# INDEX
# 645-B WHEEL LOADERS
# SERVICE MANUAL SET
# FORM NO. 73061033

| Service manual set is arranged in the following order | Individual manuals are also available in translation in form numbers listed below | | | | | |
|---|---|---|---|---|---|---|
| Service Manuals | ENGLISH Form No. | ESPAÑOL (Spanish) | FRANÇAIS (French) | PORTUGUES (Portuguese) | ITALIANO (Italian) | DEUTSCH (German) |
| Engine | 70650824 | 70690760 | 70690761 | | | |
| Turbocharger (Model T-04) | 70687805 | 70679633 | 70679634 | 70679634 | | |
| Trans, Torque Converter, Charging Pump | 73059226 | 73061831 | 73061844 | | 73063282 | 73063295 |
| Axles | 73053547 | 73061828 | 73061841 | | 73063279 | 73063292 |
| Brakes & Air System | 73057214 | 73061835 | 73061848 | | 73063286 | 73063299 |
| Powersteering | 73068993 | 73061832 | 73061845 | | 73061845 | 73063296 |
| Bucket Hydraulic Systems | 73124400 | 73061829 | 73061842 | | 73061842 | 73063293 |
| Bucket & Chassis | 73055458 | 73061830 | 73061843 | | 73061843 | 73063294 |
| Electrical System | 73146366 | 73061836 | 73061849 | | 73061849 | 73063300 |

The following additional Service Manuals, in English, are not included in the Manual Set, but may be ordered from a Fiatallis dealer:

Injection Nozzles & Holders ..... 70682797
Injection Pump (Simms) ..... 70685931
Injection Pump (Roosa Master DM) ..... 73112988

FIATALLIS

Index card 75124851

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645-B WHEEL LOADERS | SERVICE MANUAL SET | FORM 73061033

NOTICE
THESE CHANGES ARE INCLUDED IN THIS COPY

REPLACEMENT PAGES FOR

650824 (10-65)

SERVICE MANUAL

3500 ENGINES

CONSTRUCTION MACHINERY DIVISION

Mailing No. 2

The following replace like pages:

Sect. 10 Pg. 5b (No change)
Sect. 10 Pg. 5c (Revised)

Sect. 10 Pg. 5d (Revised)
Sect. 10 Pg. 6 (No change)

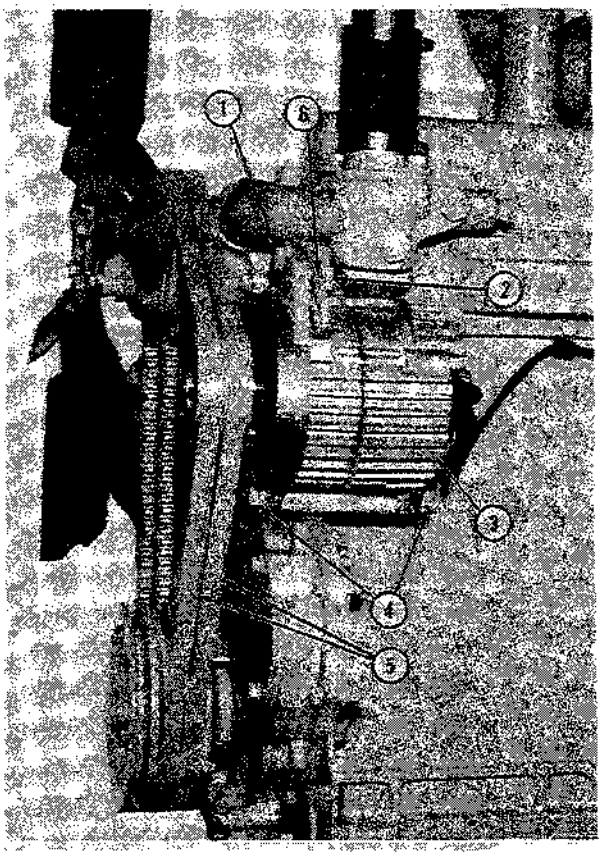
INSERT THIS SHEET INTO THE FRONT OF MANUAL 650824 (10-65) TO INDICATE RECEIPT OF THIS MAILING. Additional copies of this mailing are available. Please direct your order to Technical Publications Dept., Springfield Plant.

This mailing contains additional oil pump assembly information.

Litho in U. S. A.

Issued 1-69

# SUBJECT INDEX




T-76893

FIG. 2c BELT ADJUSTMENT (CRAWLER LOADERS EFF. ENGINE S/N 15109)

1. Adjustment brace attaching capscrew
2. Adjustment brace capscrew
3. Alternator
4. Alternator mounting capscrews
5. Belts
6. Belt adjustment brace

4. CRAWLER LOADERS (EFF. ENGINE S/N 15109)

The belts, Fig. 2c, are properly adjusted when they can be depressed .75" (19,05mm) by hand at a point midway between crankshaft pulley and fan pulley when applying a force of 25 lbs. (11.3 kg). Correct adjustment using a belt tension gauge is 102 -- 107 lbs. (46,20 --48,46 kg). Adjust belts as follows:

a. Loosen adjustment brace capscrew (2), loosen adjustment brace attaching capscrew (1), and the two alternator mounting capscrews (4).

b. Move alternator (3) in or out to obtain correct tension. Tighten all capscrews securely.

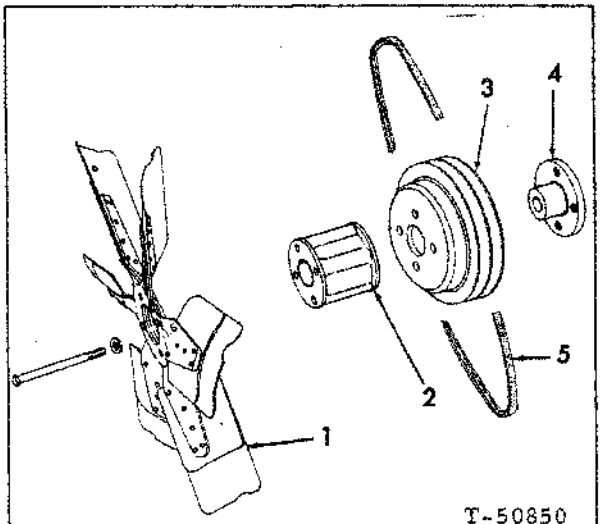



FIG. 3 FAN AND PULLEY (WHEEL LOADERS)

1. Fan
2. Fan spacer
3. Pulley
4. Pulley hub
5. Fan belts

## C. FAN BELTS REMOVAL, INSPECTION AND INSTALLATION

1. Remove the fan guard.

2. Loosen tension from fan belts so that belts can be slipped from drive pulleys and over fan blades; remove belts.

3. Inspect fan belts for excessive slickness, oil-soak, wear, tears, cracks, and overstretching. The fan belts are a matched pair. If only one belt replacement is required, it is imperative that both belts be replaced to assure that satisfactory belt performance will be obtained.

4. Install the fan belts by a direct reversal of the removal procedure and adjust the belts.

## D. FAN, FAN SPACER, AND FAN PULLEY REMOVAL, INSPECTION, AND INSTALLATION

Fan blades seldom require service. However, bent blades are conducive to inefficient cooling and will affect the balance of the fan. An unbalanced fan is detrimental to the water pump bearing. In case of damage, the fan should be removed and the blades restored to their original contour or replaced by a new fan. For removal of the fan, fan spacer, and fan pulley, refer to Fig. 3 or 3a and proceed as follows:

3. Remove radiator.

4. Loosen capscrews securing fan and pulley to water pump hub.

5. Loosen capscrew securing generator at slotted end of brace. Push generator forward to relieve tension on belts and remove drive belts.

6. Remove the loosened capscrews, fan, fan spacer, and pulley from water pump hub.

7. Remove nut, lockwasher and capscrew, washer, and lockwasher securing generator brace; remove generator brace.

8. Remove capscrews, washers, and lockwashers securing water inlet pipe to water pump. Remove water inlet pipe with by-pass hose by loosening clamp and removing by-pass hose from thermostat housing. Remove clamp and by-pass hose from water inlet pipe.

NOTE

If water pump only is being replaced, allow water inlet pipe to remain suspended by water by-pass hose.

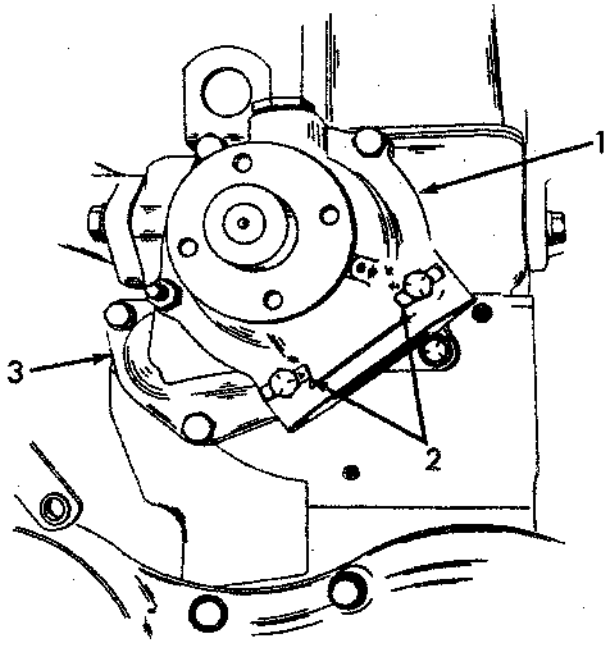



Fig. 8 -- Water Pump and Capscrew Location (T-51283)

1. Water Pump
2. Tab Washers
3. Volute

9. Remove upper capscrews, washers, lockwashers, and tab washers securing water pump to volute and remove water pump and o-ring from volute.

NOTE

If water pump only is being repaired or replaced, allow water pump volute to remain on the cylinder block.

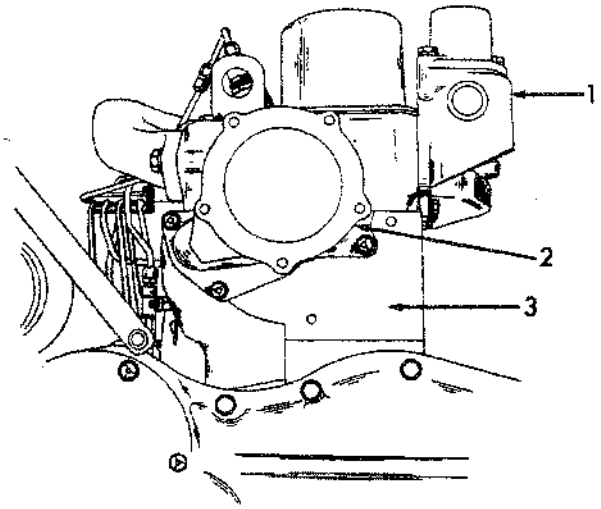



Fig. 9 -- Water Pump Volute Installed (Model 3400) (T-51281)

1. Thermostat Housing
2. Volute
3. Cylinder Block

10. Remove lower capscrews and lockwashers securing volute to cylinder block and remove volute and o-ring from the block.

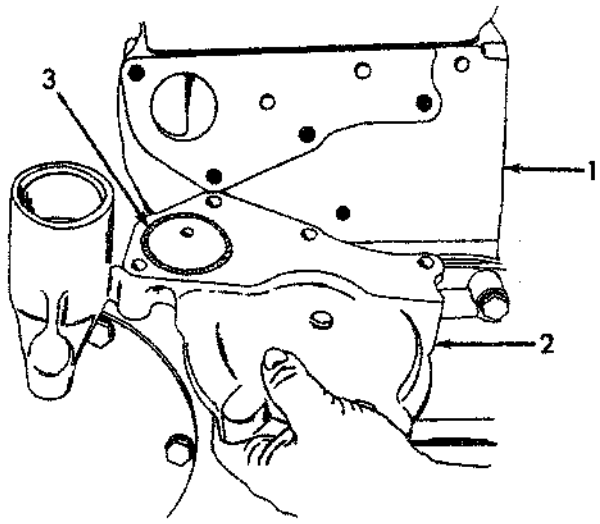



Fig. 10 -- Back Side of Volute (T-51314)

1. Cylinder Block
2. Volute
3. O-ring

# TOPIC 8 - ALTERNATOR REGULATOR

## A. DESCRIPTION

A double contact regulator is used with the alternator. The terminals of the regulator are of the slip-connection type and a special connector body on the loader wiring harness is keyed to mating slots in the regulator base to insure proper connections. A projection on the connector body serves to latch the assembly together to prevent accidental disconnection. The regulator assembly consists of a double contact voltage regulator unit and a field relay unit. The voltage regulator unit limits the alternator output voltage to a preset value whereas the field relay connects the alternator field winding directly to the battery.

## B. OPERATION

When the starter switch is activated, the field relay winding in the regulator is connected directly to the battery causing the contacts to close. This connects the alternator field winding directly to the battery, allowing field current to flow from the battery to the regulator No. 3 terminal, through the field relay contacts and then through the voltage regulator (or series) contacts. Current continues to flow to the regulator "F" terminal and then through the alternator field winding to ground. When the alternator begins to operate, AC voltages are generated in the stator windings. These voltages are then changed to DC voltages at the output terminal.

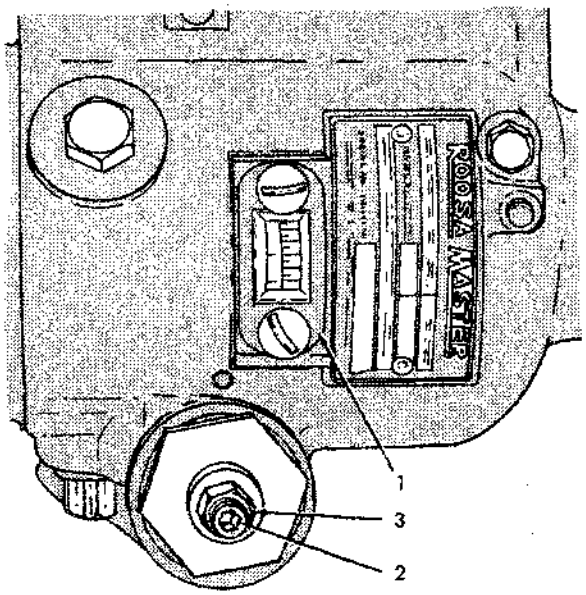



Fig. 5a -- Timing Window Installed On Fuel Injection Pump (T-74953)

1. Plastic timing window
2. Timing advance adjusting screw
3. Lock nut

2. Remove timing window cover, and install plastic timing window, Fig. 5a (1).

3. Run engine until coolant reaches normal operating temperature.

IMPORTANT

When setting or checking the automatic advance, always reduce the engine speed from high idle to the specified rpm.

4. Run engine at high idle, then reduce speed to 1600 rpm and observe timing marks. The timing mark on the governor weight retainer assembly will not be visible because the assembly is rotating at one-half engine speed. The timing mark on the cam ring should have dropped two (2) graduations on the timing window, indicating a timing advance of $4^{o}$ pump or $8^{o}$ engine.

5. Run engine at high idle, then reduce speed to 1900 rpm and observe timing mark on cam ring. The timing mark should have dropped three (3) graduations on the timing window, indicating a timing advance of $6^{o}$ pump or $12^{o}$ engine.

6. To adjust the timing advance mechanism, remove the adjusting screw cover, loosen the lock nut and turn the adjusting screw, Fig 5a, until the specified advance is attained. Turning the adjusting screw clockwise advances the timing; counter-clockwise retards the timing. Securely tighten the lock nut after each adjustment.

## D. SPEED ADJUSTMENTS

Refer to Paragraph F, GOVERNOR, for procedure to adjust the idle and full load speeds.

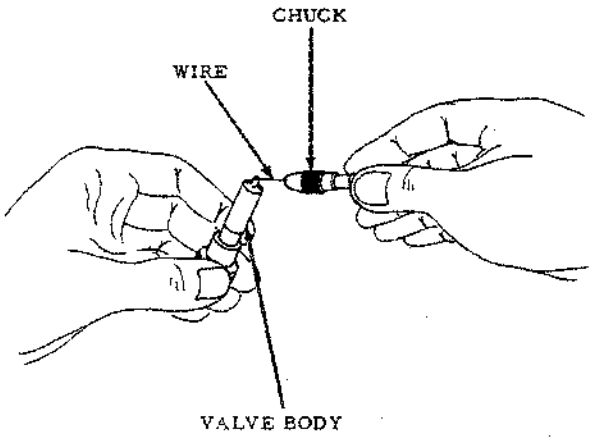



Fig. 19 -- Cleaning Nozzle Orifices
(T-50064)

Use clean paper on the work bench and as the nozzle-holder is disassembled, place the components in a container of clean diesel fuel as a protection against dirt and corrosion.

When more than one fuel injection nozzle-holder is disassembled, keep parts of each separate. Complete disassembly of the fuel injection nozzle-holder is seldom necessary. In most cases only disassembly and cleaning of the nozzle valve body and valve is required to place the nozzle-holder in good operational condition. The nozzle valve and nozzle valve body are mated parts, and must be kept together; if replacement of either part is necessary, a nozzle assembly must be ordered. Remove, clean, and inspect the nozzle valve body and valve as follows:

1. NOZZLE VALVE BODY AND VALVE REMOVAL, CLEANING AND INSTALLATION (Fig. 20)

   a. Before disassembly, thoroughly clean the injection nozzle-holder assembly.

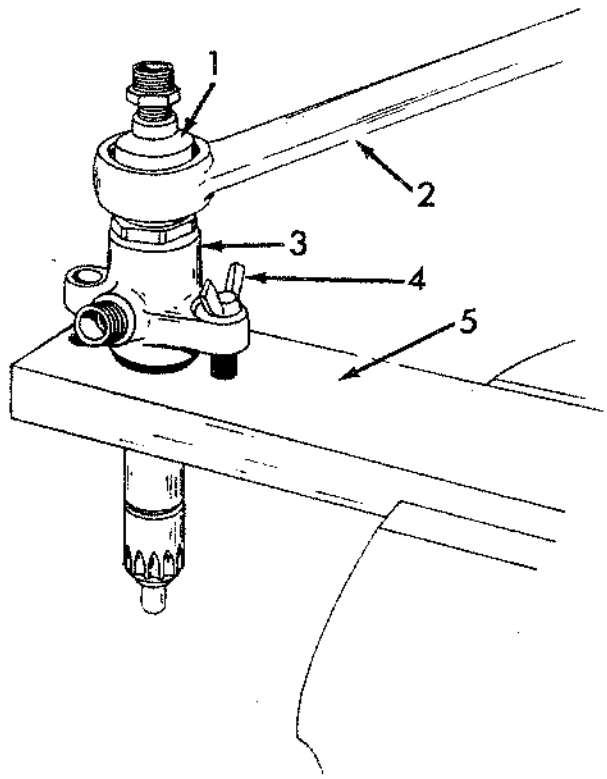



Fig. 21 -- Removing Nozzle Cap Nut
(T-52115)

1. Cap Nut
2. Wrench
3. Nozzle Holder Assembly
4. Thumb Screw
5. Injection Nozzle Holding Fixture

   b. Clamp nozzle holder body in a holding fixture similar to the one illustrated in Fig. 21.

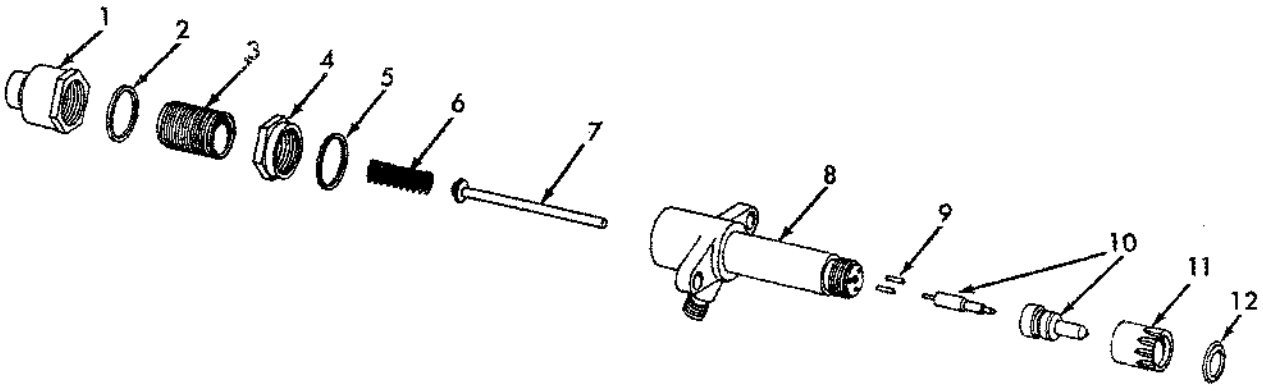
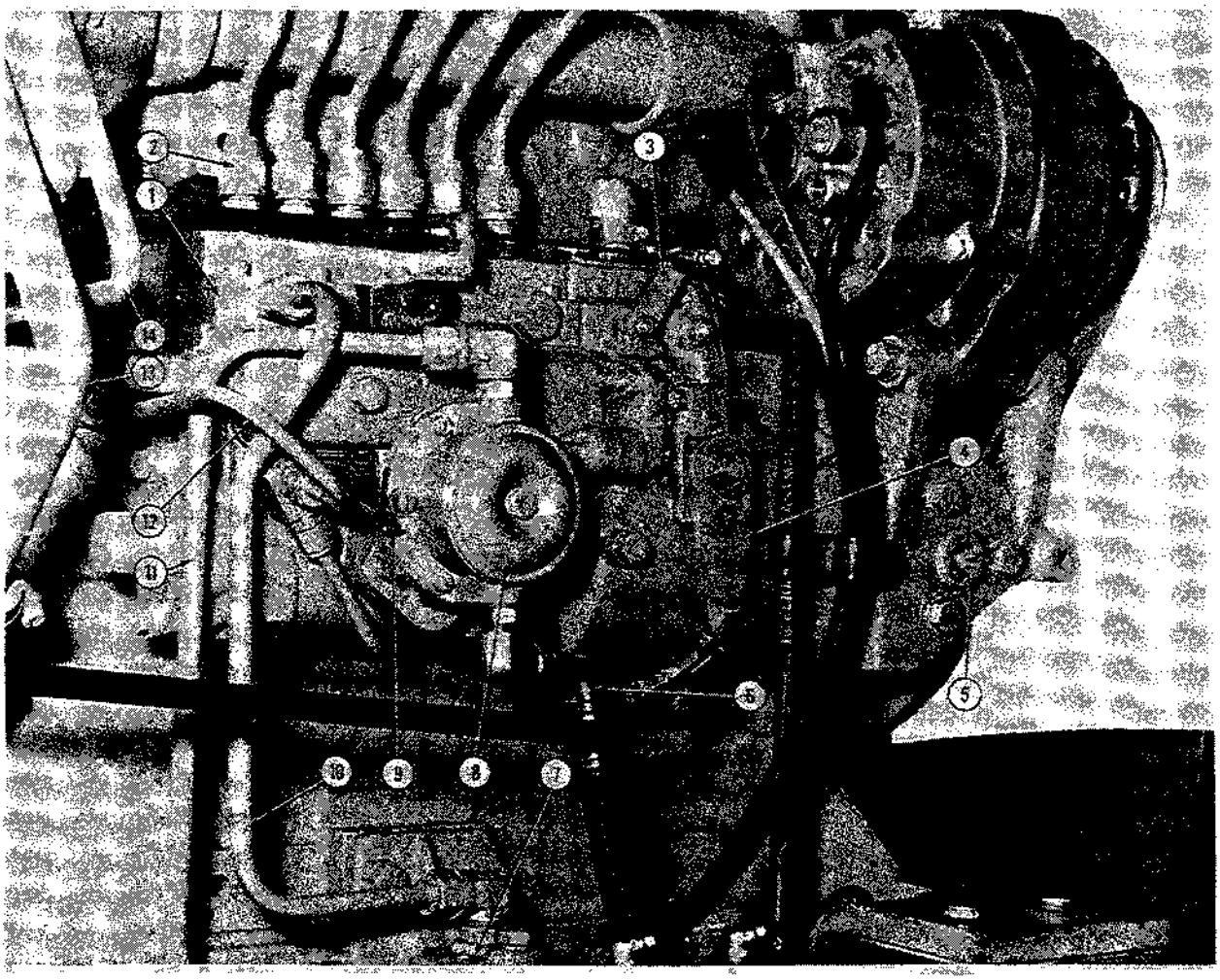



Fig. 20 -- Nozzle-Holder Assembly
(T-39751)

1. Cap Nut
2. Gasket
3. Adjusting Screw
4. Locking Nut
5. Gasket
6. Spindle Spring
7. Spindle
8. Holder Body
9. Dowel Pins
10. Nozzle Assembly
11. Retaining Nut
12. Gasket



T-76985

FIG. 7 FUEL INJECTION PUMP LINES

1. Fuel injection pump
2. Fuel lines from pump-to-nozzles
3. Stop control lever
4. Speed control lever
5. Timing hole plug
6. Fuel line-to-transfer pump inlet
7. Fuel filter
8. Fuel transfer pump
9. Hand primer lever
10. Fuel line filter-to-injection pump
11. Fuel line transfer pump-to-fuel filter
12. Oil supply tube from block-to-injection pump
13. Turbocharger oil return line
14. Turbocharger oil supply line

14. Remove capscrews and washers, Fig. 10 (5), attaching injection pump to back of front plate (3). Withdraw fuel injection pump from front plate (3) and timing gear housing cover (1).

## C. INSTALLATION AND TIMING OF FUEL INJECTION PUMP

When the fuel injection pump has been serviced and is ready to be installed, or if a new pump is to be installed on the engine, follow the procedure outlined below:

NOTE: If new injection pump is installed, remove shipping cap from fuel inlet of pump body and drain oil from gallery. Prior to operating an engine with a new or repaired injection pump remove plug on top of governor and pour 3/4 pint of engine lube oil into the governor.

1. If the engine was not rotated from its position since the injection pump was removed as in preceding Paragraph B, Step 3, the engine is properly positioned for installation of the injection pump. If the engine was rotated or has been overhauled, be certain the #1 piston is on its compression stroke. This may be determined as follows:

# SECTION 6—EXHAUST MANIFOLD AND TURBOCHARGER



# TOPIC 1—EXHAUST MANIFOLD

## A. GENERAL

The exhaust system consists of those components which convey the exhaust gases to the atmosphere. The exhaust system consists of the exhaust valves, exhaust manifold, and exhaust piping. The turbine of the turbocharger is also part of the exhaust system.

The exhaust manifold is manufactured from alloy cast iron. The exhaust manifold is in three sections with the front and the rear sections inserted into the center section. The manifolds are sealed to the exhaust ports of the cylinder head with steel-asbestos gaskets and secured in place with capscrews and lockwashers.

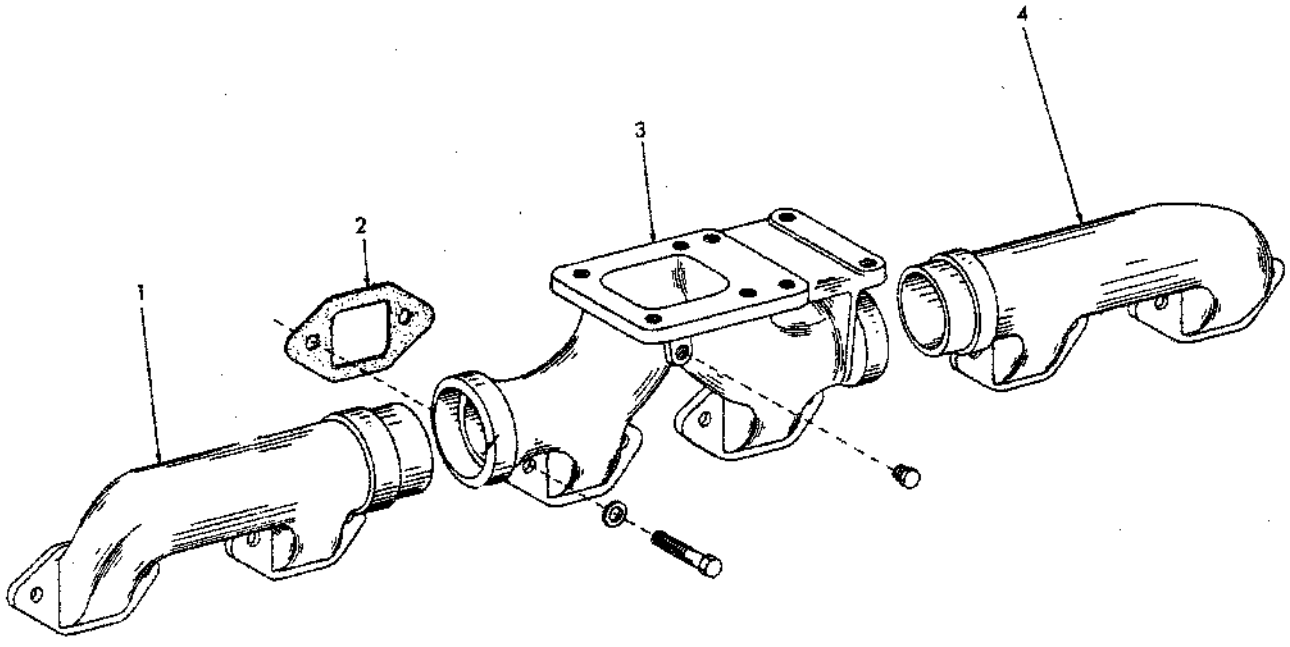



Fig. 1 -- Exhaust Manifold
(T-51063)

1. Rear Section
2. Gasket
3. Center Section
4. Front Section

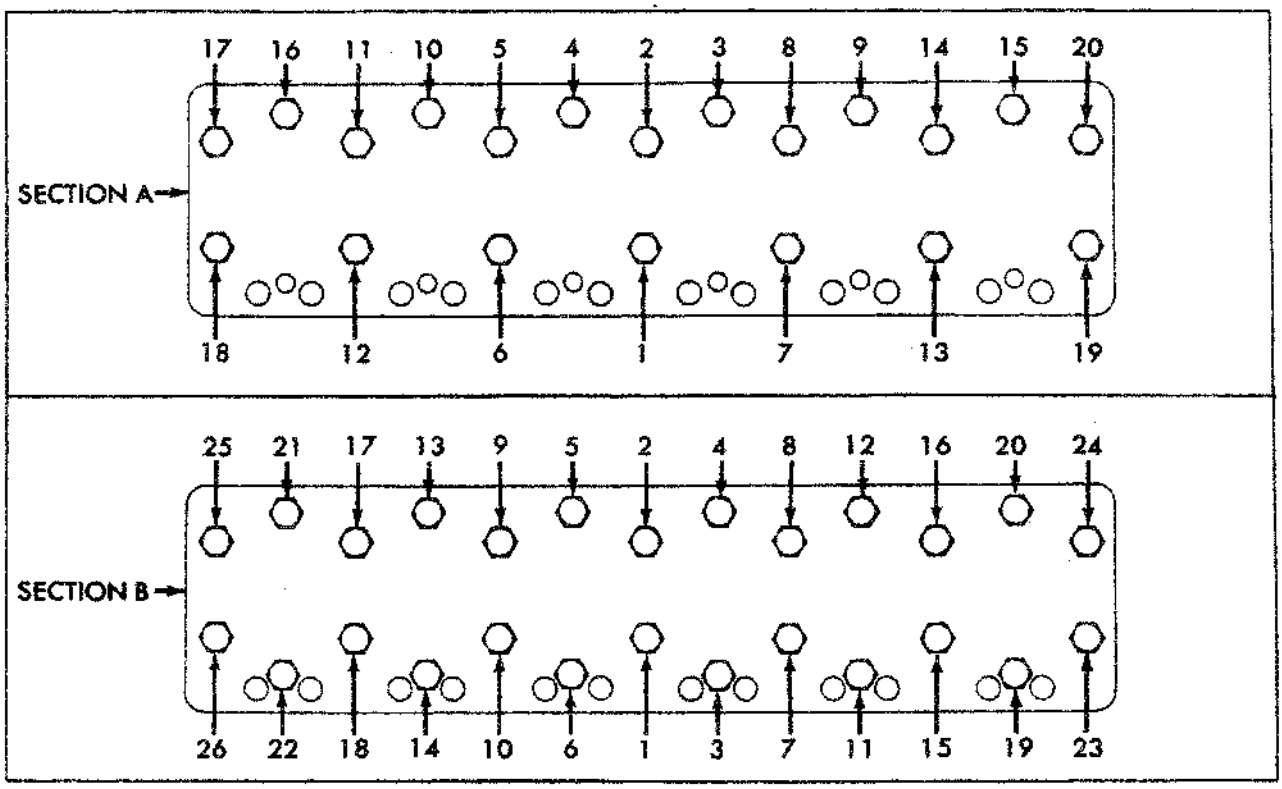



Fig. 5 -- Cylinder Head Capscrew Locations and Torquing Sequence
(T-50775)

NOTE

The use of an offset cylinder head wrench or equivalent as illustrated in Fig. 4 is required for tightening the capscrews under the rocker arm shaft assembly.

9.

10. Adjust all intake and exhaust valves to a cold tappet clearance setting of 0.018".

11. Connect the oil feed tube to the fitting in the cylinder head and install cylinder head cover and gasket.

12. Complete the rest of the installation by a direct reversal of the removal procedure.

13. Fill the cooling system. Run engine for approximately one hour, preferably under load, with a minimum coolant temperature of 160°F.

14. Allow engine to completely cool, then re-torque cylinder head capscrews (all) to 165 lbs.ft.

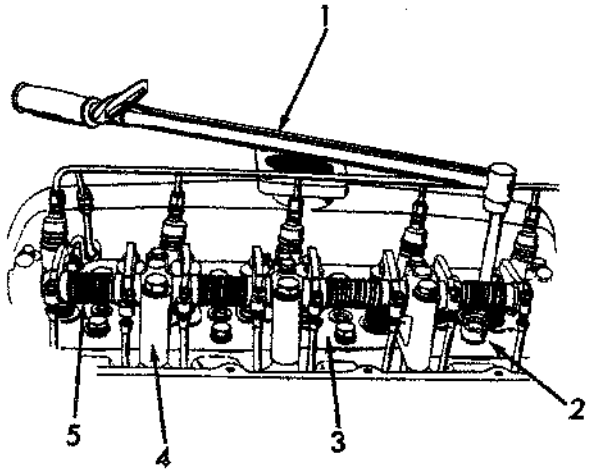



Fig. 6 -- Torquing Cylinder Head Capscrews
(T-51265)

1. Torque Wrench
2. Cylinder Head Wrench
3. Cylinder Head
4. Rocker Arm Shaft Bracket
5. Rocker Arm Shaft

# SECTION 8—FRONT END AND GEAR TRAIN



# TOPIC 1. CRANKSHAFT PULLEY AND DAMPER ASSEMBLY AND ENGINE FRONT SUSPENSION

## A. GENERAL

The type of crankshaft pulley and damper assembly used on this engine has a rubber torsional vibration damper bonded between the hub section and the pulley section of the assembly. Whenever the crankshaft pulley assembly must be replaced, it must be replaced as a unit for the parts are not serviced separately. The timing marks are rolled on the crankshaft pulley assembly for front end timing of the engine.

CAUTION

Do not, under any circumstances, fasten any type of additional pulleys or drive anything with the front crankshaft pulley and damper assembly that is not installed at the factory. Crankshaft breakage can occur if this precaution is not adhered to.

## B. CRANKSHAFT PULLEY AND DAMPER ASSEMBLY REMOVAL AND INSTALLATION

1. CRANKSHAFT PULLEY REMOVAL

a. If engine is installed in a unit, drain the cooling system. Remove components necessary to facilitate removal of the radiator, and remove the radiator.

b. Release the tension on the water pump and generator drive belts and remove the belts.

c. Loosen crankshaft pulley retaining capscrew and turn it out approximately 1/2".

d. Install leg adaptors into two opposite tapped holes of pulley and install a puller as illustrated in Fig. 1.

e. Tighten puller forcing screw. To assist in loosening pulley hub from crankshaft, strike puller forcing screw with a soft headed hammer.

f. Remove puller tools, crankshaft pulley retaining capscrew, washer, crankshaft pulley assembly, and woodruff key.

2. INSTALLATION

a. Remove any burrs if necessary and install woodruff key into crankshaft keyway.

b. Position crankshaft pulley on woodruff key and install with washer and pulley retaining capscrew. Tighten capscrew to a torque of 200 to 220 lbs. ft.

# SECTION 9 - FLYWHEEL, RING GEAR, FLEX PLATE DRIVE, FLYWHEEL HOUSING, AND CRANKSHAFT REAR OIL SEAL



# TOPIC 1 - FLYWHEEL, RING GEAR, AND FLEX PLATE DRIVE

## A. GENERAL

The engine on crawler and wheel loaders is equipped with a flywheel. A starter ring gear is shrunk onto the rim of the flywheel. The flywheel is bolted to a flange on the rear end of the crankshaft.

Two basic types of flywheels are used. On wheel loaders the flywheel has a bolted on flex plate which drives a torque converter. On crawler loaders the flywheel has internal teeth which drive a torque converter.

The engine on wheel type tractors does not have a flywheel. A flex plate drive adapter, Fig. 3, is bolted to the crankshaft flange and the flex plate drive hub is bolted to the adapter. The outer edge of the flex plate drive is bolted to the torque converter. The starter ring gear is shrunk onto the torque converter.

## B. FLYWHEEL AND/OR FLEX PLATE DRIVE REMOVAL AND INSTALLATION

1. CRAWLER LOADERS

   a. Remove the torque converter.

   b. Remove bolts attaching flywheel to crankshaft flange and remove flywheel.

NOTE: It may be necessary to pry flywheel loose with a suitable bar.

   c. Thoroughly clean and inspect the flywheel.

   d. Install flywheel by reversing the removal procedure, and on applications requiring a new sealing ring, insert it between flywheel and crankshaft flange when assembling flywheel to engine.

   e. After flywheel is assembled to crankshaft, torque the flywheel capscrews or bolts (if hex-head) to 95 to 105 lbs. ft. (13,13 -- 14,52 kg/cm). If equipped with Socket head capscrews, torque to 135 lbs. ft. (18,66 kg/m).

2. WHEEL LOADERS AND WHEEL TRACTORS

   a. Remove the access hole cover or pipe plug from front side of flywheel housing.

   b. Working through the access hole, remove the capscrews attaching the flex plate drive to the torque converter.

   c. Remove the capscrews and lockwashers attaching the torque converter housing to the flywheel housing.

   d. Separate the engine and torque converter and transmission assembly.

   e. Remove the capscrews attaching the flex drive adapter to crankshaft flange and remove the adapter and flex drive plate as an assembly.

   f. Install flywheel and/or flex plate drive by a direct reversal of the removal procedure. The engine flywheel pilot, Fig. 4, must be coated with molybdenum disulfide, extreme pressure antisieze lubricant (such as "Molykote G") prior to installation of torque converter.

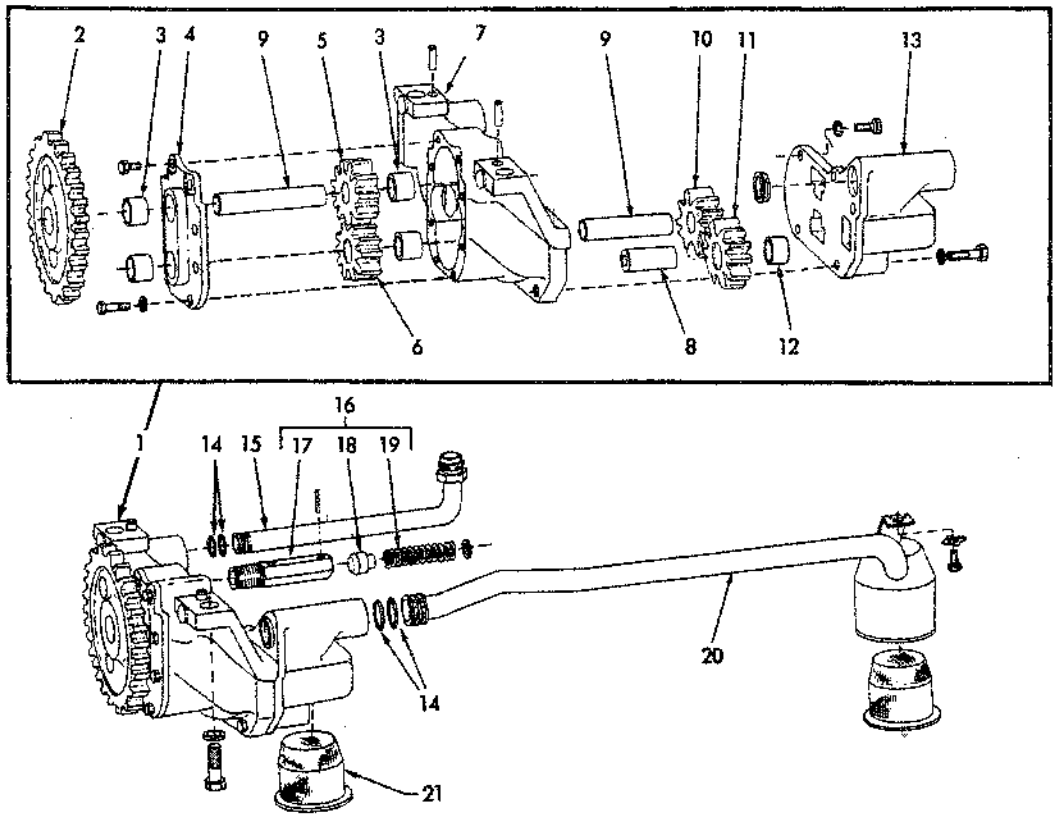



FIG. 4a OIL PUMP COMPONENTS (LATE TYPE WHEEL LOADERS AND CRAWLER LOADERS)

1. Pump assembly
2. Driving gear
3. Bushings (used on early units only)
4. Front cover
5. Drive gear (upper)
6. Drive gear (lower)
7. Pump body
8. Idler shaft
9. Drive shafts
10. Drive gear
11. Idler gear
12. Idler gear bushing
13. Rear cover (includes plug)
14. O-rings (4 on early units - 2 on late units)
15. Oil outlet tube
16. Valve assembly
17. Pressure relief valve body
18. Piston
19. Valve spring
20. Oil inlet tube
21. Oil screen

## C. OIL PRESSURE PUMP DISASSEMBLY

1. EARLY MODEL WHEEL LOADERS (Camshaft Driven)

   a. Wash the oil pump assembly in clean solvent.

   b. Remove the screen retainer wire and remove the oil pump screen.

   c. Drive out the roll pin securing the pump drive gear to the drive shaft.

   d. To prevent damage to the drive gear teeth, do not remove gear from the drive shaft with a gear puller. Press the drive gear from the shaft with the tool illustrated in Fig. 5.

   e. Remove the capscrews and lockwashers securing the pump cover to the body assembly and remove the pump cover.

NOTE

Some of the oil pumps have a dowel pin thru the cover.

   f. Remove the pump body driver gear and drive shaft from the body assembly.

   g. Remove pump idler gear from idler shaft.

(3) Carefully pull the exhaust and intake valve lifters for each cylinder up to their uppermost position and place a stout rubber band around the two dowels. Friction tape, wire, o-rings, or heavy string could also be used instead of rubber bands.

(4) As the camshaft is withdrawn from the cylinder block, remove the thrust plate and lock plate. Also, it may be necessary to rotate the crankshaft so that the connecting rods will not interfere with the camshaft lobes.

7. After removing the camshaft with gear from the cylinder block, check the thrust plate clearance (end play) by inserting a feeler gauge between the thrust plate and camshaft bearing journal as illustrated in Fig. 5. The specific end play is .003"--.010" (early models); .0027"--.0083" (late models). If the end play exceeds the maximum wear limit of .015" with a new thrust plate, the camshaft gear must be replaced.

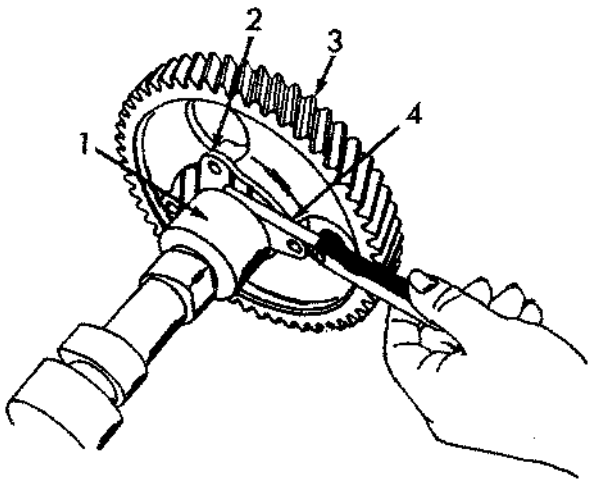



Fig. 5 -- Checking Thrust Plate Clearance (T-51649)

1. Camshaft Bearing Journal
2. Thrust Plate (early units)
3. Camshaft Gear
4. Feeler Gauge

8. On late units remove capscrew and retaining washer. Place the camshaft in a press and force the camshaft from the gear, or remove the camshaft gear with a puller (Fig. 6).

## C. CAMSHAFT, CAMSHAFT GEAR, AND THRUST PLATE INSPECTION

1. If the engine has been operated with clean oil and with the correct quantity in the oil pan, the camshaft bearing journals seldom wear to the extent that it is necessary to replace the camshaft. The specified O.D. of all camshaft bearing journal diameters is 2.130" to 2.131". The specific inside diameter of the camshaft standard bearings installed is 2.133" to 2.136". The specified running clearance between the camshaft journals and bearings is .002" to .006" and must not exceed .008". If the installation of new standard bearings would not reduce the running clearance below .008", it is recommended to grind the

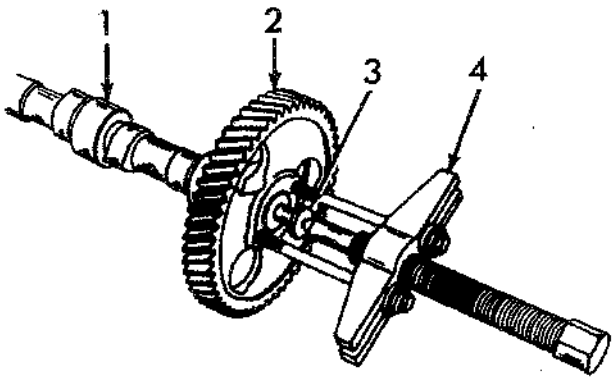



Fig. 6 -- Removing Camshaft Gear (T-51667)

1. Camshaft
2. Camshaft Gear
3. Shaft Protector
4. Gear Puller Tool

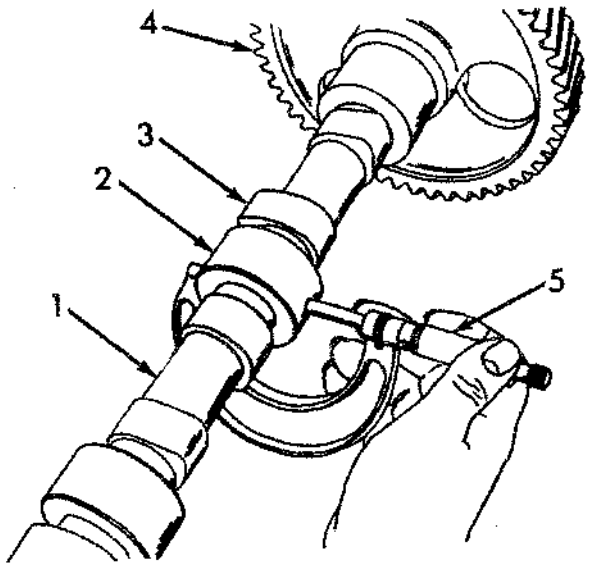



Fig. 7 -- Checking Camshaft Bearing Journal (T-51648)

1. Camshaft
2. Camshaft Bearing Journal
3. Camshaft Lobe
4. Camshaft Gear
5. Micrometer

1. Stagger piston ring gaps evenly around piston and apply clean engine oil to pistons and rings. With a piston inserter (Fig. 6) install the piston and connecting rod in the cylinder sleeve by tapping on top of piston with wooden hammer handle. If any difficulty is encountered, however slight, the piston inserter must be removed and ring set inspected for correct installation in piston grooves. Align lower end of connecting rod with crankshaft before inserting piston into cylinder.

2. Lubricate and install a bearing shell in position in connecting rod, with tang of bearing shell in the corresponding slot in connecting rod, and position rod on crankshaft journal.

CAUTION

Be certain the backs of the bearing shells are free from dirt and grit particles.

3. Lubricate and install a bearing shell in position in the connecting rod bearing cap, with tang of bearing shell in corresponding slot in bearing cap. Install bearing cap and shell, making certain identification number stamped in the bearing cap is located on the same side as corresponding number in the connecting rod.

4. Prior to installation, thoroughly clean and dry with compressed air all of the connecting rod capscrews (lock bolts).

IMPORTANT: It is necessary to use the proper capscrews Fig. 8, (socket head or hex-head) when installing bearing caps. Hex-head capscrews with washers are used on old style rod and bearing caps having serrations; socket head capscrews are used on new style rod and bearing caps without serrations.

5. If the connecting rod capscrews are the socket head type, generously coat the threads and underhead area with engine oil; if equipped with hex-head capscrews with washers, apply a thin coat of "Molykote G" on threads and underhead area.

CAUTION

Failure to use the "Molykote G" lubricant when installing hex-head connecting rod capscrews will invite capscrew and connecting rod failure due to inadequate or excessive torque.

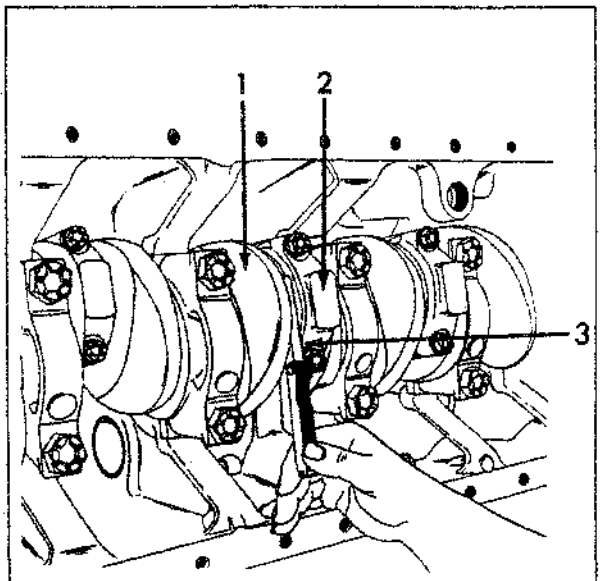



FIG. 7 CHECKING CONNECTING ROD SIDE CLEARANCE

1. Crankshaft
2. Connecting rod
3. Feeler gauge

6. Install the lubricated capscrews finger tight and force the rod and the bearing cap endwise, first to the front and then to the rear, to align the rod and cap.

7. Tighten the capscrews alternately. Torque socket head capscrews to 80 -- 85 lbs. ft. (11, 06 -- 11, 75 kg/m). Torque hex-head capscrews with washers to 65 -- 70 lbs. ft. (8, 98 -- 9, 67 kg/m).

8. Check to see that there is sufficient side clearance between connecting rods and crankshaft journals. The specified clearance is .005" -- .010".

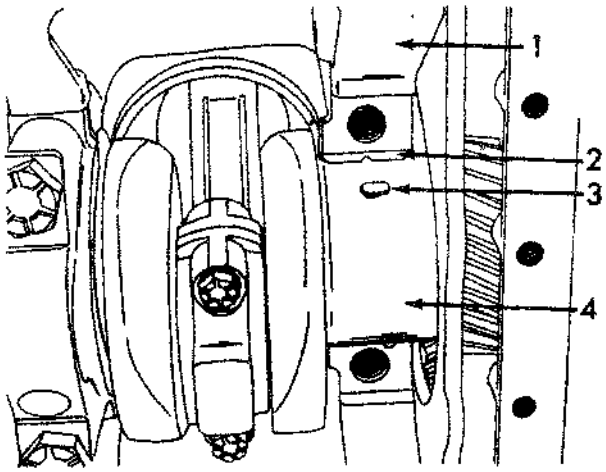



Fig. 9 -- Removing Front Main Bearing Upper Shell (T-51678)

1. Cylinder Block
2. Front Main Bearing Upper Shell
3. Cotter Pin (Head Flattened)
4. Crankshaft Main Bearing Journal

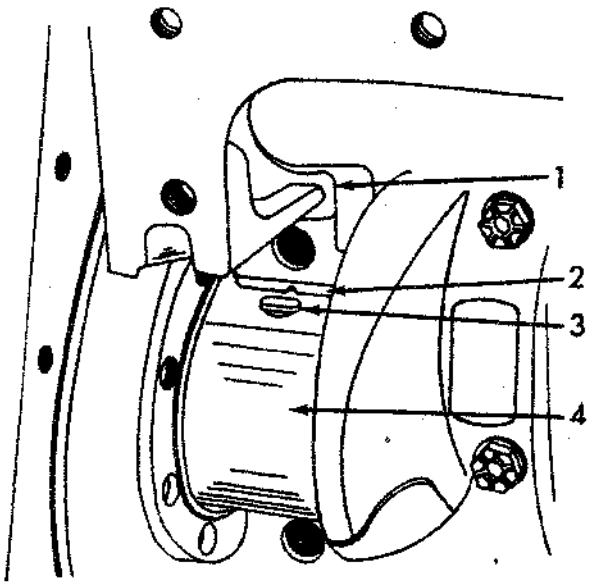



Fig. 10 -- Removing Rear Main Bearing Upper Shell (T-51673)

1. Cylinder Block
2. Rear Main Bearing Upper Shell
3. Cotter Pin (Head Flattened)
4. Crankshaft Main Bearing Journal

e. Inspect the crankshaft journals for scoring, chipping, cracking, or signs of overheating. If crankshaft has been overheated (usually indicated by discolored or blue bearing journal surfaces), or is scored or excessively worn, reconditioning or replacement will be required. Examine the bearing journals for cracks if overheating has occurred.

f. Inspect each main bearing shell as described in Paragraph B, "Main Bearing Removal, Inspection, and Installation" in this Topic.

2. MAIN BEARING INSTALLATION WITH ENGINE INSTALLED

a. Install all main bearings, except the center main, as follows:

Lubricate a bearing upper shell with clean oil and roll it around the crankshaft journal in the opposite direction that it was removed until the tang on the bearing shell is in position in the slot in the cylinder block.

CAUTION

Make certain the backs of the bearing shells are free from dirt and grit particles.

b. Install a bearing lower shell in position in the bearing cap. Lubricate the bearing shell and place the bearing cap in position on the cylinder block with the number facing the camshaft side. Install the cap retaining capscrews (lock bolts); tighten the capscrews evenly to the specified torque.

NOTE

The main bearing caps are numbered 1, 2, 3, etc. indicating their respective positions (Fig. 3).

c. Lubricate and install the upper half of center main bearing shell. Install the upper halves of the thrust flanges (flanges without dowel pin holes) with oil grooved side of flanges toward cheeks of crankshaft. Install a bearing shell in position on the dowel pin in the center main bearing cap. Install the lower halves of the thrust flanges on the dowel pins in the center main bearing cap. (Fig. 5) with the oil grooved side of flanges to the outside of bearing cap. Lubricate and place bearing cap in position on cylinder block with the number facing the camshaft side. Install cap retaining capscrews.

d. After all bearing shells have been installed, retighten main bearing capscrews (lock bolts) using a torque indicating wrench. Tighten the capscrews evenly to the specified torque.

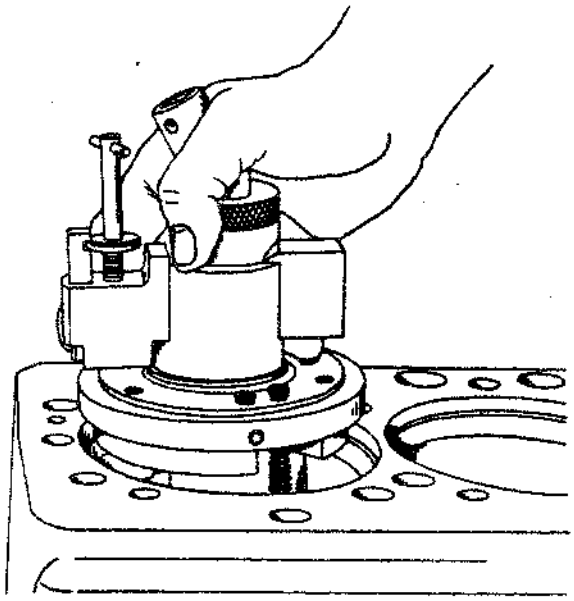


Figure 16 -- Positioning Cylinder Sleeve Reseating Tool in Cylinder Block
(T-51411)

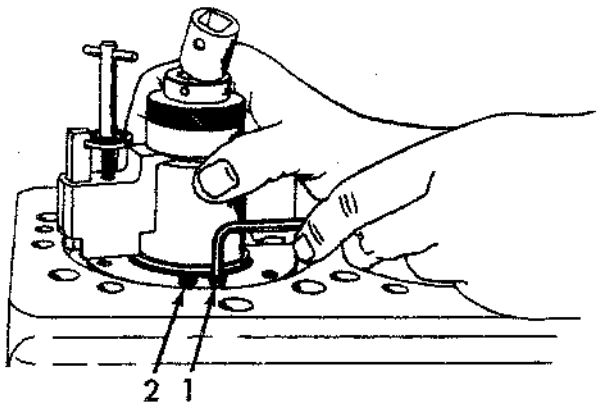



Figure 17 -- Securing Cylinder Sleeve Reseating Tool in Cylinder Block
(T-51393)

1. Set screw for securing lower adapter plate
2. Set screw for securing upper adapter plate

CAUTION

Never turn tool counterclockwise; this will damage tool bit cutting edge.

c. Do not attempt to cut deeper than .001" at a time. Each graduation on tool bit adjusting handle moves the bit approximately .002" on the tool. Loosen and retighten the two set-screws (Fig. 15) securing the tool bit each time the tool bit is readjusted for depth.

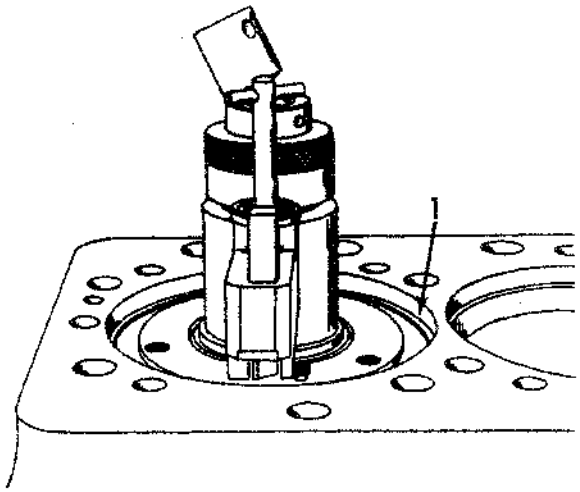



Figure 18 -- Cylinder Sleeve Reseating Tool Installed
(T-51391)

1. Counterbore sleeve seat

NOTE

The cylinder sleeve reseating tool Carboloy tool bit may be replaced with a standard tool bit for rough machining only. For the finish cuts, use the Carboloy tool bit. A regular cylinder boring bar can also be used to rough cut the cast iron to the enlarged bore but the sleeve reseating tool with the Carboloy tool bit must be used for the finish cut.

d. Determine approximate depth to be cut by checking counterbore depth and sleeve flange thickness with micrometers before starting any cuts. Refer to Item 3, Para. B. of this Topic.

e. Insert speed handle and rotate clockwise slowly until tool bit stops cutting (Fig. 19).

f. Check depth of recut seat with depth micrometer and calculate desired depth by checking sleeve flange thickness with outside micrometer and selecting desired shims to obtain the specified sleeve protrusion or projection. Cut seat at rate of approximately .001" per cut until calculated desired depth is reached.

CAUTION

When machining new seats, take micrometer readings frequently to prevent the possibility of machining a counterbore too deep.

g. Thoroughly clean cylinder block of all machining chips before attempting to install cylinder sleeves. Install shims as required under sleeve flanges to obtain the specified sleeve protrusion.

# SECTION 17—FITS AND TOLERANCES, TORQUE SPECIFICATIONS, AND STUD GAUGE HEIGHTS



# TOPIC 1—FITS AND TOLERANCES

## A. CYLINDER SLEEVE

| | Description | Size of new parts (inches) Replacement Wet | Size of new parts (mm) Replacement Wet |
|---|---|---|---|
| 1. | Type | | |
| 2. | Inside diameter | 4.2495" - 4.2510" | 107.94 - 107.97 |
| 3. | Diameter of sleeve at machined area just below flange | 4.811" - 4.813" | 122.20 - 122.25 |
| 4. | Diameter of cylinder sleeve at packing ring location | 4.749" - 4.751" | 120.62 - 120.67 |
| 5. | Sleeve flange outside diameter | 4.998" - 5.002" | 126.96 - 127.05 |
| 6. | Cylinder block-to-sleeve clearance at sleeve lower diameter | .001" - .005" | .02 - .12 |
| 7. | Cylinder block-to-sleeve clearance at machined area just below | .0005" - .0045" | .01 - .11 |
| 8. | Cylinder block-to-sleeve clearance at sleeve flange | .004" - .013" | .10 - .33 |
| 9. | Clearance of piston skirt with sleeve | | |
| | Prior to s/n 3D-05730 | .0065" - .0090" | .17 - .23 |
| | Effective with s/n 3D-05730 | .0025" - .0050" | .06 - .12 |
| 10. | Fire wall height above cylinder sleeve flange | .047" - .050" | 1.19 - .1.27 |
| 11. | Top surface of cylinder sleeve flange above cylinder block with sleeve installed | .002" - .005" | .05 - .12 |

# SECTION 18—TROUBLE SHOOTING



It has been proved that over 90% of the troubles that occur in engine operation are avoided when those responsible for maintenance adhere to an adequate program of lubrication, inspection, and maintenance. The time and expense involved in such programs is only a fraction of that incurred when poor maintenance practice results in a major malfunction or breakdown.

In most cases, when a trouble is detected and remedied immediately, a more expensive, time-consuming repair will be avoided. The following list of symptoms, causes, and remedies is given to aid the operator in locating and correcting mechanical and electrical troubles as quickly as possible. For detailed inspection and service procedures for any given component, refer to that section or topic in the manual pertaining to the part, assembly, or system.

# TOPIC 1—ENGINE

| TROUBLE | POSSIBLE CAUSES | REMEDY |
|---|---|---|
| Engine will not turn | 1. Batteries weak. | 1. Recharge or replace batteries. |
| | 2. Starter or starter switch inoperative. | 2. Repair or replace defective parts. |
| | 3. Engine locked or seized. | 3. This can be due to extended idle or storage periods, or to improper preparation of the engine for storage, in which case the parts may be rusted or corroded and seized. Broken piston rings, gears, etc., may also cause locking. Repair or replace defective parts. |
| | 4. Hydro-static lock. | 4. This can be due to rain water entering uncovered exhaust pipe, leaking cylinder head gasket, cracked block or cylinder head. Repair or replace defective parts. |
| Engine will not start | 1. Slow cranking speed. | 1. Specific gravity of batteries too low. Charge batteries. Starter not delivering maximum torque. Repair or replace defective parts. Use cold weather starting aids if applicable. |
| | 2. Engine controls out of adjustment. | 2. Check all engine control linkages for proper adjustment. |
| | 3. Insufficient supply of fuel to fuel injection nozzles. | 3. Check fuel system and clean sediment bowl. |

# SECTION 19—SERVICE TOOLS

Service tools required to perform the various repairs explained in this manual are listed below.

Order service tools from your local Fiat-Allis dealer.

IMPORTANT: Refer to Fiat-Allis Tool Catalogs, as follows, for complete tool illustrations, descriptions and usage:

English....No. 73128466
French.....No. 73128467
Spanish....No. 73128468
Italian....No. 73128469

*Not serviced separately-Serviced as a Complete Set only.

| SECTION | FIG. NO. | PART NO. | DESCRIPTION |
|---|---|---|---|
| 2 | 15 | 75300073 | Water Pump Coolant Seal Installer |
| 2 | 15 | 75300520 | Seal Installer Handle |
| 2 | 17 | Not currently available | Water Pump Shaft and Bearing Assembly Installer |
| 4 | 10 | 75300882 | *Gear Puller |
| 4 | 10 | 75300882 | *Shaft Protector Adapter |
| 4 | 16 | 75300827 | Nozzle Remover Adapter |
| 4 | 16 | 75300175 | Slide Hammer |
| 4 | 17 | 75300820<br>75300823 | Nozzle Tester Set |
| 4 | 21 | 75290898 | Injection Nozzle Holding Fixture |
| 4 | 23 | 75294894 | Injection Nozzle Bore Cleaner |
| 7 | 6 | 75300379 | Torque Wrench(0-200 lbs.ft.) |
| 7 | 6 | 75294541 | Cylinder Head Wrench |
| 7 | 9 | 75300831 | Valve Spring Compressor |
| 7 | 10 | 75300281 | Valve Spring Testing Tool(Use with Torque Wrench) |
| 7 | 11 | 75300826 | Valve Guide Cleaning Tool |
| 7 | 12 | 75294458 | *Valve Guide Remover(Exhaust and Intake) |
| 7 | 13 | 75294458 | *Valve Guide Installer Stop Plate |
| 7 | 13 | 75294458 | *Valve Guide Installer Pilot |
| 7 | 13 | 75294458 | *Valve Guide Installer Adapter(Intake) |
| 7 | 13 | 75294458 | *Valve Guide Installer Adapter(Exhaust) |
| RECOMMEND MACHINE SHOP OPERATION. TOOLS NOT AVAILABLE FROM FIAT-ALLIS | | | |
| 7 | 17 | | Insert Reamer Set |
| 7 | 17 | | Cutter Head Set |
| 7 | 17 | | Arbor |
| 7 | 18 | | Valve Seat Insert Installer (Exhaust) |
| 7 | 18 | | Driver Handle (Valve Seat Insert Installer) 75300850 |
| 7 | 21 | 75300849 | Valve Seat Grinder Adapter Set |
| 8 | 1 | 75300882 | *Bar Type Puller |
| 8 | 1 | 75300882 | *Puller Legs |
| 8 | 1 | 75300882 | *Leg Adapters |
| 8 | 1 | 75300882 | *Shaft Protector Adapter(Part of Puller Set) |
| 8 | 4 | 75300850 | *Crankshaft(Front Oil Seal Installer) |
| 8 | 4 | 75300850 | *Driver Handle(Front Oil Seal Installer) |
| 8 | 7 | 75300882 | *Indler Gear Shaft Adapter |
| 8 | 7 | 75300175 | Slide Hammer |
| 9 | 3 | Not currently available | Rear Oil Seal Remover and Installer Set |
| 10 | 5 | | Oil Pump Drive Gear Remover |
| 11 | 6 | 75300882 | Utility Puller Set |
| 11 | 9 | Not currently available | Dial Indicator and Attachment Set(Magnetic Base) |
| 11 | 12 | 75294892 | Camshaft Bearing Remover and Installer |

# SAFETY RULES

To prevent entrapment in cabs or mounted enclosures, observe and know the mechanics of alternate exit routes.

On machines equipped with suction radiator fans, be sure to periodically check all engine exhaust parts for leaks as exhaust gases are dangerous to the operator. Keep a vent open to outside air at all times when operating within a closed cab.

*STARTING FLUID IS FLAMMABLE.* Follow the recommendations as outlined in the Operation and Maintenance Instruction Manual and as marked on the containers. Store containers in cool, well-ventilated place secure from unauthorized personnel. *DO NOT PUNCTURE OR BURN CONTAINERS.*

Follow the recommendations of the manufacturer for storage and disposal.

Wire rope develops steel slivers. Use authorized protective equipment such as heavy gloves, safety glasses when handling.

## OPERATION

Before starting machine, check, adjust and lock the operator's seat for maximum comfort and control of the machine.

*DO NOT START OR OPERATE AN UNSAFE MACHINE.* Before working the machine, be sure that any unsafe condition has been satisfactorily remedied. Check brakes, steering and attachment controls before moving. Advise the proper maintenance authority of any malfunctioning part or system. Be sure all protective guards or panels are in place, and all safety devices provided are in place and in good operating condition.

Check instruments at start-up and frequently during operation.

Do not run the engine of this machine in closed areas without proper ventilation to remove deadly exhaust gases.

Be sure exposed personnel in the area of operation are clear of the machine before moving the machine or its attachments. *WALK COMPLETELY AROUND* the machine before mounting. Sound horn. Obey flag man, safety signals and signs.

Know the principles of cross steering of crawler tractors. Read section in Operation and Maintenance Instruction Manual on cross steering.

Keep engine exhaust system and exhaust manifolds clear of combustible material. Equip machine with screens and guards when working under conditions of flying combustible material.

If engine has a tendency to stall for any reason under load or idle, report this for adjustment to a proper maintenance authority immediately. Do not continue to operate machine until condition has been corrected.

Never use bucket as a man-lift.

Use recommended bucket for machine and material load ability and heaping characteristics of material, terrain, and other pertinent job conditions.

Avoid abrupt starts and stops when transporting a loaded bucket.

Inspect your seat belt webbing and hardware at least twice a year for signs of fraying, wear or other weakness that could lead to failure.

Use only designated towing or pulling attachment points. Use care in making attachment. Be sure pins and locks as provided are secure before pulling. Stay clear of draw bars, cables or chains under load.

When pulling or towing through a cable or chain, do not start suddenly at full throttle. Take up slack carefully. Guard against kinking chains or cables. Inspect carefully for flaws before using. Do not pull through a kinked chain or cable due to the high stresses and possibility of failure of the kinked area. Always wear heavy gloves when handling chain or cable.

Be sure cables are anchored and the anchor point is strong enough to handle the expected load. Keep exposed personnel clear of anchor point and cable or chain. *DO NOT PULL OR TOW UNLESS OPERATOR'S COMPARTMENT OF MACHINES INVOLVED ARE PROPERLY GUARDED AGAINST POTENTIAL CABLE OR CHAIN BACKLASH.*

During operation always carry ripper in full raised position when not in use and lowered to ground when parked.

When counterweights have been provided, do not work machine if they have been removed unless their equivalent weight has been replaced. See the Operation and Maintenance Instruction Manual.

When operating a machine know what clearances will be encountered, overhead doors, wires, pipes, aisles, roadways; also the weight limitations of ground, floor, and ramps.

Know bridge and culvert load limits and do not exceed them. Know machine's height, width, and weight. Use a signal person when clearance is close.

Be sure that the exact location of gas lines, utility lines, sewers, overhead and buried power lines, and other obstructions or hazards are known. Such locations should be precisely marked by the proper authorities to reduce the risk of accidents. Obtain shut-down or relocation of any such facilities before starting work, if necessary.

Be certain to comply with all local, state, and federal regulations regarding working in the vicinity of power lines.

When roading find out what conditions are likely to be met - clearances, congestion, type of surface, etc. Be aware of fog, smoke or dust element that obscure visibility.

When backing, always look to where the machine is to be moved. Be alert to the position of exposed personnel. *DO NOT OPERATE* if exposed personnel enter the immediate work area.

(2) Remove the air cleaner-to-turbocharger compressor housing air inlet piping.

(3) Remove the hose connection between the compressor housing air outlet and intake manifold piping.

If the coating of dirt is light and even, cleaning the compressor impeller is not necessary. An uneven build-up of dirt will disturb the balance of the rotating parts and lead to failure of the turbocharger. If the coating of dirt is uneven, excessive, or approaching the appearance of a layer which might flake-off, cleaning is necessary. An excessive build-up of dirt in the diffuser will result in loss of turbocharger efficiency and is recognized by excessive exhaust smoke.

If inspection reveals the need for cleaning, refer to Topic 4, Paragraph B.

## B. 2000 HOUR INSPECTION AND MAINTENANCE

A major inspection of the turbocharger, by an experienced turbocharger mechanic, should be made after each 2000-hour interval of operation. This inspection requires removal of the turbocharger from the engine, and removal of the compressor housing and turbine housing from the turbocharger, to check shaft radial movement and shaft end play.

Perform the inspection as follows:

1. Remove turbocharger from the engine. (Refer to Topic 3, Paragraph A.)

2. Place turbocharger, with shaft in horizontal position, on a bench. Check for free rotation of the impeller and turbine wheel. If they do not turn freely, the trouble may be caused by: carbon accumulation behind the turbine impeller, the impeller shaft bearings seized to the shaft, dirt in bearings, or by excessive bearing wear. Make repairs necessary to eliminate these conditions.

3. Remove the compressor housing and turbine housing. (Refer to Topic 3, Paragraph B.)

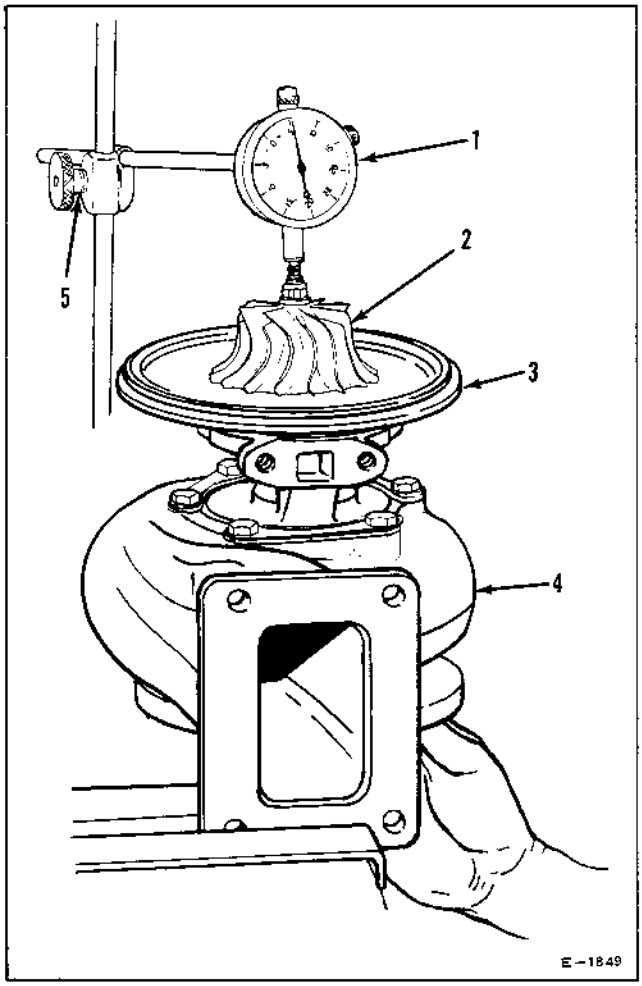
4. Check shaft end play as follows: (Specified end play .001" to .004".)

   a. Clamp the turbine housing flange (Fig 3) in a vise.

   b. Use either a clamp or magnetic base dial indicator.

   c. Place indicator contact point on end of impeller shaft.

   d. Press up on turbine wheel to force the impeller to extreme up position; record indicator reading.




1. Dial indicator
2. Compressor wheel
3. Backplate assembly
4. Turbine housing
5. Spindle clamp

Figure 3. Checking Shaft End Play

   e. Press down on impeller; again record indicator reading.

   f. The difference between the readings is the end play.

   g. End play should be from .001" to .004".

   h. Record the end play. This will be used to determine if thrust plate assembly or thrust bearing need to be replaced.

   i. If end play exceeds .004", it indicates that thrust collar thrust bearing, or thrust bearing surface of the back plate assembly are worn. If end play is less than .001", it indicates a carbon build-up behind the turbine wheel. Unit must be disassembled and condition corrected.

| TROUBLE | POSSIBLE CAUSE | REMEDY |
|---|---|---|
| Seal ring sticking in groove. Damaged seal ring contacting surfaces in center housing or center housing back plate. | Dirty oil or lack of oil. | Renew oil and filter elements. |
| Carbon deposits in center housing. | Thrust collar oil holes plugged. Over-fueling causing over-heating. Restricted oil return line. | Disassemble and clean. Check fuel injection system. |

## TOPIC 7. SERVICE TOOLS

The following tool listing has been prepared to assist service personnel in the selection of tools (other than standard hand or shop tools) to accomplish the various service operations described and illustrated in this manual. These tools must be ordered directly from the manufacturer.

(KM) Kent-Moore Organization, Inc.
1501 South Jackson Street
Jackson, Michigan

(ST) Service Tools, Inc.
1901 South Indiana
Chicago, Illinois 60616

| Topic No. | Fig. No. | Mfr. | Description | Tool No. |
|---|---|---|---|---|
| 2 | 4 | (KM) | Dial Indicator Adaptor | J-21886 |
| 5 | 11 | (ST) | Bearing Retainer Installation Tool | JD-274 |
| 3, 5 | * | | Holding Fixture | Fabricate |

* See actual size template on inside back cover

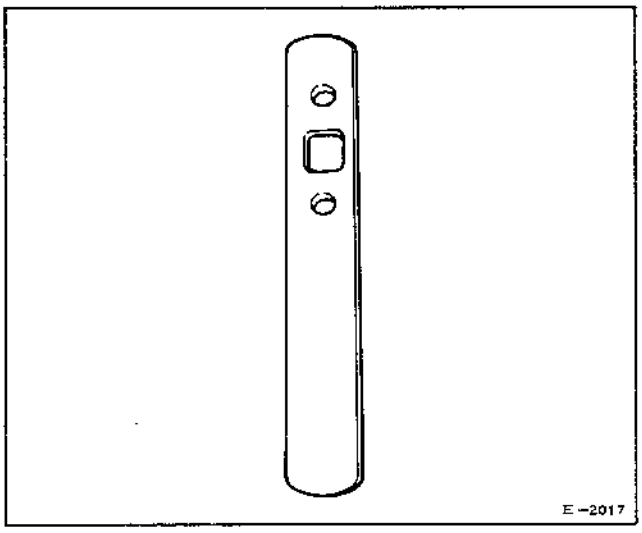



Figure 13. Dial Indicator Adaptor

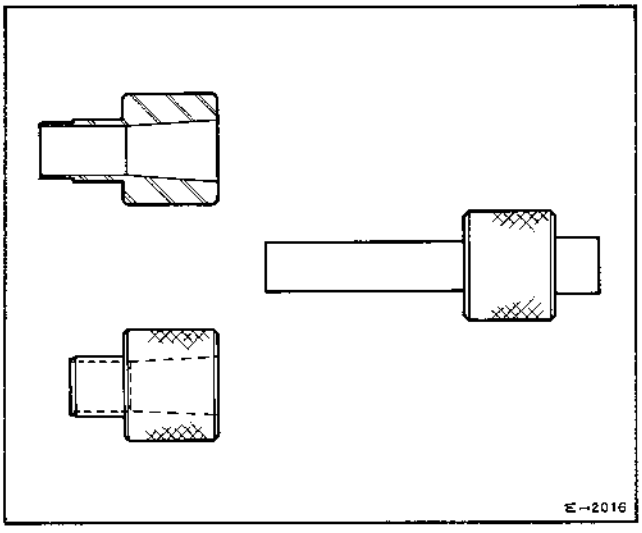



Figure 14. Bearing Retainer Installation Tool

# SAFETY RULES

Never use gasoline or solvent or other flammable fluid to clean parts. Use authorized commercial, non-flammable, non-toxic solvents.

Never place gasoline or diesel fuel in an open pan.

Shut off engine and be sure all pressure in system has been relieved before removing panels, housings, covers, and caps. See Operation and Maintenance Instruction Manual.

Do not remove hoses or check valves in the hydraulic system without first removing load and relieving pressure on the supporting cylinders. Turn radiator cap slowly to relieve pressure before removing. Add coolant only with engine stopped or idling if hot. See Operation and Maintenance Instruction Manual.

Fluid escaping under pressure from a very small hole can almost be invisible and can have sufficient force to penetrate the skin. Use a piece of card board or wood to search for suspected pressure leaks. *DO NOT USE HANDS.* If injured by escaping fluid, see a doctor at once. Serious infection or reaction can develop if proper medical treatment is not administered immediately.

Never use any gas other than dry nitrogen to charge accumulators. See Operation and Maintenance Instruction Manual.

When making pressure checks use the correct gauge for expected pressure. See the Operation and Maintenance Instruction Manual or Service Manual for guidance.

For field service, move machine to level ground if possible and block machine. If work is absolutely necessary on an incline, block machine and its attachments securely. Move the machine to level ground as soon as possible.

Brakes are inoperative when manually released for servicing. Provision must be made to maintain control of the machine by blocking or other means.

Block all wheels before bleeding or disconnecting any brake system lines and cylinders.

Never use make shift jacks when adjusting track tension. Follow the Undercarriage Service Manual.

Know your jacking equipment and its capacity. Be sure the jacking point used on the machine is appropriate for the load to be applied. Be sure the support of the jack at the machine and under the jack is appropriate and stable. Any equipment up on a jack is dangerous. Transfer load to appropriate blocking as a safety measure before proceeding with service or maintenance work according to local or national requirements.

Always block with external support any linkage or part on machine that requires work under the raised linkage, parts, or machine per local or national requirements. Never allow anyone to walk under or be near unblocked raised equipment. Avoid working or walking under raised blocked equipment unless you are assured of your safety.

When servicing or maintenance requires access to areas that cannot be reached from the ground, use a ladder or step platform that meets local or national requirements to reach the service point. If such ladders or platforms are not available, use the machine hand holds and steps as provided. Perform all service or maintenance carefully.

Shop or field service platforms and ladders used to maintain or service machinery should be constructed and maintained according to local or national requirements.

Lift and handle all heavy parts with a lifting device of proper capacity. Be sure parts are supported by proper slings and hooks. Use lifting eyes if provided. Watch out for people in the vicinity.

In lifting and handling heavy parts, slings must be of adequate strength for the purpose intended and must be in good condition.

Handle all parts with extreme care. Keep hands and fingers from between parts. Wear authorized protective equipment such as safety glasses, heavy gloves, safety shoes.

When using compressed air for cleaning parts use safety glasses with side shields or goggles. Limit the pressure to 207 kPa (30 psi) according to local or national requirements.

Wear welders protective equipment such as dark safety glasses, helmets, protective clothing, gloves and safety shoes when welding or burning. Wear dark safety glasses near welding. *DO NOT LOOK AT ARC WITHOUT PROPER EYE PROTECTION.*

Replace seat belts every two years on open canopy units and every three years on machines with cabs or at change of ownership.

Wear proper protective equipment such as safety goggles or safety glasses with side shields, hard hat, safety shoes, heavy gloves when metal or other particles are apt to fly or fall.

Use only grounded auxiliary power source for heaters, chargers, pumps and similar equipment to reduce the hazards of electrical shock.

Keep maintenance area *CLEAN* and *DRY*. Remove water or oil slicks immediately.

Remove sharp edges and burrs from reworked parts.

Be sure all mechanics tools are in good condition. *DO NOT* use tools with mushroomed heads. Always wear safety glasses with side shields.

Do not strike hardened steel parts with anything other than a soft iron or non-ferrous hammer.

Do not rush. Walk, do not run.

Know and use the hand signals used on particular jobs and know who has the responsibility for signaling.

## FOREWORD

Always furnish serial number if making an inquiry to dealer or factory about this machine.

Many equipment owners employ the Dealer Service Department for all work other than routine lubrication and minor service. This practice is encouraged, as our Dealers are well informed and equipped to render efficient service by factory trained mechanics.



Illustrations show standard and optional items.

## IMPORTANT

The information in this manual was current at the time of publication. It is our policy to constantly improve our product and to make available additional items. These changes may affect procedures outlined in this manual. If variances are observed, verify the information through your Dealer.

Fiatallis is not responsible for any liability arising from any damage resulting from defects caused by parts and/or components not approved by Fiatallis for use in maintaining and/or repairing products manufactured or merchandized by Fiatallis.

In any case, no warranty of any kind is made or shall be imposed with respect to products manufactured or merchandized by Fiatallis when failures are caused by the use of parts and/or components not approved by Fiatallis.

## 2.4 HIGH RANGE CLUTCH

2.4.1
High-range drive is obtained through the high-range clutch-no planetary gearing is involved. High-range clutch (24) (Fig. 3A consists of two friction plates and one external-tanged reaction plate. The friction plates are bolted to high-range clutch hub (25) which is driven by reverse and low-range sun gear (26). The external tangs on the reaction plate engage the drive pins in transfer drive gear (22).

2.4.2
Thus, when the high-range clutch is applied, the transfer drive gear is locked to the reverse and low-range sun gear. This causes the transfer drive gear to rotate at a 1 to 1 ratio.

## 2.5 TRANSFER GEARS, OUTPUT SHAFTS

2.5.1
TRANSFER GEARS. The transfer gears consist of two spur gears which are in constant mesh. Transfer drive gear (22) Fig. 3A, is splined to the hub of low-range planetary carrier assembly (28). Transfer driven gear (32) is located directly below the drive gear and is splined to output shaft (30).

2.5.2
TWO-PIECE SHAFT, REAR AXLE DISCONNECT - The two-piece shaft configuration allows output shaft to be disconnected from drive line. The front disconnect consists mainly of disconnect coupling which is manually shifted by disconnect shifter fork (48) and shaft. In the engaged position, torque from output shaft (30) is transmitted through the coupling splines to the front output shaft. In the disengaged position the coupling rides on the rear splines of the front output and torque to the front output is interrupted.

2.5.3
REAR OUTPUT SHAFT. Output shaft Fig. 87 (23) provides torque to the rear output only. The shifter shaft hole is closed by shifter shaft orifice plug (28).

## 2.6 HYDRAULIC PUMP, ACCESSORY DRIVE PADS

2.6.1
HYDRAULIC PUMP DRIVE PAD. The hydraulic pump drive pad, located on the rear face of oil pump body (10) Fig. 116A is a four bolt configuration. Accessory driven gear (2) Fig. 63 is engine driven through accessory drive gear (19) Fig. 59 at ratios of 0.91 to 1. Regardless of the range selector position, the shaft rotation is clockwise as viewed from the rear.

2.6.2
ACCESSORY DRIVE PAD. A 2-bolt pad is located at the upper right rear face of the transmission housing. The drive at the pad is provided by accessory drive gear (1) Fig. 63 and gear shaft (8) which rotates at a 0.91 to 1 ratio. Regardless of the range selector position, the shaft rotation is clockwise as viewed from the rear.

## 2.7 OIL PUMP

2.7.1
Oil pump assembly (2) Fig. 116A consists mainly of two spur gears (5 and 7); body assembly (9) and cover (3). The oil pump assembly furnishes the entire oil flow and pressure for all transmission operations. The pump is driven by accessory drive gear (19) Fig. 59 and rotates any time the engine rotates. The transmission oil is drawn, through oil strainer (22), into the lower end of suction tube (2) which directs it to the pump assembly. The oil is then directed, under pressure, through passages in the transmission housing to the control valve assembly and other locations for lubrication and cooling.

## 2.8 CONTROL VALVE BODY ASSEMBLY

2.8.1
CONTROL VALVE BODY (Fig. 55). The control valve body contains a manual-operated range selector valve (27) for reverse, neutral, low or high-range operation, plus main pressure regulator valve (8), and clutch cutoff valve (20).

2.8.2
MAIN-PRESSURE REGULATOR, SELECTOR VALVES (Fig. 55) Main pressure regulator valve components and trimmer valve components are contained in the upper bore of the body; clutch cutoff valve components in the middle bore; and the selector valve components in the lower bore. The main pressure regulator valve group includes items (6, 7, 8, 13, and 14). The selector valve group contains items (26 through 33).

2.8.3
Main pressure regulator valve (8) is spring loaded and regulates the pressure for all hydraulic functions. The selector valve is a spool type valve which is manually moved lengthwise to the various range positions. Spring loaded detent balls (28) position the valve in each range.

2.8.4
CLUTCH CUTOFF VALVE (Fig. 55) Clutch cutoff valve (20) is located between the main pressure regulator valve and selector valve (27). It is spool type valve which is moved rearward by spring (19) pressure and forward by plug (21) when brake hydraulic pressure acts on the plug.

# TOPIC 3 PREVENTIVE MAINTENANCE

## 3.1 SCOPE OF TOPIC 3

3.1.1
This section outlines the routine and periodic procedures required to maintain the transmission in good operating condition. Included are instructions for care of the oil system, minor adjustments of the transmission and control linkages, tests to determine condition, instructions for extended storage, and trouble-shooting, in handy chart form.

## 3.2 PERIODIC INSPECTIONS, CLEANING

3.2.1
INSPECTING EXTERIOR. The exterior of the transmission should be cleaned and inspected at regular intervals. The severity of service and operating environment will determine the frequency of such procedures. The transmission should be inspected for loose bolts, oil leaks, linkage troubles, and bent or damaged oil lines, Oil leaks that cannot be stopped by tightening the parts require immediate attention. Linkage must be kept clean,adjusted and well lubricated.

3.2.2
CLEANING BREATHER. The prevalence of dust and dirt will determine the frequency at which the breather requires cleaning. Clean the area around the breather stem before removing the breather. Wash the breather thoroughly by agitating it in mineral spirits or cleaning solvent. Dry it thoroughly with compressed air after cleaning. Always use a wrench of the proper size to remove or replace the breather. Pliers or a pipe wrench will crush or damage it and produce metal chips which could enter the transmission.

3.2.3
OIL CONTAMINATION. At each oil change examine the oil which is drained, for evidence of dirt or water. A normal amount of condensation will emulsify in the oil during operation of the transmission. However, if there is evidence of water, check the cooler (heat exchanger) for leakage between the water and oil areas. Oil in the water side of the cooler (or in the radiator) is another sign of leakage. This, however, may indicate leakage from the engine oil system. Any accumulation of sludge or soft dirt in the sump should be removed with flushing oil.

3.2.4
Metal particles in the oil (except for the minute particles normally trapped in the oil filter) indicate damage has occurred in the transmission. When these particles are found in the sump or on the magnetic drain plug, the transmission must be disassembled and closely inspected to find the source. Metal contamination will require complete disassembly of the transmission and cleaning of all internal and external circuits, cooler, filter, and all other areas where the particles could lodge.

3.2.5
If engine coolant containing ethylene glycol leaks into the transmission oil system, immediate action must be taken to prevent malfunction and possible serious damage. The transmission must be completely disassembled, inspected and cleaned. All traces of the coolant, and varnish deposits resulting from coolant contamination, must be removed.

## 3.3 CHECKING OIL LEVEL

3.3.1
COLD CHECK. With the transmission dipstick, check the oil level before starting the engine. It is safe to start the engine if the oil is in the range on the engine stopped side of the dipstick. If the oil level is not within this range, add oil.

IMPORTANT:The above method is only a precautionary method prior to starting a cold loader. After the transmission fluid reaches operating temperature a further fluid check must be made using method in 3.3.2. Always recheck fluid using method described in 3.3.2.

3.3.2
HOT CHECK. With the oil at normal operating temperature, engine operating at low idle, transmission in neutral, and parking brake set, check the oil level. The oil must be within the operating range on the engine running side of the dipstick. Add specified oil to bring level between operating range.

## 3.4 MAINTENANCE INTERVALS

3.4.1
FREQUENCY. The severity of service and the environment in which the transmission operates will determine the frequency of some maintenance operations. Under very dusty or dirty operating conditions the transmission oil should be changed more often. Oil should be changed immediately if it has been subjected to overheating-indicated by discoloration and a strong odor. The breather will require more frequent cleaning when dirt and dust conditions are severe.

3.4.2
OIL AND FILTER CHANGE. The oil and filter should be changed after each 1000 hours of operation. For severe service, refer to 3.4.1 above. Refer also to paragraph 3.2 before changing oil. Do not operate a transmission which is filled with preservative oil except for minimum necessary time and distance.

GENERAL TORQUE SPECIFICATIONS--BOLTS AND SCREWS

[All torque values are given in pound feet (kg/m)]

| Size | Threads per inch (mm) | Standard heat-treated bolts and screws | Special heat-treated bolts, screws, Allen-head screws, and self-locking capscrews | Nuts on bolts |
|---|---|---|---|---|
| | |  |  | |
| .25" | 20 | 9-11 (1.2-1.5) | 9-11 (1.2-1.5) | |
| (6.4mm) | 28 | 10-12 (1.4-1.6) | 10-12 (1.4-1.6) | |
| .31" | 18 | 12-16 (1.8-2.2) | 17-20 (2.4-2.8) | |
| (7.9mm) | 24 | 14-18 (1.9-2.5) | 19-23 (2.6-3.2) | 14-18 (1.9-2.5) |
| .38" | 16 | 26-32 (3.6-4.4) | 36-43 (5.0-5.9) | |
| (9.6mm) | 24 | 33-40 (4.6-5.5) | 41-49 (5.7-6.8) | 33-40 (4.6-5.5) |
| .44" | 14 | 42-50 (5.8-6.9) | 54-65 (7.5-9.0) | |
| (11.11mm) | 20 | 50-60 (6.9-8.3) | 64-77 (8.8-10.6) | |
| .5" | 13 | 67-80 (9.3-11.1) | 81-97 (11.2-13.4) | |
| (12.7mm) | 20 | 83-100 (11.5-13.8) | 96-115 (13.3-15.8) | |
| .63" | 11 | 117-140 (16.2-19.4) | 164-192 (22-26.5) | |
| (15.9mm) | 18 | 134-160 (18.5-22.1) | 193-225 (26.7-31.1) | 134-160 (18.5-22.1) |

# TOPIC 5 TRANSMISSION REMOVAL AND INSTALLATION

## 5.1 GENERAL

5.1.1
The following procedures cover two methods of transmission removal and installation. The serviceman has been left with the option of choosing whichever method he prefers.

## 5.2 REMOVAL -- METHOD 1

5.2.1
Remove drain plugs and drain transmission and engine oil. Allow loader to set all night with drain plugs removed, allow all oil to drain out.

5.2.2
Refer to the Operator's Manual and drain coolant from cooling system.

5.2.3
Reinstall drain plugs and close drain cocks.

5.2.4
Block front and rear wheels to prevent loader movement. Attach safety locking bar.

5.2.5
Disconnect drive shafts as described in the Axle Manual.

5.2.6
Remove bolts and raise both rear fenders.

5.2.7
Remove air intake cap and exhaust stack.

5.2.8
Remove ladder strut on rear frame. Remove capscrews and ladder platform.

5.2.9
Remove hood assembly capscrews, washer and nuts. Using a suitable hoist, remove hood.

5.2.10
Remove mechanical shut-off from hydraulic tank bonnet.

5.2.11
Remove master cylinder and brake tank cover plates on each side of the loader.

5.2.12
After plates are removed you willnow have access to the bonnet attaching capscrews. Remove bonnet with a suitable hoist.

5.2.13
With a suitable hoist, remove radiator grille.

5.2.14
Remove hydraulic oil cooler tubes and hoses.

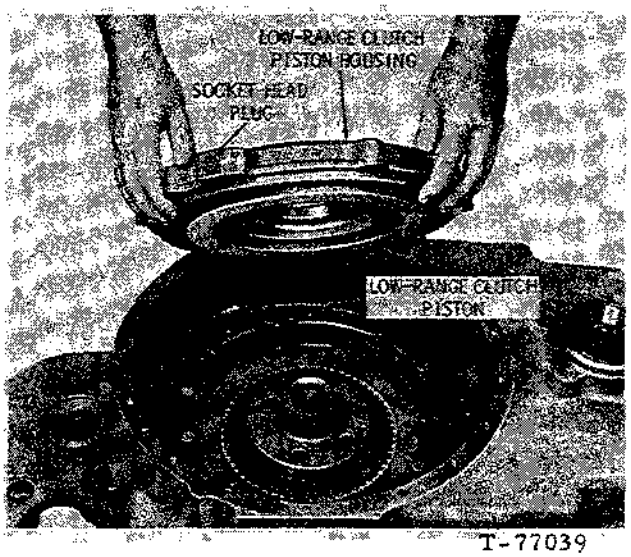



FIG. 37 REMOVING LOW-RANGE CLUTCH PISTON HOUSING AND PISTON

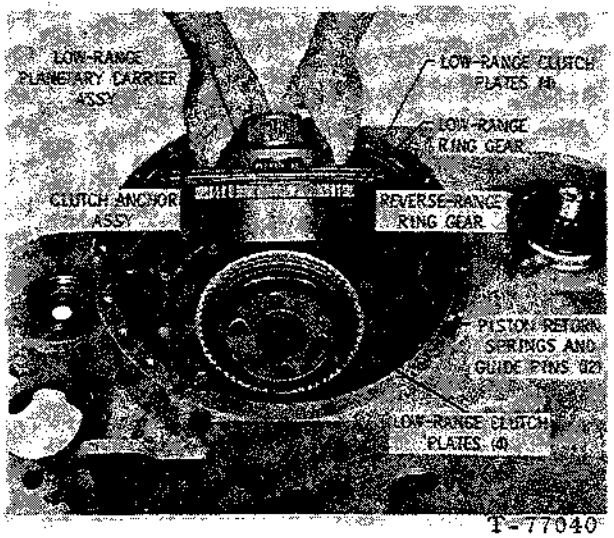



FIG. 38 REMOVING LOW-RANGE PLANETARY CARRIER ASSEMBLY

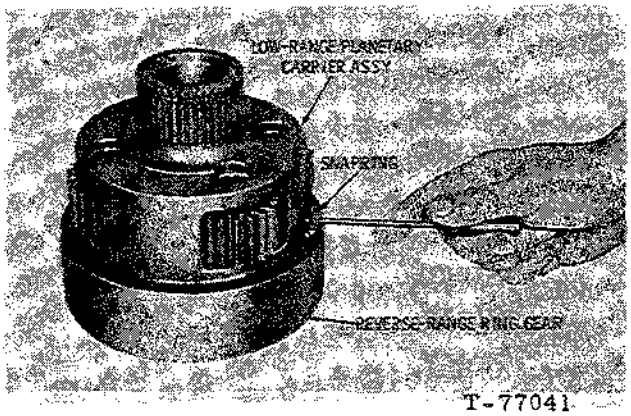



FIG. 39 REMOVING SNAP RING FROM REVERSE-RANGE RING GEAR

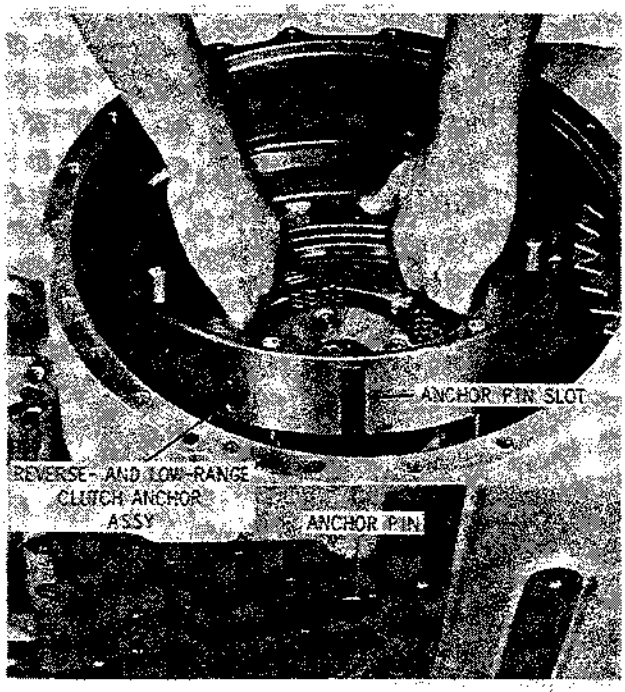



FIG. 40 REMOVING FORWARD-AND-REVERSE RANGE CLUTCH ANCHOR ASSEMBLY

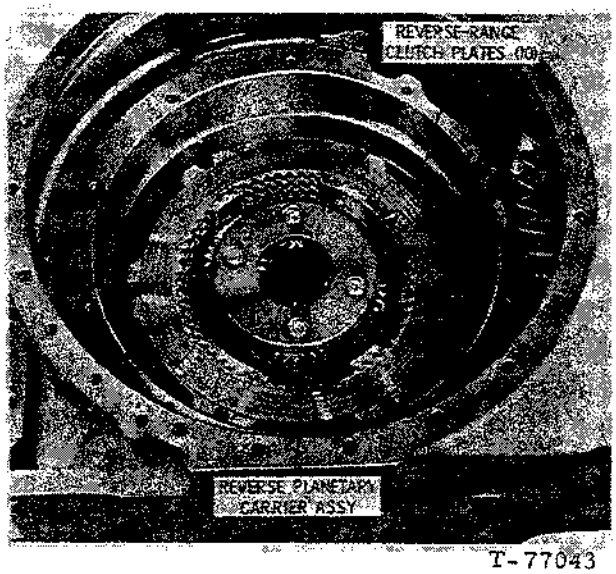



FIG. 41 REVERSE-RANGE PLANETARY CARRIER ASSEMBLY AND CLUTCH PLATES

6.7.6
Do not remove the socket-head plug from the low-range clutch piston housing unless necessary for replacement, or cleaning of the oil passage(Fig. 37).

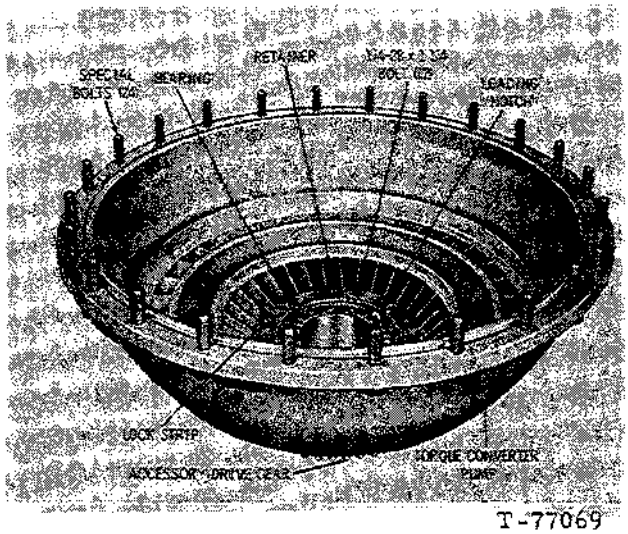



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FIG. 60 TORQUE CONVERTER PUMP ASSEMBLY

7.7.1
Disassembly (Fig. 59). The pressed steel diaphragm and oil seal (Fig. 61) must be removed. Removal of the diaphragm destroys the diaphragm and seal.

Note: The seal can not be purchased separately.

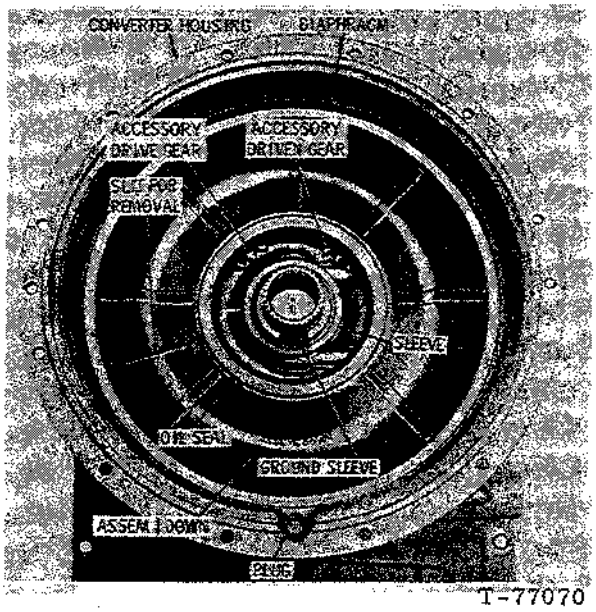


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FIG. 61 TORQUE CONVERTER HOUSING FRONT VIEW

7.7.2
To remove the diaphragm, cut a slit through the diaphragm, as shown in Fig. 61. Insert a hooked tool into the slit and pry the metal above the slit outward. This will push the metal below the slit inward. Deforming the diaphragm in this manner will reduce its outside diameter and allow the diaphragm to be lifted from the converter housing.

7.7.3
Clean the bore from which the diaphragm was removed. A smooth, clean bore will prevent leakage after the new diaphragm has been installed.

7.7.4
Remove the welch plug from the converter housing only if replacement is necessary (Fig. 61). If necessary, drive the plug from its bore, and clean the bore from which the plug was removed.

7.7.5
Remove the step-joint seal from the converter housing sleeve (Fig. 61). If replacement of the converter housing sleeve is necessary, remove it from the front of the housing.

7.7.6
At the rear of the converter housing, remove the snap ring from accessory driven gear bearing (Fig. 62). Tap the accessory driven gear forward and remove it and the attached parts from the housing.

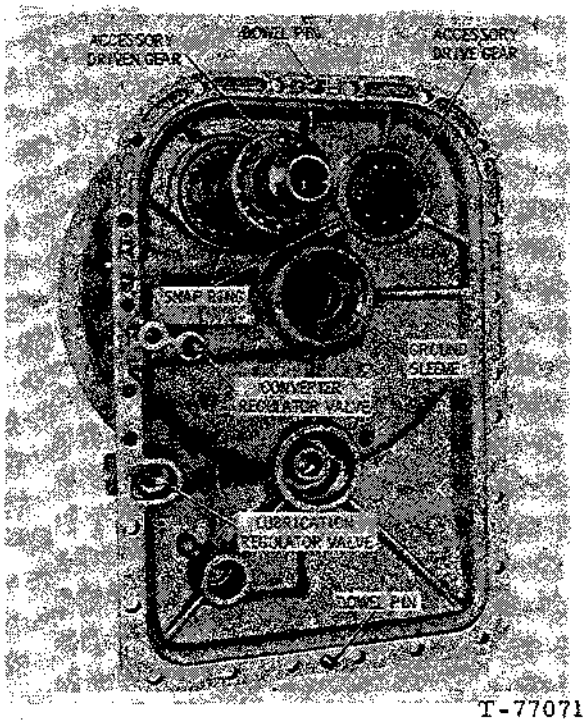


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FIG. 62 TORQUE CONVERTER HOUSING REAR VIEW

upward. Remove snap ring (9) from hub (10).

7.10.3.2
Flatten the corners of six lockstrips (6) and remove twelve nuts (7). Remove twelve bolts (13) and washers (12).

7.10.3.3
Separate hub (10) from clutch plates (7), (8), and (11).

Note: Refer to paragraph 7.2, above.

7.10.3.4
Assembly (Fig. 74). Assemble twelve washers (12) onto twelve, self-locking bolts (13). Install bolts (13) into clutch plate (11).

7.10.3.5
Install clutch hub (10) onto the bolt and clutch plate assembly. Note that the unsplined end of hub (10) should be at the same side of clutch plate (11) as washers (16).

7.10.3.6
Install external-tanged plate (8) onto the front side of clutch plate (11). Install clutch plate (7) onto the front side of external-tanged plate (8), engaging bolts (13).

7.10.3.7
Install six lockstrips (6) and twelve nuts (5). Tighten the nuts to 14 to 18 pound feet (1.9 - 2.5 kg/m) torque, and bend the lockstrip corners against the bolt heads.

7.10.3.8
Install snap ring (9) into its groove on the splined shaft.

## 7.10.4 TRANSFER DRIVE GEAR

7.10.4.1
Disassembly (Fig. 74). Remove bearing (1) and six pins (3) from transfer drive gear (2) only if replacement is necessary.

7.10.4.2
If bearing replacement is necessary, pull bearing (1) from transfer drive gear assembly. If drive pins require replacement, press pins (3) from transfer drive gear (2).

Note: Refer to paragraph 7.2, above.

7.10.4.3
Assembly (Fig. 74). If pins (3) were removed, place transfer drive gear (2), hub downward, in a press and install new pins. Press the pins until they project 0.74 to 0.76 inch (18.80 to 19.34 mm) above the surface into which they are pressed.

7.10.4.4
If bearing (1) was removed from transfer drive gear assembly, install a new bearing, outer snap ring first, onto the gear hub. Seat bearing firmly against the shoulder on the gear hub.

## 7.10.5 CLUTCH PISTON ASSEMBLIES

Note: Warming the Teflon seal rings in oil at 150° F. (66°C.) will make them easier to remove and install.

7.10.5.1
Disassembly. Do not use sharp-edged or pointed tools to remove Teflon seal rings. Rather, slip a very thin, flat blade into piston groove, between the seal ring and side of the groove and work the seal out of the groove until it can be grasped with the fingers.

7.10.5.2
Remove the seal rings.

7.10.5.3
Remove expanders from grooves in the high-range clutch piston.

7.10.5.4
Check the three holes in the reverse clutch piston (4), FIG. 77, and the low-range clutch piston (15), FIG. 74A. One hole must be empty. The other two holes have nylon ball check valves and retaining plugs in them. These must be inspected whenever the transmission has been disassembled to the extent that the valves are accessible. The nylon balls must be replaced if they are so worn that they are not perfectly round. A symptom that the nylon balls are worn or missing is hard shifting, especially in one direction only. Service the check balls and retaining plugs as follows:

7.10.5.4.1
Pry out retainer plugs (25), FIG.'s 74A and 77, from piston using a pointed instrument. Be careful not to damage the pistons.

7.10.5.4.2
Remove and discard oil nylon ball check valves.

7.10.5.4.3
Visually inspect check valve bores in pistons for signs of damage. Be sure bores are clean and free from sludge, varnish or other debris.

7.10.5.4.4 (Refer to FIG. 74B)
Install new nylon (white ) ball check valves and press in new retainer plug to a depth of .010-.030 in (.25 - .76 mm) below bore surface on reverse pistons prior to transmission S/N 106708, and forward pistons prior to transmission S/N 106046. Press retainers to a depth of .040 - .060 in. (1.0 -1.5 mm) below the bore surface on reverse pistons and forward pistons effective with above serial numbers.

# TOPIC 8 ASSEMBLY OF TRANSMISSION FROM SUBASSEMBLIES

## 8.1 SCOPE OF TOPIC 8

8.1.1
The procedures in this section describe the assembly of the transmission from the parts removed in Topic 6 and the subassemblies rebuilt in Topic 7.

8.1.2
Whenever possible, the sequence of assembly is presented in reverse order of the removal sequence in Topic 6. Techniques also are presented for installation of components in a vehicle-mounted transmission.

## 8.2 GENERAL INFORMATION FOR FINAL ASSEMBLY

8.2.1
Tools, Parts, Methods. Refer to paragraphs 4.3 through 4.5.

8.2.2
Cleaning, Inspection. Refer to paragraph 4.6.

8.2.3
Torque Specifications. The specific torque value for each threaded fastener installed in this section is stated in the applicable paragraph. Torque values are also presented in paragraphs 4.10 and 7.10.10.

8.2.4
Lubrication. Soak each friction (faced) clutch plate in transmission fluid prior to assembly.

8.2.4.1
Use oil soluble grease with a low melting point (petroleum jelly) when it is required to facilitate assembly.

8.2.4.2
Pack the inside diameter groove of the metal-encased, lip-type oil seals with high temperature grease (MIL-G-3545A or equivalent).

8.2.4.3
During final assembly, lubricate all moving parts with transmission fluid. The lubricant film will protect the friction surfaces and ferrous metals until the transmission is in service.

8.2.4.4
Component Cleanliness. Continually check each of the components during assembly to insure that they are free of lint, dirt, or foreign particles.

## 8.3 INSTALLATION OF OUTPUT COMPONENTS, TRANSFER DRIVEN GEAR

8.3.1
One-piece Output Shaft. Install the transfer driven gear into the rear of the housing (Fig. 82).

8.3.2
If shifter shaft hole plug was removed, install a new plug (Fig. 83). Apply nonhardening sealant onto the outside diameter of the new plug. Install the plug, closed end first, and seat it against the shoulder in the housing bore.

8.3.3
Install the output shaft, double-splined end first, through the front of the housing and the splined hub of the transfer driven gear (Fig. 83).

8.3.4
Start bearing (9), the shield side last, into front bore of the housing.

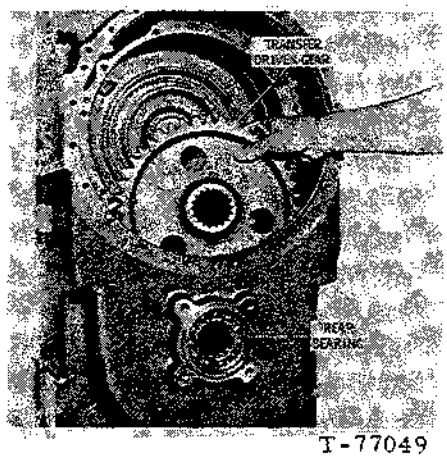

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FIG. 82 INSTALLING TRANSFER DRIVEN GEAR

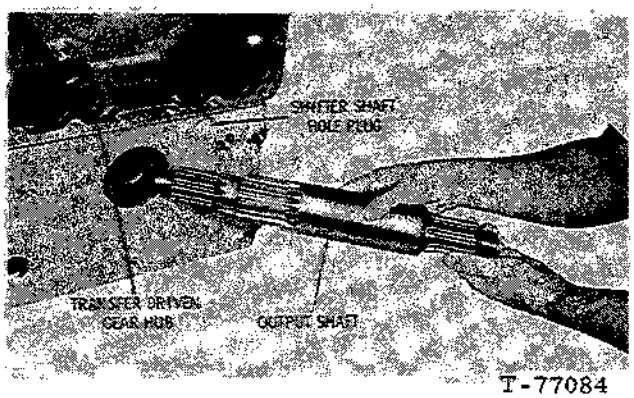

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FIG. 83 INSTALLING ONE-PIECE OUTPUT SHAFT

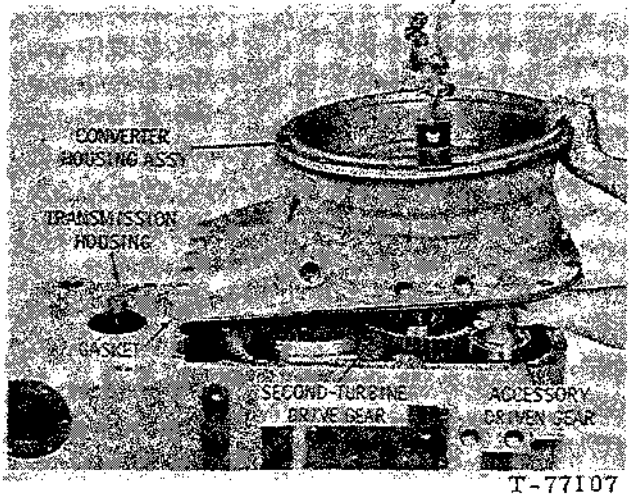



FIG. 111 INSTALLING TORQUE CONVERTER HOUSING ASSEMBLY

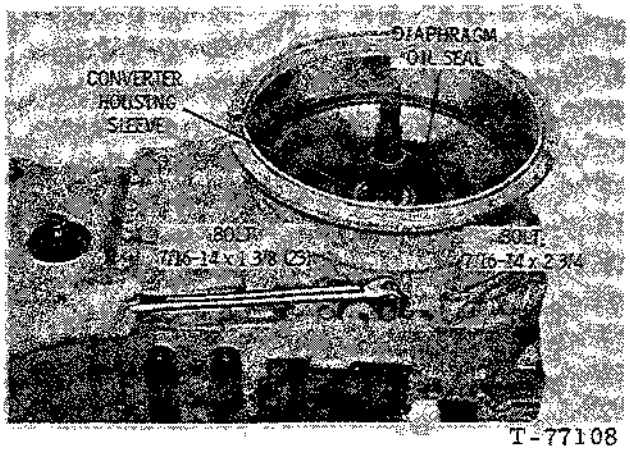



FIG. 112 INSTALLING TORQUE CONVERTER HOUSING BOLTS

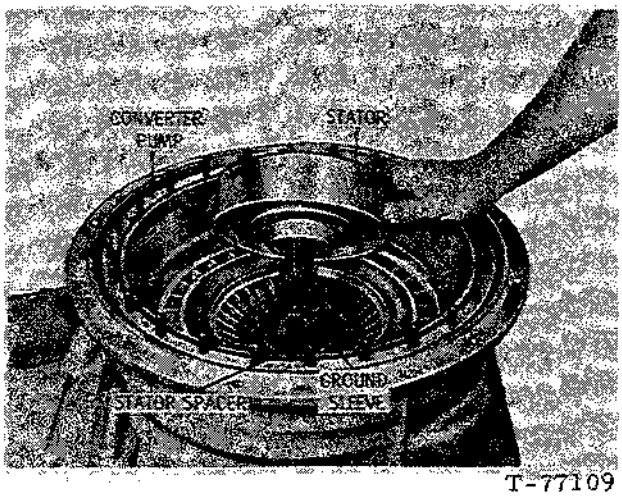



FIG. 113 INSTALLING TORQUE CONVERTER STATOR

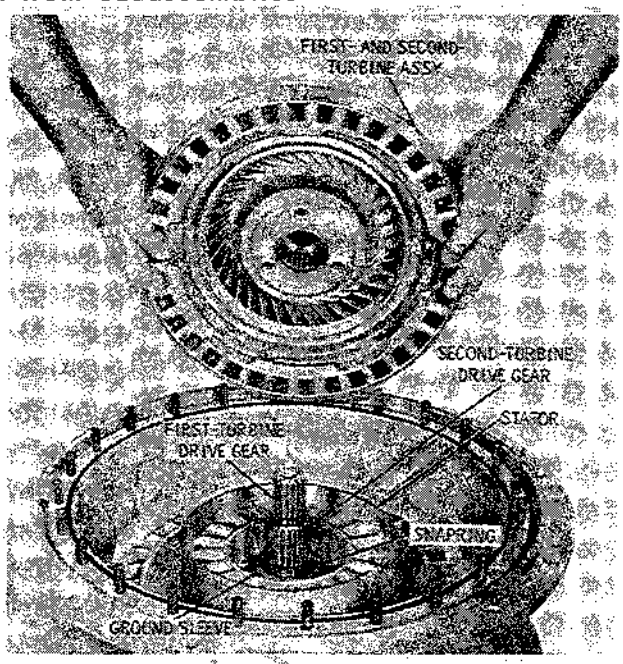



FIG. 114 INSTALLING FIRST-AND-SECOND-TURBINE ASSEMBLY

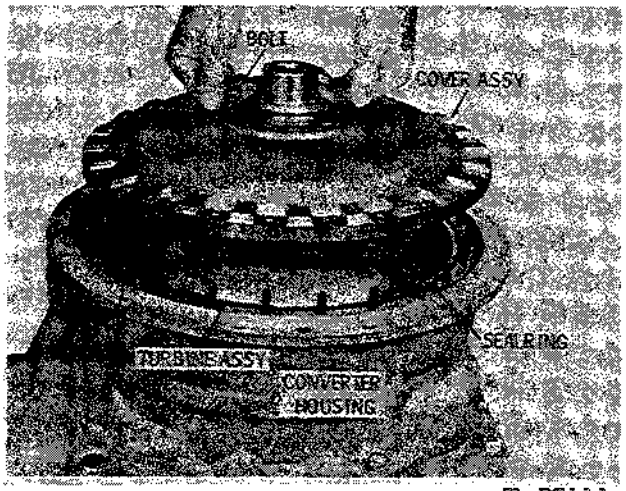



FIG. 115 INSTALLING TORQUE CONVERTER DRIVE COVER - DIRECT MOUNT

8.8.2
Install twenty-four, self-locking nuts to retain the cover (Fig. 116). Tighten the nuts to 14 to 18 pound feet (1.9 to 2.5 kg/m) torque.

8.8.3
Install the flex disk and washer assembly, washer side first, onto the hub of the converter cover (Fig. 116). Assemble the three flex disks so that the cone of each will be parallel to the flex disk and washer assembly and install the three disks as a unit. Install the

9.9.4
Oil flowing into the converter-in line is directed to the torque converter. A pressure regulator valve in the converter-in circuit limits the converter-in pressure to 80 psi (5.62 kg/cm$^2$).

9.9.5
Converter-out, Cooler, Lubrication Circuit. Oil flowing out of the torque converter is directed into the oil cooler.

9.9.6
Clutch Cutoff Valve Circuit. Main pressure oil, supplied from the left end of the main-pressure regulator valve, flows through orifice B to the clutch cutoff valve bore and then to the manual selector valve. The orifice functions in connection with trimmer action as explained in paragraph above.

9.9.7
The clutch cutoff valve is normally in the position shown, and functions only when the vehicles brakes are applied. A spring holds the valve rightward, allowing mail oil pressure to flow through the valve bore and to the manual selector valve.

9.9.8
When the vehicle has hydraulic brakes, hydraulic brake pressure acts directly against a plug which moves the clutch cutoff valve leftward during brake application. When the vehicle is equipped with air brakes, air brake pressure actuates a miniature air cylinder. The air cylinder piston rod pushes the clutch cutoff valve leftward. When leftward against its spring, the clutch cutoff valve interrupts the flow of main pressure oil to the manual selector valve. In this position, clutch apply pressure exhausts to the sump through a port shown at the top center of the valve bore. Thus, when the loader brakes are applied, the driving clutch (or clutches) in the transmission is completely released.

9.9.9
When the brake is released, the clutch cutoff valve returns to its normal position (as shown). This allows the oil retained at the trimmer to enter the exhausted clutch circuit. This additional volume from the trimmer assists in the quick application of the clutch.

9.9.10
Main Selector Valve Circuit (Fig. 126). Main-pressure oil from orifice B flows into the manual selector valve bore and surrounds the valve in the area of the detent notches. From this area, main oil flows, regardless of valve position, to another area at the right surrounding the valve. Here it is available for high range and forward clutches and for operation of the trimmer.

9.9.11
Four clutch apply lines leave the bottom of the selector valve bore. From left to right these are reverse, low range, high range, and forward. In neutral, the low range clutch is applied, and the remaining three are exhausted. Moving the selector valve one notch rightward will leave the low-range clutch applied and will charge the forward clutch. This is low forward.

9.9.12
Moving the selector valve a second notch rightward will close off oil to the low-range clutch and allow it to exhaust. The forward clutch will remain applied and the high-range clutch will be charged. This is high forward.

9.9.13
Moving the selector valve one notch leftward of neutral will charge the reverse clutch while allowing the low-range clutch to remain charged. This is low reverse.

9.9.14
Moving the valve a second notch leftward will close off oil to the low-range clutch and allow it to exhaust. The reverse clutch will remain applied and the high-range clutch will be charged. This is high reverse.

9.9.15
When the selector valve is moved to the high-range position (either HF or HR), oil to fill the high-range clutch must pass through both orifice B and the high-range clutch orifice. This is due to the oil passage immediately to the right of the high-range clutch orifice being blocked by the manual selector valve. The high-range clutch orifice is smaller than orifice B and restricts the flow of oil to the high range clutch. As a result, the high-range clutch fills at a slower rate than other clutches and thus provides smoother engagement.

9.9.16
Trimmer Circuit. The trimmer regulates clutch apply pressure during initial stages of clutch engagement, to obtain smooth operation. Normally, full-main pressure holds the trimmer plug leftward against its spring and a shoulder.

9.9.17 TORQUE PATHS THROUGH TRANSMISSION

9.9.18
How Power Flows, Input to Output. Knowledge of how engine power flows through the transmission under all operating conditions and in all gears is necessary for diagnosis of transmission troubles. The unique torque converter and its gearing, forward and reverse gearing, range gearing, output

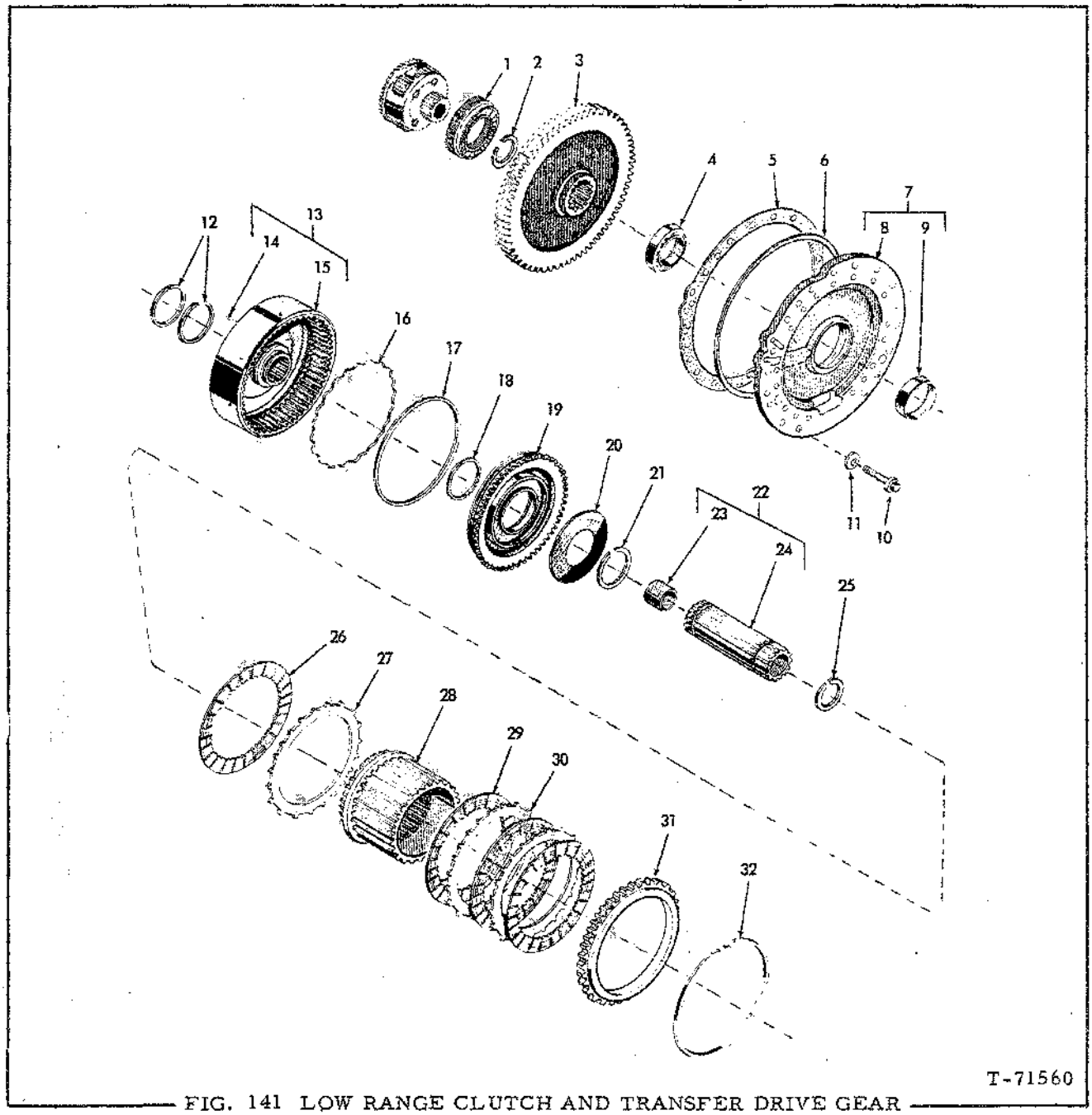
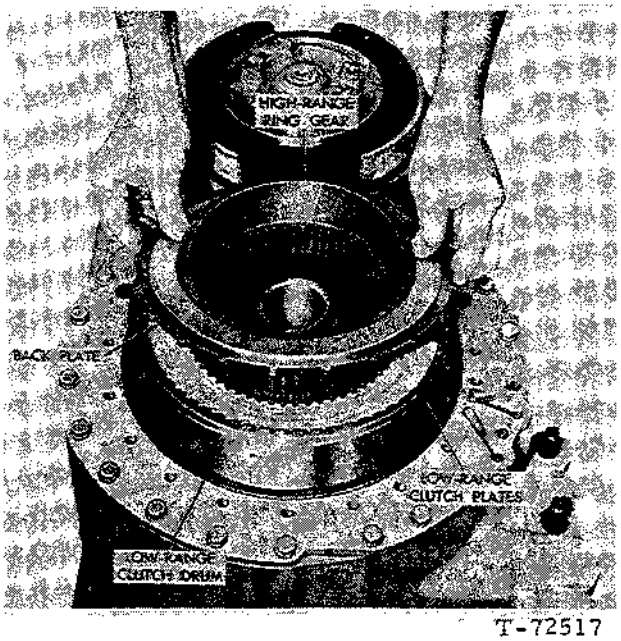



FIG. 141 LOW RANGE CLUTCH AND TRANSFER DRIVE GEAR

1. Ball bearing
2. External snap ring
3. Transfer drive gear
4. Ball bearing
5. Adapter gasket
6. Adapter seal ring
7. Adapter assembly
8. Adapter
9. Sleeve
10. Bolt
11. Lockwasher
12. Seal ring
13. Low-range clutch drum assembly
14. Pin
15. Clutch drum
16. Seal ring expander
17. Clutch piston outer seal ring
18. Clutch piston inner seal ring
19. Low-range clutch piston
20. Clutch piston return spring
21. External snap ring
22. Sleeve assembly
23. Bushing
24. Sleeve
25. External snap ring
26. Internal-splined clutch plate
27. External-splined clutch plate
28. High-range clutch ring gear
29. Internal-splined clutch plate
30. External-splined clutch plate
31. Low-range clutch back plate
32. Internal snap ring




T-72517

FIG. 158 INSTALLING LOW-RANGE CLUTCH BACK PLATE

10.14.34
Position the high-range clutch anchor assembly (12) (Fig. 146), pins upward on a flat surface. Beginning with an internal-splined clutch plate, alternately install five internal-splined and five external-tanged, high-range clutch plates. Engage the external tangs with the clutch anchor pins.

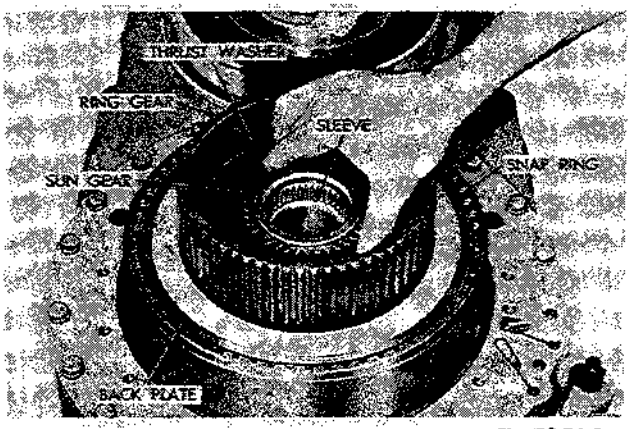
10.14.35
Grasp the entire anchor and plate assembly to hold the parts together. Install the anchor and plates into the rear housing, alining the anchor pin slot with the clutch anchor pin (Fig. 161).

10.14.36
Install the heavy internal snap ring which retains the clutch anchor. Note the position of the ends of the snap ring in relation to the two slightly extended pins in the anchor.

10.14.37
If bearing (6) (Fig. 133) was removed from shaft (5), install the bearing and snap ring (7). Press the assembled shaft and bearing, splined end first, into the rear of housing (2). Seat the bearing against the shoulder in the housing.

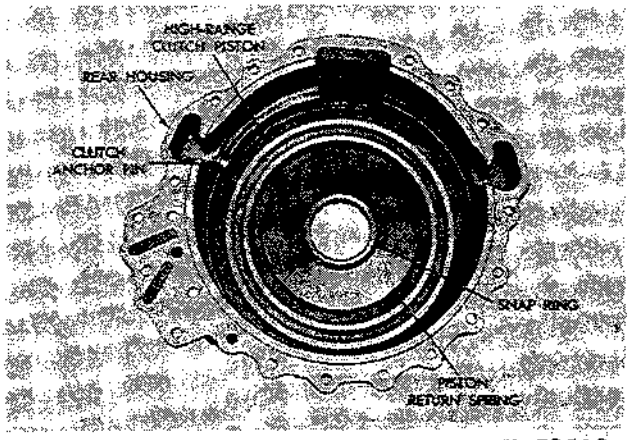
10.14.38
Install the internal snap ring which retains the shaft rear bearing (Fig. 162).

10.14.39
Install the seal ring into the groove in the rear bore of the rear housing (Fig. 162). Install the retainer, chamfered side first.




T-72518

FIG. 159 INSTALLING HIGH-RANGE SUN GEAR




T-72519

FIG. 160 REAR HOUSING AND PISTON ASSEMBLY

10.14.40
Install the snap ring which holds the oil retainer in the rear of the rear housing (Fig. 163).

10.14.41
Install the rear housing gasket onto the rear housing, using oil soluble grease to retain it. Install the rear housing onto the transmission.

NOTE: Rotate the transmission output shaft slowly to engage the splines of the high-range clutch plates with the splines of the high-range ring gear.

10.14.42
Install three 3/8-16 x 1 1/2 inch bolts and lockwashers, and seventeen 3/8-16 x 1 1/8 inch bolts and lockwashers to retain the rear housing on the adapter. Tighten the bolts to 26 to 32 pound feet (3.5 to 4.4 kg/m) torque.

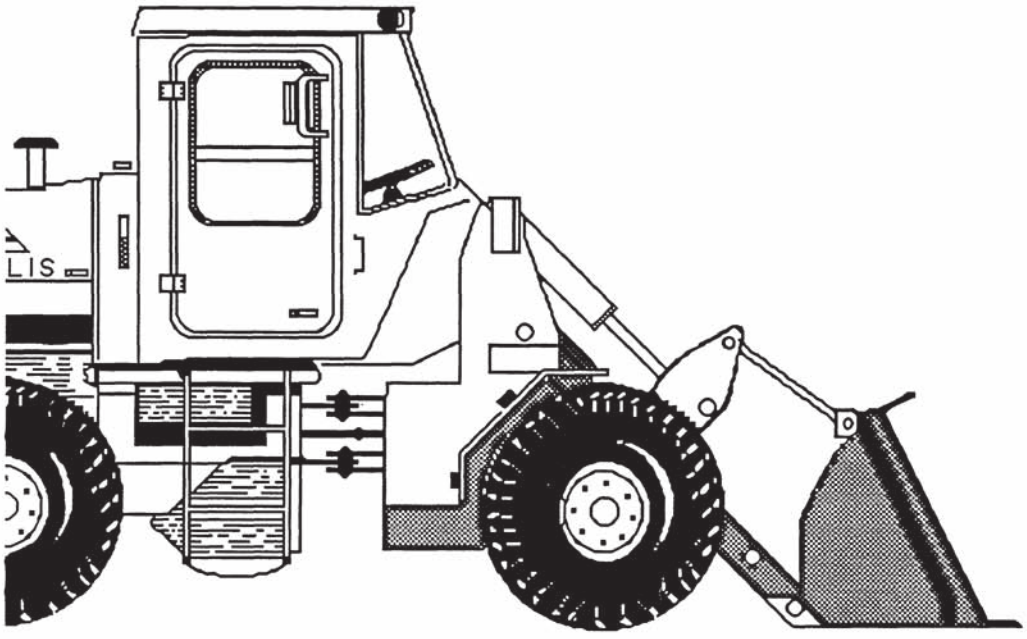
FIATALLIS®

# 545,545H,545-B
# 605-B,645,645-B
# 745,745H,745-B
# 745H-B

## wheel loaders

service manual

# AXLES



Form 73053547 English
7-89

ALLIS-CHALMERS

# SUPPLEMENT NO.2
# SERVICE MANUAL 3053547-0 (6-68)
# AXLES
# 545, 545H, 645, 745, 745H
# WHEEL LOADERS

(7-71 )

ATTENTION: Insert this sheet into the front of publication as record of receipt. Replace or add pages in the publication according to instructions below.

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| | | |
|---|---|---|
| 7 (Revised) | 37 (Revised) | 38a (Added) |
| 8 (No change) | 37a (Revised) | 39 (Revised) |
| 33 (Revised) | 37b (Revised) | 40 (Revised) |
| 34 (No change) | 38 (Revised) | |

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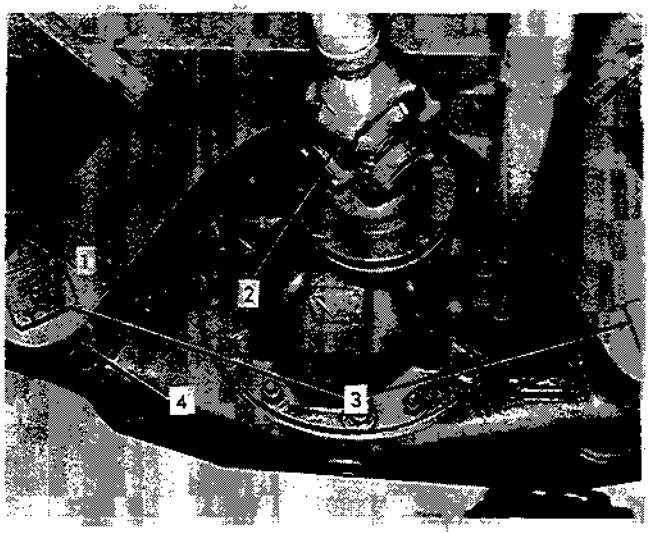


Fig. 8 Typical Rear Axle (Front Side) (T-74382)

1. Brake Lines
2. Drive Shaft
3. Axle Pins
4. Axle Support

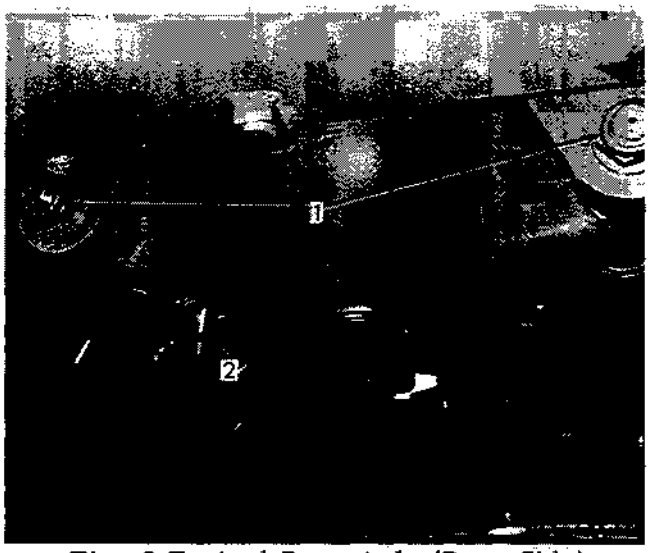


Fig. 9 Typical Rear Axle (Rear Side) (T-74383)

1. Axle Pins Nuts
2. Rear Axle

k. Attach a sling around axle housing and using a suitable hoist, lift assembly from jack.

l. Place axle assembly on blocks or stands so the planetary hubs do not rest on floor.

m. Disassembly, inspection and reassembly procedures for the complete axle assembly are covered in the following TOPICS 4 thru 9.

## 5 AXLE SUPPORT

a. Remove the lock nut, washer and shim pack. Keep shims together. Remove the rear axle supports. Inspect the pivot pins and bushings (in the frame) for wear. The bushings are serviced items and can be replaced if worn out of round an excessive amount. NOTE: Bushings can be easily removed if a longitudinal weld is run the length of the bushing. New bushings must be pressed in place.

b. Replace the axle support assembly if the pin has appreciable wear.

c. Install the axle support to the frame placing shims between the washer and shoulder of pivot pin so that a clearance of .005" to .010" (.127 to .254 mm) is maintained between washer and frame after the nut is torqued to 1325-1375 lb. ft. (183.2 to 190.0 kg-m) lubricated thread.

## 6. Installation of Rear Axle

a. Clean, inspect and, if necessary, replace the axle housing bushings. There are two hardened steel bushings in each connecting point. The bushings can be driven out and new bushings installed. Press new bushings in.

b. Before installing the axle assembly, the axle connecting pins should be inspected for wear and damage. New connecting pins should be used if there are any signs of wear or damage.

c. Refer to the above paragraphs and reverse the procedures to install the rear axle on the loader.

IMPORTANT: After connecting the brake lines it will be necessary to fill and bleed the hydraulic brake system. Refer to the BRAKE & AIR SYSTEM SERVICE MANUAL.

d. Tighten self-locking nuts Fig. 9 (1) to a torque of 900 to 950 lbs. ft. (124 - 131 kg-m).

e. Install each tire and wheel assembly on the planetary hub and attach lug nuts. Torque lug nuts to 365 - 400 lbs. ft. (50.46 - 55.30 kg-m).

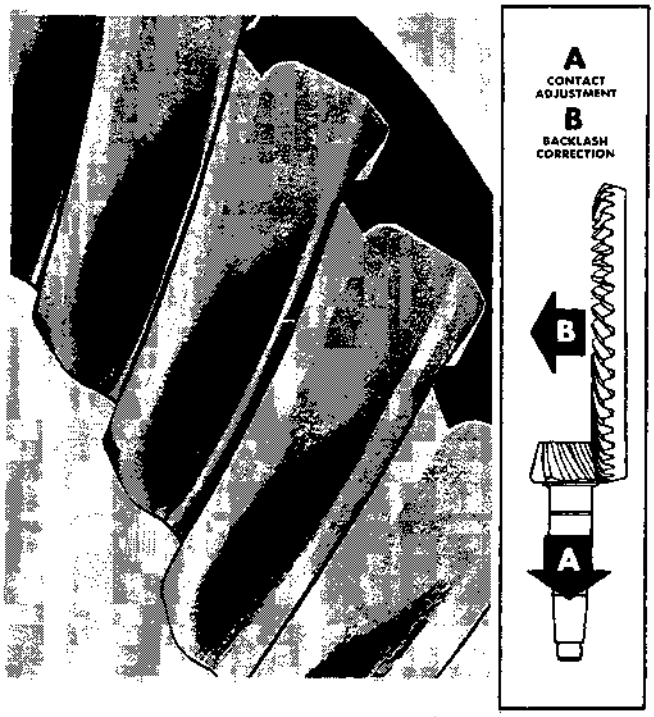


Fig. 31 Low Contact - No Load
(T-26963)

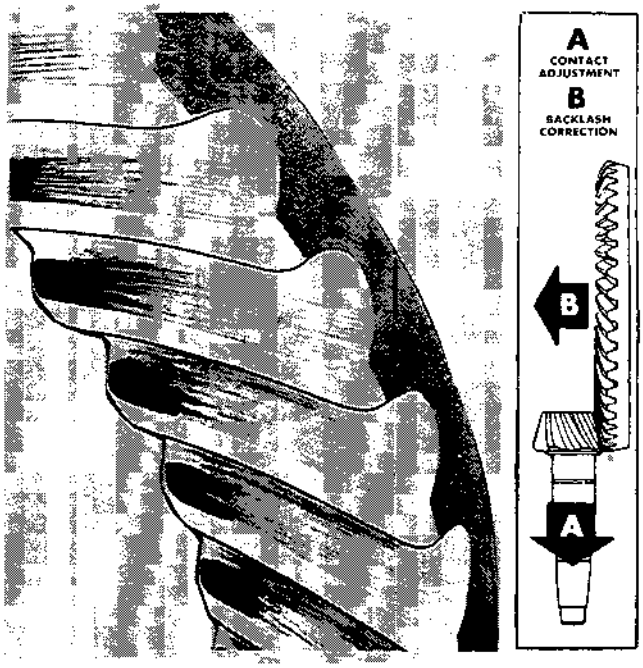


Fig. 32 Short Toe Contact - No Load
(T-71901)

c. Place thrust block (20) if used on the rear face of the ring gear and rotate gear until the hole in the thrust block is aligned with hole in carrier assembly. If no thrust block is used proceed to next paragraph.

d. Install adjusting screw (16) and locknut (42) and tighten adjusting screw. If no thrust block is used tighten adjusting screw sufficiently against back face of gear.

sufficiently to locate thrust block firmly against back face of ring gear. Refer to Fig. 34.

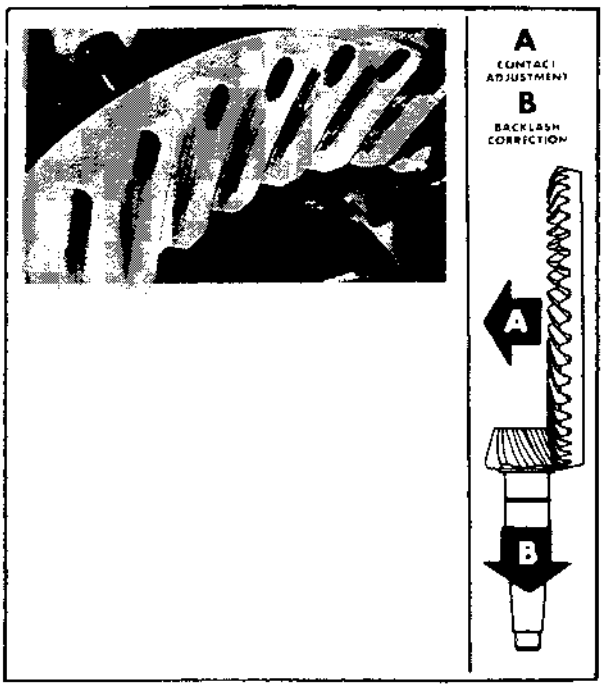


Fig. 33 Short Heel Contact
(T-28771)

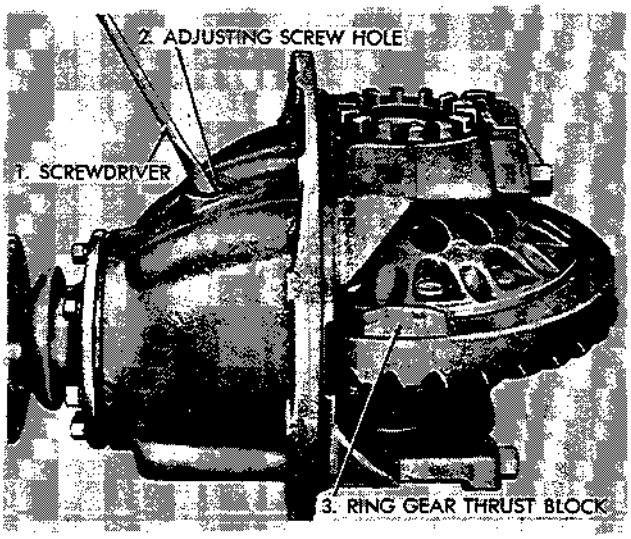


Fig. 34 Positioning Ring Gear Thrust Block
(First Type) (T-26965)

e. To secure the correct adjustment of .010 in. - .015 in. (0.254-0.381 mm) clearance, loosen adjusting screw 1/4 turn and lock securely with nut.

f. Check to assure minimum clearance of .010 in. (0.254 mm) during full rotation of ring gear.

# TOPIC 9 – ASSEMBLY AND INSTALLATION

## 1. Installing Hub Spindle Assembly

a. Late type seals incorporating the wear sleeve are interchangeable with the first type seals. To install the sleeve on the spindle of the 545, 605, 645 models it is necessary to heat the sleeve in oil to approximately 200°F. (93°C). The heavier sleeve for the 745 model will require heat applied by a torch to the inside diameter of the sleeve until a change in color (generally termed a straw color) is noted. Be sure to heat the sleeve evenly by continuously moving torch. The chamfered edge of the sleeve should be toward the spline end of spindle.

Precautionary measures in regard to the above procedures include: careful handling of the heated parts (Use asbestos gloves); steel plate should be used under the sleeve when it is being heated with the torch.

b. A tubular driver, having an inside diameter of 3-1/2" to 3-7/8" (89 to 100 m m), outside diameter 4-1/16" (103 m m) and minimum length of 6-3/4" (171.9 m m) is recommended for installing.

c. The seal should be installed according to the marking on the seal or in the instance of the 745 models, installed the same relative position as the seal that had been removed.

d. Position the O-Ring on the spindle and carefully slide spindle Fig. 38 (32) over axle shaft (6).

e. Install hub spindle stud nuts, lockwashers and capscrews that secure hub spindle to axle housing.

f. Install bearing assembly (27) over spindle (32).

g. Place oil seal and retainer assembly Fig. 38 (31) over capscrews and nuts.

h. Tighten nuts to correct torque. Refer to Topic 11.

NOTE

Some models use oil seal and retainer assembly which is held in place against the spindle by means of a dowel.

## 2. Install Brake Assemblies - Hydraulic

a. Install brake cylinder Fig. 45 (1) and push rods.

b. Install brake shoe (4) and liner assemblies (2) over anchor pins. Use shims to avoid excessive shoe side play.

c. Install anchor pin plate, nut and cotter pin

d. Align push rods with shoe webs and hook brake shoe return spring (3).

## 3. Assemble Floating Ring Gear Assembly

a. Install splined ring gear, Fig. 42 (1), splines flush with shoulder.

b. Install the hub-to-gear connecting plates (4) and capscrews.

Tighten capscrews to correct torque. Refer to Topic 11.

d. Lock wire capscrews in sets of two.

e. Install the outer wheel bearing on the ring gear hub journal squarely against the hub shoulder. The inner race of the bearing is a slide fit over the spindle hub journal. Lightly oil bearings and races to insure lubrication during first few rotations.

## 4. Assemble Hub and Drum Assembly and Install

a. Usage: 545 Front - 545H, 645, 745 Front and Rear Axle. If the hub bearing cups have been removed for replacement, install new cups with a suitable driver sleeve.

(1) Lift the hub Fig. 44 (1) and drum assembly onto the hub spindle and position so that the inner cups (2) rest on the inner bearing rolls.

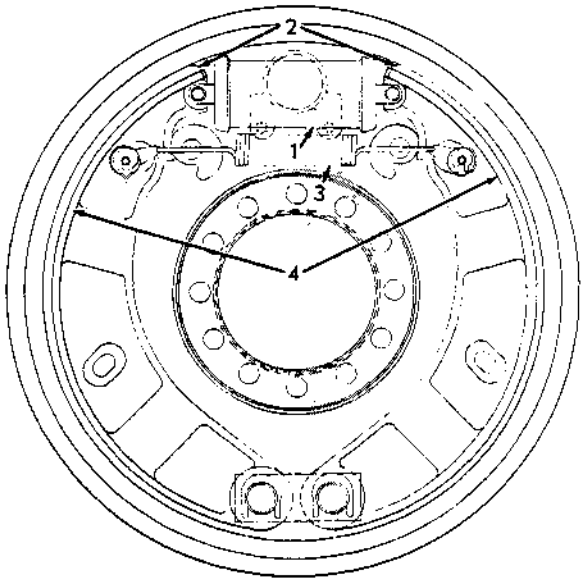


Fig. 45 Brake Assembly (T-74386)

1. Brake Actuating Cylinder
2. Brake Lining
3. Return Spring
4. Brake Shoes

c. Carefully insert yoke shaft (11) (11) through bracket (10) and install yoke (13) by attaching washer (14) and nut. Torque nut to 340 - 360 lbs. ft. (47.0 - 49.7 kg/m).

### 8. Removal of Drive Shaft Assembly (Front Axle to Cartridge)

a. Remove slip yoke end of drive shaft from front axle yoke Fig. 52 and carefully slide off opposite end of yoke shaft (11). Refer to Drive Shaft Removal.

### 9. Disassembly of Drive Shaft Assembly (Front Axle to Cartridge)

a. Refer to Disassembly of Cross Assemblies.

b. Remove dust cap Fig. 52 (1), dust cap washer (2) and washer (felt) (3).

### 10. Assembly of Drive Shaft Assembly (Front Axle to Cartridge)

a. Refer to Assembly of Cross Assemblies. Install a new felt washer Fig. 52 (3) inside dust cap (1). Hand tighten dust cap on slip yoke assembly. Do not overtighten.

### 11. Installation of Drive Shaft Assembly (Front Axle to Cartridge)

a. Carefully slide slip yoke tube Fig. 52 (4) over yoke shaft (11).

b. Install slip yoke (4) onto front axle yoke. Refer to Installation of Drive Shafts.

### 12. Removal of Drive Shaft Assembly (Cartridge to Transmission)

a. Remove drive shaft from cartridge and transmission. Refer to Drive Shaft Removal.

### 13. Disassembly of Drive Shaft Assembly (Cartridge to Transmission)

a. Partially extend the drive shaft unit to get at the open end of the drive shaft sleeve Fig. 52 (22). Use Tru-Arc type pliers and remove the snap ring (17). Usually the bent nose type will be easier to use. Slide the snap ring out of the way.

NOTE: Do not try to spring the ring over the shaft as it will be permanently deformed.

b. Over a box or a clear area carefully extend the set. This will pull two washers (18 and 20) and a guide washer (rubber) seal (19) from the sleeve counterbore. Further extension will remove the springs and balls.

c. The set may now be fully separated.

NOTE: The washer and snap ring at the inner end of the sleeve can not be removed without cutting the tube from the sleeve.

d. Clean all parts thoroughly for inspection.

e. Inspect the ball bearing grooves in the sleeve (22) and splined yoke (16). The balls will sometimes brinell into the splined yoke and sleeve causing small pockets. Check the balls for spalling. Inspect the springs for damage (If the set had slipped during and fully extended this can cause the springs to take a permanent set.

### 14. Assembly of Drive Shafts Assembly (Cartridge to Transmission)

a. Place the snap ring Fig. 52 (17), washers (18 and 20) and seal over the splined yoke in the correct order.

b. Place the sleeve end in a vertical position and grease the splined yoke assembly shaft.

c. Set the splined yoke assembly shaft end into the sleeve end far enough so the end of the shaft will come at least flush with the inner end of the sleeve.

NOTE: Be sure the two inner yokes are in line.

d. Place the required number of balls and springs in position in each groove.

e. The ends may be compressed and the washers and seal pushed into the sleeve counterbore. Then the snap ring can be inserted into the sleeve ring groove with "Tru-Arc" pliers.

NOTE: Make sure the snap ring is seated in the groove. Test action of the unit by pushing and pulling to required lengths. Do not test by letting one end drop away from the other.

f. Lubricate the assembly with an EP type at the fitting. Add no more than conventually used.

### 15. Installation of Drive Shaft Assembly (Cartridge to Transmission)

a. Install drive shaft to cartridge and

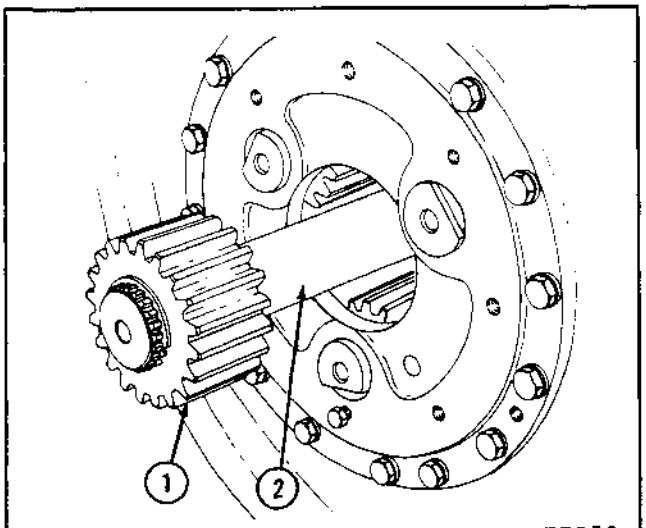


FIG. 56 DISENGAGING AXLE SHAFTS

1. Sun gear
2. Axle shaft

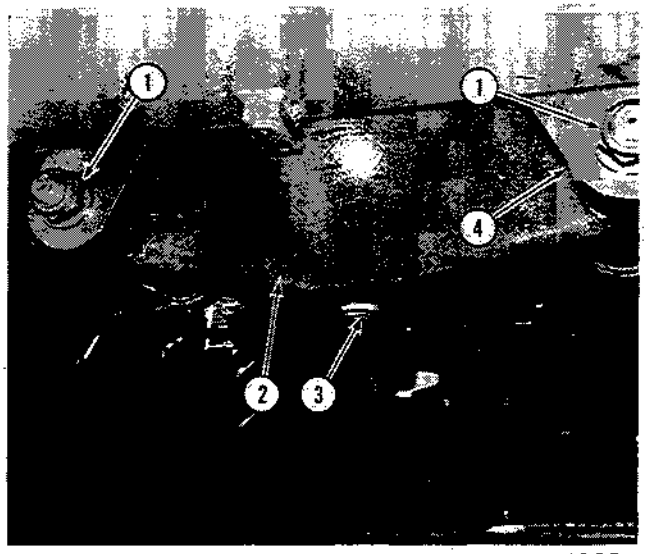


FIG. 57 AXLE

1. Axle anchor pin nuts
2. Axle
3. Drain plug
4. Axle support

13.2.4.4
Remove one self-locking axle pin nut (1, Fig. 56), washer, and pin. Loosen other pin nut slightly.

13.2.4.5
Raise loader with hoist or jacks. Oscillate machine to lower one end of axle and block in oscillated position for safety. This will eliminate interference by the axle support for removal of all stud nuts.

## 13.3 REMOVAL OF DIFFERENTIAL

13.3.1
Remove all of the carrier to housing stud nuts, except the two top nuts.

13.3.2
Loosen the two top nuts, but do not remove from studs. This will prevent the carrier from falling out of the axle, when it is broken loose from the housing.

13.3.3
Break the carrier loose from the axle housing with a row hide hammer or utilize the 3 tapped jack screw holes in the differential cover housing. Also a roller jack may be used to facilitate removal of the carrier.

13.3.4
Remove the two top nuts and washers and work the carrier free. A small pinch bar having a rounded end may be used to straighten the carrier in the housing bore.

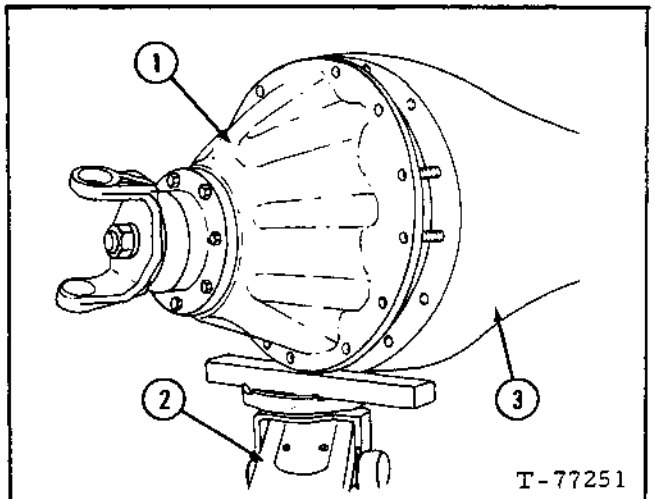


FIG. 58 REMOVING CARRIER

1. Differential assembly
2. Roller jack
3. Axle housing

## 13.4 DISASSEMBLY OF CARRIER

**13.4.1**
**For ease in handling, set carrier on a suitable holding fixture, during disassembly and assembly procedures. A Heavy Duty Repair Stand (No. J3409) can be purchased from the Kent Moore Corporation in Warren, Michigan.**

NOTE: If the initial inspection indicates that the ring gear is not going to be replaced, it is suggested that the back lash be measured (Refer to Topic 6) and noted for reference when assembling.

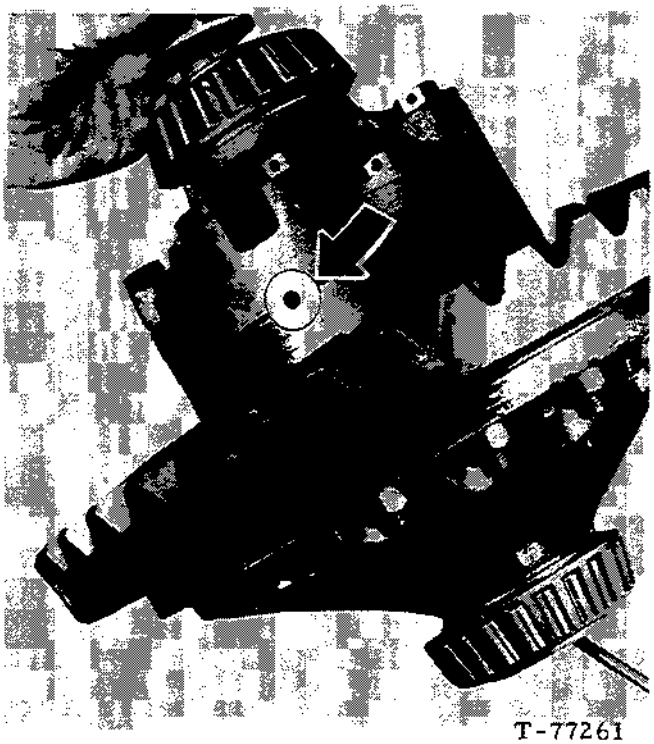

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FIG. 68 CASE AND TRUNNIONS SHOULD FIT TOGETHER SECURELY

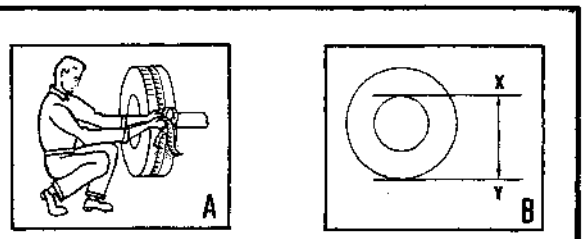


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FIG. 69 MEASURING METHODS

## 13.23 NOTES OF CAUTION

13.23.1
The NoSPIN assures maximum traction, but does not increase the load carrying capacity.

13.23.2
It is important to elevate both wheels off the ground when checking brakes or balancing wheels. If one wheel is on the ground when power is applied, the loader will begin to move.

13.23.3
It is important to check the distance around each tire, for the NoSPIN to function smoothly. See Fig. 69, methods A and B. This problem appears when accelerating or decelerating. The NoSPIN equipped loader will appear to veer. This means that you may have mismatched the tires or you may have unequal air pressure or unequal side to side axle load distribution.

13.23.4
In Fig. 69, method A, the dimension can be adjusted by varying the air pressure of the tires. In Fig. 69, method B, an alternative method is shown. Measure the distance from the top of each rear rim to the pavement (point X to point Y distances must match).

## 13.24 FACTS YOU SHOULD KNOW ABOUT YOUR NoSPIN DIFFERENTIAL

13.24.1
The NoSPIN differential provides positive drive to both driving wheels, yet permits differential action when required. The performance of a loader equipped with the NoSPIN may be somewhat different than that of one with a standard differential. For example:

13.24.2
When turning a corner, the outside wheel must rotate faster than the inside wheel, otherwise serious tire scuffing would occur. When negotiating a turn, the NoSPIN's outer Driven Member, which is driving the outside wheel, is automatically disengaged, thus permiting this wheel to overrun until the turn is completed. The outer Driven Member then reengages with the Spider to again positively lock both axles.

13.24.3
The sound of gear reengagement may be audible upon the completion of a turn. This sound, which occurs when the NoSPIN's Spider and Driven Member assemblies complete the indexing cycle, is your sign that the NoSPIN is operating properly.

13.24.4
If the NoSPIN equipped loader seems to veer, check the tire pressure and rolling diameters of the rear tires. Also, veering can result if the load is greater on one side of the loader.

13.24.5
You may experience under steer when negotiating a turn under full power. By letting off the throttle for an instant, you will reduce the torque to the wheels and permit the loader to easily maneuver into the turn.

13.24.6
Backlash in the NoSPIN (which is required for proper operation) is of a fixed amount which does not increase appreciably with use. The total backlash in the entire drive system including the transmission, joints, various splines, and gears will increase due to normal wear of these parts.

13.24.7
When alternately accelerating or decelerating during a turn you may hear an occasional snapping noise as the torque is being alternated from "driving" torque on the insdie

# SAFETY RULES

## GENERAL

Study the Operation and Maintenance Instruction Manual before starting, operating, maintaining, fueling, or servicing machine.

Read and heed all machine-mounted safety signs before starting, operating, maintaining, fueling or servicing machine.

Machine-mounted safety signs have been color coded yellow with black border and lettering for ***WARNING*** and red with white border and lettering for ***DANGER*** points.

Never attempt to operate the machine or its tools from any position other than seated in the operator's seat. Keep head, body, limbs, hands and feet inside operator's compartment at all times to reduce exposure to hazards outside the operator's compartment.

Do not allow unauthorized personnel to operate service or maintain this machine.

Always check work area for dangerous features. The following are examples of dangerous work areas: slopes, over hangs, timber, demolitions, fire, high walls, drop off, back fills, rough terrain, ditches, ridges, excavations, heavy traffic, crowded parking, crowded maintenance and closed areas. Use extreme care when in areas such as these.

An operator must know the machine's capabilities. When working on slopes or near drop offs be alert to avoid loose or soft conditions that could cause sudden tipping or loss of control.

Do not jump on or off machine. Keep two hands and one foot, or two feet and one hand, in contact with steps grab rails and handles at all times.

Do not use controls or hoses as hand holds when climbing on or off machine. Hoses and controls are movable and do not provide a solid support. Controls also may be inadvertently moved causing accidental machine or equipment movement.

Keep operator's compartment, stepping points, grab-rails and handles clear of foreign objects, oil, grease, mud or snow accumulation to minimize the danger of slipping or stumbling. Clean mud or grease from shoes before attempting to mount or operate the machine.

Be careful of slippery conditions on stepping points, hand rails, and on the ground. Wear safety boots or shoes that have a high slip resistant sole material.

For your personal protection. Do not attempt to climb on or off machine while machine is in motion.

Never leave the machine unattended with the engine running.

Always lock up machine when leaving it unattended. Return keys to authorized security. Heed all shut down procedures of the Operation and Maintenance Instruction Manual. Always set the parking brake when leaving the machine for any reason.

Do not wear rings, wrist watches, jewelry, loose or hanging apparel, such as ties, torn clothing, scarves, unbuttoned or unzipped jackets that can catch on moving parts. Wear proper safety equipment as authorized for the job. Examples: hard hats, safety shoes, heavy gloves, ear protectors, safety glasses or goggles, reflector vests, or respirators. Consult your employer for specific safety equipment requirements.

Do not carry loose objects in pockets that might fall unnoticed into open compartments. Do not use machine to carry loose objects by means other than attachments for carrying such objects.

*DO NOT CARRY RIDERS* unless the machine is equipped for carrying people to reduce personal exposure to being thrown off.

Do not operate machinery in a condition of extreme fatigue or illness. Be especially careful towards the end of the shift.

Roll Over Protective Structures are required on wheel loaders, dozer tractors, track type loaders, graders and scrapers by local or national requirements. *DO NOT* operate this machine without a Roll Over Protective Structure.

Do not operate a machine without a falling object protective structure (FOPS).

Do not operate this machine without a rear canopy screen when machine is equipped with rear mounted towing winch.

Seat belts are required to be provided with roll over protective structures or roll protection cabs by local or national regulations. Keep the safety belt fastened around you during operation.

Where noise exposure exceeds 90 dBA for 8 hours, wear authorized ear protective equipment per local or national requirements that apply.

Keep clutches and brakes on machine and attachments such as power control units, winches and master clutches adjusted according to Operation and Maintenance Instruction Manuals of the manufacturers at all times. *DO NOT* adjust machine with engine running except as specified.

Do not operate a machine with brakes out of adjustment. See the Operation and Maintenance Instruction Manual.

Move carefully when under, in or near machine or implements. Wear required protective equipment, such as hard hat, safety glasses, safety shoes, ear protectors.

To move a disabled machine, use a trailer or low boy truck if available. If towing is necessary, provide warning signals as required by local rules and regulations and follow Operation and Maintenance Instruction Manual recommendations. Load and unload on a level area that gives full support to the trailer wheels. Use ramps of adequate strength, low angle and proper height. Keep trailer bed clean of clay, oil and all materials that become slippery. Tie machine down securely to truck or trailer bed and block tracks (or wheels) as required by the carrier.

# TOPIC 1 GENERAL DESCRIPTION

**1.1 DESCRIPTION** (Used prior to loader serial no. 24S3215 and 56C03501)

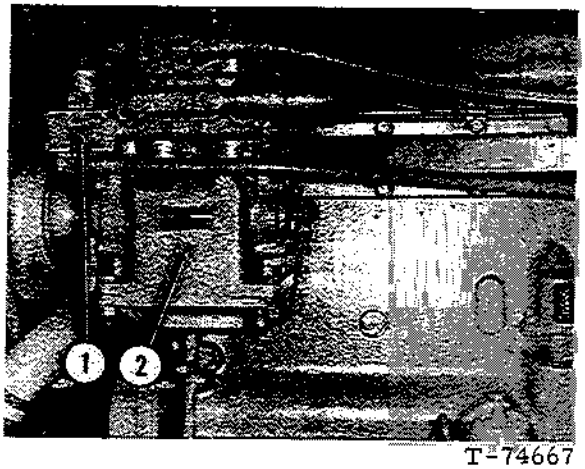
1.1.1
The subject wheel loader has a dual air-over-hydraulic brake system. Separate circuits are used to apply the front and rear brakes simultaneously. The brake system includes:

1.1.1.1
Governor Controlled Air Compressor

1.1.1.2
Air Tank

1.1.1.3
Air-over-Hydraulic Power Clusters (two)

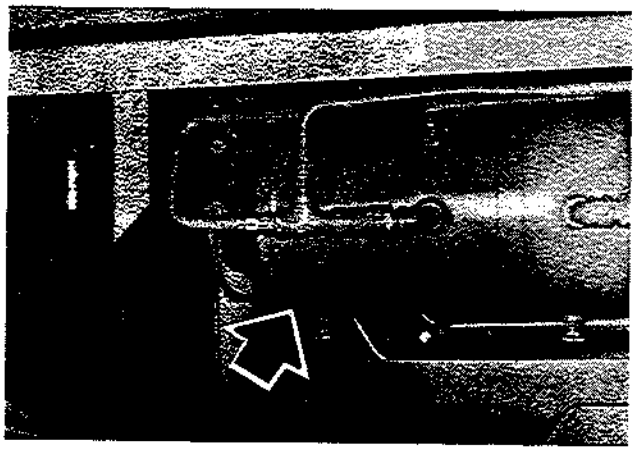
1.1.1.4
Hydraulic Cylinder actuated wheel brakes




T-74667

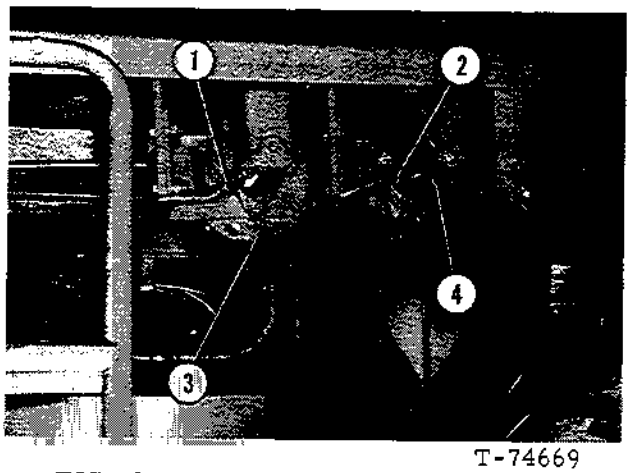
FIG. 1 GOVERNOR CONTROLLED AIR COMPRESSOR

1. Governor
2. Air compressor



T-74668

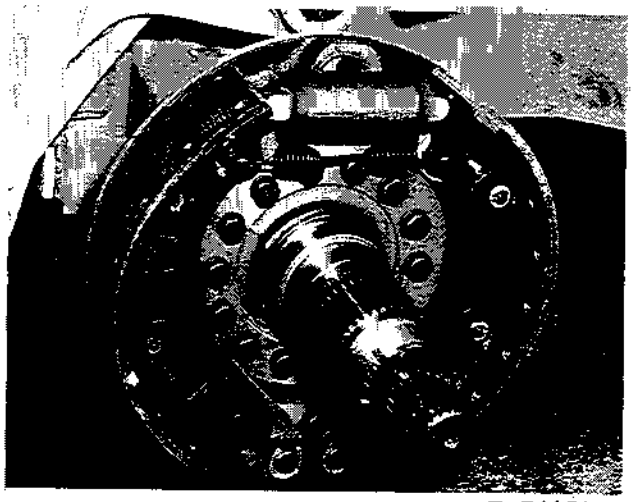
FIG. 2 AIR TANK
(Used prior to loader serial no. 24S03215 and 56C03501)




T-74669

FIG. 3 AIR-OVER-HYDRAULIC POWER CLUSTERS
(Used prior to serial no. 24S03215 and 56C03501)

1. Operates front brakes
2. Operates rear brakes
3. Air pak
4. Hydraulic cylinder



T-74670

FIG. 4 HYDRAULIC CYLINDER ACTUATED WHEEL BRAKES



(Revised April 1972)

## Trouble Shooting

| TROUBLE (Cont.) | POSSIBLE CAUSE (Cont.) | REMEDY (Cont.) |
|---|---|---|
| Excessive oil or water in system | 1. Air tank must be drained more often.<br>2. Compressor passing oil excessively. | 1. Drain tank every ten hours.<br>2. Repair or replace. |
| Parking brake lever will not operate | 1. Linkage and lever needs adjustment.<br>2. Linkage joints binding.<br>3. Linkage joints frozen.<br>4. Brake lever assy. frozen.<br>5. Brake lever assy. rusted. | 1. Adjust<br>2. Lubricate<br>3. Work loose frozen joints.<br>4. Free<br>5. Clean and lubricate. |
| Parking brake won't hold | 1. Linkage or drum damaged.<br>2. Linkage and lever needs adjustment.<br>3. Defective brake lever assy. | 1. Replace<br>2. Adjust<br>3. Repair or replace |
| Air application valve leaks when pedal is in released position. | 1. Inlet-exhaust valve not sealing. | 1. Repair or replace |
| Air application valve leaks while pedal is in applied position | 1. Indicates the valve is not sealing its exhaust. | 1. Repair or replace |

# TOPIC 3 AIR COMPRESSOR

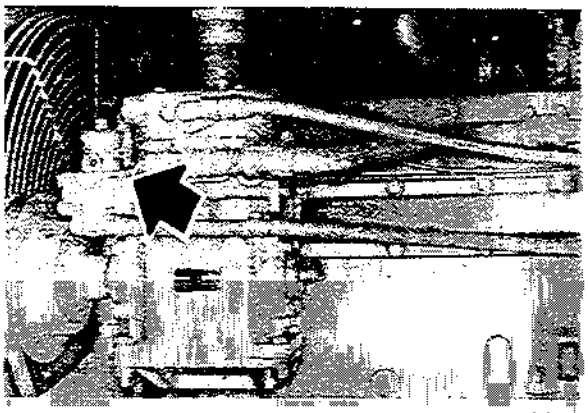
### 3.1 GENERAL

3.1.1
In this air-over-hydraulic system, the compressor furnishes the compressed air for brake operation by taking free air or atmosphere and compressing it to a pressure approximating 100 psi (7.03 kg/cm$^2$).

3.1.2
The single-acting, reciprocating air compressor has two cylinders and is belt driven. See Figure 6. This compressor (TU-FLO 400) has a capacity of 7.25 cu. ft. per minute (3,422 cu. cent. per second) when operating at 1250 R. P. M.

# TOPIC 4 GOVERNOR

## 4.1 GENERAL



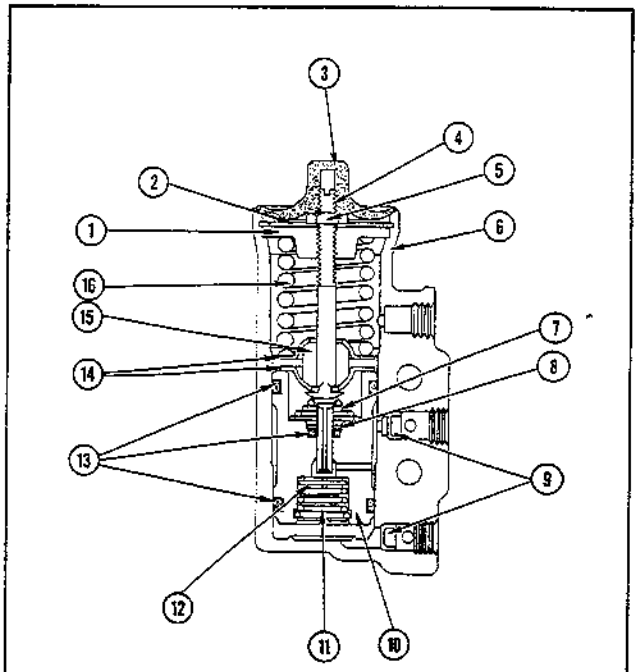
T-74667

FIG. 17 GOVERNOR

4.1.1
The governor, operating in conjunction with the compressor unloading mechanism automatically controls the air pressure in the air brake system between the minimum and maximum pressure desired. As we mentioned before the compressor runs continually while the engine runs, but the actual compression of air is controlled by the governor which stops or starts compression when the maximum or minimum air tank pressure is reached.

## 4.2 OPERATION

4.2.1
Refer to Fig. 18. Tank air pressure enters the governor at one of its reservoir ports and acts on the area of the piston and on the top of the inlet and exhaust valve. As the air pressure builds up, the piston moves against the resistance of the pressure setting spring. When the reservoir air pressure reaches the cut-out setting of the governor the piston and inlet and exhaust valve move up. The exhaust stem seats on the inlet and exhaust valve and the inlet passage opens. Reservoir air pressure then flows by the open inlet valve through the drilled passage in the piston and out the unloader port to the compressor unloading mechanism. The air, besides flowing to the compressor unloading mechanism, also flows around the piston and acts on the additional area of the piston. This additive force which results from the larger area on the piston assures a positive action and fully opens the inlet valve.



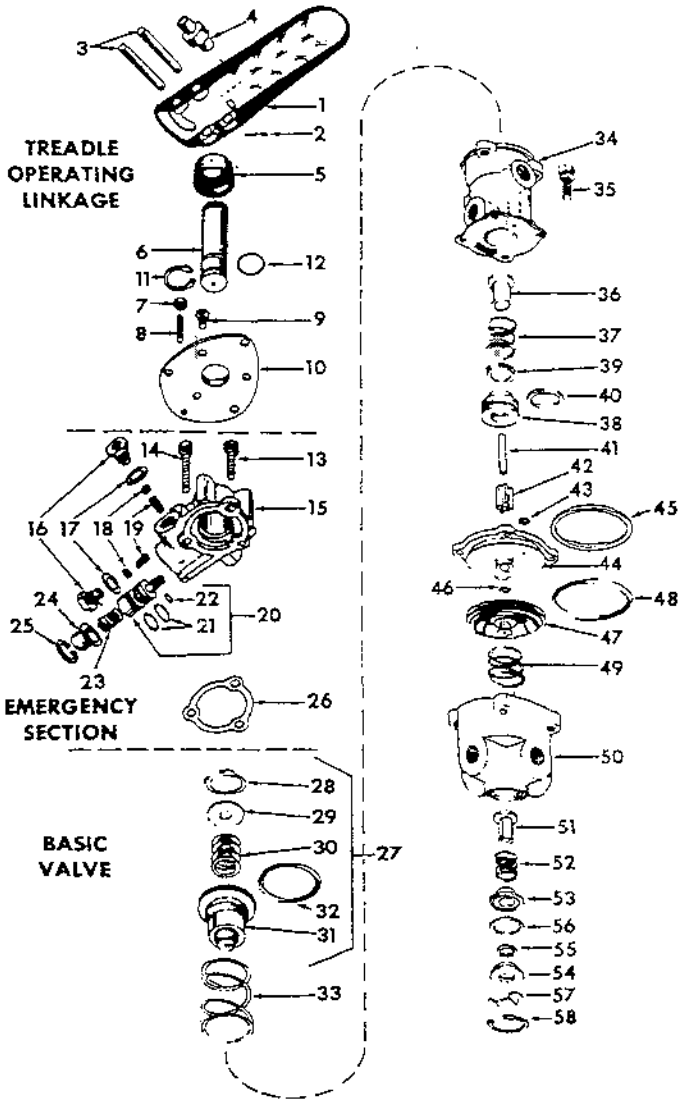

T-74673

FIG. 18 SECTIONAL OF GOVERNOR

1. Upper spring seat
2. Retaining ring
3. Cover
4. Adjusting screw
5. Adjusting screw lock nut
6. Body
7. Exhaust stem spring
8. Exhaust stem
9. Filters
10. Piston
11. Inlet-exhaust valve spring
12. Inlet and exhaust valve
13. Grommets
14. Lower spring seats
15. Spring guide
16. Pressure setting spring

4.2.2
As the system tank air pressure drops to the cut-in setting of the governor, the force exerted by the air pressure on the piston will be reduced so that the pressure setting spring will move the piston down. The inlet valve will close and the exhaust will open. With the exhaust open the air at the compressor unloader pistons will escape back through the piston, on through the exhaust stem and out the exhaust port.

## Air Application Valve



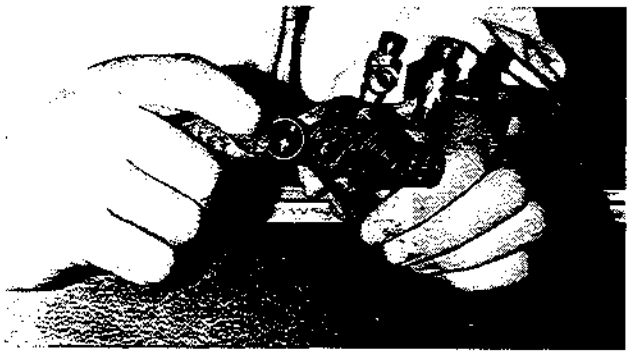

T-77772

*31A AIR APPLICATION VALVE (Second type)*

1. Treadle
2. Cotter pin
3. Pin
4. Roller
5. Boot
6. Plunger
7. Nut
8. Setscrew
9. Screw
10. Flange
11. Ring
12. O-ring
13. Screw
14. Screw
15. Body
16. Cap
17. Gasket
18. Valve
19. Spring
20. Cartridge
21. O-ring
22. O-ring
23. Spring
24. Retainer
25. Ring
26. Gasket
27. Piston assy
28. Ring
29. Retainer
30. Spring
31. Piston
32. O-ring
33. Spring
34. Body
35. Screw
36. Valve
37. Spring
38. Guide
39. V-cup
40. Seal
41. Rod
42. Guide
43. O-ring
44. Cover
45. Seal
46. O-ring
47. Piston
48. Quad-ring
49. Spring
50. Body
51. Valve
52. Spring
53. Guide
54. Retainer
55. Ring
56. Seal
57. Shield
58. Ring

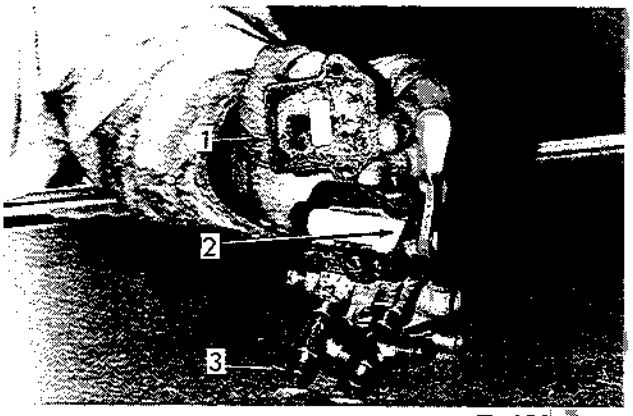


(Added October 1988)



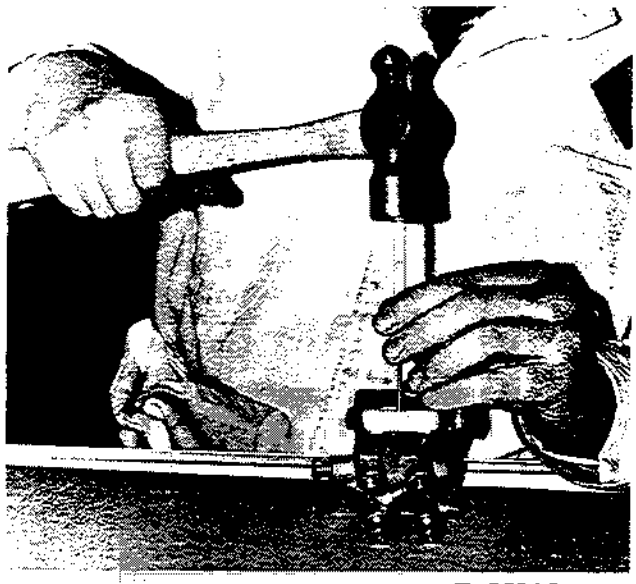
T-77212
FIG. 29 G REMOVING INLET PLATE O-RING

T-77213
FIG. 29 H REMOVING VALVES



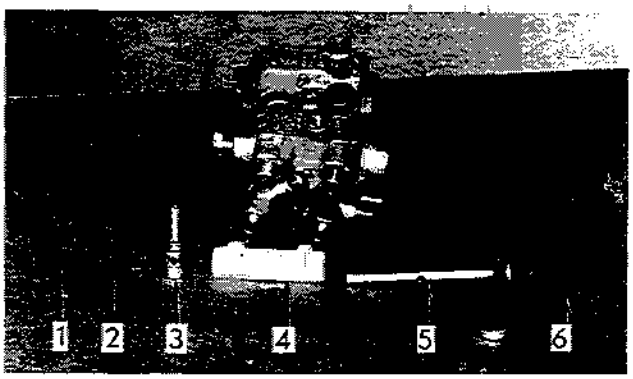

T-77214
FIG. 29 I REMOVING COVER

1. Cover
2. Circular indentation
3. Bleeder plug assy.



T-77215
FIG. 29 J REMOVING ROLL PIN

T-77216
FIG. 29 K PLUNGER, SEAL AND SPRING ASSEMBLY




T-77217
FIG. 29 L CONTROL SECTION COMPONENTS

1. Plunger o-ring
2. Plunger return spring
3. Plunger
4. Cam
5. Lever assy.
6. Spiral pin

(Added April 1972)

## 11.4 CLEANING AND INSPECTION

11.4.1
Clean metal parts in solvent.

11.4.2
Inspect spring, replace if broken or deteriorated.

11.4.3
Inspect surfaces of housing, follower, plunger and cam assembly.

## 11.5 ASSEMBLY

11.5.1
Install new back-up rings (7) and new O-rings (6) over cam assembly (8). Install cam assembly into housing (1).

11.5.2
Install follower (2) in housing as shown in Fig. 38.

11.5.3
Next install plunger (3) with opening up as shown in Fig. 38.

11.5.4
Install spring (4) in opening of plunger (3) and install pipe plug with allen wrench.

## 11.6 INSTALLATION

11.6.1
Install clutch cut-off on bracket and secure with fasteners.

11.6.2
Connect tagged lines from transmission and from tee.

# TOPIC 12 ALCOHOL INJECTOR

## 12.1 DESCRIPTION

12.1.1
The alcohol injector is an automatic vaporizing device for keeping air lines and air tank free of ice. It is connected into the discharge line between the compressor and air tank.

## 12.2 OPERATION

12.2.1
The warm compressed air stream is pumped by the compressor through a venturi shaped passage in the injector. A smaller passage ahead of and angled to the venturi admits air to the liquid alcohol below and also introduces the resulting alcohol vapor into the air stream. The air flow through the venturi then assures complexed vaporization and mixing. Leaving the venturi, the air stream passes a one-way check valve located in the injector outlet. It is there to seal off a possible back pressure and enable removing the filler cap to refill with alcohol. Refer to Fig. 39.

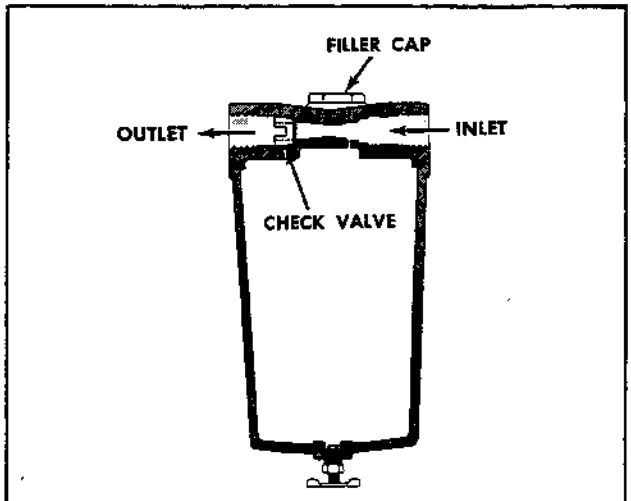


FIG. 39 ALCOHOL INJECTOR SECTIONAL

## 12.3 REMOVAL

12.3.1
Drain air in brake system by opening the three drain cocks in air tank.

system consists of two completely separate sub-systems, one for each axle. Damage or repairs to the front axle sub-system has no effect on the rear axle sub-system or vice versa. Each sub-system must be bled separately.

17.2.1.3.2
When a brake line is disconnected at an individual wheel cylinder, it may only be necessary to bleed that particular cylinder. Do this slowly to avoid draining fluid from the other lines.

17.2.1.3.3
When a master cylinder has been disconnected and the brake line remains full of fluid, it may not be necessary to bleed the sub-system concerned at the wheel cylinders. Instead, perform the following operation:

17.2.1.3.3.1
Before connecting the brake line, fill the reservoir of the master cylinder with fluid and then force the piston through its entire stroke. Repeat stroking until the fluid is forced past the check valve and out the outlet port.

17.2.1.3.3.2
Connect the outlet line nut loosely and depress the brake pedal until fluid leaks out through the loosened connection. Hold the pedal to sustain pressure while tightening the nut.

17.2.1.4
Salvaging brake fluid - Fluid drained from the system is aerated and no longer suitable for use in the hydraulic brake system.

## 17.3 BLEEDING PROCEDURE

17.3.1
Clean all dirt from the master cylinder filler cap and surrounding area. Clean each bleeder screw thoroughly.

17.3.2
Fill the master cylinder reservoir with fresh fluid.

17.3.3
Connect the pressure bleeder to the master cylinder filler opening. The pressure bleeder should be charged with the lowest air pressure which will cause the fluid to flow (about 15 psi, 1.1 $kg/cm^2$) since low pressure will produce less compression of air bubbles and provide a better bleeding job.

17.3.4
Slip a hose on the master cylinder bleeder screw of the sub-system to be bled. Submerge the other end of the hose in a glass jar partially filled with brake fluid. Open the bleeder screw approximately one turn. Open the supply valve of the pressure bleeder and permit fluid to drain until the escaping fluid is free of bubbles. Close the bleeder screw.

17.3.5
Repeat at the bleeder screw of each wheel cylinder of the axle concerned.

17.3.6
When bleeding the brake sub-system for the rear axle, also bleed the line to the clutch cut-off valve in the transmission. With the pressure bleeder in operation and the clutch cut-off control in the ON (down) position, loosen the flare type connector at the clutch cut-off valve on the transmission, allowing the brake fluid to discharge until a steady flow is observed.

17.3.7
After bleeding all cylinders of the sub-system, refill the master cylinder to within .75 in. (19.1mm) of the filler opening.

# SAFETY RULES

Face the access system when climbing up and down

Apply the parking device and place the transmission in neutral before starting the machine

Do not bypass the starter safety switch Repair the starter safety controls if they malfunction

Fasten seat belt before operating

Steering should be checked to both right and left Brakes should be tested against engine power Clutch and transmission controls should be moved through or to neutral positions to assure disengagement Operate all controls to insure proper operation If any malfunctions are found, park machine, shut off engine, report and repair before using machine

If the power steering or the engine ceases operating, stop the machine motion as quickly as possible Lower equipment, set parking device and keep machine securely parked until the malfunction is corrected or the machine can be safety towed Never lift loads in excess of capacity

Should the machine become stuck or frozen to the ground, back out to avoid roll over

Know and understand the job site traffic flow patterns

Keep the machine in the same gear going down hill as used for going up hill

When roading a machine, know and use the signaling devices required on the machine Provide an escort for roading where required

Always use the recommended transport devices when roading the machine

Do not attempt repairs unless proper training has been provided

Use extreme caution when removing radiator caps, drain plugs, grease fittings or pressure taps Park the machine and let it cool down before opening a pressurized compartment

Release all pressure before working on systems which have an accumulator

When necessary to tow the machine, do not exceed the recommended towing speed, be sure the towing machine has sufficient braking capacity to stop the towed load If the towed machine cannot be braked, a tow bar must be used or two towing machines must be used - one in front pulling and one in the rear to retard Avoid towing over long distances

Observe proper maintenance and repair of all pivot pins, hydraulic cylinders, hoses, snap rings and main attaching bolts

Always keep the brakes and steering systems in good operating condition

Replace all missing, illegible or damaged safety signs Keep all safety signs clean

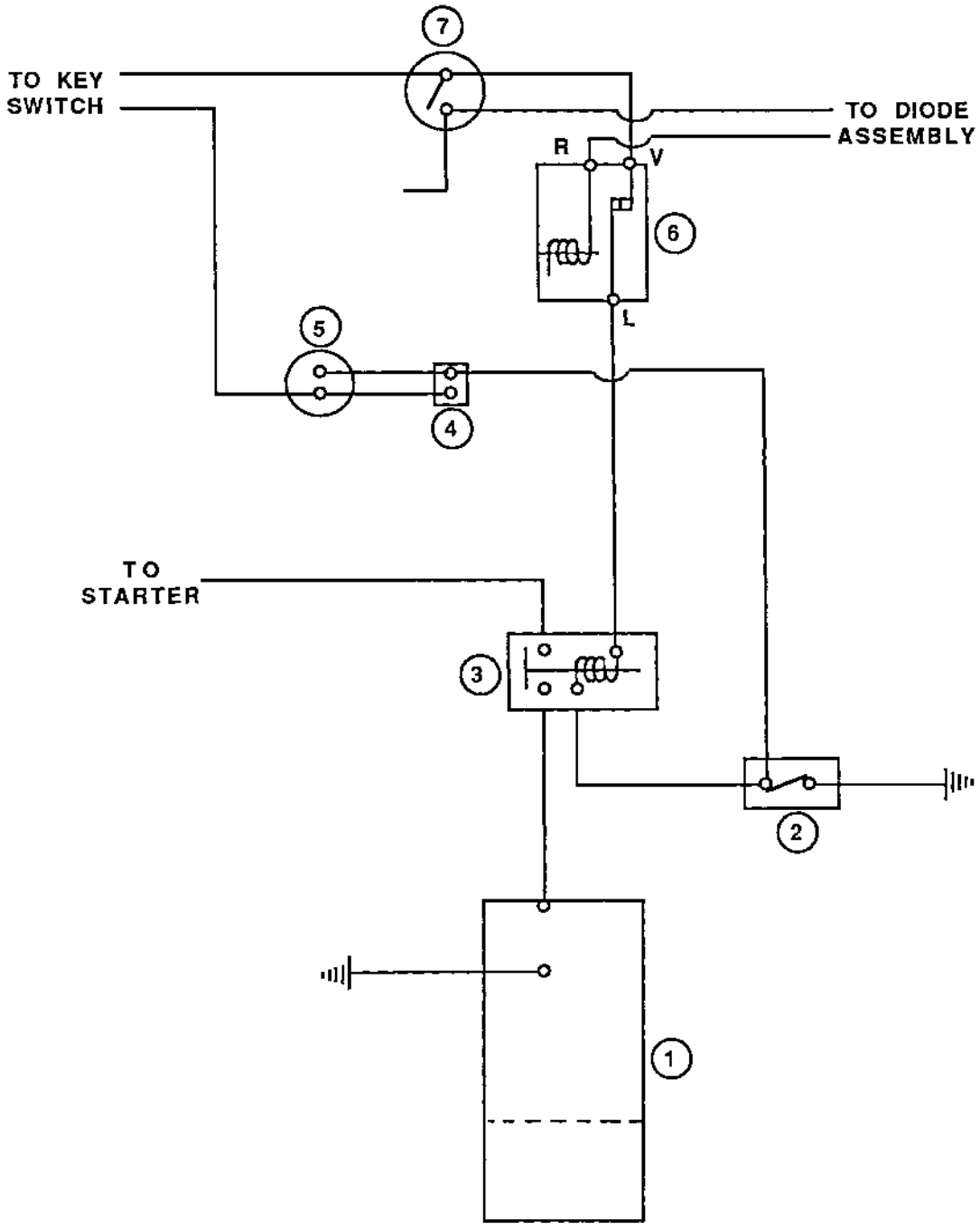
Do not fill the fuel tank to capacity Allow room for expansion

Wipe up spilled fuel immediately

Always tighten the fuel tank cap securely Should the fuel cap be lost, replace it only with the original manufacturers approved cap Use of a non-approved cap may result in overpressurization of the tank

Never drive the machine near open fires

Use the correct fuel grade for the operating season




T- 100363

*WIRING SCHEMATIC*
*(Second type)*

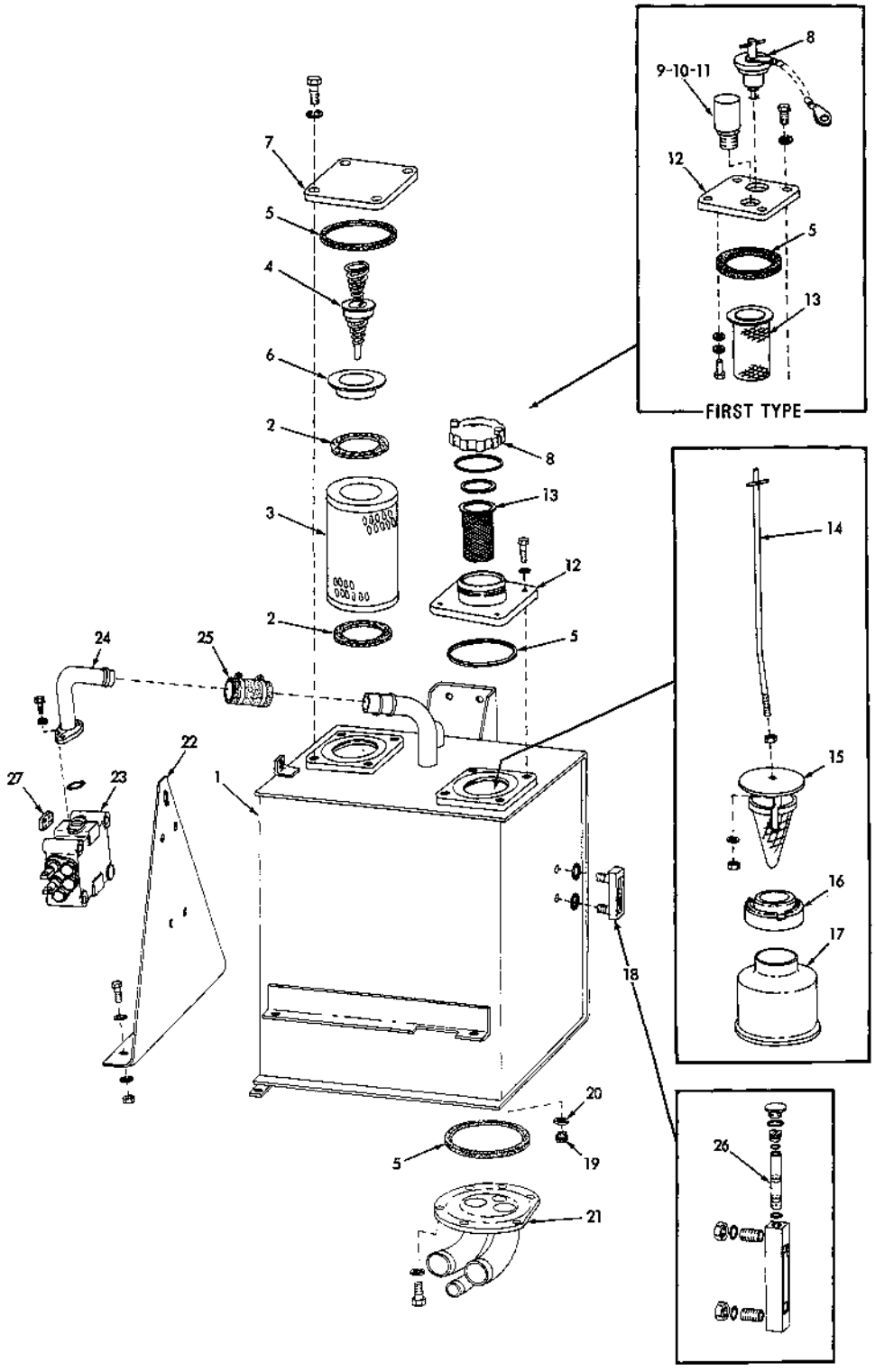



FIG. 13 HYDRAULIC TANK
645 (Effective with loader serial no. 2701); 645-B

(Legend on following page)

# TOPIC 4 POWER STEERING CYLINDERS

**DANGER**

There is insufficient clearance for personnel in the articulation point between frames. Stay clear when the engine is running. Support, using device provided when servicing. Return support to carry position and secure before moving machine.

**WARNING**

- Before moving machine or attachments be sure exposed people in the area are clear of the unit. Walk completely around machine before mounting. Sound horn.
- Warn all people who may be servicing or working around machine before starting engine.
- If engine is to be started indoors insure proper ventilation to remove deadly exhaust gases.
- Do not run the engine of this machine in closed areas without proper ventilation to remove deadly exhaust gases.
- Never attempt to operate machine or attachment except when seated in the operator's seat. Keep head, body, limbs, hands and feet inside the operator's compartment to reduce exposure to hazards outside the operator's compartment.

## 4.1 GENERAL

4.1.1
The double acting cylinders are located at the forward end of the rear frame below the floor plates. Rod ends of the cylinders are attached to the forward frame assembly and the tube ends are attached to the rear frame assembly. Depending upon direction of turn, oil under pressure is forced into the head end of one cylinder and the tube end of the other. The contracting cylinder pulls its two mounting points together and the extending cylinder pushes its two mounting points apart causing the articulation and turning of the loader. Hydraulic fluid from the steering cylinders is returned to the hydraulic tank.

## 4.2 REMOVAL – STEERING CYLINDERS ALL MODELS

4.2.1
Start engine. Articulate loader fully to the left if right hand steering cylinder is to be removed. Articulate loader fully to the right if left hand cylinder is to be removed. Stop engine.

4.2.2

**WARNING**

- Always set parking brake when leaving the machine for any reasons.
- Lock articulation with frame lock for servicing.

Set parking brake. Lock loader frames in articulated position with frame locking bar. Place blocks in front and behind all four tires to prevent unwanted movement of the loader.

4.2.3

**DANGER**

- Fluid under pressure. Always lower hydraulic equipment to ground. Shut off engine, move control levers to each position several times and loosen and retighten hydraulic tank filler caps to relieve trapped pressure before loosening hydraulic connections.
- Fluid under pressure. Turn cap or cover slowly to relieve pressure before removing.

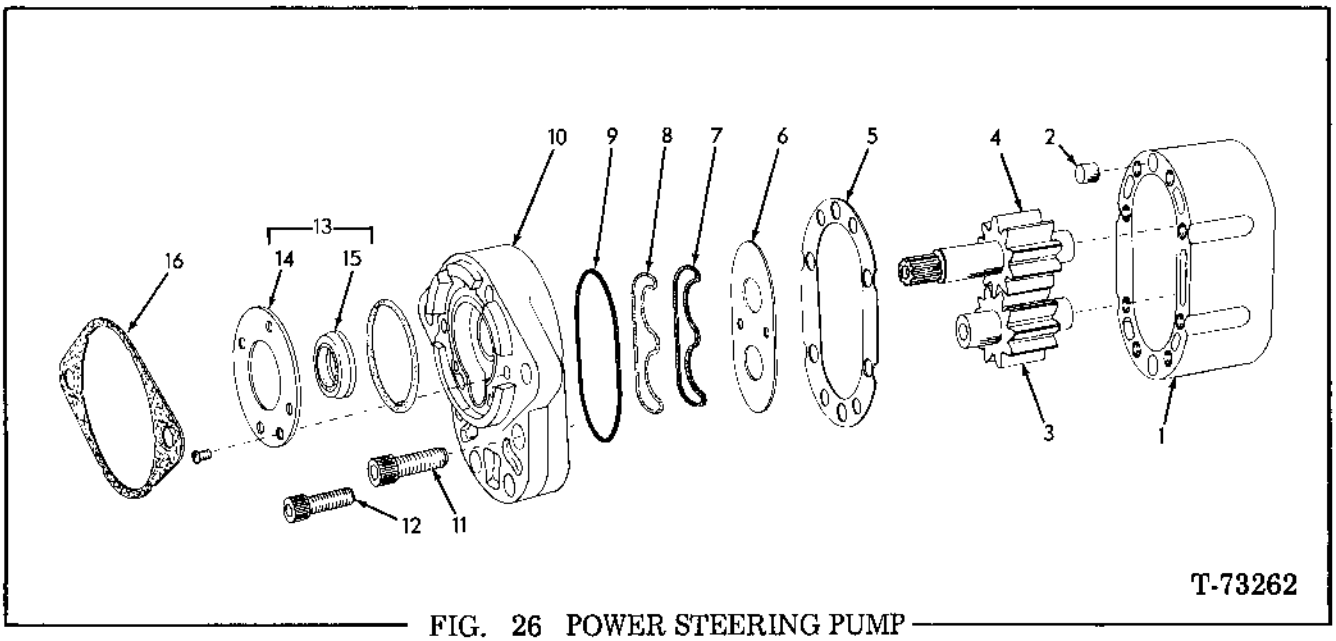



FIG. 26 POWER STEERING PUMP

USAGE: 545-B (Used on loader serial no's 21C04212 thru 21C04563 and 10L04451);
605-B (Used on loader serial no's 18Y04212 thru 18Y04587 and 38S04451).

1. Cover assy.
2. Dowel pin
3. Idler shaft and gear
4. Drive shaft and gear
5. Plate
6. Wear plate
7. Seal
8. Seal
9. Seal
10. Body assy.
11. Socket head capscrew
12. Socket head capscrew
13. Retainer assy.
14. Retainer
15. Oil seal
16. Gasket

NOTE: Never pry any of the parts apart since this will raise a burr and possibly prevent satisfactory assembly of pump.

5.3.8
If replacement is necessary, remove either or both upper or lower dowel pins (13) from pump body assembly (8) or end cover assembly (14).

5.3.9
Remove wear plate and seal (10 or 10a)and anti-extrusion block (9) from end cover assembly (14).

5.3.10
If it is necessary to remove either of the gears (11) and (12) from the end cover (14), mark the position of the gears in relation to each other.

5.4 DISASSEMBLY–

545-B (used on loader serial no's 21C04212 thru 21C04563 and 10L04451); 605-B (Used on loader serial no's 18Y04212 thru 18Y04587 and 38S04451).

5.4.1
Seal open ports of the power steering pump. Thoroughly clean exterior of the pump with a non-toxic, non-flammable cleaning solution and dry thoroughly. Scribe mark the end cover assembly (1), FIG. 26, and the body assembly (10) to facilitate assembly.

5.4.2
Remove three machine screws that secure retainer (14) to body assembly (10).

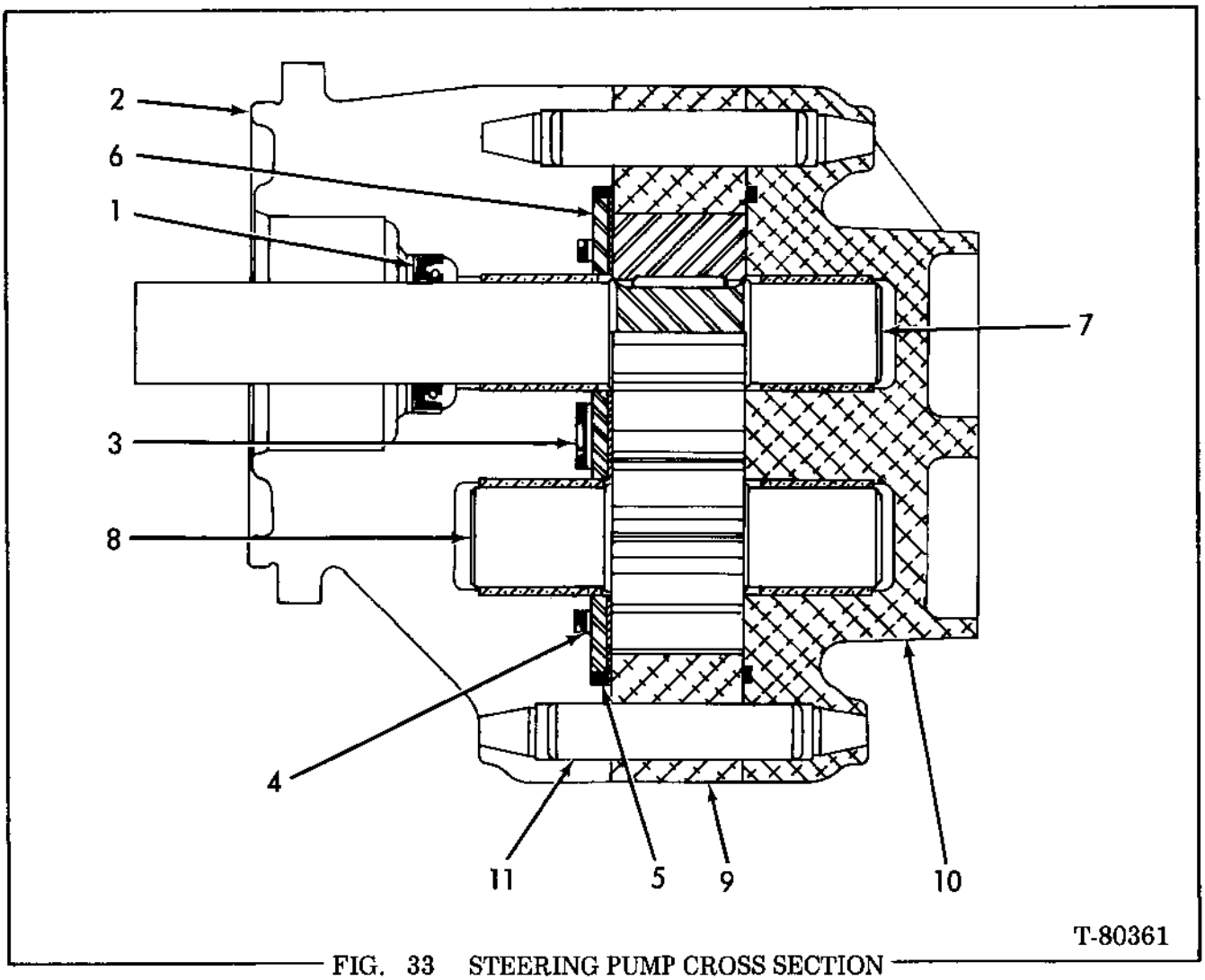



FIG. 33 STEERING PUMP CROSS SECTION

USAGE: 645 - used on loader serial no.s 2032 thru 2700.

1. Oil seal
2. Adapter
3. Ring (black)
4. Ring (tan)
5. Ring
6. Plate
7. Shaft assy.
8. Shaft
9. Housing
10. Cover
11. Pin

5.12.7
Install O-ring (7) around wear plate.

5.12.8
Install dowel pins (19) in housing (10) with an arbor press.

5.12.9
Install flat surface of housing (10) with dowel pins (19) onto adapter cover. Align exterior chalk mark or punch marks on adapter cover with exterior mark on housing. It may be necessary to tap housing into place with a soft-headed mallet.

5.12.10
Install splined end of drive gear (9) into adapter cover and carefully push splined end of drive gear through oil seal (1).

5.12.11
Install driven gear (20) shaft through wear plate (8) and into the bushing in adapter cover. Be certain to align marks on gears.

5.12.12
Install O-ring (11) into end cover (12) recess groove.

## POWER STEERING GEAR ASSEMBLY

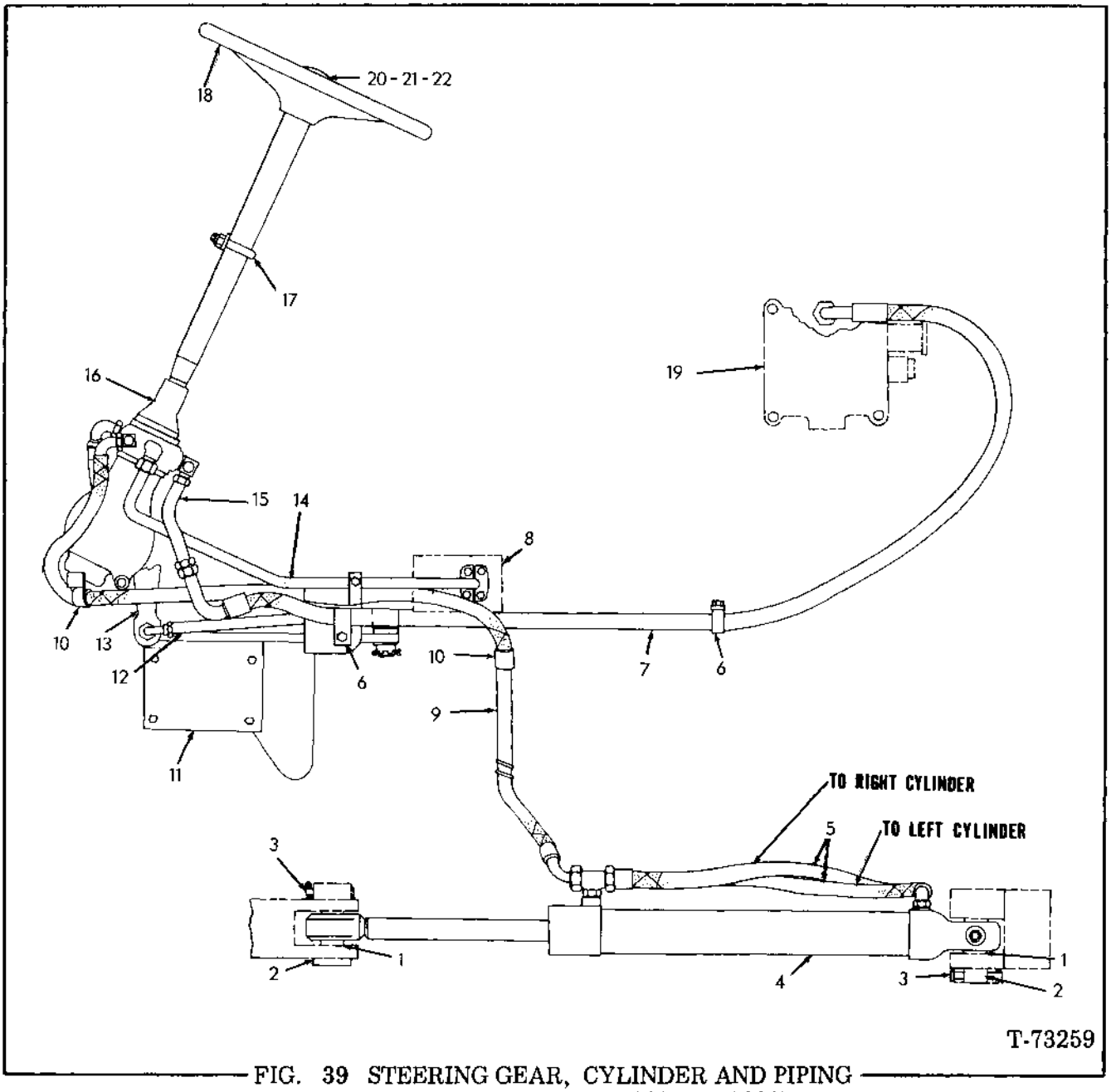
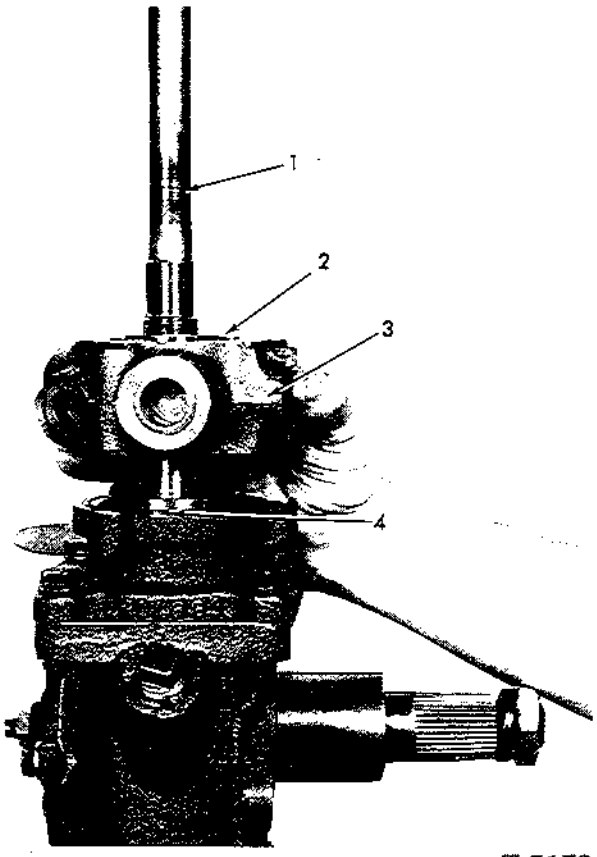



FIG. 39 STEERING GEAR, CYLINDER AND PIPING
545, 545H (Loader serial no. 2399 thru 3000)

1. Steering cylinder boss
2. Connecting cylinder pin
3. Locking pin
4. Steering cylinder assy.
5. Steering cylinder hose assy.
6. Hose supporting clip
7. Control valve to steering gear hose assy.
8. Demand valve
9. Steering cylinder to valve hose assy.
10. Hose supporting clip
11. Tie rod mounting bracket
12. Steering gear tie rod assy.
13. Pitman arm
14. Steering gear to demand valve tube assy
15. Tube assy.
16. Steering gear assy.
17. Steering gear U-bolt
18. Steering wheel
19. Control valve
20. Medallion
21. Spacer
22. Self-tapping capscrew

*Study SAFETY RULES, pages I thru III, thoroughly for the protection of personal and machine safety*




T-71764

FIG. 47 REMOVING VALVE HOUSING

1. Steering gear shaft assy.
2. Valve spool
3. Valve housing
4. Adapter assy. seal

NOTE: Be careful not to let ball nut sharply strike either end of the worm gear or ball guides will be damaged. If worm ball nut does not require disassembly, tape each end of shaft worm gear to prevent ball nut from rotating to either end.

6.4.25
Try action of the ball nut on the shaft worm gear. The ball nut must rotate smoothly with no evidence of binding or roughness. If there is evidence of roughness or damage, disassemble in the following manner: (Refer to FIG. 57).

6.4.26
Remove screws which attach ball guide clamp to ball nut.

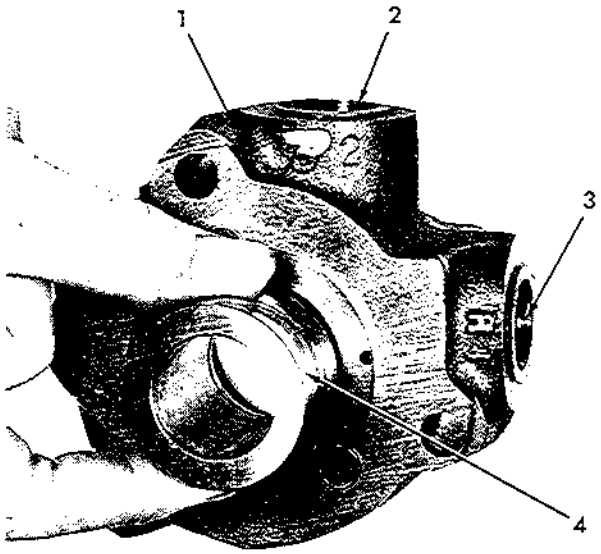



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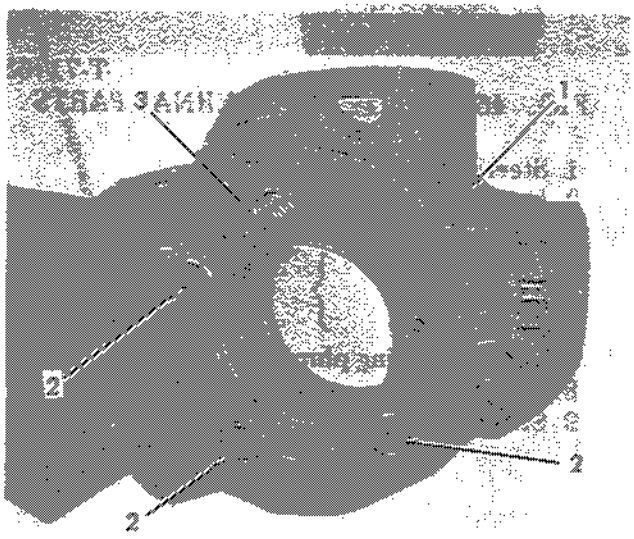
FIG. 48 REMOVING VALVE SPOOL FROM HOUSING

1. Valve housing
2. Pressure port
3. Return (to tank)
4. Valve spool




T-71766

FIG. 49 REMOVING VALVE CENTERING PLUNGERS AND CENTERING SPRINGS

1. Valve housing
2. Valve centering plunger
3. Centering spring

6.6.34
Carefully place valve housing over steering gear housing and lower the control valve into position on the adapter assembly. Be certain to align identification marks on valve housing with marks on adapter housing.

6.6.35
Coat plungers (12) and valve spool (48) with clean lubricant. Insert three of the plungers into each of the valve housing bores.

6.6.36
Insert three centering springs (13) into each of the valve housing bores.

6.6.37
Insert remaining plungers (14) into each of the valve housing bores.

6.6.38
Install spool (48) in valve housing (47) with groove, on I. D. of valve facing down toward valve adapter assembly (3).

NOTE: Do not force spool into the valve housing. When spool is properly aligned, it will drop into place. Forcing spool will damage both the spool and the valve bore.

6.6.39
Install large washer (groove up), bearing, and small washer (groove down) over steering gear shaft assembly and lower onto the valve housing.

6.6.40
Place valve spool spring preload over steering gear shaft assembly and lower on to previously installed washer.

6.6.41
Install a new bearing locknut on the threaded portion of the steering shaft.

6.6.42
Install three lockwashers (5) and capscrews (6) through holes in valve ring and tighten into threaded portion of adapter to prevent valve housing from turning and to compress springs.

6.6.43
Having installed a new locknut, grip steering wheel to prevent shaft from turning and tighten locknut to 20 - 30 lb-ft (2.7 - 4.1 kg-m). Back the nut off about 1/4 turn and stake nut to groove in shaft.

NOTE: Support the shaft from the opposite side of the groove while staking the nut in order to prevent damage to the shaft.

6.6.44
Install a new bearing seal (17 and 25) in the lower and upper steering jacket assembly. Do not allow the seals to bottom out in bores.

6.6.45
Install a new O-ring seal (19) in recess groove of steering jacket cover assembly (22).

NOTE: Place a protective coating over the splined end of the steering gear shaft to protect the seal in the cover assembly.

6.6.46
Install steering cover jacket assembly over steering gear shaft (46).

6.6.47
Secure cover assembly (22) and valve housing (47) assemblies to adapter (3) with the tree lockwashers (23) and bolts (24).

6.6.48
Remove the filler plug (41) and insert 1.5 lbs. (.7 kgs) of a lithium soap base grease, No. 1 grade consistency.

6.6.49
Install filler plug and tighten securely.

## 6.7 INSTALLATION

6.7.1
To install the steering gear assembly, reverse procedure used for the removal.

# TOPIC 8 DEMAND VALVE

**DANGER**

- Fluid under pressure. Always lower hydraulic equipment to ground. Shut off engine, move control levers to each position several times and loosen and retighten hydraulic tank filler caps to relieve trapped pressure before loosening hydraulic connections.
- Fluid under pressure. Turn cap or cover slowly to relieve pressure before removing.

**WARNING**

- DO NOT USE HANDS to search for pressure leaks. Fluid escaping under high pressure can penetrate skin.
- Always set parking brake when leaving the machine for any reasons.
- Lock articulation with frame lock for servicing.

## 8.1 GENERAL

8.1.1
At engine speeds below 1500 rpm, flow output of the power steering pump is insufficient for the full requirement of the power steering system. The function of the demand valve is to divert a portion of the flow from one pump in the tandem hydraulic pump to the power steering system to provide the additional flow volume necessary for smooth, easy steering. As engine speed increases, the power steering pump supplies more volume. At 1900 rpm the power steering pump flow output is adequate by itself to supply the requirements of the steering system, allowing the demand valve to divert all the flow output from the tandem hydraulic pump to the loader hydraulic control valve.

In addition to the flow dividing function of the demand valve, early valves contained an integral relief valve (6), FIG. 63, for steering system pressure relief. On later serial number machines, the steering system relief valve was eliminated from the demand valve and mounted remotely under the operator's platform.

8.1.2
Although demand valves for various wheel loaders perform the same function, there are different designs. Servicing procedures for valves are described separately for this reason.

## 8.11 ASSEMBLY AND INSTALLATION OF STEERING SYSTEM RELIEF VALVE

(545, 545H – Effective with loader serial no. 3001; 645—Effective with loader serial no. 2032; 545-B, 605-B; 645-B).

8.11.1
Install two plugs with new O-rings in body (10), FIG. 77.

8.11.2
Lubricate all internal parts with clean hydraulic oil prior to assembly. Be sure to use new O-rings and seals for assembly.

8.11.3
Install poppet seat (9), relief poppet assembly (8),large spring (7), pilot seat (6), pilot plunger (5), and pilot spring (4) in valve body (10).

8.11.4
Place a new O-ring and back-up ring on cap (2), tightening adjusting screw (3) to position previously marked by paint.

8.11.5
Install seal, jam nut, seal, and acorn nut (1) on adjusting screw.

8.11.6
Install relief valve in a reversal of the procedure used for removal. Check and adjust the hydraulic tank oil level. Refer to the Operation and Maintenance Instruction Manual.

## 9.11 STEERING VALVE INTERNAL LEAKAGE TEST– All Models

9.11.1
Remove the cover plates that cover the steering valve at the base of the steering column. Disconnect the tube that connects the steering valve to the hydraulic tank at the steering valve end. Plug the disconnected end of the tube. Rotate the elbow fitting in the steering valve upwards and connect one end of the flow meter to the elbow. Add hose to the other end of the flow meter and run the hose to the filler opening in the top of the hydraulic tank. Secure the loose end of the hose. Remove the filer opening strainer from the hydraulic oil tank to prevent splash back from the flow meter outlet hose.

9.11.2

> **⚠ WARNING**
>
> Lock articulation with frame lock for servicing.

Install the frame locking bar with the loader in the straight ahead positon.

9.11.3
IMPORTANT: Make sure the flow meter load valve is in the no load, wide open position before starting the engine.

Operate engine until hydraulic oil temperature stabilizes at 175 - 185 F. (79 - 85 C.).

9.11.4
With the engine at low idle, hold the steering wheel against the left stop and then against the right stop. This will cause the steering relief valve to open. Do not hold wheel for more than twenty seconds against either stop to avoid overheating the hydraulic oil.

9.11.5
Observe the flow meter reading during both tests. If the reading exceeds 1.5 gpm (5.6 lit/min) on either test, there is excessive leakage in the steering valve or steering cylinders or both.

9.11.6
Disconnect, at the steering valve, the two hose assemblies that lead from the steering valve to the steering cylinders. Cap the two open ports at the steering valve.

9.11.7
Disconnect and cap the two hose assemblies that lead from the steering valve to the steering cylinders at the steering valve. Cap the two open ports at the steering valve.

9.11.8
Perform the same tests as outlined in paragraphs 9.11.4 and 9.11.5 above. If the flow meter reading still exceeds the 1.5 gpm (5.6 lit/min) maximum rate, then rebuild or replace the steering valve.

9.11.9
After repairing and replacing the steering valve, reconnect all hoses. Refill the hydraulic tank to the proper level as specified in the Operation and Maintenance Instruction Manual.

## 9.12 STEERING RELIEF VALVE OPENING PRESSURE TEST
**(All models except 545, 545H original equipment prior to loader serial no. 2399)**

9.12.1
Machines with relief valve in demand valve; Disconnect the relief valve drain line (connecting the demand valve and the hydraulic tank) at its most accessible end.

NOTE: Disconnecting this line will cause oil to drain from the hydraulic tank so the disconnected end of the line must be capped as quickly as possible. (The elbow in the hydraulic tank of both models can be capped with cap 70921244 for flared 0.75 in. (19.0 mm) tube fittings; a cap must be fabricated for flanged end. Run a line from the relief valve drain line port on the demand valve to the opened top of the hydraulic tank using additional 0.75 in. (19.0 mm) hose.

## ALPHABETICAL INDEX



*Study SAFETY RULES, pages I thru III, thoroughly for the protection of personal and machine safety*

# TABLE OF CONTENTS

# TOPIC 1 GENERAL

## 1.1 SCOPE OF MANUAL

This manual covers the function and service procedures for the Model 545, 545H, 545-B, 605-B, 645-B, 745, 745H, 745-B, 745H-B and 745-C wheel loader, bucket hydraulic systems. This manual is in effect upon receipt and supersedes Form 73059681.

The text within this manual is arranged under primary Topic headings for ease of access to specific types of information. The basic information contained within each Topic is as follows:

TOPIC 2 - Contains hydraulic oil specifications, system oil capacity, pump volume and the main and overload relief valve pressure requirements.

TOPIC 3 - Provides a brief functional description of each major component within the bucket hydraulic system. The flow paths through each circuit of a typical hydraulic system are also provided, based on a simplified diagram.

TOPIC 4 - Contains a description and use of a flow meter and a pressure gauge. Instructions for the fabrication of special hydraulic fittings used with these instruments are also provided. The troubleshooting procedure consists of a complete system flow test and a circuit-by-circuit analysis of that test. Step-by-step instructions are also included for the adjustment of all relief valves.

TOPIC 5 - Contains instructions for repair of the tandem hydraulic pump.

TOPIC 6 - Contains instructions for repair of thirty different control valves. To prevent repetition, the repair procedure for different types of spools and valves is provided once. Table 6.2 is an index to these repair procedures. This table lists all thirty control valves by their Fiat-Allis part number and the paragraph number of the repair procedure for each different type of spool and valve contained in each assembly. Repair procedures for components of the electrical and hydraulic boom kick-out, and bucket leveler, circuits are also contained in this Topic.

TOPIC 7 - Contains instructions for the overhaul and repair of the various types of dump, lift and clam cylinders, and the clam circuit overload relief valve.

TOPIC 8 - Consists of general service instructions for the proper installation of various hydraulic flanges, fittings and hoses.

TOPIC 9 - Lists the Fiat-Allis part number of special tools and fittings required for service of the bucket hydraulic system.

TOPIC 10 - Lists the special torque values used throughout the procedures in this manual. Also listed are standard torque values for hydraulic flange capscrews and Grade 8 capscrews (NC and NF).

| | |
|---|---|
| 545, 545H | 2575-2625 rpm |
| 545-B, 605-B | 2500-2640 rpm |
| 645 | 2375-2425 rpm |
| 645-B | 2360-2480 rpm |
| 745, 745H | 2350-2450 rpm |
| 745-B, 745H-B | 2350-2450 rpm |
| 745-C | 2350-2450 rpm |

4.4.1.3
With service brakes and parking brake fully applied, place transmission control lever in high forward, gradually increase engine rpm to full throttle. Decrease engine speed and return transmission lever to neutral. The rpm obtained at full throttle in this manner is known as the converter stall speed.

Specified converter stall speeds are listed below. If specified converter stall speed cannot be attained, troubleshoot engine and/or torque converter and transmission before proceeding.

| | |
|---|---|
| 545, 545H | 2400-2500 rpm |
| 545-B | 2400-2500 rpm |
| 605-B | 2425-2525 rpm |
| 645 | 2250-2325 rpm |
| 645-B | 2225-2325 rpm |
| 745, 745H | 2225-2325 rpm |
| 745-B, 745H-B | 2225-2325 rpm |
| 745C | 2225-2325 rpm |

4.4.2 CHECK HYDRAULIC OIL LEVEL

Check the oil level of the hydraulic system. The oil must be visable about midway in the sight gauge.

4.4.3 CHECK CONDITION OF HYDRAULIC OIL

Check the hydraulic oil for foaming. If foaming is present, check all suction lines for leaks. Make certain that all clamps are tight. If the suction lines are alright, replace the oil with a non-foaming oil that meets specifications. Foaming will cause erratic operation of all implements and shorten pump life.

4.4.4 CHECK FILTER AND CONTAMINENT SEPARATORS

Replace the filter and clean contaminant separator, screens and magnets in the hydraulic tank. Refer to the Operation and Maintenance Instruction Manual for replacement and cleaning procedures.

## 4.5 FLOW TESTING THE HYDRAULIC SYSTEM

4.5.1 TEST CONNECTIONS

4.5.1.1
Provisions are not built into the wheel loaders for flow meter test connections. On the 545 and 605 series loaders, a TEE fitting (part No. 70925836) can be installed, at the control valve, in either the hydraulic line between the pump and the control valve, or in the line between the demand valve and the control valve. On the 645 and 745 series loaders a Flow Test Block will have to be fabricated in accordance with Fig. 3. The Flow Test Block can be installed in either of the same two hydraulic lines, at the pump, the control valve, or at the demand valve, whichever is most convenient. When installing the Flow Test Block, use O-rings and 7/16"NC x 2-3/4" capscrews.

**⚠ DANGER**

Fluid under pressure. Always lower hydraulic equipment to ground. Shut off engine, move control levers to each position several times and loosen and retighten hydraulic tank filler cap to relieve trapped pressure before loosening hydraulic connections.

4.5.1.2
Relieve hydraulic pressure and install the TEE fitting, or Flow Test Block, per paragraph 4.5.1.1.

make the required adjustment to the overload relief valve and repeat paragraph 4.6.6.3. If the correct pressure cannot be obtained by adjustment, refer to Topic 6 for the valve repair procedure.

4.6.6.5
Shut off the engine, relieve hydraulic pressure and disconnect the pressure gauge.

## 4.6.7 PRESSURE TESTING THE CLAM "OPEN" CIRCUIT OVERLOAD RELIEF VALVE

4.6.7.1
Make certain the pressure gauge is connected per instructions in paragraphs 4.6.1.2 and 4.6.1.3.

**⚠ WARNING**

⚠ Before moving machine or attachments be sure exposed people in the area are clear of the machine. Walk completely around machine before mounting. Sound horn.

⚠ Never attempt to operate machine or attachment except when seated in the operator's seat. Keep head, body, limbs, hands and feet inside the operator's compartment to reduce exposure to hazards outside the operator's compartment.

⚠ Warn all people who may be servicing or working around machine before starting engine.

⚠ Do not run the engine of this machine in closed areas without proper ventilation to remove deadly exhaust gases.

**⚠ WARNING**

⚠ Keep people clear of attachments and tools while in raised position, to prevent possible injury.

⚠ Observe all start up and shut down procedures and ⚠ WARNINGS listed in the Operation and Maintenance Instruction Manual.

4.6.7.2
Start the engine and set to low idle. Allow the temperature of the hydraulic oil to reach approximately 71°C (160°F).

4.6.7.3
Open the clam to the bull-doze position. With control in hold, attempt to close the clam by pushing it against a wall or similar object that cannot be moved. Read the pressure gauge as the clam closes.

4.6.7.4
If the pressure gauge reading is not between 148.2 -- 151.1 bar (151.1 -- 158.2 kg/cm$^2$)(2150 -- 2250 psi) adjust the relief valve as follows:

4.6.7.5
Refer to Topic 7, Fig. 66, and remove cap (20) from the valve. Turn adjusting screw (18) clockwise to increase the pressure setting or counterclockwise to decrease the pressure setting. Repeat paragraphs 4.6.7.3 and 4.6.7.5 until the correct setting is obtained and replace cap (20). If the correct pressure cannot be obtained by adjustment, refer to Topic 7 for the valve repair procedure.

4.6.7.6
Shut off the engine, relieve hydraulic pressure and disconnect the pressure gauge.

# TOPIC 6 HYDRAULIC CONTROL VALVE REPAIR

## 6.1 GENERAL

6.1.1
The hydraulic control valve enables the loader operator to direct a flow of hydraulic oil to the work units (cylinders) of the loader. The standard control valve includes two operating spools. One spool controls the bucket circuit and the other spool controls the boom circuit. In addition, the control valve includes an adjustable main relief valve, load check valves, make-up valves and overload relief valves. An optional three spool control valve, contains an additional auxiliary spool (for control of the clam circuit) and two load check valves.

6.1.2
This Topic contains the repair procedures for thirty (30) different control valves used in the various models of wheel loaders. Each control valve is identified by a Fiat-Allis part number stamped on the valve name plate. This part number MUST BE USED to determine which of the procedures to follow in the repair of the valve, see paragraph 6.4.2.

## 6.2 CONTROL VALVE REMOVAL

6.2.1
Drain the hydraulic tank (refer to the applicable Operation and Maintenance Instruction Manual).

**⚠ WARNING**

Never use gasoline, solvent or other flammable fluids to clean parts. See Operation and Maintenance Instruction Manual.

6.2.2
Prior to valve removal, thoroughly clean the exterior of the control valve and all fittings with a non-flammable, non-toxic cleaning solution.

NOTE: If the electrical boom kick-out and/or bucket leveler feature is included, disconnect the wiring at the control valve.

**⚠ DANGER**

Fluid under pressure. Always lower hydraulic equipment to ground. Shut off engine, move control levers to each position several times and loosen and retighten hydraulic tank filler cap to relieve trapped pressure before loosening hydraulic connections.

6.2.3
Relieve hydraulic pressure. Disconnect the control rods, hoses and tube assemblies and remove the control valve from the loader. Cap all hoses and tube assemblies to prevent dirt from entering the hydraulic system.

6.2.4
Disassembly of the control valve should be performed in clean surroundings. Interchangeable parts such as poppets and poppet seats should be tagged so they may be returned to their original locations during assembly. Interchanging of such parts may result in improper seating, sticking or leakage.

## 6.3 CONTROL VALVE INSTALLATION

6.3.1
Position the control valve on the loader, install the mounting capscrews (or nuts) and tighten securely.

6.3.2
Using new O-rings, connect all hoses and hydraulic tube assemblies to the control valve. Tighten the flange capscrews to the following torques.

6.7.3.7
Install seals (19) into the inner bore of retainer (18) and O-ring (17) over the threaded end of the retainer. Carefully install the retainer and seal assembly over the eye end of the spool and tighten securely in the valve body.

## 6.8 BOOM SPOOL (TYPE 6)

6.8.1 DISASSEMBLY

6.8.1.1
Fig. 15. Unscrew plug (1) and remove washer (2) and detent spring (3).

6.8.1.2
Unscrew and pull cap (8) away from the valve body. Remove detent cam (4) balls (5) and washer (6) from inside the cap.

6.8.1.3
Unscrew and remove detent stud (7) with retainer (9) spring (10) and spacer (11).

6.8.1.4
Carefully withdraw spool (16) from the valve body. Remove retainer (12) O-ring (13) retainer (14) and O-ring (15) from the recess in the detent side of the valve body. DO NOT remove spool eye (19) unless leakage has been detected at O-ring (18).

6.8.1.5
Unscrew and remove retainer (21) from the opposite side of the body bore. Remove O-rings (20) and (22) and seal (23) from the retainer. Remove wear sleeve (17) from the body bore.

6.8.2 INSPECTION - Refer to paragraph 6.31

6.8.3 ASSEMBLY

6.8.3.1
Refer to Fig. 15. If spool eye (19) was removed, clean the tapped hole in spool (16) and the threads on the eye with an oil free solvent. Install O-ring (18) on the eye and apply "Loctite", Type D, sealant to the threads on the eye. Clamp the spool in a soft jawed vise; install the eye in the spool and tighten securely.

6.8.3.2
Install wear sleeve (17) into the end of the body bore. Carefully insert spool (16) into the body bore, using a slight rotary motion.

6.8.3.3
At the opposite end of the bore, install O-ring (15) retainer (14) O-ring (13) and retainer (12) into the recess in the valve body.

6.8.3.4
Clean the tapped hole in the end of the spool and the threaded end of detent stud (6) with an oil free solvent. Apply "Loctite", Type D, sealant to the threads on the detent stud. Place retainer (9) spring (10) and spacer (11) over the end of the spool. Compress the spring assembly; install the detent stud and tighten securely. Install cap (7) over the detent stud and tighten securely in the valve body.

6.8.3.5
Position the valve with the detent end of the spool facing up. Install washer (6) over the detent stud and drop balls (5) into place against the washer.

6.8.3.6
Install detent cam (4) spring (3) washer (2) and plug (1). Tighten the plug securely.

6.8.3.7
Install seal (23) and O-ring (22) into the inner bore of retainer (21) and install O-ring (20) over the threaded end of the retainer. Carefully install the retainer and seal assembly over the eye end of the spool and tighten securely in the valve body.

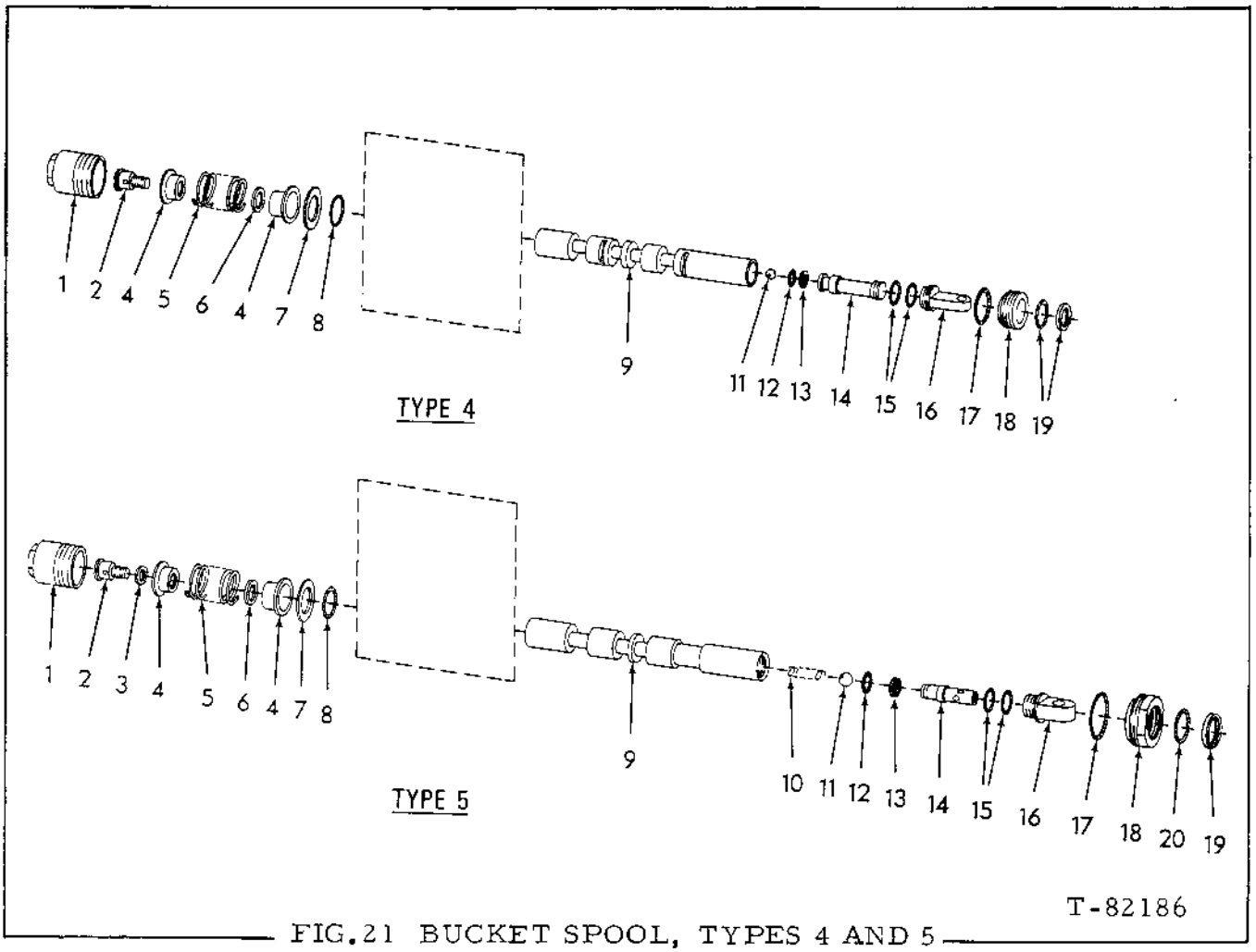



FIG. 21 BUCKET SPOOL, TYPES 4 AND 5

| TYPE 4 | TYPE 5 |
|---|---|
| 73050444 - 73054530 | 73043547 |
| 73050445 - 73058205 | 73047504 |
| 73054529 - 73058206 | |

LEGEND FOR FIG. 21

1. Spring cap
2. Spool end
3. Snap ring
4. Spring retainer
5. Return spring
6. Washer
7. Retainer
8. O-ring
9. Spool
10. Return spring
11. Ball check
12. O-ring
13. Back-up ring
14. Seat
15. O-ring
16. Spool eye
17. O-ring
18. Retainer
19. Seal
20. O-ring

6.13.3.2
Reposition the spool in the vise, eye end up. If used, install spring guide (14) ball check return spring (13) and ball check (12) in the end of the spool.

6.13.3.3
Clean the tapped hole in the spool and the threads on spool eye (1) with an oil free solvent. Install O-ring (2) back-up ring (3) and O-ring (4) on the spool

6.18.3.6
Place retainer (14) and O-ring (13) over the eye end of the spool and slide down against spring retainer (15).

6.18.3.7
Carefully insert the spool assembly into the body bore, using a slight rotary motion. Check that O-ring (13) and retainer (14) are firmly seated, install detent cover (22) and tighten securely in the valve body.

6.18.3.8
Install seal (2) and O-ring (1) into the inner bore of retainer (3) and install O-ring (4) over the threaded end of the retainer. Carefully install the retainer assembly over the eye end of the spool and tighten securely in the valve body.

6.18.3.9
Apply a small amount of grease to the small holes in the ball retainer portion of detent cover (22). Place the detent balls in the retainer holes and install detent cam (24).

6.18.3.10
Slide solenoid plunger (25) over the ball retainer as far as it will go and place detent spring (26) on the plunger.

6.18.3.11
Install back-up washer (30) coil (31) and plunger stop (32) with O-ring (33) into the end of coil housing (29) and secure with snap ring (34). Make certain the snap ring is firmly seated in its groove.

6.18.3.12
Install O-ring (27) in the other end of the coil housing and place the housing assembly over detent plunger (25). Screw the coil housing onto detent cover (22) until it is solid against the cover.

IMPORTANT: Unscrew the coil housing two (2) full turns and tighten set screws (28). This is done to establish the proper coil gap and is not an adjustment of detent force.

## 6.19 AUXILIARY SPOOL (TYPES 1 AND 2)

NOTE: The two types of auxiliary spools covered in this paragraph differ primarily in the areas of snap ring or washer (11) and screw (12), see Fig. 26.

6.19.1 DISASSEMBLY

6.19.1.1
Refer to Fig. 26. Remove the screws and washers holding cover (13) to the valve body.

6.19.1.2
Grasp the spring end of the spool and carefully withdraw the spool from the valve body. Remove retainer (8) and O-ring (7).

6.19.1.3
Clamp the spool in a soft jawed vise with the spring end of the spool up. Compress return spring (10) and remove snap ring (11) or screw (12), whichever is used. Remove spring retainers (9) return spring (10) and (if used) washer (11).

6.19.1.4
Remove the screws and washers holding retainer (1) to the valve body. Remove the retainer, wiper (2) and seal (3).

6.19.2 INSPECTION - Refer to paragraph 6.31

6,19.3 ASSEMBLY

6.19.3.1
Fig. 26. Clamp the spool in a soft jawed vise with the spring end of the spool up. If screw (12) is used, clean the tapped hole in the end of the spool and the threads on the screw with an oil free solvent. Apply "Loctite", Type D, sealant to the threads on the screw. Position spring retainer (9) return spring (10) and spring retainer

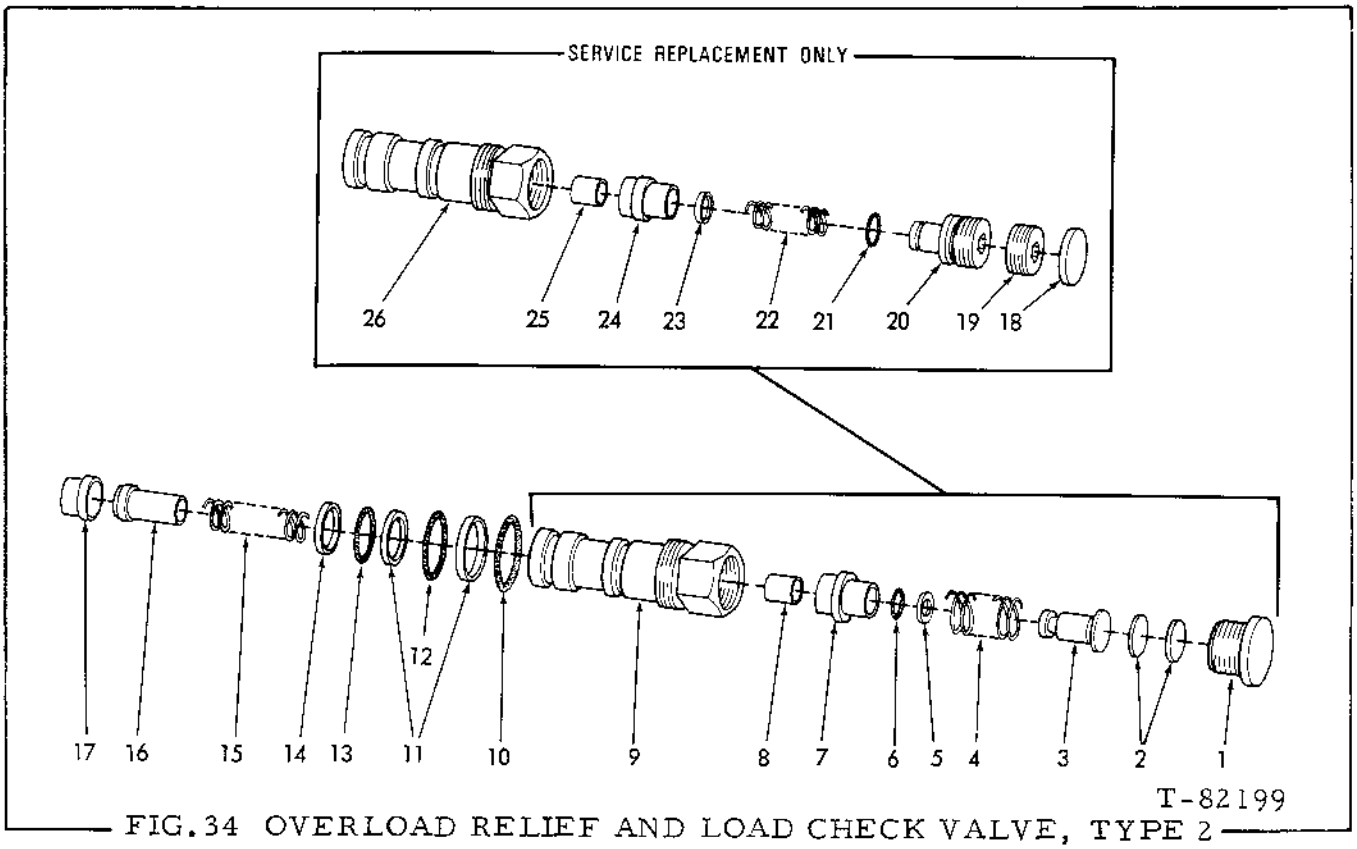



FIG. 34 OVERLOAD RELIEF AND LOAD CHECK VALVE, TYPE 2

1. Plug
2. Shim(s)
3. Spring guide
4. Spring
5. Back-up ring
6. O-ring
7. Poppet
8. Seat
9. Valve cap
10. O-ring
11. Back-up ring
12. O-ring
13. O-ring
14. Back-up ring
15. Spring
16. Poppet
17. Seat
18. Expansion plug
19. Locking nut
20. Spring guide
21. Back-up ring
22. Spring
23. O-ring
24. Poppet
25. Seat
26. Valve cap

the body bore. A soft wire hook with smooth ends may be used for this purpose. Do Not remove poppet seat (17).

6.27.1.2
Remove O-rings and back-up rings (10) through (14) from valve cap (9).

6.27.1.3
If valve has not been modified with service replacement parts, proceed as follows: Remove plug (1) shims (2) and spring guide (3) from the end of valve cap (9). Remove back-up ring (5) and O-ring (6) from the spring guide.

6.27.1.4
Remove spring (4) and poppet (7) from the bore of valve cap (9). Do Not remove poppet seat (8).

6.27.1.5
If the valve has been modified with service replacement parts, proceed as follows: Remove expansion plug (18) from the end of valve cap (26). Unscrew and remove locking nut (19) and spring guide (20). Remove O-ring (23) and back-up ring (21) from the spring guide.

6.27.1.6
Remove spring (22) and poppet (24)

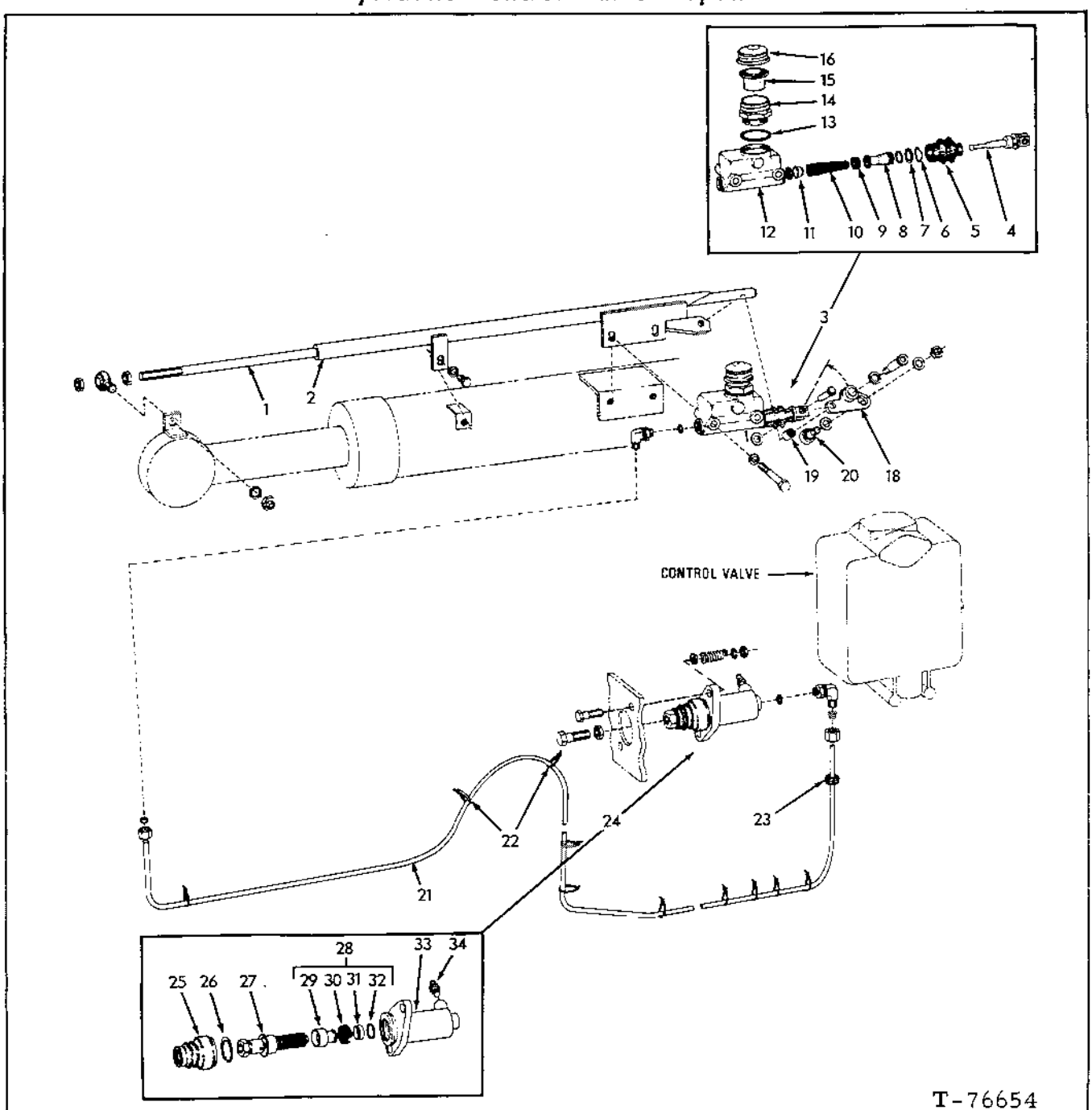



FIG. 43 HYDRAULIC BUCKET LEVELER

1. Rod
2. Tube Assy.
3. Master cylinder
4. Push rod
5. Boot
6. Lockwire
7. Plate
8. Piston Assy.
9. Cup
10. Spring Assy.
11. Valve Assy.
12. Master cylinder housing
13. Gasket
14. Adapter
15. Diaphragm
16. Cap
17. Pin
18. Bell crank Assy.
19. Bearing
20. Follower
21. Tube
22. Clip
23. Channel
24. Slave cylinder Assy.
25. Boot
26. Ring
27. Rod Assy.
28. Piston Assy.
29. Piston
30. Cup
31. Retainer
32. Ring
33. Housing
34. Screw

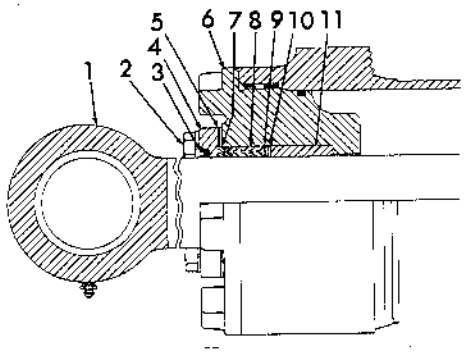



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FIG. 52 TYPE 2 PISTON ROD PACKING

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FIG. 53 REMOVING TYPE 2 ROD PACKING SHIM

1. Piston rod
2. Capscrew
3. Wiper seal
4. End plate
5. Shims
6. Cylinder head
*7. Washer (aluminum)
8. Packing
9. Back-up washer (steel)
10. Wave spring
*11. Bushing

*May not be used

toward the rear of the cylinder. Stagger the ring gaps so that no two are adjacent and ensure the edges are not overlapped or doubled back.

7.4.1.7
Slide the rod packing bearing and end plate (4) into position in the cylinder head and install the attaching capscrews. Tighten the capscrews evenly and alternately, using slight pressure on a short wrench. DO NOT OVER TIGHTEN! Lock the capscrews with the locking wire.

## 7.4.2 TYPE 2 CYLINDERS

NOTE: The rod packing set, contained in the cylinder head, Fig. 52, consists of a set of multi-lip packing rings, a wave spring, and a back-up washer. The packing is properly adjusted when a light film of oil is evident on the piston rod (a dry rod causes rapid wear of packing). Shims (5) between end plate (4) and cylinder head (6) provide the means of adjustment.

**⚠ DANGER**

Fluid under pressure. Always lower hydraulic equipment to ground. Shut off engine, move control levers to each position several times and loosen and retighten hydraulic tank filler cap to relieve trapped pressure before loosening hydraulic connections.

7.4.2.1
Relieve hydraulic pressure. Refer to Fig. 52 and remove capscrews (2) securing end plate (4). Slide the end plate down the piston rod and remove one shim (5) Fig. 53.

7.4.2.2
Reassemble the end plate to the cylinder head. If leakage persists, remove one more shim. If leakage still presists after all shims have been removed, replace the packing assembly and install four new shims.

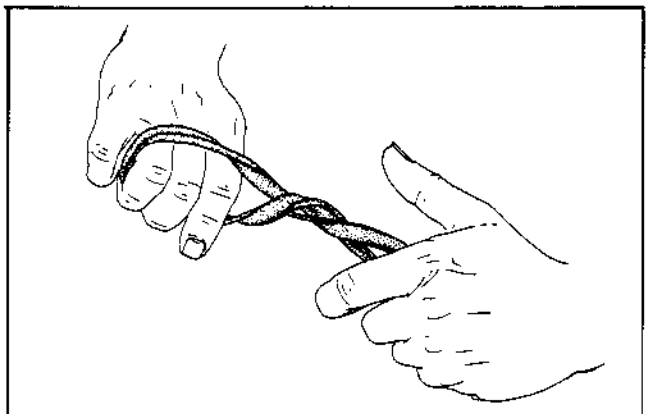
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FIG. 64 TWISTING TEFLON RING

7.6.3.6
Fig. 63. Install rubber seal ring (7) in the narrow groove in piston (6). Teflon seal ring (8) may be difficult to install. To make it more pliable, twist the ring as shown in Fig. 64, and then install the Teflon ring over the rubber ring, as shown in Fig. 65. In a few minutes the Teflon ring will be back to its original shape. Refer to Fig. 63, and install wear ring (5) into the wide groove in the piston.

7.6.3.7
Clamp piston rod (9) in a vise, Fig. 55.

7.6.3.8
Install the piston assembly and spacer (4) on the piston rod. Lubricate the threads on the end of the piston rod and install rod nut (3). Tighten the rod nut to the following torque:

| Cylinder Type | | daNm | kgm | lbs. ft. |
|---|---|---|---|---|
| 545 / 605 | Dump | 189.8-203.4 | 193.6-207.5 | 1400-1500 |
| | Lift | 264.4-291.5 | 269.6-297.3 | 1950-2150 |
| 645 | Dump | 264.4-291.5 | 269.6-297.3 | 1950-2150 |
| | Lift | 264.4-291.5 | 269.6-297.3 | 1950-2150 |
| 745 | Dump | 264.4-291.5 | 269.6-297.3 | 1950-2150 |
| | Lift | 261-277.8 | 266.2-283.5 | 1925-2050 |

7.6.3.9
Make certain the cylinder tube is clean and lubricated. Refer to Fig. 61, and install piston packing guide (1) and packing plug (2) (if applicable) in the cylinder. This is to prevent damage to the piston seal rings on the cylinder tube threads and the Teflon seal in the oil port bore during installation of the piston assembly.

NOTE: If a piston packing guide is not available, shim stock can be wrapped around the piston for protection while inserting the piston into the cylinder tube.

7.6.3.10
Lubricate the piston, and carefully insert the piston rod assembly into the cylinder tube. The assembly must be installed straight.

NOTE: If the cylinder is still mounted on the loader, the hydraulic line on the rear portion of the cylinder may have to be loosened to relieve air compressed in the cylinder as the piston is inserted.

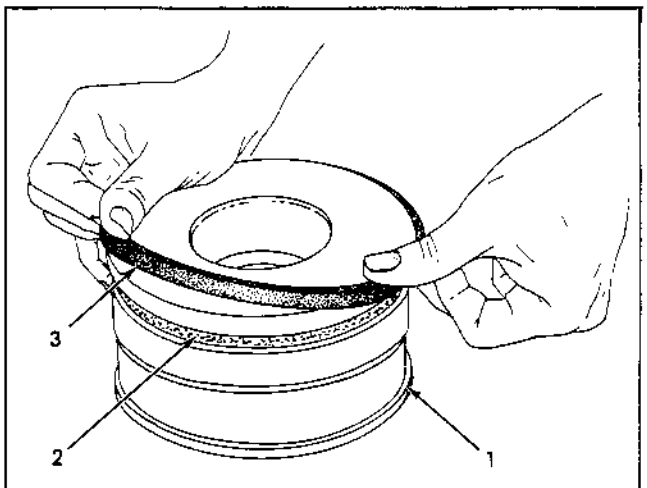

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FIG. 65 INSTALLING TEFLON RING

1. Piston
2. Rubber seal ring
3. Teflon seal ring

# TOPIC 8 HYDRAULIC FITTINGS, HOSES AND TUBING

## 8.1 GENERAL

8.1.1
The purpose of this section is to aid the customer in the proper installation of hydraulic fittings, hoses and tubing.

8.1.2
When servicing a hydraulic system, a few simple rules to keep in mind are:

1. Keep all interior and mating surfaces clean.
2. When removing a component, cap or plug all openings immediately to keep dirt and other foreign material from entering the hydraulic system.
3. DO NOT remove caps or plugs until connection is ready to be made.

## 8.2 INSTALLING TUBING

8.2.1
Install the tubing and tube clamps (leave clamps slightly loose).

8.2.2
Tighten the tubing connections to fixed units (valves, etc.) and other tubes.

8.2.3
Be sure that the tubing fits the end connections and clamps without being forced into position. Improve the fit by adjusting fittings and fixed units if possible. If necessary, bend the tubing to eliminate strain at ends.

8.2.4
Be sure that the tube touches nothing except the end connections and tube clamps.

## 8.3 FOUR BOLT FLANGE CONNECTIONS

8.3.1
Do not use or reuse flange halves that are warped or distorted more than 0.63 mm (0.025 in.) at the center, see Fig. 69. Check on a flat surface.

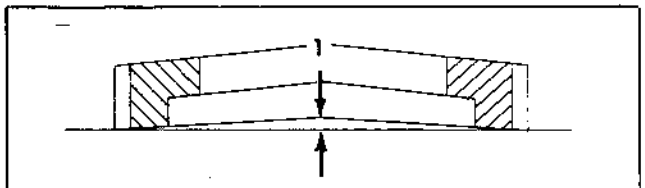



FIG. 69 CHECKING FOR WARPED FLANGE HALVES

1. Check for warp here

8.3.2
Make certain that the O-ring has no nicks or scratches and is seated properly.

8.3.3
Tighten the flange capscrews evenly to prevent binding and O-ring damage. Torque capscrews to the following values.

| Capscrew Size | daNm | kgm | lbs.ft. |
|---|---|---|---|
| 3/8" | 4.7-5.3 | 4.8-5.4 | 35-39 |
| 7/16" | 7.4-8.1 | 7.7-8.3 | 55-60 |
| 1/2" | 12.2-13.5 | 12.4-13.8 | 90-100 |
| 5/8" | 23-25.3 | 23.5-25.9 | 170-187 |

## 8.4 PROPER INSTALLATION OF STRAIGHT THREAD O-RING BOSS FITTINGS

8.4.1
If the fitting is the adjustable type, position the nut so the washer and O-ring are at the top of the smooth area, Fig. 70.

8.4.2
Lubricate the O-ring, screw the fitting into the opening and tighten properly, Fig. 71. DO NOT use pipe dope or sealing tape.

## 8.5 INSTALLING ADAPTER FITTINGS

8.5.1
Install all fittings in valves, cylinders,

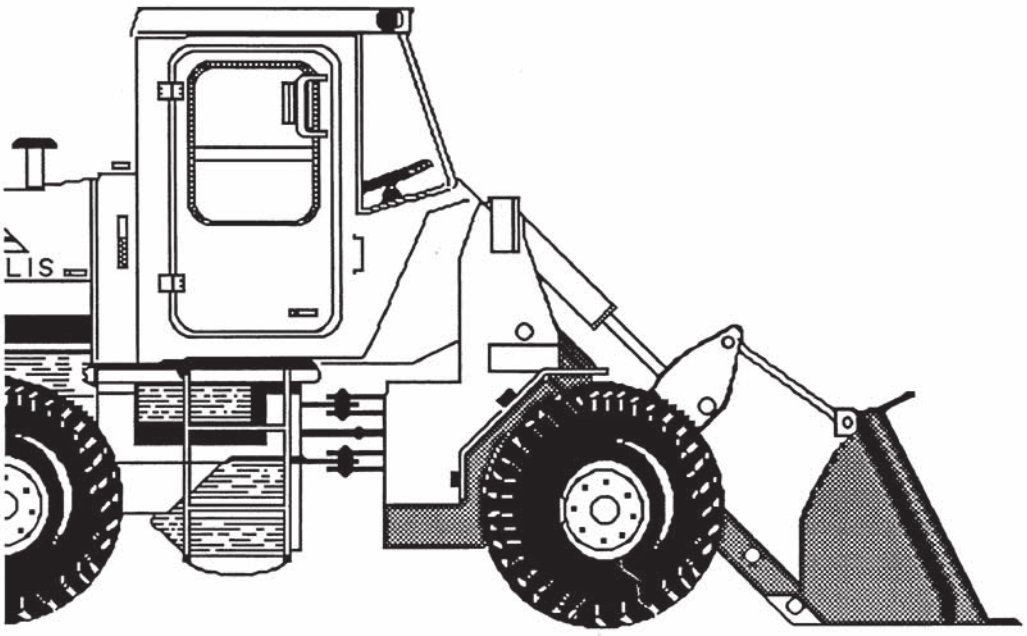
FIATALLIS®

# 545,545H,545-B
# 605-B,645,645-B
# 745,745H,745-B
# 745H-B,745-C

## wheel loaders

## service manual

# BUCKET and CHASSIS



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# SAFETY RULES

Always before leaving the operator's seat and after making certain all people are clear of the machine, slowly lower the attachments or tools flat to the ground in a positive ground support position Move any multi purpose tool to positive closed position Return the controls to hold Place transmission control in neutral and move engine controls to off position Engage all control locks, set parking brake, and open and lock the master (key, if so equipped) switch. Consult Operation and Maintenance Instruction Manual

Always follow the shut down instructions as outlined in the Operation and Maintenance Instruction Manual

MAINTENANCE

Do not perform any work on equipment that is not authorized Follow the Maintenance or Service Manual procedures

Machine should not be serviced with anyone in the operator's seat unless they are qualified to operate the machine and are assisting in the servicing

Shut off engine and disengage the Power Take Off lever if so equipped before attempting adjustments or service.

Always turn the master switch (key switch if so equipped) to the *OFF* position before cleaning, repairing, or servicing and when parking machine to forestall unintended or unauthorized starting.

Disconnect batteries and *TAG* all controls according to local or national requirements to warn that work is in progress. Block the machine and all attachments that must be raised per local or national requirements

Never lubricate, service or adjust a machine with the engine running, except as called for in the Operation and Maintenance Instruction Manual Do not wear loose clothing or jewelry near moving parts

Do not run engine when refueling and use care if engine is hot due to the increased possibility of a fire if fuel is spilled

Do not smoke or permit any open flame or spark near when refueling, or handling highly flammable materials.

Always place the fuel nozzle against the side of the filler opening before starting and during fuel flow To reduce the chance of a static electricity spark, keep contact until after fuel flow is shut off

Do not adjust engine fuel pump when the machine is in motion

Never attempt to check or adjust fan belts when engine is running.

When making equipment checks that require running of the engine, have an operator in the operator's seat at all times with the mechanic in sight Place the transmission in neutral and set the brakes and lock *KEEP HANDS AND CLOTHING AWAY FROM MOVING PARTS*

Avoid running engine with open unprotected air inlets If such running is unavoidable for service reasons, place protective screens over all inlet openings before servicing engine

Do not place head, body, limbs, feet, fingers, or hands near rotating fan or belts. Be especially alert around a pusher fan

Keep head, body, limbs, feet, fingers, or hands away from bucket, blade or ripper when in raised position

If movement of an attachment by means of machine's hydraulic system or winches is required for service or maintenance, do not raise or lower attachments from any position other than when seated in the operator's seat Before starting machine or moving attachments or tools, set brakes, sound horn and call for an all clear Raise attachments slowly

Never place head, body, limbs, feet, fingers, or hands into an exposed portion between uncontrolled or unguarded scissor points of machine without first providing secure blocking

Never align holes with fingers or hands - Use the proper aligning tool

Disconnect batteries before working on electrical system or repair work of any kind

Check for fuel or battery electrolyte leaks before starting service or maintenance work. Eliminate leaks before proceeding.

*BATTERY GAS IS HIGHLY FLAMMABLE* Leave battery box open to improve ventilation when charging batteries Never check charge by placing metal objects across the posts Keep sparks or open flame away from batteries Do not smoke near battery to guard against the possibility of an accidental explosion

Do not charge batteries in a closed area Provide proper ventilation to guard against an accidental explosion from an accumulation of explosive gases given off in the charging process

Be sure to connect the booster cables to the proper terminals (+ to +) and (- to -) at both ends. Avoid shorting clamps Follow the Operation and Maintenance Instruction Manual procedure

Due to the presence of flammable fluid, never check or fill fuel tanks, storage batteries or use starter fluid near lighted smoking materials or open flame or sparks

Rust inhibitors are volatile and flammable Prepare parts in well ventilated place Keep open flame away - *DO NOT SMOKE* Store containers in a cool well ventilated place secured against unauthorized personnel

Do not use an open flame as a light source to look for leaks or for inspection anywhere on the machine

*DO NOT* pile oily or greasy rags - they are a fire hazard Store in a closed metal container

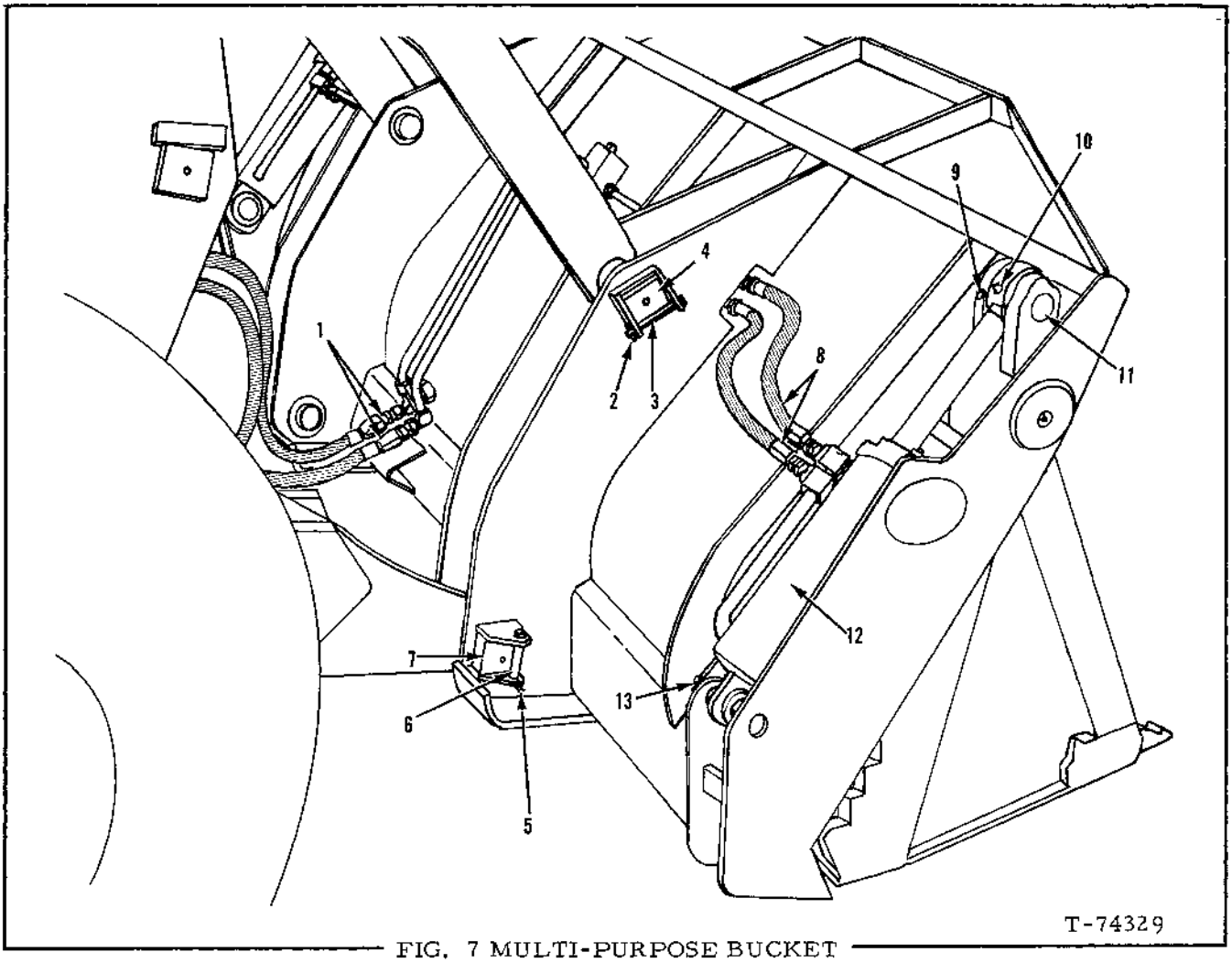


FIG. 7 MULTI-PURPOSE BUCKET

1 Hose assemblies (boom to bucket)
2. Cotter pin (dump link to bucket)
3. Locking pin
4. Pivot pin
5. Cotter pin (boom to bucket)
6. Locking pin
7. Pivot pin
8. Hose assemblies (relief valve to cylinder)
9. Locking pin (with cotter pin not shown)
10. Lubricating fitting, straight
11. Pivot pin
12. Clam cylinder
13 Locking pin (with cotter pin and pivot pin not shown)

securing the lower boom pivot pin (7) to bucket.

2.5.1.5
Start engine and back loader away from bucket.

### 2 5 2 INSTALLATION OF MULTI-PURPOSE BUCKET

2.5.2.1
To install the multi-purpose bucket, reverse the procedure used for the removal.

2.5.2.2
Refer to Operating Instructions and Field Maintenance Manual for servicing and proper lubricant.

## 2 6 CLAM CYLINDER

### 2 6 1 REMOVAL OF CLAM CYLINDER

Refer to Figure 7

2.6 1.1
Disconnect, tag and cap the upper and lower hose assemblies (8) from clam cylinder (12) tube assembly end.

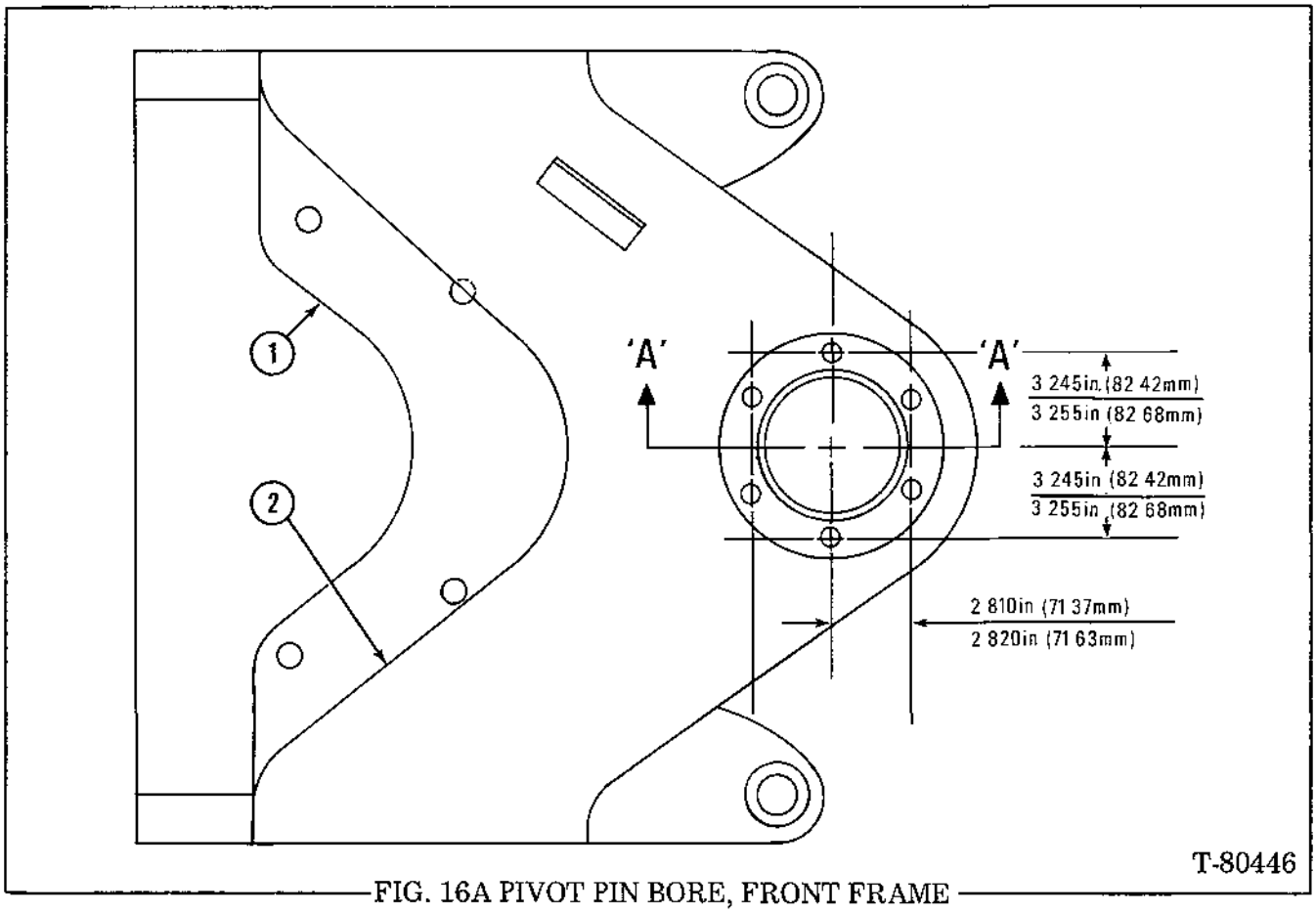


FIG. 16A PIVOT PIN BORE, FRONT FRAME
(545, 545H, 545-B, 605-B, 645, 645-B) (UPPER PLATE ILLUSTRATED)

1. Lower plate
2. Upper plate

## 6.4 REWORK OF FRONT AND REAR FRAME PIVOT PIN BORES

6.4.1

**WARNING**

Be sure to wear protective welding equipment and do not look at the arc without proper eye equipment during the following operations.

A worn or out-of-round pivot pin bore may be built up by welding. Use an E-7018 electrode and be sure the frame temperature is at least 50 ° F. (10.0 ° C). No special preheating is required.

6.4.2
Refer to FIG.'s 16A through 16D for pivot pin bore locating and finishing dimensions. Bores in upper and lower plates in both front and rear frames must be perpendicular to the top of the frame within 0.250 in (6.35 mm) per 36.0 in (914.40 mm) of length.

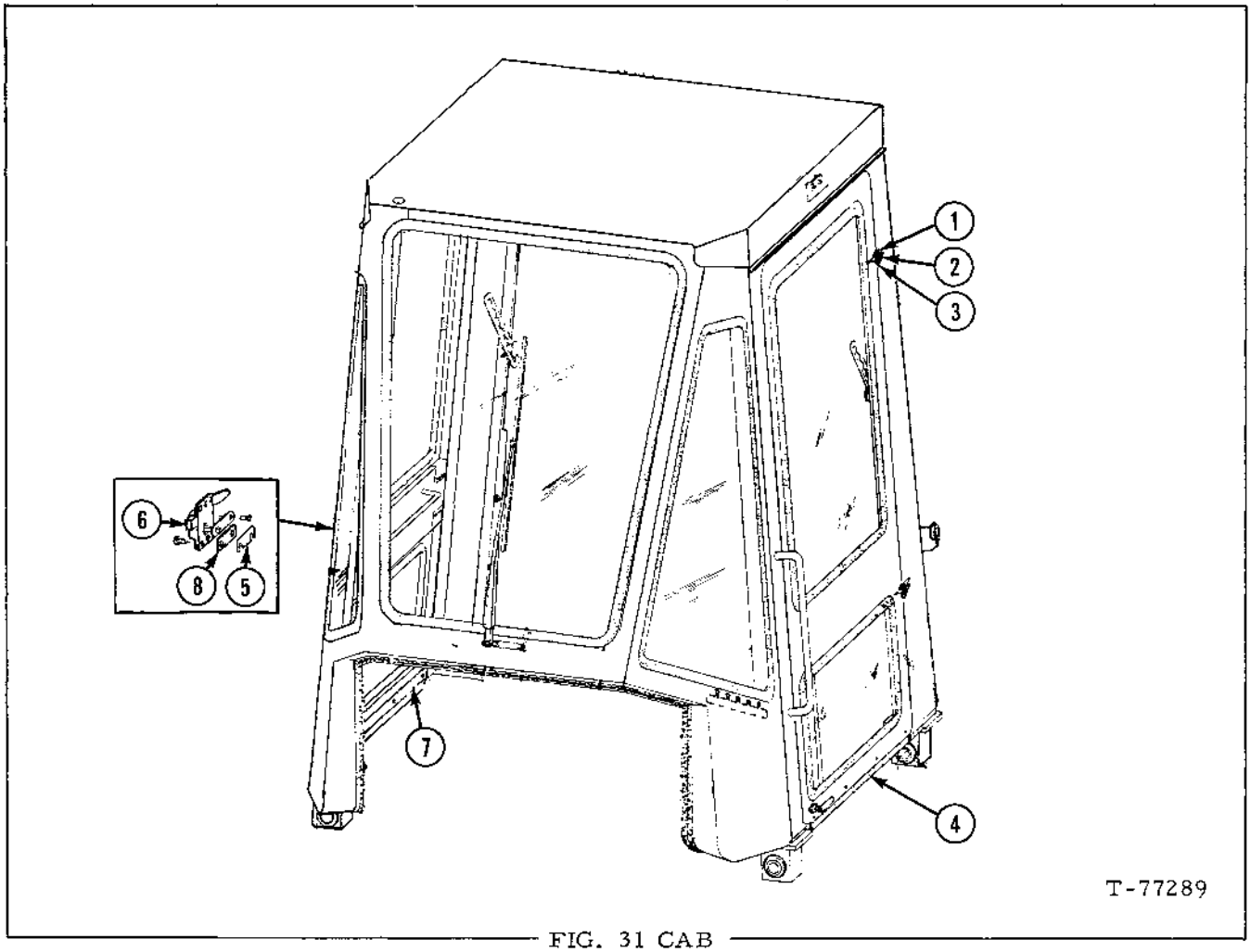


FIG. 31 CAB

1. Capscrew
2. Shims (Used as required)
3 Nut
4. Weather strip
5. Shims (Used as required)
6. Door catch
7. Bar
8. Plate

9 5.3
Weather Strip

If the weather strip (4) is damaged or has deteriorated in some way it must be replaced. On each door, four capscrews, lockwashers, and nuts must be removed, along with bar (7), to obtain access to weather strip. Install new weather strip and attach with hardware previously removed

# SAFETY RULES

Face the access system when climbing up and down.

Apply the parking device and place the transmission in neutral before starting the machine.

Do not bypass the starter safety switch. Repair the starter safety controls if they malfunction.

Fasten seat belt before operating.

Steering should be checked to both right and left. Brakes should be tested against engine power. Clutch and transmission controls should be moved through or to neutral positions to assure disengagement. Operate all controls to insure proper operation. If any malfunctions are found, park machine, shut off engine, report and repair before using machine.

If the power steering or the engine ceases operating, stop the machine motion as quickly as possible. Lower equipment, set parking device and keep machine securely parked until the malfunction is corrected or the machine can be safety towed. Never lift loads in excess of capacity.

Should the machine become stuck or frozen to the ground, back out to avoid roll over.

Know and understand the job site traffic flow patterns.

Keep the machine in the same gear going down hill as used for going up hill.

When roading a machine, know and use the signaling devices required on the machine. Provide an escort for roading where required.

Always use the recommended transport devices when roading the machine.

Do not attempt repairs unless proper training has been provided.

Use extreme caution when removing radiator caps, drain plugs, grease fittings or pressure taps. Park the machine and let it cool down before opening a pressurized compartment.

Release all pressure before working on systems which have an accumulator.

When necessary to tow the machine, do not exceed the recommended towing speed, be sure the towing machine has sufficient braking capacity to stop the towed load. If the towed machine cannot be braked, a tow bar must be used or two towing machines must be used - one in front pulling and one in the rear to retard. Avoid towing over long distances.

Observe proper maintenance and repair of all pivot pins, hydraulic cylinders, hoses, snap rings and main attaching bolts.

Always keep the brakes and steering systems in good operating condition.

Replace all missing, illegible or damaged safety signs. Keep all safety signs clean.

Do not fill the fuel tank to capacity. Allow room for expansion.

Wipe up spilled fuel immediately.

Always tighten the fuel tank cap securely. Should the fuel cap be lost, replace it only with the original manufacturers approved cap. Use of a non-approved cap may result in overpressurization of the tank.

Never drive the machine near open fires.

Use the correct fuel grade for the operating season.

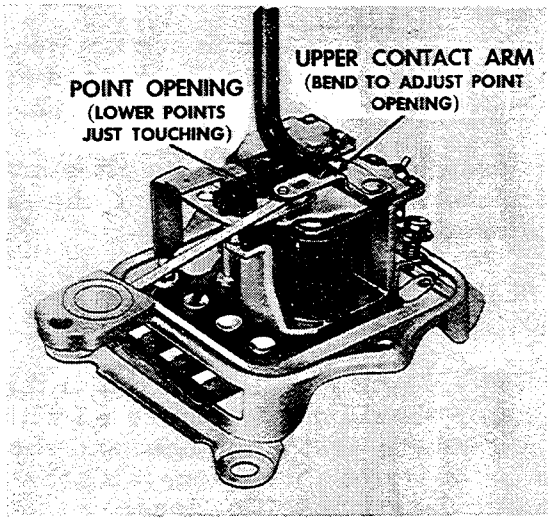


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FIG. 9 CHECKING VOLTAGE REGULATOR POINTS A.C.

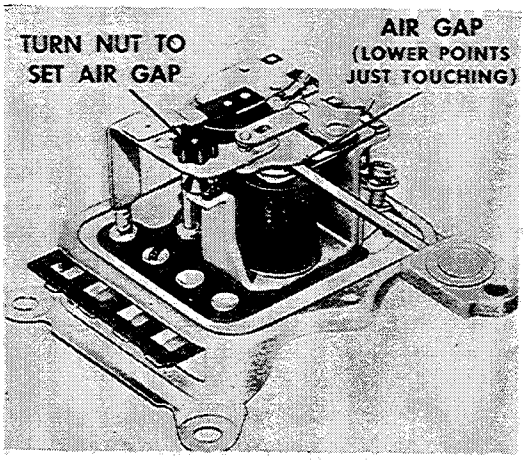


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FIG. 10 CHECKING VOLTAGE REGULATOR AIR GAP A.C.

battery remains undercharged, raise the voltage setting by .3 volts and then check for improved state of charge of the battery after a reasonable period of service. If the battery remains consistently overcharged, lower the voltage setting by .3 volts and recheck for improved battery condition. Voltage setting procedures are covered below.

3.4.2.1
Point opening - With the lower contacts points touching, check the point opening of the upper contacts as shown in Fig. 9 . If necessary, reset the opening to .010 - .020 in. (.254 -.507 mm) by bending the upper contact arm as shown in Fig. 9 .

3.4.2.2
Air gap - Measure the air gap between the armature and core, when the lower contacts are touching, as shown in Fig. 10 . The approximate setting is .067 in (1.702 mm). This setting is called approximate because the final setting must be whatever is required to obtain the specified difference in voltage (.1 - .8 volts) between the upper and lower sets of contacts as covered in the next subparagraph.

3.4.2.3
Voltage setting - The voltage at which the regulator operates varies with ambient (surrounding) temperatures. The ambient temperature is that measured 1/4 in. (6.350 mm) from the regulator cover.

| | | |
|---|---|---|
| Temperature<br>Voltage Setting | 65°F(21°C)<br>27.7-29.8 | 85°F(32°C)<br>27.4-29.4 |
| Temperature<br>Voltage Setting | 105°F(40°C)<br>27.1-29.0 | 125°F(54°C)<br>26.8-28.5 |
| Temperature<br>Voltage Setting | 145°F(66°C)<br>26.6-28.2 | 165°F(77°C)<br>26.3-27.9 |
| Temperature<br>Voltage Setting | 185°F(88°C)<br>26.0-27.6 | |

3.4.2.4
To check and adjust setting, proceed as follows:

3.4.2.4.1
Connect an ammeter and a 1/4 ohm resistor with rating of 25 watts or more in series in the circuit at the "BAT" terminal on the alternator as shown in Fig. 11 .

2. Remove the distributor cap, the rotor, and the cover. Check and adjust the point gap as previously described, and reinstall the rotor on the distributor shaft. The rotor should be facing opposite the primary lead terminal. Loosen the distributor retaining clamp capscrews, and turn the distributor housing until the primary lead terminal is opposite the rotor, and the points are just beginning to open as the distributor is rotated counterclockwise. The distributor is now properly timed to the engine. The firing order of the engine is 1-2-4-3.

3. Tighten the distributor retaining clamp capscrews. Remove the rotor, and reinstall the cover. Then reinstall the rotor and the distributor.

   If the distributor has been removed from the engine, the timing procedure will be the same as the one previously described, after the distributor is reinstalled. When the distributor is installed on the distributor drive housing, the rotor must be turned so that it faces opposite the primary terminal and so that the primary terminal faces the coil.

4. After the timing has been adjusted, a timing light should be used to check the timing in the following manner:

   a. With the engine at normal operating temperature, set the engine speed at 250 to 300 rpm. At this speed, the distributor should be in the fully retarded position, and the plain timing mark should be visible and centered in the timing hole. If the timing mark is not clearly visible to make these adjustments, mark it with white chalk or paint.

   b. If the mark is not centered in the timing hole, the two distributor retaining clamp capscrews must be loosened, and the distributor housing must be turned to advance or retard the timing as necessary. (Turning the distributor housing clockwise retards the timing; turning the housing counterclockwise advances it.)

      NOTE: The automatic spark advance is set to automatically advance the spark 25° between 300 and 1600 rpm.

   c. Operate the engine at 1600 to 1700 rpm. The distributor should now be in the fully advanced position (25°), and the F25 timing mark should be visible and centered in the timing hole. If the F25 timing mark is not visible, the automatic advance mechanism in the distributor should be checked for worn or damaged parts.

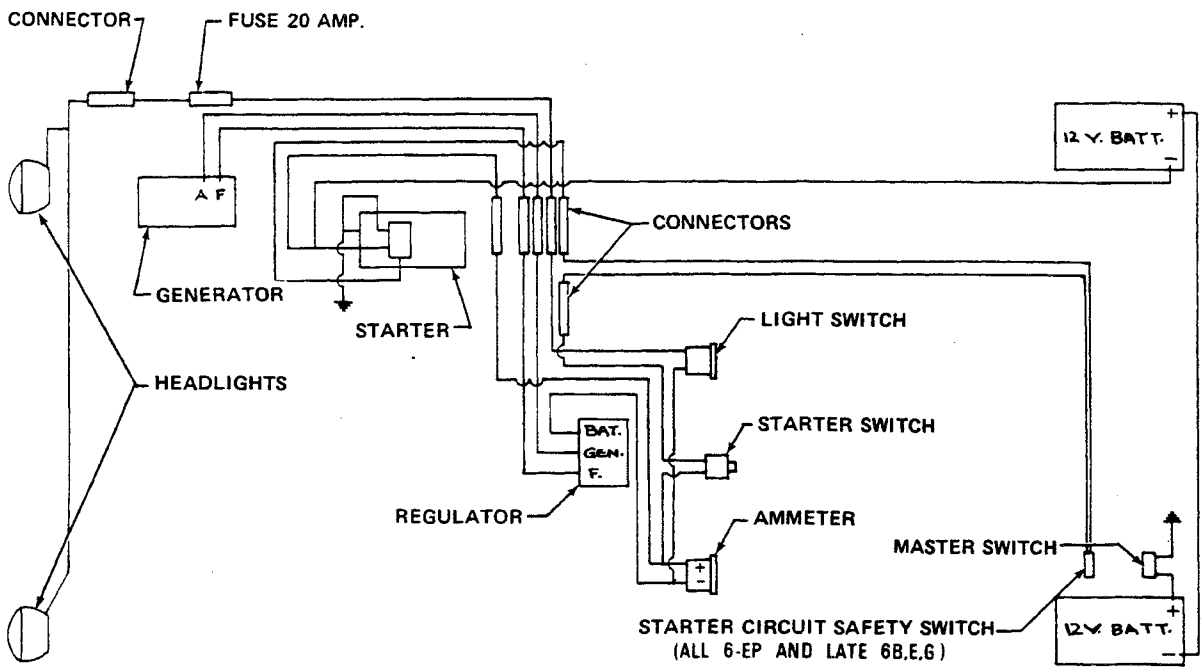



FIG. 24 HD-6 CRAWLER TRACTOR, 6G CRAWLER LOADER (Standard generator)

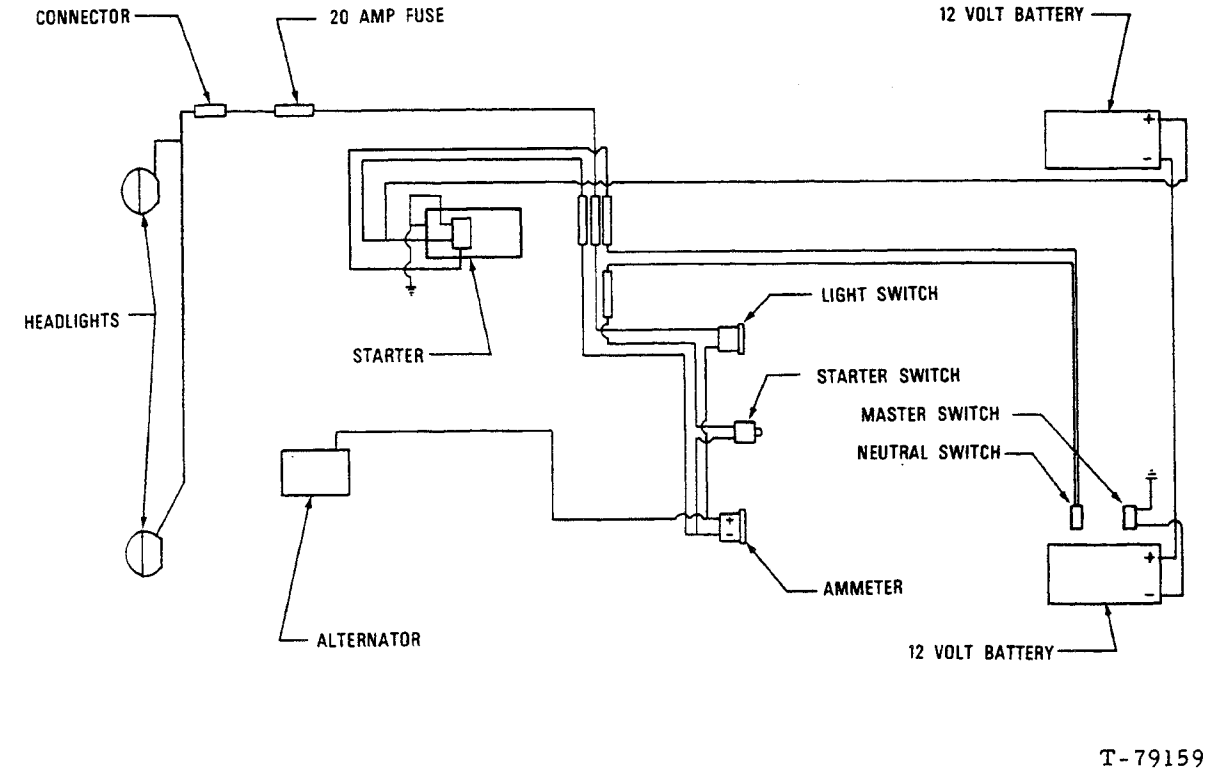



FIG. 25 6EP CRAWLER TRACTOR (Special 50 amp. alternator)

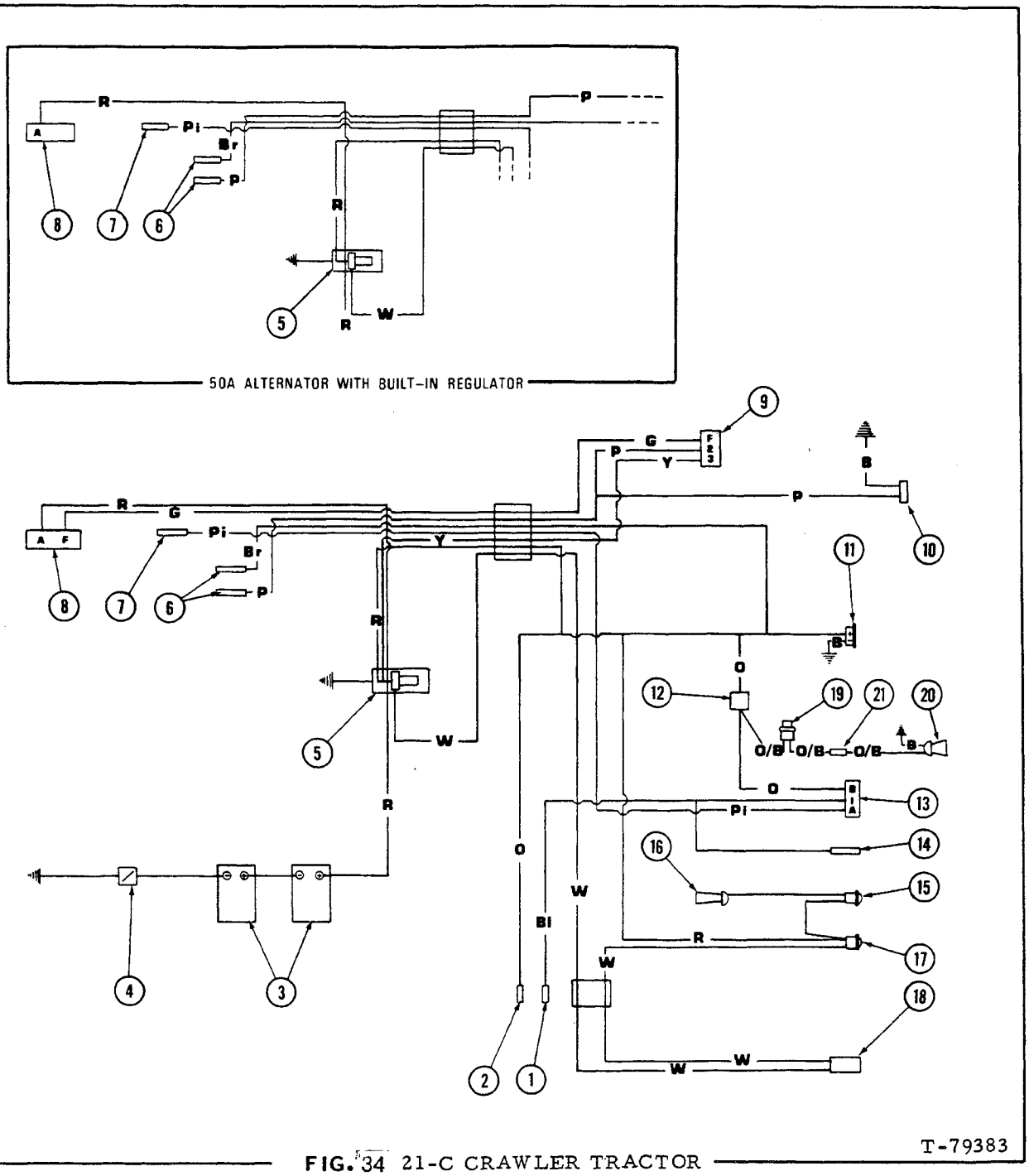
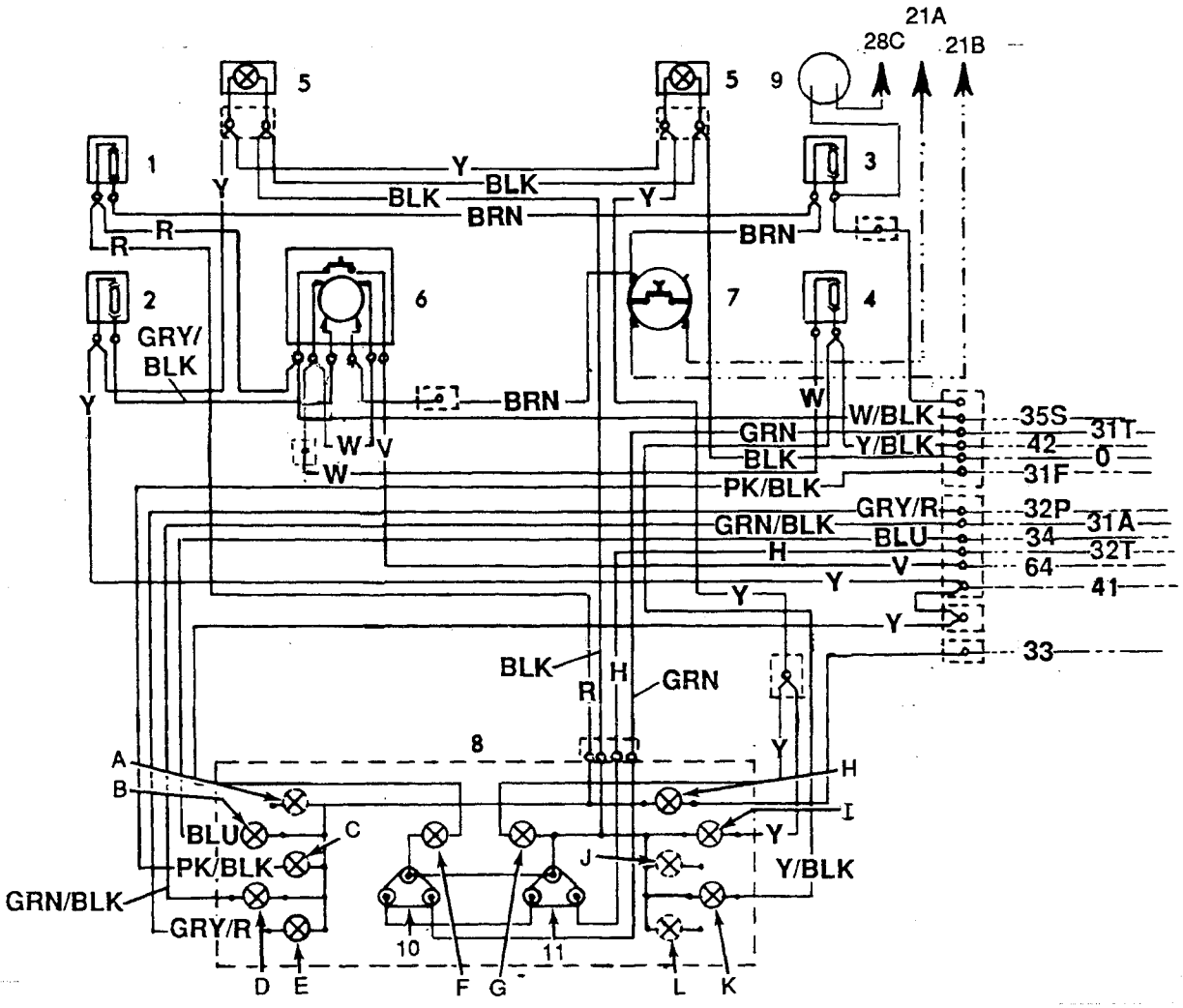



FIG. 34 21-C CRAWLER TRACTOR

1. Rear flood lights
2. Cab accessories
3. Batteries
4. Master switch
5. Starter solenoid
6. Pressure switch
7. Head lights
8. Alternator
9. Voltage regulator
10. Hour meter
11. Voltmeter
12. Circuit breaker
13. Light switch
14. Dash light
15. Horn switch
16. Horn
17. Starter switch
18. Neutral switch
19. Pressure switch
20. Back-up horn
21. Connector

B. black
Br. brown
Bl. dark blue
G. light green
O. orange
P. purple
Pi. pink
R. red
W. white
Y. yellow
O/B. Orange/Black

Study SAFETY RULES in the front of this manual thoroughly for the protection of machine and safety of personnel.




T-85078

FIG. 43 FD30B INSTRUMENT PANEL SCHEMATIC

Legend for Fig. 43

1. Fuse, instruments (8A)
2. Fuse, front lights (8A)
3. Fuse, receptacle (8A)
4. Fuse, rear lights (8A)
5. Panel lights
6. Light switch and horn button
7. Starter button
8. Instrument panel
9. Ether primer switch (special equipment)
10. Engine water temperature gauge
11. Transmission oil temperature gauge

INDICATOR LIGHTS

A. Not applicable
B. Battery charge
C. Low fuel pressure
D. Air cleaner restriction
E. Transmission low oil pressure
F. Not applicable
G. Not applicable
H. Not applicable
I. Head light high beam
J. Not applicable
K. Rear flood light (special equipment)
L. Not applicable

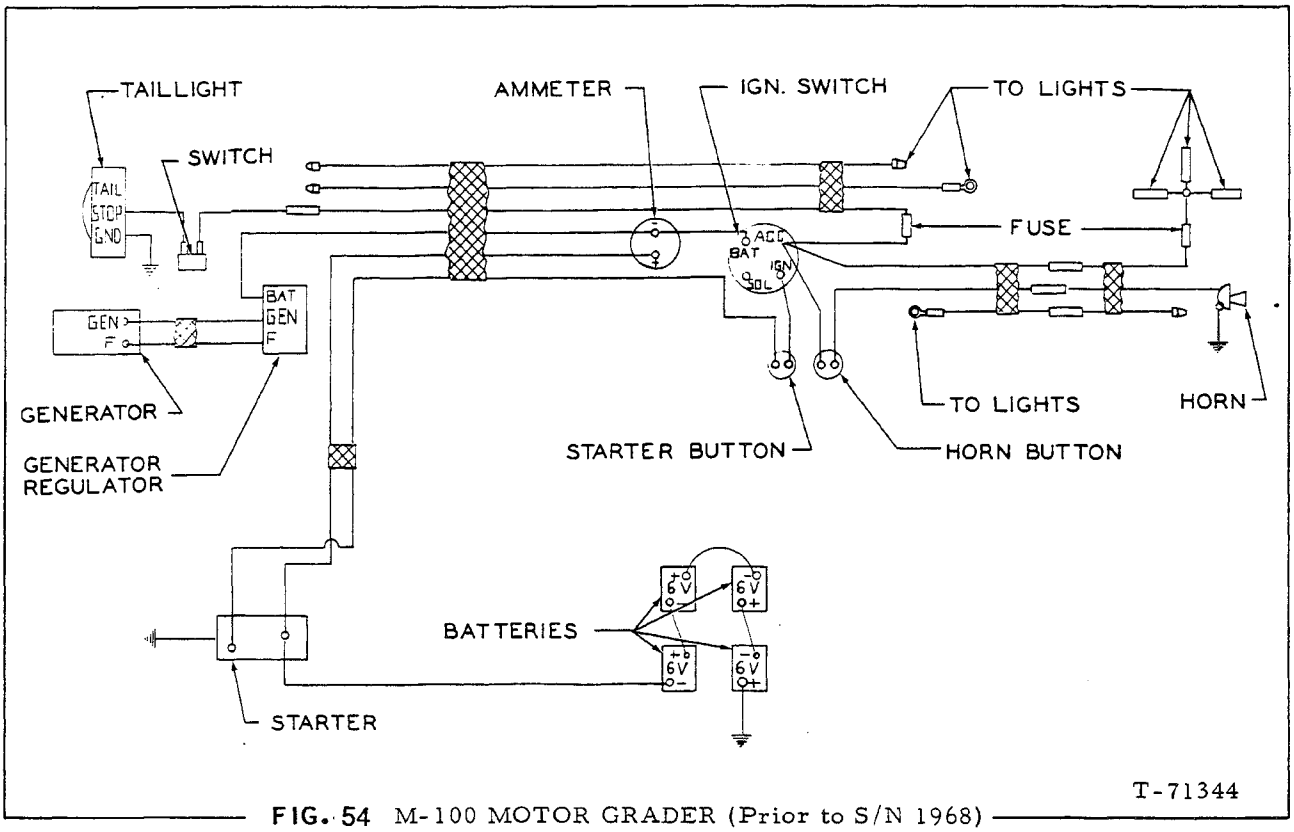



FIG. 54 M-100 MOTOR GRADER (Prior to S/N 1968)

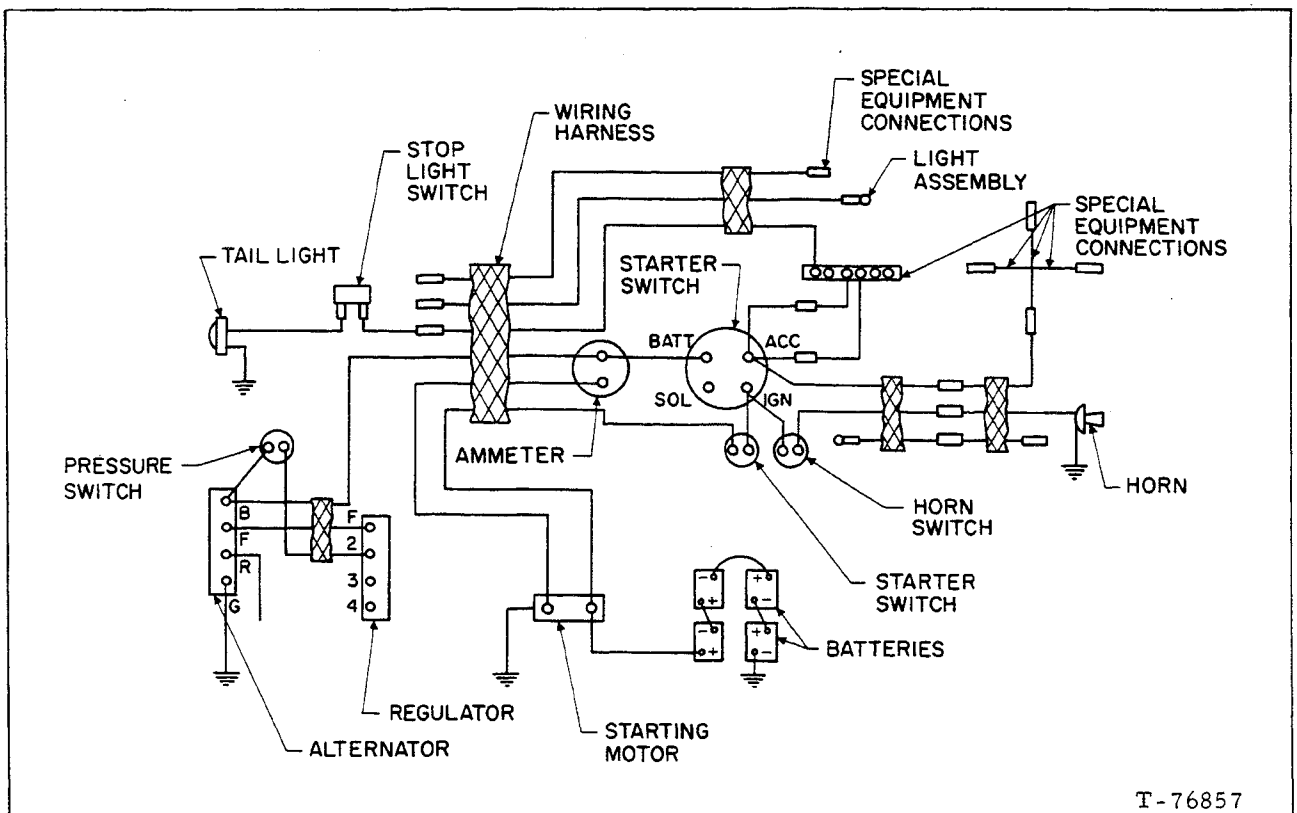



FIG. 55 M-100 MOTOR GRADER, 100-B MOTOR GRADER (S/N 1968-up; 67S05001-up)

# Electrical System Schematics

Legend for Fig. 62

1. Circuit Breaker
2. Circuit Breaker
3. Circuit Breaker
4. Circuit Breaker
5. Circuit Breaker
6. Circuit Breaker
7. Circuit Breaker
8. Circuit Breaker
9. Key switch
10. Floodlight
11. Floodlight switch
12. Heater fan switch
13. Heater
14. Horn switch
15. Horn

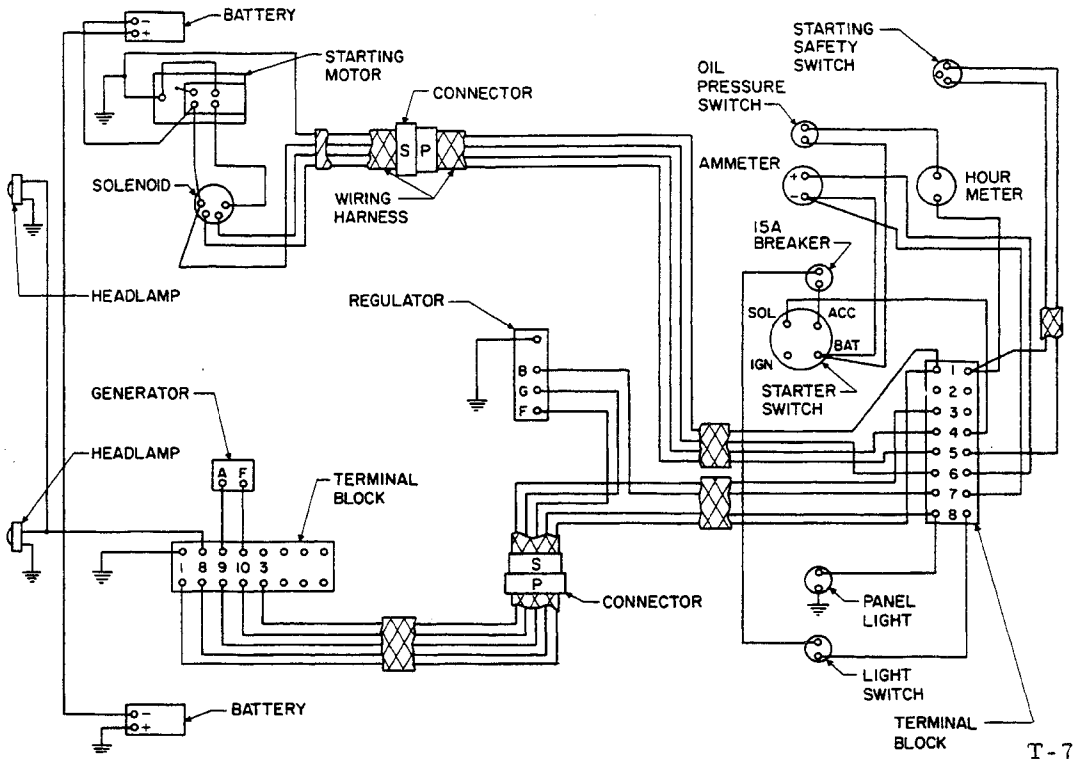



FIG. 68 260-A TRACTOR SCRAPER, 260E-A ELEVATING SCRAPER
(Standard generator; S/N 8051-up; 65A09501-up; 98C09501-up)

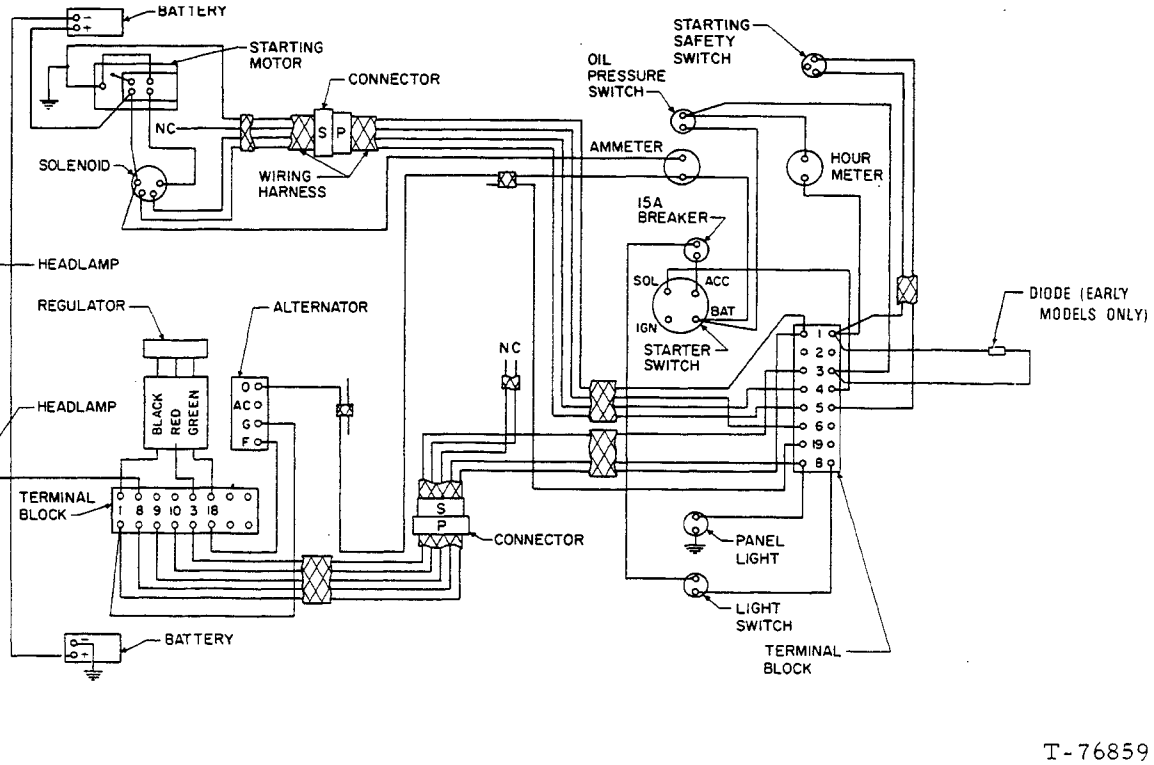



FIG. 69 260-A TRACTOR SCRAPER, 260E-A ELEVATING SCRAPER
(Special alternator; S/N 8051-up; 65A09501-up; 98C09501-up)

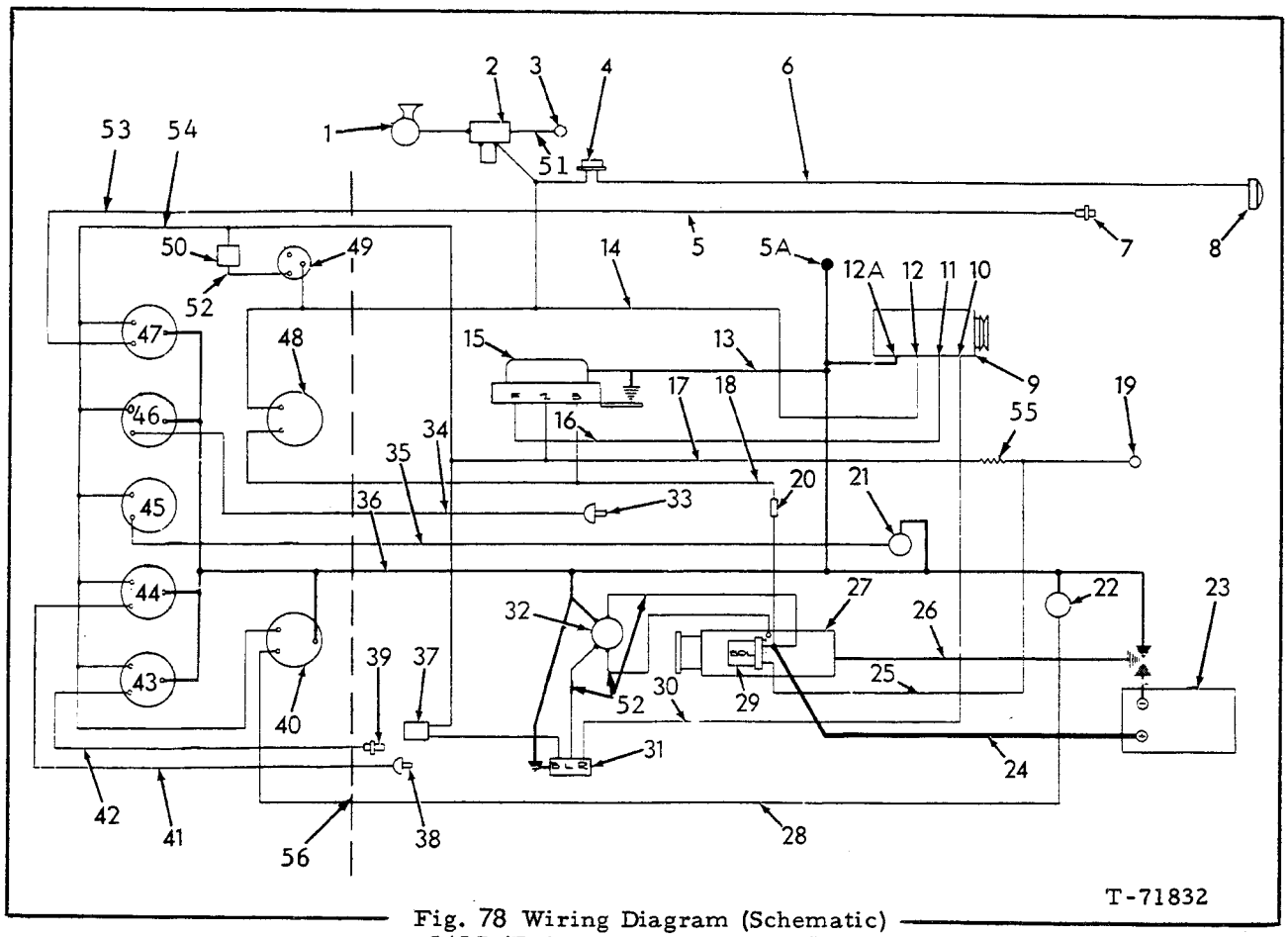



Fig. 78 Wiring Diagram (Schematic)
545G (Prior to loader serial #1759)

1. Horn
2. Relay
3. Horn button
4. Stoplight switch
5. Blue
5a. Engine ground
6. Tan
7. Engine temperature sender
8. Stoplight
9. Generator (alternator)
10. Relay terminal
11. Field terminal
12. Battery terminal
12a. Ground terminal
13. Black
14. Orange
15. Generator regulator
16. Light green
17. Purple
18. Red
19. Ignition coil
20. Fuse
21. Hour meter pressure switch
22. Fuel sender
23. Battery
24. Red
25. Gray and white
26. Black
27. Starting motor
28. Pink
29. Starting motor solenoid
30. Brown
31. Relay
32. Auxiliary solenoid
33. Engine oil pressure sender
34. Black and white
35. Yellow
36. Black
37. Starter switch
38. Transmission oil pressure sender
39. Transmission temperature sender
40. Fuel gauge
41. Dark green
42. Read and white
43. Transmission temperature sender
44. Transmission pressure gauge
45. Hour meter
46. Engine oil pressure gauge
47. Engine temperature gauge
48. Ammeter
49. Key switch
50. Circuit breaker (6 amp)
51. Gray
52. Black
53. Blue
54. Purple
55. Resistor
56. Harness connection

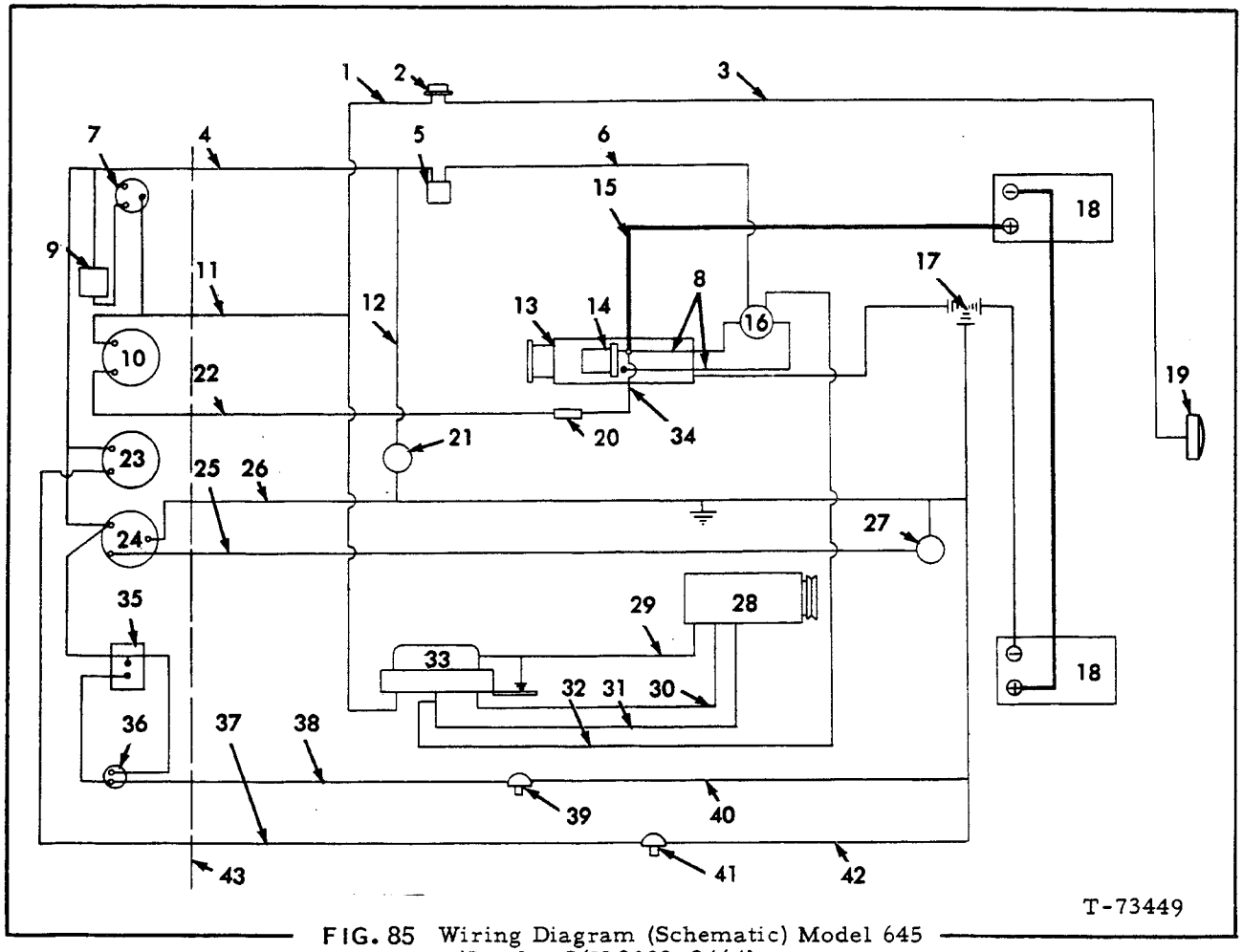



FIG. 85 Wiring Diagram (Schematic) Model 645
(Loader S/N 2032-2464)

1. Orange
2. Stoplight switch
3. Tan
4. Purple
5. Starter switch
6. White
7. Key switch
8. Black
9. Circuit breaker (2 amp)
10. Ammeter
11. Orange
12. Purple
13. Starting motor
14. Starting motor solenoid
15. Black
16. Auxiliary solenoid
17. Black (ground)
18. Battery (two)
19. Stoplight
20. Fuse (30 amps)
21. Fuel shut-off
22. Red
23. Hour meter
24. Fuel gauge
25. Pink
26. Black
27. Fuel sender
28. Generator
29. Black
30. Light green
31. Brown
32. Brown
33. Generator regulator
34. Gray
35. Buzzer (low air pressure)
36. Warning light (low air pressure)
37. Yellow
38. Yellow and black
39. Air pressure switch
40. Black
41. Hour meter pressure switch
42. Black
43. Harness connections

## WIRING COLOR CODE — FIG. 91

| | |
|---|---|
| B - Black | PI - Pink |
| LBL - Light blue | R - Red |
| BL - Blue | T - Tan |
| BR - Brown | W - White |
| G - Green | Y - Yellow |
| LG - Light green | BWR - Brown with white tracer |
| GY - Grey | OB - Orange with black tracer |
| O - Orange | PIB - Pink with black tracer |
| P - Purple | YB - Yellow with black tracer |

## LEGEND FOR FIG. 91

1. Fuse and holder
2. Switch
3. Defroster fan
4. Rear wiper
5. Cab ground
6. Front wiper
7. Panel light
8. Turn signal flasher
9. Cab turn signals (optional)
10. Key switch
11. Ammeter
12. Junction box (circuit breakers, 12A thru 12F)

12A. Stop light, 8 amp.
12B. Tail light, 8 amp.
12C. Flood light, 15 amp.
12D. Head light, 8 amp.
12E. Starting circuit, 15 amp.
12F. Cab heater, 8 amp.

13. Light switch
14. Low air pressure warning light
15. Low air pressure warning buzzer
16. Rear floodlights (optional)
17. Cab heater
18. Cab heater switch
19. Stop and tail lights
20. Alternator
21. Frame ground
22. Starter switch
23. Pressure switch
24. Voltage regulator
25. Starting motor
26. Stop light switch
27. Battery
28. Front flood lights (optional)
29. Head lights
30. Fuse

# MEMO

LEGEND FOR FIG. 99

1. Right front flood light
2. Right front head light
3. Right cab flood light
4. Right front turn signal light
5. Left front turn signal light
6. Left front cab light
7. Left front head light
8. Left front flood light
9. Right turn indicator
10. Hour meter
11. Panel lights
12. Engine oil pressure switch
13. Buzzer
14. Brake system fault light
15. Panel light
16. Cab flood light switch
17. Front windshield wiper switch
18. Front windshield wiper motor
19. Left turn indicator
20. Key switch
21. Rear windshield washer switch
22. 10 amp fuse
23. Rear windshield washer pump
24. Voltmeter
25. Air pressure switch
26. Parking brake light
27. Parking brake switch
28. Emergency steering light
29. Low air pressure light
30. Front windshield defog switch
31. Front windshield defog fan
32. Rear windshield defog switch
33. Rear windshield defog fan
34. Light switch
35. Flow switch
36. Rear windshield wiper motor
37. Rear windshield wiper switch
38. Front windshield washer pump
39. Front windshield washer switch
40. Heater assembly
41. Heater switch
42. Flasher
43. Turn signal switch
44. Dome light
45. Thermo guard
46. Ether start assembly
47. Ether start switch
48. Diode assembly
49. Overstroke sensor switch
50. Relay
51. Neutral safety switch
52. Brake light switch
53. Circuit breaker assembly
54. Alternator
55. Back up alarm
56. Alarm switch
57. Batteries
58. Excess fuel solenoid
59. Starter solenoid
60. Starter motor
61. Battery disconnect switch
62. Axle disconnect light (Optional)
63. Rear axle disconnect switch
64. Right rear flood light
65. Right rear turn signal light
66. Right tail light
67. Left tail light
68. Left rear turn signal light
69. Left rear flood light
70. Transmission neutralizer switch
71. Transmission neutralizer valve

WIRE COLOR CODE

B - Black
G - Green
O - Orange
R - Red

SERVICE NOTES:

1. Circuits are identified by a number, or by a number and letter, contained in a square box. Metal tags bearing circuit identification number are attached to each wire at all connectors and/or connection points.
2. Componsnts are designated by a number in a circle. The legend for Fig. 6-1 identifies each designated component by its noun name.
3. Circuits and components shown in dashed lines are optional or accessory items.