

SECTION XXII — TROUBLE SHOOTING

This Section contains trouble shooting information and outlines tests which can be made to determine some of the troubles that may develop in the tractor when the tractor is used under average working conditions. Each symptom of trouble is recorded under the individual unit or system of the tractor

and is followed by a list of the possible causes of the trouble. The tests necessary to determine which of the possible causes is responsible for the trouble are explained after each possible cause, with reference to where instructions for their correction may be found.

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1. ENGINE

TROUBLE	POSSIBLE CAUSES	REMEDY
Engine will not turn.	1. Batteries weak.	1. Recharge or replace batteries (refer to Section VI, Topic 4).
	2. Starter or starter switch inoperative.	2. Repair or replace affected parts (refer to Section VI, Topic 6).
	3. Engine is 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. The engine should be disassembled to determine the cause, and the necessary parts replaced.

TROUBLE**POSSIBLE CAUSES****REMEDY**

Engine will not start.

1. Slow cranking speed.
2. Engine controls out of adjustment.
3. Insufficient supply of fuel to fuel injection nozzles.
4. Fuel injection nozzles not operating properly.
5. Fuel injection pump improperly timed.

1. The specific gravity of the batteries may be too low or the starter may not be delivering its maximum torque to provide adequate cranking speed. Cold weather starting requires the use of the cold weather engine primer or the engine air heater (refer to Section III, Topic 4 or 5).

2. Check all engine control linkages for proper adjustment (refer to Section II, Topic 8).

3. Check fuel system (refer to Section II, Topic 2).

4. Test and repair or replace nozzles (refer to Section II, Topic 5).

5. Time fuel injection pump (refer to Section II, Topic 7).

Engine hard to start.

1. Batteries weak.
2. Insufficient fuel in fuel tank.
3. Incorrect grade of fuel.
4. Fuel injection nozzles not operating properly.
5. Fuel transfer pump not operating properly.
6. Air in fuel system.
7. Insufficient air supply to cylinders.
8. Fuel injection pump improperly timed.
9. Valve lash incorrect.
10. Piston rings or cylinder liners worn.
11. Valves warped or pitted.

1. Recharge or replace batteries (refer to Section VI, Topic 4).

2. Check fuel level in tank. Fill with specified fuel if necessary.

3. Drain fuel system. Fill the tank with the specified fuel (refer to Section I, Topic 4).

4. Test and repair or replace nozzles (refer to Section II, Topic 5).

5. Test and repair or replace fuel transfer pump (refer to Section II, Topic 4).

6. Vent fuel system (refer to Section II, Topic 7).

7. Clean air system (refer to Section III, Topic 3).

8. Time fuel injection pump (refer to Section II, Topic 7).

9. Adjust valve lash (refer to Section VIII, Topic 3).

10. Replace affected parts (refer to Section VIII, Topic 4 or 6).

11. Recondition or replace valves and/or valve guides (refer to Section VIII, Topic 3).

Engine stops frequently.

1. Idling speed too low.
2. Restricted fuel supply.

1. Adjust low idling speed (refer to Section II, Topic 7).

2. Check fuel system (refer to Section II, Topic 2).

TROUBLE**POSSIBLE CAUSES****REMEDY**

Engine stops suddenly.

1. Out of fuel.
2. Restricted fuel supply.
3. Broken or loose fuel lines.
4. Fuel transfer pump or fuel injection pump inoperative.

1. Fill fuel tank with specified fuel and vent the fuel system (refer to Section II, Topic 7).
2. Check fuel system (refer to Section II, Topic 2).
3. Correct or replace affected parts.
4. Replace inoperative parts (refer to Section II, Topic 4 or 7).

Engine overheats.

1. Leak in cooling system.
2. Radiator core clogged.
3. Radiator air passages clogged.
4. Fan drive belts too loose.
5. Thermostats inoperative.
6. Engine oil cooler clogged.
7. Improper engine lubrication.
8. Water pump malfunctioning.
9. Fuel injection pump improperly timed.
10. Tractor overloaded.
11. On tractors with a torque converter the fluid heat exchanger clogged.

1. Correct all leaks and fill cooling system (refer to Section IV, Topic 3).
2. Clean and flush radiator (refer to Section IV, Topic 4).
3. Remove debris from radiator core (refer to Section IV, Topic 4).
4. Adjust fan drive belts to proper tension (refer to Section IV, Topic 8).
5. Test the thermostats for proper operation (refer to Section IV, Topic 7).
6. Clean or replace the oil cooler core (refer to Section V, Topic 5).
7. Check for proper operation of engine lubricating oil pump. (Refer to Section V, Topic 2).
8. Repair or replace the water pump (refer to Section IV, Topic 6).
9. Time fuel injection pump (refer to Section II, Topic 7).
10. Decrease load on tractor.
11. Clean or replace the fluid heat exchanger core (refer to Section IX, Topic 4).

Engine shows loss of power.

1. Insufficient supply of air to cylinders.
2. Insufficient supply of fuel to fuel injection nozzles.
3. Governor not operating properly.
4. Air in fuel system.

1. Clean air system (refer to Section III, Topic 3).
2. Check fuel system (refer to Section II, Topic 2).
3. Inspect and adjust governor (contact your "Allis-Chalmers" Construction Machinery Dealer).
4. Vent fuel system. Check for air leaks on suction side of fuel transfer pump (refer to Section II, Topic 2).

TROUBLE

POSSIBLE CAUSES

REMEDY

5. Clogged fuel filters.
6. Improper valve lash.
7. Fuel injection pump improperly timed.
8. Inoperative fuel injection pump or fuel injection nozzles.
9. Loss of compression.

5. Change filter elements (refer to Section II, Topic 3).
6. Adjust valve lash (refer to Section VIII, Topic 3).
7. Time fuel injection pump (refer to Section II, Topic 7).
8. Repair or replace affected parts (refer to Section II, Topics 5 and 7).
9. This may be due to leaking valves or to worn piston rings, or cylinder sleeves. Use a suitable compression tester and check each cylinder as follows:

NOTE: Engine should be at normal operating temperature (160° to 185° F.).

- a. Start with No. 1 cylinder when checking the compression. Remove the fuel injection nozzle (refer to Section II, Topic 5) and install the compression tester adapter in the same manner as the fuel injection nozzle was installed. Install the compression tester hose and gage assembly. **NOTE:** On tractors Serial No. 4001 and above, it will be necessary to install a flexible fuel jumper line between the fuel injection line connector and the fuel return line connector so that the fuel from the open fuel injection line will be pumped directly to the fuel return line when the engine is running.
- b. Start the engine, run it at approximately 600 R.P.M. and take several readings on the tester gage. **NOTE:** Do not check the compression by cranking the engine with the starter.

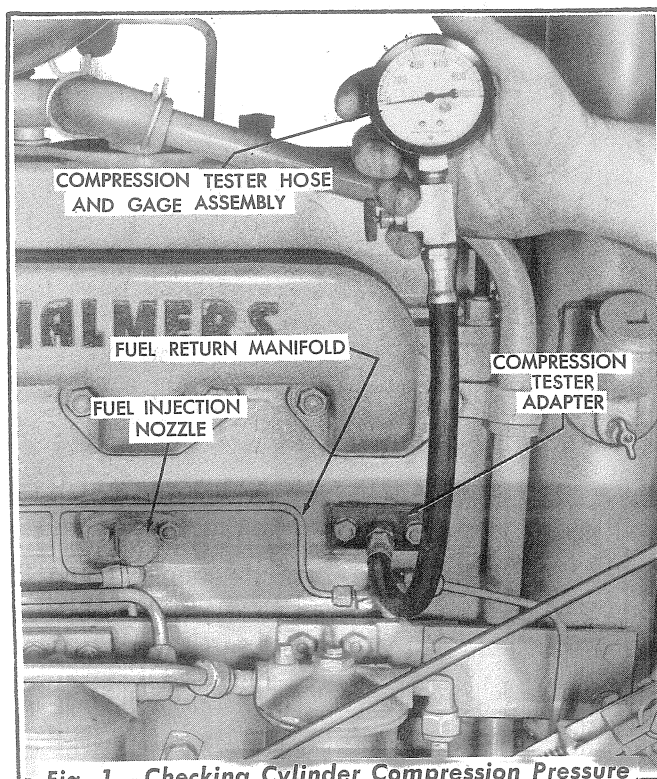


Fig. 1 — Checking Cylinder Compression Pressure
(Tractors Prior to Serial No. 4001)

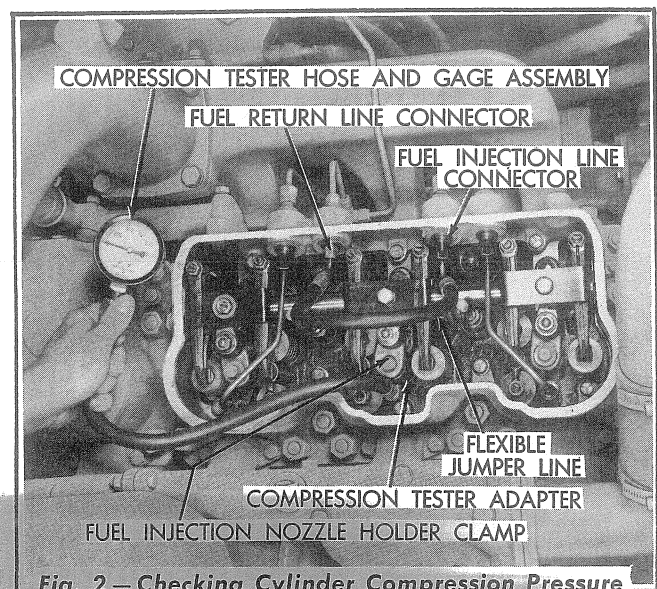


Fig. 2 — Checking Cylinder Compression Pressure
(Tractors Serial No. 4001 and Above)

TROUBLE**POSSIBLE CAUSES****REMEDY**

- c. Reinstall the fuel injection nozzle and connect the fuel injection line.
- d. Perform this same operation on the remaining cylinders.
- e. The compression pressure for a normal engine at normal operating temperature, firing on 5 cylinders at 600 R.P.M., and at sea level conditions is 415 P.S.I. on the HD 844 engines used in tractors prior to Serial No. 4001, and is 425 P.S.I. on the 16000 engine used in tractors Serial No. 4001 and above. Also, the pressure of any one cylinder should not vary more than 25 P.S.I. above or below the reading on the other cylinders, as for example:

CYLINDER NUMBER	TEST GAGE READING
1	415 P.S.I.
2	425 P.S.I.
3	420 P.S.I.
4	370 P.S.I.
5	405 P.S.I.
6	425 P.S.I.

Note that the compression pressure in the No. 4 cylinder falls more than 25 P.S.I. below the pressure in the other cylinders, indicating a compression leak in the No. 4 cylinder. In this case, the cylinder head must be removed, the valves and valve seats inspected for leaks, the valve stems for wear and sticking, and the cylinder head gasket for leaks. If these parts are found to be in good condition, the leakage is taking place past the piston rings. The piston must then be removed, all the parts inspected, and the necessary parts replaced.

NOTE: When using a compression tester to check the compression, make certain that the gage has been properly tested to give an accurate pressure reading. In no case should an engine be rebuilt only because a compression tester registers readings below the compression pressure of a normal engine, unless the compression tester is known to be accurate. A loss of power or excessive oil consumption should also be considered a determining factor in deciding whether or not repairs are necessary.

11. Cylinder cutting out.

11. On tractors prior to Serial No. 4001, locate a "missing" cylinder as follows: Run the engine at low idle speed and "cut-out" each fuel injection nozzle in turn by loosening the fuel injection line nut attaching the fuel injection line to its corresponding fuel injection nozzle. *NOTE: Keep hands away from loosened nut while performing this test.* A decrease in engine speed with the injection line nut loosened indicates that the nozzle for that cylinder is functioning properly. If the engine speed does not decrease, the nozzle is malfunctioning and should be replaced.

On tractors Serial No. 4001 and above, locate a "missing" cylinder in the same manner

TROUBLE**POSSIBLE CAUSES****REMEDY**

Engine runs uneven and excessive vibration.

1. Governor not operating properly.
2. Fuel supply erratic or insufficient.
3. Engine operating temperature too low.
4. Fuel injection pump malfunctions.
5. Valves in bad condition.
6. Cylinder "cutting-out."
7. Fuel injection nozzle malfunctions.

as described above, however, each fuel injection nozzle is "cut-out" in turn by loosening the fuel injection line nut attaching the fuel injection line to the fuel injection pump.

1. Adjust governor and linkage (contact your "Allis-Chalmers" Construction Machinery Dealer).
2. Check fuel system (refer to Section II, Topic 2).
3. Check thermostats (refer to Section IV, Topic 7).
4. Check fuel injection pump (refer to Section II, Topic 2).
5. Recondition valves (refer to Section VIII, Topic 3).
6. Correct cause (refer to Paragraph G, Step 11 in this Topic).
7. Repair nozzle (refer to Section II, Topic 5).

Engine detonates.

If a hard metallic knock indicates detonation in one or more cylinders, the engine must be stopped immediately to prevent serious damage due to the excessive pressures accompanying the detonation. Detonation is caused by the presence of fuel or lubricating oil in the charge of air that has been delivered to the cylinder during the compression stroke.

Check for leaky fuel injection nozzles, improper timing of the fuel injection pump, and oil pull over from the air cleaner.

Engine emits black smoke from exhaust.

1. Air system clogged.
2. Governor smoke stop positioned incorrectly.
3. Improper fuel.

1. Check engine air intake system (refer to Section III, Topic 3).
2. Correct position of smoke stop. (Contact your "Allis-Chalmers" Construction Machinery Dealer.)
3. Drain fuel system and refill with fuel of proper specification (refer to Section I, Topic 4).

4. Energy cells plugged (HD 844 engines only).

4. Remove and clean or replace energy cells (refer to Section II, Topic 7).

Engine emits blue smoke from exhaust.

1. Engine operating temperature too low.
2. Lubricating oil in combustion chambers.
3. Fuel injection nozzles not operating properly.

1. Check thermostats (refer to Section IV, Topic 7).
2. Check for oil pull over from the air cleaner.
3. Test and adjust nozzles (refer to Section II, Topic 5).

2. ENGINE STARTING SYSTEM

Refer to pertinent Topics in Section VI for detailed information on the Engine Starting System.

TROUBLE	POSSIBLE CAUSES	REMEDY
Starter will not crank engine.	1. Batteries weak.	1. Check batteries.
	2. Cables and/or connections loose or corroded.	2. Tighten all loose connections and clean corrosion from all terminals.
	3. Electrical system master switch in off position (tractors Serial No. 4001 and above only).	3. Turn switch to on position.
	4. Starter switch inoperative. NOTE: <i>Manual switch, tractors prior to Serial No. 4001. Solenoid switch, tractors Serial No. 4001 and above.</i>	4. Clean switch contact surfaces or repair switch.
	5. Starter brushes worn or not contacting properly.	5. Install new brushes or fit brushes to conform to contour of commutator.
	6. Starter brush springs weak.	6. Check brush spring tension, replace springs if necessary.
	7. Starter commutator dirty or worn.	7. Polish commutator, machine commutator, and under-cut mica if necessary.
	8. Starter armature shaft bushings worn (armature drags on fields).	8. Replace worn bushings and related items.
	9. Starter armature burned out.	9. Replace armature.
Starter pinion will not engage with flywheel ring gear.	1. Grease and/or dirt in starter drive mechanism.	1. Disassemble and clean the drive assembly.
	2. Broken or excessively worn parts.	2. Replace broken or worn parts.

3. ENGINE FUEL SYSTEM

Refer to pertinent Topics in Section II for detailed information on the Engine Fuel System.

TROUBLE	POSSIBLE CAUSES	REMEDY
Insufficient fuel supply to fuel injection nozzles.	1. No fuel in fuel tank.	1. Fill fuel system with specified fuel. Vent fuel system.
	2. Inoperative fuel transfer pump.	2. Repair or replace transfer pump.
	3. Fuel injection nozzle valve stuck shut in valve body.	3. Replace valve assembly in nozzle holder body.
	4. Fuel lines and/or fuel filters clogged.	4. Clean fuel lines, replace fuel filter elements.
	5. Fuel injection pump malfunctioning.	5. Replace fuel injection pump.
	6. Fuel injection nozzles improperly adjusted.	6. Adjust fuel injection nozzles.

TROUBLE	POSSIBLE CAUSES	REMEDY
Air in fuel system.	1. Loose fuel line fitting or leak in fuel line on suction side of fuel transfer pump.	1. Tighten loose fitting or replace damaged line.
	2. Damaged gasket on first stage fuel filter.	2. Replace gasket.

4. ENGINE AIR INTAKE SYSTEM

Refer to pertinent Topics in Section III for detailed information on the Engine Air Intake System.

TROUBLE	POSSIBLE CAUSES	REMEDY
Insufficient air supply to cylinders.	1. Air cleaner and/or air cleaner pipe clogged.	1. Clean air cleaner and pipe.
Rapid wear on engine parts.	1. Dirt admitted with intake air.	1. Inspect air cleaner body, pipe, connecting hoses, gaskets, etc. thoroughly for cracks or openings which would allow air to enter engine without passing through air cleaner. Make necessary repairs.
	2. Dirty lubricating oil.	2. Change engine oil and the lubricating oil filter element at the intervals recommended. Keep oil clean when filling engine.
	3. Improper fuel.	3. Use the proper fuel (refer to Section I, Topic 4). It is important that the fuel be within the specified limits for ash, carbon, sulphur, etc. to prevent excessive wear on engine parts.

5. ENGINE COOLING SYSTEM

Refer to pertinent Topics in Section IV for detailed information on the Engine Cooling System.

TROUBLE	POSSIBLE CAUSES	REMEDY
Engine operating temperature too high with ample coolant in system.	1. Temperature gage inoperative.	1. Check gage. Replace if necessary (refer to Topic 8 in this Section).
	2. Radiator air passages restricted.	2. Clean exterior of radiator.
	3. Thermostats inoperative.	3. Replace thermostats.
	4. Loose or broken fan drive belts.	4. Adjust or replace fan drive belts.
	5. Lime deposits in water passages of radiator cylinder heads and/or cylinder block.	5. Thoroughly clean affected parts.
	6. Water passages in oil cooler restricted.	6. Remove and clean oil cooler core.
	7. Water pump inoperative.	7. Repair or replace water pump.
	8. Excessive load on tractor.	8. Reduce load.

TROUBLE**POSSIBLE CAUSES****REMEDY**

9. Engine speed set too high.

9. Adjust speed to within specified R.P.M. limits (refer to Section II, Topic 7).

10. On tractors with a torque converter the water passages in fluid heat exchanger restricted.

10. Remove and clean fluid heat exchanger core.

Engine operating temperature too high due to loss of coolant.

1. External leaks.
2. Ruptured oil cooler core (oil in coolant).
3. Cylinder head gaskets leaking.
4. Cylinder head cracked.
5. Cylinder block cracked.
6. Ruptured fluid heat exchanger core (fuel oil in coolant).

1. Repair affected parts.
2. Replace oil cooler core.
3. Replace gaskets and torque cylinder head nuts as specified.
4. Replace cylinder head.
5. Replace cylinder block.
6. Repair fluid heat exchanger core.

Engine operating temperature too low.

1. Thermostats stuck in open position.
2. Operating in extremely cold weather.

1. Replace thermostats (refer to Section IV, Topic 7).
2. Provide covers for radiator and engine side openings.

6. ENGINE LUBRICATING SYSTEM

Refer to pertinent Topics in Section V for detailed information on the Engine Lubricating System.

TROUBLE**POSSIBLE CAUSES****REMEDY**

No lubricating oil pressure.

1. Insufficient oil in crankcase.
2. Oil pressure gage inoperative.
3. Lubricating oil pump screens clogged.
4. Lubricating oil pump inoperative.
5. Oil lines loose or broken inside crankcase.

1. Fill crankcase to proper level.
2. Replace gage (refer to Topic 8 in this Section).
3. Remove and clean the screens.
4. Repair or replace oil pump.
5. Repair or replace affected parts.

Low lubricating oil pressure with proper oil level in crankcase.

1. Oil pressure gage inaccurate.
2. Oil pressure relief valve or regulator valve stuck in open position.
3. Oil lines in crankcase loose or broken.
4. Improper lubricant.

1. Check gage. Replace if necessary (refer to Topic 8 in this Section).
2. Clean, repair, or replace affected parts.
3. Repair or replace affected items.
4. Fill crankcase with specified lubricant (refer to Section I, Topic 3).

TROUBLE**POSSIBLE CAUSES****REMEDY****Excessive lubricating oil pressure.**

5. Main and/or connecting rod bearings worn.
6. Camshaft bearings worn.
7. Accessory drive shaft bushings worn.
8. Lubricating oil pump worn.

5. Replace bearings. (Refer to Section VIII, Topic 5 or 6.)
6. Replace bearings (refer to Section VIII, Topic 7).
7. Replace bushings and inspect related parts (refer to Section VIII, Topic 9).
8. Repair or replace oil pump.

Overheating of lubricating oil.

1. Oil pressure gage inaccurate.
2. Oil pressure regulating valve improperly adjusted.
3. Improper lubricant.

1. Check gage. Replace if necessary (refer to Topic 8 in this Section).
2. Adjust valve to obtain proper pressure.
3. Fill crankcase with specified lubricant (refer to Section I, Topic 3).

Excessive oil consumption.

1. Insufficient oil in crankcase.
2. Improper lubricant.
3. Engine oil cooler clogged.

1. Fill crankcase to proper level.
2. Fill crankcase with specified lubricant (refer to Section I, Topic 3).
3. Clean or replace the oil cooler.

1. External oil leakage (gaskets, etc.).
2. Crankshaft front and/or rear oil seals worn or damaged.
3. Lubricating oil too light.
4. Pistons, rings, and/or cylinder sleeves worn.
5. Oil control rings stuck in piston ring grooves.
6. Valve guides worn.

1. Correct all external leaks.
2. Replace oil seals (refer to Section VIII, Topic 5).
3. Fill crankcase with specified lubricant (refer to Section I, Topic 3).
4. Replace affected parts (refer to Section VIII, Topic 4 or 6).
5. Clean ring grooves and replace rings (refer to Section VIII, Topic 6).
6. Replace valve guides. Check related parts (refer to Section VIII, Topic 3).

Rapid wear on engine parts.

1. Lubricating oil contaminated.
2. Improper engine lubricating oil being used.

1. Fill system with clean engine oil. Replace engine oil filters.
2. Fill system with engine lubricating oil of proper specifications (refer to Section I, Topic 3).

7. ELECTRICAL SYSTEM

Refer to pertinent Topics in Section VI for detailed information on the Electrical System.

TROUBLE	POSSIBLE CAUSES	REMEDY
Generator not charging.	<ol style="list-style-type: none">1. Generator drive belts loose or broken.2. Generator regulator inoperative.3. Generator inoperative.	<ol style="list-style-type: none">1. Adjust or replace drive belts.2. Remove regulator for repair or replacement.3. Remove generator for repair or replacement.
Generator output low and/or unsteady.	<ol style="list-style-type: none">1. Generator drive belts improperly adjusted.2. Brushes sticking in brush holders.3. Brush spring tension too low.4. Generator commutator dirty or worn.5. Generator regulator operating improperly.	<ol style="list-style-type: none">1. Adjust drive belts.2. Free brushes in holders.3. Replace brush springs.4. Clean commutator or remove generator for repair or replacement.5. Remove regulator for repair or replacement.
Batteries will not hold charge.	<ol style="list-style-type: none">1. Loose terminals or connections.2. Short in electrical system.3. Short circuit in battery.4. Electrolyte level low (generator output excessive or cracked battery case).5. Generator regulator inoperative.	<ol style="list-style-type: none">1. Tighten affected parts.2. Correct short.3. Remove and repair or replace battery.4. Reduce charging rate. Remove and repair or replace battery.5. Remove regulator for repair or replacement.
Headlights and/or dash light will not light.	<ol style="list-style-type: none">1. Light bulbs burned out.2. Light fuse burned out.3. Loose wire connections.4. Inoperative light switch.5. Electrical system master switch in off position (tractors Serial No. 4001 and above only).	<ol style="list-style-type: none">1. Replace bulbs.2. Replace fuse.3. Tighten connections.4. Replace switch assembly.5. Turn switch to on position.
Dim headlights and/or dash light.	<ol style="list-style-type: none">1. Loose wire.2. Bad circuit ground wires.3. Low batteries.	<ol style="list-style-type: none">1. Tighten connections.2. Clean and tighten ground wires.3. Charge batteries.

8. INSTRUMENTS

If any of the instruments fail to register proper readings while the tractor is in operation, the system to which the instrument applies should be thoroughly checked as outlined in the preceding parts of this Section to determine the cause. If failure of the instrument is suspected, test by installing a new tested instrument in its place. Replace any inoperative instruments.

9. ENGINE STARTING AIDS (FOR COLD WEATHER STARTING)

Cold Weather Engine Primer

Failure of the cold weather engine primer to function properly can be caused by an inoperative pump or clogged fluid lines and strainer (refer to Section III, Topic 4).

Engine Air Heater (Optional Equipment)

Failure of the air heater to function properly can be caused by failure of the ignition or by a poor fuel spray (refer to Section III, Topic 5).

10. ENGINE CLUTCH AND TORQUE CONVERTER

Refer to pertinent Topics in Section IX for detailed information on the Engine Clutch and Torque Converter.

TROUBLE	POSSIBLE CAUSES	REMEDY
Engine clutch slipping (indicated by overheating of clutch).	<ol style="list-style-type: none">1. Clutch improperly adjusted.2. Clutch facings worn.3. Oil leaking into clutch housing from crankshaft rear oil seal.4. Excessive lubrication of clutch shifting bearing.	<ol style="list-style-type: none">1. Adjust clutch.2. Replace driven plate assembly.3. Check crankshaft rear oil seal. Replace if necessary (refer to Section VIII, Topic 5).4. Wash engine clutch.
Engine clutch hard to engage.	<ol style="list-style-type: none">1. Clutch improperly adjusted.2. Clutch linkage binding.	<ol style="list-style-type: none">1. Adjust clutch2. Repair or replace broken parts. Lubricate linkage.
Gears clash when shifting.	<ol style="list-style-type: none">1. Warped pressure plate or driven plate assembly.2. Clutch not releasing completely.3. Engine speed excessive.	<ol style="list-style-type: none">1. Replace affected parts.2. Adjust clutch and linkage.3. Reduce engine speed when shifting.
Torque converter operation erratic.	<ol style="list-style-type: none">1. Air in fuel system.2. Torque converter excessively hot.	<ol style="list-style-type: none">1. Vent fuel system (refer to Section II, Topic 7).2. Check cooling system (refer to Section IV, Topic 2 or 4).
Excessive fuel oil leakage from torque converter.	<ol style="list-style-type: none">1. Converter seals leaking.2. Fuel oil seepage around turbine housing rivets.	<ol style="list-style-type: none">1. Refer to Section IX, Topic 2.2. Replace turbine housing.

TROUBLE	POSSIBLE CAUSES	REMEDY
Engine will not turn when towing tractor to start the engine.	<ol style="list-style-type: none"> 1. Engine clutch slipping. 2. On tractors with a torque converter the overrunning clutch inoperative. 	<ol style="list-style-type: none"> 1. Adjust clutch. 2. Repair or replace overrunning clutch assembly. To determine condition of overrunning clutch, move the transmission shift lever to its neutral position, engage the engine clutch, and try to turn the drive shaft universal joint counterclockwise (viewed from the rear) by hand. If the shaft can be turned counterclockwise (viewed from rear) by hand the overrunning clutch is inoperative.
Engine will not "brake" the tractor speed when descending a steep grade.	<ol style="list-style-type: none"> 1. Engine clutch slipping. 2. On tractors with a torque converter the overrunning clutch inoperative. 	<ol style="list-style-type: none"> 1. Adjust clutch. 2. Refer to above paragraph.

11. TRANSMISSION AND SHIFTING MECHANISM

Refer to pertinent Topics in Section X for detailed information on the Transmission and Shifting Mechanism.

TROUBLE	POSSIBLE CAUSES	REMEDY
Transmission hard to shift.	<ol style="list-style-type: none"> 1. Burrs on gears. 2. Rough or worn splines on shaft or in gears. 3. Worn or bent shifting controls. 4. Lubricant too heavy. 	<ol style="list-style-type: none"> 1. Remove burrs or replace affected parts. 2. Smooth splines or replace affected parts. 3. Repair or replace affected parts. 4. Replace with specified lubricant (refer to Section I, Topic 3).
Transmission disengages during operation.	<ol style="list-style-type: none"> 1. Shifting forks incorrectly positioned on shafts. 2. Shifting lock mechanism worn. 3. Shifting forks worn or bent. 4. Excessively worn gears, bearings, or shafts (causing misalignment of mating gears). 	<ol style="list-style-type: none"> 1. Reposition shifting forks. 2. Inspect for worn or broken locking plungers or springs or for edges rounded off detent notches on shifting shafts. Replace affected parts. 3. Replace worn or damaged forks. 4. Replace affected parts.
Transmission noisy.	<ol style="list-style-type: none"> 1. Broken or worn gears, bearings, or shafts. 2. Bevel gear and pinion or bearings improperly adjusted. 3. Insufficient or improper lubricant. 	<ol style="list-style-type: none"> 1. Replace worn or broken parts. 2. Adjust as explained in Section X, Topic 3. 3. Fill to proper level with specified lubricant (refer to Section I, Topic 3).

12. STEERING BRAKES

Refer to pertinent Topics in Section XII for detailed information on the Steering Brakes.

TROUBLE	POSSIBLE CAUSES	REMEDY
Brakes do not hold.	<ol style="list-style-type: none">1. Oil or grease on brake linings due to over-lubrication of steering clutch throwout bearings or bevel gear shaft oil seal leakage.2. Brakes improperly adjusted.3. Brake linings worn.4. Brake band stretched or broken.5. Brake linkage not properly adjusted.6. Brake linkage broken.	<ol style="list-style-type: none">1. Wash brakes and correct cause.2. Adjust brakes.3. Replace brake linings.4. Replace brake band assembly.5. Adjust linkage.6. Replace broken parts.
Brake action erratic.	<ol style="list-style-type: none">1. Brake band adjustment support improperly adjusted.2. Brake lever bracket mounting capscrews loose.	<ol style="list-style-type: none">1. Adjust brake band support.2. Tighten capscrews attaching bracket to front wall of steering clutch compartment.
Brakes overheating.	<ol style="list-style-type: none">1. Improper use of brakes and/or steering controls.2. Brakes improperly adjusted.3. Oil or grease on brake linings due to over-lubrication of steering clutch throwout bearings or bevel gear shaft oil seal leakage.4. Brake linkage binding or broken.5. Brakes locked in partial applied position by binding parking brake locks.	<ol style="list-style-type: none">1. Fully disengage steering clutches before depressing brake pedals.2. Adjust brakes.3. Wash brakes and correct cause.4. Free linkage or replace broken parts.5. Free locks.
Brake linings wear rapidly.	<ol style="list-style-type: none">1. Improper use of brakes and/or steering controls.2. Brakes improperly adjusted.3. Brake linkage binding or broken.4. Brakes locked in partial applied position by binding parking brake locks.5. Brake drums rough and scored.	<ol style="list-style-type: none">1. Fully disengage steering clutches before depressing brake pedals.2. Adjust brakes.3. Free linkage.4. Free locks.5. Repair or replace brake drums.

TROUBLE**POSSIBLE CAUSES****REMEDY**

Brake pedals move when tractor is in motion.

1. Brakes improperly adjusted.
2. Brake drum hub warped.
3. Worn or damaged brake drums.
4. Brake drum hub attaching cap-screws loose.
5. Brake drum hub retaining screw loose.
6. Final drive pinion shaft bearings or bevel gear shaft bearings worn or damaged.

1. Adjust brakes.
2. Replace brake drum hub.
3. Replace brake drums.
4. Tighten capscrews.
5. Tighten retaining screw.
6. Install new bearings. (Refer to Section XIII, Topic 4 and Section X, Topic 3).

13. STEERING CLUTCHES AND CONTROLS

Refer to pertinent Topics in Section XI for detailed information on the Steering Clutches and Controls.

TROUBLE**POSSIBLE CAUSES****REMEDY**

Steering clutches slip.

1. Clutch control linkage improperly adjusted.
2. Oil or grease on clutch discs due to over-lubrication of steering clutch throwout bearings or bevel gear shaft oil seal leakage.
3. Friction discs worn.
4. Pressure springs weak.
5. Steel discs warped.

1. Adjust control linkage.
2. Wash clutches and correct cause.
3. Replace discs.
4. Replace springs.
5. Replace discs.

Steering clutch control levers "chatter" when operating.

1. Insufficient oil in steering hydraulic system.
2. Air in steering hydraulic system.
3. Clutch control linkage improperly adjusted.

1. Fill to the proper level with specified lubricant (refer to Section I, Topic 3).
2. Vent system.
3. Adjust control linkage.

Steering clutches will not disengage.

1. Steering hydraulic pump inoperative.
2. Steering hydraulic system leaking.
3. Air in steering hydraulic system.
4. Insufficient oil in steering hydraulic system.
5. Throwout yoke trunnion pin broken or out of yoke.

1. Repair or replace steering hydraulic pump.
2. Correct leaks.
3. Vent system.
4. Fill to proper level with specified oil (refer to Section I, Topic 3).
5. Repair or replace pin.

TROUBLE	POSSIBLE CAUSES	REMEDY
Steering clutches wear rapidly.	6. Steering clutch control linkage improperly adjusted.	6. Adjust linkage.
	1. Improper use of steering clutches.	1. Fully disengage steering clutches; do not slip clutches.
	2. Steering clutch control linkage improperly adjusted.	2. Adjust linkage.
	3. Foreign material in steering clutch compartment.	3. Wash steering clutches. Install compartment drain plugs when operating in mud or water.

14. MAIN FRAME AND EQUALIZING SPRING

Refer to pertinent Topics in Section XVII for detailed information on the Main Frame and Equalizing Spring.

TROUBLE	POSSIBLE CAUSES	REMEDY
Front end of tractor too low.	1. Equalizing spring leaves weak or broken.	1. Replace affected parts.
	2. Spring pivot pin worn or broken.	2. Replace pivot pin.
	3. Spring saddle bushings worn.	3. Replace bushings.

15. FINAL DRIVES

Refer to pertinent Topics in Section XIII for detailed information on the Final Drives.

TROUBLE	POSSIBLE CAUSES	REMEDY
Final drive oil seals leaking.	1. Sprocket shaft bearings improperly adjusted.	1. Adjust bearings.
	2. Seal rings not contacting on sealing faces.	2. Check springs in seal follower assembly.
	3. Seal rings worn or damaged.	3. Install new seal rings.
	4. Seal boot ruptured or torn loose from seal follower assembly.	4. Replace seal boot.
Final drive assembly noisy.	1. Insufficient supply of lubricant.	1. Fill to the proper level with specified lubricant (refer to Section I, Topic 3).
	2. Final drive gears.	2. Replace worn or broken parts.
	3. Bearings worn or out of adjustment.	3. Adjust or replace bearings.
Excessive wear on track sprockets.	1. Tracks improperly adjusted.	1. Adjust tracks (refer to Section XVI, Topic 2).
	2. Truck wheel flanges excessively worn.	2. Replace truck wheels.

TROUBLE**POSSIBLE CAUSES****REMEDY**

3. Track pins and bushings excessively worn.
4. Sprocket loose on shaft.
5. Sprocket shaft bearings out of adjustment or damaged.
6. Track support roller flanges excessively worn.
7. Track release inoperative.
8. Truck frames loose, twisted or broken.

3. Replace pins and bushings (refer to Section XVI, Topic 2).
4. Tighten sprocket retaining nut to 4500 to 5000 lbs. ft. torque.
5. Adjust or replace bearings.
6. Replace track support roller.
7. Replace the affected parts (refer to Section XIV, Topic 4).
8. Repair or replace affected parts (refer to Section XIV, Topic 2).

16. TRUCK WHEELS, TRACK SUPPORT ROLLERS, AND TRACK IDLERS

Refer to pertinent Topics in Section XIV for detailed information on Truck Wheels, Track Support Rollers, and Track Idlers.

TROUBLE**POSSIBLE CAUSES****REMEDY**

Excessive wear on truck wheel, support roller, and track idler flanges.

1. Tracks improperly adjusted.
2. Track idler out of line.
3. Truck frame bent or twisted.
4. Track rail assemblies excessively worn.

1. Adjust tracks (refer to Section XVI, Topic 2).
2. Adjust idler.
3. Repair or replace damaged parts.
4. Repair or replace the affected parts.

Bearings fail in truck wheels, support rollers, and/or track idlers.

1. Improper lubricant.
2. Bearings improperly adjusted.
3. Lubricant leakage.

1. Use only the specified lubricant in these assemblies when they are overhauled.
2. Adjust bearings.
3. Repair or replace the grease seals.

17. TRACKS

Refer to pertinent Topics in Section XVI for detailed information on the Tracks.

TROUBLE**POSSIBLE CAUSES****REMEDY**

Excessive wear on pins, bushings, and rails.

1. Tracks improperly adjusted.
2. Track sprocket teeth excessively worn.
3. Excessively worn truck wheels, track support rollers, or track idlers.
4. Track idler out of line.
5. Truck frames out of line.

1. Adjust tracks.
2. Replace sprocket (refer to Section XIII, Topic 2).
3. Repair or replace (refer to Section XIV).
4. Adjust track idler (refer to Section XIV, Topic 6).
5. Repair or replace truck frames (refer to Section XIV, Topic 2).

TROUBLE	POSSIBLE CAUSES	REMEDY
Parts of track worn.	1. Pins and bushings worn, but rails in good condition.	1. Pins and bushings may be turned. If pins and bushings are excessively worn, new pins and bushings should be installed.

18. TRACK RELEASE

Refer to Topic 4, Section XIV, for detailed information on the Track Release.

TROUBLE	POSSIBLE CAUSES	REMEDY
Track release mechanism does not operate properly.	<ol style="list-style-type: none"> 1. Accumulation of packed material in track release yoke area. 2. Release spring broken inside track release housing. 3. Improper fit of track idler brackets on slide bars. 4. Tracks improperly adjusted. 	<ol style="list-style-type: none"> 1. Clean all packed material from around track release yoke. 2. Replace spring. 3. Correct fit with adjusting shims. 4. Adjust tracks (refer to Section XVI, Topic 2).

19. TRUCK FRAMES

Refer to pertinent Topics in Section XIV for detailed information on the Truck Frames.

TROUBLE	POSSIBLE CAUSES	REMEDY
Truck frames out of line.	<ol style="list-style-type: none"> 1. Truck frames bent or twisted. 2. Truck frame pivot shaft and bushings worn. 3. Loose capscrews attaching sprocket shaft outboard bearing cage to truck frame. 4. Sprocket shaft outboard bearing excessively worn or broken. 	<ol style="list-style-type: none"> 1. Repair or install new frames. 2. Install new parts. 3. Tighten capscrews (refer to Section XIII). 4. Replace bearing (refer to Section XIII).

SECTION XXIII — SPECIAL TOOLS

In many cases, the use of special tools for disassembly and assembly are required to perform the particular operation and to obtain the best results. The use of special tools enables the serviceman, or mechanic, to perform the operation in the proper manner and in the least amount of time.

The following special tool listing was prepared to assist service and maintenance personnel in the selection of proper tools and combination of tools to accomplish the various service and maintenance operations described and illustrated in the model HD 16 tractor Service Manual.

The special tools listed below must be ordered directly from the tool manufacturer.

Tool Manufacturers:

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

(OTC) Owatonna Tool Company
Owatonna, Minnesota

Section No.	Figure No.	Manufacturers Tool Number and Description	
II	17	(KM) J-6865	Injection Nozzle Remover Adapter
		(KM) J-6471-1	Slide Hammer
		or	
		(OTC) AC-522	Injection Nozzle Puller Adapter
II	19	(OTC) 943-S	Slide Hammer
		(KM) J-6765	Fuel Injection Tube Nut Wrench
		or	
		(OTC) AB-1	Fuel Injection Tube Nut Wrench
II	21, 22	(KM) J-7176	Nozzle Tester Set
II	23	(KM) J-7853	Spray Cleaner with Wire
II	28	(KM) J-3179	Lapping Block Set
II	29	(KM) J-6882	Injection Nozzle Spring Retainer Nut Wrench
		(KM) J-6999	Injection Nozzle Holding Fixture
		or	
		(OTC) AC-520	Injection Nozzle Wrench
II	30	(OTC) AC-521	Injection Nozzle Holder
		(KM) J-7871	Fuel Injection Nozzle Bore Cleaner
		(KM) J-5585	Brush Set
		(KM) J-7857	Fuel Injection Nozzle Sleeve Remover
II	32, 33	(KM) J-7865	Fuel Injection Nozzle Sleeve Installer
		(KM) J-7079-2	Handle
		(KM) J-6471-1	Slide Hammer
		(KM) J-6471-2	Adapter
II	37	or	
		(OTC) 943-S	Slide Hammer
		(OTC) AC-43	Adapter
		(KM) J-6471-1	Slide Hammer
II	38	(KM) J-6471-8	Adapter
		or	
		(OTC) AC-42	Energy Cell Removing Adapter

Section No.	Figure No.	Manufacturers Tool Number and Description
II	39	(OTC) 943-S Slide Hammer Puller
		(KM) J-6308 Timing Gage
		or
II	44	(OTC) AC-41 Timing Gage
		(KM) J-7127 Tachometer Set
		(KM) J-8306 Tachometer Drive Cable
IV	17, 18, 19, 20	(KM) J-7165 Water Pump Service Tool Set
V	4	(OTC) 1001 Grip-O-Matic Puller
V	7	(OTC) 818 Bushing Driver Set
VIII	1, 2	(OTC) AC-525 Sling
VIII	13	(KM) J-7856 Rocker Arm Bracket Retaining Nut Wrench
VIII	14, 15, 16	(KM) J-6332 Rocker Arm Bushing Tool Set
VIII	21	(KM) J-8062 Valve Spring Compressor
		or
VIII	24	(OTC) CF-16 Valve Lifter
		(KM) J-8101 Valve Guide Cleaner
VIII	25	(KM) J-269 and J-3886 Valve Guide Remover
VIII	26	(KM) J-7858, J-7859, and J-7045 Valve Guide Installer
VIII	27	(KM) J-6896 and J-7145 Valve Guide Reamer
VIII	28	(KM) J-7861, J-7862, and J-7096 Valve Seat Installer
		(KM) J-7079-2 Handle
VIII	30, 31, 32	(KM) J-7040 and J-7042 Eccentric Valve Seat Grinder
VIII	34, 35	(KM) J-7059 Cylinder Sleeve Remover
VIII	37	(KM) J-8060 Cylinder Diameter Checking Gage
VIII	38	(KM) J-5902 Cylinder Hone
VIII	40	(OTC) 938 HYD Puller
		(OTC) 952-A Attachment
		(OTC) Y-21 Pump with Y-1 Gage
		(OTC) 938 Push-Puller
VIII	41	(OTC) 930-E Leg (2)
		(OTC) 17-M Adapter (2)
		(OTC) P-61 Push-Puller Ratchet and M-28 Handle
		(KM) J-3154-02 Oil Seal and Bearing Removing and Installing Set
VIII	45	(KM) J-6897 Crankshaft Front Oil Seal Protector
VIII	47	(KM) J-6471-2 Adapter
		(KM) J-6471-1 Slide Hammer
VIII	48	(OTC) 938 HYD Puller
		(OTC) 17-M Adapter (2)
		(OTC) Y-21 Pump with Y-1 Gage

Section No.	Figure No.	Manufacturers Tool Number and Description	
VIII	49	(KM)	J-8128 Piston Ring Remover and Installer
VIII	50	(KM)	J-6331 Piston Pin Driver
VIII	59, 60, 61	(KM)	J-6334 Camshaft Bushing Removing and Installing Set
VIII	66	(OTC)	1002 Grip-O-Matic Puller
		(OTC)	625-4 Shaft Protector
VIII	76	(OTC)	515-A Gear and Pulley Puller
		(OTC)	950 Pulling Attachment
VIII	80, 81, 82, 83	(OTC)	AC-524 Engine Lifting Sling
VIII	86, 89	(KM)	J-6837 Engine Stand — Less Adapter Plate
		(KM)	J-6347 Engine Stand Adapter Plate
VIII	90	(KM)	J-7062 Piston Inserter
		or	
		(OTC)	850-T Ring Compressor — Ratcheting
IX	12	(OTC)	AC-754 Torque Converter Lifting Eye
IX	22	(OTC)	AC-964 Turbine Housing Lifting Bracket
IX	22, 23	(OTC)	AC-966 Engine Clutch Housing Stand
IX	25	(OTC)	AC-963 Spanner Nut Wrench
		(OTC)	AC-962 Input Shaft Holding Tool
		(OTC)	AC-960 Spanner Nut Wrench
		(OTC)	AC-964 Turbine Housing Lifting Bracket
		(OTC)	AC-961 Turbine and Impeller Wheels Turning Tool
IX	26	(OTC)	AC-965 Torque Converter Stand
		(OTC)	AC-960 Spanner Nut Wrench
		(OTC)	AC-961 Turbine and Impeller Wheels Turning Tool
IX	27	(OTC)	AC-966 Engine Clutch Housing Stand
		(OTC)	AC-960 Spanner Nut Wrench
		(OTC)	AC-961 Turbine and Impeller Wheels Turning Tool
IX	29	(OTC)	AC-966 Engine Clutch Stand
		(OTC)	AC-962 Input Shaft Holding Tool
		(OTC)	AC-963 Spanner Nut Wrench
IX	30	(OTC)	AC-966 Engine Clutch Housing Stand
		(OTC)	AC-964 Turbine Housing Lifting Bracket
X	5, 6	(OTC)	AC-525 Sling
X	8	(OTC)	938 HYD Puller
		(OTC)	930-D Legs (2)
		(OTC)	17-M Adapter (2)
		(OTC)	630-5 Step Plate Adapter
		(OTC)	Y-21 Pump with Y-1 Gage
X	9, 10	(KM)	J-6471-1 Slide Hammer

Section No.	Figure No.	Manufacturers Tool Number and Description	
		(KM) J-6471-11 Adapter	
		or	
		(OTC) 943-S Slide Hammer	
		(OTC) 20-P Adapter	
X	13	(OTC) 938 HYD Puller	
		(OTC) 930-C Legs (2)	
		(OTC) 17-M Adapter (2)	
		(OTC) 630-5 Step Plate Adapter	
		(OTC) Y-21 Pump with Y-1 Gage	
X	14	(KM) J-6471-1 Slide Hammer	
		(KM) J-6471-11 Adapter	
		or	
		(OTC) 943-S Slide Hammer	
		(OTC) 20-P Adapter	
X	15	(OTC) 938 HYD Puller	
		(OTC) 952-A Attachment	
		(OTC) 930-B Legs (2)	
		(OTC) Y-21 Pump with Y-1 Gage	
		(OTC) 630-17 Step Plate Adapter	
X	16	(KM) J-6471-1 Slide Hammer	
		(KM) J-3154-13 Adapter Plate	
X	31, 32	(OTC) AC-972 Puller Screw	
		(OTC) 938P-4 Thrust Washer	
		(OTC) 938P-3 Hex Nut	
		(OTC) AC-973 Tube	
		(OTC) AC-974 Tube End Plate	
		(OTC) AC-692 Split Sleeve	
X	34, 35	(OTC) AC-972 Puller Screw	
		(OTC) 938P-3 Hex Nut	
		(OTC) 938P-4 Thrust Washer	
		(OTC) AC-976 Tube End Plate	
		(OTC) AC-975 Tube	
XI	11, 12, 14	(OTC) AC-300-A Steering Clutch Spring Compression Set	
XI	16	(OTC) AC-752 Puller Plate	
		(OTC) AC-972 Forcing Screw	
XI	26	(OTC) 809 Bushing Driver	
XIII	3	(OTC) 938 HYD Puller	
		(OTC) 930-B Leg (2)	
		(OTC) 20-P Adapter (2)	
		(OTC) Y-21 Pump with Y-1 Gage	
XIII	4	(OTC) AC-748 Sprocket Retaining Nut Wrench	
XIII	5	(OTC) Y-502-A Sprocket Puller Set	

Section No.	Figure No.	Manufacturers Tool Number and Description	
XIII	10	(OTC) 939-C	Puller Leg
		(OTC) 20-M	Adapter
XIII	11	(OTC) AC-752	Puller Plate
		(OTC) Y-15-14	Forcing Screw
XIII	13	(OTC) 938	HYD Puller
		(OTC) 930-B	Leg (2)
		(OTC) 943	Bearing Cup Pulling Attachment
		(OTC) 16-M	Adapter (2)
		(OTC) Y-21	Pump with Y-1 Gage
XIII	14	(OTC) 938	HYD Puller
		(OTC) 952-A	Attachment
		(OTC) Y-21	Pump with Y-1 Gage
		(OTC) 630-7	Step Plate
		(OTC) 930-D	Leg (2)
XIII	15	(OTC) 938	HYD Puller
		(OTC) 952-A	Attachment
		(OTC) 930-B	Leg (2)
		(OTC) 630-9	Step Plate
		(OTC) Y-21	Pump with Y-1 Gage
XIII	20	(OTC) 938	HYD Puller
		(OTC) 930-E	Leg (2)
		(OTC) AC-304	Plate
		(OTC) 630-8	Step Plate
		(OTC) Y-21	Pump with Y-1 Gage
XIII	21	(OTC) AC-529	Torque Wrench Adapter
		(OTC) DR-100-1	$\frac{3}{8}$ " Drive Torque Wrench
XIII	25	(OTC) AC-977	Outboard Bearing Installing Adapter
XIII	26	(OTC) AC-527	Torque Wrench Adapter
		(OTC) DR-100-1	$\frac{3}{8}$ " Drive Torque Wrench
XIII	27	(OTC) OA-24	Adjustable Wrench
XIV	3, 4	(OTC) Y30-A	Hydraulic Unit
		(OTC) Y-21	Pump with Y-1 Gage
		(OTC) Y30-12	Forcing Screw
		(OTC) Y30-13	Adjusting Crank
		(OTC) AC-325	Tube
		(OTC) AC-322	Adapter
		(OTC) 939-1/2	Threaded Adapter
XIV	5	(KM) J-3154-02	Oil Seal and Bearing Removing and Installing Set
XIV	8	(OTC) Y18	Hydraulic Unit
		(OTC) Y15-12	Forcing Screw
		(OTC) Y15-13	Adjusting Crank
		(OTC) 970-A	Puller Head
		(OTC) AC-530	Puller Leg (3)
		(OTC) 625-2	Shaft Protector

Section No.	Figure No.	Manufacturers Tool Number and Description
XIV	9	(OTC) 938 HYD Puller (OTC) 930-B Leg (2) (OTC) 16-M Adapter (2) (OTC) 630-9 Step Plate (OTC) Y-21 Pump with Y-1 Gage (OTC) 625-2 Shaft Protector
XIV	10	(OTC) 938 HYD Puller (OTC) 930-B Leg (2) (OTC) 32-M Adapter (2) (OTC) 952-D Attachment (OTC) Y-21 Pump with Y-1 Gage
XIV	11	(OTC) 938 HYD Puller (OTC) 930-C Leg (2) (OTC) 32-M Adapter (2) (OTC) 952-D Attachment (OTC) Y-21 Pump with Y-1 Gage
XIV	13	(OTC) Y18 Hydraulic Unit (OTC) Y15-12 Forcing Screw (OTC) Y15-13 Adjusting Crank (OTC) 970-A Puller Head (OTC) AC-530 Puller Leg (3) (OTC) AC-978 Tube (OTC) 630-17 Step Plate Adapter
XIV	18, 22	(Use Same Tools as Used in Figure 8, Section XIV)
XIV	24	(Use Same Tools as Used in Figure 13, Section XIV)
XVI	3, 4, 5	(OTC) Y50-A Hydraulic Unit (OTC) Y-21 Pump with Y-1 Gage (OTC) Y50-12 Forcing Screw (OTC) Y50-13 Adjusting Crank (OTC) Y650-1 Puller Head (OTC) Y650-2 Puller Leg (2) (OTC) Y650-3 Puller Base (OTC) Y650-5 Pushing Shank (OTC) Y650-16A Pushing Shank Guide (OTC) Y650-6 Pushing Adapter (OTC) Y650-12 Bushing
XVII	2	(KM) J-6471-1 Slide Hammer (KM) J-6471-12 Adapter or (OTC) 943-S Slide Hammer (OTC) 28-P Adapter
XXIII	1	(KM) J-6761-01 Cylinder Compression Gage Adapter (KM) J-6692 Cylinder Compression Gage and Hose Assembly

Section No.	Figure No.	Manufacturers Tool Number and Description	
XXIII	2	(KM) J-7850	Cylinder Compression Gage Adapter
		(KM) J-6692	Cylinder Compression Gage and Hose Assembly
		(KM) J-7850-5	Jumper Hose

The following items are also available:

(KM) J-6895	Geared Wrench Set (2000 lbs. ft.)	(OTC) R-100	Torque Wrench (0-100 lbs. ft.)
(KM) J-6459	Torque Wrench (0-50 lbs. in.)	(KM) J-1264-A	Torque Wrench (0-200 lbs. ft.)
(OTC) DR-100-1	Torque Wrench (0-100 lbs. in.)	(OTC) S-300	Torque Wrench (0-300 lbs. ft.)
(KM) J-1313-B	Torque Wrench (0-150 lbs. ft.)		



SECTION XXIV — OIL-TYPE STEERING CLUTCHES AND POWER BRAKES

(Effective in Production with Tractor S/N 5154)

Topic Title	Topic No.	Page No.
General Description	1	1
General Description of Hydraulic System ..	2	1
Steering Clutches and Controls	3	4
Steering Clutch Throwout Bearings and Actuating Pistons	4	12
Power Brakes and Controls	5	15
Steering Control Valve	6	20
Brake Operating Control Valves	7	23
Hydraulic Pump	8	25
Hydraulic System Oil Filters	9	28
Hydraulic System Hoses and Lines	10	29
Pressure Testing of Hydraulic System	11	31
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1. GENERAL DESCRIPTION

The two multiple disc, oil-type steering clutch assemblies, one located at each end of the bevel gear shaft, are provided for steering the tractor. The steering clutches are actuated (disengaged) hydraulically. Each steering clutch assembly is enclosed in a brake drum; each drum is bolted to a brake drum hub which is splined to the corresponding final drive pinion. The brake drums serve in

conjunction with the steering clutches by stopping the rotation of the final drives when the clutches are disengaged and the brakes are applied.

The two brakes are of the foot operated, hydraulic assist type. The brake bands operate in oil, on the brake drums which enclose the steering clutches.

2. GENERAL DESCRIPTION OF HYDRAULIC SYSTEM

A. General

The hydraulic system, which actuates both the steering clutches and the power brakes, consists basically of the following: Hydraulic pump, an oil filter (full-flow type) for each set of hydraulic pump gears, steering control valve assembly, an actuating piston and components for disengaging each steering clutch, a brake operating control valve assembly for applying each steering brake, and the necessary lines, hoses, and control linkage. The transmission, bevel gear compartment, and the steering clutch compartments have a common oil sump.

The hydraulic pump has two sets of pump gears. One set of pump gears supply oil under pressure

for disengaging the left steering clutch; this same set of pump gears supply oil under pressure to apply the right steering brake. The other set of pump gears supply oil under pressure for disengaging the right steering clutch; this same set of pump gears supply oil under pressure to apply the left steering brake.

The steering control valve assembly has two oil pressure relief valves for controlling the maximum pressure delivered to the steering clutch actuating pistons. These relief valves are of the adjustable type.

Each steering brake operating control valve assembly has an oil pressure relief valve, of the pre-set type.

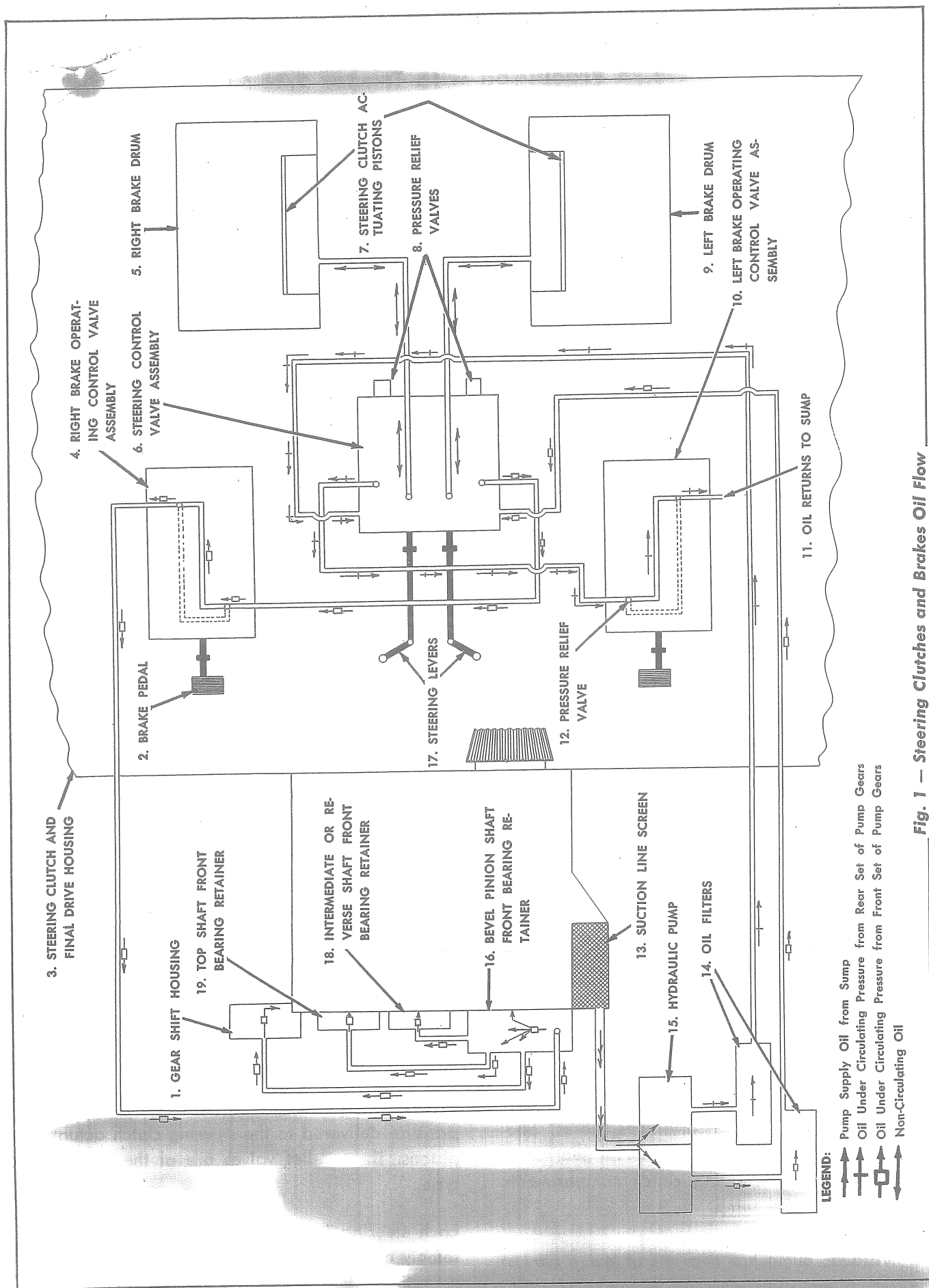


Fig. 1 -- Steering Clutches and Brakes Oil Flow Schematic -- All Control Valves in Neutral Position

B. Flow of Oil with Brake and Steering Controls in Neutral Position

The oil flow schematic shown in Fig. 1 and the following information are given to describe the flow of oil through the system when the steering and brake controls are in their neutral position:

1. The hydraulic pump draws oil through the suction line from the front of the transmission case.
2. The front set of pump gears supply oil under circulating pressure through the right oil filter and to the left side of the steering control valve housing.
3. The oil under circulating pressure passes through the left side of the steering control valve assembly to the right brake operating control valve assembly.
4. The oil, under circulating pressure, enters the right brake operating control valve, passes through the hole in the center of the brake valve piston, and flows through a hose assembly to a fitting in the bevel pinion shaft front bearing cover. Drilled passages in the bearing cover then direct the oil in four directions:
 - a. A portion of the oil is forced into a drilled oil passage extending the full length of the bevel pinion. A plug, specially drilled, is installed in the pinion end of this drilled oil passage and a portion of the oil supplied to this passage is forced through the plug and is thrown onto the bevel gear teeth. Cross drilled oil passages in the pinion shaft, connecting with the oil passage extending the full length of the pinion, provide lubricant to all the gear bushings assembled on the bevel pinion shaft.
 - b. On tractors with a torque converter, a portion of the oil is forced, through an external tube, to a fitting in the reverse shaft front bearing retainer. The oil lubricates the reverse shaft front bearing and spills back to the oil sump.
 - c. On tractors without a torque converter, a portion of the oil is forced, through an external tube, to a fitting in the intermediate shaft front bearing retainer and into a drilled oil passage in the front end of the intermediate shaft and through two cross drilled passages in the shaft to lubricate the high and low range gear bushings.
 - d. A portion of the oil is forced, through an external tube, to a fitting in the top shaft front bearing retainer. The oil lubricates the top shaft front bearing and spills back to the oil sump.
 - e. A portion of the oil is forced, through an external tube, to a fitting in the gear shift housing. The oil lubricates the gear shift lever and spills onto the front ends of the shifting fork shafts providing lubrication for the gear shifting shafts and shifting shaft lock components.
5. The rear set of pump gears supply oil under circulating pressure through the left oil filter and to the right side of the steering control valve housing.
6. The oil, under circulating pressure, passes through the right side of the steering control valve assembly to the left brake operating control valve assembly.
7. The oil, under circulating pressure, enters the left brake operating control valve, passes through the hole in the center of the brake valve piston, passes through a hole in the bottom of the valve housing, and returns directly to the left steering clutch compartment (oil sump).

C. Flow of Oil with Right Steering Clutch Disengaged and Right Brake Applied

1. The hydraulic pump draws oil through the suction line from the transmission case.
2. The rear set of pump gears supply oil under high pressure through the left oil filter and to the right side of the steering control valve housing. The oil, under high pressure,

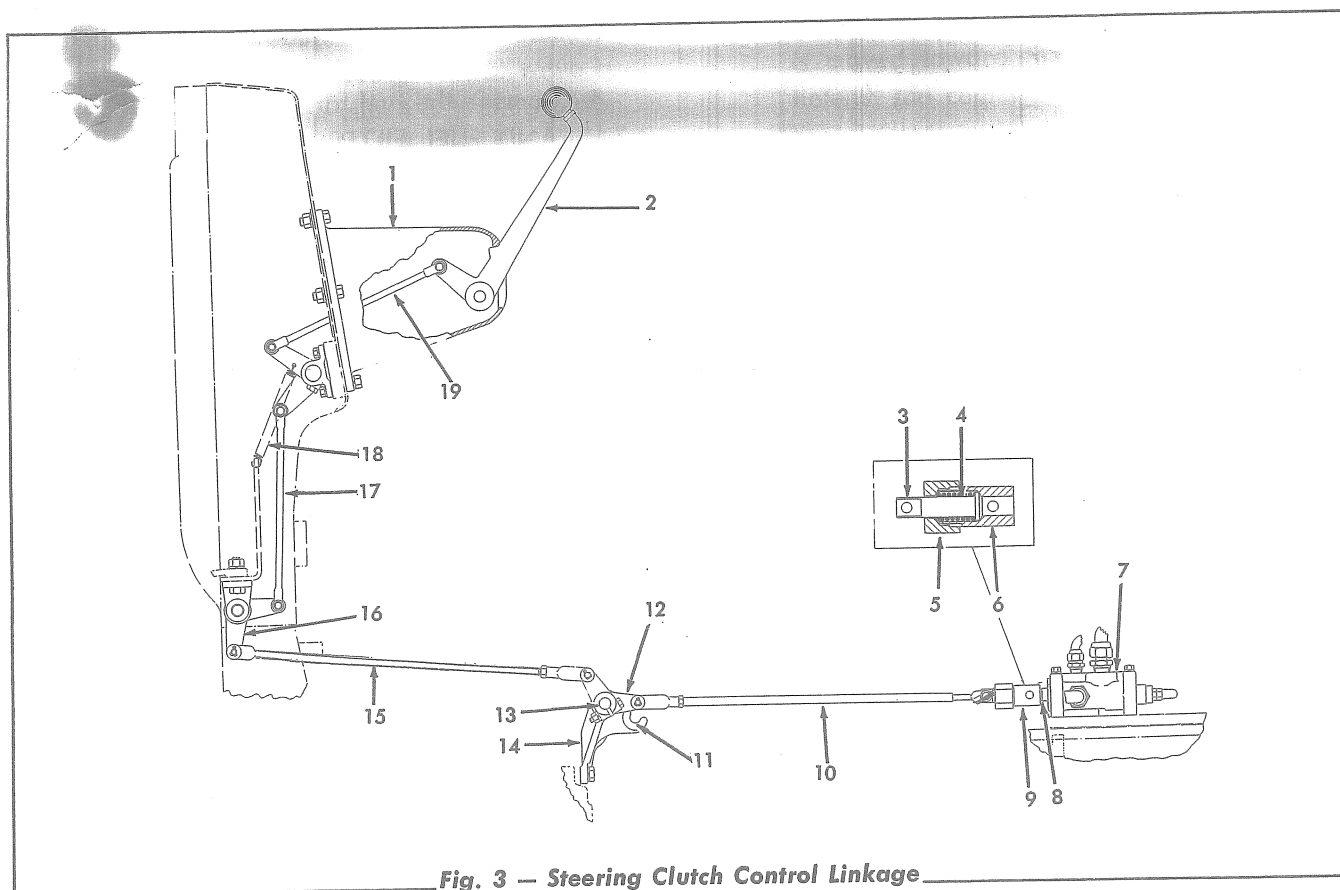


Fig. 3 — Steering Clutch Control Linkage
(Tractors With Torque Converter
Shown — Tractors Without
Torque Converter Similar)

- | | |
|-------------------------------------|----------------------------------|
| 1. Steering Lever Bracket | 11. Stop Slot |
| 2. Steering Lever | 12. Lower Rear Control Rod Lever |
| 3. Overtravel Plunger | 13. Lower Cross Shaft |
| 4. Overtravel Spring | 14. Lower Cross Shaft Bracket |
| 5. Overtravel Cap | 15. Lower Front Control Rod |
| 6. Overtravel Plunger Seat | 16. Bell Crank |
| 7. Steering Control Valve | 17. Vertical Control Rod |
| 8. Valve Plunger (Neutral Position) | 18. Retracting Spring |
| 9. Overtravel Assembly | 19. Upper Control Rod |
| 10. Lower Rear Control Rod | |

the steering clutch compartment.

13. Remove the cotter pin from the outer end of the top band pin (Fig. 6) then remove the pin from the brake band assembly. Remove the band lever bracket with yokes, lever, and pins from the steering clutch compartment. Remove the brake top section band assembly from the steering clutch compartment.
14. Remove the capscrews and lockwashers attaching the steering clutch assembly to the steering clutch driving hub. Remove the

capscrews and lockwashers attaching the brake drum hub to the brake drum. This will necessitate turning the clutch assembly and the brake drum which can be accomplished by using a jack under a track shoe grouser and moving the tractor.

15. Install a pin in the bottom section of the brake band and attach a chain to the brake band as shown in Fig. 7. Lift and remove the steering clutch and brake drum assembly from the steering clutch compartment.

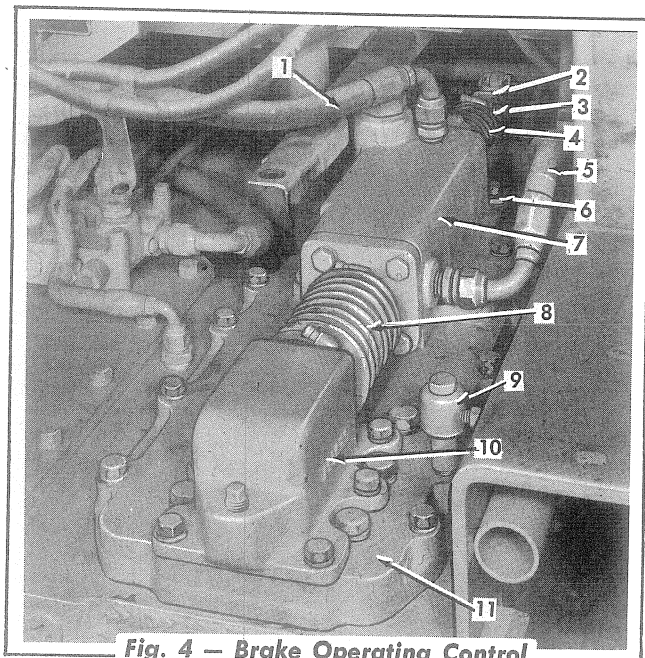


Fig. 4 — Brake Operating Control Valve Installed

1. Brake Control Hose
2. Brake Control Rear Rod
3. Yoke Pin
4. Valve Spool Boot
5. Brake Valve-to-Transmission Hose
6. Brake Pedal Retracting Spring Attaching Clip
7. Steering Control Valve
8. Linkage Cover Boot
9. Final Drive Compartment Breather
10. Band Linkage Cover
11. Steering Clutch Compartment Cover Plate

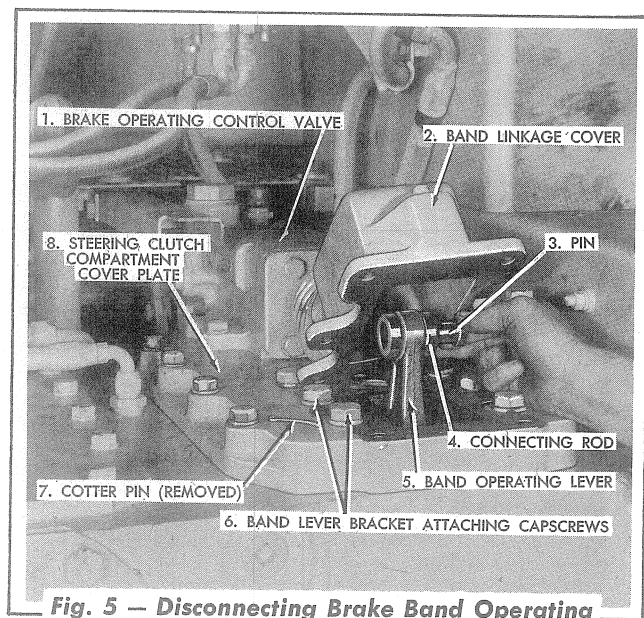


Fig. 5 — Disconnecting Brake Band Operating Lever from Connecting Rod

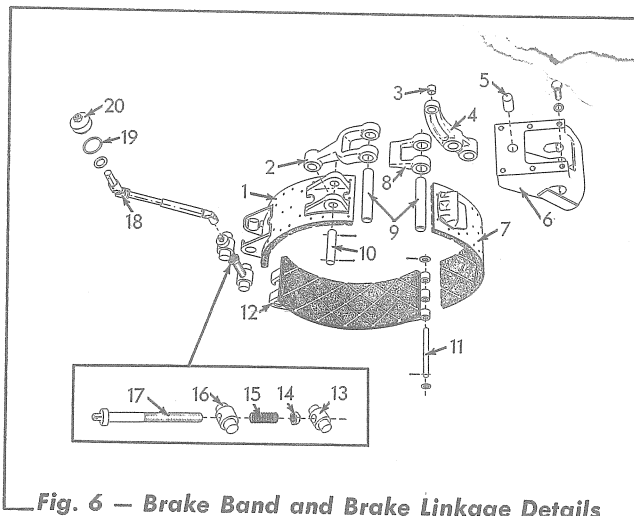


Fig. 6 — Brake Band and Brake Linkage Details

1. Top Section Band Assembly
2. Band Upper Yoke
3. Bushing
4. Band Operating Lever
4. Dowel Pin
6. Band Lever Bracket
7. Intermediate Section Band Assembly
8. Band Lower Yoke
9. Yoke Pins
10. Top Band Pin
11. Band Hinge Pin
12. Bottom Section Band Assembly
13. Adjusting Screw Pin, Lower
14. Nut
15. Spring
16. Adjusting Screw Pin, Upper
17. Band Adjusting Screw
18. Adjusting Screw Universal Drive Assembly
19. Gasket
20. Brake Adjustment Access Plug

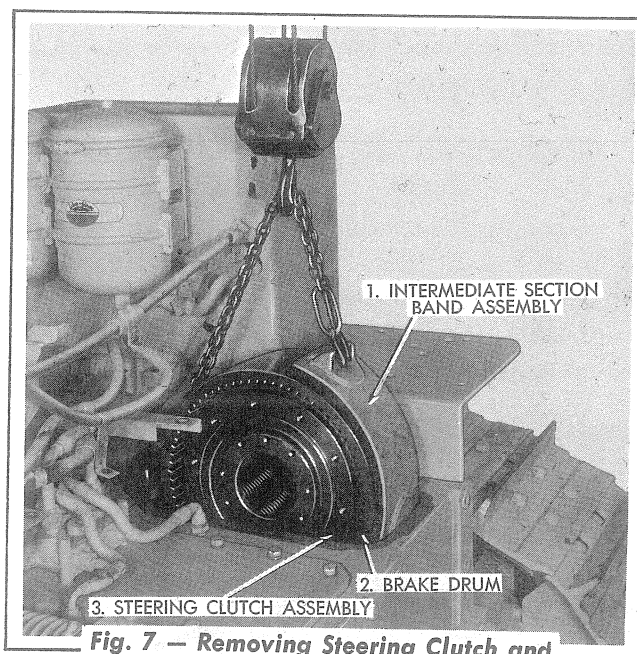


Fig. 7 — Removing Steering Clutch and Brake Drum Assembly

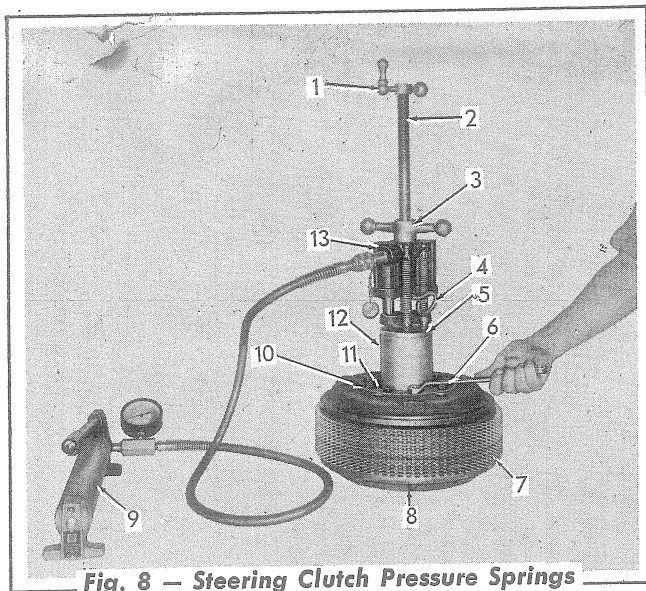


Fig. 8 — Steering Clutch Pressure Springs Compressed to Remove Throwout Plate Capscrews

1. Adjusting Crank
2. Special Forcing Screw
3. Speed Nut
4. Pin
5. Tube End Plate
6. Wrench
7. Steering Clutch Assembly
8. Tool Backing Plate
9. Hydraulic Pump
10. Throwout Plate Capscrew
11. Step Plate
12. Tube
13. Hydraulic Ram

D. Disassembly of Steering Clutch

NOTE: *The following disassembly procedure applies to either steering clutch:*

1. Remove the brake drum from the steering clutch assembly, using care to prevent damage to the clutch disc teeth.
2. Before disassembling the steering clutch assembly, center punch or mark the pressure plate, steering clutch hub, and throwout plate so that they may be reassembled in the same relative position.
3. Remove the locking wires from the throwout plate capscrews used in holding the steering clutch assembly together. Compress the steering clutch pressure springs using special tools similar to the ones shown

in Figs. 8 and 9 and remove the throwout plate capscrews. Slowly release the pressure from the hydraulic ram, allowing the assembly to separate until all tension is taken off of the steering clutch pressure springs.

4. Remove the pressure plate, steel and friction discs, and back plate from the clutch hub. Remove the clutch hub, pressure springs, and throwout plate spacers from the throwout plate.

E. Inspection of Steering Clutch Components

After the steering clutch has been disassembled inspect the following:

1. Steel Discs

The specified thickness for a new steel disc is .084" to .096". Inspect the discs for wear and scoring. The discs must be straight and flat within .015". Fifteen (15) steel discs are used in each clutch.

2. Friction Discs

The specified thickness for a new friction disc is .152" to .157". Inspect the discs for wear, condition of teeth, and the condition of the friction material. If the thickness of the disc is less than .132", or if the grooves in the friction material have worn away, new discs must be installed. Fifteen (15) friction discs are used in each clutch.

3. Pressure Springs

Each pressure spring, when new, exerts a pressure of 760 to 840 lbs. when compressed to 4.50". If a spring does not check reasonably close to this tolerance, it is an indication that it has lost its tension and a new spring should be installed.

4. Steering Clutch Hub

Inspect the steering clutch hub splines for wear as heavy grooving may cause binding with the teeth of the steel discs.

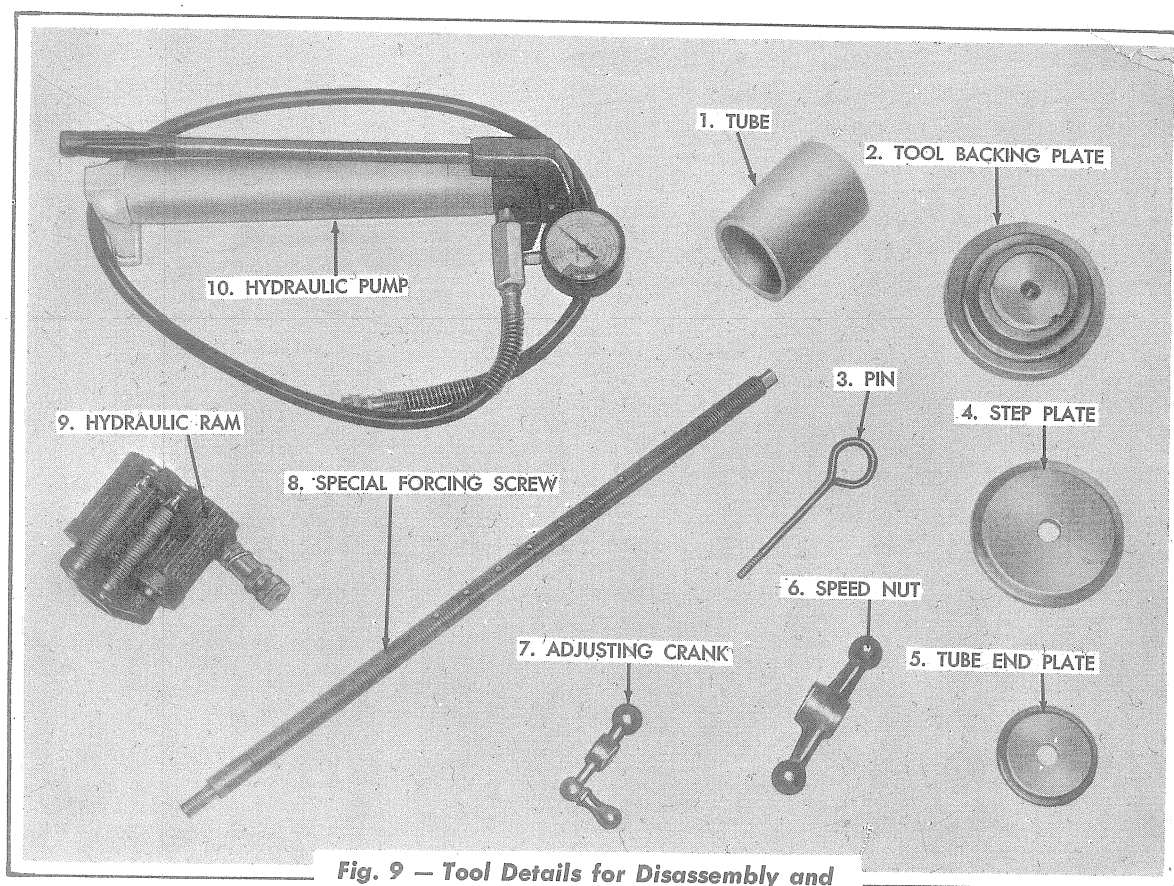


Fig. 9 — Tool Details for Disassembly and Assembly of Steering Clutch

5. Back Plate

The specified thickness for a new back plate is .245" to .255". Inspect the plate for wear and scoring. The plate must be straight and flat within .015".

F. Assembly of Steering Clutch

When assembling the clutch, refer to Fig. 10 showing the components in their relative positions.

1. Place the clutch hub, flanged side downward, on a work bench. Install the clutch back plate in position on the clutch hub.
2. Beginning with a friction disc installed next to the clutch back plate, stack 15 friction discs and 15 steel discs alternately on the clutch hub as shown in Fig. 10.
3. Measure the distance from the top steel disc to the top of the clutch hub as shown in Fig. 11. If this distance is more than $\frac{37}{64}$ ", add another steel disc to the top of

the disc stack. If this distance is less than $\frac{29}{64}$ ", remove a steel disc from the disc stack. After obtaining the proper disc stack height, remove the discs and back plate from the clutch hub, keeping the discs in their proper positions.

4. Place the tool backing plate (Fig. 9) on a work bench and place the clutch throw-out plate, flat face downward, in position on the tool backing plate.
5. Place the brake drum, final drive side downward, over the throwout plate. Keep the brake drum raised even with the throwout plate by placing wooden blocks between the drum and the work bench as shown in Fig. 12.
6. Place a pressure spring over each spring boss of the throwout plate and insert a throwout plate spacer into each spring.
7. Install the clutch hub in position over the springs making certain the locating punch

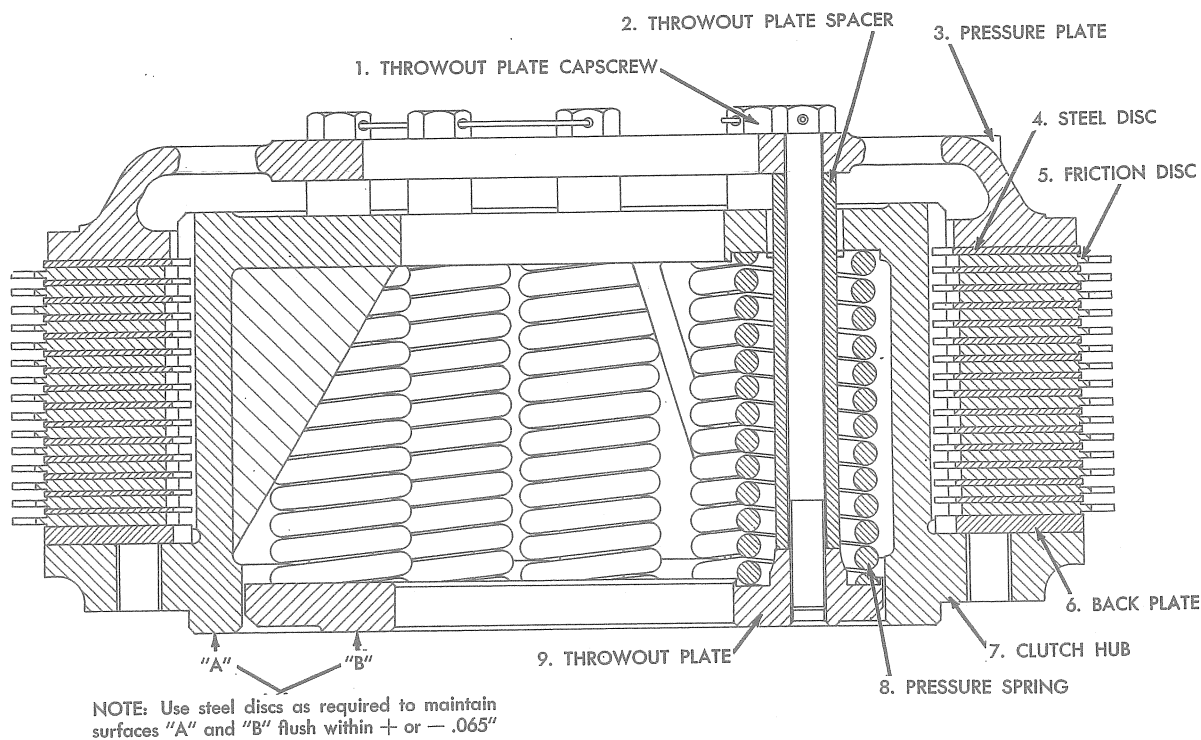


Fig. 10 — Steering Clutch Assembly

marks on the clutch hub and the throwout plate are aligned.

8. Install 2 aligning studs (Fig. 12) through the throwout plate spacers and screw the studs into the plate. Install the clutch back plate in position on the clutch hub.
9. Install the same clutch discs on the hub in the positions as originally installed in Step 2 above. Place the pressure plate in position, making certain the punch marks are aligned. Place the tool step plate on the clutch hub followed by the tool compressing tube (Fig. 12).
10. Insert the tool forcing screw and turn the screw into the tool backing plate. Install the tube end plate, hydraulic ram, and speed nut and compress the pressure springs. Install seven throwout plate cap screws and tighten evenly.

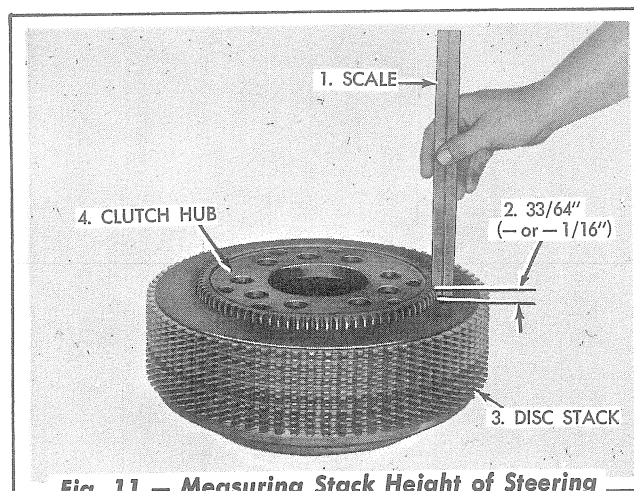


Fig. 11 — Measuring Stack Height of Steering Clutch Discs

11. Remove the aligning studs and install the two remaining throwout plate cap screws. Tighten all cap screws evenly to a torque of 90 lbs. ft. NOTE: The throwout plate cap screws are special cap screws designed for this application; do not substitute standard cap screws in their place.

12. Release the pressure from the hydraulic ram and remove the special tools. Remove the clutch assembly from the brake drum.
13. Using a straight edge and feeler gage, measure the distance between the machined end of the clutch hub and the face of the throwout plate as shown in Fig. 13; these surfaces **MUST** be flush within plus or minus .065". If the throwout plate extends out more than .065" from the face of the hub, another steel disc (or discs) must be installed next to the pressure plate. If the throwout plate is more than .065" below the face of the hub, remove a steel disc from next to the pressure plate.
14. Install new locking wires to secure the throwout plate capscrews.
15. Install the steering clutch in position in the brake drum, using care to prevent damage to the teeth of the clutch discs.

G. Installation of Steering Clutch

1. Install the steering clutch by a direct reversal of the removal procedure, using new gaskets where gaskets are required. *NOTE: Thoroughly clean the steering clutch compartment before installing the steering clutch and use extreme care to prevent dirt from entering the compartment while the clutch is being installed.*
2. Install the brake linkage and adjust the brakes (refer to "POWER BRAKES AND CONTROLS" in this Section).
3. Install the oil drain plug in the bottom of the steering clutch compartment and fill the system to the proper level with the specified oil.
4. If the adjustment of the steering clutch control linkage was disturbed refer to the following Par. H. and adjust the linkage.

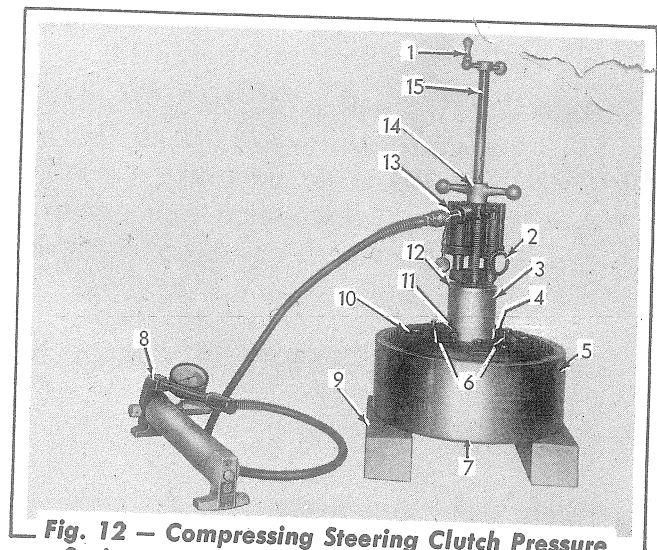


Fig. 12 — Compressing Steering Clutch Pressure Springs to Install Throwout Plate Capscrews

1. Adjusting Crank
2. Pin
3. Tube
4. Step Plate
5. Brake Drum
6. Aligning Studs
7. Tool Backing Plate
8. Hydraulic Pump
9. Wooden Block
10. Clutch Pressure Plate
11. Throwout Plate Capscrew
12. Tube End Plate
13. Hydraulic Ram
14. Speed Nut
15. Special Forcing Screw

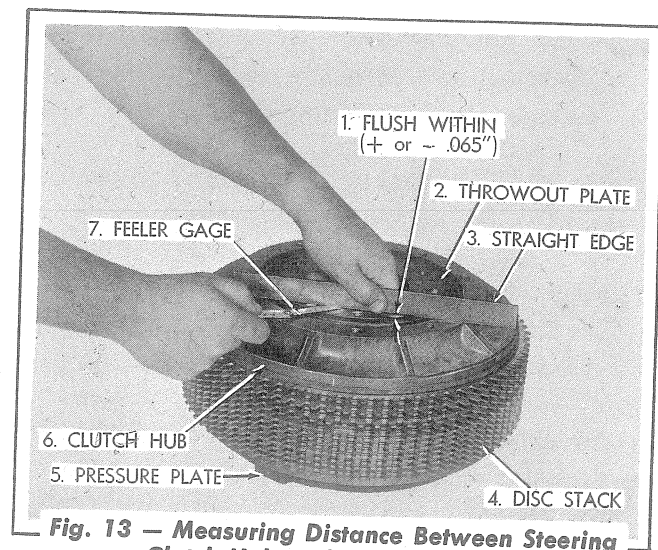


Fig. 13 — Measuring Distance Between Steering Clutch Hub and Throwout Plate

H. Adjustment of Steering Clutch Control Linkage

1. Refer to Fig. 3 and adjust the length of the lower rear control rods so that the stop pins in the levers of the lower rear control rods bottom in the stop slots of the bracket assembly when the valve plungers of the

steering control valve have been pulled forward $\frac{1}{4}$ " from their neutral position.

2. With the valve plungers of the steering control valve in their neutral position, adjust the length of the lower front control rods so that the upper side of the steering levers (hand levers) contact the steering lever bracket as shown in Fig. 3.

4. STEERING CLUTCH THROWOUT BEARINGS AND ACTUATING PISTONS

A. Description

Each steering clutch throwout bearing and actuating piston assembly consists of the following parts: Throwout tapered roller bearing, throwout sleeve, actuating piston (with inner and outer piston rings), collector ring, and three piston springs.

The throwout sleeve is a sliding fit on the steering clutch driving hub. The throwout bearing cone is a press fit on the throwout sleeve. The throwout bearing cup is a press fit in the actuating piston and the actuating piston is a sliding fit in the collector ring. The function of the piston springs is to keep the throwout bearing cup tight against the bearing cone when no hydraulic pressure is being applied to the actuating piston.

When the steering control valve is actuated, oil under pressure enters the pressure cavity in the collector ring and forces the actuating piston, throwout bearing, and throwout sleeve outward thereby disengaging the steering clutch.

B. Removal of Steering Clutch Throwout Bearings and Actuating Pistons

The steering clutch throwout bearings and actuating pistons should be removed and the parts inspected whenever the steering clutches are removed. **NOTE:** *The following removal procedure applies to either throwout bearing or actuating piston. Refer to Fig. 2 showing the components in their relative positions.*

1. Remove the steering clutch (refer to "STEERING CLUTCHES AND CONTROLS" in this Section).

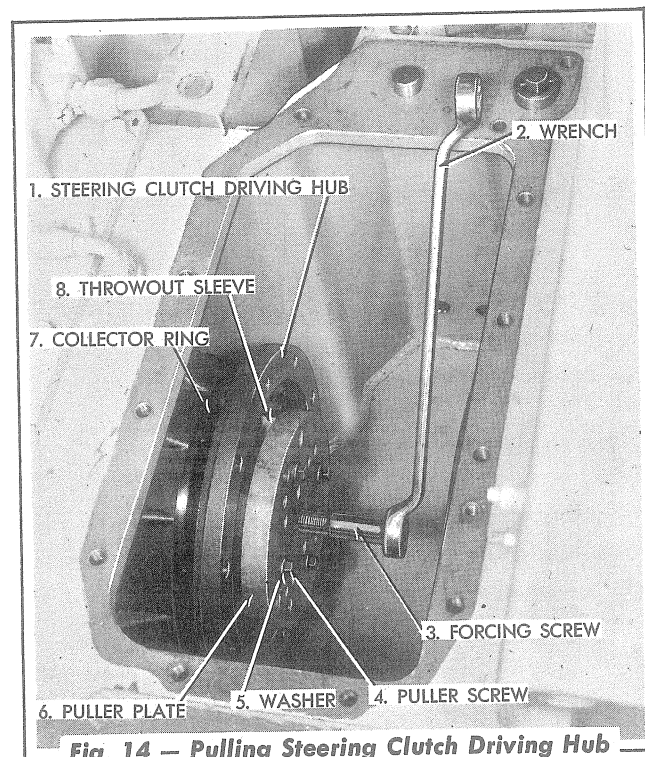


Fig. 14 — Pulling Steering Clutch Driving Hub

2. Unlock the clutch driving hub retaining cap-screw and turn it out approximately $\frac{1}{8}$ ". Using puller tools similar to the ones shown in Fig. 14, pull the steering clutch driving hub loose from the bevel gear shaft. Remove the puller tools. Remove the hub retaining cap-screw, lockwasher, and the hub retaining washer.
3. Remove the steering clutch driving hub, throwout sleeve, and throwout bearing cone. Remove the actuating piston and throwout bearing cup and the piston springs from the collector ring.
4. Disconnect the piston oil supply tube from

the collector ring. Remove the capscrews and lockwashers attaching the collector ring to the bevel gear shaft bearing cage and remove the collector ring.

C. Inspection of Steering Clutch Throwout Bearings and Actuating Pistons

1. Inspect the throwout bearings for worn or pitted rollers or races. Make certain that the roller retainers are not bent or damaged and that the rollers revolve freely.
2. Inspect the I. D. of the collector ring for nicks or scratches. Inspect the O.D. of the actuating piston for nicks or scratches and check the condition of the piston rings. If the piston rings are damaged in any way, replace the rings as follows:

- a. Remove the old piston rings from the actuating piston and carefully clean the grooves in the piston.
- b. Place the new piston rings in a container of water heated to $140^{\circ} - 160^{\circ}$ F. for about 15 minutes, then install the piston rings in position in the actuating pistons as shown in Fig. 15. Use care when installing the rings and stretch the rings only enough to permit their installation. **CAUTION:** The piston rings contain trifluorochloroethylene resin, or "Teflon." Do not destroy used piston rings by burning, as the fumes from burning "Teflon" are very toxic when inhaled.

- c. After the piston rings have been installed in the grooves of the pistons, refer to Fig. 16, and tighten hose clamps as shown around the rings to seat the rings properly in the pistons. Leave the hose clamps installed on the rings for about 30 minutes, allowing the rings to cool, then remove the hose clamps.

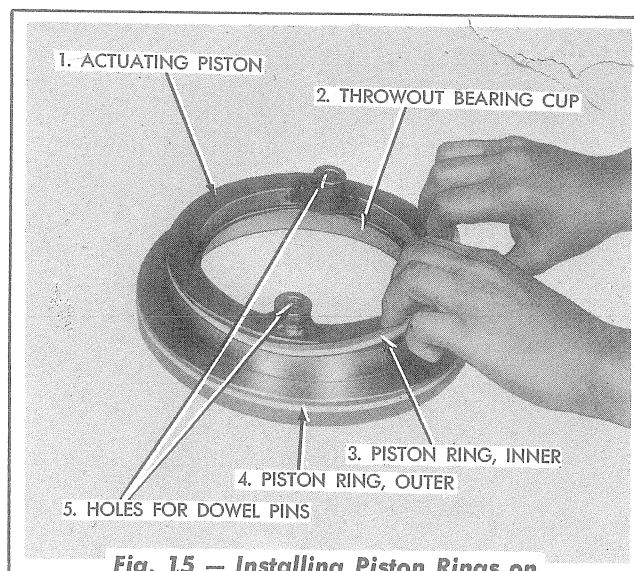


Fig. 15 — Installing Piston Rings on Actuating Piston

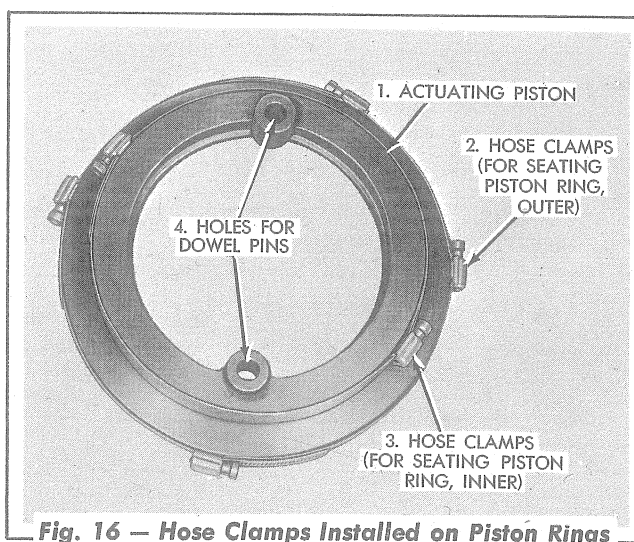


Fig. 16 — Hose Clamps Installed on Piston Rings

D. Installation of Steering Clutch Throwout Bearings and Actuating Pistons

1. Press the throwout bearing cup into position in the actuating piston.
2. Insert the piston springs into position in the collector ring as shown in Fig. 17. Lubricate the piston rings with clean oil and install the actuating piston in position in the collector ring, using care to prevent damage to the piston rings.

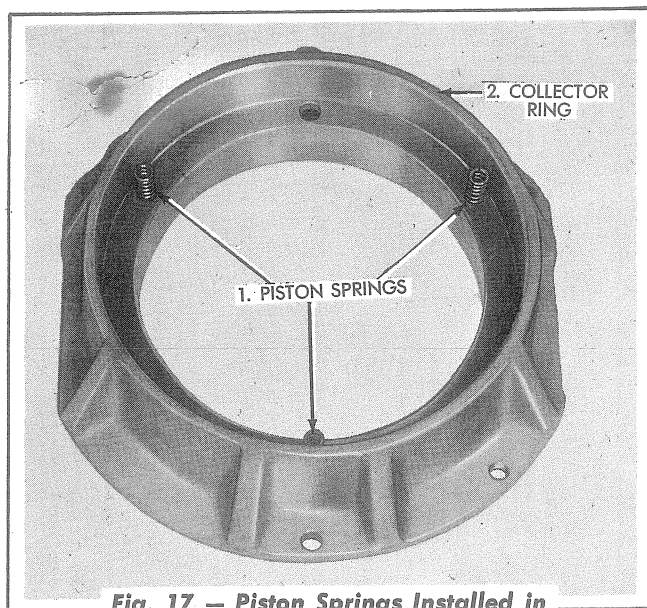


Fig. 17 — Piston Springs Installed in Collector Ring

3. Install the collector ring in position on the bevel gear bearing cage, making certain that the actuating piston is properly installed on the dowel pins in the bearing cage, and secure with capscrews and lockwashers. Connect the piston oil supply tube to the collector ring.
4. Press the throwout bearing cone into position on the throwout sleeve. Lubricate the bearing cone and the inside of the throwout sleeve with clean oil and insert the throwout sleeve in position in the steering clutch driving hub. Install the throwout sleeve and driving hub in position on the

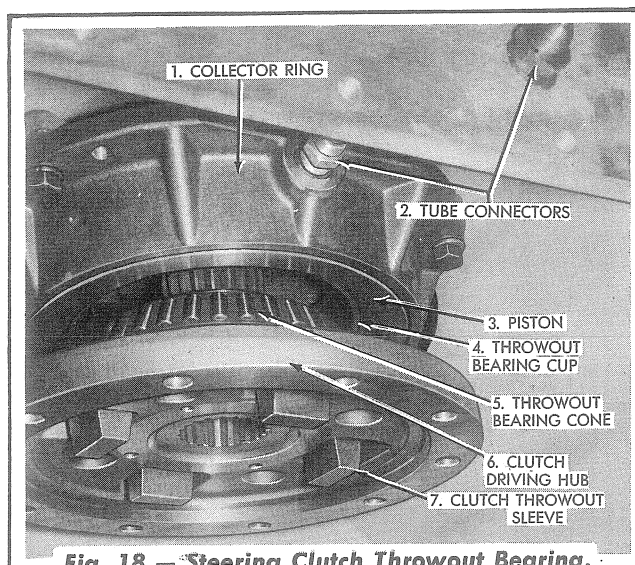


Fig. 18 — Steering Clutch Throwout Bearing, Throwout Sleeve, and Driving Hub on Bevel Gear Shaft

- bevel gear shaft. Install the hub retaining washer, a new lockwasher, and the hub retaining capscrew. Tighten the hub retaining capscrew to a torque of 400 lbs. ft. and lock with the lockwasher.
5. Install the steering clutch (refer to "STEERING CLUTCHES AND CONTROLS" in this Section).
6. Install the oil drain plug in the bottom of the steering clutch compartment and fill the system to the proper level with the specified oil.

5. POWER BRAKES AND CONTROLS

A. General

The two brakes are of the foot operated, hydraulic assist type. When the engine is not running, or if the hydraulic system should fail, the brakes can still be applied mechanically by depressing the brake pedals, however, in this case considerable pressure on the brake pedals is required to apply the brakes. The brake band assemblies are of the three piece type with replaceable lining.

The brake band assemblies operate in oil, on brake drums which enclose the steering clutches.

B. Brake Band Adjustment

The brake control linkage is properly adjusted at the factory and no further adjustment to the brake control linkage should be necessary. The linkage is adjusted so that when the brake pedals are fully released (pedal levers contacting the stop blocks in the floor plate) there is $\frac{3}{16}$ " clearance (Dim. "A," Fig. 28) between each valve spool and each brake valve piston. This dimension is obtained by adjusting the yoke on the brake control linkage front rod.

As the brake linings wear, it will become necessary to adjust the brake bands. Due to variable operating conditions, specific time intervals for brake band adjustment are not given. The brake bands require adjustment when it is possible to depress the brake pedals $4\frac{1}{2}$ " or more, using moderate pressure on the pedals with the engine STOPPED. Adjust each brake band as follows:

1. Remove the brake adjustment access plug (Fig. 19).
2. Turn the brake band adjusting screw clockwise until the brake band assembly is tight around the brake drum, then back off (loosen) the band adjusting screw 3 clicks ($1\frac{1}{2}$ turns).
3. Install and tighten the brake adjustment access plug.

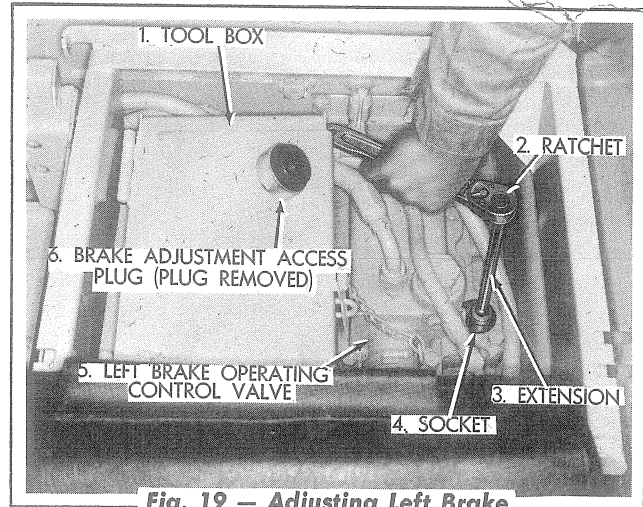


Fig. 19 — Adjusting Left Brake

C. Parking Brake Locks

The parking brake locks provide a means of holding the brakes in the applied position. With the engine running, depress the brake pedals to apply the brakes, then push down on the parking brake lock lever rod knobs (Fig. 21) to engage the parking brake locks. To disengage the parking brake locks, further depress the brake pedals and the lock lever return springs will return the brake lock lever rod knobs to their neutral position.

D. Removal of Brake Bands

In order to remove the brake band assemblies, it is necessary to remove the steering clutch and brake drum assemblies (refer to "REMOVAL OF STEERING CLUTCHES" in this Section).

E. Inspection of Brake Components

1. The brake band linings must be replaced, or new bands installed, before the linings are worn to a point where the lining retaining rivets will contact and score the brake drums.
2. If the steering brake drum is worn, scored, or grooved excessively, it must be removed and replaced.

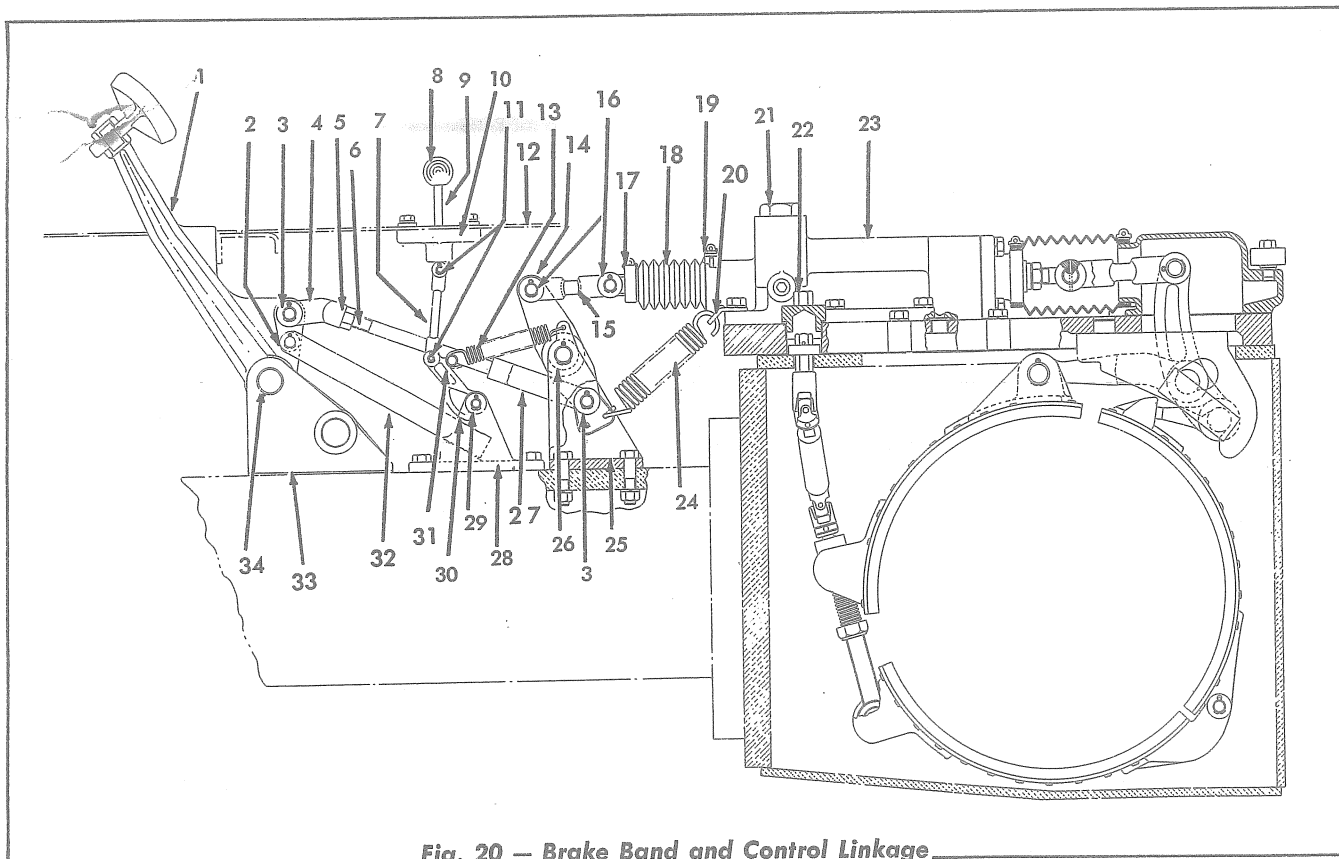


Fig. 20 — Brake Band and Control Linkage

1. Brake Pedal Lever
2. Brake Lock Pin w/Cotter Pin
3. Brake Rod Pin
4. Brake Rod Yoke
5. Jam Nut
6. Brake Rod
7. Brake Lock Connecting Link
8. Brake Lever Knob
9. Brake Lock Rod
10. Brake Lock Bracket
11. Brake Lock Connecting Link Pins w/Cotter Pins
12. Floor Plate
13. Brake Lock Retracting Spring
14. Brake Control Rod Lever
15. Brake Connecting Link
16. Connecting Link Pins w/Cotter Pins
17. Front Boot Clamp

18. Boot
19. Rear Boot Clamp
20. Spring Clip
21. Brake Pressure Relief Valve Nut
22. Brake Adjustment Access Plug
23. Brake Operating Control Valve
24. Brake Retracting Spring
25. Lever Bracket
26. Brake Control Rod Lever Yoke Pin w/Cotter Pin
27. Brake Rod Rear Yoke
28. Brake Lock Lever Bracket
29. Brake Lock Lever Pin w/Cotter Pin
30. Brake Lock Lever
31. Brake Lock Spring Retaining Capscrew
32. Brake Locking Bar
33. Brake and Engine Clutch Lever Bracket
34. Brake Lever Shaft with Roll Pin

3. Inspect the brake band end pins, yokes, yoke pins, and brake band operating lever bushings for wear. Replace the necessary parts.

4. Actuate each brake pedal to make certain that the pedal bracket needle bearings are in good condition.

5. All pins and bushings should be lubricated sparingly when reinstalled.

F. Installation of Brake Bands

1. Connect the bottom section brake band to the intermediate section band with a hinge pin, plain washers, and cotter pins. Place

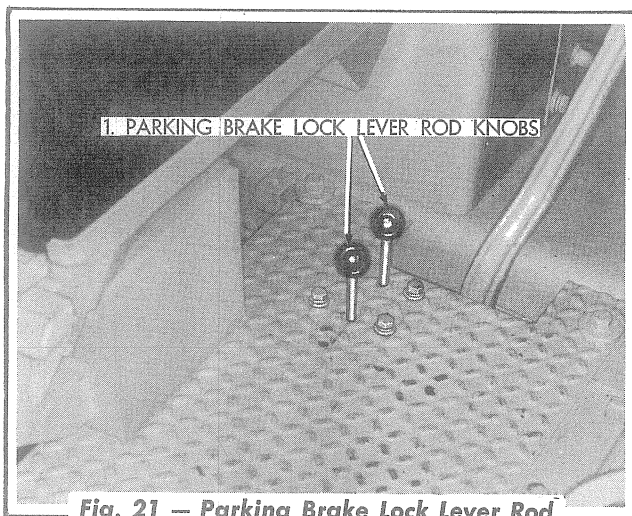


Fig. 21 — Parking Brake Lock Lever Rod Knob Location

the two band sections around the brake drum and steering clutch assembly and lower the entire assembly into the steering clutch compartment (refer to Fig. 7).

2. Secure the steering clutch assembly to the clutch driving hub with capscrews and lockwashers. Secure the brake drum to the brake drum hub with capscrews and lockwashers. Tighten all the attaching capscrews to a torque of 180 — 190 lbs. ft.
3. Refer to Fig. 22, and lower the band adjusting screw and adjusting screw universal drive lower section into position in the steering clutch compartment. Start the lower section of the universal drive assembly in position on the upper section, engage the lower adjusting screw pin in position in the pin bracket of the bottom section band assembly, and hold the adjusting screw assembly in this position. Place the top section band assembly in position on the brake drum and engage the upper adjusting screw pin in position in the pin bracket of the top section band assembly.
4. Refer to Fig. 23 and place the band upper yoke and the band operating lever in position in the band lever bracket as shown. Insert the yoke pin.

5. Refer to Fig. 24 and install the band lower yoke and yoke pin on the band operating lever as shown.
6. Place the band lever bracket assembly in position on the brake band sections, inserting the band lower yoke into the yoke bracket on the intermediate section band assembly as shown in Fig. 22. Install the top band pin to connect the band upper yoke to the top section band assembly. Secure the top band pin in position by installing a cotter pin in each end of the pin.
7. Place a new steering clutch compartment cover plate gasket in position on the steering clutch housing. Place the steering clutch compartment cover plate in position on the steering clutch housing.
8. Position the band lever bracket so that the lever bracket dowel pin (Fig. 25) is aligned with the dowel pin hole in the cover plate. Start the six capscrews and lockwashers attaching the band lever bracket to the steering clutch compartment cover plate but do not tighten the capscrews at this time.
9. Position the steering clutch compartment cover plate so that the dowel pin in the steering clutch and final drive housing enters the dowel pin hole in the cover plate. Install the capscrews and lockwashers to attach the cover plate to the housing and tighten the capscrews to a torque of 70 — 90 lbs. ft.
10. Tighten the capscrews attaching the band lever bracket to the cover plate to a torque of 150 — 165 lbs. ft.
11. If the brake operating control valve has been removed from the steering clutch compartment cover, install the valve, and connect the brake control linkage (refer to "BRAKE OPERATING CONTROL VALVES" in this Section).

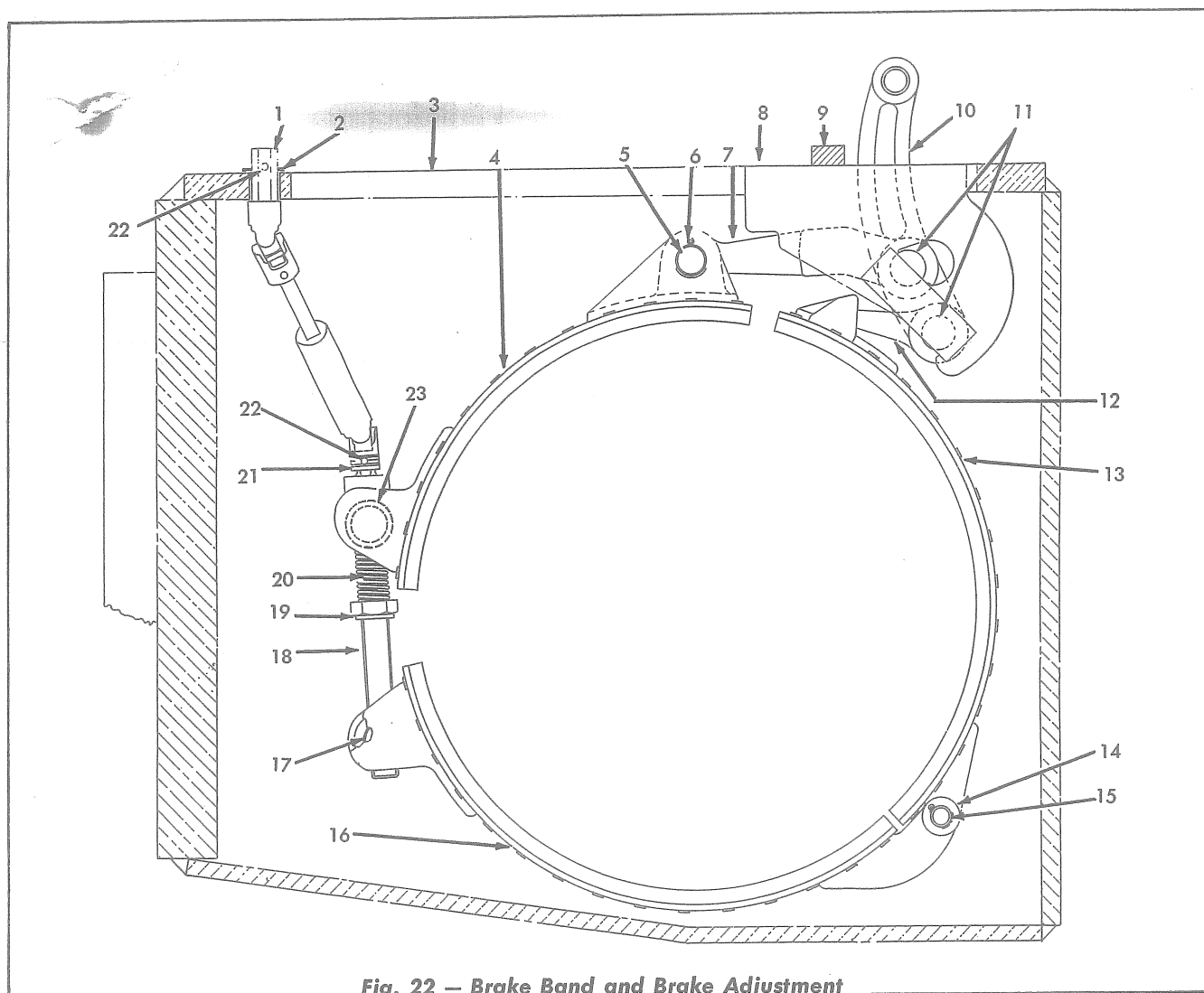


Fig. 22 — Brake Band and Brake Adjustment Assembly — Sectional View

- | | |
|---|--|
| 1. Brake Adjusting Screw Universal Assembly (Upper Section) | 13. Intermediate Section Band Assembly |
| 2. Plain Washer | 14. Washer |
| 3. Steering Clutch and Final Drive Housing | 15. Hinge Pin w/Cotter Pin |
| 4. Top Section Band Assembly | 16. Bottom Section Band Assembly |
| 5. Yoke Pin | 17. Lower Adjusting Screw Pin |
| 6. Cotter Pin | 18. Band Adjusting Screw |
| 7. Band Upper Yoke | 19. Adjusting Screw Nut |
| 8. Band Lever Bracket | 20. Spring |
| 9. Lever Bracket Dowel Pin | 21. Adjusting Screw Universal Assembly (Lower Section) |
| 10. Brake Band Operating Lever | 22. Roll Pin |
| 11. Band Operating Lever Yoke Pins | 23. Upper Adjusting Screw Pin |
| 12. Band Lower Yoke | |

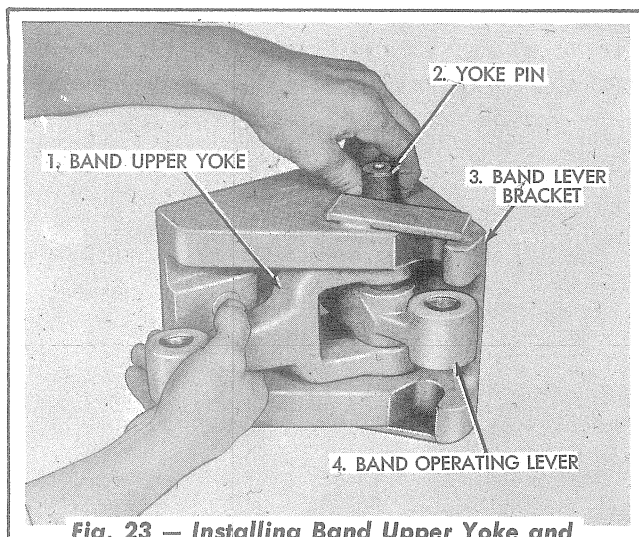


Fig. 23 — Installing Band Upper Yoke and Operating Lever in Band Lever Bracket

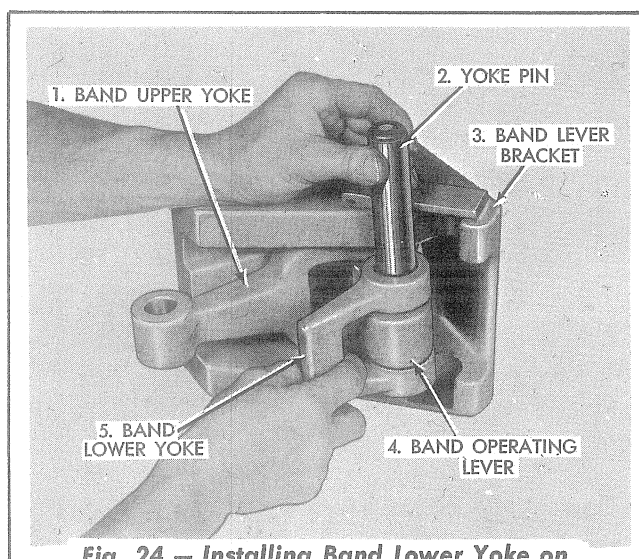


Fig. 24 — Installing Band Lower Yoke on Band Operating Lever

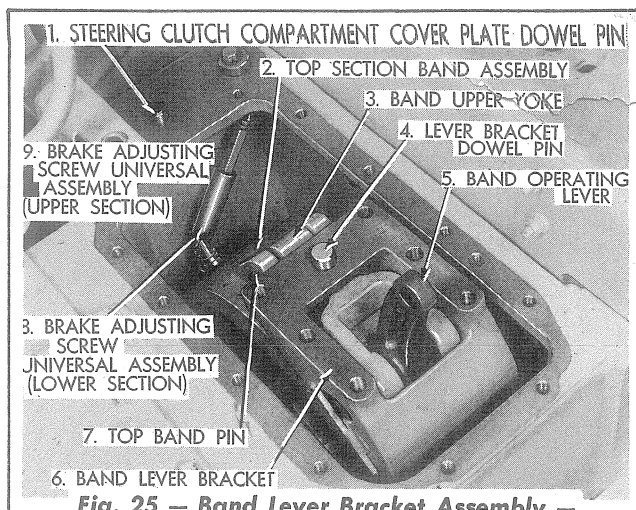


Fig. 25 — Band Lever Bracket Assembly — Installed

12. Adjust the brakes (refer to "BRAKE BAND ADJUSTMENT" in this Topic).
13. Install the fuel tank.
14. Install the oil drain plug in the bottom of the steering clutch compartment and fill the system to the proper level with the specified oil.

6. STEERING CONTROL VALVE

A. Description

The steering control valve is mounted on the bevel gear compartment cover. The steering control valve is actually two control valves contained in a common housing (refer to Fig. 26). Each valve has an independent oil supply and contains an operating plunger and an adjustable type pressure relief valve. The hydraulic pump has two sets of gears. The front set of gears supply oil to the left side of the steering control valve and the rear set of gears supply oil to the right side of the valve. Oil supplied to the left side of the steering control valve disengages the left steering clutch when the left steering control lever is pulled back and also supplies oil under circulating pressure to the right brake operating control valve. Oil supplied to the right side of the steering control valve disengages the right steering clutch when the right steering control lever is pulled back and also supplies oil under circulating pressure to the left brake operating control valve.

When the left steering control lever is in the neutral position, the left operating plunger is in approximately the position shown in Fig. 26. Oil under circulating pressure entering cavity "A" (Fig. 26) through the left inlet port flows into cavity "B" and out of cavity "B" through the outlet port (located in the top of the valve housing Fig. 27) to the right brake operating control valve. No pressures are built up within the valve and the left steering clutch remains engaged.

When the left steering control lever is pulled back, the left operating plunger is pulled forward $\frac{1}{4}$ ". The forward movement of the plunger closes cavity "B" and opens cavity "C" (Fig. 26). At the same time the slotted hole in the plunger (cavity "D") moves forward so that it no longer registers with cavity "C". Oil entering cavity "A" (Fig. 26) through the left inlet port flows into cavity "C" and out of cavity "C" through the outlet port (located in the top of the valve housing Fig. 27) to the left steering clutch. Pressure builds up in cavities "A" and "C" and behind the actuating piston in the left steering clutch and disengages the steering clutch. When the pressure in cavities "A" and "C" reaches the relief valve opening pressure, the relief valve

opens and allows excess oil to pass into cavity "B" and to the right brake operating control valve.

When the left steering control lever is returned to the neutral position, the left operating plunger returns to approximately the position shown in Fig. 26. The slotted cavity in the plunger (cavity "D") allows oil to transfer from cavity "C" to cavity "E" and the oil pressure drops to circulating pressure in cavities "A", "C", "B" and behind the actuating piston in the left steering clutch. When the oil pressure against the steering clutch actuating piston drops to circulating pressure, the steering clutch pressure springs cause the clutch to engage. The excess oil entering cavity "E" returns to the oil sump in the bevel gear compartment through the port in the bottom of the valve housing (Fig. 26).

When the right steering control lever is actuated, the flow of oil is the same as described above except that the oil flows through the cavities in the right side of the steering control valve and the right steering clutch is disengaged. Excess oil from the right side of the control valve supplies oil under circulating pressure to the left brake operating control valve.

B. Removal, Disassembly, and Inspection of Steering Control Valve

1. Thoroughly clean the exterior of the steering control valve and the surrounding area. Disconnect all hoses from the valve. Remove the capscrews and lockwashers attaching the steering control valve to the bevel gear compartment cover and remove the valve.
2. Loosen the relief valve adjustment caps Fig. 27, and remove the caps, acorn nuts, jam nuts, and adjusting screws as an assembly. Remove the relief valve spring guide and the relief valve spring.
3. Remove the hex-socket pipe plugs from the front end of the valve housing.
4. Push the relief valve plungers and the relief valve guides (Fig. 27) out of the valve housing toward the rear.

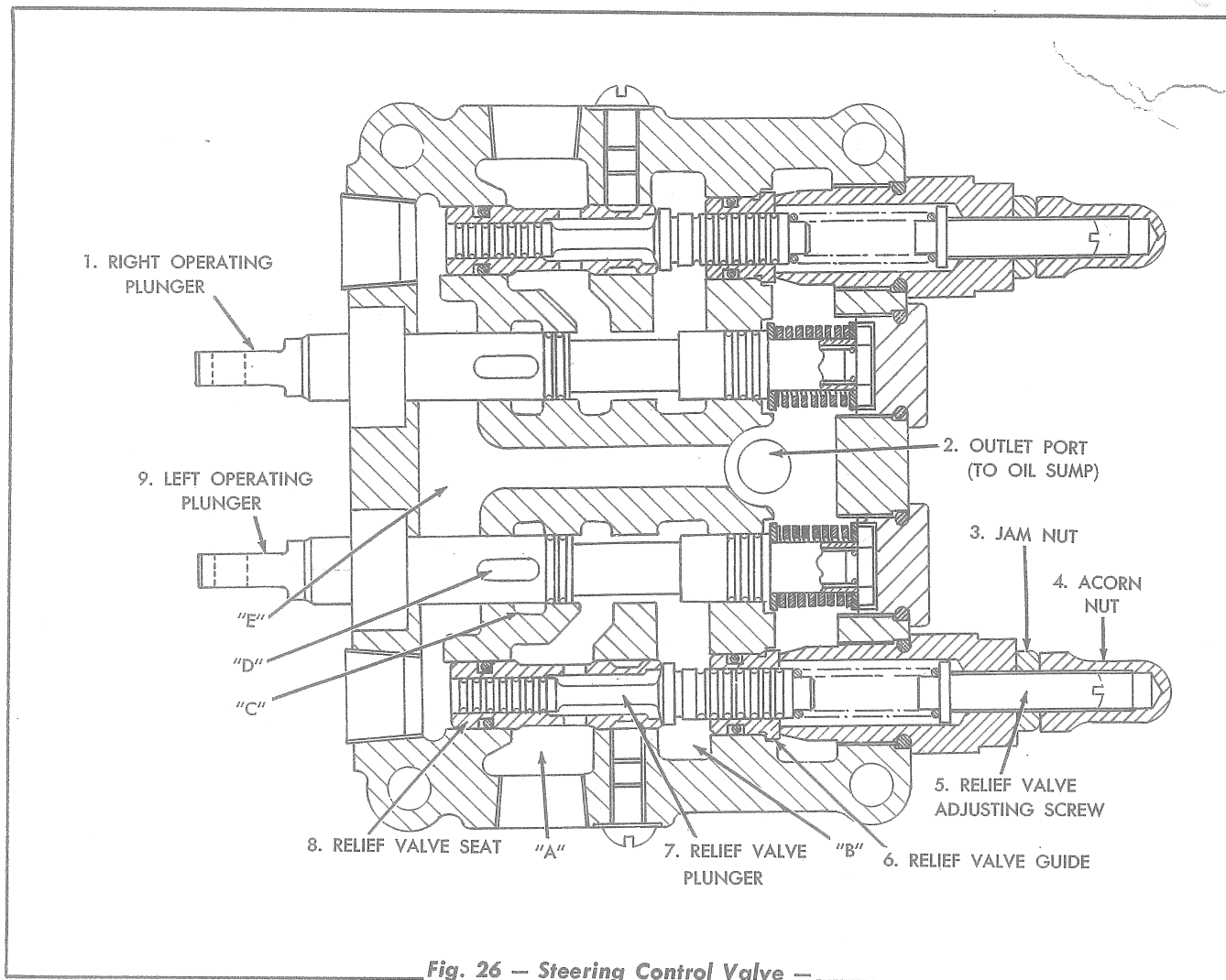


Fig. 26 — Steering Control Valve —
Sectional View

5. If it is necessary to remove the relief valve seats (Fig. 27), remove the slotted head screw and gasket from each side of the valve housing then remove the hex-socket setscrews (Fig. 27). Press the relief valve seats out of the housing toward the front.
6. Remove the operating plunger caps (Fig. 27) from the rear of the valve housing. Remove the spring retaining capscrew, spring, and washers from the rear end of each operating plunger and pull the plungers from the valve housing from the front.
7. Inspect the pressure relief valve seat and the valve plunger for dents or scratches. Inspect the relief valve springs and the operating plunger springs. Inspect the operating plunger bores in the valve housing.

Inspect the condition of the operating plunger oil seals. Repair or replace any worn or damaged parts.

C. Assembly and Installation of Steering Control Valve

The steering control valve may be assembled and installed by a direct reversal of the removal and disassembly procedure. After the valve is installed and connected the adjustment of the pressure relief valves must be tested and the relief valves adjusted if necessary (refer to "PRESSURE TESTING OF HYDRAULIC SYSTEM" in this Section). **CAUTION:** If for any reason the pressure relief valve adjusting screw was removed; when the adjusting screw is installed, turn it in only far enough to contact the relief valve spring guide (Fig. 27) then test and adjust the pressure relief valve.

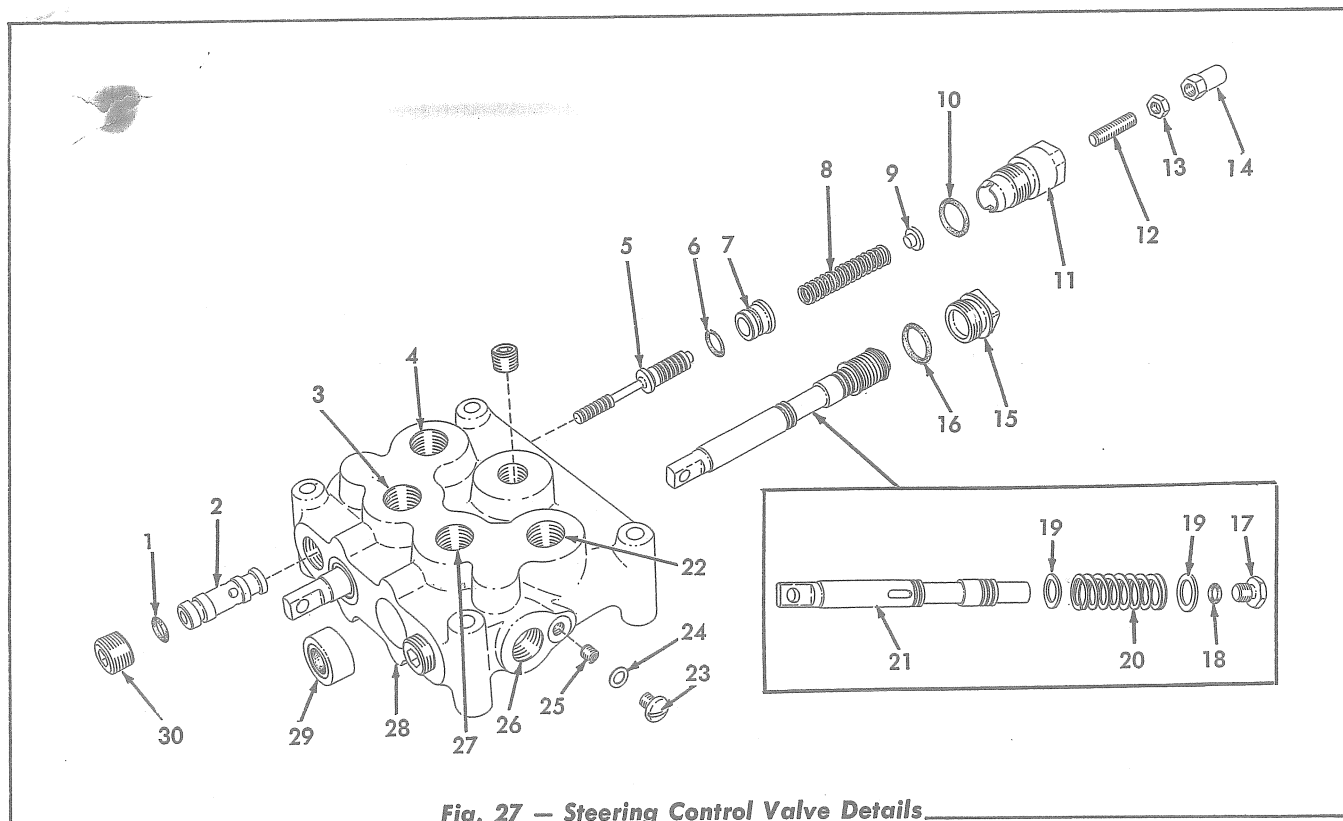


Fig. 27 — Steering Control Valve Details.

- | | |
|--|--|
| 1. Relief Valve Seat O-Ring | 16. Operating Plunger Cap O-Ring |
| 2. Relief Valve Seat | 17. Operating Plunger Spring Retaining Capscrew |
| 3. Outlet Port (To Right Steering Clutch) | 18. Spring Retaining Capscrew O-Ring |
| 4. Outlet Port (To Left Brake Operating Control Valve) | 19. Washer |
| 5. Relief Valve Plunger | 20. Operating Plunger Spring |
| 6. Relief Valve Guide O-Ring | 21. Operating Plunger |
| 7. Relief Valve Guide | 22. Outlet Port (To Right Brake Operating Control Valve) |
| 8. Relief Valve Spring | 23. Slotted Head Screw |
| 9. Relief Valve Spring Guide | 24. Gasket |
| 10. Relief Valve Adjustment Cap O-Ring | 25. Hex-Socket Setscrew |
| 11. Relief Valve Adjustment Cap | 26. Inlet Port (Left Side) |
| 12. Relief Valve Adjusting Screw | 27. Outlet Port (To Left Steering Clutch) |
| 13. Jam Nut | 28. Steering Control Valve Housing |
| 14. Acorn Nut | 29. Operating Plunger Oil Seal |
| 15. Operating Plunger Cap | 30. Pipe Plug |

When the control valve is being assembled, inspect the condition of all the O-rings and use new O-rings where necessary. If the pressure relief valve seats were removed from the control valve housing, make certain when they are pressed into the

housing, that the groove in the O. D. of the seat is aligned with the tapped hole for the hex-head setscrew (refer to Fig. 26). Then install the set-screw and the slotted head screw and gasket in each side of the control valve housing.

7. BRAKE OPERATING CONTROL VALVES

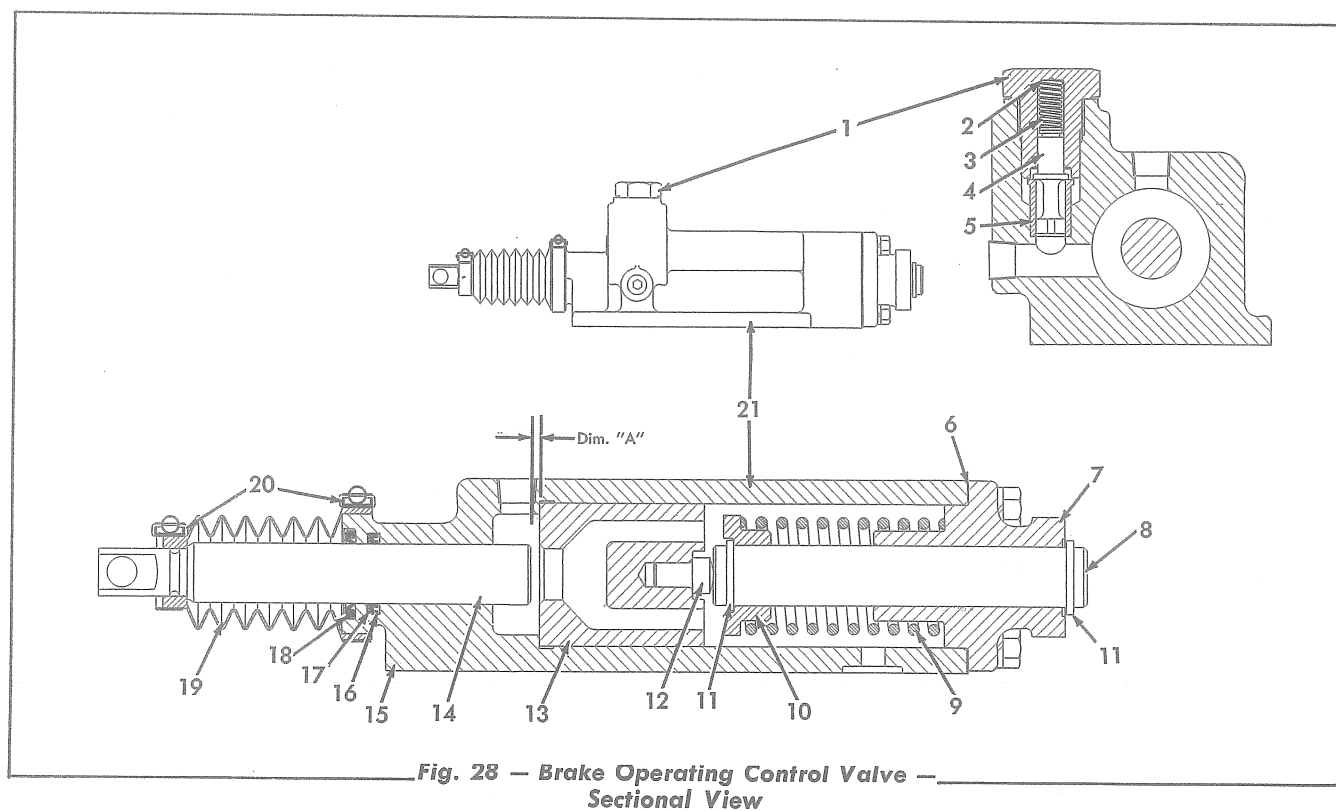
A. Description

The brake operating control valves, one mounted on each steering clutch compartment cover plate, are provided to hydraulically assist in applying the brakes.

With the left brake pedal in the released position, oil from the right side of the steering control valve enters the inlet port in the left brake operating control valve under circulating pressure. The valve spool in the brake operating control valve is in approximately the position shown in Fig. 28 thus allowing the oil to pass through the hole in the brake valve piston and return to the oil sump in the left steering clutch compartment, through a

hole in the bottom of the control valve housing and a hole in the steering clutch compartment cover plate.

With the right brake pedal in the released position, oil from the left side of the steering control valve enters the inlet port in the right brake operating control valve under circulating pressure. The valve spool in the brake operating control valve is in approximately the position shown in Fig. 28 thus allowing the oil to pass through the hole in the brake valve piston. The oil return hole in the steering clutch compartment cover plate is plugged with a pipe plug and the oil instead of returning to the oil sump in the right steering clutch compartment passes through an opening in the side



1. Pressure Relief Valve Nut
2. Adjusting Washers
3. Relief Valve Spring
4. Relief Valve
5. Relief Valve Seat
6. Gasket
7. Actuating Rod Retainer
8. Actuating Rod
9. Actuating Rod Spring
10. Spring Retainer
11. Snap Ring

12. Fulcrum Pin
 13. Brake Valve Piston
 14. Valve Spool
 15. Valve Housing
 16. Inner Seal
 17. Inner Seal Back-Up Washer
 18. Outer Seal
 19. Valve Spool Boot
 20. Hose Clamps
 21. Brake Operating Control Valve Assembly
- DIM. "A" — $\frac{3}{16}$ "

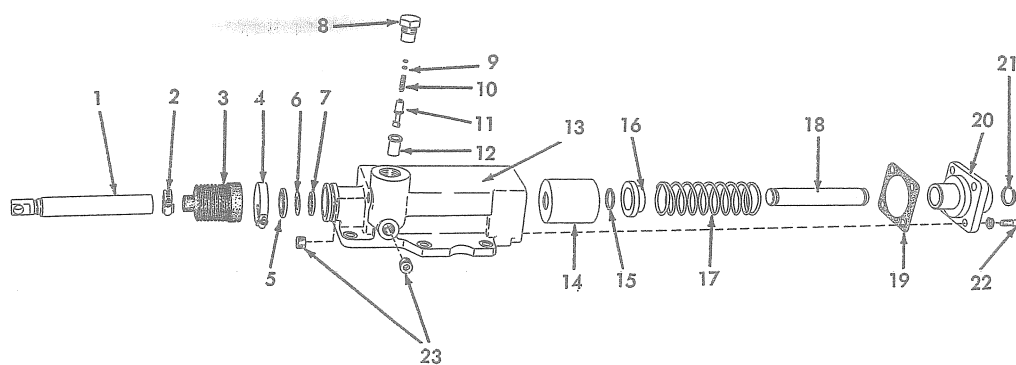


Fig. 29 — Brake Operating Control Valve Details

1. Valve Spool
2. Hose Clamp
3. Valve Spool Boot
4. Hose Clamp
5. Outer Seal
6. Back-Up Washer
7. Inner Seal
8. Pressure Relief Valve Nut
9. Adjusting Washers
10. Relief Valve Spring
11. Relief Valve
12. Relief Valve Seat

13. Valve Housing
14. Brake Valve Piston
15. Snap Ring
16. Spring Retainer
17. Actuating Rod Spring
18. Actuating Rod
19. Gasket
20. Actuating Rod Retainer
21. Snap Ring
22. Retainer Capscrew
23. Pipe Plug

of the control valve housing and through an external hose to a fitting in the transmission bevel pinion shaft front bearing cover.

When either brake pedal is depressed, the spool valve (Fig. 28) in the corresponding brake operating control valve moves back and closes the hole in the brake valve piston. Pressure builds up in the cavity in front of the brake valve piston thus forcing the piston to the rear. As the brake valve piston moves to the rear, the actuating rod (Fig. 28), which is connected directly to the brake band linkage, moves with it and tightens the brake band around the brake drum thus applying the brake.

Each brake operating control valve is equipped with a pressure relief valve of the pre-set type. When the pressure in front of the brake valve piston reaches the relief valve opening pressure, the relief valve opens and by-passes the excess oil. The excess oil from the left brake operating control valve returns to the oil sump and the excess

oil from the right brake operating control valve returns to the transmission as described in preceding paragraphs.

B. Removal, Disassembly, and Inspection of Brake Operating Control Valves

NOTE: The following procedures apply to either brake operating control valve.

1. Thoroughly clean the brake operating control valve and the surrounding area. Disconnect the hose(s) from the valve.
2. Refer to Fig. 4 and remove the yoke pin connecting the brake control rear rod to the valve spool. Remove the capscrews and lockwashers securing the brake pedal retracting spring attaching clip to the brake operating control valve. Refer to Fig. 20 and loosen the hose clamp connecting the linkage cover boot to the valve assembly

then remove the roll pin and connecting pin connecting the rear eye to the connecting rod.

3. Remove the capscrews and lockwashers securing the brake operating control valve to the steering clutch compartment cover plate and remove the valve.
4. Refer to Fig. 29 and remove the capscrews and lockwashers attaching the actuating rod retainer to the valve housing and remove the actuating rod, rod retainer, spring, and spring retainer as an assembly. Remove the snap ring from the outer end of the actuating rod and remove the actuating rod, spring, and spring retainer from the actuating rod retainer.
5. Loosen the hose clamp connecting the valve spool boot to the valve housing and pull the valve spool out of the valve housing. Slide the brake valve piston out of the valve housing.
6. Remove the pressure relief valve nut, re-

lieve valve spring, adjusting washers, and relief valve from the valve housing.

7. Inspect the O. D. of the actuating rod, valve spool, and the brake valve piston for nicks or scratches. Inspect the valve end of the valve spool and the valve seat in the piston for nicks and scratches that might prevent the valve spool from seating properly. The actuating rod, valve spool, and the brake valve piston must slide smoothly and freely in their respective bores. Inspect the relief valve and the relief valve seat in the valve housing. Repair or replace any worn or damaged parts.

C. Assembly and Installation of Brake Operating Control Valves

The brake operating control valves may be assembled and installed by a direct reversal of the removal and disassembly procedure. After the valves are installed and connected the pressure relief valves must be tested and adjusted if necessary (refer to "PRESSURE TESTING OF HYDRAULIC SYSTEM" in this Section).

8. HYDRAULIC PUMP

A. Description

The hydraulic pump is attached to the engine timing gear housing cover and is driven by the accessory drive upper shaft through a driving shaft coupling. The pump assembly consists of two sets of pump gears separated by a spacing plate. Oil is supplied to both sets of pump gears through a suction line tube extending from the oil sump of the transmission to the pump-to-suction line elbow attached to the pump. The oil is discharged from the pump gears through two separate outlets. Oil from the front set of pump gears passes through the right oil filter and then through a filter-to-valve hose to the left side of the steering control valve housing. Oil from the rear set of pump gears passes through the left oil filter and then through a filter-to-valve hose to the right side of the steering control valve housing.

B. Removal of Hydraulic Pump

1. Thoroughly clean the hydraulic pump and the surrounding area.
2. Disconnect the pump-to-filter hoses from the hydraulic pump. Remove the capscrews and lockwashers attaching the pump-to-suction line elbow to the hydraulic pump.
3. Loosen the two $\frac{7}{16}$ " NC x $4\frac{7}{8}$ " capscrews and lockwashers located on the bottom of the pump and the three $\frac{3}{8}$ " NC capscrews and lockwashers located at the top of the pump and remove the pump with the attaching capscrews from the timing gear housing cover. As the pump is removed, also remove the driving shaft coupling.

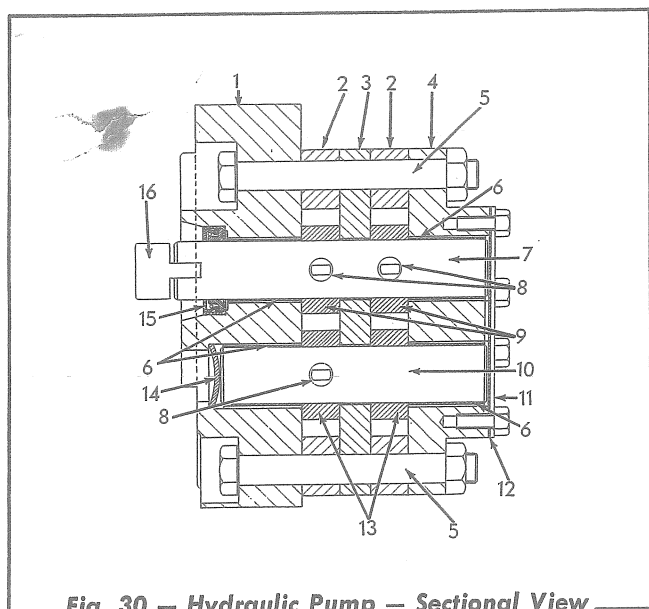


Fig. 30 - Hydraulic Pump - Sectional View

1. Back Plate
2. Case
3. Spacing Plate
4. Front Plate
5. Dowel Bolt
6. Bushing
7. Driving Shaft
8. Gear Driving Pins
9. Driving Gears
10. Idling Gear Shaft
11. Cover Plate
12. Gasket
13. Idling Gears
14. Expansion Plug
15. Oil Seal
16. Driving Shaft Coupling

C. Disassembly of Hydraulic Pump

1. Before disassembling the pump, mark the plates and cases by scribing a line the entire length of the pump, or center punching each plate and case in a line, as an index to facilitate reassembly of the pump.
2. Remove the two dowel bolt nuts located at the front of the pump and, using a suitable punch, drive the dowel bolts out of the pump assembly.
3. Remove the four capscrews from the front end of the pump assembly. Remove the front plate and front case. Remove the front driving gear and the front idling gear from their respective shafts. Remove the

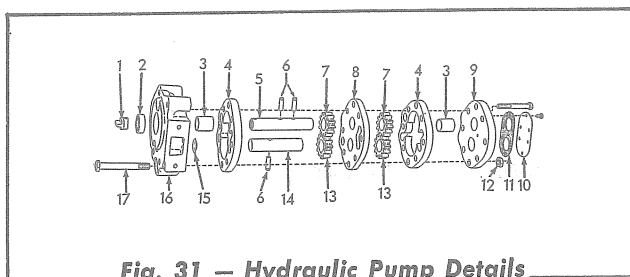


Fig. 31 - Hydraulic Pump Details

1. Driving Shaft Coupling
2. Oil Seal
3. Back Plate Bushing
4. Case
5. Driving Shaft
6. Gear Driving Pins
7. Driving Gear
8. Spacing Plate
9. Front Plate Bushing
10. Front Plate
11. Cover Plate
12. Gasket
13. Dowel Bolt Nut
14. Idling Gear
15. Idling Gear Shaft
16. Expansion Plug
17. Back Plate
18. Dowel Bolt

gear driving pin from the driving shaft. Remove the spacing plate and the rear case. Remove the rear driving gear and the rear idling gear from their respective shafts. Remove the gear driving pin from each shaft. Remove the driving shaft and the idling gear shaft.

4. If the front plate bushings are to be replaced, remove the capscrews attaching the cover plate to the front plate and remove the front plate and gasket. The old bushings may now be pressed or driven out of the front plate.
5. If the back plate bushing in the driving shaft bore is to be replaced, drive or press the bushing and oil seal out of the back plate toward the rear. If the back plate bushing in the idling gear shaft bore is to be replaced, drive or press the expansion plug and bushing out of the back plate toward the front.
6. If the driving shaft oil seal is to be re-

placed, the old seal may be driven out of the back plate toward the rear.

D. Cleaning and Inspection of Hydraulic Pump Parts

Wash all the parts in clean diesel fuel or solvent, being careful not to scratch or damage the sealing surfaces of the plates and cases. These sealing surfaces are precision ground and no gaskets are necessary for sealing. Inspect all parts carefully. The parts subject to the most wear are the gears. If the oil has been kept clean, the wear on these parts will be slight. If the oil in the hydraulic system has not been changed as recommended, and cleanliness was not observed while servicing, the pump wear may be pronounced in a comparatively short time. Prior to assembling the pump, examine the gear teeth, inside of both gear cases, spacing plate, bushings, and the shafts for wear. If the gear teeth are scored, or excessively worn, the gears must be replaced. Replace worn or scored gear cases, pump plates, or spacing plate. Inspect the driving shaft oil seal for damage or wear and replace if necessary.

E. Assembly of Hydraulic Pump

1. **NOTE:** *One end of the front and back plate bushings is slightly undercut on the O. D.; the bushings should be installed with the undercut end facing away from the gears when the pump is assembled.* Press a bushing into each shaft bore of the front plate so that the end of each bushing is .002" to .005" below the inner face (face next to gear) of the front plate. Install the cover plate and gasket and secure with capscrews. Refer to Fig. 30, and drive or press a new expansion plug into the idling gear shaft bore in the back plate. Press a bushing into each shaft bore of the back plate so that the end of each bushing is .002" to .005" below the inner face (face next to gear) of the back plate. The specified I. D. of the bushings when installed is 1.0015" to 1.0025" and the

specified O. D. of a new driving or idling gear shaft is .9995" to 1.0000". Press a new driving shaft oil seal into the counter-bore in the back plate, making certain that the sealing lip of the seal is directed toward the accessory drive.

2. Install the dowel bolts in position in the back plate. Clamp the back plate in a vise with the dowel bolts up. Lubricate the bushings and oil seal and insert the idling gear shaft into position in the back plate with the gear driving pin hole end toward the back plate and insert a gear driving pin in the shaft. Insert the driving shaft in the back plate with the slotted end down, using care to prevent damage to the oil seal, and insert a gear driving pin in the rear hole in the shaft. Install a gear on each shaft, engaging the slot in the I. D. of each gear with the driving pin. Install the rear case and the spacing plate making certain the scribe or punch marks, placed on the components when the pump was disassembled, are aligned. Install a gear driving pin in the front hole in the drive shaft then install the front set of gears. Install the front case then lubricate the shafts and gears and install the front plate. Install the dowel bolt nuts and the four $\frac{7}{16}$ " NC x 3" capscrews. Tighten the capscrews evenly to a torque of 25 to 35 lbs. ft. and the dowel bolt nuts to a torque of 35 to 45 lbs. ft.

F. Installation of Hydraulic Pump

The hydraulic pump may be installed on the engine by a direct reversal of the removal procedure. Make certain that the driving shaft coupling is in position between the pump driving shaft and the accessory drive upper shaft when the pump is installed. **NOTE:** *Heavy grease or gasket cement may be used to hold the driving shaft coupling in position while installing the pump.* Use a new gasket when installing the pump-to-suction line elbow on the hydraulic pump.

9. HYDRAULIC SYSTEM OIL FILTERS

A. Description

The hydraulic system oil filters are mounted on a bracket and located above the hydraulic pump (Fig 32). The filters are of the full flow type and contain replaceable type elements. A pressure relief valve is provided in each filter (refer to Fig. 33). If the filter element becomes clogged, or if in cold weather the oil is too thick to flow through the filter element, the relief valve opens and bypasses the oil directly to the filter outlet.

It is recommended that new filter elements be installed after every 1000 hours of operation. **NOTE:** On a new tractor, or when major repairs are made to the transmission, bevel gear, brakes or steering clutches, the filter elements should be replaced after the first 50 hours of operation. Thereafter, the filter elements should be replaced after every 1000 hours of operation.

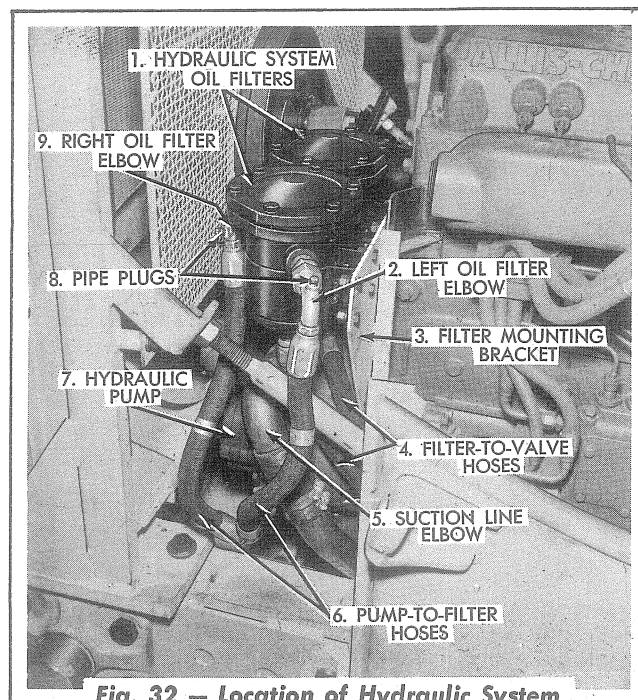


Fig. 32 — Location of Hydraulic System Oil Filters

B. Replacement of Oil Filter Elements

Thoroughly clean the exterior of the oil filters and replace each filter element as follows:

1. Remove the capscrews and lockwashers attaching the filter cover to the filter body and remove the filter cover. The pressure relief valve (Fig. 33) is an integral part of the cover.
2. Remove and discard the filter element. Remove and discard the filter body gasket.
3. Thoroughly clean the interior of the filter body and the filter cover.
4. Install a new filter element and a new filter body gasket (furnished with the filter element).
5. Install the filter cover and the filter cover attaching capscrews and lockwashers. Tighten the capscrews evenly to a torque of 15 lbs. ft.
6. Start the engine and allow it to run for a

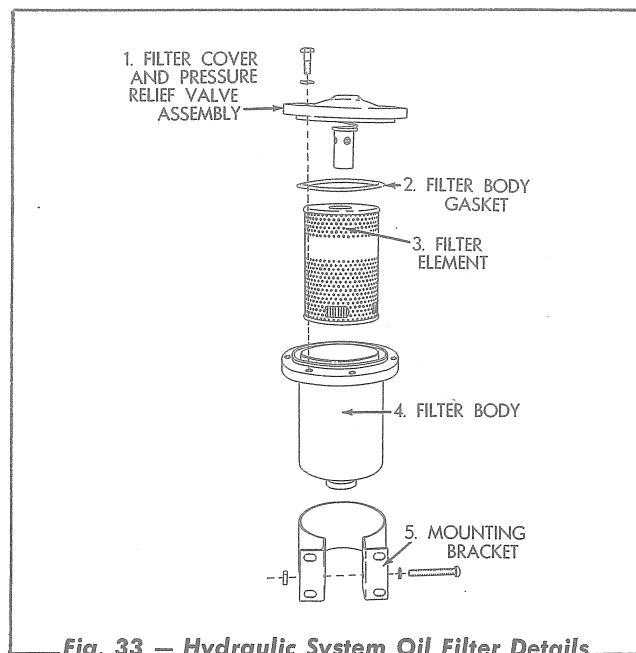


Fig. 33 — Hydraulic System Oil Filter Details

few minutes at approximately $\frac{1}{4}$ throttle. With the engine running, operate each steering clutch lever a few times. Stop the engine and inspect the filters for oil leaks; correct any leaks found.

10. HYDRAULIC SYSTEM HOSES AND LINES

A. Description

The hydraulic system oil suction line (Fig. 34) consists of two sections of metal tubing connected by hoses and hose clamps. The suction line extends from the suction line screen, located in the oil sump in the transmission case, to the suction line elbow which is attached to the hydraulic pump (Fig. 34).

Oil leaving the lower connection in the hydraulic pump enters the right oil filter through the pump-to-right filter hose. Oil leaving the upper connection in the hydraulic pump enters the left filter through the pump-to-left filter hose (Fig. 34).

Oil leaving the right oil filter passes to the left side of the steering control valve through the right oil filter-to-valve hose and oil leaving the left oil filter passes to the right side of the steer-

ing control valve through the left oil filter-to-valve hose (Fig. 34).

Clutch control hoses connect the steering control valve to the steering clutch pressure tube bushings, and brake control hoses connect the steering control valve to the brake operating control valves (refer to Fig. 35).

Oil leaving the right brake operating control valve passes through a hose to the transmission bevel pinion shaft front bearing cover (Fig. 35).

B. Service and Inspection of Hydraulic System Hoses and Lines

The supporting clamps and brackets for the hydraulic system hoses and lines should be checked periodically and kept tight to prevent damage to the hoses, lines, and fittings.

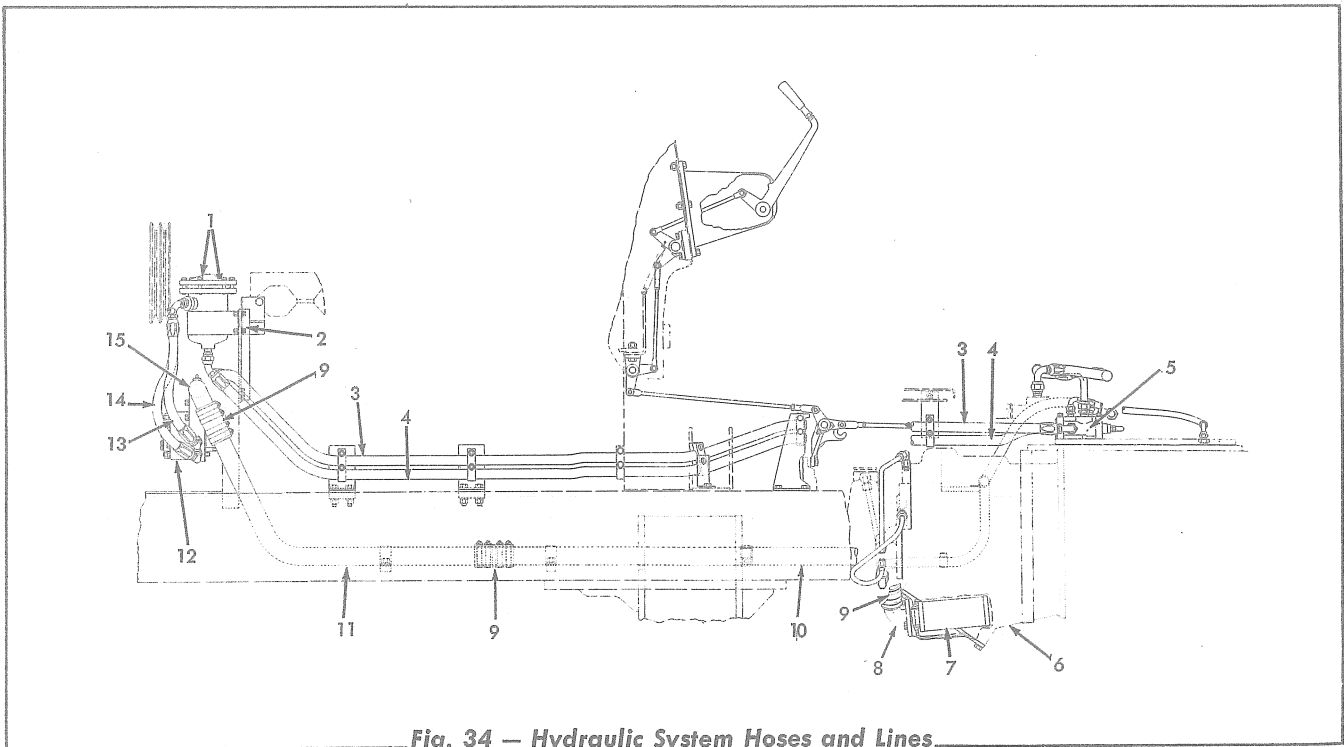


Fig. 34 — Hydraulic System Hoses and Lines.

1. Hydraulic System Oil Filters
2. Filter Mounting Bracket
3. Right Oil Filter-To-Valve Hose
4. Left Oil Filter-To-Valve Hose
5. Steering Control Valve
6. Transmission Case
7. Suction Line Screen
8. Suction Line Connector

9. Connecting Hose
10. Suction Line Rear Section
11. Suction Line Front Section
12. Hydraulic Pump
13. Pump-To-Left Filter Hose
14. Pump-To-Right Filter Hose
15. Suction Line Elbow

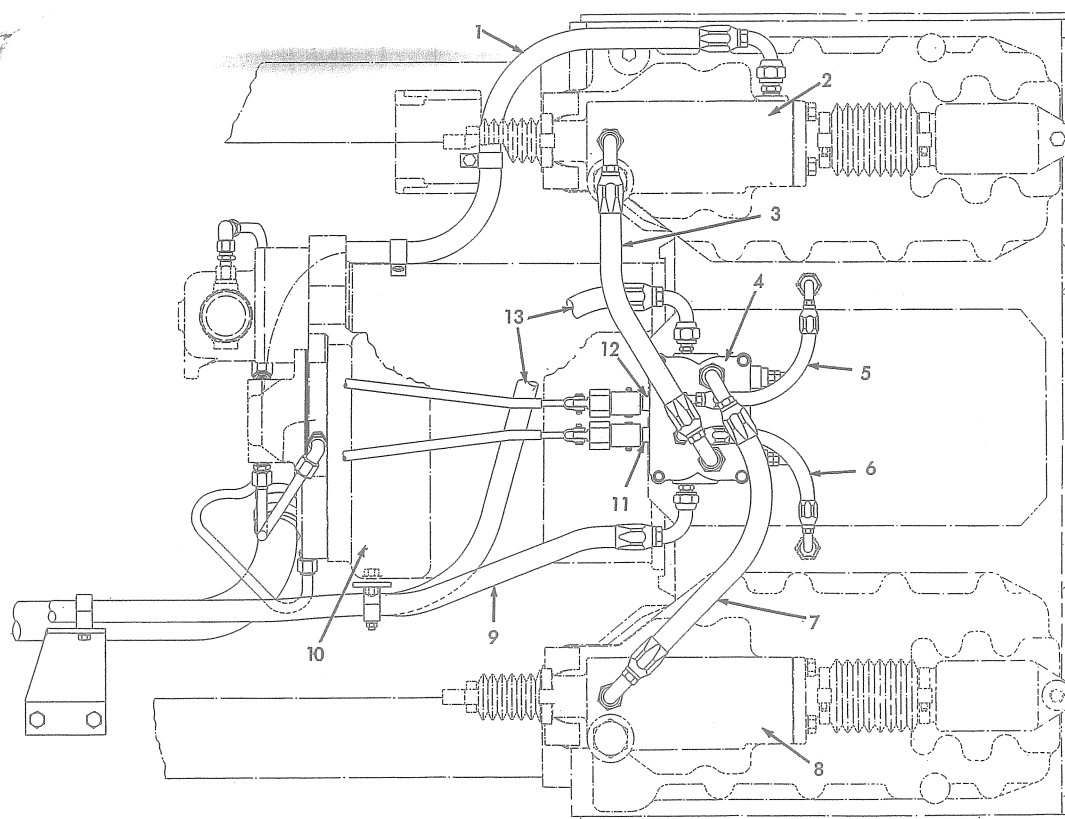
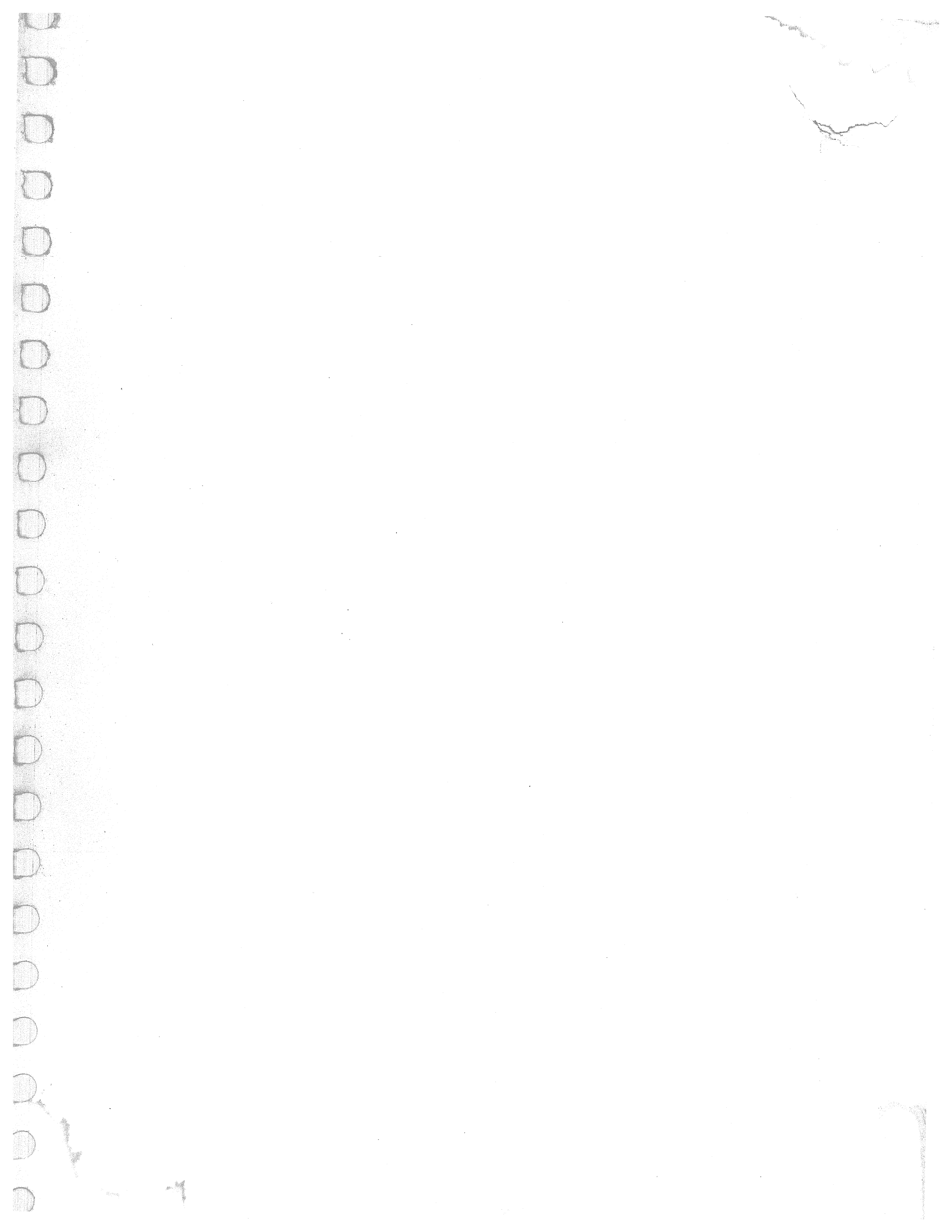


Fig. 35 — Steering Control Valve and Brake Operating Control Valve Hoses

- | | |
|---|---|
| 1. Right Brake Operating Control Valve-To-Transmission Hose | 7. Valve-To-Left Brake Operating Control Valve Hose |
| 2. Right Brake Operating Control Valve | 8. Left Brake Operating Control Valve |
| 3. Valve-To-Right Brake Operating Control Valve Hose | 9. Right Oil Filter-To-Valve Hose |
| 4. Steering Control Valve | 10. Transmission |
| 5. Valve-To-Right Steering Clutch Hose | 11. Left Operating Plunger |
| 6. Valve-To-Left Steering Clutch Hose | 12. Right Operating Plunger |
| | 13. Left Oil Filter-To-Valve Hose |

In the event of failure of the hydraulic system and metal chips or cuttings are noted within the system, the oil hoses and lines should be removed and thoroughly cleaned.

The suction line screen, located in the bottom of the transmission case (Fig. 34), must be removed and cleaned whenever major repairs are made to the transmission, bevel gear, brakes, or steering clutches.



- d. If an adjustment is necessary, stop the engine and remove the pressure relief valve nut (Fig. 29) from the LEFT brake control valve. The pressure can be increased by adding an adjusting washer (SAE #10 std. washer) on the top of the relief valve spring, or decreased by removing a washer. Add or remove washers as necessary and install and tighten the relief valve nut.
- e. Start the engine and recheck the pressure relief valve as described above. After the proper adjustment has been made, stop the engine, remove the

pressure gage, and install the pipe plug.

C. Pressure Testing Left Steering Clutch or Right Brake Oil Pressure Relief Valves

1. With the engine stopped, remove the pipe plug from the RIGHT oil filter elbow and install a 1000 PSI capacity pressure gage.
2. Repeat the operations in Paragraph B above and pressure test and adjust the oil pressure relief valves for the right steering clutch and the left brake in a similar manner.

12. FITS AND TOLERANCES

Description	Size of New Parts
A. Steering Clutches	
1. Pressure plate	
a. Contact surfaces to be smooth and flat within .....	.010"
b. I.D.	6.997" — 7.000"
2. Friction disc	
a. Thickness .....	.152" — .157"
b. Flat within .....	.015"
3. Steel disc	
a. Thickness .....	.084" — .096"
b. Flat within .....	.015"
4. Back plate	
a. Thickness .....	.307" — .311"
b. Flat within .....	.015"
5. Clutch hub	
a. Bore diameter	4.500" — 4.502"
b. Width of flange .....	.935" — .940"
c. I.D. of flange	8.875" — 8.880"
6. Pressure spring	
a. Number of coils	12½
b. Assembled height	4.500"
c. Load at assembled height	800 (+ or — 40) lbs.
7. Throwout plate spacer	
a. Length	5.125" — 5.135"
b. O.D.	7/8"
8. Throwout plate	
a. O.D.	8.810" — 8.815"
b. Width	1.058" — 1.068"
9. Driving hub	
a. I.D. for clutch hub	10.375" — 10.377"

Description

Size of
New Parts

10. Throwout sleeve	
a. I.D.	4.210" — 4.212"
b. Bearing surface O.D.	5.065" — 5.066"
11. Bearing cone	
a. I.D.	5.0625" — 5.0635"
12. Bearing cup	
a. O.D.	7.500" — 7.501"
13. Actuating piston	
a. I.D. for bearing cup	7.4980" — 7.4990"
14. Collector ring	
a. Bore	8.250" — 8.252"
b. I.D. for piston	9.875" — 9.877"

B. Brakes

1. Lining thickness .....	.500"
2. Drum O.D.	16 $\frac{3}{4}$ "

C. Steering Control Valve

1. Relief valve seat	
a. Bore .....	.3125" — .3130"
b. O.D. at seating end .....	.6260" — .6265"
c. O.D. at opposite end .....	.615" — .620"
d. O.D. at relief port .....	.562" — .572"
2. Relief valve plunger	
a. O.D. at spring end .....	.4687" — .4697"
b. O.D. at valve end .....	.3115" — .3120"
3. Relief valve guide	
a. Bore .....	.4702" — .4707"
b. O.D. of body .....	.7480" — .7485"
c. O.D. of flange	$\frac{27}{32}$ "
4. Relief valve spring	
a. Number of coils	17
b. Load when compressed to 1 $\frac{3}{4}$ "	24 lbs.

D. Brake Operating Control Valves

1. Spool valve O.D.	1.2575" — 1.2580"
2. Housing piston bore	3.001" — 3.003"
3. Piston O.D.	2.9995" — 3.0005"
4. Spring	
a. Load at 4 $\frac{1}{4}$ " assembled height	99 lbs.
b. Number of coils	10
5. Actuating rod	
a. Length	7 $\frac{15}{16}$ "
b. O.D.	1.2575" — 1.2580"
6. Relief valve seat	
a. O.D. at flange	1.000"
b. O.D. of body .....	.871" — .872"

Description	Size of New Parts
c. Length	1.178" — 1.188"
d. I.D. ....	.626" — .629"
7. Relief valve plunger	
a. O.D. at round end .....	.558" — .560"
b. O.D. at vane end .....	.623" — .625"
8. Relief valve spring	
a. Number of coils	10
b. Load when compressed to 1"	24 lbs.

E. Hydraulic Pump

1. I.D. of back plate and front plate bushings after installation	1.0015" — 1.0025"
2. Bushings to be pressed in below plate face .....	.002" — .005"
3. O.D. of bushings	1.1269" — 1.1279"
4. O.D. of drive shaft and idler shaft .....	.9995" — 1.0000"
5. Gears	
a. Number of teeth	12
b. Bore	1.0005" — 1.0010"
c. Width .....	.6220" — .6225"
d. Backlash .....	.006" — .009"
6. Spacer	
a. Bores for shafts	1.013" — 1.016"
b. Width .....	.498" — .501"
7. Case	
a. Bores for gears	2.105" — 2.106"
b. Width .....	.6240" — .6245"