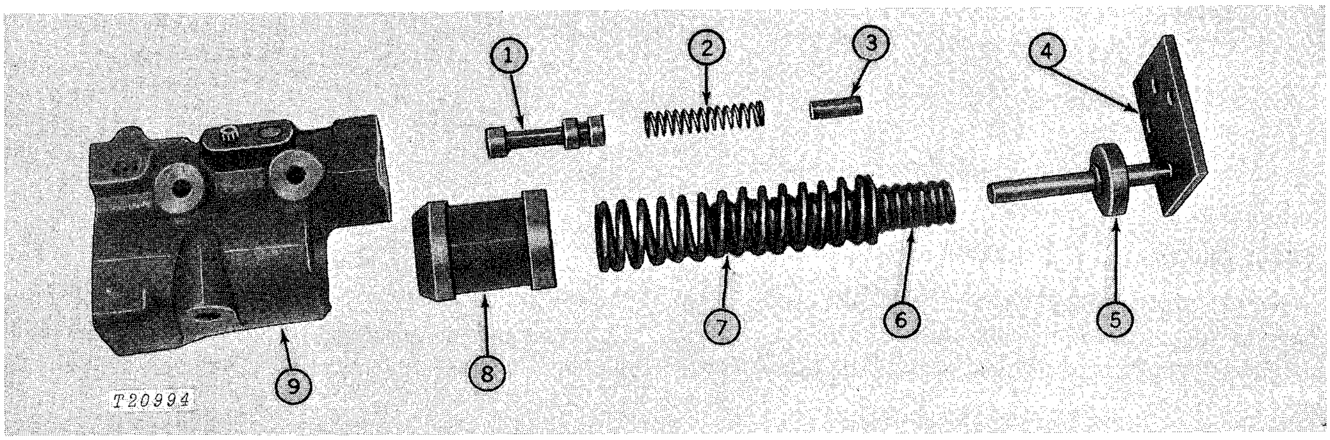
IMPORTANT: If the needle valve is turned in too tightly, the needle valve, or its seat, may be damage.

Install O-rings in bores of control valve housing. Check to see that dowel is in place. Place new gasket on shift valve housing.

Install stop and spring in bore. Hold check valve ball on its seat and carefully place shift valve housing on its mounting. Install three cap screws and locks. Recheck gasket position and tighten screws.

Insert modulating spring and headed pin into top of clutch valve. Drive spring pin through valve. Slide clutch valve into its bore.

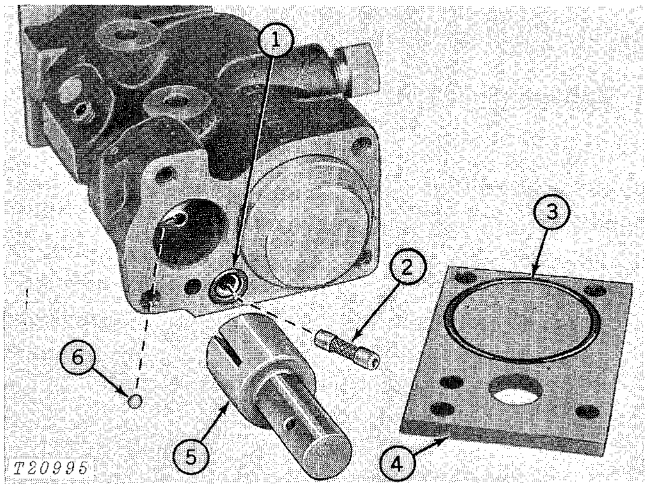
Insert bypass valve in bore (Fig. 28). End with double ramp should be out next to spring and stop pin. Insert pin in spring and push both into bore.



1—Bypass Valve
2—Bypass Spring
3—Stop Pin
4—Stop Cover
5—Spacer
6—Inner Accumulator Piston Spring
7—Outer Accumulator Piston Spring
8—Accumulator Piston
9—Accumulator Housing

Fig. 28-Installing Accumulator and Bypass Valve Assemblies.

Install accumulator piston in bore (Fig. 28, page 50-15-22). Slide round spacer over rod on stop cover. Assemble springs over rod and insert in accumulator bore. Press down cover and secure with cap screws.



1—O-Ring
2—Filter Screen
3—O-Ring
4—Detent Plate
5—Pilot Valve
6—Ball

Fig. 29-Installing Pilot Valve and Parts

Place small ball in hole in pilot valve bore (Fig. 29). Then insert pilot valve in bore. Install filter screen in bore with new O-ring. Install detent plate, making sure large O-ring is secure in groove.

Place shift valve link in arm yoke and insert pin. Insert spring in arm bore. Hold ball on spring, and slide arm on pilot valve shaft. Seat ball in a detent hole in plate. Drive in roll pin to secure arm to shaft.

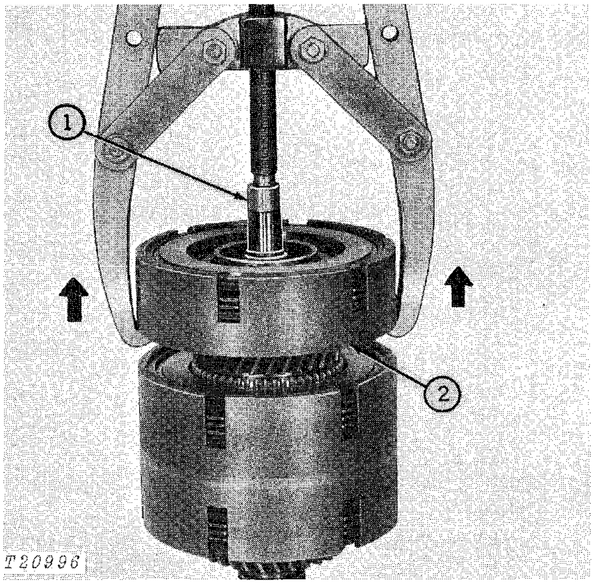
H-L-R Clutch Unit

Remove five sealing rings from clutch shaft. Do this by pressing in side of ring opposite joint, disengaging tangs, and releasing.

Pull out front clutch hub.

Remove snap ring holding front clutch drum.

Pull front clutch assembly using a gear puller (Fig. 30). This pack is keyed to the clutch shaft. Be sure to use a protector over end of clutch shaft.

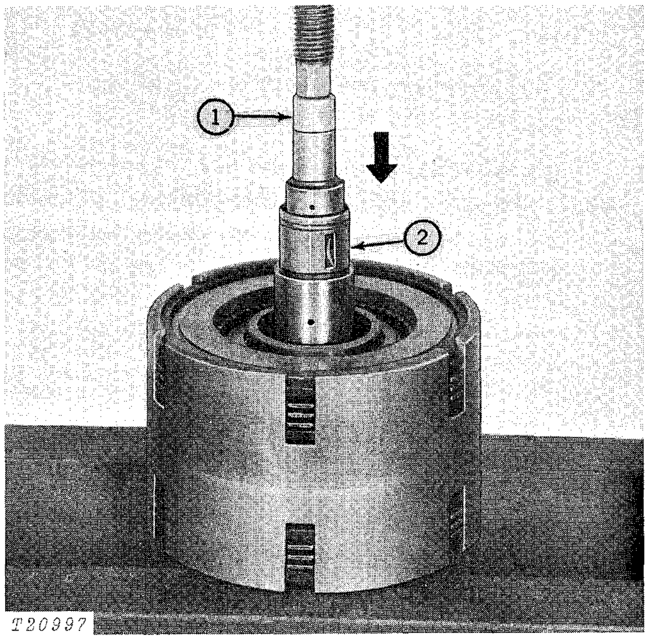


1—Shaft Protector
2—Front Clutch

Fig. 30-Pulling Front Clutch From Shaft

Remove key from clutch shaft. Then lift off thrust washer.

Pull out clutch hub. Then lift off thrust washer and remove snap ring from groove on clutch shaft.



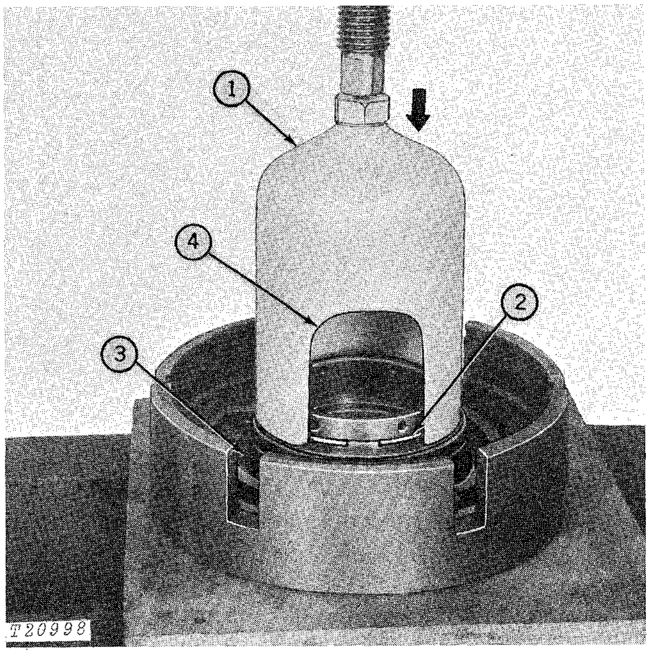
1—Shaft Protector
2—Clutch Shaft

Fig. 31-Pressing Off Dual Clutch Pack

Support dual clutch pack in a press and press out clutch shaft as shown (Fig. 31). The pack is keyed to the shaft. Be sure to use a protector over end of shaft.

Remove keys and snap ring and remove parts from clutch shaft.

Remove large snap ring from clutch pack. Lift whole pack from drum.



1—Oil Filter Cap
2—Snap Ring
3—Release Spring
4—Revised Area

Fig. 32-Pressing Down Clutch Release Springs to Remove Snap Ring

Snap ring must be removed to free spring pack from clutch drum (Fig. 32). This demands a special pressing tool. Shown above is an AM236T engine oil filter cap with one side cut out. This tool allows the spring to be pressed down until snap ring can be removed from groove. Then release pressure slowly.

CAUTION: Clutch release springs are under high pressure when loaded. Make sure tool is centered while pressing and keep fingers away.

Remove clutch release spring parts from hub. Unit has four spring washers as a clutch release mechanism.

Remove piston from clutch drum. Do this by turning drum over and pounding against a wooden block or, blow out with air pressure in hole in inner surface of drum. Piston should then slide out.

Remove sealing ring from rim of piston. Also remove sealing ring from drum.

NOTE: Other two clutch packs can be disassembled in same manner as above. Keep packs together for correct reassembly.

Refer to Fig. 29, page 50-15-23 for parts identification.

Wash all clutch parts in clean solvent and dry thoroughly before inspection.

Check rims of clutch pistons (10 and 26) for wear. Replace piston seals (24 and 25) if wear is excessive.

Inspect two small orifices in each clutch piston (10) for clogging.

Check bronze friction clutch disks (31) and steel plates (29 and 30) for wear. Examine facings on disks to see that grooved pattern has not been worn or chipped off. Also check inside teeth for breakage. Place flat disks (30) together and check for flatness.

NOTE: Some clutch drive plates (29) used in the clutch packs are designed to be slightly wavy. These plates have a notch on one tang.

Check spring washers (42) for damage. Place cupped rims of each pair together and inspect for bends, warping, or flatness.

Examine clutch hub bushings for wear. These bushings are "burnished" into the hub. If damaged, replace whole hub assembly.

Inspect transmission clutch shaft (21) for cracks or damaged splines; check shaft for straightness in a lathe or on "V" blocks, using a dial indicator.

Flush out drilled passages in clutch shaft with solvent. Inspect restrictor (19) in front bore to see that orifice is open and not damaged. Remove and replace if necessary.

Inspect sealing rings (18) for cracks or wear. Clean out oil grooves on shaft.

Clean all bearings thoroughly in solvent and inspect for wear or breakage.

Inspect thrust washers for wear or warping. Replace any damaged washers.

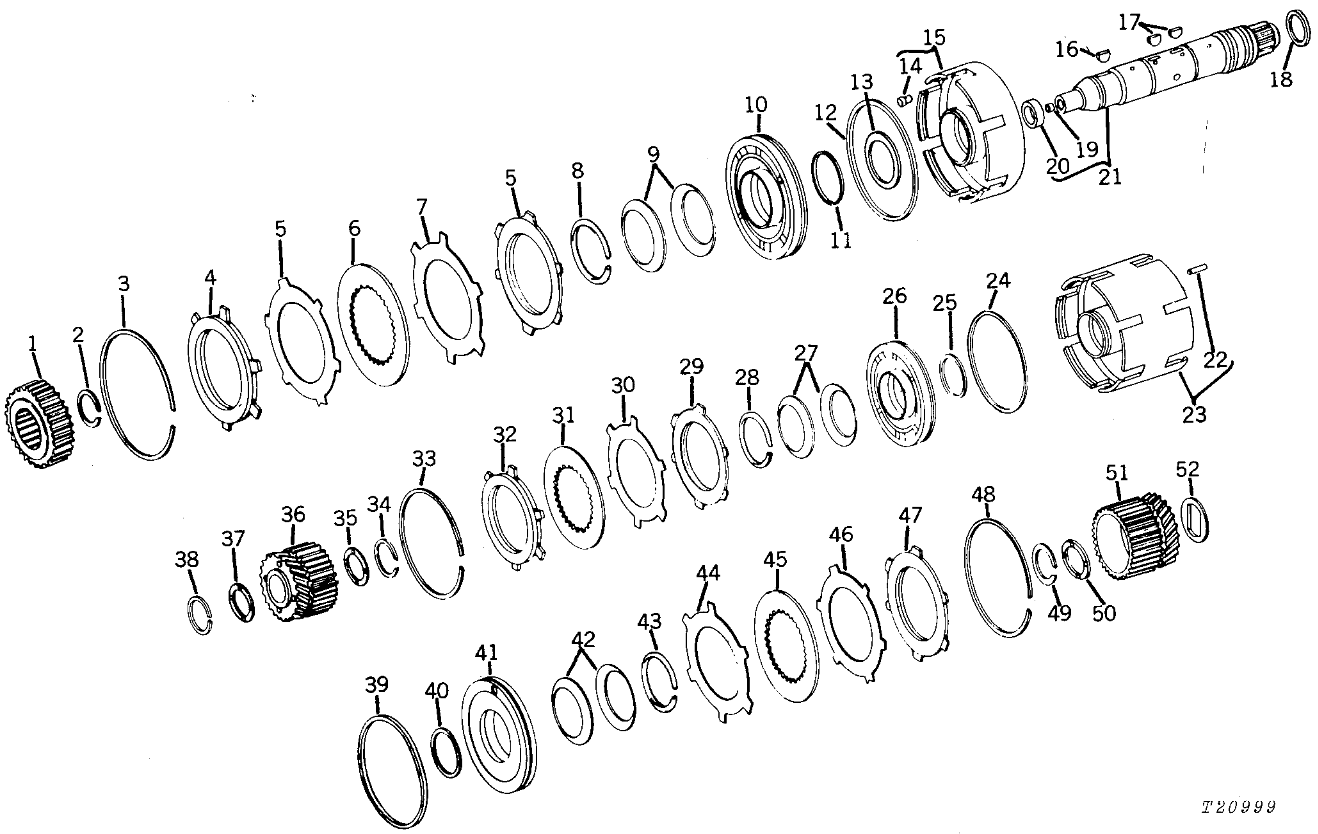
Inspect all gears for cracks or broken teeth.

Install pistons in both clutch drums (Fig. 33). Make sure sealing rings are installed on rim of piston and on hub of drum. Check to see that two small bleed holes in piston are open and clean. Line up dowel and tap in piston to bottom.

Stack four spring washers over center of clutch drum. Stack them alternately with the outer rim of the first washer bent up away from piston. Refer to Fig. 35, page 50-15-26.

Install snap ring to hold clutch release spring retainer or spring pack (Fig. 32, page 50-15-24).

IMPORTANT: Make sure ring seats in groove all around (Fig. 35, page 50-15-26). Then release pressure slowly and recheck it.



1—High Range Clutch Gear
2—Snap Ring
3—Snap Ring
4—Outer Clutch Locking Plate
5—Clutch Notched Plate (4 used)
6—Clutch Disk (4 used)
7—Clutch Plate
8—Snap Ring
9—Spring (4 used)
10—Clutch Piston
11—Piston Inner Seal
12—Piston Outer Seal
13—Thrust Washer
14—Pin
15—High Range Clutch Drum
16—Woodruff Key
17—Woodruff Key (2 used)
18—Seal Ring (5 used)
19—Drilled Brass Pin
20—Bearing Race
21—Transmission Clutch Shaft
22—Pin
23—Clutch Drum
24—Piston Outer Seal
25—Piston Inner Seal
26—Clutch Piston
27—Spring (4 used)
28—Snap Ring
29—Clutch Notched Plate
30—Clutch Plate (4 used)
31—Clutch Disk (4 used)
32—Outer Plate
33—Backing Plate Snap Ring
34—Drum Retaining Snap Ring
35—Thrust Washer
36—Reverser Range Pinion
37—Thrust Washer
38—Snap Ring
39—Piston Outer Seal
40—Piston Inner Seal
41—Clutch Piston
42—Spring (4 used)
43—Snap Ring
44—Clutch Plate (2 used)
45—Clutch Disk (4 used)
46—Clutch Notched Plate (3 used)
47—Clutch Backing Plate
48—Snap Ring
49—Snap Ring
50—Thrust Washer
51—Low Range Pinion
52—Thrust Washer

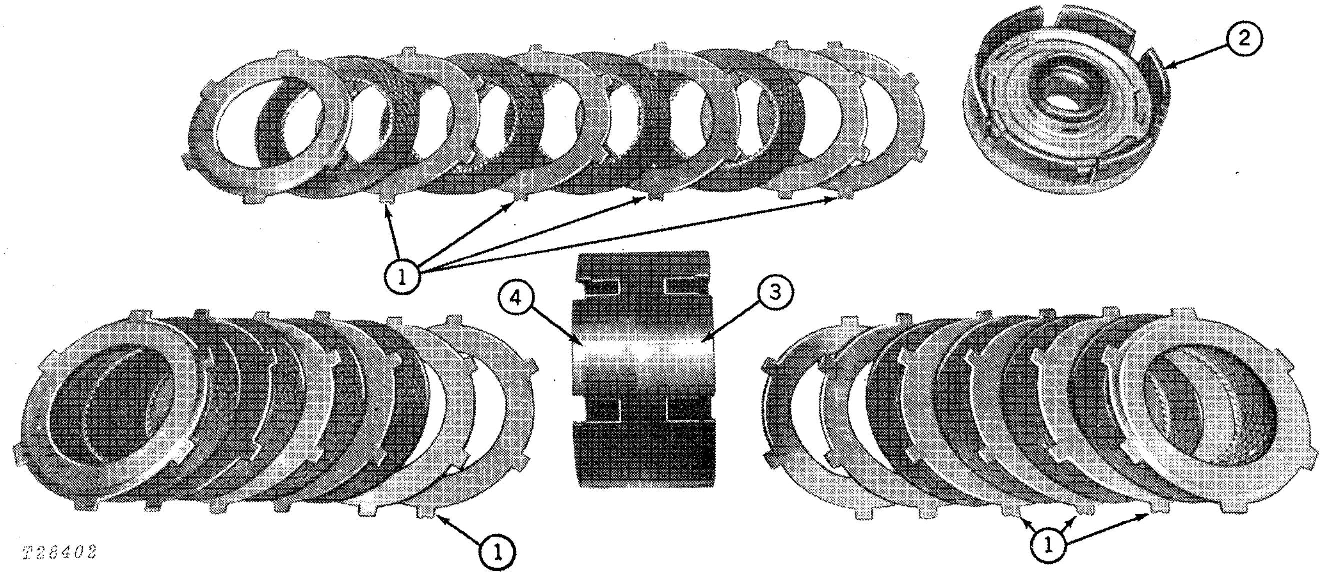
Fig. 33-H-L-R Clutches

Assemble high clutch pack into single drum, over piston, as shown in Fig. 34, page 50-15-26.

Install snap ring in groove of thick outer plate to hold pack in drum.

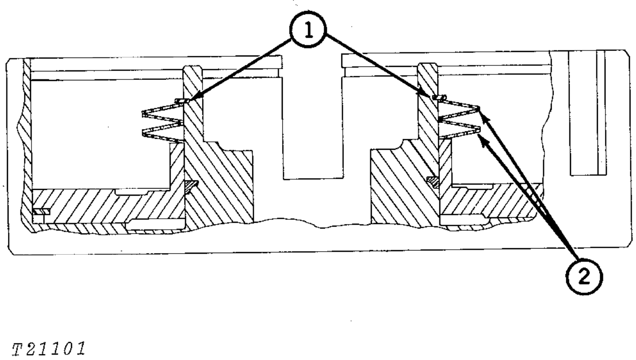
Install clutch pack in reverse clutch drum.

Stand clutch shaft on end and install thick thrust washer with bronze surface next to gear. Seat on slotted shoulder. Then install low clutch hub. Secure hub on shaft with thrust washer and snap ring. Key center of clutch shaft.



1—Notched Plates 2—High Clutch 3—Low Clutch 4—Reverse Clutch

Fig. 34-Correct Arrangement of Disks and Plates in Clutch Packs



1—Snap Ring 2—Spring Washers

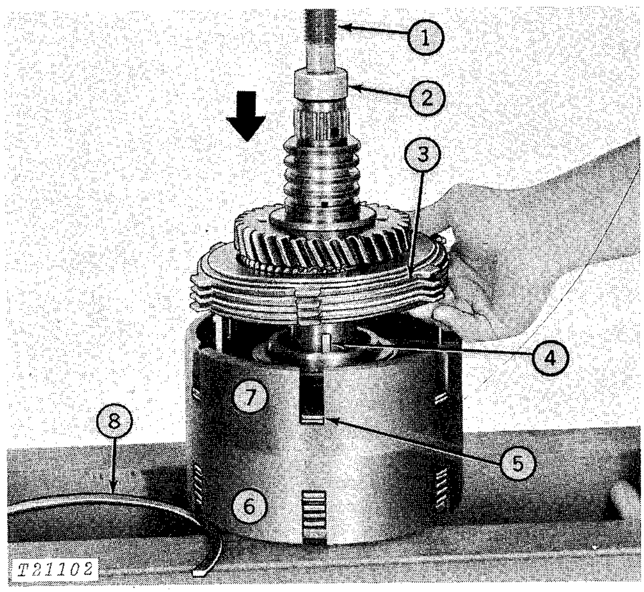
Fig. 35-Correct Position of Spring Washers and Snap Rings

Place low and reverse clutch drum on platform of a press (Fig. 36). Place two flat plates (without notches) in low clutch drum.

Alternate four disks and three plates in a pack. (Plates should have notch on one tang.) Place thick plate on top of pack. Position pack on splines of clutch shaft hub as shown (Fig. 36).

Insert clutch shaft in drum as shown and line up keyway. Press in clutch shaft, being careful to keep disks up on splines. Also match tangs with slots in drum as you press shaft into bottom. Secure pack in drum with snap ring.

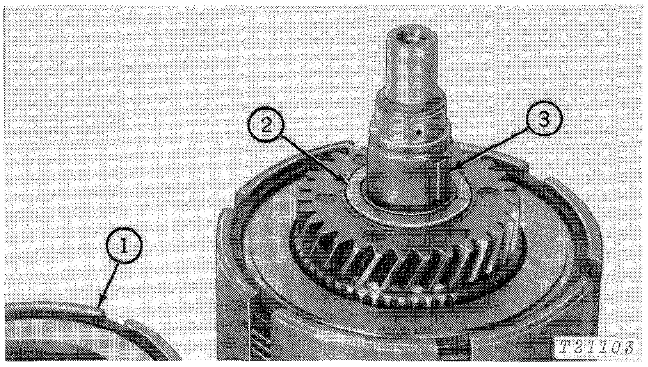
NOTE: Low clutch hub can be identified by two radial oil grooves on its gear face.



1—Press
2—Shaft Protector
3—Clutch Disks
4—Key
5—Flat Plates
6—Reverse Clutch
7—Low Clutch
8—Snap Ring

Fig. 36-Pressing Clutch Shaft into Dual Clutch Drum

Turn over clutch assembly and install snap ring. Then install thrust washer. Spline hub to clutch disks by jiggling assembly until it bottoms.



1—Front Clutch
2—Thrust Washer
3—Key

Fig. 37-Installing Thrust Washer and Key

Install thrust washer over clutch hub pinion (Fig. 37). If hub is all the way down, washer should just fit down around shoulder of shaft as shown. Key shaft.

Press front clutch pack on shaft, aligning key.

Install snap ring in shaft groove to secure front clutch. Then install hub inside disks by jiggling until it bottoms.

Install five sealing rings on clutch shaft. Do this by placing ring in groove, pressing in on side opposite joint, engaging tangs, and releasing.

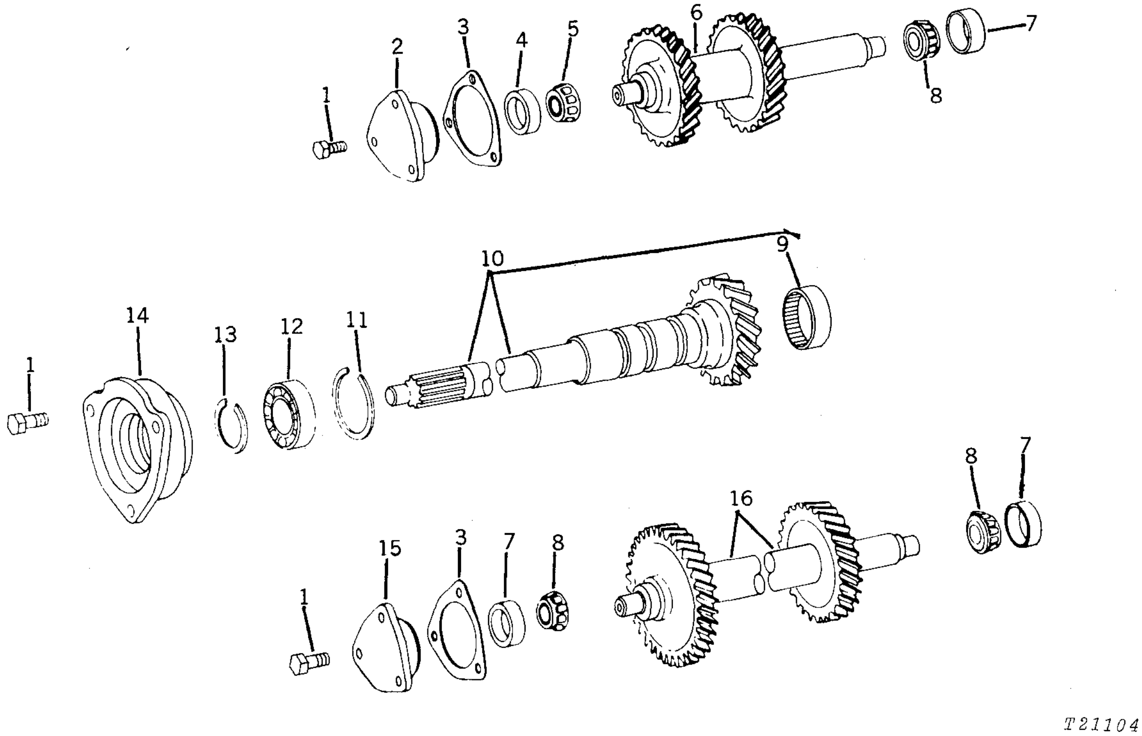
Front Drive Shaft (Fig. 38)

Clean all parts thoroughly in solvent before inspecting.

Inspect front drive shaft bearing for possible damage. Check to see that inner and outer race of bearing is perfectly smooth. If either race is rough, replace bearing.

Inspect splines on front of front drive shaft for wear or possible damage.

Check all snap rings for wear or "sprung" condition.



1—Special Cap Screw (9 used)
2—Bearing Quill
3—Shim (as required)
4—Bearing Cup
5—Roller Bearing Cone
6—Reverse Countershaft
7—Bearing Cup (3 used)
8—Roller Bearing Cone (3 used)
9—Needle Bearing
10—Front Drive Shaft (-129060)
Front Drive Shaft (129061-)
11—Snap Ring
12—Ball Bearing
13—Snap Ring
14—Bearing Quill
15—Bearing Quill
16—Underdrive Countershaft

Fig. 38-Front Drive Shaft and Countershafts

Inspect front quill for cracks or other damage. Replace if necessary.

Inspect pinions and collar gears for excessive tooth wear or broken teeth.

Underdrive and Reverse Countershaft (Fig. 38, page 50-15-27)

Inspect shims on countershaft bearing quills for damage and replace as necessary.

Inspect bearing cups and cones for excessive wear or damage. Replace if necessary.

Inspect roller bearing cones for damaged or worn rollers.

Inspect countershaft gears for excessive tooth wear or broken teeth.

Inspect quill attaching cap screws for excessive wear or damage and replace as necessary. If nylock screws are not tight in threaded holes they must be replaced.

Rear Drive Shaft (Fig. 39)

Inspect integral driving teeth for excessive tooth wear or broken teeth.

Inspect shims for damaged condition. If replacement is necessary, be sure to install new shims of same thickness as those removed or readjust bearings.

Inspect roller and taper bearing cones for damaged or worn rollers.

Inspect bearing cups and cones for excessive wear or damage. Replace if necessary.

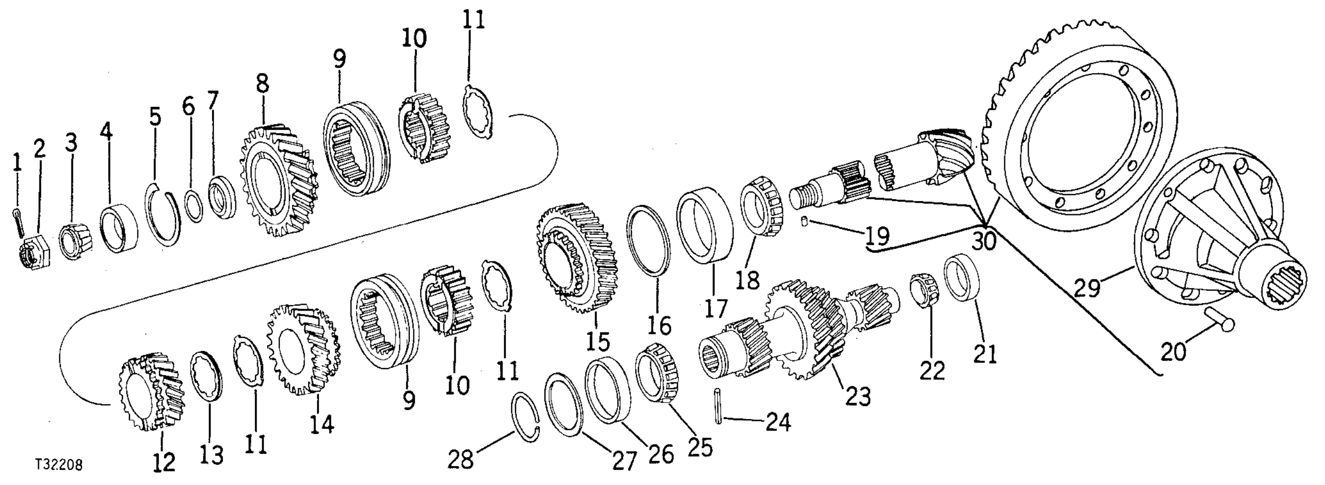
Inspect shaft retainer, lock plate, cap screws, and snap rings for excessive wear or damage and replace as necessary.

Pinion Shaft (Fig. 39)

Inspect teeth on the four speed gears for excessive tooth wear or broken teeth.

Inspect shifter gear collars (especially splined hubs) for damaged condition.

Inspect teeth and splined hubs of both shifter gears for excessively worn or damaged condition.



1—Cotter Pin
2—Output Shaft Nut
3—Roller Bearing Cone
4—Bearing Cup
5—Snap Ring
6—Shim (as required)
7—Spacer
8—Second Speed Gear (38 teeth)
9—Shifter Collar (2 used)
10—Shifter Gear (2 used)
11—Thrust Washer (3 used)
12—Fourth Speed Gear (26 teeth)
13—Thrust Plate
14—Third Speed Gear (32 teeth)
15—First Speed Gear (43 teeth)
16—Shim (as required)
17—Bearing Cup
18—Bearing Cone
19—Pin
20—Rivet (10 used)
21—Bearing Cup
22—Bearing Cone
23—Rear Drive Shaft
24—Roller Needle
25—Bearing Cone
26—Bearing Cup
27—Shim (as required)
28—Retaining Ring
29—Ring Gear Hub
30—Pinion Shaft and Ring Gear

Fig. 39-Speed Change Gears and Shafts

Inspect roller bearing cones for damaged or worn rollers.

Inspect locating pin in threaded end of pinion shaft for damage. If pin is bent or sheared off, replace with new pin.

IMPORTANT: If pinion shaft is no longer servicable and must be replaced, it will be necessary to replace the ring gear also as these parts are furnished only as matched sets.

Inspect thrust plate and washers for wear or damage. Replace if necessary.

Inspect pinion shaft retaining hex. nut for stripped threads. Examine shims and spacer for damage. Replace parts as necessary.

Inspect pinion shaft front and rear bearing cups for excessive wear or damage. Install rear cup with large diameter facing to the rear and install front cup with large diameter facing to the front.

NOTE: If either a new transmission case, a new ring gear hub quill, or a new ring gear and pinion shaft set are to be installed, it will be necessary to readjust pinion shaft preload and to readjust pinion and ring gear backlash.

Filter Assembly

Remove filter cap, gasket, and seal. Remove and inspect oil filter element.

Inspect seals on ends of filter element for damage. If seals are leaking or damaged replace them. Inspect filter base for cracks or other damage.

Ring Gear and Hub (Fig. 40)

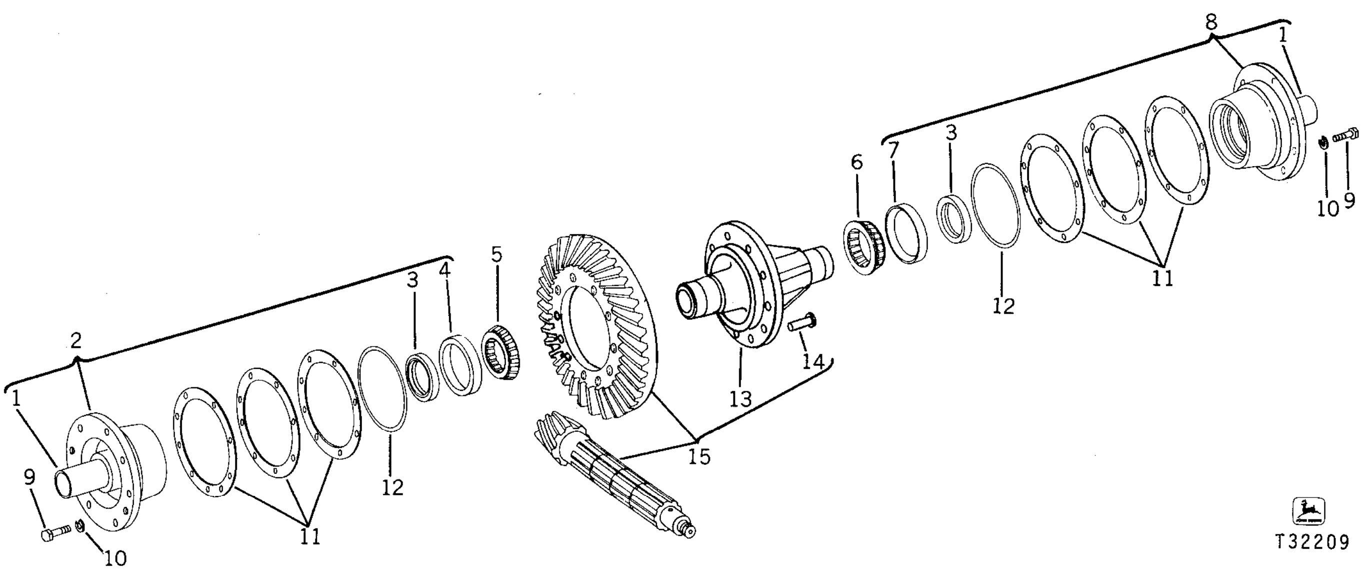
Inspect ring gear (15) for cracks or excessive wear.

Inspect bearing cups (7) in the two quills for excessive wear and replace as necessary.

Inspect bearing cones (6) for worn or damaged rollers. When new bearings are installed, always check bearing preload and ring gear backlash as described under "ADJUSTMENTS" on page 50-15-30.

If oil seal (3) in quill is worn or damaged, install new seal with sealing lip to inside of quill. Coat lip of seal with Lubriplate.

Inspect tubes (1) in quill for wear or damage. If replacement is required, press in new tube until inner end is flush with inside edge of bore.



1—Tube (2 used)
2—Quill
3—Oil Seal (2 used)
4—Bearing Cup
5—Bearing Cone
6—Bearing Cone
7—Bearing Cup
8—Quill
9—Cap Screw (12 used)
10—Lock Washer (12 used)
11—Shim (as required)
12—O-Ring (2 used)
13—Ring Gear Hub
14—Rivet (10 used)
15—Pinion Shaft with Ring Gear

Fig. 40-Ring Gear and Hub

Inspect ring gear and pinion teeth for excessive wear and tooth damage. If wear is excessive, it will be necessary to replace the ring gear and pinion shaft as a matched set.

To rivet ring gear to ring gear hub, heat ring gear to 200°F. Press heated ring gear on ring gear hub to seat squarely on hub.

Start rivets in all locations around ring gear hub prior to the seating of any rivets.

Seat rivets in ring gear until holes in gear are filled evenly with rivets.

TRANSMISSION ASSEMBLY

Clean transmission case thoroughly and inspect for cracks or other damage. Remove all lose parts which may have dropped in case.

Assembly and Adjustments

When installing a new transmission case, ring gear and pinion set, rear input shaft, or the bearing quills, cones, or cups which support these parts, it will be necessary to make certain adjustments to be sure of proper tooth contact, quiet operation, and longer service life. These adjustments are as follows:

Cone Point Adjustments

The pinion is actually a part of a cone; that is, if the pitch lines of the pinion teeth were extended they would come together at a cone point (Fig. 41). The dimension which is etched on the end of each pinion is the actual distance from the base of the pinion gear to the cone point.

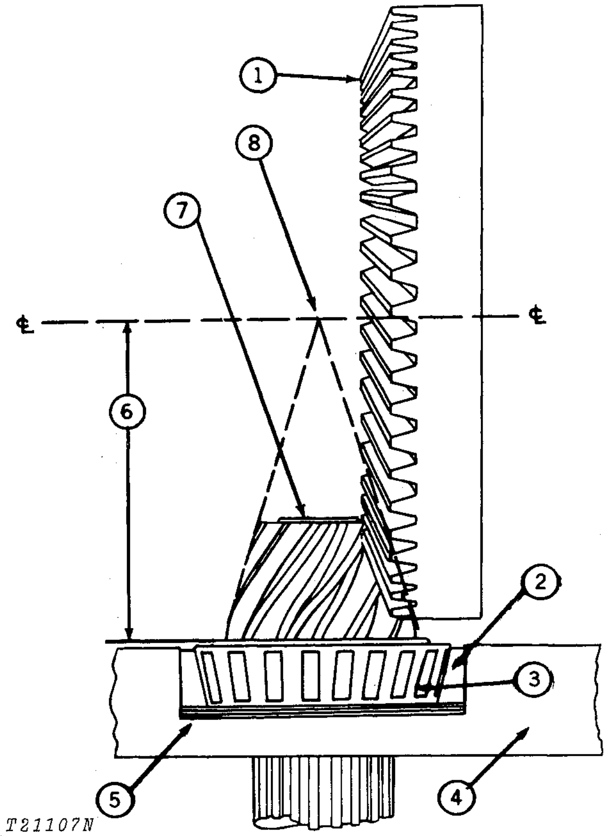
It is essential that the cone point of pinion be exactly on centerline of ring gear as shown in Fig. 41.

This relationship is obtained by controlling the number of shims between the output shaft rear bearing cups and transmission case (Fig. 41).

To determine number of shims required proceed as follows:

A. Use the figure 1.4375 as a nominal measurement of the height of the output shaft bearing cone and cup.

B. Observe the actual dimension stamped on the top rear of the transmission case. (Use 7.800 inches for this dimension only if no dimension is stamped on the transmission case.) This dimension is the dis-



1—Ring Gear
2—Cup
3—Bearing Cone
4—Differential Compartment Front Wall
5—Shims
6—Dimension of Pinion
7—Etched Dimension on Pinion
8—Cone Point

Fig. 41-Ring Gear and Pinion Cone Point Adjustment

tance from the centerline of the ring gear crossbores to the output shaft bearing cup backing shoulder in the transmission case.

C. Observe the dimension etched on the ground face of the bevel pinion. (Use 6.335 inches for the bevel pinion shaft only if no dimension is etched on the ground face).

D. To determine shim pack, subtract the measurements found in Steps A and C from measurement observed in Step B.

Example: 6.335, the number etched on the pinion, plus 1.4375, the nominal bearing cone and cup measurement, equals 7.7725. Subtracting this from 7.7945, the number etched on the transmission case, equals 0.022, the total thickness of shims that must be added.

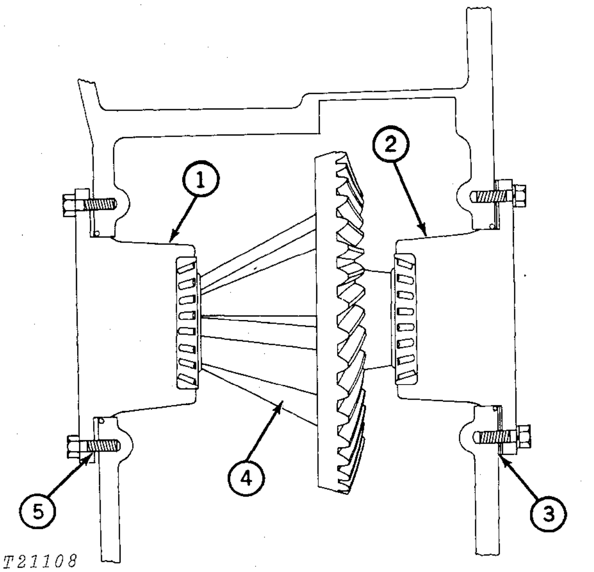
After correct shim pack has been installed behind bearing cup, proceed with "Ring Gear Bearing Preload Adjustment."

Ring Gear Bearing Preload Adjustment

Two adjustments of the ring gear and hub assembly are necessary for quiet and proper operation. They are:

a. Preload on Bearings.
b. Backlash between ring gear and output shaft pinion.

These adjustments are made by use of shims located between the transmission case and ring gear hub bearing quill (Fig. 42, page 50-15-31). The total thickness of shims on both sides determines the preload. Backlash is established by shifting shims from one side to the other. Preload must be adjusted before checking backlash.



1—Left Hand Quill
2—Right Hand Quill
3—Shims
4—Ring Gear and Hub
5—Space

Fig. 42-Ring Gear and Hub Bearing Preload Adjustment

To determine thickness of shim packs required to preload ring gear bearings to 0.002-0.005-in., proceed as follows:

Place the ring gear and hub assembly in transmission case (refer to Fig. 40, page 50-15-29 for identification of parts and sequence of installation).

As a starting point, use no shims between the transmission case and the right-hand ring gear hub bearing quill.

Install right-hand quill so that the right-hand bearing cone fits into the right-hand bearing cup. Secure with cap screws.

Install the left bearing quill with enough shims to obtain a measurable amount of end play.

The measured end play plus 0.002 inch subtracted from the left bearing quill shim pack will give the specified preload.

Once ring gear bearing preload has been set, remove ring gear from transmission case being sure that right'hand quill (and its shims) and left-hand quill (and its shims) are tagged and kept together so that they may be correctly reinstalled.

Pinion Shaft Bearing Preload Adjustment

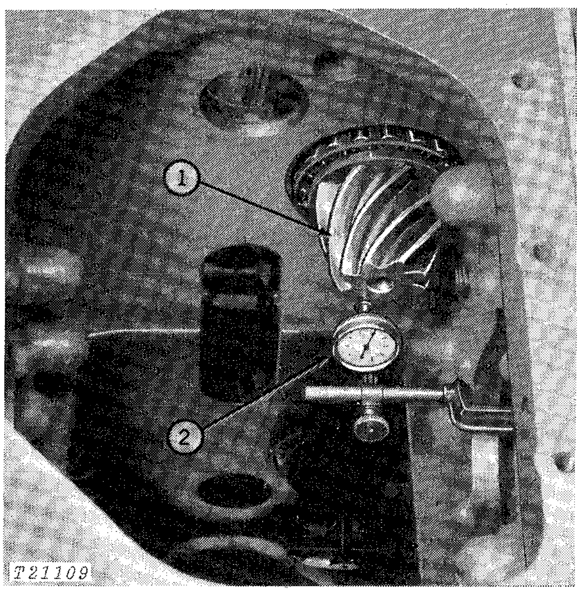
Pinion shaft must have a preload (0.003-0.005-in.). This preload is obtained by varying the number of shims behind the front bearing cone. Refer to Fig. 39 for parts identification and sequence of assembly.

To establish preload on pinion shaft, proceed as follows:

Install bearing cup (4) and snap ring (5) in front wall of speed change compartment. Position shim pack (16), bearing cup (17), and bearing cone (18).

Install pinion shaft and one gear (as a means of holding shaft from turning). Position spacer (7) on front of shaft with chamfered edge of hole against shoulder of shaft with locating pin in pinion shaft indexed in slot on spacer. A "pip" mark on threaded end of pinion shaft indicates proper location of pin in shaft. Install a preliminary shim pack (6) on shaft and install front bearing cone and nut. Tighten nut securely.

Seat bearing cups by lightly tapping on shaft. Install a dial indicator and measure introduced end play on shaft (Fig. 43). Rotate the shaft while taking the reading. If there is no end play, remove nut and bearing cone and add enough shims so there is a measurable amount of end play.



1—Pinion Shaft **2—Dial Indicator**

Fig. 43-Measuring Preliminary End Play in Pinion Shaft

IMPORTANT: For a more accurate bearing preload setting, introduced end play should not exceed 0.005-in. End play readings in excess of this figure cannot be measured accurately because the roller bearing easily becomes misaligned. Also, the longer indicator travel is difficult to measure accurately.

Record measured end play shown by dial indicator and take from shim pack the thickness of shims equal to end play reading to give the desired preload (0.003-0.005 in. and 6 to 12 in-lbs rolling torque.)

Installing Pinion Shaft

Refer to Fig. 39, page 50-15-28 for identification of parts and sequence of installation.

Insert pinion shaft with rear bearing cone into rear end of speed change compartment. Slide shaft forward about one-half the distance of the shaft and install parts in the following sequence:

First install first speed gear (15) (small teeth to front); then slide a locking thrust washer (with outside tangs) on shaft; next install rear shifter gear and collar (9 and 10).

Inch pinion shaft forward and install third speed gear (14) (small teeth to rear) on shaft, followed by a locking thrust washer and thrust plate. After moving the shaft further into speed change compartment, install the fourth speed gear (12) (small teeth to front) and another thrust washer.

Slide shifter gear and shift collar on pinion shaft. Install second speed gear (8) (small teeth to rear).

NOTE: Before completing pinion shaft assembly, refer to "Speed Change Shifter Mechanism" on this page.

Position spacer with large diameter of spacer facing to the rear. Install previously established shim pack (6).

Slide pinion shaft all the way to the front, indexing the small pin on the shaft with slot in spacer. (A "pip" mark on end of shaft indicates proper position of pin.) Place a wooden block against the rear of the pinion shaft to hold it securely in place to facilitate final assembly of shaft. Position roller bearing cone (3) and thread hex. nut on shaft.

IMPORTANT: Before tightening hex. nut, be sure pin on output shaft is indexed with slot on spacer or pin may be damaged or broken off.

Keep shaft from turning and tighten nut to 300 ft-lbs., lining up a slot with one hole in end of pinion shaft. (If cotter pin hole in shaft does not line up with a slot, tighten until hole does line up-do not loosen.)

NOTE: If cotter pin is not used; put JOHN DEERE LOCTITE PLASTIC GASKET or an equivalent on the threads of the pinion shaft and nut. Tighten nut to 300 ft-lbs.

Remove blocking from behind pinion shaft.

Speed Change Shifter Mechanism Installation

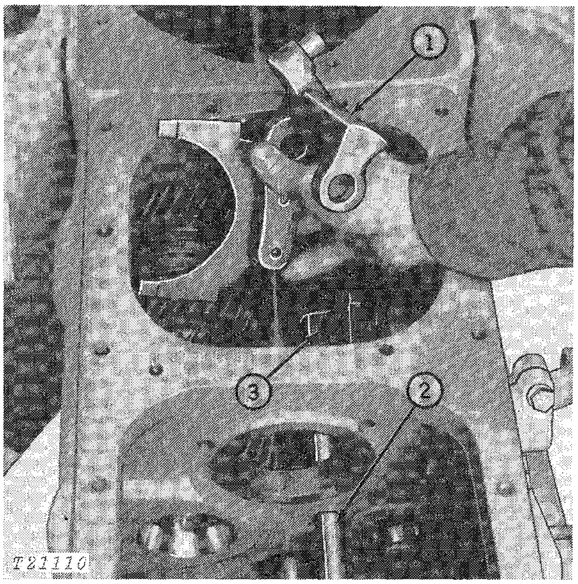
Install speed change shifter cam shaft oil seal in transmission case with sealing lips facing inward. Coat lip of seal with John Deere multi-purpose grease or an equivalent prior to installing shifter cam shaft.

Assemble shifter cam and shaft using self-locking nut.

IMPORTANT: Remove burrs or other damage from shaft that may ruin oil seals during assembly.

NOTE: Be sure to align "V" mark on shifter cam with "V" mark on cam shifter shaft. The shifter will not function unless the two marks are properly aligned.

Install cam and shaft in speed change compartment with grooves facing center of compartment.



1—1st and 3rd Speed Fork **3—2nd and 4th Speed Fork**
2—Shifter Forks Shaft

Fig 44-Installing Speed Change Shifters

Key shifter arm to cam shifter shaft and secure cap screw.

Install detent ball, retainer, spring, washer and retainer in rear port of speed change compartment.

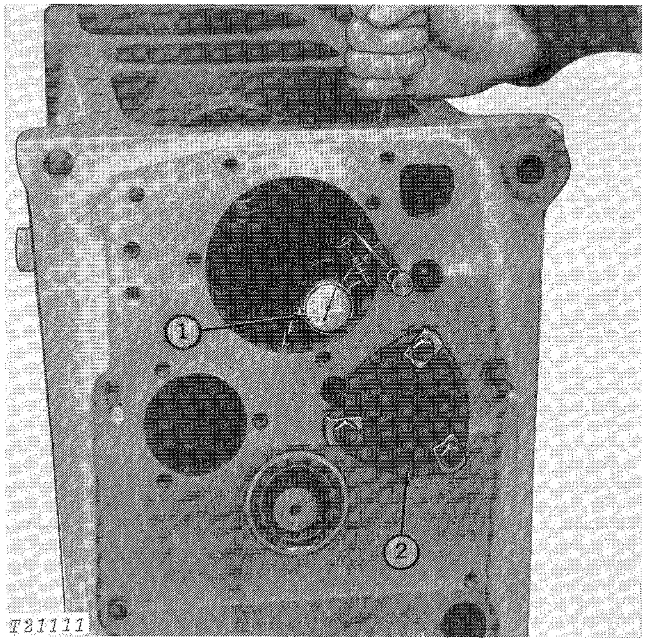
Install 2nd and 4th speed shifter fork on shifter fork shaft so that fork seats in groove of forward shifter collar and roller seats on rear groove of shifter cam (Fig. 44).

Install 1st and 3rd speed shifter fork on shifter fork shaft so that fork seats in groove of rearward shifter collar and roller seats in front groove of shifter cam.

Underdrive Countershaft Installation

Install underdrive countershaft with long end to rear.

Install underdrive countershaft bearing quill with shim pack.



1—Dial Indicator **2—Bearing Quill**

Fig. 45-Measuring End Play in Underdrive Countershaft

Proper end play (0.003 to 0.005-in.) in the underdrive countershaft is established by shims under the bearing quill.

Install a dial indicator as shown in Fig. 45 and measure end play in countershaft. Remove quill and add or deduct shims as necessary to obtain proper end play.

NOTE: Remove quill and shim pack so shaft can be free for installation of H-L-R clutch packs. Keep shims together with quill.

After installation of H-L-R clutch packs, position shim pack and secure quill with cap screws.

Reverse Countershaft Installation

Install reverse countershaft with long end to rear.

Install reverse countershaft bearing quill with shim pack.

Proper end play (0.003 to 0.005-in.) in the reverse countershaft is established by shims under the bearing quill.

Install a dial indicator as shown in Fig. 45, page 50-15-33 and measure end play in countershaft. Remove quill and add or deduct shims as necessary to obtain proper end play.

NOTE: Remove quill and shim pack so shaft can be free for installation of H-L-R clutch packs. Keep shims together with quill.

After installation of H-L-R clutch packs, position shim pack, and secure quill with cap screws.

Rear Input Shaft Installation

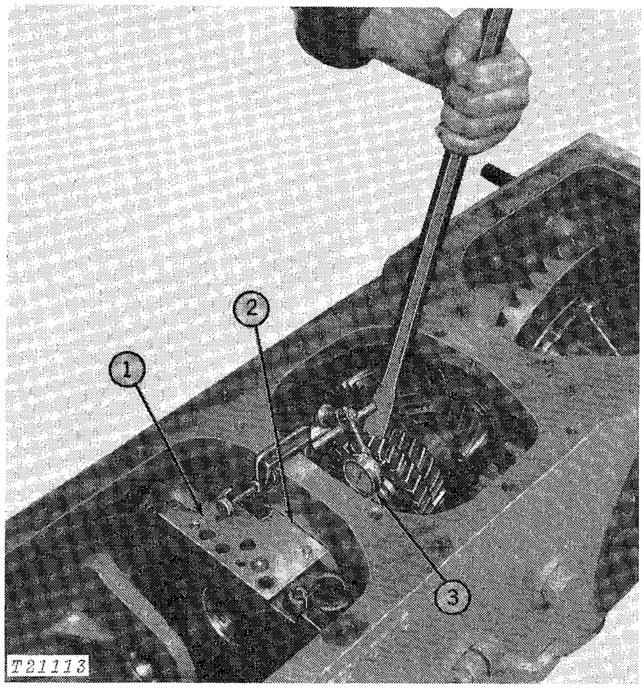
Install rear input shaft into speed change compartment and out through bore of compartment front wall, and then slide shaft rearward until rear taper bearing cone is seated in its cup. Install front bearing cone and cup.

Install clutch oil manifold (Fig. 46). Use a shim pack on rear shoulder. Install lock plate and three cap screws on rear of wall to secure unit. Draw up valve slowly and watch for any binding. Make sure that shaft does not begin to bind, and rotate shaft to be sure bearings are seating properly. Tighten cap screws securely.

Proper end play in the rear input shaft is set by shims on the rear shoulder of the H-L-R clutch oil manifold (0.003-0.005-in.).

Install a dial indicator against the 4th speed gear as shown in Fig. 46 and measure end play in shaft while moving rear input with a small bar as shown. Remove clutch oil manifold and add or deduct shims as necessary to obtain proper end play.

IMPORTANT: Avoid heavy pressure on pry bar when checking end play.



1—H-L-R Clutch Oil Manifold **3—Dial Indicator**
2—Shim Position

Fig. 46-Measuring End Play on Rear Input Shaft

When proper end play has been obtained, remove clutch oil manifold. Keeping proper shim pack together.

Ring Gear Installation

To determine amount of shims required to provide specified backlash (0.006-0.008-in.) between ring gear and pinion, proceed as follows:

Reinstall the ring gear and hub assembly and quills with their proper number of shims as determined in "Ring Gear Bearing Preload Adjustment" (page 50-15-31). Be sure to install new O-rings on quills.

Tighten all quill attaching cap screws securely.

Set up a dial indicator as shown in Fig. 47, page 50-15-35 and measure backlash at several different points around the entire circumference of ring gear. If backlash reading is 0.006-0.008 in., backlash is set.

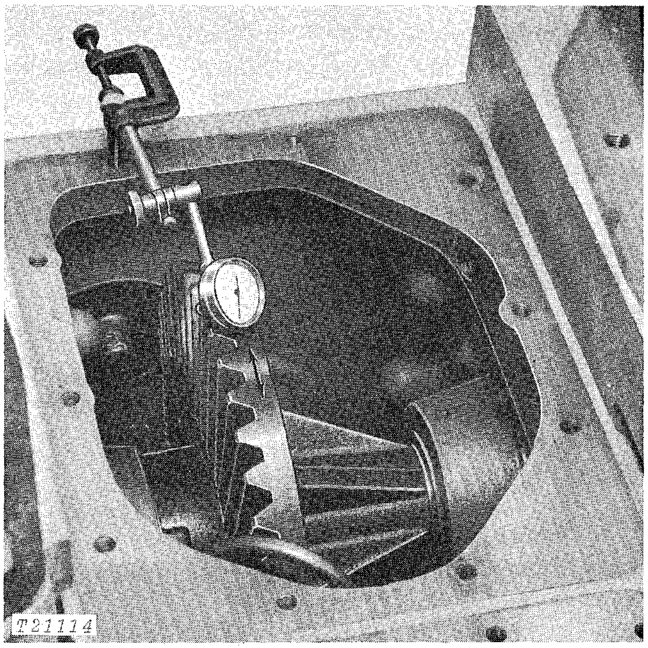


Fig. 47-Measuring Pinion and Ring Gear Backlash

To decrease backlash, transfer shims from left quill to right quill. To increase backlash, transfer shims from right side to the left side.

CAUTION: If shims are removed from one bearing quill, same thickness of shims must be added to the other bearing quill to maintain proper preload adjustment on ring gear bearings.

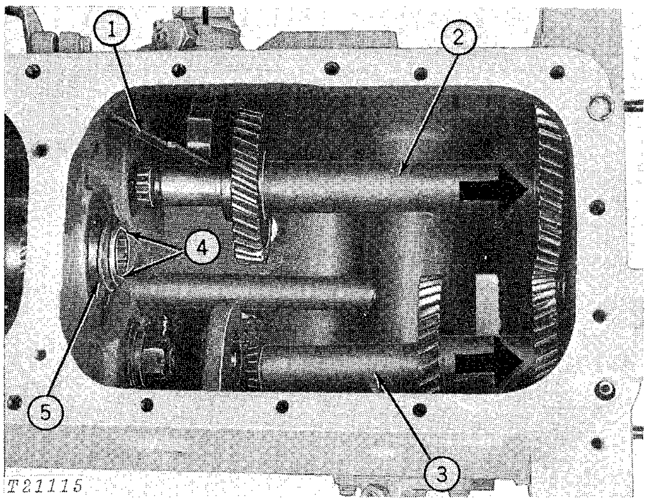
NOTE: Backlash is reduced or increased an amount less than the shim thickness.

Backlash movement compared to shim thickness is as follows:

Shim Thickness	Approximate Backlash Movement
0.010-inch	0.008-inch
0.005-inch	0.004-inch
0.002-inch	0.0016-inch

H-L-R Clutches Installation

Lay countershafts loosely in case as shown (Fig. 48). Pull shafts forward through front bearing bores to give extra clearance. As an aid in lining up gears when installing clutch packs, loop a wire under rear of each countershaft.



1—Link
2—Underdrive Countershaft
3—Reverse Countershaft
4—Slot
5—Retaining Ring

Fig. 48-Range Change Compartment

Turn range change shifter arm down so that link lies against side of case as shown.

Slip retainer ring over rear input shaft and position to rear of groove with one end in groove to cover pin hole (Fig. 48).

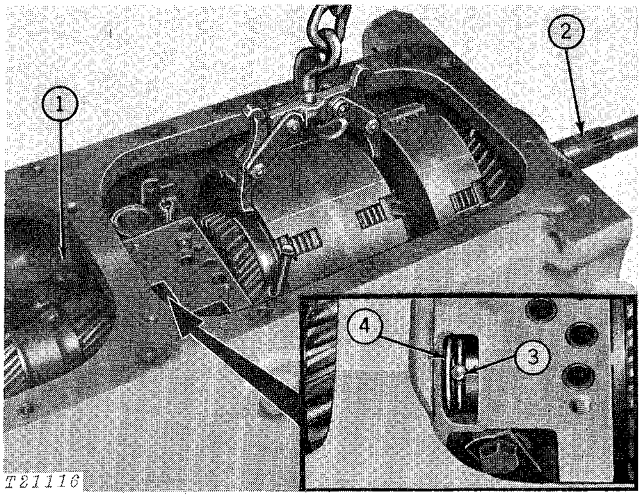
Install vertical lubricating line on elbow installed in clutch control housing at angle. Tighten securely.

Be sure correct shim pack is secure on rear shoulder of clutch valve. (This shim pack sets the end play for the rear input.)

Using a gear puller clamped over rims of dual clutch drum as shown, (Fig. 49, page 50-15-36) lower clutch unit into case. Tilt down rear of unit so that it slides past wall of case. Then engage rear of unit in rear input slot and lower assembly into case. Be careful with shim pack.

Loosely insert front input shaft and quill into case to guide front of clutch unit. Carefully work assemblies to rear while supporting parts with puller and loops of wires. Make sure countershaft rear bearings guide into their cups and all gears are engaged.

Line up splines on rear of clutch shaft with splines in rear input shaft. Pin holes must line up (see inset in Fig. 49, page 50-15-36).



1—Lock Plate
2—Front Input Shaft
3—Pin
4—Retainer Ring

Fig. 49-H-L-R Clutches and Control Unit Installed

Insert pin through clutch shaft and rear input, then slide retainer ring forward into groove on rear input to hold pin in place.

Install lock plate and cap screws on rear of case wall. Draw up screws slowly and watch for any binding.

Installing Countershaft Quills (Fig. 50)

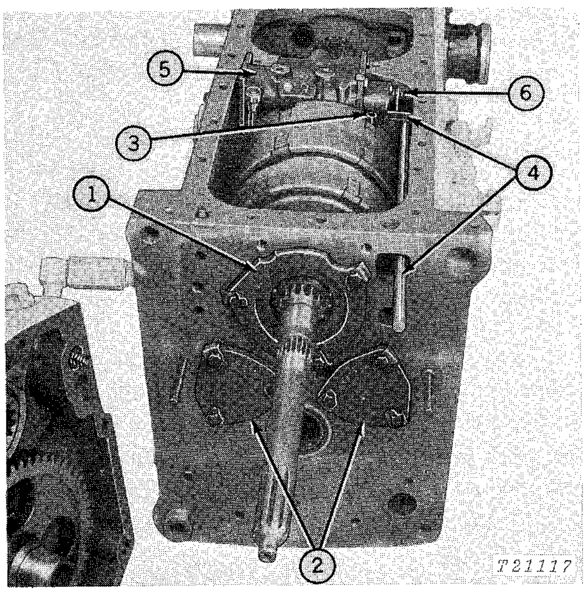


Fig. 50-Installing Countershaft Quills and Operating Linkage

1. Secure front input shaft quill to case.

2. Install countershaft quills and shim packs.

Check for free turning of all gears, rotating front input shaft by hand. If gears are binding, loosen quills and recheck alignment of shafts and gears.

Installing Operating Linkage (Fig. 50)

3. Lift up clutch valve and insert point of valve operating lever into valve slot, under roll pin. Off set in lever must face to rear of case.

4. Insert valve operating shaft into case. Align hole in rear of shaft with hole in clutch valve lever and tap shaft on through until holes line up. To avoid possible breakage, support lever while tapping shaft. Drive spring pin through lever and shaft.

5. Install accumulator housing. Insert shift valve in bore while lowering assembly onto locating dowel.

6. Attach shifter link to shift valve arm and secure with retainer ring.

Installing Transmission Front Cover and Oil Pump (Fig. 51)

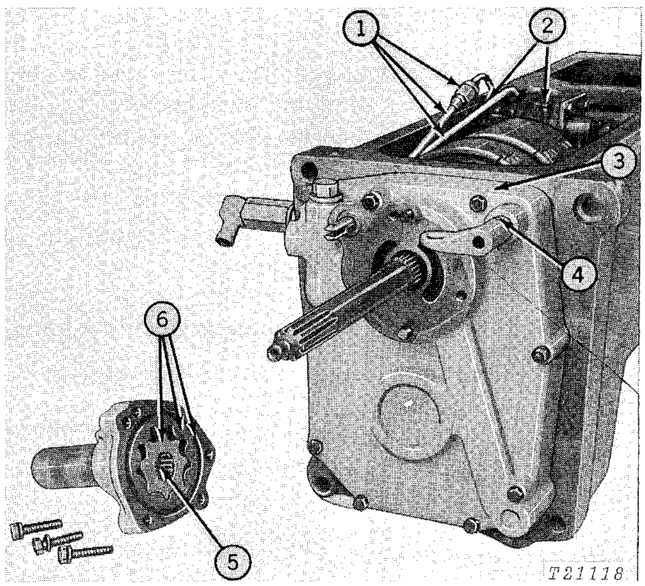


Fig. 51-Installing Transmission Front Cover and Oil Pump

Oil line must not touch accumulator housing or lube line fitting. Torque flare nut to 35 ft-lbs.

2. Install accumulator housing cap screws and tighten securely.

3. Install transmission front cover, using a new gasket. Be sure that cooler bypass valve and spring are in bore in rear of cover. Secure front cover with cap screws, hex. nuts, and lock washers shown.

4. Tap arm onto shaft and secure with spring pin.

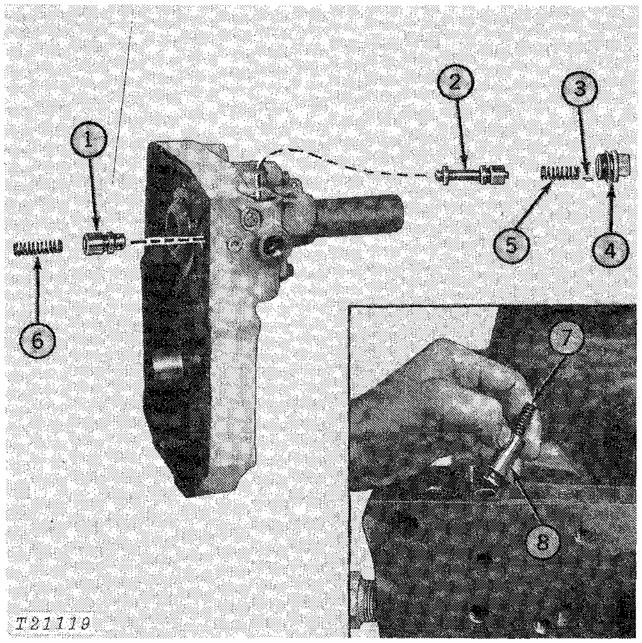
IMPORTANT: To avoid possible breakage of clutch valve arm, support rear end of shaft while driving on front arm.

5. Apply Lubriplate to lips of oil seal in pump cover.

6. Place outer and inner rotors in pump cover and install new sealing ring in cover groove. Slide cover onto front input shaft with a slow rotary motion. Align cover on dowels and secure with cap screws and lock washers.

Install Transmission Top Cover

Use Loctite plastic gasket (AT26341) to seal transmission top covers.



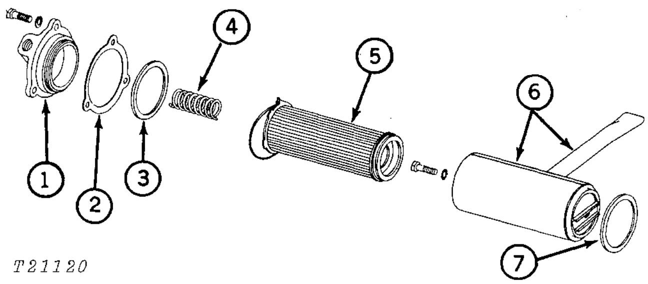
1—Oil Cooler Bypass Valve
2—Oil Pressure Regulating Valve
3—Shim(s)
4—Plug
5—Spring
6—Spring
7—Spring
8—Clutch Lubricating Bypass Valve

Fig. 52-Transmission Front Cover and Oil Supply Regulating Valves

Be sure clutch lubricating bypass valve spring and plug are in bore in top front of case (see Fig. 52). Tighten screws down evenly to avoid stress on cover and then tighten them to 50 ft-lbs front and 35 ft-lbs rear.

Connect rods to steering levers.

Transmission Case Oil Filter Assembly



1—Cover
2—Gasket
3—Seal
4—Spring
5—Filter Element
6—Filter Case
7—Seal

Fig. 53-Transmission Case Oil Filter Unit

Install a new John Deere element, making sure that sealing ring is secure in bottom groove of element. Apply a thin film of oil to sealing ring.

Apply a thin film of oil to the bottom of the oil filter gasket. Tighten oil filter 3/4 to 1-1/4 turns after gasket contacts the oil filter base.

Refill transmission with oil of the proper quantity and viscosity (Section 10, Group 20).

Join transmission to clutch housing (Section 10, Group 25) and position assemblies in tractor.

Oil Filter Assembly Removal

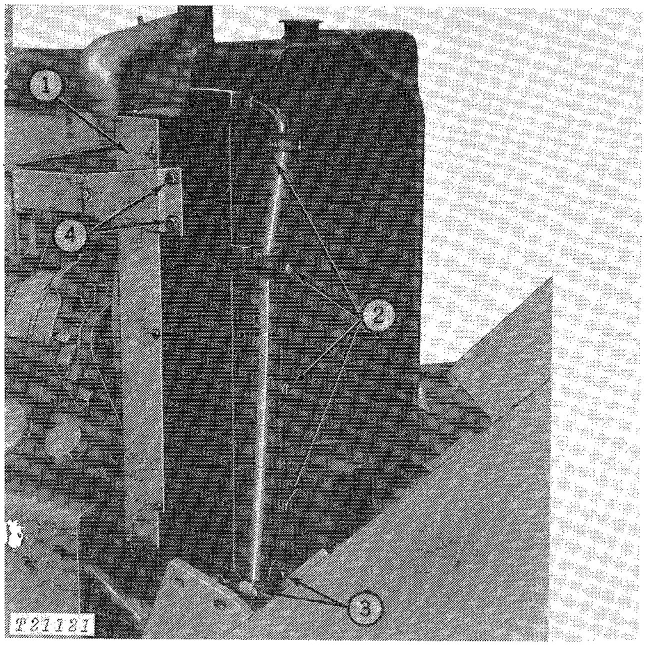
Remove grille from tractor.

Loosen hose clamps and free inlet and outlet tubes.

Remove top cap screw from filter base bracket and lift out filter assembly.

Removing Oil Cooler Unit

Remove hood from tractor. Remove side frame-to-grille housing cap screws. Also remove bottom plate-to-grille housing cap screws. Then tilt grille housing forward on pivot pins as shown in Fig. 55, page 50-15-38.



1—Radiator Cooler 3—Hoses
2—Cooler-To-Radiator Cap Screws 4—Bracket Cap Screws

Fig. 54-Removing Oil Cooler (Early Unit)

Loosen radiator collar and remove rear cap screws securing oil cooler to radiator (not shown).

Remove two cap screws holding radiator bracket to cooler.

Loosen hose clamps and free hoses from cooler inlet and outlet.

Remove front cap screws securing oil cooler to radiator and lift out oil cooler.

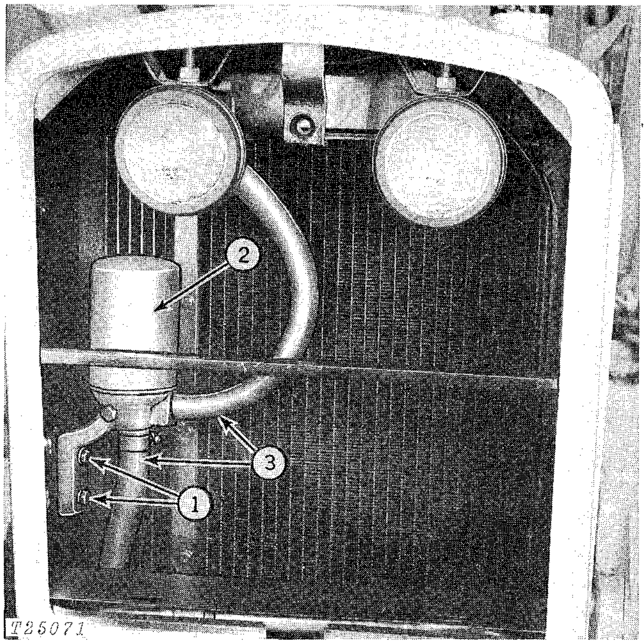
Straighten any bent fins and clean trash from screen.

Flush out passages in oil cooler. Blow out with compressed air. Check for any restrictions in lines and passages. Inspect hoses for "mushy" condition.

Set oil cooler into place on side of radiator (Fig. 54). Insert hoses onto oil tubes. Attach cooler to front and rear of radiator using cap screws and lock washers. Attach fan shroud to radiator. Secure radiator bracket to cooler. Tighten all hose clamps.

Tilt up grille housing and attach at side frames and bottom plate. Install hood.

Installing Oil Filter Assembly



1—Bracket Attaching Cap Screws 3—Hoses
2—Filter Element

Fig. 55-Installing Oil Filter Assembly

Set oil filter assembly into place inside grille housing (Fig. 55). Insert hoses on tubes and attach filter bracket using two cap screws and lock washers. Tighten hose clamp securely.

Spin off old filter element and discard it. Install a new John Deere element, making sure that sealing ring is secure in bottom groove of element. Apply a thin film of oil to sealing ring and turn element down until the seal contacts the base. Tighten element an additional 3/4 to 1-1/4 turns.

Install grille on tractor.

Starter Safety Switch

Install the maximum number of shims (at least two) under the starter safety switch which will still permit starting the engine with the reverser lever lock in the neutral position (between high and reverse).

IMPORTANT: Do not overtighten starter safety switch (35 ft-lbs.).

Group 20
POWER TAKE-OFF AND WINCH DRIVE

GENERAL INFORMATION

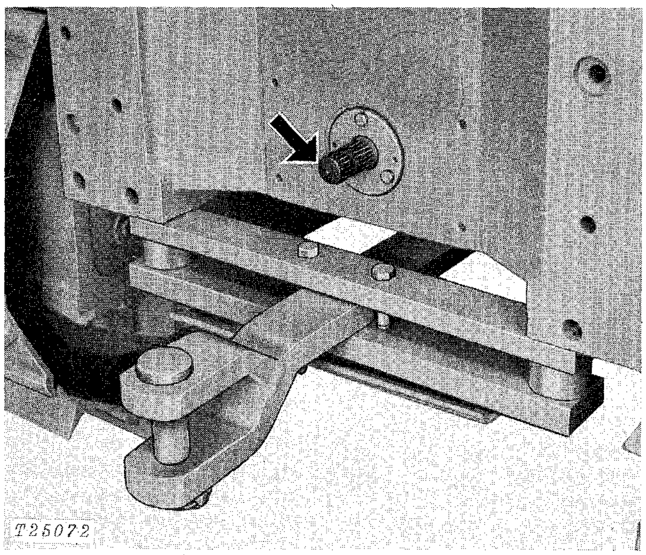


Fig. 1-Powershaft and Winch Drive

JD450-B Crawlers can be equipped with a 1000 rpm power take-off or winch drive unit. The powershaft is the same in both applications and drives equipment from the rear of the crawler (Fig. 1).

The powershaft gives a standard speed of 1000 rpm when operated with the engine at the recommended PTO speed of 1900 rpm.

The powershaft is continuous running, that is, it is possible to stop tractor movement without stopping powershaft rotation. By depressing the clutch pedal 3-1/2 inches (or until resistance is felt), crawler movement is stopped, but the powershaft will still rotate if the control lever is in the engaged position.

OPERATION

The front drive shaft carries the powershaft drive gear which is in constant mesh with the powershaft driven gear. A shifter fork controlled by the PTO control lever moves the drive gear internal splines in and out of mesh with splines on the front drive shaft. The shifter and PTO gears are housed in the transmission front cover.

The powershaft driven gear is splined to the powershaft which extends from the front wall of the transmission case out to rear of the transmission. The shaft is supported on the front by a roller bearing and on the rear by a ball bearing in the rear powershaft housing.

Pulling the PTO control lever to the rear moves the powershaft drive gear rearward into mesh with splines on the front shaft. Power is picked up from the powershaft drive gear by the powershaft driven gear which turns the powershaft. The engine clutch must be fully disengaged before powershaft can be engaged or disengaged by the lever. The powershaft drive gears and bearings are lubricated by oil in the transmission reservoir.

REPAIR

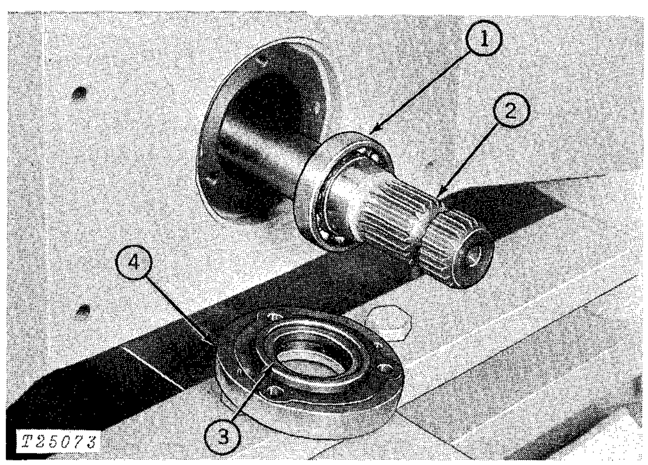
Remove drain plug from transmission case and drain the entire case.

Remove engine from clutch housing as instructed on page 10-25-1.

Separate engine clutch housing from transmission, page 10-25-2.

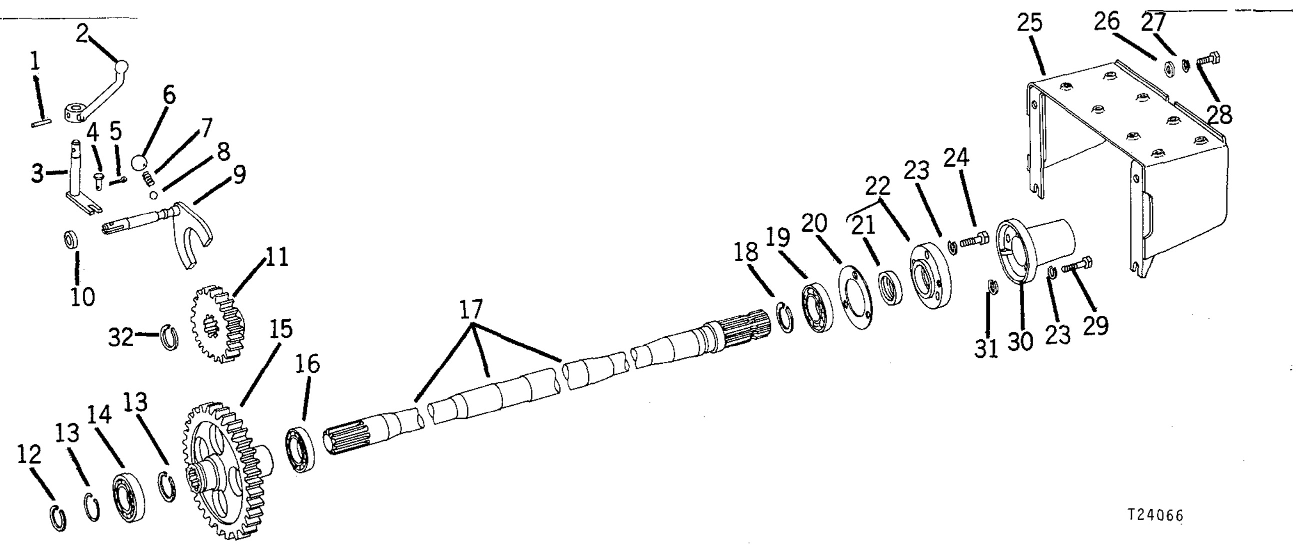
To remove transmission front cover, drive out roll pin fastening valve operating arm to shaft. Lift transmission front cover with gears and shifter away from transmission case.

To remove the powershaft, take out the three cap screws fastening the rear powershaft housing to transmission case. Withdraw powershaft with bearing from transmission case.



1—Ball Bearing **3—Oil Seal**
2—Powershaft **4—Housing**

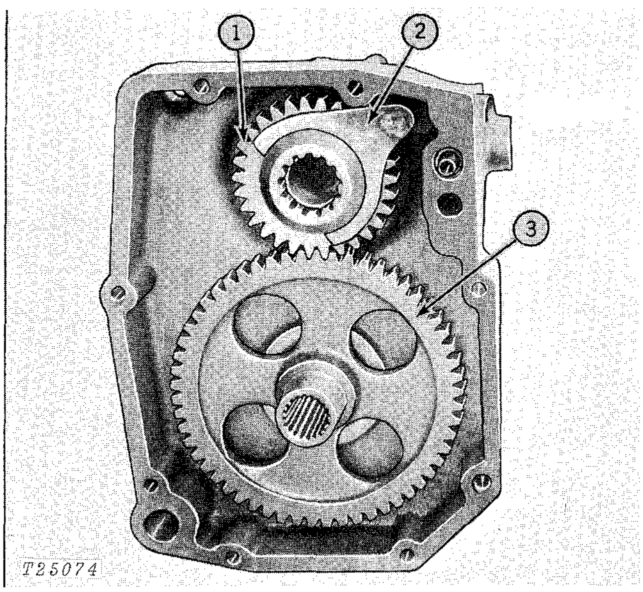
Fig. 2-Removing Powershaft Rear Housing



1—Spring Pin*
2—Crank*
3—PTO Shifter*
4—Pin*
5—Cotter Pin*
6—Steel Ball*
7—Spring*
8—Ball*
9—PTO Shifter Yoke*
10—Oil Seal*
11—Drive Gear
12—Snap Ring
13—Snap Ring (2 used)
14—Ball Bearing
15—Driven Gear
16—Roller Bearing
17—Powershaft*
18—Snap Ring*
19—Ball Bearing*
20—Gasket*
21—Oil Seal*
22—Rear Housing*
23—Lock Washer (5 used)*
24—Cap Screw (3 used)
25—Powershaft Shield*
26—Washer (2 used)
27—Lock Washer (4 used)*
28—Cap Screw (4 used)*
29—Cap Screw (2 used)
30—Powershaft Guard*
31—Retaining Ring (2 used)*
32—Snap Ring* *

* *Used with PTO only*
* * *Used without PTO only*

Fig. 3-Powershaft and Winch Drive Assembly



1—Drive Gear
2—Shifter Yoke
3—Driven Gear

Fig. 4-Transmission Front Cover

Pull PTO shifter yoke (9, Fig. 3) and drive gear (11) from the front cover. Be careful not to lose ball (8) and spring (7). Check gear for chipped or worn teeth. Examine PTO shifter yoke for bent condition. Check grooves or shaft portion of yoke for wear. Examine ball for flat spots. Replace damaged parts as needed.

Remove snap ring holding driven gear and bearing in front cover. Remove gear. Inspect ball bearing on hub of driven gear to see that it rotates freely. If bearing is worn or damaged, remove snap ring and slip bearing from hub of gear. Inspect teeth on driven gear for wear or breakage. Replace worn or damaged parts as needed.

Check oil seal in shifter bore of cover and examine roller bearing in transmission case front wall. Replace as needed.

Inspect powershaft for damaged splines or bent condition. Check ball bearing on shaft.

Check oil seal in rear housing. If replacement is necessary, install new seal with sealing lips facing drive.

ASSEMBLY AND INSTALLATION

Refer to Fig. 3, page 50-2-2 for location and identification of parts.

Install a large snap ring (13) in forward groove of the transmission front cover. Loosely slip the other large snap ring on hub of driven gear (15). Install bearing on hub of gear and secure with snap ring (12). Slip bearing and gear hub into bore of front cover and lock in place by sealing the large snap ring in its groove.

Coat sealing lips of PTO shifter yoke bore oil seal (10) with Lubriplate. Place spring (7) and ball (8) into shifter detent bore in cover. Position PTO shifter yoke (9) on drive gear and slide slotted end of shifter into bore from inside of cover. Mesh gear teeth with driven gear.

Install transmission front cover using a new gasket. Attach linkage removed during disassembly.

Install ball bearing (16) on powershaft (17) by assembling from long end of shaft (driving only on inner race of bearing). Position snap ring.

Slide powershaft into transmission case. Be sure splines on front end of powershaft fit into splines of powershaft drive gear.

NOTE: Coat lip of oil seal (21) with number 107 Lubriplate prior to installing powershaft rear housing on the powershaft. Tape powershaft splines to protect oil seal in housing.

Install powershaft rear housing using a new gasket. Remove tape from splines.

Install clutch housing (page 10-25-2).

Install engine (page 10-25-1).

Fill transmission case with quantity and viscosity of oil recommended on page 10-20-1.

Group 25

SPECIFICATIONS AND SPECIAL TOOLS

CLUTCH ASSEMBLY

Specifications

Item	Measurement	New Part	Wear Tolerance
Clutch pedal	Free travel	3.750 in. ± 0.187	
Clutch plate friction surface	Flat	Within 0.006 in.	
Flywheel friction driving surface	Flat	Within 0.006 in.	
Pedal return spring	Free length	4.475 in.	
Pressure plate springs	Free length	2.687 in.	
	Test length	1.687 in. at 149 lbs.	
Release levers	Adjusted height variation	Not to exceed 0.010 in.	
	Height	2.000 ± 0.031 in.	

Torque Values

Item	Torque (ft-lbs)
Clutch control adjusting lever jam nut	35
Clutch fork to shaft	35
Clutch pressure plate assembly to flywheel	20

Special Tools

No.	Name	Use
Essential Tools		
JD227*	Clutch lever adjusting gauge	Adjust clutch lever height
Convenience Tools		
JDE-52	Clutch aligning tool	To install clutch

** Modify JD227 Clutch Lever Adjusting Gauge so that gauge will clear spring ring. Remove 0.25 in. material from the arms of the gauge.*

H-L-R TRANSMISSION

Specifications

Item	Measurement	New Part	Wear Tolerance
Transmission Shafts			
Reverse countershaft bearing	End play	0.003 - 0.005 in.	
Underdrive countershaft bearing	End play	0.003 - 0.005 in.	
Rear input shaft bearing	End play	0.003 - 0.005 in.	
Pinion shaft bearing	Preload	0.003 - 0.005 in.	
Input shaft bore oil seal	Location from machined face of cover	2.72 in. to front of seal	
Front cover tube	Location from machined face of cover	7.28 in.	
Needle bearing	Location below face of bore	0.35 in.	
Output shaft	Nominal measurement	1.4375 in.	
Ring Gear			
Ring gear housing bearing	Preload	0.002 - 0.005 in.	
Ring gear and pinion	Backlash	0.006 - 0.008 in.	
Transmission Oil Pump			
Rotor	Width	0.7460 - 0.7470 in.	
Rotor	Diameter	2.9990 - 3.001 in.	
Hydraulic Oil Pressures (with engine at 1800 rpm and oil at 150-180°F.)			
Lubrication oil to H-L-R clutches	Pressure setting	* 58 - 72 psi	
Engaging oil to H-L-R clutches	Pressure setting	* 170 - 180 psi	
Pressure regulating valve	Pressure setting	* 170 - 180 psi	
Oil cooler bypass valve	Pressure setting	* 80 - 100 psi above lube pressure	
Clutch lubricating bypass valve	Pressure setting	* 58 - 72 psi	
Shifting (with engine at 1900 rpm)			
High to low range	Time span	1 second maximum	
High to reverse range	Time span	1.5 second average	

* *Pressure will be slightly higher at lower temperatures, or lower at higher oil temperatures.*

Torque Values

Item	Torque (ft-lbs)
Transmission top cover (front)	50
Transmission top cover (rear)	35
Starter safety switch	35
Pinion shaft nut	300

Section 60
STEERING AND BRAKES

CONTENTS OF THIS SECTION

Group 5
GENERAL INFORMATION, TESTING AND DIAGNOSIS

GENERAL INFORMATION

CAUTION: Escaping fluid under pressure can have sufficient force to penetrate the skin causing serious personal injury. Before disconnecting lines, be sure to relieve all pressure. Before applying pressure to the system, be sure all connections are tight and that lines and hoses are not damaged. Fluid escaping from a very small hole can be almost invisible. Use a piece of cardboard or wood, rather than the hands to search for suspected leaks.

If injured by escaping fluid, see a doctor at once. Serious infection or reaction can develop if proper medical treatment is not administered immediately.

The steering and brakes (Fig. 1) are controlled by multiple-disk clutches and contracting band-type brakes located in the steering-brake assembly. These clutches and brakes are operated by hand-operated steering levers.

When a steering lever is operated, a clutch throw-out bearing disengages the steering clutches which disconnects transmission power flow to the track drive sprockets.

Any further movement of the steering levers will engage the brake band which brakes the track on that side.

The brakes can also be applied by means of a foot brake. When this brake pedal is operated the brake bands are activated, but the steering clutches are not disengaged. Therefore, when the foot brake is applied the unit will not stop unless the engine or steering clutches are disengaged.

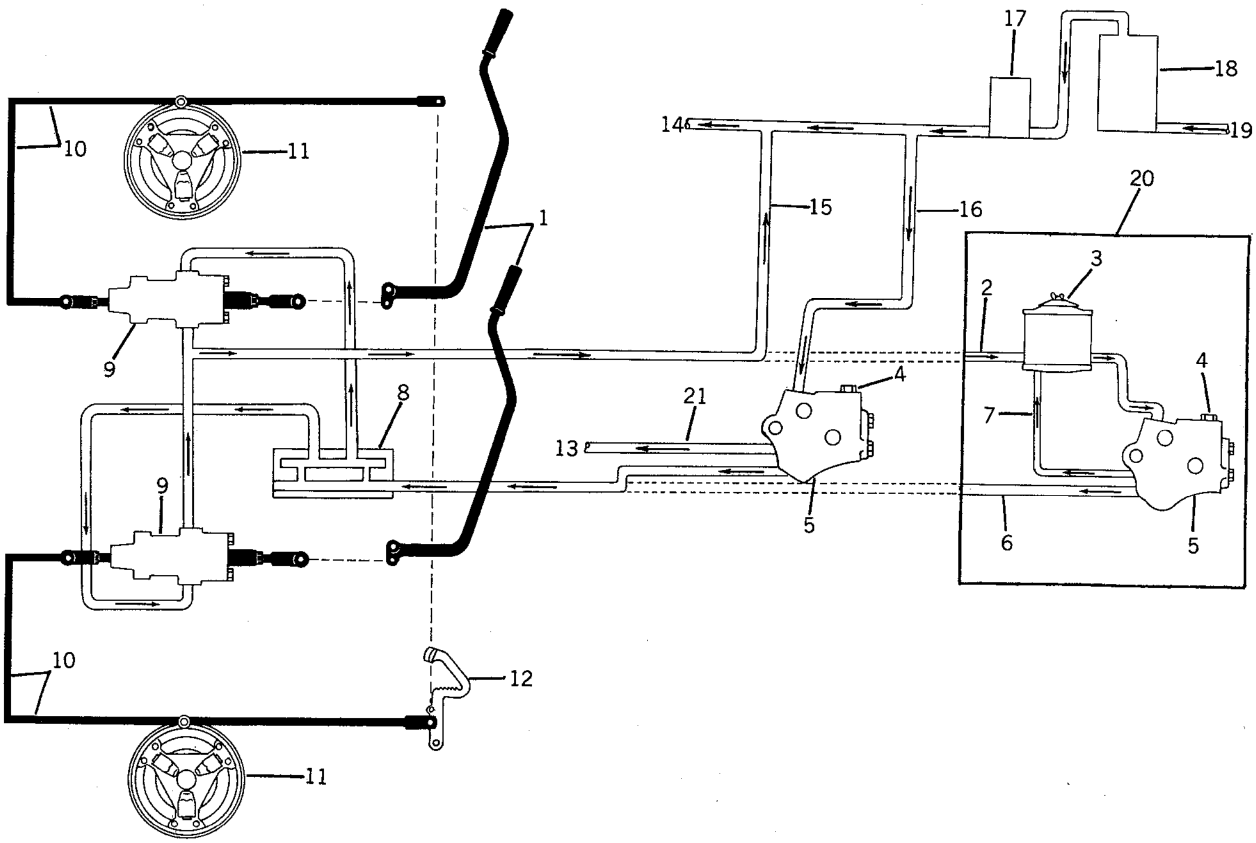
The power steering system is an open-center hydraulic circuit which contains its own pump, cylinders, and reservoir (early units) (Fig. 1).

Early units have a reservoir which supplies oil to the power steering pump. This reservoir contains a wire mesh filter and is located in front of the engine on the right hand side. Later units do not have a reservoir. On these units, oil for the power steering system is taken from and returned to the oil cooler to clutch lube line.

The gear-type power steering pump mounts on the front of the engine and is driven by the engine upper idler gear.

The two cylinders mount under the seat and connect to the steering levers for hydraulic assist.

FOS Refer to FOS Manual-HYDRAULICS for additional information and description of hydraulic components.



1—Steering Levers
2—Return Line (early units)
3—Reservoir (early units)
4—Relief Valve
5—Pump
6—Pressure Line
7—Bleed Line (early units)
8—Flow Divider
9—Cylinders
10—Mechanical Linkage
11—Steering Brake Assembly
12—Foot Brake
13—To Transmission
14—Lube to Clutch
15—Return Line (later units)
16—Inlet Line (later units)
17—Filter
18—Oil Cooler
19—From Pressure Regulating Valve
20—Pump Assembly (early units)
21—Bleed Line (later units)

Fig. 1-Steering and Brake System

TESTING

Checking Steering Lever Free Travel

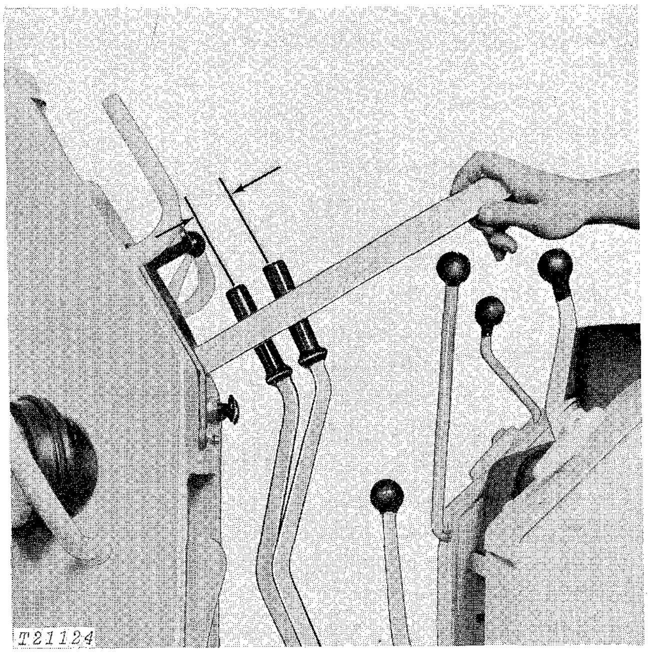


Fig. 2-Steering Lever Free Travel

Measure from top of steering levers to dash as shown in Fig. 2 to check for correct free travel.

If free travel is not to specifications, refer to Group 25 of this Section for proper adjustment procedure.

Testing Power Steering Cylinders

Testing With Engine Running

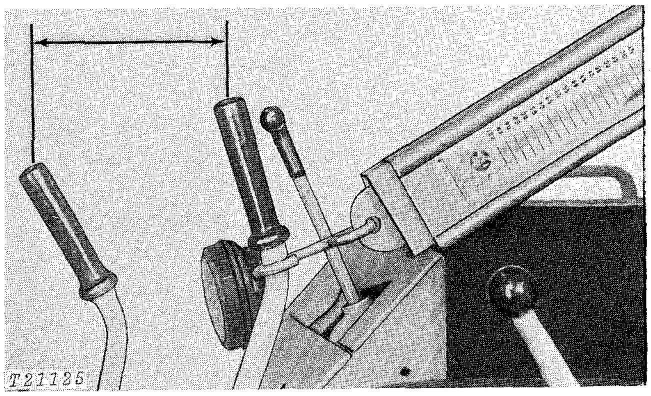


Fig. 3-Checking Power Steering Effort

With engine at specified rpm and at normal operating temperatures, attach a spring scale just below hand grip of steering lever (Fig. 3).

Pull lever rearward with spring scale and compare the amount of force required with specifications.

Testing With Engine Shut Off

With engine shut-off, attach a spring scale just below hand grip of steering lever (Fig. 3).

Pull lever rearward with spring scale and compare the amount of force required with specifications.

Repeat test on other steering lever.

Test Diagnosis

If the two tests are not to specifications, check for the following possible causes:

1. Low power steering pump pressures. (with "engine running" test)
2. Improper steering clutch adjustment.
3. Faulty steering clutch assembly.
4. Binding of steering linkage.

Testing Power Steering Pump

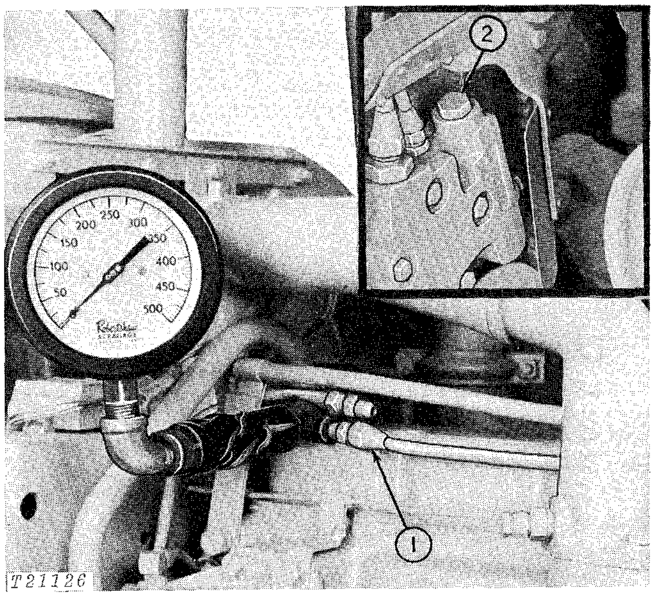


Fig. 4-Testing Power Steering Pump

Install a 0-500 psi pressure gauge as shown in Fig. 4. Operate engine at the specified speed and at normal engine temperatures.

If pressure is not to specifications, remove plug from top of pump (see inset Fig. 4) and adjust screw in end of metering valve. Screw in to increase pressure; screw out to lower pressure.

IMPORTANT: Do not run pump in relief for long periods of time as pump may be damaged.

DIAGNOSING MALFUNCTIONS

Loss of Power Transmitted

Pump worn or damaged (Power Steering).
  Test pump to specifications.
No oil in system (Power Steering).
  Fill with proper oil.
External oil leak (Power Steering).
Linkage out of adjustment.
  Adjust linkage (Section 60, Group 25).
Steering clutch pressure plate damaged.
  Replace pressure plate.
Pressure plate release levers, pivot pins or bracket worn.
  Replace parts.
Return springs weak or worn.
  Replace return springs.
Pressure and auxiliary springs damaged.
  Replace springs.
Clutch pack plates and facings damaged.
  Replace plates and facings.

Dragging Brakes

Linkage out of adjustment.
  Adjust linkage (Section 60, Group 25).
Pressure plate damaged.
  Replace pressure plate.

Dragging Brakes—Continued

Pressure plate release levers, pivot pins, or bracket worn.
  Replace parts.
Return springs weak or worn.
  Replace return springs.
Pressure and auxiliary springs damaged.
  Replace springs.
Brake band damaged.
  Replace brake band.

Incomplete Disengagement

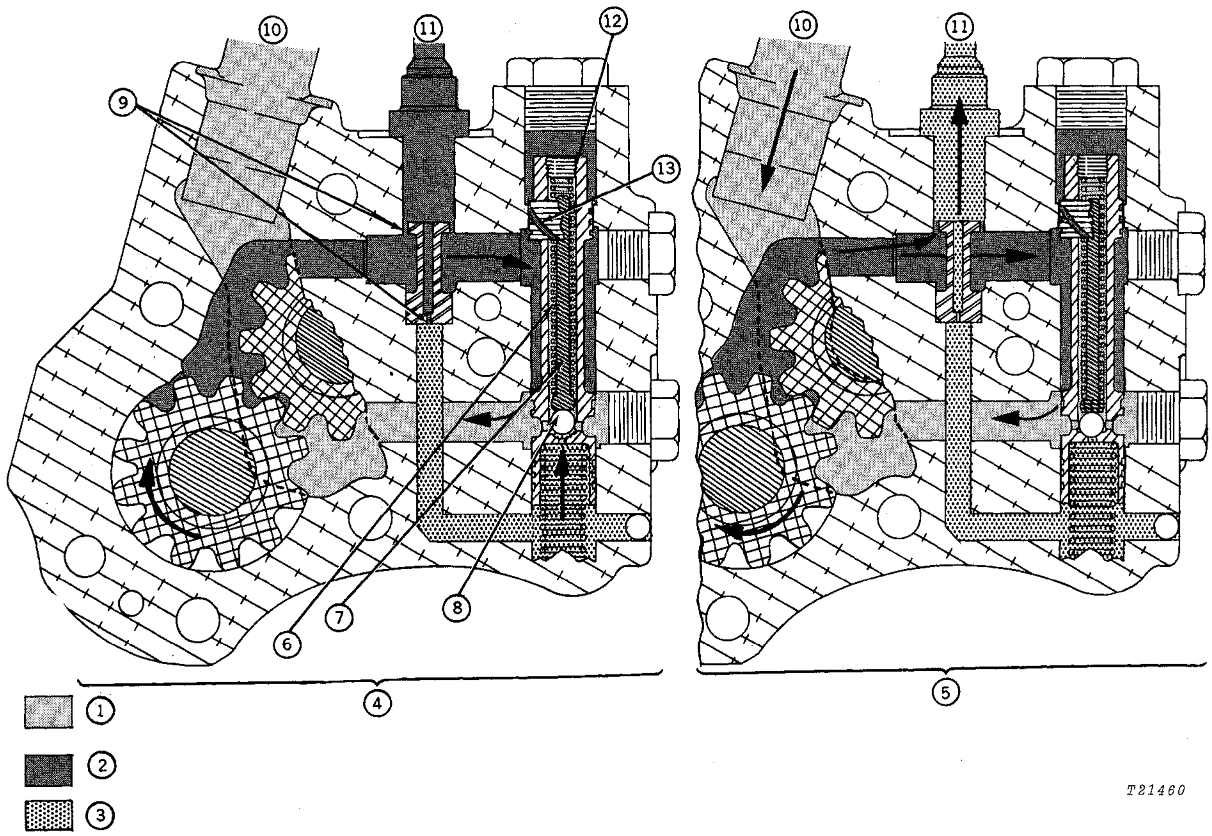
Linkage out of adjustment.
  Adjust linkage (Section 60, Group 25).
Pressure plate damaged.
  Replace pressure plate.
Pressure plate release levers, pivot pins, or bracket worn.
  Replace parts.
Return springs weak or worn.
  Replace return springs.
Pressure and auxiliary springs damaged.
  Replace springs.
Clutch pack plates and facings damaged.
  Replace plates and facings.

SPECIFICATIONS

STEERING LEVER FREE TRAVEL	1-1/2 to 2 in.
POWER STEERING EFFORT	
Engine Running (1200 rpm)	12 lbs. at 6 in. 4 lbs. max. variation between levers
Engine Shut-off	60 lbs. at 10 to 12-1/2 in. 3/4 in. max. variation between levers
POWER STEERING PUMP	
Capacity	2.9 gpm at 210 psi at 2400 rpm
Relief valve setting (with reservoir)	275 to 340 psi
(without reservoir)	360 to 425 psi

Group 10
POWER STEERING PUMP

GENERAL INFORMATION



1—Inlet Oil
2—Pressure Oil
3—Approx. 30 psi Below Pressure Oil
4—Relief Operation
5—Metering Operation
6—Spring
7—Guide
8—Relief Valve
9—Orifice
10—Inlet
11—To Power Steering Valve
12—Metering Valve Assembly
13—Spiral Groove

Fig. 1-Power Steering Pump Operation

Pump Metering Operation

As the oil is discharged by the gears, some of the oil is diverted through an orifice into a passage connected to the bottom side of the metering valve. Oil not passing by or through the orifice moves past the outer groove of the orifice body and surrounds the metering valve. A groove on the metering valve passes oil to the top outside of the valve.

When oil reaches full flow (at increased engine speeds), a pressure drop occurs in the circuit between the orifice and the bottom of the metering valve. This causes the valve to move down uncovering a passage leading to the inlet side of the pump gears. The excess oil recirculates within the pump instead of fully discharging to the steering cylinders. This metering action provides a constant pump discharge rate.

Pump Relief Operation

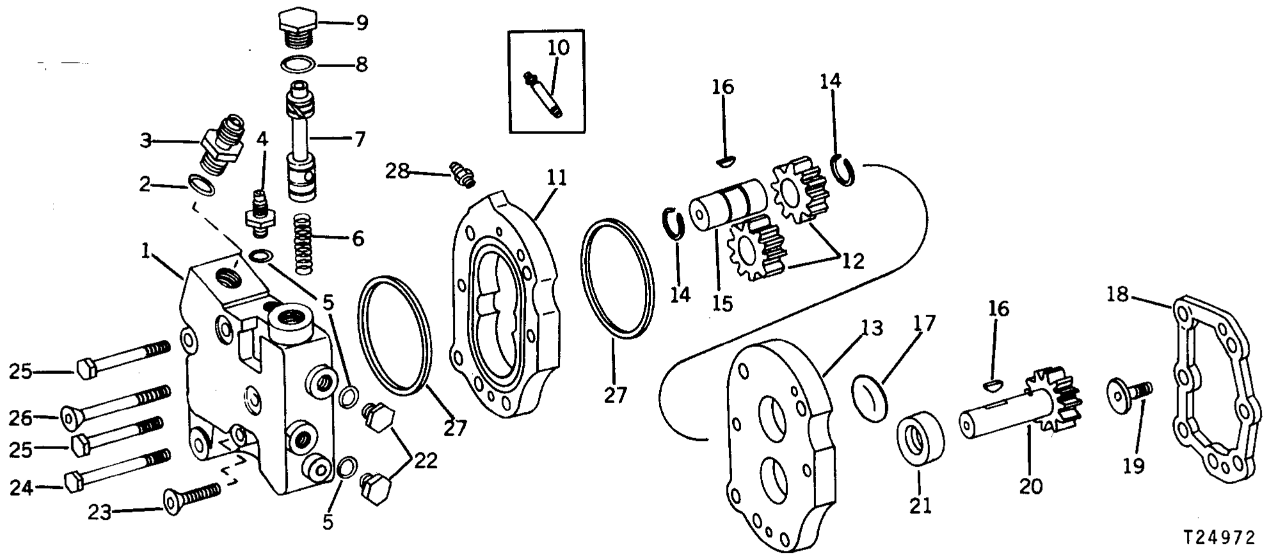
Whenever pump discharge oil is blocked (cylinder piston is obstructed), the increased pressure is sensed on the bottom of the metering valve through the hole in the center of the orifice. This unseats the relief ball in the valve as pressure rises to relief pressure.

Excess oil passes through the center of the metering valve to the inlet side of the pump gears. Since a pressure differential exists between the ends of the metering valve, the remainder of the pump pressure oil is passed to the inlet side of the pump via the inlet passage uncovered by the metering valve body.

FOS

Refer to FOS Manual—HYDRAULICS for additional information on gear-type pumps.

REPAIR



1—Pump Cover
2—O-Ring Packing
3—Connector
4—Connector
5—O-Ring Packing (3 used)
6—Metering Valve Spring
7—Metering Valve Assembly
8—O-Ring Packing
9—Plug
10—Nipple (Early Units)
11—Pump Body
12—Gears (2 used)
13—Pump Base
14—Retaining Ring (2 used)
15—Idler Gear Shaft
16—Woodruff Key (2 used)
17—Expansion Plug
18—Gasket
19—Thrust Screw (in Engine Front Plate)
20—Drive Gear Shaft
21—Oil Seal
22—Plugs (2 used)
23—Cap Screw
24—Cap Screw (3 used)
25—Cap Screw (3 used)
26—Cap Screw
27—Packing (2 used)
28—Connector (Later Units)

Fig. 2-Power Steering Pump

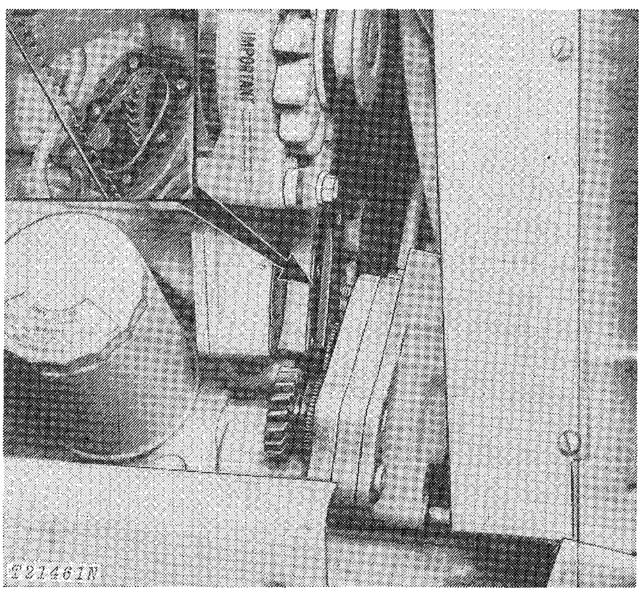


Fig. 3-Removing Pump

Remove cap screws securing pump to engine front cover and remove pump from unit as shown in Fig. 3.

Remove metering valve plug and slide metering valve assembly and spring from bore in pump cover.

Separate cover from pump body and base. Remove pump gears from pump.

Inspect pump gears for wear or damage (see specifications). Examine gear shafts for damage.

Replace oil seal in pump base. Drive in new seal with spring lip side facing bottom of bore.

Examine pump base for wear or damage. Finished side of base should not be marred as this finish provides sealing between pump housing parts. Check bushings in idler and drive shaft bores. If bushings are worn, replace complete pump base.

Replace packings between pump body and pump base or pump cover if external oil leakage is noted or if packings are damaged.

Check expansion plug in idler shaft bore of base. Replace plug if necessary. Press new plug in flush with face of bore.

Inspect pump body for wear or scoring. Replace if necessary. Check special nipple in cover. If replacement is required, screw in new nipple until tight.

Check pump cover for cracks or scoring. Inspect bushings for damage. As no gasket is used between cover and pump body, the finished surface on body must not be scratched or marred. If any parts are damaged, replace complete cover assembly.

Inspect metering valve assembly for damage or obstructions in valve. Clean assembly thoroughly. If valve parts are damaged, replace complete valve assembly.

Check metering valve spring for weak or distorted coils (see Specifications).

Locate special thrust screw in engine timing gear cover hole. If screw is worn or damaged, replace it. Tighten new screw to specifications.

Assembly

Refer to Fig. 2 during assembly and note the following:

Thoroughly clean all parts prior to assembly.

Coat lips of oil seal in pump base with Lubriplate.

Apply joint sealing compound to pressure line connector threads prior to installation.

NOTE: Allow 4 hours curing time before exposing pressure line connector to oil.

Place pump on engine timing gear cover, meshing drive gear with upper idler gear (Fig. 3). Use a new gasket on pump mounting surface.

Secure pump to timing gear cover and engine front cover. Tighten cap screws to specifications.

Check pump pressure and adjust if necessary (refer to Group 5 of this Section).

SPECIFICATIONS

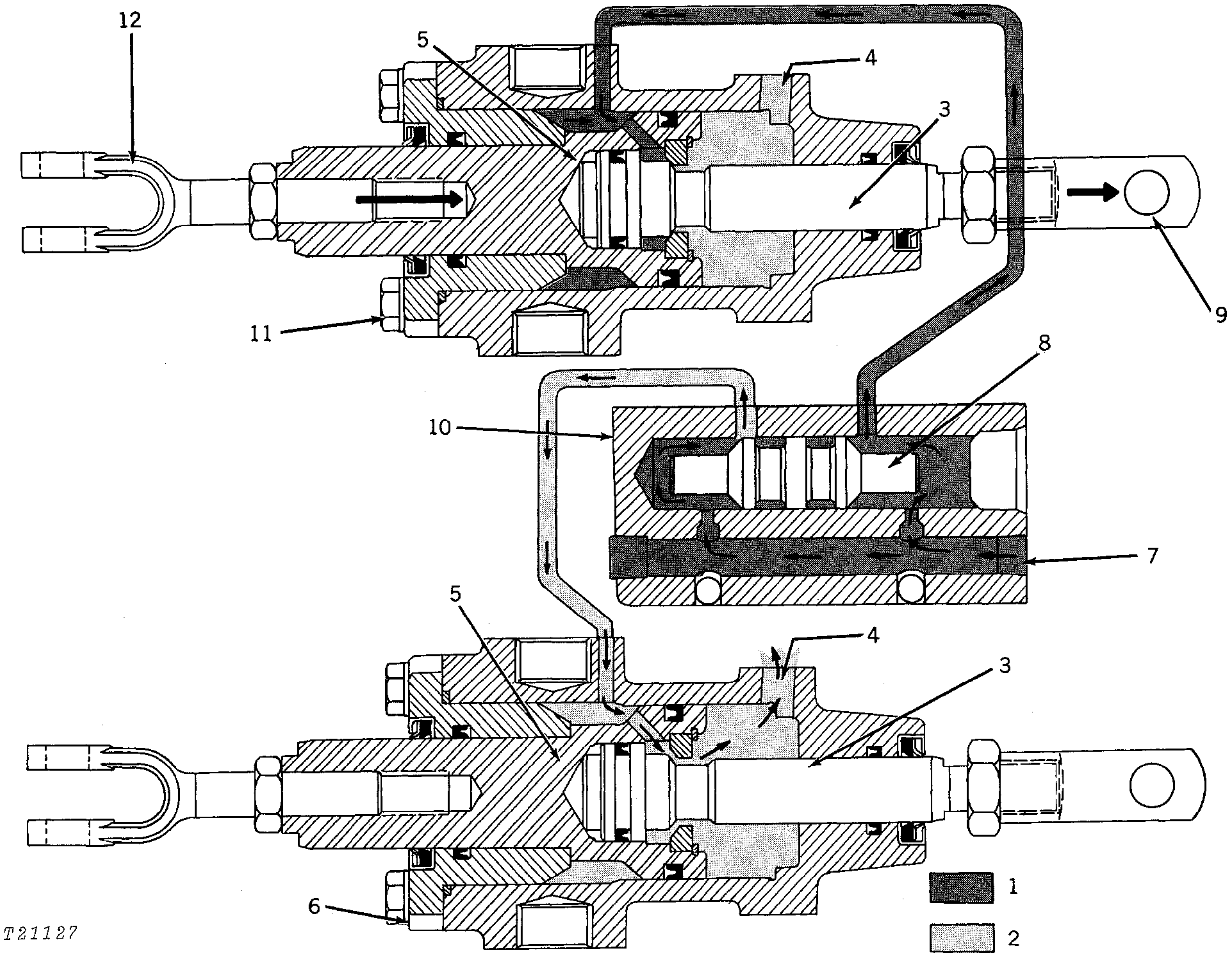
Item	New Part
PUMP ASSEMBLY	
Thickness of pump gears	0.5902 to 0.5908 in.
O.D. of pump gears	1.9568 to 1.9578 in.
I.D. of pump gear bore	0.8755 to 0.8765 in.
O.D. of pump idler gear shaft	0.8744 to 0.8750 in.
O.D. of pump drive gear shaft	0.8744 to 0.8750 in.
O.D. of drive gear	1.9650 to 1.9750 in.
I.D. of bushings in pump cover	0.8775 to 0.8780 in.
Thickness of pump cover	1.6470 to 1.6530 in.
METERING VALVE ASSEMBLY	
O.D. of metering valve	0.6259 to 0.6263 in.
Valve spring (free length)	1-9/16 in.
(test strength)	8-3/4 to 10-3/4 lbs. at 1-1/8 in.

TORQUE VALUES

Item	Torques (ft-lbs)
Thrust screw (in engine timing hole cover)	20-25
Pump to engine front cover	35

Group 15
POWER STEERING CYLINDERS AND RESERVOIR

GENERAL INFORMATION



1—Pressure Oil
2—Return Oil
3—Steering Valve
4—To Reservoir
5—Piston
6—Right Cylinder (in neutral)
7—Inlet Oil (from pump)
8—Shuttle Valve
9—Link to Steering Lever
10—Flow Divider
11—Left Cylinder (in left turn)
12—Link to Steering and Brake Assembly

Fig. 1-Power Steering Cylinder

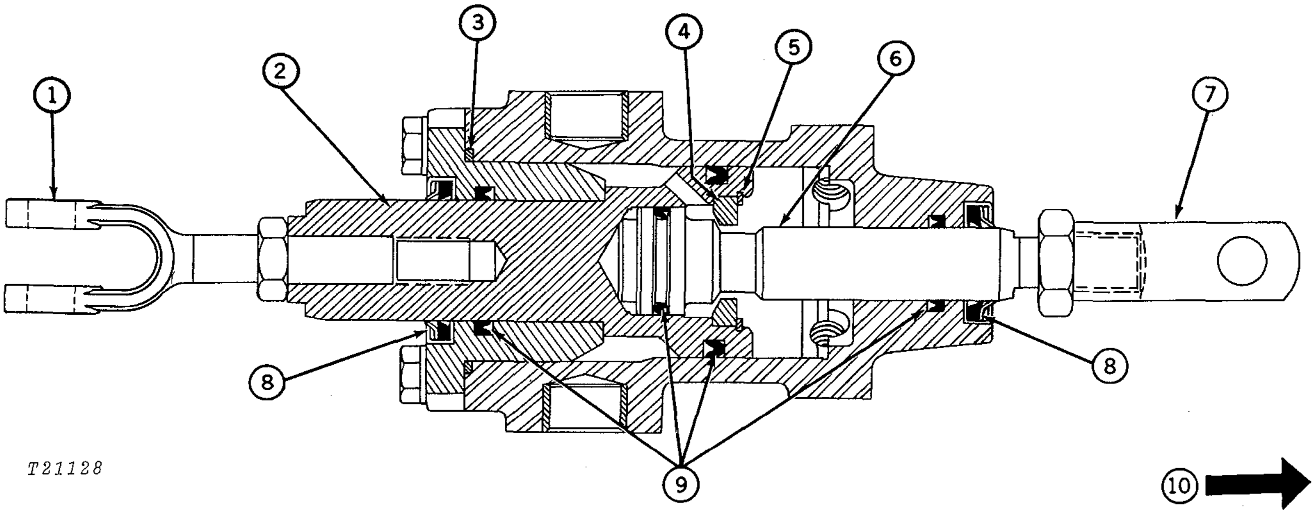
Cylinders in Neutral—In neutral, both cylinder valves are open. Incoming oil from the pump flows through both cylinders and returns to reservoir. The flow divider is held centered, allowing full flow through each cylinder.

Cylinders During Left Turn—When the left steering lever is pulled rearward, the valve in the left cylinder is pulled forward against the piston seat. This traps oil against the piston and causes a pressure build-up. The pressure causes the flow divider to partially restrict the right cylinder opening, allowing pressure to build further in the left cylinder. This pressure moves the piston forward to actuate the steering clutch and brake. When the left steering lever is released, the system returns to neutral.

Cylinders During Right Turn—During a right turn, oil flow is reversed from that of a left turn.

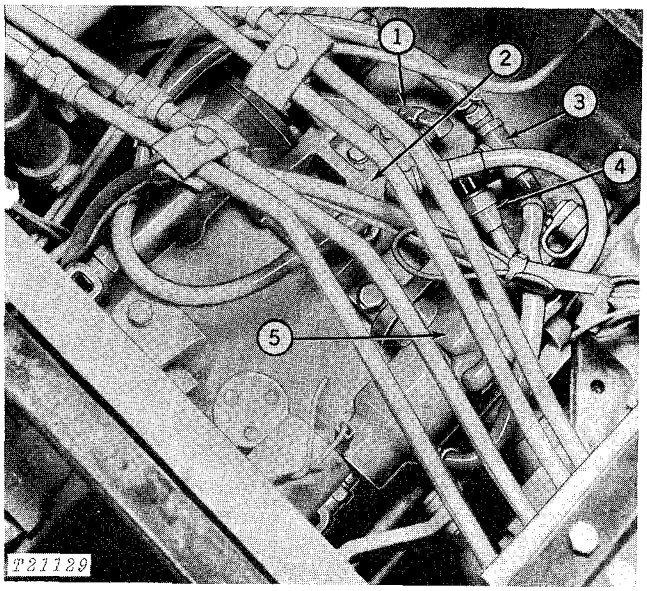
Cylinders During Braking—When both steering levers are pulled rearward, both cylinder valves are closed and pressure builds to actuate both pistons in the same manner as described under "Cylinders During Left Turn."

REPAIR



1—Piston Yoke
2—Piston
3—Sealing Ring
4—Piston Seat
5—Snap Ring
6—Valve
7—Valve Yoke
8—Scraper Seal
9—Vee Block Packing
10—Front of Machine

Fig. 2-Cutaway of Steering Cylinder



1—Pressure Line
2—Flow Divider
3—Return Tee
4—Return Line
5—Steering Cylinders

Fig. 3-Removing Cylinders

Disconnect lines from power steering cylinders. Disconnect cylinders from mounting bracket and lift out cylinders. Remove mounting bracket.

Refer to Fig. 4 to disassemble and assemble steering cylinders and proceed as follows:

Inspect all vee block packings for wear or damage.

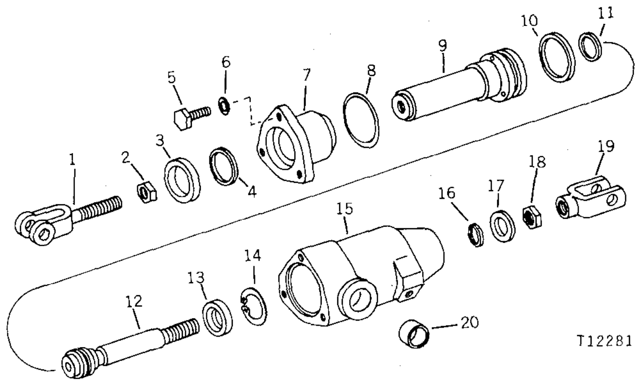
Examine scraper seal in cylinder cap for damage. If metal outer ring is bent or damaged, dirt will enter cylinder.

Inspect cylinder valve and piston for wear. If seats on mating parts are worn, replace both valve and piston.

Examine cylinder housing for cracks or other damage. Inspect cylinder pivot bushings for damage.

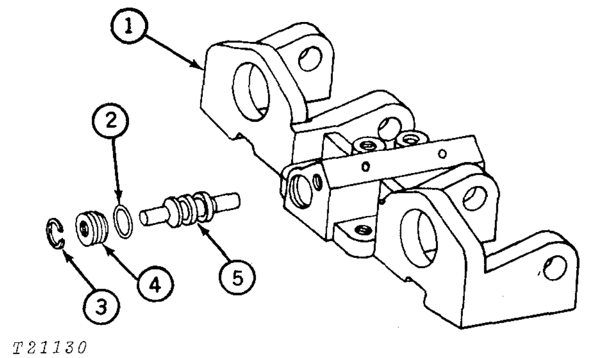
Remove shuttle valve from flow divider bore (see Fig. 5). Remove elbow, snap ring, and plug in end of mounting bracket to reach valve.

Examine shuttle valve for nicks or burrs. Valve must slide freely in bore.



1—Piston Yoke	**6—Lock Washer (3 used)**	**11—Vee Block Packing**	**16—Vee Block Packing**
2—Hex. Nut	**7—Cylinder Cap**	**12—Valve**	**17—Scraper Seal**
3—Scraper Seal	**8—Sealing Ring**	**13—Piston Seat**	**18—Hex. Nut**
4—Vee Block Packing	**9—Piston**	**14—Snap Ring**	**19—Valve Yoke**
5—Cap Screw (3 used)	**10—Vee Block Packing**	**15—Cylinder**	**20—Bushing (2 used)**

Fig. 4-Exploded View of Power Steering Cylinder

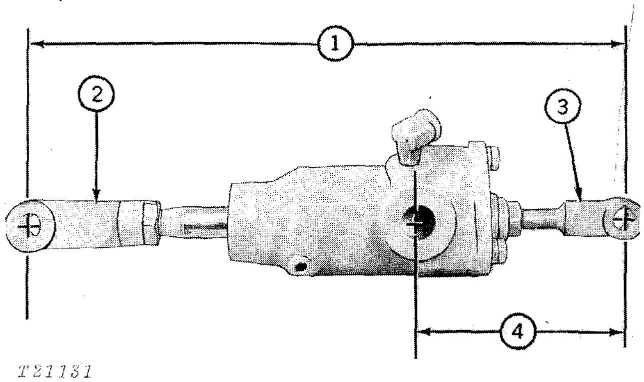


1—Mounting Bracket	**3—Snap Ring**
2—O-ring	**4—Plug**
	5—Shuttle Valve

Fig. 5-Flow Divider Assembly

Adjust yokes on cylinders as follows (Fig. 6):

1. With piston out against cylinder cap, set center line of piston yoke hole 5-5/8 inches from center line of cylinder housing pivot hole.
2. Tighten lock nut on piston yoke end to specifications.
3. Completely retract both ends of cylinders. Set center line of valve yoke 12-1/2 inches from center line of piston yoke hole.
4. Tighten lock nuts slightly to keep valve yokes from turning as valve yokes will have to be readjusted when installed on tractor.



1—12-1/2 in. (yokes in)	**3—Cylinder Piston Yoke**
2—Cylinder Valve Yoke	**4—5-5/8 in. (yoke out)**

Fig. 6-Adjusting Yokes

Install mounting bracket and steering cylinders on unit. Install two shims under each rear boss of mounting bracket.

Attach yoke ends of cylinders to steering levers and steering shaft arms using pins and cotter pins.

Pry upward at front center of mounting bracket and insert as many shims as possible under front bosses of mounting bracket.

NOTE: If necessary, adjust cylinder valve yoke. With steering lever against stop, piston in against cylinder cap at rear, and valve fully extended at front, holes should line up for pin insertion.

Refer to Group 25 of this Section and adjust steering clutch free travel.

RESERVOIR
(Serial No. -142199)

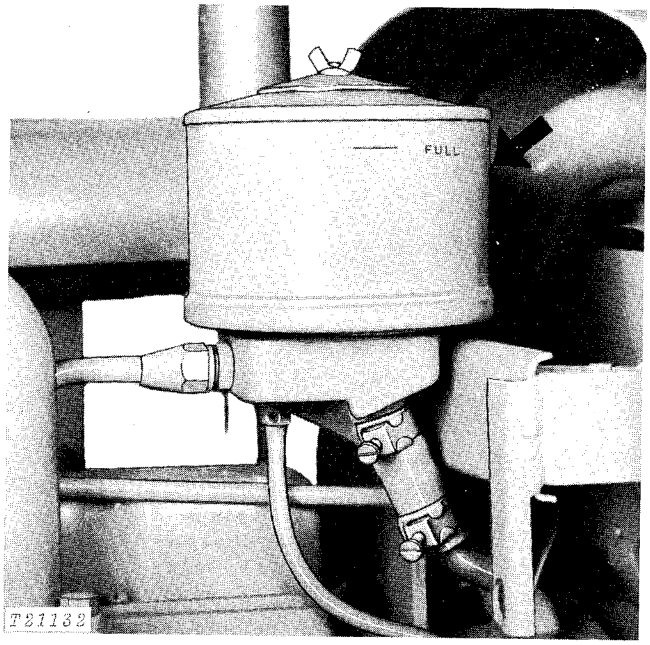


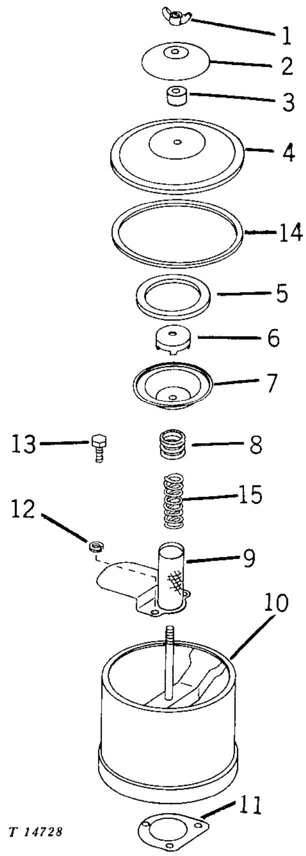
Fig. 7-Power Steering Reservoir

Remove and disassemble reservoir. Clean wire mesh filter and inspect for damaged condition. Replace filter washer.

Examine bottom of reservoir tank on tractor for dirt or foreign material. Wipe inside of reservoir tank clean. Replace tank if damaged.

Check tank mounting bracket for leaks or other damage. Replace O-ring on tank mount of the bracket. Replace all gaskets.

Assemble reservoir and install on unit. Fill reservoir to "FULL" line on tank with recommended oil (Section 10). Operate unit, check for leaks and recheck oil level in reservoir.



1—Wing Nut
2—Cap
3—Filter Washer
4—Lid
5—Gasket
6—Filter Cap
7—Pocket Filter
8—Spring
9—Filter
10—Tank
11—Gasket
12—Lock Washer (3 used)
13—Cap Screw (3 used)
14—Gasket
15—Spring

Fig. 8-Power Steering Reservoir

SPECIFICATIONS

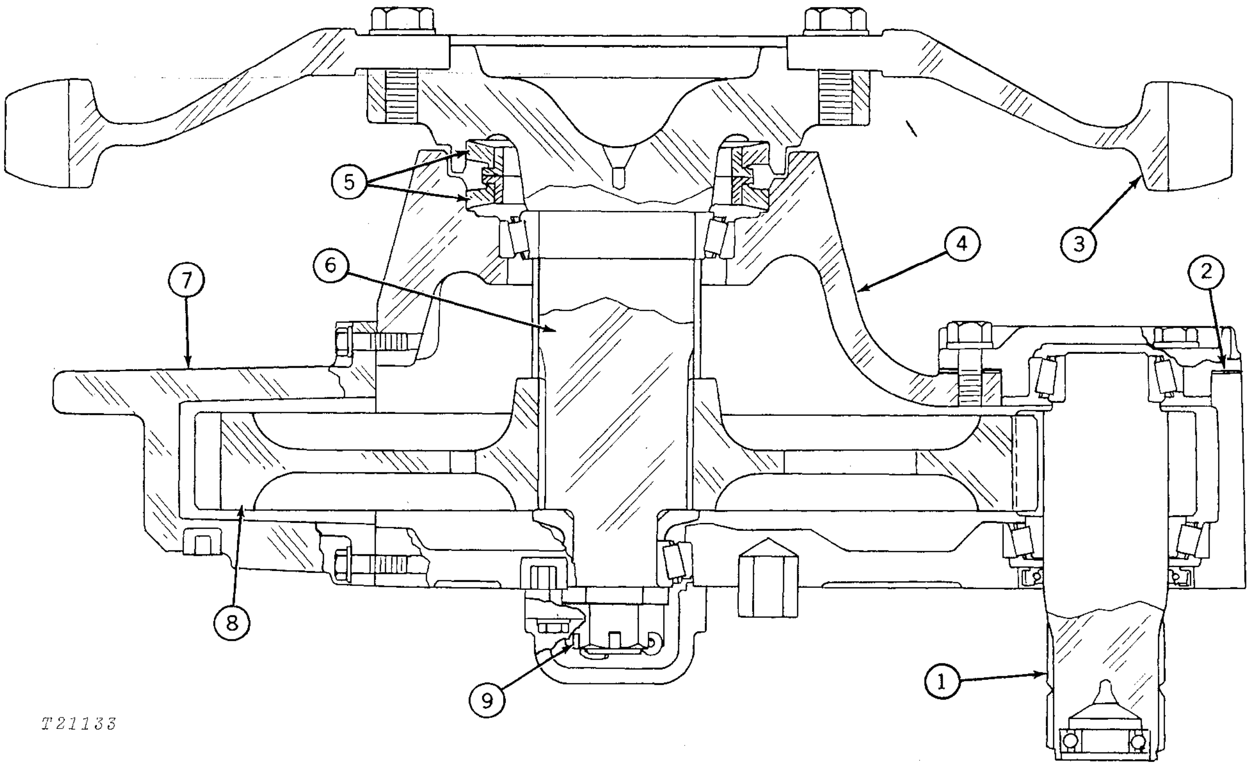
I.D. of cylinder (piston bore)	2.0000 to 2.0020 in.
O.D. of piston	1.9950 to 1.9970 in.
O.D. of piston and rod (at oil seal area)	1.2495 to 1.2505 in.
I.D. of cylinder cap (valve bore)	2.0670 to 2.0690 in.
O.D. of valve (at oil seal area)	0.7500 to 0.7510 in.
Angle of valve seat	30 Degrees

TORQUE VALUES

Item	Torque (ft-lbs)
Cylinder cap to cylinder	20
Cylinder yokes (valve yoke)	100
(piston yoke)	40
Mounting bracket (front cap screws)	85
(rear cap screws)	50

Group 20
FINAL DRIVE ASSEMBLY

GENERAL INFORMATION



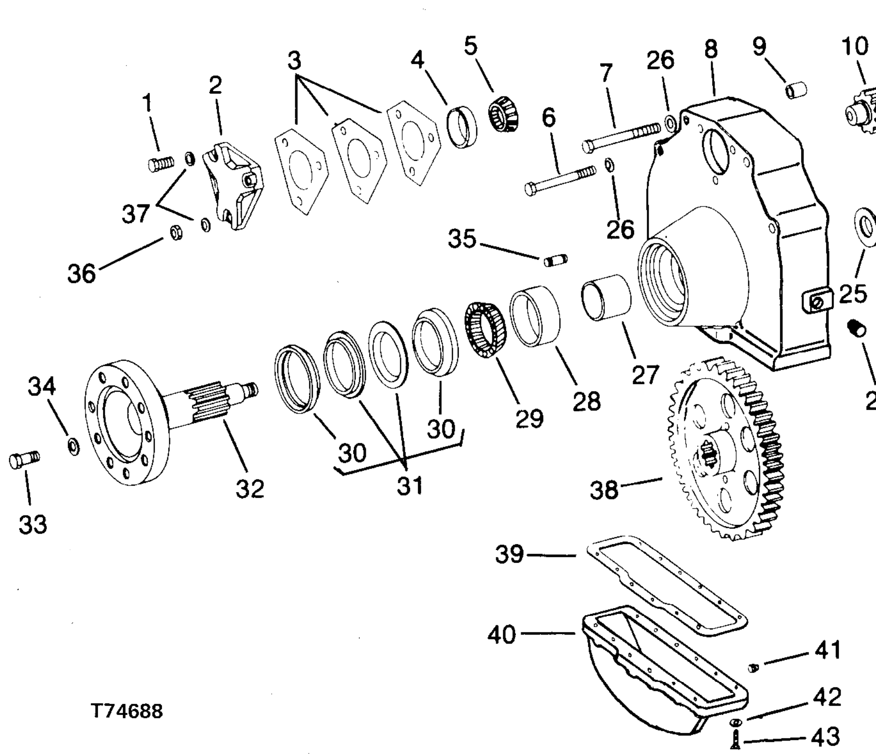
1—Pinion Shaft
2—Shims for Preload Adjustment
3—Track Drive Sprocket
4—Final Drive Housing
5—Oil Seal with Belleville Washers
6—Flanged Axle Shaft
7—Oil Pan
8—Bull Gears
9—Nut for End Play Adjustment

Fig. 1-Final Drive Assembly

The final drive assembly transmits power from the steering clutches to the rear track drive of the machine.

Each final drive unit contains one rear axle mounted on two tapered roller bearings and driven off the final drive pinion by a large bull gear.

REPAIR



1—Cap Screw (2 used)	11—Ball Bearing	22—Bearing Cone	33—Cap Screw (9 used)
2—Quill	12—Bearing Cone	23—Bearing Cup	34—Washer (9 used)
3—Shim (as required)	13—Bearing Cup	24—Plug (4 used)	35—Stud
4—Bearing Cup	14—Oil Seal	25—Spacer	36—Nut
5—Bearing Cone	15—Cap Screw (4 used)	26—Washer (2 used)	37—Lock Washer (3 used)
6—Cap Screw (2 used)	16—Lock Washer (4 used)	27—Spacer	38—Gear
7—Cap Screw (2 used)	17—Cover	28—Bearing Cup	39—Gasket
8—Housing	18—Gasket	29—Bearing Cone	40—Oil Pan
9—Dowel (3 used)	19—Cotter Pin	30—Oil Seal Kit	41—Plug
10—Pinion Shaft	20—Slotted Nut	31—Oil Seal	42—Lock Washer (12 used)
	21—Special Washer	32—Flanged Axle	43—Cap Screw (12 used)

Fig. 2-Final Drive Assembly

Refer to Section 10, Group 25 for instructions to remove final drive assemblies from machine.

Remove oil pan and inner bearing cones.

For units with serial number 178497 and below, remove slotted nut and the two pipe plugs from the final drive housing.

Remove slotted nut and the two pipe plugs from the final drive housing.

Use push-puller to remove flanged axle shaft (Fig. 3). Then slide flanged axle and related parts free from housing.

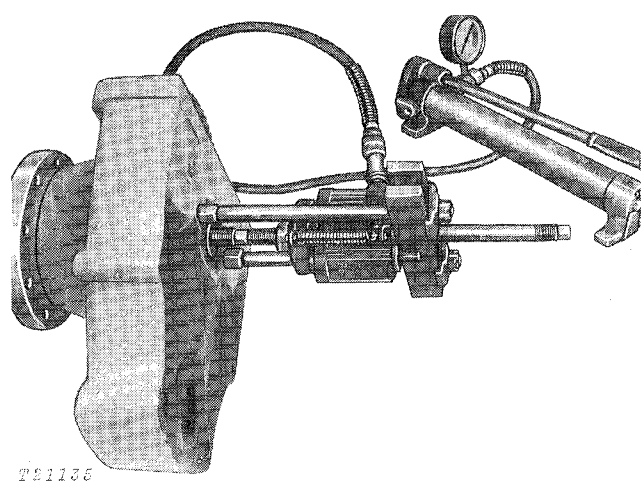


Fig. 3-Removing Flanged Axle

For units with serial number 178498 and above remove cover (17, Fig. 2), gasket (18), cotter pin (19) and slotted nut (20).

Reverse slotted nut (20) and tighten on flanged axle. Make a plate as shown in Specifications and Special Tools to match bolt pattern of nut cover (17).

Position plate over reversed slotted nut and tighten cap screws evenly to push flanged axle from its seat. Then slide flanged axle and related parts from housing.

Final Drive Pinion Shaft and Bearings

Examine the final drive pinion shaft (10) for excessive spline wear and damage to the oil seal and bearing contact areas. The oil seal and bearing contact areas must be free of nicks, burrs, and roughness. Check pinion for damaged or excessively worn gear teeth. Replace pinion shaft if necessary.

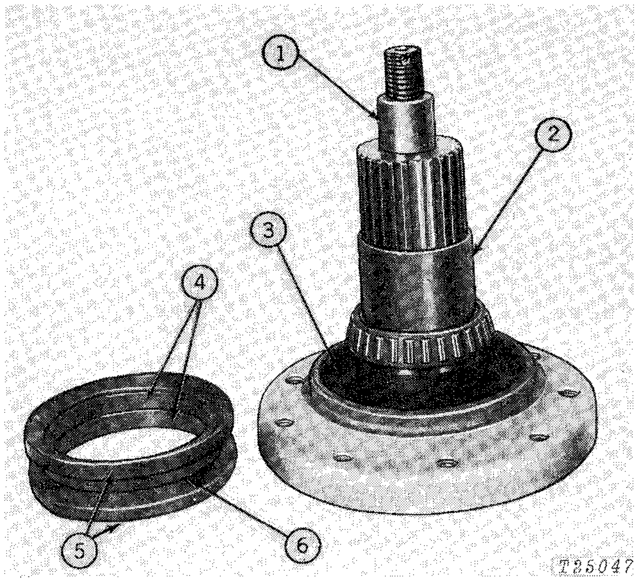
Inspect bearing (11) inside final drive pinion shaft. If replacement is necessary, install new bearing in pinion shaft with open side toward the shaft.

Inspect bearing quill (2) and housing (8) for damage or excessive wear and replace if necessary. Examine oil seal (14) in housing and replace if it has permitted oil to leak into clutch housing. Install new seal with lip pointing toward inside of final drive housing. Seal should be pressed in flush with bottom of bearing cone.

Remove bearing and seal housing from flanged axle by attaching a knife-edge puller under housing.

Examine splines on axle shaft for galling or excessive spline wear. Remove all metal deposits from splines caused by galling. Inspect final drive gear for wear or damage to gear teeth or splines.

Carefully inspect bearings for wear which may have been caused by foreign material entering the housing through a damaged seal. Inspect the final drive housing for any damage which would make it unserviceable.



1—Flanged Axle
2—Axle Bearing Spacer
3—Oil Seal Bearing Area
4—Metal Sealing Rings
5—Rubber Sealing Rings
6—Plastic Retainer Band

Fig. 4-Replacing Flanged Axle Oil Seal

Flanged Axle Oil Seal

IMPORTANT: Belleville washers on the flanged axle oil seal must be replaced every time axle shaft is removed from final drive housing.

Examine sealing faces for wear to determine whether seal rings can be reused or must be replaced. If highly polished sealing band is in the middle or toward the outside of the seal face, sealing rings can be reused. If highly polished sealing band is not uniform or is toward the inside of the seal face, sealing rings must be replaced.

1. Clean the bores and shoulders where oil seal fits with a cleaning solvent and wipe dry. Surfaces that contact rubber sealing rings must be free of grease, oil, dirt, and scale.

2. Remove and discard retainer band from seal. Check rubber sealing rings to be sure they are flush against the inside shoulder of the metal sealing rings.

3. All seal parts must be free of grease, oil, dirt, and scale.

4. Sealing rings must be handled with care. The lapped sealing faces of the metal sealing rings must not be damaged, scratched, or contaminated with dirt or grease.

5. Install one seal half (metal ring and rubber ring) into the final drive housing. Install second seal half (metal ring and rubber ring) into the flanged axle. Check each seal half to be sure that seal is not cocked and that rubber rings are seated evenly at the bottom of the bore.

6. Wipe both metal sealing faces clean with a lint free wiper and apply a thin film of clean SAE 30 oil.

IMPORTANT: Oil must not wet areas other than the lapped surface of the metal sealing rings.

Install Flanged Axle

NOTE: Refer to Fig. 2 for identification and relationship of parts.

Press the outer bearing cone against shoulder on the flanged axle.

Slip outer spacer onto axle.

Roll final drive gear into housing.

IMPORTANT: Make certain gear is inserted with long hub end toward sprocket side of housing.

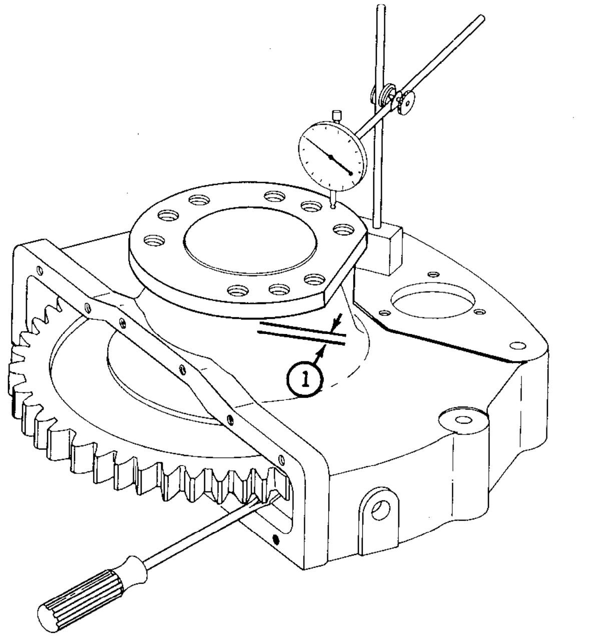
When installing flanged axle shaft, avoid getting any dirt, oil, or other foreign material on oil seal.

Place inner spacer in end of shaft with shoulder facing away from gear. Start inner bearing cone on shaft. Place washer on end of shaft and start slotted hex. nut on shaft.

With all parts assembled on flanged axle shaft, tighten slotted hex. nut to give specified end play as shown in Fig. 5. Advance nut if necessary, to line up slot in nut with cotter pin hole in shaft. Then tighten nut ONE additional slot and lock with cotter pin.

Install inner bearing cover with a new gasket and tighten cap screws securely.

Install final drive oil pan with a new gasket and tighten all cap screws securely.



1—End Play Measurement

Fig. 5-Measuring Axle Shaft Introduced End Play

Set Pinion Shaft Preload

Before installing final drive housing on machine, install final drive pinion shaft in housing. Install a preliminary shim pack to record a measurable amount of end play. Install bearing quill and torque retaining cap screws.

Using a dial indicator, record the end play and take from the shim pack the thickness of shims equal to end play reading plus an additional 0.002 inch to give the desired preload setting.

Retain the proper shim pack and remove pinion shaft from final drive housing for final assembly of steering clutches in machine.

Before final installation of bearing quill and shims, apply a light coat of sealer to the quill and the final drive housing.

INSTALLATION

Refer to Section 10, Group 25, for instructions on installing final drive assembly on machine.

SPECIFICATIONS

Flanged axle shaft end play .... 0.0020 to 0.0050 in.

NOTE: After obtaining correct end play setting, advance nut if necessary to line up slot in nut with nearest cotter pin hole. Then tighten nut one additional slot.

Final drive pinion shaft preload .... 0.0000 to 0.0030 in.

TORQUE VALUES

Item	Torque (ft-lbs)
Flanged axle shaft inner bearing cover (D strength - early units)	35
(F strength - later units)	50
Final drive housing to steering clutch housing	170
Final drive pinion shaft quill	85

SPECIAL TOOLS

Convenience Tools

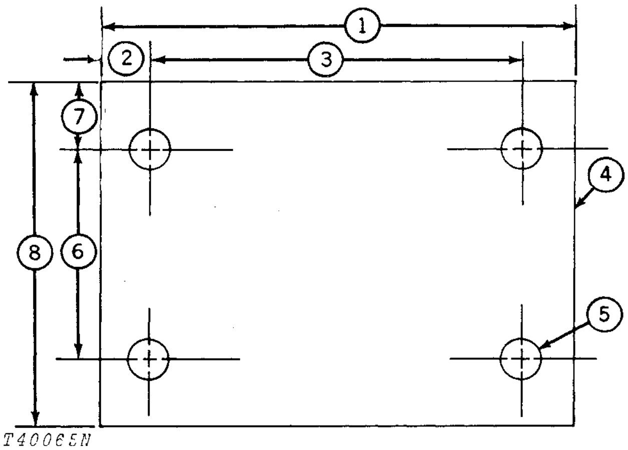
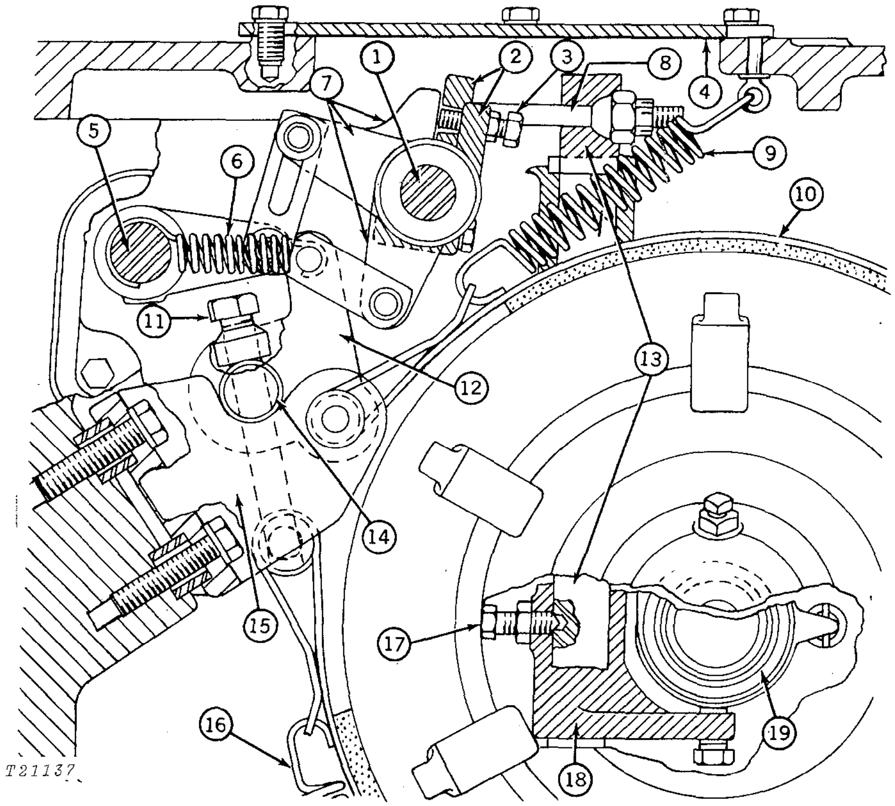


Fig. 6-Flanged Axle Shaft Removing Tool

1. Length of flat stock .... 5.00 in.
2. Edge to centerline .... 0.55 in.
3. Center distance of holes .... 3.90 in.
4. Flat stock thickness (min.) .... 0.75 in.
5. Hole diameter .... 0.438 in.
6. Center distance of holes .... 2.25 in.
7. Edge to centerline .... 1.12 in.
8. Width of flat stock .... 3.75 in.

Group 25
STEERING AND BRAKE ASSEMBLY

GENERAL INFORMATION



1—Steering Lever Shaft
2—Steering Lever Arm
3—Brake Actuator Screw
4—Adjusting Cover
5—Foot Brake Shaft
6—Return Spring
7—Brake Bell Crank
8—Clutch Operating Rod
9—Brake Band Return Spring
10—Brake Band
11—Brake Adjusting Screw
12—Brake Band Yoke
13—Throw-Out Shaft
14—Yoke Pin
15—Brake Anchor
16—Brake Band Return Spring
17—Set Screw
18—Throw-Out Bearing Fork
19—Throw-Out Bearing

Fig. 1-Steering and Brake Assembly

The combination clutch and brake mechanism on each rear axle engages or disengages the flow of power to each rear axle by means of individual steering levers.

In addition, a brake pedal is used to stop tractor motion on both axles by means of a contracting brake band device. The relationship of steering clutch and brake linkage is shown in Fig. 1.

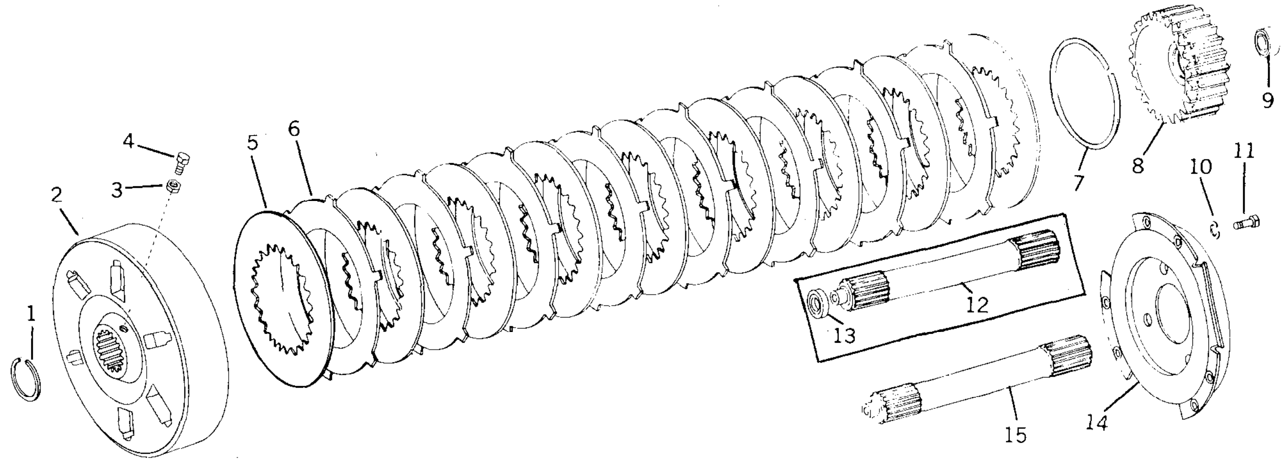
IMPORTANT: To avoid damage to the drive assembly use the following procedure for towing.

Remove steering clutch housing side covers and back off brake band adjusting screws two full turns (four detents).

Pull back both steering levers eight inches at base of handles and tie them in this position.

Do not tow over 5 mph.

REPAIR



1—Snap Ring
2—Brake Drum
3—Jam Nut
4—Set Screw
5—Facing (9 used)
6—Driving Plate (8 used)
7—Snap Ring
8—Hub
9—Pilot Bearing
10—Lock Washer (6 used)
11—Cap Screw (6 used)
12—Drive Shaft (early units)
13—Spacer (early units)
14—Pressure Plate
15—Drive Shaft (later units)

Fig. 2-Steering Clutch

Remove final drive housing from unit as outlined in Section 10, Group 25.

NOTE: If steering clutch housing does not require service, you need not remove the final drive housing from the tractor. In this case, you can service the steering clutches as follows: Split track and remove drive sprocket and final drive pinion shaft. If this method is used, be sure to reset final drive bearing preload before reinstalling steering clutches. To do this, install shaft and record a measurable amount of end play at end of shaft. Then remove pinion shaft and install steering clutch. Before reinstalling pinion shaft, deduct from shim pack the thickness of shims equal to end play reading PLUS an extra 0.002 inch to give the desired preload to the pinion shaft.

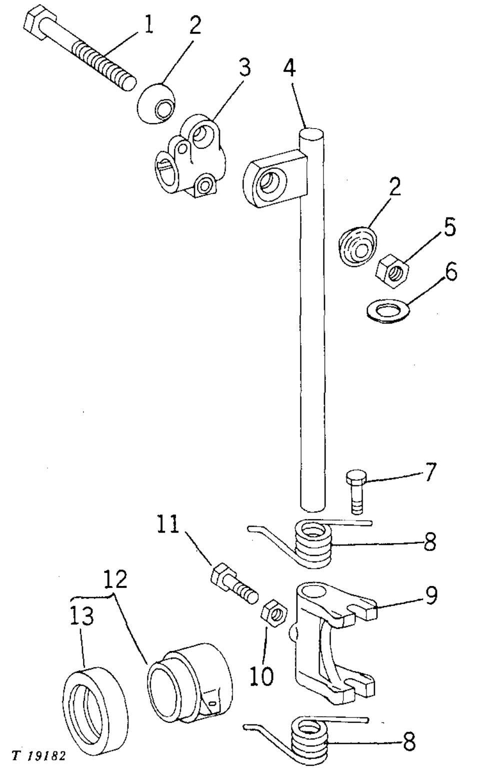
To remove the steering clutches, refer to procedure in Section 10, Group 25.

Clutch Pack and Brake Drum

Remove pressure plate and inspect steel plates and composition facings for burrs, warpage, or excessive wear. Excessive wear can be detected by comparing the thickness of contact areas with that of noncontact areas.

All plates and facings should be flat and free from defects of any kind. DO NOT wash composition facings in any type of solution as it will tend to glaze them. Examine brake drum for galls or scores. Remove any defects which may cause the brake to drag or operate improperly.

Clutch Throw-Out Bearing



1—Cap Screw	**7—Cap Screw (2 used)**
2—Washer (2 used)	**8—Spring (2 used)**
3—Arm	**9—Clutch Fork**
4—Shaft	**10—Nut**
5—Lock Nut	**11—Set Screw**
6—Washer (2 used)	**12—Bearing Carrier**
	13—Throw-Out Bearing

Fig. 3-Clutch Throw-Out Bearing

Examine throw-out bearing for binding, excessive looseness, or evidence of heat. Replace worn or defective bearing. This is a sealed, factory lubricated bearing and should not be washed in solvent. Press a new throw-out bearing onto bearing carrier so that the highly polished surface of the bearing faces away from the long part of the carrier casting.

IMPORTANT: Rotate bearing when installing it on carrier to prevent internal damage to the bearing.

See that carrier rides freely on sleeve without any binding. Replace excessively worn links or pins.

Check clutch throw-out shaft for excessive wear.

Clutch Pack and Brake Drum

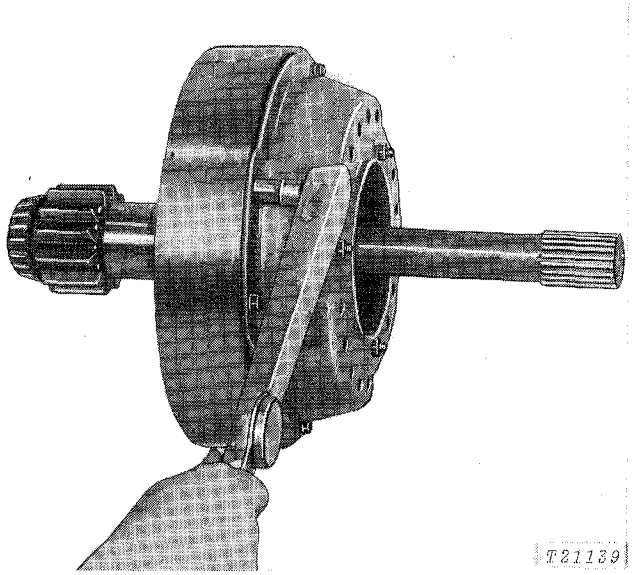


Fig. 4-Installing Pressure Plate

To assemble steering clutch, first align hub with brake drum by installing final drive pinion shaft with pilot bearing and steering clutch drive shaft.

With shafts in place, install steel driving plates and composition facings in hub as follows:

1. Install one composition facing against the brake drum.

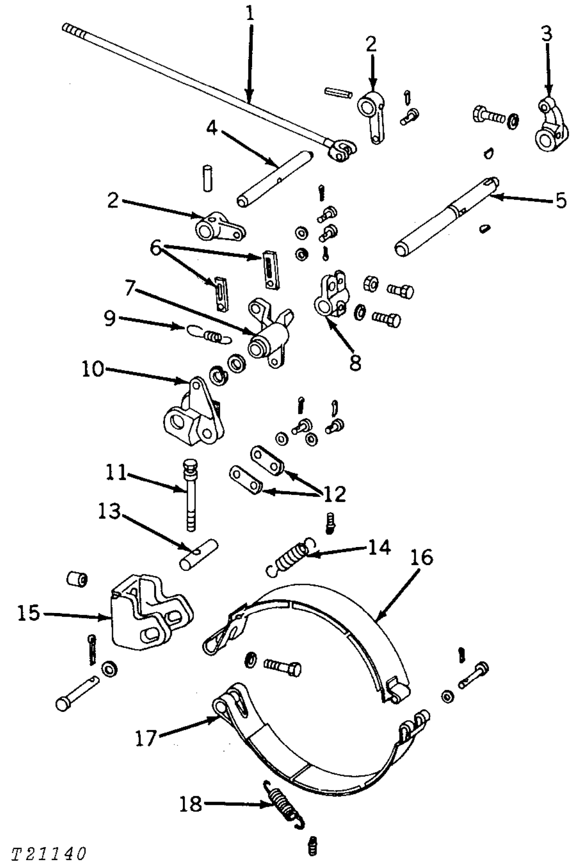
2. With snap ring in place on hub, alternately install eight steel plates and eight composition facings on hub.

3. Install pressure plate and tighten cap screws to specifications. Remove both shafts.

Steering Clutch Drive Shaft

Examine splines on shaft for damage or abnormal wear. Clutch hub is not intended to be a tight fit on clutch drive shaft. Do not be concerned if it is slightly loose.

Steering and Brake Linkage



1—Brake Rod	5—Steering Control Shaft	9—Spring	14—Upper Spring
2—Brake Lever	6—Slotted Links	10—Brake Band Yoke	15—Brake Anchor
3—Steering Control Arm	7—Bell Crank	11—Brake Band Adjusting Screw	16—Upper Brake Band
4—Brake Lever Shaft	8—Steering Lever Shaft Arm	12—Links	17—Lower Brake Band
		13—Yoke Pin	18—Lower Spring

Fig. 5-Brake Bands and Controls

Replace brake lining if it is torn, glazed, or oil-soaked. Inspect brake linkage and yoke and replace all damaged or excessively worn parts.

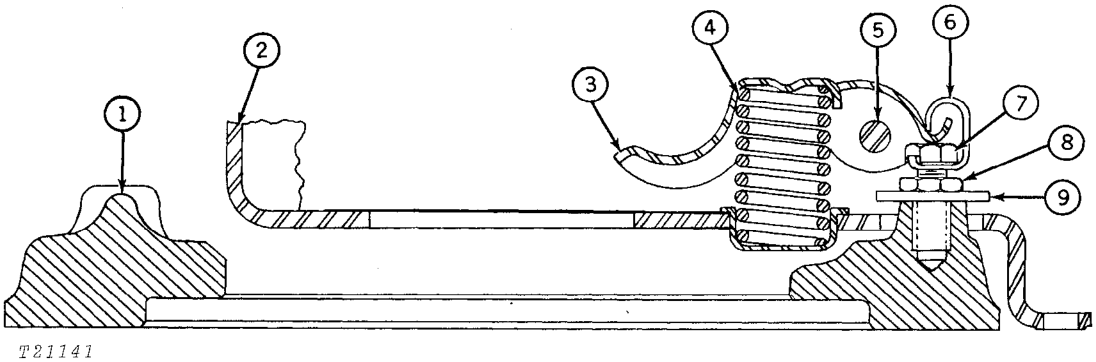
Note condition of bushings which support brake lever shaft and steering control shaft. Use a suitable tool to install new bushings if replacement is necessary.

Inspect steering lever arm and brake operating bell crank for damage or excessive wear.

Inspect all springs, links and pins for damage and replace if necessary.

Inspect brake lever shaft and steering control shaft for excessive wear.

Steering Clutch Pressure Plate



1—Pressure Plate
2—Bracket
3—Release Lever
4—Pressure Spring
5—Pivot Pin
6—Return Clip
7—Adjusting Screw
8—Adjusting Screw Lock Nut
9—Adjusting Screw Washer

Fig. 6-Steering Clutch Pressure Plate

Disassembly

Place the pressure plate assembly on a brake drum, pressure plate down, and centrally located. Depress the inner ends of the release levers as far as possible without forcing against bracket. This can be done by placing the brake drum on a hydraulic press and applying the load through a steel plate representing the clutch release bearing.

Remove return clips. With an open end wrench, loosen lock nuts. Back out the three adjusting screws from the pressure plate.

Release assembly by gradually releasing load on press. The clutch may then be disassembled for inspection. To separate release levers from bracket, first grind off peened ends of pivot pins.

Inspection

Check pressure plate for cracks, warped condition, and excessive wear. Check pressure springs in the assembly for damaged, weak, or rusty coils. Each part should be carefully inspected for wear and replaced if there is any question of its serviceability.

Replace springs if not to specification.

Release levers, bracket, and pivot pins should be replaced if any wear is found on these parts. Note carefully the condition of return clips and replace as necessary.

Assembly

Assemble release levers to bracket using new pivot pins. Peen ends to secure assembly.

Place pressure springs in the spring recesses in the clutch bracket and lever assembly. Assemble bracket, spring, and lever subassembly over pressure plate making certain slots in bracket align with pressure plate drive lugs and washers are in position.

NOTE: Lubriplate driving lugs on pressure plate to insure free clutching action.

Place this assembly on hydraulic press and apply pressure on the lever directly above the pressure spring while forcing the spring into position in bracket.

Assemble return clips under adjusting screws in pressure plate. Make certain return clips are in proper position, and then tighten lock nuts.

Adjusting Clutch Release Levers

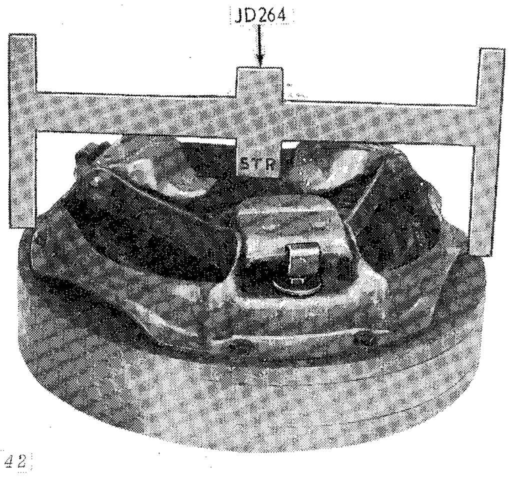


Fig. 7-Adjusting Clutch Release Levers

Bolt the pressure plate assembly to the brake drum.

Place "STR" side of JD264 gauge over pressure plate with legs of gauge resting on brake drum (Fig. 7). The three clutch release levers should be adjusted to just touch the center of the gauge. Released lever height is 2.062 ± 0.031 in.

Adjust release levers by loosening lock nuts and turning adjusting screws in or out until ends of levers contact gauge. Then tighten lock nuts.

IMPORTANT: To insure proper clutch functioning, the variation in adjusted height of release levers should not exceed 0.010 inch.

After release levers are adjusted and lock nuts tightened, exercise the release levers several times. Recheck adjustment with gauge and change if necessary. If levers dropped excessively when exercised, this process should be repeated until the setting is permanent.

ADJUSTING STEERING - BRAKE ASSEMBLY

The clutches and brakes, as well as their linkage, are so related in their operation that the adjustment must be made in a certain order. For that reason it is very important that the adjustment be made exactly as explained in the following steps.

IMPORTANT: Before making adjustments, pull back on both steering levers, then release them, to take up any slack in linkage.

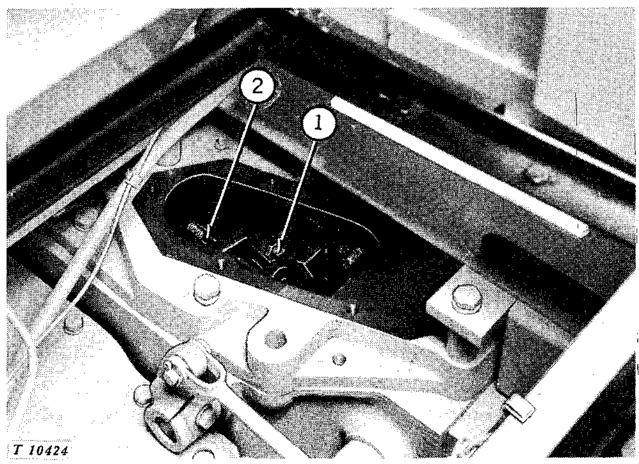


Fig. 8-Steering Lever and Brake Linkage

Remove cover and gasket from top of each steering clutch housing (Fig. 8). Also remove outside cover on each housing.

1. Loosen jam nut and back off steering brake bell crank actuator screw (Fig. 8).

2. Adjust nut on each steering clutch operating rod to obtain lever free travel measured at the top of the levers. (See Specifications for free travel measurement.)

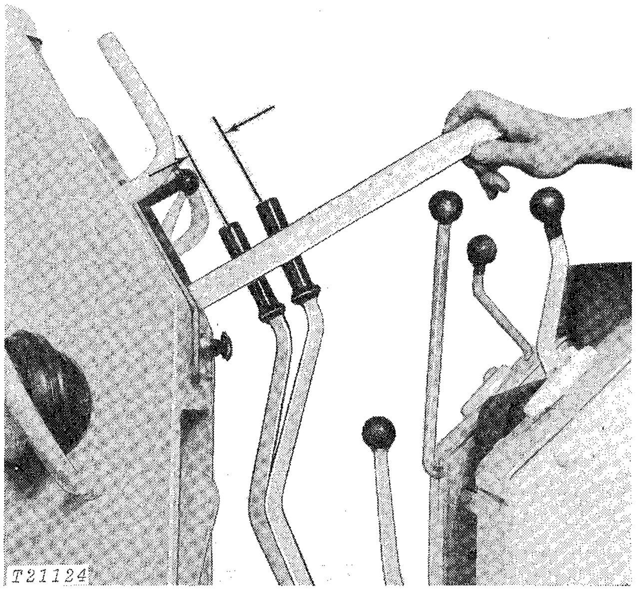


Fig. 9-Measuring Steering Clutch Free Travel

3. Block up the levers to just eliminate the free travel. Insert pins or bolts between steering levers and stops on platform to hold levers at correct position.

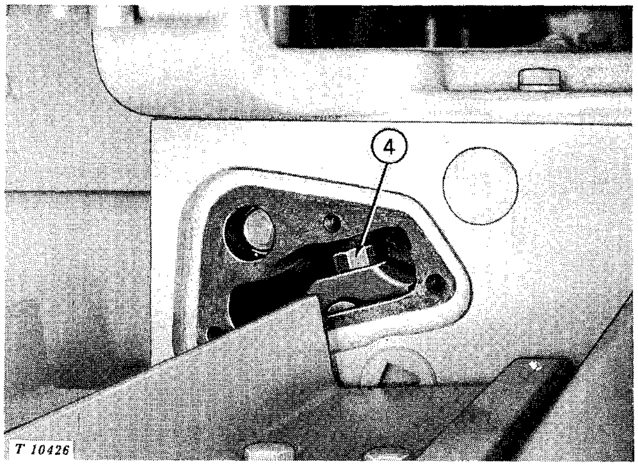


Fig. 10-Brake Band Adjusting Screw

4. Tighten the brake band adjusting screw until tight when not in detent (1/4 turn past detent).

5. With brake pedal back against stop, loosen jam nuts and adjust yokes on brake rods so that pin will just slip in. Retighten jam nuts.

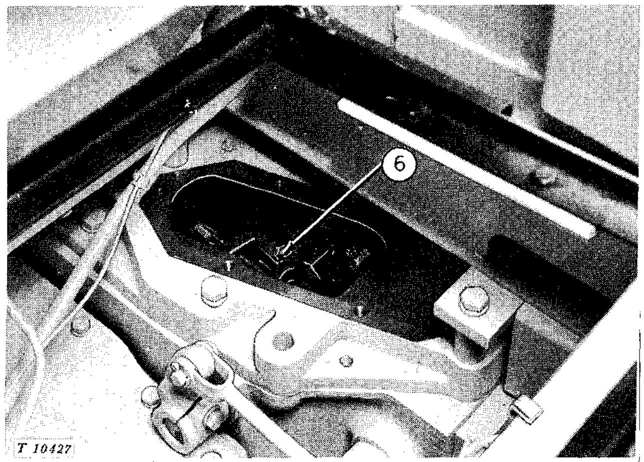


Fig. 11-Steering Brake Bell Crank Actuator Screw

6. Adjust steering brake bell crank actuator screw until it just touches the steering brake bell crank, then retighten jam nut.

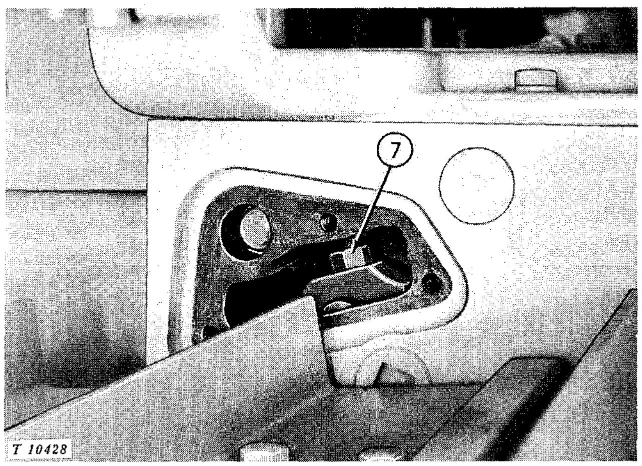


Fig. 12-Brake Band Adjusting Screw

7. Back off brake band adjusting screw three detents or 1-1/4 turns.

NOTE: It is important that both brake rods be adjusted as above to insure equal braking action from both brakes when pedal is depressed. This can be easily checked by watching action of brake band when pedal is depressed. Watch to see that both bands begin to move at the same time. This can best be seen by looking into top of steering clutch housing.

When finished, reinstall gaskets and covers.

SPECIFICATIONS

Steering lever free travel at top of handle .... 1-1/2 to 2 in.

Steering lever bushings (inside diameter) .... 0.8780 to 0.8790 in.

Clutch throw-out shaft bushings (inside diameter) .... 1.0010 to 1.0040 in.

Throw-out bearing carrier sleeve (distance from outer end of sleeve to shoulder on quill) .... 2-1/2 in.

Steering clutch pressure plate spring .... 176 to 194 lbs. at 1-11/16 in.

Released lever height .... 2.062 ± 0.031 in.

Variation in adjusted height of released levers not to exceed .... 0.010 in.

TORQUE VALUES

Item	Torque (ft-lbs)
Steering clutch pressure plate to brake drum	21
Side frame-to-steering clutch housing	170
Steering clutch housing to transmission case	300
Steering clutch housing to rear crossbar bracket	250

SPECIAL TOOL

No.	Name	Use
ESSENTIAL TOOL JD264	Clutch Adjusting Tool	Adjust clutch release lever height

Section 70
HYDRAULIC SYSTEM

CONTENTS OF THIS SECTION

Group 5
GENERAL INFORMATION, TESTING AND DIAGNOSIS

GENERAL INFORMATION

CAUTION: Escaping fluid under pressure can have sufficient force to penetrate the skin causing serious personal injury. Before disconnecting lines, be sure to relieve all pressure. Before applying pressure to the system, be sure all connections are tight and that lines and hoses are not damaged. Fluid escaping from a very small hole can be almost invisible. Use a piece of cardboard or wood, rather than the hands to search for suspected leaks.

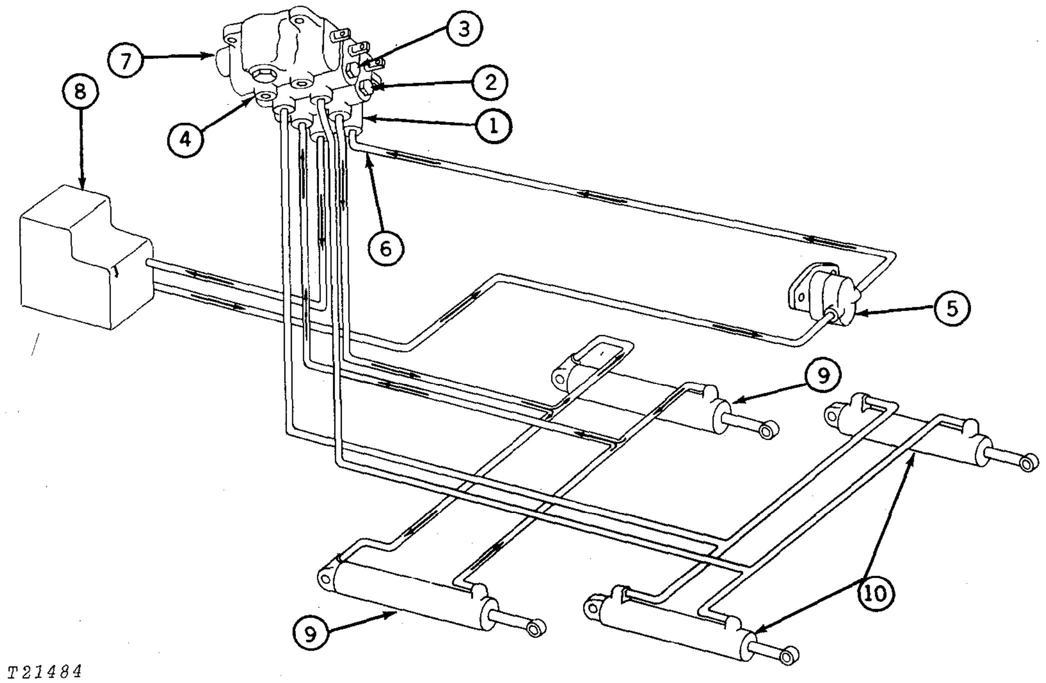
If injured by escaping fluid, see a doctor at once. Serious infection or reaction can develop if proper medical treatment is not administered immediately.

The hydraulic system for all crawler functions is of the open center type.

Basic crawler hydraulic systems consist of an engine driven gear type hydraulic pump, oil reservoir, filters, control valve and cylinders.

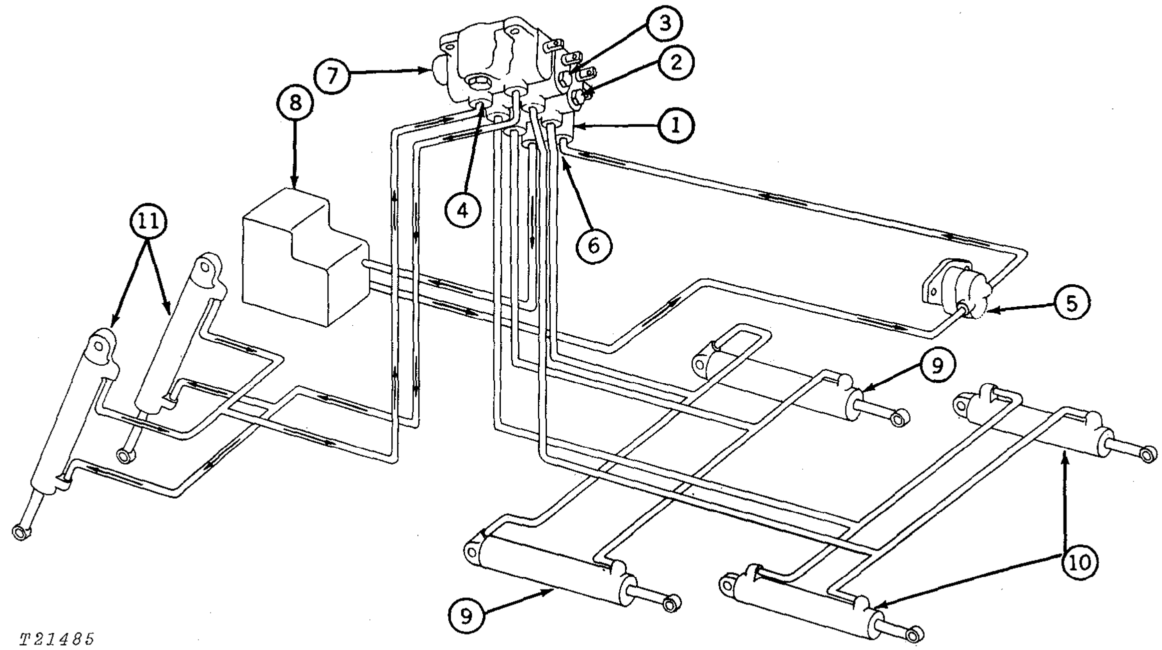
The following hydraulic circuit diagrams give a brief description of each hydraulic system and its components.

Study the circuit diagrams when diagnosing hydraulic system difficulties.



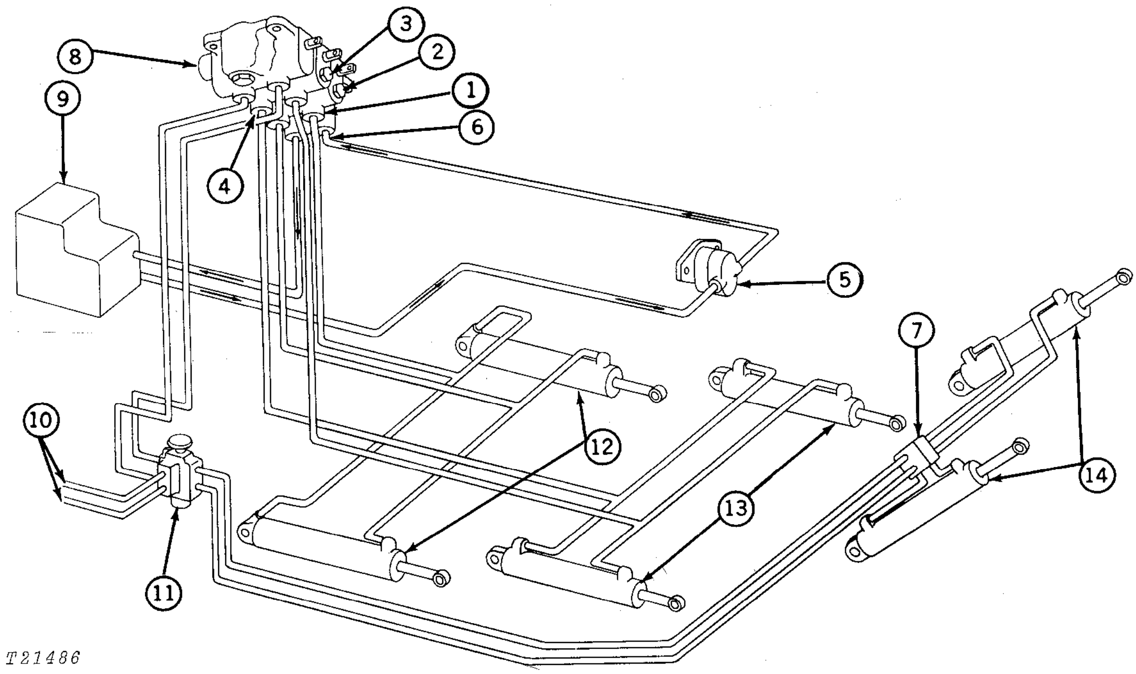
1—System Relief
2—Circuit Relief (Boom)
3—Circuit Relief (Bucket)
4—Circuit Relief (Bucket)
5—Hydraulic Pump
6—Pressure Tap
7—Control Valve
8—Reservoir
9—Boom Cylinder
10—Bucket Cylinder

Fig. 1-Crawler Loader Circuit



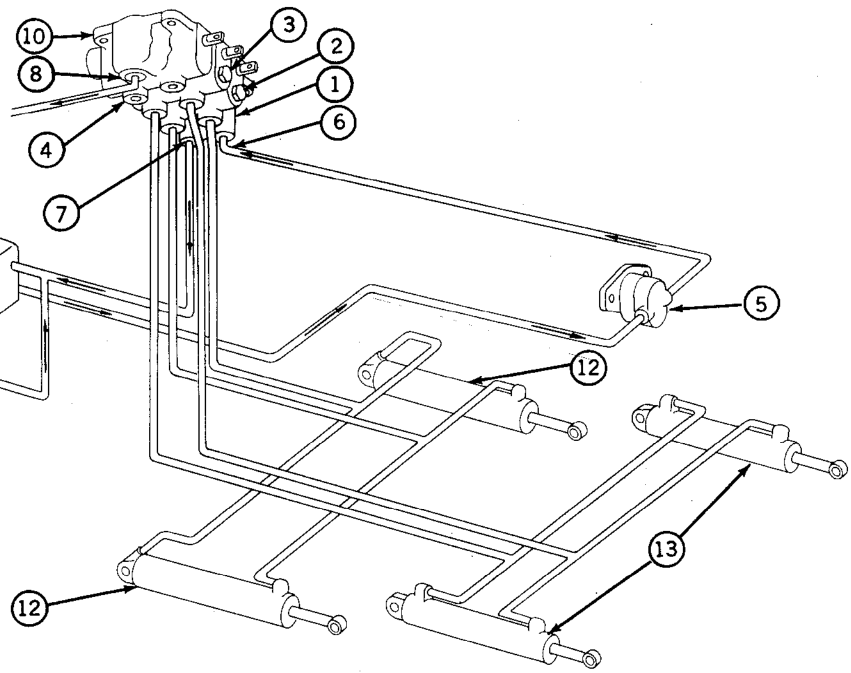
1—System Relief
2—Circuit Relief (Boom)
3—Circuit Relief (Bucket)
4—Circuit Relief (Bucket)
5—Hydraulic Pump
6—Pressure Tap
7—Control Valve
8—Reservoir
9—Boom Cylinder
10—Bucket Cylinder
11—Ripper Cylinder

Fig. 2-Crawler Loader with Ripper



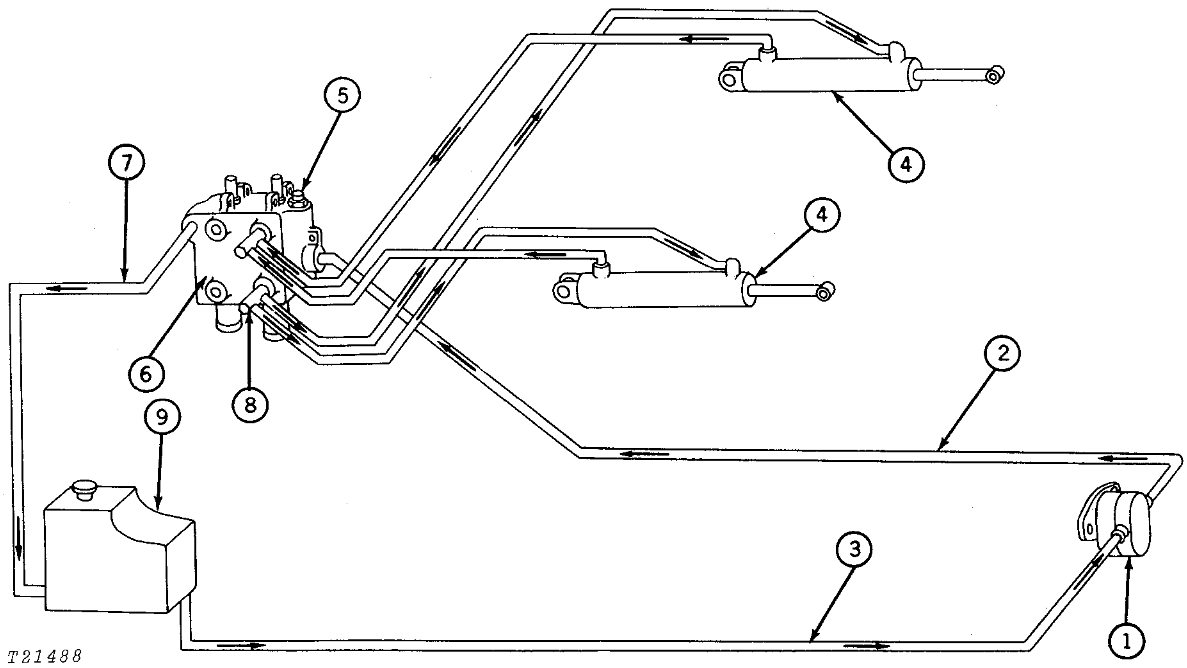
1—System Relief
2—Circuit Relief (Boom)
3—Circuit Relief (Bucket)
4—Circuit Relief (Bucket)
5—Hydraulic Pump
6—Pressure Tap
7—Drott Clam Circuit Relief
8—Control Valve
9—Reservoir
10—To Ripper Cylinder
11—Selector Valve
12—Boom Cylinders
13—Bucket Cylinders
14—Drott Cylinders

Fig. 3-Crawler Loader with Ripper and Drott Bucket



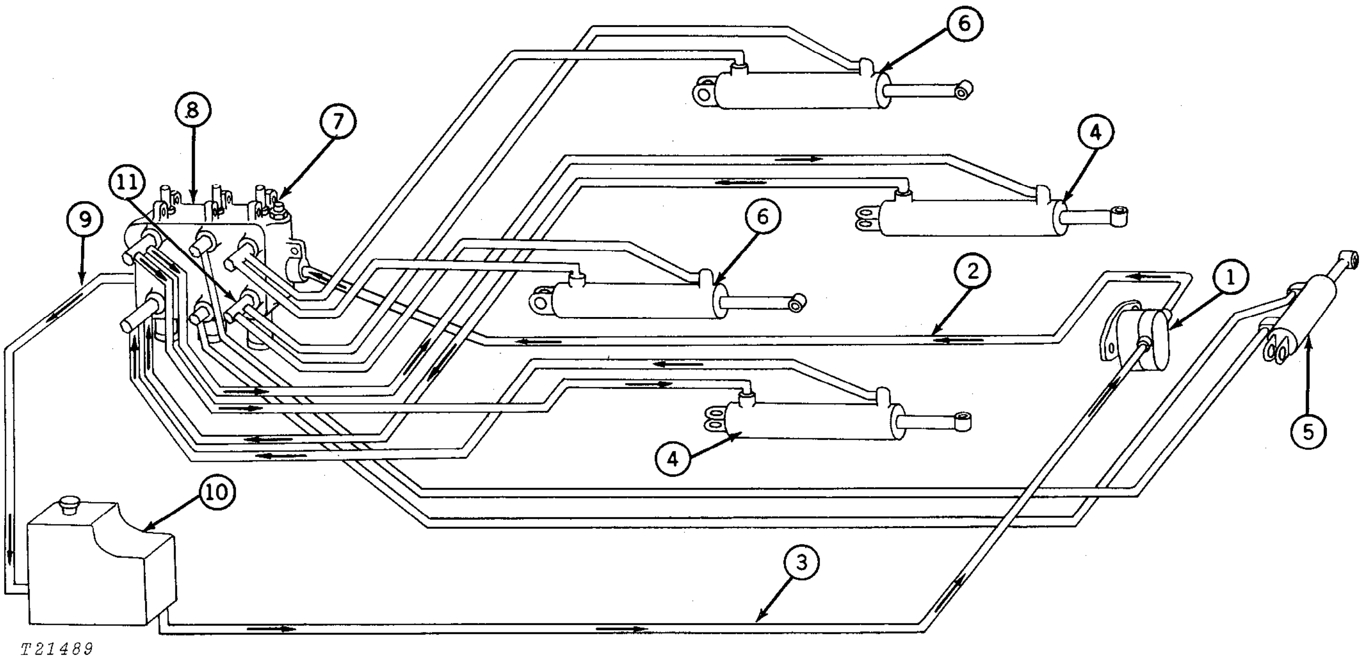
1—System Relief
2—Circuit Relief (Boom)
3—Circuit Relief (Bucket)
4—Circuit Relief (Bucket)
5—Hydraulic Pump
6—Pressure Tap
7—Return Oil
8—Power Beyond (Backhoe or 345 Rotoboom) Flow Divider (3400 Rotoboom)
9—Return from Rear Function
10—Control Valve
11—Reservoir
12—Boom Cylinders
13—Bucket Cylinders

Fig. 4-Crawler Loader with Backhoe or Rotoboom



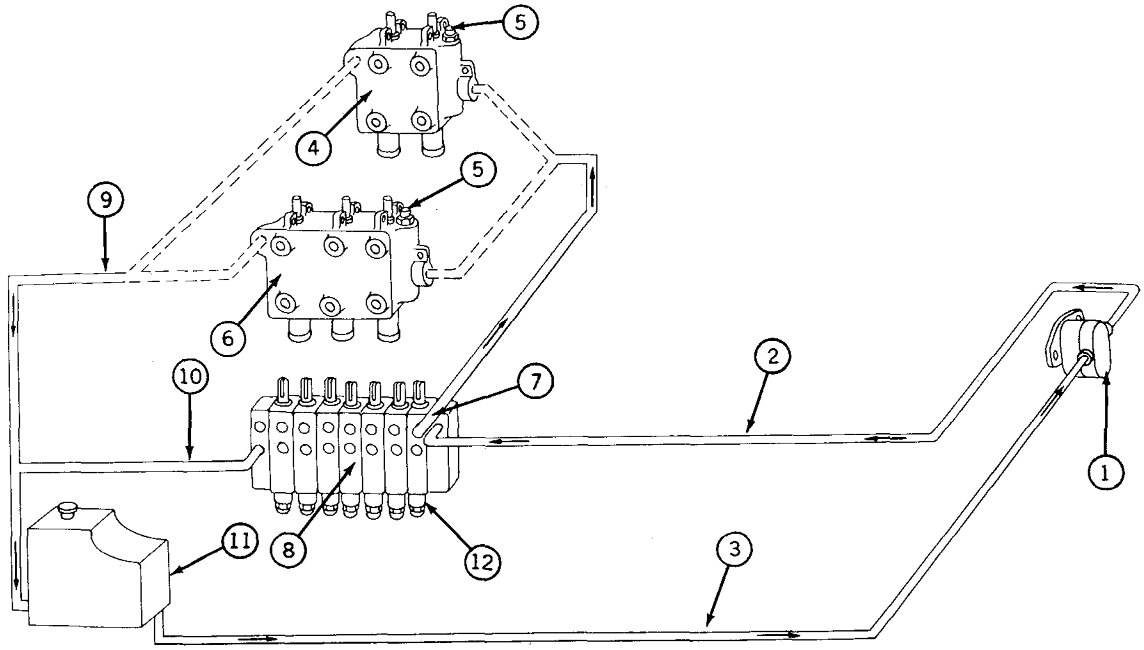
1—Hydraulic Pump
2—Pump Pressure Line
3—Pump Inlet Line
4—Lift Cylinder
5—System Relief Valve
6—Control Valve (2 spool)
7—Return Line
8—Restricted Union
9—Reservoir

Fig. 5-Mechanical Bulldozer Circuit



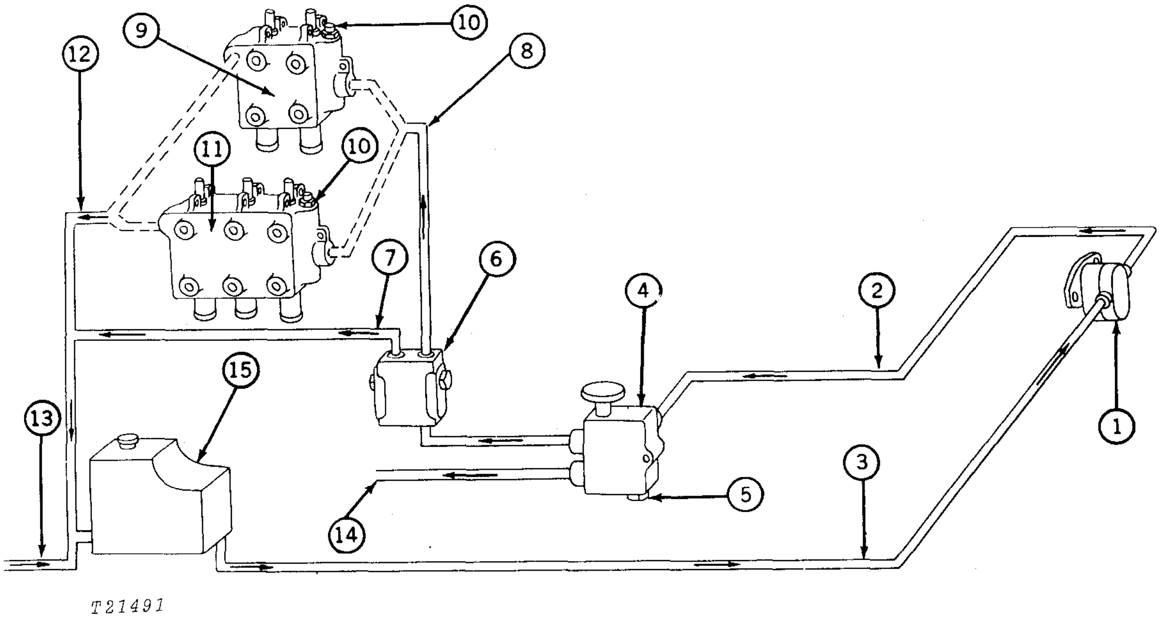
1—Hydraulic Pump
2—Pump Pressure Line
3—Pump Inlet Line
4—Angling Cylinders
5—Tilt Cylinder
6—Lift Cylinder
7—System Relief Valve
8—Control Valve (3 used)
9—Return Line
10—Reservoir
11—Restricted Union

Fig. 6-All-Hydraulic Bulldozer Circuit



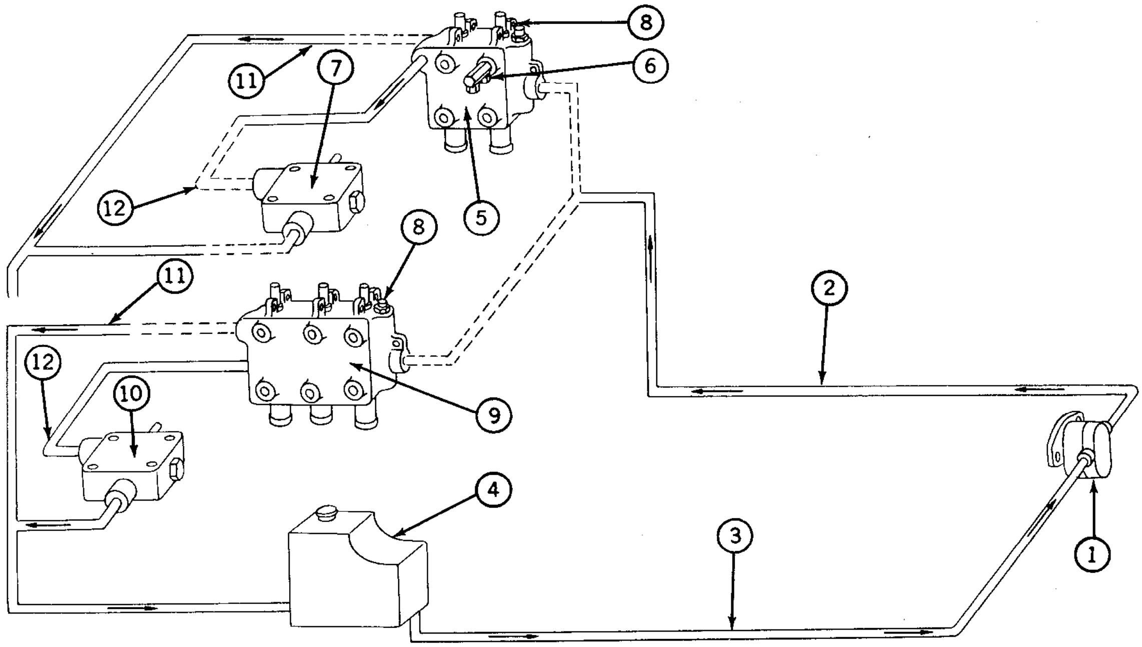
1—Hydraulic Pump
2—Pump Pressure Line
3—Pump Inlet Line
4—Dozer Control Valve (2 spool)
5—Dozer System Relief Valve
6—Dozer Control Valve (3 spool)
7—Power Beyond Sleeve
8—Rotoboom Control Valve
9—Dozer Return Line
10—Rotoboom Return Line
11—Reservoir
12—Rotoboom Relief Valve

Fig. 7-Bulldozer Equipped with 3400 Rotoboom



1—Hydraulic Pump
2—Pump Pressure Line
3—Pump Inlet Line
4—Selector Valve
5—Selector Valve Relief
6—Flow Divider
7—Return Line
8—Dozer Valve Inlet Line
9—Dozer Control Valve (2 spool)
10—Dozer System Relief Valve
11—Dozer Control Valve (3 spool)
12—Dozer Valve Return Line
13—Return Line from Function
14—Auxiliary Valve Inlet Line
15—Reservoir

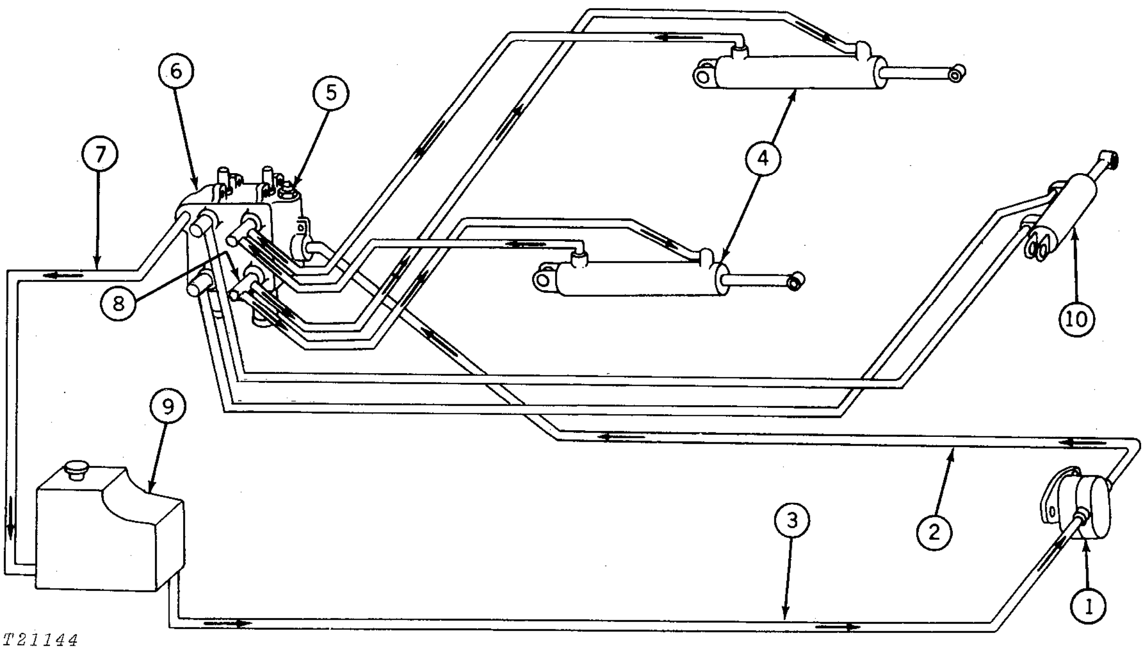
Fig. 8-Bulldozer Equipped with Backhoe, 345 Rotoboom or Midwestern Sideboom



T21143

1—Hydraulic Pump
2—Pump Pressure Line
3—Pump Inlet Line
4—Reservoir
5—Dozer Valve (2 spool)
6—To Function
7—Auxiliary Valve (1 spool)
8—System Relief
9—Dozer Valve (3 spool)
10—Auxiliary Valve (2 spool)
11—Return from Dozer Valve
12—Pressure to Auxiliary Valve

Fig. 9-Bulldozer Equipped with Auxiliary Valves



T21144

1—Hydraulic Pump
2—Pump Pressure Line
3—Pump Inlet Line
4—Lift Cylinder
5—System Relief Valve
6—Control Valve
7—Return Line
8—Restricted Union
9—Reservoir
10—Tilt Cylinder

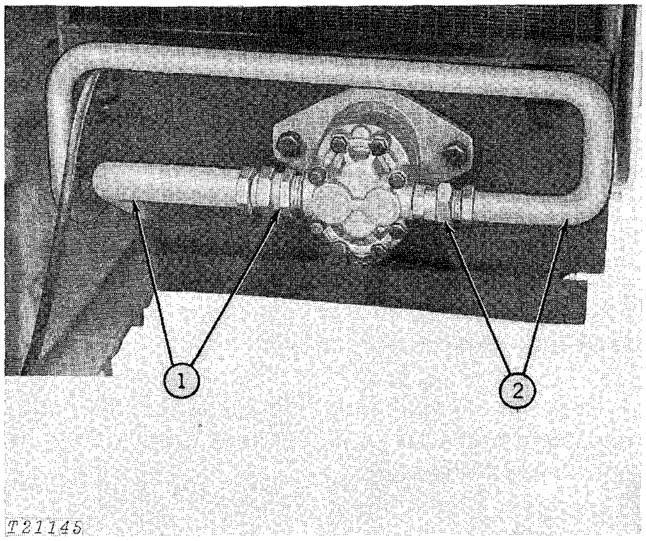
Fig. 10-Mechanical Bulldozer with Hydraulic Tilt

TESTING

Operational Tests

Checking Oil Lines and Hoses

Slow function operation may be an indication that the hydraulic system is leaking. Check all oil lines and connections for leaks.



1—Suction Line **2—Pressure Line**

Fig. 11-Suction and Pressure Circuit Checks

Leaks in the pressure side of the system can be located by carefully inspecting the external area of the components, fittings and hoses.

Check the suction side of the system for leaks by examining the oil in the reservoir. If air is being drawn into the system, the oil will contain air bubbles and will appear to foam.

Dented tubing can cause oil foaming, heat, faulty function operation or pump failure. Replace damaged tubing immediately.

Wash inside and outside of oil lines and fittings with clean diesel fuel or petroleum solvent to remove dirt before installing them on the machine.

When tightening connections, always use two wrenches to prevent damage to hoses, tubing and fittings.

IMPORTANT: Tighten fittings only tight enough to eliminate leaks. Do not overtighten connections.

Checking Control Valve for Leaks

After long use, the valve spools may become worn, allowing oil to leak past them. Check the valve leaks as follows:

NOTE: Use loaded bucket to perform checks on crawler loader machines.

1. Raise the function a few feet off the ground and shut off the engine. Disconnect the return line between control valve and reservoir.

2. If the function settles because of valve spool leakage, oil will seep from the disconnected return line. Connect the return line and lower the blade to the ground.

If the control valve check valves appear to be leaking, proceed as follows:

1. Start engine. Raise the function a few feet off the ground and return the control lever to the neutral position.

2. Slowly move the control lever back to the raise position. If the function settles before it begins to rise, the check valve is probably leaking. Lower the function to the ground and, if necessary, remove control valve for service.

Checking System Relief Valve

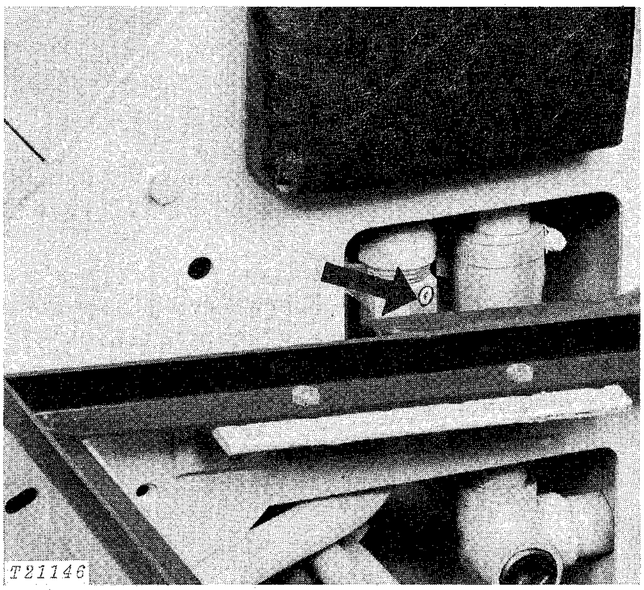


Fig. 12-Pressure Tap Location

Install pressure gauge in pressure tap (1/8 in-27 NPT) (Fig. 12).

With hydraulic oil at normal operating temperature and engine at fast idle. lower the function to the ground.

Continue to hold the control valve open. This will cause system pressure to build and the system relief valve to open.

Observe reading on pressure gauge at this time. Refer to "Specifications" for relief valve operating pressure.

Checking Cylinders for Leaks

NOTE: Before checking the cylinders for leaks, inspect the control valve and relief valves.

If the control valve is not leaking and the function continues to settle with the control valve in neutral, oil is probably leaking past the packings in the cylinders. Check each cylinder individually to determine which one is leaking.

With the cylinder to be checked either fully extended or retracted, remove a hydraulic hose from one end of the cylinder. (If the cylinder is extended, remove hose from rod end; if the cylinder is retracted, remove hose from the head end). Cap end of hose removed and operate the cylinder. Because the cylinder piston is at the end of its stroke, the relief valve will open.

IMPORTANT: To prevent oil discharge from the disconnected hose, be sure to operate cylinder in same direction as chosen above. For example, if hose is disconnected from the rod end, operate the valve lever to extend the cylinder.

Examine the open port on the cylinder. If any oil is leaking from the port, cylinder packings are defective and should be replaced.

Be sure to replace any oil lost during each test.

Checking Pump Efficiency

Check oil lines, control valve and cylinders before checking the pump. To obtain correct timing, the hydraulic oil should be at normal operating temperature and the engine at fast idle.

Check cycle times with a stop watch and refer to Specifications for correct times.

If the cycle times are above the maximum times given in specifications, the pump is probably faulty and should be serviced.

FLOW METER TESTS

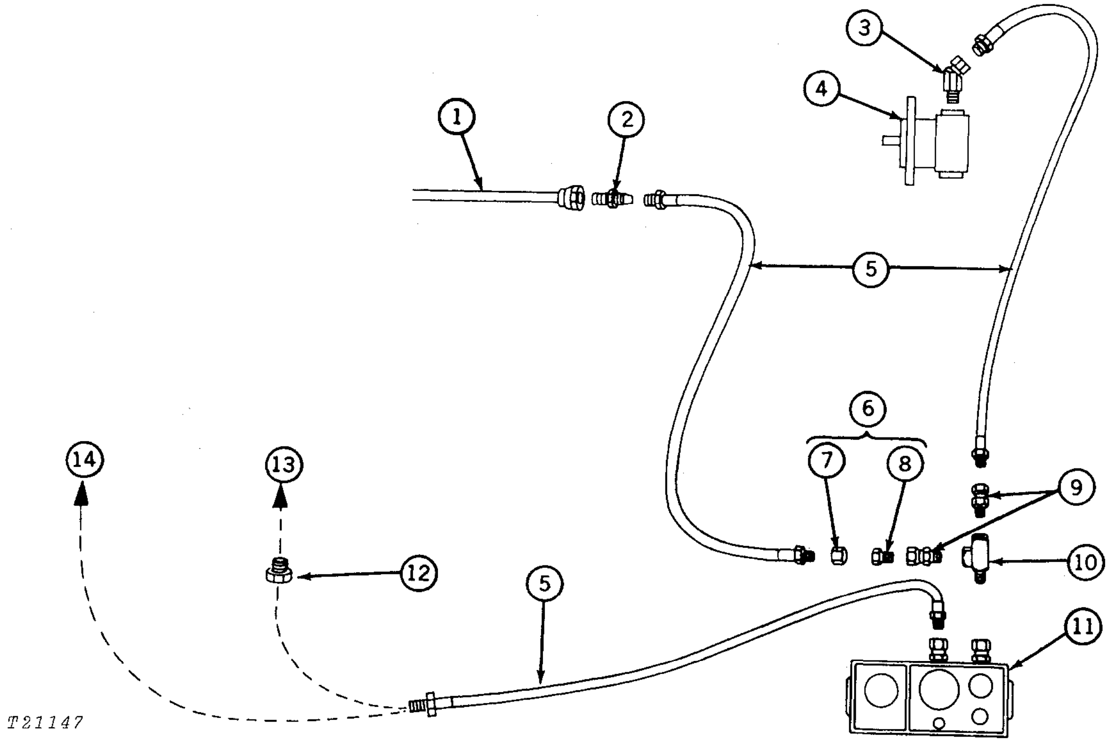
Before proceeding with these tests, read the operating and instruction manual furnished with each hydraulic tester and review the machine hydraulic system. A thorough understanding of the tester and the hydraulic system will enable you to obtain more exact and helpful data when performing the test. Also refer to "Diagnosing System Malfunctions" for an orderly process of eliminating the most likely trouble first.

There are two basic flow meter tests used to check out the loader hydraulic system:

First is the "pump test" which checks the pump flow at rated pressure.

Second is the "circuit test" which checks the efficiency of the control valves, relief valves and cylinders.

A preliminary check of the hydraulic system oil supply, oil lines and cylinder rods as well as for externul leaks, should be made prior to hydraulic tester installation.



1—Pressure Line to Control Valve
2—Dozer D-88
Loader D-98, Y3011
3—Dozer D-99, Y3016
Loader D-97, Y3010
4—Pump
5—D-91, Y21-10
6—Use with Pump Test To Plug Hose and Tee
7—D-93, Y3019
8—D-94, Y3020
9—D-96, Y3018
10—D-92, Y3013
11—Hydraulic Tester
12—D-101, Y3012
13—To Loader Control Valve Return Line
14—To Dozer Control Valve or Tee into Return Line

Fig. 13-Installing Hydraulic Tester

When making test connections according to the diagram use either all OTC fittings ("Y" prefix) with OTC tester and hoses or all Nuday fittings ("D" prefix) with Nuday tester and hoses.

FOS Refer to FOS Manual—HYDRAULICS for additional information on Hydraulic testing.

Hydraulic Pump Test

Connect hydraulic tester for pump test as shown in Fig. 13.

Open hydraulic tester pressure loading and operate engine at fast idle.

Slowly close pressure loading valve to system operating pressure until normal operating temperature is reached.

NOTE: Make all tests at operating temperature because as oil heats it becomes thinner and will disclose any internal leakage; however, never exceed 210°F.

Open pressure loading valve to read maximum pump flow at zero pressure.

Close loading valve slowly to increase pressure and record flow at 250 psi increments from zero psi to maximum system pressure.

Open hydraulic tester pressure loading valve until maximum pump flow is again at zero pressure.

Pump Test Diagnosis

The decrease in flow from zero pressure to maximum pressure is used to determine the pump condition (efficiency). A pump that delivers a constant low flow at zero pressure and at maximum pressure indicates suction problems.

Hydraulic Circuit Test

Remove plug from 90° side of tee at inlet side of hydraulic tester. Connect hose from control valve pressure line (located along right side of tractor) to 90° side of tee. Quick disconnect couplers may be used at this point if desired.

NOTE: If flow divider is used in the hydraulic system, the hydraulic tester must be installed between the flow divider and bulldozer or loader control valve in order to test the bulldozer or loader circuit. Basic test (same as pump test) is made on flow divider to compare with bulldozer or loader circuit tests. This applies to the Sideboom, 345 Rotoboom and all backhoes used with dozers. This also applies to the 3400 Rotoboom when used with loaders.

Open hydraulic tester pressure loading valve and operate engine at fast idle.

Slowly close pressure valve to load system until normal operating temperatures (160°F) are reached.

Open pressure loading valve to read maximum system flow at "0" pressure.

Operate function control valve and hold valve in a power position (piston in cylinder at the end of its stroke).

NOTE: Only one control valve should be in a power position at any one time.

With control valve held in a power position, slowly close hydraulic tester loading valve and record flow at 250 psi increments from "0" psi to maximum system pressure.

NOTE: Readings should be made at the same increments as recorded during the pump test.

Open hydraulic tester pressure loading valve until maximum flow is again at "0" pressure.

Repeat all power positions for all control valve circuits.

NOTE: Make all tests at normal operating temperature (160°F). If temperature is too hot (over 210°F) from previous circuit test, keep loading valve closed and work function control valve to circulate oil through the system.

Circuit Test Diagnosis

If all components are in good operating condition, circuit flow measurements at each recorded pressure will be the same as made during the hydraulic pump test.

If a continuous decrease in flow is noted in any of the control valve positions, leakage is indicated either within the control valve or in the cylinder.

To determine whether leakage is in the control valve or in the cylinder, remove cylinder return line with the control valve in a power position. If no oil is leaking from cylinder return port, the control valve is at fault. If leakage is noted, the cylinder is defective.

If the decrease in flow is the same with the control valve in all positions, the system relief valve may be at fault.

NOTE: This can also indicate some other leak is present in the control valve such as a defective casting; however, always check the relief valve first.

If equipment with circuit relief valve is being checked, cracking pressure would be indicated by a sudden decrease of approximately 3 gpm (or more) or a drop to "0" gpm depending on whether a full flow relief valve is used.

Relief Valves

Often relief valves will start to open before they reach their full pressure flow settings. This can be noted by comparing the pressure and flow rate reading made in the circuit test. Any great decrease in flow rate indicates a faulty relief valve.

Faulty system relief valves will affect pressure readings in all tests.

Faulty circuit relief valves will affect only pressure readings in individual circuits.

DIAGNOSING SYSTEM MALFUNCTIONS

Functions Lift Slowly

Cold oil.
Allow oil to warm up.
Oil viscosity too heavy.
Use recommended oil.
Insufficient engine speed.
Open crawler throttle.
Air leak in suction line.
Check and tighten.
Badly worn pump.
Replace or repair pump.
Oil leaking past cylinder packings.
Replace worn parts.
Oil leaking past control valve.
Replace or repair valve.
Restriction in suction line.
Check and replace suction line.
Dirty oil filter (if used).
Replace or clean filter.
System relief valve dirty or leaking.
Clean or replace relief valve.

Functions Fail To Stay Raised

Leaking or broken oil lines or fittings from control valve to cylinder.
Check for leaks. Tighten or replace lines.
Oil leaking past control valve spool(s).
Repair or replace valve spool(s).
Oil leaking past cylinder seals.
Replace worn parts in cylinder.

Functions Fail To Work

Insufficient oil in reservoir.
Add recommended oil.
Relief valve not functioning.
Replace relief valve.
Insufficient relief valve pressure.
Clean or replace relief valve.
Pump badly worn or damaged.
Repair or replace pump.
Broken oil line.
Check for leaks and repair.
Obstruction in oil lines or valve.
Check flow of oil through system.
Worn control valve.
Repair or replace valve.
Oil leaking past cylinder seals.
Replace worn parts in cylinder.

Oil Heats

Operator holds valves open too long causing relief valve to open.
Return levers to neutral position when not in use.
Incorrect system relief valve pressure.
Replace relief valve.
Using light oil in very hot weather.
Use recommended oil.
Dirty oil.
Drain and refill with new oil.
Tractor engine running too fast.
Reset speed control linkage or reduce throttle.

Oil Foams

Air leak in line from reservoir to pump.
Tighten or replace suction line.
Kink or dent in oil lines.
Replace oil lines.
Worn seal around pump shaft.
Replace seal.
Wrong oil used.
Use recommended oil.

Control Valve Sticks Or Works Hard

Return spring binding or broken.
Replace spring.
Dirty valve.
Clean valve.
Scored valve bore or bent spool.
Replace valve.
Misalignment of control linkage.
Correct misalignment.
Foreign matter in spool bore.
Clean control valve and hydraulic system.

Engine Stalls While Working

Load beyond crawler or hydraulic system capacity.
Move smaller loads.
Incorrect relief valve pressure.
Replace or clean cartridge.

System Pressure Is Low

Relief valve ball held open by foreign material or broken valve spring. Allows oil to return to reservoir because valve will not seat.
Replace or clean relief valve.

SPECIFICATIONS

Item	New Part	
SYSTEM OPERATING TEMPERATURE		
Normal Operating Range	150°F to 180°F	
HYDRAULIC PUMPS (New Spec. Minimum Output)		
Bulldozer Pump (15 gpm)	14.0 gpm at 1750 psi at 2500 rpm	
(23 gpm)	21.6 gpm at 2250 psi at 2500 rpm	
Loader Pump (28 gpm)	26.1 gpm at 2250 psi at 2500 rpm	
RELIEF VALVE PRESSURE (PSI)		
Bulldozer Valve System Relief	1750	
Selector Valve (with Backhoe or 345 Rotoboom)	2000	
Rotoboom (3400) System Relief	2000	
Loader		
System Relief	2250	
Boom Raise Circuit Relief	2500	
(service valve)	3100	
Bucket Roll-Back Circuit Relief	2500	
Bucket Dump Circuit Relief	1000	
(service valve)	1250	
	(9300 Backhoe)	(9250 Backhoe)
Backhoe Valve		
Crowd Relief Valve	2375	2500
Swing Relief Valve (2 used)	1625 or 2000 (as marked)	1750 (right) 2375 (left)
Boom Relief Valve (boom raise-early units)	3000	2750
(boom raise-later units)	3500	2750
(boom lower)	2375	2500
Drott Bucket Clam Relief	2500	

CYCLE TIMES (at 2500 rpm)*	Seconds Min.	Seconds Max.
Bulldozers		
Blade Raise	3.0	5.0
Blade Lower (Power Down)	4.0	5.0
Blade Tilt	0.5	1.5
Blade Angle	2.5	3.8
Loaders (Empty Bucket)		
Boom Raise	6.6	7.1
Boom Lower (Float Down)	3.6	4.2
(Power Down)	4.0	5.0
Bucket Dump (Boom at Full Height)	1.7	2.3
Bucket Roll-Back (From Bucket Level)	0.6	1.0
Backhoe		
Bucket cylinder retract	...	2.0
Bucket cylinder extend	...	3.0
Swing 180° (right or left)(9250)	2.5	4.5
(9300)	3.5	5.5

** NOTE: Cycle times given are to be used only as guidelines. Therefore, when a unit does not perform according to the cycle times given, the service technician must use his own judgment to decide if the difference is great enough to indicate a malfunction of some component in the system.*

Group 10

HYDRAULIC COMPONENTS

RESERVOIR AND FILTERS

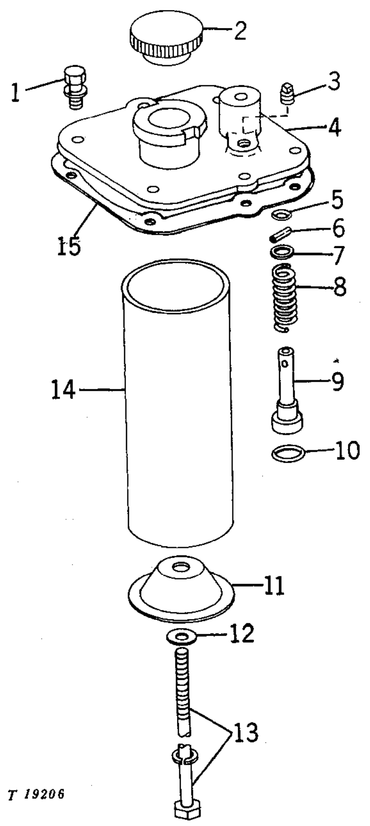
GENERAL INFORMATION

The hydraulic reservoir is the sump area for the hydraulic functions and is pressurized to keep out dirt and to hold pressure for positive flow to the pump.

The hydraulic system filtering unit consists of a return line filter element that filters the oil as it returns to the reservoir, and a wire mesh filter (early units) that filters the suction oil as it goes to the pump.

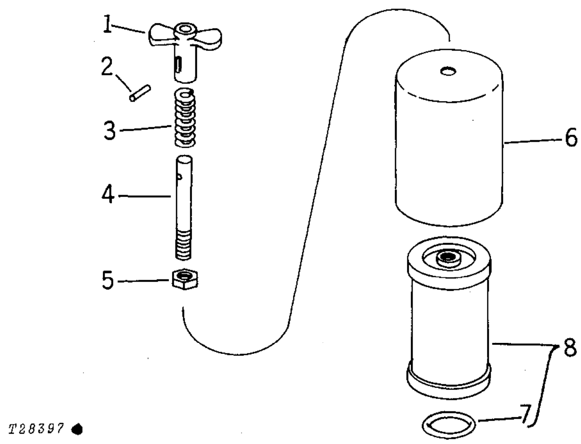
Should the return line filter become plugged, a valve at the top of the reservoir allows oil to bypass the filter and enter the reservoir.

REPAIR



1—Cap Screw (6 used)
2—Pressure Cap
3—Pipe Plug
4—Filter Cap
5—O-Ring
6—Spring Pin
7—Washer
8—Spring
9—Indicator Piston
10—O-Ring
11—Filter Cap
12—Washer
13—Machine Bolt
14—Micronic Filter
15—Gasket

Fig. 1-Return Line Filter



1—Latch
2—Spring Pin
3—Spring
4—Rod
5—Nut
6—Filter Can
7—O-Ring
8—Wire Mesh Filter

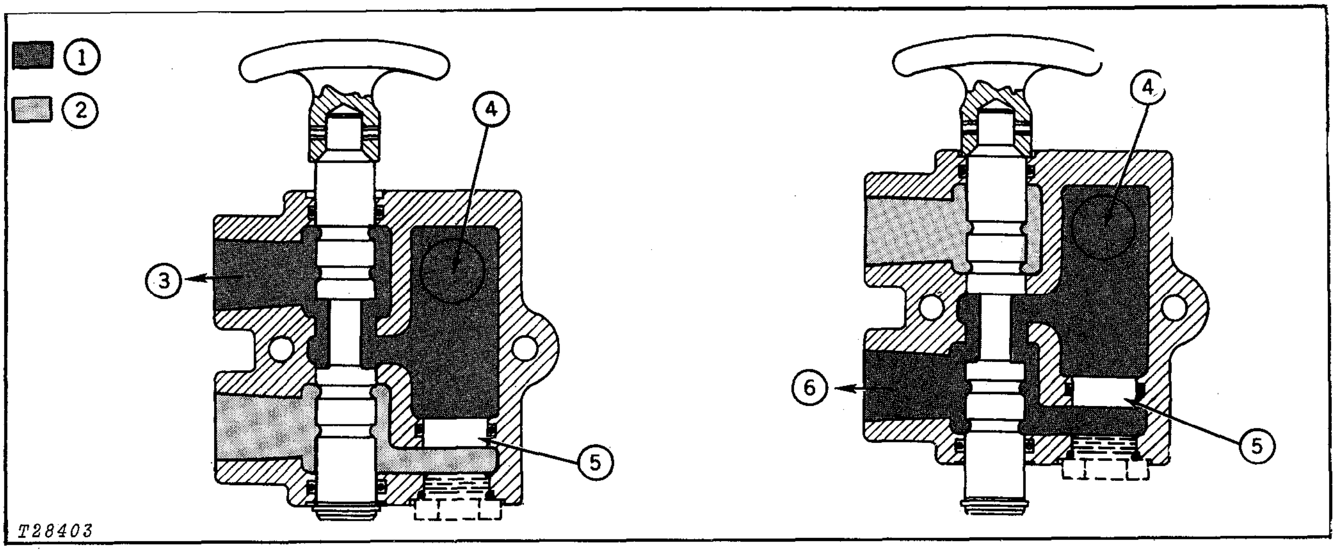
Fig. 2-Wire Mesh Filter (early units)

Replace the return line filter at the service periods outlined in the operator's manual. Also replace return line filter when major service work is performed on the crawler hydraulic components.

The wire mesh filter may be washed in a solvent such as diesel fuel and the impurities blown out with compressed air.

SELECTOR VALVE

GENERAL INFORMATION



1—Pressure Oil
2—Pressure Free Oil
3—Flow To Rear Mounted Equipment
4—Pump Inlet
5—Relief Valve
6—Flow To Front Mounted Equipment

Fig. 3-Selector Valve Operation

The selector valve directs oil flow to either front mounted or rear mounted equipment determined by the position of the valve (Fig. 3).

A system relief valve is incorporated into the selector valve to provide pump protection.

REPAIR

Remove selector valve from unit. Remove snap ring from bottom end of spool and disassemble valve using Fig. 4 for a guide.

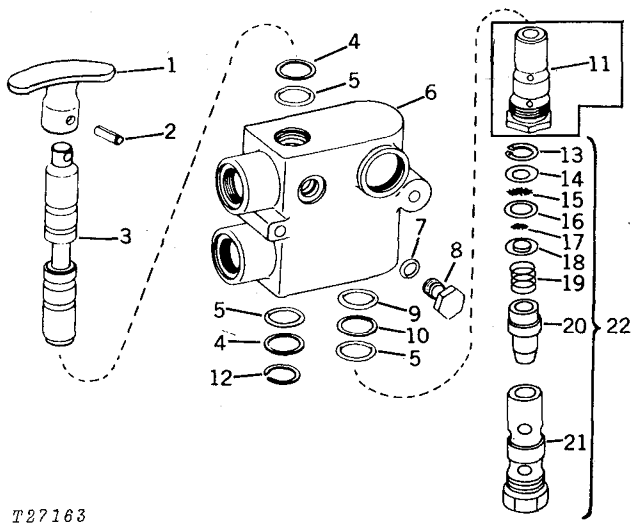
Thoroughly clean and dry all parts. Inspect the spool for dents and scratches.

Replace spool and housing as a matched set. Replace all O-rings and backup washers.

Thoroughly lubricate O-rings, when assembling, to prevent damage to them.

Secure the selector valve to the unit and connect hoses and fittings as previously removed.

The 2000 psi relief valve (11, Fig. 4) used in early selector valves is not field adjustable. The 2000 psi relief valves (22) used in later selector valves can be adjusted by adding or removing washers (14).



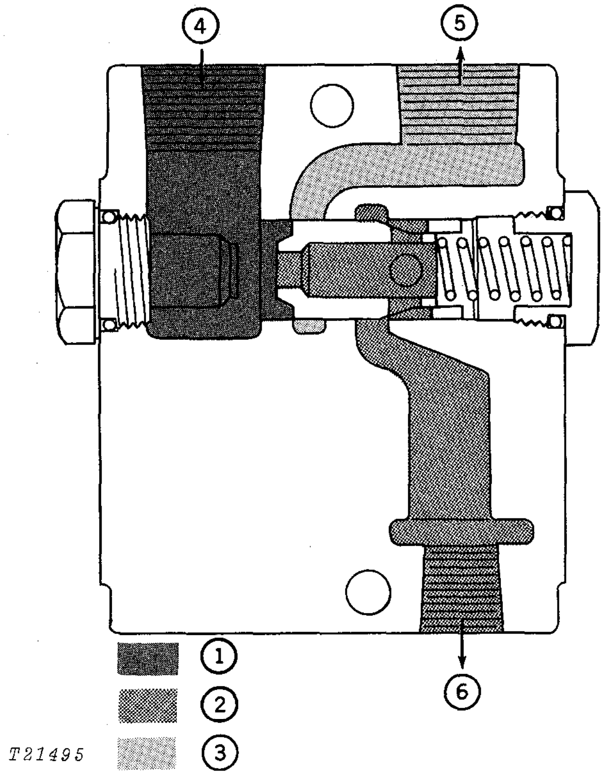
1—Handle
2—Spring Pin
3—Spool
4—Backup Washer (2 used)
5—O-Ring (3 used)
6—Valve Body
7—O-Ring
8—Spool Detent Plug
9—O-Ring
10—Backup Washer
11—Relief Valve (early units)
12—Snap Ring
13—Snap Ring
14—Washer
15—Screen
16—O-Ring
17—Screen
18—Orifice Plate
19—Spring
20—Pilot Assembly*
21—Cage*
22—Relief Valve (later units)

* *Not available as individual service part.*

Fig. 4-Selector Valve

FLOW DIVIDER

GENERAL INFORMATION

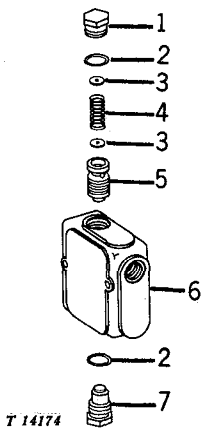


1—Pump Oil Flow
2—Function Oil Flow
3—Return Oil Flow
4—From Pump
5—To Reservoir
6—To Control Valve

Fig. 5-Flow Divider

When the function control valve requires less GPM capacity than the pump delivers, the flow divider provides the required GPM to the control valve and returns excess GPM to the reservoir (Fig. 5).

REPAIR



1—Plug
2—O-Ring (2 used)
3—Disk (2 used)
4—Spring
5—Spool
6—Housing
7—Plug

Fig. 6-Flow Divider

Remove flow divider from unit and disassemble.

Thoroughly clean and dry all parts.

Inspect the spool and the housing for wear and scoring. Replace the spool and housing as a matched set.

Replace worn or damaged parts. Make sure the hole in the orifice disk is open.

Assemble flow divider and secure to unit. Connect hoses and fittings as previously removed.

DROTT BUCKET CLAM RELIEF VALVE

GENERAL INFORMATION

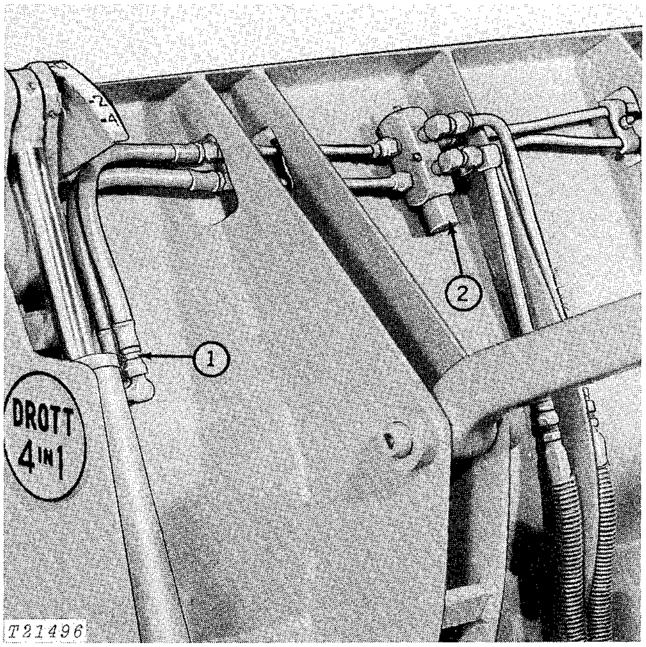
A single-acting circuit relief valve, located at the top rear of the bucket, provides pressure relief when the attachment control lever is in neutral. The relief valve allows a fully or partially opened clam to close, preventing damage to the clam when tractor forces the clam against an obstacle.

REPAIR

Whenever clam cylinder operation is abnormal (bucket does not remain open in dozer or scraper operation), the bucket relief valve may be incorrectly adjusted or in need of servicing. The valve is adjusted by adding or subtracting shims under the relief valve cap.

Tee a 0-3000 psi pressure gauge into the clam bucket opening pressure line at cylinder (Fig. 7). Open bucket approximately 8 inches. With clam bucket control lever in neutral, push clam section of bucket against a solid object. DO NOT RAM BUCKET.

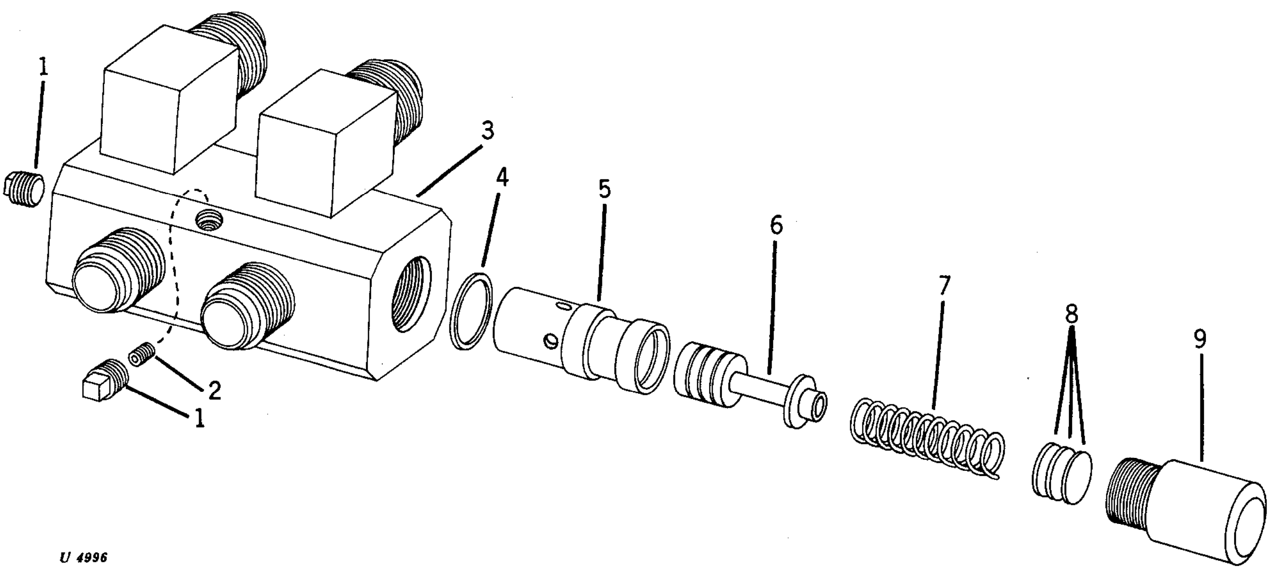
Observe when bucket starts to close. Pressure gauge reading at this time is the relief valve setting. By adding or subtracting shims under relief valve cap, adjust relief valve setting if necessary.



1. Tee in Pressure Gauge **2. Relief Valve Cap**

Fig. 7-Drott Bucket Relief Valve

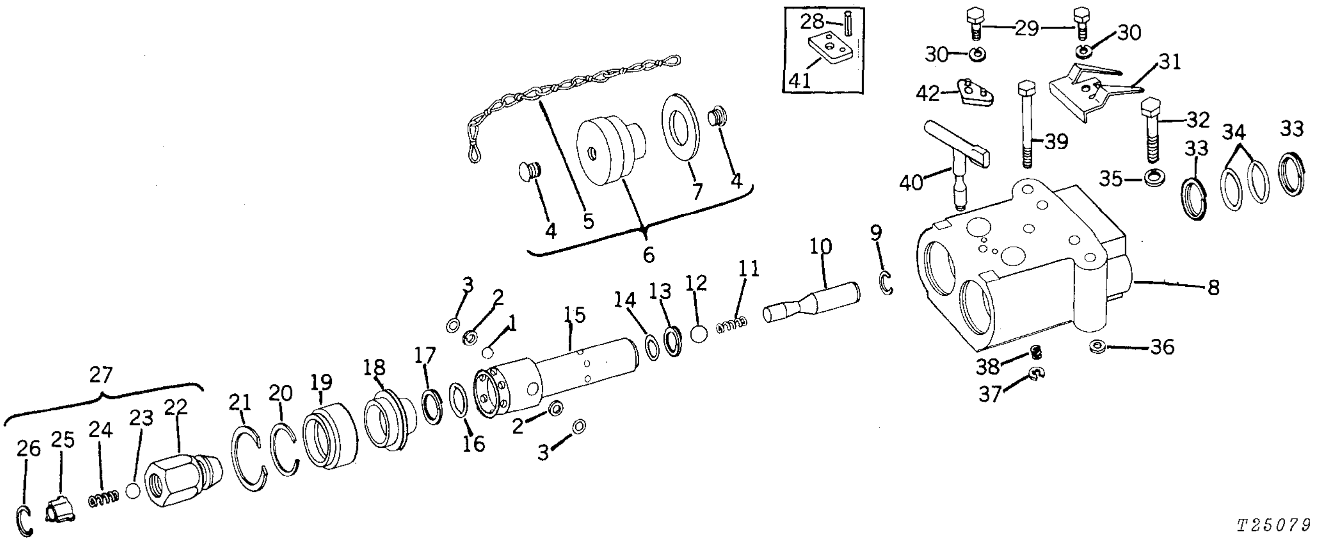
If relief pressure cannot be adjusted correctly or if bucket still malfunctions, remove the relief valve for servicing (Fig. 8).



1—Pipe **4—O-Ring** **7—Spring**
2—Plug **5—Seat** **8—Shims (as required)**
3—Body **6—Plunger** **9—Cap**

Fig. 8-Drott Bucket Clam Relief Valve

BREAKAWAY COUPLERS



1—Ball (12 used)	12—Ball (2 used)	23—Ball (2 used)	33—Back-up Ring (4 used)
2—O-ring (4 used)	13—Back-up Ring (2 used)	24—Spring (2 used)	34—O-Ring (4 used)
3—Back-up Ring (4 used)	14—O-ring (2 used)	25—Guide (2 used)	35—Lock Washer (8 used)
4—Drive Screw (4 used)	15—Receptacle (2 used)	26—Snap Ring (2 used)	36—Gasket (2 used)
5—Chain (2 used)	16—O-ring (2 used)	27—Plug (2 used)	37—Retaining Ring (2 used)
6—Dust Plug (2 used)	17—Back-Up Ring (2 used)	28—Spring Pin (2 used) (early units)	38—Spring (2 used)
7—Gasket (2 used)	18—Dust Cover (2 used)	29—Cap Screw (2 used)	39—Cap Screw
8—Body	19—Sleeve (2 used)	30—Lock Washer (2 used)	40—Lever
9—Snap Ring (2 used)	20—Snap Ring (2 used)	31—Spring	41—Cam (early units)
10—Plug (2 used)	21—Snap Ring (2 used)	32—Cap Screw (2 used)	42—Cam (later units)
11—Spring (2 used)	22—Plug (2 used)		

Fig. 9-Breakaway Coupler

Refer to machine operator's manual for use of breakaway couplers and to "Quick Disconnect Couplers" in FOS Manual—HYDRAULICS for theory of operation.

See "Specifications" for the pounds pull required to remove hoses from receptacle. Increasing the angle of pull from the receptacle causes the breaking force to increase proportionately. Avoid any angle of pull as hose failure may result.

DIAGNOSING MALFUNCTIONS

Cylinder Will Not Extend

Breakaway coupler valve closed.

Turn breakaway coupler operating handles 90 degrees.

Cylinders Will Not Retract

Breakaway coupler valve closed.

Turn breakaway coupler operating handles 90 degrees.

REPAIR

Refer to Fig. 9 and disassemble couplers.

Remove retaining rings (37) and springs (38) from operating levers and remove levers from receptacles and coupler body.

Remove receptacle assembly from coupler body. Remove steel balls (1) and snap ring (20) from receptacle.

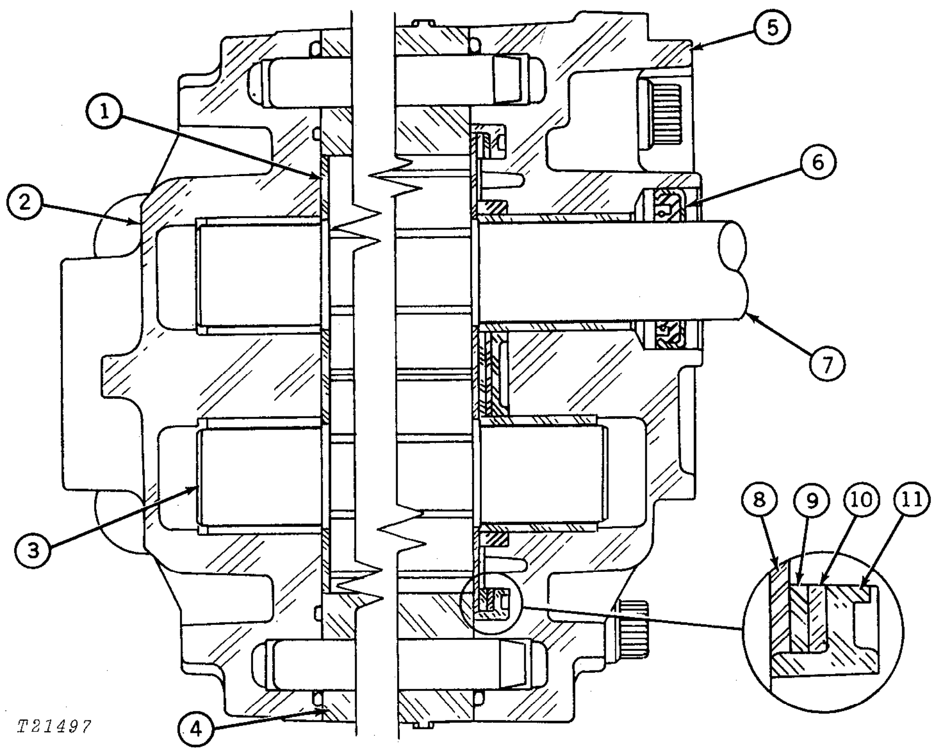
Invert and install receptacle in coupler body and place coupler body in vise. Press down on receptacle plug (10) and remove snap ring (9). Use a brass drift to drive receptacle plug, spring (11), and ball (12) from receptacle.

Inspect all parts of the assembly for wear or damage.

SPECIFICATIONS

Item	New Part
Reservoir Pressure Cap Setting	12 to 15 psi
Vacuum Valve Setting in Pressure Cap	6 psi
Return Line Filter Indicator Piston Spring	
Free Length	2-7/8-in.
Test Strength	23.5 lbs. at 1-1/2 in.
Wire Mesh Latch Spring	
Free Length	2-1/8-in.
Test Strength	16.2 lbs. at 1-1/2 in.
Selector Valve System Relief Pressure	2000 psi
Flow Divider Spool Spring	
Free Length	1-21/32"
Test Strength	15.9 lbs. at 1 in.
Drott Bucket Clam Relief Valve Pressure	2500 psi
Breakaway Couplers	
Force to uncouple coupler	30 pounds at 0 psi 150 pounds at 2000 psi
Maximum breakaway angle	30 degrees
Pressure drop through coupler	22 psi at 6 gpm (150°F)

Group 15
HYDRAULIC PUMP



1—Thrust Plate
2—Back Plate
3—Idler Gear Assembly
4—Pump Body
5—Front Plate
6—Shaft Seal
7—Drive Gear Assembly
8—Diaphragm
9—Back-Up Gasket
10—Protective Gasket
11—Diaphragm

Fig. 1-Hydraulic Pump (23 gpm Pump Illustrated)

GENERAL INFORMATION

The hydraulic pump is a positive-displacement, gear-type pump mounted at the front of the engine block.

The pump may be manually connected or disconnected whether the engine is running or stopped.

When connected, the pump is driven by the crankshaft and operates whenever the engine is running.

FOS Refer to "Gear-Type Pumps" in FOS Manual-HYDRAULICS for additional description and theory of operation.

DIAGNOSING MALFUNCTIONS

No Pump Output Or Low Flow

Pump worn or damaged.
Test pump against specifications.

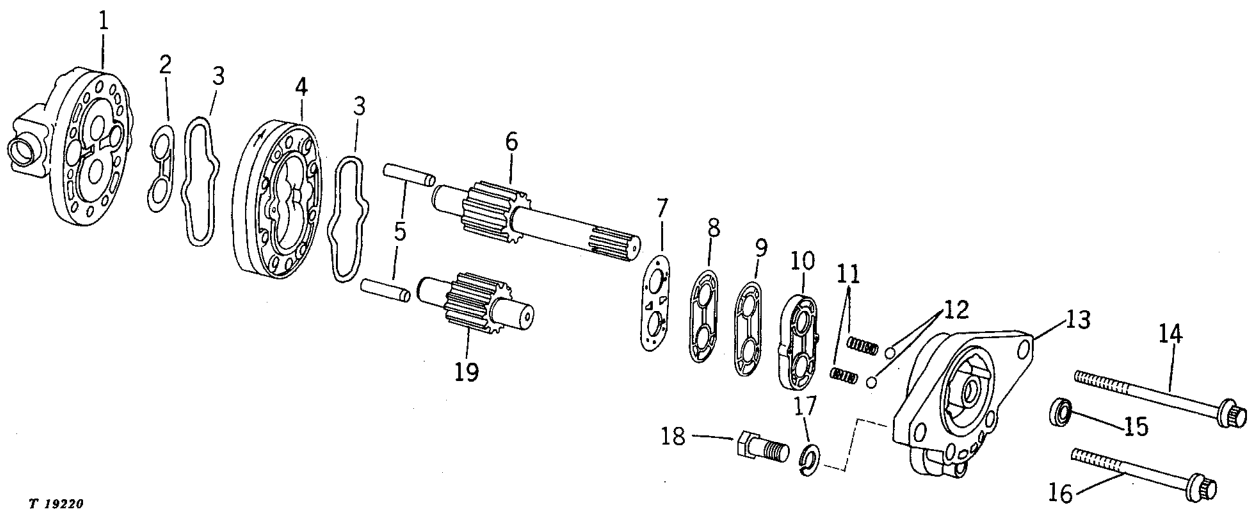
Shaft Seal Leaking

Worn shaft seal.
Replace shaft seal.
Broken diaphragm "vee" seal or backup gasket.
Repair pump.
Excessive internal leakage.
Repair pump.

Noisy Pump

Pump worn or damaged.
Test pump against specfications.
Low oil supply or oil of wrong viscosity
Fill reservoir with proper oil.
Suction line plugged or pinched
Clean or replace line.

REPAIR



1—Back Plate
2—Thrust Plate
3—O-ring (2 used)
4—Pump Body
5—Dowel (2 used)
6—Drive Gear
7—Diaphragm
8—Backup Gasket
9—Protector Gasket
10—Diaphragm Seal
11—Spring (2 used)
12—Ball (2 used)
13—Front Plate
14—Cap Screw (4 used)
15—Shaft Seal
16—Cap Screw (4 used)
17—Lock Washer (2 used)
18—Cap Screw (2 used)
19—Idler Gear

Fig. 2-Hydraulic Pump (23 gpm Pump Illustrated)

Disconnect pump lines and remove pump from unit.

Scribe a mark across pump front plate, body, and back plate for proper reassembly.

Disassemble pump using Fig. 2 as a guide

(1) Check pump gear and shaft dimensions against specifications.

(2) Measure inside diameter of shaft bushings (see "Specifications"). Oil grooves in bushings should be in line with dowel pin holes in plates, and at the outer sides of their respective bores. Bushings in front plate should be flush with islands in groove pattern. Bushings are not available as separate service parts.

(3) Using a straightedge and feeler gauge, measure wear against specifications on gear areas of back plate surface.

(4) Measure inside gear pockets of pump body (see "Specifications").

Assemble pump as follows using Fig. 2 as a guide.

(1) Position diaphragm on gasket with bronze face of diaphragm up. Entire diaphragm must fit inside the raised rim of the rubber seal.

(2) Assemble pump with O-rings between pump bodies. Be sure O-rings are fitted into grooves in pump sections before assembly.

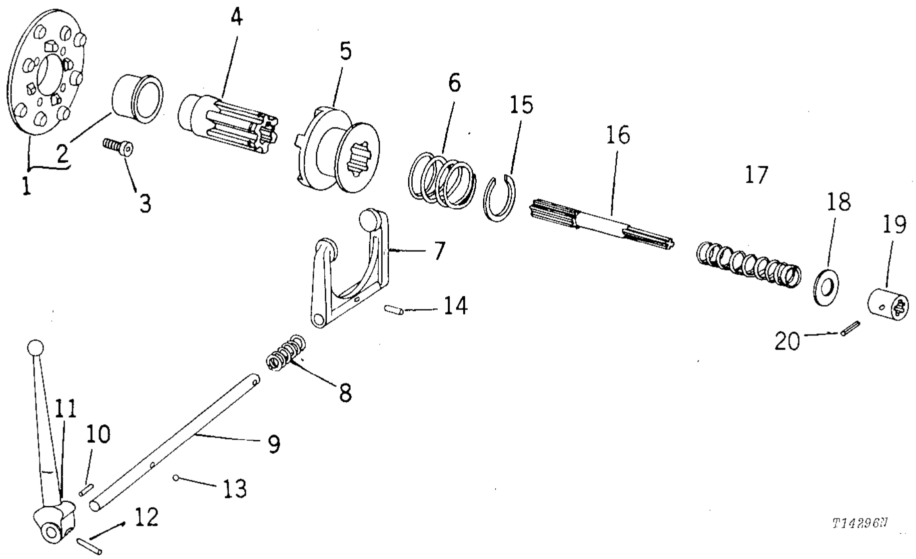
(3) Assemble pump making sure that scribe marks made during disassembly match on plates and body.

(4) Tighten cap screws to specified torque.

(5) Coat new drive shaft with Lubriplate and install seal to specifications.

(6) Rotate the drive shaft. A smooth heavy drag indicates proper assembly. A jerky drag or frozen shaft indicates an improperly assembled pump.

PUMP DISCONNECT



1—Adapter	**6—Spring**	**11—Lever**	**16—Drive Shaft**
2—Bushing	**7—Fork**	**12—Groove Pin**	**17—Spring**
3—Cap Screw (4 used)	**8—Spring**	**13—Ball**	**18—Washer (Dozer only)**
4—Pump Drive	**9—Disconnect Shaft**	**14—Groove Pin**	**19—Coupler**
5—Coupling	**10—Spring Pin**	**15—Snap Ring**	**20—Spring Pin**

Fig. 3-Pump Disconnect

To service the hydraulic pump disconnect, remove the grille housing, radiator, hydraulic pump and mounting bracket from the machine.

Disassemble and inspect all parts for wear or damage using Fig. 3 as a guide.

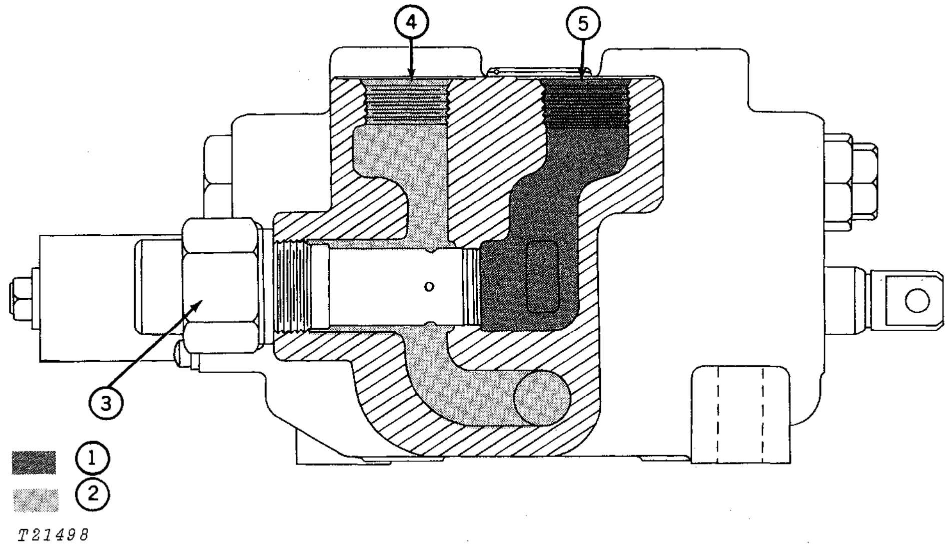
Assemble pump disconnect using Fig. 3 as a guide.

SPECIFICATIONS

Item	Wear Tolerance
15 GPM PUMP	
O.D. of pump idler and drive shafts at bearing area	0.6850 in. (min.)
Pump gear widths	1.1070 in. (min.)
I.D. of bearings	0.6910 in. (max.)
I.D. of gear pockets	1.7190 in. (max.)
Back plate gear surface	Flat within 0.0015 in.
Pump assembly cap screws (torque)	27 to 30 ft-lbs
Relationship of oil seal to front plate surface	Flush
Check springs - free length	5/8 in.
test strength	.28 lbs. at 7/16 in.
23 GPM PUMP	
O.D. of pump idler and drive shafts at bearing area	0.8730 in. (min.)
Pump gear widths	1.1660 in. (min.)
I.D. of bearings	0.8790 in. (max.)
I.D. of gear pockets	2.1070 in. (max.)
Back plate gear surface	Flat within 0.0015 in.
Pump assembly cap screws (torque)	40 ft-lbs
Relationship of oil seal to front plate surface	0.1560 in. (below)
Check springs - free length	7/8 in.
test strength	.41 lbs at 9/16 in.
28 GPM PUMP	
O.D. of pump idler and drive shaft at bearing area	0.8730 in. (min.)
Pump gear widths	1.4100 in. (min.)
I.D. of bearings	0.8790 in. (max.)
I.D. of gear pockets	2.1070 in. (max.)
Back plate gear surface	Flat within 0.0015 in.
Pump assembly cap screw (torque)	40 ft-lbs
Relationship of oil seal to front plate surface	0.1562 in. (below)
Check springs - free length	7/8 in.
test strength	.41 lbs at 9/16 in.
PUMP DISCONNECT (Fig. 3)	
Drive shaft spring (17) free length	4 in.
test strength	8.6 lbs at 3-3/8 in.
Coupling spring (6) free length	1-13/16 in.
test strength	6 lbs at 3/4 in.
Disconnect shaft spring (8) free length	1-15/16 in.
test strength	15-19 lbs at 1-3/8 in.
Disconnect adapter to crankshaft pulley cap screws (torque)	33 ft-lbs

Group 20
LOADER CONTROL VALVE

GENERAL INFORMATION



1—Pressure Oil
2—Return Oil
3—System Relief
4—Outlet
5—Inlet

Fig. 1-Pressure and Return Ports in Boom Section

Valve Construction

The loader control valve is an open-center, three-spool, stack-type valve. The boom, bucket and auxiliary sections are separate bodies with the valve pressure and return ports located in the boom section. A power beyond port is located in the auxiliary section.

All three valve sections have lift checks, which serve as one-way valves to keep oil on the applied side of the cylinders from flowing back through the valve.

The boom valve spool uses a detent in the spool end cap to retain the spool in the float position. Both the boom and bucket sections have circuit relief valves and anticavitation checks to protect their particular circuits.

The bucket section may be equipped with a electrical return-to-dig option.

The auxiliary valve section is served by the system relief valve; no circuit relief valves are used in the section.

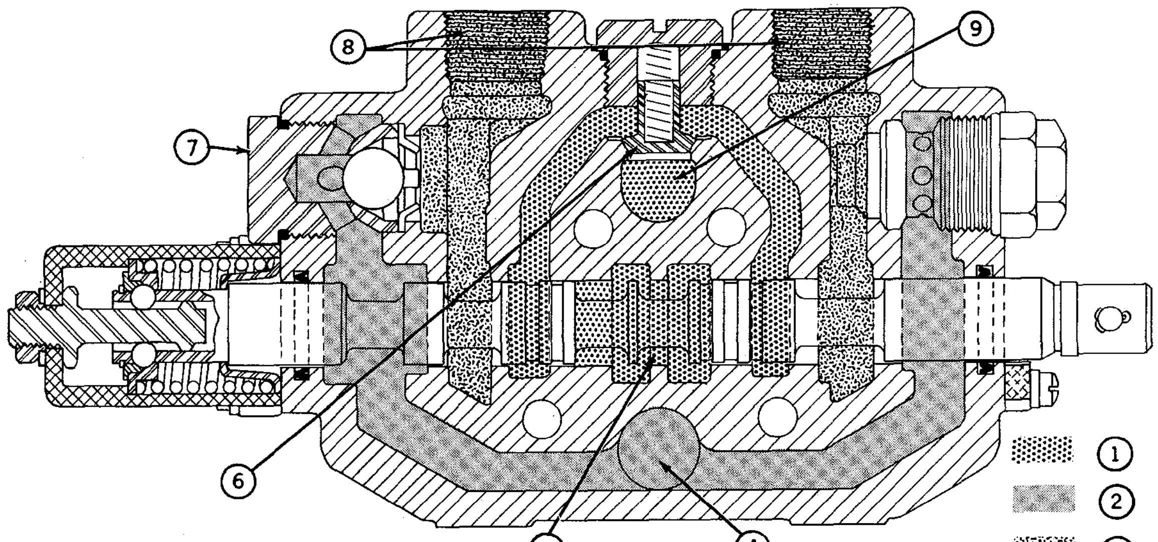
Control Valve Flows

For a thorough understanding of control valve operation, review the following oil flow illustrations.

When the control valve is in neutral position, the oil flow is the same through the boom, bucket and auxiliary sections.

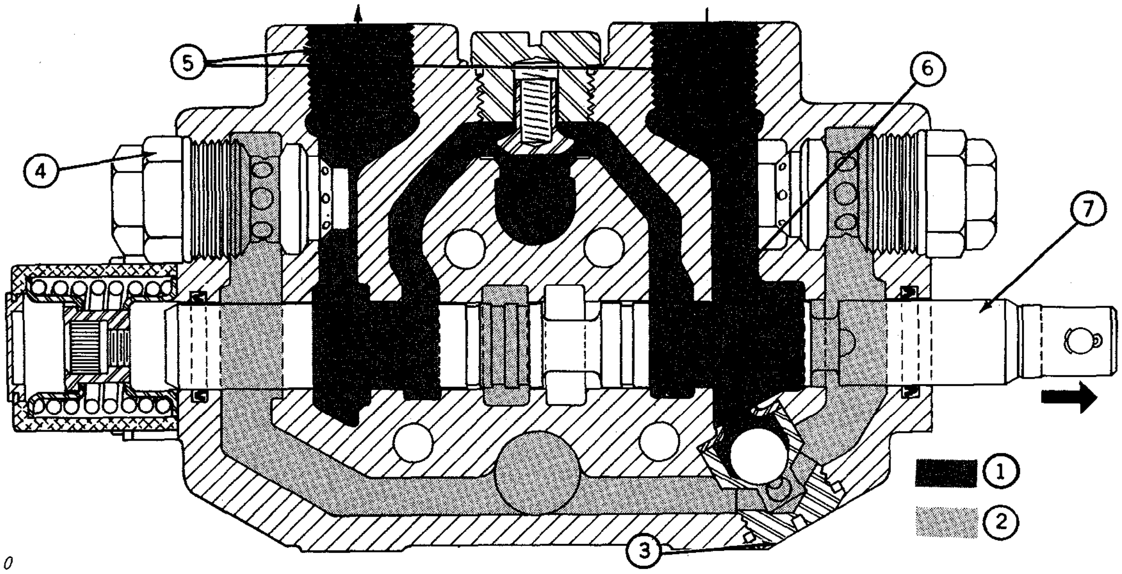
A relief valve is incorporated on the boom-raise side of the valve. An anti-cavitation check is used on the boom-lower side of the valve. Oil from the pump enters the inlet port, and divides into two columns. One column becomes functional inlet oil and the other inlet oil. Oil in the functional inlet travels through the valve stacks and is blocked at the end plate.

With the valve spools in neutral, inlet oil is free to pass to the end plate. At the end plate, oil is channeled back through the valve sections and out the return port to the reservoir. Oil in the cylinders and lines is trapped between spools in the central valve section.



1—Oil Under Slight Pressure
2—Return Oil
3—Trapped Oil
4—Outlet
5—Inlet
6—Check Poppet
7—Anti-Cavitation Check
8—To Boom Cylinders
9—Functional Inlet

Fig. 2-Boom Section in Neutral Position

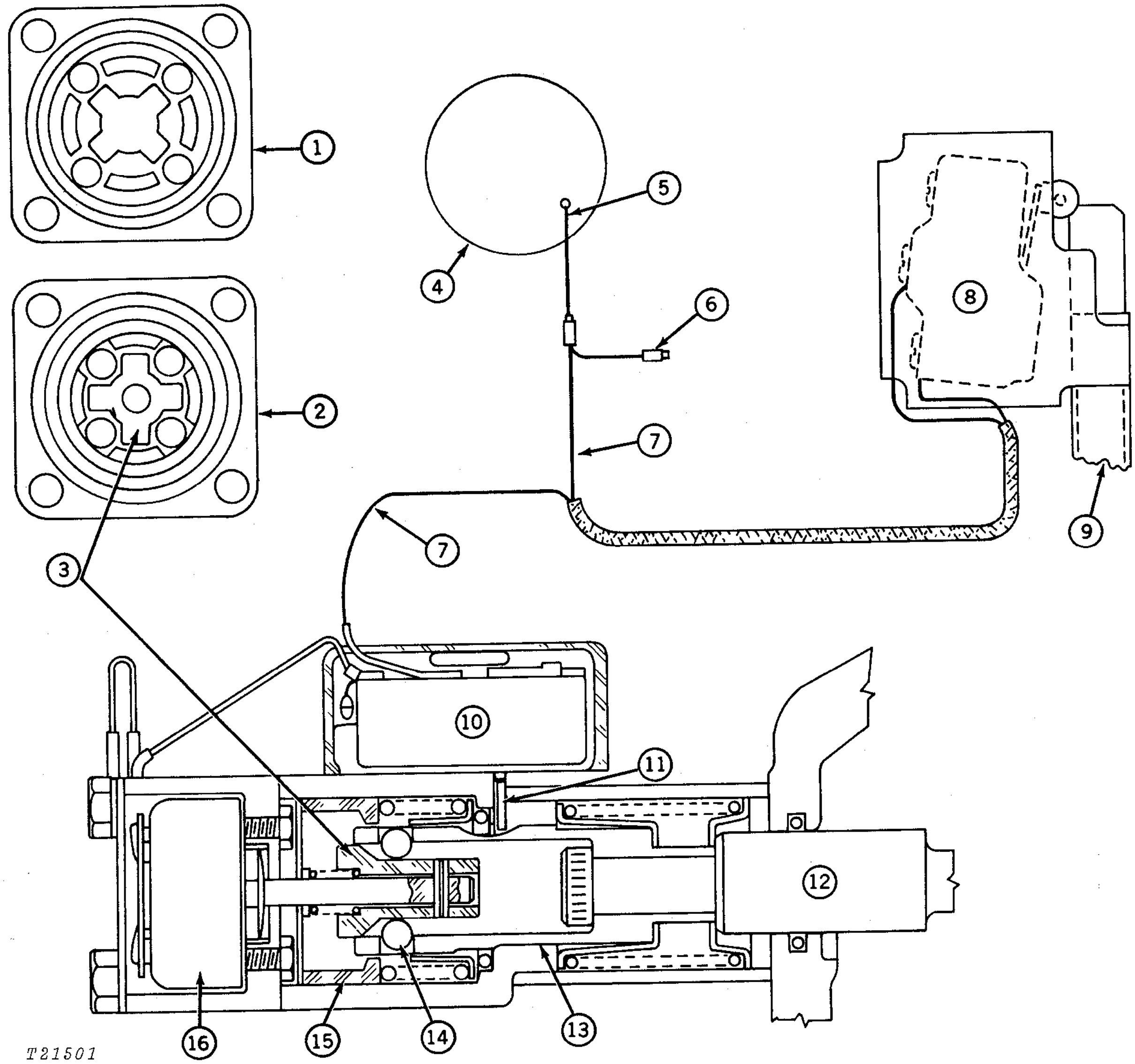


1—Pressure Oil
2—Return Oil
3—Anti-Cavitation Check
4—Circuit Relief
5—To Bucket Cylinders
6—Regenerative Channel

Fig. 3-Bucket Section in Fast Dump Position (Regenerative Cycle)

Inlet oil travels past the boom spool (which is in neutral), but is blocked by the bucket spool which is in a power position. Functional inlet oil is blocked at the end plate and must flow past the bucket spool to the bucket cylinders.

With the bucket spool in full dump position, the regenerative channel is opened to the cylinder port under power. As the cylinder rods begin to move, oil displaced from the cylinders is now directed to the other end of the cylinder instead of the reservoir as in a normal dump position. This "closed" circuit between the two ends of cylinders creates an increased volume of oil going to the cylinders and a fast bucket dump.



1—Detent Position
2—Release Position (Solenoid Energized)
3—Detent Ramp
4—Key Switch
5—Acc. Terminal
6—To Light Switch
7—White Lead
8—Bucket Switch
9—Indicator Rod
10—Spool Switch
11—Activator Pin
12—Bucket Spool
13—Ball Guide
14—Detent Balls
15—Detent Seat
16—Solenoid

Fig. 4-Electrical Return-To-Dig Mechanism

Refer to "Electrical System", Section 40 to service the electrical components of the return-to-dig mechanism.

When the bucket spool is moved rearward, the ball guide that carries the balls up the detent ramp is also forced rearward allowing the balls to roll between the detent ramp and the detent seat lip. After the balls have passed the detent seat lip, the detent ramp moves forward locking the balls behind the detent seat.

During the rearward movement of the ball guide, the activator pin moves up and closes the spool switch (detent position). The bucket switch is normally open until closed by the indicator rod.

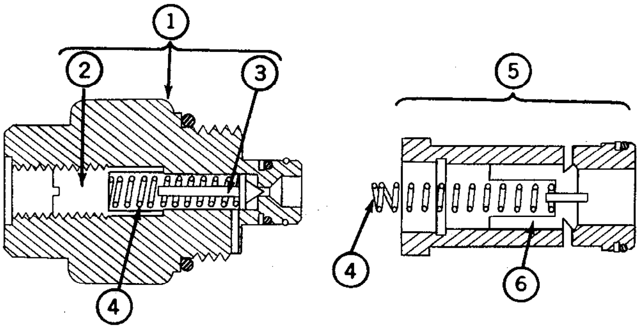
As the bucket rolls back, the indicator rod hits the bucket switch. This closes the circuit and energizes the solenoid which turns the ball ramp releasing the detent balls. The spool centering spring now returns the spool to the neutral position stopping the bucket at return-to-dig position. With the ball guide in the neutral position, the activator pin moves down and opens the spool switch de-energizing the solenoid.

The spool may be mechanically released from the detent position by manually moving the spool lever forward. As the ball guide moves forward the detent seat is forced forward against spring tension allowing the balls to roll down the detent ramp to a released position.

RELIEF VALVES

System Relief Valves

General Information



T21502

1—Upper Section
2—Screw Plug
3—Pilot Poppet
4—Spring
5—Lower Section
6—Poppet

Fig. 5-System Relief Valve

A non-adjustable, pilot-operated relief valve within the control valve provides system relief. The valve consists of an upper and lower section. The upper section contains the pilot poppet and the lower section houses the main relief poppet. The system relief valve operates on the differential oil pressure principle.

Refer to "Hydraulic Valves" in FOS Manual - HYDRAULICS for basic information on the operation of pilot-operated relief valves.

Repair

To test the system relief valve, refer to Group 5 of this section.

System relief valves are not field adjustable and any attempt to adjust the valves will damage them.

Individual service parts are available for valve repair.

If a drop-off in pressure occurs, replace the valve lower section.

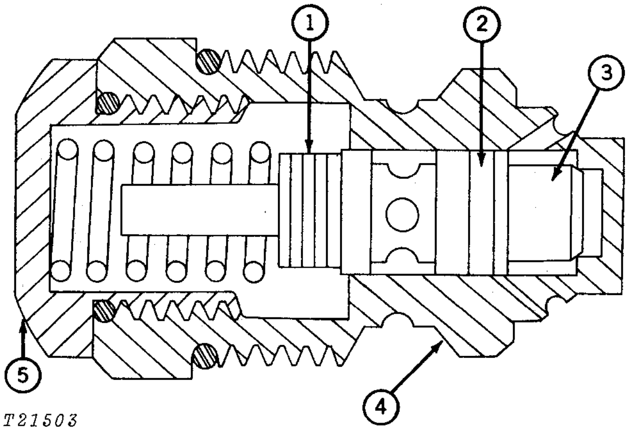
If the sytem pressure is low, replace the valve upper section.

If there is no pressure, replace the complete relief valve.

When installing the system relief valve, tighten to specifications.

Circuit Relief Valves

General Information



T21503

1—Shims
2—Seal
3—Poppet
4—Body
5—Cap

Fig. 6-Circuit Relief Valve

The relief valves used in the boom and bucket valve sections are of the direct poppet type. Pressure oil enters through the radial holes in the valve body. As oil pressure on the face of the poppet overcomes spring tension, the poppet is opened allowing oil to flow to the reservoir.

Refer to "Hydraulic Valves" in FOS Manual - HYDRAULICS for basic information on the operation of pilot operated relief valves.

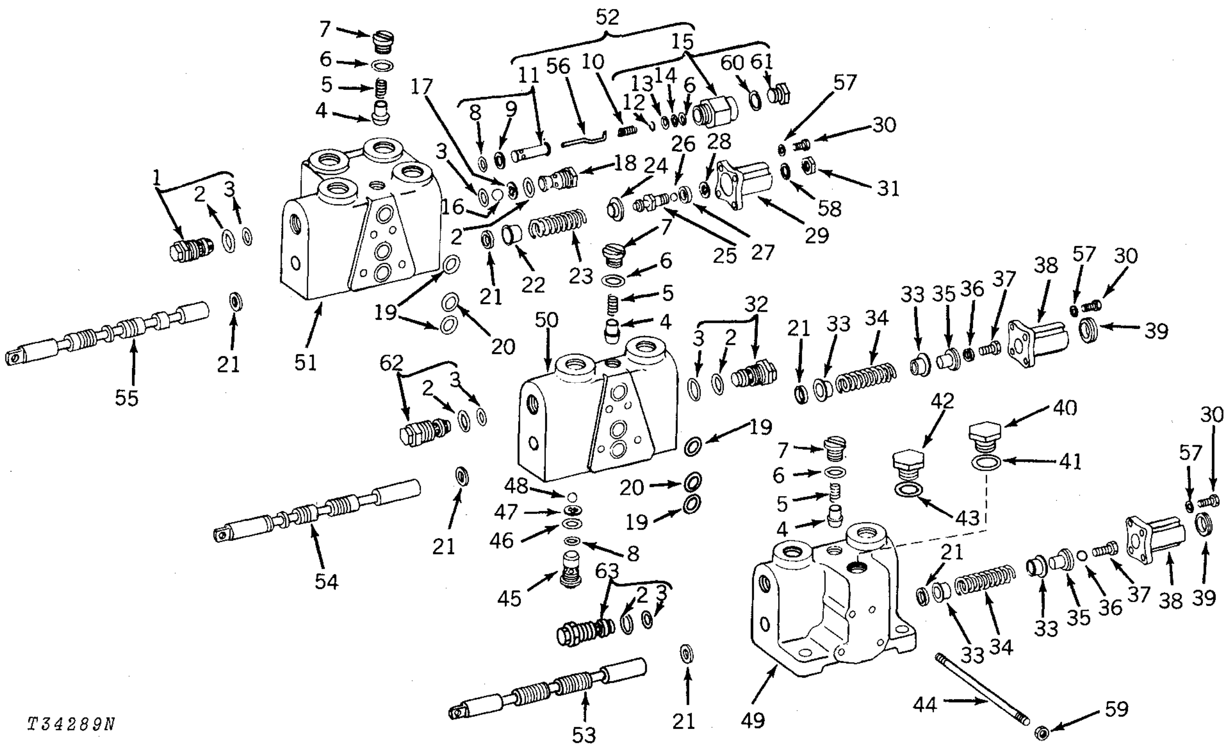
Repair

To test the circuit relief valves, refer to Group 5 of this Section.

The circuit relief valve cartridges are factory set and should not be adjusted. The relief pressure on each circuit relief valve is stamped on the head end of the cartridge.

When replacing circuit relief valves, install new O-rings and tighten the cartridge to specifications.

REPAIR



1—Relief Valve
2—O-Ring
3—O-Ring
4—Check Poppet
5—Spring
6—O-Ring
7—Plug
8—O-Ring
9—Backup Washer
10—Spring
11—Lower System Relief
12—Section Ring
13—Seal
14—Backup Washer
15—Upper System Relief
16—Check Ball
17—Retainer
18—Anti-Cavitation Check
19—Seal
20—Seal
21—Vee Seal
22—Stop Collar
23—Spring
24—Detent Collar
25—Detent Adapter
26—Detent Ball
27—Retaining Ring
28—Ball Retainer
29—Bonnet
30—Machine Screw
31—Jam Nut
32—Relief Valve
33—Stop Collar
34—Spring
35—Spool Collar
36—Detent Ball
37—Cap Screw
38—Bonnet
39—Diaphragm
40—Plug
41—O-Ring
42—Plug
43—O-Ring
44—Stud
45—Anti-Cavitation Check
46—O-Ring
47—Ball Retainer
48—Ball
49—Auxiliary Section
50—Bucket Section
51—Boom Section
52—System Relief Valve
53—Auxiliary Spool
54—Bucket Spool
55—Boom Spool
56—Relief Pin
57—Lock Washer
58—Lock Washer
59—Lock Nut
60—O-Ring (later units)
61—Plug (later units)
62—Relief Valve
63—Relief Valve (used with multi-purpose bucket)

Fig. 7-Exploded View of Control Valve

For tests and diagnosis of the loader control valve, refer to Group 5 of this Section.

Refer to Fig. 7 when servicing the control valve for proper parts identification.

Operate control valve lever until all hydraulic pressure is relieved.

Release pressure in reservoir by slowly removing filler cap at top of tank.

Service individual valves separately. Be sure valve bodies and their spools are kept together because these parts are matched.

Remove tie bolts and separate valve sections.

Remove valve bonnets and remove spools from valve housing. Before removing boom spool, be sure spool is in float position.

Clean and dry all parts thoroughly and inspect for wear or damage as follows:

1. Inspect valve housings for cracks or damaged threads. If a housing is damaged, replace the housing and valve spool as a matched assembly.

Use new O-rings when assembling valve housings.

2. Remove burrs from spool assembly parts using fine emery cloth. If a spool is worn or damaged, replace the spool and valve housing as a matched assembly.

If a spool spring is worn or broken, replace it. Use new O-rings and backup washers when reassembling the spools.

3. Inspect the lift check cage, spring, and poppet, and replace damaged or worn parts.

Use new O-rings and backup washers when reassembling the lift check cage.

4. Inspect anti-cavitation valve and replace if worn or damaged.

Use new O-ring and aluminum check ball when reassembling the anti-cavitation check valve.

Control Valve Installation

Thoroughly clean and dry all parts. Oil all parts lightly prior to assembly.

Replace all O-rings and backup washers with new parts.

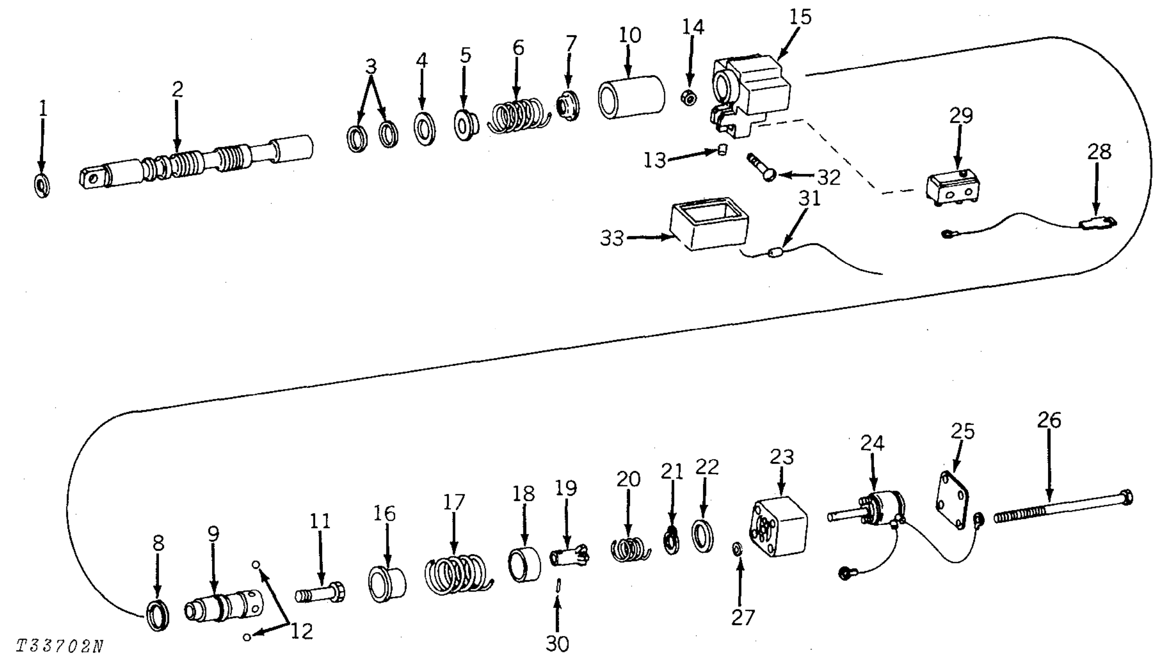
Use heavy grease to hold detent balls in place when assembling the boom control valve spool.

Install spools in proper valve section.

Stack valve sections in proper sequence and tighten tie bolts evenly to 20 ft-lbs.

Install control valve in loader and connect linkage and oil lines.

RETURN-TO-DIG MECHANISM



1—Lock Washer	**9—Ball Guide**	**17—Spring**	**25—Solenoid Cover**
2—Spool	**10—Body Sleeve**	**18—Detent Seat**	**26—Cap Screw (4 used)**
3—Vee-Type Seal (2 used)	**11—Shoulder Screw**	**19—Ball Ramp**	**27—Lock Washer (2 used)**
4—Pilot Ring	**12—Ball (4 used)**	**20—Spring**	**28—Lead Wire**
5—Spring Guide	**13—Needle Roller (2 used)**	**21—Retaining Ring**	**29—Switch**
6—Centering Spring	**14—Nut (2 used)**	**22—Shim**	**30—Groove Pin**
7—Spring Guide	**15—Detent Body**	**23—Solenoid Body**	**31—Semiconductor**
8—Snap Ring	**16—Spring Retainer**	**24—Rotary Solenoid**	**32—Machine Screw**
			33—Switch Enclosure

Fig. 8-Detent Assembly

Removal

The return-to-dig mechanism can be removed from the bucket section of the control valve without removing the control valve.

Completely loosen the cap screws (26, Fig. 8). Rotate the mechanism so the cap screw is on the top to clear the reservoir. Remove the cap screw. Do the same for the remaining cap screws.

Disconnect wiring and remove solenoid assembly. The four steel balls (12) will usually fall from their seat in the ball guide (9) so be careful not to loose them.

The detent body is held loosely in place by the snap ring (8) pushed on to the ball guide. Do not pull the detent body off the ball guide.

Disconnect the bucket control valve linkage at the spool to avoid bending the linkage when removing the remainder of the mechanism.

Use a 1/4 inch hex. wrench to remove the shoulder screw (11). It will be necessary to use a wrench at the front of the valve spool (2) to keep it from turning.

There is a needle roller (13) in the detent body underneath the switch (29). Be careful not to lose the roller.

Remove remainder of mechanism. The pilot ring (4) need not be removed. If it is removed reinstall with chamfered edge toward the solenoid.

Repair

Refer to "Electrical System", Section 40 to service the electrical components of the return-to-dig mechanism.

Clean and dry all parts thoroughly and inspect for wear or damage. Check springs for fatigue.

Refer to Fig. 8 during installation of the mechanism.

Be sure snap ring (8) is on the ball guide (9). Insert the ball guide through the back end of the detent body (15). Set the body sleeve (10) on the detent body. Insert the spring guide (7), spring (6), and spring guide (5) into the body sleeve. Fasten this portion of the mechanism to the valve spool (2) with the shoulder screw (11). Put T43512 JOHN DEERE LOCTITE THREAD LOCK AND SEALER MEDIUM STRENGTH or an equivalent on threads and tighten to 35 ft-lbs.

Grease the four balls (12) with heavy grease so they will remain in place when installed. It is helpful to insert the balls in the ball guide by turning the valve spool so the holes in the ball guide are on the bottom when inserting the balls.

When installing the remainder of the mechanism be sure the flat surface of the detent seat (18) rests against the spring (17). Be careful not to unseat the balls from the ball guide during installation. To get the retaining cap screws in place rotate the mechanism the same as for removal.

NOTE: When making the electrical connections be sure to connect the black end of the semi-conducter (31) to the terminal side of the switch (29).

The shim (22) fits in the bore of the detent body. Be sure it is properly installed or the assembly will not go together correctly. It is helpful to use grease to hold it in place against the detent seat a bit on the high side of dead center. Snug up the cap screws and push the shim down so it will fit in the detent cap when the cap screws are tightened.

Adjustment

The return-to-dig mechanism may be adjusted to return the bucket to a slight dig or slight roll-back position.

Adjusting the bucket indicator rod forward provides a bucket dig position.

Adjusting the bucket indicator rod rearward provides a bucket roll-back position.

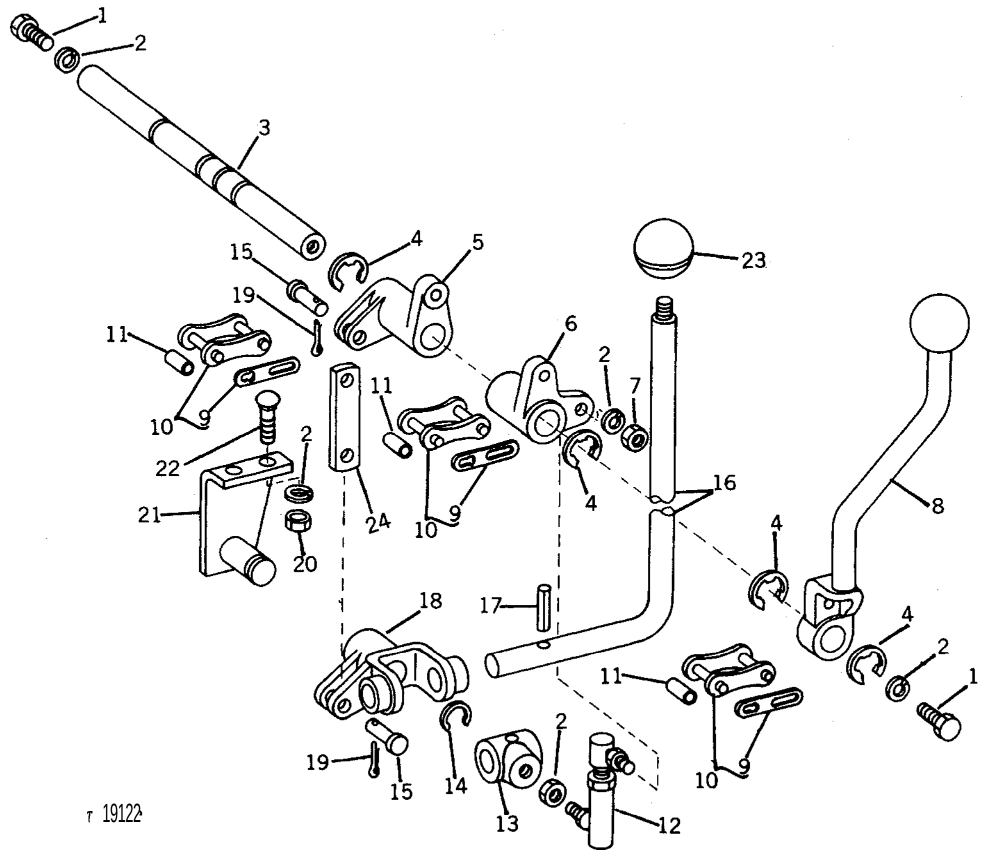
To adjust the boom switch, raise the boom slightly and dump the bucket to retract the indicator rod into the tube.

CAUTION: Shut engine off and support the bucket to prevent personal injury.

Loosen the two screws on top of the return-to-dig support and adjust roller on the boom switch lever so it is at least to the center of the tube when looking down the tube bore. Tighten the two screws.

To adjust the spool switch, loosen the two screws holding the switch. Position the switch so that the activator pin will depress the lever on the bottom of the spool switch when the control valve handle is in the bucket roll-back position.

CONTROL VALVE LINKAGE



1 -Cap Screw (2 used)
P-Lock Washer (6 used)
3-Shaft
4-Snap Ring (4 used)
5—Boom Bell Crank
B-Bucket Bell Crank
7-Nut
6-Auxiliary Lever
9—Spring Clip (3 used)
10—Link (3 used)
11 -Bushing (3 used)
12-Ball Joint
13—Lever
14—Snap Ring
15—Pin (2 used)
1 B-Lever
17-Spring Pin
1 I-Pivot
19—Cotter Pin (2 used)
20-Nut (2 used)
21 -Pivot
22-Bolt (2 used)
23-Lever Ball
24-Link

Fig. 9-Control Valve Linkage

Inspect control valve linkage for worn or damaged parts and replace as necessary.

Coat bearing surfaces of all bell cranks with grease before assembling to shaft.

SPECIFICATIONS

Item		New Part
Lift check spring	(free length)	1-5/16 in.
	(test strength)	1 lb. at 1-1/16 in.
System relief valve spring	(free length)	1-13/16 in.
	(test strength)	15 lbs. at 1-11/32 in.
Boom spool spring	(free length)	3-3/16 in.
	(test strength)	50 lbs. at 1-7/16 in.
Bucket and auxiliary spool spring	(free length)	2-11/16 in.
	(test strength)	52 lbs. at 1-3/8 in.
Return-to-dig mechanism (bucket section)		
Spool spring	(free length)	2-3/4 in.
	(test strength)	52 lbs. at 1-3/8 in.
Detent seat spring	(free length)	1-3/8 in.
	(test strength)	84 lbs. at 11/16 in.
Detent ramp spring	(free length)	9/16 in.
	(test strength)	35 lbs. at 3/8 in.

TORQUE VALUES

Item	Torque (ft-lbs)
System relief valve assembly	40
Circuit relief valve cartridges	20
Tie bolt lock nuts	20
Bucket or auxiliary spool screw	15
Spool bonnet screws	10
Anti-cavitation check valve bodies	30
Lift check plugs	60
Return-to-dig mechanism (bucket section)	
Spool screw	30
Solenoid screws	15

Group 25
DOZER CONTROL VALVES

GENERAL INFORMATION

Mechanical Bulldozer Valve

Mechanical bulldozers are equipped with a two-spool hydraulic control valve. The valve body is a one-piece casting. One of the two double-action valve spools controls bulldozer boom raising and lowering. The other spool is reserved for an auxiliary function. A float position is provided on the bulldozer control valve spool for use as required. Poppet type check valves and an adjustable system relief valve are incorporated into each control valve assembly.

All-Hydraulic Bulldozer Valve

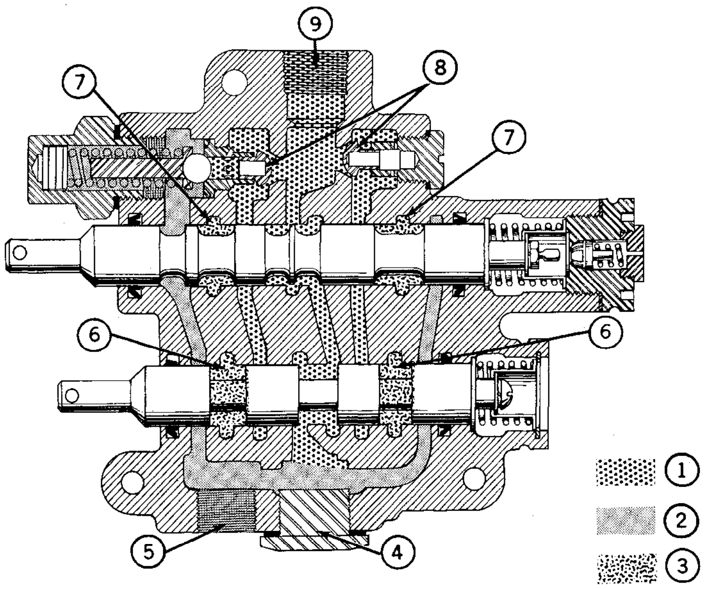
All-hydraulic bulldozers are equipped with a three-spool control valve. A single "T-Bar" control lever is used to actuate the three valve spools. Bulldozer raising, lowering, tilting and angling cycles are easily controlled by this type of linkage. Poppet type check valves and an adjustable relief valve are built into the valve assembly. The valve body is a sturdy one-piece casting.

Control Valve Power Beyond Sleeve

In cases when it is necessary to add an additional hydraulic function an auxiliary valve may be installed.

Hydraulic pressure oil for auxiliary valve is taken from the dozer valve by means of a power beyond sleeve. The power beyond sleeve closes off the neutral circuit to the bulldozer control valve return port. Return oil from both auxiliary and dozer control valves is returned directly to the reservoir.

CONTROL VALVE OIL FLOWS



1—Oil Under Slight Pressure
2—Return Oil
3—Trapped Oil
4—Plug
5—Outlet
6—Auxiliary Port
7—Boom Port
8—Poppet Check Valves
9—Inlet

Fig. 1-Control Valve in Neutral Position (2-spool valve shown)

Control Valve in Neutral Position

When the control valve spools are in neutral position (Fig. 1), oil from the pump enters the control valve and follows a direct channel past the spools and back to the reservoir. At the same time, oil unseats the two check poppet valves and moves down the control valve power channels. Since the valve spools are blocking the valve power ports, oil cannot reach the bulldozer cylinders. The oil in the valve power ports is trapped by the valve spools.

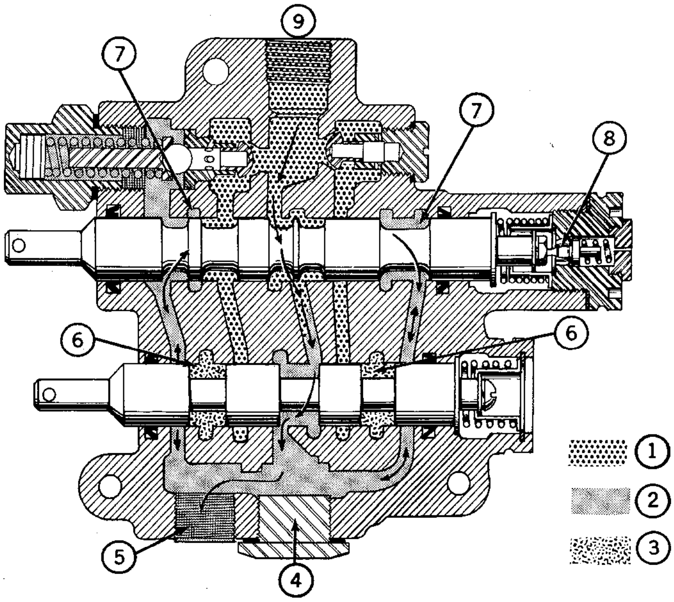


Fig. 2-Control Valve in Float Position (2-spool valve shown)

Control Valve in Float Position

Oil under slight pressure enters the control valve inlet port and travels through the neutral circuit past the spools and back to the reservoir. Oil also lifts the two check poppet valves and travels down the valve power channels but cannot reach the cylinder ports as the valve spools are blocking the channels.

With the spool in the detent position, both boom cylinder ports are interconnected and open to the reservoir allowing the cylinder pistons to move back and forth as the blade floats over the ground. Displaced oil is free to return to the reservoir. Oil in the auxiliary valve spool ports remains trapped.

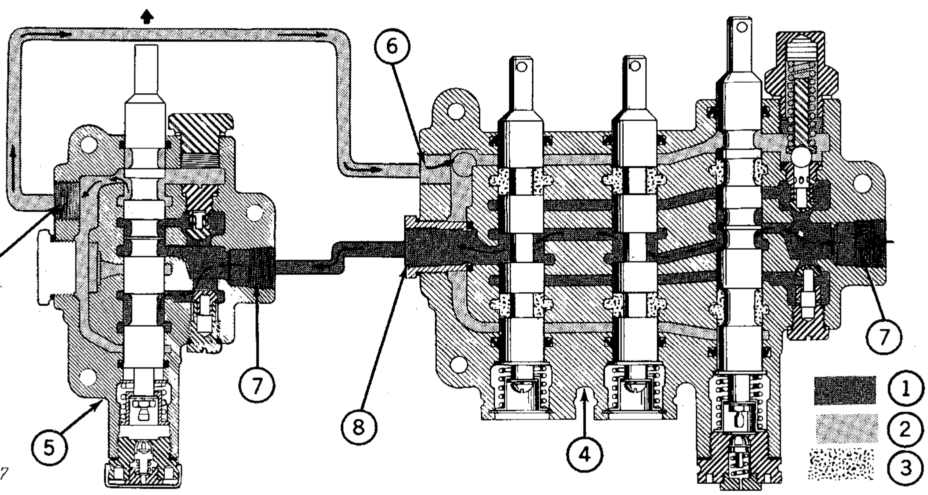


Fig. 3-Three-Spool Control Valve with Auxiliary Valve

Three-Spool Control Valve with Auxiliary Valve

Oil enters the bulldozer control valve inlet port, and with the valve spools in neutral, travels through the neutral circuit and out the power beyond port. The return oil channel is blocked by the power beyond sleeve and connected to reservoir through an additional reservoir oil line. With the auxiliary valve spool in a power position, oil enters the inlet port as pressure oil. Return oil from the auxiliary valve is returned directly to the reservoir. High oil pressure resulting from auxiliary valve functions is relieved by the bulldozer relief valve.

REPAIR

For diagnosis and test of the dozer control valve, refer to Group 5 of this section.

Operate control valve lever until all hydraulic pressure is relieved. Release pressure in reservoir by slowly removing filler cap.

If the unit is equipped with an auxiliary function, operate the auxiliary control valve lever until all hydraulic pressure is released.

If dozer control valve or auxiliary valve is to be removed for servicing and it is believed that fragments of failed parts may have entered the dozer hydraulic system, completely drain the system and replace or clean the hydraulic filters.

Service the valve body and spools as a matched set. Be sure to keep spools matched with their proper bore.

Disconnect hydraulic lines and remove the dozer control valve from unit. Remove auxiliary control valve if unit is equipped with an auxiliary function.

Disassemble control linkage from valve.

Valve Repair

Refer to Figs. 4 and 5 for sequence of disassembly and assembly of the dozer control valve and the auxiliary valve.

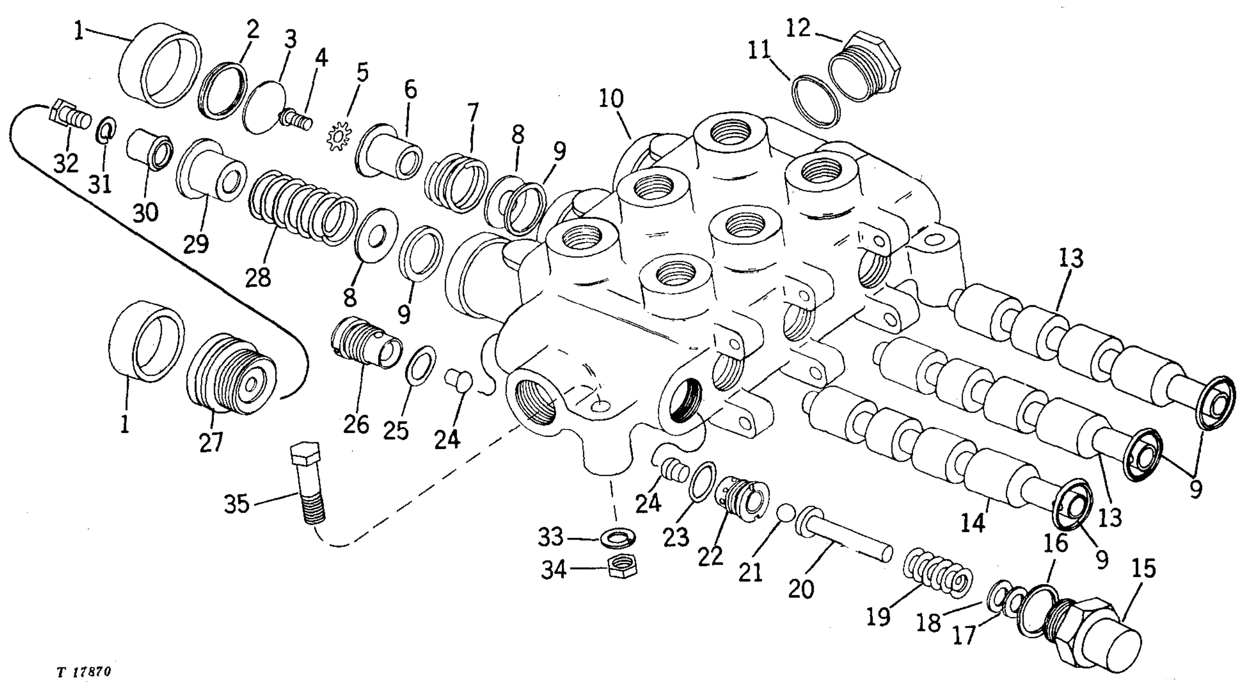
Remove snap rings and stop disks from control valve. Remove float detent cap. Tap all spools lightly and remove from control valve housing.

Clean and dry all parts thoroughly and inspect parts for wear or damage.

Valve Housing

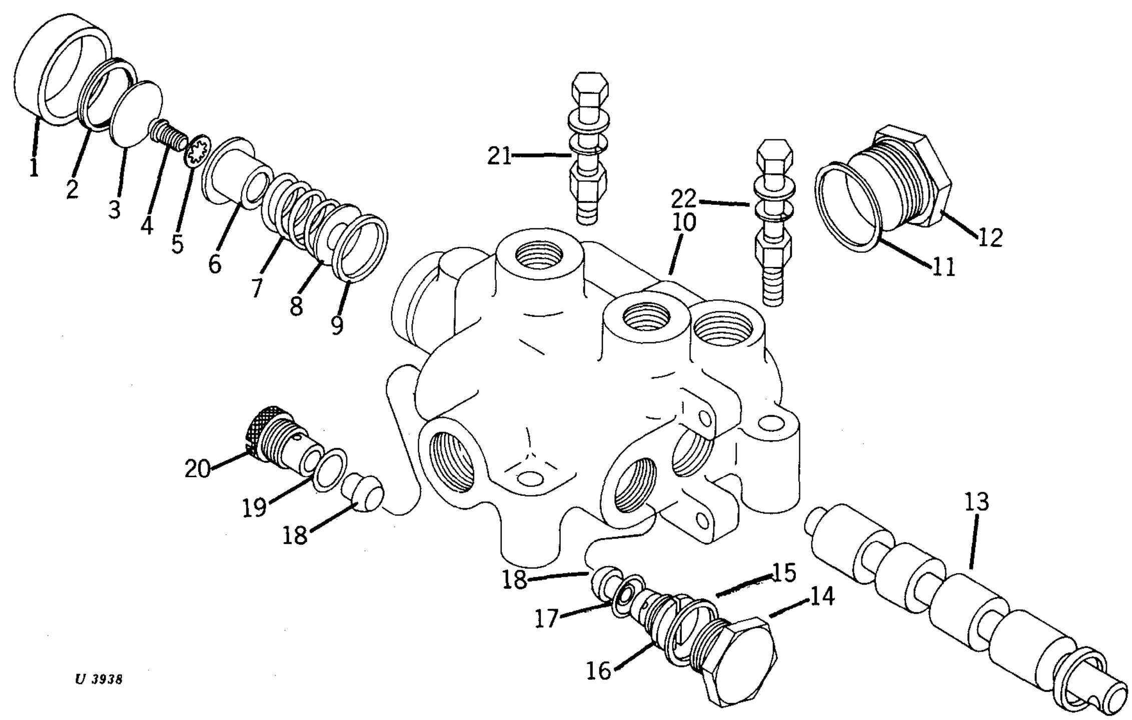
Check valve housings for cracks or damaged threads. If housings are damaged, replace the housings and valve spools as matched assemblies.

If valves show signs of external oil leakage, inspect spool seals in control valve housings for wear or damage. Replace spool seals any time valve is disassembled or leakage is observed.



1—Bonnet (3 used)
2—Snap Ring (2 used)
3—Stop Disk (2 used)
4—Machine Screw (2 used)
5—Lock Washer (2 used)
6—Stop Collar (2 used)
7—Spring
8—Washer (3 used)
9—Spool Seal (6 used)
10—Housing
11—Seal
12—Plug
13—Spool (2 used)
14—Float Spool
15—Relief Valve Body
16—Gasket
17—Shim
18—Spring Washer (3 used)
19—Spring
20—Spacer
21—Ball
22—Seat
23—O-Ring
24—Poppet Check (2 used)
25—O-Ring
26—Plug (2 used)
27—Detent Segment
28—Spring
29—Collar
30—Detent Plunger
31—Lock Washer
32—Cap Screw
33—Washer
34—Nut
35—Cap Screw

Fig. 4-Three-Spool Dozer Control Valve



1—Bonnet Cap	8—Stop Washer	15—Gasket
2—Snap Ring	9—Spool Seal (2 used)	16—Seat
3—Stop Disk	10—Valve Housing	17—O-Ring
4—Screw	11—Gasket	18—Check (2 used)
5—Lock Washer	12—Plug	19—O-Ring
6—Stop Collar	13—Spool	20—Check Plug
7—Spring	14—Plug	21—Cap Screw (2 used)
		22—Cap Screw

Fig. 5-Auxiliary Valve

Valve Spool Assemblies

Remove burrs from spool assembly parts using fine emery cloth. If spools are worn or damaged, replace spools and valve housing as a matched assembly.

Inspect spool springs for fatigue (see specifications).

Relief Valve Assembly

Check relief valve ball (21, Fig. 4) and seat (22) for wear or imperfections which could cause leakage. Test relief valve springs (see specifications).

Valve Check Poppets

If valve diagnosis indicated that control valve check poppets were leaking, examine each poppet check for wear or damage. Also check poppet seats integral with control valve housing for wear or presence of foreign matter.

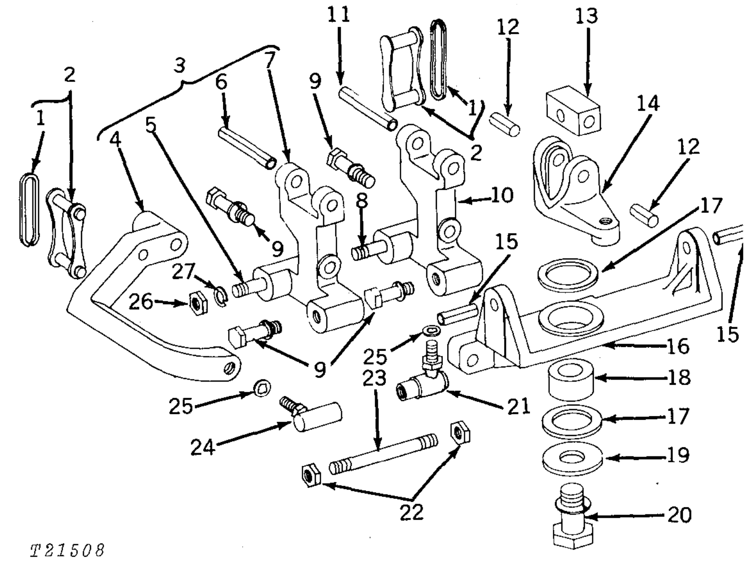
ASSEMBLY

Thoroughly clean and dry all parts. Oil all parts prior to assembly.

Install spools in proper valve bore.

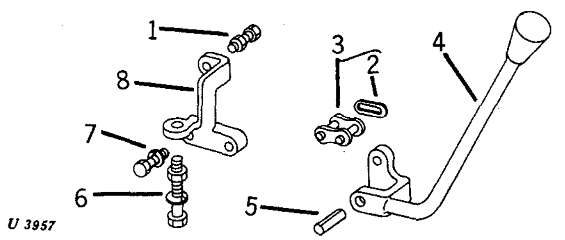
Valve Linkage

Inspect control valve linkage for worn or damaged parts.



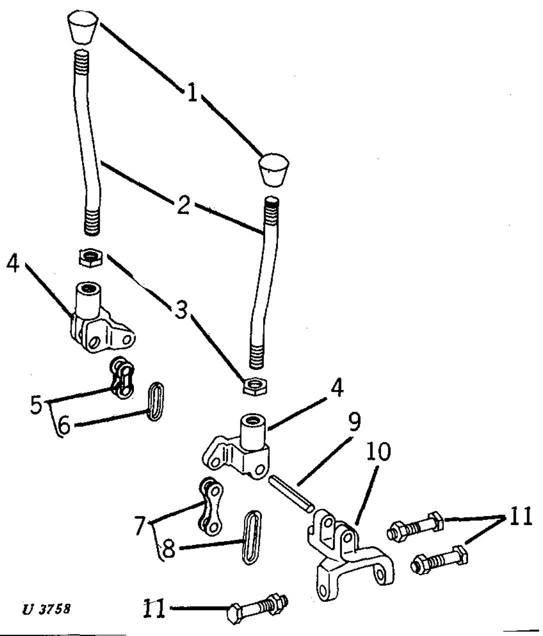
1—Spring Clip
2—Connector Link (2 used)
3—Lever Assembly
4—Rear Lever
5—Stud
6—Spring Pin
7—Attaching Standard
8—Stud
9—Cap Screw (4 used)
10—Attaching Standard
11—Spring Pin
12—Spring Pin (2 used)
13—Pivot Block
14—Rotary Pivot
15—Spring Pin (2 used)
16—Pivot Base
17—Washer (2 used)
18—Bushing
19—Washer
20—Cap Screw
21—Ball Joint
22—Jam Nut (2 used)
23—Push Rod
24—Ball Joint
25—Tooth Washer (2 used)
26—Nut (2 used)
27—Lock Washers (2 used)

Fig. 6-Three-Spool Valve Linkage



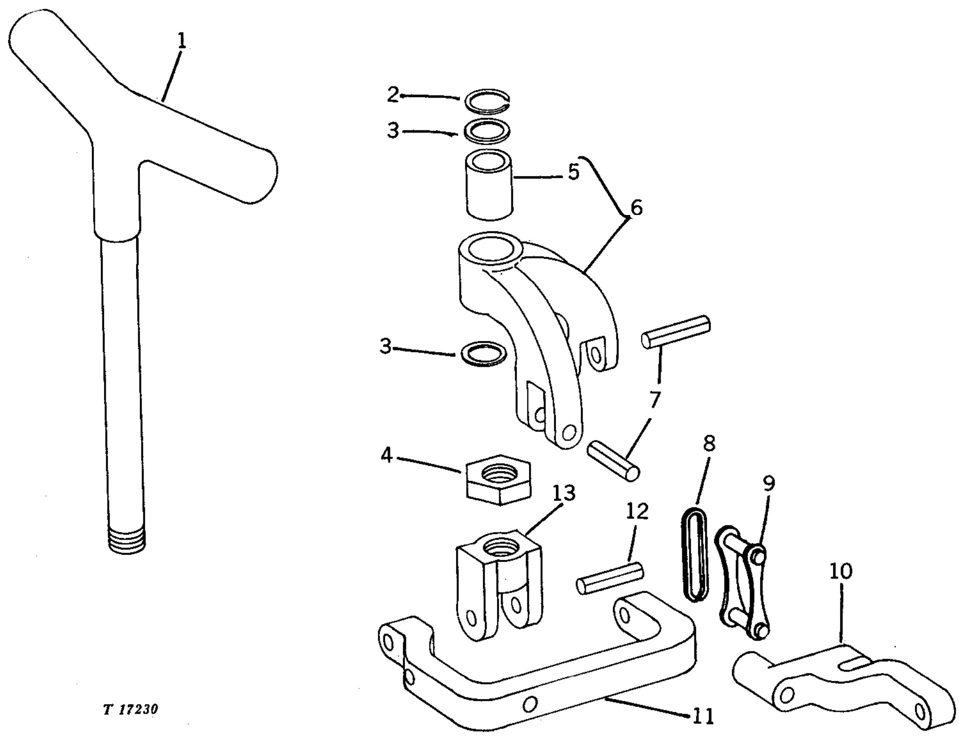
1—Cap Screw
2—Spring Clip
3—Coupler Link
4—Lever
5—Spring Pin
6—Cap Screw
7—Cap Screw
8—Mounting Bracket

Fig. 7-Auxiliary Valve Linkage



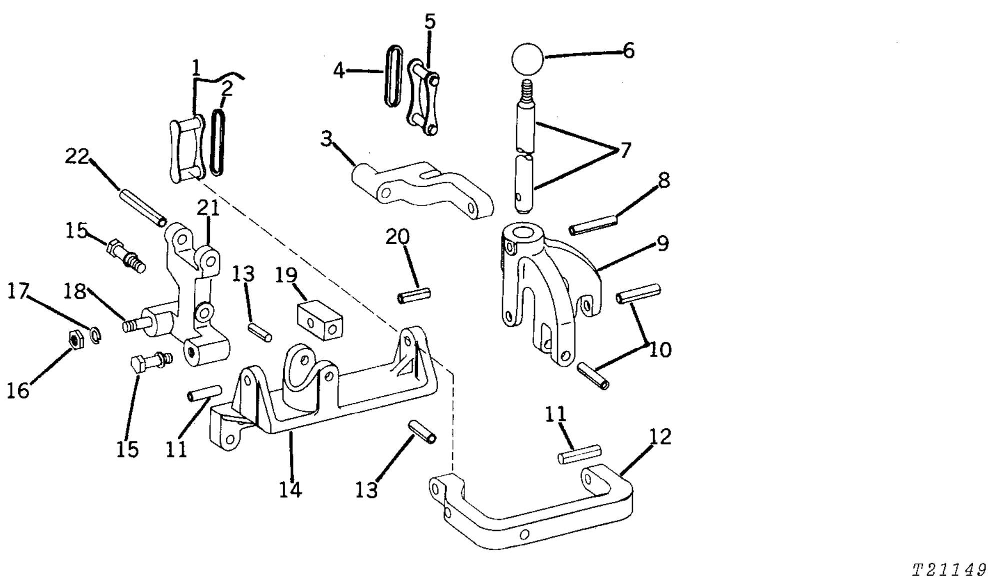
1—Knob (2 used)
2—Lever (2 used)
3—Jam Nut (2 used)
4—Pivot (2 used)
5—Roller Link
6—Spring Clip
7—Roller Link
8—Spring Clip
9—Spring Pin
10—Base
11—Cap Screw

Fig. 8-Two-Spool Valve Linkage



1—Handle
2—Snap Ring
3—Washer (2 used)
4—Jam Nut
5—Bushing
6—Handle Slide
7—Spring Pin (2 used)
8—Spring Clip
9—Connector Link
10—Float Lever
11—Center Lever
12—Spring Pin (2 used)
13—Handle Pivot

Fig. 9-Three Spool Valve Handle Assembly



1—Connector Link
2—Spring Clip
3—Float Lever
4—Spring Clip
5—Connector Link
6—Knob
7—Lever
8—Spring Pin
9—Lever
10—Spring Pin (2 used)
11—Spring Pin (2 used)
12—Center Lever
13—Spring Pin (2 used)
14—Lever Base
15—Cap Screw (2 used)
16—Nut
17—Lock Washer
18—Stud
19—Pivot Block
20—Spring Pin
21—Attaching Standard
22—Spring Pin

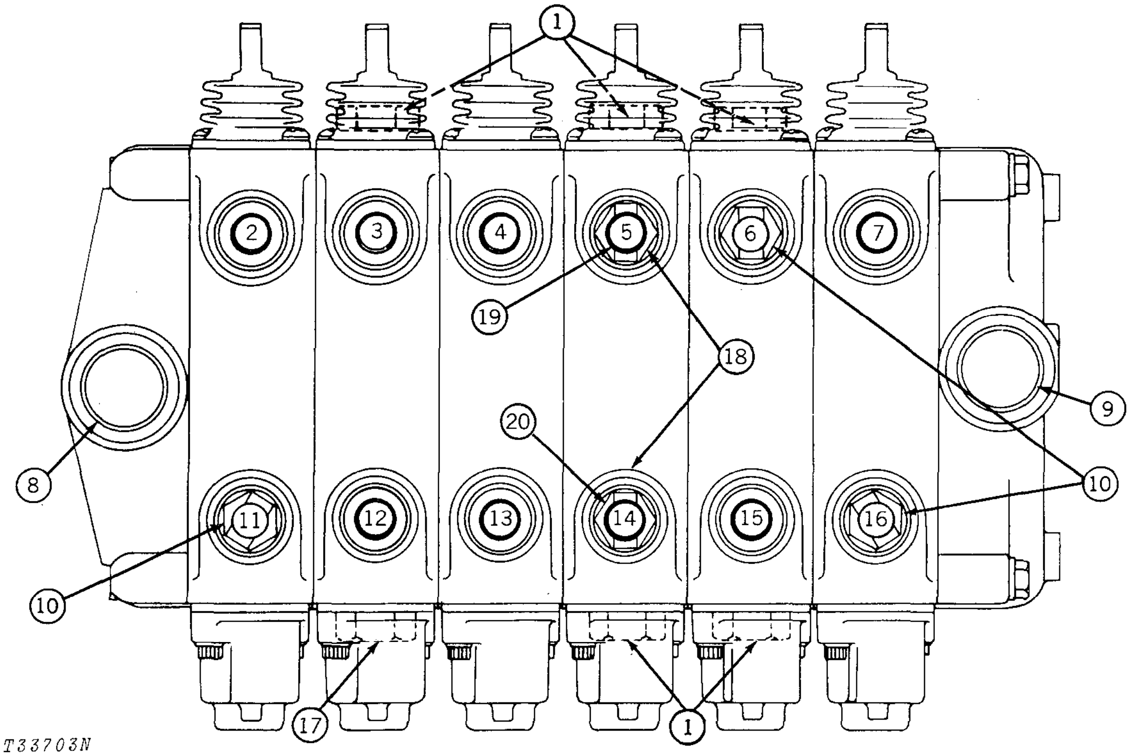
Fig. 10-Two Spool Valve Linkage (6415 Dozer)

SPECIFICATIONS

Item		New Part
CONTROL VALVE SPRING TENSIONS		
Spool Centering Springs		
Lift spool	(free length)	1-9/16 in.
	(test strength)	31-1/2 to 38-1/8 lbs at 1-1/4 in.
Angling spool and auxiliary spool in 2 spool valve	(free length)	1-3/16 in.
	(test strength)	21 to 25 lbs at 15/16 in.
Tilt spool and function spool in auxiliary valve	(free length)	1-13/64 in.
	(test strength)	27-1/2 lbs at 15/16 in.
RELIEF VALVE SPRING TENSION		
Relief Valve Spring	(free length)	2-13/16 in.
	(test strength)	243 to 297 lbs at 2-5/16 in.

Group 30
BACKHOE CONTROL VALVE

GENERAL INFORMATION



1—Circuit Relief
2—Stab. Cyl. (Right Rod)
3—Crowd Cyl. (Piston End)
4—Bucket Cyl. (Piston End)
5—Swing Cyl. (Left)
6—Boom Cyl. (Rod End)
7—Stab. Cyl. (Left Rod)
8—Pressure Port
9—Return Port
10—Orifice Plate
11—Stab. Cyl. (Left Piston)
12—Crowd Cyl. (Rod End)
13—Bucket Cyl. (Rod End)
14—Swing Cyl. (Right)
15—Boom (Piston End)
16—Stab. Cyl. (Right Piston)
17—Plug
18—Orifice (2 used-9300)
(-013337)
19—Orifice (9250)
20—Orifice (9250)

Fig. 1-Backhoe Control Valve

The backhoe control valve is an open center, six-spool, stack-type valve.

All six valve sections are separate bodies containing single spools. All valve sections contain lift checks which serve as one-way valves to prevent pressure oil from entering the port passages and causing cylinder movement.

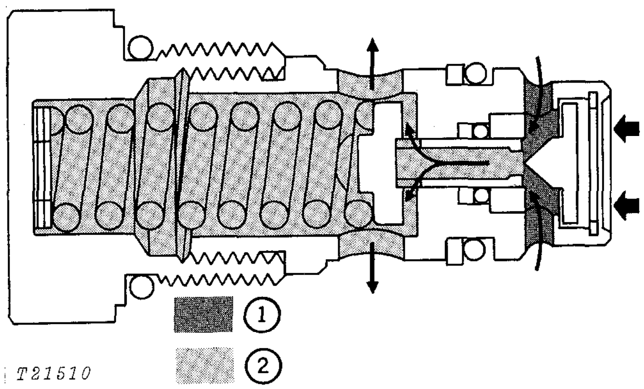
The crowd, boom and swing sections contain direct acting circuit relief valves to protect their circuits from excessive pressures.

FOS Refer to "Hydraulic Valves" in FOS Manual — HYDRAULICS for basic information on the operation of direct-acting relief valves.

Field adjustment is possible on all relief valves.

Anti-cavitation check valves are contained in the boom and swing valve sections.

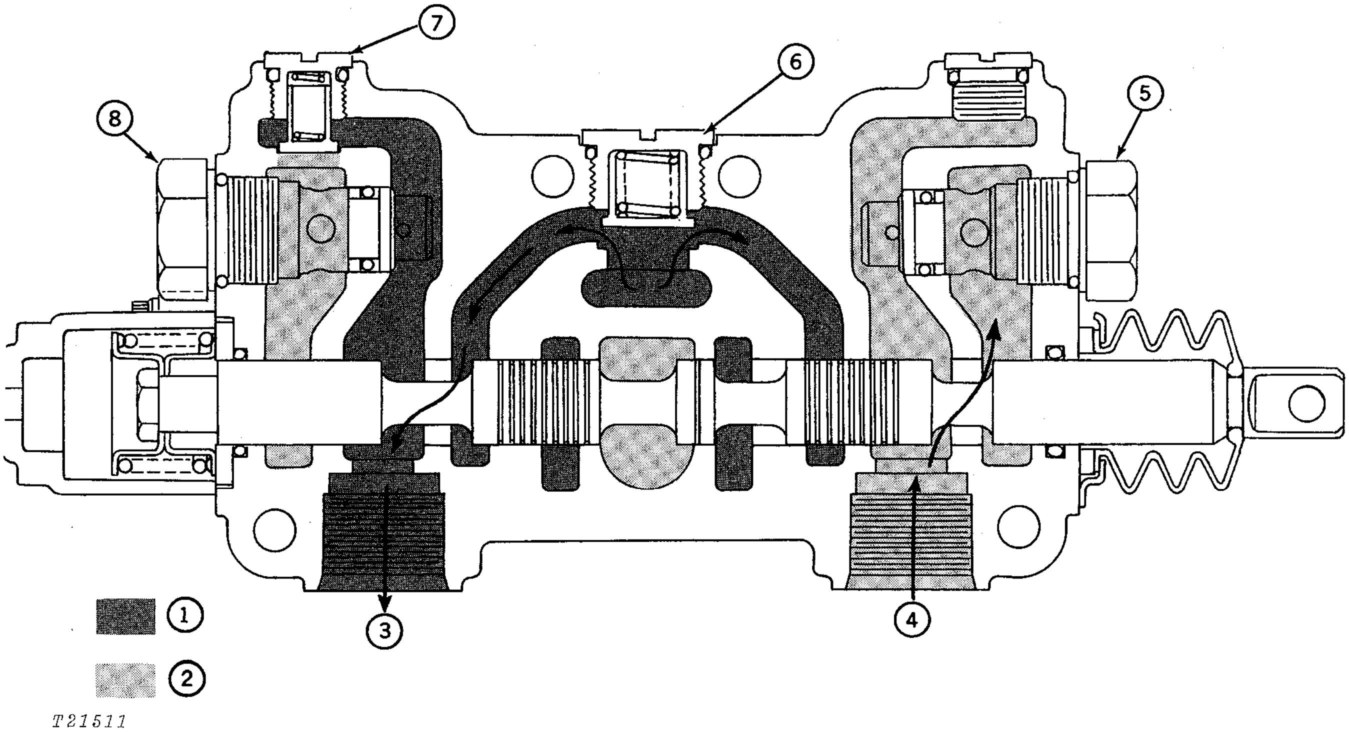
The pressure port is located in the port plate and the return port is in the end plate.



1—Pressure Oil
2—Return Oil

Fig. 2-Direct Acting Relief Valves

Control Valve Oil Flows



1—Pressure Oil
2—Return Oil
3—To Cylinder
4—From Cylinder
5—Circuit Relief Valve
6—Lift Check
7—Anti-Cavitation Valve
8—Circuit Relief Valve

Fig. 3-Oil Flow Through Valve Section (Boom Section Illustrated)

Neutral Oil Flow

With all spools in neutral position, oil from the pump enters the port plate and is split into two columns:

1. One column flows through the valve stacks and is stopped at the end plate. This is called functional oil — oil that can be diverted to one or more cylinders by moving one of the control valve spools to an operating position.

2. The other column of inlet oil flows freely through the valve stack into the end plate and back to the reservoir.

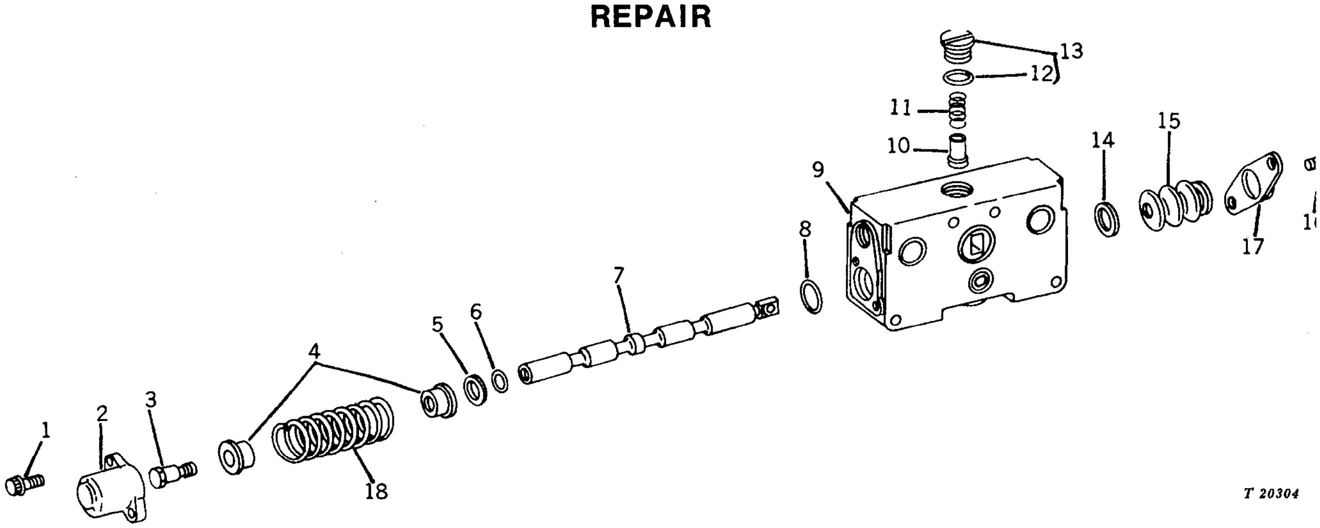
Boom Power Circuit (Fig. 3)

When the boom spool is extended or retracted to lower or raise the boom, functional oil is directed past the valve spool to the boom cylinders.

Displaced oil from the cylinders is forced back to the control valve through the valve outlet and back to the reservoir. Oil in the remaining cylinders remains trapped by the valve spools.

To prevent cavitation, a portion of the return oil may unseat the anti-cavitation check valve in the valve housing and supplement the flow to the boom cylinders.

REPAIR



1—Screw (2 used)	**6—O-Ring**	**11—Spring**	**16—Machine Screw (2 used)**
2—Cap Assembly	**7—Spool**	**12—O-Ring**	**17—Dust Seal Retainer**
3—Spool Screw	**8—O-Ring**	**13—Lift Check**	**18—Centering Spring**
4—Washers (2 used)	**9—Valve Housing**	**14—Breather Washer**	
5—Retainer	**10—Plunger**	**15—Spool Seal**	

Fig. 4-Control Valve Section (Stabilizer Valve Illustrated)

Operate backhoe control valve levers until all hydraulic pressure is relieved.

Label control valve ports and lines for proper assembly.

If control valve stack is to be removed for servicing and it is believed that fragments of failed valve parts may have entered the hydraulic system, completely drain the system and replace the hydraulic filters.

Separating Valve Bodies

Service individual valves separately. Be sure valve bodies and their spools are kept together because these parts are matched assemblies.

Remove tie bolts and separate valve sections.

Remove end caps and remove spools from valve housings.

Clean and dry all parts thoroughly and inspect for wear and damage.

Inspecting Valve Parts

Valve Housing

Check valve housing for damage or evidence of leakage. Replace housing and spool as a matched assembly.

Anti-Cavitation Check Valves

Remove check valves from valve sections and inspect for damage. Check the springs for fatigue (see "Specifications").

Spool

Remove any burrs or rough spots from spool bodies with fine emery cloth. If spools are worn or damaged, replace spool and valve housing as a matched assembly.

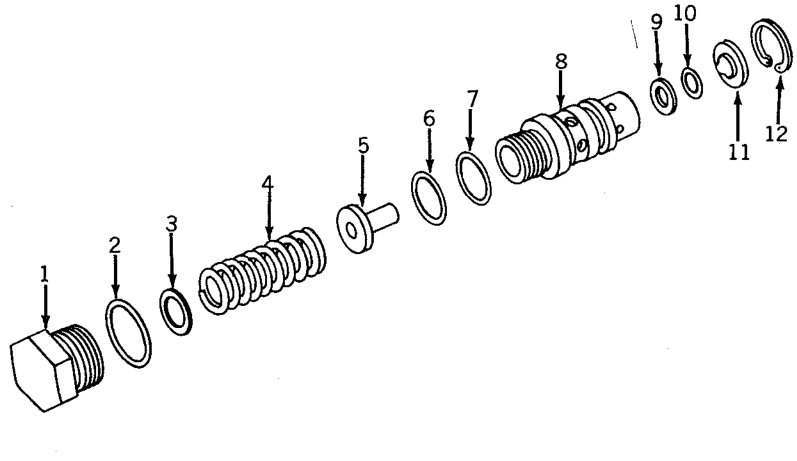
Lift Checks

Inspect lift checks for damage. Check springs for fatigue (see "Specifications").

Orifice Plates

Inspect hole in orifice plates for plugged condition. Install all plates with the smooth side toward the valve housing.

RELIEF VALVE REPAIR



1—Relief valve cage*	**5—Seat***	**9—Back-up Washer**
2—O-Ring	**6—Back-up Washer**	**10—O-Ring**
3—Shims (as required)	**7—O-Ring**	**11—Poppet***
4—Spring*	**8—Cartridge**	**12—Snap Ring**

* *Not available for service*

Fig. 5-Direct Acting Circuit Relief Valve

Remove relief valve from valve housing.

Disassemble relief valve using Fig. 5 as a guide.

Position the hex. head of the relief valve cartridges in a vise and remove snap ring and retainer.

Remove parts from valve cage.

Thoroughly clean and dry all parts. Inspect parts and replace as necessary.

When assembling the relief valve, be sure to use all the shims removed.

Assemble parts in cage and install retainer and snap ring.

Test pressure setting of the relief valve.

If test reading does not agree with the pressure setting stamped on relief valve cage, disassemble the relief valve and add or deduct shims to adjust for proper pressure.

CONTROL VALVE ASSEMBLY

Thoroughly clean and dry all parts. Oil all parts lightly prior to assembly.

Replace all O-ring and backup washers with new parts.

Install spools in proper valve section.

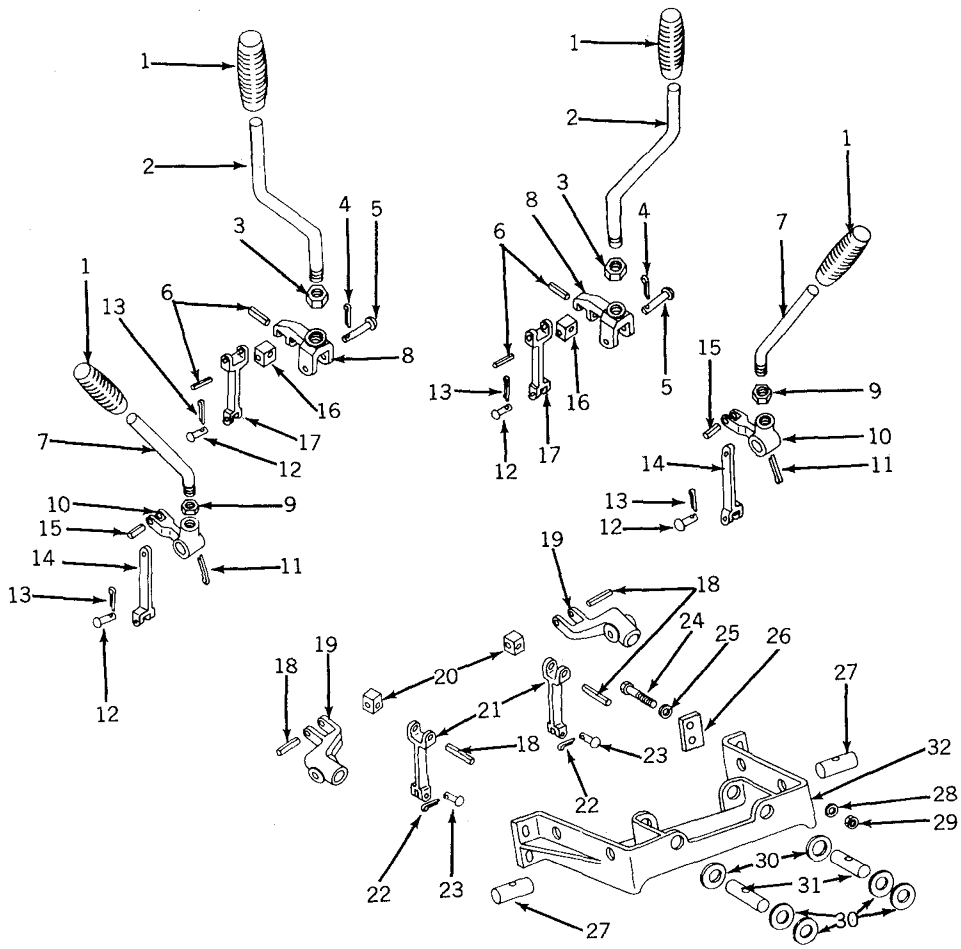
Stack port plate, valve sections, and end plate in proper sequence.

Install tie bolts and tighten evenly with 25 to 40 ft-lbs.

Install control valve and connect linkage and oil lines.

Run machine and check backhoe circuit for proper operation and leaks.

CONTROL VALVE LINKAGE



T21513N

1—Hand Grip (4 used)
2—Lever (2 used)
3—Hex. Nut (2 used)
4—Cotter Pin (2 used)
5—Pivot Pin (2 used)
6—Spring Pin (4 used)
7—Stabilizer Lever (2 used)
8—Handle Mount (2 used)
9—Nut (2 used)
10—Handle Mount (2 used)
11—Cotter Pin (2 used)
12—Pin (4 used)
13—Cotter Pin (4 used)
14—Link (2 used)
15—Spring Pin (2 used)
16—Lever Block (2 used)
17—Link (2 used)
18—Spring Pin (4 used)
19—Pivot Block (2 used)
20—Lever Block (2 used)
21—Lever Link (2 used)
22—Cotter Pin (2 used)
23—Pin (2 used)
24—Cap Screw (4 used)
25—Washer (4 used)
26—Spacer (2 used)
27—Pivot Shaft (2 used)
28—Lock Washer (4 used)
29—Nut (4 used)
30—Washer (6 used)
31—Pivot Shaft (2 used)
32—Mounting Frame

Fig. 6-Backhoe Control Valve Levers and Linkage

Inspect control valve linkage for worn or damaged parts.

Coat shafts and movable linkage parts with grease before assembly.

QUICK-DISCONNECT COUPLERS

Use the following procedure when installing quick-disconnect couplers:

1. Install one male coupler on machine control valve pressure line and the other male coupler on the backhoe reservoir return line.

2. Install one female coupler on the machine control valve return line and the other female coupler on the backhoe reservoir pressure line.

SPECIFICATIONS

Relief Valve Pressure (9300 Backhoe)

Item	New Part
Crowd relief valve	2375 psi
Swing relief valve (2 used)	1625 psi or 2000 (as marked)
Boom relief valve (boom raise - early units)	3000 psi
(boom raise - later units)	3500 psi
(boom lower)	2375 psi
Reservoir relief valve	140 ± 7 psi

Relief Valve Pressure (9250 Backhoe)

Item	New Part
Crowd relief valve	2500 psi
Swing relief valve (right)	1750 psi
Swing relief valve (left)	2375 psi
Boom relief valve (raise)	2750 psi
Boom relief valve (lower)	2500 psi

Control Valve Springs

Item	New Part
Anti-cavitation check valve springs	0.75 pounds compression at 5/8 in.
Lift check springs	1/8 pound at 3/4 in.
Spool spring	27 pounds compression at 1-1/4 in.

TORQUE VALUES

Item	Torque (ft-lbs)
Tie bolts	25 to 40

Group 35

HYDRAULIC CYLINDERS

GENERAL INFORMATION

The hydraulic cylinders used on the crawlers are double acting and use "V"-packing type seals on their pistons. Piston rods are heat treated, chrome plated, and polished. Replaceable non-metalic wear rings are used on piston retainers to prevent scoring of the cylinder barrels.

The backhoe crowd and boom cylinders are hydraulically cushioned. This prevents harsh stops when the cylinder reaches the end of its stroke.

FOS See "Hydraulic Cylinders" in FOS Manual - HYDRAULICS for additional information on cylinders and an explanation of the hydraulic cushion design.

REPAIR

For cylinder testing and diagnosis, refer to Group 5 of this Section.

Operate control valve lever until all hydraulic pressure is relieved.

Remove cylinders and cap all openings to prevent dirt entry.

If cylinder packings have failed, some fragments of the deteriorated parts may have entered the system. Completely drain the system and replace or clean the filters.

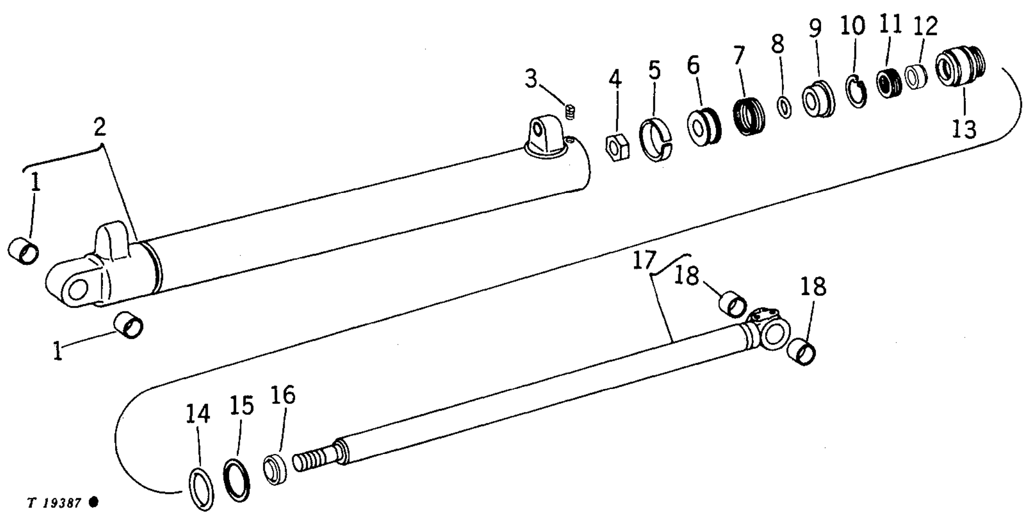
Clamp the cylinder in a vise to prevent it from turning. Remove set screw and rod guide (Fig. 1). Use a spanner wrench to loosen rod guide.

Remove piston rod, rod guide and piston from barrel.

Clamp the rod end in a vise taking care to prevent damage to the piston rod. Remove nut from end of rod. Slide parts from end of rod.

Wash all parts thoroughly with diesel fuel and inspect the following:

1. Barrel, rod guide and rod for scoring, and O-rings for surface damage.



1—Bushing (2 used)
2—Barrel
3—Set Screw
4—Stop Nut
5—Wear Ring
6—Retainer
7—V-Packing
8—O-Ring
9—Piston
10—Snap Ring
11—V-Packing
12—Wear Ring
13—Rod Guide
14—O-Ring
15—Back-up Washer
16—Wiper Seal
17—Piston Rod
18—Bushing (2 used)

Fig. 1-Hydraulic Cylinder (Loader Bucket Cylinder Shown)

2. V-packings and wear rings for breaks, cuts or embedded foreign material.

3. Piston rod seal and wiper for wear or damage. Remove sharp edges from piston rod with emery cloth.

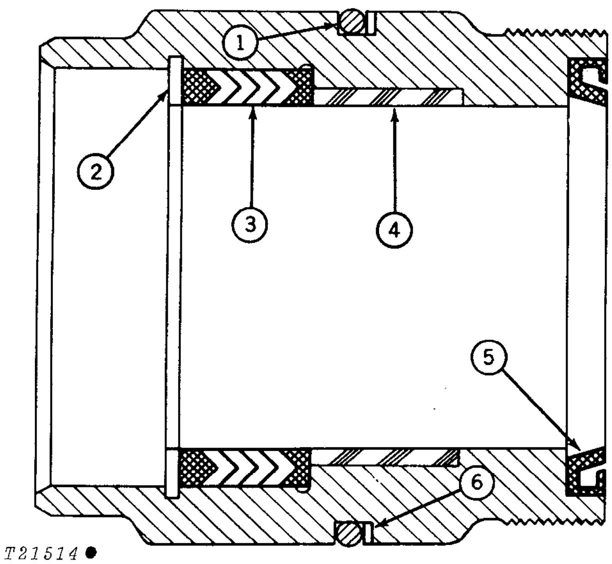
Repair kits are available for overhauling all cylinders. Discard used parts and use all new parts provided in kits when assembling cylinders.

Lubricate all O-rings, seals, and packings before assembly.

Use Fig. 2 as guide to install rod guide components.

Install new wiper seal in rod guide.

Install new wear ring in rod guide. Position backup washer and O-ring on rod guide.



1—O-ring
2—Snap Ring
3—V-Packing
4—Wear Ring
5—Wiper Seal
6—Back-Up Washer

Fig. 2-Rod Guide Components

Install V-packing in rod guide with the apex of the V toward the wiper seal and secure with snap ring.

Slip rod guide assembly on piston rod being careful not to damage packing.

Use Figs. 1, 3 and 4 as guides to assemble cylinder.

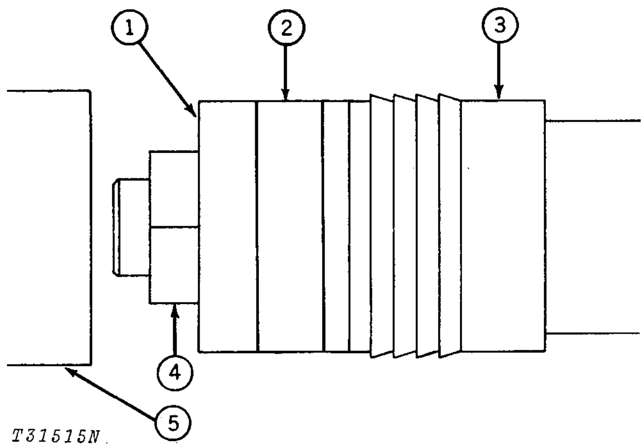
Install O-ring in piston and V-packing on piston. (See "Piston V-Packing Installation.")

Position piston on piston rod. Install wear ring on piston retainer. Position retainer on piston rod and secure with stop nut. Tighten to specifications.

Install piston rod assembly into barrel.

Secure piston rod assembly in barrel with rod guide and tighten to specified torque. Install set screw and tighten after rod guide is tightened to proper torque.

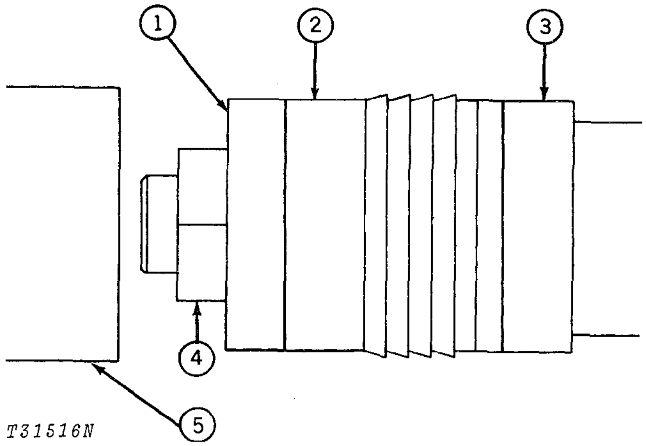
PISTON V-PACKING INSTALLATION



1—Retainer
2—Wear Ring
3—Piston
4—Nut
5—Cylinder Barrel

Fig. 3-Installation of V-Packing with Compressor

Piston V-packings are originally installed on the piston with the apex of the "V" pointing away from the barrel (Fig. 3). This procedure can be used if a suitable ring compressor is available to compress packings when installed in cylinders.



1—Retainer
2—Wear Ring
3—Piston
4—Nut
5—Cylinder Barrel

Fig. 4-Installation of V-Packing Without Compressor

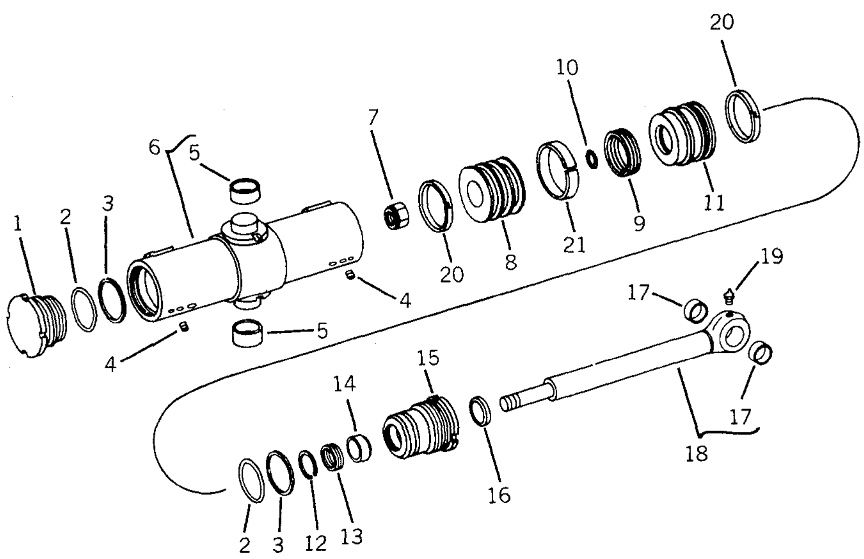
If a suitable compressor is not available, assemble the packing on the piston with the apex of the "V" pointing toward the barrel (Fig. 4). This eliminates scuffing that may occur in assembly; however, the V-packing may be torn if the cylinder has to be disassembled in the future.

SWING CYLINDER (9250 BACKHOE)

Use Fig. 5 as a guide when repairing the swing cylinder.

Install V-packing in rod guide with the apex of the V toward the wiper seal and secure with snap ring.

When installing O-ring in piston and V-packing on piston, see "Piston V-Packing Installation" on page 70-35-2.

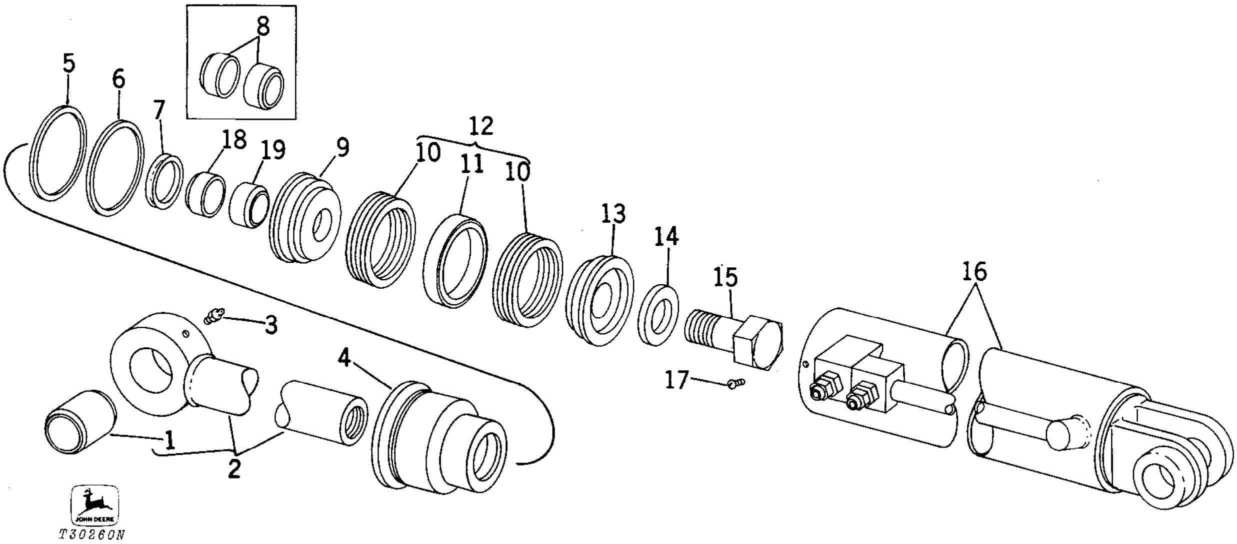


1—Cylinder Head
2—O-Ring (2 used)
3—Backup Washer (2 used)
4—Set Screw (2 used)
5—Trunnion Bushing
6—Barrel and Trunnion
7—Special Lock Nut
8—Piston
9—Piston V-Bushing
10—Piston O-Ring
11—Piston
12—Rod Guide Snap Ring
13—Rod Guide V-Packing
14—Rod Guide Wear Ring
15—Rod Guide
16—Wiper Seal
17—Piston Rod Bushing
18—Piston Rod
19—Grease Fitting
20—Brake Seal (2 used)
21—Piston Wear Ring

Fig. 5-Swing Cylinder (9250 Backhoe)

DROTT BUCKET CYLINDER

Clam Cylinders



1—Bushing (2 used)
2—Piston Rod
3—Grease Fitting
4—Packing Gland
5—Ring
6—O-Ring
7—Seal
8—Wiper (2 used) (Early Units)
9—Piston
10—Packing (2 used)
11—Ring
12—Packing Assembly
13—Piston
14—Special Washer
15—Special Bolt
16—Cylinder Tube
17—Special Screw
18—Outer Wiper (Later Units)
19—Inner Wiper (Later Units)

Fig. 6-Clam Cylinder

If clam cylinders require servicing, remove them from bucket as follows:

Lower loader boom to the ground. With crawler engine stopped, actuate all loader control levers to relieve oil pressure.

See caution note on page 70-5-1.

Break clam cylinder connections. Remove cylinder pins and lift cylinders from bucket.

Disassembly (Fig. 6)

Clamp cylinder securely in a vise. Remove special screw (17), then turn packing gland out of cylinder tube using a spanner wrench. Do not allow piston rod to drop on threaded part of cylinder tube.

Pull piston rod assembly from cylinder. Inspect cylinder tube for wear grooves, scratches, or pits which could cause cylinder leaking. Replace cylinder if any of these conditions are present.

Clamp piston rod-eye in a vise and remove special bolt (15) from other end of rod. Remove pistons and packings. Check pistons for wear or damage. Replace if necessary. Replace packings (10) if damaged.

Replace rings (5 and 11) if damaged. Replace seal (7) and wipers (8 or 18 and 19).

Assembly and Installation

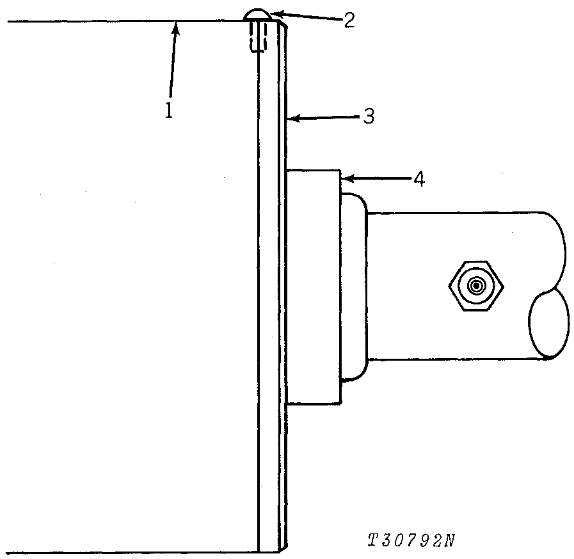
Assemble cylinder using reverse procedure from that of disassembly. Coat all O-rings, backup washers, and cylinder bore with a light film of oil.

Torque special bolt (15) in piston rod to 1000-1200 ft-lbs.

After piston has been started into the cylinder tube, slide packing gland into position. Work piston rod further into the tube, keeping rod in a straight line with the tube.

Screw packing gland into the tube and tighten to 100-200 ft-lbs using a spanner wrench. Tighten until torque is reached and special screw holes line up.

If a new packing gland or cylinder tube is used, drill a new hole for the special screw (2, Fig. 7), half in the packing gland and half in the tube. Do not drill in line with spanner wrench holes. Use a No. 26 drill and drill approximately 5/16-inch deep.



1—Cylinder Tube
2—Special Screw
3—Packing Gland
4—Piston Rod

Fig. 7-Special Screw Location

Install Clam Cylinder

Check hydraulic system oil level. Replace any oil lost during cylinder removal. (See Section 10 of this manual.)

REMOTE CYLINDERS

(Early Units)

The remote cylinders are double-acting cylinders and are provided with a hydraulic adjustable stop to vary the working stroke from 0 to 8 inches.

See "Hydraulic Cylinders" in FOS Manual - HYDRAULICS for cylinder theory of operation. Refer to machine operator's manual for information on connecting cylinders.

DIAGNOSING REMOTE CYLINDER MALFUNCTIONS

Cylinder Will Not Extend

Cylinder overloaded.
Insufficient hydraulic pressure.
  Check hydraulic pump.
Air in remote cylinder.
  Bleed cylinder.
Breakaway coupler valve closed.
  Turn coupler operating handles 90 degrees.
Remote cylinder piston packings failed.
  Replace O-ring and backing washer.

Cylinder Will Not Retract

Air in remote cylinder.
  Bleed cylinder.
Remote cylinder stop valve stuck in seated position.
  Clean and repair valve.

Stop on piston rod positioned incorrectly.
  Change position of stop.
Breakaway coupler valve closed.
  Turn coupler operating handles 90 degrees.

Cylinder Settles Under Load

Cylinder piston packings failed.
  Replace O-ring and backing washer.

Cylinder Operates Slowly

Insufficient oil pressure or flow.
  Check hydraulic pump.
Air in remote cylinder.
  Bleed cylinder.
Cylinder hydraulic stop valve sticking.
  Clean and repair valve.

REPAIR

Disassembly

Refer to Fig. 8 for reference to disassemble the remote cylinder.

Remove cylinder end cap (16). Stop and bleed valves (13) may be removed by pushing stop rod assembly into cylinder to its limit. Pull stop valve from bleed valve. After removing ball from recess, bleed valve may be removed from the stop rod.

Remove piston (22), and piston rod (36).

Push stop rod (9) all the way into cylinder to prevent distortion of stop rod while driving groove pin (25) from stop rod arm (26). Push V-packing assembly (2) from housing.

Assembly

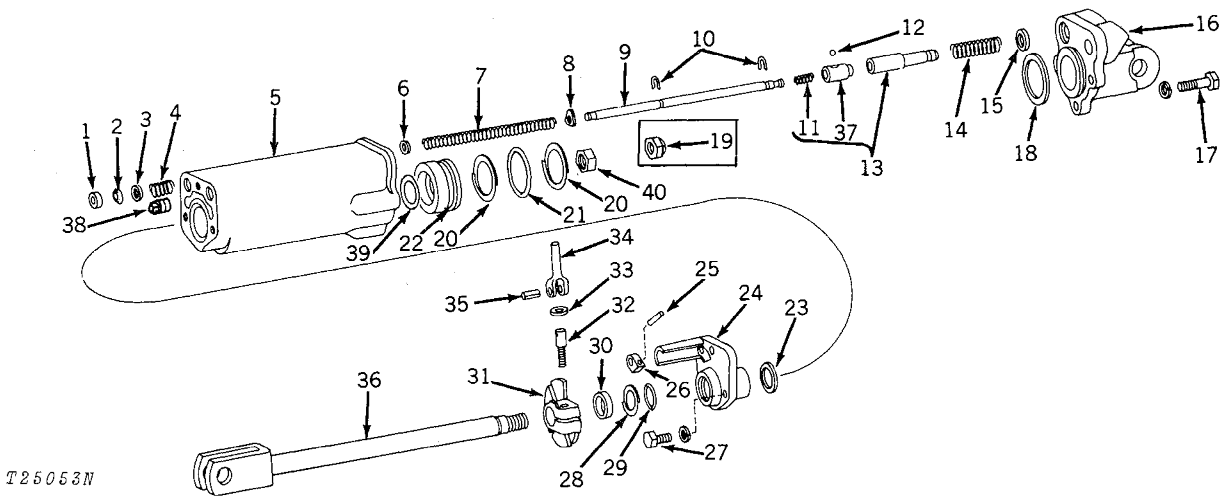
Refer to Fig. 8 and assemble remote cylinder. Observe the following:

1. Press in a new piston rod oil seal (30) with sealing lip toward outer end of bore.

2. Install stop rod V-packing assembly (2) with sealing lip toward outer end of bore.

3. Install piston rod guide (24) and gasket (23) but do not tighten attaching hardware.

Install stop rod assembly. Use stop and bleed valve assembly to push stop rod (9) through stop rod V-packing. Tighten piston rod guide hardware to 35 ft-lbs.



1—Stop Rod Packing Adapter
2—V-Packing (3 used)
3—Stop Rod Packing Adapter
4—Stop Rod Packing Spring
5—Remote Cylinder
6—Washer
7—Stop Rod Spring
8—Stop Rod Washer
9—Stop Rod
10—Snap Ring (2 used)
11—Bleed Valve Spring
12—Bleed Valve Ball
13—Stop and Bleed Valves
14—Stop Valve Spring
15—Oil Passage Gasket (2 used)
16—Remote Cylinder End Cap
17—Cap Screw and Lock Washer (4 used)
18—Gasket
19—Self-Locking Nut (early units)
20—Backup Ring (2 used)
21—O-Ring
22—Piston
23—Piston Rod Guide Gasket
24—Piston Rod Guide
25—Groove Pin
26—Stop Rod Arm
27—Cap Screw and Lock Washer (3 used)
28—Backup Ring
29—O-Ring
30—Oil Seal
31—Piston Rod Stop
32—Stop Screw
33—Washer
34—Adjusting Lever
35—Spring Pin
36—Piston Rod with Yoke
37—Bleed Valve
38—Pipe Plug
39—O-Ring
40—Piston Nut (later units)

Fig. 8-Hydraulic Stop Remote Cylinder

4. Install stop rod arm (26) and groove pin (25). When installing groove pin, push stop rod (9) all the way into the cylinder to avoid bending the stop rod.

5. Install bleed and stop valves (13) making certain retaining ball is in the recess. Push valve assembly into the cylinder. Install piston rod (36) in cylinder.

6. Install O-ring packing (21) and backup rings (20) on piston.

Install piston (22) on piston rod (36). Before nut (19 or 40) is tightend, push piston well into the cylinder. Tighten self-locking nut securely. If nut is not self-locking (40-later units), tighten to 300 ft-lbs.

7. Locate the piston rod stop (31) on the piston rod with adjusting lever (34) opposite the stop rod arm (26).

8. Install gasket (18) on end cap (16). Insert two oil passage gaskets (15). Place spring (14) over end of stop valve (13) and install end cap. Tighten cap screws (17) to 85 ft-lbs.

Bleeding

After the cylinder is assembled, attach the hoses to breakaway coupler.

Start the engine and move the control valve to extend and retract the piston rod seven or eight times to remove any air trapped in the remote cylinder.

SPECIFICATIONS

TORQUE VALUES

Cylinder	Stop Nut (ft-lbs)	Rod Guide or Spanner Nut (ft-lbs)	Set Screw (in-lbs)
Loader			
Boom	500-700	250-300	40
Bucket	500-700	250-300	40
Multi-Purpose Bucket Clam	600-700	125-175	—
Dozer			
Lift	500	150	—
Angle	500	150	—
Tilt	500	150	—
Tilt (6415)	500	250-300	40
Backhoe			
Stabilizer	600-700	250-300	40
Boom	1000-1100	250-300	40
Crowd	600-700	250-300	40
Bucket	500	250-300	—
Swing Cylinder (9250 Backhoe)	950-1050	250-300	40

Remote

Piston Rod Guide .... 35 ft-lbs
End Cap .... 85 ft-lbs
Piston Nut (later units) .... 300 ft-lbs

Drott Clam

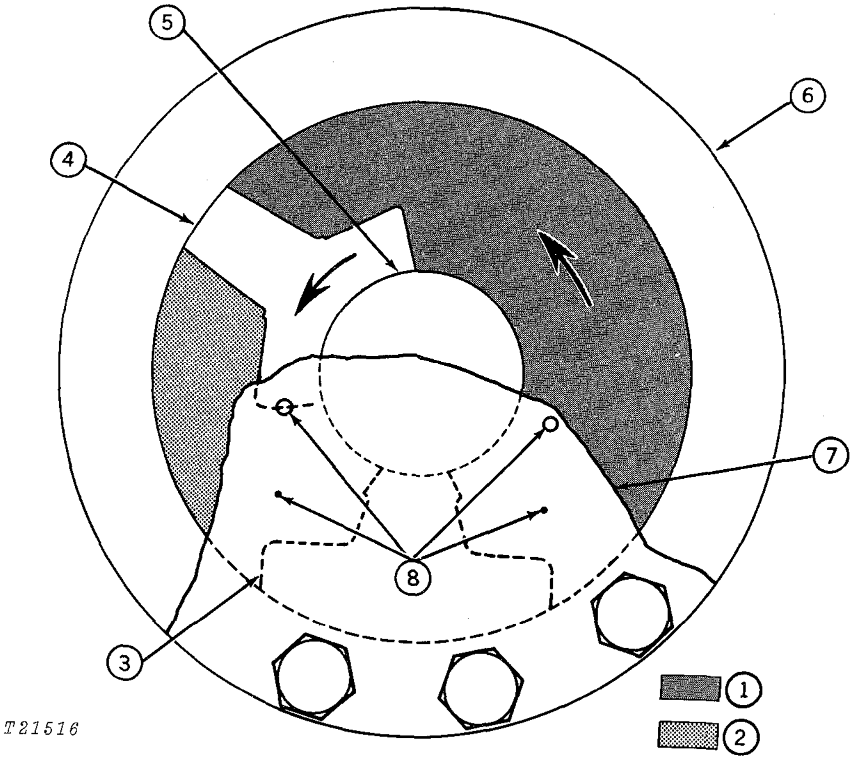
Special Bolt into Piston Rod .... 1000-1200 ft-lbs
Packing Gland .... 100 -200 ft-lbs

SPECIAL TOOLS

No.	Name	Use
Convenience Tools		
D-05113ST	Spanner Wrench (Adjustable from 2 to 4-3/4 in.)	To remove and install rod guide.

Group 40
BACKHOE SWING CYLINDER

GENERAL INFORMATION



1—Pressure Oil
2—Oil Under Slight Pressure
3—Barrel Vane
4—Shaft Vane
5—Splined Shaft
6—Barrel
7—Top Plate
8—Brake Holes

Fig. 1-Swing Cylinder Hydraulic Brake Operation

A rotary, vane-type, double-acting swing cylinder with incorporated brake swings the boom. The cylinder is composed of a barrel and vane assembly, top and bottom plates, splined shaft, and a vane assembly.

During operation, the cylinder barrel is held in a stationary position by the swing cylinder link assembly, while the splined shaft and vane assembly rotate within the barrel. The top plate, which is stationary with the barrel, has two brake holes drilled on each side of the barrel vane.

As the shaft and vane assembly rotates, the shaft vane gradually closes the larger brake hole. (The small brake hole is never closed.) This gradual closing causes a reduction in the flow of return oil from the swing cylinder to the reservoir. The reduction in the flow of return oil slows down the rotation of the swing cylinder providing a hydraulic braking action.

The braking action is the same in either direction.

REMOVAL

Extend the boom and dipperstick along the ground so they are resting on the bucket.

Remove hoses from back of swing cylinder.

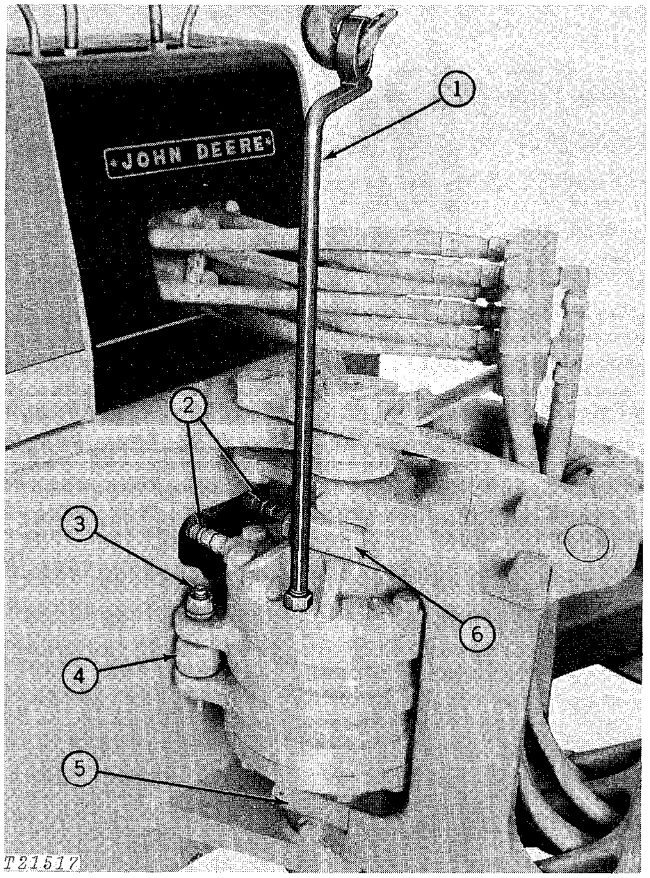
Replace cap screw with special swing cylinder removal bar (Fig. 2). A drawing of this bar is shown in "Special Tools."

Remove the tapered pin and tapered bushing.

Remove cap screws holding the top and bottom shaft couplings to the pivot casting.

Break shaft coupling dowels loose by prying rearward on swing cylinder barrel.

Carefully slide the cylinder out and up.



1—Removal Bar
2—Two Hoses
3—Tapered Pin
4—Torque Link
5—Bottom Coupling
6—Top Coupling

Fig. 2-Removing Swing Cylinder

DISASSEMBLY

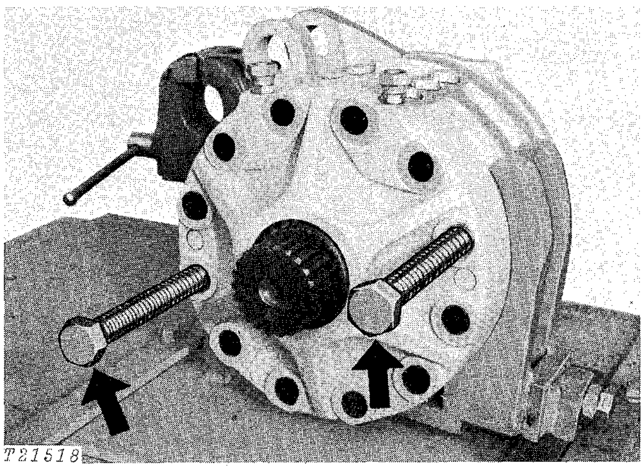
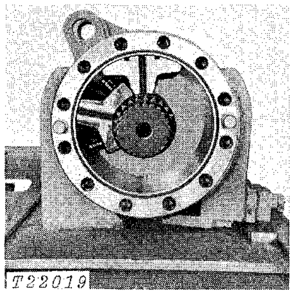


Fig. 3-Removing Top Plate

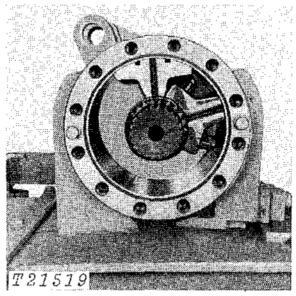
Clamp swing cylinder in special fixture (Fig. 3). Drawings of this fixture are shown in "Specical Tools."

Use two 7/8-inch cap screws as jack screws (Fig. 3) and force the top plate from the cylinder barrel. Turn jack screws alternately and evenly so that top and bottom plates are always square.

Slide top plate from splined shaft being careful not to damage O-ring and backup washer.



Vane Right



Vane Left

Fig. 4-Removing Shaft Vane

The shaft vane must contact either the right or left side of the barrel vane (Fig. 4) before it can be removed. Rotate it either to the right or left position.

Remove the shaft vane being careful not to scratch the barrel surface.

Support the barrel vane so it cannot drop inside the barrel, and remove the barrel vane.

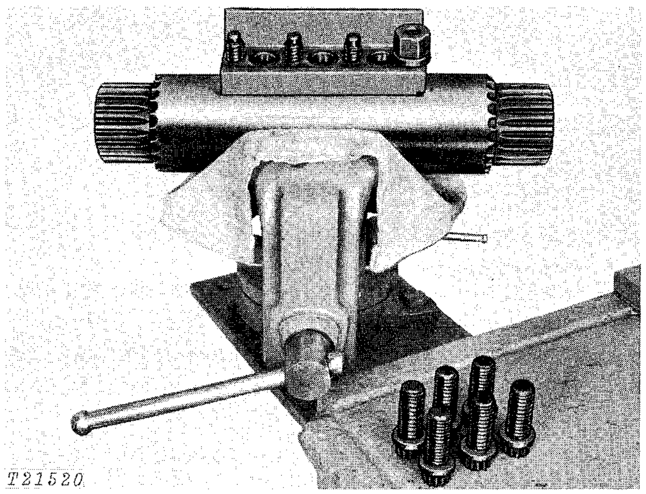
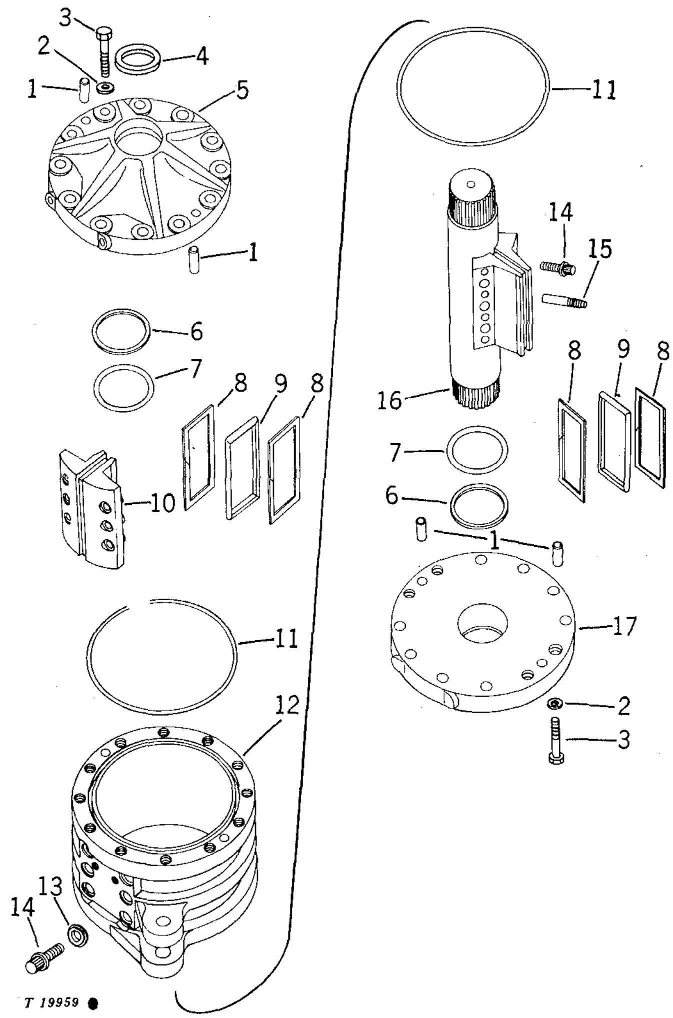


Fig. 5-Removing Shaft Vane

Place splined shaft in vise being careful not to scratch the shaft. Mark the shaft and vane before disassembly so the vane can be installed in exactly the original position.

To remove dowel pins, place a spacer and nut on a pin (Fig. 5) and tighten to end of threads. Remove the nut, add a second spacer, install the nut and tighten until pin is removed.

REPAIR



1—Dowel (4 used)
2—Washer (24 used)
3—Cap Screw (24 used)
4—Dust Seal
5—Top Plate
6—Backup Washer (2 used)
7—O-ring (2 used)
8—Backup Seal (4 used)
9—Vane Seal (2 used)
10—Cylinder Vane
11—O-ring (2 used)
12—Barrel
13—Seal Washer (6 used)
14—Cap Screw (12 used)
15—Dowel (8 used)
16—Vane and Shaft Assembly
17—Bottom Plate

Fig. 6-Swing Cylinder

Wash all parts thoroughly with a solvent and inspect for scoring of cylinder and surface damage to O-rings, backup washers, and packings.

If brass choke plates on the vane of the splined shaft (16) are damaged, replace the shaft and vane assembly. Damaged choke plates will stop brake action of the swing cylinder.

ASSEMBLY

Soak backup washers in oil and install them. Attach rubber packing to the vanes.

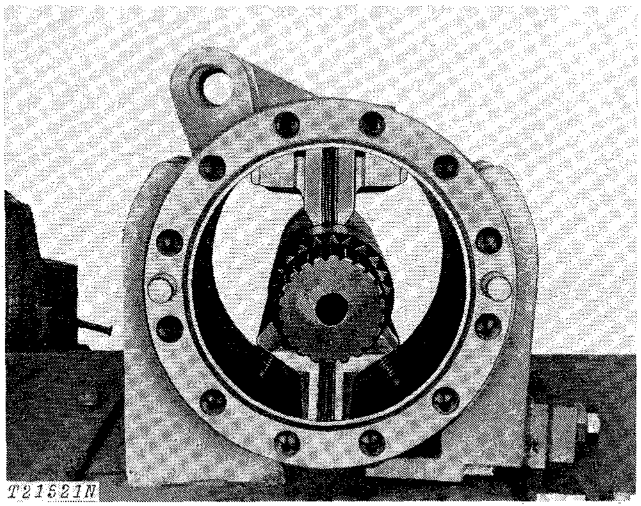


Fig. 7-Installing Shaft and Vane

IMPORTANT: Always use new sealing washers under heads of cap screws when installing vane.

Attach the vane to the barrel with cap screws. Tighten with 370 to 380 ft-lbs.

Place the vane on the shaft in the exact position from which it was removed (as indicated by markings made before removal). Drive in dowels and secure vane with cap screws.

Install splined shaft in cylinder barrel with the large brass choke plates toward the top of the barrel. Position the shaft so that the vane contacts either the right or left side of the barrel vane (Fig. 4).

Rotate the splined shaft until the barrel vane and shaft vane are exactly opposite each other (Fig. 7).

NOTE: Do not attempt to force the shaft and vane assembly into position. When properly assembled, parts should rotate smoothly.

Insert backup washer and O-rings in bore of the top and bottom plate.

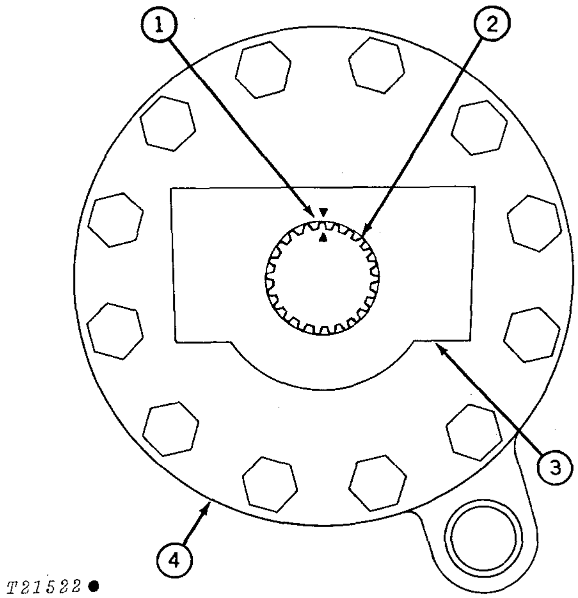
Replace O-rings in top and bottom of cylinder barrel. Attach top and bottom plates to the barrel.

After assembling, the shaft must turn freely using 100 ft-lbs.

IMPORTANT: After the top plate is in place, the shaft and vane assembly must not be turned more than 95° left or right from the position shown in Fig. 7. To do so can damage the vane seals as they slide over the work ports in the top plate.

Lightly grease the shaft splines to make future removal easier.

Insert the swing cylinder removal bar into swing cylinder and raise the cylinder with a chain hoist.



1—Timing Arrows
2—Splined Shaft
3—Coupling
4—Swing Cylinder

Fig. 8-Timing Coupling and Shaft

Place the ring spacer over the splined shaft at the bottom. Align stamped arrows on each end of shaft with mark on each coupling (Fig. 8), and place couplings on splined shaft.

Push cylinder in place until the dowels in the couplings align with dowel holes in the pivot casting.

Install cap screws holding shaft couplings to pivot casting. Tighten to 300 ft-lbs.

Align the torque link with the upper bracket on the cylinder barrel and insert tapered pin. Place the tapered bushing in the upper bracket.

Install a lock nut on each end of the tapered pin. Tighten bottom lock nut with 175 to 195 ft-lbs to draw tapered pin through lower bracket. Then tighten top lock nut with 175 to 195 ft-lbs. **It is important that the bottom lock nut be tightened first.**

TORQUE VALUES

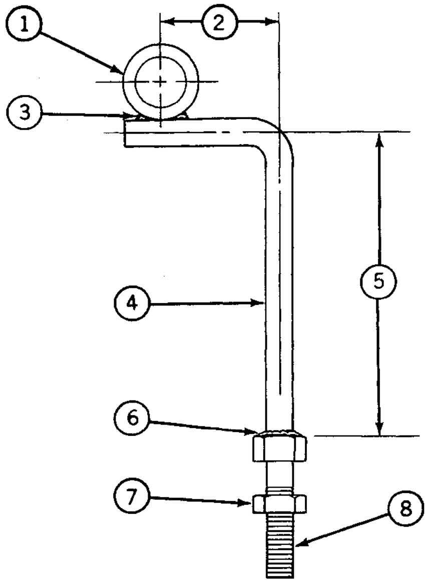
Item	Torque (Ft-Lbs)
Vane-to-barrel	370 to 380 ft-lbs
Top and bottom plates-to-barrel	375 ft-lbs
Shaft couplings-to-pivot casting	300 ft-lbs
Tapered pin lock nuts	175 to 195 ft-lbs.

SPECIAL TOOLS

Convenience Tools

No.	Name	Use
...	Removal Bar Assembly (see Fig. 9)	To remove swing cylinder
...	Holding fixture (See Figs. 10, 11, 12, 13, 14 and 15)	To hold swing cylinder during repair

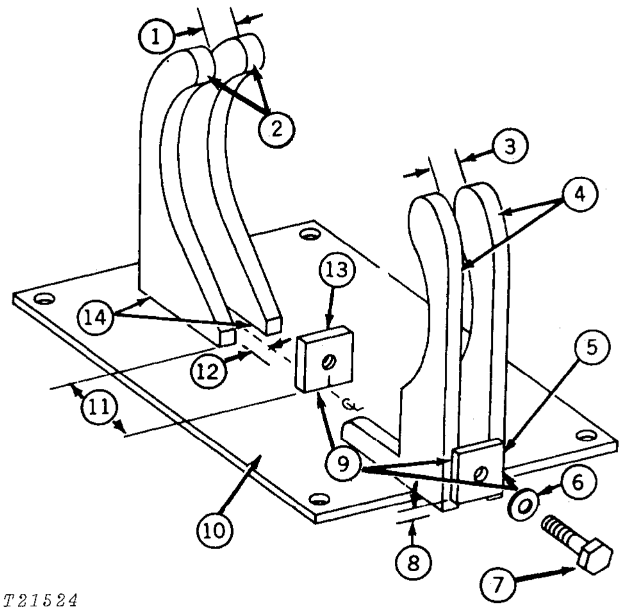
Making Special Tools



T21523

1—2 in. I.D. Pipe Ring
2—4.75 in.
3—Weld
4—1 in. Dia. Round Bar
5—16.50 in.
6—Weld
7—Jam Nut
8—3/4″ x 6-1/2″ Bolt (3/4-10 UNC Thread)

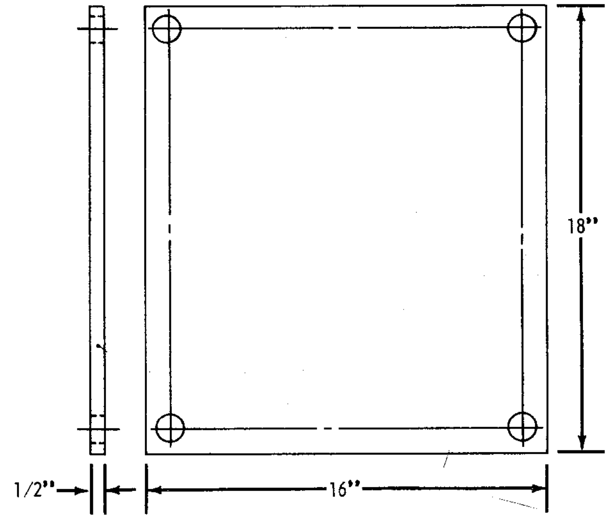
Fig. 9-Removal Bar



T21524

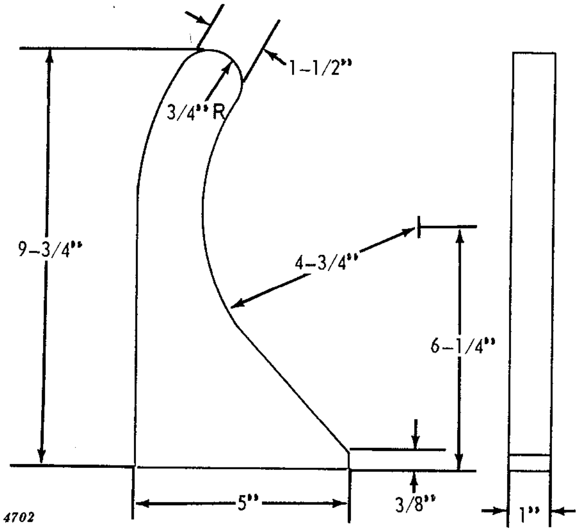
1—1-3/4 in.
2—Part "B"
3—1-3/4 in.
4—Part "A"
5—Part "D"
6—Flat Washer
7—7/8″ x 3-3/4″ Cap Screw
8—8-1/2 in.
9—Weld
10—Part "E"
11—6-1/2 in.
12—7/8 in.
13—Part "C"
14—Weld

Fig. 10-Holding Fixture



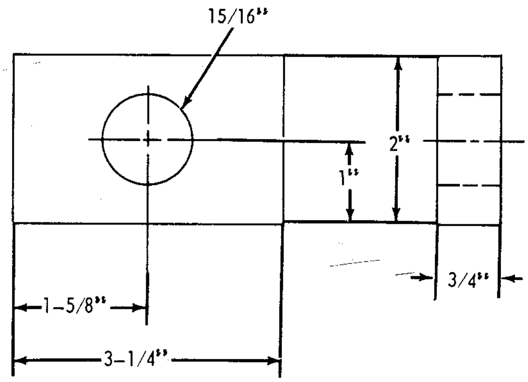
T21525

Fig. 11-Part "E" Fixture Pring



U 4702

Fig. 14-Part "B" Fixture Print



T21526

Fig. 12-Part "D" Fixture Print

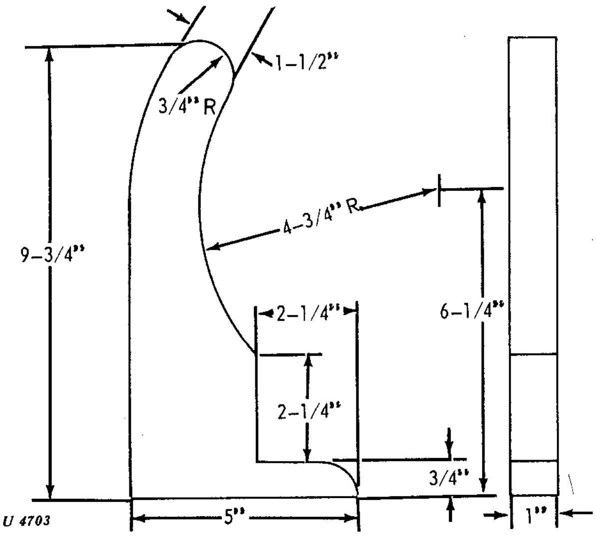


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Fig. 15-Part "A" Fixture Print

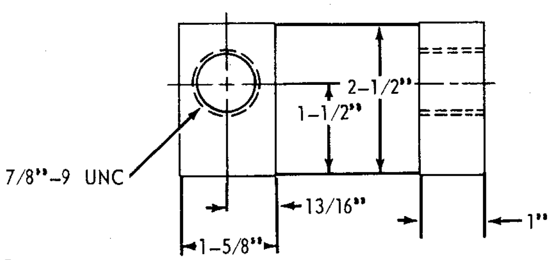

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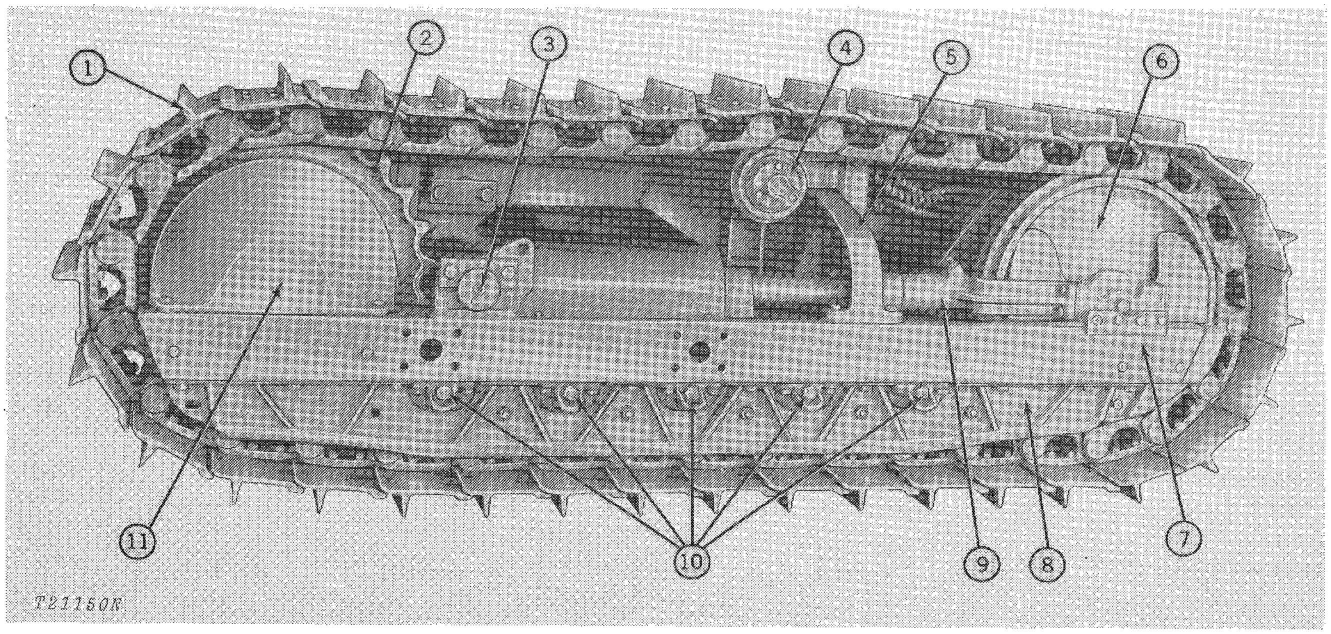
Fig. 13-Part "C" Fixture Print

Section 80
MISCELLANEOUS COMPONENTS

CONTENTS OF THIS SECTION

Group 5
TRACKS

GENERAL INFORMATION



1—Track
2—Track Drive Sprocket
3—Rear Crossbar
4—Track Carrier Roller
5—Front Crossbar
6—Front Idler
7—Track Frame
8—Rock Guard
9—Track Adjusting Cylinder
10—Track Rollers
11—Sprocket Shield

Fig. 1-Track System

The track system consists of two tracks mounted on track frame assemblies, piloted by and connected to two fixed crossbars (Fig. 1). The track frame assemblies are mounted on the crossbars to give a fixed tread of 52 inches.

Each track is driven from the rear by a hardened cast-steel sprocket bolted to a flanged axle shaft and deriving power through a final drive and steering clutch-brake mechanism. The tracks are guided at the front by idler wheels which are hydraulically shifted forward or rearward to adjust track tension.

Track shoes are available in a variety of widths and types to accommodate various ground and working conditions.

Track link joints should never be reversed since doing so will cause the lugs to contact the ground backwards and will throw dirt over the track system.

The track carrier assemblies (Fig. 1) keep the tracks in position and distribute the weight of the tractor on the tracks.

Each assembly includes a frame which forms a support for the idler wheels and the five track rollers. A heavy spring and a hydraulic track adjusting cylinder provide a means of adjusting track tension. Rock guards greatly reduce the entrance of foreign material into the track system and thereby increase track life. Outer sprocket shields are available as optional equipment. Upper and lower front idler shields are also provided as optional equipment.

The track frame assemblies are held in position by two fixed crossbars. The front crossbar is of cast nodular iron and is fastened to the side frames. The rear crossbar is a round solid steel bar.

Servicing of track carriers is covered in Group 10 of this Section.

DIAGNOSING MALFUNCTIONS

Possible results of improper track adjustment are listed below.

Loose Track

If this condition exists, the following may result:

1. Extremely fast wear on pins, bushings, and track links.

2. Unnecessary and rapid wear on sides of drive sprocket teeth and idler wheel flanges.

3. Possible damage to, or breakage of, drive sprocket, idler wheel and idler wheel bracket, fenders, side frames, and rollers.

4. Track may jump sprocket in both forward and rearward operation. Track may be thrown off when tractor is turned.

5. Noisy track.

6. Frequent accumulation of trash in track.

Tight Track

If this condition exists, the following may result:

1. Extreme loss of drawbar power and ground speed. Tractor will not handle rated working load.

2. Drifting of tractor to right or left, depending on which track is the tighter.

3. Fast wear on pins, bushings, and track links.

4. Excessive and rapid wear on drive sprockets and idler wheels. Undue strain on entire track system because track flexibility is lost.

5. Unnecessary wear on final drive bearings and oil seals.

6. Abnormal steering clutch wear.

Misaligned Track

If this condition exists, the following may result:

1. Drifting of tractor from a direct course.

2. Abnormal wear on idler wheel flanges and front idler flanges.

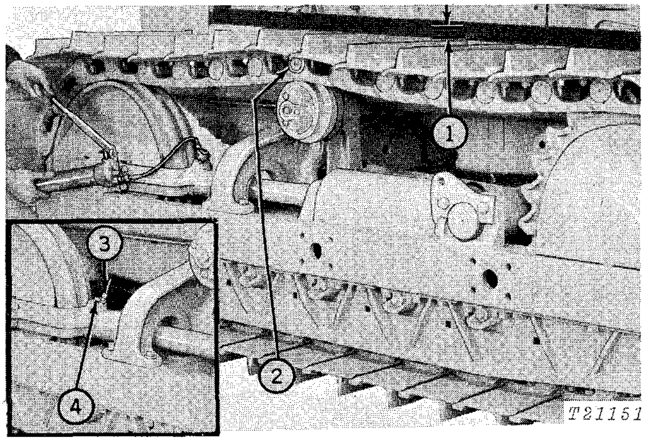
3. Excessive track link and drive sprocket wear.

4. Rapid steering clutch and brake wear.

5. Operator annoyance and fatigue caused by the constant necessity of steering the tractor to keep it from drifting.

INSPECTION AND REPAIR

For proper track and tractor operation, it is necessary that track tension and track alignment adjustments be properly made.



1—Track Sag 3—Decrease Tension
2—Pin Centered 4—Increase Tension

Fig. 2-Track Tension Adjustment

When measuring track sag, a pin and bushing must be lined up over center of track carrier roller. Adjust track sag so there is 7/8 to 1-1/8 inch sag in center of track between rear sprocket and carrier roller (Fig. 2).

Track tension is adjusted by attaching flexible hose with special adapter furnished with crawler on a grease gun that has a maximum capacity of 8000 psi.

To tighten track, apply grease with gun until the proper tension is achieved (Fig. 2).

IMPORTANT: Never, under any circumstances, use a grease gun to adjust track having a capacity higher than 8000 psi. Tee a pressure gauge (0 to 10,000 psi capacity) in grease gun tube to check pressure. If piston cannot be moved with this type grease gun, disassemble track adjuster and free seized parts.

To loosen track, first loosen jam nut on set screw of track adjusting cylinder. Then turn set screw counterclockwise a slight amount to relieve track tension. As pressure is relieved, grease will run out of hole in bottom of cylinder. Turn set screw in to original position and tighten jam nut.

IMPORTANT: Warn operator never to lubricate fitting on hydraulic track adjusting cylinder except when track is in need of adjustment.

When operating track in conditions where extreme soil packing occurs in track system, check track tension often as tension may increase when soil is picked up. Also check coils of recoil springs. Mud packing in the recoil spring can cause restriction of the idler travel and recoil action. This restriction can result in overstressing the track link assemblies, recoil mechanism, and final drive components.

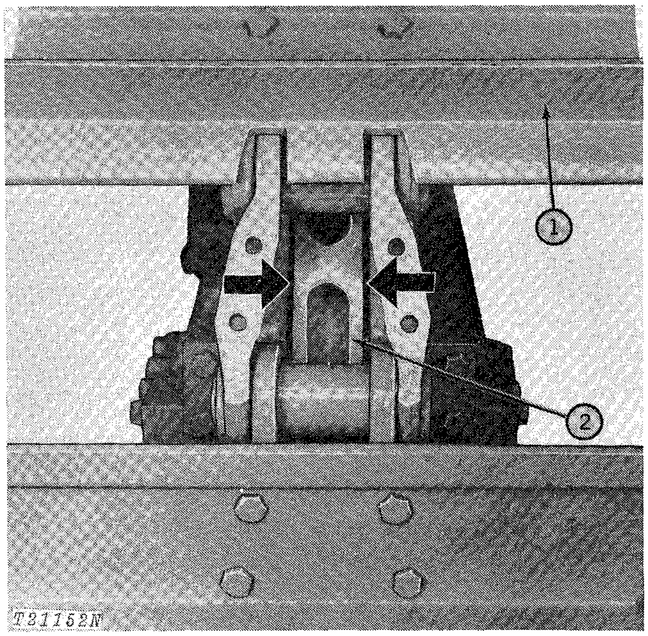
IMPORTANT: When forward edge of track front bracket is approximately 1-inch from the end of the track frame, track bushings and pins should be inspected for excessive wear. Replace excessively worn bushing and pins as needed. When the forward edge of the front idler and forward end of the track frame are in line, track assemblies are in need of reconditioning.

After adjusting for proper tension, check alignment and adjust if necessary.

Track Alignment

The importance of proper track alignment cannot be too greatly emphasized. If the sides of the drive sprockets and front idler flanges show heavy wear, the track is probably out of alignment.

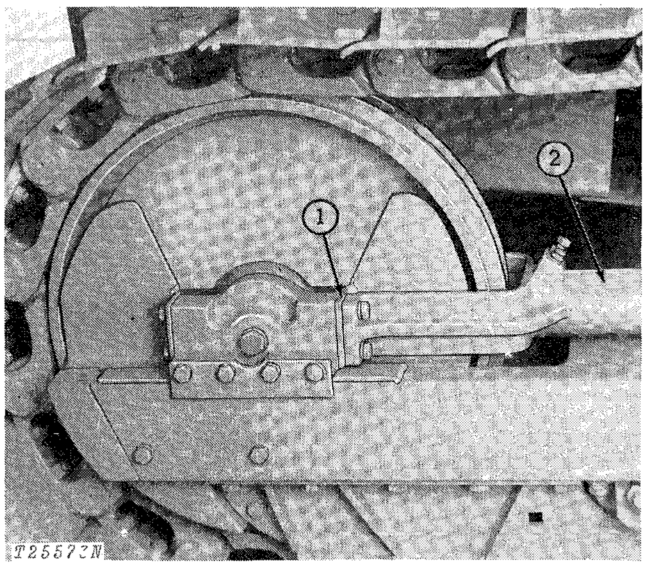
Check track alignment by driving forward on level ground for about 25 feet. Stop tractor without touching steering levers and examine location of the track link in relation to the front idler flanges (Fig. 3). (In the illustration one shoe has been removed for better visibility.)



1—Track Shoe 2—Track Idler

Fig. 3-Checking Track Alignment

If clearance between idler flange and track link is not equal on both sides of the idler, tracks are not properly aligned.



1—Adjusting Shims 2—Track Adjusting Cylinder

Fig. 4-Aligning Track Front Idler

Shims are provided on each side at the rear of track idler bracket to properly adjust position of track on front idler. Remove one shim at a time from the rear of idler bracket (Fig. 4) on the side of idler flange and track link having the least clearance. Remove one shim, then test by running the tractor in straight line. Proceed to remove shims until idler is centered between track links.

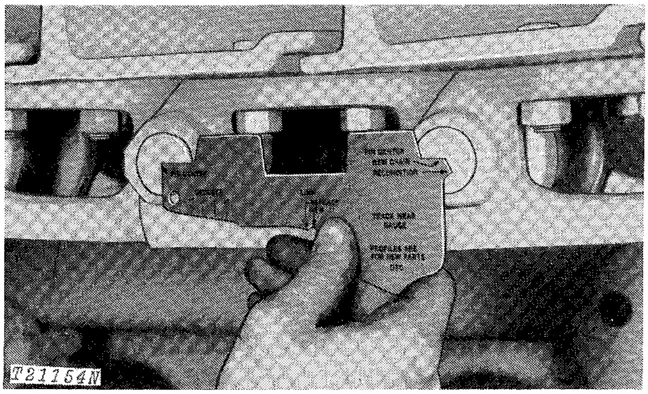
Using Track Wear Gauge

A track wear gauge (JD268A) is available, enabling the serviceman to quickly check the condition of a track assembly for use as a guide in replacing the track components. The track assembly components that can be checked are listed below and illustrated in Fig. 5.

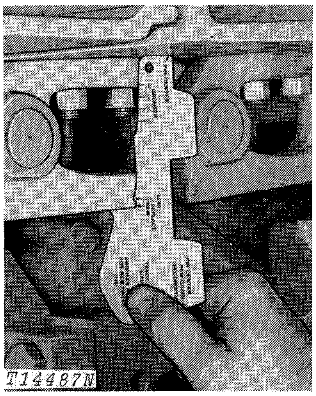
Pin and Bushing Wear - Position gauge on track link as shown. Place corner of gauge marked "Pin Center" at center of one pin and other end of gauge at center of next pin. If point of gauge marked "New Chain" falls at center of pin, track chain does not require servicing. If point marked "Recondition" falls on pin center, track pins and bushing are probably worn.

Link Wear - Position gauge on track link. With top of gauge (end with hole) against track shoe, check position of two arrows on gauge in relation to bottom of link. Link is worn if arrow marked "Replace" is at bottom edge of link.

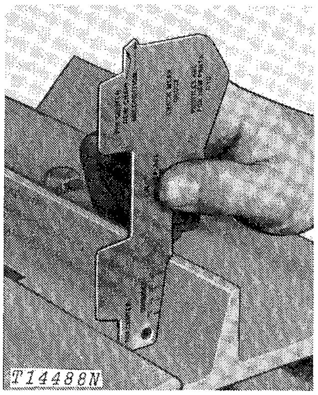
Grouser Wear - To measure amount of wear on grouser lugs, position gauge upright and against grouser lug. Point on gauge at which top of lug falls is amount of wear.



Pin and Bushing Wear



Link Wear

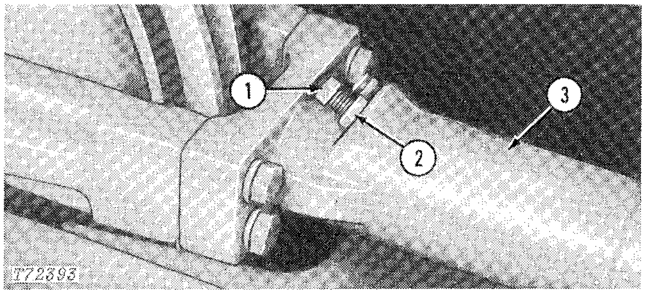


Grouser Wear

Fig. 5-Using Track Wear Gauge

REMOVAL

Drive the crawler forward until the master pin is on the front idler or raise the track off the ground using a service jack with at least 10 ton capacity and rotate track until master pin is on the front idler.

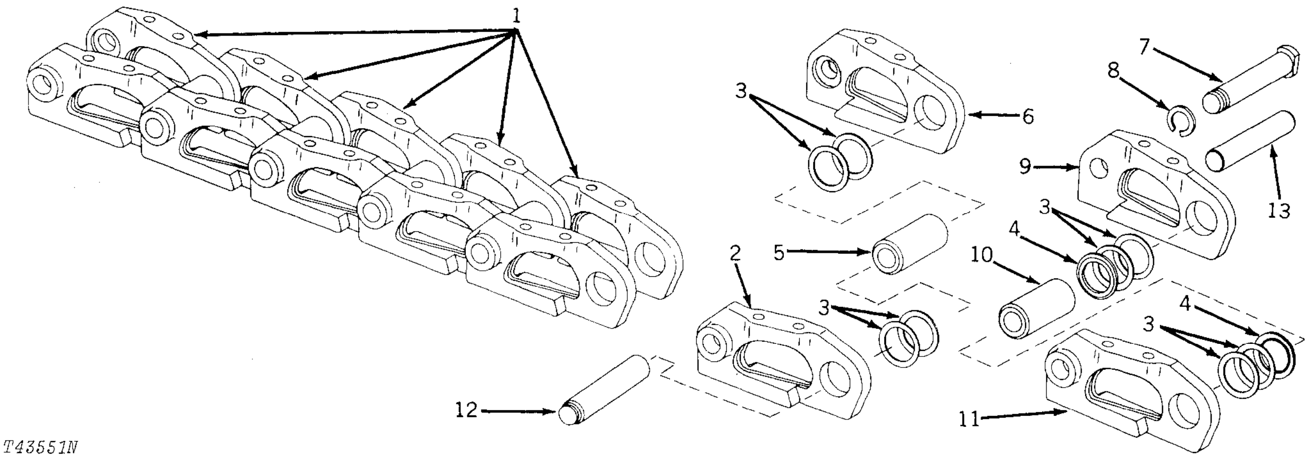


1—Set Screw
2—Nut
3—Track Adjusting Cylinder

Fig. 6-Track Adjusting Cylinder

Release track tension by loosening nut (2, Fig. 6) and turning the set screw (1) counterclockwise approximately three turns.

Put a piece of pipe between the sprocket and track chain and rotate the chain to retract the adjusting cylinder if required.



1—Track Chain
2—Left Track Link (35-Dozer, 36-Loader)
3—Seals (144-Dozer, 148-Loader)
4—Spacer (2 used)
5—Track Bushing (35-dozer, 36-Loader)
6—Right Track Link (35-Dozer, 36-Loader)
7—Track Master Pin
8—Snap Ring
9—Right Track End Link
10—Master Bushing
11—Left Track End Link
12—Track Pin (35-Dozer, 36-Loader)
13—Headless Master Pin

Fig. 7-Track Assembly and Shoes

CAUTION: High pressure can be present in track adjuster cylinder. Do not visually inspect grease vent hole.

Remove snap ring (8, Fig. 7) and track master pin (7). Move track assembly clear of drive sprocket. For units with a headless master pin (13), use the D-01030AA 50-ton Master Pin Pusher to remove headless master pin (Fig. 9).

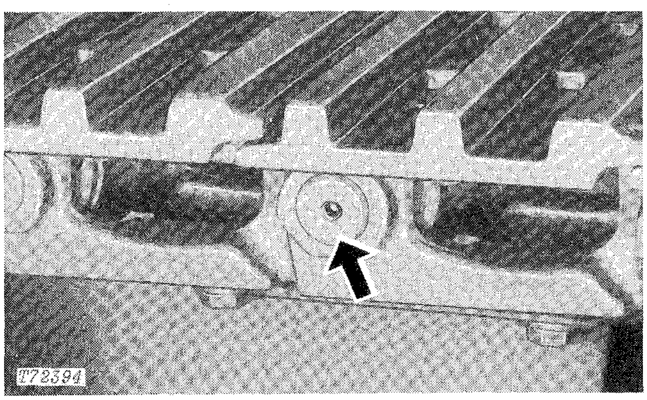
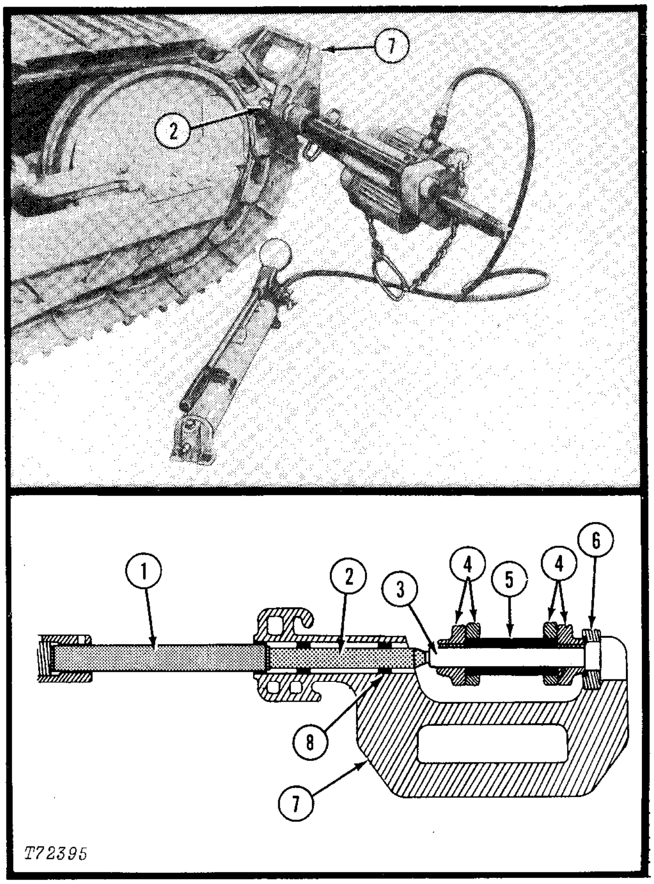


Fig. 8-Master Track Pin

The headless master pin (13, Fig. 7) can be identified by the drill point in the end of the pin (Fig. 8).

Remove the track shoe on each side of the master pin.



1—Forcing Pin
2—Forcing Pin
3—Master Pin
4—Side Links
5—Bushing
6—Aligning Adapter
7—"C" Frame
8—Aligning Bushing

Fig. 9-Removing Headless Master Pin

Install aligning adapter (6, Fig. 9) into C-frame and secure with holding screw.

Place forcing pin (2) into C-frame assembly.

Position master pin pusher over master pin, using a hoist with load positioning sling.

Advance ram adjusting screw with crank until forcing pin contacts track master pin.

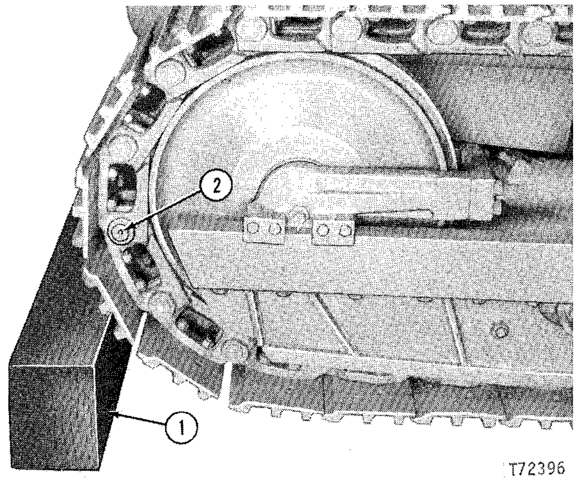
Attach hydraulic hand pump and activate ram to remove the master pin. Advance ram manually with crank and recycle as necessary.

NOTE: Forcing pin (2) replaces master pin in track.

Remove forcing pin from track links.

If a master pin pusher is not available, the master pin can be driven out using the following procedure:

CAUTION: Hitting a hardened steel pin can cause it to chip or break. Always wear safety glasses when hitting a hardened pin.

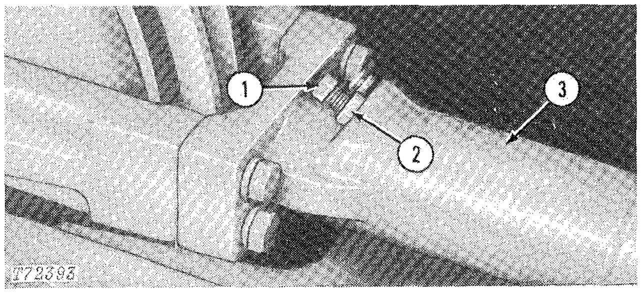


1—Wood Block
2—Master Pin

Fig. 10-Supporting Track Pad

1. Place the crawler on a hard level surface. Support the track shoe next to the master pin (2, Fig. 10) with a 4 x 4 inch wood block (1).

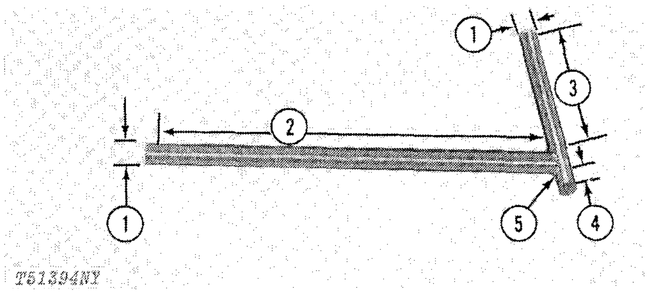
Do not remove any track shoes because they will provide support for the links during master pin removal.



1—Set Screw
2—Nut
3—Track Adjusting Cylinder

Fig. 11-Track Adjusting Cylinder

2. Release track tension by loosening nut (2, Fig. 11) and turning the set screw (1) counterclockwise approximately three turns.



1—7/8 Inch Round Bar
2—48 Inches
3—14 Inches
4—5-1/8 Inches
5—Weld

Fig. 12-Pin Driver

3. Make pin driver from 7/8 inch round bar stock (should not be heat treated steel). Approximately 68 inches will be needed. Cut to length and weld as shown in Fig. 12.

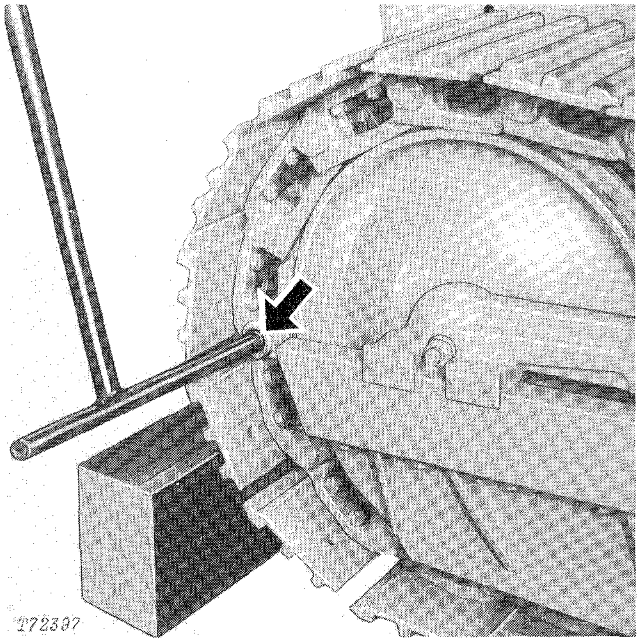


Fig. 13-Using Pin Driver

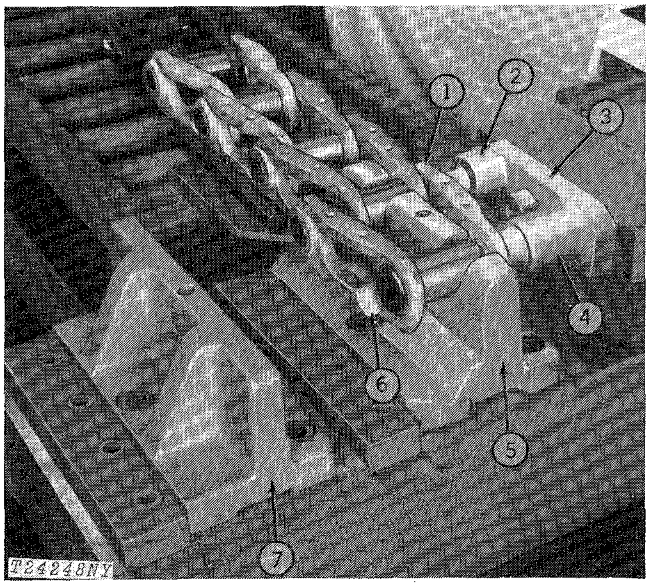
4. Remove the master pin using the pin driver (Fig. 13).

5. Lift the side of machine.

6. Slowly, turn the drive sprocket in the reverse direction to remove track.

7. Remove master link seals and spacers from track links.

Disassembly (Starting At Master Link)



1—Right-Hand Link
2—Pin Remove
3—26819 Disassembly Adapter Plate
4—Bushing Remover
5—40599 Saddle
6—Left-Hand Link Assembly
7—40706 Abutment

Fig. 14-Removing Right Hand Link

Install saddle (5, Fig. 14) and fasten it to track press frame with socket head cap screws.

Adjust conveyor extension to desired conveyor working height.

Remove outside row of cap screws (row away from work head or press) securing track shoes to link assemblies.

Install ram end disassembly adapter plate (3) to work head of press and secure with attaching nut. Install forcing sleeve to disassembly adapter and secure with socket head cap screw.

Raise the elevating conveyor and manually pull the track chain assembly toward the press operator until the link assembly bushing male end is directly over the top of the saddle.

Lower conveyor so that chain link assembly is indexed into saddle.

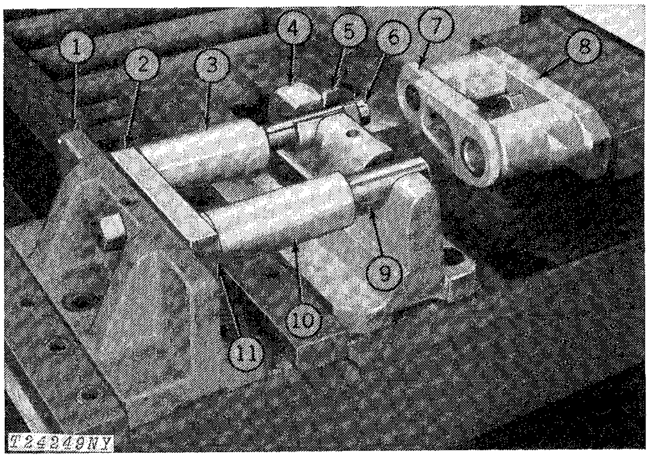
Advance work head of track press until the cam and disassembly adapter come in contact with bushing and pin. Press bushing and pin from right hand link. Remove right hand link with shoe as an assembly (Fig. 14).

Remove left hand link, with bushing and pin intact from saddle.

To remove pins and bushings from left-hand links, position saddle bushing spacer (pin side) (5, Fig. 15) on saddle (4). Advance work head of track press and remove bushing and pin from left hand link.

Continue these steps with each link assembly until the track is completely disassembled.

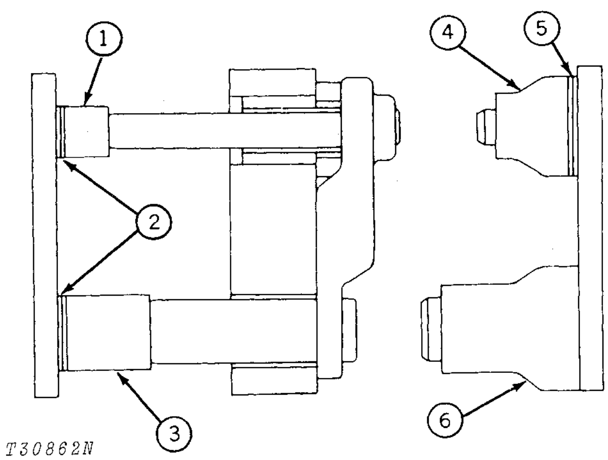
ASSEMBLY (Starting At Master Link)



1—40706 Abutment
2—24282 Rear Abutment Assembly Adapter Plate
3—30194 Pin Side Spacing Post
4—40599 Saddle
5—24284 Saddle Bushing Spacer (pin side)
6—Pin
7—Left-Hand Link
8—24288 Ram End Assembly Adapter Plate
9—Bushing
10—30174 Bushing Side Spacing Post
11—21887 Bushing Side Spacer

Fig. 15-Preparing Press for Track Pin and Bushing Installation

Remove cam end disassembly adapter from press head and install cam end assembly adapter. Install rear abutment assembly adapter on press as shown in Figure 15. Do not remove saddle.



1—Pin Abutment
2—Shims
3—Bushing Abutment
4—Pin Assembly Adapter
5—Shims
6—Bushing Assembly Adapter

Fig. 16-Installing Shims Behind Abutment Adapter Block

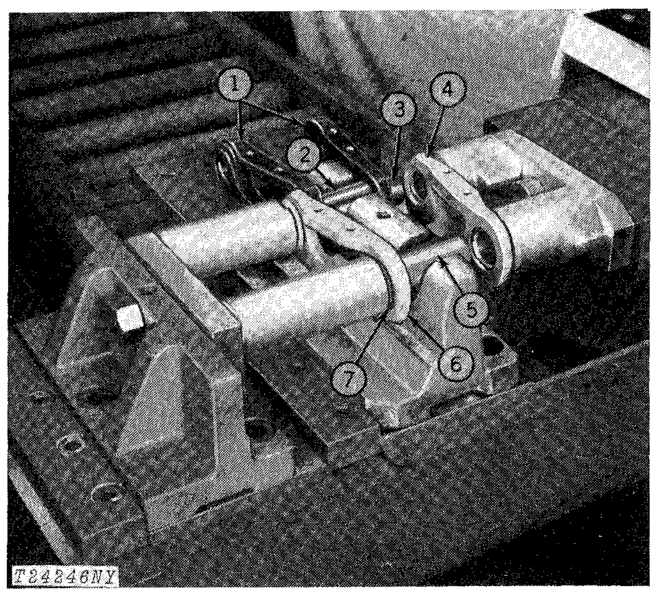
Position shims behind rear abutment assembly adapter blocks to align abutment blocks so that link assemblies remain loose during assembly.

With pin and bushing in saddle, position left link with track shoe mounting holes down between saddle and work head of press and press link onto pin and bushing.

NOTE: The track shoe mounting holes are in the down position. After the link is pressed onto the pin and bushing, it becomes the left hand link assembly.

After all left-hand links have been assembled with pins and bushings, remove the saddle bushing spacer (pin side) (5, Fig. 15).

With the conveyor in the raised position, install the left hand link assembly into the male end of the track chain. Lower the conveyor positioning the left hand link assembly into the saddle.



1—Master Links
2—Bushing
3—Pin
4—Right-Hand Link
5—Bushing
6—Left-Hand Link
7—26327 Master Bushing Spacer

Fig. 17-Installing Right Link to Left Link

Install right hand link, with track shoes attached, into position. Advance track press work head and press right hand link onto left hand link (Fig. 17). Continue to advance work head until right hand link assembly is properly positioned so that bolt holes in track shoes align with bolt holes in left link.

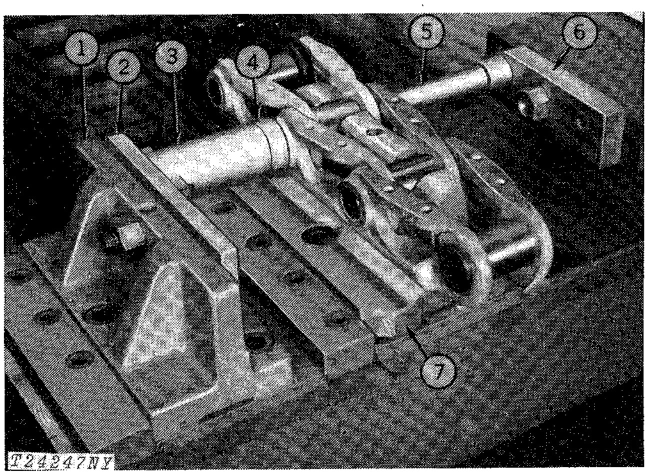
If a new right link is to be installed, it will be necessary to remove the track bolts securing the track shoes to the right hand link.

IMPORTANT: One link assembly should be completely assembled prior to assembling various components. This is recommended because it may be necessary, depending upon link wear, to vary the number of adjusting shims behind the rear abutment assembly adapter blocks.

NOTE: When the right hand link is pressed onto the pin and bushing, use care to properly align the track shoe bolt holes with the left hand link.

Continue these steps with each link assembly until the track is completely assembled.

Disassembly (Starting At Position Other Than Master Link)



1—40706 Abutment
2—32655 Rear Abutment Assembly Adapter Plate
3—32649 Pin Side Spacing Post
3—22776 Pin Side Spacer
5—32642 Removable Forcing Pin
6—32621 Disassembly Adapter Plate
7—40599 Saddle

Fig. 18-Tract Splitting Other Than Master Link

To replace a single bushing, pin, or link in the track system it is not necessary to completely disassemble the track. The procedure for this type of replacement is as follows:

Remove cap screws which secure track shoes to link assemblies that are to be disassembled.

Raise the elevating conveyor. Manually pull the track chain assembly toward the press operator until the link to be disassembled is directly over the top of the saddle.

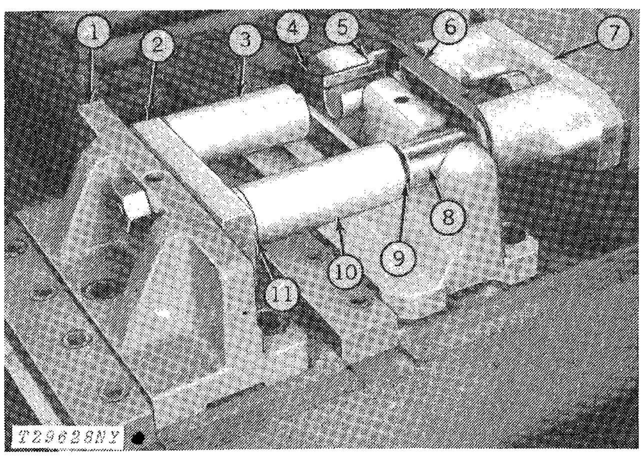
Lower conveyor so that chain link assembly is indexed into the saddle.

Advance ram head of track press until pin remover comes in contact with pin to be removed. Push pin from bushing. Raise track high enough to remove pin from pin side spacing post (3, Fig. 18). After pin has been removed from pin side spacing post, lower and advance track into position and remove remaining pin from link. With a cutting torch, cut bushings in two to free right- and left-hand links from the rest of track.

To remove cut bushing from track links (if links are to be re-used, attach disassembly adapter plate (3, Fig. 14) to track press ram.

Place link with cut off bushing in saddle. Advance ram head slowly until forcing sleeve comes in contact with the bushing to be removed. Push bushing from link. Repeat procedure until all cut-off bushings have been removed from links.

Assembly (Starting At Position Other Than Master Link)



1—40706 Abutment
2—24282 Rear Abutment Assembly Adapter Plate
3—30194 Pin Side Spacing Post
4—41959 Saddle
5—35596 Saddle Bushing Spacer
6—Left-Hand Link
7—35594 Ram End Assembly Adapter Plate
8—Master Bushing
9—20829 Master Bushing Spacer
10—30193 Bushing Side Spacing Post
11—24030 Bushing Side Spacer

Fig. 19-Master Bushing Installation

Press a master bushing (short bushing) into left-hand link. Turn link and bushing sub-assembly over 180° toward rear abutment and press on right-hand link. Continue until all cut-off bushings are replaced.

To assemble repaired section into track chain, remove ram end assembly adapter (7, Fig. 19), master bushing spacer (9), and saddle bushing spacer (5).

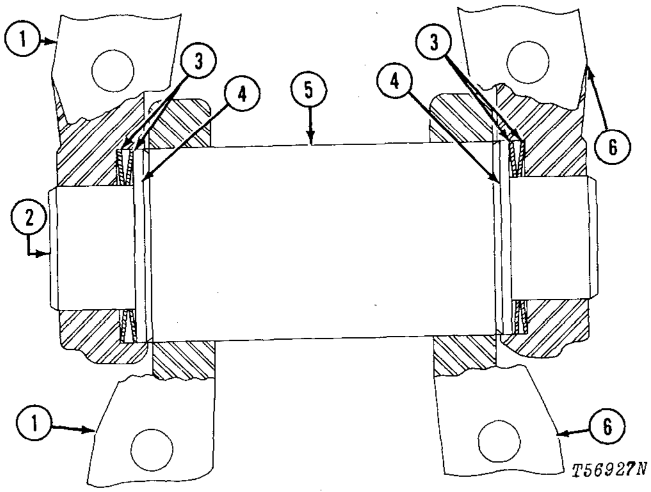
Secure pin side plunger (22764) to disassembly adapter plate (32621). Attach pin plunger and plate assembly to press ram.

Place track chain in saddle in final assembly position. Raise link high enough to position master bushing spacers into link counterbores. Lower link into alignment with master bushing and press in pin.

Continue this operation until track is assembled.

INSTALLATION (Headless Master Track Pin)

Install track assembly on the unit.



1—Right Track Link
2—Master Pin
3—Seals
4—Master Bushing Spacer
5—Master Bushing
6—Left Track Link

Fig. 20-Master Pin Connection

See Fig. 20 for correct installation of parts.

Install the track spacers (4, Fig. 20) in the counterbores with the flat side against the seal.

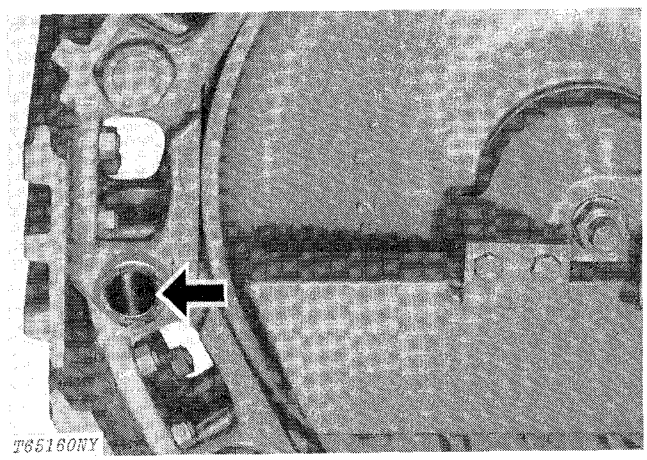
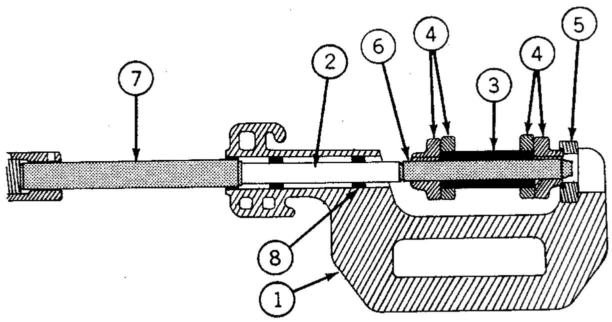


Fig. 21-Track in Alignment

Align links with track bushings (Fig. 21).



T45601N

1—"C" Frame
2—Master Pin
3—Bushing
4—Side Links
5—Aligning Adapter
6—Forcing Pin
7—Forcing Pin - 2-1/4" Dia.
8—Aligning Bushing

Fig. 22-Master Pin Assembly

Refer to Fig. 22 when using D-01030A master pin pusher to push master pin (2) into master pin side links (4).

With the same two track shoes removed as before, use a hoist to raise master pin pusher near master pin hole.

Use the same aligning adapter (5) as used for removing.

Place the flattened forcing pin (6) into master pin hole. Insert master pin (2) through aligning bushings (8) and into the hollowed out portioned in the "C" frame (1).

Place "C" frame securely around forcing pin (6, Fig. 22) and tighten forcing screw. This will apply just enough pressure to hold master pin pusher in place.

Use the hydraulic hand pump and pump until pressure forces out forcing pin (6, Fig. 22) and replaces it with the master pin.

NOTE: When installing a new master pin, it is recommended that the complete master pin kit be installed. The kit contains a master pin, two spacers and four seals.

If a master pin pusher is not available, the master pin may be driven in using the pin driver (Fig. 13) and the following procedure.

CAUTION: Striking hardened steel pins may cause them to chip or break. Always wear safety glasses when striking hardened pins.

Thoroughly clean master pin and links.

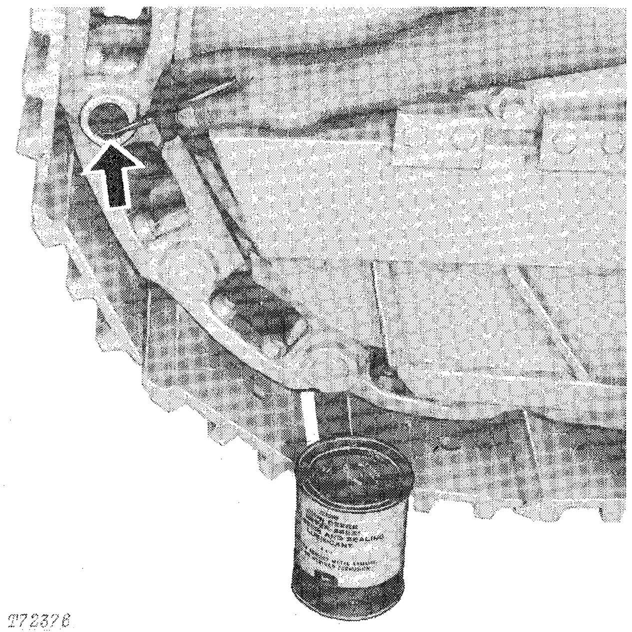

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Fig. 23-Coating Pin Bore

Coat the pin bore (Fig. 23) on the left and right hand side of the track with John Deere Never-Seez or an equivalent.

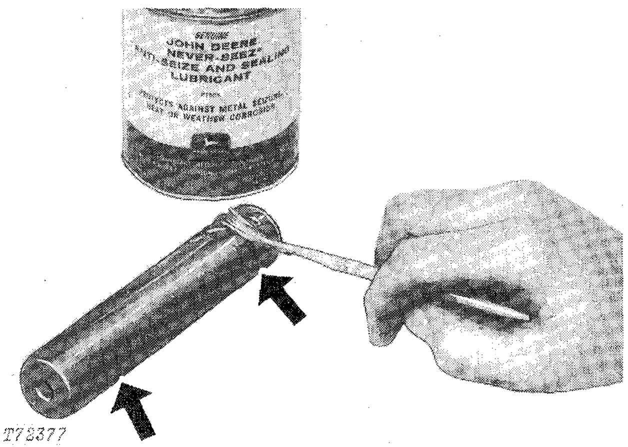

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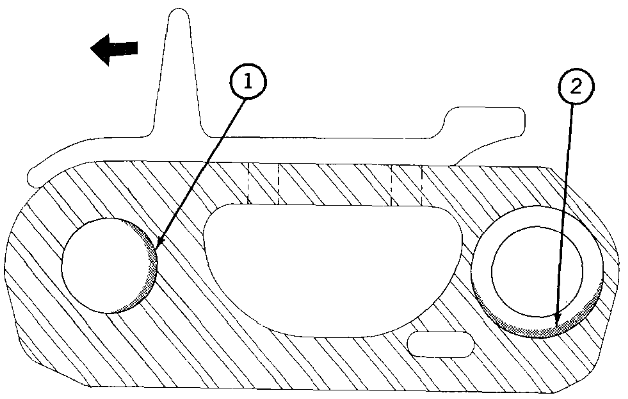
Fig. 24-Coating Master Pin

Coat the master pin (Fig. 24) approximately 1 inch from both ends with John Deere Never-Seez or an equivalent.

Drive the master pin through the track chain until it extends equally from the left and right-hand track links.

Align track and adjust tension.

Turning Pins and Bushings



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1—Worn Side of Pin **2—Worn Side of Bushing**

Fig. 25-Turning Track Pins and Bushings

The wear on pins and bushings does not extend over the entire surface of these parts; the life of worn pins and bushings can often be restored by turning them 180 degrees with respect to the track link (Fig. 25).

SPECIFICATIONS

Item	New Part	Wear Tolerance
Track and Shoes		
Rubber shoe width	13 in.	
Triple semi-grouser	13 or 14 in.	
Grouser	14, 16, or 18 in.	
Notched grouser, open center	14 or 16 in.	
Open center grouser	14, 16, or 18 in.	
Number of track shoes per track (loader)	37	
(dozer)	36	
Track gauge (center to center)	52	
Track sag (measured between rear sprocket and track carrier roller)	7/8 to 1-1/8 in.	
Pins, Bushings, and Links		
Pin and bushing clearance (factory parts)	0.0035 to 0.0245 in.	
Pin, dia. (replacement) (identify by step on end)	1.3740 to 1.3790 in.	
Pin, dia. (factory)	1.3715 to 1.3765 in.	
Master pins, dia.	1.3680 to 1.3690 in.	
Bushing outside dia. (replacement)	2.0075 to 2.0085 in.	
Bushing outside dia. (factory)	2.0055 to 2.0065 in.	
Bushing inside dia. (replacement)	1.382 to 1.398 in.	
Bushing inside dia. (factory)	1.380 to 1.396 in.	
Diameter of pin hole in link	1.3660 to 1.3690 in.	
Diameter of bushing hole in link	1.9985 to 2.0015 in.	
Center of pin hole in link to center line of bushing hole	6.288 to 6.292 in.	
Undercarriage		
Track pitch	6.29 in.	6.45 in.
Link height	3.38 in.	3.19 in.
Grouser height	1.95 in.	0.78 in.
Idler flange height	0.76	0.91 in.
Carrier flange height	0.58	0.64 in.
Track roller diameter	7.18 in.	6.80 in.
Pin boss clearance	0.30 in.	0.00 in.

TORQUE VALUES

Item	Torque (ft-lbs)
Track shoe cap screws (lubricate cap screw before assembly)	120 ± 12

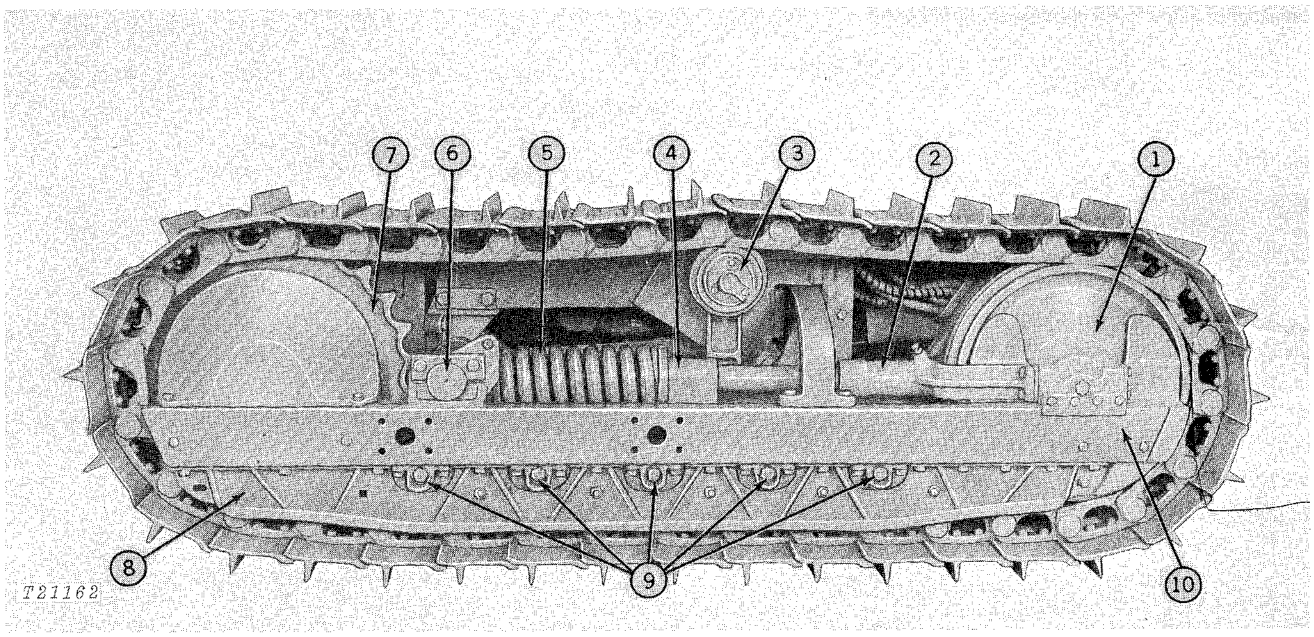
SPECIAL TOOLS

No.	Name	Use
JD268A	Track Wear Gauge	Check crawler track and track system component parts
Y760	60-Ton Owatonna Track Press	Track disassembly and assembly

Group 10

TRACK CARRIER ASSEMBLY

GENERAL INFORMATION



1—Front Idler
2—Track Adjusting Cylinder
3—Track Carrier Roller
4—Spring Retainer Plate
5—Idler Spring
6—Rear Crossbar
7—Drive Sprocket
8—Rock Guard
9—Track Rollers
10—Track Frame

Fig. 1-Track Carrier Assembly

Each track carrier assembly (Fig. 1) consists of welded rolled channels of high-strength steel which support the individual roller assemblies and the front idler with its adjusting mechanism. The assembly is fastened to the fixed crossbars which support the tractor.

The individual roller assemblies used on the track bolt directly to the lower edges of the carriers and distribute the weight of the tractor evenly on the tracks. Each roller assembly consists of a forged-steel roller with two replaceable bronze bushings which rotate on a hardened steel shaft.

The front idler assemblies are held in place on the track carriers by idler brackets which are shim adjusted so they will slide freely on the track frame.

The idler springs and caps are compressed by means of a special bolt which is removed when spring is installed on track frame. Track tension adjustments are made by hydraulically shifting the entire idler wheel assemblies forward or backward on the carrier assemblies.

The rollers and front idlers are factory lubricated and sealed with metal face type seals.

The track carrier roller assembly is located approximately in the center of the track frame. Its cast roller has two replaceable bronze bushings which rotate on a hardened steel shaft pressed into the mounting bracket.

DIAGNOSING MALFUNCTIONS

Possible results of improper track adjustment are listed below.

Loose Track

If this condition exists, the following may result:

1. Extremely fast wear on pins, bushings, and track links.

2. Unnecessary and rapid wear on sides of drive sprocket teeth and idler wheel flanges.

3. Possible damage to, or breakage of, drive sprocket, idler wheel and idler wheel bracket, fenders, side frames, and rollers.

4. Track may jump sprocket in both forward and rearward operation. Track may be thrown off when tractor is turned.

5. Noisy track.

6. Frequent accumulation of trash in track.

Tight Track

If this condition exists, the following may result:

1. Extreme loss of drawbar power and ground speed. Tractor will not handle rated working load.

2. Drifting of tractor to right or left, depending on which track is the tighter.

3. Fast wear on pins, bushings, and track links.

4. Excessive and rapid wear on drive sprockets and idler wheels. Undue strain on entire track system because track flexibility is lost.

5. Unnecessary wear on final drive bearings and oil seals.

6. Abnormal steering clutch wear.

Misaligned Track

If this condition exists, the following may result:

1. Drifting of tractor from a direct course.

2. Abnormal wear on idler wheel flanges and front idler flanges.

3. Excessive track link and drive sprocket wear.

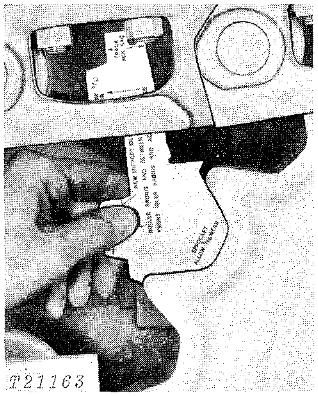
4. Rapid steering clutch and brake wear.

5. Operator annoyance and fatigue caused by the constant necessity of steering the tractor to keep it from drifting.

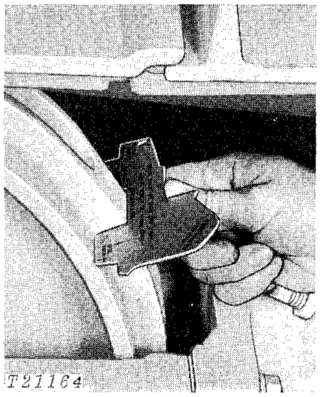
INSPECTION AND REPAIR

Using Track Wear Gauge

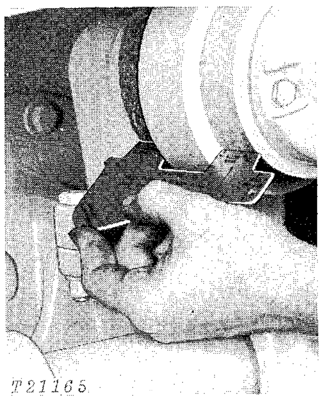
A track wear gauge (JD-268A) is available to enable the serviceman to quickly check the condition of many of the components on the track carrier assembly. The components on the track carrier assembly that can be checked are listed below and illustrated in Figure 2.



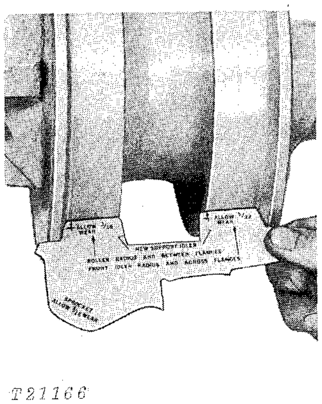
Sprocket Wear



Front Idler Wear



Support Idler Wear



Track Roller Wear

Fig. 2-Using Track Wear Gauge

Sprocket Wear: Place rounded portion of gauge against root of sprocket. See "gauge" for wear allowed before replacement is considered.

Front Idler Wear: The front idler has a tendency to wear on the sides and outer surface of the idler flanges. Place the gauge large cutout notch over the idler flanges. Push the gauge to one side against side of idler flange. Allowable wear is shown by arrows on gauge.

Support Idler Wear: Place gauge over support idler so that large cutout is over raised portion of idler. The lines on gauge will match outer edge of center flange on a new idler. Wear is reflected by the distance the center flange passes the line of gauge.

Track Roller Wear: Roller will wear on the sides and outer surface of roller flanges. Place gauge between roller flanges as shown. Allowable wear on outer surface and side of rollers is shown by arrows on gauge.

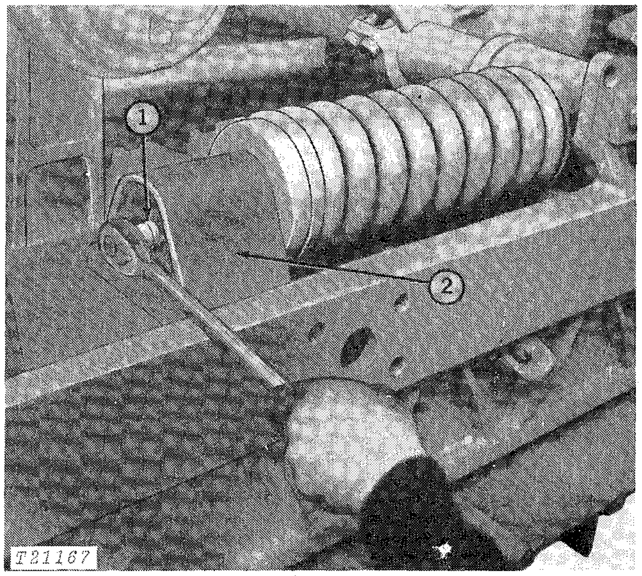
Removing Track Rollers Only

NOTE: Due to the design of the track frame assembly, it is possible to remove the track rollers individually.

To remove roller, remove outer rock guard, loosen inner rock guard, and release tension from track. Place jack or hoist under front and rear crossbar and raise tractor high enough to allow removal of roller.

Track Idler Recoil Spring

To remove idler recoil spring, disconnect track (Group 5) and pull front idler forward. Insert a Special Bolt (T 16678) with one-inch spacer through the track spring retainer plate and thread into the rear spring cap (Fig. 3). Tighten bolt until spring is free. Lift spring from track frame.



1—Special Bolt **2—Spring Retainer Plate**

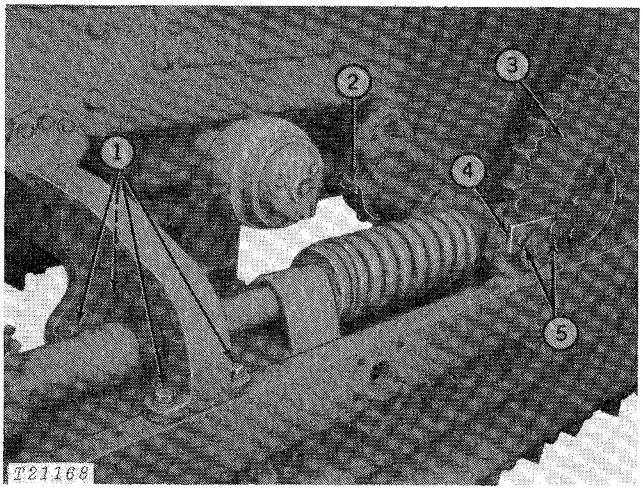
Fig. 3-Removing Track Idler Recoil Spring

NOTE: When sliding front idler assembly forward, do not pull track adjusting piston from cylinder as scraper seal on cylinder may damage piston seal (quad ring seal, early units) on piston.

CAUTION: Use care when handling spring as accidental release of spring can cause serious personal injury. Do not, under any circumstances, attempt to remove spring without special bolt.

Track Carrier Assembly

Remove track (Group 5 of this Section).



1—Front Attaching Point
2—Rear Crossbar Cap
3—Drive Sprocket
4—Shims
5—Retainer Cap Screws

Fig. 4-Removing Track Carrier

Remove track drive sprocket (Fig. 4).

Slide front idler assembly from track frame.

Remove six cap screws from front crossbar. Take out cap screws in rear crossbar retainer and remove retainer and shims.

Place a jack or hoist under both crossbars and raise tractor until roller flanges clear the track. Drive carrier assembly free from rear crossbar and slide clear of tractor.

IMPORTANT: Do not lose or damage shims during track carrier removal.

Track Rollers

Refer to Fig. 12 and remove the two cap screws and lock-washers which attach the roller brackets (7) to the roller shaft (16). Slide brackets and seals (9) free from roller assembly half of seal will remain with bracket. Remove the 6 socket head cap screws (10) and slip off thrust plate (12) and shims (13). Roller shaft can now be pulled free from roller. Remove thrust plate and shims from outer side of roller.

Track Front Idler

Refer to Figure 13 and remove idler brackets (5) from adjusting cylinder crosshead. Unscrew cap screws (1) from shaft (11) and remove idler brackets with oil seal (6).

Remove the six cap screws and slip the thrust plate and shims from the idler shaft. The idler shaft can now be pulled free from the idler wheel. Remove thrust plate and shims from other side of idler wheel.

Track Carrier Roller

Remove the cap screws which attach cover to idler and lift cover and shims free from idler. Take out the two socket head cap screws and remove the thrust plate. The track carrier roller and half of seal can now be pulled from its mounting shaft. Remove track carrier support from track carrier.

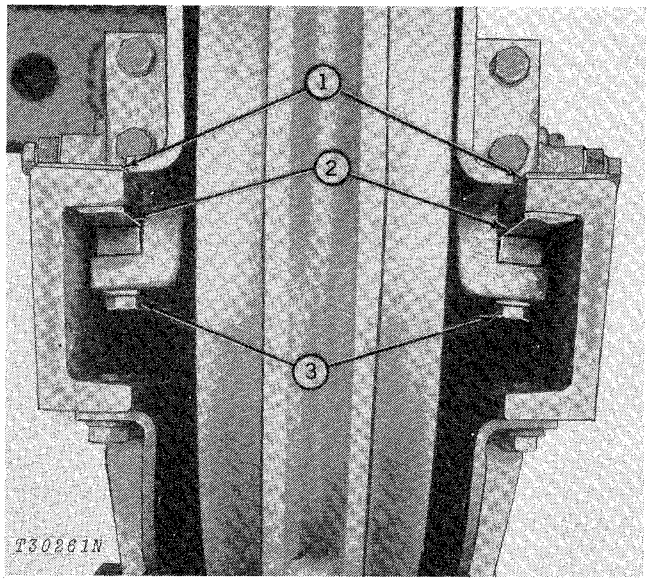
Track Frame

Due to welded construction of the track frame, no further disassembly of the frame should be attempted except for the track channel wear strips which can be removed if worn.

Inspect for bent channel frames, excessive wear on idler rails, cracked or broken welds. Since no integral parts of the carrier (except wear strips) are furnished as repair parts, it will be necessary to replace the entire frame if damage is such that it cannot be repaired by straightening or welding the damaged parts.

Inspect front idler wear strips on track frame channels for wear. If strips are excessively worn refer to Figure 5 and replace according to the following procedure.

Replacing Track Frame Channel Wear Strips



1—Wide Wear Strip
2—Narrow Wear Strip
3—Idler Bracket Cap Screws

Fig. 5-Replacing Track Channel Wear Strip

IMPORTANT: Disconnect battery ground strap before doing any welding on the crawler. Failure to do so may damage the electrical system.

Release track cylinder pressure to loosen track. Remove master track pin and split track.

The front idler wheel, idler bracket, crosshead, and tube can be removed from the track frame as a unit. However, it may be necessary to loosen or remove the cap screws that screw into the underside of the idler bracket. See Fig. 5.

IMPORTANT: Be careful not to pull piston from track adjusting cylinder as piston seal may be damaged.

Grind off the old wear strips on the track frame channel so that none of the strips or welds remain.

Install new wear strips.

NOTE: The wide wear strips fit on top of the track channel. The narrow strips fit underneath. See Fig. 5.

Recommended Welding Procedure

1. Remove dirt, oil and paint from areas to be welded.

2. Use 5/32-inch diameter low hydrogen AWS-ASTM E-7018 covered electrode.

NOTE: Flux covering on low hydrogen electrodes readily takes on moisture which causes welding problems. Be sure electrodes are dry. Electrodes stored in open containers should be suspected of containing excessive moisture and may require baking prior to use.

3. Use AC or DC reversed polarity welding current [ELECTRODE POSITIVE (+)].

4. The suggested amperage range is 100 to 115 amps.

When putting on new wear strips, do not clamp wear strips firmly to channel. A secure clamping which still allows a slight wear strip shift will prevent cracking of weld fillet during the cooling process.

Weld the narrow wear strips to track frame channel, melting as little as possible of the wear strips by starting and maintaining the arc primarily on the track frame channel. The wear strip is a high carbon steel, so best results are obtained by washing the weld metal toward the wear strip. This will produce a slightly convex weld fillet.

Weld the wide wear strips to track frame channel using the same procedure as for the narrow wear strips.

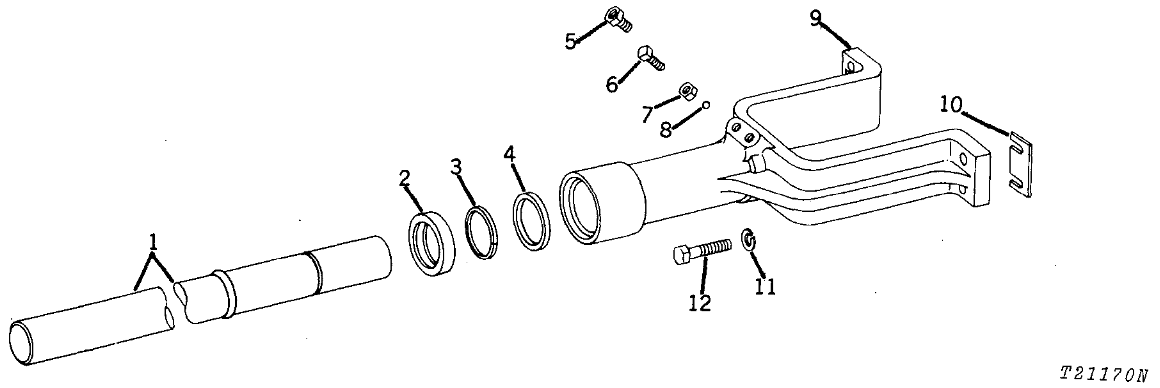
Reinstall front idler and bracket assembly. Adjust wear plate with the maximum of shims that will still allow the idler bracket to slide freely on the track frame. This may require removal of some of the shims.

Join track and install master pin and snap ring.

NOTE: To adjust track tension and to check track alignment, refer to Group 5 of this Section.

Connect negative battery ground strap.

Hydraulic Track Tension Adjuster



1—Piston (-140454)
Piston (140455-)
2—Scraper Seal
3—Back-up Washer (-140454)
4—Quad Ring Seal (-140454)
Piston Seal (140455-)
5—Grease Fitting
6—Set Screw
7—Jam Nut
8—Ball
9—Yoke
10—Shim (6 used)
11—Lockwasher (4 used)
12—Cap Screw (4 used)

Fig. 6-Hydraulic Track Tension Adjuster

IMPORTANT: Do not pull piston from track adjusting yoke unless scraper seal and piston seal (quad ring seal, early units) are to be replaced or seals will be damaged.

Pull track adjusting piston from yoke. Remove scraper-type oil seal and discard. Inspect yoke for damage. Replace if necessary.

Remove piston seal (quad ring seal and back-up washer. early units) from piston. Examine piston for evidence of bending or other damage.

Use a JD284 Track Adjuster Tool Set to install piston seal, oil seal and piston in cylinder. Make sure all parts are clean before starting the following steps:

Insert the oil seal (1, Fig. 7), metal side up, on the piston (2). Set the conical seal installation tool (3) on end of piston and lubricate tool.

Insert the piston seal (4) onto conical tool, groove side up. Using the seal installation driver (3), drive the piston seal onto recessed area of piston.

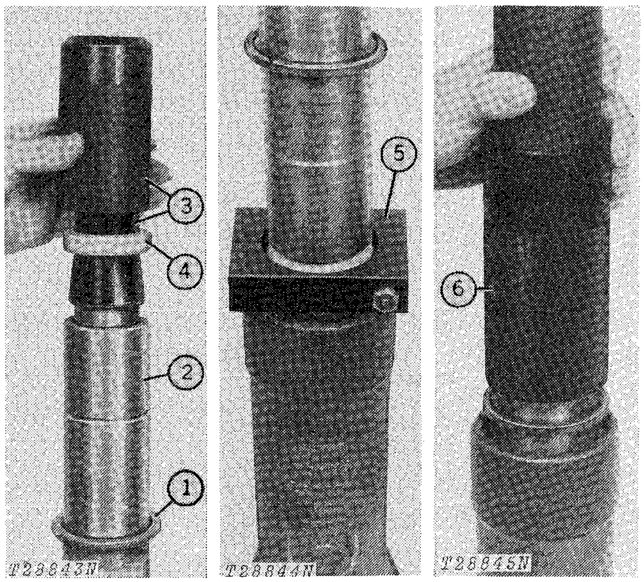
Insert approximately two tablespoons of grease in cylinder and lubricate top two inches of cylinder wall.

Install piston guide (5) on cylinder, with square flange to the top. Tighten bolts and lubricate inside diameter of flange.

Place piston with seal end into flange. Force downward by hand until piston seal clears the flange. Remove piston guide.

Using a dust seal driver (6), drive the oil seal into the recess of the cylinder.

NOTE: If grease has been removed from track adjusting cylinder or if a new cylinder is installed, bleed cylinder as follows: (a) With cylinder release screw loosened, place a small amount of grease (see Section 10) in bottom of cylinder. (b) Move piston to bottom of bore without seating oil seal. A small amount of grease should be forced out bleed hole. If necessary, add grease and repeat procedure until grease is observed at bleed hole. Seat oil seal as described above and tighten release screw.

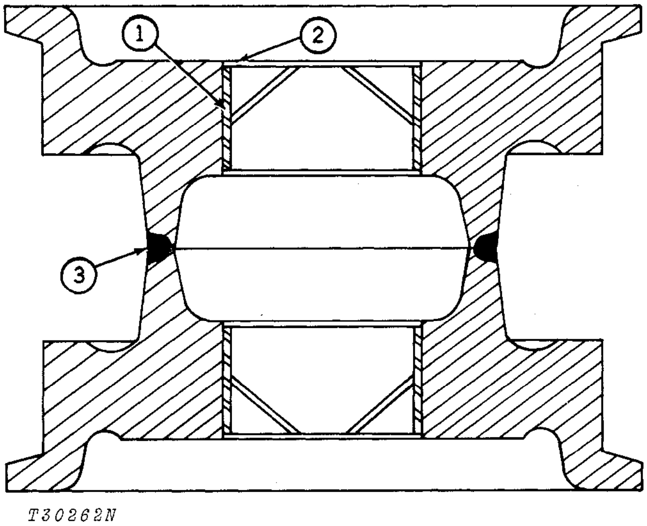


1—Oil Seal
2—Piston
3—JD284-1
4—Piston Seal
5—JD284-3
6—JD284-2

Fig. 7-Using Track Adjuster Tool Set

Track Rollers and Front Idlers

Inspect bushings in rollers and front idlers for scoring or excessive wear. The I.D. of the roller bushing is 2.3785 inches to 2.3795 inches and the I.D. of the front idler bushings is 2.6285 to 2.6295 inches. If it is necessary to replace the bushings, use a suitable driver to press old bushings out. Install a new bushings 1/32 inch below face of roller (Fig. 8).



1—Bushing
2—Locate Bushing Below Face
3—Track Roller (Later Model Shown)

Fig. 8-Correct Location of Bushing in Track Rollers

NOTE: Replacement roller and idler bushings are presized and, therefore, do not need to be sized after installation.

Check roller (O.D. 2.3745 to 2.3755 inches) and idler shafts (O.D. 2.6245 to 2.6255 inches) and thrust plates for damage or excessive wear. Make sure oil passages in shafts are open. Note condition of oil seals. Replace all unserviceable parts.

Track Idler Recoil Spring

Check to see that spring (Fig. 9) is in good condition. Replace if it has taken a permanent set.

If spring has been removed from track frame it must be compressed to a length of 16 inches (between outer ends of spring caps). Compress spring and cap in a press and install a special bolt to hold the spring at 16 inches.

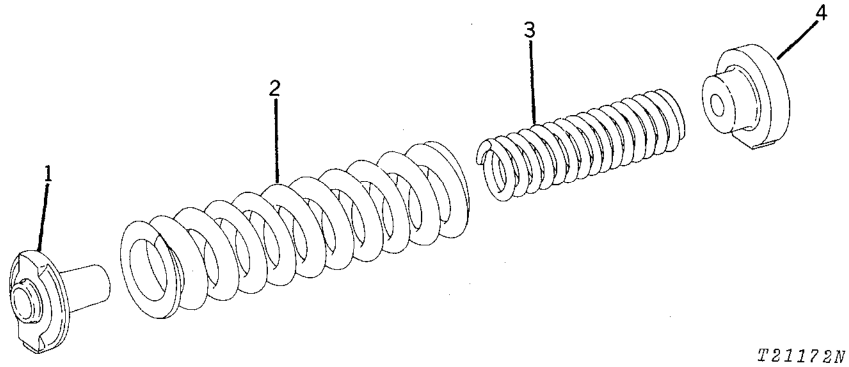
CAUTION: Always use the special bolt or a bolt similar in strength to prevent accidental release of idler recoil spring.

Track Carrier Rollers

Examine bushing in track carrier roller for scoring or excessive wear. The I.D. of the bushing is 1.377 inches to 1.379 inches. Use a suitable driver to install new bushing to bottom of chamfer on outside of roller bore.

Inspect oil seal in carrier support. Keep seals in pairs as removed. It is recommended the new seal kit be installed.

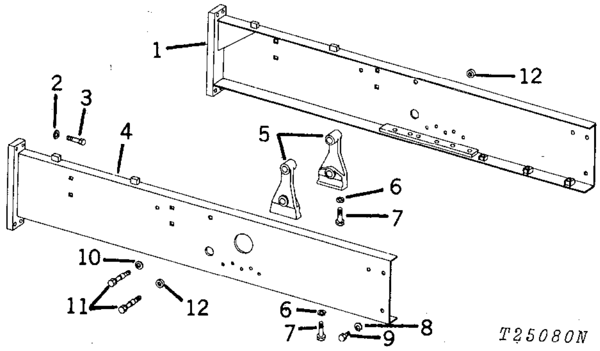
Inspect track carrier roller shaft (O.D. 1.3745 to 1.3750 inches) for damage and excessive wear. This shaft can be replaced by removing old shaft from support bracket and pressing new one into bracket. The shaft dimension should be 5.850 inches above the face of seal bore.



1—Rear Cap 2—Spring 3—Idler Auxiliary Spring 4—Front Cap

Fig. 9-Track Idler Recoil Spring

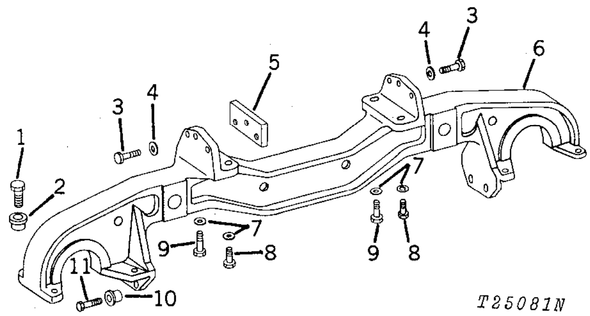
Side Frames



1—Left Side Frame
2—Special Washer (8 used)
3—Cap Screw (8 used)
4—Right Side Frame
5—Spacer (2 used)
6—Special Washer (4 used)
7—Cap Screw (4 used)
8—Lock Washer (6 used)
9—Cap Screw (6 used)
10—Special Washer (2 used)
11—Cap Screw (4 used)
12—Spacer (2 used)

Fig. 10-Side Frames

Front Crossbar

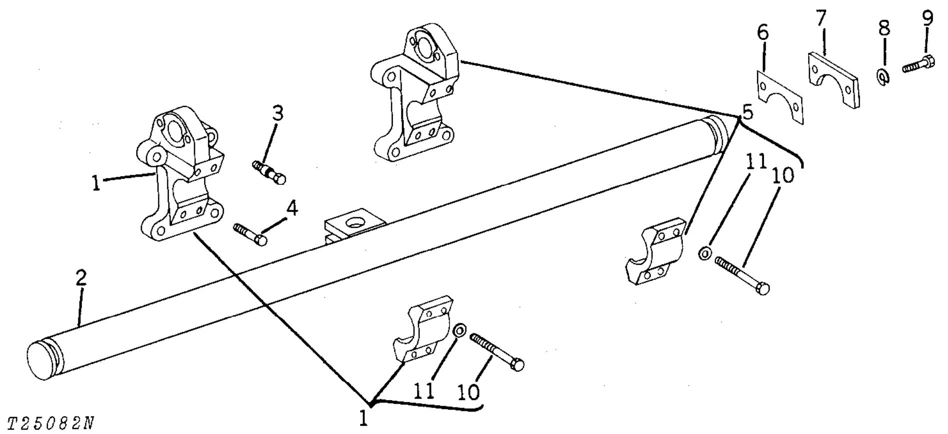


1—Cap Screw (8 used)
2—Spacer (8 used)
3—Cap Screw (6 used)
4—Special Washer (6 used)
5—Tapping Bar (2 used)
6—Front Crossbar
7—Special Washer (4 used)
8—Cap Screw (2 used dozer 4 used loader)
9—Cap Screw (2 used dozer)
10—Spacer (4 used)
11—Cap Screw (4 used)

Fig. 11-Front Crossbar

Tighten side frame-to-steering clutch housing cap screws (3) to 170 ft-lbs prior to tightening side frame-to-clutch housing cap screws (11) to 445 ft-lbs.

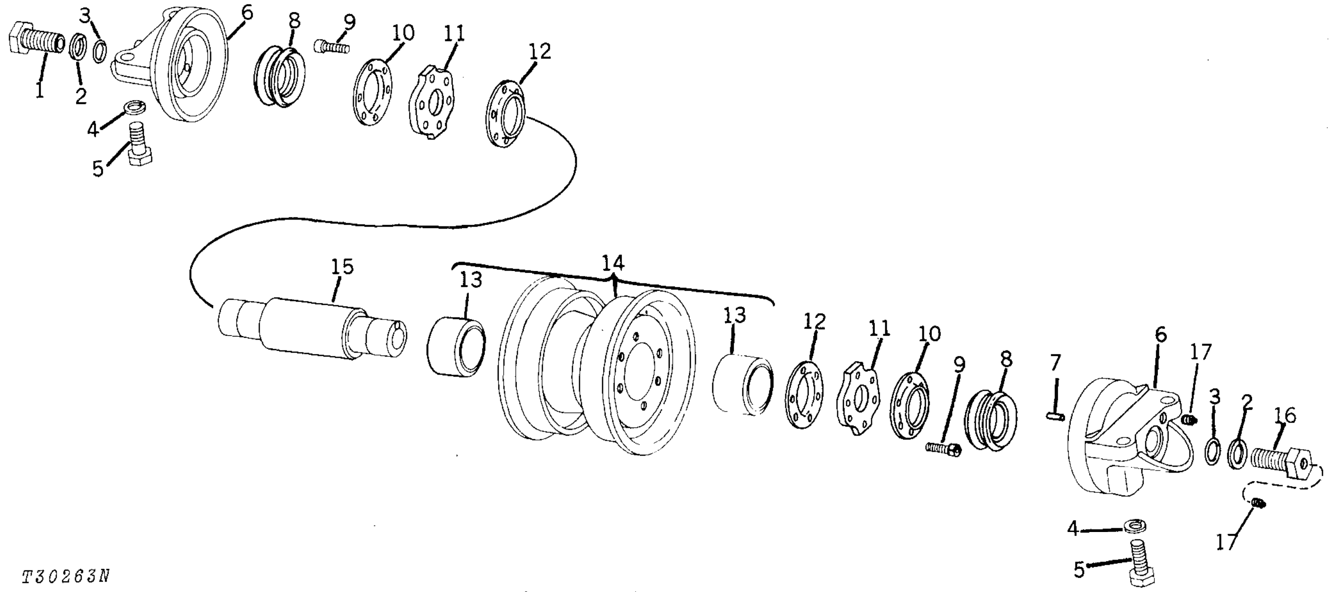
Rear Crossbar



1—Right Rear Bar Bracket
2—Rear Crossbar
3—Cap Screw (4 used)
4—Cap Screw (4 used)
5—Left Rear Bar Bracket
6—Shim (approx. 6 used)
7—Retainer (2 used)
8—Lock Washer (4 used)
9—Cap Screw (4 used)
10—Cap Screw (8 used)
11—Special Washer (8 used)

Fig. 12-Rear Crossbar

Track Roller Assembly (Fig. 13)



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- 1—Cap Screw
- 2—Special Washer (2 used)
- 3—O-Ring (2 used)
- 4—Lock Washer (4 per roller)
- 5—Cap Screw (4 per roller)
- 6—Roller Bracket (2 used)
- 7—Pin (1 used)
- 8—Oil Seal (2 used)
- 9—Cap Screw (12 used)
- 10—Seal Ring (2 used)
- 11—Thrust Plate (2 used)
- 12—Shim (2 used)
- 13—Bushing (2 used)
- 14—Roller Assembly
- 15—Shaft
- 16—Special Cap Screw
- 17—Plug (2 used)

Fig. 13-Track Roller Assembly

NOTE: Lubricate bushings in track rollers with oil before installing roller shaft.

Position shaft (15, Fig. 13) in roller and install a thrust plate (11) on each side, using one shim (12) under each thrust plate. Install seal rings (10) and tighten the socket head cap screw (9) to 45 to 55 ft-lbs.

Place oil seal into counterbore in roller bracket. Bore must be degreased with clean solvent prior to installing seal. Washer with retainer is to be installed first into seal ring.

Slip roller bracket (6) onto end of shaft (end without hole) and install O-ring (3), cap screw (1) and flat washer. Tighten finger tight.

Degrease sealing surface and install seal into its bore. Position pin and slip roller bracket on shaft. Complete assembly by installing O-ring, flat washer and cap screw.

Tighten inner bracket cap screw to 300 ft-lbs. and outer bracket cap screw to 210 ft-lbs.

Fill assembly with approximately 3/8 pint SAE 30 oil.

Track Front Idler and Track Adjusting Mechanism Assembly (Fig. 14)

For identification and correct location of parts, refer to Figure 14.

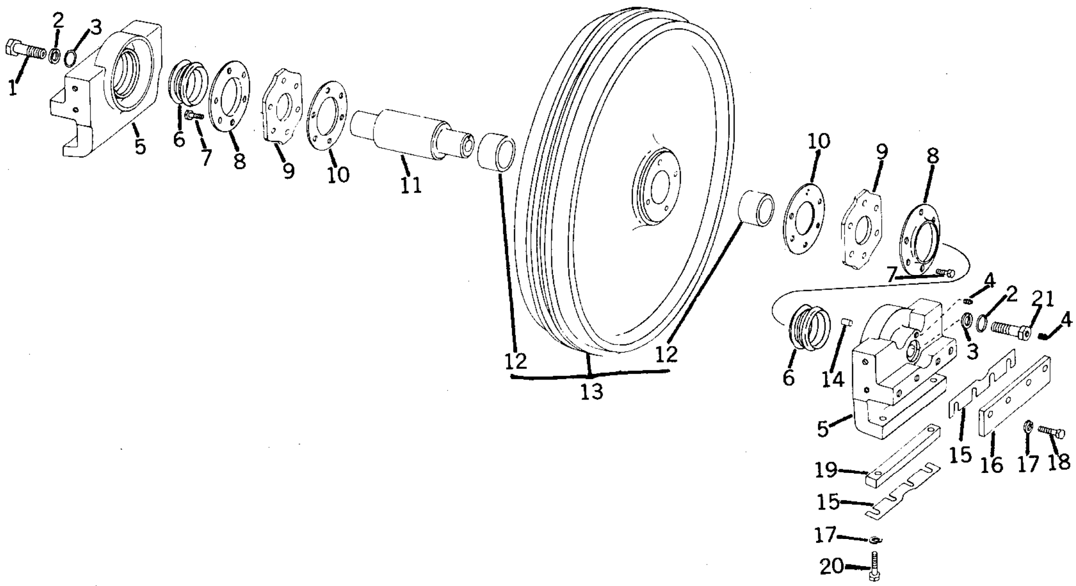
NOTE: Since the assembly for the front idler is the same as for the roller assembly, follow roller assembly procedure when assembling front idler. Tighten the thrust plate-to-roller cap screws to 45 to 55 ft-lbs.

Apply Loctite to threads of bracket-to-idler shaft cap screws. Tighten the inner bracket-to-idler shaft cap screws to 300 ft-lbs and tighten outer bracket-to-idler shaft cap screws to 210 ft-lbs.

Fill assembly with approximately 3/4 pint SAE 30 oil.

If wear plates (19) have been removed, assemble them loosely to idler bracket using the same number of shims as removed. Refer to paragraph on "Front Idler" for procedure on checking and adjusting front idler wear plate and guides.

Attach track adjusting yoke to idler bracket using same shims as removed. If unit is equipped with front idler shields, attach them at this time.



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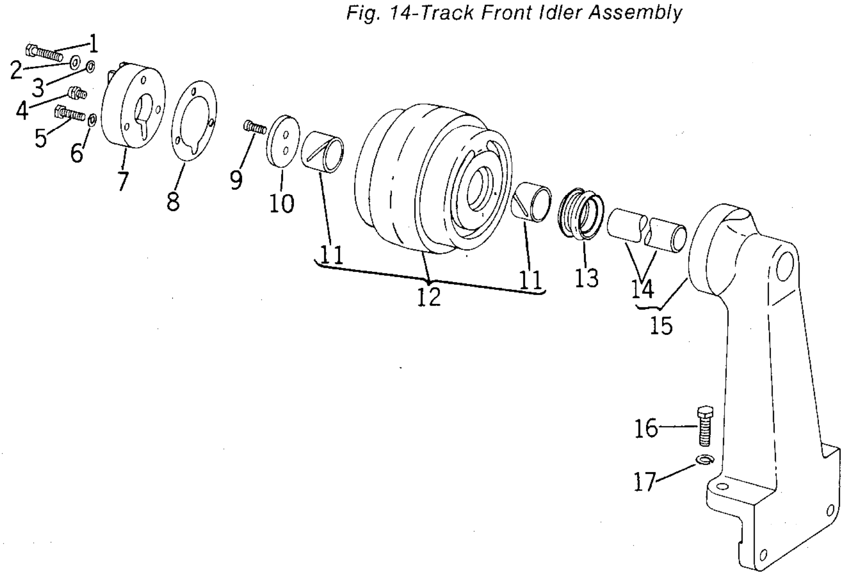
1—Cap Screw
2—Special Washer (2 used)
3—O-Ring (2 used)
4—Pipe Plug (2 used)
5—Idler Bracket (2 used)
6—Oil Seal (2 used)
7—Cap Screw (12 used)
8—Seal Ring (2 used)
9—Thrust Plate (2 used)
10—Shim (2 used)
11—Shaft
12—Bushing (2 used)
13—Front idler
14—Pin
15—Shim (Approx. 18 used)
16—Idler Guide (2 used)
17—Lock Washer (12 used)
18—Cap Screw (8 used)
19—Wear Plate (2 used)
20—Cap Screw (4 used)
21—Special Cap Screw

Fig. 14-Track Front Idler Assembly



T21175N

1—Cap Screw
2—Washer
3—Gasket
4—Pipe Plug
5—Cap Screw (2 used)
6—Lock Washer (2 used)
7—Cover
8—Gasket
9—Cap Screw (2 used)
10—Thrust Plate
11—Bushing (2 used)
12—Roller
13—Oil Seal
14—Shaft
15—Support
16—Cap Screw (4 used)
17—Lock Washer (4 used)

Fig. 15-Upper Track Carrier Roller Assembly

Track Carrier Roller Assembly (Fig. 15)

NOTE: Before installing support idler on shaft, lubricate roller bushings with oil.

Attach support (15) to track carrier frame making sure that the horizontal and vertical surfaces of the support are flush against frame. Tighten cap screws to 85 ft-lbs.

Procedure for installation of oil seal is similar to that of the track rollers (refer to page 80-10-9). Position oil seal (13) in roller support. Slide roller (12) on shaft. Install thrust plate (10) and tighten the socket head cap screws (9) to 40 ft-lbs.

Install gasket (8) under cover (7) and tighten attaching cap screws securely. Fill assembly with approximately 1-1/2 pints of SAE 30 oil.

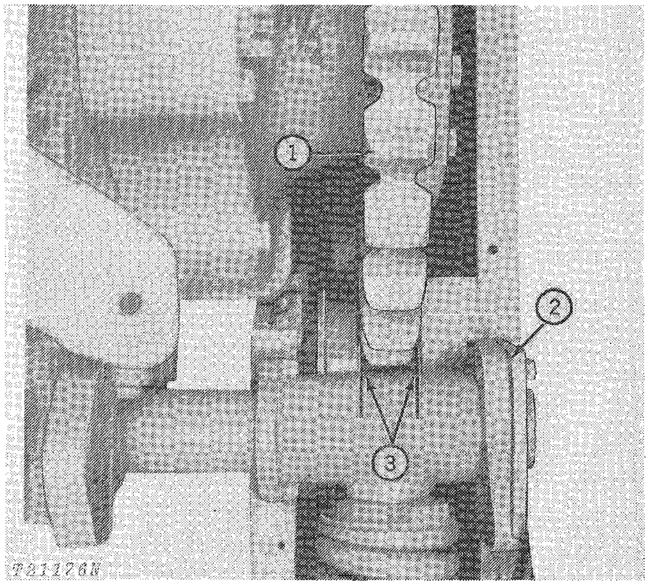
Track Carrier Installation (Fig. 4)

Before installing track carrier, be sure that front and rear crossbar are secure and that front crossbar extends an equal distance from side frames on both sides. Add shims between side frames and crossbar if necessary. Tighten front crossbar-to-side frame horizontal cap screws to 240 ft-lbs and vertical cap screw to 425 ft-lbs. Evenly tighten the rear crossbar cap-to-bracket cap screws to 250 ft-lbs.

With the tractor supported under both crossbars, start the track carrier on the rear crossbar and slide in place. Position the rear crossbar retainer and shims and loosely install the cap screws. Note that spacers are used at front attaching points.

Install the drive sprocket on hub dowels and tighten cap screws to 300 ft-lbs.

Shift track carrier in or out until drive sprocket is centered between flanges of rear track roller (Fig. 16). Then install just enough shims to fill space between retainer and retainer seating surface.



1—Sprocket
2—Adjusting Shims
3—Sprocket Centered

Fig. 16-Centering Drive Sprocket in Track Frame

Tighten the retainer cap screws to 170 ft-lbs. and the front crossbar horizontal cap screws to 425 ft-lbs. and the vertical cap screws to 240 ft-lbs.

Recheck centering of sprocket between rear track flanges.

Track Rollers

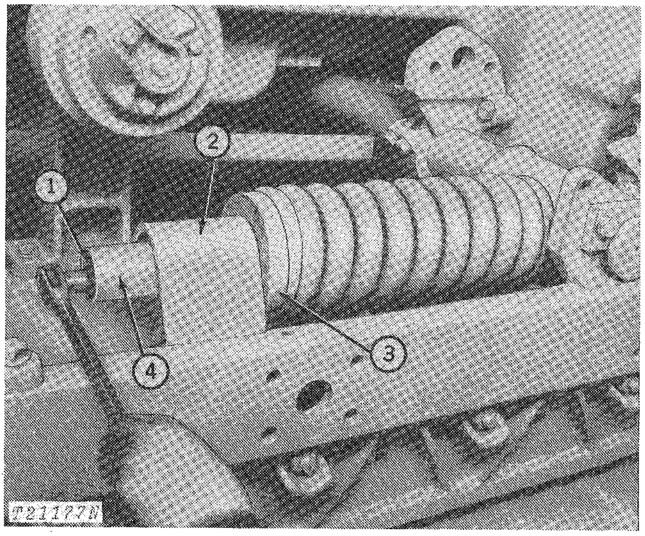
If track has been disconnected, install rollers before connecting track. However, roller assemblies can be installed by loosening track and raising tractor.

Using a track roller installation tool (see Special Tools) position rollers under track carrier frame. Make sure that special cap screws (16, Fig. 13) are facing outward. Install the four attaching cap screws and lock washers and tighten to 85 ft-lbs.

NOTE: The front and rear rollers usually wear at a faster rate than the center rollers. Move some of the center rollers to the front and rear to distribute wear evenly to all of the rollers and extend track service life.

Install rock guards. Tighten hex. nuts on rock guard spacer bolts to 120 ft-lbs. Tighten rock guard mounting cap screws to 170 ft-lbs.

Track Idler Recoil Spring Assembly

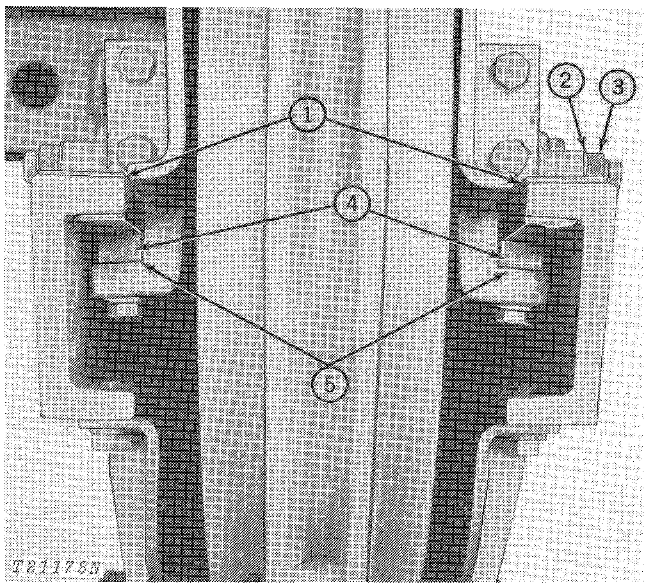


1—Special Bolt
2—Spring Retainer Plate
3—Front Spring Cap
4—Pipe

Fig. 17-Installing Track Idler Recoil Spring

Position preloaded spring between spring retaining plate and rear mounting pad and remove special bolt and one inch spacer. Use a 2 by 8-inch section of pipe to center front spring cap with track adjuster guide under spring retaining plate (Fig. 17). Be sure spring is firmly fixed in place.

Track Front Idler Assembly



1—Idler Brackets
2—Shims
3—Idler Guide
4—Wear Plates
5—Shims

Fig. 18-Installing and Adjusting Track Front Idler

Slip front idler assembly into position on track carrier frame assembly. Check for excessive play between idler bracket and track channels. If clearance is excessive, add shims under wear plates (Fig. 18). Tighten cap screws to 85 ft-lbs. Also check for vertical play in idler brackets. Add or subtract shims under idler guides to correct excessive clearance. Front idler should slide freely on track frames but without undue looseness.

Move the front idler assembly back and forth through its entire moveable range on the track frame channel, checking to see that the brackets do not bind on the rails. Remove shims if necessary to correct binding.

Install and connect the track (Section 10, Group 25).

Adjust track tension and check track alignment (Group 5 of this Section).

SPECIFICATIONS

Item	New Part
Roller and Idler Bearings	
Idler shaft outside dia.	2.6245 to 2.6255 in.
Idler bushing inside dia.	2.6285 to 2.6295 in.
Roller shaft outside dia.	2.3745 to 2.3755 in.
Roller bushing inside dia.	2.3785 to 2.3795 in.
Track carrier shaft outside dia.	1.3745 to 1.3750 in.
Track carrier bushing inside dia.	1.377 to 1.379 in.
Track roller and front idler bushing location below face of roller	1/32 in.
Track carrier roller shaft dimension above face of seal bore	5.850 in.
Track idler recoil spring compression for assembly (cap to cap)	16 in.
Track rollers rebuild lubrication	SAE 30 oil, approx. 3/8 pint
Track front idler rebuild lubrication	SAE 30 oil, approx. 3/4 pint
Track carrier rollers rebuild lubrication	SAE 30 oil, approx. 1-1/2 pint

TORQUE VALUES

Item	Torque (ft-lbs)
Idler bracket to guide cap screws	85
Idler bracket to shaft attaching cap screw (Inner)	300
(Outer)	210
Roller bracket to shaft attaching cap screw (Inner)	300
(Outer)	210
Roller bracket to track frame	130
Front idler thrust plate attaching cap screws	45 to 55
Roller thrust plate attaching socket head cap screws	45 to 55
Track carrier roller thrust plate attaching socket head cap screws	40
Track carrier roller support to track frame	85
Rock guard spacer bolt hex. nuts	120
Rock guard to track frame mounting cap screws	170
Rear crossbar retainer cap screws	170
Sprocket to flanged axle	300
Front idler brackets to adjusting cylinder yoke	85
Rear crossbar cap to bracket	250
Front crossbar to track frame cap screws (vertical)	425
Sprocket to flanged axle	300
Front idler brackets to adjusting cylinder yoke	85
Side frame to front crossbar attaching cap screws (horizontal)	240
(vertical)	425
Rear crossbar cap to bracket	250
Side frame to steering clutch housing cap screws	170
Side frame to engine clutch housing cap screws	445

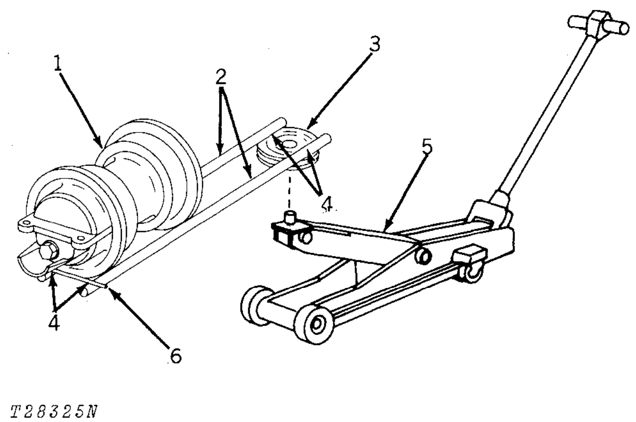
SPECIAL TOOLS

Essential Tools

No.	Name	Use
JD268	Track Wear Gauge	Check track system component parts for wear.
T16678	Special Bolt	Compress track idler recoil spring.
JD284-1+	Seal Installation Tool	To install piston seal.
JD284-2+	Dust Seal Driver	To install oil seal.
JD284-3+	Piston Guide	To install piston in cylinder.
JD284	Track Adjuster Tool Set	To install piston seals, oil seals, and piston in track tension adjuster cylinder.

Convenience Tools

No.	Name	Use
Fig. 19*	Track Roller Installation Tool	To install roller in track carrier.



1—Track Roller
2—Rods or Angle Irons
3—Pulley
4—Weld
5—Modified Floor Jack
6—Rod

Fig. 19-Track Roller Installation Tool

This tool is used with a large floor jack with lift pad removed. To make the tool, weld two quarter-inch rods or angle irons (2, Fig. 19), approximately 24 inches long, to a pulley (3) that has a flange that will fit on the jack. A 2010 Crawler crankshaft pulley is suggested as sufficient size.

Weld a rod (6) across the top of the quarter inch rods or angle irons (opposite end of pulley) to prevent roller from sliding off. Rods or angle irons should be placed close enough together to prevent roller from falling through.

+*Included in JD284 Track Adjuster Tool Set.*
* *Construct in dealer's shop.*

Group 15
WINCH SYSTEM

GENERAL INFORMATION

The winch system consists of a control valve, hydraulic pump, and housing with gear train.

The Winch Pump is of the positive-displacement gear type and is located in the winch housing under the output shaft. The pump is driven by the pinion shaft drive gear and supplies pressure oil for clutching and releasing the winch brake.

The Oil Filter is of the full-flow replaceable element type. Oil flows through the filter when the control lever is in the "HOLD" position.

The Winch Clutch (disk type) is located inside the clutch and brake drum. A pressure plate hydraulically engages the clutch. A release spring disengages the clutch pack after pressure oil is released.

The Winch Brake is of the contracting band type mounted around the winch drum and operated by a hydraulic piston and cylinder mechanism. The brake band is released by oil pressure and engaged by spring pressure.

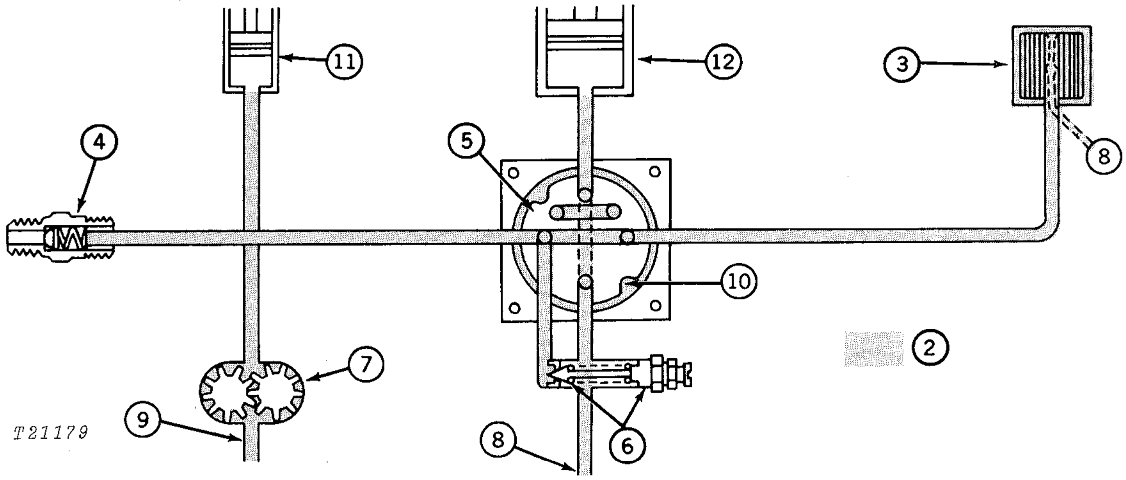
Winch Control Valve Operation (Fig. 1)

The control valve spool is manually operated by a control lever mounted on the left side of the operator's seat. The lever has three positions:

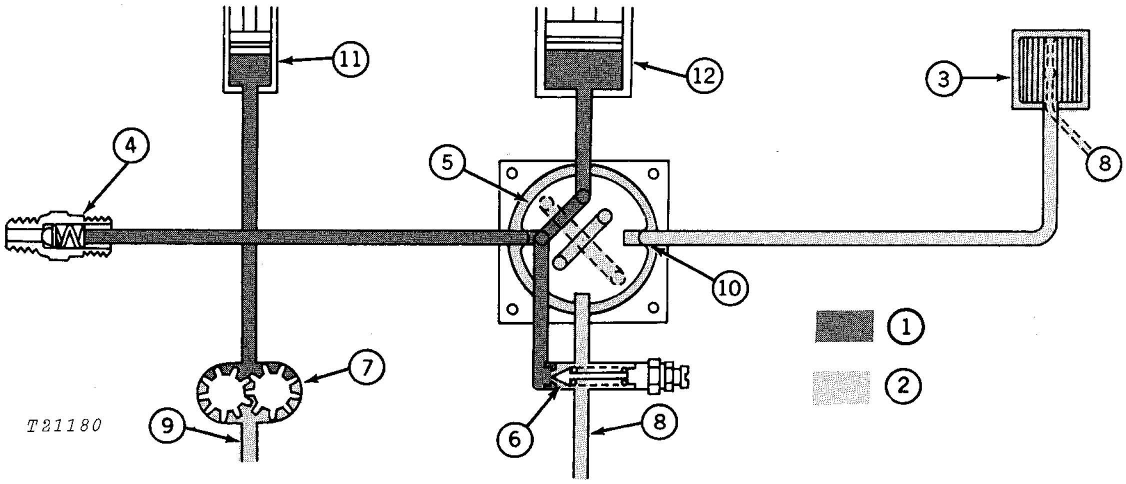
(1) In the "HOLD" (center) position the winch drum is in neutral. Pressure oil from the pump passes through the valve spool, through the filter, and dumps back into the reservoir.

(2) In the "WIND" (forward) position the winch drum is engaged. The valve spool closes off the passage to the filter and regulates pressure oil flow to engage the clutch. Back-up pressure from the engaged clutch releases the brake and the gear train turns the winch drum.

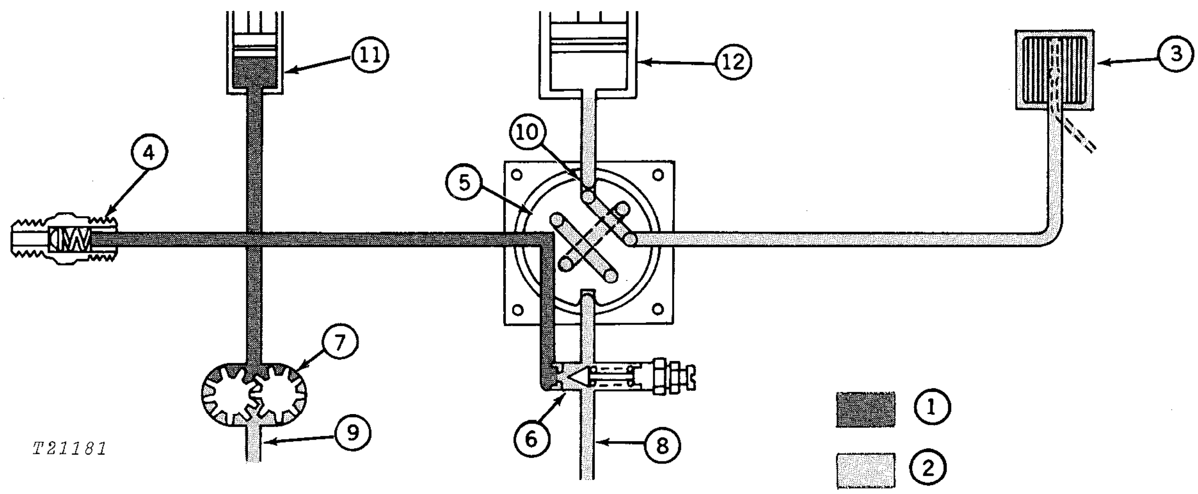
(3) In the "FREE-SPOOL" (rear) position the winch drum is released. The valve spool prevents oil from passing through the valve. Pressure backs up to the brake cylinder, disengaging the brake.



(Hold Position)



(Wind Position)



(Free Spool Position)

1—Pressure Oil	**4—Ball Connector**	**7—Pump**	**1[illegible]-Spool Detent**
2—Return Oil	**5—Valve Spool**	**8—To Sump**	**1[illegible]-Brake Piston**
3—Filter	**6—Relief Valve**	**9—From Reservoir**	**1[illegible]-Pressure Plate**

Fig. 1-Winch Control Valve Operation

TESTING

Pressure Tests

NOTE: Brake band must be correctly adjusted and if new brake facings have been installed, they must be burnished before the following tests are performed (see page 80-15-14).

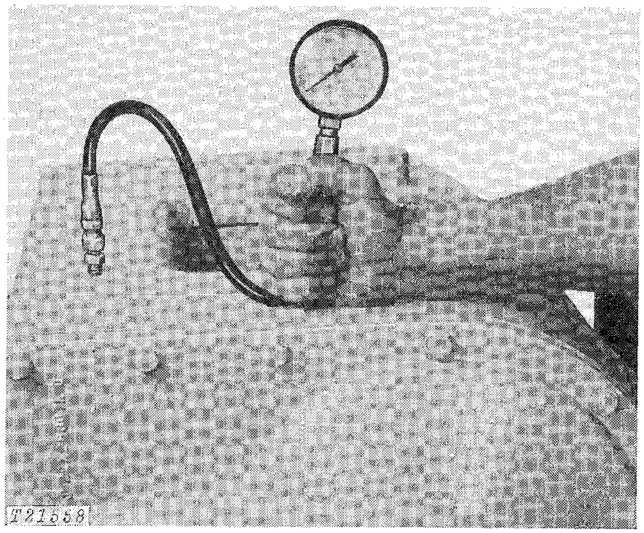


Fig. 2-Checking Relief Valve

Install a 0 to 1500 psi pressure gauge in winch housing as shown in Fig. 2.

Start and run unit until oil temperature reaches 160 ± 5°F.

Adjust engine speed to 1900 rpm.

Move the winch control lever from hold to wind position and observe reading on pressure gauge. Pressure should rise rapidly to 950 to 1050 psi.

Repeat test a minimum of ten times. Pressure must repeat and be stable.

Adjust engine speed to 800 rpm.

Again move winch control lever from hold to wind position and observe reading on pressure gauge. Pressure should rise rapidly to at least 850 psi.

Repeat test a minimum of ten times. Pressure must repeat and be stable.

High pressure indicates that relief valve is out of adjustment.

Low pressure indicates that the relief valve is out of adjustment, winch pump is faulty or damaged or oil is leaking past the control valve, brake piston or clutch pressure plate.

Leakage Checks

Brake Piston Seals and Clutch Pressure Plate Diaphragm

Remove left quill from the winch housing. If oil is found behind this quill, the brake piston or clutch pressure plate is leaking and should be repaired.

CONTROL LEVER ADJUSTMENT

Push control lever forward (with a force not to exceed 50 lbs.) until the internal stop inside the control valve is contacted.

NOTE: If you cannot contact the internal stop inside the control valve adjust yoke accordingly.

When the internal stop inside the control valve has been contacted, adjust lever stop cap screw to contact control lever (later models). Then turn control lever stop cap screw 1/2 turn counterclockwise and tighten nut.

DIAGNOSING MALFUNCTIONS

Brake Band Slippage

Brake band out of adjustment.
Brake lining not fully contacting braking surface.
Burnish lining or replace brake band.
Oil on lining.
(Early Units) Inspect "vee" packings around inlet sleeve.
(Later Units) Inspect diaphragm or swivel fittings.
Check brake cylinder O-rings and connectors.
Excessive heat in brake band.
Let cool for one hour and recheck.
Brake band spring broken.
Mechanical binding in control linkage.

Brake Does Not Disengage

Low oil pressure - Check pressure.
Oil leaks - Replace cracked lines.

Clutch Slips or Does Not Engage

Low oil pressure - Check pressure.
Oil on clutch facings.
(Early Units) Replace piston and pressure plate "vee" packings.
(Later Units) Inspect diaphragm or swivel fitting.
Excessive oil leakage out small hole in left quill.
(Early Units). Replace piston "vee" block packing.

Clutch Does Not Disengage

Middle or intermediate disk hanging up.
Repair clutch pressure plate assembly.
Damage to clutch release bearing or spring.
Repair and replace spring.
(Early Units) Repair and replace spring.
(Later Units) Pressure plate not retracting.

Hydraulic Failure

Low oil pressure - Check pressure.
Leakage of piston seals.
Low oil supply. (See Section 10, Group 20.)
Oil leaks - Replace cracked lines.
Failure to lock in "Free Spool" Position.
Inspect detent ball and spring. Add shims.
(Early Units). Inspect detent ball and spring. Add shims.

Excessive "Free Spool" Effort (Clutch Dragging and Cable Winding In "Free Spool" Position)

See "Clutch Does Not Disengage."
Clutch hub rubbing on brake drum to winch screws.
Left drive shaft bearing dragging.
Replace bearing.
Foreign material between facings.
Mechanical binding in control linkage.
Repair linkage.

Control Will Not Stay in Detent (Early Units)

Insufficient detent spring tension.
Add shims to spring.

Excessive "Free Spool" Effort Only

Low oil pressure - Check pressure.
Brake dragging - Readjust brake.
Excessive preload in winch drum.
Cable binding against winch housing.
Too much cable.
Snarled cable - Straighten or replace cable.

Noisy Pump Caused by Cavitation

Oil supply low. (See Section 10, Group 20.)
Contaminated oil.
Oil filter plugged.
Suction line plugged.

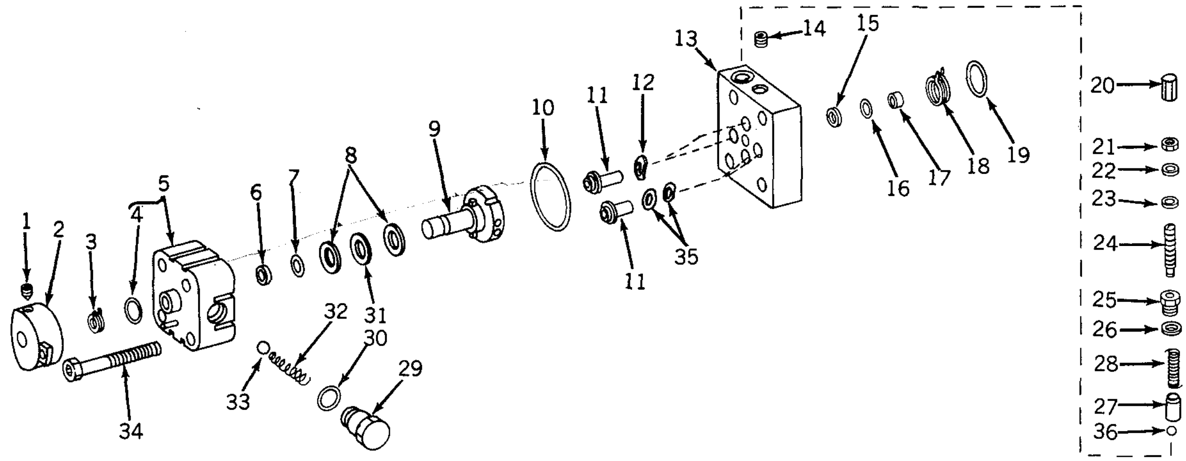
Oil Heating

Low oil supply. (See Section 10, Group 20.)
Contaminated oil.
Oil in system too light. (See Operator's Manual.)

Foaming Oil

Low oil level.
Air leaking into suction line.
Wrong kind of oil. (See Operator's Manual.)

CONTROL VALVE



T27252

1—Set Screw	13—Body and Seat	25—Plug
2—Handle Cap	14—Level Seal Plug (2 used)	26—O-Ring
3—Spring	15—Backup Ring (4 used)	27—Ball Guide
4—O-Ring	16—O-Ring (4 used)	28—Spring
5—Valve Cap	17—Retainer (4 used)	29—Detent Plug (2 used)
6—Backup Ring	18—Compression Spring (4 used)	30—O-Ring (2 used)
7—O-Ring	19—O-Ring (5 used)	31—Thrust Bearing
8—Thrust Bearing Race	20—Valve Cap	32—Detent Spring (2 used)
9—Rotor and Shaft	21—Nut	33—Detent Ball (2 used)
10—O-Ring	22—Washer	34—Cap Screw (4 used)
11—Valve Seat (4 used)	23—Seal	35—Spring Washer (4 used)
12—Curved Washer (2 used)	24—Adjusting Screw	36—Steel Ball

Fig. 3-Winch Control Valve

Use Fig. 3 as a guide and disassemble control valve.

Clean old parts in solvent and dry with compressed air. Inspect parts for wear or damage.

Check relief valve and seat for wear or damage.

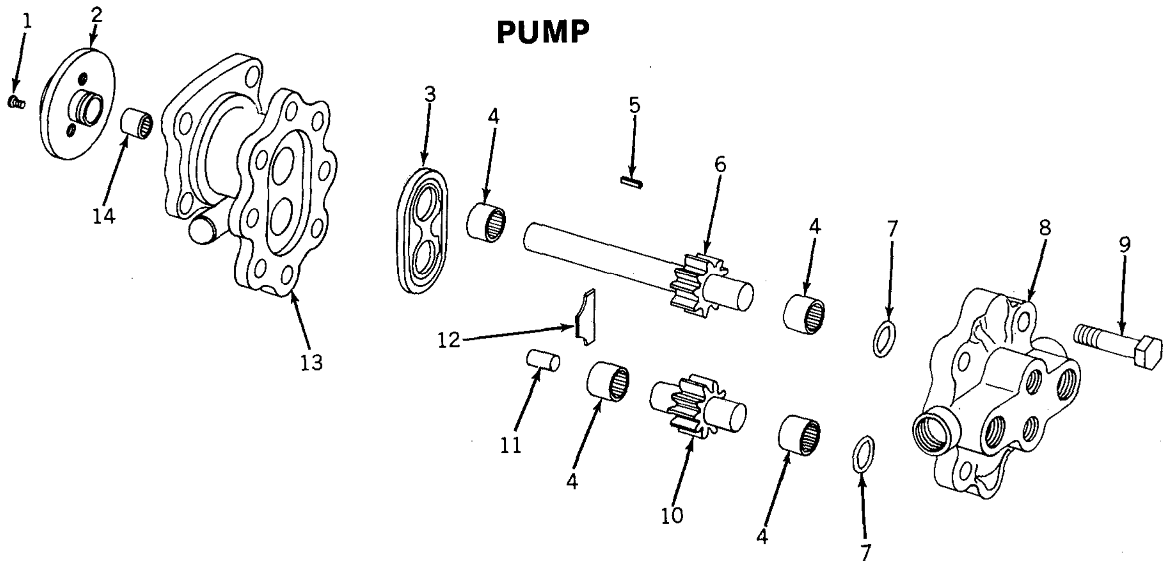
Replace all O-rings and assemble control valve.

Adjusting Relief Valve

Refer to page 80-15-3 and test relief valve for correct pressure setting.

If adjustment is necessary, remove cap, loosen jam nut and turn set screw in or out until the correct pressure is obtained.

PUMP



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1—Special Screw
2—Seal Plate
3—Wear Plate
4—Needle Bearing
5—Key
6—Drive Shaft
7—O-Ring
8—Cover
9—Cap Screw
10—Idler Gear
11—Dowel Pin
12—Block
13—Body
14—Needle Bearing

Fig. 4-Winch Hydraulic Pump

Check relief valve pressure as described under "Testing" before removing winch to service pump.

Drain winch housing.

Remove cover on bottom of winch housing and disconnect hydraulic pump oil pressure line at elbow (Fig. 5).

Remove cap screws securing pump bracket to winch housing and remove pump.

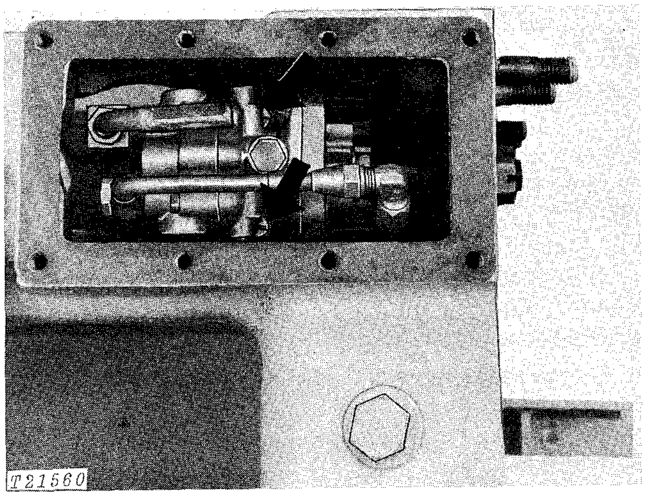


Fig. 5-Pump Attaching Cap Screws

Disassemble pump using Figure 4 and the following steps:

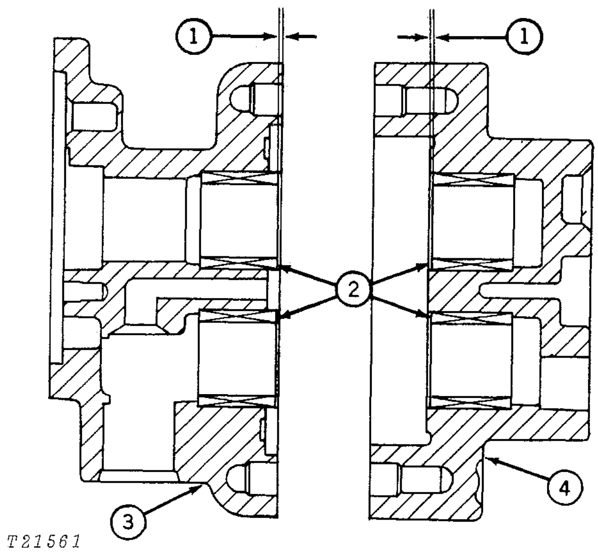
1. Scribe pump body and cover for reassembly purposes.

2. To separate pump cover from body, tap protruding end of drive shaft lightly with a plastic hammer. Be very careful to avoid damaging finely machined surfaces.

3. Remove wear plate assembly (3) and steel plate from pump body.

NOTE: Whenever pump is disassembled for inspection and repair, replace wear plate assembly. Installation of old parts could result in possible leakage.

Clean all parts in solvent. Inspect pump parts for wear or damage.



1—See Specifications
2—Bearings
3—Pump Body
4—Pump Cover

Fig. 6-Installing Pump Bearings

Inspecting Pump Body Cover

Inspect needle bearings (4) for wear or damage.

Press needle bearings into pump body and cover until they bottom out (Fig. 6). Refer to "Specifications" for locating bearings below pump machined surfaces. Be sure bearings are bottomed out to avoid the possibility of interference with the pump gears and to assure proper mating of the body and cover.

Inspect bearing at drive shaft end of pump body. To replace, press in new bearing until it bottoms.

Inspecting Pump Mounting Bracket

Inspect pump mounting bracket for damage and replace if necessary. If dowels securing bracket to winch housing are damaged, remove old dowels and press new dowels into winch housing to specifications.

Assembly

Assemble pump, using Figure 4 as a guide. Be sure to use new wear plate assembly and O-rings.

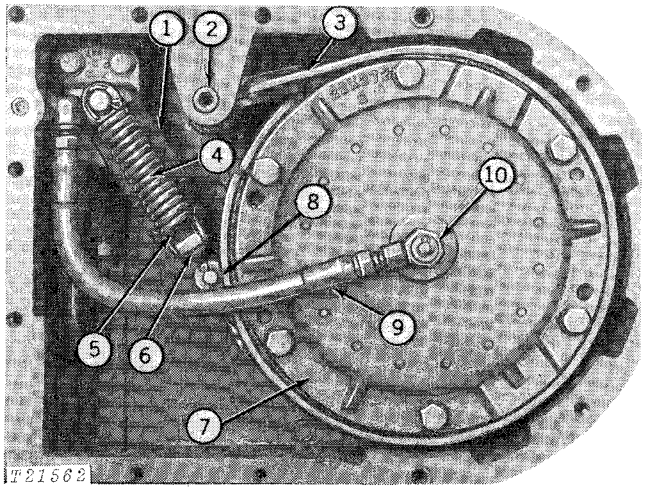
Secure pump with mounting bracket to winch housing. Connect pressure line and install bottom plate.

WINCH HOUSING ASSEMBLY

Disconnect winch control lever linkage and drive shaft. Remove winch from unit.

Place winch on a stand or bench for disassembly. Drain oil from winch housing.

Removing Brake Band and Clutch Cover



1—Brake Cylinder
2—Anchor Pin
3—Brake Band Assembly
4—Springs
5—Brake Adjusting Nut
6—Lock Nut
7—Clutch Cover
8—Adjusting Screw Pin
9—Oil Line
10—Swivel Fitting

Fig. 7-Removing Brake Band

Remove left quill from winch housing.

Release brake spring pressure.

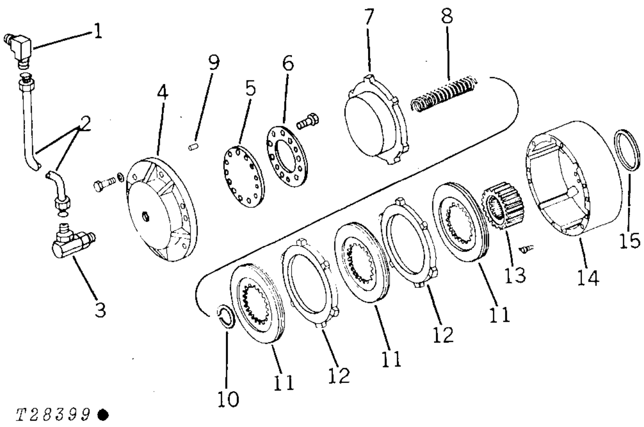
Remove brake springs and adjusting screw.

Remove anchor pin and brake cylinder from winch housing. Slide brake band assembly off the clutch and brake drum.

Removing Clutch Disks

Remove two clutch cover attaching cap screws (Fig. 8) and install two 1/2 x 2-inch cap screws to facilitate the removal of the spring-loaded clutch screws.

Remove diaphragm and diaphragm ring.



1—Elbow
2—Oil Line
3—Swivel Fitting
4—Clutch Cover
5—Diaphragm
6—Diaphragm Ring
7—Pressure Plate
8—Spring (6 used)
9—Dowel (2 used)
10—Snap Ring
11—Middle Disk (3 used)
12—Intermediate Disk (2 used)
13—Drive Hub
14—Clutch and Brake Drum
15—V-Packing

Fig. 8-Clutch Pressure Plate Assembly

Remove middle disks (11) and intermediate disks (12) from clutch and brake drum.

Removing Main Drive Shaft

Remove right bearing retainer with shims and right quill from winch housing.

Slide the main drive shaft and ring gear assembly out through right-hand side of winch housing.

Removing Clutch and Brake Drum

Remove the socket head cap screws attaching the clutch and brake drum to the winch drum and pull brake drum free from winch drum dowels.

Removing Winch Drum

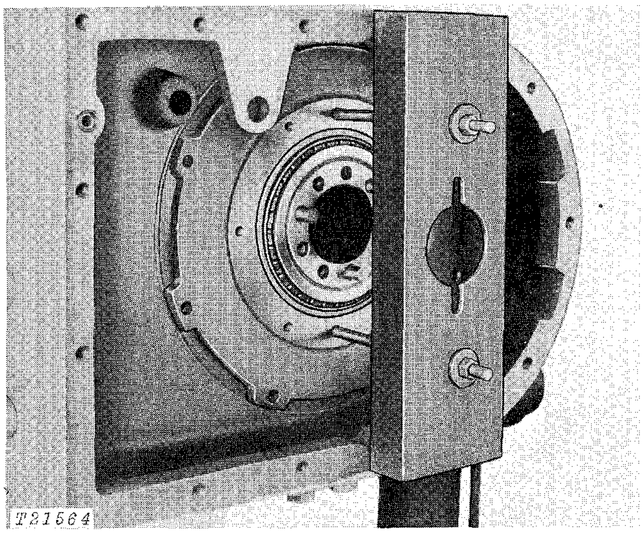


Fig. 9-Removing Left Bearing Quill

Remove inner grease retainer secured to left bearing quill. Remove bearing quill cap screws. Attach a puller to the bearing quill and force the bearing cone off the end of the winch drum (Fig. 9). Remove the bearing quill and gasket from the winch housing.

Remove end plate and shim pack (from right side of winch).

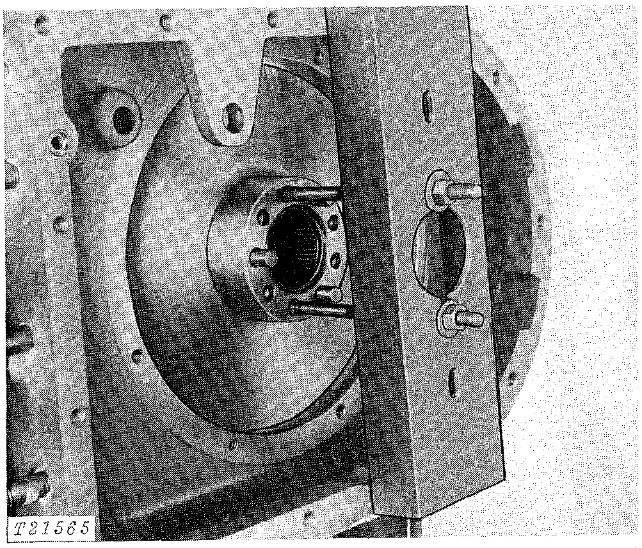


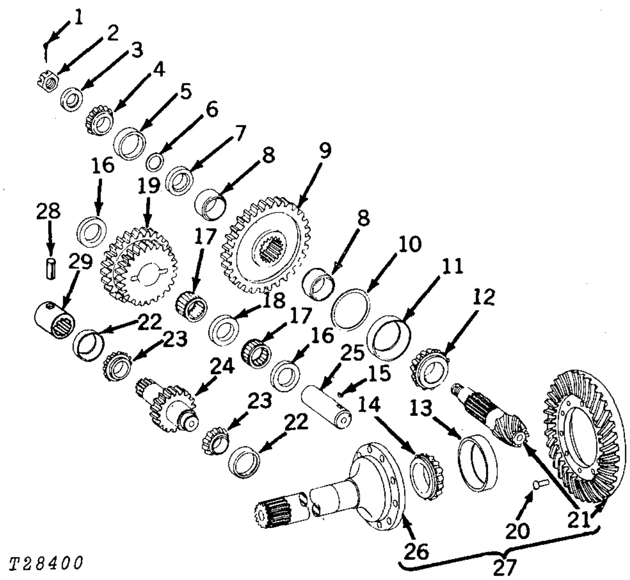
Fig. 10-Removing Winch Drum

Attach a puller to the winch drum and force the bearing cone off the right-hand end of the winch drum. Slide the winch drum out the left side of the winch housing.

Removing Gear Train (Fig. 11)

Remove coupling from input shaft. Remove the input shaft bearing quill and shim pack. Remove gear cover from front of the winch housing.

NOTE: To facilitate removal of the gear cover, screw two of the attaching cap screws in the unused threaded holes and force off gear cover.



1—Cotter Pin
2—Slotted Nut
3—Special Washer
4—Bearing Cone
5—Bearing Cup
6—Shims
7—Tapered Spacer
8—Spacer (2 used)
9—Drive Gear
10—Shims
11—Bearing Cup
12—Bearing Cone
13—Bearing Cup
14—Bearing Cone
15—Woodruff Key
16—Thrust Washer (2 used)
17—Roller Bearing (2 used)
18—Special Washer
19—Cluster Gear
20—Rivet (10 used)
21—Ring Gear and Output Shaft
22—Bearing Cup (2 used)
23—Bearing Cone (2 used)
24—Input Shaft
25—Idler Shaft
26—Shaft
27—Main Drive Shaft Assembly
28—Spring Pin
29—Coupling

Fig. 11-Output Shaft Assembly

Using Figure 11, remove parts from idler shaft.

Remove cover on bottom of winch housing and remove hydraulic pump with bracket from winch housing.

Remove expansion plug from rear of idler shaft bore and drive out idler shaft.

Using Figure 11, remove parts from output shaft and remove shaft from housing.

Checking Brake Cylinder and Brake Band

To disassemble brake cylinder, remove internal snap ring and slide out piston.

Inspect brake cylinder and piston parts for damage. Replace all O-rings.

Checking Shafts and Bearings

Inspect all bearings, cups and cones for damage.

Inspect the input shaft bearing quill sealing ring.

Inspect the input shaft bearing quill oil seal. If replacement is necessary, press in new oil seal, lips inward, to flush with input shaft bearing quill bore using a 630-11 Tool.

Inspect the bearing cup in the input shaft bearing quill. If replacement is necessary, press in new bearing cup until it bottoms.

Inspect the bearing cone on each end of the input shaft. If replacement is necessary, press on new bearing cone until bearing bottoms.

Inspect idler shaft for damage or bent conditions.

Inspect cluster gear (19, Fig. 11) for excessively worn or broken teeth.

Inspect roller bearings for wear or damage.

Examine thrust washer for wear or damage and replace if necessary.

Inspect ring gear, pinion shaft, and gears for damage. See Figure 11 for parts identification.

NOTE: The ring gear and pinion shaft are furnished in matched sets and are not available individually for replacement.

Inspect the bearing cone on the pinion shaft for wear or damage. If replacement is necessary press on new cone with large end toward spiral bevel gear of pinion shaft, using the pinion shaft spacer as a tool (Fig. 12).

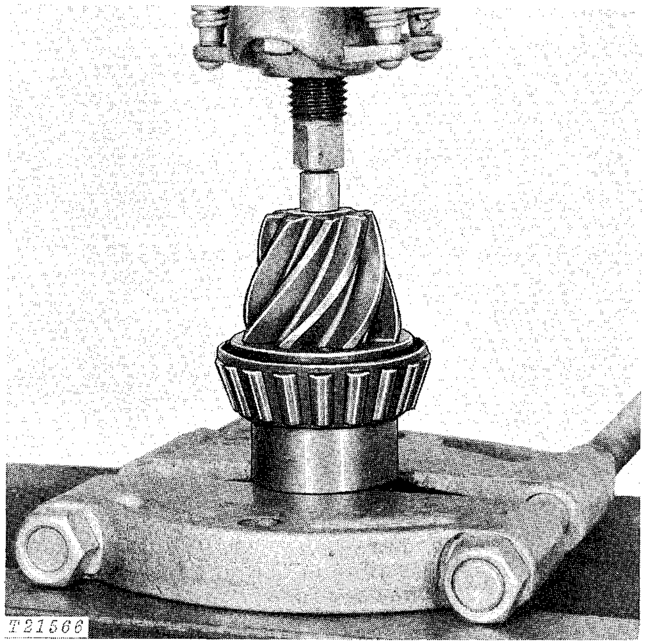


Fig. 12-Pressing Pinion Shaft Bearing Cone

Inspect the rear bearing cup in the pinion shaft bore for wear or damage. If replacement is necessary, drive out the old bearing cup, being careful not to damage or lose shim pack behind cup. Drive in new bearing cup, with large end facing driver, until it bottoms in bore.

Examine special washer and spacers for wear or damage.

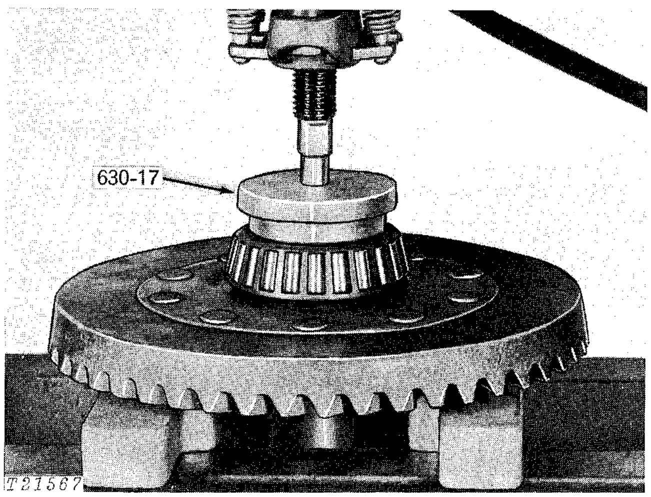


Fig. 13-Installing Main Drive Shaft Bearing Cone

Inspect the bearing cone on the main drive shaft. If replacement is necessary, press on new cone to flush with the end of the shaft. Small end should face driver. Use 630-17 Tool (Fig. 13).

Inspecting Winch Drum Bearing Quills

Inspect the oil seal in the bearing quills for damage. Press in new oil seals to flush with bore (lips of the seals facing driver).

Inspect bearing cup in the bearing quills. Drive new bearing cup into quill, large end facing driver, until it bottoms.

Inspect the quill bearing cones for wear or damage. Pack cones with John Deere Winch Bearing Grease.

Inspecting Winch Drum

If winch drum needle bearing is damaged, press new bearing to 0.25 in. from end of winch drum. Pack with John Deere Winch Bearing Grease.

Install new vee packing with lip facing needle bearing.

Inspecting Clutch Assembly (Fig. 8)

Pull clutch cover from pressure plate and inspect for wear.

Examine diaphragm and diaphragm ring for wear or damage. Make sure the machined surface of the pressure plate (7, Fig. 8) which makes contact with the diaphragm (5) is carefully examined for nicks, scratches and sharp edges.

To remove or smooth out nicks, scratches or sharp edges, use a very fine file and an emery cloth.

It is extremely important to remove nicks, scratches or sharp edges, if present, to prevent premature failure of the diaphragm.

Inspect the clutch and brake drum for oil or grease before installing a new brake band. If a small amount of either is indicated, wash drum in an alkaline solution.

If the drum has been soaked in oil or grease, it is strongly recommended that the drum be replaced. An oil- or grease-soaked drum will continue to bleed oil and grease under operating conditions, thus ruining another brake band.

NOTE: If drum is being replaced because it has been soaked with oil or grease, make sure to correct the leakage problems.

Special care should be taken when installing a new band to prevent oil or grease from getting on the brake band or drum. Any oil or grease on the brake band or drum braking surfaces will cause the band to slip in the "Hold" position.

After burnishing a new brake band, the brake band adjustment should be rechecked and the powder substance created during burnishing should be blown out from between brake band and the drum.

ASSEMBLY

Installing Winch Drum

Install the right bearing quill and gasket at the inner bore in right-hand side of the winch housing.

Install two guides in the cap screw holes to facilitate quill installation.

Remove the guides and tighten the attaching cap screws to 55 ft-lbs.

Install the winch drum in the left-hand side of the winch housing. End of drum with six holes and three dowels should face out to left side.

Install gasket and left bearing quill in inner bore on left hand side of winch housing.

Install two guides in the cap screw bores to facilitate quill installation.

Remove the guides and tighten the attaching cap screws.

Pack the left and right bearing cones with John Deere Winch Bearing Grease and drive cones on winch drum, leaving the bearing cones protruding to specifications over end of winch drum.

Position the inner grease retainer on the left bearing quill and secure with attaching cap screws.

Installing Clutch and Brake Drum

Position clutch and brake drum on the winch dowels and secure to the winch drum with cap screws. Tighten cap screws to 120 ft-lbs.

Establishing Winch Drum Preload

1. Place shims under the end plate to induce end play and attach the end plate to the right-hand end of winch drum. Tighten attaching cap screws to 35 ft-lbs.

2. Check the end play on the drum. Remove the correct quantity of shims to give the desired adjustment of 0.002 inch preload to 0.002 inch end play.

3. Install the winch hydraulic pump.

Ring Gear and Pinion Adjustment

When installing a new winch housing, a new ring gear and pinion shaft set, or new bearing cones or cups which support these parts, it will be necessary to make certain adjustments. These adjustments are covered on the following pages and must be made in the sequence given below.

Step 1 - Cone point adjustment

Step 2 - Pinion shaft bearing preload adjustment

Step 3 - Ring gear and pinion backlash adjustment

Step 1 - Adjusting Cone Point

1. Add the number which is etched on the end of the pinion shaft to the mean dimension (1.93 inch) of the output shaft rear bearing cup and cone.

2. Subtract this figure from the number stamped on the right quill bore.

3. The difference is equivalent to the thickness of the shim pack that must be added behind the rear bearing cup to obtain the correct cone point setting.

Step 2 - Adjusting Pinion Shaft Bearing Preload

1. Slide pinion shaft with rear bearing cone and rear spacer into pinion shaft bore. Install drive gear, spacer, and beveled spacer (flat side to the rear) on the pinion shaft and slide the pinion shaft into the front bore. Place a 0.090-inch shim pack on the shaft and install the front bearing cone, flat washer, and nut.

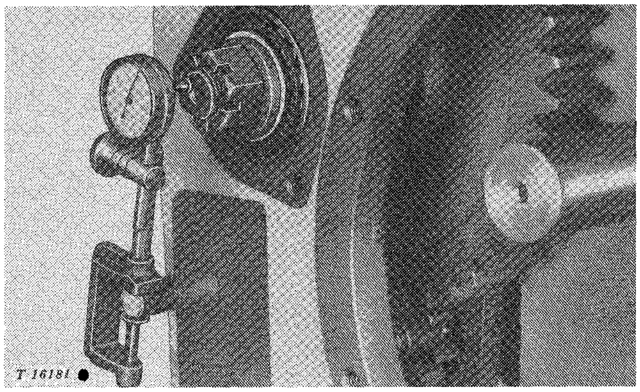


Fig. 14-Pinion Shaft Preliminary End Play

2. Install a dial indicator and measure introduced end play in shaft (Fig. 14). If there is no end play, remove nut and bearing cone and add enough shims so there is a measurable amount of end play.

3. Measure end play and determine the shim pack required to give the desired preload adjustment of 0.004 to 0.006 inch.

4. Tighten pinion shaft nut 100 to 125 ft-lbs. Advance nut as required to install cotter pin. Install cotter key, gasket and cover.

NOTE: The winch drum and the clutch and brake drum must be in place before ring gear backlash can be determined.

Installing Idler Shaft and Cluster Gear

Refer to Figure 11 and the following:

1. Install a Woodruff key in the idler shaft keyway. Drive the shaft in flush with the counterbore at the rear of bore in gear cover.

Install expansion plug in the idler shaft counterbore in gear cover.

2. Place a thrust washer on the idler shaft.

Place a roller bearing, spacer washer, and roller bearing in cluster gear and slide onto idler shaft.

3. Place a thrust washer over the idler shaft.

4. Install input shaft assembly.

5. Screw two guides into the cap screw holes in front of the winch housing. Install gasket and gear cover on the guides and on hollow dowel. Remove the guides and install the attaching cap screws.

Establishing Input Shaft Preload

This preload is established by shims under the input shaft bearing quill and can be determined as follows:

1. Remove the sealing ring from the groove in the input shaft bearing quill.

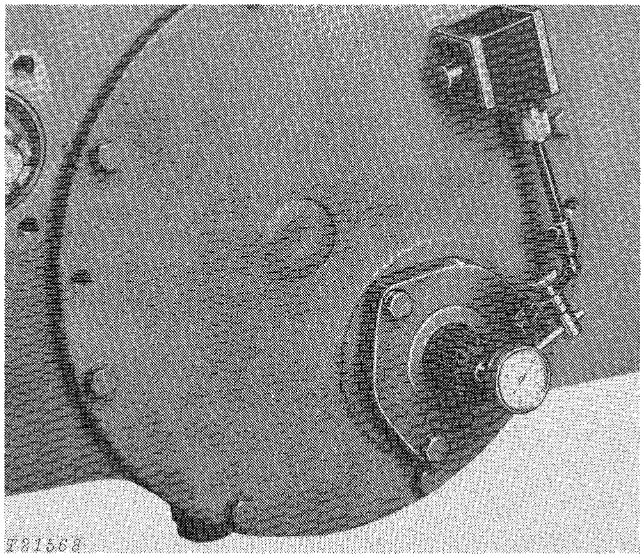


Fig. 15-Measuring Input Shaft End Play

2. Place shims under the input shaft bearing quill to induce end play. Install quill and tighten attaching cap screws. Check end play as shown in Figure 15. Remove the correct quantity of shims to give the desired preload of 0.002 to 0.004 inch.

3. When the preload has been determined, remove the input shaft bearing quill and install the sealing ring previously removed. Install the quill and again tighten the attaching cap screws to 35 ft-lbs.

Installing Main Drive Shaft and Right Quill

Install main drive shaft from the right-hand side into the winch housing. Install quill with gasket. Take care not to damage seals.

Drive in bearing cup to 1/8 inch below shim surface on the right quill.

Step 3 - Ring Gear and Pinion Backlash Adjustment

Make ring gear and backlash adjustment as follows:

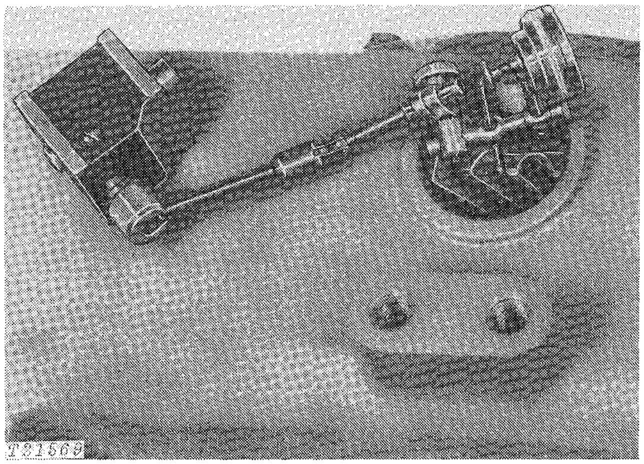


Fig. 16-Measuring Ring Gear and Pinion Backlash

1. Check backlash of ring gear at several points around ring gear (Fig. 16). Due to allowable machine tolerances, there may be one point where there is less backlash than at other points. By proper placement of shims, establish 0.006 to 0.012 inch backlash at the point of least backlash.

2. Adding the calculated quantity of shims under the right bearing retainer will increase the backlash.

Deducting the calculated quantity of shims under the right bearing retainer will decrease backlash.

3. When the correct backlash of the ring gear and pinion have been established, remove the right bearing retainer and install sealing ring. Lubricate sealing ring before installing. Install right bearing retainer and tighten attaching cap screws to 55 ft-lbs.

Installing Clutch Assembly (Fig. 8)

Install clutch drive hub and snap ring on main drive shaft.

Alternately install middle disks and intermediate disks into the clutch drive hub.

IMPORTANT: Place the diaphragm in the clutch pressure plate assembly so that the smooth side is facing the clutch cover and the textured side is out.

Use the following torque sequence when fastening diaphragm and diaphragm ring to clutch cover.

1. Snug cap screws down using a criss-cross pattern to 5 ft-lbs torque.

2. Tighten cap screws using a criss-cross pattern to 30 ft-lbs torque.

3. Retorque cap screws to 30 ft-lbs torque.

4. Allow clutch cover assembly to set for 30 minutes and retorque the cap screws to 30 ft-lbs.

Pack bearing cone with John Deere Winch Bearing Grease.

Install assembled clutch pressure plate.

Installing Brake Band (Fig. 7)

Position brake band on clutch and brake drum.

Secure top brake anchor to boss in winch housing pin. Attach adjusting screw to bottom of brake anchor with pin. With adjusting screw loose, connect brake springs.

INSTALLING WINCH ON UNIT

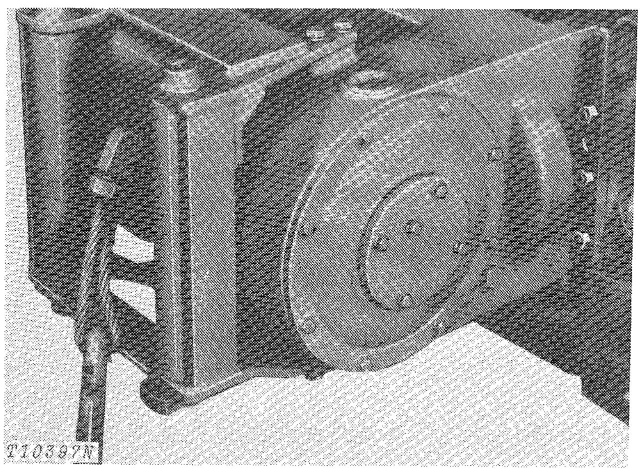


Fig. 17-Winch Housing Attaching Points

Attach a chain hoist to the winch housing and lift it into position on studs and dowels at rear of tractor. At the same time, engage PTO shaft coupler.

Attach winch housing to steering clutch housing pads. Torque cap screws to 150 ft-lbs.

Install winch fairlead and drawbar on winch housing (if equipped).

Attach control cable to winch control lever.

Refill winch housing with proper oil (Section 10, Group 20).

Adjusting Winch Brake Band

Always adjust the winch control lever before adjusting the winch brake (see page 15-3).

If the winch brake band or linkage have been removed or replaced, they must be readjusted to prevent slippage.

Remove the left quill from winch housing. Losen the jam nut (see inset, Fig. 18) and back off brake adjusting nut until brake band is loose. Tighten brake adjusting nut until there is 4-11/16 inches distance between bottom edge of spring anchor pin and bottom edge of spring anchor. Tighten jam nut and install cover.

Recheck operation of winch. If brake still slips, inspect brake band facings for damage from excessive heat, grease, or oil.

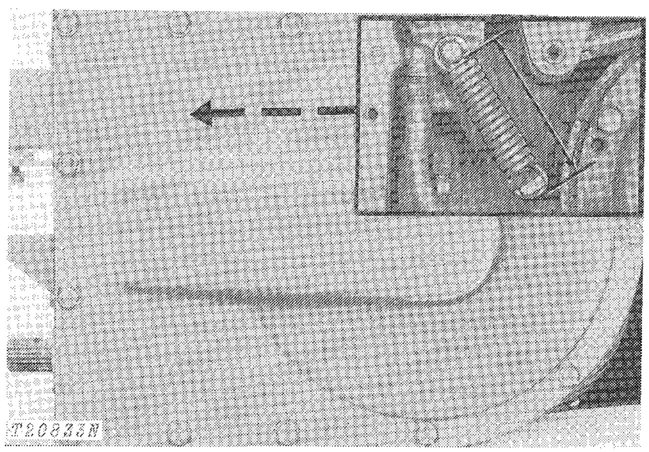


Fig. 18-Adjusting Winch Brake Band

No "Free Spool" After Winch Brake Band Adjustment

Shifting the position of the brake cylinder a very small amount sometimes will free the brake band if difficulty is encountered in getting the winch brake band to release for free spool after the brake band has been adjusted for slippage.

The brake cylinder's position can be shifted by loosening the two cap screws on brake cylinder and with the aid of a screw driver placed between the brake cylinder and the anchor pin boss, move the brake cylinder slightly forward until free spool occurs. When free spool occurs hold the position of the brake cylinder and tighten cap screws.

Burnishing New Brake Facings

On field installation of repair parts, it is necessary to burnish the brake band to obtain full capacity.

Burnish new replacement brake bands as follows:

Tighten brake adjusting nut until there is 4-11/16-inch distance between bottom edge of spring anchor pin and bottom edge of spring anchor. Hook on to something solid and drive away with winch brake applied. A short distance (25 to 30 feet) will bring brake to full capacity.

In practically all cases this will develop full winch brake capacity; if not, repeat the above procedure.

Attaching Cable to Winch Drum

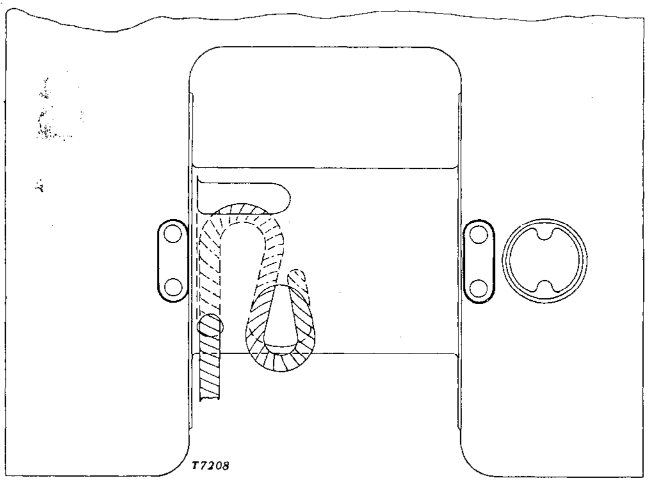


Fig. 19-Attaching Cable to Drum

Thread cable through winch drum, fold end of cable back into drum and pound it in.

To conform to certain state laws, the winch cable must be attached to the winch drum so that it can come loose if the cable is unwound.

Thread the cable through the winch drum as shown above and wind the cable onto the drum.

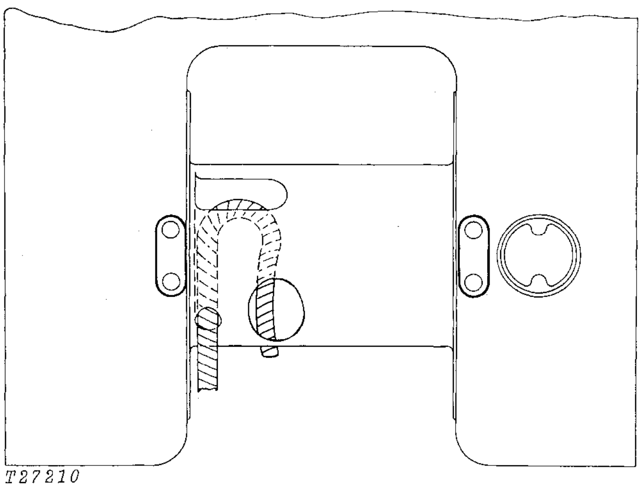
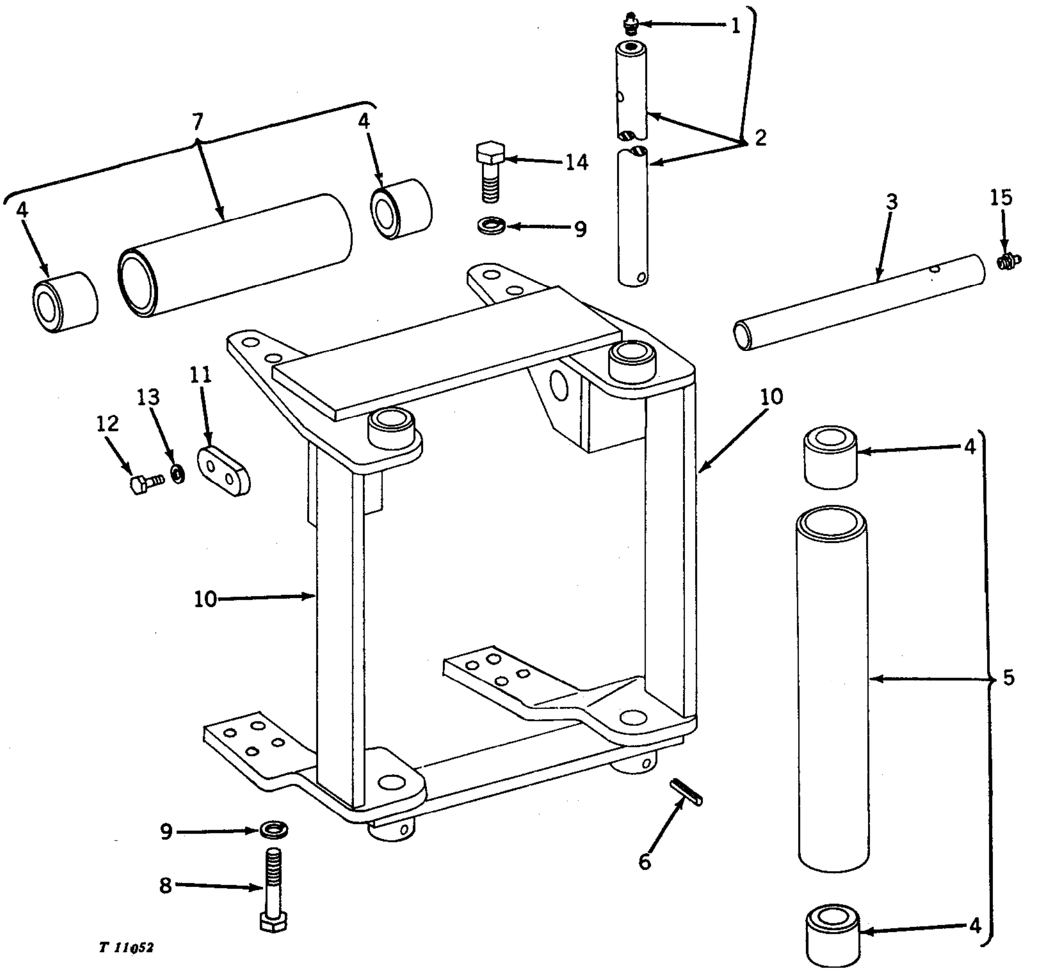


Fig. 20-Attaching Cable To Drum

IMPORTANT: When the cable is attached to the winch in this manner, unwinding the cable below five turns on the drum will allow the cable to disconnect from the drum.

WINCH FAIRLEAD ASSEMBLY



1—Grease Fitting (2 used)
2—Side Roller Shaft (2 used)
3—Top Roller Shaft (2 used)
4—Roller Bushing (6 used)
5—Side Roller (2 used)
6—Spring Pin (2 used)
7—Top Roller
8—Cap Screw (8 used)
9—Lock Washer (12 used)
10—Fairlead Frame
11—Shaft Retainer
12—Cap Screw (2 used)
13—Lock Washer (2 used)
14—Cap Screw (4 used)
15—Grease Fitting

Fig. 19-Winch Fairlead Assembly

Examine the top roller and each side roller for excessively worn or damaged condition and replace if necessary.

Inspect the roller bushing in each end of the top roller and in each side roller. Replace any excessively worn or damaged bushing.

Using a JD630-13 tool, press in the new bushing to the bottom of the counterbore in the top roller and in each side roller.

Inspect each roller shaft for worn or damaged condition and replace if necessary.

Examine the lubricating hole in each shaft for a plugged condition.

Inspect and replace all defective grease fittings.

SPECIFICATIONS

Item	New Part	Wear Tolerance
PUMP		
Pump output (2100 engine rpm at 650 psi)	1.4 gpm (minimum)	1.0 gpm (minimum)
Distance needle bearings below pump machined surfaces		
Body bearings	0.0150 to 0.0200 inch	......
Cover bearings	0.0050 to 0.0150 inch	......
Distance pump mounting bracket dowels protrude from mounting surface	1/4 inch	......
Width of idler or drive gear	0.3745 to 0.3750 inch	......
O.D. of idler or drive gear	1.2430 to 1.2435 inch	......
O.D. of idler or drive shaft	0.5623 to 0.5625 inch	......
Length of drive shaft	4.4375 inches	......
Length of idler shaft	1.7500 inch	......
Depth of gear pocket	0.4490 to 0.4500 inch	......
Width of gear pocket	1.2425 to 1.2430 inch	......
WINCH ASSEMBLY		
Distance needle bearing is pressed in from left end of winch drum	1/4 inch	......
Distance bearing cup is pressed in below shim surface of right quill	1/8 inch	......
Distance bearing cone protrudes from edge of winch drum	1/16 inch	......
Mean dimension of output shaft rear bearing cup and cone for cone point setting	1.193 inch	......
Input shaft bearing adjustment	0.002 to 0.004 inch preload	......
Pinion shaft bearing adjustment	0.004 to 0.006 inch preload	......
Winch drum bearing adjustment	0.002 inch preload to 0.002 inch end play	......
Ring gear and pinion backlash adjustment	0.006 to 0.012 inch backlash	......

NOTE: Backlash is reduced or increased an amount less than the shim thickness. Backlash movement compared to shim thickness is as follows:

Shim Thickness	Approximate Backlash Movement
0.010 inch	0.008 inch
0.005 inch	0.004 inch
0.002 inch	0.0016 inch

Item		New Part
RELIEF VALVE		
Relief valve setting	(1900 engine rpm)	950 to 1050 psi
	(800 engine rpm)	800 psi minimum
BRAKE BAND		
Distance between bottom edge of spring anchor pin and bottom spring hook edge of spring anchor		4-11/16 inch

TORQUE VALUES

Item	Torque (ft-lbs)
Pinion shaft nut	100 to 125
Front gear cover-to-winch housing	35
Input shaft bearing quill-to-gear cover	35
Right and left winch drum bearing quills	35
Clutch and brake drum-to-winch drum	120
End plate to winch drum	35
Filter base insert-to-filter base	50
Right and left quills-to-winch housing	55
Bearing retainer-to-right quill	55
Oil inlet cover-to-left quill	35
Clutch cover-to-clutch and brake drum	85
Brake cylinder-to-winch housing	55
Winch mounting adapters to winch housing	150
Winch mounting adapters to steering clutch housing	150
Diaphragm to clutch cover	30

SPECIAL TOOLS

Number	Name	Use
CONVENIENCE TOOLS		
630-11	Driver	To press oil seal in input shaft quill
630-17	Driver	To press bearing cone on main drive shaft
630-13	Driver	To press bushings in fairlead rollers
....	Pressure Gauge	To check pump relief pressure

Group 20

DOZER FRAMES AND BLADES

GENERAL INFORMATION

Three types of bulldozers are available on the JD450-B Crawler.

All dozers have a one-lever hydraulic control.

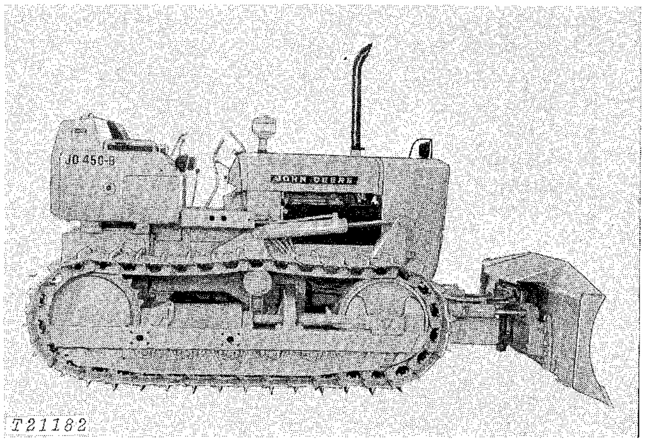


Fig. 1-6405 Bulldozer and JD450-B Crawler

The 6405 Bulldozer is inside mounted (Fig. 1). The tilting, angling, and raising of the blade are all done hydraulically.

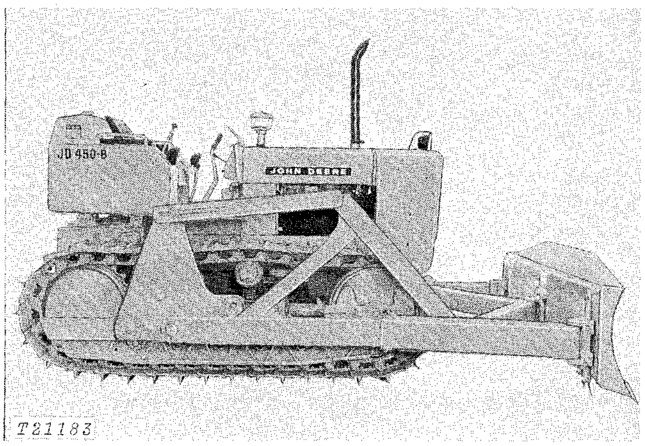


Fig. 2-6410 Bulldozer and JD450-B Crawler

The 6410 Bulldozer is outside mounted (Fig. 2), and is raised and lowered hydraulically. The blade is angled or tilted manually.

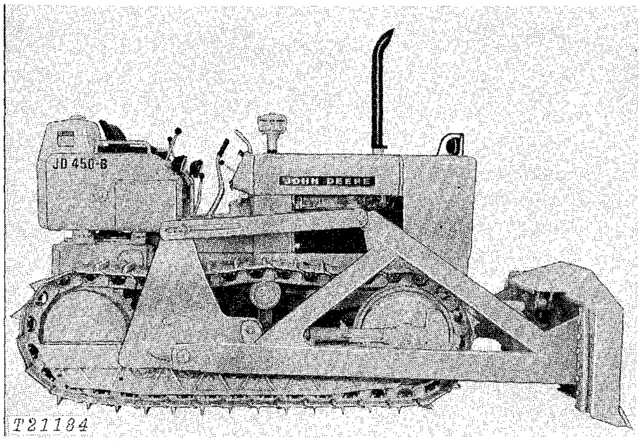


Fig. 3-6415 Bulldozer and JD450-B Crawler

The 6415 Bulldozer is outside mounted (Fig. 3). The tilting and raising of the blade are done hydraulically.

Bulldozer blades are of reinforced box-welded steel construction. All blades have reversible and replaceable cutting edges and end bits. Gauge shoes can be attached to the bottom of the blade to assist in regulating the depth of blade penetration.

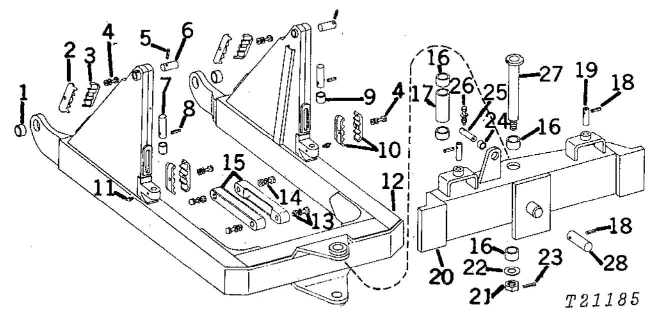
Blades are contoured to move material with an easy rolling action that reduces power needs and clogging at the cutting edge.

REPAIR

Frames and Booms

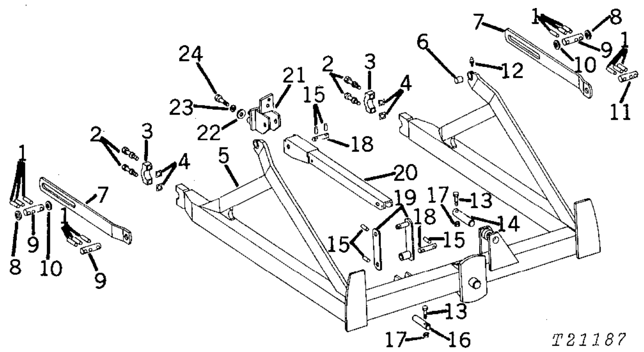
CAUTION: To avoid possible injury and to insure best results, always stop tractor operation and lower or block up frame and blade before servicing dozer frames and booms.

Refer to figures 4 through 9 during disassembly and assembly of dozer frames and booms.



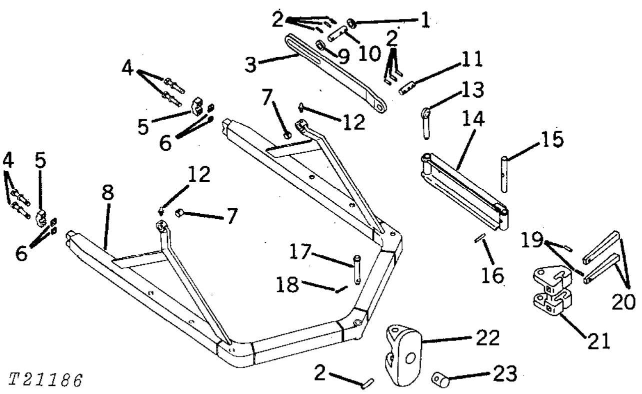
1—Bushing
2—Clamp
3—Clamp
4—Cap Screw, Lock Washer, and Nut
5—Spring Pin
6—Pin
7—Pin
8—Spring Pin
9—Bushing
10—Clamp
11—Grease Fitting
12—Boom
13—Cap Screw and Lock Nut
14—Cap Screw, Lock Washer, and Nut
15—Guide Block
16—Bushing
17—Spacer
18—Spring Pin
19—Pin
20—Angling Frame
21—Slotted Nut
22—Keeper
23—Cotter Pin
24—Bushing
25—Pin
26—Cap Screw, Lock Washer, and Nut
27—Pin
28—Pin

Fig. 4-6405 Boom and Angling Frame



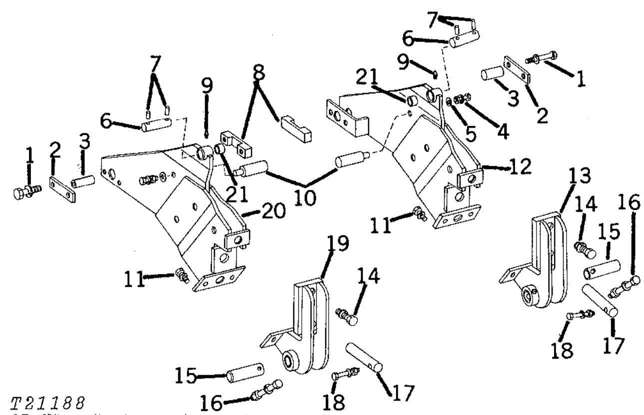
1—Spring Pin
2—Cap Screw and Lock Washer
3—Cap
4—Shim
5—Frame
6—Bushing
7—Guard
8—Washer
9—Pin
10—Washer
11—Pin
12—Grease Fitting
13—Cap Screw
14—Pin
15—Spring Pin
16—Pin
17—Lock Nut
18—Pin
19—Vertical Link
20—Hydraulic Line Link
21—Pivot Bracket
22—Lock Washer
23—Special Washer
24—Cap Screw

Fig. 6-6415 Frame and Angling Arms



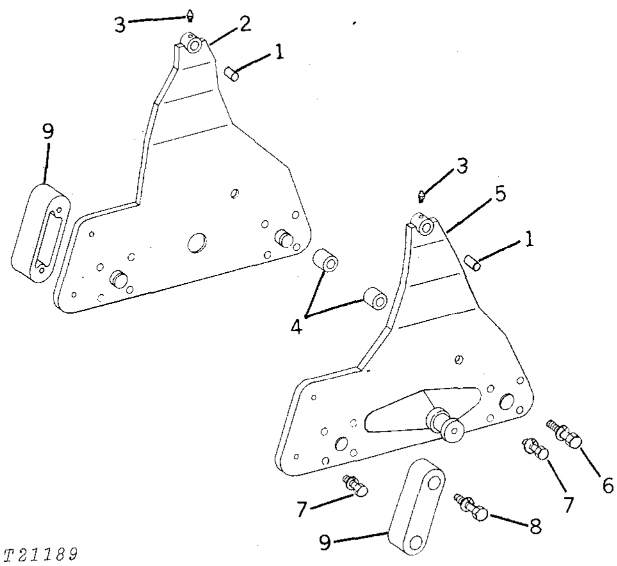
1—Washer
2—Spring Pin
3—Guard
4—Cap Screw and Lock Washer
5—Cap
6—Shim
7—Bushing
8—Boom
9—Washer
10—Pin
11—Pin
12—Grease Fitting
13—Pin
14—Arm
15—Pin
16—Spring Pin
17—Pin
18—Cotter Pin
19—Groove Pin
20—Wedge
21—Clamp Lock
22—Blade Pivot
23—Pin

Fig. 5-6410 Boom and Angling Arms



1—Cap Screw and Lock Washer
2—Retainer
3—Pin
4—Cap Screw, Lock Washer, and Nut
5—Washer
6—Pin
7—Spring Pin
8—Double Retainer
9—Grease Fitting
10—Support
11—Cap Screw
12—Mounting Frame
13—Pivot Assembly
14—Cap Screw
15—Pin
16—Cap Screw and Lock Nut
17—Pin
18—Cap Screw
19—Pivot Assembly
20—Mounting Frame
21—Bushing

Fig. 7-6405 Mounting Frames and Pivot Assembly



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1—Bushing
2—Lift Frame
3—Grease Fitting
4—Spacer
5—Lift Frame
6—Cap Screw and Lock Washer
7—Cap Screw and Lock Washer
8—Cap Screw and Lock Washer
9—Bumper

Fig. 8-6410 and 6415 Lift Frame

Inspect lift frame and boom for damage. Replace parts as necessary.

Inspect all pins and bushings. If loose, worn or damaged replace as necessary.

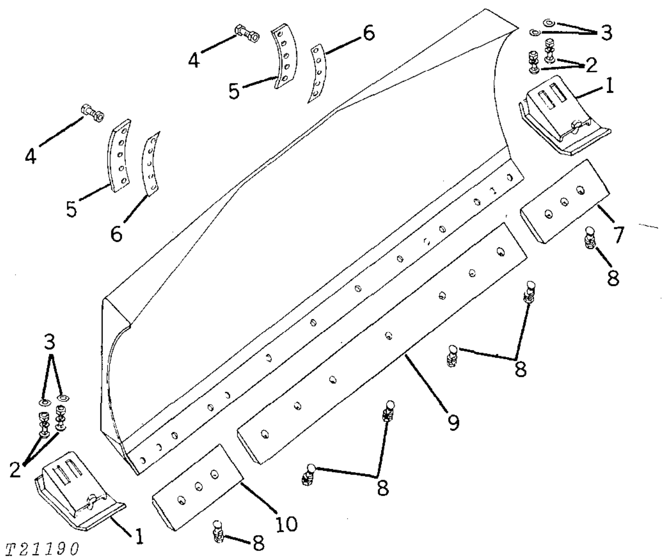
Tighten all cap screws and bolts to specified torques (See Specifications).

Blades

Inspect all blade parts for cracks or other damage (Fig. 9). Reverse or replace the blade cutting edge when dull or damaged for new cutting action. Reverse or replace end bits when they become dull, damaged or broken.

Protect the polished surface of the blade when bulldozer is not in use by applying a coat of cup grease.

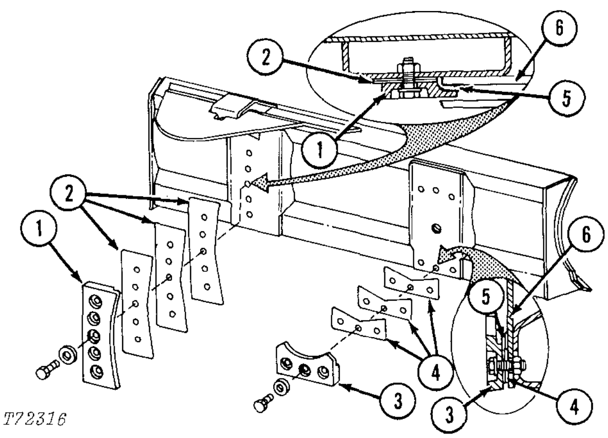
Check for clearance between tilt sector (1, Fig. 10) and frame (6), and between pivot races (3) and frame (6). Gaps (5) must be less than thickness of one shim (2 or 4), but still allow blade to tilt without binding.



T21190

1—Gauge Shoe
2—Bolt, Lock Washer, and Nut
3—Washer
4—Cap Screw and Lock Washer
5—Blade Keeper
6—Shim
7—Bit
8—Plow Bolt, Lock Washer, and Nut
9—Center Cutting Edge
10—End Bit
11—Blade

Fig. 9-6405 Blade



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1—Tilt Sector
2—Shims
3—Pivot Race
4—Shims
5—Gap
6—Frame

Fig. 10-Check Clearance—6405 Blade

If necessary, remove shim(s) (2 or 4) to minimize the gap (5).

ADJUSTMENT

Angling Bulldozer Blades

The bulldozer blades (except the 6415) can be angled 25 degrees to the right or the left.

6410 Bulldozer

Raise the blade off the ground before attempting to change the angle.

Remove both angling pins. Set blade at desired angle and replace pins.

Tilting and Leveling Bulldozer Blades

6410 Bulldozer

Drive wedges loose and adjust the tilt of the blade.

The blade is level when the top of the clamp lock is even with the dot on the track.

6405 Bulldozer

The blade is level when the indicator on the angling frame and the second cap screw retaining the blade keeper are aligned.

6415 Bulldozer

The blade is level when the boom guide plates are even with the blade keepers.

Regulating Blade Depth

Gauge shoes can be attached to the bottom of the blade to assist in regulating depth of blade penetration. Adjust the shoes up or down by loosening the bolts holding them to the blade.

TORQUE VALUES

Item		Torque (Ft-Lbs)
BLADE		
Cutting edge-to-blade		300
Gauge shoe-to-blade		170
Blade keeper to blade (6405 and 6415)		300
Lift and mounting frames		
Double retainer-to-mounting frame (6405)		300
Support-to-mounting frame (6405)		85
Pivot assembly-to-mounting frame (6405)		300
Lift frame attaching cap screws (6410 and 6415)	1"	670
	3/4"	300
Bumper to lift frame (6410 and 6415)		170
BOOM		
Guide block attaching cap screws (6405)		170
Cap-to-boom (6410 and 6415)		670
Pivot bracket-to-crawler (6415)		300

Group 25
LOADER FRAME, BOOM, AND BUCKET

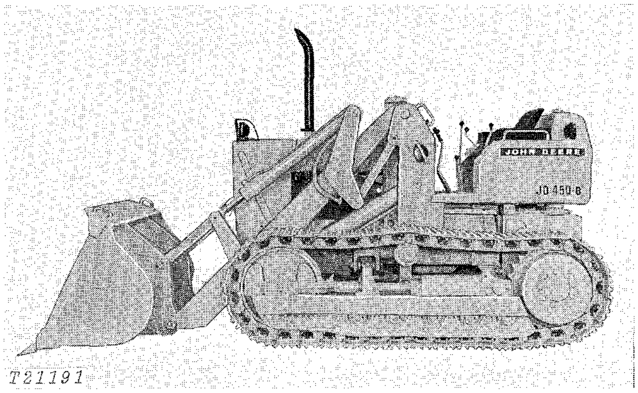


Fig. 1-JD450-B Crawler Loader

The loader main frame has a low profile and is of welded steel construction.

The loader boom is of welded construction and attaches to the main frame with eccentric pins making several boom adjustments possible.

Loaders have either a bucket level indicator or a solenoid actuated return-to-dig switch mounted on the loader frame (see Operator's Manual).

Loader hydraulic functions are performed by a single control lever.

The bucket cutting edge and teeth are made of high carbon steel.

Two utility rings are welded to the top of the bucket to aid in attaching or removing the bucket.

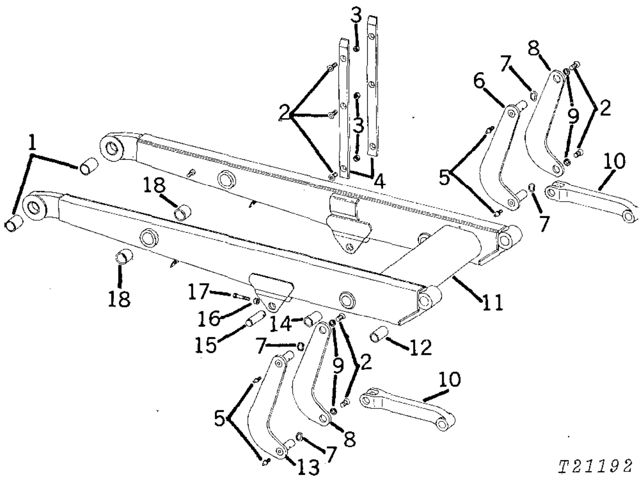
REPAIR

CAUTION: To avoid possible injury, always stop tractor and lower or block up boom and bucket before servicing loader units.

Frame and Boom

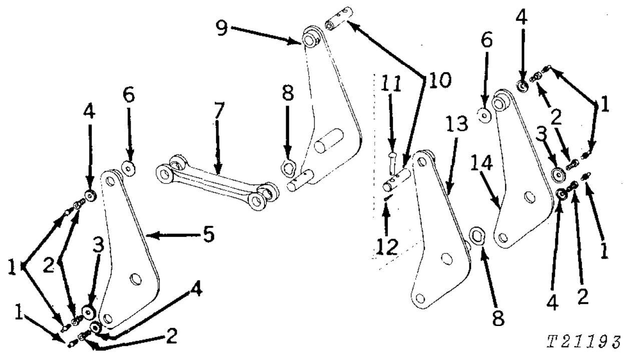
To remove loader frame and boom refer to Section 10, Group 25.

Refer to Figs. 2, 3, and 4 when disassembling and assembling boom, frame, and connecting linkage.



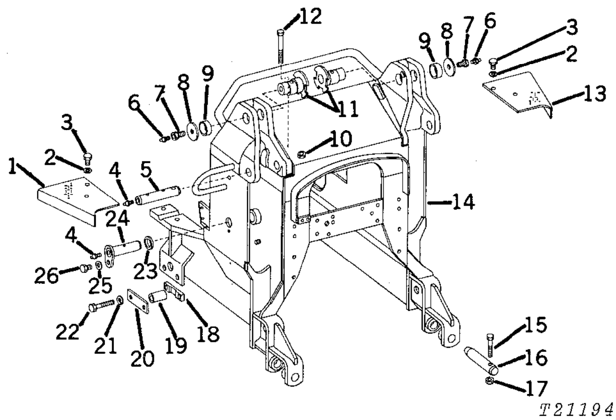
1—Bushing
2—Hex. Bolt (10 used)
3—Nut (6 used)
4—Rub Bar
5—Grease Fitting
6—Bucket Lever
7—Wave Washer
8—Front Lever
9—Retainer
10—Lever Link
11—Main Boom
12—Bushing (2 used)
13—Bucket Lever
14—Bushing (4 used)
15—Cylinder Pivot Pin (2 used)
16—Stop Nut (2 used)
17—Cap Screw (2 used)
18—Bushing (4 used)

Fig. 2-Boom and Bucket Linkage



1—Grease Fitting
2—Special Screw
3—Collar
4—Collar
5—Lever
6—Washer
7—Leveling Link
8—Wave Washer
9—Lever
10—Bucket Cylinder Pin
11—Drilled Pin (2 used)
12—Cotter Pin (2 used)
13—Lever
14—Lever

Fig. 3-Boom-to-Frame Linkage



1—Fender	14—Loader Frame
2—Lock Washer (4 used)	15—Cap Screw (2 used)
3—Cap Screw (4 used)	16—Pin (2 used)
4—Grease Fitting (4 used)	17—Stop Nut (2 used)
5—Pin (2 used)	18—Retainer (2 used)
6—Grease Fitting	19—Dowel (2 used)
7—Special Screw	20—Retainer (2 used)
8—Washer	21—Lock Washer (4 used)
9—Bushing	22—Cap Screw (4 used)
10—Stop Nut	23—Spacer (2 used)
11—Pivot Pin	24—Cylinder Pin (2 used)
12—Cap Screw (2 used)	25—Washer (2 used)
13—Fender	26—Cap Screw (2 used)

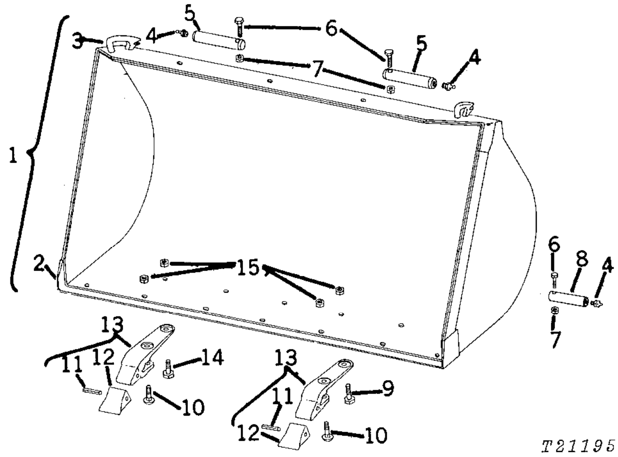
Fig. 4-Loader Frame

Inspect boom, upper links, bucket levers, and bucket links for damage. Replace parts if necessary.

Inspect all loader pivot points. If pivot points are loose, worn, or damaged, replace as necessary.

Grease all fittings where new parts have been installed before resuming operation.

Bucket



1—Bucket	9—Cap Screw (2 used)
2—Cutting Edge	10—Plow Bolt (7 used)
3—Ring Hook	11—Groove Pin (7 used)
4—Grease Fitting	12—Tooth Tip (7 used)
5—Pin	13—Bucket Tooth (7 used)
6—Cap Screw (4 used)	14—Cap Screw (5 used)
7—Stop Nut (4 used)	15—Lock Nut (14 used)
8—Pin (2 used)	

Fig. 5-Loader Bucket

Refer to Fig. 5 when disassembling or assembling bucket parts.

Inspect bucket pins and cutting edge for damage. Repair or replace if necessary.

IMPORTANT: Because bucket cutting edges are made of high carbon steel, special welding techniques are required (See "Special Welding Instructions," page 80-25-4).

When cutting edge is cracked, cut completely through cutting edge. Extend cut 1/2-inch beyond each end of crack.

Weld crack from both sides.

When welding cracks between cutting edge and bucket, extend weld at least 1/2-inch beyond each end of the crack.

Bucket Teeth

Drive out pin and remove old tip (12,Fig. 5) from bucket tooth shank (13).

Hand fit tip on tooth shank.

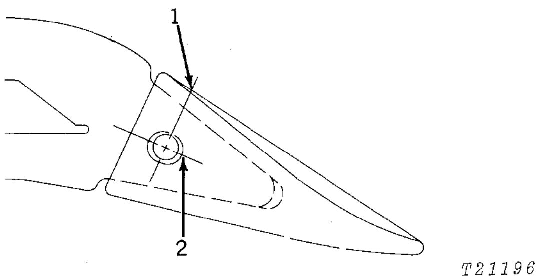
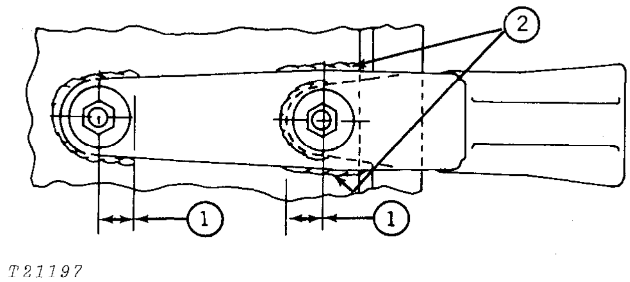


Fig. 6-Installing Tooth Tip

Drive tip on tooth shank until pin can be assembled or until center of hole in shank aligns with center of slot in tip (Point "1", Fig. 6).

Secure tip to tooth shank with grooved pin.

IMPORTANT: Pin should not contact front edge of slot (Point "2", Fig. 6). Point must fit tight with no movement between tooth shank and tip when twisted by hand.



1—1 Inch **2—5/16 inch Bead (all welds)**

Fig. 7-Tooth Shank Welded to Bucket

Side impacting or wedging of rocks between bucket teeth can sometimes cause the tooth shank attaching hardware to loosen or fail. To prevent this, tooth shanks can be welded to the bucket in the following manner.

Attach all hardware and tighten to specifications (See Specifications).

See "Special Welding Instructions" (page 25-4) and weld tooth shank to bucket (Fig. 7).

Do not remove attaching hardware.

ADJUSTMENTS

Boom

To adjust the boom proceed as follows:

Raise the loader boom five feet and secure with a hoist.

Remove special screws and retaining washers (7 and 8, Fig. 4) from the boom pivot pins (11). Drive pins out 1/2-inch to clear retaining blocks.

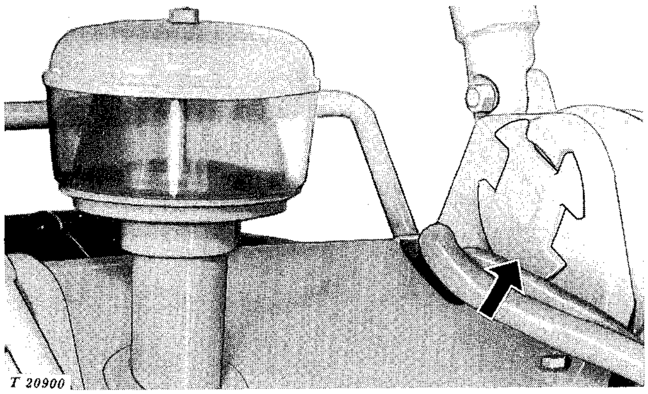


Fig. 8-Pivot Pin with Low Side of Eccentric Down

The boom is in neutral position when both pivot pins have the low side of eccentric in the down position (Fig. 8).

One-half inch side adjustment can be obtained by positioning the low side of eccentric of one pin forward and the low side of eccentric of the opposite pin rearward.

One-fourth inch side adjustment can be obtained by positioning the low side of eccentric of one pin in forward or rearward position and the low side of eccentric of the opposite pin in the down position.

Return-to-Dig Switch

For adjustment of bucket level indicator and return-to-dig switch see Operator's Manual.

Special Welding Instructions

A low hydrogen (with iron powder) electrode (American Welding Society, Series E7018) is recommended for this type of work. The sizes most easily handled in horizontal or out of flat positions are 5/32-inch and 3/16-inch diameters.

To obtain maximum strength, it is imperative that all craters at the termination of each weld be filled. Because of the cupping action of heavy electrode coating, it is necessary to drag the electrode lightly or hold a very short arc.

As a second choice, an E7010 Series Electrode can be used in DC reverse polarity after preheating the cutting edge to approximately 300 degrees F. Allow the edge to cool slowly.

IMPORTANT: When repairing a small section of the cutting edge, it is necessary to preheat around damaged area regardless of the electrode used. This will prevent rapid cooling of the edge around the weld which could cause the cutting edge to become brittle.

TORQUE VALUES

Item	Torque (Ft-Lbs)
Bucket teeth-to-bucket	170
Lever links-to-boom and bucket	105
Fenders-to-frame	35
Dowel retainers (boom frame-to-crawler frame)	425
Pin retaining cap screws (3/8 in.)	35
(1/2 in.)	85

Group 30
DROTT 4-IN-1 BUCKET

GENERAL INFORMATION

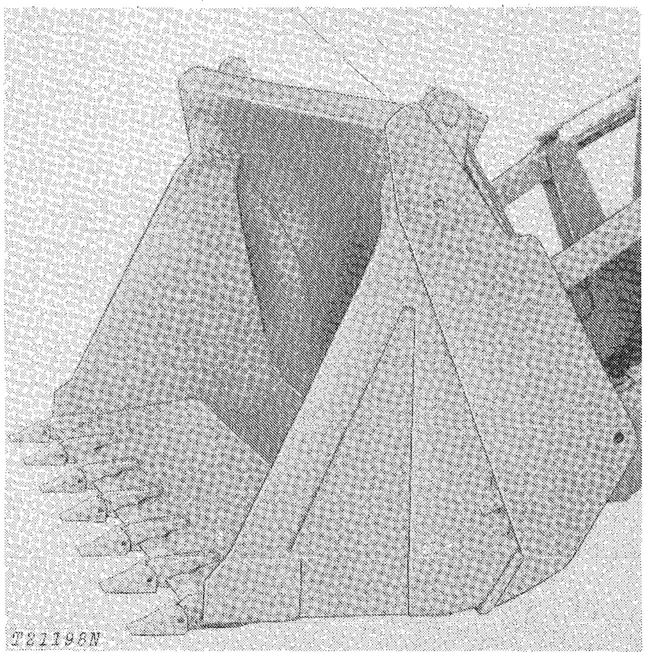


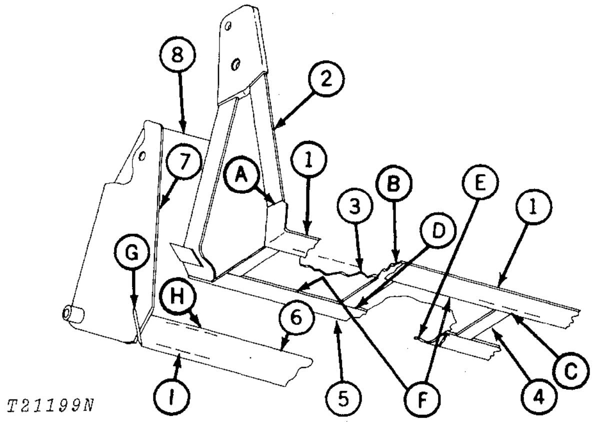
Fig. 1-Drott 4-in-1 Bucket

The Drott 4-in-1 Bucket (Fig. 1) may be used as a loader, scraper, bulldozer, or clam shell. The bucket has a replaceable wrap-around cutting edge which is equipped with six replaceable steel teeth.

The boom and bucket are operated by the loader control lever, while the clamp action of the bucket is operated by the attachment control lever.

The clam is opened and closed by two double-acting hydraulic cylinders.

A single-acting circuit relief valve, located at the top rear of the bucket (Fig. 2), provides pressure relief when the attachment control lever is in neutral.



1—Clam Cutting Edge
2—Reinforcing Plate
3—Bottom Plate
4—Support Runner
5—Compaction Plate
6—Blade Cutting Edge
7—Blade
8—Moldboard

Fig. 2-Replacing Bucket Cutting Edges

REPAIR

Bucket Cutting Edges

Remove worn clam cutting edges from the bucket using a torch and chisel. The blade cutting edge is attached with bolts.

Because bucket cutting edges are made of high carbon steel, special welding techniques are required (80-25-4).

When replacing cutting edges refer to Fig. 2 and weld according to the following instructions.

1. Use 3-5/16-inch fillet weld on areas A and C.

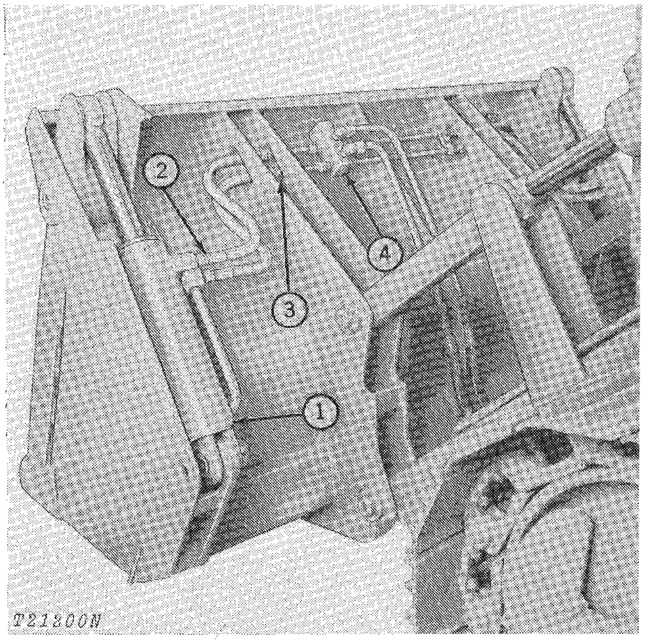
2. Use 1/4-inch fillet weld on area B. Welds are to be 6 inches long and centered on cutting teeth holes.

3. Use 5/16-inch bevel weld on area D.

4. Use 5/16-inch fillet skip weld on area E. Welds are to be 6 inches long and 12 inches between centers.

5. Use 1/4-inch fillet weld on area F. Welds are 3 inches long and centered between support runners.

ADJUSTMENTS



1—Clam Cylinder L.H. **3—Clam Closing Circuit**
2—Clam Opening Circuit **4—Relief Valve Cap**

Fig. 3—Adjusting Drott Bucket Relief Valve

Tee a pressure gauge into the clam bucket opening pressure line at cylinder (Fig. 3). Open bucket approximately 8 inches.

With clam bucket control lever in neutral, push clam section of bucket against a solid object.

IMPORTANT: Do not ram bucket.

Observe when bucket starts to close. Pressure gauge reading at this time is the relief valve setting. By adding or subtracting shims under relief valve cap, adjust relief valve setting to specifications. (See Specifications).

If relief pressure cannot be adjusted correctly or if bucket still malfunctions the relief valve should be removed for servicing (Section 70).

SPECIFICATIONS

Item	Measurement
Relief valve setting	2200 psi

Group 35
LUMBER FORK AND PULPWOOD LOADER

GENERAL INFORMATION

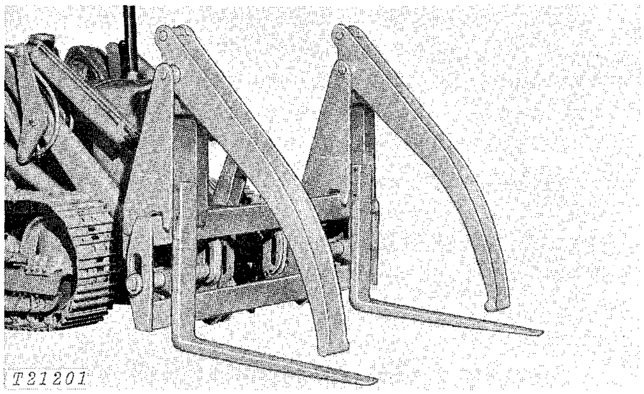


Fig. 1-JD450-B Lumber Fork

The lumber fork is ideal for handling all kinds of cut lumber. It can be used with standard load arms only or with single or dual clamps.

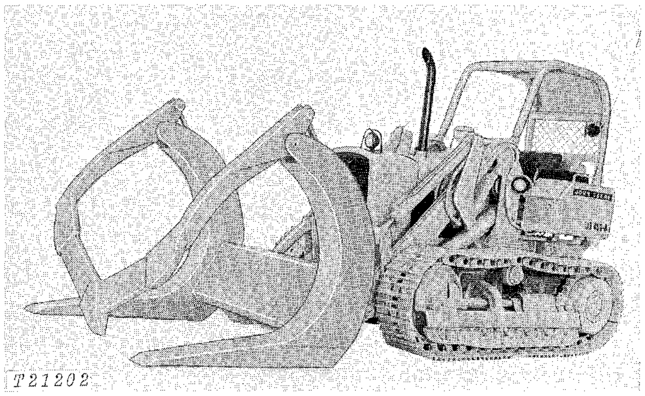


Fig. 2-JD450-B Pulpwood Loader

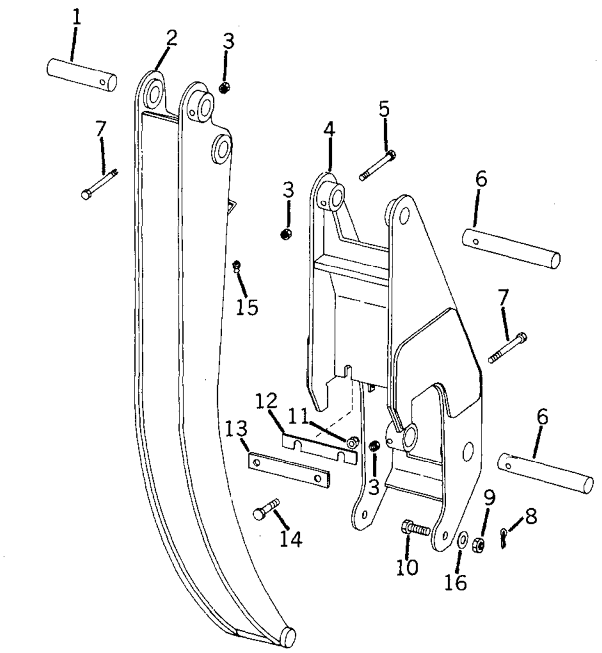
The pulpwood loader is an ideal unit for handling all types of logs. It can be used as a basic log fork or with grapple arms for positive clamping action.

REPAIR

CAUTION: To avoid possible injury and to insure best results, always stop tractor operation and lower or block up frame before servicing.

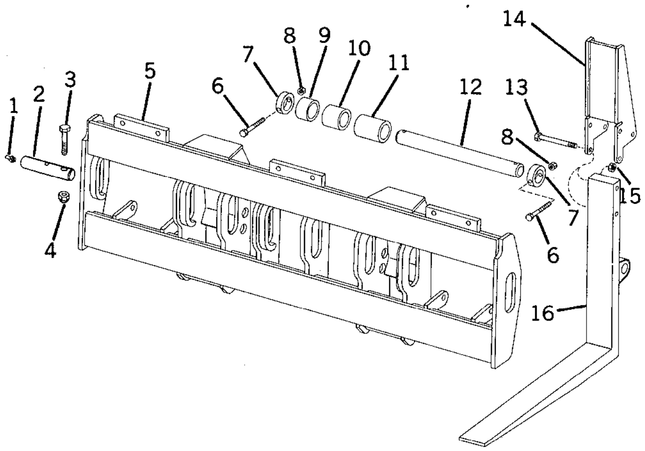
Refer to Figs. 3 through 5 during disassembly and assembly of the lumber fork and pulpwood loader.

Check all parts for wear and damage. Replace parts as necessary.



1—Pin
2—Clamp
3—Nut (3 used)
4—Clamp Support
5—Cap Screw
6—Pin (2 used)
7—Cap Screw (2 used)
8—Cotter Pin
9—Nut (2 used)
10—Cap Screw (2 used)
11—Lock Nut (2 used)
12—Shim (as required)
13—Back-Up Washer (2 used)
14—Cap Screw (2 used)
15—Grease Fitting
16—Washer (2 used) (single clamp only)

Fig. 3-Lumber Fork Clamp



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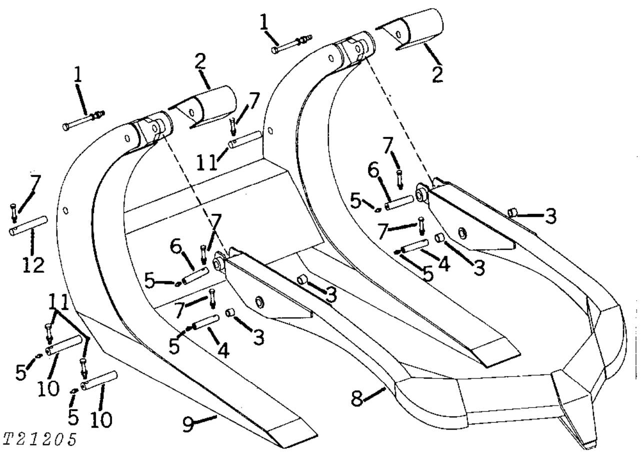
1—Grease Fitting (4 used)
2—Boom Pin (4 used)
3—Cap Screw (4 used)
4—Stop Nut (4 used)
5—Frame
6—Cap Screw (4 used)
7—Retainer (4 used)
8—Nut
9—Spacer (6 used)
10—Spacer (2 used)
11—Spacer (2 used)
12—Load Arm Shaft (2 used)
13—Bolt (2 used)*
14—Load Arm Standard*
15—Nut (4 used)*
16—Load Arm

* With single clamp

Fig. 4-Lumber Fork Frame and Load Arm



T21205

1—Bolt, Lock Washer, and Nut
2—Mast End Cover
3—Bushing (4 used)
4—Pin (2 used)
5—Grease Fitting (8 used)
6—Pin (2 used)
7—Cap Screw and Lock Nut (6 used)
8—Grapple
9—Main Frame
10—Pin (4 used)
11—Cap Screw and Lock Nut (4 used)
12—Pin

Fig. 5-Pulpwood Loader Main Frame and Grapple

ASSEMBLY

Lumber Fork

Mount the clamp support on the main frame with the lower attaching cap screws. Do not tighten these screws at this time.

Position the inner surface of the clamp support against the front surface of the main frame. Insert as many shims (12, Fig. 3) as possible between the clamp support and the clamp locating strip on the lumber fork frame. Attach back-up washer (13) with two cap screws and tighten to specifications.

Tighten lower attaching cap screws to specifications. Back nut off to nearest slot and insert cotter pin.

Lumber Fork and Pulpwood Loader

Tighten all attaching cap screws and bolts to specifications.

Grease fittings before resuming operation.

TORQUE VALUES

Item	Torque (Ft-Lbs)
Pin retaining cap screws (3/8″)	35
(1/2″)	85
Mast end cover-to-mast	85
Load arm standard-to-load arm	300
Clamp support to frame (upper cap screws through back-up washer	425
Clamp support to frame (lower cap screws)	670

Group 40

BACKHOE BOOM AND BUCKET

GENERAL INFORMATION

Double-acting hydraulic cylinders are used in five operations of the 9250 Backhoe and four operations of the 9300 Backhoe.

A rotary vane-type cylinder is used to swing the boom of the 9300 Backhoe during operation.

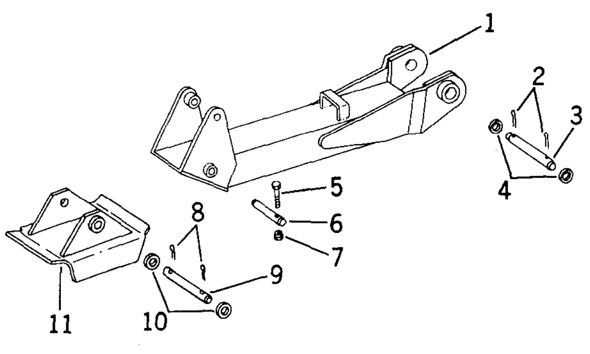
The backhoes operate with a two-lever control. The two-lever control with its universal-joint-type hookup provides eight operations. Both operating control levers provide normal simultaneous operation with minimum operator fatigue and effort. Two shorter levers operate the stabilizers which are individually controlled.

(See Section 70 for service of hydraulic cylinders and valves.)

9300 BACKHOE

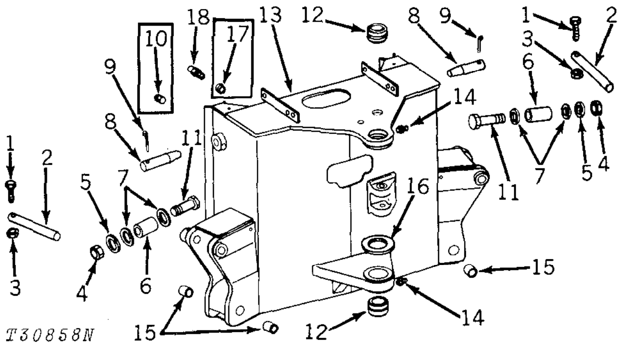
Repair

See Section 10, Group 25 for separation of backhoe from Crawler.



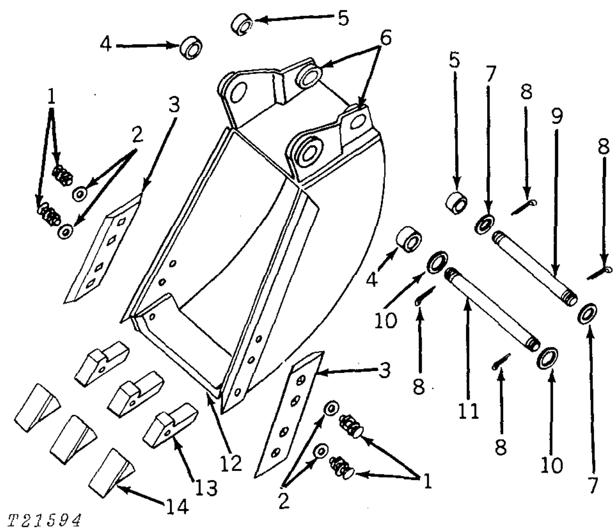
1—Stabilizer
2—Cotter Pin
3—Stabilizer Pin
4—Washer
5—Cap Screw
6—Stabilizer Cylinder Pin
7—Lock Nut
8—Cotter Pin
9—Stabilizer Foot Pin
10—Washer
11—Stabilizer Foot

Fig. 1-Stabilizer



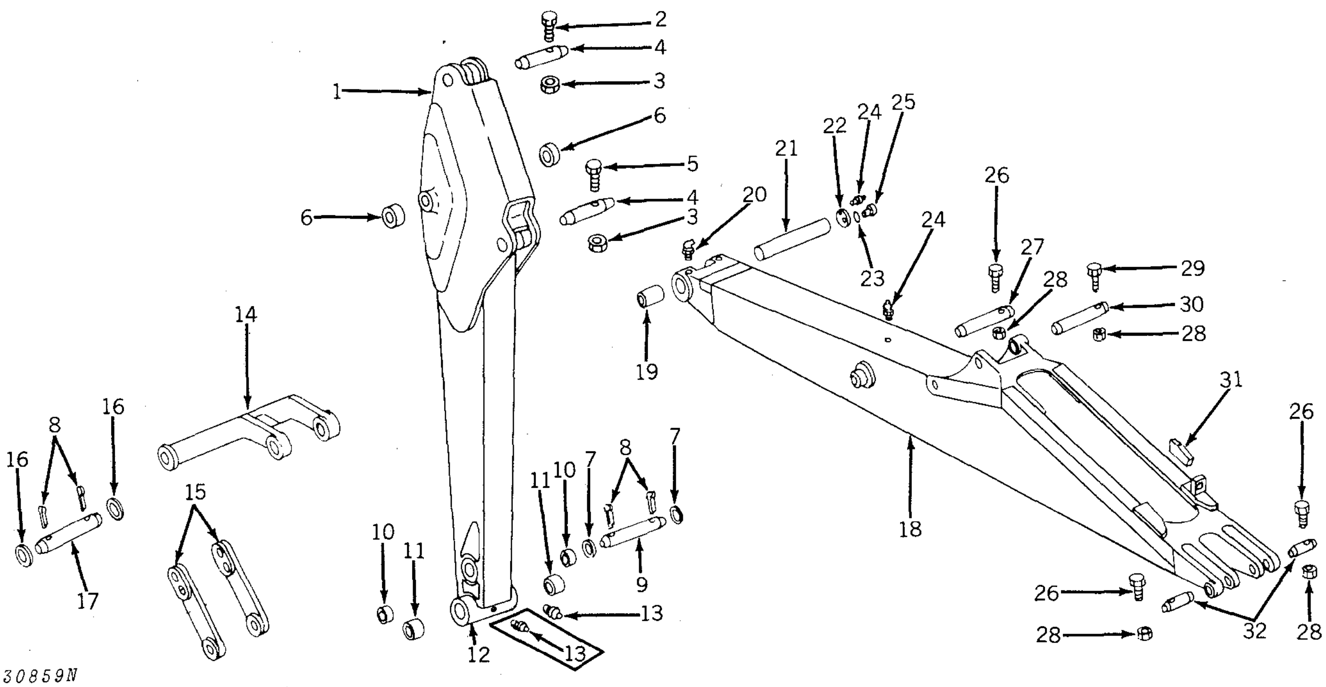
1—Cap Screw (2 used)
2—Stabilizer Cylinder Pin (2 used)
3—Lock Nut (2 used)
4—Nut (2 used)
5—Lock Washer (2 used)
6—Pivot Ferrule (2 used)
7—Washer (4 used)
8—Pivot Pin (2 used)
9—Cotter Pin (2 used)
10—Plug (Early Units)
11—Cap Screw (2 used)
12—Bushing (2 used)
13—Main Frame
14—Grease Fitting (2 used)
15—Bushing (4 used)
16—Special Washer (2 used)
17—Bushing (002827-XXXXXX)
18—Relief Valve (Later Units)

Fig. 2-Main Frame



1—Bolt, Lock Washer, and Nut (6 used)
2—Washer
3—Side Cutting Edge
4—Bushing
5—Bushing
6—Pivot Plate
7—Backup Washer
8—Cotter Pin
9—Pin
10—Backup Washer
11—Pin
12—Front Cutting Edge
13—Tooth Shank
14—Tooth Tip

Fig. 3-Bucket (with straight pivot plates)



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1—Dipperstick (Later Units Illustrated)
2—Cap Screw
3—Lock Nut (2 used)
4—Cylinder Pin
5—Cap Screw
6—Bushing
7—Special Washer (2 used)
8—Cotter Pin
9—Pin
10—Bushing
11—Bushing
12—Pivot End
13—Grease Fitting (2 used Early Units) (1 used Later Units)
14—Guide Link
15—Coupler Link (2 used)
16—Special Washer (2 used)
17—Pin
18—Boom
19—Bushing (2 used)
20—Grease Fitting (2 used)
21—Boom Pivot Pin
22—Retaining Washer (2 used)
23—Lock Washer (4 used)
24—Grease Fitting (3 used)
25—Cap Screw (4 used)
26—Cap Screw (3 used)
27—Boom Cylinder Pin
28—Stop Nut (3 used)
29—Cap Screw
30—Crowd Cylinder Pin
31—Boom Wedge
32—Boom Pivot Pin (2 used)

Fig. 4-Boom and Dipperstick

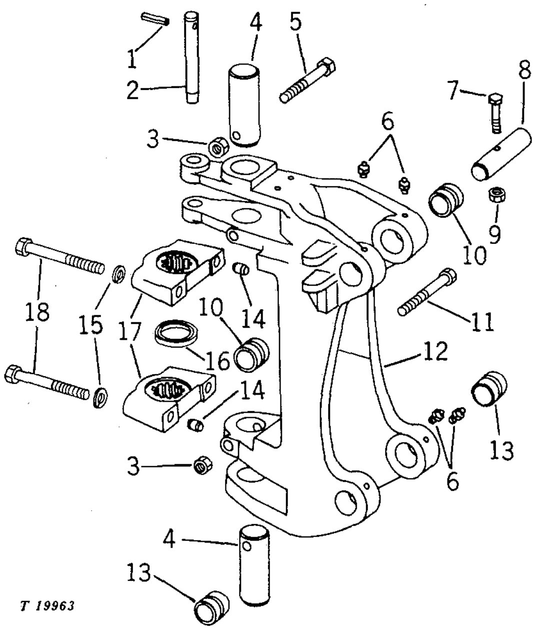

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Fig. 5-Boom Pivot

1—Spring Pin
2—Pin
3—Lock Nut (2 used)
4—Pivot Pin (2 used)
5—Cap Screw
6—Grease Fitting (4 used)
7—Cap Screw
8—Pin
9—Lock Nut
10—Bushing (2 used)
11—Cap Screw
12—Boom Pivot
13—Bushing (2 used)
14—Dowel (2 used)
15—Lock Washer (4 used)
16—Spacer Ring
17—Shaft Coupling (2 used)
18—Cap Screw (4 used)

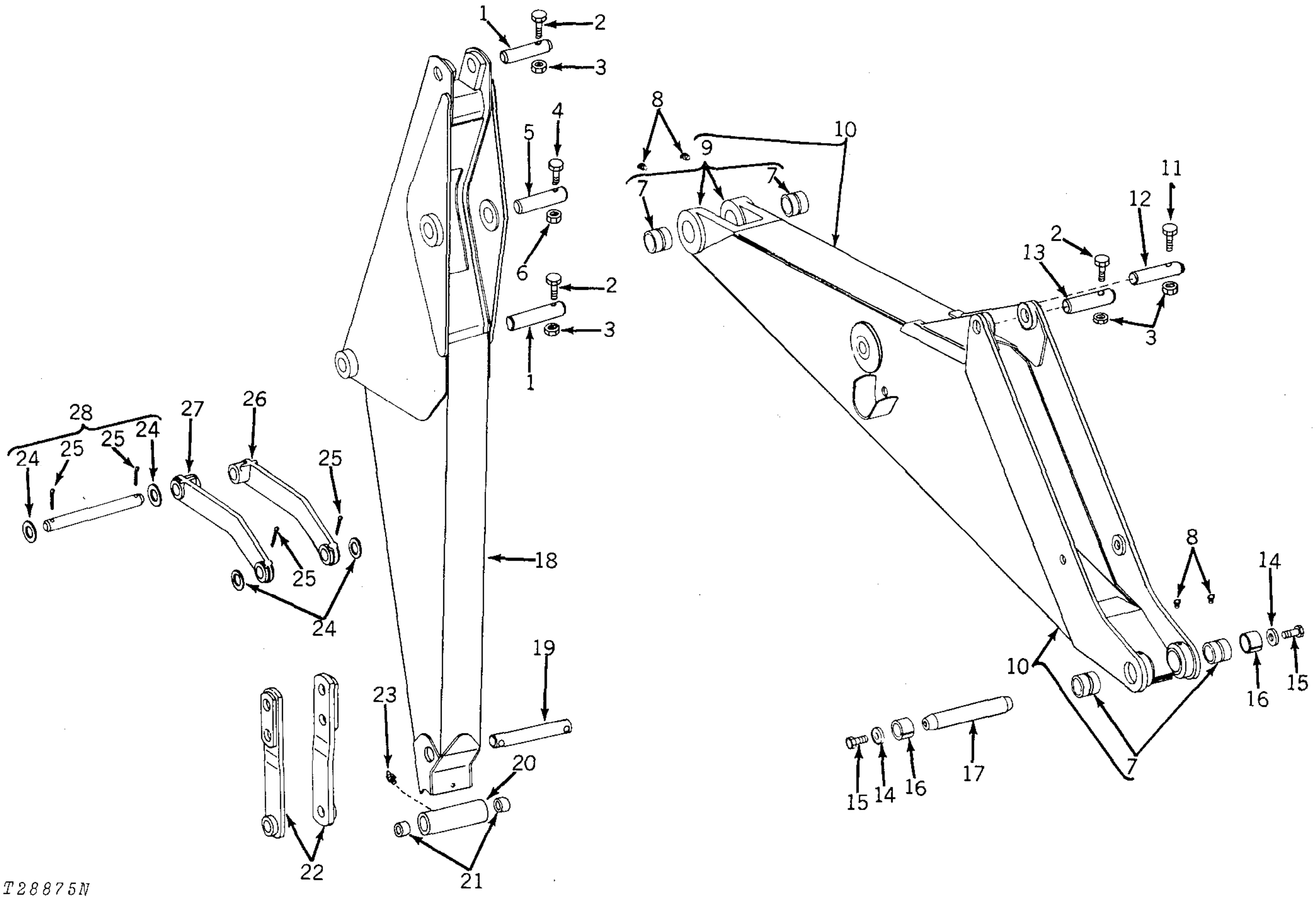
Legend for Fig. 5

Refer to Figs. 1 through 5 during disassembly and assembly of backhoe components.

9250 BACKHOE

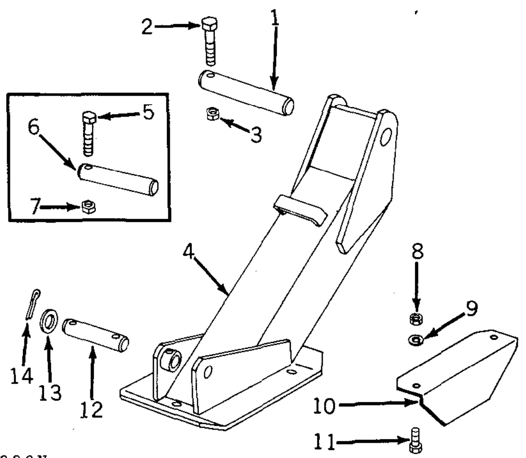
Repair

See Section 10, Group 25 for separation of backhoe from crawler



1—Pin (2 used)
2—Cap Screw (3 used)
3—Lock Nut (4 used)
4—Cap Screw
5—Pin
6—Lock Nut
7—Bushing (4 used)
8—Grease Fitting (4 used)
9—Bushing Pivot Assembly
10—Boom Assembly with Pivot and Bushings
11—Cap Screw
12—Pin
13—Pin
14—Washer (2 used)
15—Cap Screw (2 used)
16—Wedge Bushing (2 used)
17—Tapered Pin
18—Dipperstick Assembly
19—Pin
20—Dipper End
21—Dipperstick Bushing (2 used)
22—Bucket Link (2 used)
23—Grease Fitting
24—Special Washer (4 used)
25—Cotter Pin (4 used)
26—R.H. Driver Link
27—L.H. Driver Link
28—Pin

Fig. 6-Boom and Dipperstick Assembly



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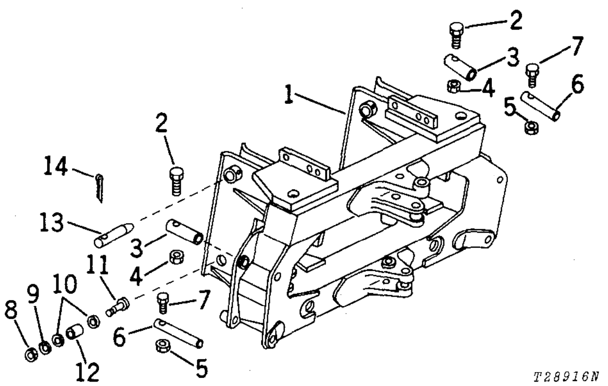
1—Stabilizer Pivot Pin (2 used)
2—Cap Screw (2 used)
3—Lock Nut (2 used)
4—Stabilizer (2 used)
5—Cap Screw (2 used - early units)
6—Stabilizer Cylinder Pin (2 used - early units)
7—Lock Nut (2 used - early units)
8—Nut (4 used)
9—Lock Washer (4 used)
10—Stabilizer Cleat (2 used)
11—Cap Screw (4 used)
12—Stabilizer Cylinder Pin (2 used - later units)
13—Washer (4 used - later units)
14—Cotter Pin (4 used - later units)

Fig. 7-Stabilizer



1—Main Frame
2—Cap Screw (2 used)
3—Stabilizer Cylinder Pin (2 used)
4—Lock Nut (2 used)
5—Lock Nut (2 used)
6—Stabilizer Pivot Pin (2 used)
7—Cap Screw (2 used)
8—Nut (2 used)
9—Lock Washer (2 used)
10—Washer (4 used)
11—Cap Screw (2 used)
12—Pivot Ferrule (2 used)
13—Pivot Pin (2 used)
14—Cotter Pin (2 used)

Fig. 8-Main Frame

Refer to Figs. 6 through 8 during disassembly and assembly of backhoe components. Refer to Fig. 3 for repair of bucket.

9250 AND 9300 BACKHOES

REMOVING TAPERED PINS AND BUSHINGS

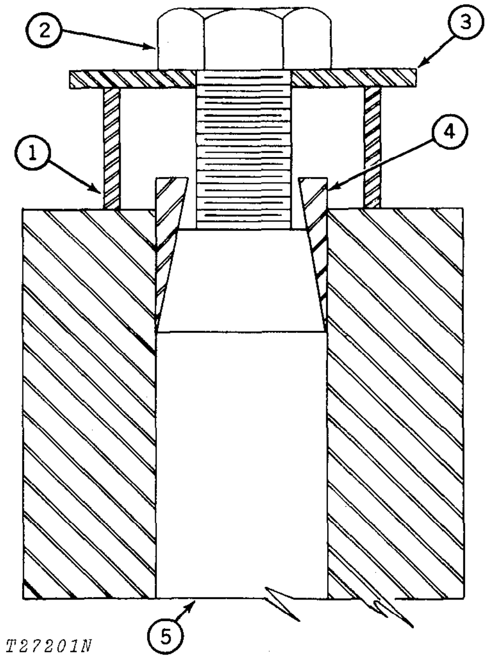
The procedures for removing tapered pins and bushings are as follows:

Remove cap screws from both ends of tapered pin (5, Fig. 9).

Place a short piece of pipe (1) around the tapered bushing (4). Lay a piece of steel plate (3) with a hole in the center over the pipe (1). Insert a long cap screw (2) through the hole in the steel plate (3).

IMPORTANT: To avoid damaging the threads in the tapered pin, be sure several threads of the cap screw are engaged sufficiently before applying force.

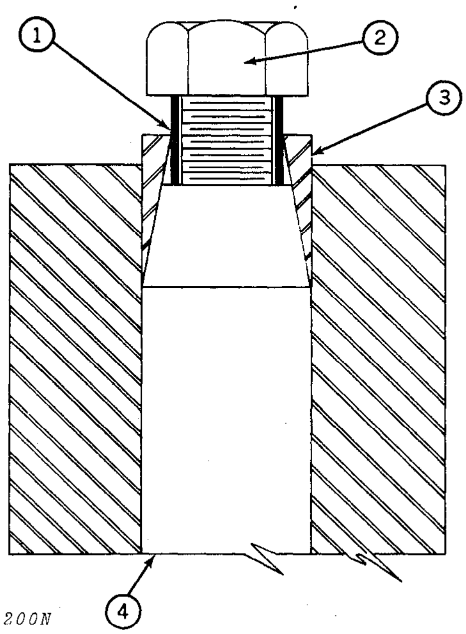
Screw cap screw (2) into tapered pin (5) until the pin and bushing are pulled from the bore.



1—Pipe
2—Cap Screw
3—Steel Plate
4—Tapered Bushing
5—Tapered Pin

Fig. 9-Pulling Tapered Pins and Bushings

Whenever it is not possible to remove tapered pins and bushings by the method given above, use the second procedure outlined as follows:



1—Pipe Spacer or Washers **3—Tapered Bushing**
2—Cap Screw **4—Tapered Pin**

Fig. 10-Removing Tapered Pins and Bushings

Place a pipe spacer or washer (1, Fig. 10) between the cap screw (2) and tapered pin (4). This will transfer the force applied at the cap screw to the tapered pin and not the bushing.

Tighten cap screw to standard torque.

Strike head of cap screw to drive tapered pin and bushing from bore.

If neither of the above procedures will remove tapered pin and bushings, use both procedures simultaneously.

ASSEMBLING TAPERED PINS AND WEDGE BUSHINGS

When installing tapered pins use the following procedure:

1. Before inserting pins and bushings, be sure bushing bores are clean, dry and unpainted.

2. Assemble parts loosely. Center pin assembly in pin joint within 0.12 inch.

3. Tighten bolts as follows:

   A. Tighten all bolts associated with the tapered pin assembly to a minimum of one-half the standard torque.

   B. Shock both wedge bushings with a brass, lead, or aluminum hammer.

      a. If the washers are accessible and large enough, strike both washers in three places.

      b. If the washers are not accessible or are too small to strike directly, place a spacer over the bolt head or bolt nut and strike the spacer three times.

NOTE: Do not pound on bolt head or nut.

   C. Tighten bolts to full torque.

   D. Repeat step B.

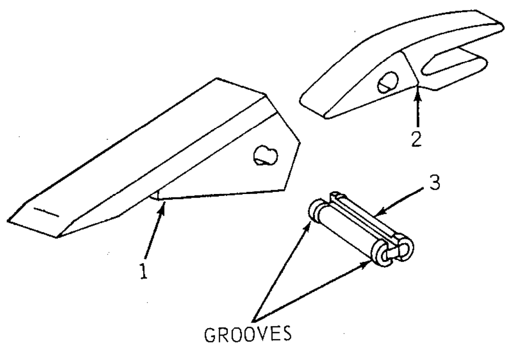
   E. Check torque.

   F. Repeat steps B and C alternately until shocking the assembly does not reduce the torque reading on bolts.

   G. Recheck for centered position.

9300 BUCKETS AND 9250 HEAVY-DUTY BUCKETS

Backhoe Bucket Tooth Assembly



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1—Tooth Tip
2—Tooth Shank
3—Flex Pin

Fig. 11-Tooth Assembly

To fasten the tooth tip to shank, drive the flex pin in making sure that the half grooves face toward the tooth tip as shown in Figure 11. The grooves are the locking mechanism.

NOTE: If "back" is stamped on the pin, it should face toward the shank.

TORQUE VALUES

Item	Torque (Ft-Lbs)
Retaining washers-to-boom to dipperstick pivot pin	35
All 1/2" pin retaining screws	85
Pivot ferrule-to-main frame	300
Swing cylinder pin nut	240 to 260

INDEX

A

B

C

D

E

O

P

Q

R

S

SAFETY
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