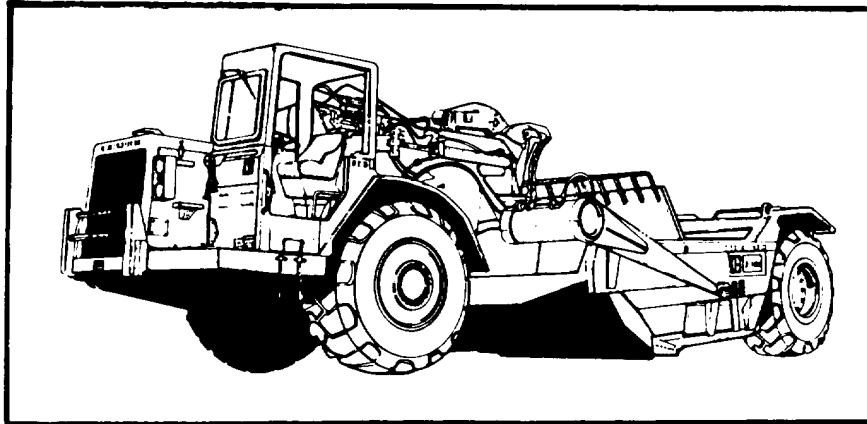


TECHNICAL MANUAL
FOR
SCRAPER, EARTH MOVING, MOTORIZED
DIESEL ENGINE DRIVEN

NSN 3805-011 53-1854



MAINTENANCE

HEADQUARTERS, DEPARTMENT OF THE ARMY
AUGUST 1985

**TECHNICAL MANUAL
FOR
SCRAPER, EARTH MOVING, MOTORIZED
DIESEL ENGINE DRIVEN
NSN 3805-01-153-1854
MAINTENANCE**

REPORTING OF ERRORS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms) or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Tank-Automotive Command, ATTN:AMSTA-MBP, Warren, MI 48397-5000. A reply will be furnished direct to you.

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Vehicle System**

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**PART FOUR
SOMARPI**

Supplemental Operating, Maintenance and Repair Parts Instructions..... i

This technical manual is an authentication of the manufacturers commercial literature and does not conform with the format and content specified in AR 310-3, Military Publications. This technical manual does, however, contain available information that is essential to the operation and maintenance of the equipment.

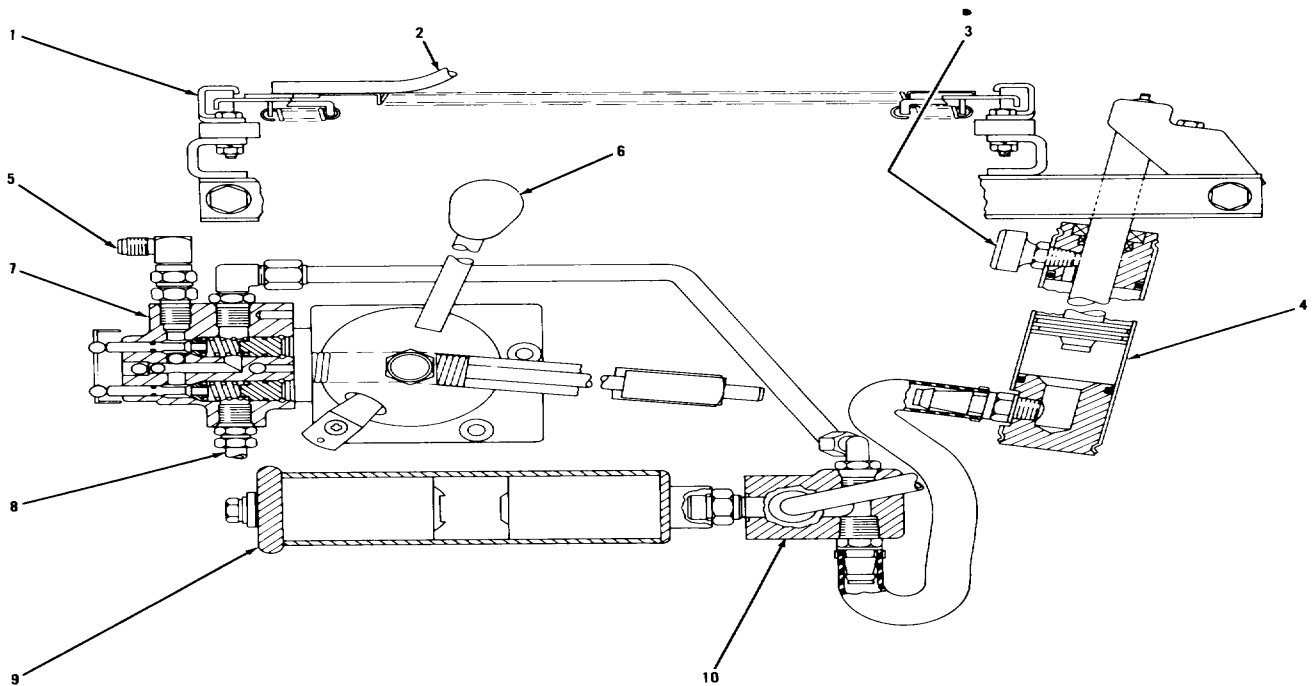
CHAPTER 1
 VEHICLE SYSTEMS
 COACH AND CAR AIRDRAULIC
 SEAT SYSTEM

TORQUE SPECIFICATIONS: You will find instances in this publication where the manufacturer has used "Meter-Kilograms" or "Centimeter-Kilograms" in place of "Newton-Meters" for the metric torque. In these instances, use the following conversion factors to obtain the metric torque in "Newton-Meters."

- lb. ft. x 1.355819 = N-m
- lb. in. x 0.1129848 = N-m

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SEAT SYSTEM



SCHEMATIC OF SEAT HYDRAULIC SYSTEM

- 1. Bottom of seat.
- 2. Forward and backward adjustment lever.
- 3. Breather.
- 4. Cylinder.
- 5. Inlet for pressure oil from transmission oil filter housing.
- 6. Height adjustment lever.
- 7. Height adjustment valve.
- 8. Outlet to reservoir.
- 9. Nitrogen charged accumulator.
- 10. Ride control valve.

*Breather has been replaced with a vent line to flywheel housing.

The breather line vents the flywheel housing and seat cylinder to the atmosphere, while retaining oil which could bypass the cylinder piston.

The suspension seat is mounted on a linkage assembly. The air-oil system supplies vertical support for the seat, plus keeps shock and vibration

from the operator. The seat permits the operator to move up and down a total of four inches. He then has contact with the controls at all times. The seat will automatically adjust for the weight of the operator. Adjustments can be made to the seat for correct height and desired hardness of ride. The seat can be moved forwards and backwards a total of four inches.

SEAT SYSTEM

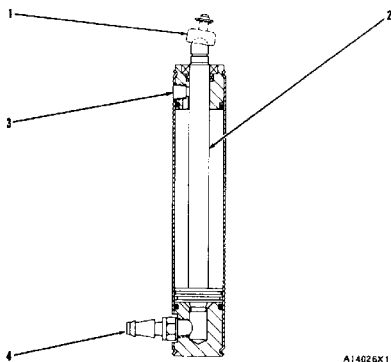
OPERATION

Oil from the transmission oil filter housing flows into inlet (5) of the height adjustment valve (7). The valve is operated by a servo-linkage (6) which opens or closes oil pressure inlet (5) and outlet to reservoir line (8). The servo-linkage is operated by the up and down movement of the seat.

The operator adjusts the seat to height needed. The position of the seat is the same until changed by the operator. When the valve is open, oil will be sent to accumulator (9) and to cylinder (4). When the seat moves up past the position set, the valve will open and oil is free to flow to the reservoir. The valve closes when the seat returns to normal position. When the height adjustment valve is closed, oil moves between the cylinder and accumulator as the seat moves up and down. The oil under pressure in the cylinder supports the weight of the seat and operator.

Cylinder

The cylinder assembly moves the weight on the seat through the oil to the nitrogen in the accumulator, which is the cushion for the seat system.



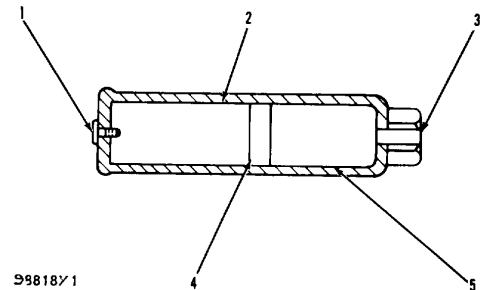
SEAT CYLINDER

1. Bearing assembly. 2. Piston rod end. 3. Opening for breather. 4. Line from ride control valve.

The cylinder is fastened to the rear of the seat frame. The bearing assembly (1) is fastened to the top of cylinder rod (2) and is connected to the seat linkage. This provides a flexible junction so the seat can move up and down freely.

Oil from the height control valve flows through line (4) to the head end of cylinder. Oil under pressure in the cylinder supports the weight of the seat and operator.

Accumulator



ACCUMULATOR

1. Charging valve. 2. Nitrogen charged chamber. 3. Oil passage. 4. Piston. 5. Oil filled chamber.

The accumulator location is horizontal across the front of the seat linkage. It is a sealed unit. A piston (4) moves in the bore of the accumulator and keeps the dry nitrogen charge separate from the oil.

A charge of dry nitrogen gas at 95 ± 5 psi (6.7 ± 0.4 kg/cm²) is put into chamber (2) through valve (1). Oil from the cylinder under the seat comes in opening (3) into chamber (5). This oil pushes piston (4) toward the nitrogen and puts more force in the accumulator. More oil in the accumulator increases the pressure of the nitrogen charge.

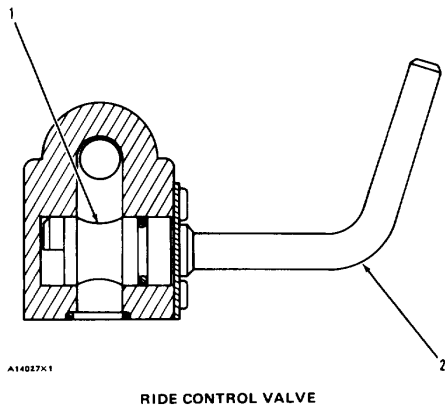
When the height adjustment valve is opened, the correct amount of oil for the weight of the operator goes into the accumulator and cylinder. The pressure in the dry nitrogen then gives the correct spring for that operator.

Ride Control Valve

The ride control valve is a variable orifice valve (1). When lever (2) is turned down, there is a maximum flow of oil between the cylinder and the accumulator. When the lever is turned up, the flow of oil is less and the ride is harder.

SEAT SYSTEM

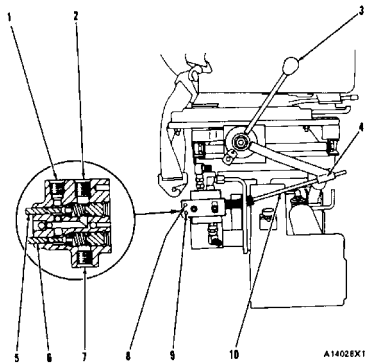
SYSTEMS OPERATION



- 1. Variable orifice valve. 2. Lever.

Height Adjustment Valve

The height adjustment valve is on the right side of the seat frame. A linkage assembly is connected from the valve to the seat. When the seat moves up or down, the linkage activates the valve.



HEIGHT ADJUSTMENT VALVE AND LEVER LINKAGE

- 1. Inlet for pressure oil from transmission filter housing. 2. Outlet for pressure oil to cylinder. 3. Height adjustment lever. 4. Pivot. 5. Valve. 6. Valve. 7. Outlet to reservoir. 8. Valve actuator. 9. Valve actuator. 10. Spring arm.

The height adjustment lever (3) is manually adjusted. The operator adjusts the lever for the height desired. After the lever is adjusted, the

height of the seat will remain the same until it is changed by the operator.

When the seat moves up, as the tractor goes over a rough surface, spring arm (10) is pulled upward at pivot (4). This will cause valve actuator (9) to push valve (6) open. Oil from the accumulator cylinder goes to reservoir through outlet (7). This lets the seat move down.

When the seat moves down, spring arm (10) pushes down at pivot (4). This will cause valve actuator (8) to push valve (5) open. Pressure oil, from the transmission filter housing flows through inlet (1) to outlet (2) to the cylinder and will move the seat up.

As the seat moves up and down, each cycle becomes shorter until it returns to the original position set by the operator. The valve is in the closed position and oil flows between the cylinder and the accumulator.

Weight adjustment is automatic. A heavier operator will cause the seat to go down. This will push the spring arm down and activate valve (5). Increased oil will increase the pressure in the cylinder and move the seat up and support the heavier operator.

Forward and Backward Adjustment



FORWARD AND BACKWARD ADJUSTMENT LEVER

- 1. Forward and backward adjustment lever. 2. Slide rail assembly.

The forward and backward movement of the seat is a mechanical adjustment. To adjust seat, push lever (1) toward the right side of seat. The seat will move along slide rail (2) a maximum of four inches (10.16 centimeters).

TROUBLESHOOTING**TESTING AND ADJUSTING****TROUBLESHOOTING**

Troubleshooting can be difficult. On the following pages there is a list of possible problems. To make a repair to a problem, make reference to the cause and correction.

This list of problems, causes, and corrections, will only give, an indication of where a possible problem can be, and what repairs are needed. Normal, more or other repair work is needed beyond the recommendations in the list. Remember that a problems not normally caused only by one part, but b the relation of one part with other parts. This list can not give all possible problems and corrections. The serviceman must find the problem and it source, then make the necessary repairs.

TROUBLESHOOTING

TESTING AND ADJUSTING

Item Problem

1. Constant Drift Up From RIDE Position.
2. Constant Drift Down From RIDE Position.
3. Ride is Too Hard.

Item Problem

4. Ride is Too Soft.
5. Seat Will Not Move When Height Adjustment is Made.

Problem	Cause	Correction
1. CONSTANT DRIFT UP FROM RIDE POSITION	Expansion of Oil Because of Hot Outside Temperature or Difficult Work Conditions Leakage Past the Seal Between Pressure Inlet and Outlet to Cylinder Linkage Adjustment Not Correct	Make adjustment with height adjustment lever. Check for dirt and clean valve. Check for worn or damaged seals. Check for weak spring in valve. Install new valve if needed. Make adjustment to linkage.
2. CONSTANT DRIFT DOWN FROM RIDE POSITION	Oil Volume Gets Smaller Because of Cold Outside Temperature Leakage Past the Seal Between Outlet to Cylinder and Outlet to Reservoir Linkage Adjustment Not Correct Leakage in Cylinder	Make adjustment with height adjustment lever. Check for dirt and clean valve. Check for worn or damaged seal. Check for weak spring in valve. Install new valve if needed. Make adjustment to linkage. Install new cylinder.

TROUBLESHOOTING

TESTING AND ADJUSTING

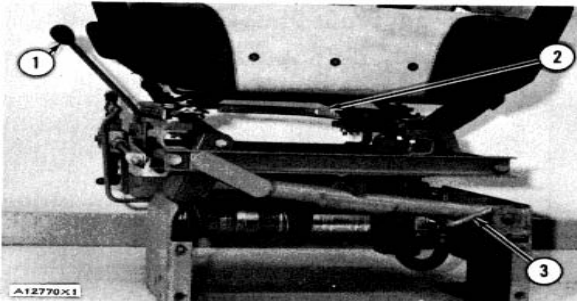
Problem	Cause	Correction
<p>3. RIDE IS TOO HARD</p>	<p>Ride Control Valve in Wrong Position</p> <p>Accumulator Gas Pressure Low</p> <p>Frame of Suspension Not in Correct Alignment When Assembling Seat</p> <p>Bearings or Slides in Assembly Damage</p>	<p>Make adjustment to valve setting.</p> <p>Check accumulator pressure and put in new charge. Install new accumulator if needed.</p> <p>Make correct alignment of suspension, so seat moves freely.</p> <p>Install new bearings or slides.</p>
<p>4. RIDE IS TOO SOFT</p>	<p>Ride Control Valve in Wrong Position</p> <p>Cylinder is Worn</p>	<p>Make adjustment to valve setting.</p> <p>Install new cylinder.</p>
<p>5. SEAT WILL NOT MOVE WHEN HEIGHT ADJUSTMENT IS MADE</p>	<p>Linkage Adjustment Not Correct</p> <p>Leakage Past the Seal Between Outlet to Cylinder and Outlet to Reservoir</p>	<p>Make adjustment to height control lever.</p> <p>Install new seals and spring.</p>

SEAT SYSTEM

TESTING AND ADJUSTING

ADJUSTMENTS TO SEAT AFTER ASSEMBLY

1. Sit in seat normally, start engine and let transmission oil pressure get to operating pressure.



LEVERS FOR ADJUSTMENT OF SEAT

1. Height adjustment lever. 2. Forward and backward adjustment lever. 3. Ride control lever.
2. Turn lever (3) on ride control valve to bottom position (valve completely open).
3. Adjust the height adjustment lever (1) to the ride position desired.
4. Cause the seat to move up and down by changing the force on it. The seat must move back to the same position setting. If the system does not work correctly check for:
 - a. Low hydraulic pressure.
 - b. Restriction in the hydraulic lines.
 - c. Pressure and return lines installed backwards.
 - d. Seat linkage damaged.

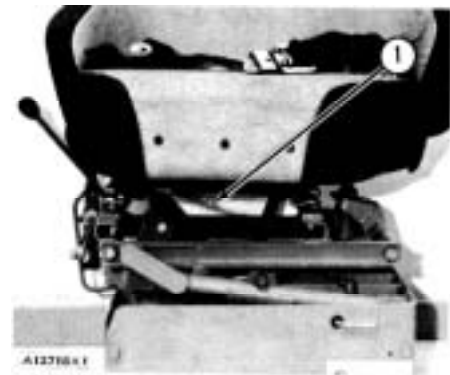
WARNING: Never remove oil lines, accumulator, or cylinder until the pressure in the hydraulic system of the seat is removed.

5. If there is a constant drift up or down from the ride position check:
 - a. For dirt in or damage to height adjustment valve.
 - b. Adjustment of height adjustment linkage.
 - c. Leakage in cylinder assembly.

- d. Clearance between actuator valve in the height linkage and the stem of the valve in the height adjustment valve.'

NOTE: For the procedure to make adjustment and alignment of height adjustment valve and linkage see the subject, ADJUSTMENT OF HEIGHT CONTROL VALVE LINKAGE.

ADJUSTMENT TO FORWARD AND BACKWARD POSITION OF SEAT

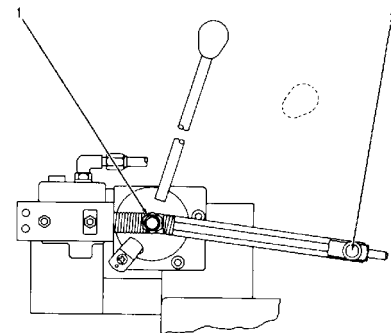


FORWARD AND BACKWARD ADJUSTMENT

1. Forward and backward adjustment lever.

To adjust seat, push lever (1) towards the right side of seat and slide seat forward or backward to desired position.

ADJUSTMENT OF HEIGHT CONTROL VALVE LINKAGE



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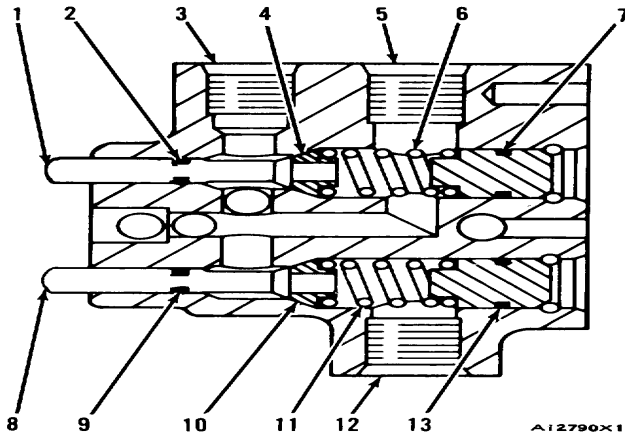
ADJUSTMENT OF HEIGHT CONTROL LINKAGE

1. Nut. 2. Spring arm.

SEAT SYSTEM

Tighten nut (1). Put a 8 lb. 2 oz. (3.69 kg) weight at spring arm (2). Loosen nut (1) until spring arm moves down. Do not tighten nut.

HEIGHT CONTROL VALVE



HEIGHT CONTROL VALVE

- 1. Valve poppet. 2. Seal. 3. Pressure inlet. 4. Seal on valve guide. 5. Opening to cylinder. 6. Spring. 7. Seal. 8. Valve poppet. 9. Seal. 10. Seal on valve guide. 11. Spring. 12. Outlet to reservoir. 13. Seal.

If there is a constant drift of the seat up from the ride position, check for leakage around the seal (4) in the valve. Leakage here can be a result of:

- a. No clearance between the valve actuator and valve poppet (1).
- b. Dirt in the valve.
- c. Worn poppet (1), or worn seals (2), (4) and (7).
- d. A weak spring (6).

If there is a constant drift of the seat down from the ride position, check for leakage around seal (10) in the valve. Leakage here can be a result of:

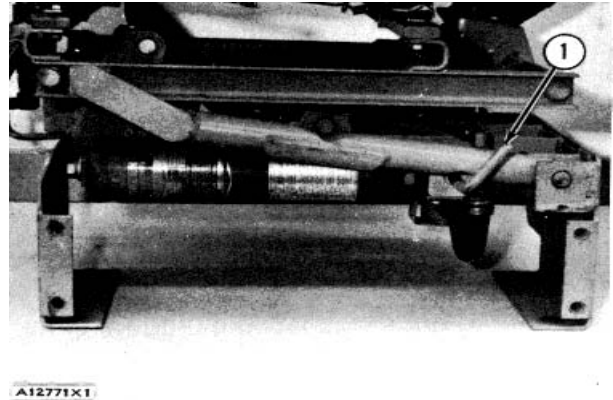
- a. No clearance between the valve actuator and valve poppet (8).

TESTING AND ADJUSTMENTING

- b. Dirt in the valve.
- c. Worn poppet (8) or worn seals (9), (10) and (13).
- d. A weak spring (11).

If the valve still leaks after new seals are installed, replace the valve.

RIDE CONTROL VALVE ADJUSTMENT



RIDE CONTROL ADJUSTMENT VALVE

- 1. Ride control lever.

Turn the lever (1) on the ride control up for a harder ride.

Turn the lever (1) down for the softest ride. The valve will permit a very small oil flow through it in this position. There will be a slow drift of the seat when the lever is in this position.

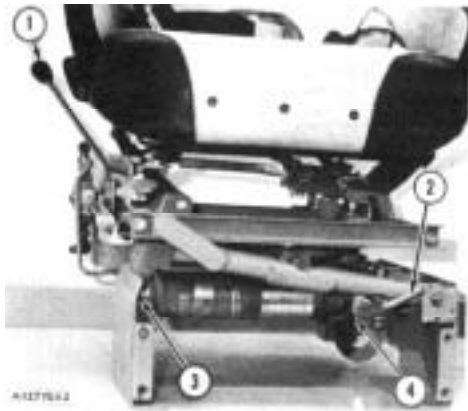
CHECK OF PRESSURE OF NITROGEN CHARGE IN ACCUMULATOR (On Machine)

Tools Needed: 7S5437 Charging Group.
5P2963 Charging Adapter.

- 1. Turn lever (2) on ride control valve to bottom position (down).
- 2. Pull height control lever (1) back. This will permit the oil in the cylinder to go back to the reservoir.

SEAT SYSTEM

WARNING: Never remove oil lines, accumulator, or cylinder, until the pressure in the hydraulic system of the seat is removed.



PREPARATION TO CHECK THE PRESSURE) IN THE ACCUMULATOR

1. Height adjustment lever. 2. Ride adjustment lever. 3. Bolt. 4. Screw.
3. Remove two screws (4) from the ride control valve. Remove bolt (3) and plastic cap inside the hole. If there are two rubber washers in the hole, remove one.

NOTE: One rubber washer is needed to give a seal for adapter (5).



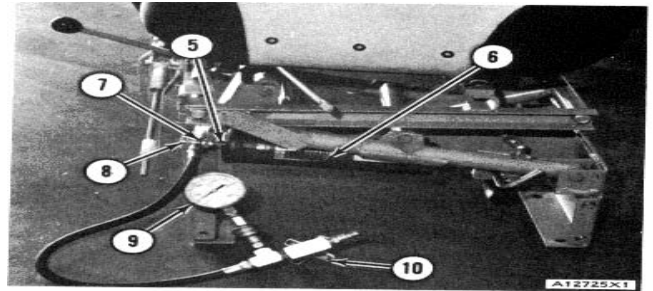
CHARGING ADAPTER

5. 5P2963 Charging Adapter.
4. Install the 5P2963 Charging Adapter (5) in the valve of the accumulator. Install chuck (7) on adapter (5).
5. Use the 0 to 1000 psi (0 to 70.3 kg/cm²) gauge (9) to check the nitrogen charge in the

TESTING AND ADJUSTING

accumulator.

6. Close valve (10).



CHECK OF PRESSURE OF NITROGEN CHARGE IN ACCUMULATOR

5. 5P2963 Charging Adapter. 6. Accumulator. 7. Chuck. 8. Valve handle. 9. Pressure gauge. 10. Valve.
7. Turn valve handle (8) on chuck (7) completely in (clockwise).
8. If the pressure on the gauge is too high, slowly open valve (10) to lower the pressure.

Gas pressure is variable with temperature. The accumulator must be at the same temperature as the air around it before it can be checked or a charge put into it. To get the correct nitrogen charge, use the chart that follows.

CHARGING PRESSURE AND TEMPERATURE RELATIONSHIP for the 95 psi (6.7 kg/cm ²) ACCUMULATOR			
AMBIENT TEMPERATURE		PRESSURE*	
°F	°C	psi	kg/cm ²
20	-7	85	6.0
30	-1	87	6.1
40	4	89	6.3
50	10	91	6.4
60	16	93	6.5
70	21	95	6, 7
80	27	97	6.8
90	32	99	7.0
100	38	101	7.1
110	43	103	7.2
120	49	105	7.4

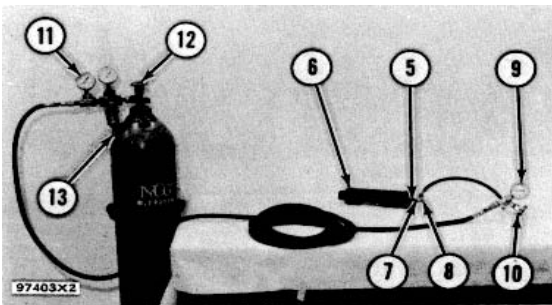
+ 5 psi (+ 0.35 kg/cm²) tolerance permitted!
Every 10°F causes approximately 2 psi change.
Every 5.6°C causes approximately 0.1 kg/cm² change

SEAT SYSTEM

9. If the pressure on the gauge is too low, put a charge in the accumulator. See the subject, CHARGING THE ACCUMULATOR.

CHARGING THE ACCUMULATOR

WARNING: Dry nitrogen is the only gas approved for use in the accumulators. Charging the accumulators with oxygen gas will cause an EXPLOSION. This danger will not happen if nitrogen cylinders with standard CGA (Compressed Gas Association, Inc.) No. 580 connections are used. When you order nitrogen gas be sure that the cylinders are equipped with CGA No. 580 Connections. Do not use color codes or other methods of identification to tell the difference between nitrogen and oxygen cylinders. In any application, never use an adapter to connect the nitrogen charging equipment to a valve that can be used on nitrogen, oxygen or other gas cylinders. **BE SURE YOU ARE USING DRY NITROGEN.**



CHARGING THE ACCUMULATOR

5. 5P2963 Charging Adapter. 6. Accumulator. 7. Chuck. 8. Valve handle. 9. Pressure gauge. 10. Valve. 11. Pressure gauge. 12. Nitrogen cylinder valve. 13. Pressure regulating screw.

TESTING AND ADJUSTING

NOTE: If charging a new accumulator, put clean hydraulic oil in the oil end of the accumulator. This lets the bag in the accumulator get lubrication to prevent damage while charging the accumulator. Leave the oil in for one minute.

1. Connect the hose from the nitrogen cylinder to valve (10).
2. Close valve (10) and open valve (12) on the nitrogen cylinder. Make an adjustment to screw (13) on the regulator assembly until gauge (11) is at the pressure needed for the correct charge in the accumulator. Use the respective chart as a reference for the correct charging pressure.
3. Open valve (10) and put a charge in the accumulator. Turn valve (12) off. If the pressure on gauge (9) is the same as gauge (11) and does not change, the accumulator has the correct charge. If there is a decrease in pressure on gauge (9), open valve (10) and let more nitrogen go to the accumulator. Do this procedure as many times as necessary until the pressure on gauge (9) is the same as gauge (11) and does not change when valve (10) is turned off.
4. Turn off valve (10). Turn off valve (12) on the nitrogen cylinder.
5. Turn valve handle (8) on chuck (7) completely out (counterclockwise).
6. Remove the test and charging equipment.
7. Install the accumulator back on the seat assembly.

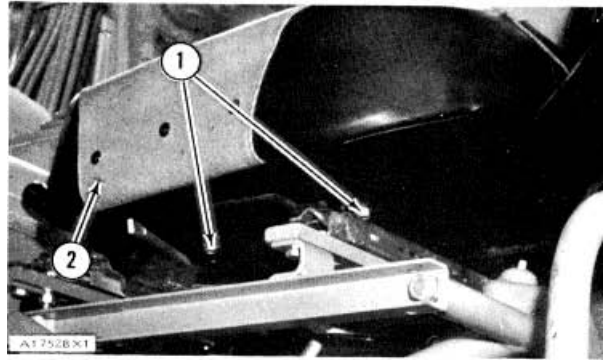
COACH AND CAR SUSPENSION

SEATDISASSEMBLY AND ASSEMBLY

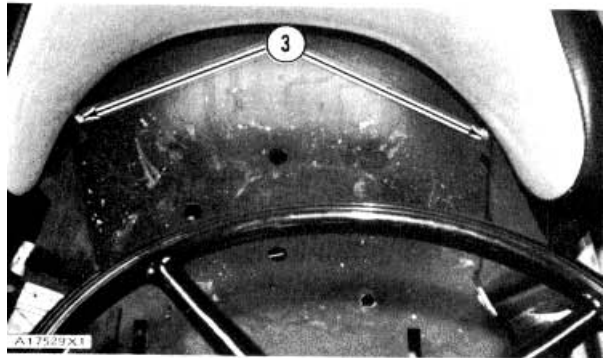
SEAT BELTS

REMOVE AND INSTALL SEAT BELTS

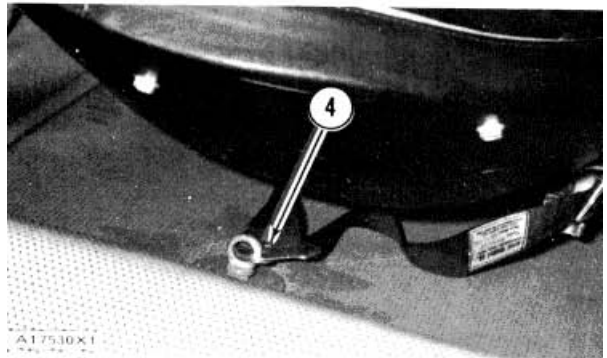
1. Remove two bolts (1) that hold seat cushion (2) to seat frame.



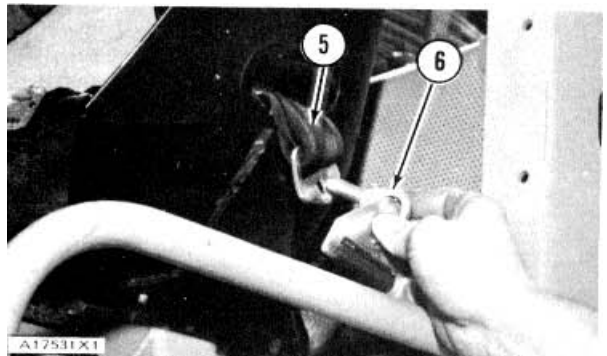
2. Remove nuts (3) that hold eyebolts to seat frame.



3. Remove pins (4) that fasten seat belts.



4. Remove eyebolts (6) and remove seat belts (5).



COACH AND CAR SUSPENSION SEAT

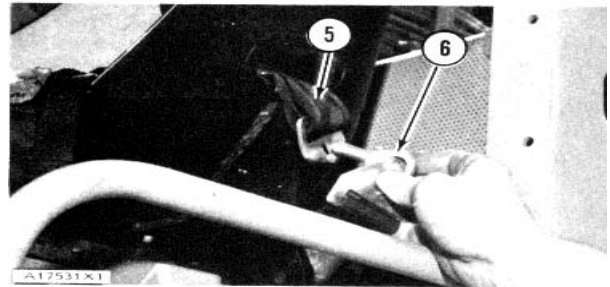
DISASSEMBLY AND ASSEMBLY

SEAT BELTS

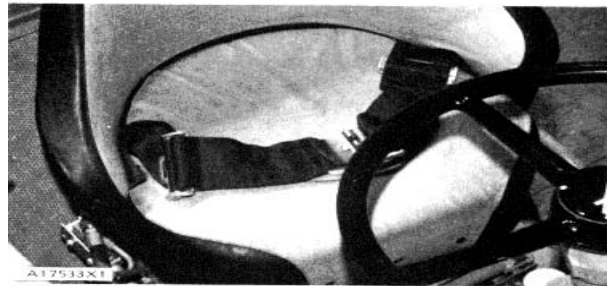
5. Install new seat belts.



6. Install seat belts to seat frame with eyebolts (6).



7. Install seat cushions, and check seat belts to see that they are not twisted.



COACH AND CAR SUSPENSION SEAT

DISASSEMBLY AND ASSEMBLY

SEAT CYLINDER

REMOVE AND INSTALL SEAT CYLINDER



WARNING: Do not remove any oil lines until pressure in the hydraulic system of the seat is removed.

1. Remove bolt (1) that holds top of cylinder to seat.

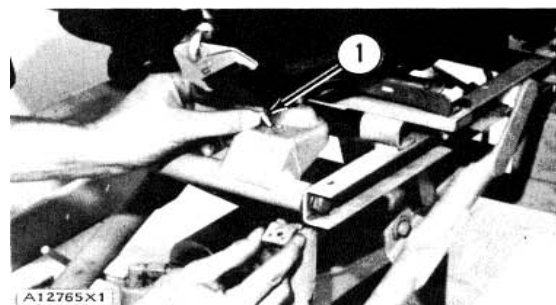
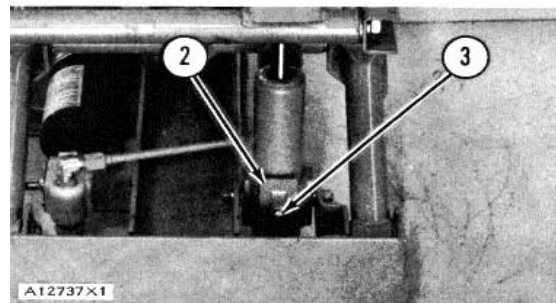
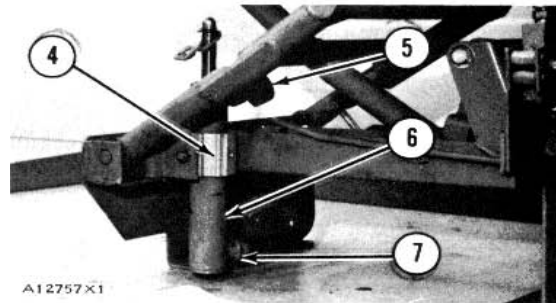
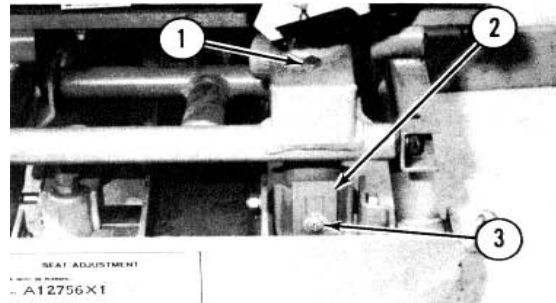
2. Remove two screws (3). Remove bracket (2) that holds cylinder.

3. Remove breather (5). Disconnect oil line (7) from the cylinder (6). Remove cylinder from bracket (4).

4. Install new cylinder in bracket (4). Connect oil line (7). Install breather (5).

5. Install bracket (2) and two screws (3).

6. Install bolt (1) that holds cylinder to seat.



COACH AND CAR SUSPENSION SEAT

DISASSEMBLY AND ASSEMBLY

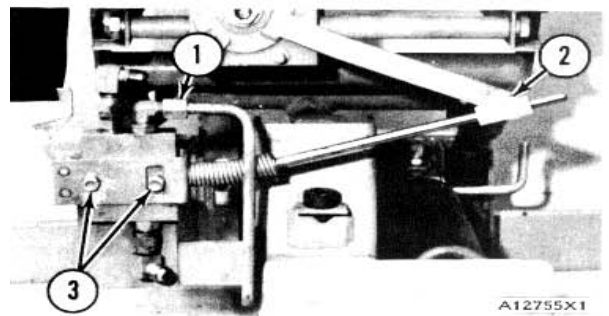
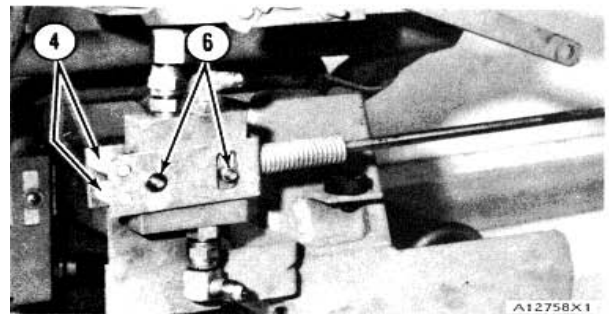
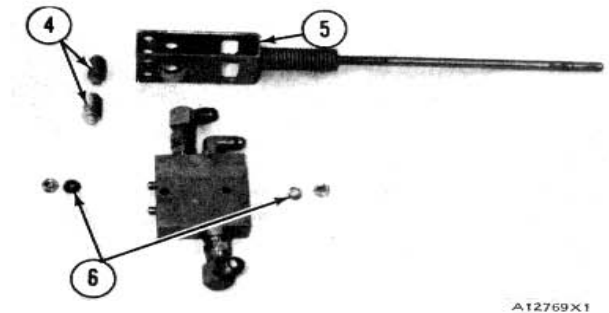
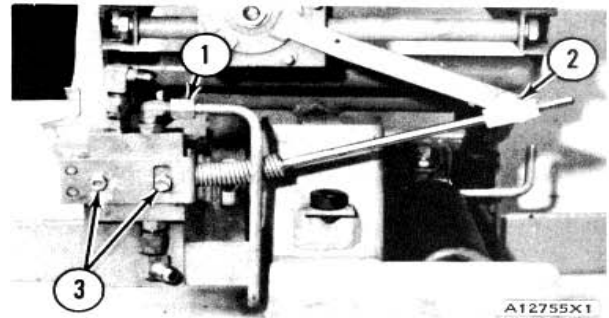
HEIGHT CONTROL VALVE

REMOVE AND INSTALL HEIGHT CONTROL VALVE



WARNING: Do not remove any oil lines until pressure in the hydraulic system of the seat is removed.

1. Remove oil line (1).
2. Remove screw that holds slide bearing (2) to spring arm. Remove slide bearing.
3. Remove two nuts (3) and bearings (6) that fasten valve to seat frame. Remove valve and spring arm.
4. Remove valve actuators (4) from spring arm (5). Remove spring arm from valve.
5. Put spring arm in position on valve. Install valve actuators (4). Install bearings (6).
6. Install nuts (3) that hold valve to seat frame.
7. Position slide bearing (2) on spring arm, and fasten to height adjustment lever.
8. Install oil line (1).
9. See ADJUSTMENT OF HEIGHT CONTROL LINKAGE in the TESTING AND ADJUSTING section of this manual for correct procedure on making adjustments.



COACH AND CAR SUSPENSION SEAT

DISASSEMBLY AND ASSEMBLY

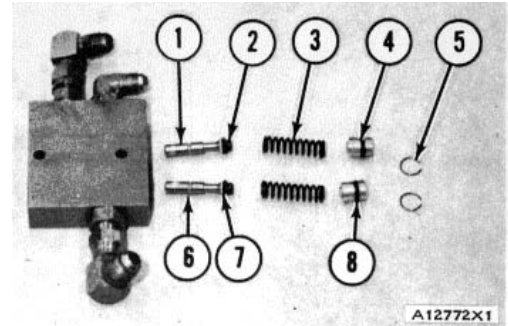
HEIGHT CONTROL VALVE

DISASSEMBLE AND ASSEMBLE HEIGHT CONTROL VALVE

Start by:

a) remove height control valve

1. Clean all outside surfaces and drain oil from the valve.
2. Push guide (4) against spring (3) approximately 0.625 in. (1.59 mm). Use a small screw driver and remove retainer (5).

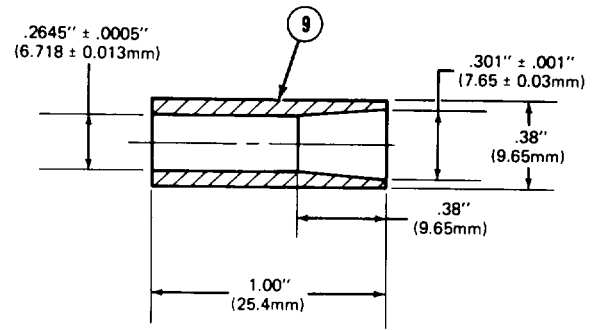


WARNING: Use care when guides are removed. Spring force behind the guides can cause guides to leave the body with force.

3. Remove guide (4), spring (3), guide (2) and poppet (1).
4. Remove slipper and O-ring (6), seal (7) and O-ring (8).
5. Before assembly clean the valve.
6. Install O-ring and slipper (6) on poppet. Install new seals and O-ring. Tool (9) can be used to compress slipper on poppet.
7. Assemble parts in the reverse order that they were disassembled.

end by:

a) install height control valve



SUSPENSION SEAT

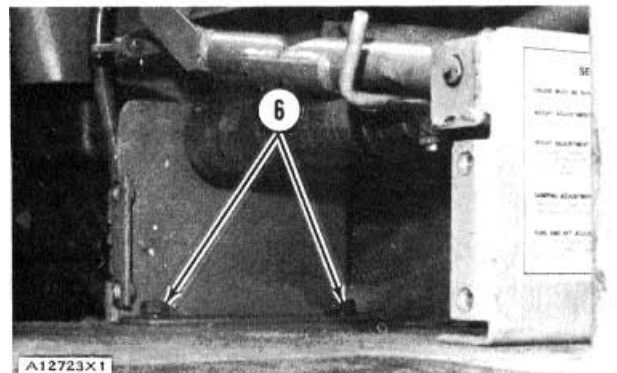
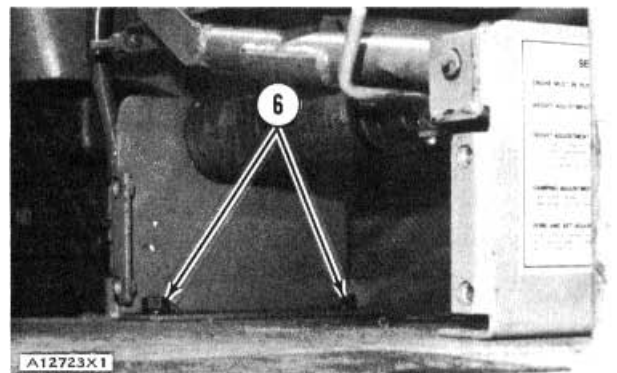
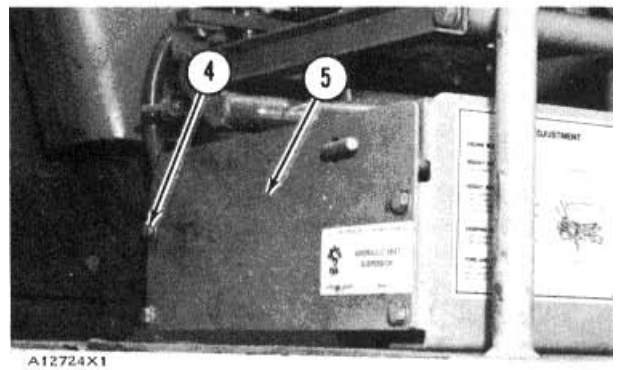
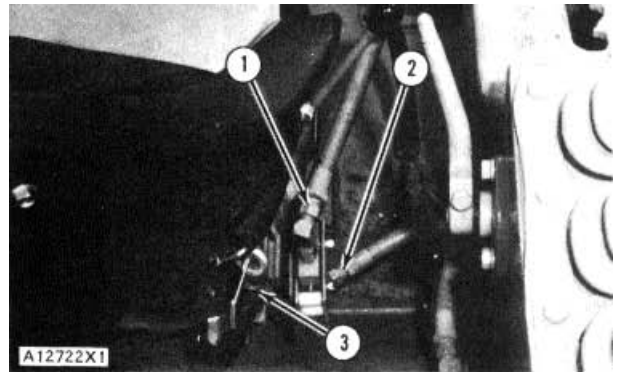
REMOVE AND INSTALL SUSPENSION SEAT

NOTE: This is a typical procedure for the removal of the seat.



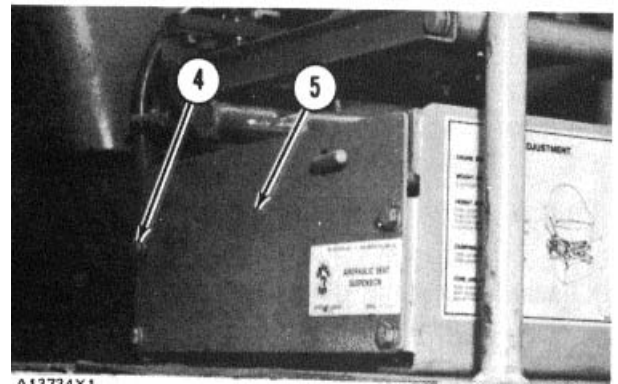
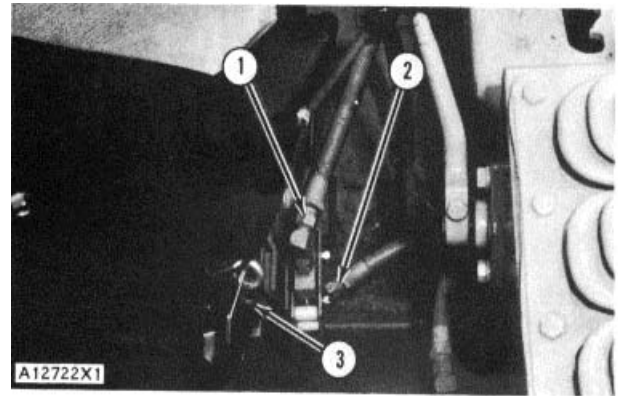
WARNING: Never remove the seat front panel, any oil lines, or the bolt on the seat cylinder rod until the pressure in the hydraulic system of the seat is removed.

1. Move height control lever up and down to release the hydraulic pressure.
2. Put identification on oil lines as to their location on the valve. Disconnect oil lines (1) and (2) from the valve.
3. Remove the pins (3) that hold the seat belts to the seat. Disconnect seat belts.
4. Remove four bolts (4) that hold front panel of seat and remove panel (5).
5. Remove bolts (6) from each side of seat. Fasten a hoist to the seat and remove seat.
6. Fasten a hoist to the seat. Put the seat in position on the machine. Install bolts (6) that hold the seat.



SUSPENSION SEAT

7. Install seat belts on seat. Install pin (3) that fasten seat belt to seat on each side of the seat.
8. Connect oil lines (1) and (2) to their correct location on the valve.
9. Install front panel (5).
10. See ADJUSTMENTS TO SEAT AFTER ASSEMBLY in the TESTING AND ADJUSTING section of this manual for the correct adjustment procedure.



SUSPENSION SEAT

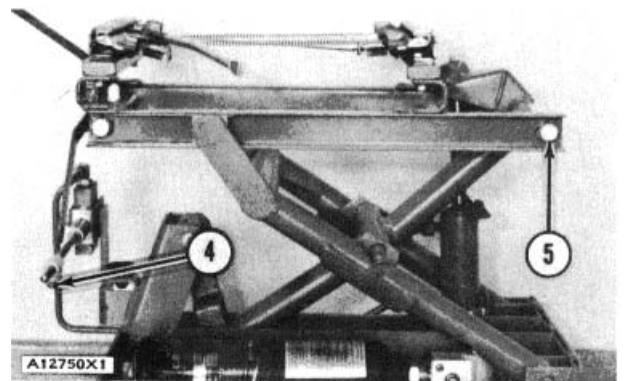
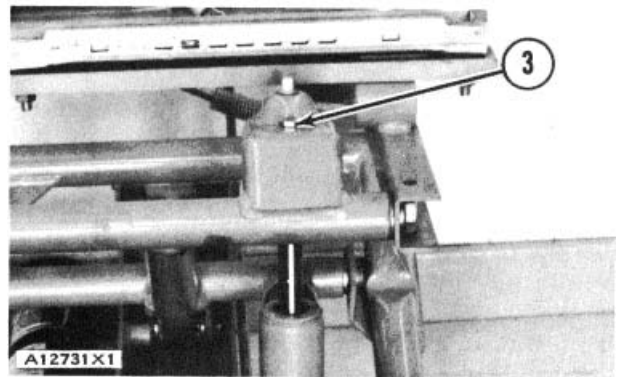
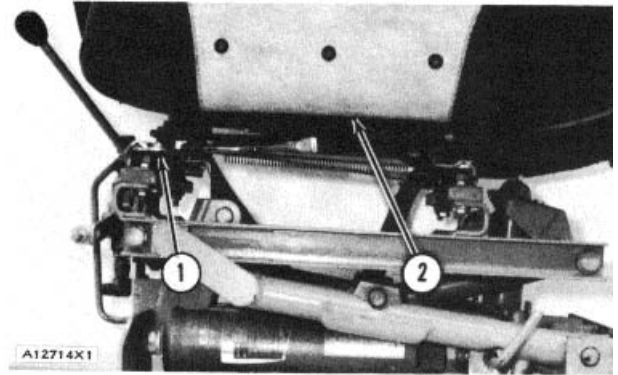
DISASSEMBLE SUSPENSION SEAT

Tools Needed		A
1P74	Slide Hammer	1
8B7559	Adapter	1

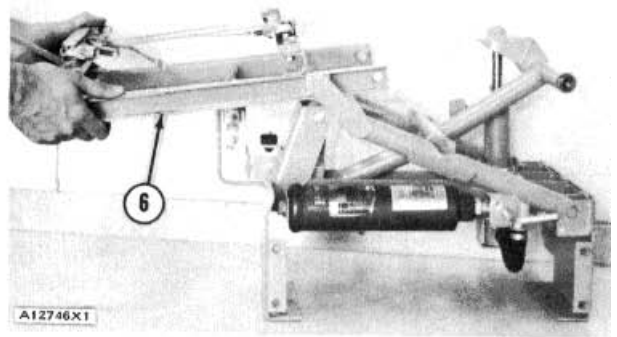
start by:

a) remove suspension seat

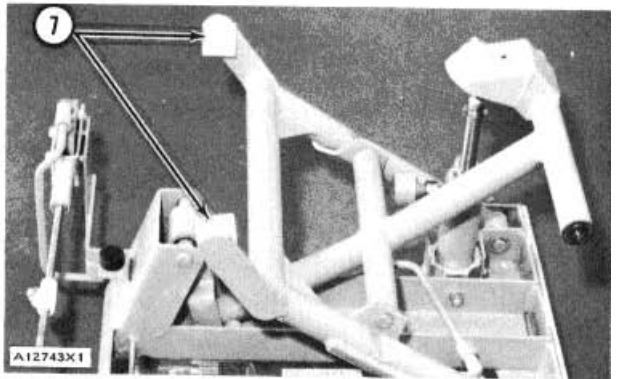
1. Remove four bolts (1) that hold seat cushion (2). Remove seat cushion.
2. Remove bolt (3) and disconnect cylinder rod from the seat suspension.
3. Disconnect height control linkage (4). Remove two bolts (5) and washers that hold rail assembly.



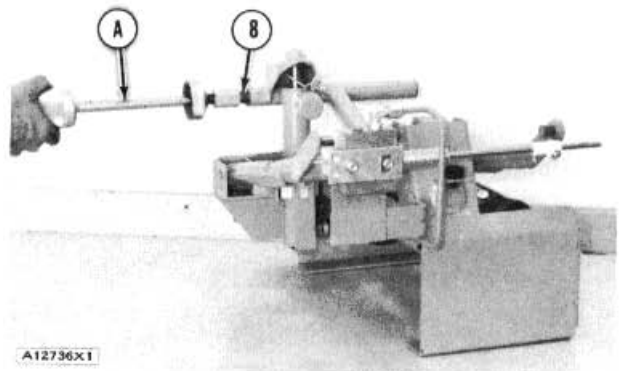
4. Remove rail assembly (6).



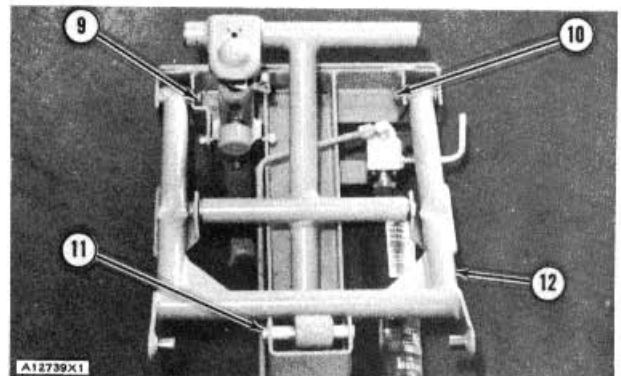
5. Remove slides (7).



6. Remove two bearings (8) and shaft with tooling (A).

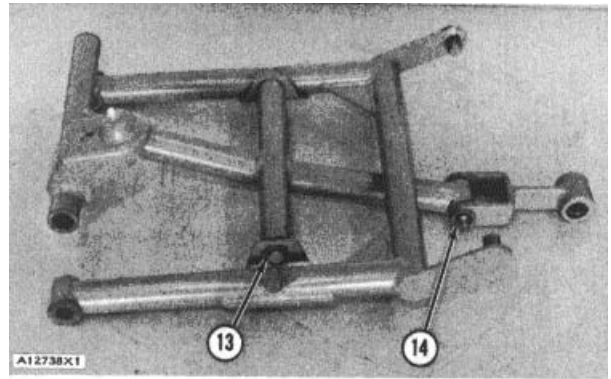


7. Remove snap rings (9), (10), (11), washers and pins. Remove lever assembly (12).

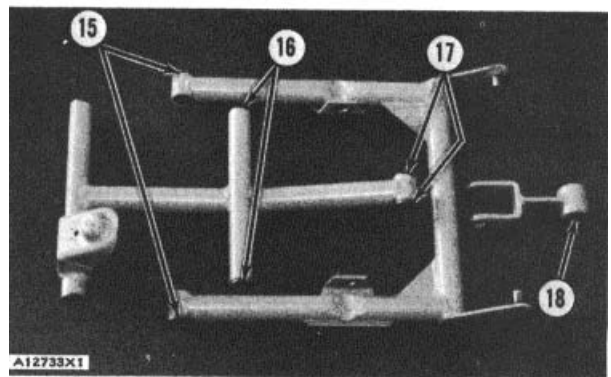


SUSPENSION SEAT

8. Remove snap rings (13), (14) washers and pins.



9. Remove bearings (15), (16), (17) and bearing (18).

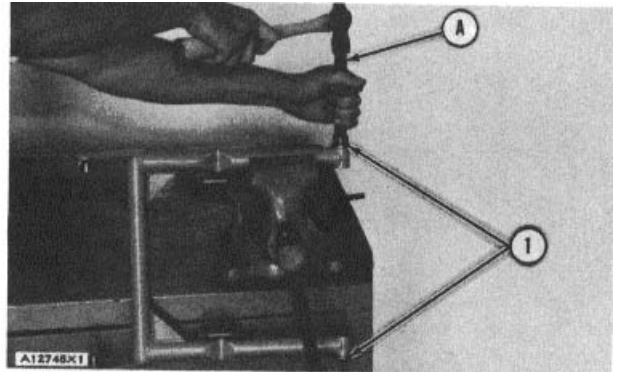


SUSPENSION SEAT

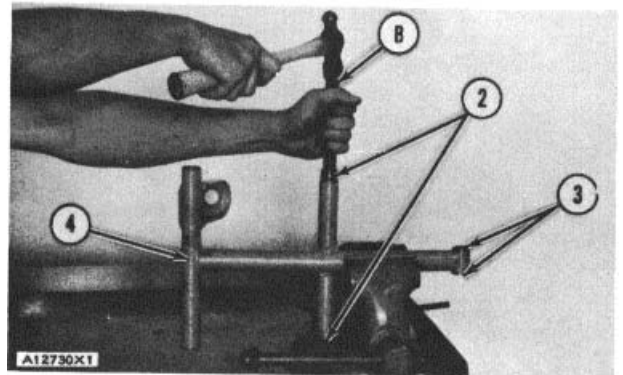
ASSEMBLE SUSPENSION SEAT

Tools Needed	A	B	C
1P529 Handle	1	1	1
1P459 Drive Plate	1		
1P463 Drive Plate	1	1	
1P457 Drive Plate		1	1
1P460 Drive Plate			1

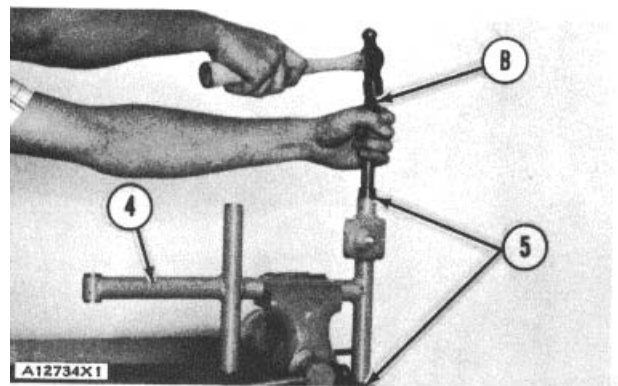
1. Install two .750 in. (19.05 mm) bearings (1) with tooling (A).



2. Install four .63\25 inc. (15.88 mm) bearings (2) and (3) in inner lever (4) with tooling (B).

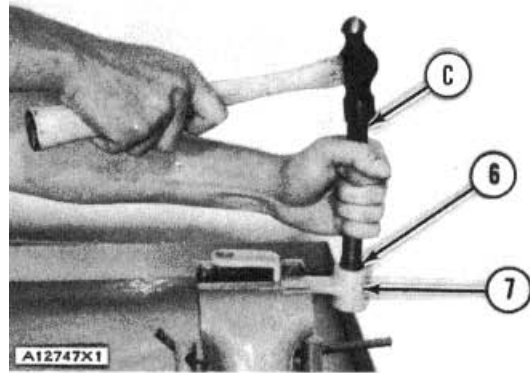


3. Install two .625 in. (15.88 mm) bearings (5) in lever (4) with tooling (B).

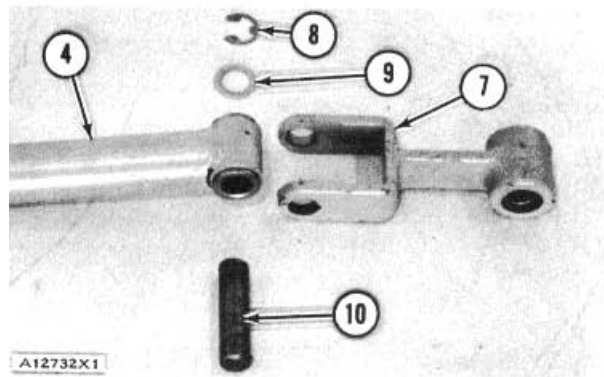


SUSPENSION SEAT

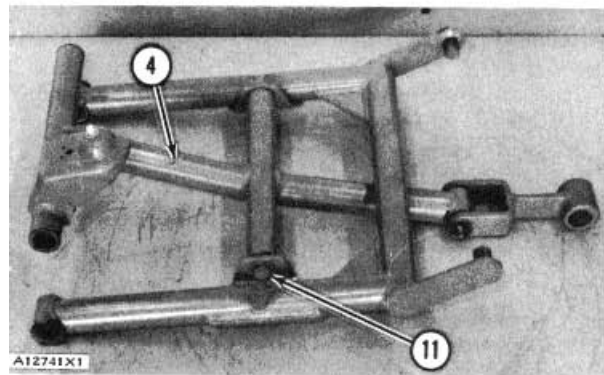
4. Install one .625 in. (15.88 mm) bearing (6) in lever (7) with tooling (C).



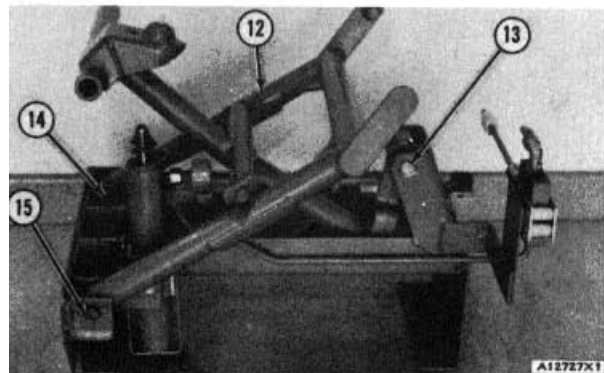
5. Put lever (7) in position with lever (4). Install pin (10) washer (9) and snap ring (8).



6. Put lever (4) in position, install pin (11) washer and snap ring.

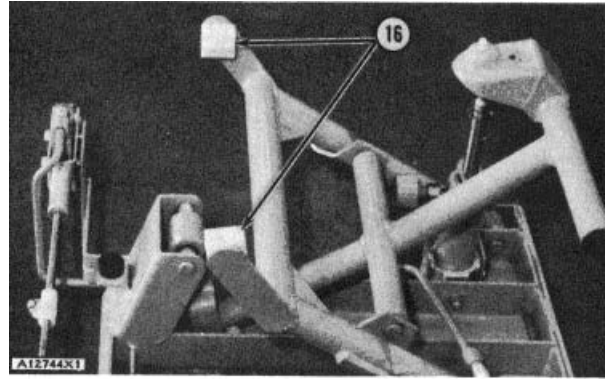


7. Install lever assembly (12) on seat frame. Install pins (13), (14), (15), washers and snap rings.

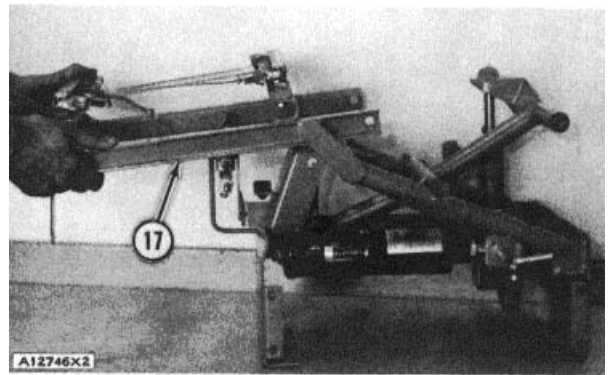


SUSPENSION SEAT

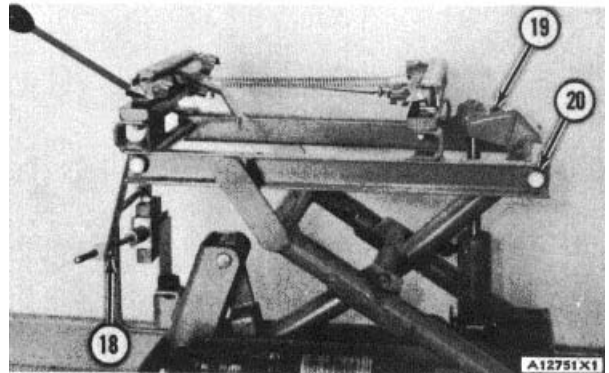
8. Install slides (16).



9. Install rail assembly (17) to lever assembly.



10. Install the bolts and washers (20) that hold rail assembly to lever assembly. Connect cylinder rod to lever assembly. Connect cylinder rod to rail assembly and install bolt (19).



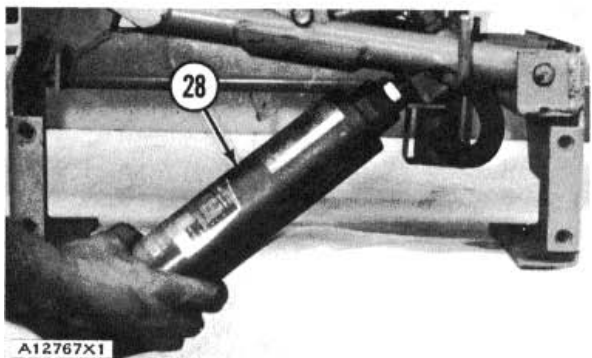
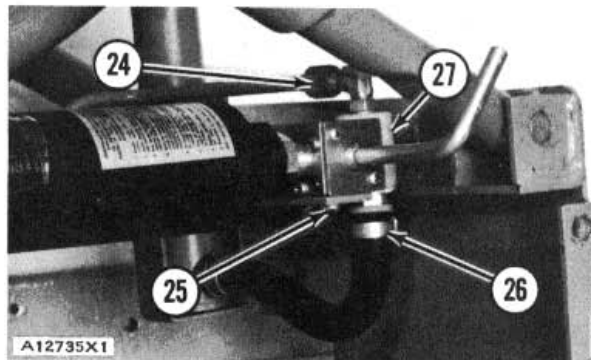
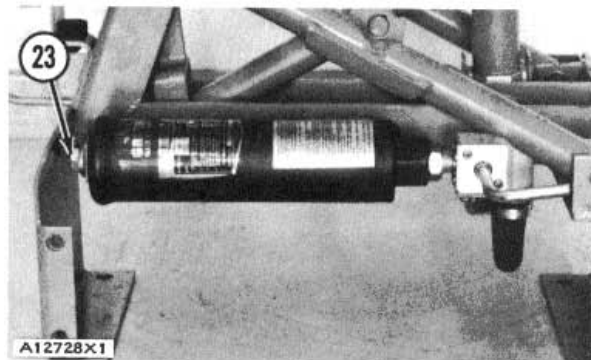
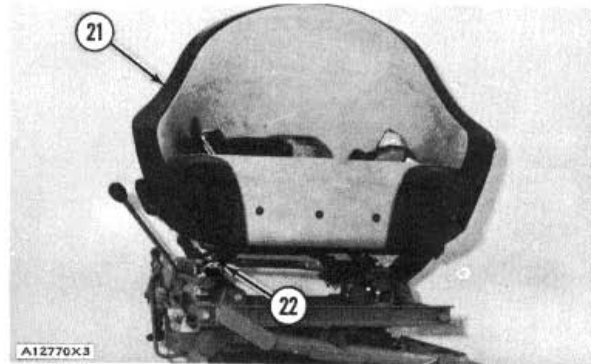
11. Connect height control lever (18) to height control valve.

SUSPENSION SEAT

12. Put seat cushion (21) in position on rail assembly.
13. Install four bolts (22) that hold seat cushion to rail assembly.
14. NOTE: The Steps that follow are to be used to remove and install the ride control valve and the accumulator.
15. Remove bolt (23) that holds the accumulator.
16. Disconnect lines (24) and (26) from the ride control valve (27).
17. Remove two screws (25) that hold the ride control valve.
18. Remove accumulator (28) and ride control valve. Remove accumulator from ride control valve.
19. Install accumulator (28) to ride control valve (27).
20. Put accumulator and ride control valve in position and install bolt (23) and screws (25).
21. Connect oil lines (24) and (26).
22. See ADJUSTMENTS TO SEAT AFTER ASSEMBLY in the TESTING AND ADJUSTING section of this manual for the correct adjustments to the seat.

end by:

- a) install suspension seat



**CHAPTER 2
VEHICLE SYSTEMS
HYDRAULIC SYSTEMS**

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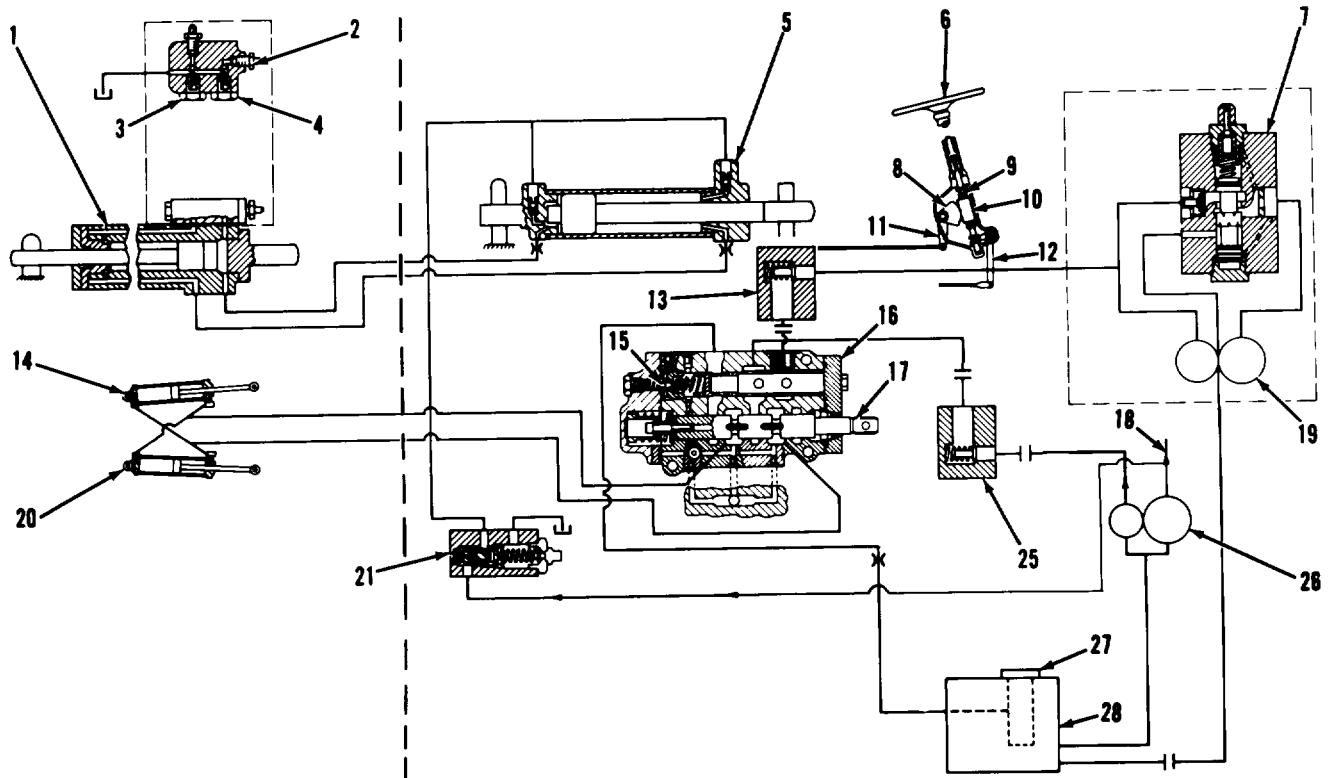
**SECTION I
STEERING SYSTEM
SYSTEMS OPERATION, TESTING AND ADJUSTING**

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NOTE: For Specifications with illustrations, make reference to the SPECIFICATIONS FOR STEERING SYSTEM.

STEERING SYSTEM SYSTEMS OPERATION

TM 5-3805-248-14&P-3

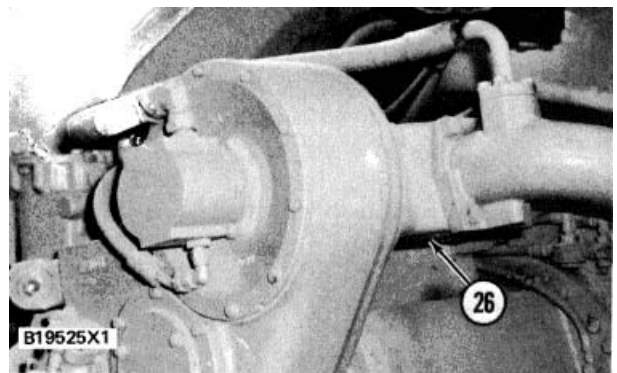


STEERING SYSTEM SCHEMATIC

- | | | | |
|-----------------------------------------------------|---------------------------------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------|
| 1. Follow-up cylinder (sender) | 6. Steering wheel | 15. Relief valve (main). | 21. Pressure reducing valve. |
| 2. Bleed valves (for removal of air from follow-up) | 7. Diverter valve (part of supplemental steering pump). | 16. Steering control valve. | 25. Check valve. |
| 3. Relief valve (rod end of follow-up cylinders). | 8. Gear sector. | 17. Valve spool. | 26. Hydraulic pump for steering (small section) and scraper (large section) hydraulic systems. |
| 4. Relief valve (head end of follow-up cylinders). | 9. Worm (part of shaft). | 18. Line to scraper hydraulic pump. | 27. Oil filter. |
| 5. Follow-up cylinder (receiver). | 10. Gear nut. | 19. Supplemental steering pump. | 28. Hydraulic tank. |
| | 11. Lever | 20. Steering cylinder (right side). | |
| | 12. Lever. | | |
| | 13. Check valve | | |
| | 14. Steering cylinder (left side). | | |

STEERING OPERATION

When the engine is running, hydraulic pump (26) is driven by the transfer gears. The pump gets oil from hydraulic tank (28). The pump is a vane-type with two pump sections. The small pump section at the cover end is for the steering system. The pump oil goes to the steering control valve (16). When steering wheel (6) is turned, it moves valve spool (17). Hydraulic pump (26) is for steering and implement (bowl) hydraulic systems.



STEERING SYSTEM

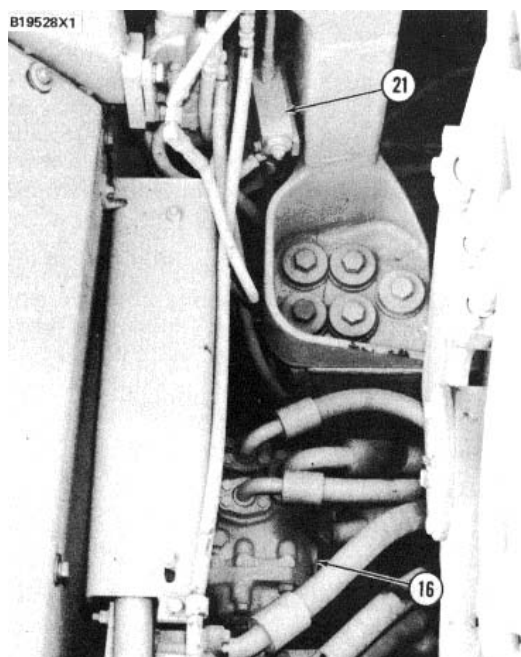
SYSTEMS OPERATION



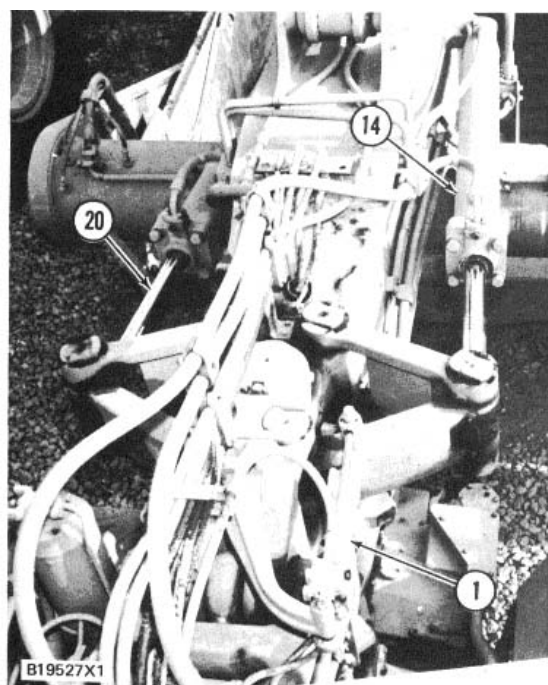
The steering wheel shaft has a worm (9), with left hand threads, in nut gear (10). When the steering wheel is turned, either to the right or left, worm (9) moves a short distance into or out of gear nut (10). The movement of worm (9) moves lever (12), which is connected to valve spool (17), and valve spool (17) moves to another position in steering control valve (16). The positions of the valve spool are: LEFT TURN (L), RIGHT TURN (R) and HOLD (H). When the steering wheel is held stationary, valve spool (17) is in HOLD position (H) and pump oil in the steering control valve goes out to hydraulic tank (28). The remainder of the oil goes directly to the hydraulic tank.

HYDRAULIC PUMPS ON TRACTOR 0

26. Hydraulic pump for steering and elevator hydraulic systems. 30. Hydraulic pump for implement (bowl) and elevator hydraulic systems.



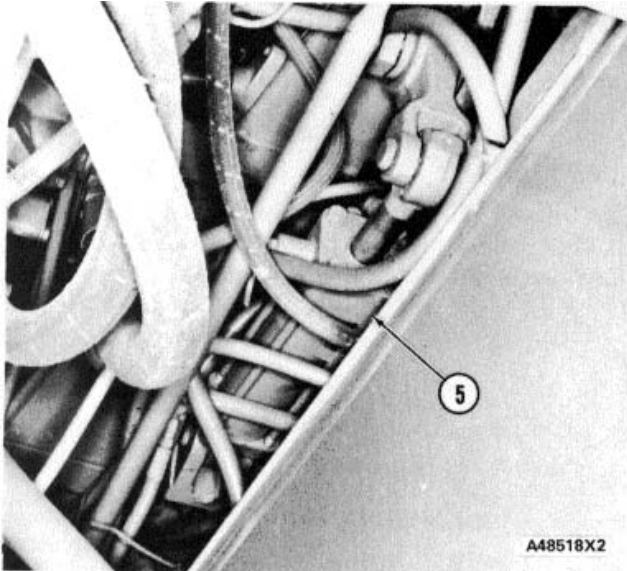
LEFT REAR FENDER (HITCH SIDE)
16. Steering control valve. 21. Pressure reducing valve.



TOP OF HITCH
1. Follow-up cylinder (sender). 14. Steering cylinder (left side). 20. Steering cylinder (right side).

SYSTEMS OPERATION

Oil from hydraulic pump goes to pressure reducing valve (21). This oil is used to keep follow-up cylinders (1) and (5) filled with oil. The pressure reducing valve keeps the oil that goes to the follow-up cylinders at a constant pressure of 60 psi (415 kPa).

**LEFT SIDE OF ENGINE**

5. Follow-up cylinder (receiver). (View from under machine.)

Follow-Up System

The location of follow-up cylinder (1), which is a servo-sender cylinder, is on the hitch of the tractor and scraper. The location of follow-up cylinder (5), which gets oil from follow-up cylinder (1) when it moves, is under the floor plate of the operator's station. The rod of cylinder (5) is connected to lever (11) of the steering gear. Lever (11) is on the shaft of gear sector (8).

The operation of the follow-up cylinders during a right turn of the machine is as follows:

When steering wheel (6) is turned to the right, worm (9) in gear nut (10) moves up. [There are left

hand threads on worm (9). Gear nut (10) is held stationary by gear sector (8)].

One end of lever (12) is in a groove near the bottom of the worm shaft. The lever moves when worm (9) moves. The other end of lever (12) pushes valve spool (17) into RIGHT TURN position (R).

The oil from pump (26), in steering control valve (16), now goes to the rod end of right steering cylinder (20) and the head end of left steering cylinder (14) and the machine starts to turn.

As the steering cylinders turn the machine, the rod is moved out of follow-up cylinder (1) and the movement of the piston sends oil to the rod end of follow-up cylinder (5).

The oil sent to the rod end of cylinder (5) moves the rod into the cylinder which also moves lever (11), the shaft and gear sector (8). The movement of the gear sector lets gear nut (10) move worm (9) when the steering wheel and the worm are turned.

The operator stops turning the steering wheel when the machine is at the amount of turn desired.

When movement of the steering wheel is stopped, worm (9) also stops turning. The moving steering cylinders and follow-up cylinders do not stop until lever (11) moves gear sector (8). which moves gear nut (10) and worm (9) down.

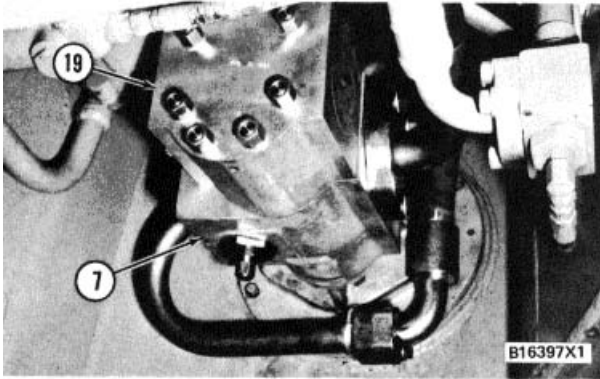
When worm (9) is moved down, lever (12) on the end of the worm shaft moves valve spool (17) to HOLD position (H). This stops the flow of pump oil to the steering cylinders and the machine stops turning at the amount of turn desired.

The operation of the follow-up cylinders is so fast that it can not be felt when the steering wheel is either turned or stopped from turning.

Relief valves (3) and (4) give protection to the follow-up cylinders and lines. Bleed valves (2) are used to remove air from the follow-up system.

STEERING SYSTEM**SYSTEMS OPERATION****SUPPLEMENTAL STEERING**

Supplemental steering operates the steering cylinders when the wheels turn (machine not stopped) if either the engine stops or hydraulic pump (26) has a failure.

**FRONT OF DIFFERENTIAL CASE AND FRAME**

7. Diverter valve. 19. Supplemental steering pump.

Supplemental steering pump (19) is a two-section pump that has diverter valve (7) combined with it. The pump is fastened to the front of the differential case and frame. Pump (19) is driven by the ring gear of the differential when the wheels turn. When the wheels turn supplemental steering pump (19), oil goes into the steering hydraulic system. The oil output from the supplemental steering pump adds to the output from hydraulic pump (26).

Two check valves (13) and (25), one on the out-put side of pump (26) and one on the output side of supplemental steering pump (19), are other parts of the supplemental steering attachment. The oil from supplemental steering pump (19) always goes through check valve (13) but can not go through check valve (25), if there is a failure in either the pump or the engine.

When the speed of the machine is less than 15 mph (25 km/hr) the output from both pump sections goes through check valve (13) into steering control valve (16). When the speed of the machine is between 15 and 20 mph (24 and 32 km hr), diverter valve (7) lets the output from the large pump section go back to the pump inlet of the valve and only the output from the small pump section goes to steering control valve (16).

The amount of oil from supplemental steering pump (19) is in a relation with the rpm of the machine drive wheels. When the rpm of the machine drive wheels decreases, the output of oil from pump (19) is less and steering cylinders (14) and (20) move slower. When the machine goes slower, less mph (km, hr), it takes longer for the machine to make a turn.

STEERING SYSTEM

STEERING CONTROL VALVE

HOLD Position

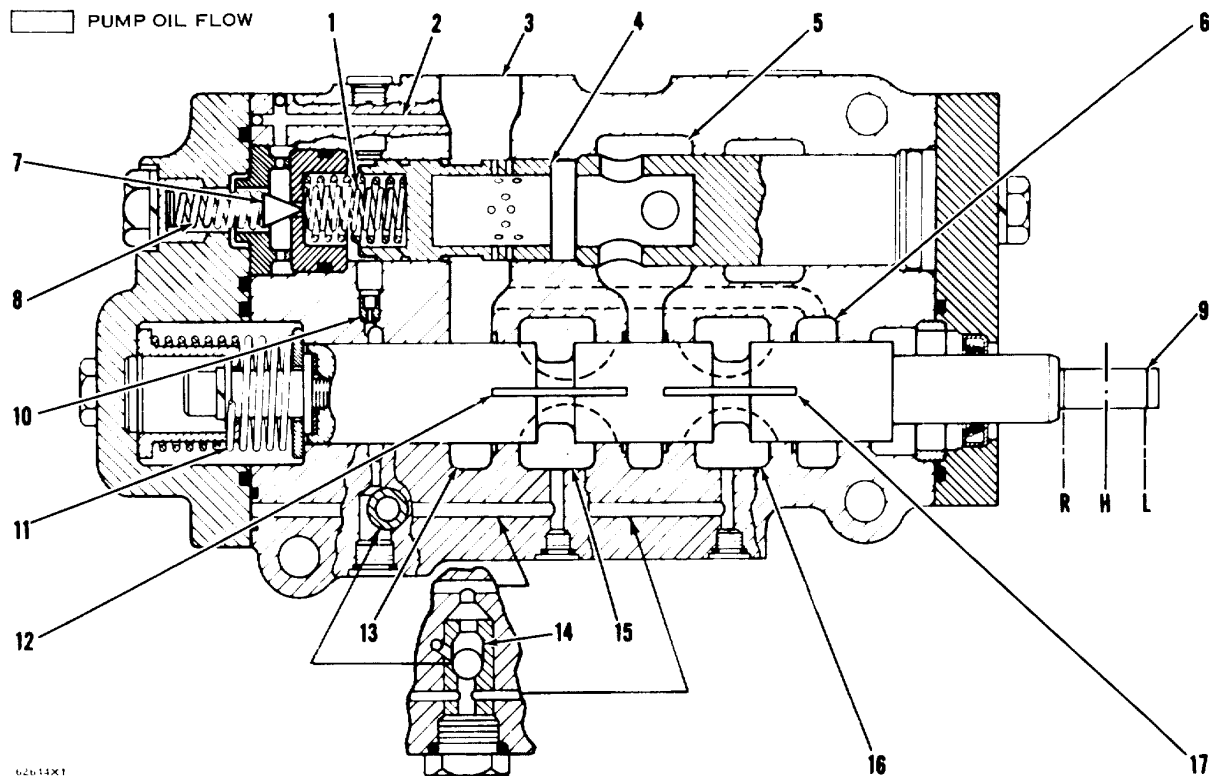
When there is no force on the steering wheel, spring (11) in the steering control valve keeps valve spool (9) in the HOLD position (H).

The oil from the hydraulic pump goes in the control valve through inlet passage (5). The pump oil goes in flow control valve (4) and there is an increase of oil pressure. The pressure of the oil moves flow control valve (4). The position of valve (4) now lets the pump oil go through holes in the valve into passage (13), through a passage in the control valve into passage (6). The oil also goes through outlet (3) to the supply tank.

SYSTEMS OPEATION

A small amount of oil in passages (13) and (6) goes through slots (12) and (17), in valve spool (9), into passages (15) and (16) to the steering cylinders. The low pressure of the oil in each end of each steering cylinder stops any shock, on the wheels, from going to the steering wheel.

The oil in passages (15) and (16) also goes to ball chamber (14) in the shuttle valve. The pump oil moves the ball to open the passage with orifice (10), and the oil goes through the passage and orifice into chamber (1). Pilot valve (7) feels the pressure of the oil in chamber (1). The pressure of the oil in passages (15) and (16) is the same as in chamber (1).



CONTROL VALVE IN HOLD POSITION

1. Chamber.
 2. Passage from the pilot valve of the relief valve.
 3. Outlet to the supply tank.
 4. Flow control valve.
 5. Inlet passage for the pump oil.
 6. Passage.
 7. Pilot valve for relief valve.
 8. Spring for pilot valve.
 9. Valve spool.
 10. Orifice.
 11. Spring for valve spool.
 12. Slot.
 13. Passage.
 14. Ball chamber in shuttle valve.
 15. Passage (to head end of right side and rod end of left side steering cylinders).
 16. Passage (to the rod end of the right side and head end of the left side steering cylinders).
 17. Slot.
- H. HOLD position. L. LEFT TURN position. R. RIGHT TURN position.

STEERING SYSTEM

RIGHT TURN Position

When the steering wheel is being turned to the right it moves control valve spool (9) to RIGHT TURN position (R).

The oil from the hydraulic pump goes in the control valve through inlet passage (5). With valve spool (9) in RIGHT TURN position (R) the pump oil goes around the valve spool into passage (16) and to the rod end of the right side and the head end of the left side steering cylinders. The oil in the right side cylinder moves the rod in and the oil in the left side cylinder moves the rod out. This movement turns the vehicle at the hitch to make a right turn.

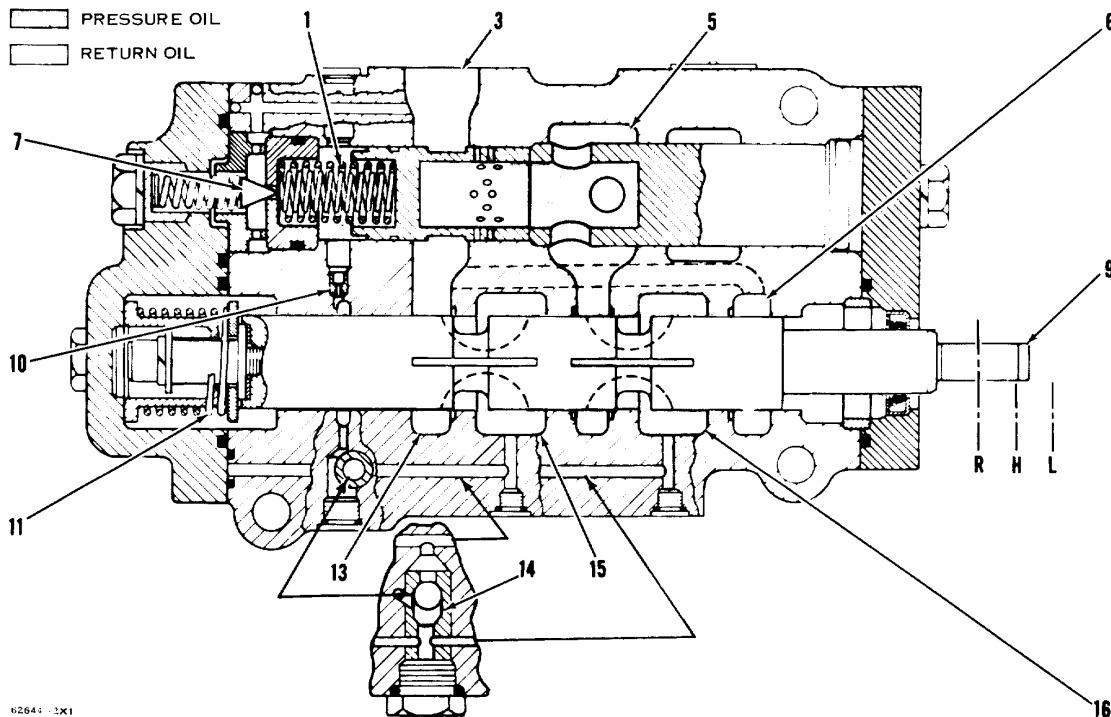
The oil in passage (16) to the steering cylinders also goes to ball chamber (14) in the shuttle valve. The oil from passage (16) moves the ball. The ball now

SYSTEMS OPERATION

stops the oil in passage (15) from entering the ball chamber. The position of the ball in the chamber of the shuttle valve opens the passage, with orifice (10), to chamber (1). The pressure of the oil in chamber (1) is the same as in passage (16) to the steering cylinders. Pilot valve (7) of the relief valve feels the pressure of the oil in chamber (1).

The oil from the head end of the right side and the rod end of the left side steering cylinders goes into passage (15). The oil in passage (15) goes around valve spool (9) into passage (13) and through outlet (3) to the supply tank.

Valve spool (9) is kept in the RIGHT TURN position (R) when the steering wheel is being turned to the right. When turning of the steering wheel is stopped, follow-up cylinders and spring (11) move the valve spool to HOLD position (H).



CONTROL VALVE IN RIGHT TURN POSITION

1. Chamber. 3. Outlet to supply tank. 5. Inlet passage for the pump oil. 6. Passage. 7. Pilot valve for relief valve. 9. Valve spool. 10. Orifice. 11. Spring for valve spool. 13. Passage. 14. Ball chamber in shuttle valve. 15. Passage (to the head end of the right side and the rod end of the left side steering cylinders). 16. Passage (to the rod end of the right side and the head end of the left side steering cylinders). H. HOLD position. L. LEFT TURN position. R. RIGHT TURN position.

STEERING SYSTEM

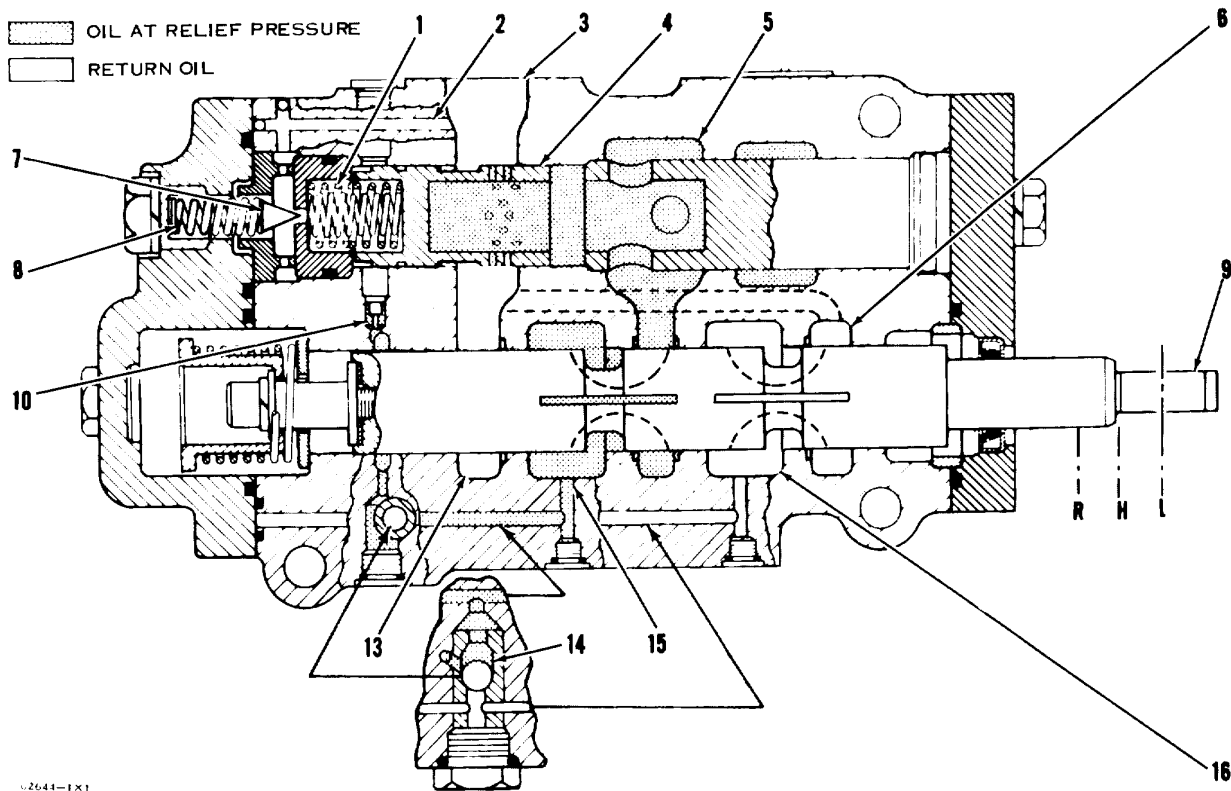
Relief Valve for the Steering Circuit

The following is an example of relief valve operation when the machine is making a left turn.

The steering wheel is being turned to the left to make a left turn. Before the vehicle turns to the amount of turn desired, an outside force prevents the vehicle from turning. With spool valve (9) in LEFT TURN position (L), the pump oil from inlet passage (5), going through passage (15) to the head end of the right side and rod end of the left side steering cylinders, can not move the rods in the cylinders. This causes an increase in the pressure of the pump oil. The high pressure oil is also through

SYSTEMS OPERATION

ball chamber (14) in the shuttle valve, through the passage with orifice (10) and in chamber (1). The pressure of the oil in the steering circuit and in chamber (1) has more force than spring (8) and the oil opens pilot valve (7). The oil from chamber (1) flows through the open pilot valve and through passage (2) into outlet (3) faster than the oil from passage (15) can get through orifice (10). The reduction in the pressure of the oil in chamber (1) lets the oil in inlet (5) move flow control valve (4). The holes in the flow control valve are now open to outlet (3). The oil flow in the steering circuit, that was stopped by the cylinders, now flows through the holes in valve (4) and the pressure of the oil in the steering circuit does not go higher.



**CONTROL VALVE WITH RELIEF VALVE OPEN
(Valve in LEFT TURN position)**

- 1. Chamber. 2. Passage from the pilot valve. 3. Outlet to supply tank. 4. Flow control valve. 5. Inlet passage for pump oil. 6. Passage. 7. Pilot valve for relief valve. 8. Spring for pilot valve. 9. Valve spool. 10. Orifice. 13. Passage. 14. Ball chamber in shuttle valve. 15. Passage (to the head end of the right side and the rod end of the left side steering cylinders). 16. Passage (to the rod end of the right side and the head end of the left side steering cylinders). H. HOLD position. L. LEFT TURN position. R. RIGHT TURN position.

STEERING SYSTEM

STEERING HYDRAULIC SYSTEM

TESTING AND ADJUSTING

The 5S5123 Hydraulic Test Group and the 6V4161 Hydraulic Test Group are used to make the pressure test of the hydraulic system. Before making any tests, visually inspect the complete hydraulic system for leakage of oil and for parts that have damage. For some of the tests a magnet and measuring rule (either for inches or millimeters) are usable tools.

⚠ WARNING

When testing and adjusting the hydraulic system, move the machine to a smooth horizontal location. Move away from machines that are at work and any personnel. There must be only one operator. Keep all other personnel either away from the machine or where the operator can see them.

VISUAL CHECKS

A visual inspection of the hydraulic system and its components is the first step when a diagnosis of a problem is made. Stop the engine and lower the scraper bowl to the ground. To remove the tank filler cap, slowly turn the filler cap until it is loose. If oil comes out the bleed hole, let the tank pressure lower before the filler cap is removed. Make the following inspections:

1. Measure the oil level.
2. Look for air in the oil that is in the tank. Do this immediately after the machine is stopped. Use a clear bottle or container to get a sample of the oil. Look for air bubbles in the oil that is in the bottle.
3. Remove the filter elements and look for particles removed from the oil by the filter element. A magnet will separate ferrous particles from non-ferrous particles (piston rings, O-ring seals, etc.).
4. Check all oil lines and connections for damage or leaks.

PERFORMANCE TESTS

Performance tests of the steering system can be used for a diagnosis of poor performance and to find the source of oil leakage inside the hydraulic system.

PROBLEM: Machine turns slowly in one direction only.

PROBABLE CAUSE:

1. Valve spool does not move enough in one direction only.
2. Linkage between steering gear assembly and steering control valve needs an adjustment.

PROBLEM: Machine turns a small amount when steering wheel is stationary.

PROBABLE CAUSE:

1. Valve spool in steering control valve needs an adjustment.
2. Leak in follow-up cylinder relief valve or in follow-up cylinder check valve.
3. The setting of the pressure reducing valve is not correct.

PROBLEM: Pump makes noise, the cylinder rods do not move smoothly and there are air bubbles in the oil.

PROBABLE CAUSE:

1. The viscosity of the oil is wrong.
2. The relief valve opens at too low oil pressure.
3. Loose connection of the oil line on the inlet side of the pump.
4. The pump has too much wear.
5. Leak in follow-up cylinder relief valve or in follow-up cylinder check valves.

PROBLEM: The temperature of the oil is too hot.

PROBABLE CAUSE:

1. The viscosity of the oil is wrong.
2. The relief valve opens at low oil pressure.
3. The pump has too much wear.
4. There is a restriction in an oil passage.
5. The load of the system is too high.

PROBLEM: The cylinder rods move too slow (slow steering).

PROBABLE CAUSE:

1. The pressure of the oil is low.
2. The output of the pump is low.
3. The failure of a seal on the piston in a cylinder.

STEERING SYSTEM

TESTING AND ADJUSTING

PROBLEM: The output of the pump is low.

PROBABLE CAUSE:

1. Low level of the oil in the tank.
2. The viscosity of the oil is wrong.
3. The pump has too much wear.

PROBLEM: The pressure of the oil is low.

PROBABLE CAUSE:

1. The relief valve opens at low oil pressure.
2. The pump has too much wear.
3. The failure of an O-ring seal in the system.

PROBLEM: Hard steering.

PROBABLE CAUSE:

1. Setting of main relief valve is too low.
2. Pilot valve of main relief valve is not closed (seating).
3. Movement of the flow control valve in the steering control valve is not smooth (sticking).
4. The pump has too much wear.
5. Leakage in the follow-up cylinder relief valves or in follow-up cylinder check valves.
6. Valve spool in the steering control valve does not move enough.
7. Steering wheel nut is too tight and or binding in steering gear and linkage.
8. Differential lock or brakes are activated.

PROBLEM: Erratic steering [difficulty in changing direction (either left or right)] and self steering.

PROBABLE CAUSE:

1. Setting of the pressure reducing valve is not correct.
2. Leakage in the follow-up cylinder relief valves or in follow-up cylinder check valves.
3. Steering linkage is binding.
4. Setting of follow-up cylinder relief valves is not correct.
5. Differential lock or brakes are activated.

PROBLEM: Hard steering to the left only.

PROBABLE CAUSE:

1. Drain passage (hole) in worm gear shaft of the steering gear is plugged (causes a hydraulic lock).

CHECKING PUMP EFFICIENCY

For any pump test, the pump flow, measured in gpm (liter/min) at 100 psi (690 kPa) will be larger than the pump flow at 1000 psi (6900 kPa) at the same rpm.

The difference between the pump flow of two operating pressures is the flow loss.

Method of finding flow loss.....
 Pump flow at 100 psi.....57.5 gpm (liter/min)*
 Pump flow at 1000 psi.....-52.0 gpm (liter/min)*
 Flow loss5.5 gpm (liter/min)*

Flow loss when given as a percent of pump flow is used as a measure of pump performance.

Example of finding percent of flow loss.....

$$\frac{\text{gpm flow loss}}{\text{Pump flow @ 100 psi}} \times 100 = \text{Percent of flow loss}$$

or $\frac{* 5.5}{* 57.5} \times 100 = 9.5\%$

If the percent of flow loss is more than 10%, pump performance is not good enough.

*Numbers in examples are for illustrations and are not values for any specific pump or pump condition. See SPECIFICATIONS for STEERING SYSTEM, for pump flow of a new pump at 100 psi and 1000 psi.

Test On The Machine

Install a Flow Meter. Measure pump flow at 100 psi (690 kPa) and at 1000 psi (6900 kPa) with engine at 2000 rpm. Use these values in Formula 1.

Formula I

$$\frac{\text{gpm @ 100 psi} - \text{gpm @ 1000 psi}}{\text{gpm @ 100 psi}} \times 100 = \text{Percent of flow loss}$$

Test On The Bench

If the test bench can be run at 1000 psi and at full pump rpm, find the percent of flow loss using Formula I.

If the test bench can not be run at 1000 psi at full pump rpm, run the pump shaft at 1000 rpm. Measure the pump flow at 100 psi (690 kPa) and at 1000 psi (6900 kPa). Use these values in the top part of Formula II. For the bottom part of the formula, run the pump shaft at 2000 rpm. Measure the pump flow at 100 psi.

STEERING SYSTEM

Formula II:

$$\frac{\text{gpm @ 100 psi} - \text{gpm @ 1000 psi}}{\text{gpm @ 100 psi @ 2000 rpm}} \times 100 = \text{Percent of flow loss}$$

OPERATION CHECKS

Run the engine and operate the scraper bowl circuits to increase the temperature of the oil in the hydraulic system. Hydraulic oil temperature of more than 120° F (50° C) is needed to get accuracy for the tests and gauge readings for the relief valves.

Time to Turn Machine

The time it takes to turn the machine from full left to full right and from full right to full left, with the scraper bowl empty and off the ground, must be the same. The machine must be stopped and the rpm of the engine must not change when taking the times for the full turns.

With the engine running at high idle rpm, the time for a full turn, from stop to stop, is 5.5 to 7 seconds.

⚠ WARNING

Do not make a 900 angle turn when the speed of the machine is more than 7 mph (11 km/hr).

STEERING CONTROL VALVE

Relief Valve for the Steering Circuit

Tools Needed:

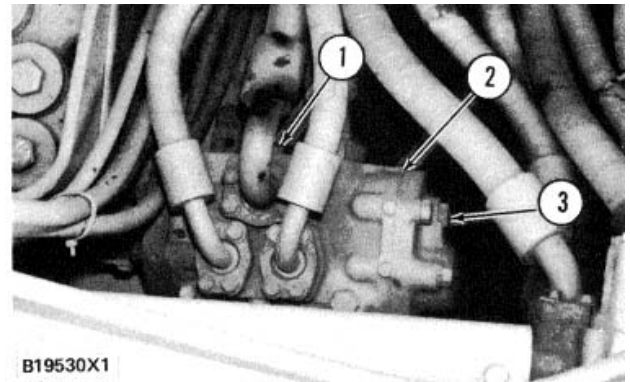
- 2P1314 Connector
- 5P4775 Hose Assembly
- 7S8714 Pressure Gauge

The steering control valve is located on the left side of the tractor next to the fender. The valve is mounted in front of the scraper control valve.

1. With the engine stopped, remove plug (1) from steering control valve (2) and install the hose for the pressure gauge in the hole. Connect the other end of the hose to the gauge.
2. Start and run the engine at high idle rpm. The pressure of the oil is approximately 110 psi (760 kPa).

TESTING AND ADJUSTING

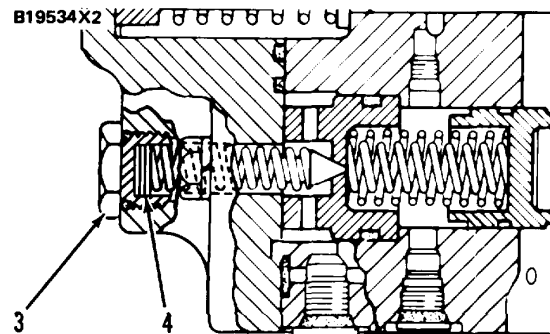
3. Turn the steering wheel either to the right or to the left as far as it will turn, then use force on the steering wheel to keep it turned. Watch the pressure gauge.
4. The indication on the gauge is the pressure of the oil which opens the relief valve for the steering circuit. The correct pressure setting of the relief value is 2 250 ± 25 psi (15 500 ± 170 kPa).



STEERING CONTROL VALVE LOCATION

1. Plug. 2. Control valve. 3. Plug.

5. If it is necessary to change the relief setting, remove plug (3) from the back of the steering control valve. Add shims (4) for an increase in the pressure setting, remove shims (4) to decrease the relief valve pressure setting.



STEERING RELIEF VALVE

3. Plug. 4. Shims.

PRESSURE CHANGE FOR ONE SHIM		
Part No.	Thickness	Change in Pressure
3H2549	.010 in. (0.25 mm)	40 psi (280 kPa)
3J7473	.005 in. (0.13 mm)	20 psi (140 kPa)

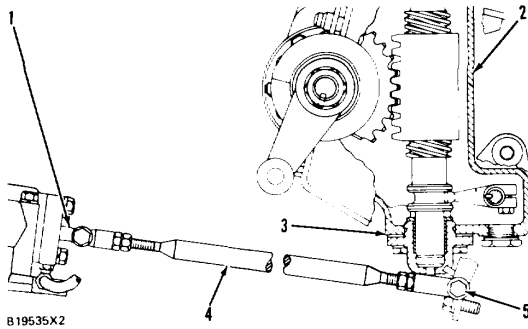
STEERING SYSTEM

TESTING AND ADJUSTING

Travel of Valve Spool in Steering Control Valve

Measure the travel of valve spool (1) with the engine stopped.

1. Use force to turn the steering wheel as far as possible in one direction.
2. Measure the movement of valve spool (1) when the steering wheel is turned in the other direction as far as possible. The correct movement is 1.12 to 1.15 in. (28.4 to 29.2 mm).



STEERING LINKAGE

1. Valve spool. 2. Steering gear. 3. Shims. 4. Rod. 5. Bolt.

3. If an adjustment must be made, disconnect rod (4) at bolt (5). Turn the steering wheel until it stops.
4. Measure the movement of the lever (at the hole where the bolt was removed) when the steering wheel is turned completely in the other direction.
5. If the lever movement is less than 1.12 in. (28.4 mm), add shims (3). If the lever movement is more than 1.15 in. (29.2 mm), shims must be removed.
6. After the adjustment has been made, turn the steering wheel until the lever is in the center of its movement.
7. Keep the lever in this position and connect rod (4) and the lever. Make sure that spool (1) does not move when the rod and lever are connected.

NOTE: If bolt (5) can not be installed because the rod is too long or too short, make an adjustment to the length of the rod.

8. After the bolt is installed, check the movement of the spool again to see if it is correct.

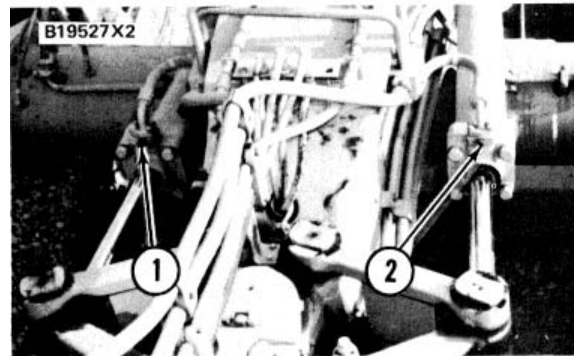
Location of Valve Spool in Steering Control Valve

Tools Needed:

- 306984 Connector (two)**
- 5P4775 Hose Assembly (two)**
- 5P4815 Pressure Gauge (two)**

NOTE: One gauge can be used for the test, if the gauge hose is installed first in one steering cylinder and the test made, then the hose is removed and installed in the other steering cylinder for the complete test.

Valve spool (6) is kept in the HOLD position by spring (3). It is important that the spool is in the correct location when in the HOLD position.



STEERING CYLINDERS

1. Bleed valve for right turn circuit. 2. Bleed valve for left turn circuit.

1. With the engine stopped, remove bleed valves (1) and (2) from the junction blocks. Install the hoses from the gauges in the holes for the valves. Valve (1) is the pressure tap for the right turn circuit and valve (2) is the pressure tap for the left turn circuit.

CAUTION

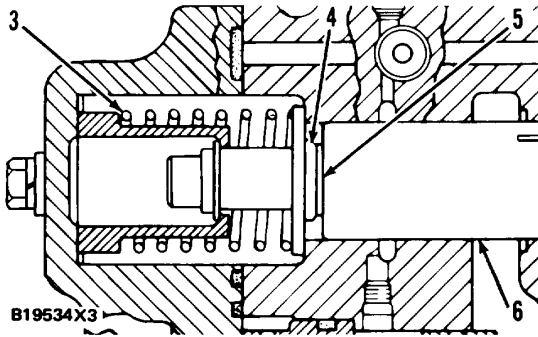
Do not turn the steering wheel when the engine is running and a low pressure gauge is in-stalled in the steering circuit. If the steering wheel is turned, the pressure of the oil to the steering cylinders will be too high for a low pressure gauge.

2. Start and run the engine at high idle. Watch the gauges.
3. The indication on each gauge must be 55 ± 15 psi (380 ± 105 kPa).

The difference between the two indications must not be more than 20 psi (140 kPa).

STEERING SYSTEM

TESTING AND ADJUSTING



STEERING CONTROL VALVE

3. Spring. 4. Retainer. 5. Shims. 6. Valve spool.

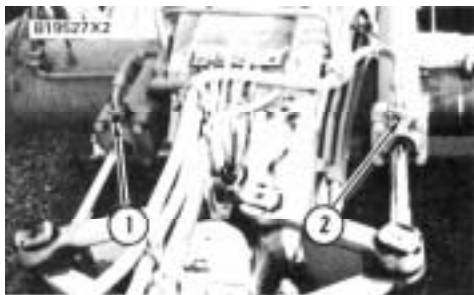
If the difference between the indications is too much, an adjustment must be made to the valve spool location. Shims (5) between retainer (4) and valve stem (6) are used to make the adjustment for the location of the valve stem.

4. Add shims to increase the pressure at pressure tap (2) and decrease the pressure at tap (1).
5. If the pressure needs to be increased at tap (1), remove shims. This will also decrease the pressure at pressure tap (2).

AIR IN THE STEERING CIRCUIT

Use the procedure that follows to remove air from the steering system before and after tests are made:

1. Start the engine and turn the machine against either the right or left stop.
2. With the engine running and the machine against the stop, open valves (1) and (2).



STEERING CYLINDERS

1. Bleed valve for right turn circuit. 2. Bleed valve for left turn circuit.

3. When only oil (with no air) can be seen running out of the open valves, close the valves.

4. Turn the machine against the stop in the other direction and open the valves again.
5. Close both valves when no air can be seen in the oil running out of the open valves.

NOTE: Torque for valves (1) and (2) is 24 ± 2 lb. ft. (30 ± 3 N•m).

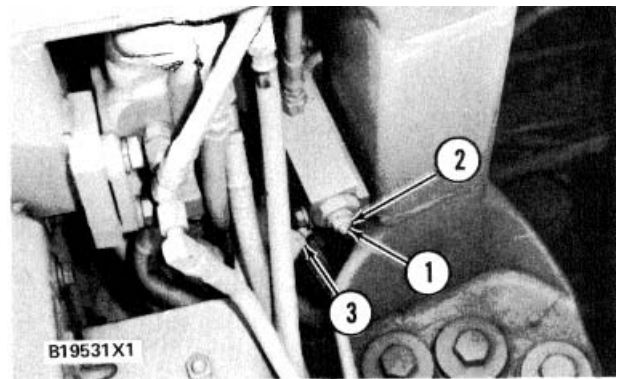
FOLLOW-UP SYSTEM

Pressure Reducing Valve

Tools Needed:

- 520572 Swivel Tee
- 5P4775 Hose Assembly
- 5P4815 Pressure Gauge

The pressure of the oil from outlet oil line (5) to the follow-up cylinder (receiver) is 60 ± 10 psi (415 ± 70 kPa). If the outlet pressure is either too high or too low the pressure reducing valve needs an adjustment.



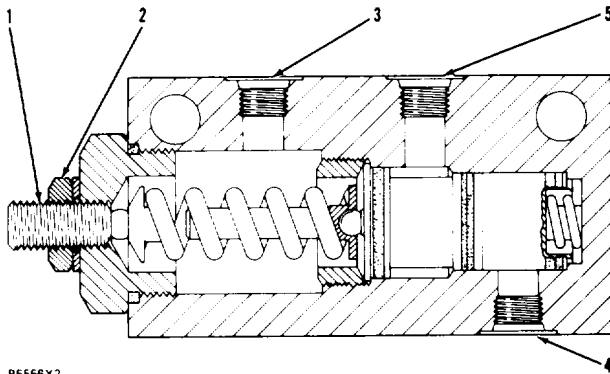
PRESSURE REDUCING VALVE

1. Adjustment screw. 2. Locknut. 3. Drain oil line.

1. With the engine stopped, disconnect the oil line from outlet (5) and install the tee fitting, hose and gauge.
2. After the pressure gauge is installed in the oil line to the follow-up cylinder, start the engine.
3. The indication on the gauge is the reduced pressure of the pump oil for the follow-up cylinder. The correct pressure is 60 ± 10 psi (415 ± 70 kPa).
4. If it is necessary to change the reduced pressure setting for the oil from the valve, loosen locknut (2) and turn adjustment screw (1) until the correct oil pressure indication is on the test gauge.

STEERING SYSTEM

TESTING AND ADJUSTING



B5556X2

PRESSURE REDUCING VALVE

1. Adjustment screw. 2. Locknut. 3. Drain oil line outlet. 4. Pump oil line inlet. 5. Outlet for reduced pressure oil.

5. When the reduced pressure is correct, tighten locknut (2).

Relief Valve Pressure Check

Tools Needed: Two of each.

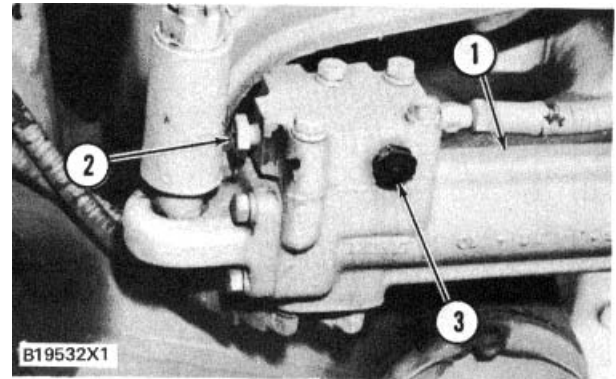
306984 Connector

5P4775 Hose Assembly

7S8712 Pressure Gauge

The test for the opening pressure of the relief valve, in the circuit for the follow-up cylinders, is made with the engine stopped.

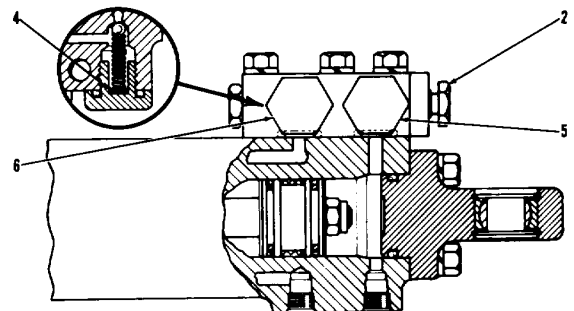
1. Remove the bleed valves (2) and (3) from the body assembly. Valve (3) is for the rod end of the follow-up cylinders and valve (2) is for the head end.
2. Install a connector, hose and gauge at each of the two locations where the valves were removed.
3. Turn the steering wheel to the left until it stops. Use force to turn the steering wheel some more until the relief valve opens. Make a note of the indication on the gauge. This indication is the pressure of the oil that opens the relief valve in the circuit for the head end of the follow-up cylinders.
4. Turn the steering wheel to the right until it stops. Use force to turn the steering wheel some more until the relief valve opens. Make a note of the indication on the gauge. This indication is the pressure of the oil in the circuit for the rod end of the follow-up circuit.
5. The pressure of the oil that opens the relief valve (either head end or rod end) must be 525 ± 25 psi (3600 ± 170 kPa).



FOLLOW-UP CYLINDER (SENDER)

1. Follow-up cylinder (sender). 2. Bleed valve (head end circuit). 3. Bleed valve (rod end circuit).

6. If the pressure was not correct when the steering wheel was turned, shims (4) under plugs (5) and (6) must be added or removed. Addition of shims will increase the pressure and removal of shims will cause a decrease in pressure. If the indication was not correct during a left turn (head end circuit), change the amount of shims under plug (5). If the indication was not correct to the right (rod end circuit), change the shims under plug (6).



FOLLOW-UP CYLINDER (SENDER)

2. Bled valve (head end circuit). 4. Shims. 5. Plug (head end circuit). 6. Plug (rod end circuit).

NOTE: The torque for plugs (5) and (6) is 42 ± 3 lb. ft. (58 ± 4 N•m). The torque for valves (2) and (3) is 24 ± 2 lb. ft. (30 ± 3 N•m).

PRESSURE CHANGE FOR ONE SHIM		
Part No.	Thickness	Change in Pressure
6J1832	.010 in (0.25 mm)	20 psi (140 kPa)

STEERING SYSTEM

TESTING AND ADJUSTING

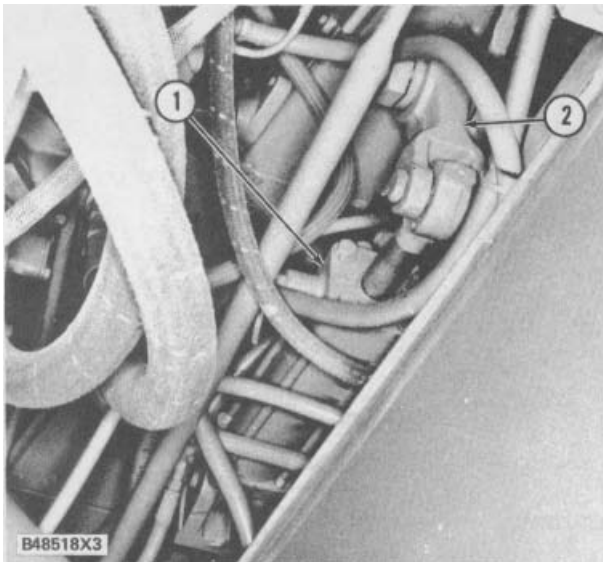
Braking Action in Receiver Cylinder

Tools Needed:

- 5P3100 or 9S5800 Pump Group**
- 520572 Swivel Tee**
- 5P4775 Hose Assembly (two if desired)**
- 5P4815 Pressure Gauge**
- 4M5317 Bushing**

The friction between the housing of the receiver cylinder and the piston ring and seals causes a resistance to movement (braking action) of the cylinder rod. This resistance to movement (braking action) prevents the complete loss of steering if there is a failure in the follow-up circuit.

NOTE: To use the 5P3100 or 9S5800 Pump Group, one of the hoses must be removed from the pump.



FOLLOW-UP CYLINDER (RECEIVER)

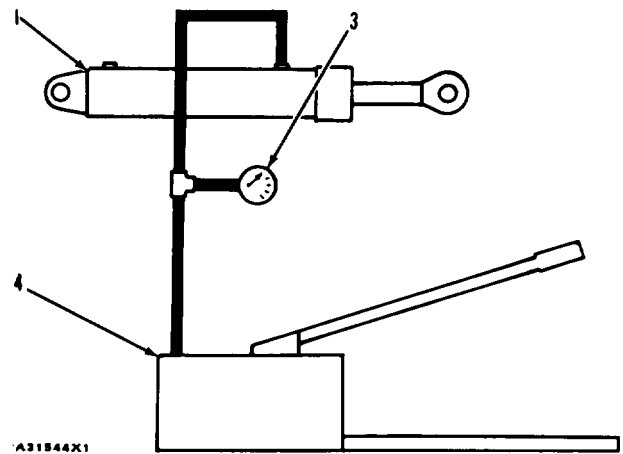
- 1. Receiver cylinder. 2. Lever.**

1. Disconnect the hoses from receiver cylinder (1) that go to the head end and rod end of the sender cylinder. Do not disconnect the hoses that go to the pressure reducing valve.

2. Use a tee to install gauge (3) in the line between pump (4) and the cylinder. Connect the hose and gauge to the rod end of the cylinder as shown.

NOTE: Another hose can be installed in the head end of the cylinder as a drain if desired.

3. Disconnect the cylinder rod from lever (2) on the steering gear. Be sure the lever does not interfere with the movement of the cylinder rod.
4. Look at the cylinder rod and gauge and move the pump handle.



SCHEMATIC FOR BRAKING ACTION CHECK

- 1. Receiver cylinder. 3. 5P4815 Pressure gauge. 4. 9S5800 or 5P3100 Pump Group.**

5. When the cylinder rod moves, note the indication on the gauge. The pressure must be 125 ± 50 psi (860 ± 340 kPa).
6. If the pressure indication is low, there is not enough braking action. Remove the cylinder and repair it, or install a new one.

STEERING SYSTEM

TESTING AND ADJUSTING

Check of Ball Seating Surface for Oil Leakage in Receiver Cylinder

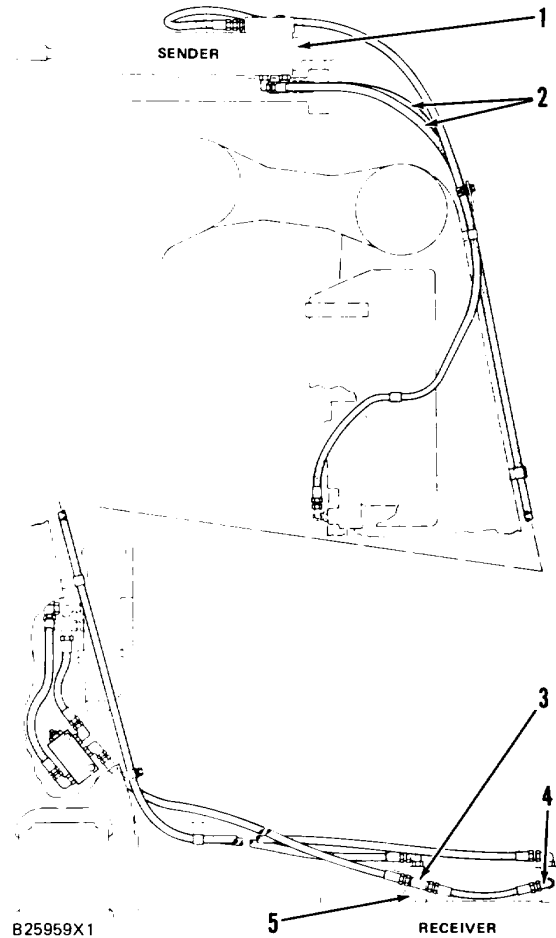
Tools Needed:

- 9S5518 Plugs (two).**
- 9L8493 Caps (two).**

Oil leaking past seats (7) can cause the machine to continue turning after the operator has stopped moving the steering heel. Turning the steering heel in the opposite direction will stop the turn. Leakage occurs because of a loose ball seat and or an out-of-round (not round) bore to the seat in the cylinder.

Use the procedure that follows a quick check of ball seating surface for oil leakage in the steering follow-up unit.

1. Put the machine on level ground, in a straight forward position. Start the engine and run it until the hydraulic oil is at its normal temperature. Shut off the engine.
2. Disconnect two hoses (2) at sender cylinder (1). Put 9S5518 Plugs and 9L8493 Caps in hoses (2) and fittings to prevent the loss of too much hydraulic oil and to keep dirt out of the system.
3. With the operator in a normal position in the seat and the engine OFF. turn the steering wheel to the right until it stops. This is approximately 6 to 8 in. (152 to 203 mm) of movement. After wheel has stopped, keep normal force on it for an additional 15 seconds. Note any additional movement. An additional 2 in. (51 mm) of movement is permitted. If the steering heel goes more than the 2 in. (51 mm) in 15 seconds, there is oil leakage past the seat.
4. If the steering wheel stops and holds in the correct position as in Step 3. turn the steering wheel to the left and do the procedure in the other direction.

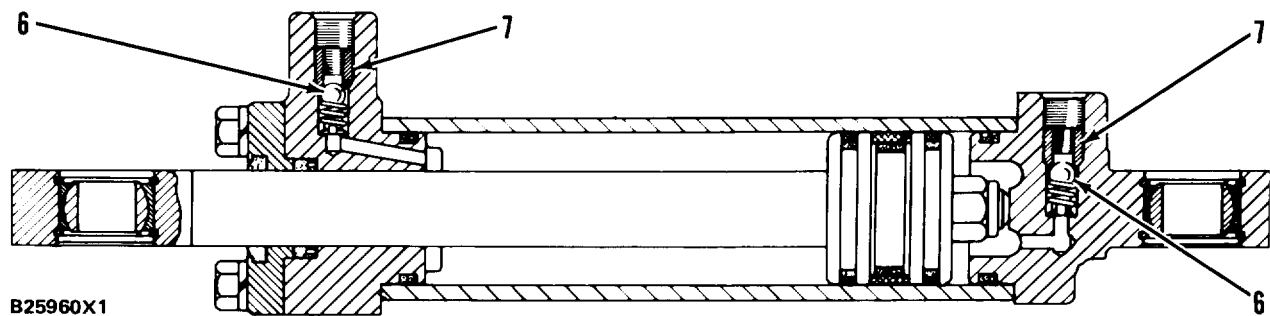


HYDRAULIC LINES

- 1. Sender cylinder. 2. Hoses. 3. Tee. 4. Elbow. 5. Receiver cylinder.**

5. If the steering wheel does not stop or goes past the additional amount of movement during the 15 second test. the procedure which follows can be used to correct the problem.

Procedure for Correcting Leakage



RECEIVER CYLINDER

6. Balls (two). 7. Seats (two).

1. Remove seats (7) from the cylinder. Inspect the components for damage or a loose fit of the seats in their bores. Make a replacement of any damaged parts.
2. When elbow (4) and tee (3) are installed, make sure they are tightened against seats (7), so the seats make a good seal in the bores of the cylinder.
3. Check operation of the steering system again as shown in Steps 3 and 4.

If there is still an oil leakage problem, make a replacement of the receiver cylinder. After installation of the new cylinder, check the operation of the steering system again.

NOTE: If there is any indication of a possible problem with the steering follow-up system operation after installation of the new cylinder, The above test must be done several times to be sure there is no oil leakage at the check . Seats (7) can be out-of-round (not round) in a new cylinder and make a good fit with balls (6) only some of the time.

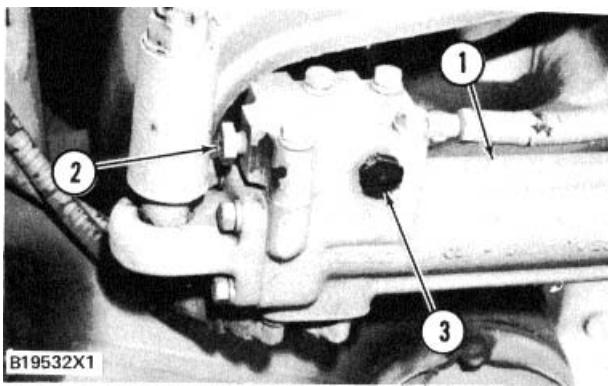
STEERING SYSTEM

TESTING AND ADJUSTING

AIR IN FOLLOW-UP CIRCUIT

Remove all air from the circuit for the follow-up cylinders before and after any test is made on the follow-up system.

1. Start the engine and turn the machine against either the right or the left stop.
2. With the engine running and the machine against the stop, open valves (2) and (3).
3. When only oil (with no air) can be seen running out of the open valves, close the valves.
4. Turn the machine against the stop in the other direction and open the valves again.



FOLLOW-UP CYLINDER (SENDER)

1. Sender cylinder. 2. Bleed valve. 3. Bleed valve.

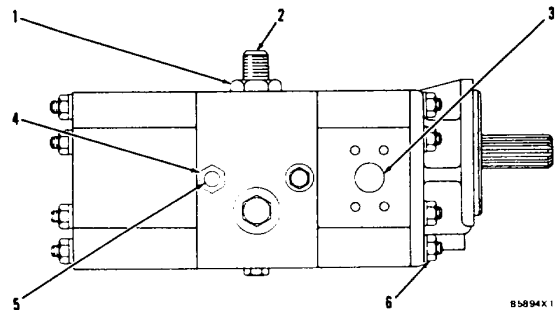
5. Close both valves when no air can be seen in the oil running out of the open valves.

NOTE: Torque for the valves is 24 ± 2 lb. ft. (30 ± 3 N.m).

SUPPLEMENTAL STEERING PUMP

Valve Adjustment (Pump on Test Bench)

1. Turn screw (2) to get seven threads above locknut (1) after nut is tightened. Install the acorn nut.
2. With pump shaft at 1200 rpm, turn speed adjusting screw (5) until the 56 U.S. gpm (212 liter/min) oil at a pressure of 100 psi (690 kPa) from pump outlet (3) starts to decrease.
3. The oil from the large pump section must stop completely when the pump shaft is at 1600 rpm. The oil from pump outlet (3) must be 33.5 U.S. gpm (127 liter/min) at 100 psi (690 kPa) with pump at 1600 rpm.
4. When pump output is correct, tighten locknut (4) and install the acorn nut.



SUPPLEMENTAL STEERING PUMP

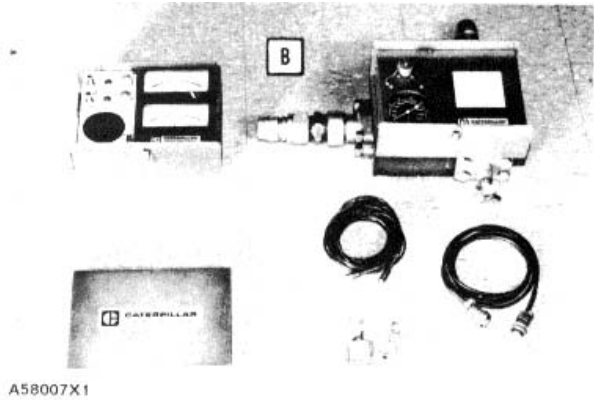
1. Locknut. 2. Screw. 3. Pump outlet. 4. Locknut. 5. Speed adjusting screw. 6. 85 ± 5 lb. ft (115 ± 7 N.m) torque for nuts on each end of pump.

**SECTION II
FLOW METER TEE TEST TOOLS**

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FLOW METER TEE TEST

TEE TEST TOOLS



A58007X1

9S2000 FLOW METER ASSEMBLY



A55645X1

5P3600 FLOW METER ASSEMBLY

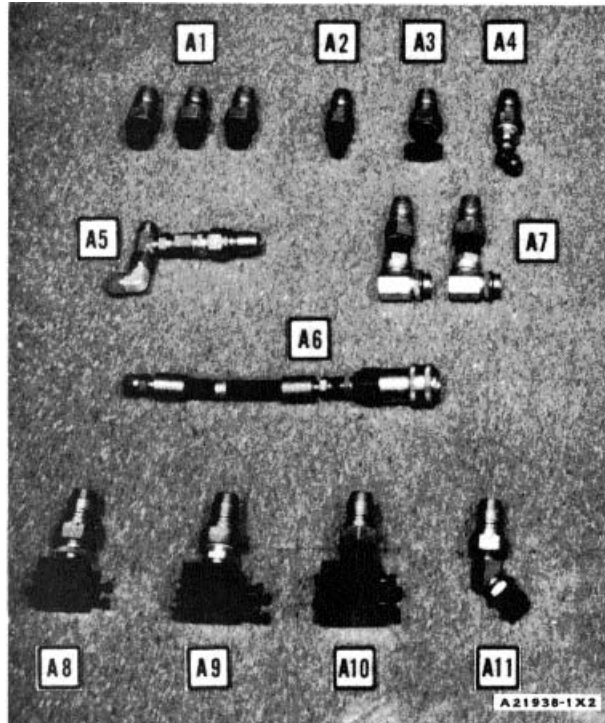
Part No.	Description	Quantity Required
<u>B-9S2000 Flow Meter Assembly</u>		
9S2000	Flow Meter	1
5P7360	Tachometer Generator (Part of 9S2000)	a
2P5523	Cable Assembly (Part of 9S2000)	
9S3048	Cable Assembly (Part of 9S2000)	a
9S6341	Safety Disc (.010" 4300 psi) (Part of 9S2000)	a
1P7411	Safety Disc (.013" 6200 psi) (Part of 9S2000)	a
3H4330	Split Flange	4
S1587	Bolt	8
3B4508	Lockwasher	8
8S9964	Flange Type Fitting	2
7F8267	O-Ring Seal	2
8S9965	Pipe Nipple	2
2P8334	Plain Nipple	2

Part No.	Description	Quantity Required
<u>B-5P3600 Flow Meter Assembly</u>		
5P3600	Flow Meter Group	1
5P7360	Tachometer Generator (Part of 5P3600)	
5P7362	Cable Assembly (Tachometer) (Part of 5P3600)	a
5P7365	Cable Assembly (Flow Block) (Part of 5P3600)	
5P7366	Cable Assembly (Power) (Part of 5P3600)	
5P7363	Hose Assembly (Pressure Gauge) (Part of 5P3600)	
9S6341	Safety Disc (.010" - 4300 psi) (Part of 5P3600)	a
1P7411	Safety Disc (.013" - 6200 psi) (Part of 5P3600)	a
7N4154	Lamp (No. 45) (Part of 5P3600)	a
7N4153	Lamp (No. 1408) (Part of 5P3600)	a
5P7372	Meter (RPM, Temp) (Part of 5P3600)	
5P7368	Meter (GPM) (Part of 5P3600)	
8S9967	Adapter	2
2P8334	Plain Nipple	2

a - Recommend spare parts be kept on hand.

FLOW METER TEE TEST

TM 5-3805-248-14&P-3
TEE TEST TOOLS

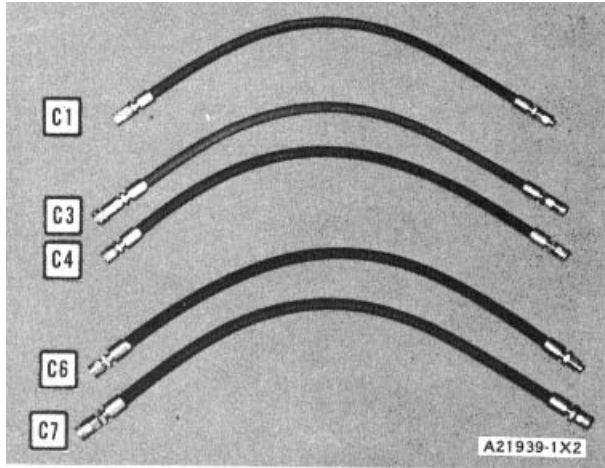


A - PUMP SUPPLY LINE ADAPTERS

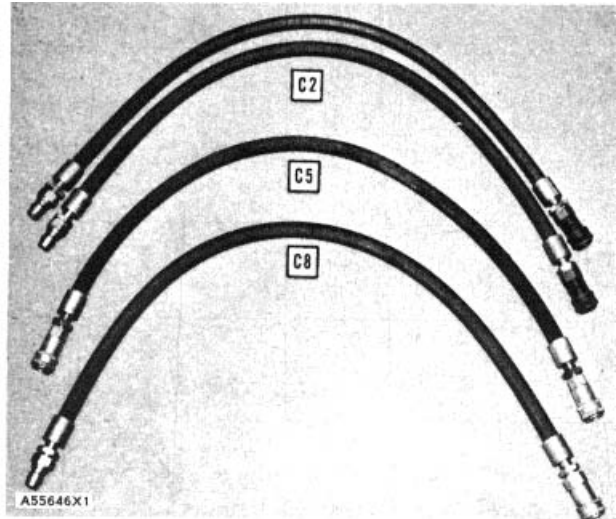
Assembly No.	Part No.	Description	Quantity Required	Assembly No.	Part No.	Description	Quantity Required
A - Pump Supply Line Adapter				A - Pump Supply Line Adapter			
	8S9967	Adapter	3		5P3032	Adapter (1" Hose)	1
A1	2S4078	O-Ring Seal (Part of 8S9967)	a		1P5597	Pipe Nipple (1" x 1¼")	1
	2P8336	Valved Nipple (1¼")	3	A8	4F7391	O-Ring Seal	1
	9S7336	Adapter	1		2P8336	Valved Nipple (1¼")	1
	3D2824	O-Ring Seal (Part of 9S7336)	a		8S9191	Bolt	4
A2	9S7337	Reducing Bushing	1		1D4717	Nut	4
	2P8336	Valved Nipple (1¼")	1		5P3033	Adapter (1¼" Hose)	1
	2P8339	Quad Ring (Part of 2P8336)	a		1P5597	Pipe Nipple (1" x ¼")	1
	2P8336	Valved Nipple (1¼")	1	A9	4F7952	O-Ring Seal	1
	1P5596	Pipe Nipple (¾" x 1¼")	1		2P8336	Valved Nipple (1¼")	1
A4	307976	Adapter-45° Union	1		7H3472	Bolt	4
	3D2824	O-Ring Seal	1		1D4718	Nut	4
	5P2242	Tee	1		5P3034	Adapter (1½" Hose)	1
	5P2244	Union	1		1P5598	Pipe Nipple (1¼" x 1¼")	d
A5	1P5597	Pipe Nipple (1" x 1¼")	c		7F8267	O-Ring Seal	1
	2P8336	Valved Nipple (1¼")	c	A10	2P8336	Valved Nipple (1¼")	d
	315744	Elbow-90°	1		2H6488	Bolt	4
	8S6646	Hose	1		1D4719	Nut	4
	3B7257	Bushing	1		44977	Elbow--45°	1
A6	43099	Fitting	1	A11	2P8336	Valved Nipple (1¼")	1
	2P8337	Valved Coupler	1		8S9967	Adapter	1
	307980	Adapter-90°	2				
A7	2S4078	O-Ring Seal	2				
	1P5598	Pipe Nipple (1¼" x 1¼")	2				
	2P8336	Valved Nipple (1¼")	2				

a - Recommend spare parts be kept on hand.
c - Use from A8 assembly.
d - Use from A7 assembly.

FLOW METER TEE TEST



C - CONNECTING HOSE ASSEMBLIES



C - CONNECTING HOSE ASSEMBLIES

Assembly No.	Part No.	Description	Quantity Required
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C - Connecting Hose Assembly

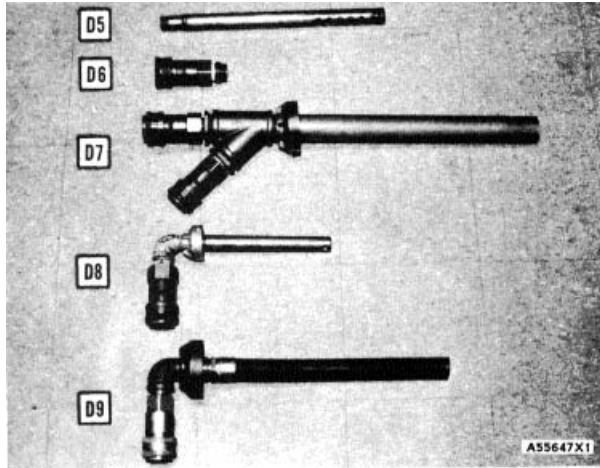
C1		Use C2 on 9S2000 Flow Meter Not used on 5P3600 Flow Meter	
	2P2349	Hose Assembly	2*
C2	2P8335	Plain Coupler	2*
	2P8334	Plain Nipple	2*
C3		Use C5 except on the 992 Use C8 on 992	
C4		Use C2 on 9S2000 Flow Meter. Not used on 5P3600 Flow Meter	
	2P2349	Hose Assembly	1
C5	2P8335	Plain Coupler	1
	2P8337	Valved Coupler	1

Assembly No.	Part No.	Description	Quantity Required
--------------	----------	-------------	-------------------

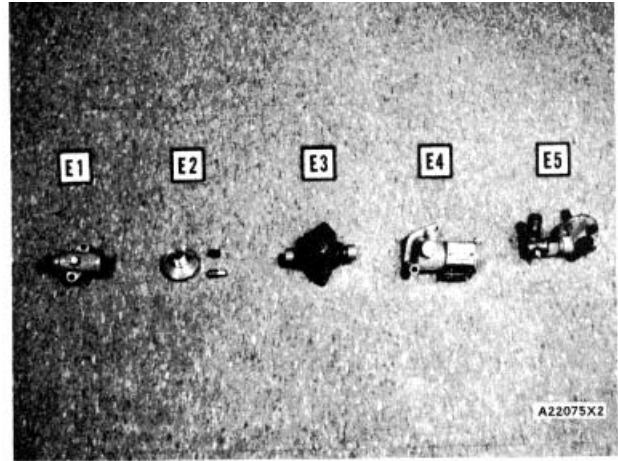
C - Connecting Hose Assembly

C6		Use Connecting Hose Assembly C2	
C7		Use C2 on 992 only.	
	2P2349	Hose Assembly	1
C8	2P8337	Valved Coupler	1
	2P8336	Valved Nipple (1¼")	1
	8S9976	Coupler Repair Kit (Part of 8S9972 & 8S9974)	

FLOW METER TEE TEST



D - RETURN LINE ASSEMBLIES



E - TACHOMETER DRIVE ASSEMBLIES

Assembly No.	Part No.	Description	Quantity Required
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Assembly No.	Part No.	Description	Quantity Required
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D - Return Line Assembly

E - Tachometer Drive

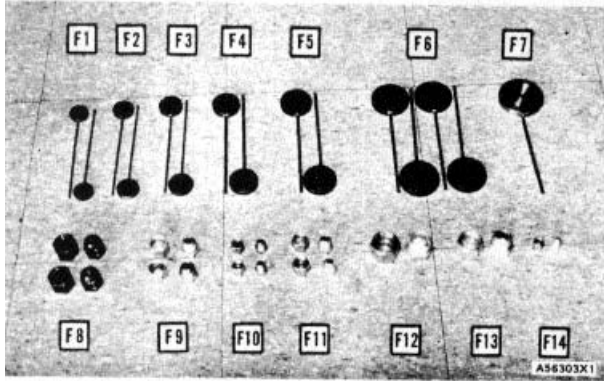
D1	Use Return Line Assembly D6		
D2	Use Return Line Assembly D7		
D3	Use Return Line Assembly D8		
D4	Use Return Line Assembly D9		
D5	5P3517	Tube Assembly-Return	1
	8S9967	Adapter	1
D6	2P8335	Plain Coupler	1
	3B7750	Pipe Nipple	2
	4J3815	Gasket	1
D7	1P58	Filler Return Group	1
	2P8337	Valved Coupler	2
	3B6555	Street Ell	1
	3B7749	Nipple	1
D8	3B7257	Bushing	1
	9H6454	Gasket	1
	1P757	Filler Return Group	1
	2P8337	Valved Coupler	1
D9	•FT794	Return Line Cap Assembly	1

	1M5061	Tachometer Drive Group	1
E1	3B4505	Lockwasher	2
	5P1759	Tachometer Adapter (9S5609)	1
	9N641	Adapter Group (Part of 5P1759)	
	4M8303	Seal (Part of 5P1759)	
E2	5P1758	Shaft Assembly (Part of 5P1759)	
	4N538	Coupling (Part of 5P1759)	
	9S211	Clamp	2
	9S3032	Clamp	2
	4L8393	Tachometer Drive Group (1:1) (Drill out holes to 11/32" Dia.)	1
E3	1B2714	Bolt (1/4"-20 x 2 1/2")	2
	3B4504	Lockwasher (1/4")	2
	3B4505	Lockwasher (5/16")	2
	2S424	Service Meter Group	1
E4	2B2695	Bolt (5/16"-18 x 7/8")	1
	3B4505	Lockwasher (5/16")	2
E5	7M6006	Drive Group (Modified)	1
	5S6106	Adapter, 2:1 Drive	1
	1B7182	Bolts	2

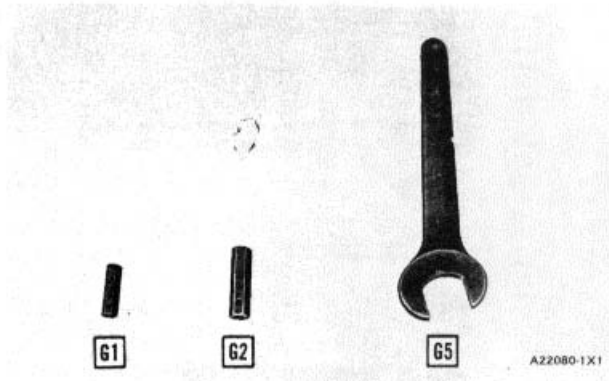
▲ Included in 5P8687 Tool Group.

• Use 2P8337 Valved Coupler instead of 8S9974.

FLOW METER TEE TEST



F - BLOCKING PLATE ASSEMBLIES



G - TOOLS

Assembly No.	Part No.	Description	Quantity Required
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F - Blocking Plate Assemblies

F1	9S7358	Blocking Plate Assembly (1/2")	2
	5F7054	O-Ring Seal	2
F2	9S8894	Blocking Plate Assembly (5/8")	2
	4J8996	O-Ring Seal	2
F3	9S7359	Blocking Plate Assembly (3/4")	2
	5F1678	O-Ring Seal	2
F4	9S8092	Blocking Plate Assembly (1")	2
	4F7391	O-Ring Seal	2
F5	9S8093	Blocking Plate Assembly (1 1/4")	2
	4F7952	O-Ring Seal	2
F6	9S8094	Blocking Plate Assembly (1 1/2")	4
	7F8267	O-Ring Seal	4
F7	9S8095	Blocking Plate Assembly (2")	1
	8F6711	O-Ring Seal	1
F8	9S8895	Plug (1 1/16"-12 Thread)	2
	9S8896	Cap (1 1/16"-12 Thread)	2
F9	2P9697	Plug (7/8"-14 Thread)	2
	8L6111	Cap (7/8"-14 Thread)	2
F10	9S8927	Plug (9/16"-18 Thread)	2
	8S4950	Cap (9/16"-18 Thread)	2
F11	5P2909	Plug (3/4"-16 Thread)	2
	8S4951	Cap (3/4"-16 Thread)	2
F12	5P2299	Plug (1 5/16"-12 Thread)	1
	3R6789	Cap (1 5/16"-12 Thread)	1
F13	5P4299	Plug (1 3/16"-12 Thread)	1
	8L9137	Cap (1 3/16"-12 Thread)	1
F14	9S5518	Plug (7/16"-12 Thread)	1
	9L8493	Cap (7/16"-12 Thread)	1

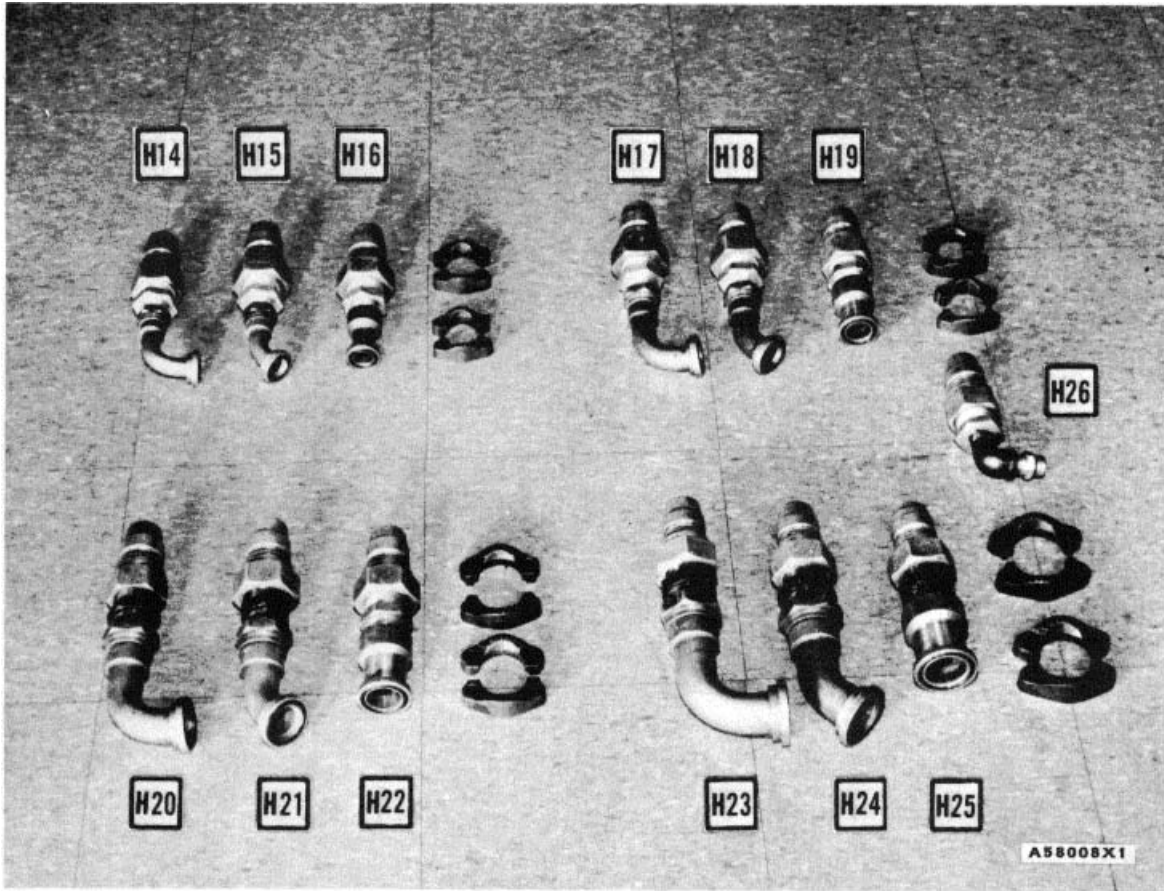
Assembly No.	Part No.	Description	Quantity Required
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G - Tools

G1	1P3566	Bit-Tool (9/16")	1•
G2	1P3567	Bit-Tool (3/8")	1•
G3	2P2339	Box Assembly	1
G4	2P2337	Box Assembly	1
G5	V455	Wrench	1
	2P8290	OX Assembly	1•
G6	2P8304	Block (Lid)	1•
	5P8686	Block (Tool Holder)	1•

- - Included in 5P8687 Tool Group.
- * - Use only with 9S2000 Flow Meter.

*All of the above assemblies are included in the 5P8687 Tool Group.



H -PUMP SUPPLY LINE ADAPTERS

Assembly No.	Description
<u>H - Pump Supply Line Adapter</u>	
H1	Use H14 Pump Supply Line Adapter
H2	Use H15 Pump Supply Line Adapter
H3	Use H16 Pump Supply Line Adapter
H4	Use H17 Pump Supply Line Adapter
H5	Use H18 Pump Supply Line Adapter
H6	Use H19 Pump Supply Line Adapter

Assembly No.	Description
<u>H - Pump Supply Line Adapter</u>	
H7	Use H20 Pump Supply Line Adapter.
H8	Use H21 Pump Supply Line Adapter.
H9	Use H22 Pump Supply Line Adapter.
H10	Use H23 Pump Supply Line Adapter.
H11	Use H24 Pump Supply Line Adapter.
H12	Use H25 Pump Supply Line Adapter.
H13	Use H26 Pump Supply Line Adapter.

FLOW METER TEE TEST

ADAPTERS FOR THE 9S2000 & 5P3600 FLOW METER

This set of adapters can be used to make a hydraulic pump test on all Caterpillar machines. With these adapters, the Flow Meter can be connected to the pump outlet for a pump test. The adapters can also be used on systems with more than one pump, to find which pump is damaged.

Assembly No.	Part No.	Description	Quan. Req.	Assembly No.	Part No.	Description	Quan. Req.	Assembly No.	Part No.	Description	Quan. Req.
H - Pump Supply Line Adapter											
	1P7365	Flanged Adapter Assembly (¾" x 90°)	1		1P5570	Flange Type Fitting (1")	1		1P7371	Flanged Adapter Assembly (1¼" x 45°)	1
H14	1P5596	Pipe Nipple (¾" x 1¼")	a		1P5597	Pipe Nipple (1" x 1¼")	d		8S9965	Pipe Nipple (1½" x 1¼")	1
	2P8336	Valved Nipple (1¼")	a	H19	4F7391	O-Ring Seal	1	H24	2P8336	Valved Nipple (1¼")	b
	5F1678	O-Ring Seal	1		1H3305	Split Flange	2		7F8267	O-Ring Seal	1
	2K190	Split Flange	2		1P7366	Flanged Adapter Assembly (1¼" x 90°)	-		3H4330	Split Flange	2
	1P7368	Flanged Adapter Assembly (¾" x 45°)	1		1P5598	Pipe Nipple (1¼" x 1¼")	e		8S9964	Flange Type Fitting (1½")	1
H15	1P5596	Pipe Nipple (¾" x 1¼")	1	H20	2P8336	Valved Nipple (1¼")	e	H25	8S9965	Pipe Nipple (1½" x 1¼")	1
	2P8336	Valved Nipple (1¼")	b		4F7952	O-Ring Seal	1		2P8336	Valved Nipple (1¼")	b
	5F1678	O-Ring Seal	1		3H3667	Split Flange	2		7F8267	O-Ring Seal	1
	2K190	Split Flange	2		1P7370	Flanged Adapter Assembly (1¼" x 45°)	1		3H4330	Split Flange	2
	1P5568	Flange Type Fitting (¾")	1		1P5598	Pipe Nipple (1¼" x 1¼")	e	H26	2P8336	Valved Nipple (1¼")	b
H16	1P5596	Pipe Nipple (¾" x 1¼")	c	H21	2P8336	Valved Nipple (1¼")	e				
	2P8336	Valved Nipple (1¼")	b		4F7952	O-Ring Seal	1		Not Shown: FT1043 Blocking Cover (Use this with Flow Meter when flow testing the large section of D9G Tractor hydraulic system with a gear pump and also the D8H hydraulic pumps).		
	5F1678	O-Ring Seal	1		3H3667	Split Flange	1				
	2K190	Split Flange	2		1P5575	Flange Type Fitting (1¼")	1				
	1P7364	Flanged Adapter Assembly (1" x 90°)	1	H22	1P5598	Pipe Nipple (1¼" x 1¼")	1				
H17	1P5597	Pipe Nipple (1" x 1¼")	d		2P8336	Valved Nipple (1¼")	1				
	2P8336	Valved Nipple (1¼")	d		4F7952	Ring Seal	1				
	4F7391	O-Ring Seal	1		3H3667	Split Flange	1				
	1H3305	Split Flange	2		1P7367	Flanged Adapter Assembly (1¼" x 90°)	1				
	1P7369	Flanged Adapter Assembly (1" x 45°)	1		8S9965	Pipe Nipple (1½" x 1¼")	1				
H18	1P5597	Pipe Nipple (1" x 1¼")	d	H23	2P8336	Valved Nipple (1¼")	b				
	2P8336	Valved Nipple (1¼")	d		7F8267	O-Ring Seal	1				
	4F7391	O-Ring Seal	1		3H4330	Split Flange	2				
	1H3305	Split Flange	2								

- a - Use from Pump Supply Line Adapter A4
- b - Use from Pump Supply Line Adapter A1
- c - Use from Pump Supply Line Adapter H15
- d - Use from Pump Supply Line Adapter A8 or A9
- e - Use from Pump Supply Line Adapter

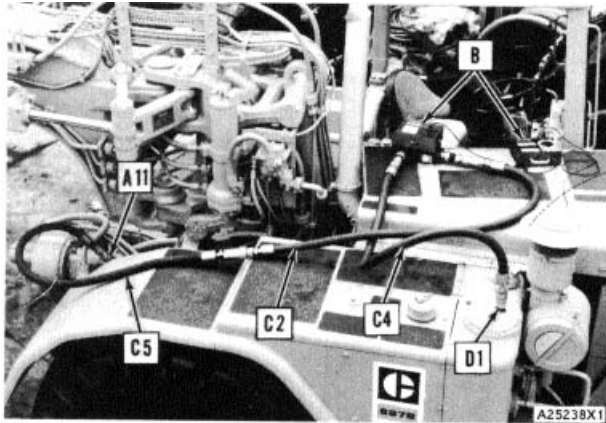


WARNING: When using the 9S2000 Flow Meter in a Series Connection, be sure the load valve is open before starting the engine.

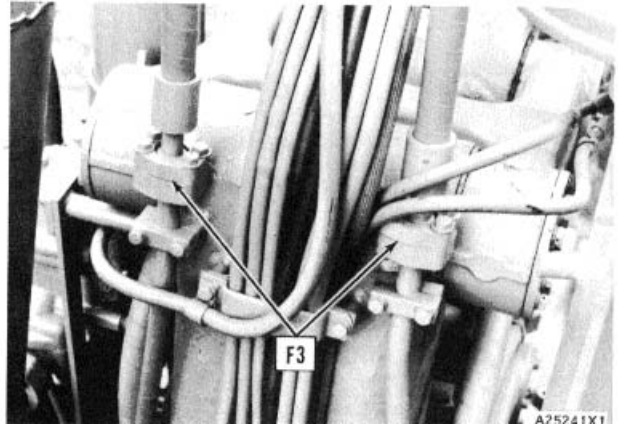
SECTION III
STEERING TEE TEST PROCEDURE-1
(SENR 7243)

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Schematic of Steering Circuit	3-55
Tee Test Tool Installation	3-54
Test Location Chart A (1 thru 5, 10)	3-56
Chart B (14 thru 24)	3-57
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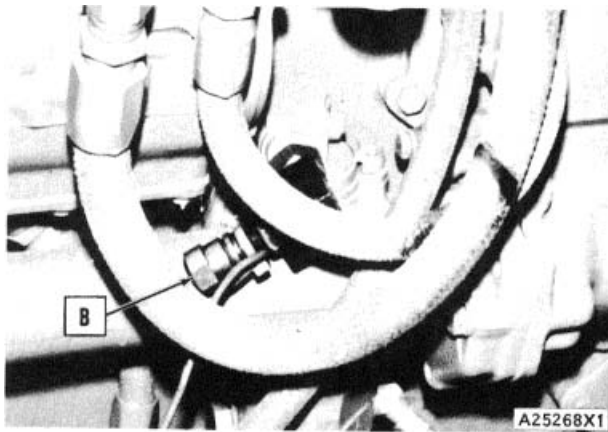
STEERING TEE TEST PROCEDURE - I



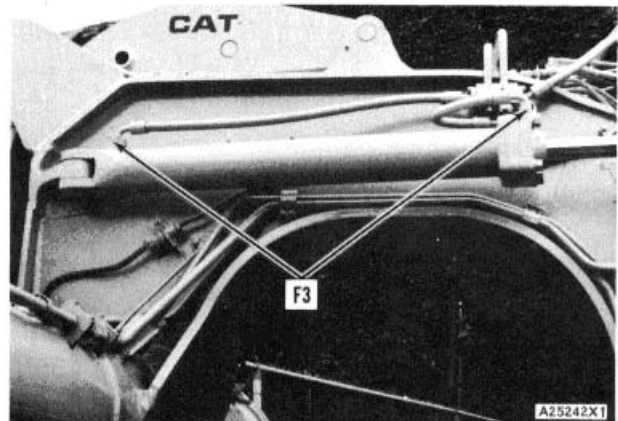
FLOW METER INSTALLED
(See Tee Test Tooling Chart for parts reference)



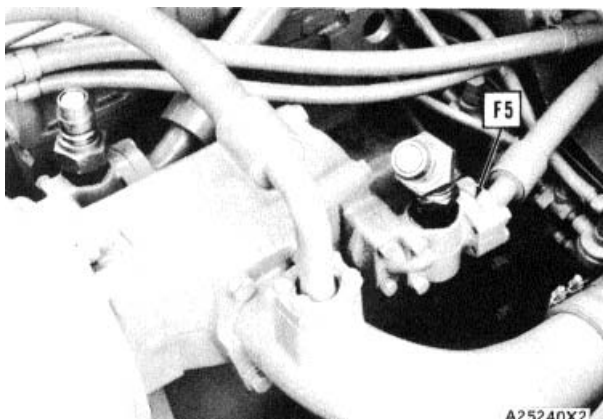
BLOCKING LOCATION FOR STEERING CYLINDERS
(See Tee Test Tooling Chart for parts reference)



TACHOMETER DRIVE INSTALLED
(See Tee Test Tooling Chart for parts reference)



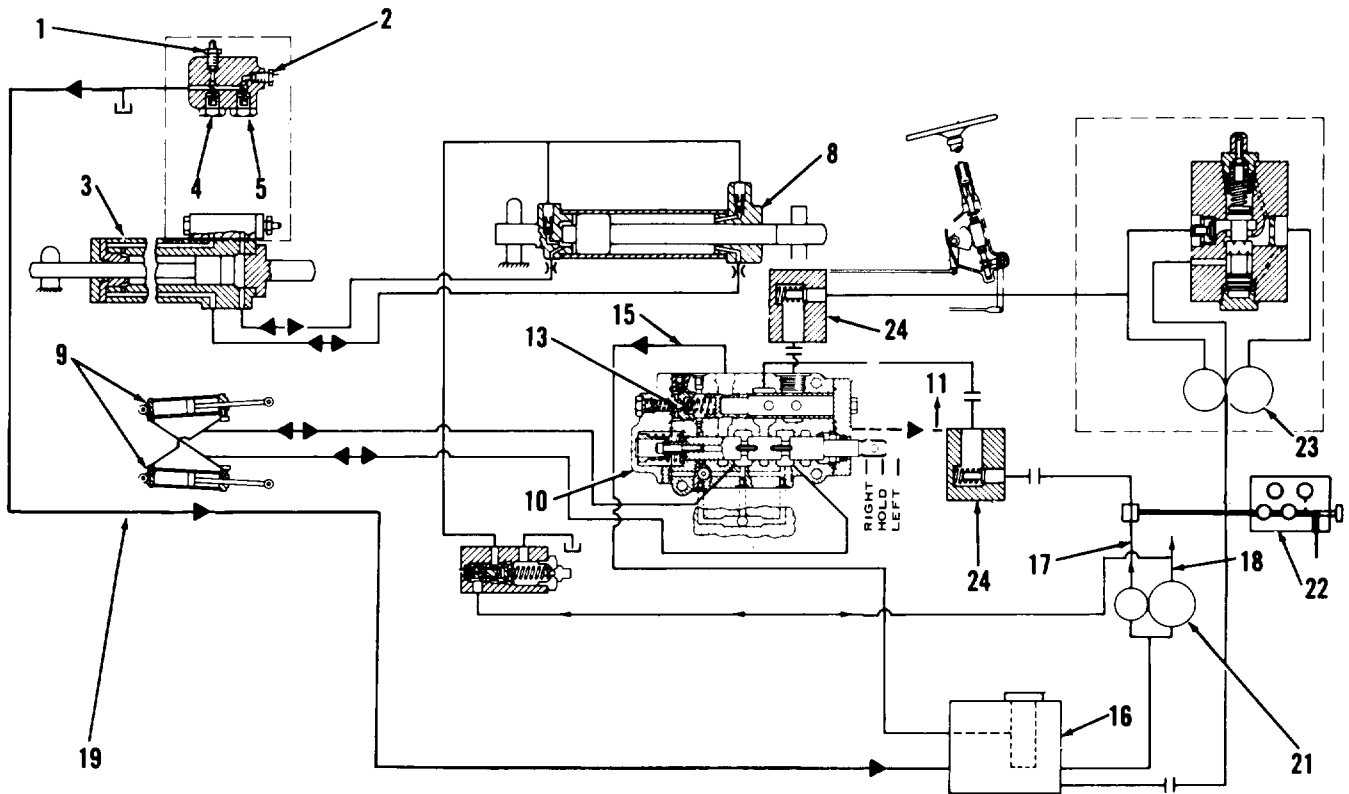
BLOCKING LOCATION FOR RIGHT CYLINDER
Tooling Chart for parts reference)



BLOCKING LOCATION FOR PUMP TEST
(See Tee Test Tooling Chart for parts reference)

STEERING TEE TEST PROCEDURE - I

TOOLS NEEDED		
Assembly No.	Description	Quantity
A11	Pump Supply Line Adapter	1
B	Flow Meter Assembly	1
C2	Connecting Hose Assembly	1
C4	Connecting Hose Assembly	1
C5	Connecting Hose Assembly	1
D1	Return Line Assembly	1
F3	Blocking Plate Assembly (3/4")	2
F5	Blocking Plate Assembly (1 1/4")	1



SCHEMATIC OF STEERING CIRCUIT

1 and 2. Valves (to let air out of follow-up system). 3. Follow-up cylinder (sender). 4. Relief valve (rod ends of follow-up cylinders). 5. Relief valve (head ends of follow-up cylinders). 8. Follow-up cylinder (receiver). 9. Steering cylinders. 10. Control valve. 11. Return oil to tank. 13. Relief valve. 15. Return oil to tank. 16. Hydraulic oil tank. 17. Pump Supply oil. 18. Pump oil to scraper system. 19. Return to tank. 21. Oil pump. 22. Tee test Flow Meter. 23. Supplemental steering. 24. Check valves.

STEERING TEE TEST PROCEDURE - I

TEE-TEST
 PROCEDURE DATA SHEET
 CHART A
 SERVICE METER READING

SYSTEM TEST

MACHINE SERIAL NUMBER

STEERING SYSTEM

Test Name	Maximum Pressure Relief Valve Setting	System Oil Temperature (Start)	System Base Flow Rate	STEER RIGHT Flow Rate *	STEER LEFT Flow Rate *	System Oil Temperature (Finish)
Test Number	1	2	3	4	5	10
STEERING WHEEL Position *	STEER RIGHT *	STEER RIGHT *	STEER RIGHT *	STEER RIGHT *	STEER LEFT *	STEER LEFT *
BOWL Position *	Fully Lowered	Fully Lowered	Fully Lowered	Fully Lowered	Fully LOWERED *	FULLY LOWERED *
Engine Speed *	1900 RPM	Any Speed	1900 RPM *	1900 RPM *	1900 RPM *	Any Speed
System Test Pressure	Maximum	0-100 PSI	100 PSI	1000 PSI	1000 PSI	0-100 PSI
Test Data	$\frac{2250}{\pm 50}$ PSI	$\frac{150}{\pm 5}$ °F	$\frac{60.0}{}$ GPM	$\frac{51.0}{}$ GPM	$\frac{51.0}{}$ GPM	$\frac{150}{\pm 5}$ °F
Flow Differential	/	/	/	$\frac{(3-4)}{}$ $\frac{9.0}{}$ GPM	$\frac{(3-5)}{}$ $\frac{9.0}{}$ GPM	/
Percent Flow Loss *	/	/	/	$\frac{(3-4)}{3} \times 100$ $\frac{15}{}$ %	$\frac{(3-5)}{3} \times 100$ $\frac{15}{}$ %	/

* FORM 01-739 - 80762 MODIFICATION FOR USE WITH THIS MACHINE

* Components that are worn, or not working correctly, are found by their flow difference (loss) and percent of flow loss or lower system efficiency. System values for new and rebuilt machines must not be greater than the percent of flow loss in the system tests shown on CHART A for the specific machine. The permissible flow difference (loss) is a function of machine application. For applications with long travel distance the permissible flow difference may be more than for applications with short travel distance.

TEE-TEST

PROCEDURE DATA SHEET

MACHINE SERIAL NUMBER _____

PUMP TESTCHART B

SERVICE METER READING _____

Test Name	Full Speed Pump Flow		Half Speed Pump Flow		Pump Test For Aeration And/Or Cavitation						
	Low Pressure	High Pressure	Low Pressure	High Pressure	Varied Speeds -- Constant Pressure						
Test Number	14	15	16	17	18	19	20	21	22	23	24
Engine Speed	1900 RPM	1900 RPM	950 RPM	950 RPM	700 RPM	900 RPM	1100 RPM	1300 RPM	1500 RPM	1700 RPM	1900 RPM
Pump Test Pressure	100 PSI	1000 PSI	100 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI
Oil Temperature	150 ± 5 °F	150 ± 5 °F	150 ± 5 °F	150 ± 5 °F	150 ± 5 °F	150 ± 5 °F	150 ± 5 °F	150 ± 5 °F	150 ± 5 °F	150 ± 5 °F	150 ± 5 °F
Test Data	60.0 GPM	54.0 GPM	30.0 GPM	24.0 GPM	16.0 GPM	22.0 GPM	29.0 GPM	35.0 GPM	42.0 GPM	48.0 GPM	54.0 GPM
Flow Differential		(14-15) 6.0 GPM		(16-17) 6.0 GPM	(19-18) 6.0 GPM	(20-19) 7.0 GPM	(21-20) 6.0 GPM	(22-21) 7.0 GPM	(23-22) 6.0 GPM	(24-23) 6.0 GPM	(25-24) - GPM
Percent Flow Loss		$\frac{(14-15)}{14} \times 100$ 10 %									

30864X42

STEERING SYSTEM
BLOCKED CYLINDER TEST

TEE TEST
PROCEDURE DATA SHEET
CHART C

MACHINE SERIAL NUMBER _____
SERVICE METER READING _____

Test Name	All Cylinders Blocked			Right Cylinder Blocked			
	System Oil Temperature (Start)	STEER RIGHT Flow Rate	STEER LEFT Flow Rate	System Oil Temperature (End)	System Oil Temperature (Start)	STEER RIGHT Flow Rate	System Oil Temperature (End)
Test Number	26	27	28	33	34	35	38
STEERING WHEEL Position	STEER RIGHT	STEER RIGHT	STEER LEFT	STEER LEFT	STEER RIGHT	STEER RIGHT	STEER RIGHT
Engine Speed	Any Speed	1900 RPM	1900 RPM	Any Speed	Any Speed	1900 RPM	Any Speed
System Test Pressure	0-100 PSI	1000 PSI	1000 PSI	0-100 PSI	0-100 PSI	1000 PSI	0-100 PSI
Test Data	$\frac{150 \pm 5}{\text{°F}}$	$\frac{52.0}{\text{GPM}}$	$\frac{52.0}{\text{GPM}}$	$\frac{150 \pm 5}{\text{°F}}$	$\frac{150 \pm 5}{\text{°F}}$	$\frac{51.0 - 52.0}{\text{GPM}}$	$\frac{150 \pm 5}{\text{°F}}$
Cylinder Leakage Rate	/	(27-4) $\frac{1.0}{\text{GPM}}$	(28-5) $\frac{1.0}{\text{GPM}}$	/	Right Cylinder Leakage (35-4) $\frac{0 - 1.0}{\text{GPM}}$	/	/
Control Valve Group Leakage	/	(15-27) $\frac{2.0}{\text{GPM}}$	(15-28) $\frac{2.0}{\text{GPM}}$	/	Left Cylinder Leakage (27-35) $\frac{1.0 - 0}{\text{GPM}}$	/	/

**SECTION IV
STEERING TEE TEST PROCEDURE-1
(REGO 1193-02)**

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GLOSSARY

aeration: Air mixed with the oil.

block, blocking, blocked: To close off a passage; to stop or prevent movement.

cavitation: Air present at the inlet of the pump.

data: Specific information.

flow differential (flow loss): The difference between two oil flows.

stick, sticking, stuck: To prevent free movement; keep open or closed.

tip, tipping, tipped: To move from a vertical position; to slope.

viscosity: The property of a fluid that resists internal flow by releasing counteracting forces

STEERING TEE TEST PROCEDURE - 1

INTRODUCTION

When making an analysis of the hydraulic system, a standard procedure of checking must be used. This method of checking the system will follow these steps in order:

1. Visual checks.
2. Performance tests.
3. Instrument tests.

The procedures for following each of these steps are given in the TESTING AND ADJUSTING Section of the Service Manual for each machine.

EQUIPMENT INSTALLATION

1. Remove the cap for the hydraulic tank to release any pressure and tighten the cap again.
2. If the machine is not already so equipped, install the correct filter cover assembly.
3. Start the engine.
4. Move the ejector fully forward.
5. Stop the engine.



WARNING: Do not install the adapter in the supply line for the pump with the engine running. Injury to personnel can result.

6. Remove the plug for the tee test from the supply line for the pump. Install the correct adapter.

NOTE: Install the adapter as rapidly as possible to keep the oil loss at a minimum.

7. Install the return line assembly. Connect the return line assembly and the adapter for the pump supply line to the flow meter with the correct connecting hose assemblies. (See the Tee Test Insert for the machine under test.)

NOTE: A plain coupler will not open valve in the adapter for the supply line or return line assembly.

8. Return the ejector to the rear position.

9. Install the tachometer generator with the correct drive. Install the cable between the generator and the input connection for the tachometer (rpm) on the flow meter.

10. Connect the safety link (if equipped) to hold the articulated frames rigid.

PREPARATION OF SYSTEM FOR TEST

1. Open the manual load valve fully (turn counterclockwise).
2. Hold the steering wheel in the RIGHT TURN position. (On machines equipped with flow amplified steering, the steering wheel must be turned constantly.)
3. With the engine at test rpm, slowly turn the manual load valve clockwise until the pressure goes up to 1000 psi.



WARNING: Tractor will articulate (turn) to the right until it is against the stop.

4. Look at the oil temperature.
5. When the oil temperature is 100° F, turn the manual load valve clockwise until the pressure is 1500 psi.
6. When the temperature is 160° F, disconnect the safety link (if equipped).
7. Move the steering cylinders several times through full cylinder travel.
8. Move the cylinders through their cycles as long as necessary to get the desired oil temperature of 150° F all through the system.
9. Connect the safety link (if equipped).

SYSTEM TEST (CHART A)

Write Down The Basic Test Data

NOTE: Conditions in the hydraulic system must be constant before writing down the test data. The steering wheel must be held in the full turn position. (On machines equipped with flow amplified steering, the steering wheel must be turned constantly.) Best results are found when the oil temperature is 150 ± 5° F. On larger machines, make sure the brake accumulator is not operating while taking test data.

1. Open the manual load valve fully.

STEERING TEE TEST PROCEDURE - 1

2. Hold the steering wheel in the RIGHT TURN position.
3. With the engine at test rpm, slowly close the manual load valve until the oil flow through the flow meter stops (0 gpm).
4. Write down the pressure.

The setting of the relief valve for maximum pressure must be according to the Service Manual.

CAUTION: When the pressures are higher than 1000 psi, slowly open the manual load valve before turning the steering wheel back to center. This will prevent possible damage to the pressure gauge.

Test 2: System Oil Temperature

1. Open the manual load valve fully.
2. Turn the steering wheel to the RIGHT TURN position.
3. Write down the oil temperature.

Test 3: System Base Flow Rate

1. Open the manual load valve fully.
2. Turn the steering wheel to the RIGHT TURN position.
3. Run the engine at test rpm.
4. Check pressure to make sure it is at a minimum valve of approximately 100 psi.
5. Write down the flow rate (gpm).

The base flow rate of the system will be the same as the low pressure flow of the hydraulic pump. Because there will be minimum leakage in the control valves, lines and cylinder packings at 100 psi, the base flow rate can be used to find the flow differential in Tests 4 and 5.

NOTE: If the base flow rate (Test 3) is less than the flow rate in Test 4, do Test 4 first and then Test 3. For vane pumps only, this takes place when the vanes in the pump do not have full extension at low pressure.

Tests 4 and 5: Leakage Rates

These two tests are similar. Each test is done as follows:

1. Move the steering wheel to the respective TURN positions.
2. Run the engine at test rpm.
3. Make an adjustment to the manual load valve

to get 1000 psi pressure.

4. Make the system constant with these conditions.
5. Write down the flow rate (gpm) for each test.

The flow differential for each test (4 and 5) is found by taking the flow rate for each test away from the base flow rate (Test 3). The percent of flow loss for each test (4 and 5) is found by dividing the flow differential for each test by the base flow rate (Test 3).

Test 10: System Oil Temperature

1. Open the manual load valve fully.
2. Turn the steering wheel to the RIGHT TURN position.
3. Write down the oil temperature.

Make a comparison of the oil temperature from Tests 2 and 10. Test 2 must be $150 \pm 5^\circ \text{F}$ and Test 10 must be inside of (within) 10°F of Test 2. For each 10°F higher difference (Test 10 higher than Test 2), take away .5 gallon per pump cartridge from the leakage rate. For each 10°F lower difference, add .5 gallon per pump cartridge to the leakage rate.

Is It Necessary To Make More Tests? If so, Which Circuit(s)?

Make a comparison of the test data with the data on Chart A for the specific machine under test. The percent of flow loss on Chart A is maximum for best performance.

Components that are worn, or not working correctly, are found by their flow differential and percent of flow loss or lower system efficiency. System values for new and rebuilt machines must not be more than the percent of flow loss in the system tests shown on Chart A for the specific machine. The permissible flow differential is a function of machine application. For applications with low travel speeds, the permissible flow differential can be more than for applications with high travel speeds.

If the percent of flow loss is acceptable, the Tee Test is completed.

If the percent of flow loss is not acceptable, the tests for the pump and/or the blocked cylinders must be done.

Troubleshooting

The following examples are a list of problems and probable reasons. They will aid in finding the

STEERING TEE TEST PROCEDURE - 1

location of the components that are worn, or not working correctly. Not all probable reasons have an application to all machines.

PROBLEM: Setting of the relief valve is higher or lower than given in Test 1. Percent of flow loss for Tests 4 and 5 is 15% to 50%.

PROBABLE REASON:

Setting for relief valve is not correct and leakage is too high.

RECOMMENDATION FOR ACTION:

Make adjustments to the relief valve to get the correct pressure. See the Service Manual for the machine under test. Make a test for leakage in the following problems.

PROBLEM: Percent of flow loss for Tests 4 and 5 is 15% or MORE,

PROBABLE REASON:

- A. Bad pump.
- B. Leakage in the relief valve.
- C. Leakage in one or both of the piston seals for the steering cylinders.
- D. Wear or damage in the valve body or valve spool.
- E. Hand metering pump, unloading valve, selector valve or diverter valve is worn or not working correctly (if so equipped).

RECOMMENDATION FOR ACTION:

- A. Do the Pump Test.
- B. If the extra percent of flow loss is not caused by a bad pump, the problem is in the control valve or cylinders. Do the Blocked Cylinder Tests 26, 27 and 28. If the leakage is still too high, the problem is in the control valve. Inspect its components.

PROBLEM: Percent of flow loss for Test 4 is 15% or MORE; for Test 5 it is 0 to 15%.

PROBABLE REASON:

- A. Wear or damage in the valve body or valve spool.
- B. Adjustment of follow-up linkage is not correct (if so equipped).
- C. Unloading valve or relief valve does not move freely (if so equipped).

RECOMMENDATION FOR ACTION:

The problem is in the control valve or linkage. Inspect these components.

PROBLEM: Percent of flow loss for Test 5 is 15% or MORE; for Test 4 it is 0 to 15%.

PROBABLE REASON:

- A. Wear or damage in the valve body or valve spool.
- B. Adjustment of follow-up linkage is not correct (if so equipped).
- C. Unloading valve or relief valve does not move freely (if so equipped).

RECOMMENDATION FOR ACTION:

The problem is in the control valve or linkage. Inspect these components.

PUMP TEST (CHART B)

This test is used to find the efficiency of the hydraulic pump. Install a Blocking Plate Assembly in the pressure line from the hydraulic pump, or in the return line on the control valve on larger machines. This prevents oil from going through the system. All pump flow now goes through the flow meter.

NOTE: On some smaller machines with supplemental steering, the Blocking Plate Assembly is installed on the other side of the diverter valve. Data for the Pump Test will show any leakage in this valve. On larger machines, make sure the brake accumulator is not operating while taking test data.



WARNING: Open the manual load valve on the flow meter fully before starting the diesel engine. The relief valve is not part of the circuit for the Pump Test. If the pressure gets too high, it is possible to cause injury to personnel or damage to equipment.

Test 14: Pump Flow at Low Pressure (test rpm)

1. Open the manual load valve fully.
2. Start the diesel engine.
3. Run the engine at test rpm.
4. Slowly close the manual load valve to get 100 psi pressure.
5. Write down the oil temperature and flow rate (gpm).

STEERING TEE TEST PROCEDURE - 1

Test 15: Pump Flow at High Pressure (test rpm)

1. Run the engine at test rpm.
2. Slowly close the load valve to get 1000 psi pressure.
3. Write down the oil temperature and flow rate (gpm).

Flow differential for Test 15 is higher than the flow differential for Test 17 by 0 to 2 gpm.

PROBABLE REASON:

Pump is worn.

RECOMMENDATION FOR ACTION:

If flow loss is found to be too high for machine application, install a new or rebuilt pump.

PROBLEM: For vane pumps only, the percent of flow loss for Test 15 is 10% or MORE. Flow differential for Test 15 is higher than the flow differential for Test 17 by 2 gpm or MORE.

PROBABLE REASON:

- A. Oil aeration (low oil level, hydraulic oil that is not the correct type, air leak in the suction line for the pump, oil leaks in the tank such as failure of seals or loose connections).
- B. Pump cavitation (restriction in the suction line for the pump, oil viscosity that is not correct).

RECOMMENDATION FOR ACTION:

Do Tests 18 through 24 to find if the reason is aeration or cavitation.

PROBLEM: For gear pumps only, the percent of flow loss for Test 15 is 10% or MORE. Flow differential for Test 17 is higher than the flow differential for Test 15 by 0 gpm or MORE.

PROBABLE REASON:

Pump is worn.

RECOMMENDATION FOR ACTION:

If flow loss is found to be too high for machine application, install a new or rebuilt pump.

PROBLEM: For gear pumps only, the percent of flow loss for Test 15 is 10% or MORE. Flow differential for Test t5 is higher than the flow differential for Test 17 by 0 gpm or MORE.

PROBABLE REASON:

- A. Oil aeration (low oil level, hydraulic oil that is not the correct type, air leak in the suction line for the pump, oil leaks in the tank such as failure of seals or loose connections).
- B. Pump cavitation (restriction in the suction line for the pump, oil viscosity that is not correct).

RECOMMENDATION FOR ACTION:

Test 16: Pump Flow at Low Pressure (1/2 test rpm)

1. Run the engine at 1/2 test rpm.
2. Open the load valve to get 100 psi pressure.
3. Write down the oil temperature and flow rate (gpm).

Test 17: Pump Flow at High Pressure (1/2 test rpm)

1. Run the engine at 1/2 test rpm.
2. Slowly close the load valve to get 1000 psi pressure.
3. Write down the oil temperature and flow rate (gpm).

Make a comparison of the test data with the data on Chart B for the specific machine under test. The information on Chart B is the maximum for best performance.

Troubleshooting

PROBLEM: Percent of flow loss for Test 15 is 10% or MORE; for Tests 4 and 5 it is 15% or MORE.

PROBABLE REASON:

Pump is worn and there is leakage in control valve and/or cylinder.

RECOMMENDATION FOR ACTION:

Do the Blocked Cylinder Tests to find leakage rate in control valve and/or cylinder. Install a new or rebuilt pump.

PROBLEM: Percent of flow loss for Test 15 is 0 to 10%; for Tests 4 and 5 it is 15% or MORE.

PROBABLE REASON:

Pump is in good condition, but there is leakage in control valve and/or cylinder.

RECOMMENDATION FOR ACTION:

Do the Blocked Cylinder Tests to find leakage rate in control valve and/or cylinder.

PROBLEM: For vane pumps only, the percent of flow loss for Test 15 is 10% or MORE,

STEERING TEE TEST PROCEDURE - 1

Do Tests 18 through 24 to find if the reason is aeration or cavitation.

D. Disassemble pump and check for correct assembly.

Pump Test for Aeration and Cavitation

PROBLEM: For gear pumps only, the percent of flow loss for Test 15 is 10% or MORE. Flow differential for Test 15 is more than 0 gpm higher than the flow differential for Test 17. Tests 18 through 24 have the same flow differential.

Tests 18 through 24: Aeration and Cavitation Tests

These eight tests are similar. Do the tests as follows:

PROBABLE REASON:

1. Open the manual load valve fully before starting the diesel engine.
2. Run the engine at rpm indication shown on Chart B.
3. Slowly close the manual load valve to get 1000 psi pressure.
4. Write down the flow rate (gpm) and the oil temperature.
5. Then run the engine at the next rpm indication shown on Chart B (Test 20: rpm indication on Chart, Test 21: rpm indication on Chart, etc.) while keeping the adjustment of the manual load valve at 1000 psi pressure.
6. Write down the flow rate (gpm) and oil temperature for each test.

Oil aeration (low oil level, hydraulic oil that is not the correct type, air leak in the suction line for the pump, oil leaks in the tank such as failure of seals, loose connections or pump cartridge is not installed correctly in pump body).

RECOMMENDATION FOR ACTION:

CAUTION: Immediately after stopping the diesel engine, remove the Blocking Plate Assembly from the pressure line for the pump or the return line on the control valve on larger machines. This will prevent any possible damage later.

- A. Check oil level and type of hydraulic oil being used.
- B. Check suction line for air leaks [Put foam (like shaving cream) on all connections. The foam will be pulled into the line at any point of leakage.
- C. Remove cover from hydraulic tank and inspect for oil leak (check above the oil level first).
- D. Disassemble pump and check for correct assembly.

Troubleshooting

PROBLEM: Flow differential between each of the Tests 18 through 24 suddenly becomes lower at one test and the flow rate is the same for the remainder of the tests at higher engine speed (rpm). Example: 8 gpm differential between Tests 18 and 19, 19 and 20, 20 and 21, but 1 gpm differential between 21 and 22 and flow rates for Tests 23 and 24 are the same as 22.

PROBLEM: For vane pumps only, the percent of flow loss for Test 15 is 10% or MORE. Flow differential for Test 15 is 2 gpm or MORE than flow differential for Test 17. Tests 18 through 24 have the same flow differential.

PROBABLE REASON:

PROBABLE REASON:

Pump cavitation (restriction in the suction line for the pump).

Oil aeration (low oil level, hydraulic oil that is not the correct type, air leak in the suction line for the pump, oil leaks in the tank such as failure of seals, loose connections or pump cartridge is not installed correctly in pump body).

RECOMMENDATION FOR ACTION:

RECOMMENDATION FOR ACTION:

Inspect suction line and tank.

- A. Check oil level and type of hydraulic oil being used.
- B. Check suction line for air leaks [Put foam (like shaving cream) on all connections. The foam will be pulled into the line at any point of leakage.
- C. Remove cover from hydraulic tank and inspect for oil leak (check above the oil level first).

BLOCKED CYLINDER TESTS (CHART C)

If the System Tests and Pump Test give an indication of leakage in the control valves and/or cylinders that is not acceptable, do the Blocked Cylinder Tests.

Blocking Plate Assemblies or Caps and Plugs can be put in each of the cylinder lines. For best accuracy, do these tests with the oil temperature approximately 150° F (near the oil temperature for the System Tests and Pump Test).

STEERING TEE TEST PROCEDURE - 1



WARNING: Install the safety link. Lower all implements to the ground. Move the steering wheel from RIGHT TURN to LEFT TURN several times to release any pressure oil in the cylinder lines. All pressure in the lines must be released or injury to personnel and damage to equipment can result while loosening the lines to install or remove the plate assemblies.

All Cylinders Blocked

1. Put control levers in HOLD position.
2. Open the manual load valve fully.
3. Start the diesel engine.

Test 26: System Oil Temperature

1. Turn the steering wheel to the RIGHT TURN position.
2. Run the engine at any rpm with the system pressure at 0 to 100 psi.
3. Write down the oil temperature.

Test 27 and 28: Leakage Rates

These two tests are similar. Do the tests as follows:

1. With the manual load valve fully open, turn the steering wheel to the RIGHT TURN position.
2. Run the engine at test rpm.
3. Slowly close the manual load valve to get 1000 psi pressure.
4. Write down the flow rate (gpm).
5. Do this procedure again in the LEFT TURN position.

Test 33: System Oil Temperature

1. Turn the steering wheel to the RIGHT TURN position.
2. Run the engine at any rpm with the system pressure at 0 to 100 psi.
3. Write down the oil temperature.

Find the leakage rate of the cylinders and the leakage rate of the control valves. Use the test information from the System Tests, Pump Test and Blocked Cylinder Tests.

Example: Find the leakage rates in the RIGHT TURN position.

Test 15: flow rate of the pump only.

Test 27: flow rate of pump and control valve.

Test 4: flow rate of pump, control valve and cylinders.

The system components tested in Tests 15 and 27 are the same except for the control valve. Then the difference in flow rates must be the leakage in the control valve (take the test information for Test 27 away from the test information for Test 15).

The system components tested in Tests 27 and 4 are the same except for the cylinders. Then the difference in flow rates must be the leakage in the cylinders (take the test information for Test 4 away from the test information for Test 27).

Make a comparison of the test data with the data on Chart C for the specific machine under test. The information on Chart C is the maximum for best performance.

Troubleshooting

PROBLEM: Tests 27 and 28 give an indication of leakage in one or more of the cylinders.

PROBABLE REASON:

- A. Leakage in only one of the cylinders.
- B. Leakage in both cylinders.

RECOMMENDATION FOR ACTION:

Do the Blocked Cylinder Test for cylinders on the right side.

PROBLEM: Test 27 and 28 give an indication of leakage in the valves.

PROBABLE REASON:

- A. Leakage in the relief valve.
- B. Wear or damage in the valve body or valve spool.
- C. Hand metering pump, unloading valve, selector valve or diverter valve is worn or not working correctly (if so equipped).

RECOMMENDATION FOR ACTION:

- A. To find the leakage on machines with supplemental steering, use a Blocking Plate Assembly between the diverter valve and the control valve for steering.
- B. Inspect the components of these valves to find the problem.

Right Side Cylinders Blocked

STEERING TEE TEST PROCEDURE - 1

If the Blocked Cylinder Tests gives an indication of leakage that is too high in one or more of the cylinders, do the Blocked Cylinder Tests for the Right Side. For best accuracy, turn the steering wheel through several cycles to get the temperature of the oil in the cylinders the same as the temperature of the oil in the hydraulic tank. Make the temperature of the complete system 150° F.

1. Install the safety link.
2. Lower all implements to the ground.
3. Stop the engine.
4. Move the steering wheel from RIGHT TURN to LEFT TURN several times to release any pressure oil in the cylinder lines.
5. Move the steering wheel back to center.
6. Remove the cap for the hydraulic tank to release any pressure and tighten the cap again.
7. Put a Blocking Plate Assembly in the rod end of the right steering cylinder.

Test 34: System Oil Temperature

1. Open the manual load valve fully.
2. Start the diesel engine.
3. Run the engine at any rpm with the system pressure at 0 to 100 psi.
4. Move the steering wheel to the RIGHT TURN position.
5. Write down the oil temperature.

Test 35: STEER RIGHT Flow Rate

1. With the manual load valve fully open, move the steering wheel to the RIGHT TURN position.
2. Run the engine at test rpm.
3. Slowly close the manual load valve to get 1000 psi pressure.
4. Write down the flow rate (gpm).

Test 38: System Oil Temperature

1. Open the manual load valve fully.
2. Run the engine at any rpm with the system pressures at 0 to 100 psi.
3. Move the steering wheel to the RIGHT TURN position.
4. Write down the oil temperature.



WARNING: All pressure in the lines must be released or injury to personnel and damage to equipment can result while loosening the lines to install or remove the plate assemblies.

Find the leakage rates for the right and left cylinders. Use the test information from System Test, Pump Test and Blocked Cylinder Tests.

Example: Find the leakage rate for the steering cylinders.

Test 27: flow rate of pump and control valve.

Test 35: flow rate of pump, control valve and left side cylinder.

Test 4: flow rate of pump, control valve and both cylinders.

The system components tested in Tests 27 and 35 are the same except for the left side cylinder. Then the difference in flow rates must be the leakage in the left side cylinder (take the test information for Test 35 away from the test information for Test 27).

The system components tested in Tests 35 and 4 are the same except for the right side cylinder. Then the difference in flow rates must be the leakage in the right side cylinder (take the test information for Test 4 away from the test information for Test 35). Make a comparison of the test values with the values on Chart C.

Troubleshooting

PROBLEM: Leakage is in right steering cylinder.

PROBABLE REASON:

- A. Piston seals are worn.
- B. Loose piston nut.
- C. Damage in cylinder assembly.

RECOMMENDATION FOR ACTION:

Disassemble and make repairs to the right steering cylinder.

PROBLEM: Leakage is in left steering cylinder.

PROBABLE REASON:

- A. Piston seals are worn.
- B. Loose piston nut.
- C. Damage in cylinder assembly.

RECOMMENDATION FOR ACTION:

Disassemble and make repairs to the left steering cylinder.

SECTION V
SPECIFICATIONS-STEERING SYSTEM

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NOTE: For Systems Operation and Testing and Adjusting, make reference to the STEERING SYSTEM.

STEERING SYSTEM

**HYDRAULIC PUMP
FOR IMPLEMENT (BOWL)
AND STEERING
(3G1239)**

Rotation is clockwise when seen from drive end

Type of pump Vane

For test, use SAE 10W oil at 150° F (65° C)

LARGE SECTION OF PUMP (Drive end)

Test at Full Speed:

Output78 U S gpm (295 liter/min)
at a pressure of 100 psi (690 kPa)
with pump at 1900 rpm
with engine at 1900 rpm

Output 72 U S gpm (272 liter/mm)
at a pressure of 1000 psi (6900 kPa)
with pump at 1900 rpm
with engine at 1900 rpm

Test at Half Speed:

Output39 U S gpm (148 liter/min)
at a pressure of 100 psi (690 kPa)
with pump at 950 rpm
with engine at 950 rpm

Output33 U.S gpm (125 liter/min)
at a pressure of 1000 psi (6900 kPa)
with pump at 950 rpm
with engine at 950 rpm

SMALL SECTION OF PUMP (Cover end)

Test at Full Speed:

Output40 U.S gpm (151 liter/min)
at a pressure of 100 psi (690 kPa)
with pump at 1900 rpm
with engine at 1900 rpm

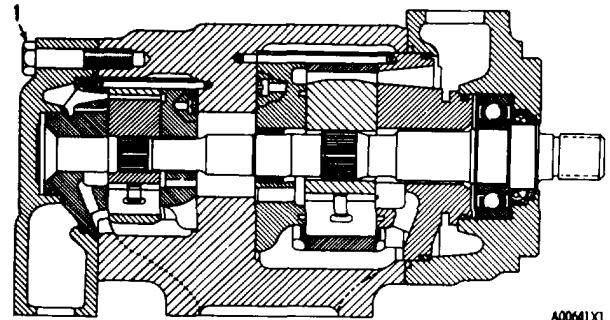
Output37 U S gpm (140 liter/min)
at a pressure of 1000 psi (6900 kPa)
with pump at 1900 rpm
with engine at 1900 rpm

Test at Half Speed:

Output 19 U.S gpm (72 liter/mm)
at a pressure of 100 psi (690 kPa)
with pump at 950 rpm
with engine at 950 rpm

Output 17 US gpm (64 liter/mm)
at a pressure of 1000 psi (6900 kPa)
with pump at 950 rpm
with engine at 950 rpm

(1) Torque for bolts270 ± 10 lb. ft. (360 ± 14 N•m)

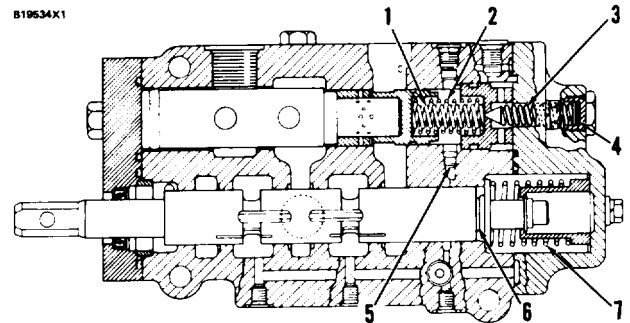


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STEERING SYSTEM

**STEERING CONTROL VALVES
(1U325)**

- Opening pressure of relief valve 2250 ± 25 psi (15500 ± 170 kPa)
 Pressure to each steering cylinder with valve in neutral 55 ± 15 psi (380 ± 105 kPa)
 Permissible difference of pressure (between steering cylinders) with valve in neutral.. 20 psi (140 kPa)
 Opening pressure of flow control valve (maximum) 125 ± 15 psi (860 ± 105 kPa)
 4J8947 Spring for ball check valve
 Length under test force50 in. (12.7 mm)
 Test force075 + .006 lb (34 ± .03 N)
 Free length after test..... .65 in. (16.5 mm)
 Outside diameter..... .312 in. (7.9 mm)
- (1) 4J7490 Spring for dump valve (inner)
 Length under test force 1.63 in. (41.4 mm)
 Test force 13.3 ± .7 lb. (59 ± 3 N)
 Free length after test..... 2.00 in. (50.8 mm)
 Outside diameter..... .60 in. (15.2 mm)
- (2) 2J6088 Spring for dump valve (outer):
 Length under test force 1.53 in. (38.9 mm)
 Test force 22.05 ± 1.10 lb. (98.1 ± 4.9 N)
 Free length after test..... 2.34 in. (59.4 mm)
 Outside diameter..... .81 in. (20.6 mm)
- (3) 2J6089 Spring for pilot valve
 Color code..... yellow stripe
 Length under test force 1.427 in. (36.2 mm)
 Test force 67.58 ± 3.38 lb. (300.7 ± 15.1 N)
 Free length after test..... 1.737 in. (44.1 mm)
 Outside diameter..... .492 in. (12.5 mm)
- (4) 3H2549 Shim thickness010 in. (0.25 mm)
 One shim will change pressure..... 40 psi (280 kPa)
 3J7473 Shim thickness005 in. (0.13 mm)
 One shim will change pressure..... 20 psi (140 kPa)
- (5) Torque for plug..... 10 + 2 lb ft. (14 ± 3 N•m)
- (6) 4J8224 Shims and 5J4776 Shims to move valve spool (to get same oil pressure to each steering cylinder)
- (7) 5J9338 Spring for valve spool:
 Length under test force 1.69 in. (42.9 mm)
 Test force 35.0 ± 25 lb. (155 ± 11 N)
 Free length after test..... 3.1 in. (79.0 mm)
 Outside diameter..... 1.51 in. (38.3 mm)



1U325

**STEERING SYSTEM
SUPPLEMENTAL STEERING
HYDRAULIC PUMP AND VALVE
(3G1233)**

Rotation is counterclockwise when seen from drive end

Type of pump Gear

For test, use SAE 10W oil at 150 F (65 C)

NOTE Specifications shown are for total pump output

Test at 1000 rpm:

- Output39 U S gpm (148 liter/min)
at a pressure of 100 psi (690 kPa)
- Output33 U S gpm (125 liter/min)
at a pressure of 1000 psi (6900 kPa)

Test at 1200 rpm:

- Output 42 U S gpm (159 liter/mm)
at a pressure of 100 psi (690 kPa)
- Output36 U S gpm (136 liter/min)
at a pressure of 1000 psi (6900 kPa)

Test at 1600 rpm:

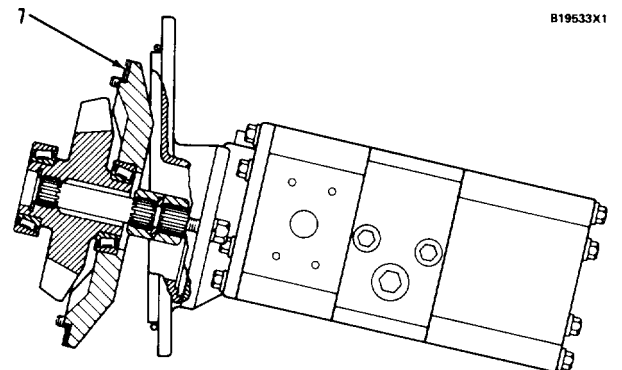
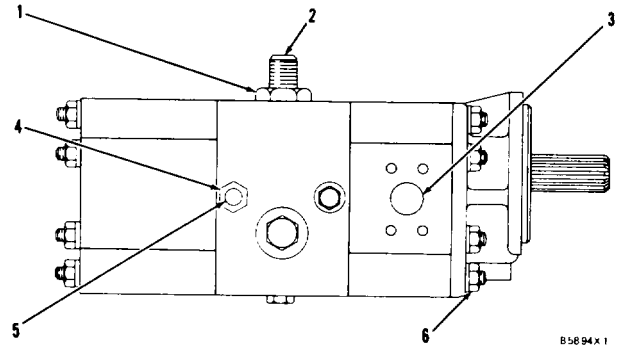
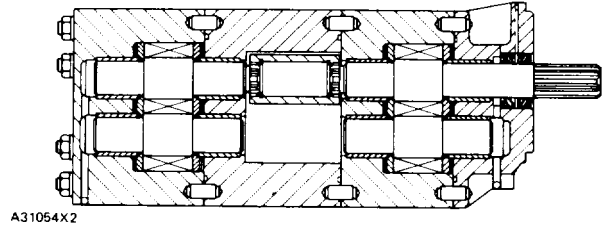
- Output55 U S gpm (208 liter/min)
at a pressure of 100 psi (690 kPa)
- Output51 US gpm (193 liter/min)
at a pressure of 1000 psi (6900 kPa)

Test at 2000 rpm:

- Output68 U S gpm (257 liter/min)
at a pressure of 100 psi (690 kPa)
- Output67 U S gpm (254 liter/min)
at a pressure of 1000 psi (6900 kPa)

Valve Adjustment (Pump on Test Bench)

1. Turn screw (2) to get seven threads above locknut (1) after lock-nut is tightened Install the acorn nut
2. With pump shaft at 1200 rpm, turn speed adjusting screw (5) until the 56 U S gpm (212 liter min) oil at a pressure of 100 psi (690 kPa) from pump outlet (3) starts to decrease
3. With the pump shaft at 1600 rpm, the output from the large pump section must completely stop The oil from pump outlet (3) must be 33.5 U S gpm (127 liter mm) at 100 psi (690 kPa) with pump at 1600 rpm
4. When pump output is correct tighten locknut (4) and install the acorn nut
- (6) Torque for nuts85 ± 51 lb. ft. (115 ± 7 N•m)
- (7) Use shims as needed to get end play of.... .001 to .007 in. (0.03 to 0.18 mm)

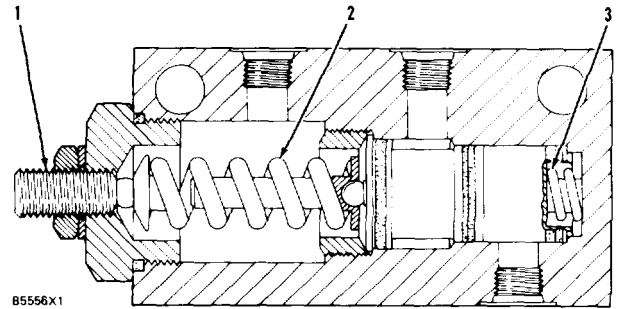


NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

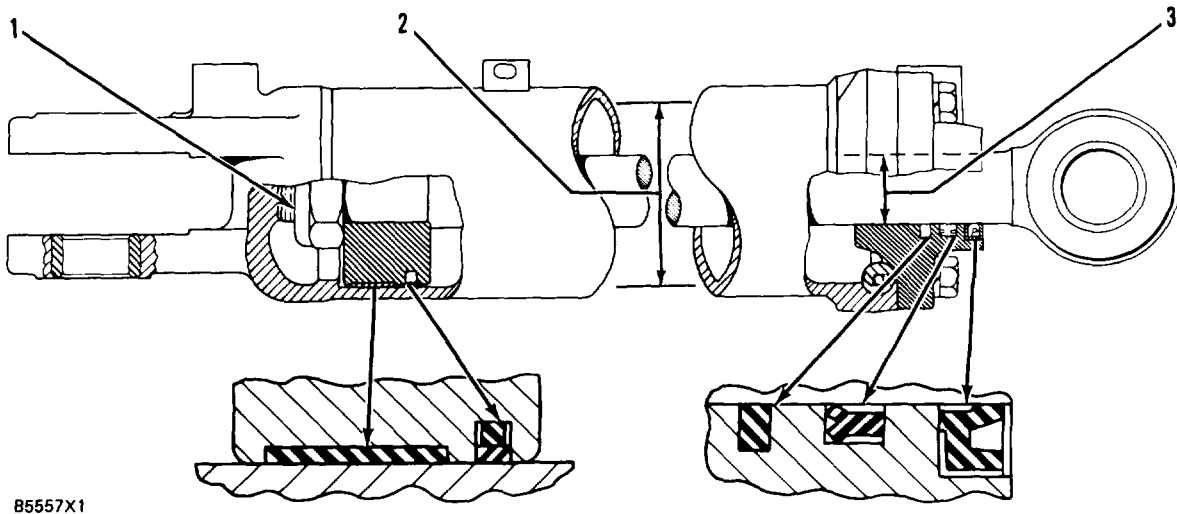
**PRESSURE REDUCING VALVE
(3G7594)**

Valve reduced oil pressure 60 ± 10 psi (415 ± 70 kPa)

- (1) Adjustment screw Turn adjustment screw clockwise to increase the pressure of the reduced oil pressure from the valve
- (2) 3G3731 Spring
 - Length under test force 1.68 in. (42.7 mm)
 - Test force 5.4 lb. (24 N)
 - Free length after test..... 1.75 in. (44.5 mm)
 - Outside diameter..... .60 in. (15.2 mm)
- (3) 3G670 Spring
 - Length under test force25 in. (6.4 mm)
 - Test force 6.1 lb. (27 N)
 - Free length after test..... .58 in. (14.7 mm)
 - Outside diameter..... .27 in. (6.9 mm)



**STEERING CYLINDER
(3G5192)**



- (1) Torque for nut with lubricant on threads 1600 ± 160 lb. ft. (2160 ± 219 N•m)
- (2) Bore of cylinder (new) $5.000 + .005 - .002$ in ($127.000 + 0.13 - 0.05$ mm)

- (3) Bore of head (new) $2.503 \pm .001$ in. (63.58 ± 0.03 mm)
- Diameter of rod (new) $2.4980 \pm .0015$ in. (63.450 ± 0.038 mm)

STEERING SYSTEM
FOLLOW-UP CYLINDER
FOR STEERING (SENDER)
(3G6904)

NOTE: Tighten the head bolts with the rod fully extended

Torque for valves to let air

out of circuit24 ± 2 lb ft (30 ± 3 N•m)

(1) Length of retracted cylinder 16.8 in. (427 mm)

(2) 5J8004 Springs for relief valves

Length under test force 1.09 in. (27.7 mm)

Test force 13.6 ± 1.0 lb. (60 ± 4 N)

Free length after test..... 1.31 in. (33.3 mm)

Outside diameter..... .30 in (7.6 mm)

(3) 6J1832 Shim thickness010 in. (0.25 mm)

One shim will change relief

valve pressure..... 20 psi (140 kPa)

Pressure to open relief

valve..... 525 ± 25 psi (3600 ± 170 kPa)

(4) Torque for plugs (two)..... 42 ± 3 lb. ft. (58 ± 4 N•m)

(5) Torque for plugs (two)..... 9 ± 2 lb. ft. (12 ± 3 N•m)

(6) Bore in new

cylinder..... 1.4995 ± .0015 in. (38.02 ± 0.04 mm)

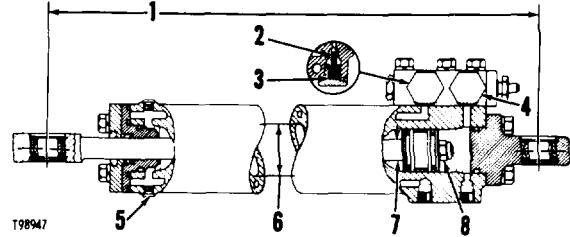
(7) Diameter of new rod..... .748 ± .001 - .002 in.

(19.00 ± 0.02 - 0.05 mm)

Bore in new head

(for rod)753 ± .001 in. (19.13 ± 0.02 mm)

(8) Torque for nut on rod 35 ± 3 lb. ft. (45 ± 4 N•m)



FOLLOW-UP CYLINDER
FOR STEERING (RECEIVER)
(4T7819)

NOTE: Tighten the head bolts with the rod fully extended.

Minimum pressure needed to retract

cylinder rod 125 ± 50 psi (860 ± 345 kPa)

9J8733 Springs for check valves:

Length under test force34 in (8.6 mm)

Test force50 ± .04 lb. (2.2 ± 0.2 N)

Free length after test..... .55 in (14.0 mm)

Outside diameter..... .328 in (8.33 mm)

(1) Length of retracted cylinder 14 in. (356 mm)

(2) Bore in new

cylinder..... 2.000 ± .001 in. (50.80 ± 0.02 mm)

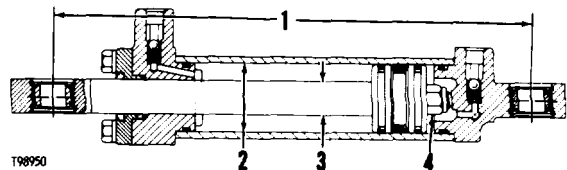
(3) Diameter of new rod..... .998 ± .001 - .002 in.

(25.35 ± 0.02 - 0.05 mm)

Bore in new head

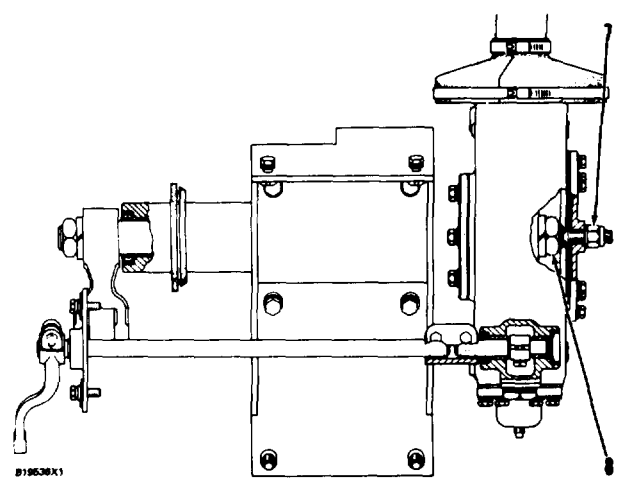
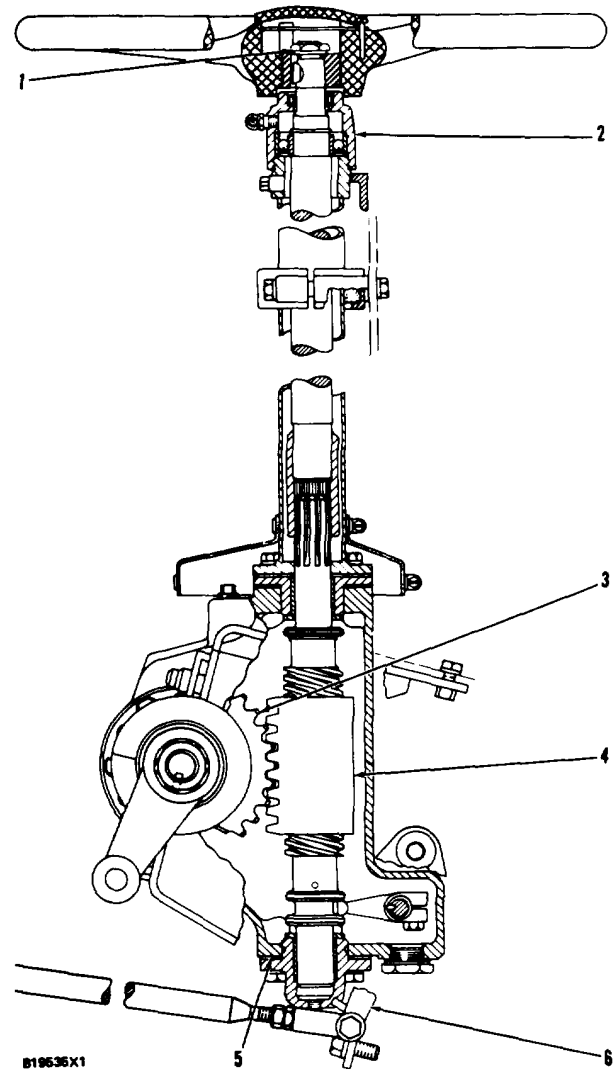
(for rod) 1.003 ± .001 in (25.48 ± 0.02 mm)

(4) Torque for nut on rod ..165 ± 16 lb. ft. (223 ± 22 N•m)



STEERING GEAR

- (1) Torque for nut100 ± 10 lb. ft. (135 ± 14 N•m)
- (2) Torque for nut150 ± 20 lb. ft. (205 ± 25 N•m)
- (3) The center tooth of gear sector (3) must be in the center of gear nut (4).
- (4) Tooth clearance between gear sector (3) and nut gear (4) is..... .00 in. (0.0 mm)
Turn the housing for sector gear shaft to get .00 in. (0.0 mm) tooth clearance between gears (3) and (4)
- (5) 9M5552 Shim Thickness010 in. (0.25 mm)
- (6) When the steering wheel is turned from right to left or from left to right (with the engine stopped) the distance the pin hole in lever (6) moves is..... 1.12 to 1.15 in. (28.4 to 29.2 mm)
Add shims (5) to increase, or remove shims to decrease the distance lever (6) can move.
- (7) Loosen the locknut and turn screw (7) against the lever shaft which is connected to the follow-up linkage, then loosen screw (7) 1/8 turn and tighten the locknut
- (8) Torque for nut150 ± 20 lb. ft. (205 ± 25 N•m)



**SECTION VI
SCRAPER HYDRAULIC SYSTEM
SYSTEMS OPERATION, TESTING AND ADJUSTING**

INDEX Page

SYSTEMS OPERATION

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NOTE: For illustrated Specifications, make reference to the HYDRAULIC SYSTEM SPECIFICATIONS for SCRAPERS.

SCRAPER HYDRAULIC SYSTEM

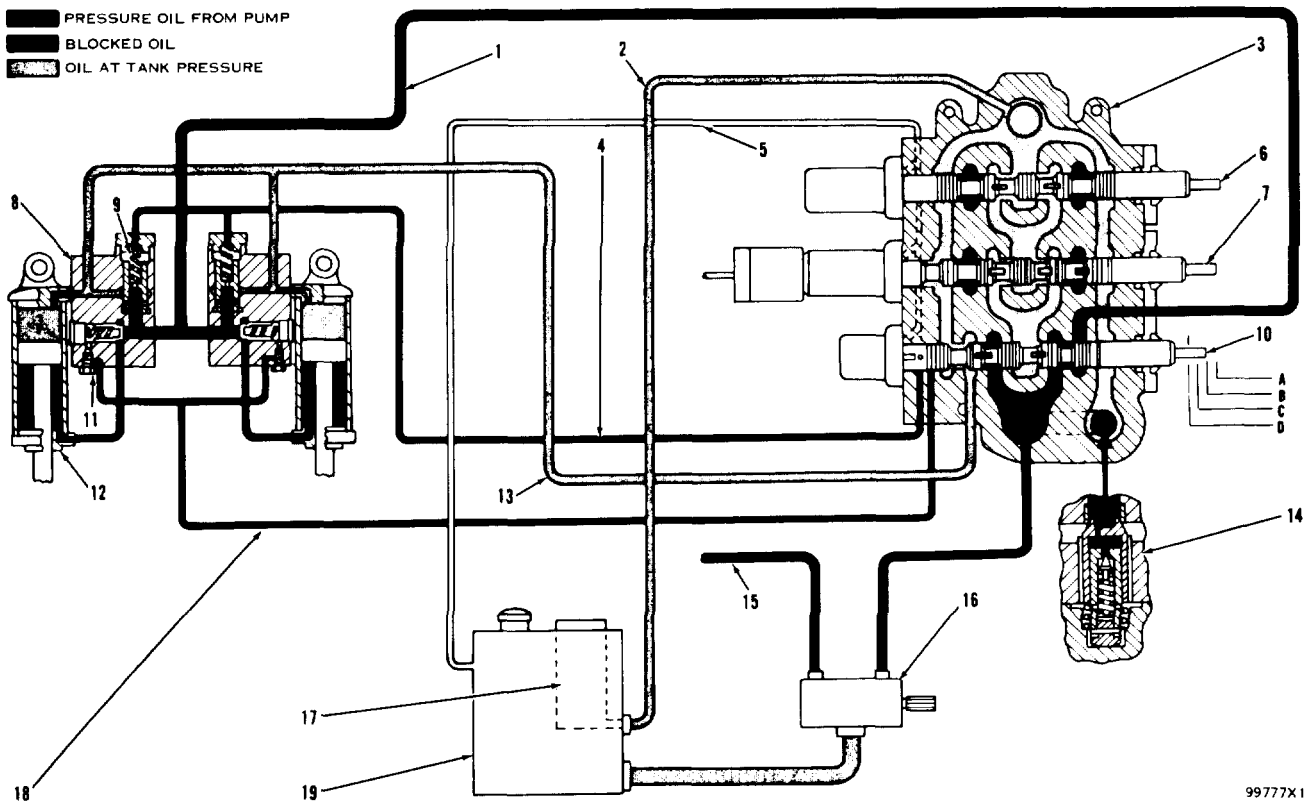
The two section pump is for the hydraulic steering and the hydraulic system for the scraper bowl. The schematic for the complete hydraulic system is on the last page of the manual.

The section of the two section pump near the drive end is for the hydraulic system for the scraper. The location of the pump is on the front of the housing for the transfer gears to the transmission. The location of the control valve for the scraper is near the left side and on top of the differential housing. The control levers for the scraper are at the right side of the operators seat. Rods and levers

are used to connect the control levers to the valve spools in the control valve.

The pump oil goes through the control valve when the engine is running and the control levers are in HOLD positions. The oil from the control valve goes through a filter, and then into the hydraulic tank. The filter has a bypass valve. If the filter element is full of dirt, and oil can not easily go through the element, there is an increase in the pressure of the oil and the bypass valve opens. When the bypass valve is open, the oil from the control valve goes through the bypass valve and into the hydraulic tank.

BOWL CIRCUIT



SCHEMATIC OF BOWL CIRCUIT IN RAISE POSITION

1. Line to rod ends of bowl cylinders.
 2. Line to filters and hydraulic tank.
 3. Control valve.
 4. Vent line for quick drop valves.
 5. Oil line to hydraulic tank.
 6. Valve spool for ejector cylinder.
 7. Valve spool for apron cylinder.
 8. Quick drop and check valve (two).
 9. Quick drop valve.
 10. Valve spool for bowl cylinders.
 11. Vent valve.
 12. Bowl cylinder (two).
 13. Line to head ends of bowl cylinders.
 14. Relief valve (in control valve).
 15. Line from small section of hydraulic pump to the steering system.
 16. Pump, with two sections.
 17. Filter in hydraulic tank.
 18. Vent line from carry check valves.
 19. Hydraulic tank.
- A. QUICK DROP position. B. LOWER position. C. HOLD position. D. RAISE position.

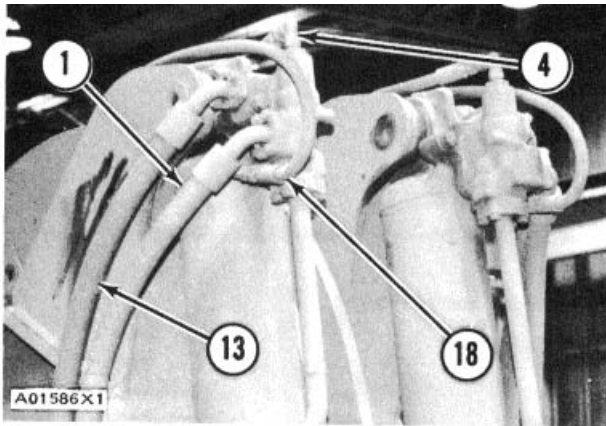
Bowl Raise

When valve spool (10) is moved to RAISE position (D), the oil from the pump goes around the valve spool

and through line (1) to quick drop and check valves (8). The pressure of the pump oil opens vent valves (11) which lets the check valves open and the pump oil goes to the rod ends of bowl cylinders (12). The pump oil in

HYDRAULIC SYSTEM

the rod ends of the cylinders moves the pistons up which lifts the bowl. The pistons push the oil out of the head ends of the cylinders, through line (13) to control valve (3). The oil then goes around valve spool (10), through the control valve, through line (2), filter (17) and into hydraulic tank (19). When the control lever for the bowl is released, a spring on valve spool (10) moves the valve spool to HOLD position (C). There is blocked oil in lines (1) and (13).



QUICK DROP AND CHECK VALVES

1 Line to rod end of bowl cylinder. **4** Vent line for quick drop valve. **13** Line to head end of bowl cylinder. **18** Vent line for carry check valve.

When valve spool (10) is in HOLD position (C), there is blocked oil in line (18) between the valve spool and vent valves (11) and the check valves cannot open. The pressure of the oil in the rod end of the bowl cylinders keeps the quick drop valve (9), and check valves (8) closed, and the bowl stays in RAISE position (D).

Bowl Lower

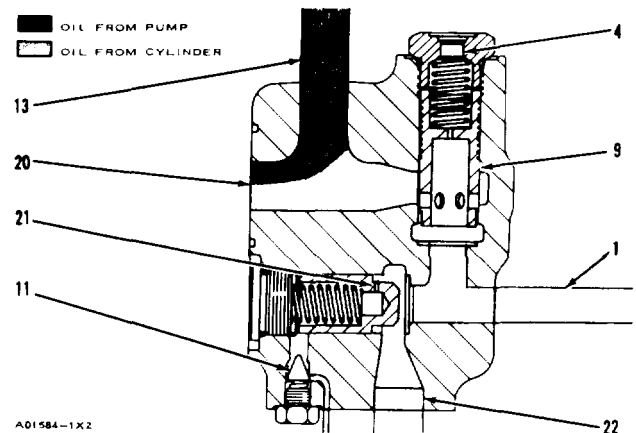
When valve spool (10) is moved to LOWER position (B) (no illustration), the pump oil goes around valve spool (10) and through line (13) into the head ends of bowl cylinders (12). The pump oil moves the pistons down and the bowl moves down. As the pistons go down, oil is pushed out of the rod ends of the bowl cylinders. The oil opens the check valves in quick drop and check valves (8). The check valves open because the pressure of the oil in the check valves opens the vent valves (11). The vent valves open because the oil in line (18) can go around valve spool (10), when it is in LOWER position (B), and through the control valve and line (5) into the hydraulic tank.

The oil from the rod ends of the bowl cylinders is moved through line (1), around valve spool (10) through the control valve and line (2) into filter (17), and then to hydraulic tank (19).

Release the control lever for the bowl and a spring on valve spool (10) moves the valve spool to HOLD position (C).

Bowl Quick Drop

When valve spool (10) is moved to QUICK DROP position (A) (no illustration), the oil in vent lines (4) and (18), from quick drop valves (9) and vent valves (11) can go around the valve spool and through line (5) into the hydraulic tank. With the valve spool in QUICK DROP position (A), the pump oil goes around the valve spool and through line (13) to the head ends of bowl cylinders (12). The weight of the bowl and the pump oil in the head ends of the cylinders moves the pistons down.



QUICK DROP AND CHECK VALVE

1 Line to rod end of bowl cylinder. **4** Vent line for quick drop valve. **9** Quick drop valve. **11** Vent valve. **13** Line for head end of bowl cylinder. **20** Passage to head end of bowl cylinder. **21** Orifice in check valve. **22** Passage from rod end of bowl cylinder.

The oil from the rod end of the cylinder goes through passage (22) and through orifice (21) in the check valve. The oil in the check valve opens vent valve (11) and goes through vent line (18). The position of valve spool (10) lets the oil from line (18) go through the control valve and through line (5) to the tank. Now the oil in passage (22) easily opens the check valve and goes through the orifice in quick drop valve (9). The oil that goes through the orifice, goes through vent line (4) and to the tank. The oil from passage (22) now opens quick drop valve (9) and adds to the pump oil through line (13). The oil goes through passage

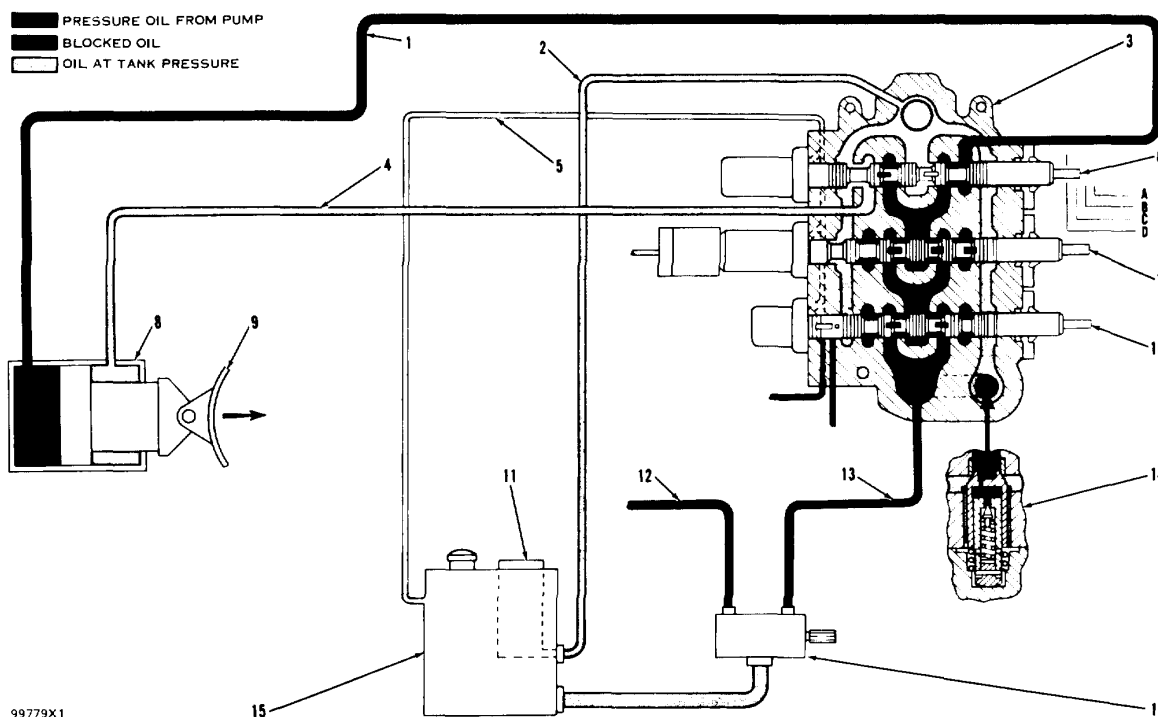
HYDRAULIC SYSTEM

(20) to the head end of the bowl cylinder. With pump oil and rod end oil going to the head ends of the cylinders, the pistons and bowl go down faster.

SYSTEMS OPERATION

When the control lever for the bowl is released, a spring on valve spool (10) moves the valve spool to HOLD position (C) and the bowl movement stops.

EJECTOR CIRCUIT



SCHEMATIC OF EJECTOR CIRCUIT IN FORWARD POSITION

1. Line to head end of ejector cylinder. 2. Line to filter and hydraulic tank. 3. Control valve. 4. Line to rod end of ejector cylinder. 5. Oil line to hydraulic tank. 6. Valve spool for ejector cylinder. 7. Valve spool for apron cylinder. 8. Ejector cylinder. 9. Ejector. 10. Valve spool for bowl cylinders. 11. Filter in hydraulic tank. 12. Line from small section of hydraulic pump to the steering system. 13. Line from the pump to control valve. 14. Relief valve (in control valve). 15. Hydraulic tank. 16. Pump with two sections. A. RETURN, detent position. B. RETURN position. C. HOLD position. D. FORWARD position.

Ejector Forward

When valve spool (6) in control valve (3) is moved to FORWARD position (D), the pump oil goes around the valve spool and through line (1) to the head end of ejector cylinder (8). The pump oil in the head end of the cylinder moves the piston which moves ejector (9) forward. The piston pushes the oil from the rod end through line (4), through control valve (3) and through line (2) into filter (11) and hydraulic tank (15).

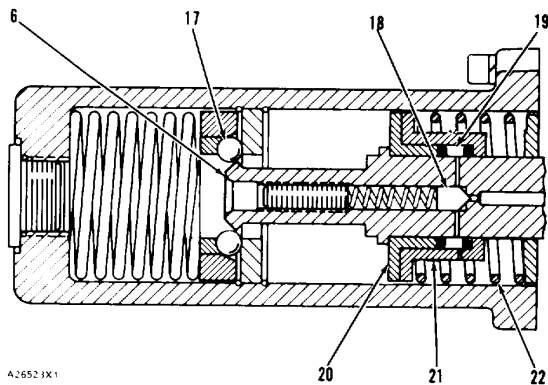
When the control lever for the ejector cylinder is released, a spring on the valve spool moves the valve spool to HOLD position (C).

Ejector Return

When valve spool (6) in control valve (3) is moved to either RETURN position (B), or RETURN, detent position (A), the pump oil goes around the valve spool and through line (4) to the rod end of ejector cylinder (8). (No illustration for this operation.) The pump oil in the rod end of the cylinder moves the piston which pulls the ejector toward its retracted position in the bowl. The piston pushes the oil from the head end of the cylinder through line (1), around valve spool (6) and through line (2) into filter (11) and hydraulic tank (15).

HYDRAULIC SYSTEM

SYSTEMS OPERATION



moving piston in ejector cylinder (8) is stopped in the head of the cylinder. When the piston stops, there is an increase in the pressure of the pump oil in the circuit to the rod end of the cylinder. The pump oil is also in a passage in valve spool (6). When the increase in the pressure of the pump oil gets to approximately 1600 psi (112.5 kg/cm²) (11040 kPa), the oil opens kickout valve (18) and goes into chamber (19). The chamber is between retainers (20) and (21). The pressure of the pump oil moves retainer (20). Retainer (21) is against spring (22) and is not easy to move. Retainer (20) moves valve spool (6) beyond detent balls (17), and then spring (22) moves valve spool (6) to HOLD position (C).

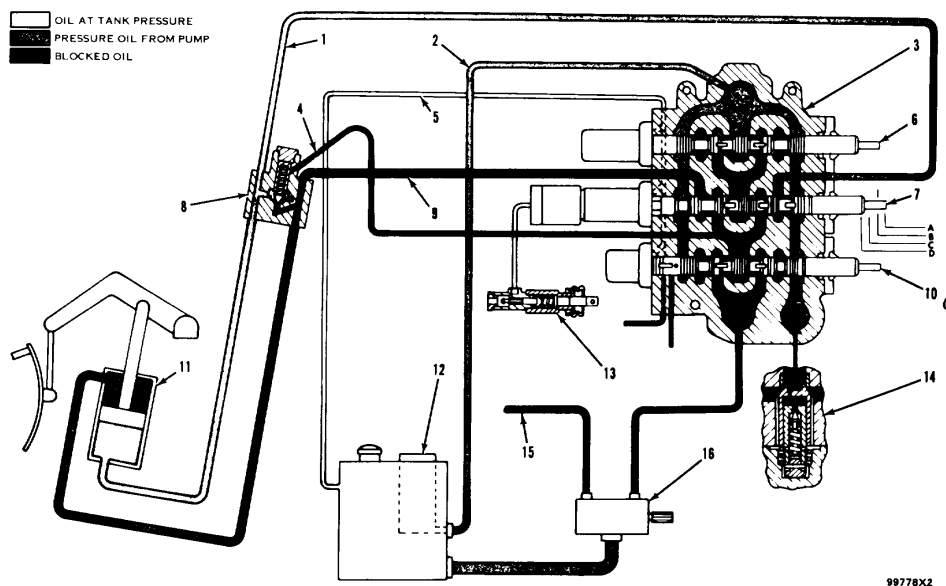
SPRING HOUSING ON CONTROL VALVE

6. Valve spool. 17. Detent balls (four). 18. Kickout valve. 19. Chamber. 20. Retainer. 21. Retainer. 22. Spring.

When valve spool (6) is in RETURN, detent position (A), detent balls (17) keep the valve spool in the RETURN. detent position (A), until the

Loosen the screw, that holds kickout valve (18) and the valve spring, when the pressure of the oil which opens kickout valve (18) is too high. Tighten the screw when the pressure of the oil which opens the kickout valve is too low. Earlier control valves have shims between the spring and kickout valve (18) which are used to adjust the pressure setting of the kickout valve.

APRON CIRCUIT



SCHEMATIC OF APRON CIRCUIT IN APRON LOWER POSITION

1. Line to head end of apron cylinder. 2. Line to filter and hydraulic tank. 3. Control valve. 4. Line to sequence valve for the apron. 5. Line to the hydraulic tank. 6. Valve spool for ejector cylinder. 7. Valve spool for apron cylinder. 8. Sequence valve for apron cylinder. 9. Line to rod end of apron cylinder. 10. Valve spool for bowl cylinder. 11. Apron cylinder. 12. Filter in hydraulic tank. 13. Air valve used to move valve spool to position (B). 14. Relief valve in control valve. 15. Line from small section of hydraulic pump to the steering system. 16. Pump with two sections. 17. Hydraulic tank. A. FLOAT position. B. LOWER position. C. HOLD position. D. RAISE position.

HYDRAULIC SYSTEM

SYSTEMS OPERATION

Apron Lower

When valve spool (7) is moved to LOWER position (B). the pump oil goes around the valve spool and through line (9) and sequence valve (8) to the rod end of the apron cylinder (11). The pump oil in the rod end moves the piston down and the apron goes down. When the piston moves down it pushes the oil in the head end of the cylinder through line (1), through control valve (3), and through line (2) into filter (12) and hydraulic tank (17).

Sequence valve (8) is a pressure relief valve for the rod end of the apron cylinder. The pressure setting for the relief valve is approximately 1000 psi (70.3 kg/cm²) (6900 kPa). When the pump oil goes through line (4) to a piston in the sequence valve, the pump oil around the piston increases the pressure for the relief valve to approximately 2275 psi (193.3 kg/cm²) (15700 kPa).

Valve spool (7) can be moved to LOWER position (B) by air valve (13). Air valve (13) is actuated by linkage when the control lever for the bowl cylinders is moved forward. When air valve (13) is activated, pressure air goes through the air valve and through air line (18) into cylinder (21). The pressure of the air moves piston (19), which moves valve spool (7) against detent balls (20), and valve spool (7) is in LOWER position (B).

Apron Float

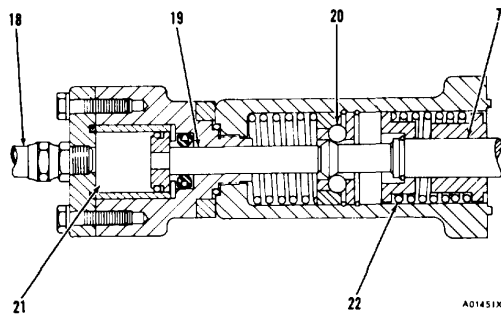
When valve (7) is moved to FLOAT position (A) (no illustration), the detent balls (20) keep the valve spool in FLOAT position (A). The control lever must be moved to move valve spool (7) away from the HOLD position (C). When valve spool (7) is in the FLOAT position (A), the pump oil goes through control valve (3) and line (2) into filter (12) and hydraulic tank (17). The pump oil can also go around the valve spool and through lines (1) and (9), to the head end and rod end of the apron cylinder. The weight of the apron and gravity are the controls for the movement of the apron cylinder when valve spool (7) is in FLOAT position (A).

Apron Raise

When valve spool (7) is moved to RAISE position (D) (no illustration), the pump oil goes around the valve spool and through line (1) to the head end of apron cylinder (11). The pump oil in the head end moves the piston and the apron moves up. When the piston moves up it pushes the oil from the rod end of the cylinder through line (9), through control valve (3) and through line (2) into filter (12) and hydraulic tank (17). Release the control lever for the apron and spring (22) moves valve spool (7) to HOLD position (C).

RELIEF VALVES

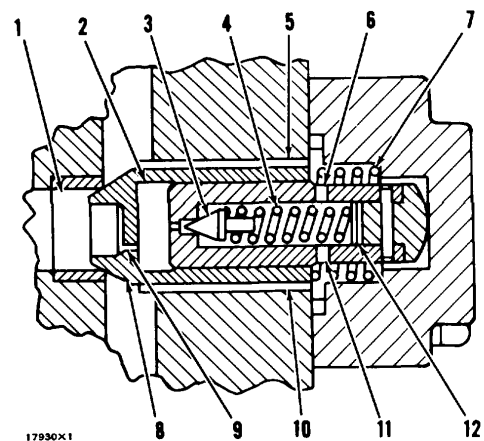
Relief Valve in Control Valve



**SPRING HOUSING ON CONTROL VALVE
(Apron valve spool in LOWER position)**

7. Valve spool. 18. Air line. 19. Piston. 20. Detent balls (four). 21. Air cylinder. 22. Spring.

When the control lever for the apron cylinder is released, and air valve (13) is not activated, spring (22) moves valve spool (7) to HOLD position (C). The valve spool moves piston (19) into air cylinder (21).



SCHEMATIC OF RELIEF VALVE

1. Passage. 2. Passage. 3. Pilot valve. 4. Spring. 5. Slot. 6. Passage. 7. Spring. 8. Relief valve. 9. Orifice. 10. Slot. 11. Passage. 12. Shims.

HYDRAULIC SYSTEM

When either the bowl, the apron or the ejector is operating, the oil from the pump goes through orifice (9) to fill passage (2). The oil pressure in passage (1) and (2) is the same. Spring (4) keeps pilot valve (3) closed. Spring (7) keeps relief valve (8) closed.

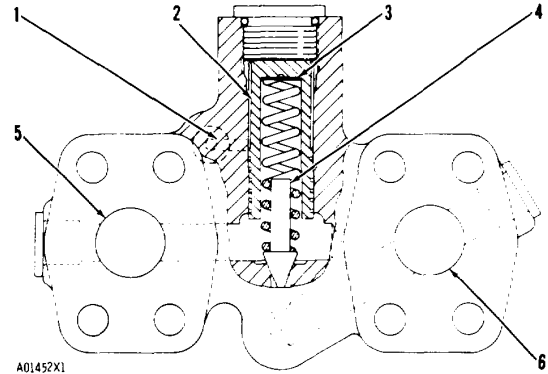
When the pressure in the bowl, apron or ejector circuit goes to 2150 psi (151.1 kg/cm²) (14835 kPa) or on earlier valves 2000 psi (140.6 kg/cm²) (13800 kPa). pilot valve (3) opens. The oil in passage (2) goes out passages (6) and (11), and through slots (5) and (10) to the oil at tank pressure in the control valve. The oil pressure in passage (1) is now higher than the oil pressure in passage (2). The oil pressure will open valve (8) against the force of spring (7), letting full pump flow go through the relief valve to the tank.

Sequence Valve

The sequence valve is a bypass valve and a relief valve with two opening pressures. The pressure setting of the valve is approximately 1000 psi (70.3 kg/cm²) (6900 kPa). When the pump oil is used to lift or lower the apron, the opening pressure of the valve automatically goes to approximately 2275 psi (193.3 kg/cm²) (15700 kPa). The relief valve (4) is in passage (6) for the rod end circuit of the apron cylinder. When the bowl is lifting and the apron is down, the sequence valve lets the apron be lifted by the bowl. When the pressure increase of the oil in passage (6) for the rod end circuit of the apron cylinder gets to 1000 psi (70.3 kg/cm²) (6900 kPa). relief valve (4) opens.

SYSTEMS OPERATION

Now the oil in rod end passage (6) goes through open relief valve (4) into passage (5) for the head end circuit as the apron is being lifted by the bowl.



SEQUENCE VALVE

- 1. Passage for pump oil. 2. Piston. 3. Shims. 4. Relief valve. 5. Passage in the circuit for the head end of the apron cylinder. 6. Passage in the circuit for the rod end of the apron cylinder.

When pump oil goes through passage (1) into the sequence valve, the oil moves piston (2) which puts more force on the spring for relief valve (4). Now the opening pressure of relief valve (4) goes to approximately 2275 psi (193.3 kg/cm²) (15700 kPa).

Add to shims (3), in piston (2), for an increase or remove shims for a decrease in the pressure setting of the sequence valve.

HYDRAULIC SYSTEM

TESTING AND ADJUSTING

SCRAPER HYDRAULIC SYSTEM

The 5S5123 Hydraulic Test Group is used to make pressure tests of the hydraulic system. Before making any tests, visually inspect the complete hydraulic system by looking for leakage of oil and for parts that have damage. For some of the tests a magnet and a measuring rule (either for inches or millimeters) are usable tools.



WARNING: When testing and adjusting the hydraulic system, move the machine to a smooth horizontal location. Move away from working machines and personnel. There must be only one operator. Keep all other personnel either away from the machine or where the operator can see them.

VISUAL CHECKS

A visual inspection of the hydraulic system and its components is the first step when making a diagnosis of a problem. Stop the engine and lower the scraper bowl to the ground. When the oil is cool, pressure in the tank will be at a minimum, make the following inspections:

1. Measure the oil level. Slowly turn the filler cap until it is loose. If oil comes out the bleed hole when the filler cap is turned, let the tank pressure lower before removing the filler cap. Look for air in the oil in the tank.
2. Remove the filter elements and look for particles removed from the oil by the filter element. A magnet will separate ferrous particles from non-ferrous particles (piston rings, O-ring seals, etc.).
3. Check all oil lines and connections for damage or leaks.

OPERATION CHECKS

Checks of scraper operation can be used for a diagnosis of bad performance and to find the source of oil leakage in the hydraulic system. The oil in the hydraulic system must be at operating temperature.

Drift of Bowl Cylinders

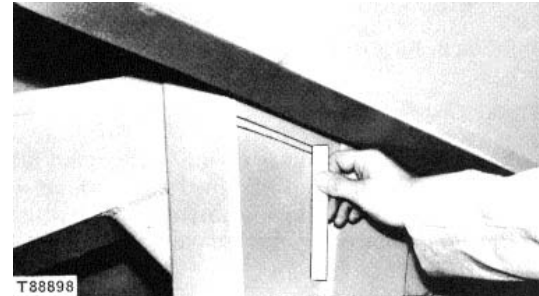
Check the drift of the bowl cylinders by lifting the bowl 6 to 10 in. (15 to 25 cm). Then move the control lever to the HOLD position.

After three minutes, put a mark on the side of the bowl at the bottom of the draft arm. After five

minutes, put a mark on the side of the bowl, measure the drift. Make this measurement 6 in. (152.4 mm) from the front of the bowl side. Drift for a new machine is not more than .31 in. (7.6 mm).

If the drift is too much:

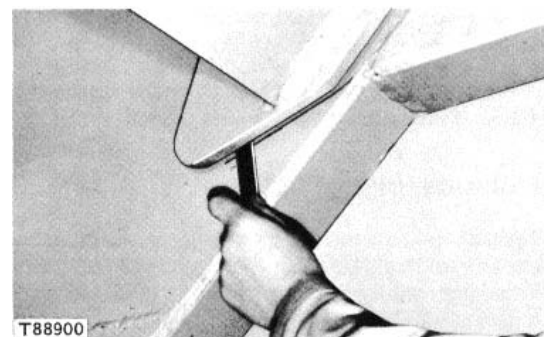
1. Check the carry check valves.
2. Check the piston seals in the bowl cylinders.



**MEASURING DRIFT OF BOWL CYLINDERS
(Typical Example)**

Drift of Apron Cylinder

Check the drift of the apron cylinder by first lifting the bowl 6 to 10 in. (15 to 25 cm). Then move the control lever to the HOLD position. Lift the apron approximately 15 in. (38 cm) above the edge of the bowl and move the control lever to the HOLD position. Put a mark on the bowl at the side of the apron. After four minutes, measure the drift. Drift for a new machine is not more than 1 in. (25.4 mm).



**MEASURING DRIFT OF APRON CYLINDER
(Typical Example)**

If the drift is too much:

1. Check apron sequence valve.
2. Check the piston seals in the apron cylinders.

HYDRAULIC SYSTEM

TESTING AND ADJUSTING

SPEED TESTS

Make all tests with oil at normal operating temperature and the tractor engine speed at high idle rpm. Use a stop watch to find the times.

If the travel time is not correct:

1. Check pump efficiency.
2. Check the setting of the relief valve in the control valve.
3. Check the operation of the valve spools in the control valve.
4. Check the piston seals in the cylinders.

Travel Time for Bowl Lift

Lower the scraper bowl to the ground and lift the apron. The time to lift bowl from ground to maximum height with bowl empty and apron lifted on a new machine is 3.0 ± .5 seconds.

Travel Time for Apron Lift

Lower the scraper bowl to the ground and lower the apron. The time to lift apron from lowered to maximum height on a new machine is 3.0 ± .5 seconds.

Travel Time for Ejector

Operate the ejector through several full EJECT and RETURN cycles then move the ejector to the rear of the scraper bowl.

The time to move ejector from rear to forward position on a new machine is 7.0 ± .5 seconds.

The time to move ejector from forward to rear position on a new machine is 5.0 ± .5 seconds.

The time required to return ejector in the RETURN detent position is 8 to 18 seconds.

CHECKING PUMP EFFICIENCY

For any pump test, the pump flow, measured in gpm (lit/min) at 100 psi (7.0 kg/cm²) (690 kPa) will be larger than the pump flow at 1000 psi (70.3 kg/cm²) (6900 kPa) at the same rpm.

The difference between the pump flow of two operating pressures is the flow loss.

Method of finding flow loss.....

Pump flow at 100 psi	57.5 gpm (lit/min)*
Pump flow at 1000 psi	<u>-52.0 gpm (lit/min)*</u>
Flow loss.....	5.5 gpm (lit/min)*

Flow loss when expressed as a percent of flow loss is used as a measure of pump performance.

Example of finding percent of flow loss.....

$$\frac{\text{gpm flow loss}}{\text{Pump flow @ 100 psi}} \times 100 = \text{Percent of flow loss}$$

$$\text{or } \frac{*5.5}{(*57.5)} \times 100 = 9.5\%$$

If the percent of flow loss is more than 10%, pump performance is not good enough.

*Numbers in examples are for illustration and are not values for any specific pump or pump condition. See SCRAPER HYDRAULIC SYSTEM SPECIFICATIONS, for pump flow of a new pump at 100 psi and 1000 psi.

Test On The Machine

Install a 9S2000 Flow Meter. Run the engine at 1900 rpm. Measure the pump flow at 100 psi (7.0 kg/cm²) (690 kPa) and at 1000 psi (70.3 kg/cm²) (6900 kPa). Use these values in Formula I.

Formula I:

$$\frac{\text{gpm @ 100 psi} - \text{gpm @ 1000 psi}}{\text{gpm @ 100 psi}} \times 100 = \text{Percent of flow loss}$$

Test On The Bench

If the test bench can be run at 1000 psi and at full pump rpm, find the percent of flow loss using Formula I.

If the test bench can not be run at 1000 psi at full pump rpm, run the pump shaft at 850 rpm. Measure the pump flow at 100 psi (7.0 kg/cm²) (690 kPa) and at 1000 psi (70.3 kg/cm²) (6900 kPa). Use these values in the top part of Formula II. For the bottom part of the formula, run the pump shaft at 1900 rpm. Measure the pump flow at 100 psi.

Formula II:

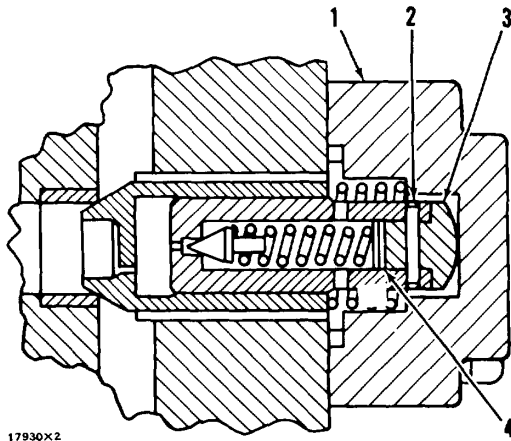
$$\frac{\text{gpm @ 100 psi} - \text{gpm @ 1000 psi}}{\text{gpm @ 100 psi}} \times 100 = \text{Percent of flow loss}$$

RELIEF VALVE

The relief valve is in the control valve for the scraper and is near the oil line connection from the pump.

HYDRAULIC SYSTEM

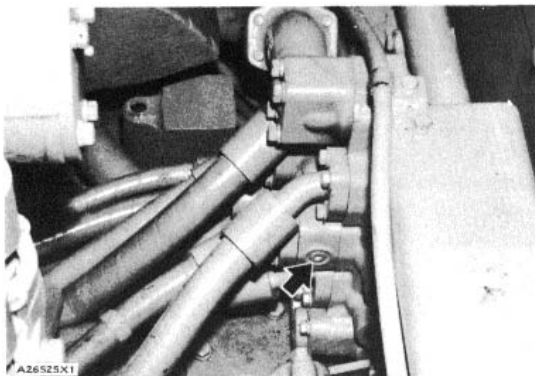
To check the pressure setting of the relief valve use the 7S8714 Pressure Gauge (0 to 4000 psi), the 5S4648 Hose Assembly and the 5P3501 Adapter.



17930x2

RELIEF VALVE (IN CONTROL VALVE)
 1. Cover. 2. Pin. 3. Cap. 4. Shims.

Remove the plug from the side of the sequence valve on the control valve for the scraper. Install the adapter where the plug was removed from the sequence valve. Install the hose assembly and pressure gauge in the adapter.



A26525x1

PLUG IN SEQUENCE VALVE

Start and run the engine at high idle. Look at the pressure gauge and move the control lever for the apron to the RAISE position and keep it in that position. The high reading on the pressure gauge is the pressure setting of the relief valve. The correct pressure setting of the relief valve is 2000 ± 50 psi (140.6 ± 3.5 kg/cm²) (13800 ± 345 kPa).

If it is necessary to change the setting of the relief valve, remove the cover (1) for the relief

TESTING AND ADJUSTING

valve Remove the pin (2) and cap (3). Add shims (4) to make the setting of the relief valve higher. Remove shims to make setting lower.

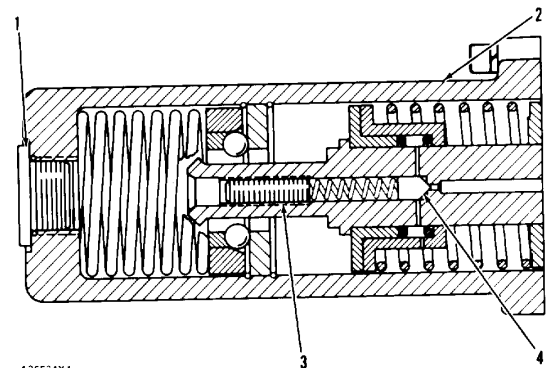
PRESSURE CHANGE TO RELIEF VALVE BY REMOVAL OR ADDITION OF ONE SHIM		
Shim No. 3J7473	Shim Thickness 005 In (0.13 mm)	Change In Pressure 90 psi (6.3 kg/cm ²) (620 kPa)
3H2549	010 In. (0.25 mm)	175 psi (12.3 kg/cm ²) (1200 kPa)

EJECTOR KICKOUT VALVE

The ejector kickout valve is in the end of the valve spool for the ejector (in the control valve for the scraper).

To check the pressure setting of the kickout valve, use the test equipment installed in the hose connection for the rod end of the ejector cylinder that was used in the test for the relief valve.

With the engine running at high idle rpm and the ejector in the FORWARD position, move the control lever for the ejector to the RETURN detent position. Look at the pressure gauge when the ejector is going to the RETURN position. When the pressure is 1600 ± 200 psi (112.5 ± 14.1 kg/cm²) (11040 ± 1380 kPa), the ejector kickout valve opens and moves the control lever for the ejector, to the HOLD position.



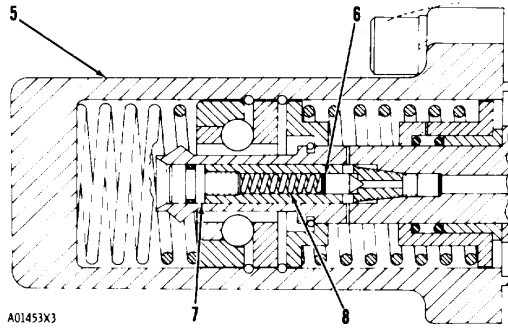
A26524x1

EJECTOR KICKOUT VALVE
 1. Plug. 2. Spring housing. 3. Screw. 4. Valve.

If it is necessary to change the pressure setting of the ejector kickout valve, remove plug (1) from the control valve spring housing (4) for the ejector. Use a .12 inch hex wrench to turn screw (3) either clockwise, to increase, or counterclockwise, to decrease, the pressure setting. One turn of the screw changes the pressure setting 170 psi (11.9 kg/cm²) (173 kPa).

HYDRAULIC SYSTEM

TESTING AND ADJUSTING



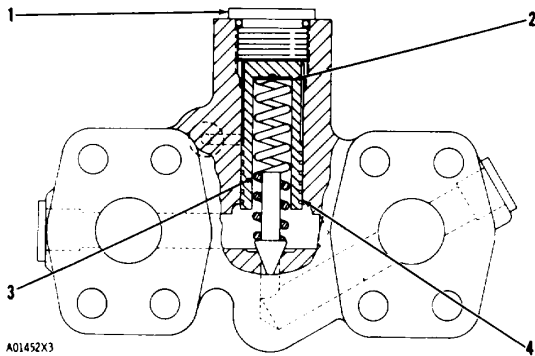
LOCATION OF SHIMS FOR EJECTOR KICKOUT VALVE (Earlier Control Valve)

5. Spring housing. 6. Shims. 7. Screw. 8. Spring.

On earlier control valves remove spring housing (5), screw (7), spring (8) and shims (6). Add to shims (6) to make the pressure setting of the kickout valve higher. Remove shims to make the pressure setting lower. The torque for screw (7) is 108 ± 36 lb. in. (184.5 ± 41.5 cm.kg) (12.20 + 4.07 N-m).

PRESSURE CHANGE TO POPPET VALVE BY REMOVAL OR ADDITION OF ONE SHIM		
Shim No.	Shim Thickness	Change in Pressure
8J2084	.010 in. (0.25 mm)	60 psi (4.2 kg/cm ²) (415 kPa)

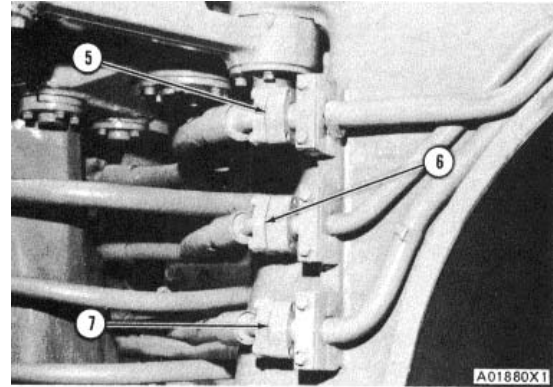
SEQUENCE VALVE



SEQUENCE VALVE CROSS SECTION
1. Plug. 2. Shims. 3. Spring. 4. Piston.

The location of the sequence valve is on the control valve, under the line connections to the apron

cylinder. To check the pressure setting of the sequence valve use the 7S8712 Pressure Gauge (0 to 2000 psi), the 5S4648 Hose Assembly, and the correct size plate assembly with the necessary fittings. Install the plate assembly on the left side of the draft frame in hose connection (6) for the rod end of the apron cylinder.



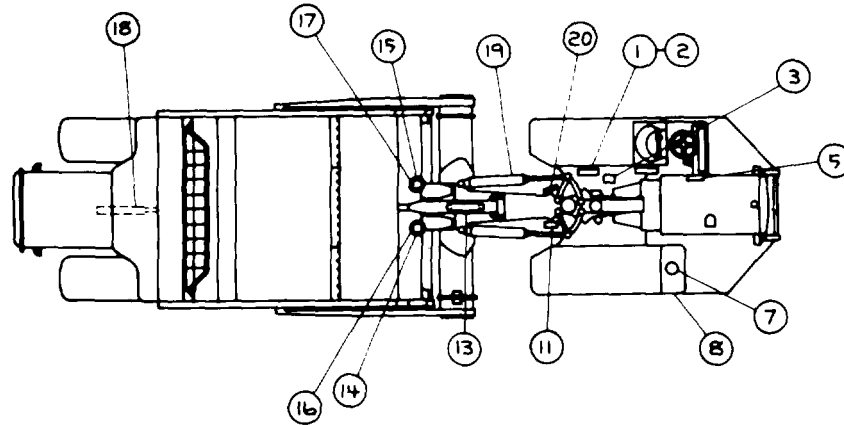
SCRAPER CYLINDER HOSE CONNECTIONS

5. Hose connection for rod end of ejector cylinder (RETURN). 6. Hose connection for rod end of apron cylinder (LOWER). 7. Hose connection for head ends of bowl cylinders (LOWER).

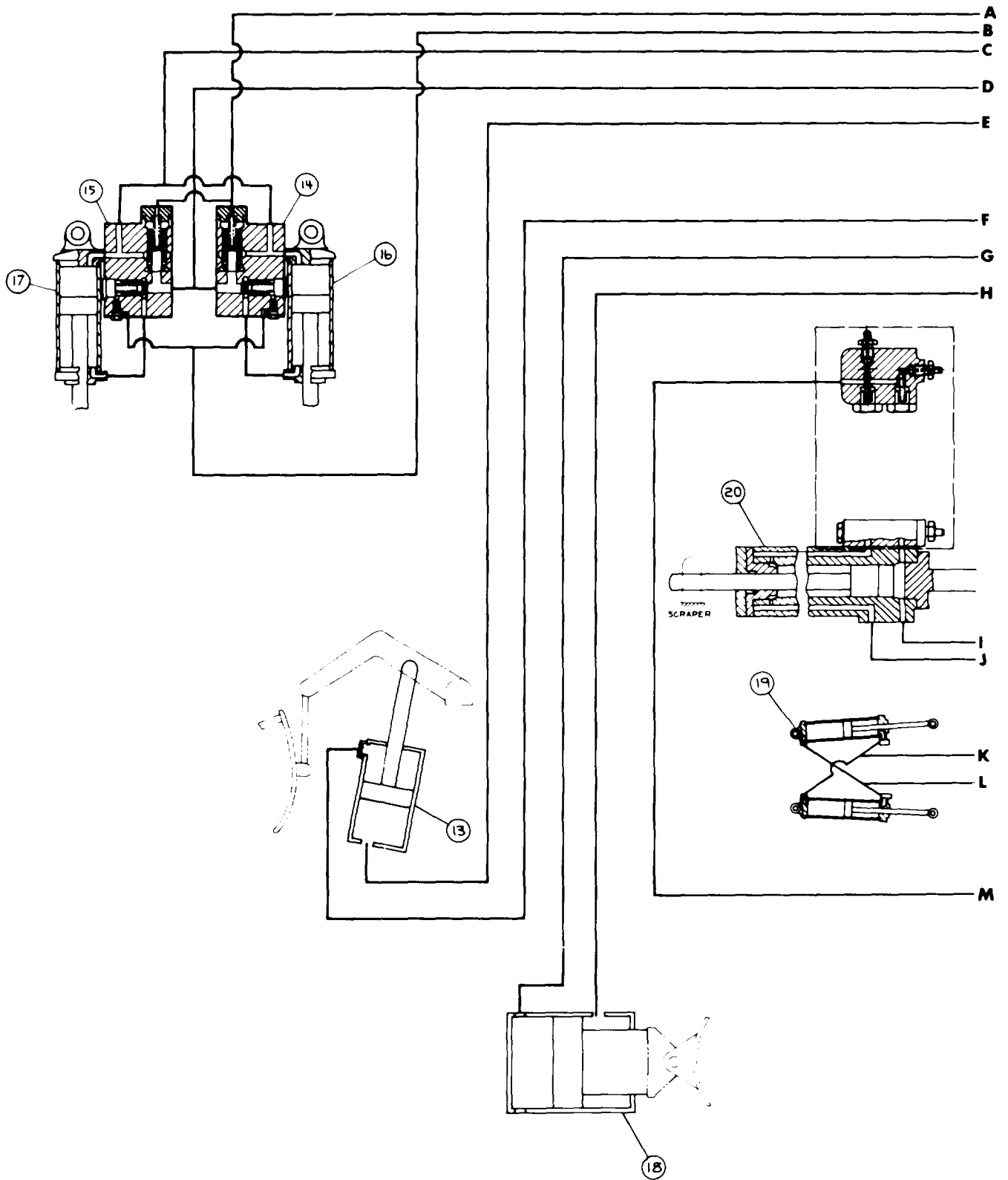
With the engine running, put the bowl on the ground and lower the apron against the bowl. With the apron control lever in HOLD position, look at the pressure gauge and move the bowl control lever to the RAISE position. When the pressure is 1000 + 50 psi (70.3 + 3.5 kg/cm²) (6900 + 345 kPa), the sequence valve must open. The oil in rod end circuit will bypass through the sequence valve into the head end circuit.

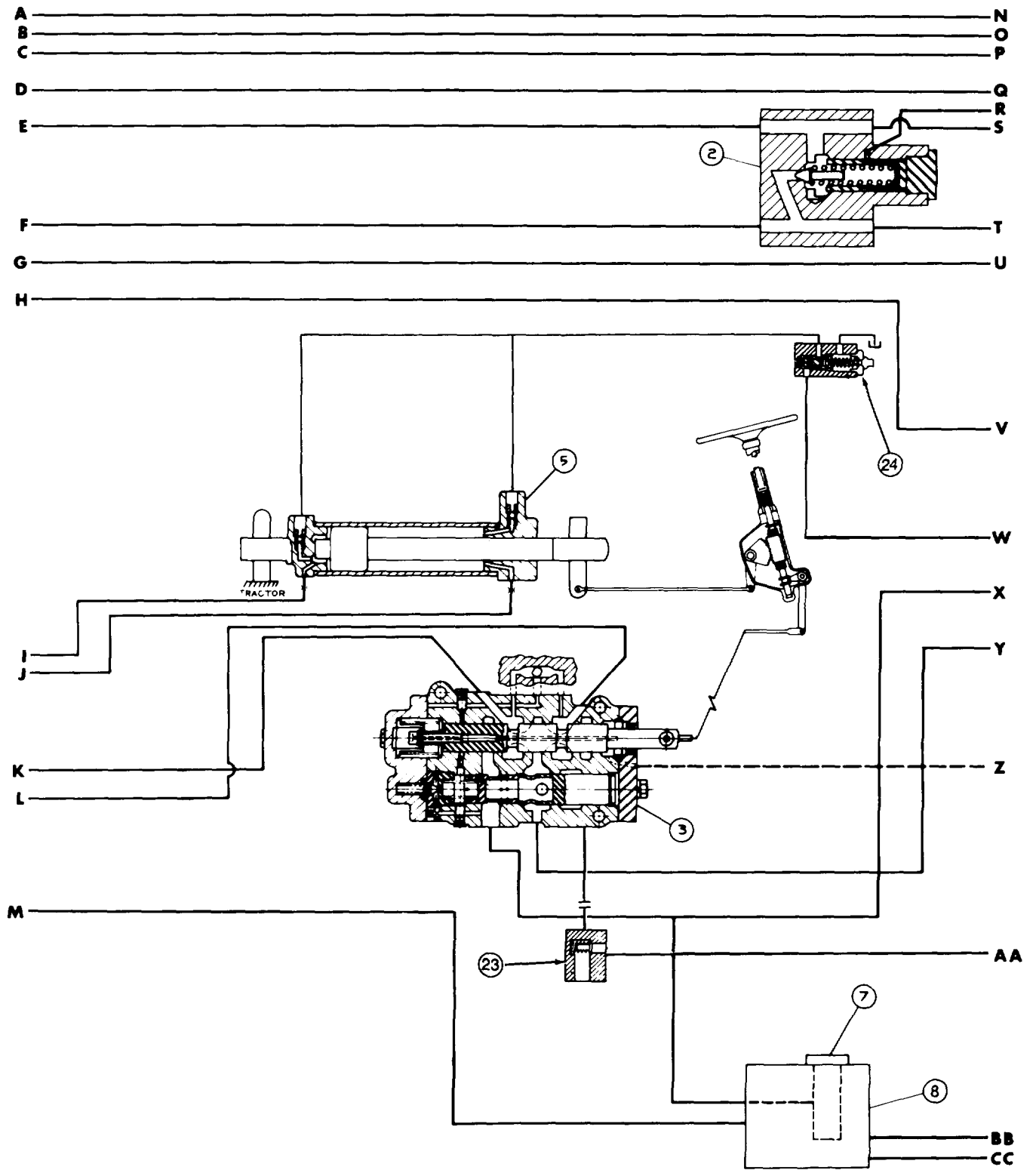
If it is necessary to change the pressure setting of the sequence valve, remove plug (1), piston (4) and spring (3). Add shims (2) between the spring and piston to make the setting higher. Remove shims to make the setting lower.

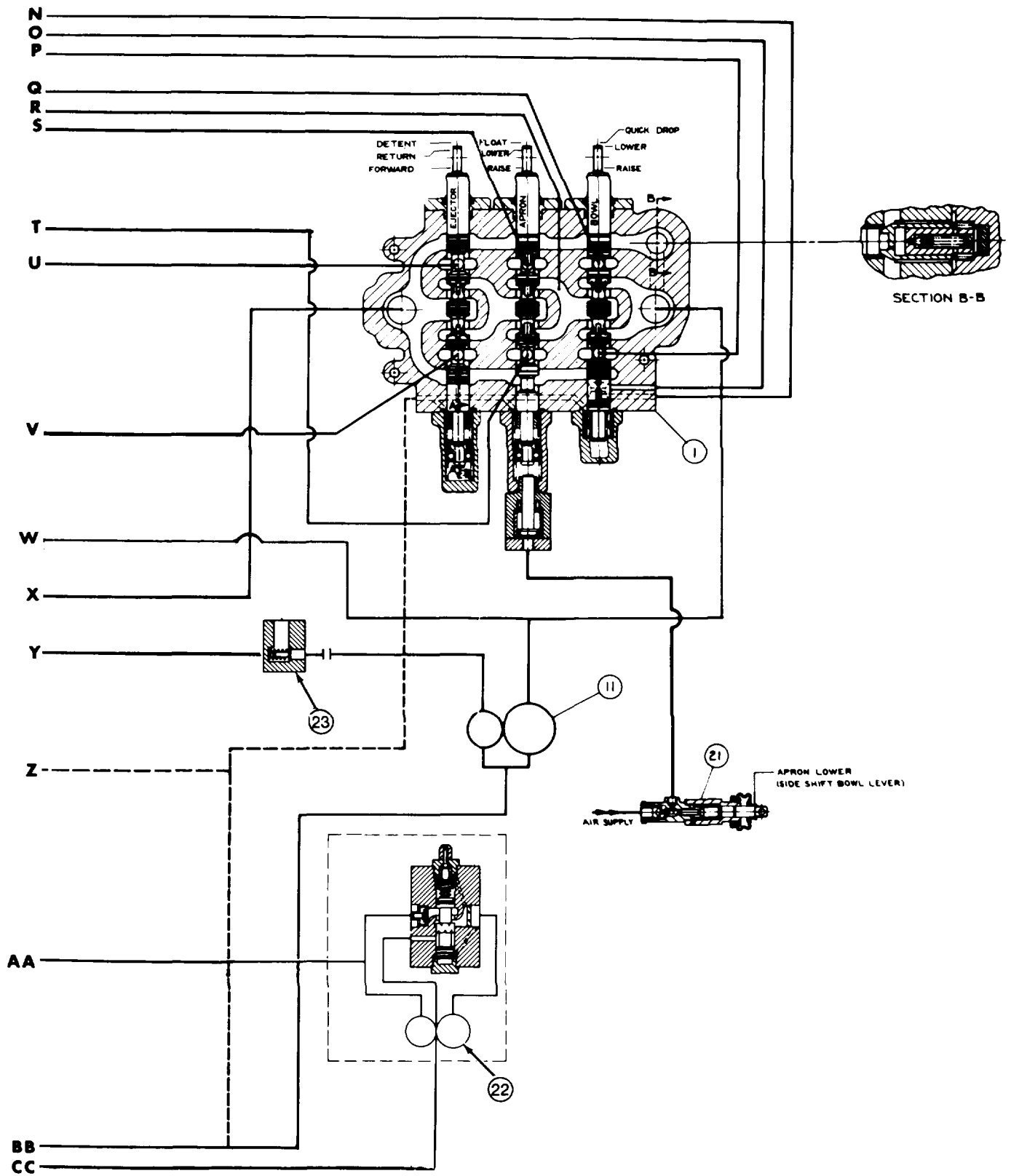
PRESSURE CHANGE TO SEQUENCE VALVE BY REMOVAL OR ADDITION OF ONE SHIM		
Shim No.	Shim Thickness	Change in Pressure
8J4436	.005 in. (0.13 mm)	20 psi (1.4 kg/cm ²) (138 kPa)
9J1330	.031 in. (0.79 mm)	120 psi (8.4 kg/cm ²) (828 kPa)



1	CONTROL VALVE FOR SCRAPER
2	SEQUENCE VALVE (APRON)
3	VALVE FOR STEERING
5	RECEIVER CYLINDER (STEERING)
7	FILTER
8	TANK
11	PUMP
13	CYLINDER (APRON)
14	CHECK VALVE (R.H.)
15	CHECK VALVE (L.H.)
16	CYLINDER (BOWL)
17	CYLINDER (BOWL)
18	CYLINDER (EJECTOR)
19	CYLINDER (STEERING)
20	SENDER CYLINDER (STEERING)
21	AIR VALVE
22	SUPPLEMENTAL STEERING
23	CHECK VALVES
24	PRESSURE REDUCING VALVE



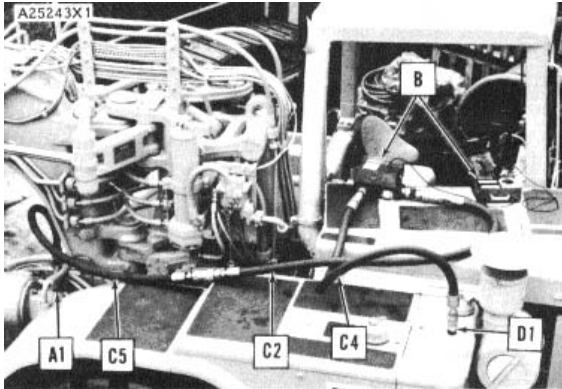




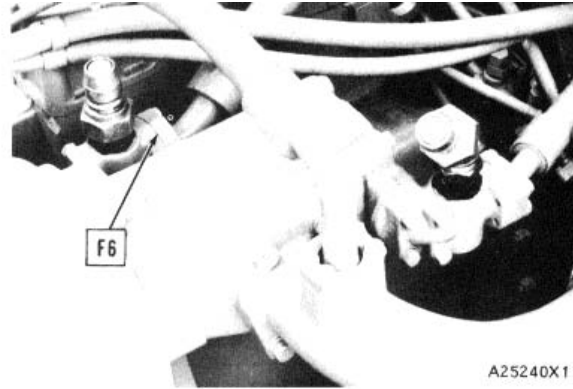
**SECTION VII
FLOW METER TEE TEST PROCEDURE VIII**

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Schematic of Bowl Circuit.....	3-90
Schematic of Ejector Circuit	3-90
Schematic of Scraper Hydraulic System	3-89
Tee Test Tool Installation	3-88
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FLOW METER TEE TEST PROCEDURE - VIII



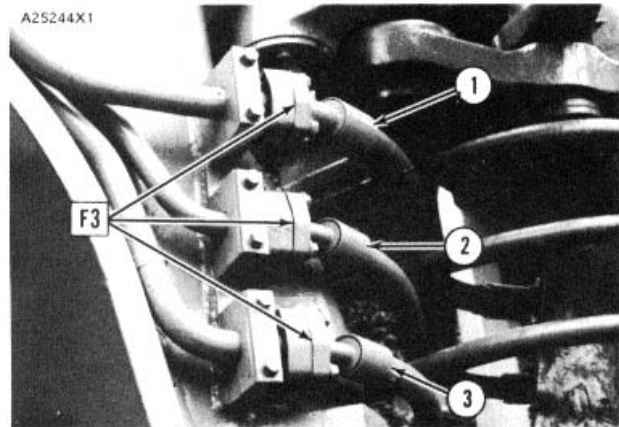
FLOW METER INSTALLED
(See Tee Test Tooling Chart for parts reference)



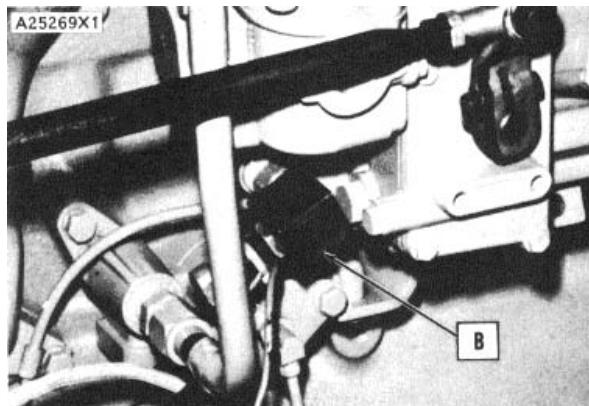
BLOCKING LOCATION FOR PUMP TEST
(See Tee test Tooling Chart for parts reference)



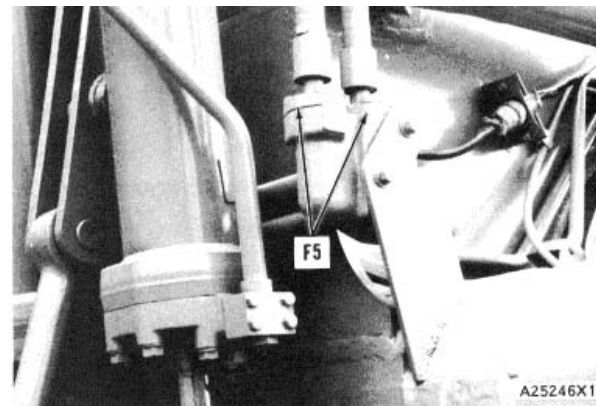
621B: TACHOMETER DRIVE INSTALLED
(See Tee Test Tooling Chart for parts reference)



BLOCKING LOCATIONS FOR THE CIRCUITS
(See Tee Test Tooling Chart for parts reference)
1. Ejector Cylinder. 2. Apron Cylinder. 3. Bowl Cylinders.

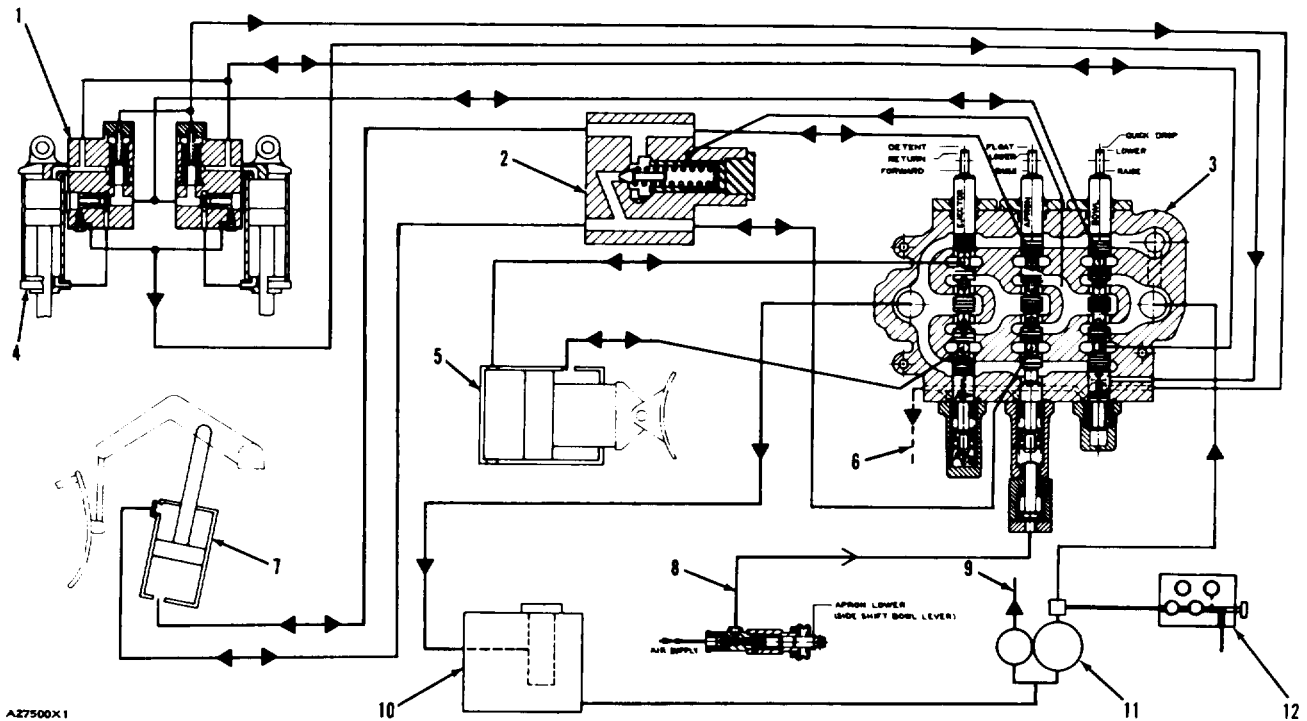


627B: TACHOMETER DRIVE INSTALLED
(See Tee Test Tooling Chart for parts reference)



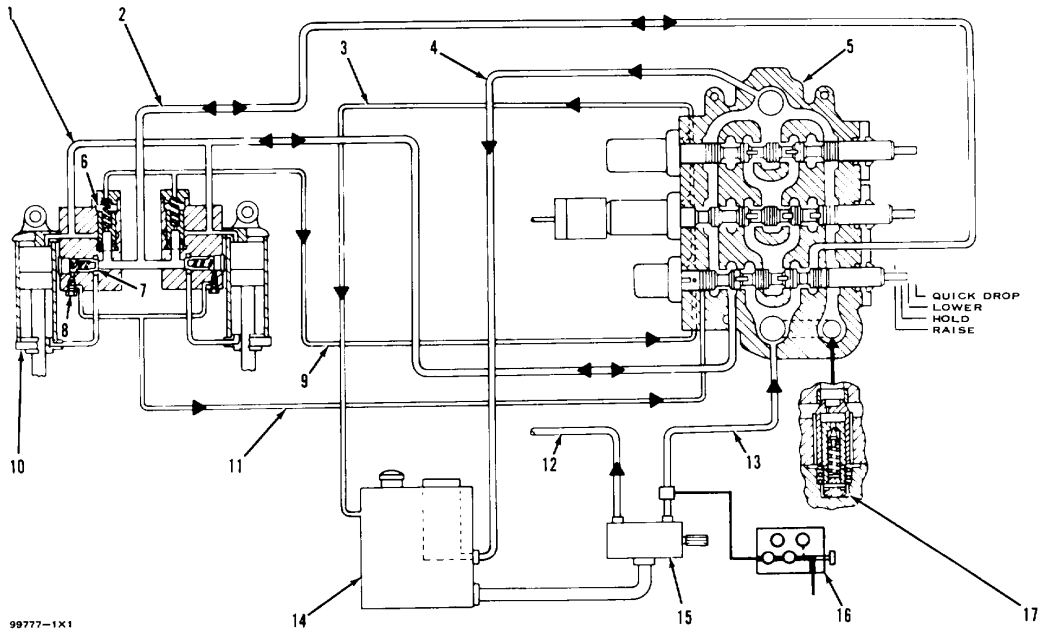
BLOCKING LOCATION FOR RIGHT BOWL CIRCUIT
(See Tee Test Tooling Chart for parts reference)

TOOLS NEEDED		
Assembly No.	Description	Quantity
A1	Pump Supply Line Adapter	1
B	Flow Meter Assembly	1
C2	Connecting Hose Assembly	1
C4	Connecting Hose Assembly	1
C5	Connecting Hose Assembly	1
D1	Return Line Assembly	1
F3	Blocking Plate Assembly (3/4")	2
F5	Blocking Plate Assembly (1 1/4")	2
F6	Blocking Plate Assembly (1 1/2")	1



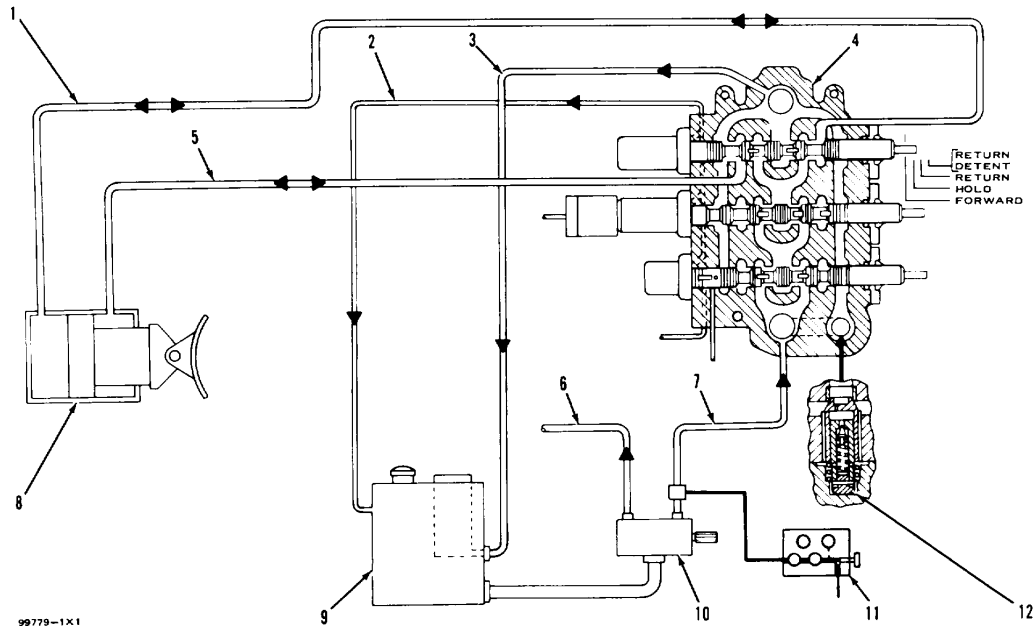
SCHEMATIC OF SCARAPER HYDRAULIC SYSTEM

1. Quick-dump, check and vent valves (one each per bowl cylinder). 2. Apron circuit sequence valve. 3. Control valve. 4. Bowl cylinders (two). 5. Ejector cylinder. 6. Return oil to tank. 7. Apron cylinder. 8. Air line to apron control valve (apron lower). 9. Pump oil to steering circuit. 10. Hydraulic oil tank. 11. Oil pump. 12. Tee test Flow Meter.



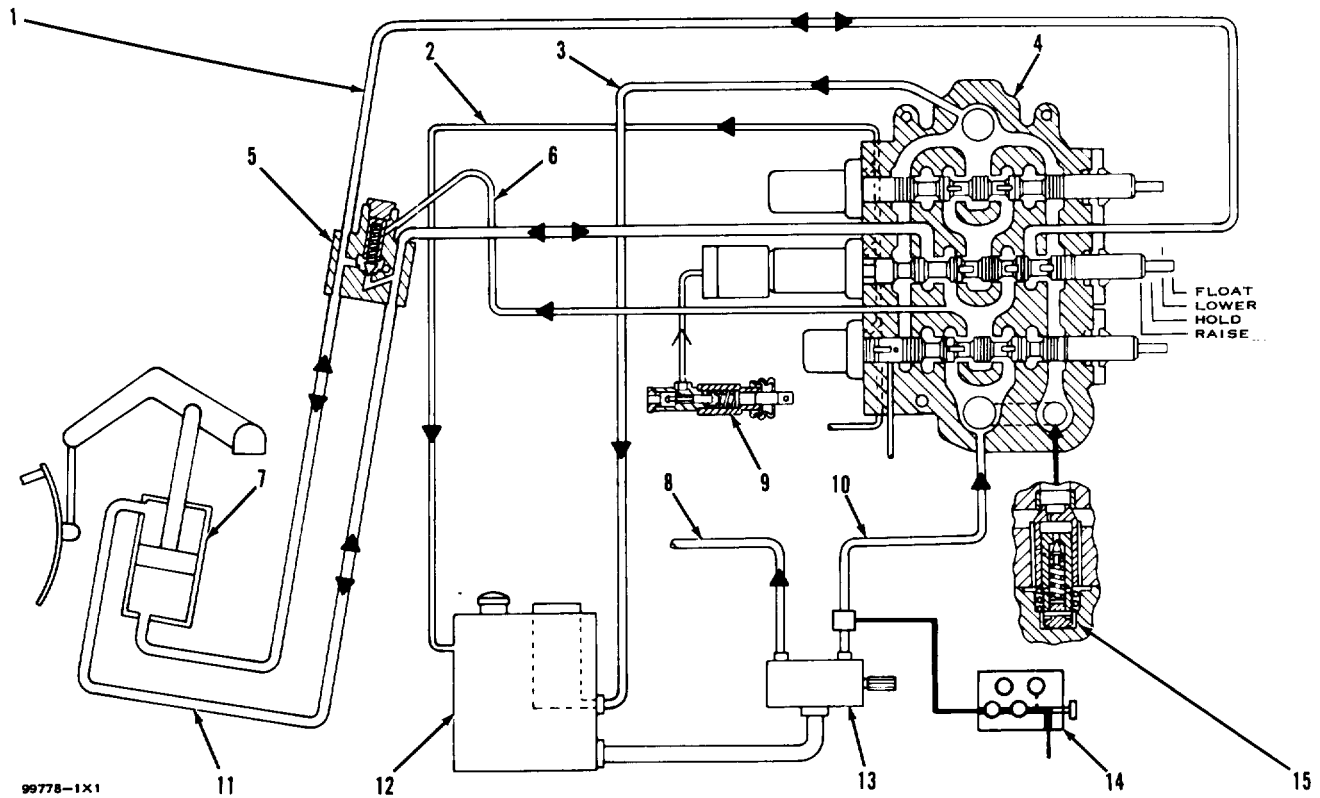
SCHEMATIC OF BOWL CIRCUIT

1. To head ends of bowl cylinders (bowl lower). 2. To rod ends of bowl cylinders (bowl raise). 3 and 4. Return oil to tank. 5. Control valve. 6. Quick-dump valve (two). 7. Check valve (two). 8. Vent valve (two). 9. Vent line for quick-drop valves. 10. Bowl cylinders (two). 11. Vent line for vent valves. 12. Pump oil to steering circuit. 13. Pump supply oil. 14. Hydraulic oil tank. 15. Oil pump. 16. Tee test Flow Meter. 17. System relief valve.



SCHEMATIC OF EJECTOR CIRCUIT

1. To head end of ejector cylinder (ejector forward). 2 and 3. Return oil to tank. 4. Control valve. 5. To rod end of ejector cylinder (ejector return). 6. Pump oil to steering circuit. 7. Pump supply oil. 8. Ejector cylinder. 9. Hydraulic oil tank. 10. Oil pump. 11. Tee test Flow Meter. 12. System relief valve.



SCHEMATIC OF APRON CIRCUIT

1. To head end of apron cylinder (apron raise).
- 2 and 3. Return oil to tank.
4. Control valve.
5. Sequence valve.
6. Pressure oil to sequence valve.
7. Apron cylinder.
8. Pump oil to steering circuit.
9. Air valve for apron lower (with side movement of bowl control lever).
10. Pump supply oil.
11. To rod end of apron cylinder (apron lower).
12. Hydraulic oil tank.
13. Oil pump.
14. Tee test Flow Meter.
15. System relief valve.

FLOW METER TEE TEST PROCEDURE - VIII

SCRAPER SYSTEM TEST
DATE _____

TEE - TEST
PROCEDURE DATA SHEET
CHART A

MACHINE SERIAL NUMBER _____
SERVICE METER READING _____

Test Name	Maximum Pressure Relief Valve Setting	System Oil Temperature (Start)	System Base Flow Rate	Ejector FORWARD Flow Rate	Ejector RETURN Flow Rate	Bowl RAISE Flow Rate	Bowl LOWER Flow Rate	Apron UP Flow Rate	Apron DOWN Flow Rate	System Oil Temperature (End)	Bowl Circuit Drift Comparison	Apron Circuit Drift Comparison
Test Number	1	2	3	4	5	6	7	8	9	10	11	12
Control Lever Position	Ejector FORWARD	Ejector FORWARD	Ejector FORWARD	Ejector FORWARD	Ejector RETURN	Bowl RAISE	Bowl LOWER	Apron UP	Apron DOWN	Ejector FORWARD	Bowl 1. HOLD 2. RAISE	Apron 1. HOLD 2. RAISE
Engine Speed	<u>1900</u> RPM	Any Speed	<u>1900</u> RPM	<u>1900</u> RPM	<u>1900</u> RPM	<u>1900</u> RPM	<u>1900</u> RPM	<u>1900</u> RPM	<u>1900</u> RPM	Any Speed	Low Idle or Stopped	Low Idle or Stopped
System Test Pressure	Maximum	0-100 PSI	100 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	0-100 PSI	0 PSI	0 PSI
Test Data	<u>2150</u> ± 50 PSI	<u>150</u> ± 5 °F	<u>79.0</u> GPM	<u>67.0</u> GPM	<u>67.0</u> GPM	<u>67.0</u> GPM	<u>63.0</u> GPM	<u>67.0</u> GPM	<u>67.0</u> GPM	<u>150</u> ± 5 °F	HOLD M DRIFT S	HOLD M DRIFT S
											Than RAISE Drift Rate	Than RAISE Drift Rate
Flow Differential	/	/	/	(3-4) <u>12.0</u> GPM	(3-5) <u>12.0</u> GPM	(3-6) <u>12.0</u> GPM	(3-7) <u>16.0</u> GPM	(3-8) <u>12.0</u> GPM	(3-9) <u>12.0</u> GPM	/	/	/
Percent Flow Loss *	/	/	/	$\left(\frac{3-4}{3}\right) \times 100$ <u>15</u> %	$\left(\frac{3-5}{3}\right) \times 100$ <u>15</u> %	$\left(\frac{3-6}{3}\right) \times 100$ <u>15</u> %	$\left(\frac{3-7}{3}\right) \times 100$ <u>20</u> %	$\left(\frac{3-8}{3}\right) \times 100$ <u>15</u> %	$\left(\frac{3-9}{3}\right) \times 100$ <u>15</u> %	/	/	/

* Components that are worn, or not working correctly, are found by their flow difference (loss) and percent of flow loss or lower system efficiency. System values for new and rebuilt machines must not be greater than the percent of flow loss in the system tests shown on CHART A for the specific machine. The permissible flow difference (loss) is a function of machine application. For applications with long travel distance the permissible flow difference may be more than for applications with short travel distance.

80865x4

FLOW METER TEE TEST PROCEDURE - VIII

FLOW METER TEE TEST PROCEDURE - VIII

SCRAPER PUMP TEST
DATE _____

TEE - TEST
PROCEDURE DATA SHEET
CHART B

MACHINE SERIAL NUMBER _____
SERVICE METER READING _____

	Full Speed Pump Flow		Half Speed Pump Flow		Pump Test for Aeration And/Or Cavitation						
	Low Pressure	High Pressure	Low Pressure	High Pressure	Varied Speeds - Constant Pressure						
Test Number	13	14	15	16	17	18	19	20	21	22	23
Engine Speed	<u>1900</u> RPM	<u>1900</u> RPM	<u>950</u> RPM	<u>950</u> RPM	<u>700</u> RPM	<u>900</u> RPM	<u>1100</u> RPM	<u>1300</u> RPM	<u>1500</u> RPM	<u>1700</u> RPM	<u>1900</u> RPM
Pump Test Pressure	100 PSI	1000 PSI	100 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI
Oil Temperature	<u>150</u> ± 5 ° F	<u>150</u> ± 5 ° F	<u>150</u> ± 5 ° F	<u>150</u> ± 5 ° F	<u>150</u> ± 5 ° F	<u>150</u> ± 5 ° F	<u>150</u> ± 5 ° F	<u>150</u> ± 5 ° F	<u>150</u> ± 5 ° F	<u>150</u> ± 5 ° F	<u>150</u> ± 5 ° F
Test Data	<u>79.0</u> GPM	<u>71.0</u> GPM	<u>40.0</u> GPM	<u>32.0</u> GPM	<u>22.0</u> GPM	<u>30.0</u> GPM	<u>39.0</u> GPM	<u>47.0</u> GPM	<u>55.0</u> GPM	<u>63.0</u> GPM	<u>71.0</u> GPM
Flow Differential	/	(13-14) <u>8.0</u> GPM	/	(15-16) <u>8.0</u> GPM	(18-17) <u>8.0</u> GPM	(19-18) <u>9.0</u> GPM	(20-19) <u>8.0</u> GPM	(21-20) <u>8.0</u> GPM	(22-21) <u>8.0</u> GPM	(23-22) <u>8.0</u> GPM	(24-23) — GPM
Percent Flow Loss	/	$\frac{(13-14) \times 100}{13}$ <u>10</u> %	/	/	/	/	/	/	/	/	/

FLOW METER TEE TEST PROCEDURE - VIII

SCRAPER BLOCKED DICRCUITTEST
DATE _____

TEE - TEST
PROCEDURE DATA SHEET
CHART C

MACHINE SERIAL NUMBER _____
SERVICE METER READING _____

Test Name	System Oil Temperature (Start)	Ejector FORWARD Flow Rate	Ejector RETURN Flow Rate	Bowl RAISE Flow Rate	Bowl LOWER Flow Rate	Apron UP Flow Rate	Apron DOWN Flow Rate	System Oil Temperature (End)
Test Number	25	26	27	28	29	30	31	32
Control Lever Position	Ejector FORWARD	Ejector FORWARD	Ejector RETURN	Bowl RAISE	Bowl LOWER	Apron UP	Apron DOWN	Ejector FORWARD
Engine Speed	Any Speed	<u>1900</u> RPM	<u>1900</u> RPM	<u>1900</u> RPM	<u>1900</u> RPM	<u>1900</u> RPM	<u>1900</u> RPM	Any Speed
System Test Pressure	0-100 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	0-100 PSI
Test Data	<u>150</u> ±5 °F	<u>68.0</u> GPM	<u>68.0</u> GPM	<u>68.0</u> GPM	<u>68.0</u> GPM	<u>68.0</u> GPM	<u>68.0</u> GPM	<u>150</u> ±5 °F
Circuit Leakage Rate		(26-4) <u>1.0</u> GPM	(27-5) <u>1.0</u> GPM	(28-6) <u>1.0</u> GPM	(29-7) <u>5.0</u> GPM	(30-8) <u>1.0</u> GPM	(31-9) <u>1.0</u> GPM	
Control Valve Group Leakage		(14-26) <u>3.0</u> GPM	(14-27) <u>3.0</u> GPM	(14-28) <u>3.0</u> GPM	(14-29) <u>3.0</u> GPM	(14-30) <u>3.0</u> GPM	(14-31) <u>3.0</u> GPM	

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FLOW METER TEE TEST PROCEDURE - VIII

SCRAPER BLOCKED COMPONENT TEST

DATE _____

TEE - TEST
PROCEDURE DATA SHEET
CHART D

MACHINE SERIAL NUMBER _____

SERVICE METER READING _____

Test Name	System Oil Temperature (Start)	Ejector Circuit Blocked	Right & Left Bowl Control Circuit Blocked	Right Bowl Control Circuit Blocked		Right Cyl. & Bal. Line Blocked		Left Cyl. & Bal. Line Blocked		Apron Circuit Blocked	Apron Cylinder Blocked		System Oil Temperature (End)
		Ejector FORWARD Flow Rate	Bowl RAISE Flow Rate	Bowl RAISE Flow Rate	Bowl LOWER Flow Rate	Bowl RAISE Flow Rate	Bowl LOWER Flow Rate	Bowl RAISE Flow Rate	Bowl LOWER Flow Rate	Apron RAISE Flow Rate	Apron RAISE Flow Rate	Apron LOWER Flow Rate	
Test Number	33	34	37	38	39	40	41	42	43	44	45	46	47
Control Lever Position	Ejector FORWARD	Ejector FORWARD	Bowl RAISE	Bowl RAISE	Bowl LOWER	Bowl RAISE	Bowl LOWER	Bowl RAISE	Bowl LOWER	Apron UP	Apron UP	Apron DOWN	Ejector FORWARD
Engine Speed	Any Speed	_____ RPM	_____ RPM	1900 RPM	1900 RPM	_____ RPM	_____ RPM	_____ RPM	_____ RPM	_____ RPM	_____ RPM	_____ RPM	Any Speed
System Test Pressure	0-100 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	0-100 PSI
Test Data	150 ± 5 °F	_____ GPM	_____ GPM	68.0 GPM	65.5 GPM	_____ GPM	_____ GPM	_____ GPM	_____ GPM	_____ GPM	_____ GPM	_____ GPM	150 ± 5 °F
Leakage Rate	/	Ejector Circuit Leakage (34-4)	Bowl Circuit Leakage (37-6)	Right Bowl Circuit Leakage (38-6) (39-7)		Right Cylinder Leakage (40-6) (41-7)		Left Cylinder Leakage (42-6) (43-7)		Apron Circuit Leakage (44-8)	Cylinder Leakage (45-8) (46-9)		/
		_____ GPM	_____ GPM	1.0 GPM	2.5 GPM	_____ GPM	_____ GPM	B = _____ GPM	D = _____ GPM	_____ GPM	_____ GPM	_____ GPM	
Leakage Rate	/	/	/	Left Bowl Circuit Leakage (28-38) (29-39)		Right Carry Check Valve Leakage (38-40) (39-41)		Left Carry-Check Valve Leakage (A-B) (C-D)		/	Apron Sequence Relief Valve Leakage (44-45) (44-46)		/
				A 1.0 GPM	C 2.5 GPM	_____ GPM	_____ GPM	_____ GPM	_____ GPM		_____ GPM	_____ GPM	

**SECTION VIII
FLOW METER TEE TEST PROCEDURE-VIII
SERVICE MANUAL**

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GLOSSARY

aeration: Air mixed with the oil.

block, blocking, blocked: To close off a passage; to stop or prevent movement.

cavitation: Air present at the inlet of the pump.

data: Specific information.

flow differential (flow loss): The difference between two oil flows.

stick, sticking, stuck: To prevent free movement; keep open or closed.

FLOW METER TEE TEST PROCEDURE - VIII

INTRODUCTION

The Tee Test is a method of testing a hydraulic system under conditions as close as possible to those existing when the system is working. When used correctly, the Tee Test will find the cause of a problem. When used as part of a preventive maintenance program, it will give an indication of a problem that can cause a failure. For a complete explanation of how the Tee Test works, see the INTRODUCTION. This form is a part of the TESTING HYDRAULIC SYSTEMS AND COMPONENTS manual (Tee Test manual).

Data recording sheets are available in pads of 50. Copies can be ordered by the following form numbers:

System Test
Pump Test
Blocked Circuit Test
Blocked Component Test

EQUIPMENT INSTALLATION

1. With the engine stopped, remove the cap on the hydraulic tank to release any pressure and then tighten. Start the engine and move the ejector to the full forward position. This will cause a vacuum in the tank to keep oil leakage at a minimum. Stop the engine.
2. Remove the plug for the tee test from the supply line elbow.
3. Install a supply line adapter in the supply line elbow.



WARNING: Do not install the adapter for the supply line for the pump or the return line assembly with the engine running.

Injury to personnel can result.

4. Install the return line assembly in the filter cover.
5. Connect the return line assembly and the adapter for the pump supply line to the flow meter with the correct connecting hose assemblies.



WARNING: A plain coupler will not open the valve in the adapter for the pump supply line. Use a valved coupler against a valved nipple when connecting hoses.

6. Install the tachometer generator with the correct drive.
7. Install the cable between the tachometer generator and the input connection for the tachometer (rpm) on the flow meter.

PREPARATION OF SYSTEM FOR TEST

1. Open the manual load valve fully (turn counterclockwise).
2. Start the diesel engine.
3. Move the ejector control lever to the FORWARD position.
4. With the engine at high idle, slowly turn the manual load valve clockwise until the pressure goes up to 1000 psi.
5. Look at the oil temperature.
6. When the oil temperature is 1000 F, turn the manual load valve clockwise until the pressure is 1500 psi.
7. When the oil temperature is 1600 F, move all control levers several times to get full cylinder travel of all cylinders.
8. Move the cylinders through their cycles as long as necessary to get the desired oil temperature of 1500 F all through the system.

SYSTEM TEST (CHART A)

Write Down the Basic Test Data

NOTE: Conditions in the hydraulic system must be constant before writing down the test data. The control levers must be held in the exact position desired. Best results are found when oil temperature is 150 ± 50 F°.

Test 1: Maximum Pressure Relief Valve Setting

1. Open the manual load valve fully.
2. Move the ejector control lever to FORWARD position.
3. With the engine throttle at test rpm, slowly close the manual load valve until oil flow through the flow meter stops (0 gpm).

NOTE: The test rpm is given on the Procedure Data Sheet, CHART A.

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4. Write down the pressure and engine rpm.
5. The setting for the relief valve for maximum pressure must be according to the Service Manual.

CAUTION: When the pressures are higher than 1000 psi, slowly open manual load valve before releasing the control lever. This will prevent possible damage to the pressure gauge.

Test 2: System Oil Temperature

1. Open the manual load valve fully.
2. Move the ejector control lever to FORWARD position.
3. Write down the oil temperature. Oil temperature must be 150 ± 50 F°.

Test 3: System Base Flow Rate

1. Open the manual load valve fully.
2. Move the ejector control lever to the FORWARD position.
3. Get the engine to test rpm.
4. Check pressure to make sure it is at a minimum value of approximately 100 psi.
5. Write down the flow rate (gpm).

The base flow rate of the system will be the same as the low pressure flow of the hydraulic pump. Because there will be minimum leakage in the control valves, lines and cylinder seals at low pressure, the base flow rate can be used to find the flow differential in Tests 4 through 9.

Tests 4 through 9: Leakage Rates

These six tests are similar. Each test is done as follows:

1. Move the control lever to the respective OPERATE position.
2. Get the engine to test rpm.
3. Make an adjustment to the manual load valve to get 1000 psi pressure.
4. Then make the system constant with these conditions.
5. Write down the flow rate (gpm) for each test.

The flow differential for each test (4 through 9) is found by taking the flow rate (gpm) for each test away from the base flow rate (Test 3). The percent of flow loss for each test (4 through 9) is found by dividing the flow differential for each test by the base flow rate (Test 3) and multiplying by 100.

Test 10: System Oil Temperature

1. Open the manual load valve fully.
2. Move the ejector control lever to the FORWARD position.
3. Write down the oil temperature.

Make a comparison of the oil temperature from Test 2 and 10. Test 2 must be 150 ± 5 ° F and Test 10 must be inside of (within) 100 F of Test 2. For each 100 F higher difference make a subtraction of .5 gallon per pump cartridge from the leakage rate. For each 10° F lower difference, add .5 gallon per pump cartridge to the leakage rate.

Test 11: Bowl Circuit Drift Comparison

Test 11 is a comparison of visual drift rates for the bowl circuit. This test is used to check the condition of the carry-check valves. Raise the bowl approximately one foot off the ground. Turn the manual load valve all the way out for minimum restriction. Stop the engine.

With the bowl control lever in the HOLD position, look for a down drift (movement) in the bowl. Then move the control lever to the RAISE position. Look for down drift again. If the drift in the RAISE position is more than the drift in the HOLD position, put a circle around the M in the Test Data box. If the drift in the RAISE position is the same or less than the drift in the HOLD position, put a circle around the S in the Test Data box.

Test 12: Apron Circuit Drift Comparison

Test 12 is a comparison of the visual drift rate in the apron circuit. This test is used to check the condition of the check valve. Raise the bowl until the cutting edge is 6 to 10 inches above the ground. Raise the apron until it is open approximately 15 inches. Turn the manual load valve all the way out for minimum restriction. Stop the engine.

With the apron control lever in the HOLD position, look for a down drift (movement) in the apron. Then move the control lever to the RAISE position. Look for down drift again. If the drift in

FLOW METER TEE TEST PROCEDURE - VIII

the RAISE position is more than the drift in the HOLD position, put a circle around the M in the Test Data box. If the drift in the RAISE position is the same or less than the drift in the HOLD position, put a circle around the S in the Test Data box.

"Is It Necessary to Make More Tests? If So, Which Circuit (s)?"

Make a comparison of the test data on Chart A for the specific machine under test. The percent of flow loss on Chart A is the maximum for best performance.

Components that are worn, or not working correctly, are found by their flow differential and percent of flow loss or lower system efficiency. System values for new and rebuilt machines must not be more than the percent of flow loss in the system tests shown on Chart A for the specific machine. The permissible flow differential is a function of machine application.

If the flow loss is acceptable, the Tee Test is completed.

If the flow loss is not acceptable in one or more circuits, the tests for the pump and/or the blocked circuits must be done.

If the flow loss is not acceptable in only one of the circuits, do the tests as shown on the insert pages TESTING BOWL CIRCUIT, TESTING APRON CIRCUIT or TESTING EJECTOR CIRCUIT. The leakage rate of any component in a circuit is found by making a subtraction of the test information with the component in the circuit from, the test information with the component out of the circuit.

NOTE: The leakage rate of the left carry-check valve is found by making a subtraction of the Left Cylinder Leakage from the Left Bowl Circuit Leakage.

Troubleshooting

The following examples are a list of problems and probable reasons. They will give aid in finding the location of the components that are worn, or not working correctly. Not all probable reasons have an application to all machines.

PROBLEM: Setting for the main relief valve is higher or lower than given in Test 1. Percent of flow loss for Tests 4 through 9 is 15% to 50%.

PROBABLE REASON:

Setting for main relief valve is not correct and leakage is too high.

RECOMMENDATION FOR ACTION:

Make adjustments to the main relief valve to get the correct pressure. Make a test for leakage in the following problems.

PROBLEM: Percent of flow loss for Tests 4 through 9 is more than the percent shown on Chart A.

PROBABLE REASON:

- A. Bad pump.
- B. Leakage in the relief valve.
- C. Wear or damage in the valve body and/or valve spools.
- D. Leakage in the swivel joint.

RECOMMENDATION FOR ACTION

- A. Do the Pump Test.
- B. If the extra percent of flow loss is not caused by a bad pump, problem is in the control valves or relief valve.

PROBLEM: Percent of flow loss for Tests 4 and/or 5 is more than 15%; for Tests 6, 7, 8 and 9, percent of flow loss is less than the percent shown in Chart A.

PROBABLE REASON:

- A. Leakage in the piston seals for the ejector cylinder.
- B. Wear or damage in the valve body and/or valve spool.
- C. Leakage in the seals of the speed change valve for the ejector and/or damage in the valve body.

RECOMMENDATION FOR ACTION:

Do the Blocked Circuit Tests 26 and 27 for the ejector circuit. If leakage is still too high, the problem is in the ejector control valve. Inspect its components.

PROBLEM: Percent of flow loss for Tests 6 and 7 is more than the percent shown in Chart A; for Tests 4, 5, 8 and 9, it is less than the percent shown in Chart A.

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PROBABLE REASON:

- A. Leakage in one or both of the piston seals for the bowl cylinders.
- B. Wear or damage in the valve body or spool in the bowl circuit.
- C. Leakage in the seals for the carry-check valve and/or damage in the valve body.

RECOMMENDATION FOR ACTION:

Do the Blocked Circuit Tests 28 and 29 for the bowl circuit. If leakage is still too high, the problem is in the bowl control valve. Inspect its components.

PROBLEM: Percent of flow loss for Tests 8 and 9 is more than the percent shown in Chart A; for Tests 4, 5, 6 and 7 it is less than the percent shown in Chart A.

PROBABLE REASON:

- A. Leakage in the piston seals for the apron cylinder.
- B. Wear or damage in the valve body or spool in the apron circuit.
- C. Leakage in the seals for the sequence relief valve for the apron and/or damage in the valve body.

RECOMMENDATION FOR ACTION:

Do Blocked Circuit Tests 30 and 31 for the apron circuit. If the leakage is still too high, the problem is in the apron control valve. Inspect its components.

PROBLEM: Percent of flow loss for Tests 5 and 7 is more than the percent shown in Chart A; Test 9 is 0 to 15%.

PROBABLE REASON:

Wear or damage in the valve body and/or valve spool.

RECOMMENDATION FOR ACTION:

Inspect the valve body and its components.

PROBLEM: Percent of flow loss for Tests 5 and 9 is more than the percent shown in Chart A; for Tests 4, 6, 7 and 8 it is less than the percent shown in Chart A.

PROBABLE REASON:

Wear or damage in the control valve and/or spools for the apron and/or ejector circuits.

RECOMMENDATION FOR ACTION:

Inspect the control valve and its components.

PROBLEM: Percent of flow loss for Tests 7 and 9 is more than the percent shown in Chart A; for Tests 4, 5, 6 and 7 it is less than the percent shown in Chart A.

PROBABLE REASON:

Wear or damage in the control valve and/or spools for the bowl and/or the apron circuits.

RECOMMENDATION FOR ACTION:

Inspect the control valve and its components.

PROBLEM: Percent of flow loss for Tests 5, 7 and 9 is more than the percent shown in Chart A; for Tests 4, 6 and 8 it is less than the percent shown in Chart A.

PROBABLE REASON:

Wear or damage in the control valve or the valve spools.

RECOMMENDATION FOR ACTION:

Inspect the control valve and its components.

PUMP TEST (CHART B)

This test is used to find the efficiency of the hydraulic pump. Install a Blocking Plate Assembly in the pressure line from the hydraulic pump at the control valve. This prevents the oil from going through the system. All of the pump flow now goes through the flow meter.



WARNING: Open the manual load valve on the flow meter fully before starting the diesel engine. The main relief valve is not part of the circuit for the Pump Test. If the pressure gets too high, it is possible to cause injury to personnel or damage to equipment.

Test 13: Pump Flow at Low Pressure (Test rpm)

1. Open the manual load valve fully.
2. Start the diesel engine.
3. Run the engine at test rpm.
4. Slowly close the manual load valve to get 100psi pressure.

FLOW METER TEE TEST PROCEDURE - VIII

5. Write down the oil temperature and the flow rate (gpm).

Test 14: Pump Flow at High Pressure (Test rpm)

1. Run the engine at test rpm.
2. Slowly close the load valve to get 1000 psi pressure.
3. Write down the oil temperature and flow rate (gpm).

Test 15: Pump Flow at Low Pressure (1/ Test rpm)

1. Run the engine at 1/2 Test rpm.
2. Open the load valve to get 100 psi pressure.
3. Write down the oil temperature and the flow rate (gpm).

Test 16: Pump Flow at High Pressure (12 Test rpm)

1. Run the engine at 1/2 Test rpm.
2. Slowly close load valve to get 1000 psi pressure.
3. Write down the oil temperature and flow rate (gpm).

Make a comparison of the test data with the data on Chart B for the specific machine under test. The information on Chart B is the maximum for best performance.

Troubleshooting

PROBLEM: Percent of flow loss for Test 14 is 10% or more; for Test 4 through 9 it is more than the percent shown in Chart A.

PROBABLE REASON:

Pump has a problem and leakage is in the control valve, valve circuits and/or cylinders.

RECOMMENDATION FOR ACTION:

Find pump problem. Install a new or rebuilt pump, if necessary. Do the Blocked Cylinder Tests to find leakage rate in the control valve, valve circuits and/or cylinders.

PROBLEM: Percent of flow loss for Test 14 is 0 to 10%; for Tests 4 through 9 is more than the percent shown in Chart A.

PROBABLE REASON:

Pump is in good condition, but there is leakage in control valve, steering valve and/or cylinders.

RECOMMENDATION FOR ACTION:

Do the Blocked Cylinder Tests to find leakage rate in control valve, valve circuits and/or cylinders.

PROBLEM: Percent of flow loss for Test 14 is 10% or MORE. Flow differential for Test 14 is higher than the flow differential for Test 16 by 0 to 2 gpm.

PROBABLE REASON:

Pump is worn.

RECOMMENDATION FOR ACTION:

If flow loss is found to be too high for the machine application, install a new or rebuilt pump.

PROBLEM: Percent of flow loss for Test 14 is 10% or MORE. Flow differential for Test 14 is higher than flow differential for Test 16 by 2 gpm or MORE.

PROBABLE REASON:

- A. Oil aeration (low oil level, hydraulic oil that is not the correct type, air leak in the suction line for the pump, oil leaks in the tank such as failure of seals or loose connections).
- B. Pump cavitation (restriction in the suction line for the pump, oil viscosity that is not correct).

RECOMMENDATION FOR ACTION:

Do Tests 17 through 23 to find if the reason is aeration or cavitation.

NOTE: Test 24 is not used on any machines.

Pump Test for Aeration and Cavitation

Test 17 through 23: Aeration and Cavitation Tests

These seven tests are similar. Do the tests as follows:

1. Open the manual load valve fully before starting the diesel engine.
2. Run the engine at the test rpm for Test 17.
3. Slowly close the manual load valve to get 1000 psi pressure.
4. Write down the flow rate (gpm) and the oil temperature.
5. Then run the engine at test rpm (for Tests 18, 19, 20, 21, 22 and 23).

FLOW METER TEE TEST PROCEDURE - VIII

6. Write down the flow rate (gpm) and oil temperature for each test.

CAUTION: Immediately after stopping the diesel engine, remove the Blocking Plate Assembly from the pressure line for the pump to prevent any possible damage later.

Troubleshooting

PROBLEM: Percent of flow loss for Test 14 is 10% or MORE and flow differential for Test 14 is more than 2 gpm higher than the flow differential for Test 16. Tests 17 through 23 have the same flow differential.

PROBABLE REASON:

Oil aeration (low oil level, hydraulic oil that is not the correct type, air leak in the suction line for the pump, oil leaks in the tank such as failure of seals, loose connections or pump cartridge is not installed correctly in pump body).

RECOMMENDATION FOR ACTION:

- A. Check oil level and type of hydraulic oil being used.
- B. Check suction line for air leaks [put foam (like shaving cream) on all connections. The foam will be pulled into the line at any point of leakage].
- C. Remove the cover from the hydraulic tank and inspect for oil leaks (check above the oil level first).
- D. Disassemble the pump and check for correct assembly and damage to seals.

PROBLEM: Flow differential between each of the Tests 17 through 23 suddenly becomes lower at one test and the flow rate is the same for the remainder of the tests at higher engine speed (rpm). Example: 8 gpm differential between Tests 17 and 18. 18 and 19, 19 and 20, but 1 gpm differential between 20 and 21 and flow rates for Tests 22 and 23 are the same as 21.

PROBABLE REASON:

Pump cavitation (restriction in the suction line for the pump).

RECOMMENDATION FOR ACTION:

Inspect suction line and tank.

BLOCKED CIRCUIT TESTS (CHART C)

If the System Tests and Pump Tests give an indication of leakage in the control valves and/or cylinders that is not acceptable, do the Blocked Circuit Tests. Blocking Plate Assemblies can be put in each of the circuit lines. For best accuracy, do these tests with the oil temperature approximately 1500 F (near the oil temperature for the system tests and Pump Test).



WARNING: Lower all implements to the ground.

All Circuits Blocked

1. Put control levers in HOLD position.
2. Open the manual load valve fully.
3. Start the diesel engine.

Test 25: System Oil Temperature

1. Put the ejector control lever in the FORWARD position.
2. Run the engine at any rpm with the system pressure at 0 to 100 psi.
3. Write down the oil temperature.

Tests 26 through 31: Leakage Rates

These six tests are similar. Do the tests as follows:

1. Block the circuit line for the ejector, bowl and apron circuits at the control valve.
2. With the manual load valve fully open, move the ejector control lever to the FORWARD position.
3. Run the engine at full load rpm.
4. Slowly close the manual load valve to get 1000 psi pressure.
5. Write down the flow rate (gpm).
6. Do this procedure again for ejector RETURN bowl RAISE and LOWER, and apron RAISE and LOWER.

Test 32: System Oil Temperature

1. Put the ejector control lever in FORWARD position.

FLOW METER TEE TEST PROCEDURE - VIII

2. Run the engine at any rpm with the system pressure at 0 to 100 psi.
3. Write down the oil temperature.

Find the leakage rate of the circuit and the leakage rate of the control valves. Use the test information from the System Tests, Pump Test and Blocked Circuit Tests.

Example: Find the leakage rates of the ejector circuit in the FORWARD position.

Test 14: Flow rate of the pump only.

Test 26: Flow of pump and control valves.

Test 4: Flow rate of pump, control valve and circuit.

The system components tested in Tests 26 and 14 are the same except for the control valves. Then the difference in flow rates must be the leakage in the control valves in the circuit (take the test information for Test 26 away from the test information for Test 14).

The system components tested in Tests 26 and 4 are the same except for the cylinders, speed change valve for the ejector and the swivel joint (if so equipped). Then the difference in flow rates must be the leakage in the cylinders, speed change valve for the ejector and the swivel joint (take the test information for Test 4 away from the test information for Test 26).

Make a comparison of the test data with the data on Chart C, for the specific machine under test. The information on Chart C is the maximum for best performance.

Troubleshooting

PROBLEM: Leakage rates for Tests 26, 27, 28, 29, 30 and 31 are more than the rates shown in Chart C.

PROBABLE REASON:

Pressure relief valve.

RECOMMENDATION FOR ACTION:

Inspect the relief valve.

PROBLEM: Tests 26 and 27 give an indication of leakage in the ejector circuit.

PROBABLE REASON:

A. Leakage in the ejector cylinder.

RECOMMENDATION FOR ACTION:

Remove and inspect the ejector cylinder.

PROBLEM: Tests 28 and 29 give an indication of leakage in the bowl circuit.

PROBABLE REASON:

A. Leakage in only one of the cylinders.

B. Leakage in both cylinders.

C. Leakage in the Quick-Drop and/or Carry-Check Valve.

RECOMMENDATION FOR ACTION:

Do Tests 38, 39, 41, 42 and 43 to find the cause of flow loss. Do Tests 38 and 39 to find the cause of flow loss.

PROBLEM: Tests 30 and 31 give an indication of leakage in the apron circuit.

PROBABLE REASON:

A. Leakage in the cylinder.

B. Leakage in the apron sequence relief valve.

RECOMMENDATION FOR ACTION:

Do Tests 45 and 46 for the apron circuit.

FLOW METER TEE TEST PROCEDURE - VIII

BLOCKED COMPONENT TESTS (CHART D)

If the Blocked Circuit Tests gives an indication of leakage that is too high in the cylinder valves or the swivel joint, do the Blocked Component Tests. For best accuracy, operate all controls through several cycles to get the temperature of the oil in the cylinders the same as the temperature of the oil in the hydraulic tank. Make the temperature of the complete system 1500 F.

Lower all implements to the ground. Stop the diesel engine. Move the control levers through OPERATE and HOLD positions to release any oil pressure. Put the control levers in HOLD position. Open the filler cap for the hydraulic tank to release any tank pressure and close the cap. Use the Blocking Plate Assemblies to block each component for testing.

Test 33: System Oil Temperature

Open the manual load valve fully. Start the diesel engine. Run the engine at any rpm with the system pressure at 0 to 100 psi. Move the ejector control lever to FORWARD position. Write down the oil temperature.

NOTE: Tests 34 through 46 are leakage rate Tests.

Test 34: Ejector FORWARD Flow Rate (Ejector Circuit Blocked)

With the manual load valve fully open, move the ejector control lever to FORWARD position. Run the engine at test rpm. Slowly close the manual load valve to get 1000 psi pressure. Write down the flow rate of the oil.

Test 37: Bowl RAISE Flow Rate (Bowl Circuit Blocked)

With the manual load valve fully open, move the control lever to RAISE position. Run the engine at test rpm. Slowly close the manual load valve to get 1000 psi pressure. Write down the flow rate of the oil.

Test 38: Bowl RAISE Flow Rate (Right Bowl Control Circuit Blocked)

With the manual load valve fully open, move the control lever to RAISE position. Run the engine at test rpm. Slowly close the manual load valve to get 1000 psi pressure. Write down the flow rate of the oil.

Test 39: Bowl LOWER Flow Rate (Right Bowl Control Circuit Blocked)

With the manual load valve fully open, move the control lever to LOWER position. Run the engine at test rpm. Slowly close the manual load valve to get 1000 psi pressure. Write down the flow rate of the oil.

Test 40: Bowl RAISE Flow Rate (Right Cylinder and Balance Line Blocked)

With the manual load valve fully open, move the control lever to RAISE position. Run the engine at test rpm. Slowly close the manual load valve to get 1000 psi pressure. Write down the flow rate of the oil.

Test 41: Bowl LOWER Flow Rate (Right Cylinder and Balance Line Blocked)

With the manual load valve fully open, move the control lever to LOWER position. Run the engine at test rpm. Slowly close the manual load valve to get 1000 psi pressure. Write down the flow rate of the oil.

Test 42: Bowl RAISE Flow Rate (Left Cylinder and Balance Line Blocked)

With the manual load valve fully open, move the control lever to RAISE position. Run the engine at test rpm. Slowly close the manual load valve to get 1000 psi pressure. Write down the flow rate of the oil.

Test 43: Bowl LOWER Flow Rate (Left Cylinder and Balance Line Blocked)

With the manual load valve fully open, move the control lever to LOWER position. Run the engine at test rpm. Slowly close the manual load valve to get 1000 psi pressure. Write down the flow rate of the oil.

FLOW METER TEE TEST PROCEDURE - VIII

Test 44: Apron Raise Flow Rate (Apron Circuit Blocked)

With the manual load valve fully open, move the control lever to RAISE position. Run the engine at test rpm. Slowly close the manual load valve to get 1000 psi pressure. Write down the flow rate of the oil.

Test 45: Apron RAISE Flow Rate (Cylinder blocked)

With the manual load valve fully open, move the control lever to RAISE position. Run the engine at test rpm. Slowly close the manual load valve to get 1000 psi pressure. Write down the flow rate of the oil.

Test 46: Apron LOWER Flow Rate (Cylinder blocked)

With the manual load valve fully open, move the control lever to LOWER position. Run the engine at test rpm. Slowly close the manual load valve to get 1000 psi pressure. Write down the flow rate of the oil.

Test 47: System Oil Temperature (Oil Temperature of System)

Put control lever in LOWER position. Run the engine at any rpm with the system pressure at 0 to 100 psi. Write down the oil temperature.



WARNING: All pressure in the lines must be released or injury to personnel or damage to equipment can result while loosening the lines to install or remove the plate assemblies. The implement can move and pressure oil can be released.

Find the leakage rate of the cylinders, control valves, and carry-check valves. Use the test information from the System Tests, Pump Test and Blocked Component Tests.

Example: Find the leakage rate of sequence relief valve for the apron in the RAISE position.

Test 44: Flow rate of the pump and control valve.

Test 45: Flow rate of the pump, control valve, and the sequence relief valve for the apron.

The system components tested in Tests 44 and 45 are the same except for the sequence relief valve for the apron. The difference in flow rates must be the leakage in the sequence relief valve. (Make a subtraction of the test information for Test 45 from the test information for Test 44).

NOTE: Use Test 30 to find the leakage rate of the sequence relief valve for the apron. (Make a subtraction of the test information for Test 45 from the test information for Test 30).

Troubleshooting

PROBLEM: Leakage is in the right or left bowl cylinder.

PROBABLE REASON:

- A. Leakage in one or both of the piston seals.
- B. Loose nut on a piston.
- C. Wear or damage in a cylinder assembly.

RECOMMENDATION FOR ACTION:

Disassemble and make repairs to the right or left cylinder.

PROBLEM: Leakage in a carry-check valve.

PROBABLE REASON:

- A. Worn valve.
- B. Damage to the valve body.

RECOMMENDATION FOR ACTION:

Disassemble and make repairs to the carry-check valve.

PROBLEM: Leakage in the apron cylinder.

PROBABLE REASON:

- A. Piston seals are worn.
- B. Loose piston nut.
- C. Wear or damage in the cylinder assembly.

RECOMMENDATION FOR ACTION:

Disassemble and make repairs to the apron cylinder.

PROBLEM: Leakage in the sequence relief valve for the apron.

PROBABLE REASON:

- A. Worn valve.
- B. Damage to the valve body.

RECOMMENDATION FOR ACTION:

Disassemble and make repairs to the sequence relief valve.

FLOW METER TEE TEST PROCEDURE - VIII

PROBLEM: Leakage in the ejector cylinder.

PROBABLE REASON:

- A. Piston seals are worn.
- B. Wear or damage in the cylinder assembly.

RECOMMENDATION FOR ACTION:

Disassemble and make repairs to the ejector cylinder.

PROBLEM: Leakage in the speed change valve for the ejector.

PROBABLE REASON:

- A. Worn valve.
- B. Damage to the valve body.

RECOMMENDATION FOR ACTION:

Disassemble and make repairs to the speed change valve.

PROBLEM: Leakage in the swivel joint.

PROBABLE REASON:

- A. Seals are worn.
- B. Wear or damage to the rotor.

RECOMMENDATION FOR ACTION:

Disassemble and make repairs to the swivel joint.

**SECTION IX
SPECIFICATIONS-HYDRAULIC SYSTEM**

TORQUE SPECIFICATIONS: You will find instances in this publication where the manufacturer has used "Meter-Kilograms" or "Centimeter-Kilograms" in place of "Newton-Meters" for the metric torque. In these Instances, use the following conversion factors to obtain the metric torque in "Newton-Meters."

- lb. ft. x 1.355819 = N•m**
- lb. in. x 0.1129848 = N•m**

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NOTE: For Systems Operation and Testing and Adjusting, make reference to the SCRAPER HYDRAULIC SYSTEM.

SCRAPER HYDRAULIC SYSTEM

SPECIFICATIONS

**CONTROL VALVE
(8J5920)**

- (1) Spring housing for ejector valve spool, see illustration with detail
- (2) 8J5649 Sequence Valve for apron cylinder, see Illustration with detail
- (3) Spring housing for apron valve spool
9J6441 Spring on valve spool

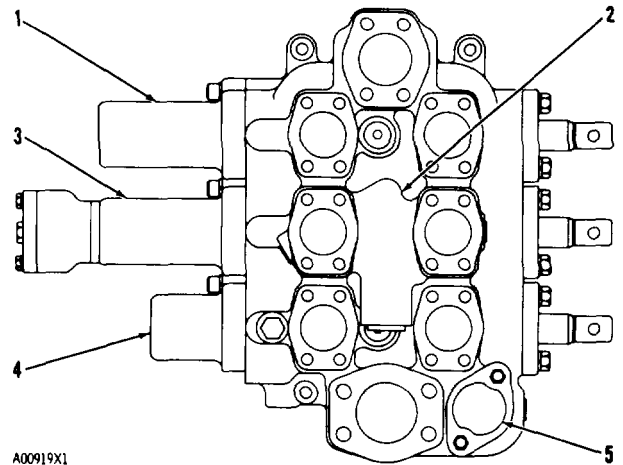
Length under test force 1 81 in (46.0 mm)
 Test force30.0 ± 2.4 lb (13.6 ± 1.1 kg)
 Free length after test..... 2 95 in (74 9 mm)
 Outside diameter..... 1 58 in. (40.1 mm)

9J6442 Spring for detent balls
 Length under test force 1 20 In (30 8 mm)
 Test force20 0 ± 1 6 lb. (9.1 ± 0.7 kg)
 Free length after test..... 1 58 in. (40.1 mm)
 Outside diameter..... 1 56 In (39 6 mm)

Torque to install air valve on spring housing40 ± 5 lb ft (54.2 t 6.8 N m)

- (4) Spring housing for bowl valve spool
8J9422 Spring on valve spool (inner)
 Length under test force 1 38 in (35.1 mm)
 Test force27.0 ± 1.6 lb. (12.3 ± 0.7 kg)
 Free length after test..... 2.32 in (58.9 mm)
 Outside diameter..... 1.01 in. (25.7 mm)
 8J2097 Spring on valve spool (outer)
 Length under test force 1.03 In (26.2 mm)
 Test force27 ± 3 lb (12.2 ± 1.4 kg)
 Free length after test..... 2.91 in (73.9 mm)
 Outside diameter..... 1.68 in (42.7 mm)

- (5) Relief valve.
 Pressure setting
2150; +75 or -25 psi (151.1; +5.3 or -1.8 kg/cm²)
 (14835: +517 or -172 kPa)
 3J7473 Shim thickness005 in. (0.13 mm)
 One shim will change pressure90 psi (6.3 kg/cm²)(620 kPa)
 3H2549 Shim thickness 0.10 in (025 mm)
 One shim will change pressure175 psi (12 3 kg/cm²) (1207 kPa)
 8J4446 Spring for relief valve
 Length under test force 69 In (17.5 mm)
 Test force8 20 ± 65 lb (3.7 ± 0.3 kg)
 Free length after test..... 1.00 in (25.4 mm)
 Outside diameter..... 1.09 In (27.7 mm)
 8J4437 Spring for pilot valve
 Length under test force 1.31 in (33.3 mm)
 Test force55 8 ± 4 5 lb (25.3 ± 2.0 kg)
 Free length after test..... 1.42 in. (36.1 mm)
 Outside diameter..... 46 In. (11.7 mm)



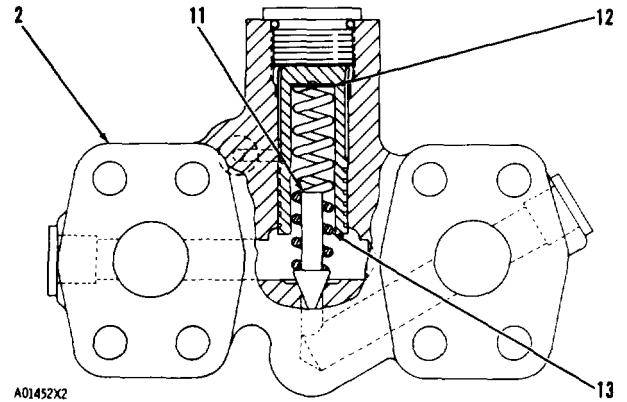
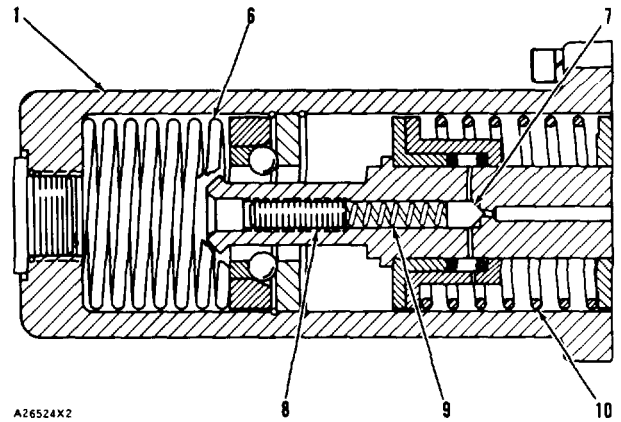
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SCRAPER HYDRAULIC SYSTEM

SPECIFICATIONS

Control Valve (Cont.)

- (6) 9J6442 Spring for detent balls.
 Length under test force 1.20 in. (30.8 mm)
 Test force 200 ± 1.6 lb. 19.1 - 0.7 kg
 Free length after test 1.58 in. (40.1 mm)
 Outside diameter 1.56 in (39.6 mm)
- (7) Valve to move ejector valve spool away from detent balls.
 Pressure of oil in rod end circuit of ejector cylinder to open valve 1600 ± 150 psi (112.5 ± 10.6 kg/cm²) (11040 ± 1035 kPa)
- (8) Screw to adjust opening pressure.
 One turn of screw changes opening pressure 170 psi (11.9 kg/cm²) (1173 kPa)
- (9) 8J2086 Spring on pilot valve.
 Length under test force 82 in (20.8 mm)
 Test force 7.69 + .85 lb (3.5 ± 0.4 kg)
 Free length after test 1.08 in. (27.4 mm)
 Outside diameter 20 in (5.1 mm)
- (10) 9J5622 Spring on valve spool
 Length under test force 1.38 in. (35.1 mm)
 Test force 30.0 ± 2.4 lb. (13.6 ± 1.1 kg)
 Free length after test 2.48 in (63.0 mm)
 Outside diameter 1.55 in. (39.4 mm)
- (11) Pressure of oil in rod end circuit of apron cylinder to open valve 1000 ± 50 psi (70.3 ± 3.5 kg/cm²) (6900 ± 345 kPa)
- (12) 8J4452 Shim thickness 005 in (0.13 mm)
 One shim will change opening pressure 20 psi (1.4kg/cm²) (138kPa)
- 9J1330 Shim thickness031 in. (0.8 mm)
 One shim will change opening pressure 120 psi (8.4 kg/cm²) (828 kPa)
- (13) 8J5436 Spring on valve
 Length under test force 2.31 in. (58.7 mm)
 Test force 59 ± 3 lb. (26.8 ± 1.4kg)
 Free length after test 2.57 in. (65.3 mm)
 Outside diameter 53 in. (13.5 mm)

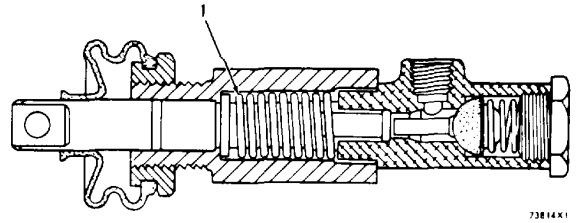


SCRAPER HYDRAULIC SYSTEM

SPECIFICATIONS

**AIR VALVE
(4J8500)**

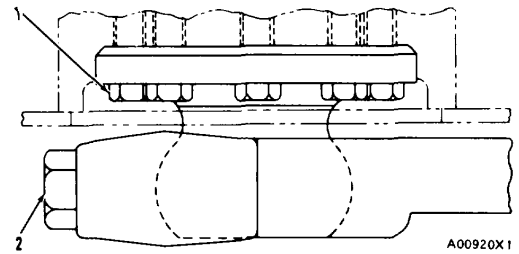
- (1) 4J8394 Spring
 Length under test force 1.09 min (27.7 mm)
 Test force 18 lb (8.2 kg)
 Free length after test..... 1.55 in. (38.1 mm)
 Outside diameter..... 66 min. (16.8 mm)



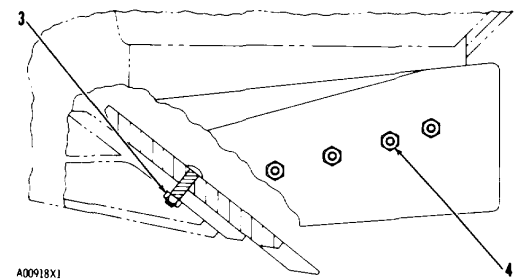
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SCRAPER

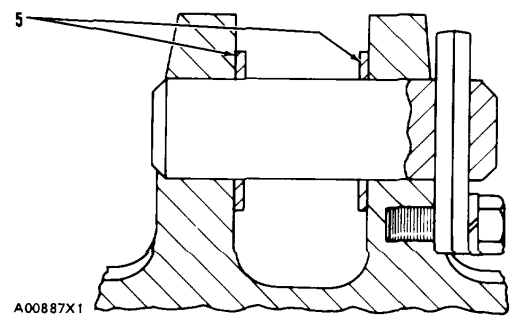
- (1) Torque to install trunnion for draft frame on bowl 185 + 10 lb. ft (250.8 ± 13.6 N-m)
 Torque to install apron trunnion on bowl..... 95 ± 5 lb ft. (128.8 ± 6.8 N-m)
- (2) Torque for bolts to install clamp on draft frame440 ± 35 lb. ft. (596.6 ± 47.5 N-m)
 Torque for bolts to install clamp on apron..... 515 ± 20 lb. ft. (698.3 + 27.1 N-m)
- (3) Torque for nut on bolt through edge on bowl..... 900 ± 110 lb. ft (1220 ± 150 N-m)
- (4) Torque for nut (end bit)..... 900 ± 110 lb ft. (1220 ± 150 N-m)



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BOWL CYLINDER INSTALLATION

- Step 1 Put bow(cylinders to the center between the draft arms and install the pins In the cylinders and draft frame.
- Step 2 Use spacers l5), as needed, on both sides of the cylinder rods to get correct cylinder alignment.

SCRAPER HYDRAULIC SYSTEM

SPECIFICATIONS

CYLINDERS

5J778 Cylinder (Apron)

- (1) Torque for nut 1200 ± 100 lb. ft. (1630 ± 135 N m)
- (2) Bore in new head $2.753 \pm .001$ in. (69.93 ± 0.03 mm)
Diameter of
new rod $2.7480 \pm .0015$ in. (69.80 ± 0.04 mm)
- (3) Bore in new cylinder
. $7.250 +.005$ or $-.002$ in. ($184.15 +0.13$ or -0.05 mm)

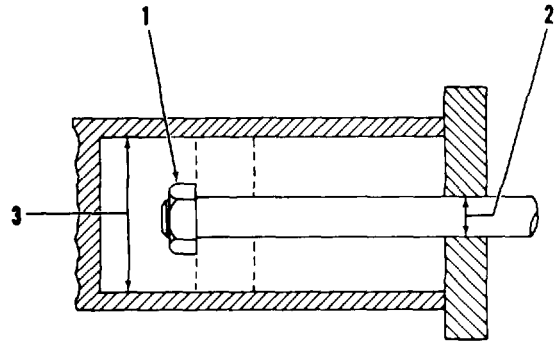
5J2449, 5J2450 Cylinders (Bowl)

- (1) Torque for nut 1200 ± 100 lb. ft. (1630 ± 135 N-m)
- (2) Bore in new head $2.503 \pm .001$ in. (63.58 ± 0.03 mm)
Diameter of
new rod $2.4980 \pm .0015$ in. (63.45 ± 0.04 mm)
- (3) Bore in new cylinder
. $6.000 +.005$ or $-.002$ in. ($152.40 +0.13$ or -0.05 mm)

Torque for bolts in head (with extended rod) 300 ± 35 lb. ft. (406.8 ± 47.5 N-m)

6J9573, 6J9689 Cylinders (Ejector)

- (1) Torque for nut 800 ± 75 lb. ft. (1085 ± 102 N-m)
- (2) Bore in new head $4.003 \pm .001$ in. (101.68 ± 0.03 mm)
Diameter of new rod $3.998 \pm .001$ in. (110.55 ± 0.03 mm)
- (3) Bore in new cylinder
. $6.500 \pm .005$ or $-.002$ in. ($165.10 +0.13$ or -0.05 mm)



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3-111 (3-112 Blank)

**CHAPTER 3
VEHICLE SYSTEMS
AIR SYSTEM**

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**SECTION I
SERVICE MANUAL
AIR SYSTEM AND BRAKES**

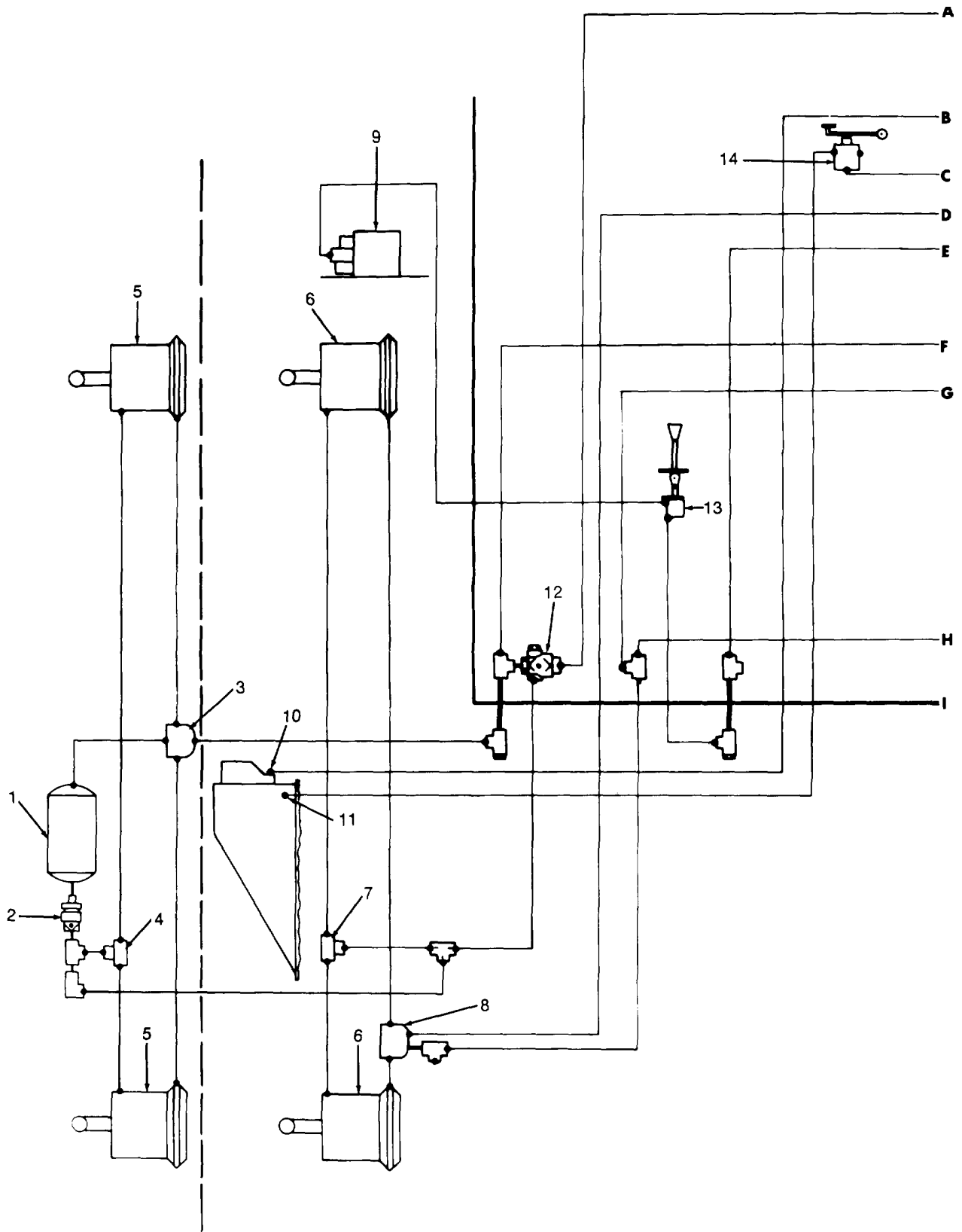
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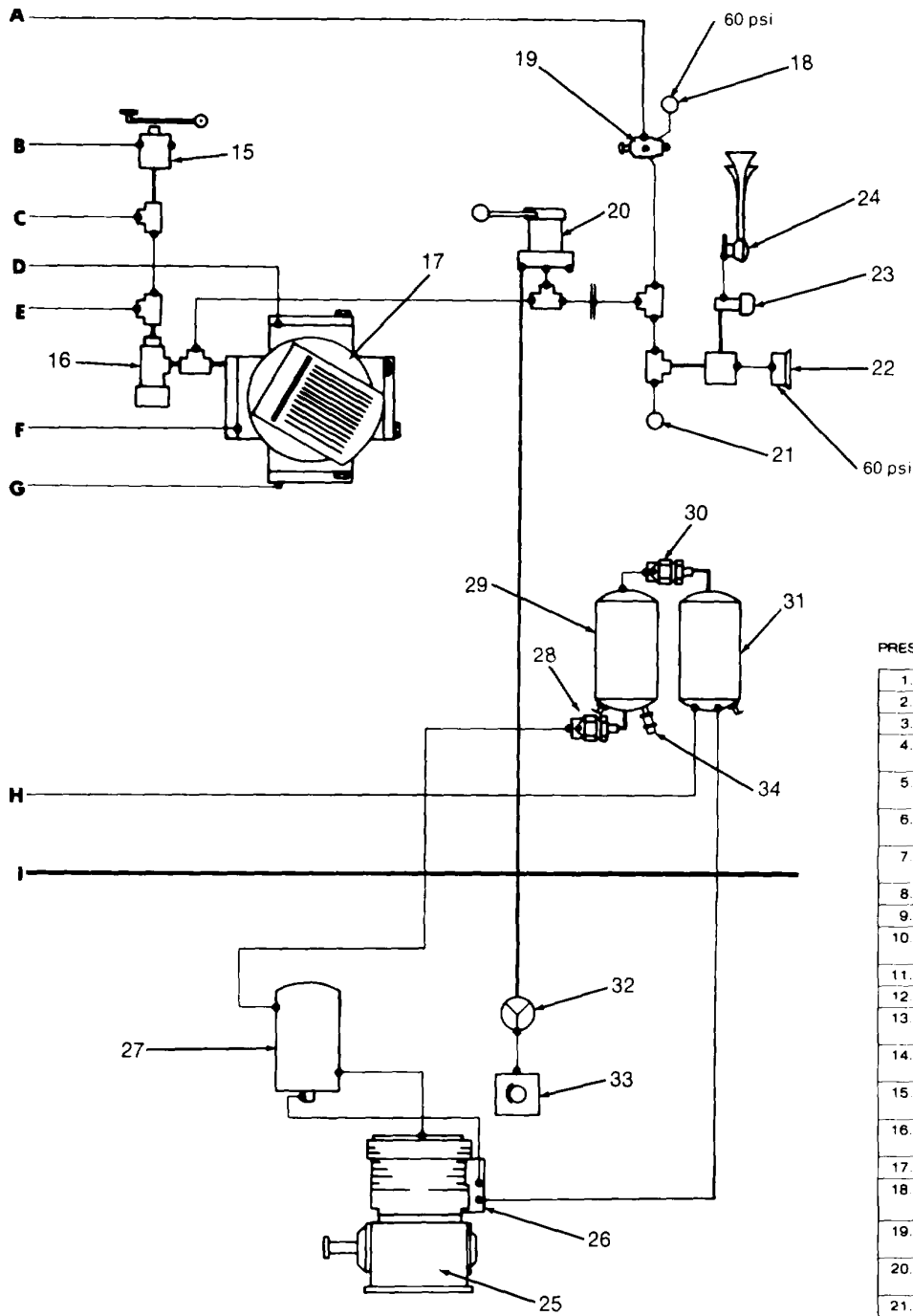
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NOTE: For Specifications with illustrations, make reference to AIR SYSTEM AND BRAKES SPECIFICATIONS FOR TRACTOR-SCRAPERS.





PRESSURE REDUCING VALVE

1.	SCRAPER AIR RESERVOIR
2.	ONE-WAY CHECK VALVE
3.	RELAY VALVE
4.	QUICK RELEASE AND HOLDING VALVE
5.	SCRAPER BRAKE ACTUATORS
6.	TRACTOR BRAKE ACTUATORS
7.	QUICK RELEASE AND HOLDING VALVE
8.	RELAY VALVE
9.	SCRAPER CONTROL VALVE
10.	TRANSMISSION HOLD CONTROL
11.	DIFFERENTIAL LOCK
12.	DOUBLE CHECK VALVE
13.	COMBINATION BOWL APRON CONTROL VALVE
14.	DIFFERENTIAL LOCK CONTROL VALVE
15.	TRANSMISSION HOLD CONTROL VALVE
16.	PRESSURE PROTECTION VALVE
17.	BRAKE CONTROL VALVE
18.	LOW AIR WARNING LIGHT SWITCH
19.	PARKING AND EMERGENCY BRAKE CONTROL VALVE
20.	RETARDER HAND CONTROL VALVE
21.	LOW AIR WARNING HORN
22.	AIR PRESSURE GAUGE
23.	SOLENOID VALVE
24.	AIR HORN
25.	AIR COMPRESSOR
26.	AIR COMPRESSOR GOVERNOR
27.	AIR DRYER
28.	ONE-WAY CHECK VALVE
29.	TRACTOR AIR RESERVOIR
30.	ONE-WAY CHECK VALVE
31.	TRACTOR AIR RESERVOIR
32.	PRESSURE REGULATOR
33.	RETARDER VALVE
34.	RELIEF VALVE

AIR SYSTEM AND BRAKES**SYSTEMS OPERATION****AIR SYSTEM AND BRAKES**

All of the brakes in the brake system are shoe-type brakes. There is a brake at each wheel of the tractor and scraper. These brakes are activated by air pressure in brake actuators (5) and (6). The brake actuators give the machine three types of brakes: service, emergency and parking.

Air compressor (25) sends air to tractor air reservoirs (29) and (31) and scraper air reservoir (1). At brake control valve (17), the flow of air is divided into three separate circuits: service brake, parking and emergency brake and accessory air circuits.

SERVICE BRAKE CIRCUIT

When the brake pedal is pushed, pressure air is sent from brake control valve (17) to tractor relay valve (8). This air pressure opens the relay valve which sends air pressure on to the service brake chambers of the tractor brake actuators. At the same time that air pressure goes to tractor relay valve (8), it also goes to scraper relay valve (3). This air pressure opens the relay valve which permits air pressure to go from scraper air reservoir (1) to the service brake chambers of the scraper brake actuators.

During normal service brake application, air pressure from parking and emergency brake control valve (19) goes to double check valve (12), quick release and holding valves (7) and (4) and on to the parking and emergency brake chambers of the brake actuators. This releases the parking and emergency brakes. When the brake pedal is pushed (service brakes activated) before the parking and emergency brakes are released, double check valve (12) lets air pressure go to quick release and holding valves (7) and (4) and the parking and emergency brake chambers of brake actuators (5) and (6). This prevents parking and emergency brake application in addition to service brake application, and prevents damage to the brake slack adjusters and brake camshafts.

PARKING AND EMERGENCY BRAKE CIRCUIT

Parking and emergency brake control valve (19) is activated either manually or automatically. The valve is controlled manually by a knob and automatically when air pressure in the system is too low.

When there is no pressure in the air system, the knob on parking and emergency brake control valve is pulled out (parking and emergency brake ON position). There is no air pressure in the parking and emergency brake chambers of brake actuators (5) and (6). The parking and emergency brake spring force in the brake actuators keeps the brakes activated (parking brakes).

After the engine is started and air pressure is at the correct pressure for operation, the knob on the control valve must be pushed in and held for a moment (parking and emergency brake OFF position). Air pressure now goes from parking and emergency brake control valve (19) to double check valve (12), quick release and holding valves (7) and (4) and on to the parking and emergency brake chambers of brake actuators (5) and (6). The air pressure puts the parking and emergency brake springs of the brake actuators in compression. The parking and emergency brakes are released.

The machine can be stopped in an emergency by movement of the knob on the control valve to the parking and emergency brake ON position (pulled out). The flow of air pressure through parking and emergency brake control valve (19) is stopped. This causes quick release and holding valves (7) and (4) to move to the released (exhaust) position. This re-moves the air pressure from the parking and emergency brake chambers of brake actuators (5) and (6). The parking and emergency brake spring force in the brake actuators causes the brakes to activate (emergency brakes).

AIR SYSTEM AND BRAKES

SYSTEMS OPERATION

ACCESSORY CIRCUITS

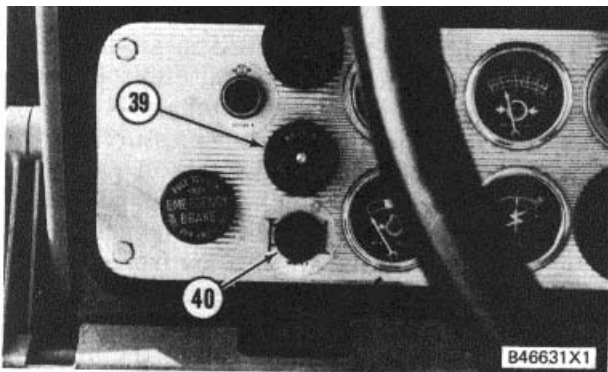
Air pressure for the accessory air circuits goes from brake control valve (17) to pressure protection valve (16) except for the air supply to retarder control valve (20), air pressure gauge (22), air horn solenoid valve (23), and the warning system. The pressure protection valve opens at approximately 75 psi (520 kPa) and sends air pressure to the remainder of the accessory circuits.

From pressure protection valve (16), the flow of air is to differential lock valve (11), transmission hold control valve (10), and apron control valve (13).

WARNING SYSTEM

A warning light and an electric horn give a warning of low air pressure. The light will operate when the parking or emergency brakes are activated. The electric horn will operate until the air pressure increases to approximately 75 psi (520 kPa). When the air pressure decreases to approximately 60 psi (415 kPa), the electric horn will again operate. Air pressure switch (11) controls the operation of the electric horn.

NOTE: Warning horn override switch (39) is on the dash. When the button is pushed, the operation of the electric horn will be stopped.



LEFT SIDE OF STEERING WHEEL
39. Warning horn override switch. 40. Air horn switch.

When the engine is started, the warning light will operate until the air pressure increases to approximately 75 psi (520 kPa). At this pressure, air pressure switch (12) will open and the warning light will not operate. When either the knob on the parking and emergency brake control valve is in the ON position (pulled out), or the air pressure decreases to approximately 60 psi (415 kPa), air pressure switch (18) closes to operate the warning light.

Air horn switch on the dash controls air horn solenoid valve (23). When the button is pushed, the solenoid valve opens to let air pressure go to air horn (24).

Any failure that results in a loss of air pressure will activate the emergency brakes, the electric horn and the warning light.

AIR COMPRESSOR AND GOVERNOR

The air compressor mounts on the engine and the air compressor governor controls the operating pressure.

The governor senses reservoir air pressure. If the reservoir pressure is low, nothing happens within the governor and the compressor continues to function. When the reservoir pressure reaches the maximum (cut-out) setting, air pressure moves the governor piston against its spring and allows air to flow from the governor to the compressor unloading valves. Compressed air acting against the unloading valves holds them open and stops the delivery of air from the compressor.

When the reservoir pressure drops to minimum (cut-in) pressure, the force of the governor spring returns the governor piston and stops the flow of air from the reservoir to the compressor unloading valves. The compressor unloading valves close and the compressor again delivers air to the reservoir.

AIR RELIEF VALVE

The air relief valve is fastened to the rear tractor air reservoir. If the governor does not operate correctly, the relief valve will open at approximately 150 psi (1030 kPa) to prevent damage to the air system. The setting of the relief valve can not be adjusted.

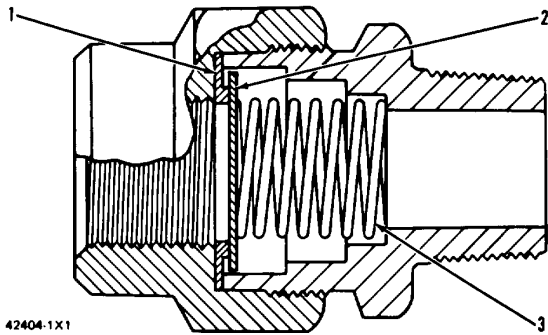
AIR SYSTEM AND BRAKES

SYSTEMS OPERATION

CHECK VALVE

The one-way check valves are used to let air flow in one direction only. Air, coming into the check valve on the internal thread end of the valve, will put spring (3) in compression and valve (2) will open. Air under pressure is now free to flow through the check valve.

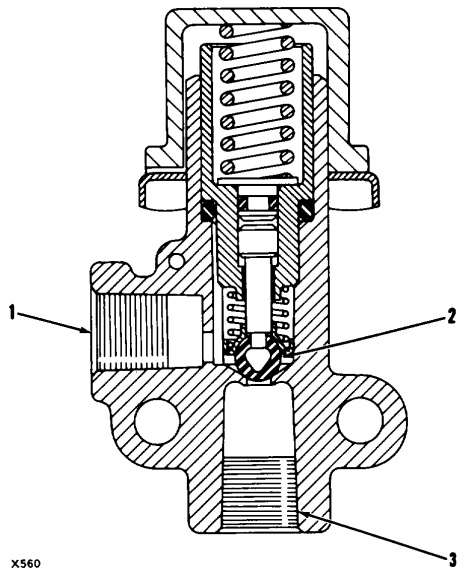
Air, coming into the check valve on the external thread end, will push valve (2) against seat (1). The flow of air is stopped.



COMPONENTS OF THE CHECK VALVE

- 1. Seat. 2. Valve. 3. Spring.

PRESSURE PROTECTION VALVE



PRESSURE PROTECTION VALVE

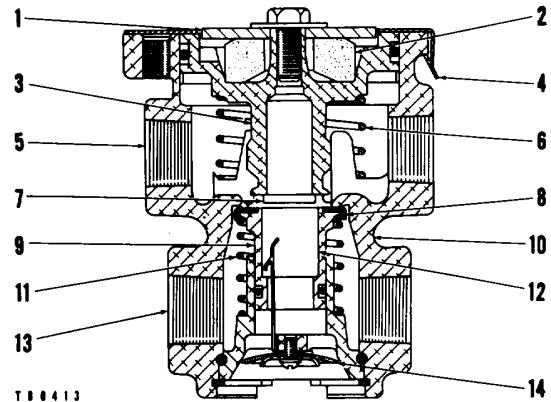
- 1. Supply port. 2. Valve spool. 3. Delivery port.

All air flow to the accessory air circuits must pass through the pressure protection valve. No air will flow through the valve until the pressure at supply port (1) reaches 75 psi (520 k Pa). When the pressure reaches 75 psi (520 kPa), spool (2) raises and allows air to pass through the valve and out delivery port (3).

BRAKE CONTROL VALVE

When the brake pedal is pushed, a force is put on seat (1). This force pushes rubber spring(2) and piston assembly (3) down. Valve seat (7) closes exhaust passage (12) in valve (9). Piston assembly (3) moves valve (9) off of valve seat (8). Pressure air from inlet passage (13) goes around valve (9) to outlet passage (5). The air then goes to the relay valves for the scraper and tractor brake actuators.

When the air pressure below piston assembly (3) becomes more than the force above the piston, the piston lifts enough to let valve (9) move up to valve seat (8). This stops the supply of pressure air. Piston assembly (3) is still in contact with valve (9), so exhaust passage (12) is also closed. The control valve is now in balance. Air pressure is held in the lines and the brake actuators.



BRAKE CONTROL VALVE

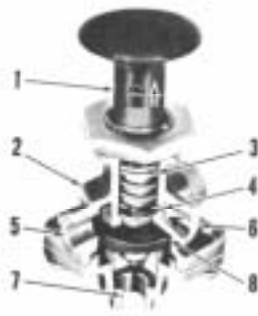
- 1. Seat. 2. Rubber spring. 3. Piston assembly. 4. Retainer. 5. Outlet passage. 6. Spring. 7. Valve seat. 8. Valve seat. 9. Valve. 10. Valve body. 11. Valve spring. 12. Exhaust passage. 13. Inlet passage. 14. Exhaust diaphragm.

AIR SYSTEM AND BRAKES

SYSTEMS OPERATION

If the pedal is lifted a small amount, the mechanical force above piston assembly (3) is less. The pressure air below the piston and the force of spring (6) will lift the piston off of valve (9). Pressure air in the lines and the brake actuators goes around piston assembly (3), through exhaust passage (12) and out exhaust diaphragm (14) until the forces above and below the piston are in balance. When the pedal is completely released, piston assembly (3) moves off valve (9) and releases the air pressure. Valve (9) is held against valve seat (8) by spring (11).

PARKING AND EMERGENCY BRAKE CONTROL VALVE



T87717

T87717

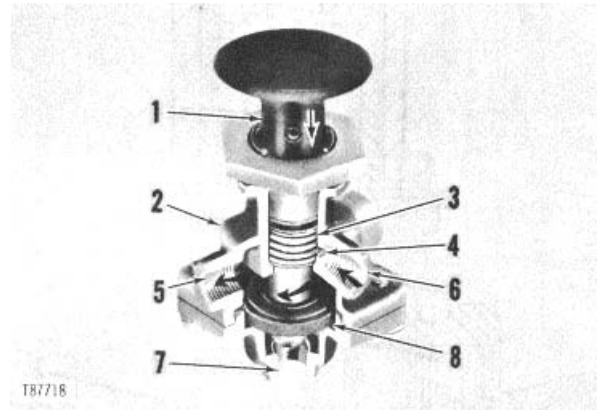
FLOW OF AIR (BRAKES APPLIED)

1. Knob. 2. Valve body. 3. Spring. 4. Orifice. 5. Outlet port (to brake actuators).
6. Inlet port (from air reservoir). 7. Exhaust port (to atmosphere). 8. Valve assembly.

With the air reservoir discharged, the parking and emergency brake control valve will be in the ON position [knob (1) pulled out]. Valve (8) will be seated against upper face of valve body (2) sealing off pressure air supply to outlet port (5) and exhaust port (7). Air pressure in the reservoir is allowed to build to the operating range.

When the air pressure gauge registers in the operating range, the operator must push in and hold knob (1) to release the brakes. Pressure air from the reservoir enters the valve through inlet port (6), passes through orifice (4) and outlet port (5) to the brake actuators, releasing the brakes. Air pressure then holds valve (8) seated over exhaust port (7).

The parking and emergency brake control valve can be actuated either manually or by a pressure reduction in the air system. To actuate the valve manually, the operator pulls knob (1) out to exhaust the pressure air and apply the brake.



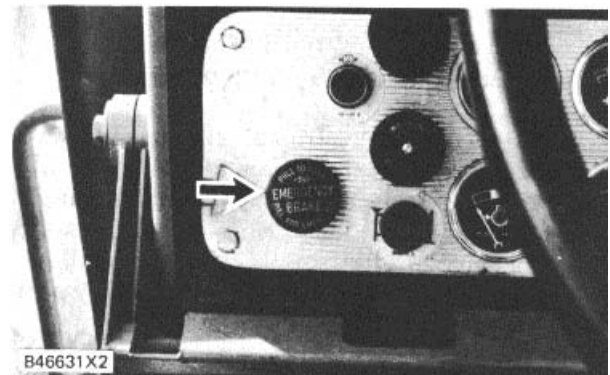
T87718

T87718

FLOW OF AIR (BRAKES RELEASED)

1. Knob. 2. Valve body. 3. Spring. 4. Orifice. 5. Outlet port (to brake actuators).
6. Inlet port (from reservoir). 7. Exhaust port (to atmosphere). 8. Valve assembly.

In the event of an air system failure or the pressure drops below approximately 40 psi (280 kPa), spring (3) will unseat valve (8), exhaust pressure air to the atmosphere and apply the brakes.

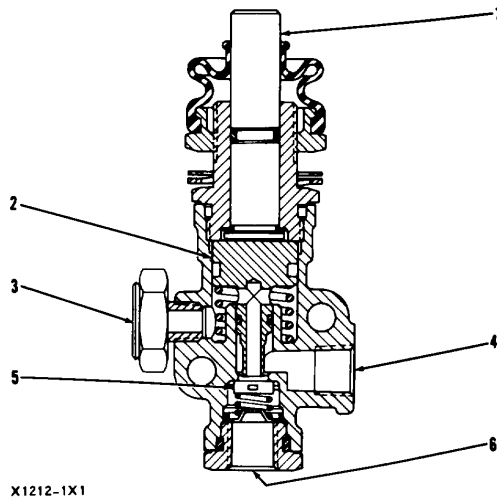


LOCATION OF PARKING AND EMERGENCY BRAKE CONTROL VALVE

AIR SYSTEM AND BRAKES

SYSTEMS OPERATION

DIFFERENTIAL LOCK VALVE



X1212-1X1

DIFFERENTIAL LOCK VALVE

1. Plunger. 2. Spool. 3. Exhaust port. 4. Delivery port. 5. Valve. 6. Supply port.

The differential lock valve controls the supply of air to the differential lock cylinder. Depressing the pedal moves plunger (1) and spool (2) down unseating valve (5). This allows air to flow from supply port (6) out through delivery port (4) to the locking piston. Releasing the pedal allows the valve to return, sealing supply port (6) and allowing air to flow from the piston out through exhaust port (3). The operation and construction of the transmission hold control valve is similar.

TRANSMISSION HOLD CONTROL VALVE

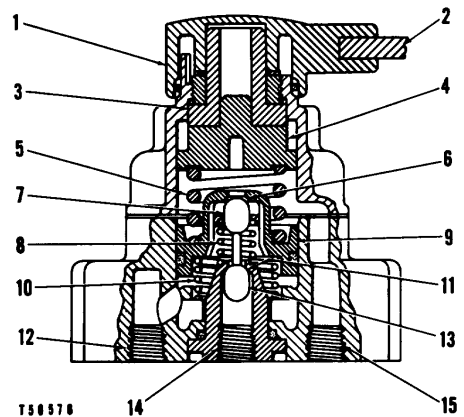
See DIFFERENTIAL LOCK VALVE. The operation and construction of the transmission hold control valve is similar to the differential lock valve. The transmission hold control controls the supply of air to the hydraulic control valve in the transmission.

RETARDER CONTROL VALVE

The retarder control valve controls the braking capacity of the retarder by metering air pressure to the retarder control group (hydraulic). The distance the air control valve handle is moved in a clock-wise direction, toward applied position. the greater the braking capacity of the retarder.

As control handle (2) is moved toward the applied position, head (1) and cam follower (3) are rotated, exerting a force on top pressure regulating spring (5) through the cam follower and cam (4).

This force on the pressure regulating spring moves piston (9) downward, engaging exhaust valve seat (6) in the piston with exhaust valve (7), sealing exhaust port (15) from delivery port (12). Exhaust valve (7) and inlet valve (13) are a rigid assembly. Therefore, after the exhaust valve is closed and the piston continues its downward movement, the inlet valve is forced off its seat (11). This permits air pressure from supply port (14) to flow past the inlet valve to delivery port (12) to actuate the retarder valves.



T38578

RETARDER AIR CONTROL VALVE

1. Head. 2. Handle. 3. Cam follower. 4. Cam. 5. Pressure regulating spring. 6. Exhaust valve seat. 7. Exhaust valve. 8. Spring. 9. Piston. 10. Piston return spring. 11. Inlet valve seat. 12. Delivery port. 13. Inlet valve. 14. Supply port. 15. Exhaust port.

When the air pressure below the piston becomes slightly greater and overcomes the mechanical force exerted above the piston, the piston lifts, but only enough to permit inlet valve (13) to move upward and seat, cutting off any further supply of air pressure. Exhaust valve (7) remains seated, preventing any loss of air pressure through the exhaust port. Thus, the retarder air control valves are in a balanced position with the forces below and above the piston being equal.

If the control handle is partially moved toward the off position, the mechanical force above the piston is decreased. The greater force below the piston, exerted by air pressure and piston return

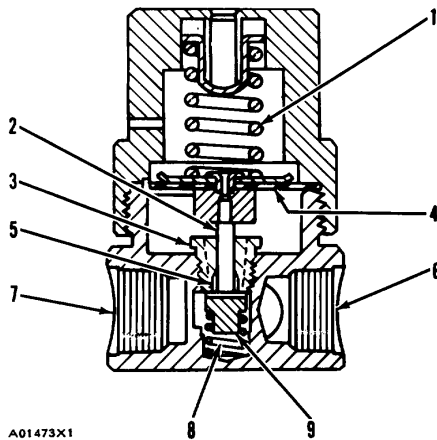
AIR SYSTEM AND BRAKES

spring (10), lifts the piston, unseating exhaust valve (7), until a decreased pressure is established to balance the decreased mechanical force above the piston. When the handle is moved to the full off position, the exhaust valve will remain open exhausting all air pressure from the retarder control group. Inlet valve (13) is held in its seat by spring(8).

REGULATOR FOR RETARDER CONTROL VALVE

There is a regulator for the retarder control valve in each air line to the hydraulic control valve of each retarder. It keeps the air pressure from the retarder control valve to a maximum of approximately 65 psi (450 kPa).

When the air pressure is between 0 and 65 psi (0 and 450 kPa), the force of spring (1) against diaphragm (4) and stem (2) keeps valve (9) off of seat (3). Air pressure goes through inlet passage (6) to air chamber (5). With valve (9) held off of seat (3), air pressure can go out delivery passage (7) to the inlet passage of the hydraulic control valve on the retarder. When air pressure from the retarder control valve becomes higher than 65 psi (450 kPa), the air pressure in delivery passage (7) and the force of spring (8) move valve (9) up to seat (3) against the force of spring (1). This stops the increase of pressure in the delivery passage.



A01473X1

REGULATOR

- 1. Spring. 2. Stem. 3. Seat. 4. Diaphragm.
- 5. Air chamber. 6. Inlet passage. 7. Delivery passage. 8. Spring. 9. Valve.

SYSTEMS OPERATION

When the handle on the retarder control valve is moved away from the operator, air pressure in inlet passage (6) becomes less. As the air pressure decreases below 65 psi (450 kPa), the force of spring (1) on the diaphragm and the stem will again move valve (9) off of seat (3). The air pressure in delivery passage (7) can then go out inlet passage (6) to exhaust passage of the retarder control valve.

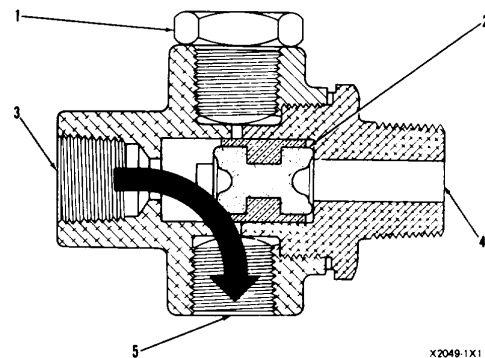
DOUBLE CHECK VALVE FOR BRAKE ACTUATORS

This double check valve is to keep the parking and emergency brake piston and the service brake diaphragm in the brake actuators from being activated at the same time. This would damage the slack adjusters and brake camshafts

When the brake pedal is pushed before the parking and emergency brake control valve is re-released, there is no air pressure at inlet passage (4).

Air pressure from the brake control valve causes shuttle (2) to move to the left and air pressure goes to the parking and emergency brake chamber of the brake actuator. This causes the parking and emergency brakes to release as the service brakes are activated.

When the brake pedal is released and the parking and emergency brake control valve is moved to the OFF position (pushed in), there is no air pressure at inlet passage (3). Air pressure from the parking and emergency brake control valve causes shuttle (2) to move to the right and again releases the parking and emergency brakes.



X2049-1X1

DOUBLE CHECK VALVE

- 1. Plug. 2. Shuttle. 3. Inlet passage from parking and emergency brake control valve.
- 4. Inlet passage from brake control valve.
- 5. Outlet to brake actuators.

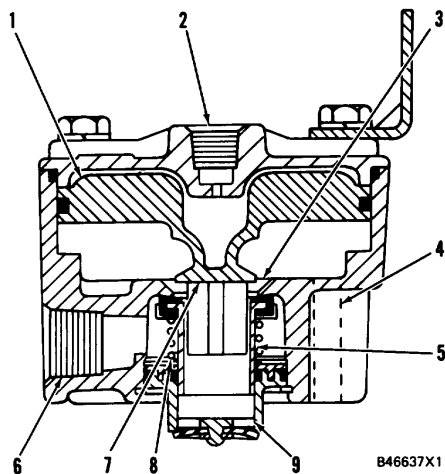
AIR SYSTEM AND BRAKES

SYSTEMS OPERATION

RELAY VALVE FOR TRACTOR BRAKES

Supply passage (6) is connected to the air reservoirs on the tractor. Spring (8) holds valve (5) on its seat to stop the flow of air to delivery passage (4).

When air pressure is sent to control passage (2), piston (1) will be forced down. As piston (1) moves down, valve (7), part of piston (1), will make contact with valve (5) and close the exhaust passage inside valve (5). Piston (1) will push valve (5) down and open a passage so that air from supply passage (6) will go through the valve and out delivery passage (4) to the tractor brake actuators.



TRACTOR RELAY VALVE

1. Piston. 2. Control passage. 3. Valve passage. 4. Delivery passage. 5. Valve. 6. Supply passage. 7. Valve [part of piston (1)]. 8. Spring. 9. Exhaust passage.

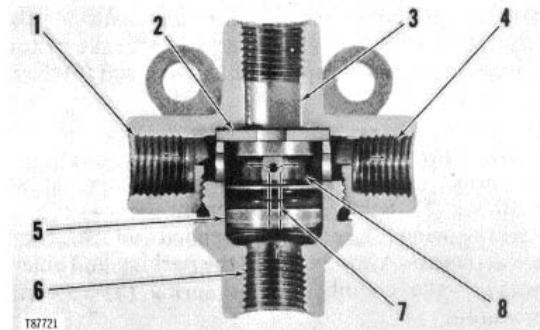
When the air pressure to control passage (2) is released, spring (8) will push valve (5) up and stop the flow of supply air pressure through supply passage (6). Air pressure in delivery passage (4) will push piston (1) up against the cover of the valve. Valve (7) will move away from valve (5), and open a passage through valve (5), so the air pressure can go out through exhaust passage (9).

QUICK RELEASE AND HOLDING VALVE

The quick release and holding valves reduce the time required to apply the parking and emergency brakes by hastening the exhaust of air pressure from the parking and emergency brake chambers of the brake actuators.

When the parking and emergency brake control valve is moved to release the brakes or when the brake control valve is activated, air enters the quick release and holding valve through inlet port (6). Shuttle assembly (5) moves against sealing washer (2) to close exhaust port (3). Air enters drilled passage (7) in the shuttle expanding sealing band (8). As the band expands, it unseats from the opening in air passage (7) sending air to the parking and emergency brake chambers of the brake actuators to release the brakes.

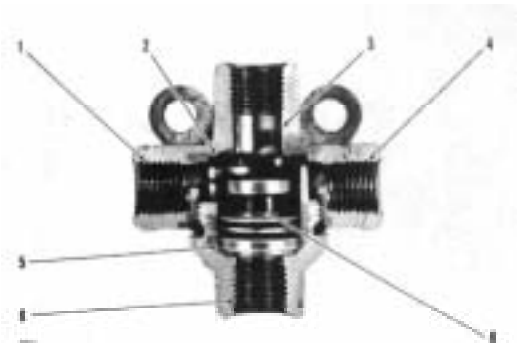
When the valve assumes its holding position, pressures at inlet port (6) and outlet ports (1) and (4) are equal. Sealing band (8) has contracted, closing air passage (7) through shuttle (5) blocking the re-turn of air from the parking and emergency brake chambers.



187721

QUICK RELEASE AND HOLDING VALVE IN PARKING BRAKE RELEASED POSITION

1. Outlet port to brake chamber. 2. Sealing washer. 3. Exhaust port to atmosphere. 4. Outlet port to brake chamber. 5. Shuttle assembly. 6. Inlet port. 7. Air passage through shuttle. 8. Rubber sealing band.



QUICK RELEASE AND HOLDING VALVE IN PARKING BRAKE APPLIED POSITION

1. Outlet port to brake chamber. 2. Sealing washer. 3. Exhaust port to atmosphere. 4. Outlet port to brake chamber. 5. Shuttle assembly. 6. Inlet port. 8. Rubber sealing band.

AIR SYSTEM AND BRAKES

A pressure reduction, caused either by an application of the parking and emergency brake control valve, the release of the brake control valve or a failure, will activate the quick release and holding valves.

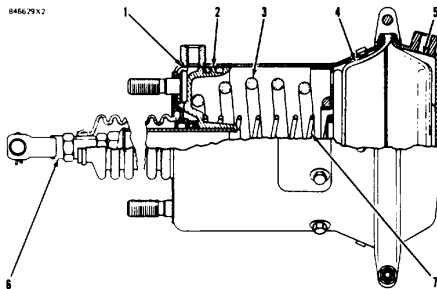
When the pressure at port (6) is reduced, shuttle (5) unseats from exhaust port (3). This allows the air in the parking and emergency brake chambers to exhaust and apply the brakes.

BRAKE ACTUATOR WITH PARKING AND EMERGENCY BRAKE

Each brake actuator has two air chambers: parking and emergency brake chamber (1) and service brake chamber (5). When there is no pressure in the air system, the air pressure in parking and emergency brake chamber (1) is released. Parking and emergency brake spring (3) moves parking and emergency brake piston (2) and rod (6) to activate the brakes.

The brakes stay activated until the air system is at the correct pressure for operation and the parking and emergency brake control valve is moved to the OFF position (knob is pushed in). At this time, air pressure goes into parking and emergency brake chamber (1). Parking and emergency brake piston (2) moves against its spring and moves rod (6) to re-release the brakes.

When the brake pedal is pushed, air pressure from the brake control valve goes into service brake chamber (5). Service brake diaphragm (4) moves against spring (7), rod (6) is extended and the brakes are activated. Air pressure in the parking and emergency brake chamber keeps spring (3) in compression.



BRAKE ACTUATOR

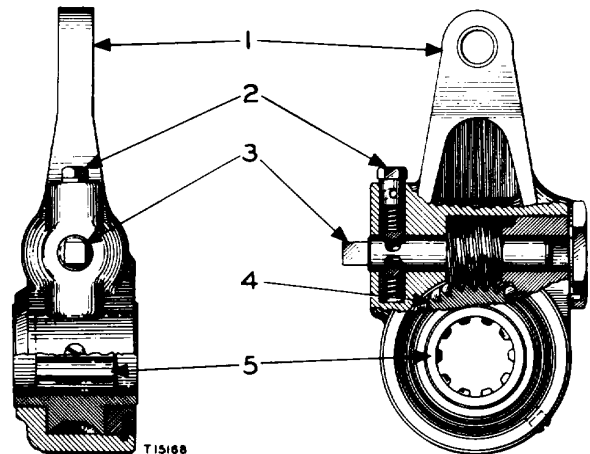
- 1. Parking and emergency brake chamber.
- 2. Parking and emergency brake piston.
- 3. Parking and emergency brake spring.
- 4. Service brake diaphragm.
- 5. Service brake chamber.
- 6. Rod.
- 7. Service brake return spring.

SYSTEMS OPERATION

When air pressure decreases to approximately 40 psi (280 kPa), the parking and emergency brake control valve closes automatically (moves to the ON position) and stops the flow of air to parking and emergency brake chamber (1). Spring (3) is no longer in compression and pushes rod (6) out. The brakes are activated (emergency brakes). This same operation takes place when the parking and emergency brake control valve is manually moved to the ON position (pulled out). This activates the service brakes for parking.

SLACK ADJUSTER

The slack adjusters function as adjustable levers and provide a quick and easy method of adjusting the brakes to compensate for brake lining wear. One slack adjuster is used for the brake on each wheel. The slack adjuster operates as a unit, rotating with the brake camshaft.



TYPICAL SLACK ADJUSTER

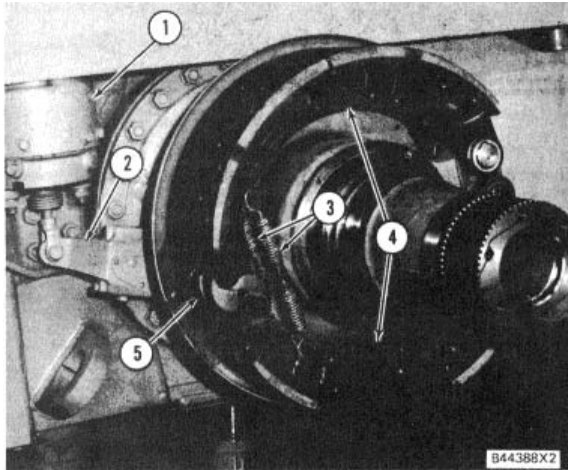
- 1. Arm.
- 2. Adjustment lock.
- 3. Worm.
- 4. Worm gear.
- 5. Spline.

Arm (1) is connected to the brake actuator push rod, spline (5) is connected to the brake camshaft. Worm (3), adjustment lock (2) and worm gear (4) are used to adjust the slack adjuster.

AIR SYSTEM AND BRAKES

SYSTEMS OPERATION

WHEEL BRAKE

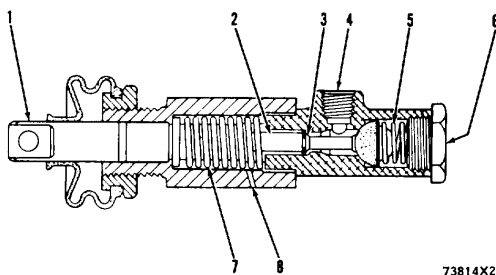


TRACTOR WHEEL BRAKE

1. Brake actuator. 2. Slack adjuster. 3. Return springs. 4. Brake shoes. 5. Brake camshaft.

Air operated brakes are used on the wheels. Air pressure moves brake actuator () which turns slack adjuster (2). The slack adjuster turns brake cam-shaft (5) against the ends of brake shoes (4). The brake shoes are then pushed against the brake drum. When the air pressure is released, the brake actuator returns to its original position and return springs (3) move the brake shoes back to their original position.

APRON CONTROL VALVE



APRON CONTROL VALVE

1. Plunger. 2. Stem. 3. Chamfer on stem. 4. Delivery passage. 5. Spring. 6. Supply passage. 7. Spring. 8. Exhaust passage.

The apron control valve is connected through linkage to the bowl control lever at the operator's station. The flow of air goes into supply passage (6). When the bowl control lever is pushed forward, plunger (1) is pushed into the control valve. The plunger moves stem (2) to open a passage from supply passage (6) to delivery passage (4). Chamfer (3) closes the opening from deliver passage (4) to exhaust passage (8). Pressure air then goes through the control valve to the air control valve at the bottom of the apron valve spool in the implement control valve. The air pressure will move the apron valve spool into the LOWER position.

When the bowl control lever is released, plunger (1) is moved by spring (7). Spring (5) moves stem (2) to stop the flow of air to delivery passage (4). This also opens the delivery passage to exhaust passage (8). Air in the line to the air control valve is released through the exhaust passage. The apron valve spool will then move back to the HOLD position.

AIR SYSTEM AND BRAKES

TESTING AND ADJUSTING

AIR SYSTEM AND BRAKES

⚠ WARNING

Sudden movement of the machine or release of air under pressure can cause injury to persons on or near the machine. To prevent possible injury, do the procedure that follows before testing and adjusting the air system and brakes:

1. Move the machine to a smooth horizontal location. Move away from working machines and personnel. Stop the engine.
2. Permit only one operator on the machine. Keep all other personnel either away from the machine or in view of the operator.
3. Activate the parking and emergency brakes. Lower the bowl to the ground. Lower the apron, if so equipped. Put blocks in front of and behind the wheels.
4. Push on the brake pedal many times until there is no more brake air pressure.
5. Make sure all air pressure is released before any fitting, hose or component is loosened, tightened, removed or adjusted.

NOTE: Before any operation checks are made, open the drain valves to release any water in the air reservoirs. Water lowers the capacity in the reservoirs and can cause the air compressor to run constantly. Close the drain valve. Start the engine and operate the machine until it is at the normal temperature for operation.

VISUAL CHECKS

Before any operation checks are made to the air system and brakes, visually inspect the complete system as follows:

1. Check for cracks or wear in hoses and lines.
2. Check for restriction to flow, like sharp bends, clamps that are not installed correctly, and damage to hoses and lines.
3. Check for loose connections.
4. Check for damage to components.

OPERATION CHECKS

Operation checks of the air system and brakes can be used to find the source of leakage in the system or to make a diagnosis of bad performance.

⚠ WARNING

Make reference to WARNING at the beginning of AIR SYSTEM AND BRAKES TESTING AND ADJUSTING section.

Leakage Checks

**Tools Needed: 8M2885 Pressure Gauge, 0 to 200 psi (0 to 1380 kPa).
5S5123 or 6V4161 Hydraulic Testing Group.**

NOTE: It is possible to hear the sound of air leakage. Air leakage can be seen when water with soap (soapy water) is put on the connections, valves and hoses.

1. Start the tractor engine and let the air pressure go up to the cutout pressure. Stop the engine.

NOTE: The governor cutout pressure is to be 115 to 125 psi (795 to 860 kPa). If cutout pressure is not correct, see the subject, AIR COMPRESSOR GOVERNOR.

2. Check for leakage in the hoses, lines and connections from the air compressor and governor to the tractor reservoirs.
3. Check for leakage in the hoses, lines and connections from the tractor reservoirs to the brake control valve.
4. Check for leakage in the brake control valve.

NOTE: If the air pressure gets below 95 psi (660 kPa) (cut-in pressure), start and run the tractor engine until the air pressure goes up to the cutout pressure.

5. Check for leakage in the hoses, lines and connections from the brake control valve to the accessory air circuit and the scraper reservoir and relay valve.
6. Check for leakage in the valves and switches.
7. Check for leakage in the hoses, lines and connections from the brake control valve to the parking and emergency brake control valve.
8. Move the knob on the parking and emergency brake control valve to the OFF position (pushed in).
9. Check for leakage in the hoses, lines and connections from the parking and emergency brake control valve to the double check valve and the quick release holding valves.

AIR SYSTEM AND BRAKES

10. Check for leakage in the double check valve and the quick release and holding valves.
11. Check for leakage in the hoses, lines, connections and components from the quick release and holding valves to the tractor and scraper brake actuators.
12. Push the pedal for the brake control valve. Check for leakage in the hoses, lines and connections from the brake control valve to the scraper relay valve and the scraper brake actuators.
13. Check for leakage in the hoses, lines and connections from the brake control to the tractor relay valve and the tractor brake actuators. Release the pedal.
14. Operate each valve in the accessory circuit separately.
15. Check for leakage in the hoses, lines, connections and components from each valve.

NOTE: During the time the valves are checked for leakage, check the exhaust passages for restrictions, like mud or dirt. A restriction in an exhaust passage will prevent or slow the release of pressure air during normal operations.

Parking and Emergency Brake Check

1. Start the tractor engine and let the pressure go up to the cutout pressure.
2. Lift the bowl (empty).
3. Move the knob on the parking and emergency brake control valve to the ON position (pulled out).
4. The brake actuators must hold the rods extended.
5. If the brake actuators do not hold the rods, see TROUBLESHOOTING.
6. Move the knob on the control valve to the OFF position (pushed in).
7. The brake actuators must release the rods.
8. If the brake actuators do not release, see TROUBLESHOOTING.

Accessory Circuit Checks**Transmission Hold Control Valve**

1. Start the tractor engine and let the pressure go up to the cutout pressure.
2. Put the bowl (empty) on the ground with down pressure. Make sure the parking brakes are activated.
3. Push the pedal for the hold control valve down fully and hold.

TESTING AND ADJUSTING

4. Operate the engine at low idle rpm.
5. Move the transmission shift lever from Neutral to 1st speed.
6. If the transmission goes into 1st speed, see TROUBLESHOOTING.
7. Release the pedal.
8. If the transmission does not go into 1st speed, see TROUBLESHOOTING.
9. Stop the engine.

Retarder Control Valve For The Tractor

NOTE: Engine performance must be good in order to get an accurate check.

1. Start the tractor engine and let the pressure go up to the cutout pressure.
2. Lift the bowl (empty).
3. Put the transmission shift lever in the NEUTRAL position.
4. Operate the tractor engine at high idle rpm.
5. Pull the lever on the retarder control valve.
6. The engine rpm must be 2010 ± 50 rpm for the 621B and 623B. The engine rpm must be 1950 ± 150 rpm for the 627B.

CAUTION

Do not get the transmission oil too hot.

7. If the rpm is not correct, see TROUBLESHOOTING.
8. Push the lever back to the RELEASE position.
9. The rpm must go up to the high idle specification.
10. If the rpm does not go up to the high idle specification, see TROUBLESHOOTING.
11. Stop the tractor engine.

Apron Control Valve

1. Start the engine and let the pressure go up to the cutout pressure.
2. Lift the apron.
3. Move the bowl control lever forward.
4. The apron must lower.
5. If the apron does not lower, see TROUBLESHOOTING.
6. Move the bowl control lever back to the HOLD position.
7. If the apron still lowers, see TROUBLESHOOTING.

AIR SYSTEM AND BRAKES

TESTING AND ADJUSTING

TROUBLESHOOTING

Item	Problem	Item	Problem
1.	Service Brakes Do Not Engage Correctly.	9.	Transmission Hold Does Not Engage Correctly.
2.	Service Brakes Do Not Release Correctly.	10.	Transmission Hold Does Not Release Correctly.
3.	Parking and Emergency Brakes Do Not Engage Correctly.	13.	Throttle Lock Does Not Engage Correctly.
4.	Parking and Emergency Brakes Do Not Release Correctly.	14.	Throttle Lock Does Not Release Correctly.
5.	Retarder Does Not Engage Correctly.	15.	Apron Will Not Lower When Bowl Control Lever Is Pushed Forward.
6.	Retarder Does Not Release Correctly.	16.	Apron Does Not Stop When Bowl Control Lever is Moved Out of the Lower (Forward) Position.
7.	Differential Lock Does Not Engage Correctly.		
8.	Differential Lock Does Not Release Correctly.		

NOTE: If the TROUBLESHOOTING gives an indication that pressure air is not available at the supply passage(s) of the control valves. loosen the connection at the supply passage and use soapy water to check for pressure air.

If the TROUBLESHOOTING gives an indication of leakage through a control valve(s), disconnect the delivery hose at the end opposite the delivery passage. Put the end of the hose in a pan of water to check for leakage.

1. SERVICE BRAKES DO NOT ENGAGE CORRECTLY

Causes:

- a. No pressure air at the inlet passage of the brake control valve.
- b. Wear or damage to brake control valve permits little or no pressure air at the outlet passages.
- c. Wear or damage to the components between the brake control valve and the tractor brake actuators.
- d. Wear or damage to the scraper relay valve permits little or no pressure air at the delivery passages to the scraper brake actuators.
- e. Wear or damage to the brake actuators.
- f. Adjustment of rod travel of brake actuators.
- g. Brakes have wear or damage.

2. SERVICE BRAKES DO NOT RELEASE CORRECTLY

Causes:

- a. Mud or dirt under pedal does not let the brake control valve release fully.
- b. Wear or damage to the brake control valve prevents or slows the release of pressure air from the lines to the tractor relay valve on the tractor brake actuators and/or the line to the scraper relay valve.
- c. Wear or damage to the scraper relay valve prevents or slows the release of pressure air from the scraper brake actuator.
- d. Wear or damage to the components between the brake control valve and the tractor brake actuators.
- e. Wear or damage to the brake actuators.
- f. Wear or damage to the parking and emergency brake control valve releases the pressure air to the parking and emergency brake chambers in the brake actuators.
- g. Wear or damage to the quick release and holding valves and, or the double check valve.

3. PARKING AND EMERGENCY BRAKES DO NOT ENGAGE CORRECTLY

Causes:

- a. Wear or damage to the parking and emergency brake control valve prevents or slows the release of pressure air.

AIR SYSTEM AND BRAKES

TESTING AND ADJUSTING

- b. Wear or damage to the quick release and holding valves and/or the double check valve.
- c. Adjustment of rod travel of brake actuators not correct.
- d. Brakes have wear or damage.
- e. Wear or damage to the brake actuators.

4. PARKING AND EMERGENCY BRAKES DO NOT RELEASE CORRECTLY

Causes:

- a. Wear or damage to the parking and emergency brake control valve releases the pressure air to the parking and emergency brake chambers in the brake actuators.
- b. Wear or damage to the quick release and holding valves.
- c. Wear or damage to the brake actuators.

5. RETARDER DOES NOT ENGAGE CORRECTLY (Tractor and/or Scraper)

Causes:

- a. No pressure air at the supply passage of the control valve.
- b. Wear or damage to the control valve permits little or no pressure air at the delivery passage.
- c. Wear or damage to the regulator valve.
- d. Wear or damage to the hydraulic control valve for the retarder.
- e. Wear or damage to the retarder.

6. RETARDER DOES NOT RELEASE CORRECTLY (Tractor and,; or Scraper)

Causes:

- a. Wear or damage to the control valve prevents or slows the release of pressure air from the line to regulator valve.
- b. Wear or damage to the regulator valve.
- c. Wear or damage to the hydraulic control valve for the retarder.

7. DIFFERENTIAL LOCK DOES NOT ENGAGE CORRECTLY

Causes:

- a. No pressure air at the supply passage of the differential lock valve.
- b. Wear or damage to the differential lock valve permits little or no air pressure at the differential lock.
- c. Pedal adjustment not correct.

8. DIFFERENTIAL LOCK DOES NOT RELEASE CORRECTLY

Causes:

- a. Wear or damage to the differential lock valve prevents or slows the release of pressure air from the line to the differential lock.
- b. Pedal adjustment not correct.

9. TRANSMISSION HOLD DOES NOT ENGAGE CORRECTLY

Causes:

- a. No pressure air at the supply passage of the hold control valve.
- b. Wear or damage to the hold control valve permits little or no pressure air at the hold valve in the transmission hydraulic controls.
- c. Wear or damage to the hold in the transmission hydraulic controls.
- d. Pedal adjustment not correct.

10. TRANSMISSION HOLD DOES NOT RELEASE CORRECTLY

Causes:

- a. Wear or damage to the hold control valve prevents or slows the release of pressure air from the line to the hold valve in the transmission hydraulic controls.
- b. Wear or damage to the hold valve in the transmission hydraulic controls.
- c. Pedal adjustment not correct.

AIR SYSTEM AND BRAKES**TESTING AND ADJUSTING****13. THROTTLE LOCK DOES NOT ENGAGE CORRECTLY**

Causes:

- a. No pressure air at the supply passage of the throttle lock control valve.
- b. Wear or damage to the throttle lock control valve permits little or no pressure air at the air chamber for throttle lock.
- c. Wear or damage to the air chamber.
- d. Adjustment of air chamber linkage not correct.

14. THROTTLE LOCK DOES NOT RELEASE CORRECTLY

Causes:

- a. Wear or damage to the throttle lock control valve prevents or slows the release of pressure air from the line to the air chamber for throttle lock.
- b. Wear or damage to the air chamber.
- c. Adjustment of air chamber linkage not correct.
- d. No pressure air at the pilot passage of the throttle lock control valve.

15. APRON WILL NOT LOWER WHEN BOWL CONTROL LEVER IS PUSHED FORWARD

Causes:

- a. No pressure air at the supply passage of the apron control valve.
- b. Wear or damage to the apron control valve (air) permits little or no pressure air at the air control valve on the implement control valve.
- c. Wear or damage to the air control valve.

16. APRON DOES NOT STOP WHEN BOWL CONTROL LEVER IS MOVED OUT OF THE APRON LOWER (FORWARD) POSITION

Causes:

- a. Wear or damage to the apron control valve (air) prevents or slows the release of pressure air from the line to the air control valve on the implement control valve.
- b. Wear or damage to the air control valve.

AIR SYSTEM AND BRAKES

TESTING ADJUSTING

TEST PROCEDURES

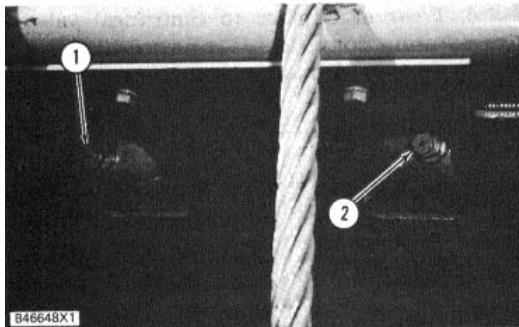
WARNING

Make reference to **WARNING** on first page of **AIR SYSTEM AND BRAKES TESTING AND ADJUSTING** section.

Air Pressure Gauge

**Tools Needed: 8M2885 Pressure Gauge, 0 to 200 psi (0 to 1380 kPa).
SS5123 or 6V4161 Hydraulic Testing Group.**

1. Release the pressure air from the tractor reservoirs by opening front drain valve (1).
2. Remove the front drain valve.
3. Install an adapter assembly and the hose assembly in the opening for the drain valve.
4. Connect the hose assembly to the IS8937 Valve from the test group. Connect the 200 psi (1380 kPa) gauge to the valve.



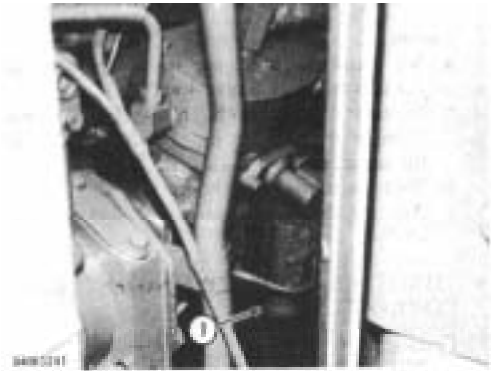
DRAIN VALVES

1. Front tank drain valve. 2. Rear tank drain valve.

5. Start the tractor engine and let the pressure go up to the cutout pressure.
6. Make a comparison of the pressure gauge on the machine with the test gauge.
7. If the pressure on the gauge on the machine is more than 15 psi (105 kPa) different than the pressure on the test gauge, install a new gauge.
8. If it is necessary to install a new gauge, stop the engine and open the rear drain valve until the pressure in the tractor reservoirs is released.
9. Do not disconnect the test gauge. It will be used in other tests.

Air Compressor Governor

1. Start the tractor engine and let the pressure go up to the cutout pressure.
2. Read the cutout pressure on the test gauge.
3. Push the brake pedal rapidly several times.
4. Read the cut-in pressure on the test gauge.



AIR COMPRESSOR

1. Cover.

5. The cut-in pressure is 95 to 100 psi (660 to 690 kPa). The cutout pressure is 120 ± 5 psi (830 ± 35 kPa).
6. If necessary, make an adjustment to the air compressor governor as follows:
 - a. Remove cover (1) on top of the governor.
 - b. Loosen the locknut on the adjustment screw.
 - c. Turn the adjustment screw counterclockwise to make the cutout pressure higher. One turn of the adjustment screw changes the pressure approximately 20 psi (140 kPa). The cut-in pressure will change the same amount.
7. If the adjustment screw does not change the cutout pressure, the unloading valves in the air compressor are not working correctly.
8. If the cut-in to cutout pressure difference is not correct, the governor is not working correctly.

Air Relief Valve

The air relief valve opens at 150 psi (1030 kPa) and has no adjustment.

AIR SYSTEM AND BRAKES

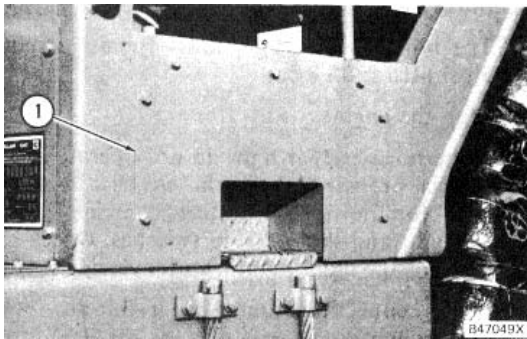
TESTING AND ADJUSTING

Pressure Protection Valve

All Tractors

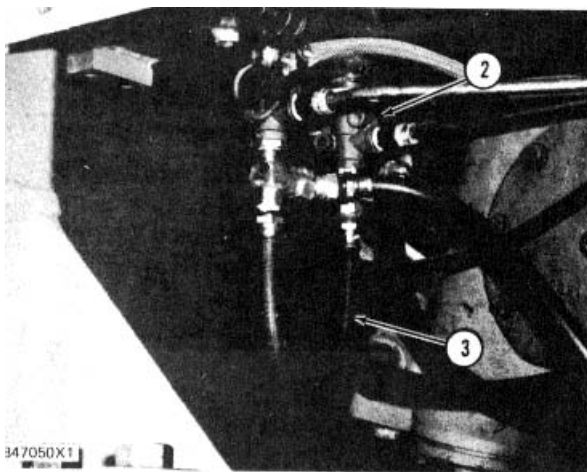
Tools Needed: 8M2885 Pressure Gauge, 0 to 200 psi (01 to 1380 kPa).

1. Make sure the air pressure is released from the tractor reservoirs by opening the rear drain valve.
2. Close the drain valve.



LEFT SIDE OF TRACTOR
1. Plate assembly.

3. Remove plate assembly (1) from the left side of the tractor.
4. Disconnect hose assembly (3) from differential lock control valve (2).



DIFFERENTIAL LOCK CONTROL VALVE
2. Differential lock control valve. 3. Hose assembly.

5. Connect the pressure gauge to hose assembly (3).
6. Start the tractor engine.

7. The pressure on the pressure gauge will be 0 psi (0 kPa) until the pressure protection valve opens.
8. As soon as the pressure increases on the pressure gauge, read the pressure on the pressure gauge in the front drain valve.
9. The pressure protection valve must open at 75 psi (520 kPa).
10. Stop the engine.

Optional Method

1. Make sure the pressure air is released from the tractor reservoirs by opening the rear drain valve.
2. Close the drain valve.
3. Start the tractor engine.
4. Move the apron control lever to lift the apron.
5. Move the bowl control lever forward to lower the apron.
6. When the apron starts to lower, look at the test gauge.
7. The pressure protection valve must open at 75 psi (520 kPa).
8. Stop the engine.

Parking and Emergency Brake Control Valve

1. Start the tractor engine and let the pressure go up to cutout pressure [120 ± 5 psi (830 ± 35 kPa)].
2. With the control knob for the parking and emergency brakes in the OFF position (pushed in), stop the engine.
3. Push the brake pedal rapidly several times, until the control knob automatically moves to the ON position.
4. Read the pressure on the gauge.
5. The correct pressure to automatically engage the brakes is 40 ± 5 psi (280 ± 35 kPa). If the pressure on the gauge is not correct, the operation of the control valve is not correct.
6. Disassemble the control valve and check for worn or damaged parts.
7. If this does not correct the problem, install a new valve.

AIR SYSTEM AND BRAKES**TESTING AND ADJUSTING****Quick Release and Holding Valve**

1. Start the tractor engine and let the pressure go up to cutout pressure.
2. Move the control knob of the parking and emergency brakes in and out (OFF and ON).
3. If the brakes do not activate and release immediately when the control knob is moved, there is a failure in one or both of the quick release and holding valves.

NOTE: There are two quick release and holding valves, one for the scraper and one for the tractor. It will take a moment for the brakes to activate, but the brakes must release immediately.

Warning System

1. Turn on the disconnect switch.
2. Start the tractor engine.
3. Let the pressure go up to approximately 100 psi (690 kPa).
4. The electric horn and the warning light for low air pressure will operate until the pressure is approximately 75 psi (520 kPa).
5. If the horn and or light do not operate, stop the engine.
6. Check the electrical connections for the horn, the horn override switch, the light and the pressure switches. Check the bulb for the light.
7. If the connections are good, connect a continuity light across the terminals of one of the pressure switches.

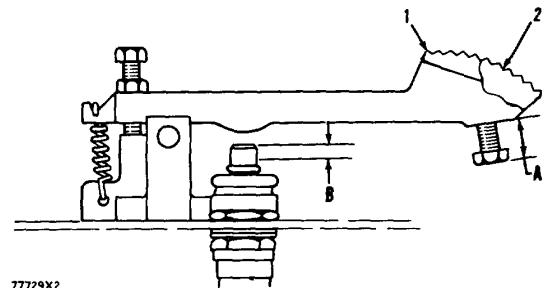
NOTE: The air pressure must be below the specifications of the pressure switches.

8. If the continuity light does not operate, install a new pressure switch.
9. Check the other pressure switch.
10. If the electric horn does not operate, connect a continuity light across the terminals of the horn override switch.
11. If the continuity light does not operate, install a new horn override switch.
12. If the horn and or light operate above 60 psi (415 kPa), stop the engine.

13. Install new pressure switch(es).
14. Start the tractor engine.
15. Let the pressure go up to approximately 100 psi (690 kPa).
16. Slowly open the rear drain valve.
17. The horn and the light must operate at 60 ± 5 psi (415 ± 35 kPa).
18. Stop the engine.
19. If the horn and or light do not operate at the correct pressure, check the electrical connections for the horn, the horn override switch, the light and the pressure switches. Check the bulb for the light and the horn override switch.
20. If the connections are good, install new pressure switch(es).
21. Remove the test equipment.

WARNING

Before the test equipment is disconnected, make reference to **WARNING** on first page of **AIR SYSTEM AND BRAKES TESTING AND ADJUSTING** section.

TRANSMISSION HOLD AND DIFFERENTIAL LOCK PEDAL ADJUSTMENT**PEDAL ADJUSTMENT**

1. Transmission hold pedal. 2. Differential lock pedal. A..75 in. (19.1 mm) dimension. B..16 ± .03 in. (4.1 ± 0.8 mm) dimension.

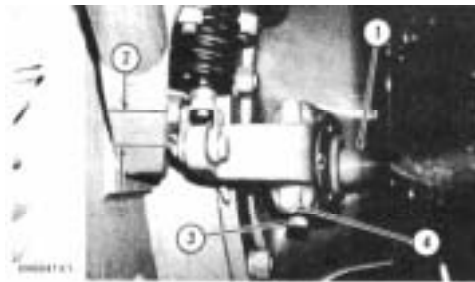
AIR SYSTEM AND BRAKES

TESTING AND ADJUSTING

1. Adjust the bolt on the bottom of pedals (1 and 2) so there is a clearance (A) of approximately $.75$ in. (19.0 mm) between the bottom of the bolt head and the bottom of the shoulder on the pedals.
2. With the pedal, fully depressed the bolt should be adjusted to allow a valve stem movement (B) of $.164 \pm .03$ in. (4.1 ± 0.8 mm).

BRAKE ADJUSTMENT

1. Measure movement (2) of the slack adjuster at the pin when the brakes are applied. If the movement is 2.5 in (64 mm) or more, adjust the brakes.
2. To adjust, loosen lock bolt (4). Turn adjusting shaft (3) so that shaft (1) is turned the same direction as it turns when the brakes are applied. Adjust as needed to limit movement (2) to 1.62 in. (41.1 mm).
3. Tighten lock bolt (4).



BRAKE ADJUSTMENT

1. Shaft. 2. Movement of slack adjuster: correct adjustment is 1.62 in. (41.1 mm). 3. Adjusting shaft. 4. Lock bolt.

TOO MUCH HEAT CAN CAUSE A TIRE TO HAVE AN EXPLOSION (SUDDEN BREAK)

WARNING

Explosions of pneumatic tires have resulted from heat-causing gas combustion inside the tires. The heat, caused by welding or heating rim components, fire, or too much use of brakes, can cause gas combustion.

A tire explosion is much more violent than a blowout. The explosion can throw the tire, rim, and final drive components as far as 1500 ft. (460 m) or more from the machine. Both the force of the explosion and the debris can cause personal injury or death, and property damage.

Although an explosion is not probable, the hazard (danger) is very great, especially with large tires used on wheel tractor-scraper.

All personnel must know of this danger and the actions to take to keep the risk at a minimum.

Heat from any source can be sent to the tire. This causes deterioration (decrease in quality) of the bead. Normally, the burned bead causes loss of air, and the tire goes flat without danger to anyone in the area.

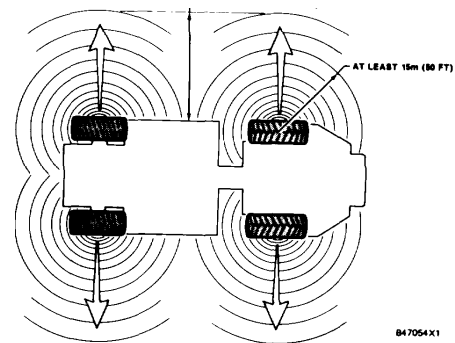
A bead that is burnt can result in the release of an explosive mixture of gas inside the tire. It is possible for the mixture of gas inside the tire to burn. The fire inside the tire causes a rapid increase in pressure. The result is a violent tire explosion. The explosion causes a blowout at the tire bead which throws the tire, rim assembly and final drive components far away from the machine.

When a wheel is in rotation, the movement of air around the tire helps in cooling the tire. There is more danger of a tire explosion after the machine stops, because of the loss of this cooling effect.

If smoke, too much heat, the smell of burning rubber or hot brakes, or other indications of bead burning are noticed, take action to prevent personal injury.

Move the machine to a remote area, but only if it can be done without danger to the operator or other personnel in the area.

Remove all personnel in the area of the machine.



WARNING

APPROACH AREAS. Do not get within 1500 ft. (460 m) from the side or within 50 ft. (15 m) from the front, rear, or above a tire.

AIR SYSTEM AND BRAKES

Do not go near any tire on the machine if there is a brake fire, burning rubber or other indications that the brakes have caused too much heat. This heat can have an effect on all other tires on the machine, even though the visual indication is only at one tire.

If there is an indication of a brake fire or the smell of burning rubber, do not go near the machine. **FIGHT (put out) THESE FIRES FROM A RE-MOTE LOCATION.** (Many times, the immediate action to a fire caused by tires or brakes, is for people to use a hand fire extinguisher and run up close to the machine to help put out the fire.) Keep away from the machine until the tires cool (temperature decreases). Permit at least eight hours for the tires to cool before a person goes near the machine.

Keep personnel out of the area, and at least 1500 ft. (460 m) away from the side of the tire and 50 ft. (15 m) away from the front or rear of the machine.

A small fire caused by debris on the machine is not a hazard. This type of fire can be put out with a hand fire extinguisher. A burning (smoking) tire or fire in the brake area is hazardous. These are sure indications of a hot tire. There is no completely safe way to get near a machine to put out this type of hazardous fire. Go near only at the front or rear of a machine and use a large bulldozer as a shield.

Current Recommendation

Use dry nitrogen (N₂) gas for all pneumatic tires. Nitrogen will not burn inside the tire.

⚠ WARNING

Correct nitrogen inflation (charging) equipment and training in its use are needed to pre-vent too much pressure in a tire. A tire blowout or rim failure can result from equipment that is not correct or is not correctly used.

Also, the use of nitrogen instead of air in the tires, decreases the amount of tire deterioration. This is especially important for tires that have an expected long service life (4 or more years). It also decreases the corrosion of rim components, which decreases disassembly problems.

The pressure of a fully charged nitrogen cylinder is approximately 2200 psi (15000 kPa). This high pressure can cause a tire blowout and, or rim failure if the charging equipment is not used correctly. See Tire Inflation (Charging) With Nitrogen.

TESTING AND ADJUSTING

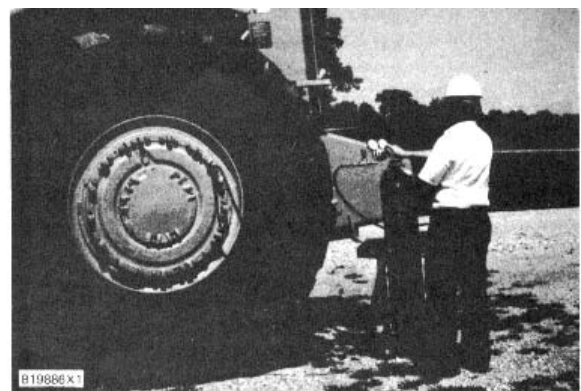
Tire Inflation (Charging) With Nitrogen

⚠ WARNING

Servicing and changing tires and rims can be dangerous. This work must be done only by trained personnel with correct tools and procedures. If correct procedures are not followed while servicing tires and rims, the assemblies can burst with explosive force and cause serious physical injury or death. Follow carefully the specific information provided by your tire servicing man or dealer.

When tires are changed be sure to clean all rim parts. If necessary, paint the components to prevent corrosion. Sand blasting is recommended for removal of rust. Check all components carefully and replace any cracked, badly worn, damaged, severely rusted or corroded parts with new parts of the same size and type. If there is any doubt, replace with new parts. Never rework, weld, heat or braze any rim components.

The tires on these machines are inflated (charged) with nitrogen instead of air. The recommendation is that nitrogen be used for pressure adjustments in a tire. See your tire dealer for the correct tire pressures for job conditions and for any questions on nitrogen inflation.



**CORRECT POSITION FOR TIRE INFLATION
(Behind the Tread)**

AIR SYSTEM AND BRAKES

TESTING AND ADJUSTING

⚠ WARNING

A tire blowout or rim failure can occur during tire inflation. To prevent possible injury, get next to (behind) the tread, as shown, when inflating a tire.

Set the regulator of the nitrogen inflation equipment at no more than 140 kPa (20 psi) over the correct tire pressure.

CAUTION

Use only the 6V4040 Nitrogen Tire Inflation Group to inflate tires from a nitrogen gas cylinder. See Special Instruction, Form Number SMHS7867 for tire inflation instructions. Use the same tire pressures for nitrogen inflation that are used for air inflation. See the Maintenance Guide for the shipping pressure. See your tire dealer for operating pressures.

Wheel Coolant

⚠ WARNING

Not enough wheel coolant or not correctly used or dragging brakes can cause enough heat to burn the tire bead. A burning bead gives off gases inside the tire. The gases can cause an explosion,(sudden break) which throws the tire, rim and parts of the final drive as far as 1500 ft. (460 m).

If smoke, too much heat, smell of burning rubber or hot brakes, or other indications of tire bead burning are noticed, move the machine to a remote area. Do not permit personnel within 1500 ft. (460 m) of the machine until the tire cools. Eight hours may be needed to cool the tire.

Heat from a machine can cause a tire explosion. Stay 1500 ft. (460 m) from a rubber tired machine that is on fire. Death or personal injury can result, if a tire explodes, while a fire is put out.

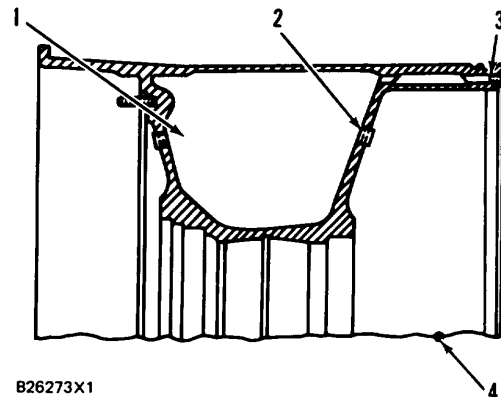
The coolant must be the correct type, mixture and level to work correctly. The recommended coolant solution is 20% mixture of ethylene glycol type antifreeze (2P9868) and 80% water. Oil or any other fluid, other than what is recommended, must never be used as a wheel coolant. The coolant level must be checked at least every 1000 hours as recommended in the Lubrication and Maintenance Guide. In addition, on earlier machines, which need the removal of a brake drum stud to add or check coolant level, cooling system sealant must be added every 2000 hours.

CAUTION

Leakage of wheel coolant into the final drives will cause a failure of the final drives.

Coolant Capacity [Compartment (1) half full]:

- 29 in. (735 mm) Wheel.....12 gal. (45 liter)
- 35 in. (890 mm) Wheel.....20 gal. (75 liter)



WHEEL ASSEMBLY

- 1. Compartment for coolant. 2. Fill plug on nondriven wheels. 3. Fill plug and passage on driven wheels. 4. Coolant level (half full).

SECTION II
AIR COMPRESSOR

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SPECIFICATIONS

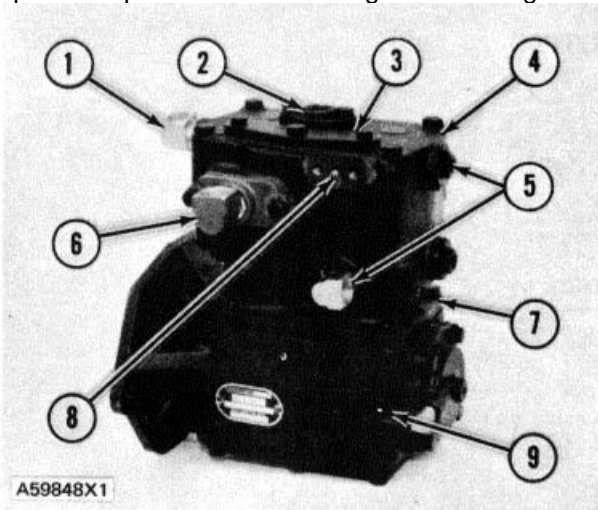
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AIR COMPRESSOR

SYSTEMS OPERATION

AIR COMPRESSOR OPERATION

The two cylinder air compressor is an air pump that fills an air supply tank with pressure air. The crankshaft in the air compressor is driven by the engine and the air compressor operates when the engine is running.

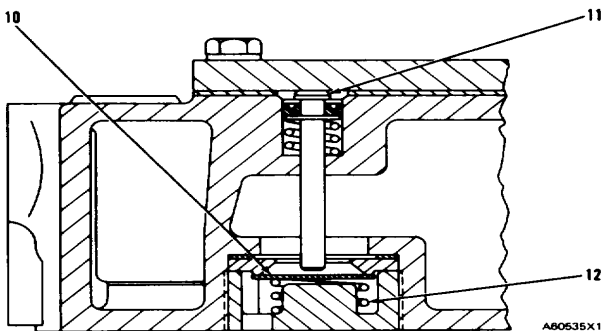


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TWO CYLINDER AIR COMPRESSOR

- 1. Coolant outlet (to the engine cooling system).
- 2. Air outlet (to the air supply tank).
- 3. Cover over unloader valves.
- 4. Cylinder head.
- 5. Coolant inlets, either one (coolant from engine cooling system).
- 6. Air inlet (from inlet air manifold of the engine).
- 7. Cylinder block.
- 8. Passage (to the top of each unloader valve in the cylinder head).
- 9. Crankcase.

Coolant from the engine enters one of inlets (5). Inlet (5) on some air compressor installations is in cylinder head (4). The coolant from the air compressor goes through outlet (1) and to the engine cooling system. The engine water pump moves the coolant through the air compressor when the engine is running.



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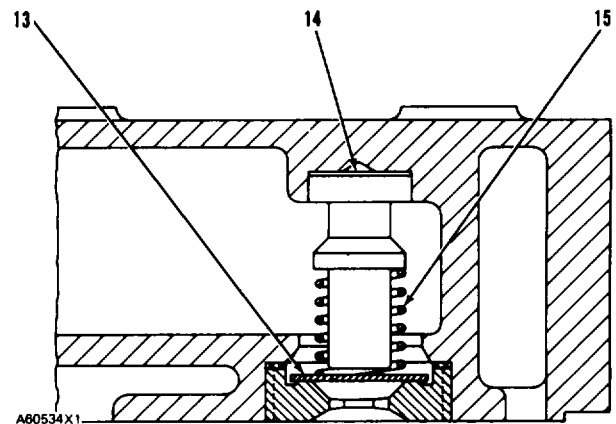
CYLINDER HEAD. AIR INLET SECTION

- 10. Inlet valve.
- 11. Unloader valve.
- 12. Spring.

The lubricating oil pump for the engine puts oil through a passage in the air compressor crankshaft to each of the rod journals of the crankshaft. The lubricating oil goes from the air compressor crankcase through holes and into the timing gear housing of the engine.

There are two inlet valves (10), two unloader valves (11) and two outlet valves (13) in cylinder head (4) of the air compressor. Each piston in cylinder block (7) has one each of the three valves. The air compressor cylinder head (4) gets filtered air from the engine air inlet manifold through a line that connects to air inlet (6).

When the crankshaft of the air compressor is turned, the two pistons go up and down in the cylinder block. When a piston goes down the pressure of the air in the cylinder head is more than the pressure of the air in the piston cylinder. The pressure of the air in the cylinder head now opens inlet valve (13) and goes into the piston cylinder.



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CYLINDER HEAD, AIR OUTLET SECTION

- 13. Outlet valve.
- 14. Outlet valve stop.
- 15. Spring.

As a piston goes up the pressure of the air in the piston cylinder increases. The pressure of the air and spring (12) now closes inlet valve (10). The piston moves further up and the pressure of the air in the piston cylinder increases until the air has more force than both spring (15), that keeps outlet valve (13) closed, and the pressure of the air in the other compartment in cylinder head (4). The high pressure of the air from the piston opens outlet valve (13), goes through the compartment in the cylinder head and through outlet (2) that goes to the air supply tank.

An air compressor governor, that feels the amount of air (pressure), is installed on cylinder head (4) over passage (8) that goes to unloader valves (11).

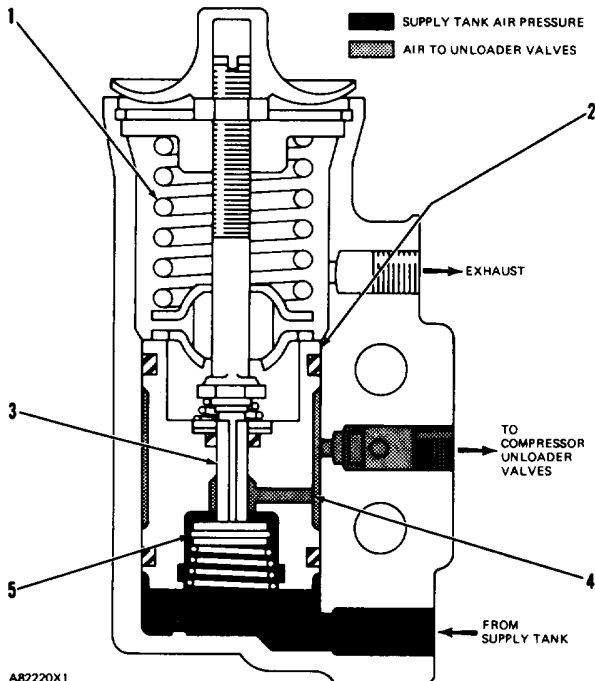
AIR COMPRESSOR

SYSTEMS OPERATION

AIR COMPRESSOR GOVERNOR

Some Midland Compressors, as used on Caterpillar equipment, have a Bendix governor. The main components of this governor are pressure setting spring (1), piston (2), exhaust stem (3), and inlet and exhaust valve (5).

Pressure air from the supply tank goes through the passage at the bottom of the governor. This air pressure is felt against the bottom of piston (2). The piston and inlet and exhaust valve (5) move up as the air pressure in the tank increases.



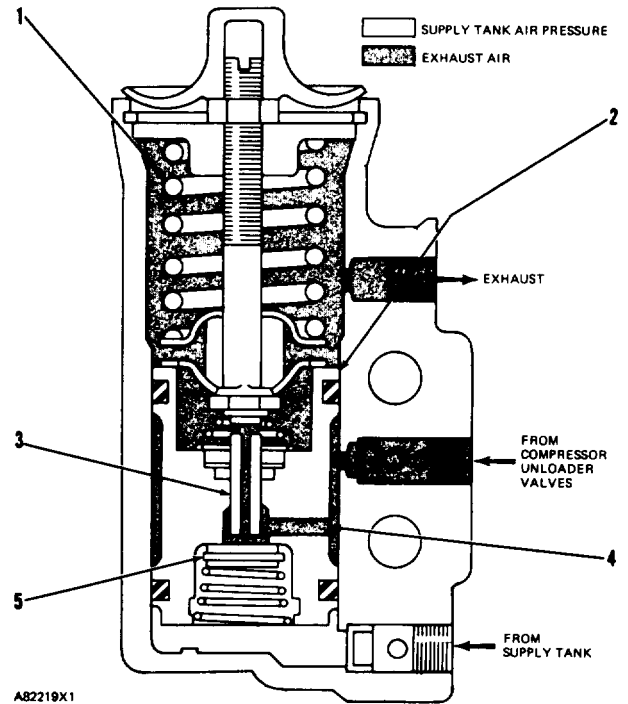
**AIR COMPRESSOR GOVERNOR
(Piston in Cutout Position)**

- 1. Pressure setting spring.
- 2. Piston.
- 3. Exhaust stem.
- 4. Passage.
- 5. Inlet and exhaust valve.

When the tank air pressure increases to the cut-out setting, exhaust stem (3) will lift inlet and exhaust valve (5) off its seat. This lets high pressure air from the supply tank go through passage (4) and then through the outlet to the compressor unloader valves (1 1).

The high pressure air moves unloader valve (7) down. This opens inlet valve (6). When the inlet valve for each piston is open, there can be no compression of air. The air from the pistons can move freely through the open inlet valves and through the cylinder head.

The air pressure in the supply tank decreases as the air is used for the components on the vehicle. When the air pressure in the supply tank (and against the governor piston) decreases to the cut-in pressure, pressure setting spring (1) will move piston (2) down. The piston movement closes inlet and exhaust valve (5).

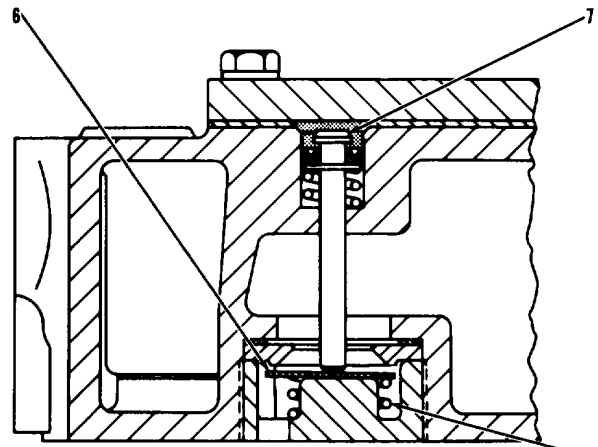


**AIR COMPRESSOR GOVERNOR
(Piston in Cut-In Position)**

- 1. Pressure setting spring.
- 2. Piston.
- 3. Exhaust stem.
- 4. Passage.
- 5. Inlet and exhaust valve.

The piston moves until the high pressure air at the top of unloader valve (7) can go back through passage (4). The air can flow from passage (4), through the center of exhaust stem (3) and then through the exhaust port.

With no air pressure in the chamber over unloader valve (7), the spring will move the unloader valve away from the inlet valve. This lets the inlet valve operate normally and compression of air starts again.



**CYLINDER HEAD, AIR INLET SECTION
(Inlet Valve Open)**

- 6. Inlet valve.
- 7. Unloader valve.
- 8. Spring.

TROUBLESHOOTING

Problem	Probable Cause
<p>A LOW AIR PRESSURE</p>	<p>1 Gauge. 2 Air Compressor Governor Adjustment. 3 Air Compressor Governor Parts. 4 Cylinder Head, Outlet Valves. 5 Cylinder Head, Inlet Valves. 6 Piston Rings Cylinder Block, Pistons.</p>
<p>B HIGH AIR PRESSURE</p>	<p>1 Gauge. 2 Air Compressor Governor Adjustment. 7 Unloader Valves. 8 Line from Supply Tank to Governor.</p>
<p>C AIR PRESSURE DECREASES (No equipment in use)</p>	<p>3 Air Compressor Governor Parts. 4 Cylinder Head, Outlet Valves. 9 Leaks in Air System.</p>
<p>D NOT ENOUGH DIFFERENCE BETWEEN CUTOUT AND CUT-IN AIR PRESSURE</p>	<p>3 Air Compressor Governor Parts. 4 Cylinder Head, Outlet Valves. 7 Unloader Valves.</p>
<p>E AIR COMPRESSOR WITH TOO MUCH NOISE</p>	<p>6 Piston Rings Cylinder Block, Pistons. 10 Crankshaft Crankcase Bearings.</p>
<p>1 Gauge Install a test air pressure gauge, that is known to be correct, in the air system with the vehicle pressure gauge. Compare the differences in the pressures of the two gauges when the air compressor fills the air supply tank. Install a new air pressure gauge, if necessary.</p>	

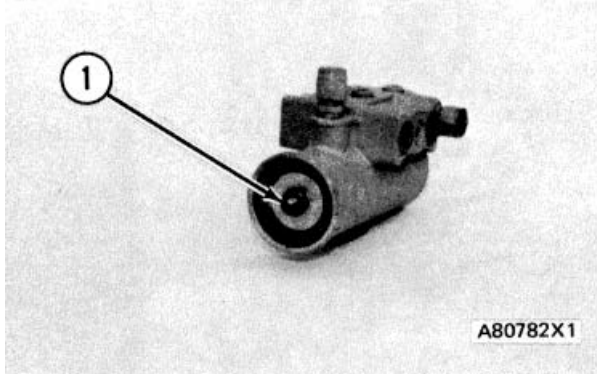
AIR COMPRESSOR

TROUBLESHOOTING

2. Governor Adjustment

To increase the system air pressure, turn adjustment screw (1) counterclockwise. Turn the adjustment screw clockwise to decrease the air pressure.

The correct governor cutout pressure is 115 to 125 psi (795 to 860 kPa). The cut-in setting is 95 to 100 psi (660 to 690 kPa).



AIR COMPRESSOR GOVERNOR
1. Adjustment screw.

3. Governor Parts Put soap suds (water with too much soap) around the governor gaskets and exhaust hole (2). Bubbles must be seen from the exhaust hole only when the governor parts move to air pressure cut-in, any other bubbles show the governor needs a repair. The bubbles do not show a broken or weak spring. See the DISASSEMBLY AND ASSEMBLY, AIR COMPRESSOR GOVERNOR.

4. Outlet Valve The outlet valves are in the cylinder head and it is necessary to remove the cylinder head from the air compressor before the outlet valves can be removed, cleaned or replaced. See the DISASSEMBLY AND ASSEMBLY, CYLINDER HEAD.

5. Inlet Valve

The inlet valves are in the cylinder head and it is necessary to remove the cylinder head from the air compressor before the inlet valves can be removed, cleaned or replaced.

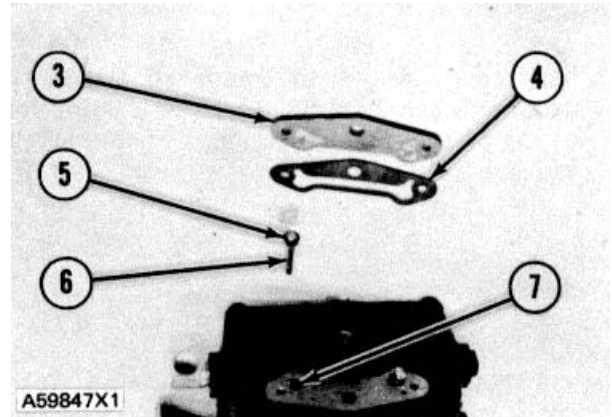
6. Piston Rings.

Cylinder Block, Pistons The air compressor is removed from the engine to remove the pistons, rings and

cylinder block. See the DISASSEMBLY AND ASSEMBLY, PISTONS AND RODS.

7. Unloader Valves

Remove cover (3), on top of the cylinder head, over the unloader valves. Check the condition of each spring (7) and unloader valve (6), replace if necessary. Install new V-seals (5) and put more than enough (too much) grease-silicone on the seals. Install the springs, the unloader valve (with a new V-seal), a new gasket (4) and cover (3). Torque for the two small bolts is 75 to 105 lb. in. (8.5 to 11.9 N•m). Torque for the third long bolt is 27 to 33 lb. ft. (38 to 44 N•m). See ASSEMBLY CYLINDER HEAD.



AIR COMPRESSOR UNLOADER VALVES

3. Cover. 4. Gasket. 5. Seal. 6. Unloader valve. 7. Spring.

8. Line From Supply

Tank The line from the air supply tank to the inlet and filter of the air compressor governor must not have a break or a bend that would make the passage in the line too small. Install a new line if necessary.

9. Leaks in the Air System

Check the complete air system and the air components for air leaks. When an air line connection is tightened, put soap suds (water with too much soap) on the connection to see if the pressure air makes bubbles in the soap suds (a leak).

10. Crankshaft, Crankcase and Bearings

The air compressor is removed from the engine to remove the crankshaft and bearings from the crankcase. See the DISASSEMBLY AND ASSEMBLY, CRANKSHAFT.

AIR COMPRESSOR

DISASSEMBLY AND ASSEMBLY

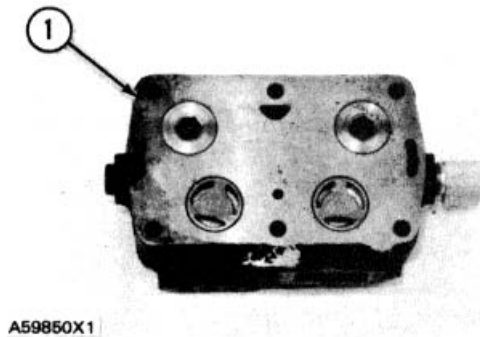
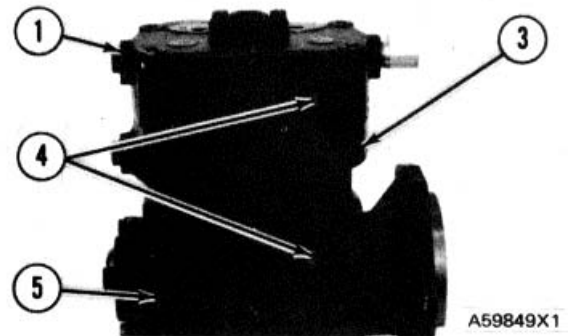
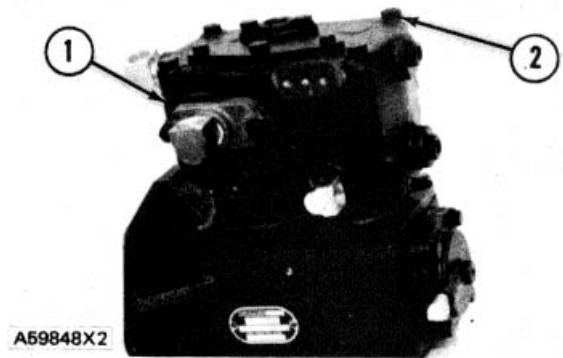
CYLINDER HEAD

REMOVE CYLINDER HEAD

1. Remove six bolts (2) from cylinder head (1).

2. Put marks (4) on air compressor head (1), block (3) and crankcase (5). The location for these parts must not change when the air compressor is assembled.

3. It may be necessary to hit cylinder head (1) with a soft hammer to remove the cylinder head from block (3).



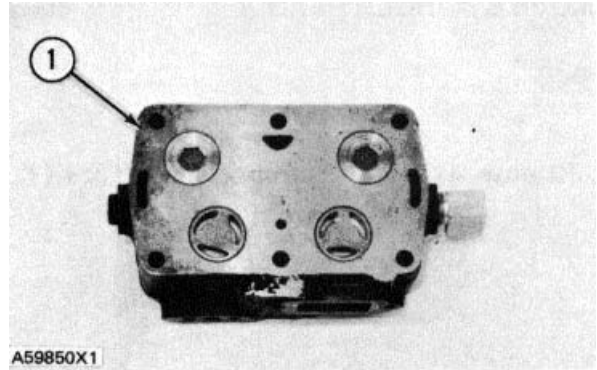
AIR COMPRESSOR

DISASSEMBLY AND ASSEMBLY

CYLINDER HEAD

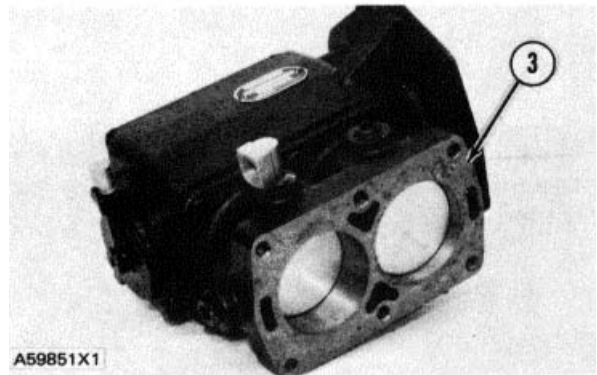
INSTALL CYLINDER HEAD

1. Clean the valve surface of cylinder head (1).



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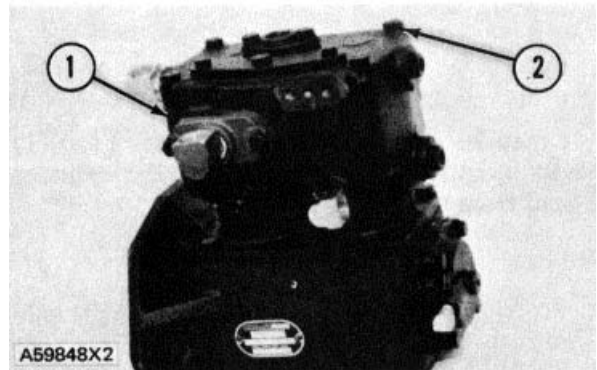
2. Clean the surface of cylinder block (3).



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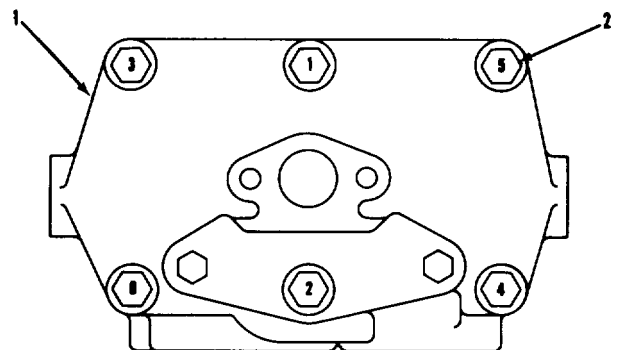
4. Install head (1) with a new head gasket.

5. The long head bolt is through the cover for the unloader valves.



A59848X2

6. Tighten head bolts (2), in the numbered sequence, with a torque of 18 to 22 lb. ft. (24 to 28 N•m). Tighten the bolts again in the same numbered sequence to a torque of 27 to 33 lb. ft. (38 to 34 N•m).
7. Torque for the two small bolts in the cover over the unloader valves is 75 to 105 lb. in. (8.5 to 11.9 N•m).



AIR COMPRESSOR

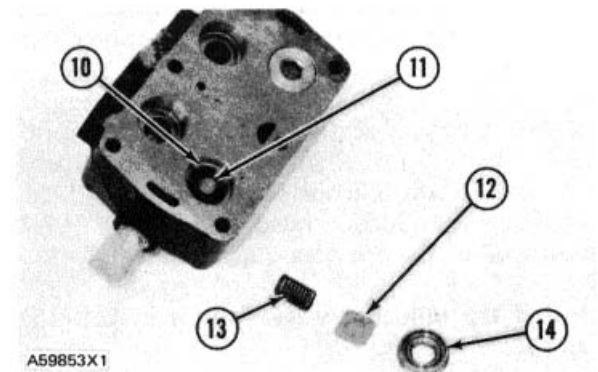
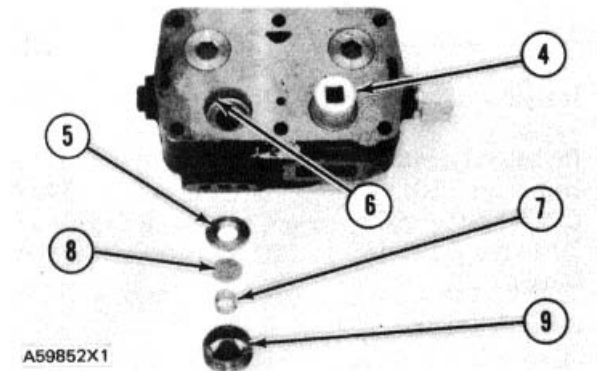
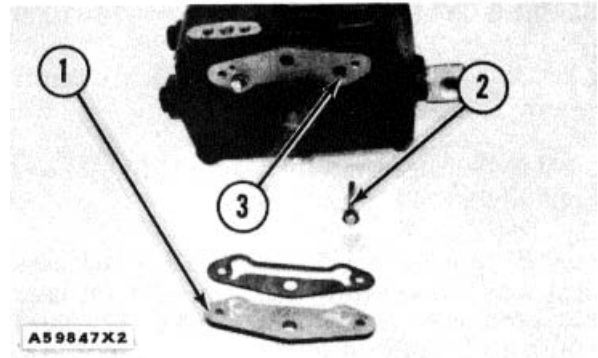
DISASSEMBLY AND ASSEMBLY

CYLINDER HEAD

DISASSEMBLE CYLINDER HEAD

start by: a) Remove cylinder head

1. Remove cover (1) from the cylinder head.
2. Remove unloader valve (2) and spring (3).
3. Use a Kent-Moore #J-25447 tool (4) and remove cage (9). Remove spring (7), inlet valve (8) and valve seat (5) (both inlet valves).
4. Remove washer (6). Use a new washer under each valve seat at assembly.
5. Use a 9/16 hex wrench and remove cage (14). Remove exhaust valve (12) and spring (13). Remove valve stop (11), if necessary (both exhaust valves).
6. Remove washer (10). Use a new washer under each cage at assembly.



AIR COMPRESSOR

DISASSEMBLY AND ASSEMBLY

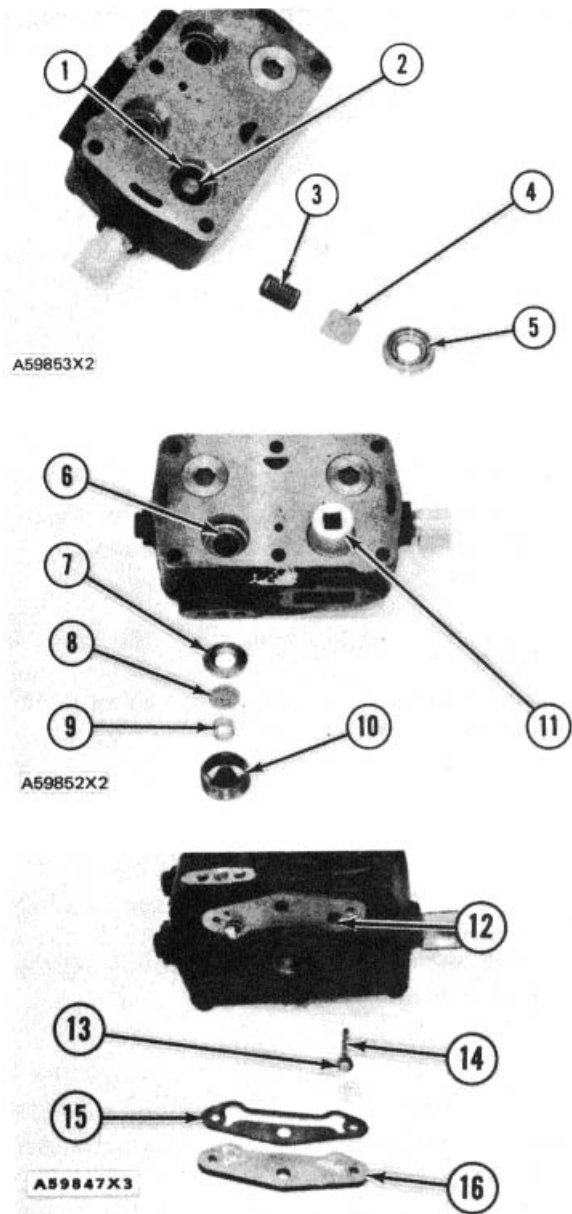
CYLINDER HEAD

ASSEMBLE CYLINDER HEAD

1. Install a new washer (1), for each exhaust valve.
2. Install exhaust valve stop (2) (if it was removed).
3. Install spring (3), exhaust valve (4) and cage (5). Use a 9/16 hex wrench to tighten the cage to a torque of 70 to 90 lb. ft. (95 to 120 N-m) for both exhaust valves.
4. Install a new washer (6) for each intake valve.
5. Install valve seat (7), inlet valve (8), spring (9) and cage (10). Use a Kent-Moore #J-25447 tool (11) to tighten cage (10) to a torque of 70 to 90 lb. ft. (95 to 120 N.m) for both inlet valves.
6. Install spring (12) and the spring for the other unloader valve.
7. Install a new V-seal (13) on unloader valve (14). Put more than enough (too much) grease-silicone on the V-seal and the end of the unloader valve [a 1/2 inch (12.7 mm) ball of silicone grease on both seals].
8. Install the unloader valves, a new gasket (15) and cover (16).

end by:

- a) install cylinder head



PISTONS AND RODS

REMOVE PISTONS AND RODS

start by:

- a) Remove cylinder head.

1. Remove bolts (1) and bottom cover (2).

NOTE: Some compressors have a drain in the bottom cover.

2. Turn the crankshaft and look for the alignment arrows (5) on the connecting rods and the rod bearing caps.

NOTE: Make a record which end the crankshaft arrows (5) face, and which piston and rod is number one and number two. They must be installed in the same locations they were removed.

3. Remove bolts (3) and rod cap (4). Turn the crank enough to push piston (6) to the top of the block and remove the piston and rod.

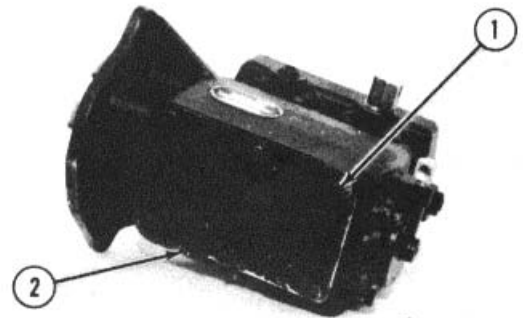
NOTE: Put cap (4) and bolts (3) in the connecting rod until they are to be installed on the crankshaft.

4. Remove snap ring (7) and press pin (8) out of piston (6).

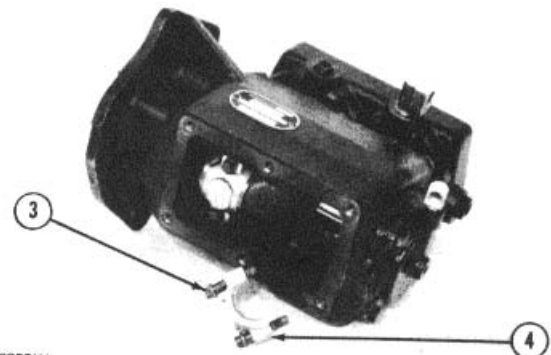
5. Remove rings (9) from the piston.

6. Remove the block from the crankcase.

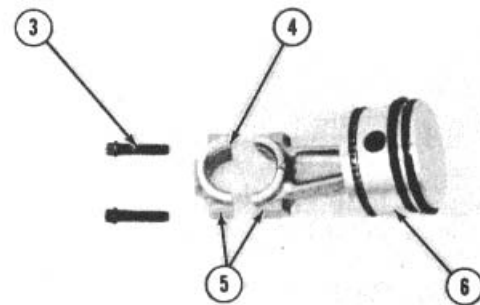
NOTE: The piston diameter, measured 90° from the piston pin, must not be .008 in. (0.20 mm) less than the bore in the block. The bore at the top of the block can not be more than .001 in. (0.03 mm) larger than the bore at the bottom of the block.



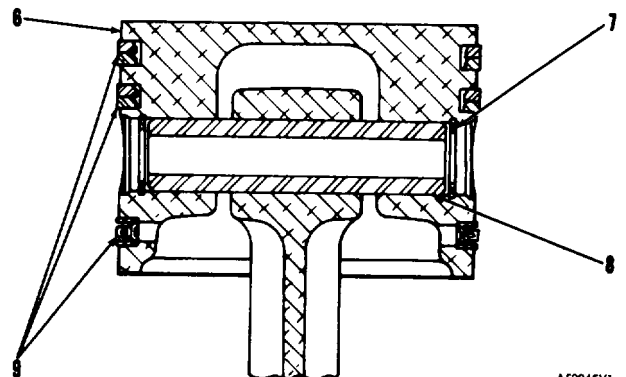
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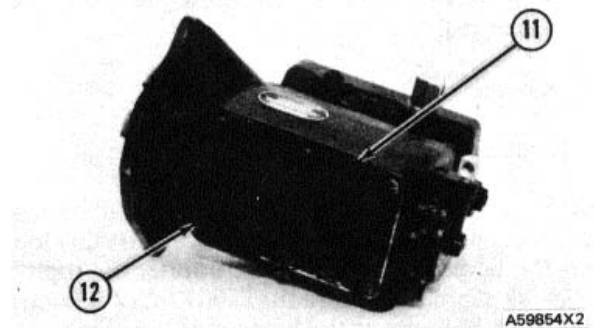
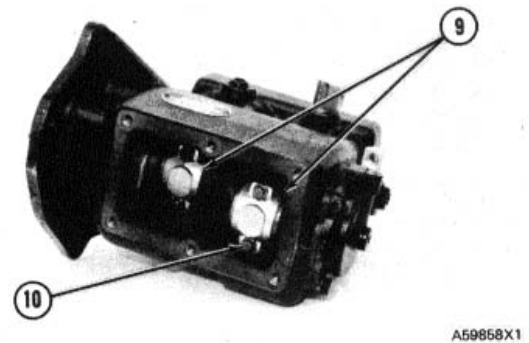
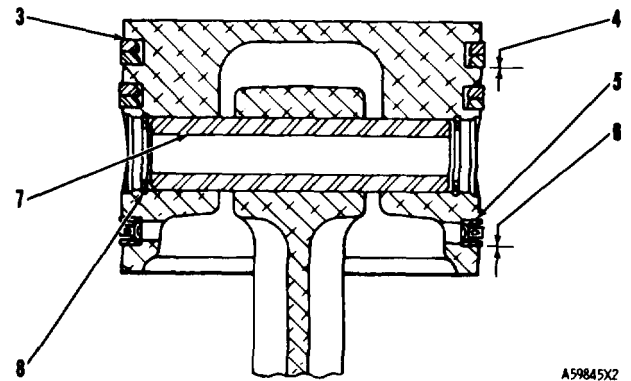
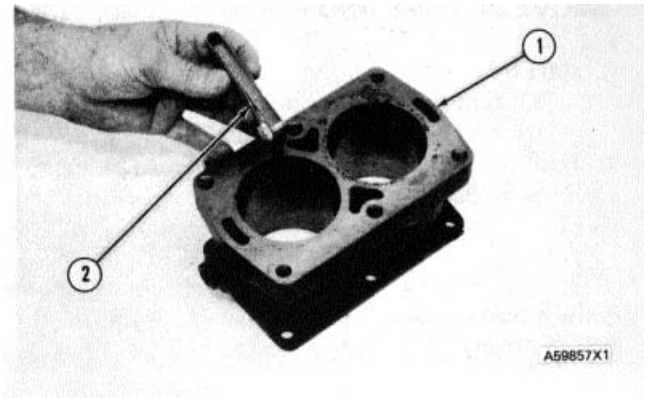
AIR COMPRESSOR

DISASSEMBLY AND ASSEMBLY

PISTONS AND RODS

INSTALL PISTONS AND RODS

1. Put each piston ring in the bore of block (1) approximately 1/2 in. (38 mm) from the top. Use a thickness gauge (2) to measure the ring gaps. Compression ring (3) gap is .002 to .007 in. (0.05 to 0.19 mm), oil ring (5) gap is .015 to .055 in. (0.38 to 1.40 mm).
2. Press pin (7) into the piston and connecting rod. Install snap ring (8).
3. Use a piston ring installation tool to install the rings on the pistons. Compression rings (3) either have "TOP" or dots to indicate the surface of the ring that must face the top of the piston. Side clearance (4), for compression rings, is .0015 to .0045 in. (0.038 to 0.114 mm). Side clearance (6), for oil rings, is .0005 to .0021 in. (0.013 to 0.053 mm).
4. Install block (1), with a new gasket, on the crankcase (the marks put on the crankcase and block must be in alignment). Tighten the two center bolts to a torque of 8 lb. ft. (11 N-m), then tighten the other four bolts to the same torque. Next tighten the center bolts to a torque of 17 to 21 lb. ft. (23 to 26 N-m), tighten the other bolts to the same torque.
5. Use a ring compressor and install the rods and pistons through the top of block (1). Be sure each piston and rod are in the same location in the block and crankcase as before they were removed. Install caps (9) on the rods with the point of each arrow, on the cap, toward the point of the arrow, on each connecting rod. Torque for bolts (10) is 185 to 225 lb. in. (21 to 26 N•m).
6. Install cover (11). Torque for bolts (12) is 110 to 150 lb. in. (13 to 17 N•m).end by: a) install cylinder head



DISASSEMBLY AND A

DISASSEMBLY AND ASSEMBLY

CRANKSHAFT

REMOVE CRANKSHAFT

start by:

- a) remove cylinder head
- b) remove pistons and rods (and block)

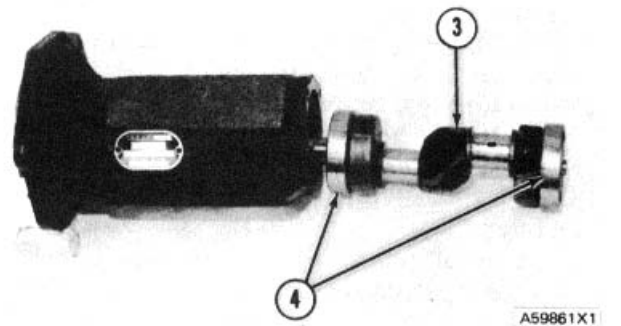
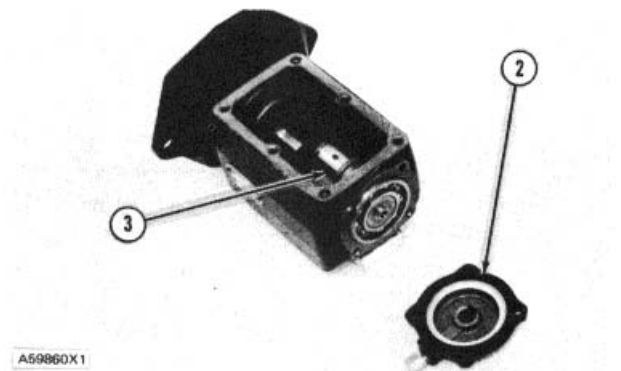
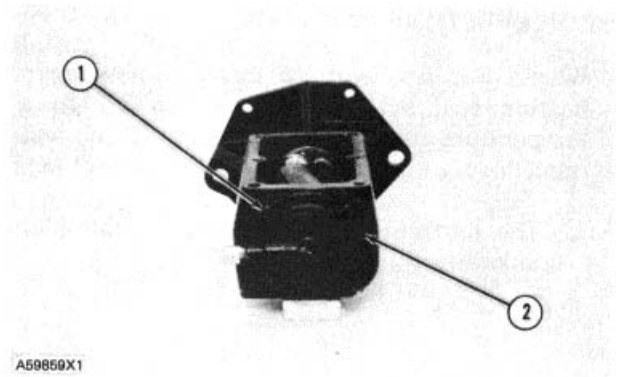
1. Remove four bolts (1) and remove bearing cap (2).

NOTE: The bearing cap on some air compressors does not have oil line connections.

2. Remove the crankshaft (3) through the opening where bearing cap (2) was removed.

NOTE: If the bearing cap has a seal and spring, check the condition of the seal. If scratches in the seal are more than .005 in. (0.13 mm) deep, replace the seal.

3. Check the condition of crankshaft (3) rod bearing journals. Damaged journals are ground smooth and undersize bearing inserts are installed in the connecting rods.
4. Check the condition of the main ball bearings (4). A damaged bearing must be removed.



AIR COMPRESSOR

DISASSEMBLY AND ASSEMBLY

CRANKSHAFT

INSTALL CRANKSHAFT

1. When it is necessary to install a new main bearing (1), heat the bearing in oil to a temperature of not over 350° F (175° C) and immediately put the bearing on crankshaft (3).

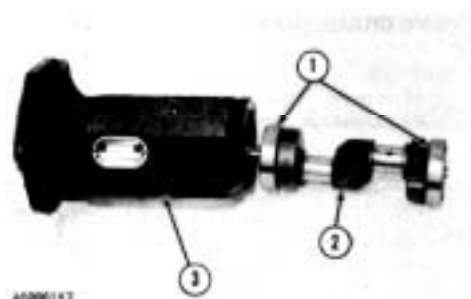
NOTE: The bearing must be against the shoulder of the crankshaft.

2. Install the crankshaft and bearings in the crankcase (3). Bearing (1) must extend .135 in. (3.5 mm) from crankcase (3).

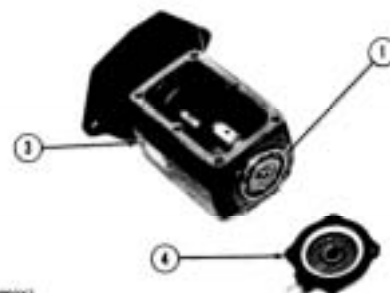
3. Install bearing cap (4). Tighten a bolt (5) to a torque of 80 lb. in. (9 N•m) then tighten bolt (6). Tighten the other two bolts. Tighten bolt (5) to a torque of 120 to 160 lb. in. (14 to 18 N•m), tighten bolt (6) and then the other bolts to the same torque.

end by:

- a) install (block) pistons and rods
- b) install cylinder head



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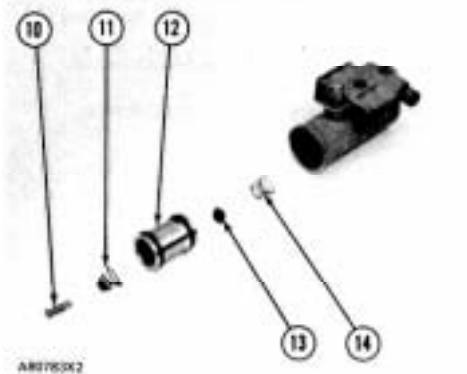
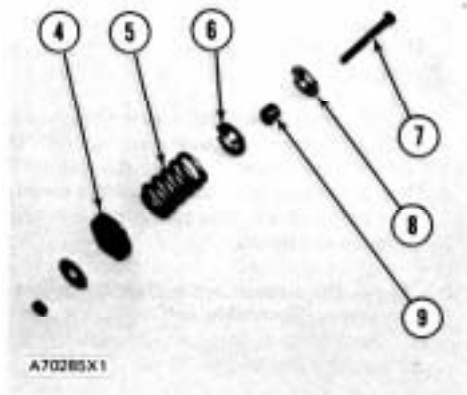
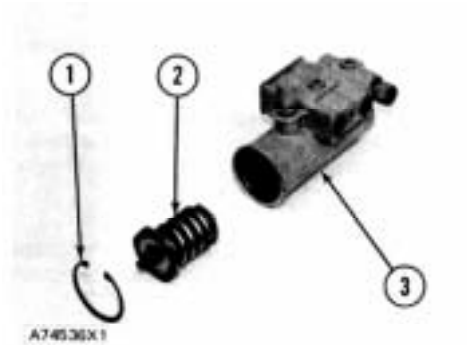
AIR COMPRESSOR

DISASSEMBLY AND ASSEMBLY

AIR COMPRESSOR GOVERNOR

DISASSEMBLE GOVERNOR

1. Remove the governor from the air compressor.
2. Remove the rubber cover from governor body (3).
3. Use snap ring pliers to remove snap ring (1). Pull adjusting screw and spring assembly (2) from the body.
4. Remove the nut and washer from adjusting screw (7). For use during assembly, make a note of the distance from the end of the adjustment screw to upper spring seat (4). Turn the upper spring seat to release tension on pressure setting spring (5).
5. Remove the upper spring seat and spring (5) from the adjusting screw.
6. Remove lower spring seats (6) and (8) with spring guide (9).
7. Slide piston (12) from the governor body.
8. Remove exhaust stem (10) and spring (11) from the piston. Remove inlet and exhaust valve (13) and its spring (14).
9. Remove the filter from the reservoir and unloader port.



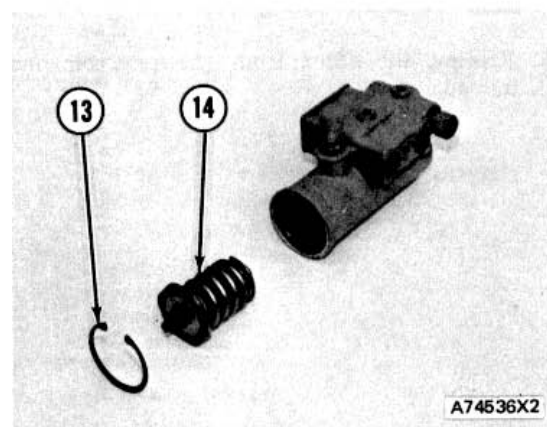
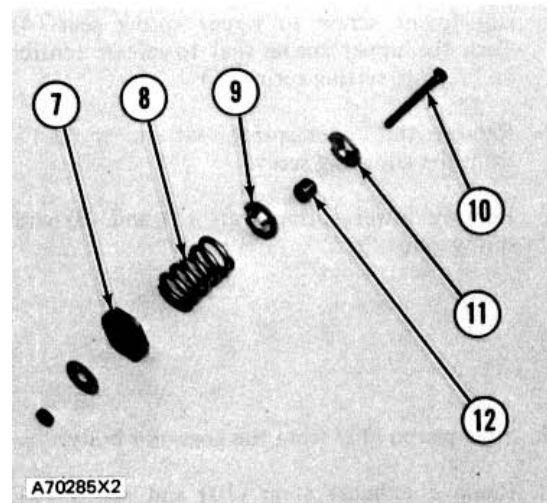
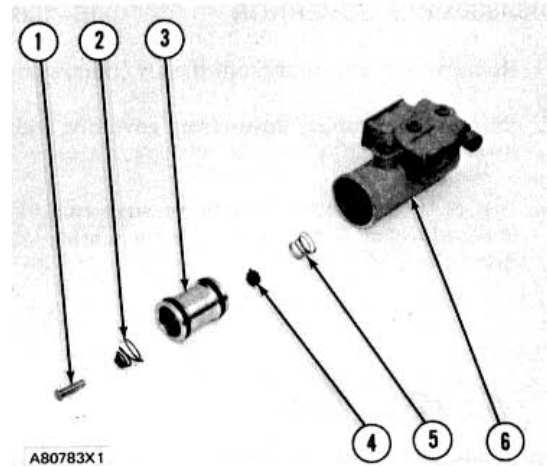
AIR COMPRESSOR

DISASSEMBLY AND ASSEMBLY

AIR COMPRESSOR GOVERNOR

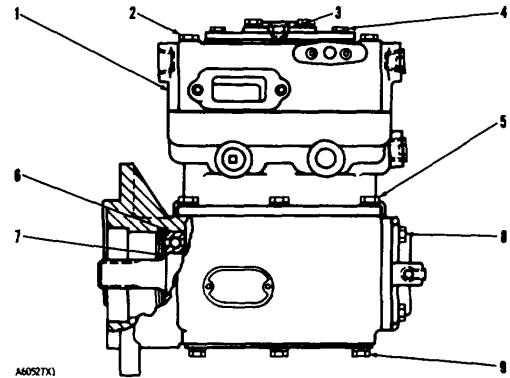
ASSEMBLE GOVERNOR

1. Put new filters in the reservoir and unloader ports.
2. Install new O-ring seals in piston; (3). Put exhaust stem (1) and spring (2) in place on the piston. Install a new inlet and exhaust valve (4) and spring (5) in the piston.
3. Put a small amount of lubricant on the piston outside diameter and in the bore of governor body (6). Slide the piston into the body.
4. Assemble adjusting screw and spring assembly (14).
 - a. Put lower spring seat (11), spring guide (12) and lower spring seat (9) on adjusting screw (10).
 - b. Install pressure setting spring (8) on the adjusting screw. Put upper spring seat (7) on the adjusting screw. Turn the seat until the dimension from the end of the adjusting screw to the seat is the same as the original dimension.
 - c. Install the washer and nut on the adjusting screw. Tighten the nut.
5. Install the adjusting screw and spring assembly into the governor body. Install snap ring (13).
6. Install the rubber cover on the governor.
7. Install the governor on the compressor.



AIR COMPRESSOR

- (1) Cylinder head.
 - Unloader valve spring (two):
 - Length under test force40 in. (10.5 mm)
 - Test force34 to .41 lb. (1.5 to 1.8 N)
 - Inlet valve spring (two)
 - Length under test force29 in. (7.4 mm)
 - Test force36 to .62 lb. (1.6 to 2.7 N)
 - Outlet valve spring (two)'
 - Length under test force73 in. (18.5 mm)
 - Test force3.3 to 3.7 lb. (14.7 to 16.5 N)
- (2) Torque for head bolt (five)27 to 33 lb. ft. (38 to 44 N•m)
- (3) Torque for cover head bolt 27 to 33 lb. ft. (38 to 44 N•m)
- (4) Torque for cover bolt (two) 75 to 105 lb. in. (8.5 to 11.9 N•m)
- (5) Torque for block bolt (six) 17 to 21 lb. ft. (23 to 26 N•m)
 Piston bore (new) 2.7495 to 2.7500 in. (69.837 to 69.850 mm)
- (6) Crankcase bearing bore (new) .. 2.8344 to 2.8350 in. (71.994 to 72.009 mm)
- (7) Crankshaft:
 - Main bearing diameter (new) .. 2.8341 to 2.8346 in. (71.986 to 71.999 mm)
 - Rod bearing diameter (new) 1.1850 to 1.1855 in. (30.099 to 30.111 mm)
 - Rod bearing width (new) 1.365 to 1.367 in. (34.67 to 34.72 mm)
- (8) Torque for bolt (four)120 to 160 lb. in. (14 to 18 N•m)
- (9) Torque for bolt (six)110 to 150 lb. in. (13 to 17 N•m)



AIR COMPRESSOR

SPECIFICATIONS

Air Compressor (Cont.)

(10)Piston:
 diameter (below compression rings) .. 2.7440 to 2.7450 in. (69.698 to 69.723 mm)
 Maximum clearance, piston to bore in block..... .008 in. (0.20 mm)
 Piston pin bore..5615 to .5618 in. (14.267 to 14.270 mm)

(11)Piston pin diameter (new)5618 to .5620 in. (14.270 to 14.275mm)

(12)Compression ring gap {measured in a 2.750 in. (69.85 mm) bore}.002 to .007 in. (0.05 to 0.18 mm)
 Ring to groove clearance0015 to .0045 in. (0.38 to 0.114 mm)

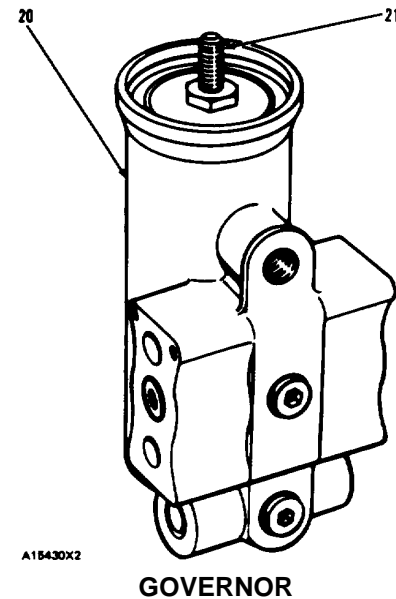
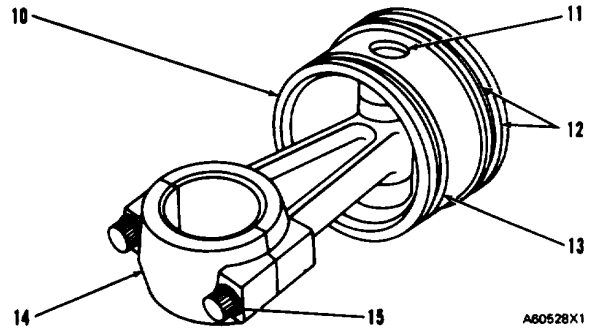
(13)Oil ring gap [measured in a 2.750 in. (69.85 mm) bore] .015 to .055 in (0.38 to 1.40 mm)
 Ring to groove clearance0005 to .002 in. (0.013 to 0.053 mm)

(14)Connecting rod:
 Piston pin bore (new)5622 to .5624 in. (14.280 to 14.285 mm)
 Clearance between rod bearing bore and crankshaft bearing width..... .0005 to .0021 in. (0.013 to 0.043 mm)
 Maximum clearance between rod bearing width and crankshaft bearing width..... .010 in. (0.25 mm)

(15)Torque for bolts..... 185 to 225 lb in. (21 to 26 N•m)

(20)4N9680 Air Compressor Governor (Bendix)
 Cutout pressure setting 115 to 125 psi (795 to 860 kPa)
 Cut-in pressure setting 95 to 100 psi (660 to 690 kPa)

(21)Pressure adjustment screw:
 Turn counterclockwise to increase air pressure.



**SECTION III
AIR DRYER**

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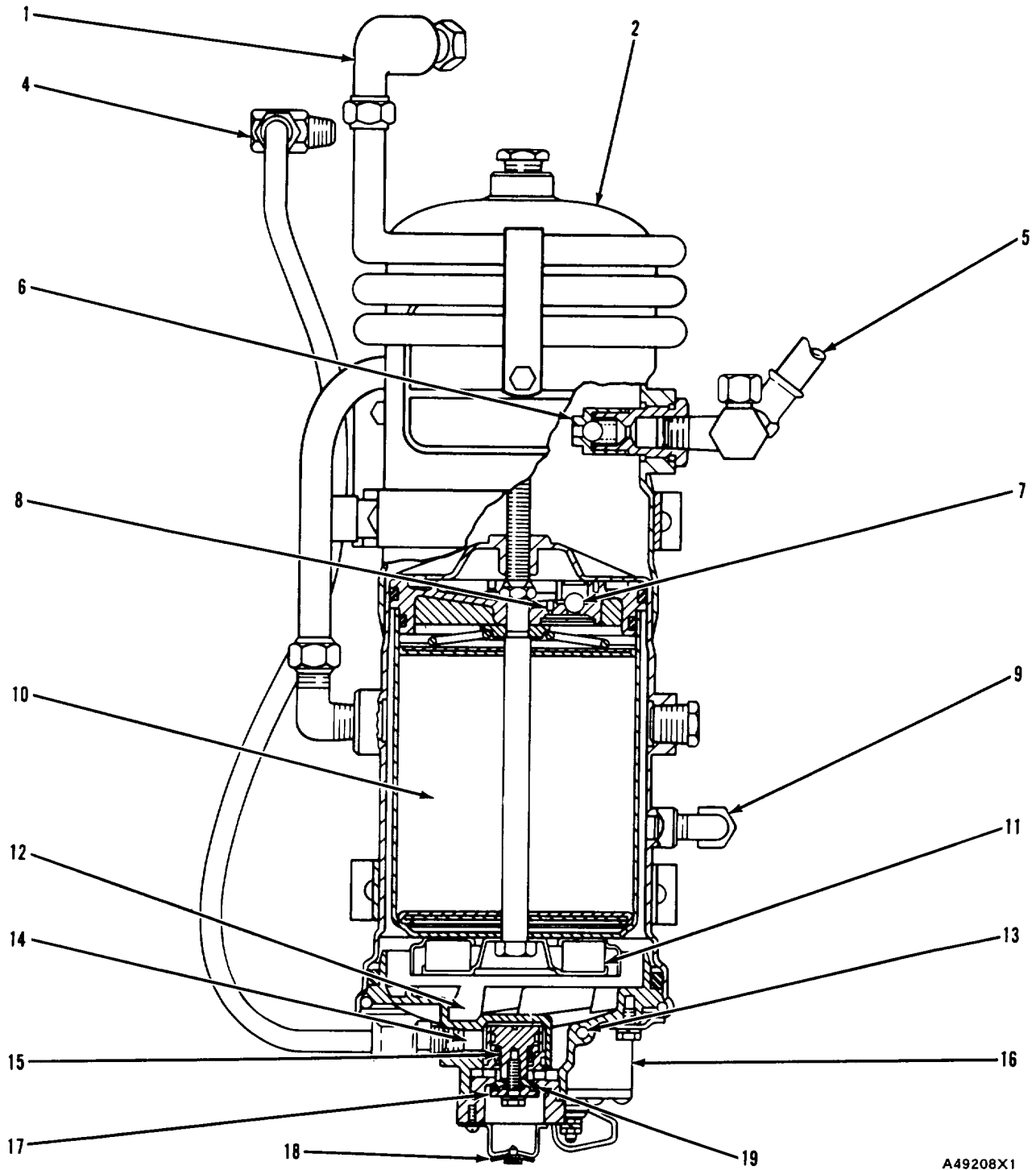
GLOSSARY

To better understand the operation of the air dryer, a glossary of words and definitions not of common use is provided.

1. AMBIENT TEMPERATURE °F-Temperature of air outside of reservoir (surrounding air).
2. DEW POINT °F-Temperature at which water will begin to condense (separate) from a mixture of water vapor and air.
3. DEW POINT DEPRESSION °F-Difference between ambient temperature and reservoir air dew point temperature.
4. ADSORPTION-To collect molecules (small particles) of a gas or substance (foreign material) on micro-crystalline particles (very small crystal-like particles).
5. DESORPTION-To remove molecules of a gas from the pore openings of the crystal.
6. DESICCANT-A drying material for the air dryer (drying bed).
7. REGENERATION-Process of drying or reactivating the desiccant, (procedure to dry and make the desiccant so it can be used again).
8. PURGE VOLUME-Storage area in the air dryer for air that has passed through the drying bed.
9. PURGE VALVE-The drain valve to let the moisture and other foreign material taken from the air go out of the air dryer.
10. SUBMICROSCOPIC CAVITIES-Very small holes.
11. LOADED CYCLE-Air compressor compressing air.
12. CONDENSATION-Moisture in the air that has changed into water.

AIR DRYER

SCHEMATIC



AIR DRYER

A49208X1

- | | | | |
|------------------------------------------------------|---------------------------|--------------------------|------------------------------------|
| 1. Line from air compressor to air dryer. | 5. Line to air reservoir. | 11. Oil filter. | 16. Thermostat for heater. |
| 2. Purge volume. | 6. Check valve. | 12. Sump. | 17. Purge valve plunger. |
| 4. Unloader line from air compressor to purge valve. | 7. Check valve. | 13. Heater. | 18. Purge valve exhaust deflector. |
| | 8. Purge orifice. | 14. Purge valve opening. | 19. Seat. |
| | 9. Air relief valve. | 15. Purge valve piston. | |
| | 10. Desiccant cartridge. | | |

AIR DRYER**SYSTEMS OPERATION****SYSTEMS OPERATION****INTRODUCTION**

The air dryer is used to remove moisture and foreign material from the compressed air before it gets to the air reservoir. Clean dry air is very important for safe operation and performance of brake systems that use compressed air. Clean dry air will also prevent corrosion of parts.

Desiccant beads are used to make the drying bed. The desiccant beads are of a material that cleans and makes the air dry. Each bead has a large number of submicroscopic cavities. Each desiccant bead absorbs or collects moisture and other foreign material from the air.

The air dryer is installed in the vertical position in the air line between the air compressor and the first air reservoir. The dryer will help reduce corrosion and prevent possible problems in the air system, especially the air brake system caused by moisture in temperatures below 32°F (0°C).

With the use of an air dryer, it is not necessary to drain the air system reservoirs daily. The desiccant cartridge and the paper oil filter are removable and must be replaced at regular service intervals.

The cartridge housing is used to hold the desiccant beads. The cartridge housing has a plate with holes in it on each end. There is a filter cloth under each plate. The top plate is held in place by a spring and the bottom plate is held by a shoulder near the bottom of the cartridge housing. A long bolt is used through the center of the assembled cartridge to hold it in place in the air dryer.

The end cover assembly is held to the bottom of the air dryer by a lock ring, bolts and retainers. The purge valve and heater assembly are in the cover assembly.

The heater and thermostat assembly keeps moisture from freezing in the purge valve drain when the air dryer is used in temperatures of 32°F (0°C) or lower. The 60 watt, 12 or 24 volt DC heater and thermostat assembly has an operating range between 50°F (10°C) and 85°F (30°C).

OPERATION

The operation of the air dryer is given in two parts, the charge cycle and the purge cycle.

CHARGE CYCLE

With the air compressor in its' 'loaded" or compressing cycle, air under pressure is sent to the air dryer from the air compressor through air supply line (1). When the air enters the Air Dryer, the velocity (speed) of the air goes down and cools. Much of the oil and water in the air drops into the sump (12). The direction of the air flow is to the bottom of the Air Dryer where its direction is reversed and more water and oil go into the sump.

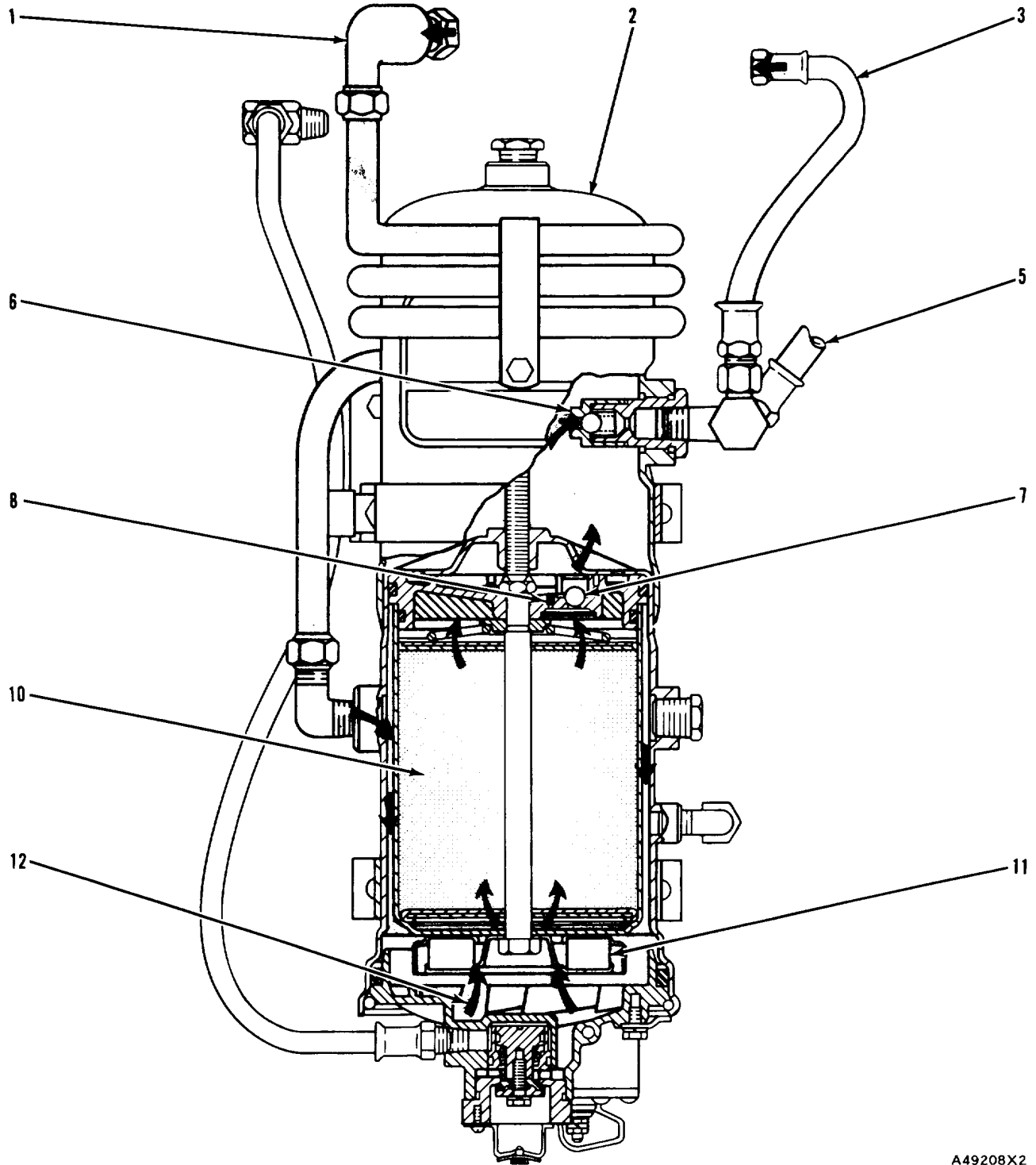
The air now goes through the oil filter (11) and some oil and foreign material is removed, but the water vapor is not removed. At this point, the air is still saturated (full) of water.

The filtered air and vapors go up into the bottom of the desiccant drying bed of the desiccant cartridge (10) and the adsorption procedure begins. Water vapor is removed from the air by the desiccant.

The unsaturated "dry air" goes through the check valve (7) and purge orifice (8) into the purge volume (2). From the purge volume (2) the air goes through check valve (6), through line (5) to the air reservoir and line (3) to the air compressor governor.

AIR DRYER

SYSTEMS OPERATION



CHARGE CYCLE

A49208X2

- 1. Line from air compressor to air dryer.
- 2. Purge volume.
- 3. Line to air compressor governor.

- 5. Line to air reservoir.
- 6. Check valve.
- 7. Check valve.
- 8. Purge orifice.

- 10. Dessicant cartridge.
- 11. Oil filter.
- 12. Sump.

AIR DRYER**SYSTEMS OPERATION****PURGE CYCLE**

For the purge or regeneration cycle, the air flow through the desiccant bed of the air dryer goes in reverse.

When the air pressure from the air compressor goes up to high pressure setting of the governor, it goes through the governor and into the area below the unloader pistons in the air compressor cylinder block. The unloader pistons go up and the unloader plungers move up and hold the inlet valves off of their seats.

With the inlet valves held off their seats, air goes through the unloader line (4) into the purge valve opening (14). The purge valve plunger (17) is moved off of its seat (19). The sudden opening of the the purge valve piston (15) and purge valve plunger (17) permits the air pressure that is in the dryer to exhaust the condensation and foreign material that has gathered in the sump (12) past the purge valve exhaust deflector (18) to the atmosphere. The sudden decompression (decrease in air pressure) of the drying bed of the desiccant cartridge (10) removes moisture from the pores (cavities) of the micro-crystalline particles that make up the drying bed. After the rapid decompression caused when the purge valve is opened, air goes from the purge volume (2) through the purge orifice (8) into the desiccant cartridge (10). As the air passes through the purge orifice (8) it expands and goes through the drying bed in the reverse direction, and through the purge valve to exhaust to atmosphere.

The air in the purge volume (2) was dried as it moved through the desiccant bed during the charge cycle. As it moves back into the desiccant bed, it becomes "super dry" (extra dry) after expansion to atmosphere pressure through purge orifice (8). This super dry air is very efficient (very good) in removal of water in its reverse flow through the desiccant bed.

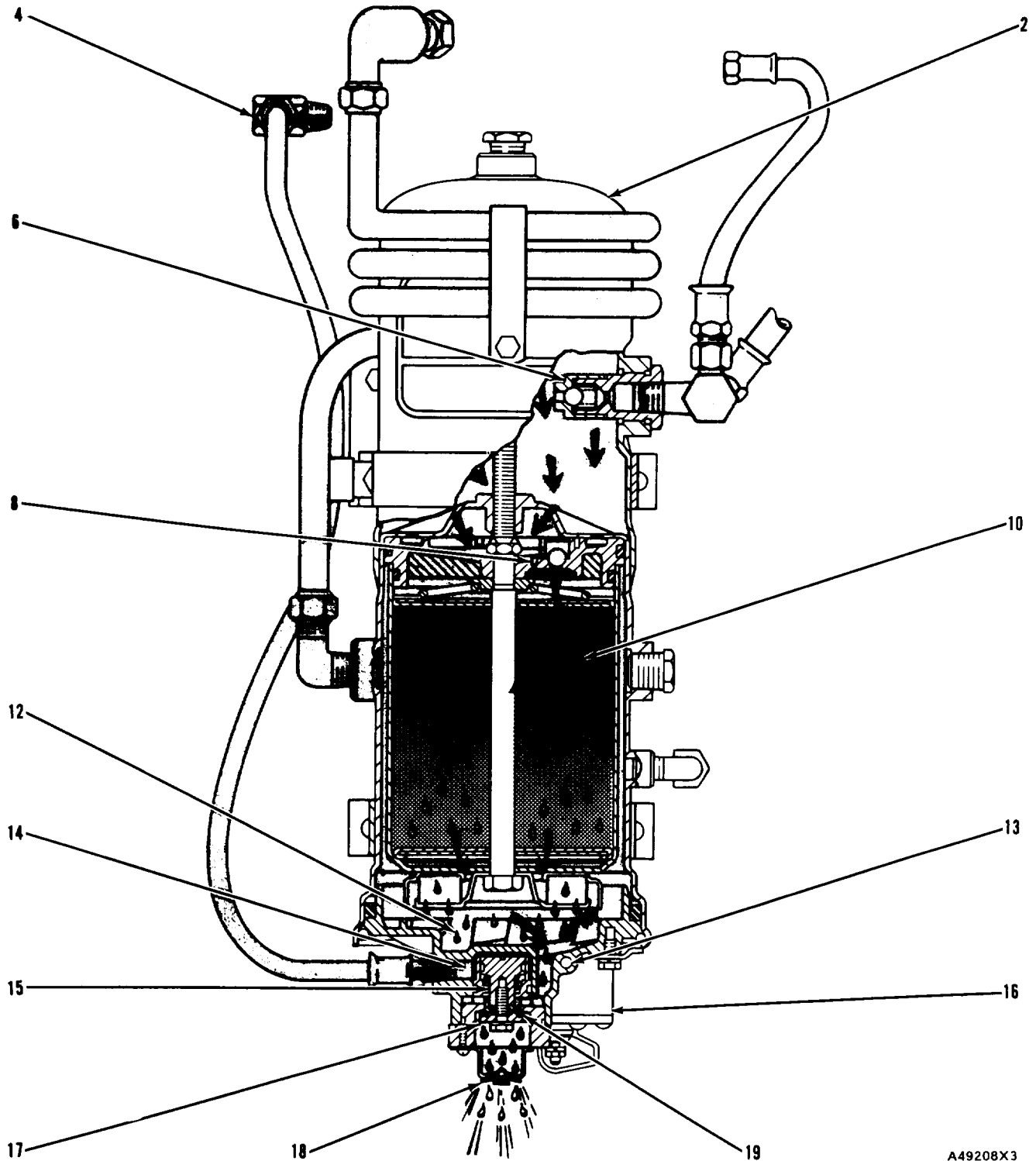
If the purge cycle goes longer than the time needed to completely drain the purge volume to atmosphere, no more action takes place. The air dryer check valve (6) will keep the air in the air reservoirs from going into the purge volume (2).

The electric heater (13) and thermostat (16) keeps moisture in the sump (12) from freezing. The thermostat will operate between 50°F (10°C) and 85°F (30°C).

When the air pressure in the air system goes below the governor pressure setting, the governor will cut in and the unloader pistons and plunger will no longer hold the inlet valves of the air compressor off their seats. The air compressor will again begin sending compressed air to the air dryer through air supply line (1) and the charge cycle begins.

AIR DRYER

SYSTEMS OPERATION

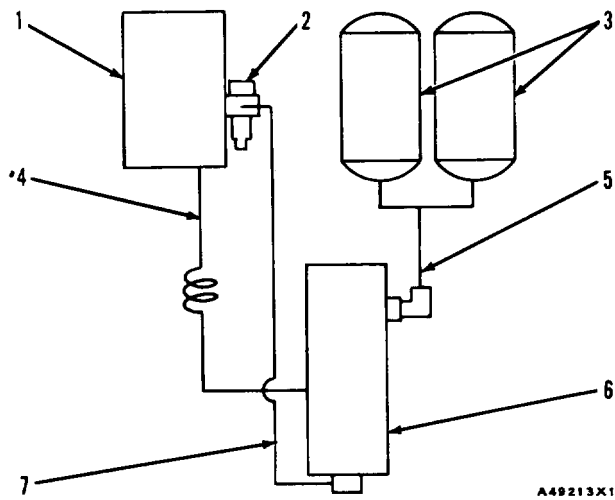


A49208X3

PURGE CYCLE

- | | | |
|------------------------------------------------------|--------------------------|------------------------------------|
| 2. Purge volume. | 10. Desiccant cartridge. | 16. Thermostat. |
| 4. Unloader line from air compressor to purge valve. | 12. Sump. | 17. Purge valve plunger. |
| 6. Check valve. | 13. Heater. | 18. Purge valve exhaust deflector. |
| 8. Purge orifice. | 14. Purge valve opening. | 19. Seat. |
| | 15. Purge valve piston. | |

AIR DRYER



SCHEMATIC FOR TRACTOR-SCRAPER

- 1. Air compressor.
- 2. Governor.
- 3. Air reservoirs.
- 4. Tube coil.
- 5. Line from air dryer to air reservoirs.
- 6. Air dryer.
- 7. Unloader line from air compressor to air dryer.

AIR DRYER

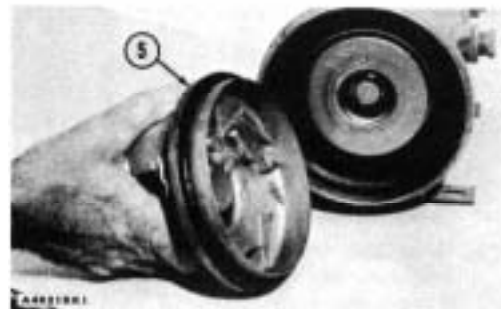
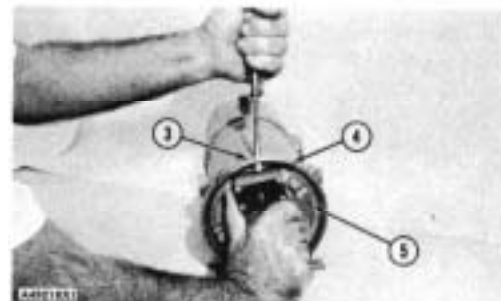
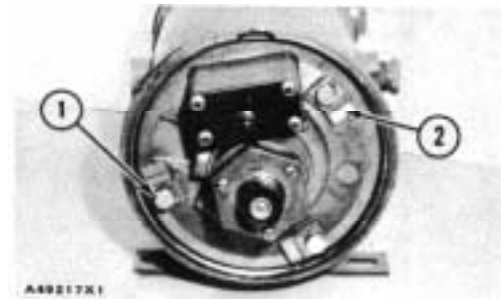
DISASSEMBLY AND ASSEMBLY

DISASSEMBLY AND ASSEMBLY

1. Put the machine on level ground. Lower all equipment to the ground, put blocks in front and in back of the wheels so the machine cannot move. Shut off the engine.
2. Remove all of the air pressure from the air reservoirs and air system. Make sure the lines to and from the air dryer are at atmospheric pressure.
3. Disconnect the unloader line from the end cover of the air dryer. Disconnect the wire at the air dryer.

NOTE: To better show the disassembly and assembly of the air dryer, it has been removed from the machine.

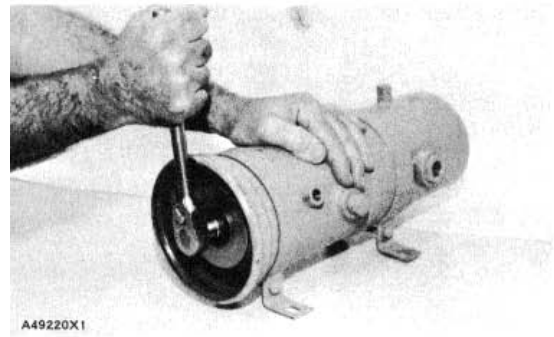
4. Loosen the bolts (1) and turn the clamps (2) 90° as shown.
5. Push in on end cover assembly (5).
6. Put a screw driver in notch (3) and remove snap ring (4).
7. Remove end cover assembly (5).



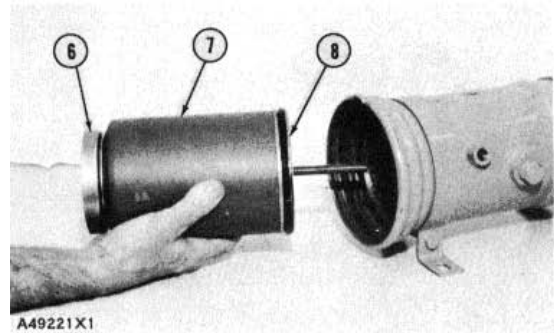
AIR DRYER

DISASSEMBLY AND ASSEMBLY

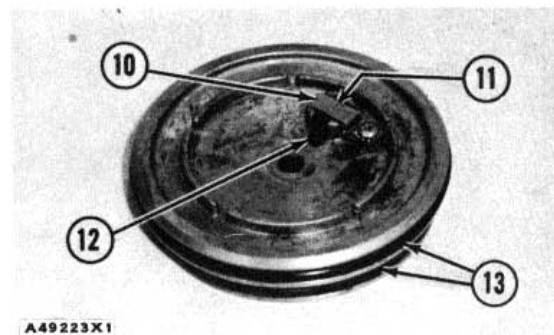
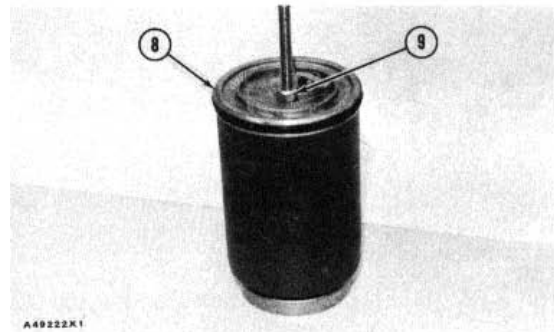
8. Using a 3/4 in. socket wrench, remove the oil filter (6), the desiccant cartridge (7) and desiccant sealing plate (8) as an assembly.



9. Remove the nut (9) and desiccant sealing plate (8).



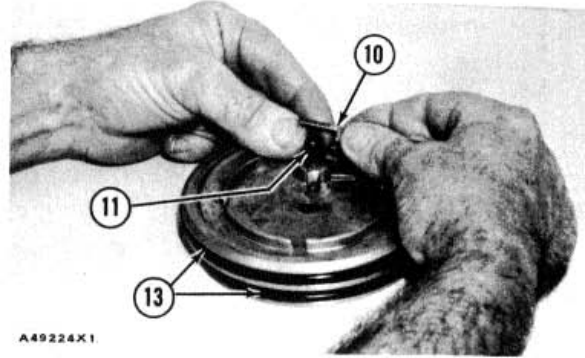
10. Remove the O-ring seals (13).
11. Remove the clip (10) and ball check valve (11) under the clip.
12. Clean the desiccant plate in a solvent. Make sure the purge valve orifice (12) and check valve seat are open and clean.



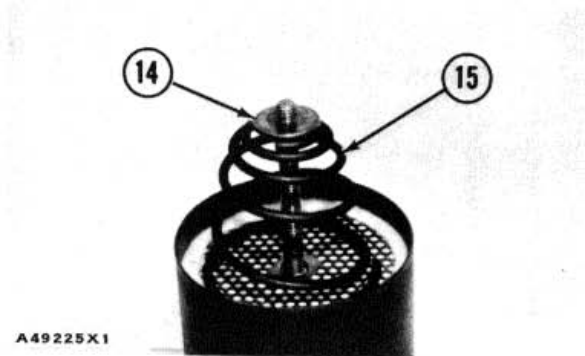
AIR DRYER

DISASSEMBLY AND ASSEMBLY

13. Put some of the lubricant from the repair kit on new o-ring seals (13) and put them in their respective grooves.

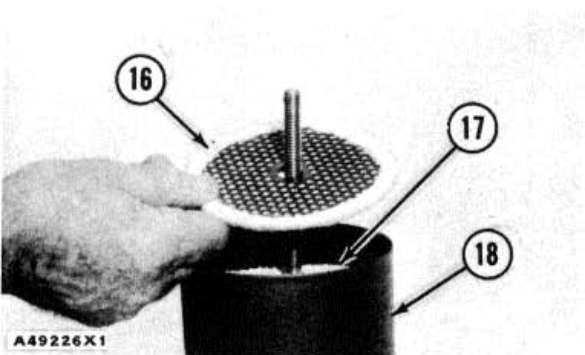


14. Install a new ball check valve (11). Install the clip (10).

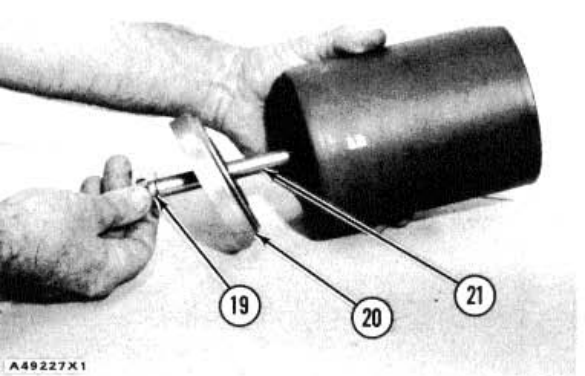


15. Remove the seat (14) and spring (15).

16. Remove the plate (16) and desiccant material (17) from the cartridge shell (18).



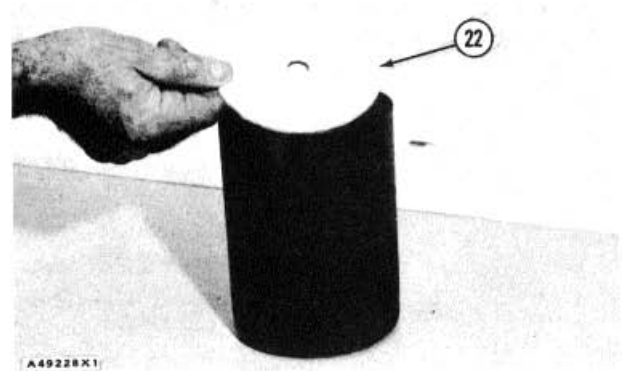
17. Remove bolt (21), washer (19) and oil filter (20).



AIR DRYER

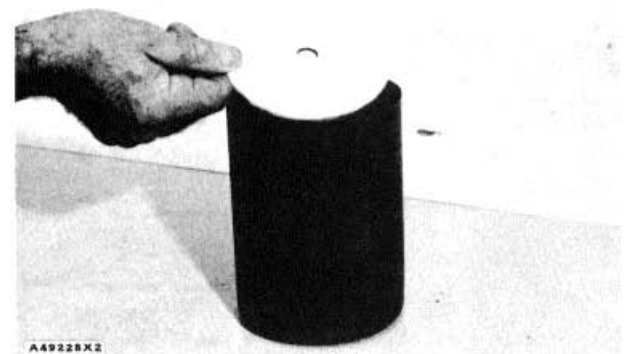
DISASSEMBLY AND ASSEMBLY

18. Remove the plate (22) from the cartridge shell.



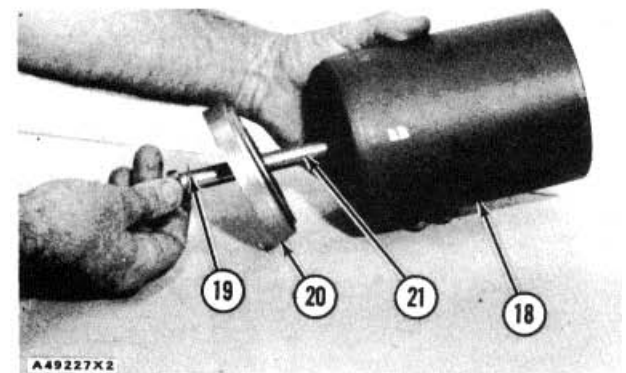
19. Clean the bolt and washer and the inside and outside of the cartridge shell.

20. Put a new plate in the bottom of the cartridge shell with the felt side (cloth side) up.

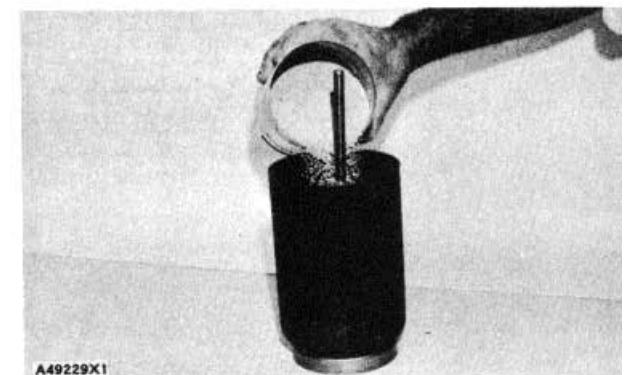


NOTE: The cloth side of the plate is always towards the desiccant.

21. Put the washer (19) and a new oil filter (20) on the bolt (21). Be sure the side of the oil filter that has the gasket on it is next to the bottom of the cartridge shell (18).



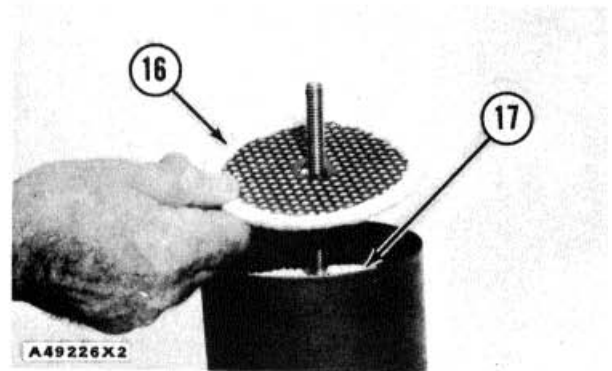
22. Put all of a package of new desiccant material in the cartridge shell. DO NOT let the bolt come out or the desiccant material will come out.



AIR DRYER

DISASSEMBLY AND ASSEMBLY

23. Install a new plate (16) with the cloth side towards the desiccant (17).



24. Make sure the shoulder (23) on the bolt is above the plate. Use a soft hammer to hit the side of the cartridge shell to make the desiccant go down (settle).



25. Put the spring (15), seat (14) and rebuilt desiccant sealing plate (8) over the bolt.



26. Put the nut (9) on the bolt and tighten it several turns. To make the desiccant go into place (settle into place), hit the side of the cartridge shell several times with a soft hammer.

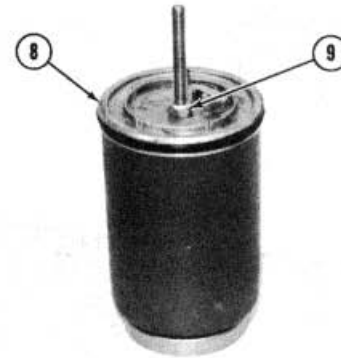


27. Put some of the lubricant from the repair kit on the seals (13).

AIR DRYER

DISASSEMBLY AND ASSEMBLY

28. Tighten the nut (9) until the desiccant sealing plate (8) is in place.

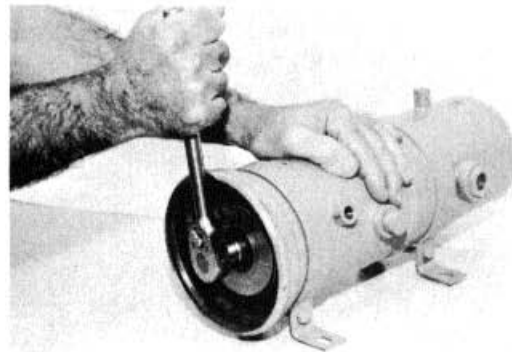


A49222X1

29. Inspect the inside of the air dryer body to see that it is clean.

30. Put some of the lubricant from the repair kit on the o-ring seal on the purge plate assembly.

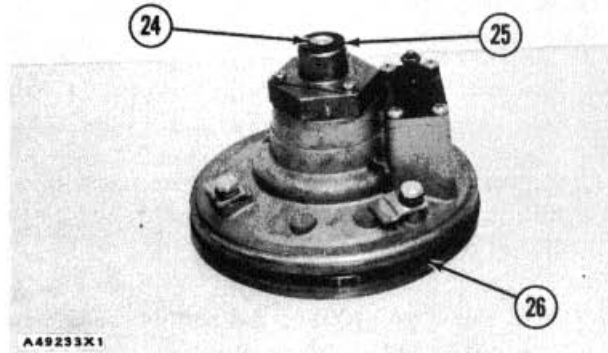
31. Install the oil filter, desiccant cartridge and purge plate assembly in the air dryer body as an assembly. Tighten the bolt to a torque of 32 lb. ft. (43 N•m).



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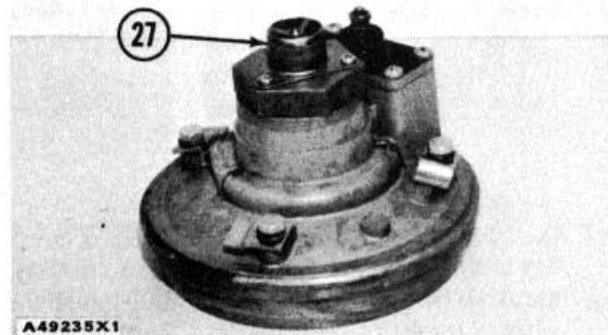
32. Remove the o-ring seal (26).

33. Remove the screw and washer (24) and diaphragm (25).



A49233X1

34. Remove the cover (27).



A49235X1

AIR DRYER

DISASSEMBLY AND ASSEMBLY

35. Remove the purge valve assembly (28).

36. Put a large screw driver in the slot (29) to hold the purge valve piston (30) from turning.
37. Loosen the bolt (33).

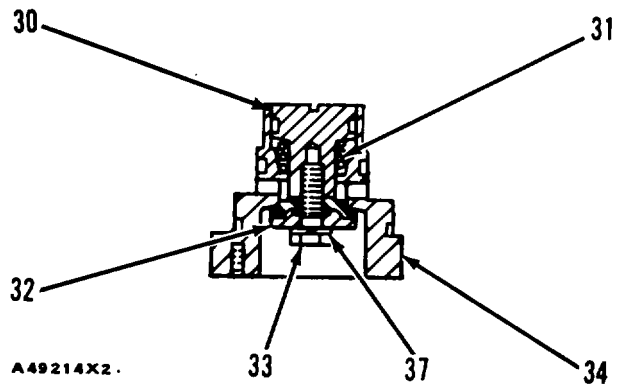
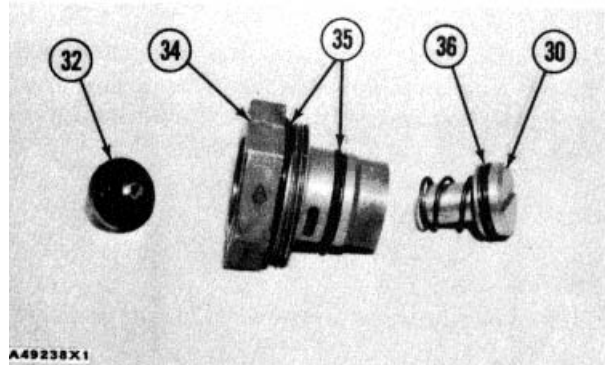
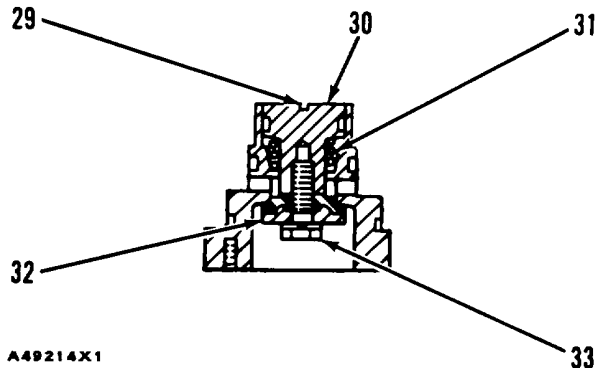
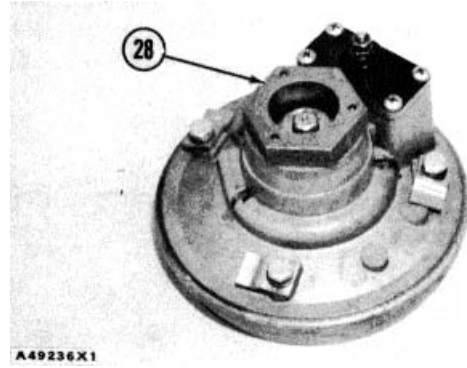
38. Remove the bolt (33), purge valve (32), purge valve piston (30) and spring (31).

39. Remove O-ring seals (35) from cap nut (34).
40. Remove O-ring (36) from purge valve piston (30).

41. Put some of the lubricant from the repair kit on a new purge valve (32), new seals (35) and a new seal (36).

42. Put the new seals (35) on cap nut (34) and a new seal (36) on purge valve piston (30).

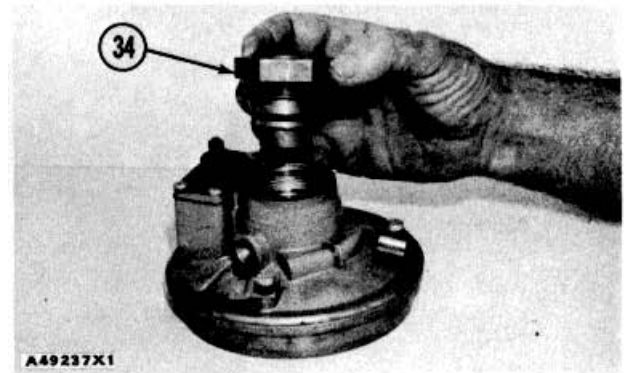
43. Assemble the purge valve piston (30), new spring (31) and new purge valve (32) in cap nut (34). Install lockwasher (37) and bolt (33). Tighten the bolt to a torque of 50 lb. in. (5.7 N•m).



AIR DRYER

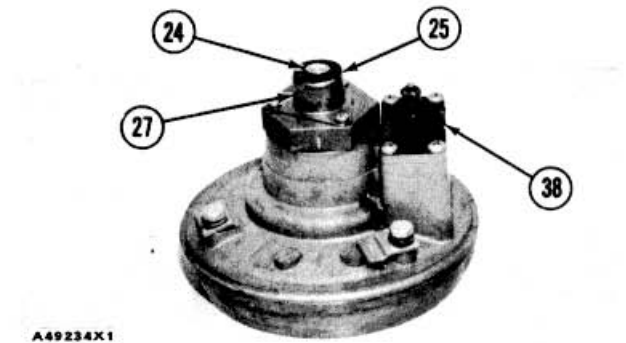
DISASSEMBLY AND ASSEMBLY TM 5-3805-248-14&P-3

44. Put some of the lubricant from repair kit on the threads of cap nut (34). Install the purge valve assembly and tighten to a torque of 180 to 250 lb. in. (20 to 28 N.m).



45. Install the cover (27), a new diaphragm (25) and the washer and screw (24).

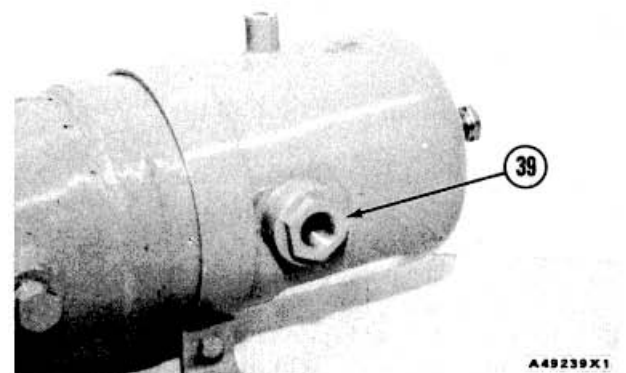
NOTE : The heater and thermostat are not serviced. If there is a defect in the heater and thermostat, install a new end cover assembly. **DO NOT** remove the cover (38).



46. If the check valve in the outlet passage is to be removed while the air dryer is on the machine, do the following.

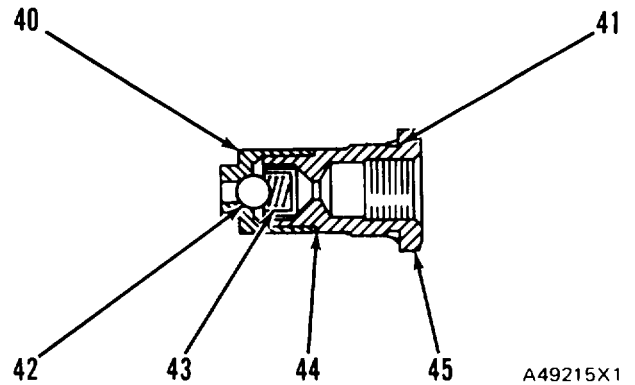
- A. Make sure the machine is in a safe place on level ground. Put blocks in front and in back of the wheels and lower all equipment to the ground.
- B. Shut off the engine and let all of the air pressure out of the air system.
- C. Disconnect the air line from the check valve outlet passage.

47. Remove the check valve assembly (39).



AIR DRYER

48. Remove the body (40) from the body (45).
49. Remove the check valve (42), spring (43), seal washer (44) and the o-ring seal (41).
50. Put some of the lubricant from the repair kit on a new check valve, new spring, new seal washer and new O-ring seal.
51. Assemble the spring (43), check valve (42), seal washer (44), body (40) and body (45).
52. Tighten the bodies together to a torque of 200 to 225 lb. in. (22 to 25 N.m).
53. Install the o-ring seal (41) and install the check valve assembly.
54. Connect the air line to the check valve.



MAINTENANCE

NOTE: The check for water may be made at 250 service hours but it is not expected that maintenance of the desiccant will be required for at least 1000 service hours.

Put a new or rebuilt desiccant cartridge in the air dryer when the desiccant in the cartridge does not have enough water absorption ability. First, make the checks that follow.

1. Check for water in the air tanks. Open the drains on the tanks. In areas where there is more than 30° F (170 C) change in ambient temperature, there can be water in the air tanks because of condensation. A small amount of water from condensation is normal and is not an indication that the air dryer is not in operation. Steps A, B and C are probable causes of too much water in the air tanks.

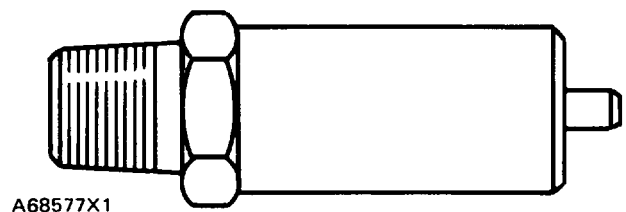
- A. Air from another machine without an air dryer was put in the air reservoirs and did not go through an air dryer.
- B. Too much air has been used for a long time and the air compressor has not been let to load and unload in a normal way (abnormal usage of air compressor).
- C. The air dryer has been installed on a machine that did not have one before. This type of system will be saturated with moisture and several weeks of operation may be needed to dry it out.

2. Check all bolts that hold the air dryer to see that they are tight. Check all air and electrical connections.

- 3. Check the operation of the check valve in the discharge opening of the air dryer. Install an air pressure gauge in the line between the air dryer discharge and the air tanks. With the system air pressure at governor cut-out pressure and the engine not running, check the air pressure gauge. If there is a fast drop in air pressure, it could be an indication of a check valve with a defect. This can be checked by an inspection of the purge valve exhaust. The purge valve will be open when the air pressure has gone up to governor cut-out pressure. Let two minutes go by for a complete purge cycle. If there is a constant flow of air from the purge valve exhaust with the engine shut off and if the air pressure on the test gauge went down, it is an indication there is an air leak in the check valve.
- 4. With the compressor loaded (compressing air), put a mixture of liquid soap and water on the exhaust of the purge valve to see if there is an air leak in the valve.
- 5. Pull on the stem of the relief valve while the air compressor is loaded (compressing air). There must be an exhaust of air from the valve and it must stop when the stem of the valve is released.
- 6. Check all lines and fittings that go to and from the air dryer for leakage.
- 7. Check the operation of the heater and the thermostat during cold weather operation.

**RELIEF VALVE
(2G 1034)**

On side of air dryer housing pressure needed to open valve . . . 175 ± 8 psi (1200 - 55 kPa)



SECTION IV
 SPECIFICATIONS-AIR SYSTEM AND BRAKES

TORQUE SPECIFICATIONS: You will find instances in this publication where the manufacturer has used "Meter-Kilograms" or "Centimeter-Kilograms" in place of "Newton-Meters" for the metric torque. In these instances, use the following conversion factors to obtain the metric torque in "Newton-Meters."

- lb. ft. x 1.355819 = N-m
- lb. in. x 0.1129848 = N-m

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NOTE: For Systems Operation and Testing and Adjusting, make reference to AIR SYSTEM AND BRAKES.

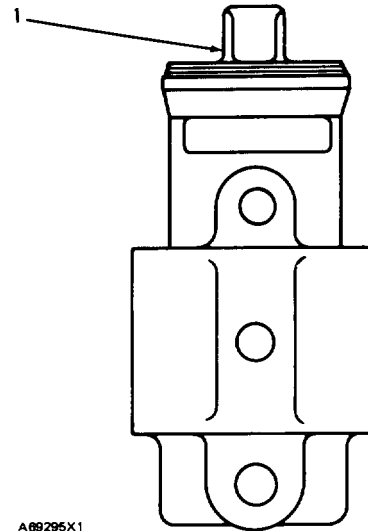
AIR COMPRESSOR GOVERNOR

Governor settings:

Cut-in pressure..... 95 to 100 psi
(660 to 690 kPa)

Cutout pressure 120 ± 5 psi (830 ± 35 kPa)

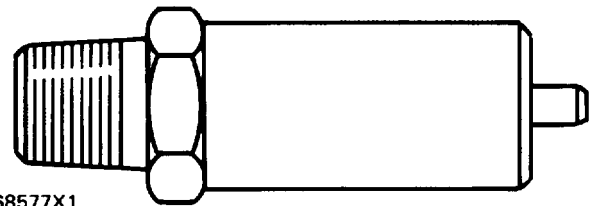
(1) Pressure change (when screw is turned to one revolution) 20 psi (140 kPa)



A69295X1

**AIR RELIEF VALVE
(6B9664)**

Pressure needed to open valve..... 150 + 8
psi (1030 + 55 kPa)



A68577X1

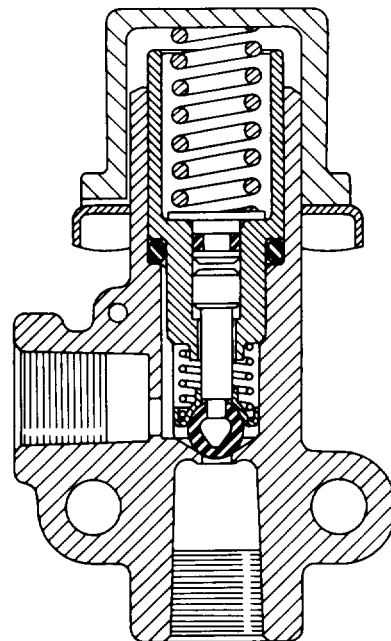
**PRESSURE PROTECTION VALVE
(6D918)**

Valve has a normally closed position.

Maximum operating pressure..... 150 psi
(1030 kPa)

Pressure needed to open valve..... 75 psi
(520 kPa)

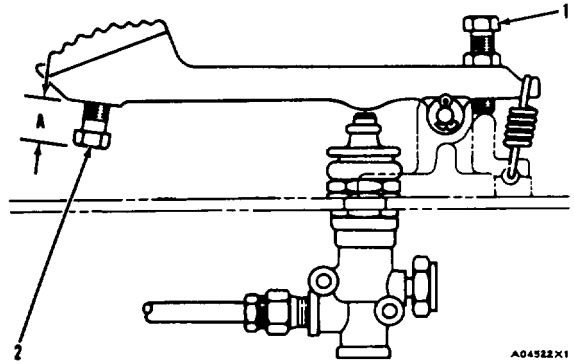
Pressure needed to close valve 60 psi
(415 kPa)



AIR SYSTEM AND BRAKES

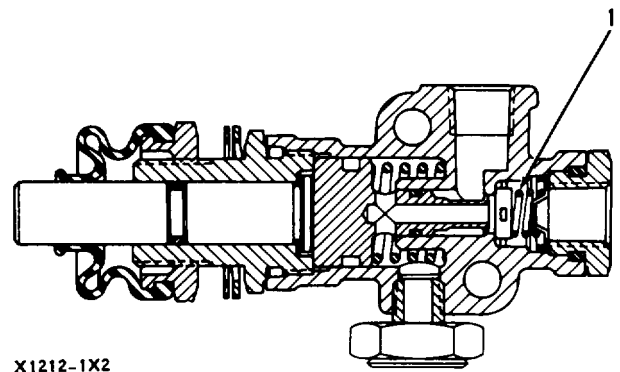
ADJUSTMENT OF TRANSMISSION HOLD AND DIFFERENTIAL LOCK PEDALS

1. Make an adjustment to bolt (1) until the pedal is parallel with the floor plate without moving the valve plunger.
2. Make an adjustment to bolt (2) until dimension (A) is .75 in. (19.1 mm).
3. Push the pedal down fully..
4. If necessary, make an adjustment to bolt (2) to give a valve plunger movement of16 + .03 in. (4.1 + 0.8 mm)



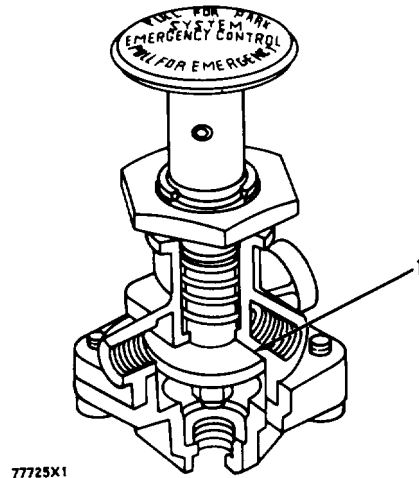
DIFFERENTIAL LOCK AND TRANSMISSION HOLD CONTROL VALVES (6D856)

- Valve has a normally closed position.
 Maximum operating pressure 150 psi (1030 kPa)
 (1) 4J3957 Spring:
 Free length67 in. (17.0 mm)
 Inside diameter......42 in. (10.7 mm)



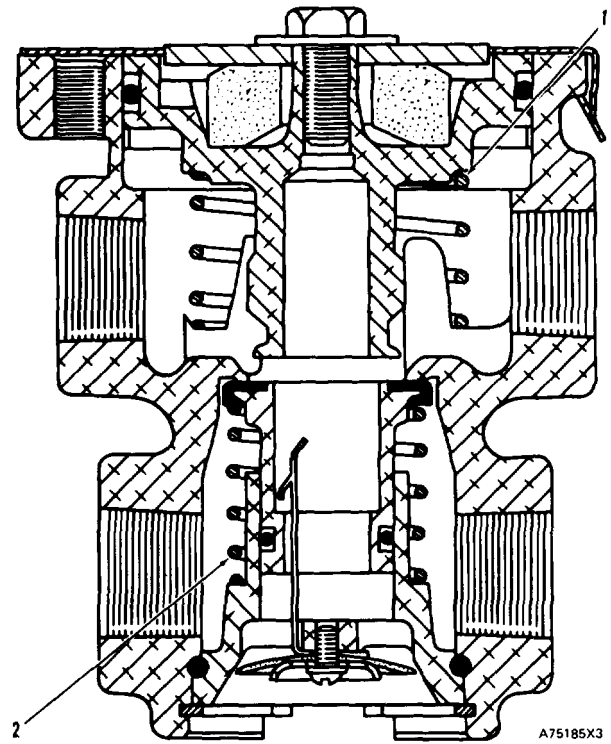
PARKING AND EMERGENCY BRAKE CONTROL VALVES (7K2738)

- (1) Pressure to activate valve 40+ 5 psi (280 + 35 kPa)
 Pressure to keep valve closed when knob is pushed in 55 + 5 psi (380 + 35 kPa)



**BRAKE CONTROL VALVES
(6G1576)**

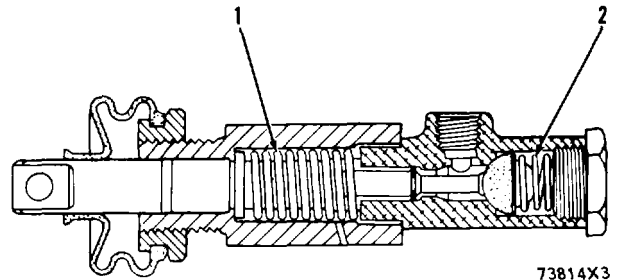
- (1) 4D2634 Spring
 - Free length 2.34 In (59.4 mm)
 - Inside diameter 1.44 In (36.6 mm)
- (2) 4D2298 Spring
 - Free length 1.66 In (42.2 mm)
 - Inside diameter98 In (24.9 mm)



A75185X3

**APRON CONTROL VALVE
(4J8500)**

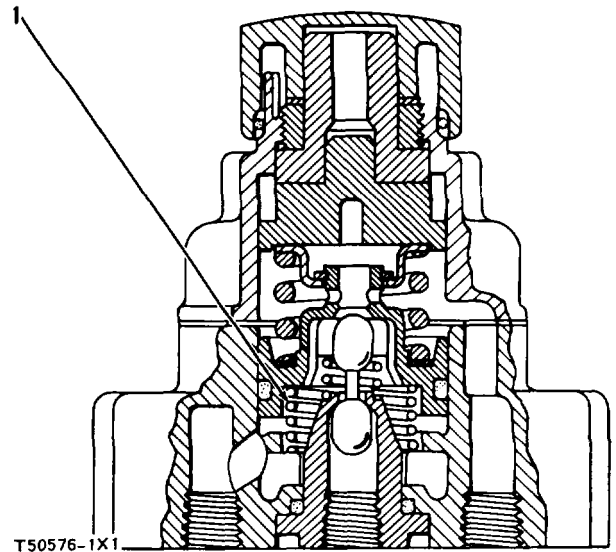
- (1) 4J8394 Spring
 Length under test force 1.09 in (27.7 mm)
 Test force 18 lbs (80 N)
 Free length after test 1.55 in (39.4 mm)
 Outside diameter66 in (16.8 mm)
- (2) 4DI 133 Spring
 Free length69 in (17.5 mm)
 Inside diameter44 in (11.2 mm)



73814X3

**RETARDER CONTROL VALVE
(6D3943)**

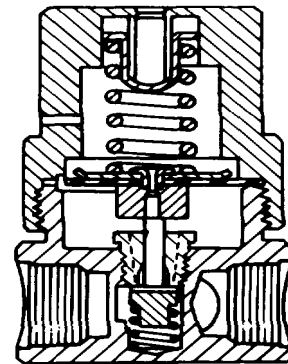
- Delivery pressure
 Minimum 27 - 3 psi (190 + 20 kPa)
 Maximum 80 - 5 psi (550 - 35 kPa)
- (1) 4D5262 Spring
 Free length62 in (15.7 mm)
 Outside diameter 1.12 in (28.4 mm)



T50576-1X1

**REGULATOR FOR RETARDER
CONTROL VALVE
(8D4765)**

- Delivery pressure65 ± .3 psi (450 ± 20 kPa)
 When checked with a
 supply pressure of 100 ± 2 psi (690 - 14 kPa)

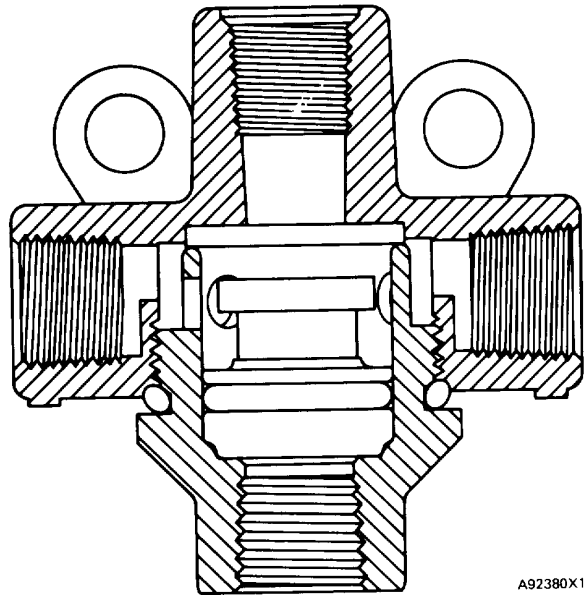


A01473X2

AIR SYSTEM AND BRAKES

**QUICK RELEASE AND HOLDING VALVE
(6G593)**

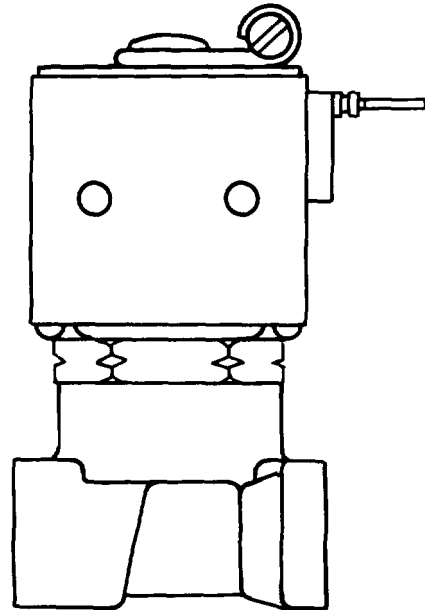
Valve has a normally closed position.
 Maximum operating pressure..... 150 psi (1030 kPa)
 Valve will exhaust when
 inlet pressure is 43 + 3 psi (295 + 20 kPa)



A92380X1

**AIR HORN
SOLENOID VALVE
(2G5694)**

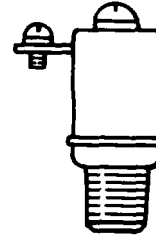
Valve has a normally closed position
 Maximum operating pressure..... 150 psi (1030 kPa)



A69406X

AIR PRESSURE SWITCHES
(7D7378)

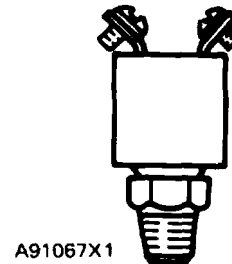
Switch has a normally closed position.
 Pressure needed to open switch ... 6 psi (415 ±40 kPa)



91026X1

AIR PRESSURE SWITCHES
(7N1062)

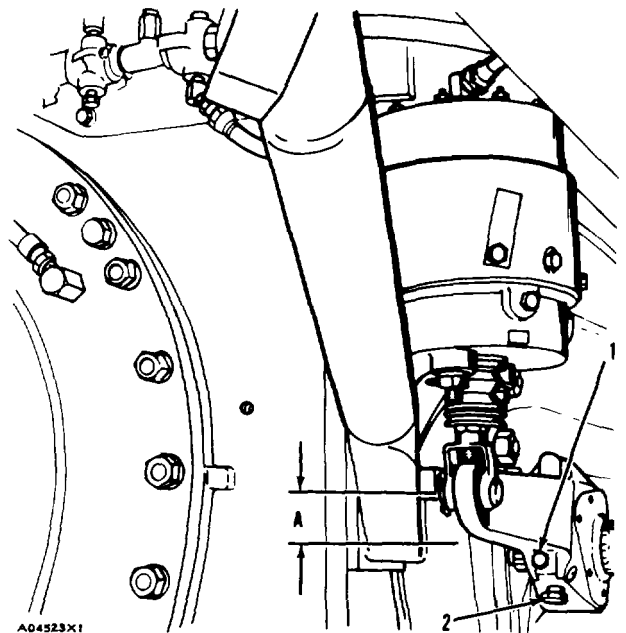
9D7032 Switch has a normally open position
 7N1062 Switch has a normally closed position
 With an increase in pressure,
 switch activates at 75 + 5 psi (520 + 35 kPa)
 With a decrease in pressure,
 switch activates at 60 - 5 psi (41535 kPa)



A91067X1

BRAKE ADJUSTMENT

Maximum rod travel (A) before adjustment is needed 2 5 in (64 mm)
 1. Loosen lock bolt (1).
 2. Turn worm (2) until the rod travel (A) is (cold) 1 62 in (41 1 mm)
 3. Tighten lock bolt.



BRAKE DRUMS

Torque for 42 bolts that hold each drum assembly in position 95 + 7 lb ft (130 + 10 N-m)

CHAPTER 4
 VEHICLE SYSTEMS
 DISASSEMBLY AND ASSEMBLY

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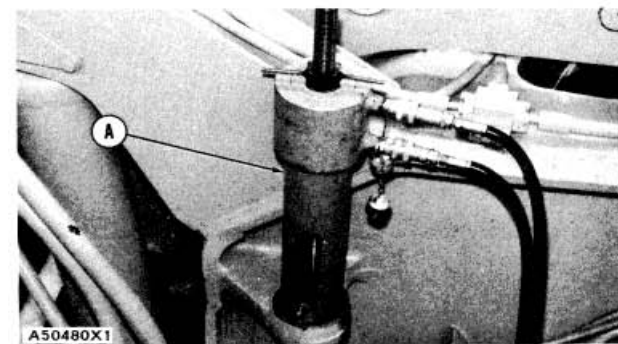
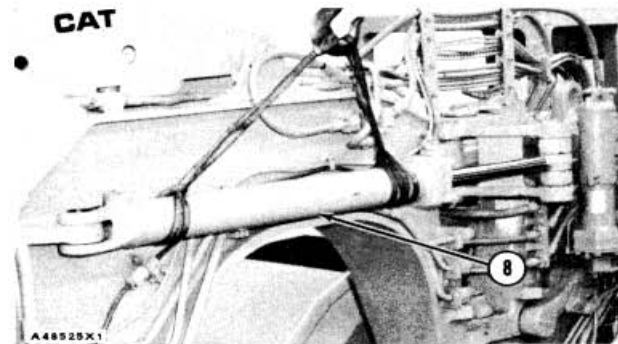
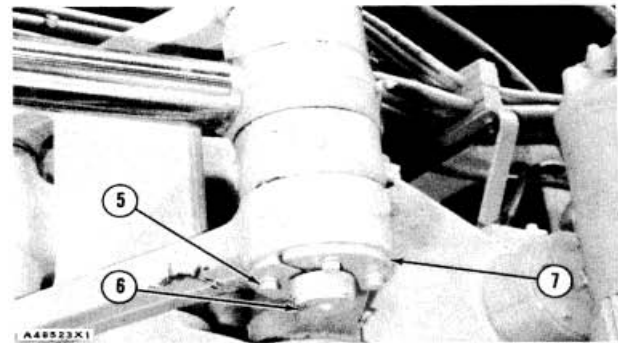
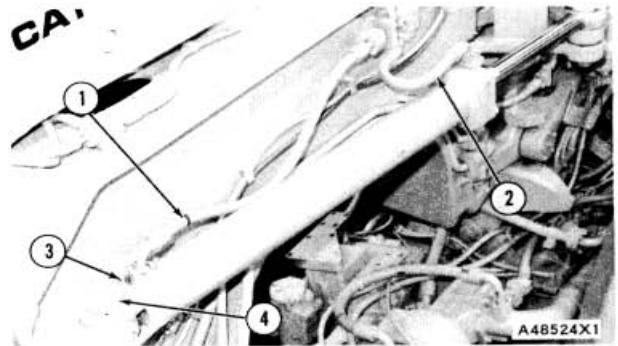


STEERING CYLINDERS

REMOVE STEERING CYLINDERS

	Tools Needed	A
1P544	Nut	1
9S5558	Stud	1
5H9817	Hydraulic Puller	1
5P3100	Pump Group	1
9S5565	Sleeve	1
1P1835	Adapter	1

WARNING: Before any hydraulic hoses are disconnected from the steering cylinder, release the pressure in the hydraulic system. Start the engine and move the ejector forward all the way. Stop the engine and loosen the cap slowly on the hydraulic tank. Move all the hydraulic controls backward and forward.



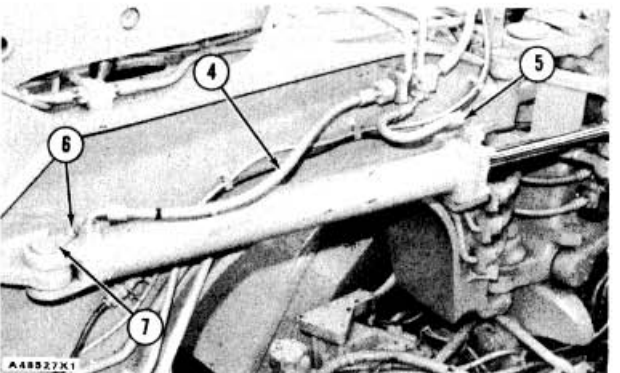
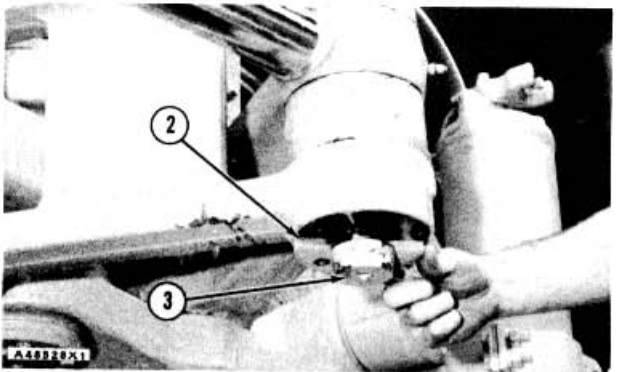
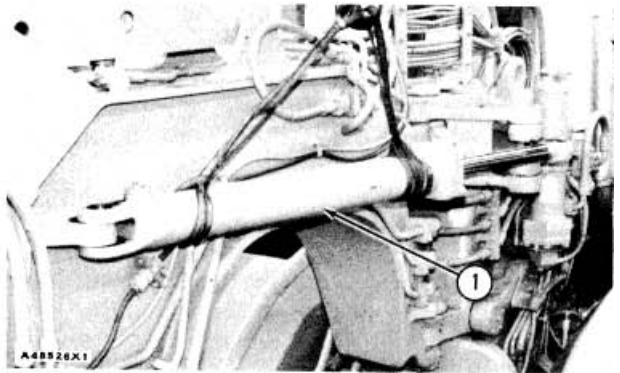
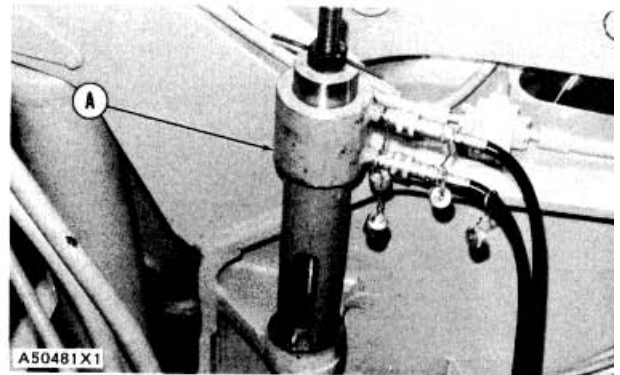
1. Disconnect hose assemblies (1) and (2) from the steering cylinder.
2. Fasten a hoist to the steering cylinder. Remove bolt (3) and pin assembly (4) from the head end of the cylinder.
3. Remove four bolts (5) and two yokes (7). Remove pin (6) from the rod end of the cylinder.
4. Remove steering cylinder (8). The weight of the cylinder is 200 lb. (90kg).
5. Remove the bearing from the draft frame with tooling (A).

STEERING CYLINDERS

INSTALL STEERING CYLINDERS

	Tools Needed	A
1P544	Nut	1
9S5558	Stud	1
5H9817	Hydraulic Puller	1
5P3100	Pump Group	1
9S5565	Sleeve	1
1P1835	Adapter	1

1. Install the bearing in the draft frame with tooling (A). Install the bearing until it is even with the outside surface of the bracket on the draft frame.
2. Fasten a hoist to steering cylinder (1) and put it in position on the draft frame and between the link assemblies.
3. Install pin (3) in the rod end of the cylinder. Install two yokes (2) and the four bolts that hold the two yokes.
4. Install pin assembly (7) and bolt (6) in the head end of the cylinder.
5. Connect hose assemblies (4) and (5) to the steering cylinder.
6. Start the machine. Turn the machine from stop to stop to release the air in the steering cylinders.
7. Fill the hydraulic tank with oil to the correct level. See Lubrication and Maintenance Guide.



VEHICLE SYSTEMS

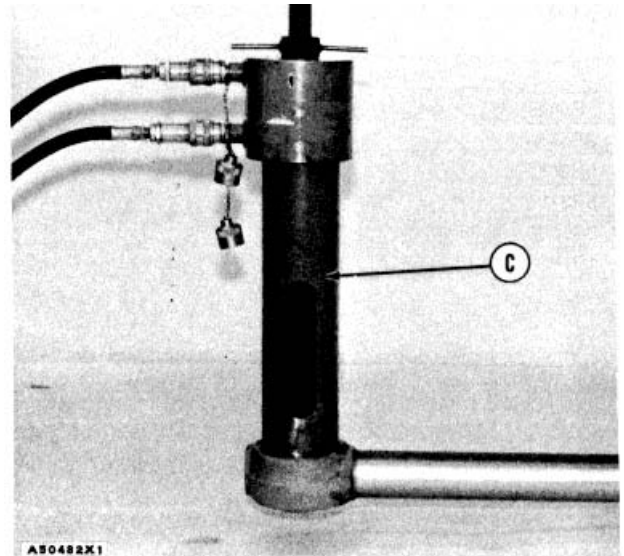
STEERING CYLINDERS

DISASSEMBLE STEERING CYLINDERS

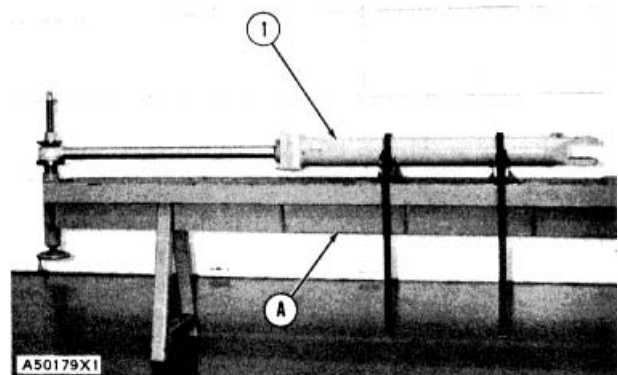
	Tools Needed	A	B	C
1P1784	Hydraulic Cylinder Repair			
	Stand	1		
5S6029	Socket		1	
1P850	Torque Multiplier		1	
1P851	Adapter		1	
1P544	Nut			1
9S5558	Stud			1
5H9817	Hydraulic Puller			1
5P3100	Pump Group	1		1
9S5565	Sleeve			1
1P1853	Adapter			1
FT948	Bracket	1		

start by:

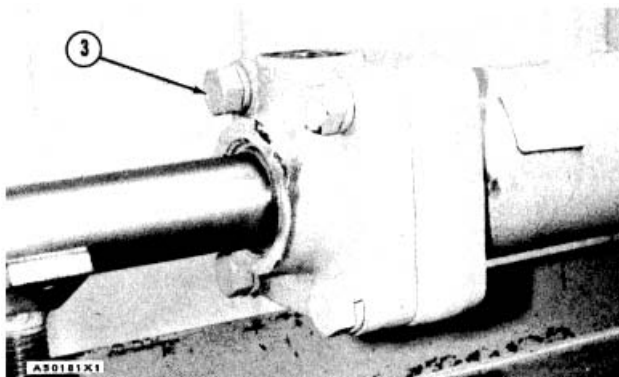
- a) remove steering cylinders
1. Remove the bearing from the rod end of the steering cylinder with tooling (C).
2. Fasten a hoist to steering cylinder () and put it in position on tool (A) as shown with the openings for the hydraulic lines down.
3. Pull the rod out of the cylinder all the way and install support (2) under the rod. Fasten a strap around the rod to hold it in position.
4. Remove four bolts (3). Pull the cylinder off of the rod and piston.



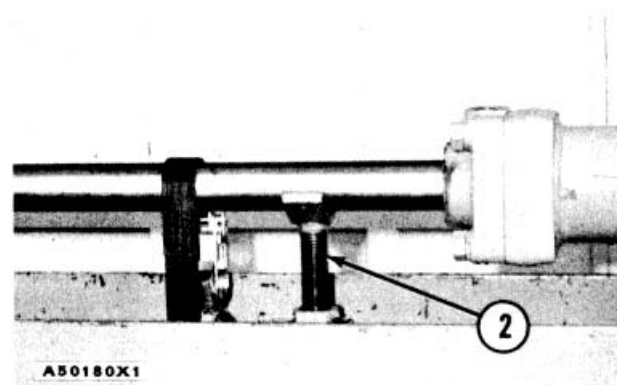
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A50179X1



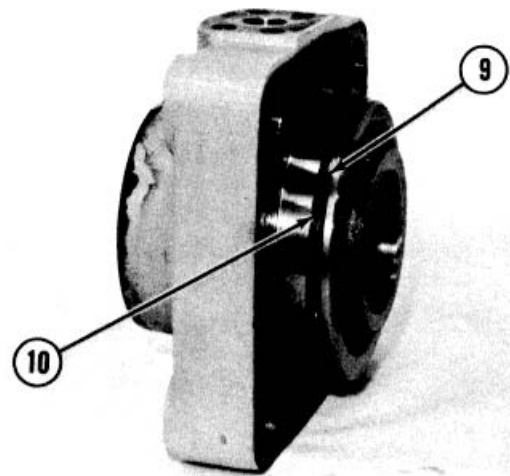
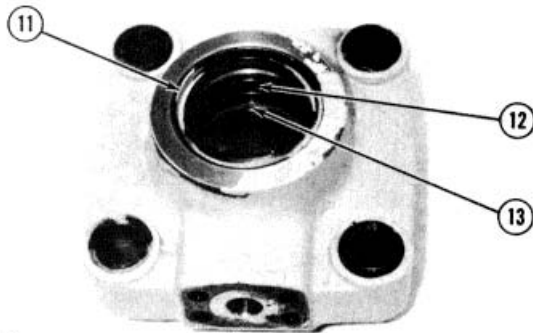
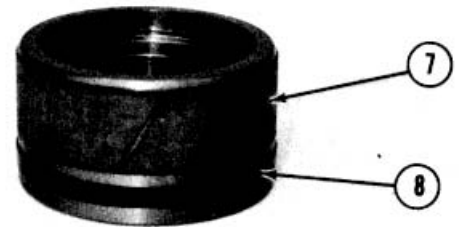
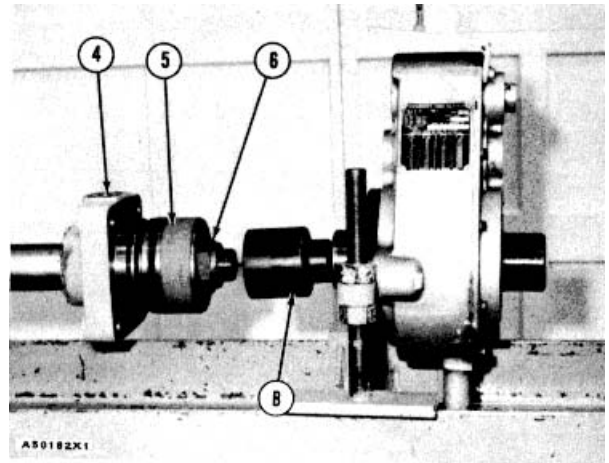
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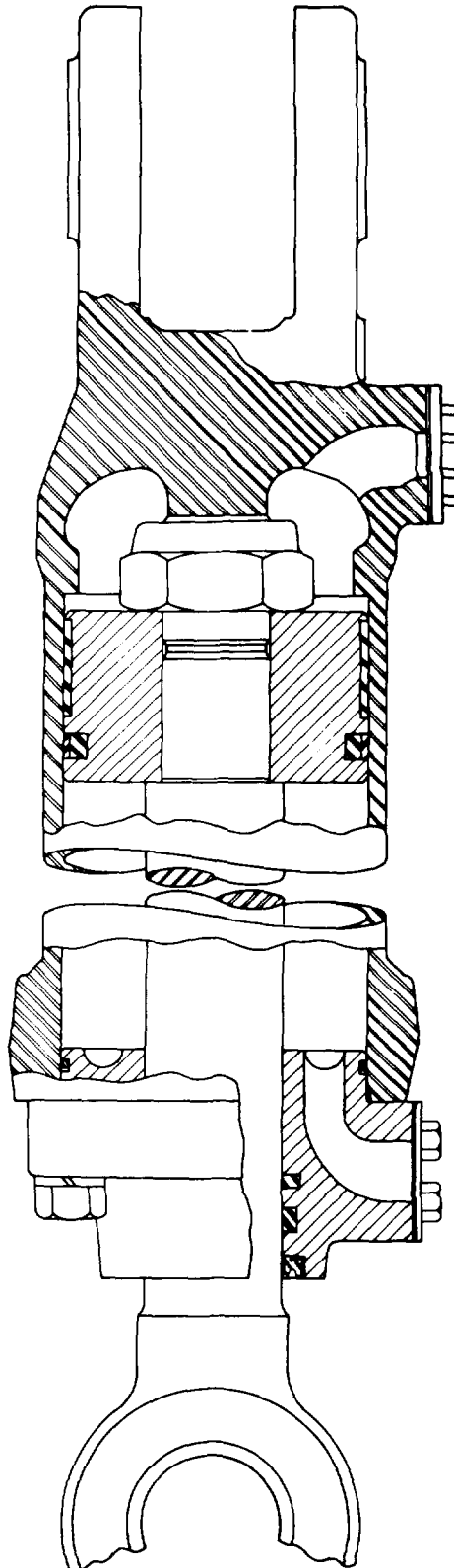
A50180X1

STEERING CYLINDERS

5. Remove nut (6) from the rod with tooling (B).
6. Remove piston assembly (5) and head (4) from the rod.
7. Remove wear ring (7) and seal assembly (8) from the piston.
8. Remove O-ring seal (9) and back-up ring (10) from the head. Check the condition of the O-ring seal. If the seal has damage. use a new part for replacement.
9. Remove seals (11), (12) and(13) from the head.



STEERING CYLINDERS



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STEERING CYLINDERS

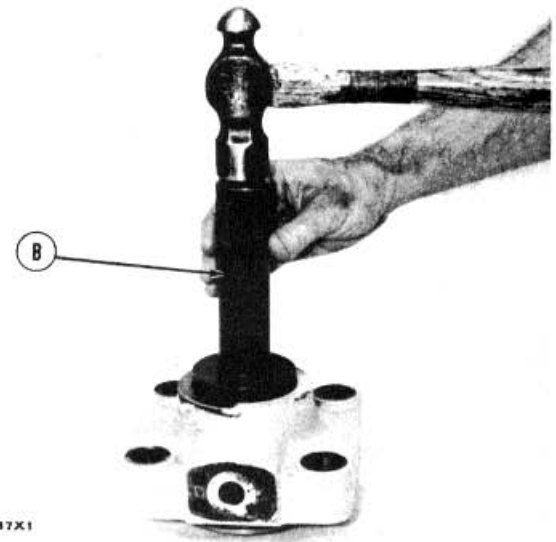
ASSEMBLE STEERING CYLINDERS

	Tools Needed	A	B	C	D	E	F
1P1784	Hydraulic Cylinder						
	Repair Stand	1					
1 P520	Driver Group		1				
5S6079	Socket			1			
1P1850	Torque Multiplier			1			
1P851	Adapter			1			
9S7352	Torque Wrench				1		
1P768	Seal Guide					1	
1P544	Nut						1
9S5558	Stud						1
5H9817	Hydraulic Puller						1
5P3100	Pump Group	1					1
9S5565	Sleeve						1
1P1835	Adapter						1
FT948	Bracket	1					

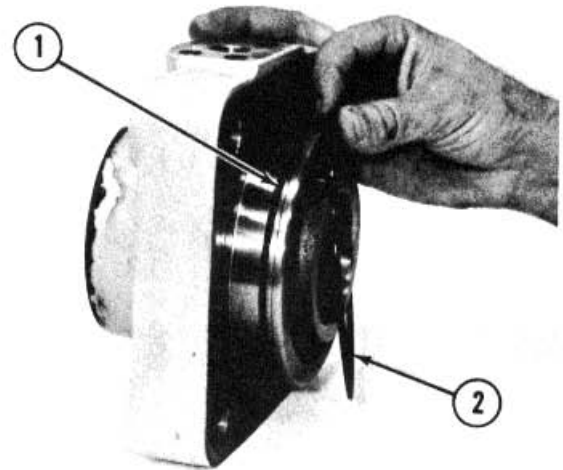
1. Install the three seals in the head. Install the inside seal and the center seal with the lip toward the inside of the cylinder. Install the outside seal with tool (B). Install the seal with the lip toward the outside of the cylinder and until the seal makes contact with the counterbore in the head.

2. Install back-up ring (1) and O-ring seal (2) on the head as shown.

3. Install seal assembly (4) and wear ring (3) on the piston.



A30187X1



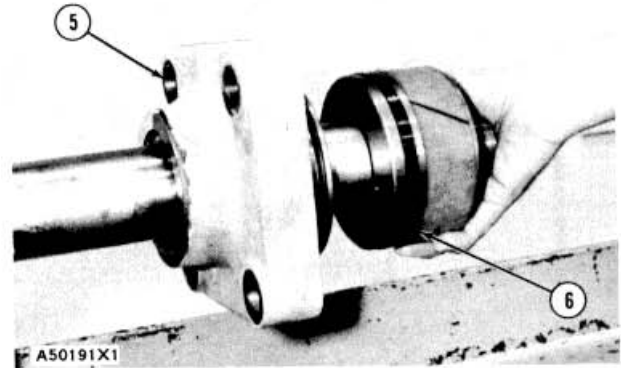
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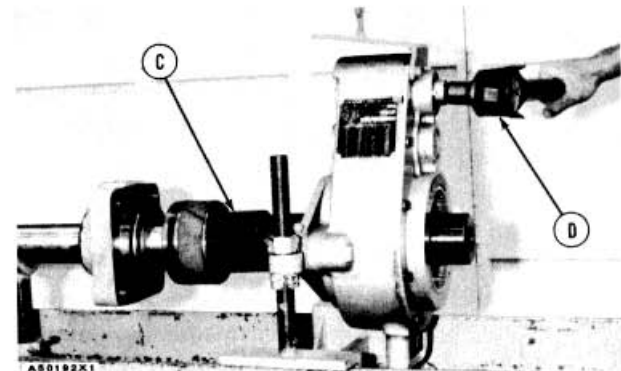
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STEERING CYLINDERS

4. Install tool (E) on the cylinder rod. Install the tool with the taper toward the threaded end of the rod. Tool (E) is used to prevent damage to the seals in the head during installation.
5. Put clean oil on the lips of the seals in the head. Put head (5) in position on the rod as shown. Remove tool (E).
6. Install piston assembly (6) on the rod as shown.



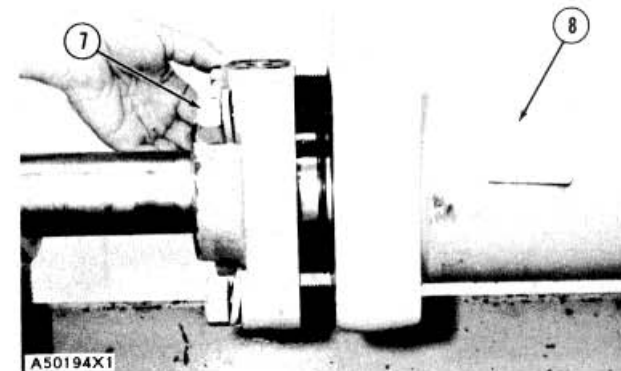
7. Install the nut that holds the piston in position on the rod. Tighten the nut with tooling (C) and (D) to a torque of 1600 ± 160 lb. ft. (2160 ± 219 N•m).



8. Put clean oil on the piston assembly and the O-ring seal on the head assembly.

9. Move cylinder (8) over the piston assembly and rod.

10. Use four bolts (7) to pull the head into the cylinder. Tighten the four bolts with the rod fully extended.

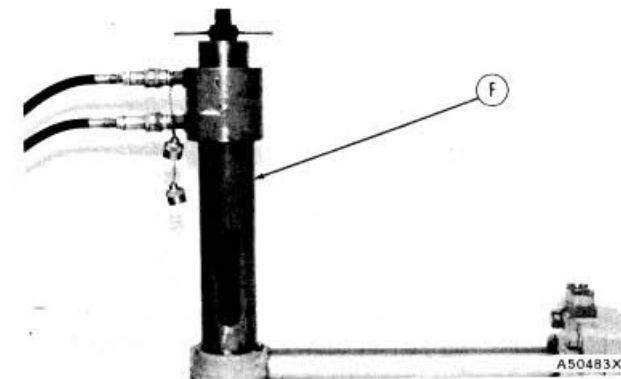


11. Remove the steering cylinder from tool (A).

12. Install the bearing in the cylinder rod with tooling (F). Install the bearing until it is .12 in. (3.05 mm) below the outside surface of the rod.

end by:

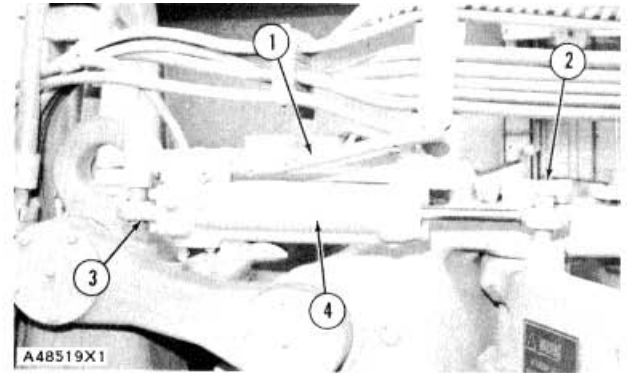
- a) install steering cylinders



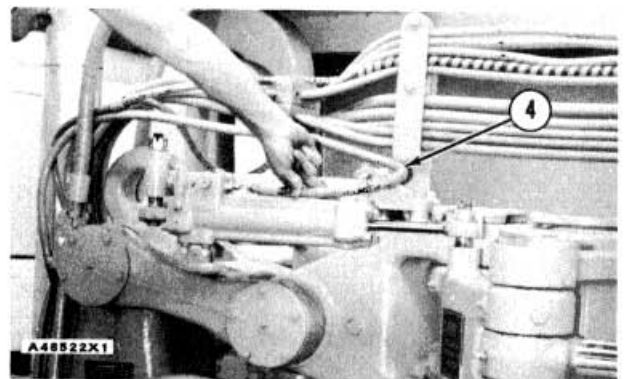
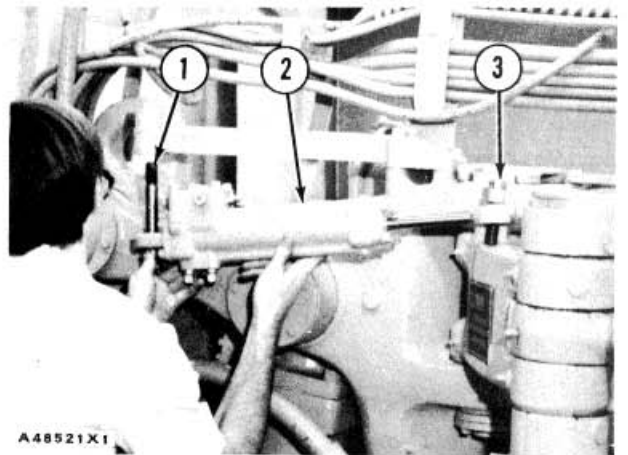
STEERING CYLINDER (SERVO-SENDER)**REMOVE STEERING CYLINDER (SERVO-SENDER)**

WARNING: Before any hydraulic lines are disconnected, release the pressure from the hydraulic system. Start the engine and move the ejector forward all the way. Stop the engine and loosen the cap on the hydraulic tank slowly.

1. Put identification on the three hydraulic lines that are connected to the cylinder for correct installation. Disconnect three hydraulic lines (1) from the cylinder.
2. Remove the cotter pin, nut, washer, bolt (3) and bushings that hold the head end of the cylinder to the bracket.
3. Remove bolt (2), washer and bushing that holds the rod end of the cylinder to the link assembly. Remove follow-up cylinder (4).

**INSTALL STEERING CYLINDER (SERVO-SENDER)**

1. Put follow-up cylinder (2) in position on the bracket and link assembly as shown.
2. Install bolt (3), washer and bushing that holds the rod end of the cylinder in position.
3. Install bolt (1), washer, two bushings, the nut and cotter pin that holds the head end of the cylinder in position.
4. Connect the three hydraulic lines (4) to the cylinder.
5. Remove the air in the follow-up circuit. See Air in Follow-Up Circuit in Steering System Testing and Adjusting.



VEHICLE SYSTEMS

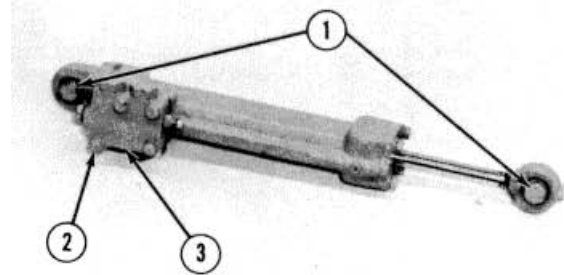
TM 5-3805-248-14&P-3 DISASSEMBLY AND ASSEMBLY

DISASSEMBLY STEERING CYLINDER (SERVO SENDER)

start by

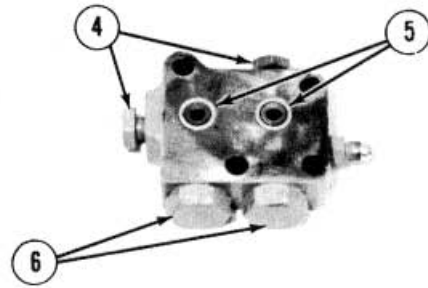
- a) remove steering cylinder (servo sender)

1. Use a soft hammer to remove bolts (1) from the cylinder.



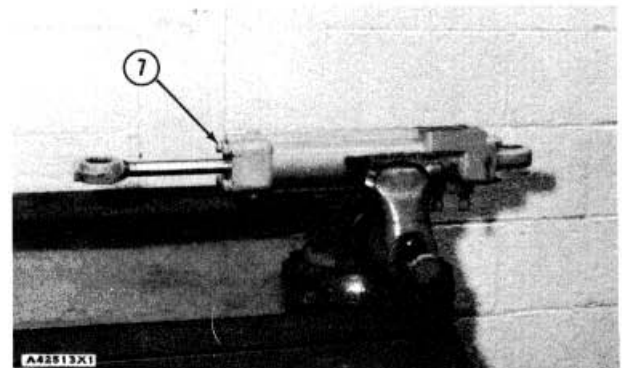
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2. Remove bolts (2) and body (3) for the relief valves and bleed valves.



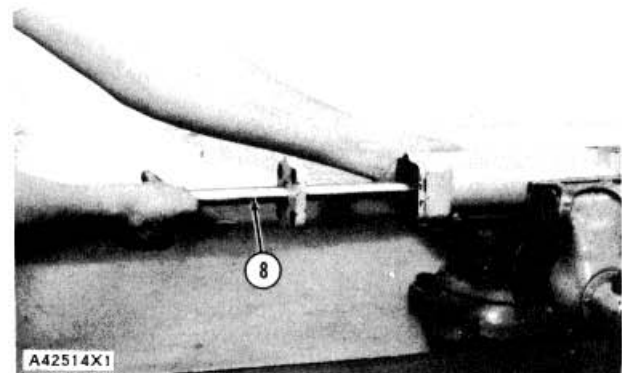
A42512X1

3. Remove bleed valves (4)) ring seals (5) and plugs (6) for the relief valves. Remove the shims, springs and balls behind plugs (6). Do not mix the shims for the relief valves.



4. Put the cylinder in a vise. Remove four bolts (7).

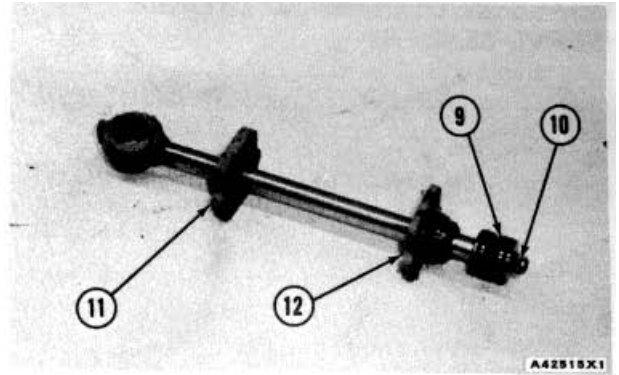
5. Pull rod (8)m, the retainer and head out of the cylinder.



VEHICLE SYSTEMS

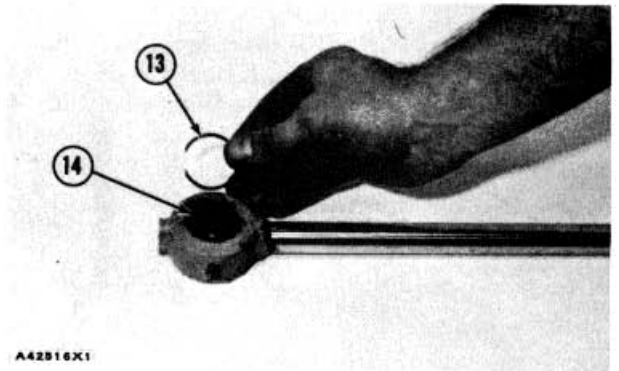
STEERING CYLINDER (SERVO-SENDER)

6. Put the rod in a vise and remove nut (10) from the rod.



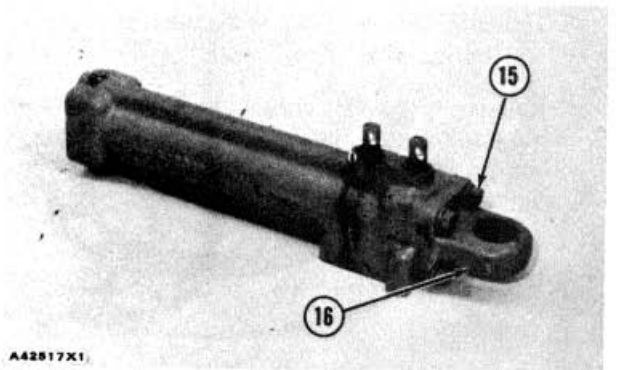
7. Remove piston (9), head (12) and retainer (11) from the rod.

8. Remove the seals and ring from the piston. Remove the O-ring seals and packing from the head. Remove the wiper from the retainer.

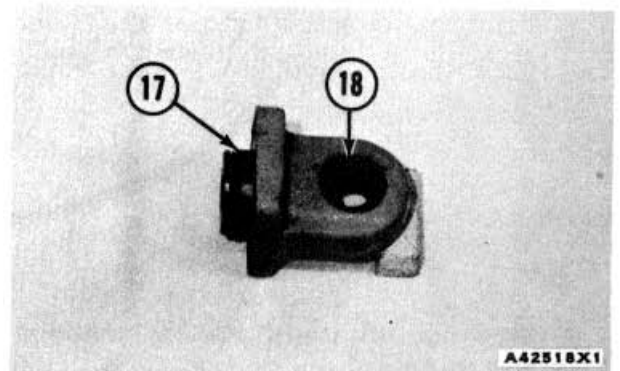


9. Remove snap ring (13) and bearing (14) from the rod.

10. Remove bolts (15) and head (16) from the cylinder body.



11. Remove O-ring seal (17) from the head. Remove snap ring (18) and the bearing from the head.

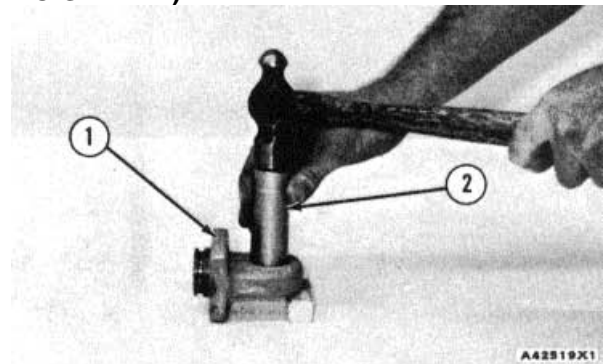


STEERING CYLINDER (SERVO-SENDER)

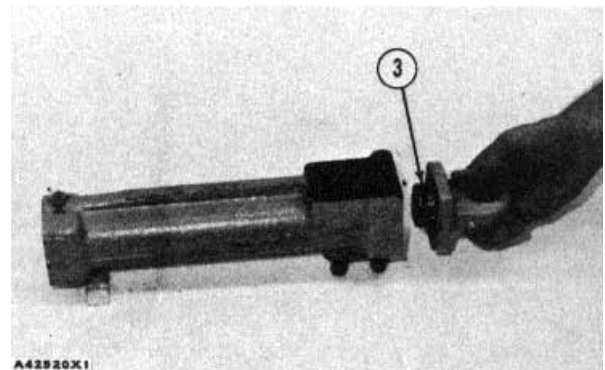
ASSEMBLE STEERING CYLINDER
(SERVO-SENDER)

	Tools Needed	A
1P510	Driver Group	1

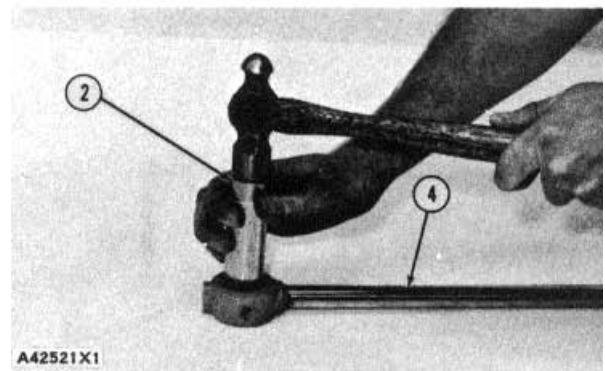
1. Install the snap ring in one side of head (1).



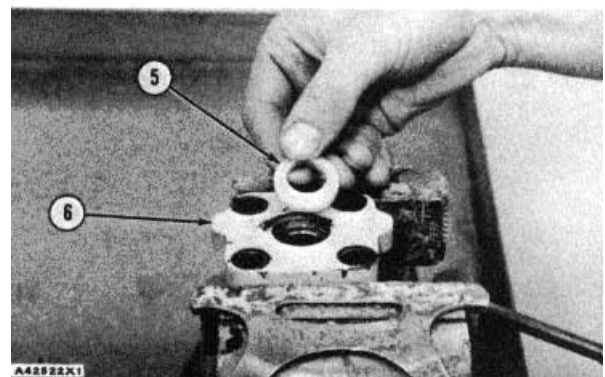
2. Use a piece of pipe (2) that is 4 in. (10.2 cm) long with a 1 ¼ in. (31.8 mm) outside diameter to install the bearing in the head until it is against the snap ring. Install the other snap ring to hold the bearing in place.



3. Install O-ring seal (3) on the head and put clean oil on the O-ring seal. Install the head on the cylinder as shown.



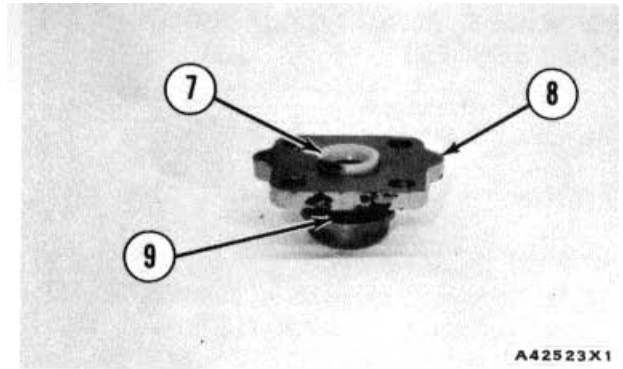
4. Install the snap ring in one side of rod (4). Use pipe (2) to install the bearing in the other side of the rod until it is against the snap ring. Install the other snap ring to hold the bearing in place.



5. Use tooling (A) to install wiper (5) in retainer (6) with the lip out.

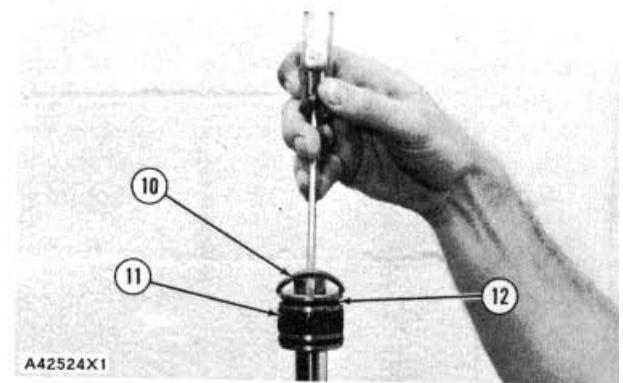
STEERING CYLINDER (SERVO-SENDER)

6. Use tooling (A) to install packing (7) in head (8) with the opening in the packing toward the cylinder bore when the head is installed.



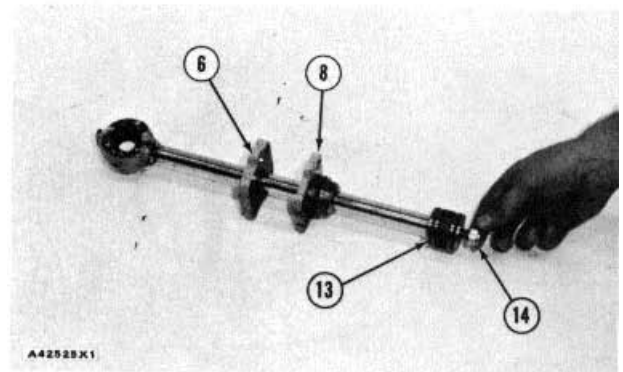
7. Install the O-ring seal (9) and other two O-ring seals on the head.

8. Put the rod in a vise and install the piston on the rod. Install ring (1) and one inner and outer seal on the piston.



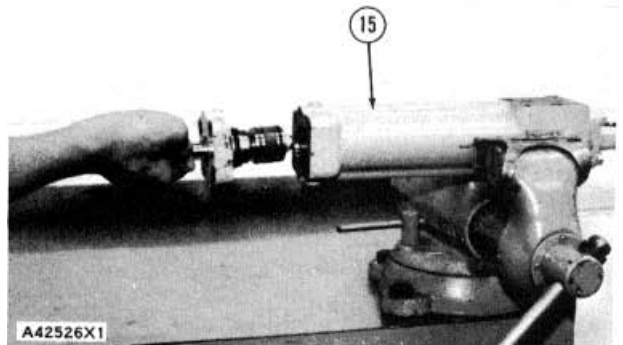
9. Remove the piston from the rod, turn it over and install it back on the rod with the empty seal groove up. Install inner seal (12) and outer seal (10) as shown. Remove the piston from the rod.

10. Install retainer (6), head (8), piston (13) and nut (14) on the rod as shown. Tighten nut (14) to a torque of 35 ± 3 lb. ft. (47.5 ± 4.1 N•m).



11. Put clean oil on the piston and O-ring seals on the head.

12. Put cylinder (15) in a vise. Install the piston, rod, head and retainer in the cylinder as a unit and install the bolts that hold the retainer and head in place. Tighten the bolts to the standard torque with the rod fully extended.



STEERING CYLINDER (SERVO-SENDER)

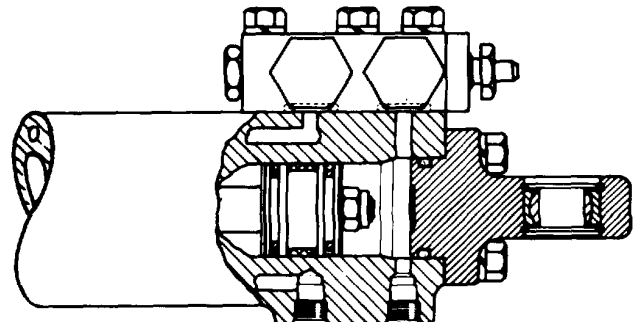
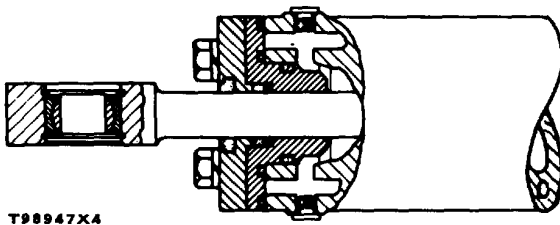
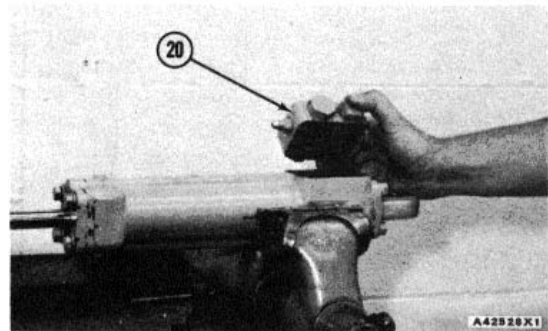
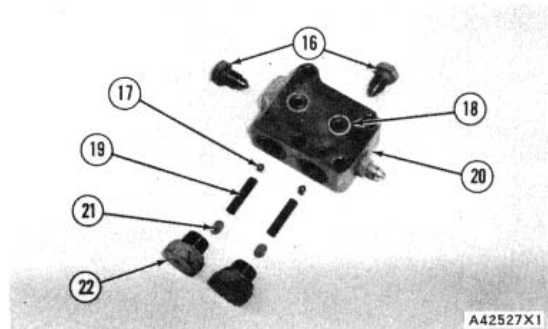
13. Install O-ring seals (18) on body (20).

14. Install bleed valves (16) in body (20).

15. Be sure the O-ring seals are in place on plugs (22). Install balls (17), springs (19), shims (21) and plugs (22) in the body. Tighten plugs (22) to a torque of 42 ± 3 lb. ft. (58 ± 4.1 N•m).

NOTE: Shims (21) control the relief valves settings and must be installed in their original position.

16. Install body (20) on the cylinder. Install the bolts in both ends of the cylinder.



STEERING CYLINDER (SERVO-RECEIVER)

REMOVE STEERING CYLINDER
(SERVO-RECEIVER)

Tools Needed		A
5P306	Transducer	1
7S8888	Nipple	1
FT1114	Cap	1

start by:

- a) remove crankcase guard (tractor engine)*

*This operation is in the Engine Disassembly and Assembly Section.

! **WARNING:** Before any hydraulic lines are disconnected from the cylinder, release the pressure from the hydraulic system. Start the engine and move the ejector forward all the way. Stop the engine and loosen the cap on the hydraulic tank slowly.

1. Drain the oil in the hydraulic tank until the level VIEW FROM UNDER MACHINE is at the "ADD" mark. Connect tooling (A) to the hydraulic tank. Connect shop air to tooling (A). Tooling (A) will hold the oil in the hydraulic lines.

2. Put identification on the three hydraulic hoses that are connected to the cylinder for correct installation.

INSTALL STEERING CYLINDER
(SERVO-RECEIVER)

Tools Needed		A
5P306	Transducer	1
7S8888	Nipple	1
FT1114	Cap	1

1. Put cylinder (1) in position in the machine.

2. Install the four bolts in the bracket at the head end of the cylinder.

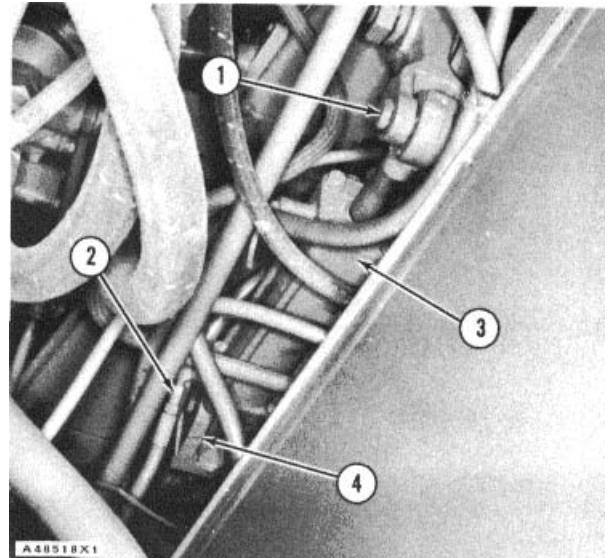
3. Install the pin, washer and cotter pin that hold the rod end of the cylinder to the lever.

4. Connect the three hoses to the cylinder. Make sure the hoses are in the correct positions.

5. Remove tooling (A) from the hydraulic tank and fill it with hydraulic oil to the correct level. See VIEW FROM UNDER MACHINE Lubrication and Maintenance Guide.

end by:

- a) install crankcase guard (tractor engine)*

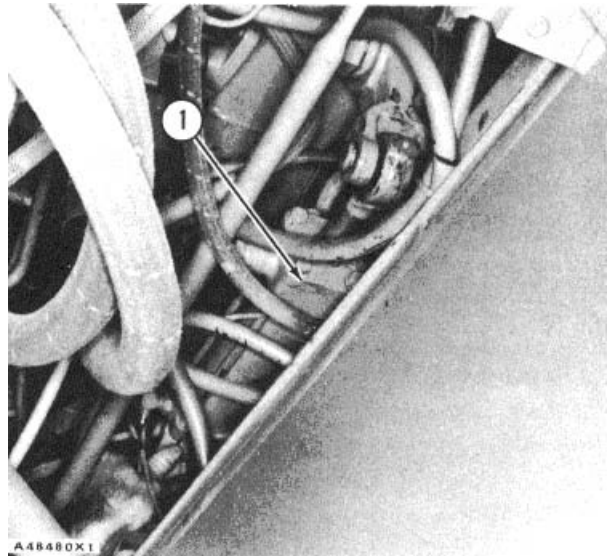


VIEW FROM UNDER MACHINE

3. Disconnect three hoses (2) from the cylinder.

4. Remove the cotter pin, washer and pin (1) that hold the rod end of the cylinder.

5. Remove the four bolts from bracket (4) on the installation head end of the cylinder. Remove cylinder (3).



VIEW FORM UNDER MACHINE

*This operation is in the Engine Disassembly and Assembly Section.

STEERING CYLINDER (SERVO-RECEIVER)

DISASSEMBLE STEERING CYLINDER
(SERVO-RECEIVER)

start by:

- a) remove steering cylinder (servo-receiver)

1. Remove cotter pin, pin (1), support (3) and the spacers from the head end of the cylinder.

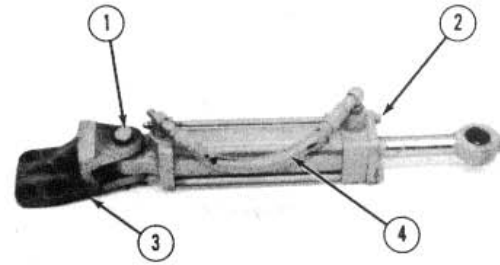
2. Remove oil line (4) and bolts (2) that hold the retainer and head on the cylinder.

3. Put the cylinder in a vise and pull rod (5) with retainer head and piston out of the cylinder.

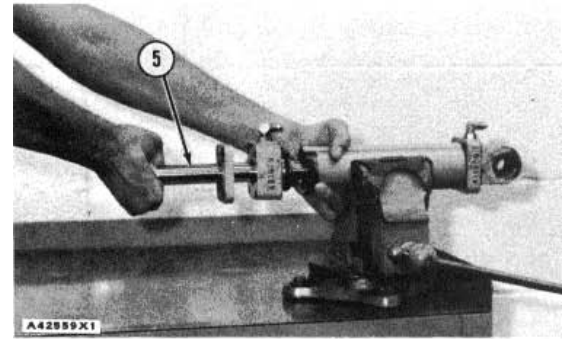
4. Put the rod in a vise. Remove nut (7), piston (6), head (9) and retainer (8) from the rod.

5. Remove the rings and seal assemblies from the piston. Remove the O-ring seal, back-up ring and seal from the head. Remove the wiper from the retainer.

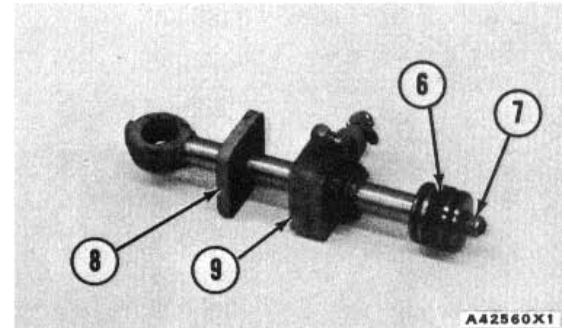
6. Remove snap ring (10) and bearing (11) from the rod.



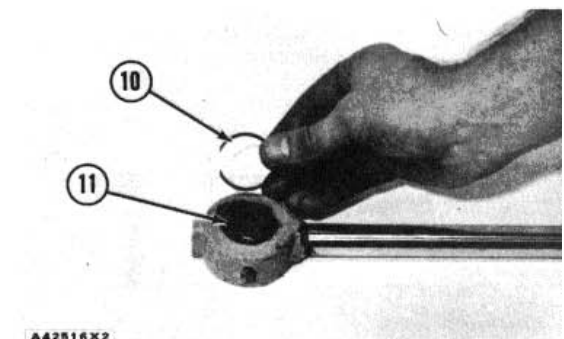
A42558X1



A42559X1



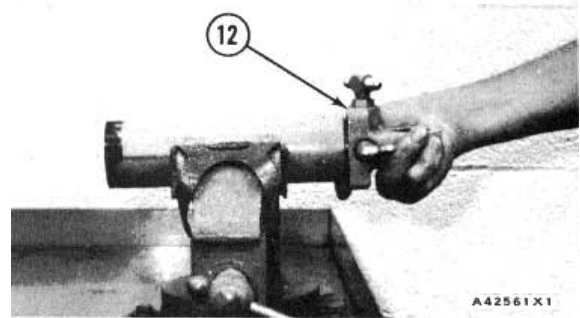
A42560X1



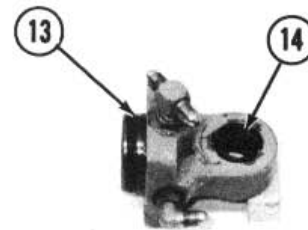
A42516X2

STEERING CYLINDER (SERVO-RECEIVER)

7. Remove head (12) from the tube of the cylinder.



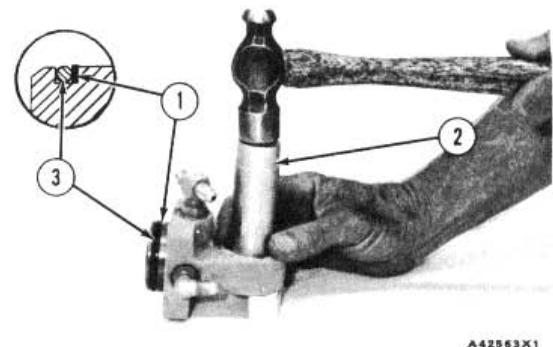
8. Remove O-ring seal (13) and the back-up ring from the head. Remove snap ring (14) and the bearing from the head.



ASSEMBLE STEERING CYLINDER (SERVO-RECEIVER)

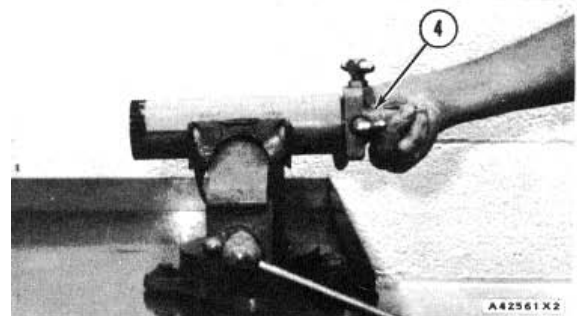
Tools Needed		A
1P510	Driver Group	1

1. Use a piece of pipe (2) that is 4 in. (10.2 cm) long with a 1/4 in. (31.8 mm) outside diameter and 15/16 in. (23.8 mm) inside diameter to install the bearing in the head until it is against the bottom snap ring. Install the top snap ring that holds the bearing in place.



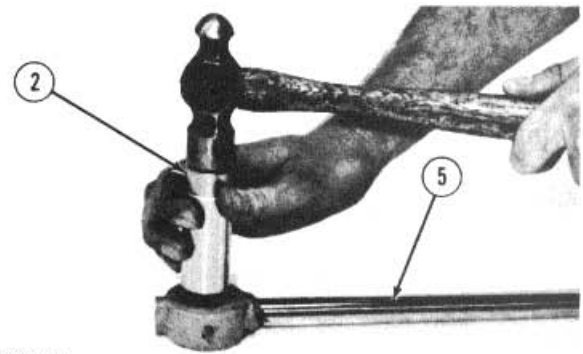
2. Install back-up ring (1) on the head next to the flange and O-ring seal (3) as shown. Put clean oil on the O-ring seal and back-up ring.

3. Install head (4) in the tube of the cylinder.



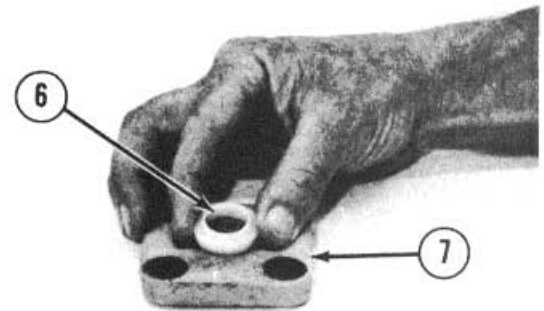
STEERING CYLINDER (SERVO-RECEIVER)

4. Use pipe (2) to install the bearing in rod (5) until it is against the bottom snap ring. Install the top snap ring that holds the bearing in place.



A42521X2

5. Use tooling (A) to install wiper (6) in retainer (7) with the lip out as shown. Put clean oil on the wiper.

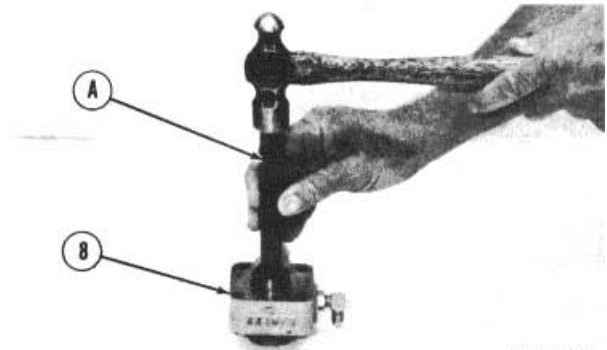


A42564X1

6. Use tooling (A) to install the seal in head (8) with the opening in the seal in toward the cylinder bore when assembled. Put clean oil on the seal.

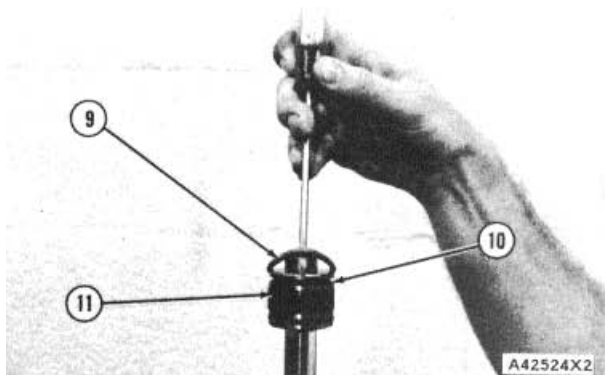
7. Install the back-up ring and O-ring seal on the head with the back-up ring toward the flange and the O-ring seal toward the piston when assembled. Put clean oil on the O-ring seal and back-up ring.

8. Put the rod in a vise and install the piston and nut on the rod. Install the two inner rings and outer ring (11) on the middle of the piston. Install one inner seal (10) and outer seal (9) on the piston as shown.



A42565X1

9. Turn the piston over on the rod and install the other inner seal (10) and outer seal (9).



A42524X2

10. Remove the piston from the rod.

STEERING CYLINDER (SERVO-RECEIVER)

11. Install retainer (7), head (8), piston (12) and nut (13) on the rod as shown. Tighten the nut to a torque of 50 ± 5 lb. ft. (70 ± 7 N•m).

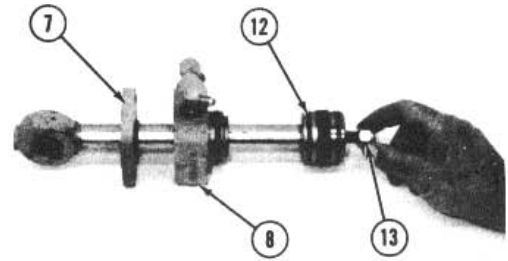
12. Use a soft hammer to install the piston, rod, head and retainer on the cylinder as shown.

13. Install the four bolts that hold the cylinder together.

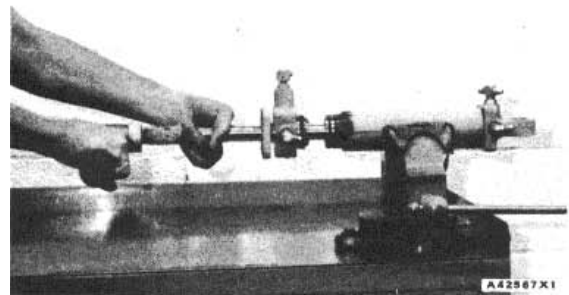
14. Install oil line (15) on the cylinder.

15. Install spacers (14) on the head end of the cylinder.

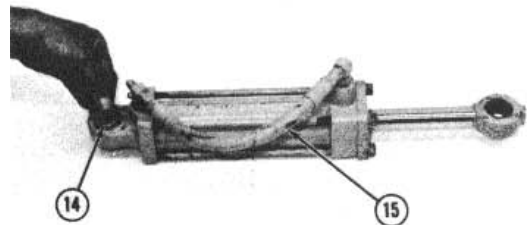
16. Put support (16) in position on the head end of the cylinder. Install pin (17), washer and cotter pin to hold the support in place.



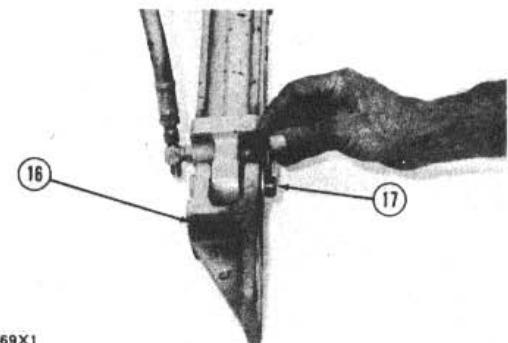
A42866X1



A42867X1



A42868X1



A42569X1

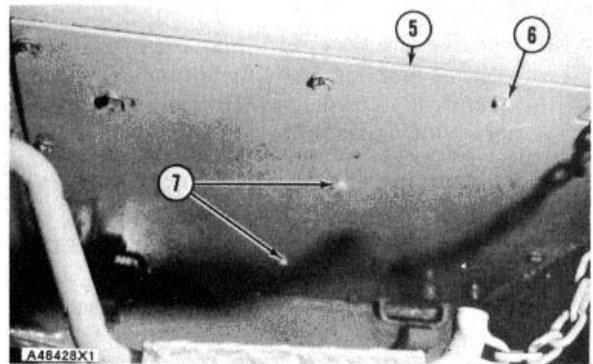
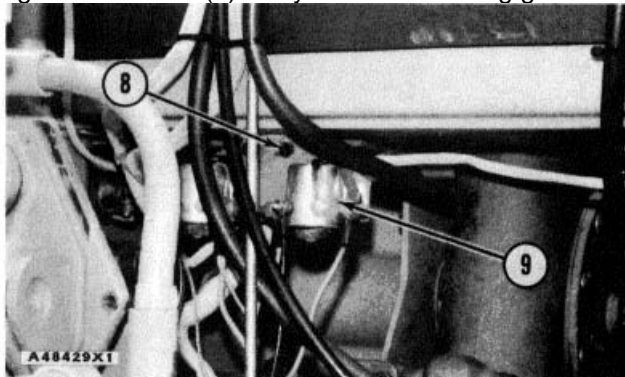
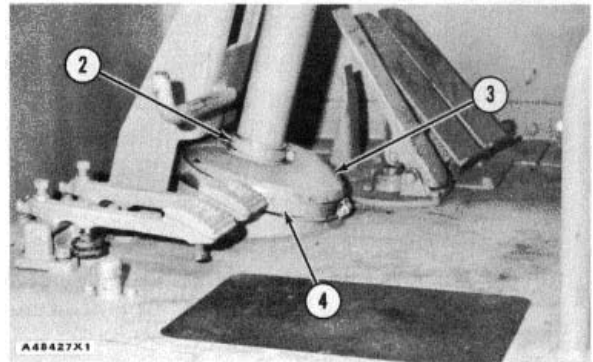
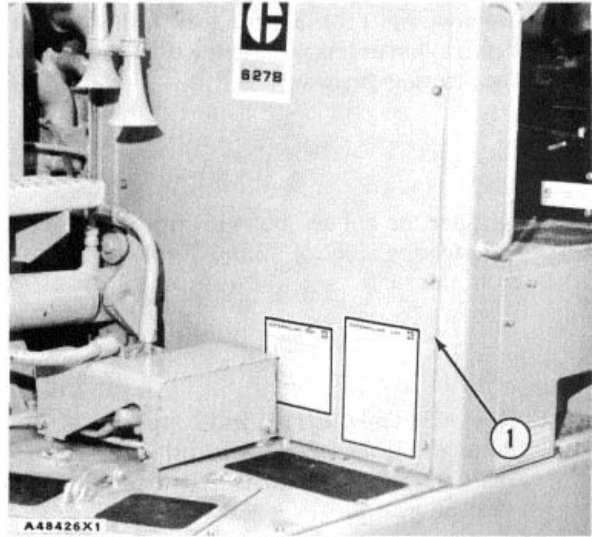
STEERING GEARS

REMOVE STEERING GEARS



WARNING: Do not disconnect any air lines until the air pressure is zero.

1. Drain the air from the air tanks that are under the operator's station.
2. Remove the hood from the tractor engine. See Remove Hoods (tractor and scraper engines) in the Engine Disassembly and Assembly Section.
3. Remove plate assembly (1).
4. Remove two clamps (2) and (4). Remove rubber boot (3).
5. Remove twelve bolts (6) that hold the plate assembly (5) in position. Do not remove two bolts (7). These two bolts hold the air tanks to the plate assembly.
6. Lower the plate assembly and air tanks.
7. Remove two bolts (8) and move the bracket and magnetic switches (9) away from the steering gear.



STEERING GEAR

8. Remove nut (10) and the lockwasher from the servo cylinder linkage. Remove the linkage from the steering gear.

9. Remove the nut and bolt (11) from the lever for the steering control valve. Remove the lever from the shaft.

10. Remove two bolts (13) and coupling (14) from the shaft for the steering control valve. Push the shaft toward the engine until it is free of the steering gear.

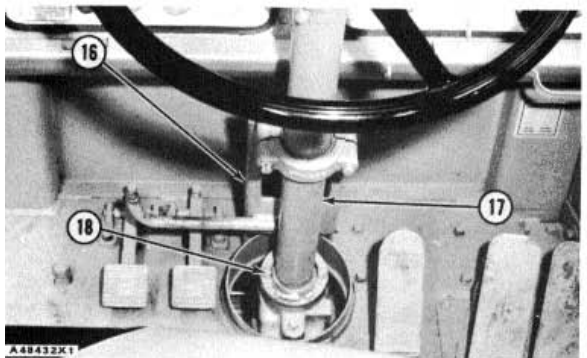
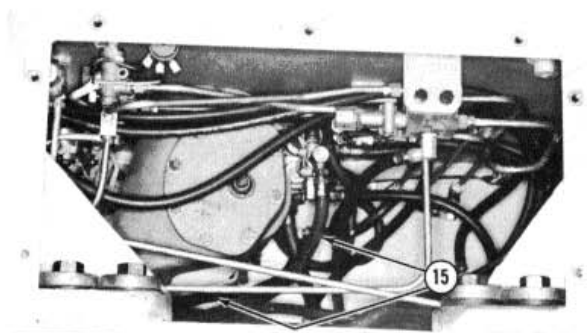
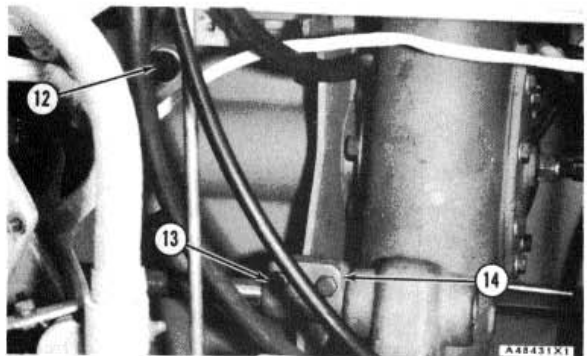
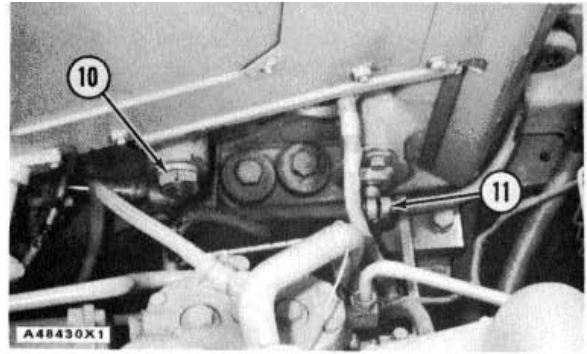
11. Loosen four bolts (12) that hold the support assembly for the steering gear.

NOTE: The plate assembly on the left side of the machine is removed for better photo illustration of the hoses to be disconnected for the removal of the steering gear.

12. Remove any hoses (15) necessary to lower the steering gear out the bottom of the machine. Put identification on the hoses for correct installation before they are removed.

13. Remove the two bolts that hold column assembly (17) to bracket (16).

14. Remove six bolts (18) and move the column assembly.

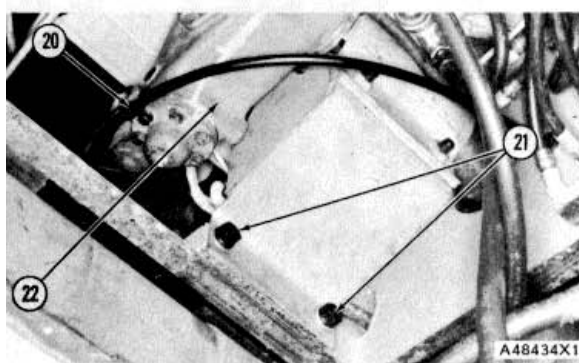
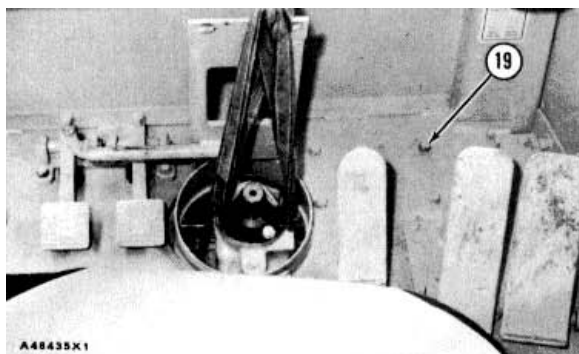


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

STEERING GEAR

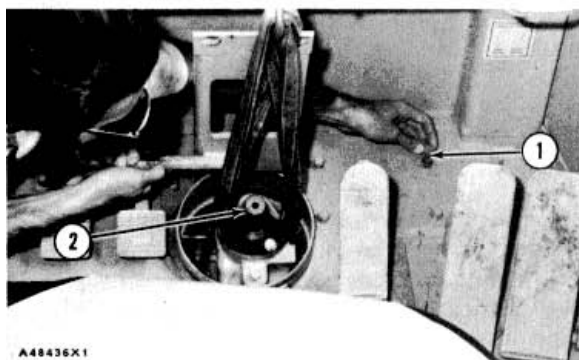
15. Install two 3/8"-16 NC forged eyebolts in the top of the housing assembly for the steering gear. Fasten a hoist to the steering gear.
16. Remove four bolts (19).
17. Remove clip (20) from the bottom of the steering gear.
18. Remove two bolts (21) from the support assembly.
19. Lower steering gear (22) out the bottom of the machine. The weight of the steering gear is 85 lb. (39 kg).



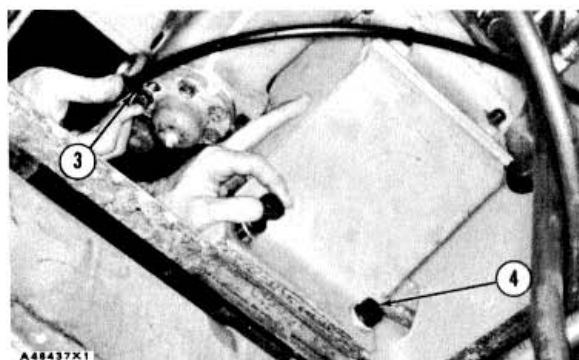
VIEW FROM UNDER MACHINE

INSTALL STEERING GEAR

1. Fasten a hoist to steering gear (2) and put it in position under the floor plates in the operator's station. Install four bolts (1).



2. Install two bolts (4) in the support assembly.
3. Connect clip (3) to the bottom of the steering gear.



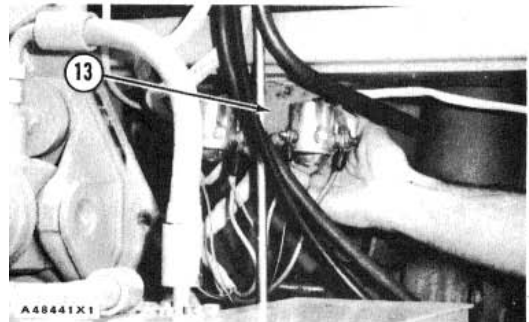
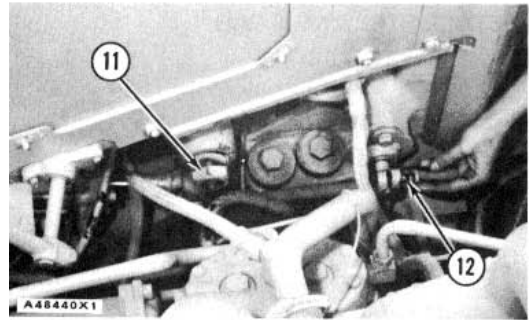
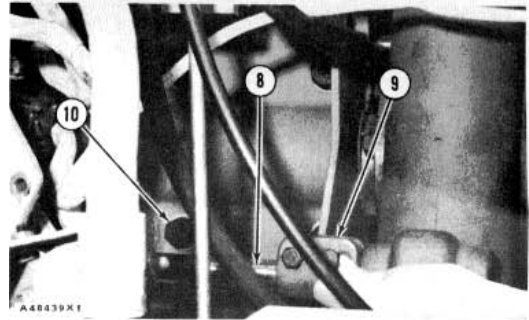
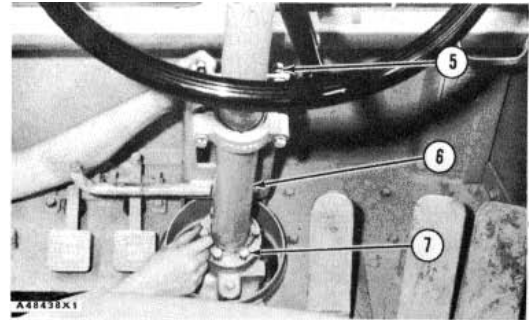
VIEW FROM UNDER MACHINE

VEHICLE SYSTEMS

STEERING GEAR

DISASSEMBLY AND ASSEMBLY

4. Put steering column assembly (6) in position on the steering gear. Install two bolts (5) that hold the column assembly to the bracket on the floor plates.
5. Install six bolts (7) that hold the column assembly to the steering gear.
6. Push shaft (8) into the steering gear and install coupling (9) and the bolts that hold it.
7. Tighten four bolts (10) in support assembly.
8. Install the lever from the servo cylinder to the steering gear. Install nut (11) and the washer that holds it.
9. Put the lever for the steering control valve in position on the shaft. Install bolt (12), washer and nut that hold it.
10. Put bracket (13) and the two magnetic switches in position under the floor plates. Install the two bolts that hold it.



VEHICLE SYSTEMS

STEERING GEAR

DISASSEMBLY AND ASSEMBLY

11. Install any hoses (14) that were removed during the removal of the steering gear.

CAUTION: Do not cause damage to the air lines when plate assembly (15) is put in position.

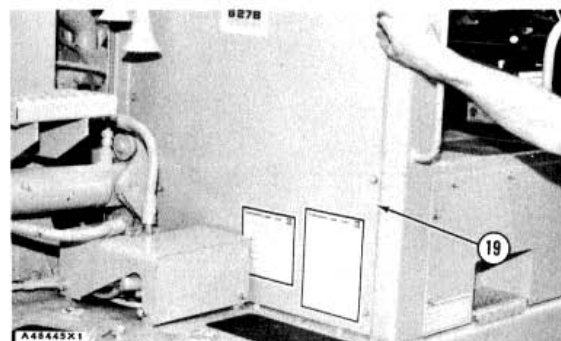
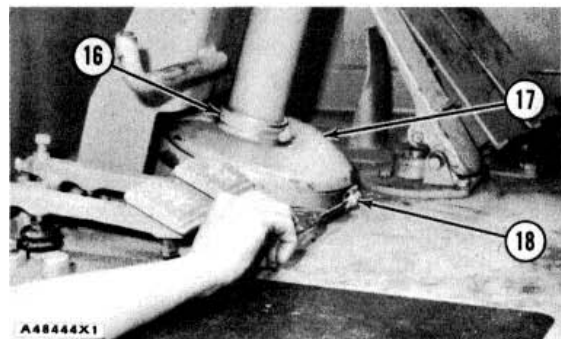
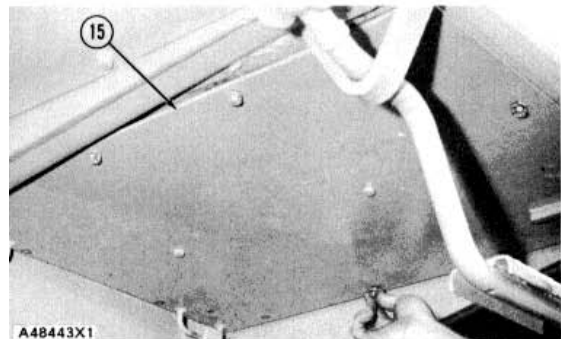
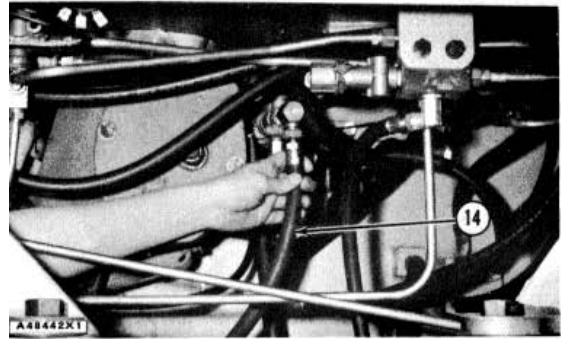
12. Put plate assembly (15) with air tanks in position under the operator's station. Install the twelve bolts that hold it.

13. Install boot (17) and clamps (16) and (18).

14. Install plate assembly (19).

15. Install the hood over the tractor engine. See Install Hoods (tractor and scraper engine) in the Engine Disassemble and Assembly Section.

16. If necessary make an adjustment to the movement of the valve spool in the steering control valve. See Travel of Valve Spool in Steering Control Valve in Testing and Adjusting Form.



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

STEERING GEAR

DISASSEMBLE STEERING GEAR

Tools Needed		A	B
1 P2321	Puller Assembly	1	
1P510	Driver Group		1

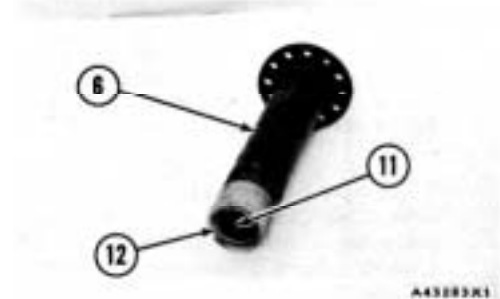
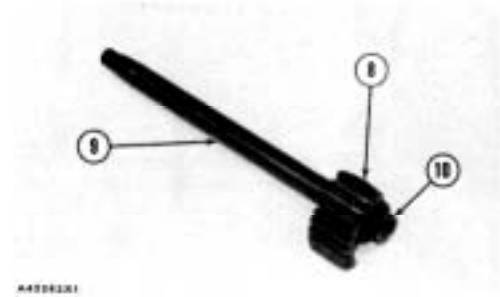
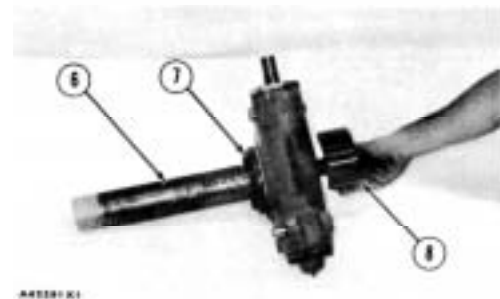
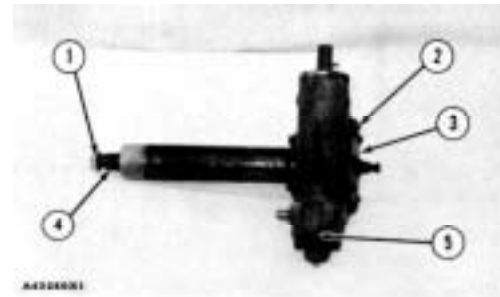
start by:

a) remove steering gear

1. Remove plug (5) and drain the oil from the steering gear.
2. Remove nut (1) and key (4) from the shaft.
3. Remove bolts (2) and cover (3) from the steering gear.
4. Remove gear sector (8) and shaft from the steering gear.
5. Remove six bolts (7) and housing (6) from the steering gear.

NOTE: The washer for bolts (2) and (7) can not be used again. If they are used again, they can cause a leakage of oil from the steering gear.

6. Remove nut and lockwasher (10) and remove gear sector (8) from shaft (9).
7. Remove seal (12) and bearings (11) from both ends of housing (6).



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

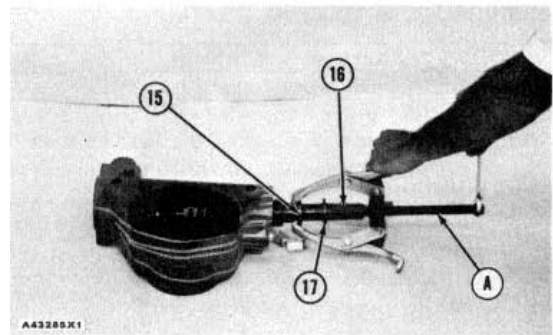
STEERING GEAR

8. Remove cap (13) and retainer (14) from the steering gear. Use a sharp chisel and hammer to remove the bearing from cap (13). Use tooling (B) to remove the bearing from retainer (14).



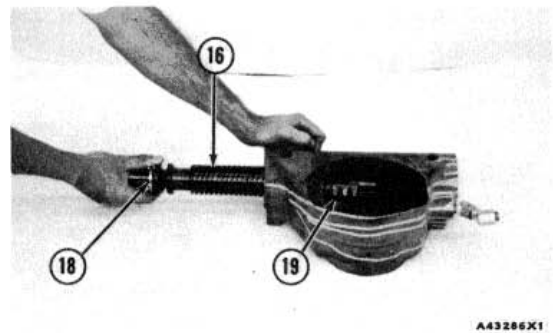
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9. Turn shaft (16) in a counterclockwise direction until it comes out of the housing far enough to install tool (A) on washer (15). Remove washer (15) and brass washer (17) from the shaft.



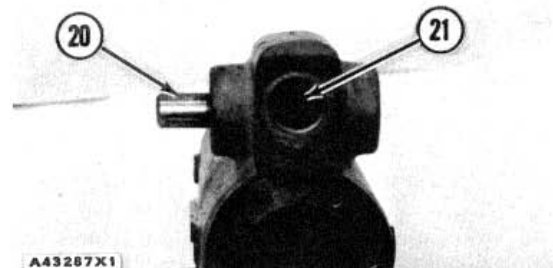
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10. Turn shaft (16) in a clockwise direction to remove the shaft from gear nut (19) and the housing as shown. Remove brass washer (18) from the shaft. Remove gear nut (19) from the housing.



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11. Remove bolt (21) from the lever on shaft (20). The bolt can be removed through the hole for the drain plug. Remove the shaft and lever from the housing.



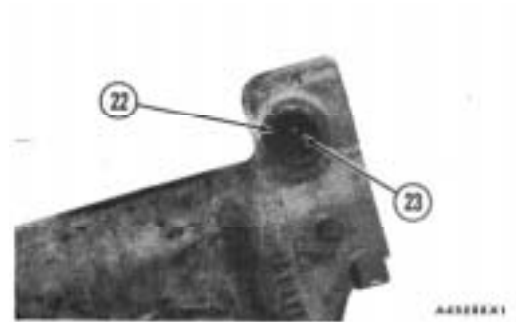
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VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

STEERING GEAR

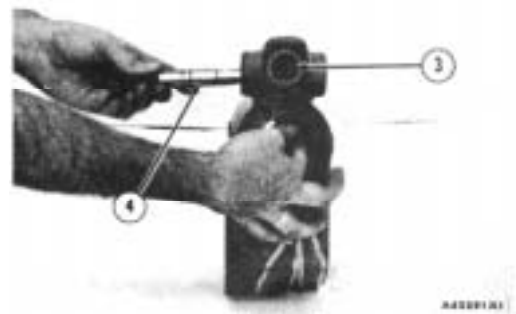
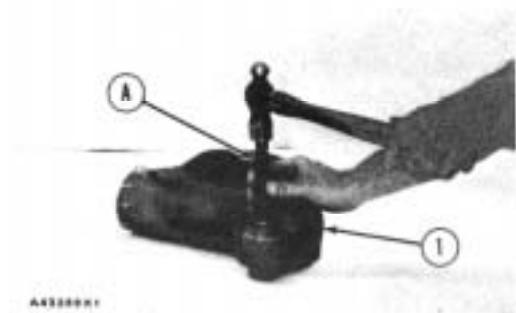
- Remove seal (22) and the plug from the housing.
Remove bearings (23) from the housing.



ASSEMBLE STEERING GEAR

Tools Needed		A
1P510	Driver Group	1

- Use tooling (A) to install the bearing with the smaller inside diameter in the same side of housing (1) that the cover goes on, as shown. Install the bearing until it is even with the bottom of the counterbore for the plug. Put 7M7260 Liquid Gasket on the plug and use tooling (A) to install the plug over the bearing.
- Use tooling (A) to install the bearing with the larger inside diameter and seal (2) in the other side of the housing as shown. Install the bearing until it is even with the bottom of the counterbore for seal (2). Put 7M7260 Liquid Gasket on the outside diameter of the seal and use tooling (A) to install the seal with the lip in.
- Put lever (3) in position in the housing. Be sure the keys are in position in shaft (4). Install shaft (4) through lever (3) with the key in the shaft in alignment with the groove (keyway) in the lever.

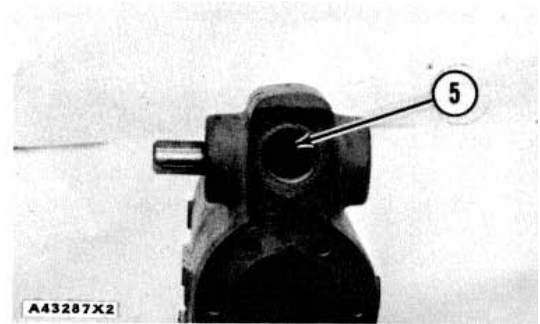


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

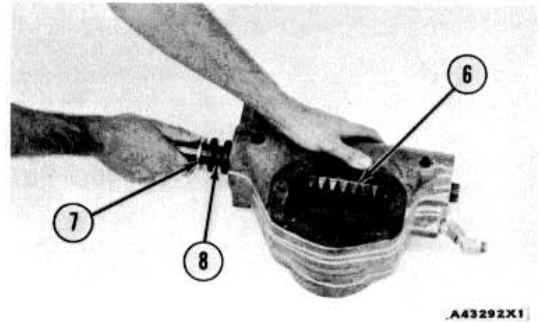
STEERING GEAR

4. Install bolt (5) that holds the lever on the shaft.



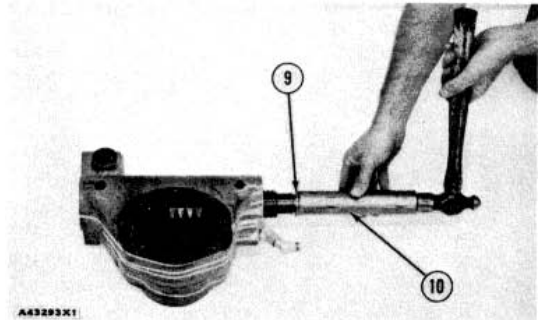
NOTE: Be sure there are no rough places (burrs) on the threads on shaft (8) or in gear nut (6). Shaft (8) must turn freely in gear nut (6).

5. Install gear nut (6) in the housing. Install shaft (8) in the housing with the splines on the shaft toward the top of the housing. Turn the shaft in a counterclockwise direction to move the shaft through gear nut (6).



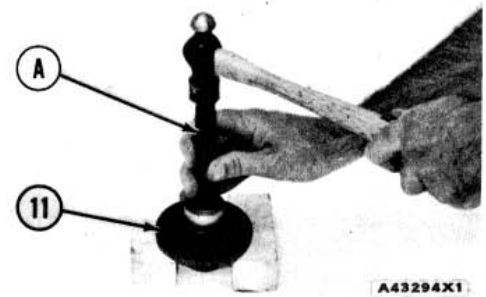
6. Install brass washer (7) on the shaft.

7. Turn shaft (8) through the housing far enough to install steel washer (9) on the shaft.



8. Use a piece of pipe (10) with an 1 3/8" (34.9 mm) inside diameter and 6" (15.2 cm) length, and a hammer to push washer (9) against its seat.

9. Use tooling (A) to install the bearing in cap (11) and the top retainer.

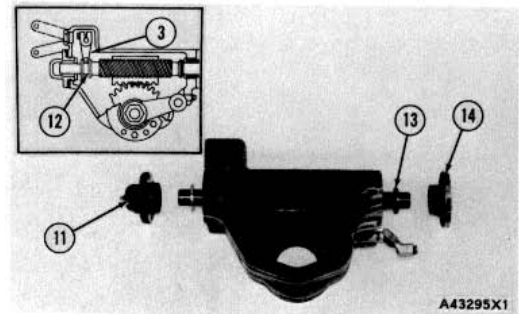


VEHICLE SYSTEMS

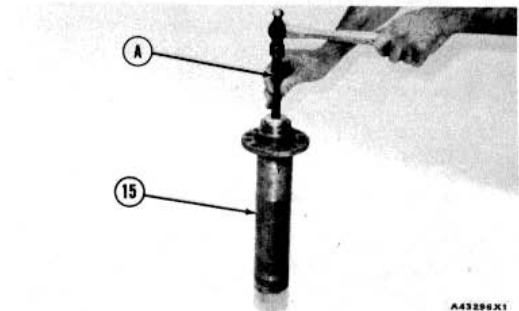
DISASSEMBLY AND ASSEMBLY

STEERING GEAR

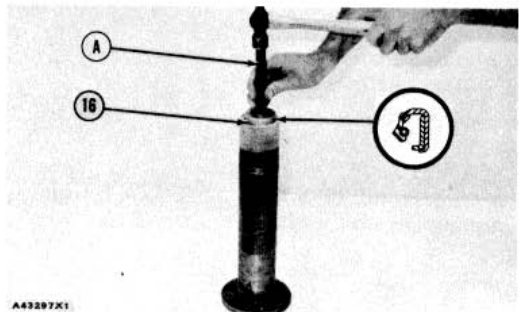
10. Be sure lever (3) is engaged in groove (12) in the lower end of the shaft.
11. Put brass washer (13) on the top of the shaft. Put retainer (14) in position and install two bolts to hold it in place.
12. Put cap (11) in position on the bottom of the housing with the original shims and without the O-ring seal. Install two bolts to hold the cap in place.
13. Use tooling (A) to install the bearing in the flange end of housing (15) until it is .06 in. (1.52 mm) below the surface of the housing.
14. Use tooling (A) to install the bearing in the other end of the housing until it is .06 in. (1.52 mm) below the bottom of the counterbore for the seal.
15. Put 7M7260 Liquid Gasket on the outside diameter of seal (16). Use tooling (A) to install the seal with the lip in as shown.
16. Install the gear sector, washer and nut on shaft (17).
17. Put housing (15) in position on the steering gear housing and install two bolts to hold the housing in place.
18. Install shaft (17) in the steering gear.



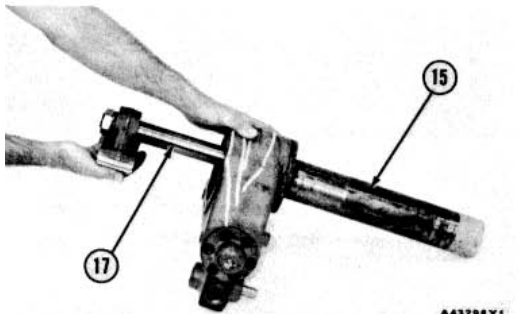
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VEHICLE SYSTEMS

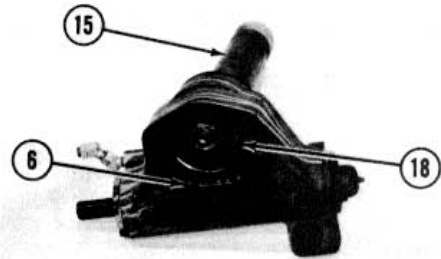
DISASSEMBLY AND ASSEMBLY

STEERING GEAR

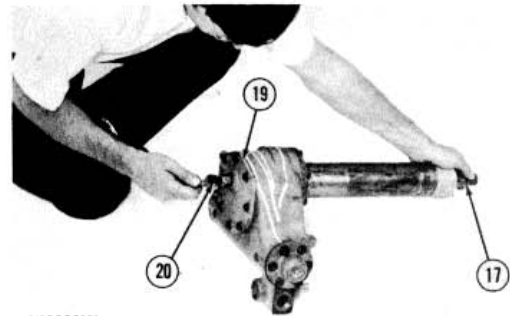
19. Slide the shaft and sector (18) into the steering gear with the center of sector (18) in the center of gear nut (6).
20. Remove the two bolts that hold housing (15) in place. Turn the housing until there is no gear clearance (backlash) between gear nut (6) and sector (18). Install all of the bolts and washers that hold housing (15) in place.
21. Loosen the locknut and turn screw (20) out of cover (19) so the screw can not make contact with the end of shaft (17) when the cover is installed.
22. Put cover (19) in position on the steering gear and install the bolts and washers that hold the cover in place.
23. Tighten screw (20) until there is no end clearance or movement in shaft (17) then loosen 1/8 turn. Tighten the locknut to hold screw (20) in place.
24. Install lever (21) on the shaft at the bottom of the steering gear.

NOTE: Lever (21) was removed from the shaft for the steering control valve linkage during removal of the steering gear.

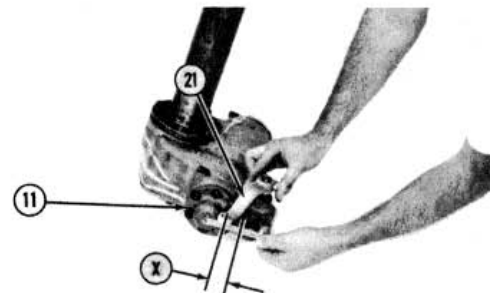
25. The shims under cap (11) control the movement of lever (21). Make an adjustment to the number of shims under cap (11) to get 1.12 to 1.15 in. (28.4 to 29.2 mm) dimension (X) movement at the pin hole in lever (21). Add shims to increase lever movement.
26. Install the correct number of shims on cap (11). Install O-ring seal (22) on the cap and put clean oil on the O-ring seal. Install cap (11) on the steering gear.
end by:
a) install steering gear



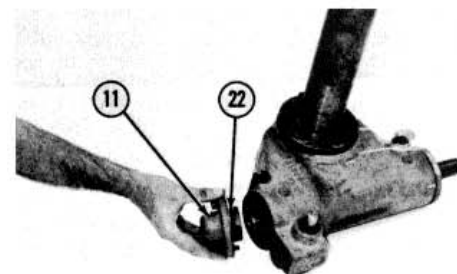
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VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

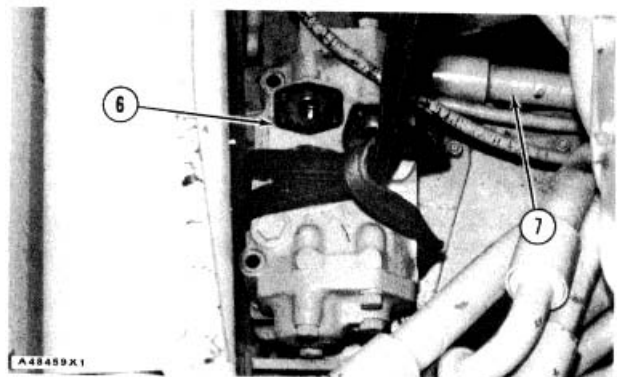
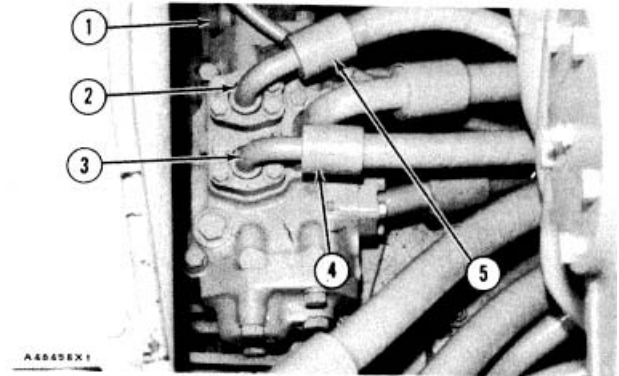
STEERING CONTROL VALVE

REMOVE AND INSTALL STEERING CONTROL VALVE

Tools Needed		A
5P306	Transducer	1
7S8888	Nipple	1
FT1114	Cap	1

! WARNING: Before any hydraulic lines are disconnected, release the pressure from the hydraulic system. Start the engine and move the ejector forward all the way. Stop the engine and loosen the cap on the hydraulic tank slowly. Move all the hydraulic controls backward and forward.

1. Drain the oil from the hydraulic tank until the level is at the "ADD" mark. Connect tooling (A) to the hydraulic tank. Connect shop air to tooling (A). Tooling (A) will hold the oil in the hydraulic lines.
2. Before any hydraulic hoses are disconnected from the steering control valve, put identification on them for correct installation.
3. Disconnect hydraulic hoses (2), (3), (4) and (5) from the valve.
4. Remove bolt (1), washer and the nut from the steering linkage rod.
5. Remove the three bolts that hold the valve in position.
6. Disconnect hydraulic hose (7) from the valve.
7. Fasten a hoist to steering control valve (6) and remove it. The weight of the valve is 52 lb. (24 kg).
8. Fasten a hoist to steering control valve (6) and put it in position in the machine. Install the three bolts that hold it.
9. Connect hydraulic hoses (7), (5), (4), (3) and (2) to the valve. Make sure the hoses are in the correct positions.
10. Connect steering control linkage rod to the valve with bolt (1) a washer and nut.
11. Remove tooling (A) from the hydraulic tank and fill it to the correct level. See Lubrication and Maintenance Guide.
12. If necessary make an adjustment to the movement of the valve spool for the steering control valve. See Travel of the Valve Spool in Steering Control Valve in Testing and Adjusting Form.



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

STEERING CONTROL VALVE

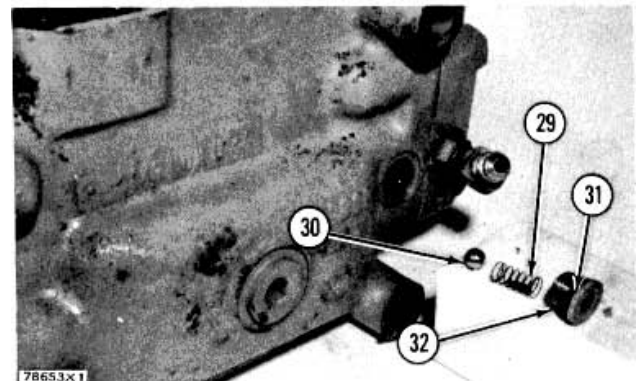
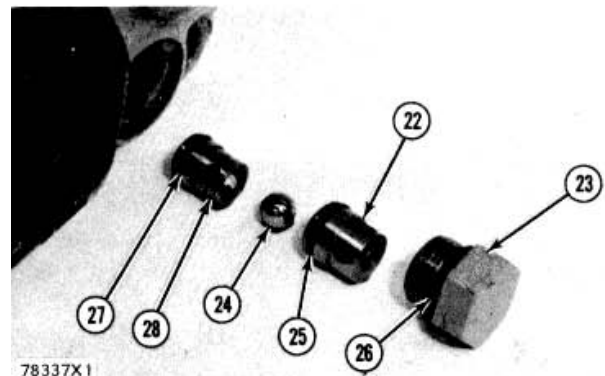
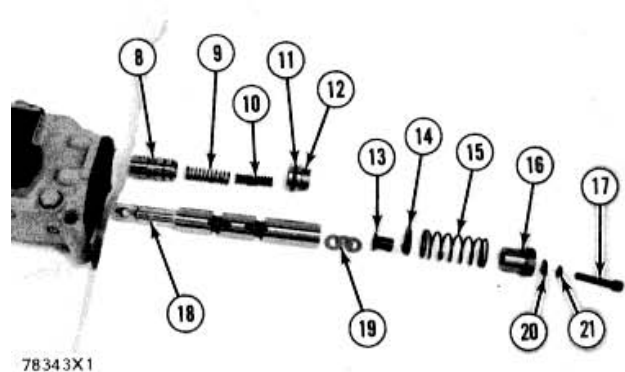
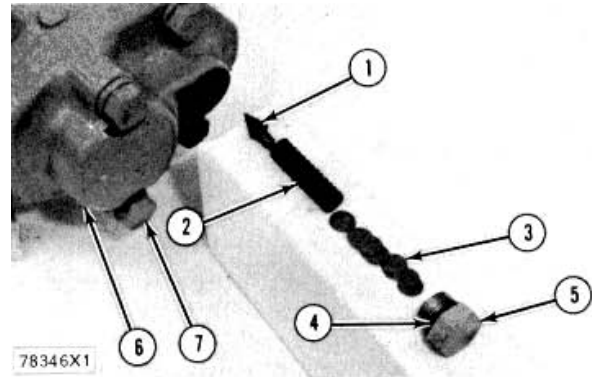
DISASSEMBLE STEERING CONTROL VALVE

	Tools Needed	A	B	C
1P3075	Puller Group	1		
2P8312	Snap Ring Pliers		1	
1P465	Drive Plate			1
1P529	Handle			1
6L5897	Bolt			1

start by:

a) remove steering control valve

1. Remove plug (5), shims (3), spring (2) and valve (1) from the valve body. Check the condition of O-ring seal (4). If the seal has damage, use a new part for replacement.
2. Remove four bolts (7) and cover (6) from the valve body. Check the condition of the four O-ring seals in the cover. If the seals have damage, use new parts for replacement.
3. Remove seat (12), springs (10) and (9) and valve (8) from the valve body. Check the condition of O-ring seal (11). If the seal has damage, use a new part for replacement.
4. Remove valve group (18) from the valve body.
5. Disassemble valve group (18) as follows:
 - a) Remove bolt (17) and lockwashers (20) and (21).
 - b) Remove retainer (16), spring (15), washer (14), retainer (13) and shims (19) from the valve stem.
6. Remove plug (23) from the valve body. Check the condition of O-ring seal (26). If the seal has damage, use a new part for replacement.
7. Remove seat (22) from the valve body with tool (A). Remove ball (24).
8. Remove seat (28) from the valve body with tool (B). Check the condition of O-ring seals (25) and (26). If the seals have damage, use new parts for replacement.
9. Remove plug (32), spring (29) and ball (30) from the valve body. Check the condition of O-ring seal (31). If the seal has damage, use a new part for replacement.

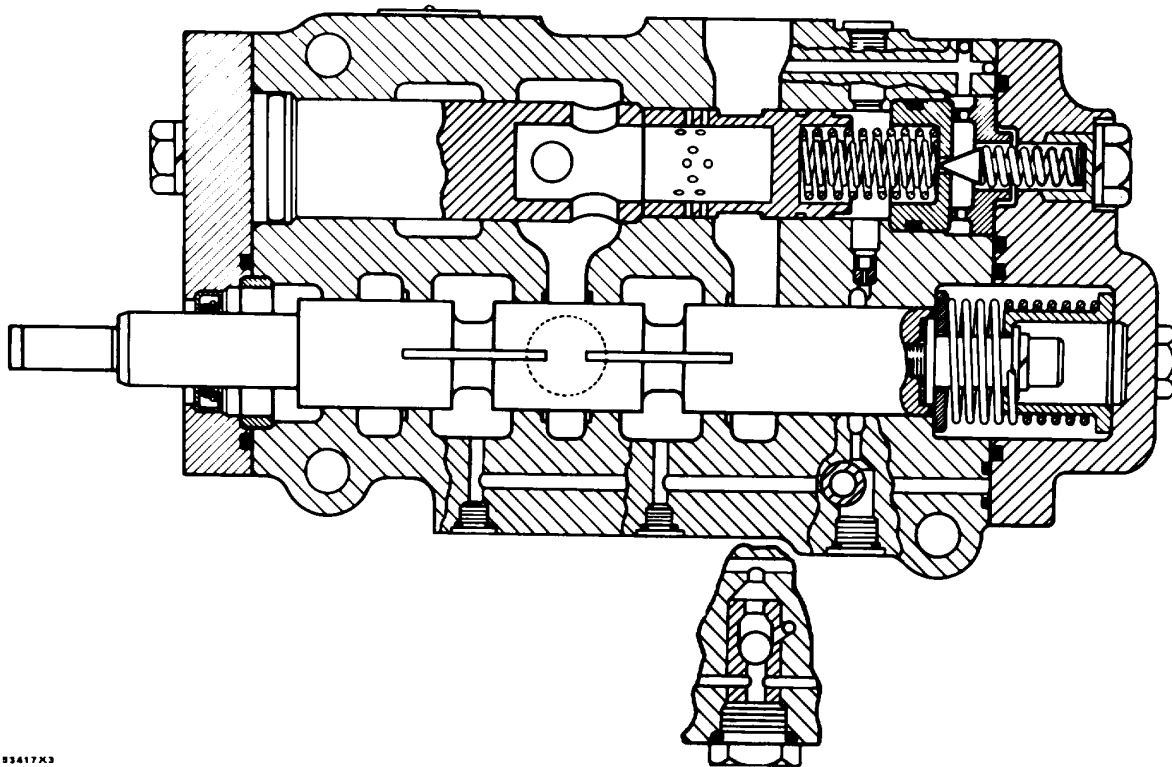
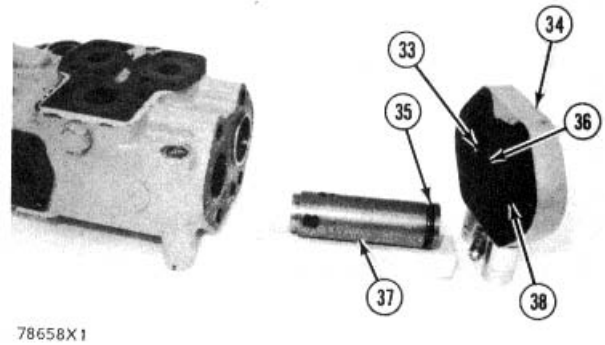


VEHICLE SYSTEMS

STEERING CONTROL VALVE

DISASSEMBLY AND ASSEMBLY

10. Remove the four bolts that hold cover (34) to the valve body. Remove the cover.
11. Remove lip type seal (33) from the cover with tooling (C).
12. Check the condition of O-ring seals (36) and (38). If the seals have damage, use new parts for replacement.
13. Remove spacer (37) from the valve body. Check the condition of O-ring seal (35). If the seal has damage, use a new part for replacement.



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VEHICLE SYSTEMS

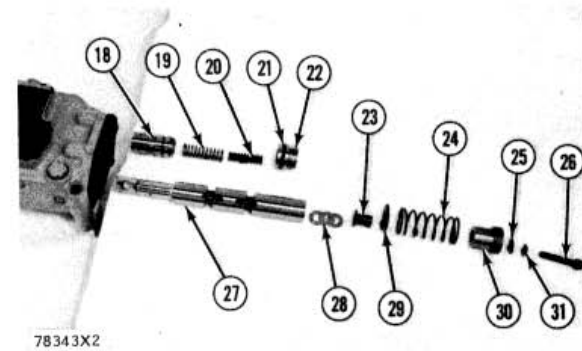
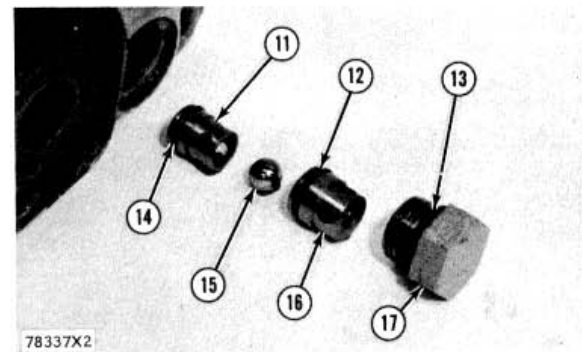
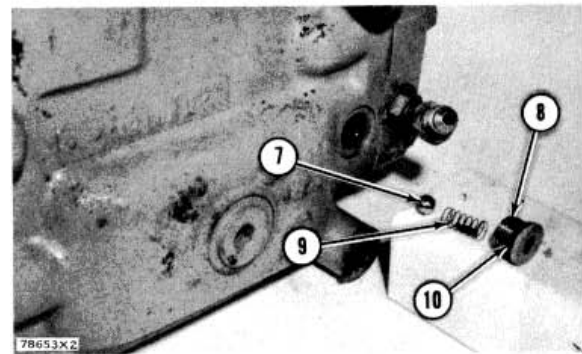
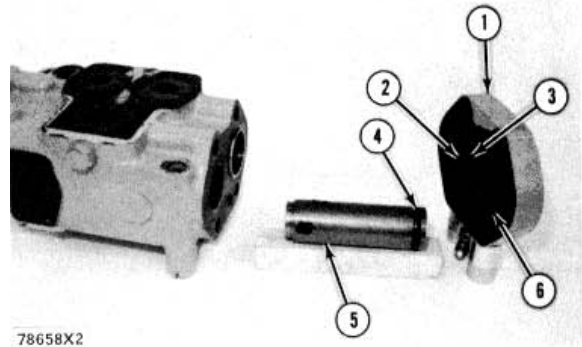
DISASSEMBLY AND ASSEMBLY

STEERING CONTROL VALVE

ASSEMBLE STEERING CONTROL VALVE

Tools Needed		A
1P510	Driver Group	1

1. Make sure all of the parts of the valve are clean before it is assembled. Put clean oil on all the parts.
2. Install O-ring seal (4) on spacer (5). Install the spacer in the valve body as shown.
3. Install the lip type seal (2) in cover (1) with tooling (A). Install the seal with the lip toward the outside of the cover and until it makes contact with the bottom of the counterbore in the cover. Put clean oil on the lip of the seal.
4. Install O-ring seals (3) and (6) in the cover. Put the cover in position on the valve body and install the bolts that hold it.
5. Install O-ring seal (10) on plug (8).
6. Install ball (7), spring (9) and the plug in the valve body.
7. Install O-ring seal (14) on seat (11). Install seat (11) and ball (15) in the valve body as shown.
8. Install O-ring seal (12) on seat (16) and O-ring seal (13) on plug (17). Install the seat and plug in the valve body as shown.
9. Install valve (18) and springs (19) and (20) in the valve body.
10. Install O-ring seal (21) on seat (22). Install the seat in the valve body.
11. Put shims (28), retainer (23), washer (29), spring (24) and retainer (30) in position on valve stem (27). Install two washers (25), (3 1) and bolt (26) that hold the parts to the valve stem.
12. Install the valve group in the valve body.

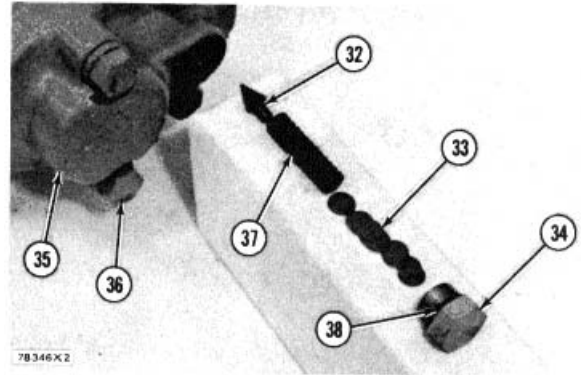


VEHICLE SYSTEMS

STEERING CONTROL VALVE

DISASSEMBLY AND ASSEMBLY

13. Install the O-ring seals in cover (35). Put the cover in position on the valve body and install four bolts (36) that hold it.
14. Install O-ring seal (38) on plug (34).
15. Install valve (32), spring (37), shims (33) and the plug in the valve body.
end by:
 - a) install steering control valve



Vehicle Systems

Disassembly and Assembly

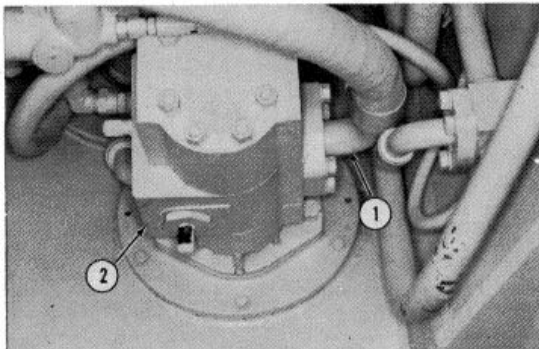
Supplemental Steering Pump
And Drive Pinion

Remove Supplemental Steering Pump
And Drive Pinion 4324-12

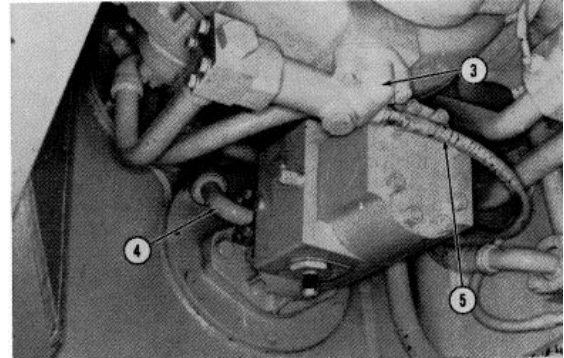
Tools Needed	A	B	C
0 T.C. Model 1790 Transmission Jack	1		
1P1853 Pliers		1	
8H684 Ratchet Wrench			1
8B7560 Step Plate			1
8B7548 Push-Puller			1
8B7550 Leg			2
8H663 Bearing Pulling Attachment			1

1. Drain the oil from the hydraulic tank and the differential housing.

2. Remove the front and rear crankcase guards from the machine. The weight of the front crankcase guard is approximately 200 kg (441 lb.). The weight of the rear crankcase guard is 61 kg (135 lb.).

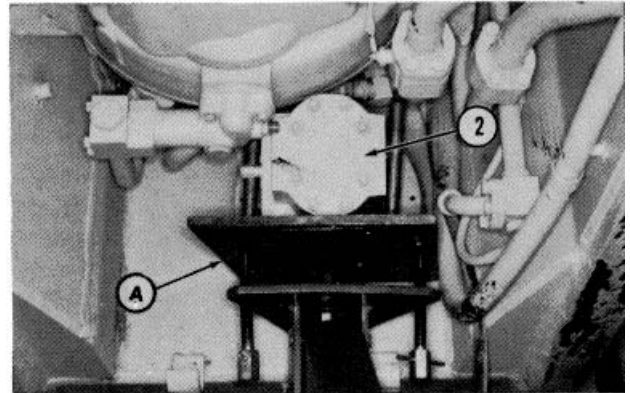


3. Remove the four bolts and disconnect hose (1) from steering pump (2).



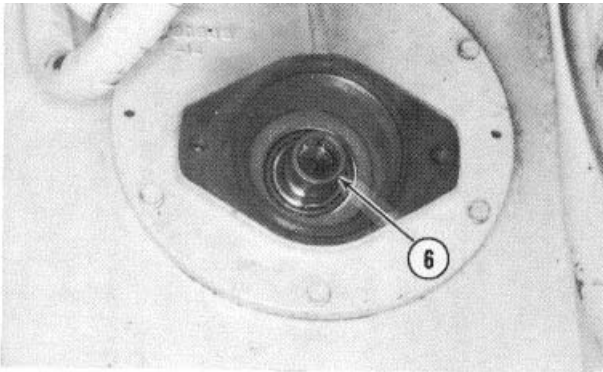
4. Disconnect hose (5) from sump screen housing (3).

5. Remove the four bolts and disconnect hose (4) from the steering pump.

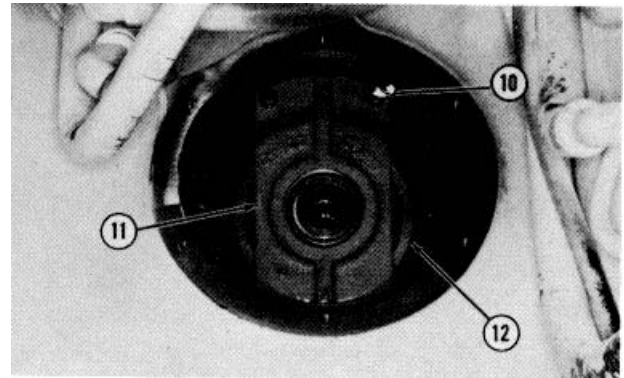


6. Put tool (A) or a suitable jack in position under the supplemental steering pump as shown. Fasten the steering pump to the jack.

7. Remove the two bolts and supplemental steering pump (2) from the machine. The weight of the supplemental steering pump is 24 kg (53 lb.).

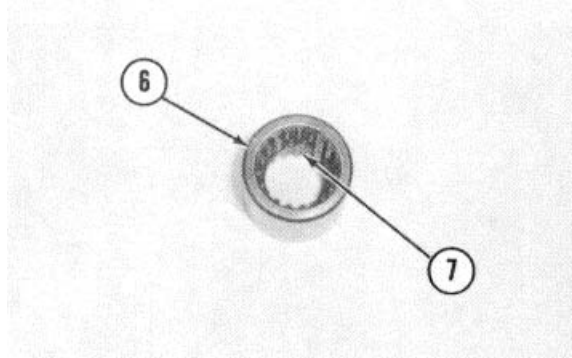


8. Remove the pump drive shaft and coupling (6) from the pinion if they did not remain with the supplemental steering pump when it was removed.

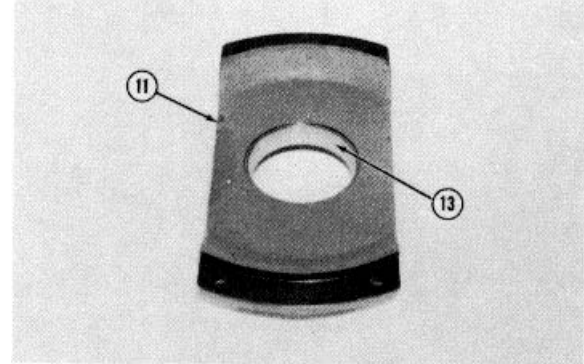


11. Remove four bolts (10), cage (11), the shims and pinion gear (12) from the cap.

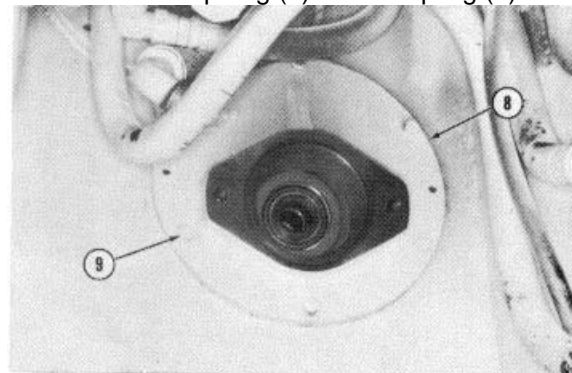
NOTE: Make sure the shims under cage (11) do not fall down in the differential housing during removal.



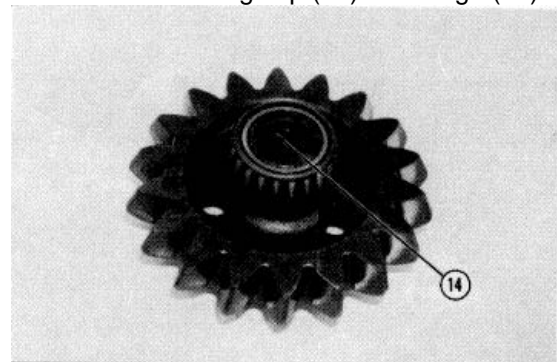
9. Remove snap ring (7) from coupling (6).



12. Remove bearing cup (13) from cage (11).



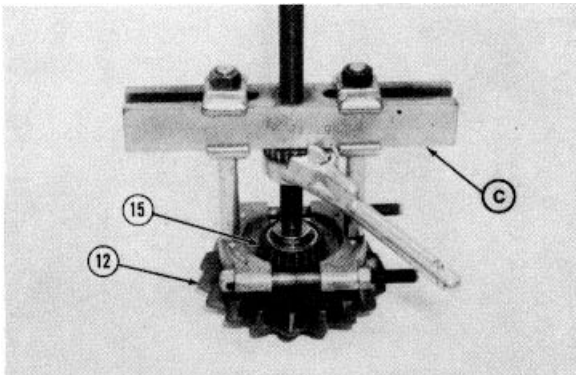
10. Remove six bolts (9), adapter (8) and the seal from the differential housing.



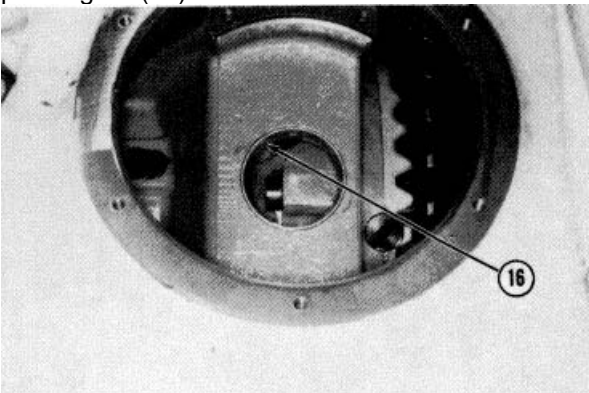
13. Use tool (B) and remove snap ring (14) from the pinion gear.

**Install Supplemental Steering Pump
And Drive Pinion 4324-12**

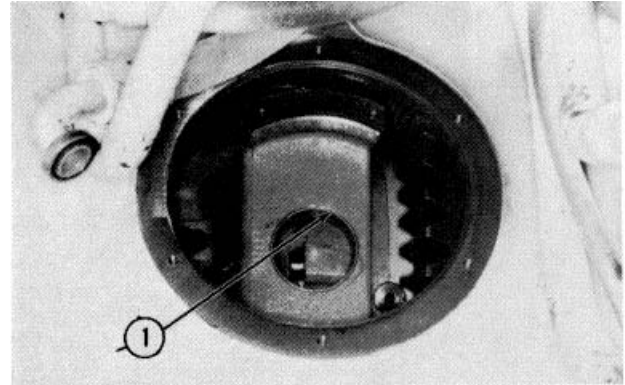
Tools Needed		A	B	C
	O.T.C. Model 1790 Transmission Jack	1		
1P1853	Pliers		1	
8S2328	Dial Indicator Test Group			1



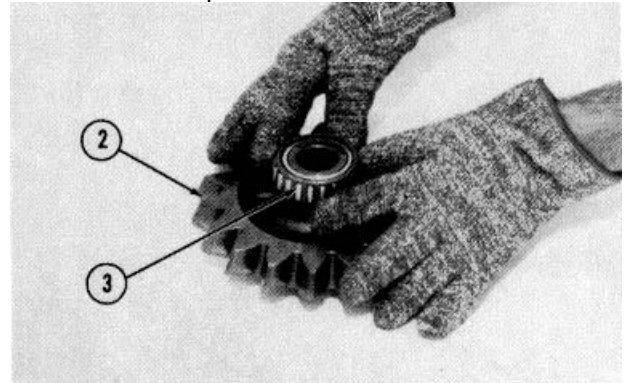
14. Use tooling (C) to remove bearing cones (15) from pinion gear (17).



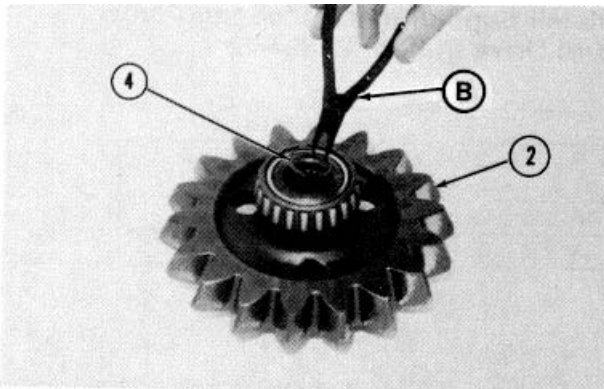
15. Remove bearing cup (16) from the cap.



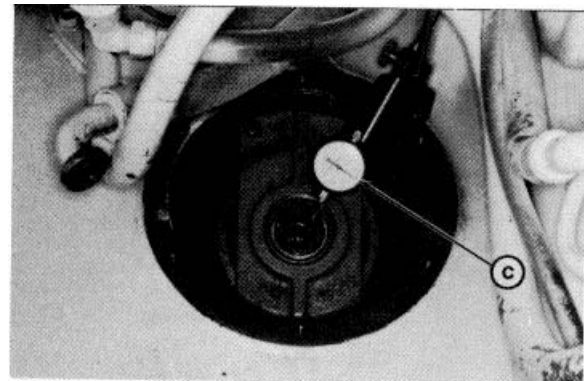
1. Lower the temperature of the bearing cup (1) and install it in the cap as shown.



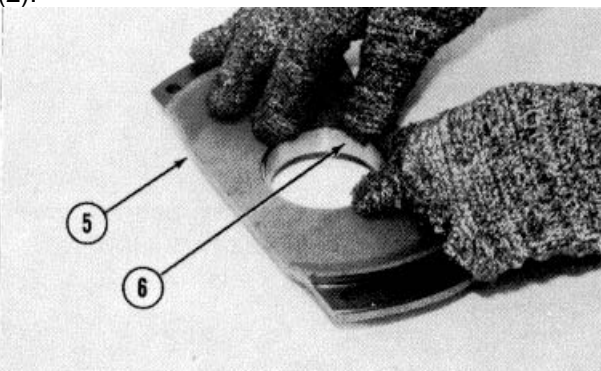
2. Heat bearing cones (3) to a maximum temperature of 135°C (275F) and install them on pinion gear (2).



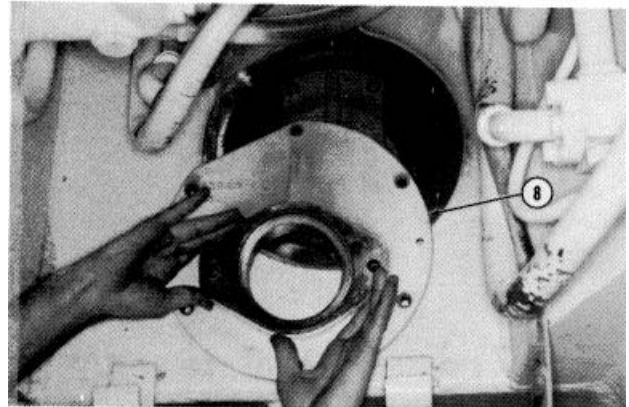
3. Use tool (B) and install snap ring (4) in pinion gear (2).



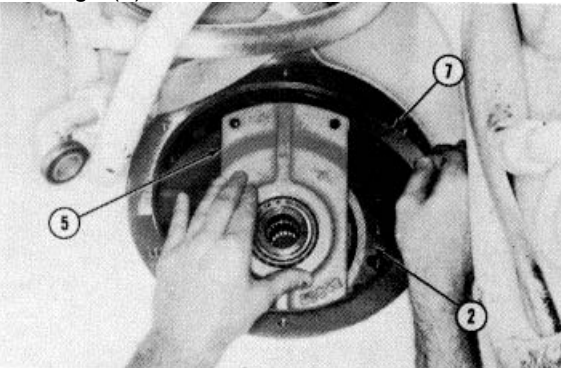
6. Use tooling (C) and check the end play A of the pinion gear. Add or remove shims until the end play is 0.03 to 0.18 mm (.001 to .007 in.).



4. Lower the temperature of bearing cup (6) and install it in cage (5) as shown.

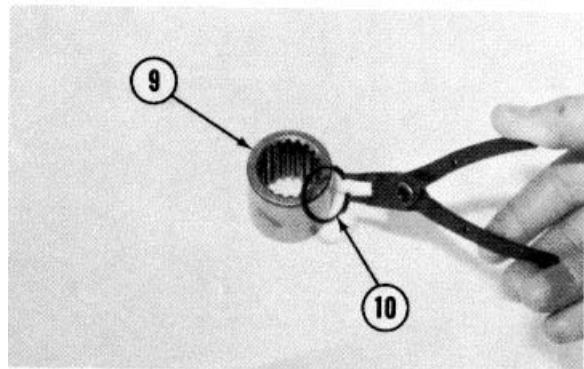


7. Put the O-ring seal in position on adapter (8).



5. Install pinion gear (2), original shims (7) and cage (5) on the cap as shown. Install the four bolts that hold cage (5) in place on the cap.

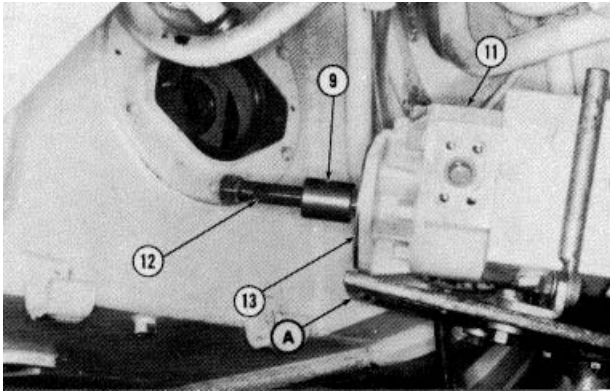
8. Put adapter (8) in position on the differential housing and install the six bolts that hold it.



9. Install snap ring (10) in coupling (9).

Vehicle Systems

Disassembly and Assembly

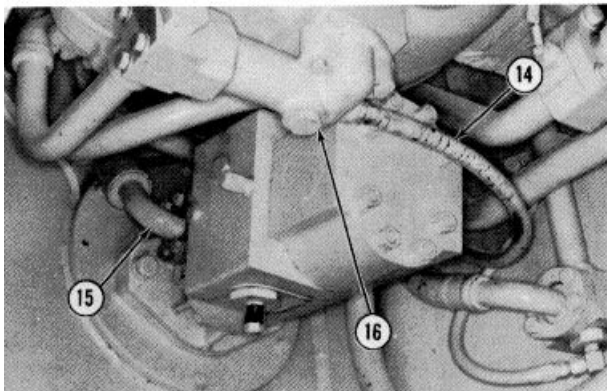


10. Check O-ring seal (13) for wear or damage and make a replacement if necessary.

11. Put coupling (9) and pump drive shaft (12) in position on supplemental steering pump (11).

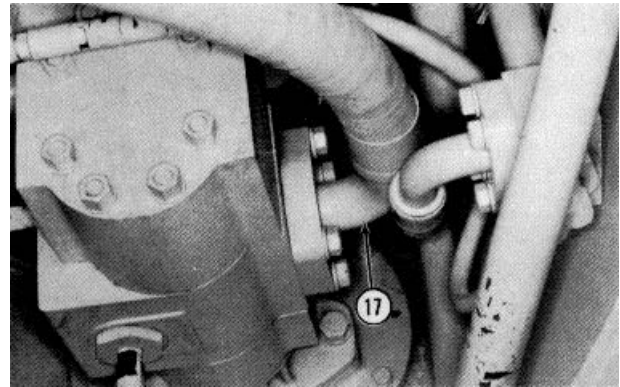
12. Fasten supplemental steering pump (11) on tool (A) or a suitable jack as shown.

13. Use tool (A) and put the supplemental steering pump in position on the machine. Make sure pump drive shaft (12) is in alignment with the pinion. Install the bolts that hold the supplemental steering pump in place.



14. Make sure the O-ring seal is in place on hose assembly (15). Put hose assembly (15) in position on the steering pump and install the bolts that hold it in place.

15. Connect hose (14) to sump screen housing (16).



16. Make sure the O-ring seal is in place on hose assembly (17). Put hose assembly (17) in position on the steering pump and install the bolts that hold it in place.

17. Install the rear and front crankcase guards on the machine.

18. Fill the differential housing and the hydraulic tank to the correct level. See the Maintenance Guide

Supplemental Steering Pump

Disassemble Supplemental Steering Pump 4324-15

Tools Needed	A	B
1P1857 Pliers	1	
5F7344 Block		1

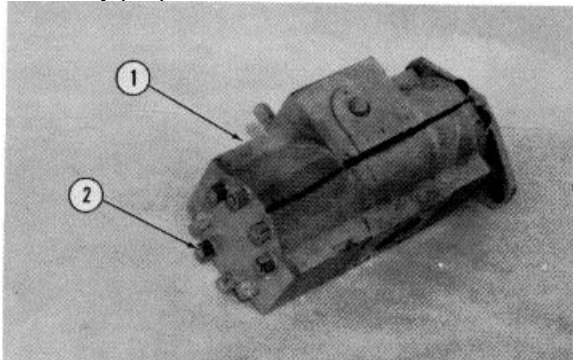
START BY:

- a) remove supplemental steering pump

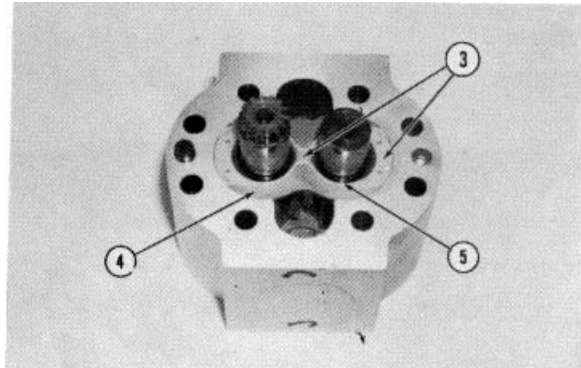
NOTICE

During disassembly of the supplemental steering pump, keep all parts with their respective section.

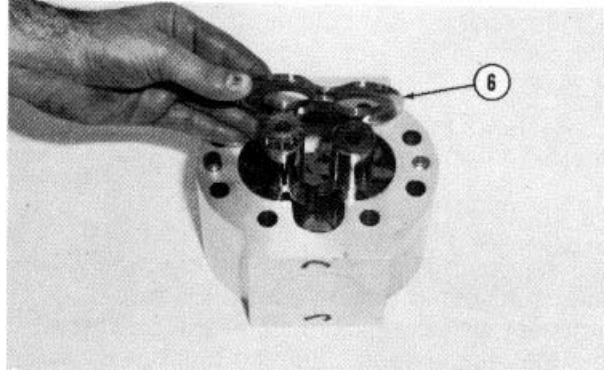
1. Thoroughly clean the outside of the pump
2. Put alignment marks on the pump sections for assembly purposes.



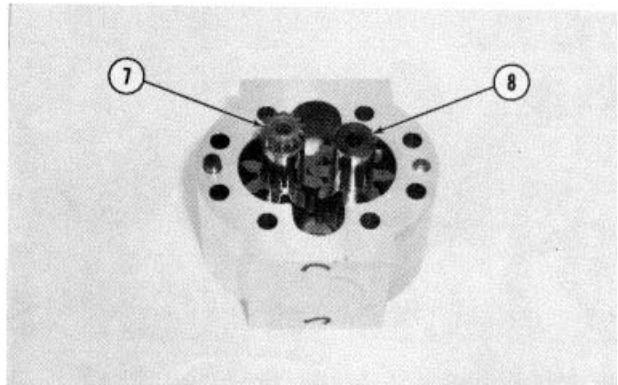
3. Remove nuts (2) and rear pump body (1).



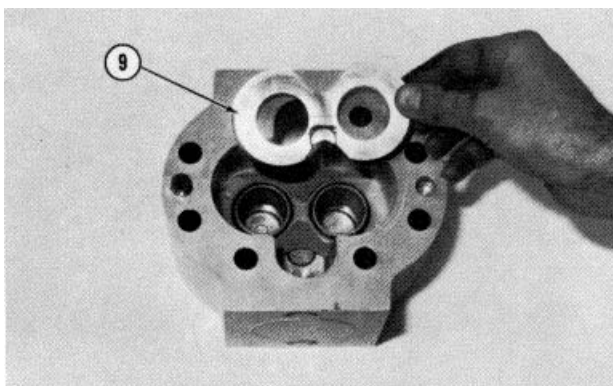
4. Remove isolation plates (4), sealing strips (5) and retainers (3) from the pressure plate



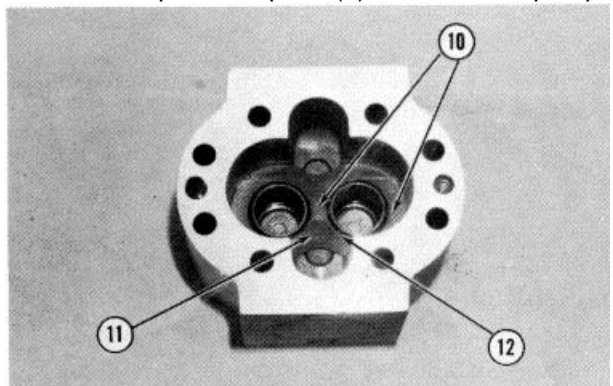
5. Remove pressure plate (6) from the rear pump body



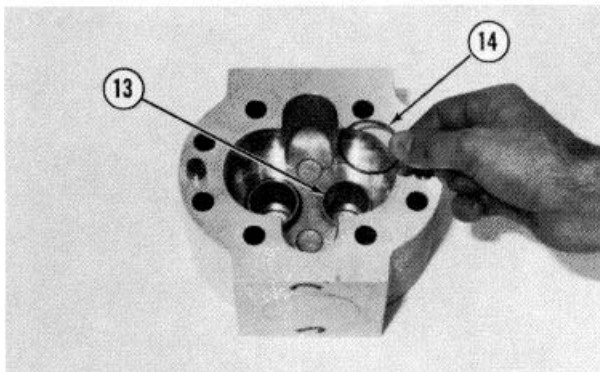
6. Remove rear drive gear (7) and rear idler (driven) gear (8) from the rear pump body.



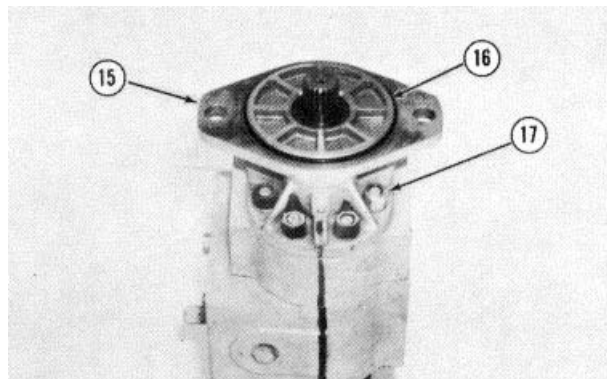
7. Remove pressure plate (9) from the rear pump body.



8. Remove isolation plates (11), sealing strips (12) and retainers (10) from the rear pump body.



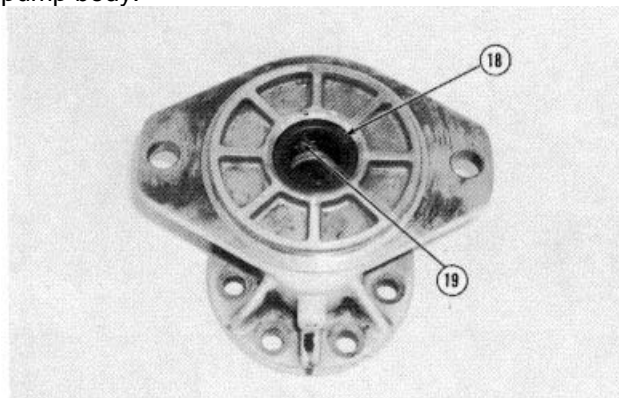
9. Remove O-ring seals (14) and backup rings (13) from the rear pump body.



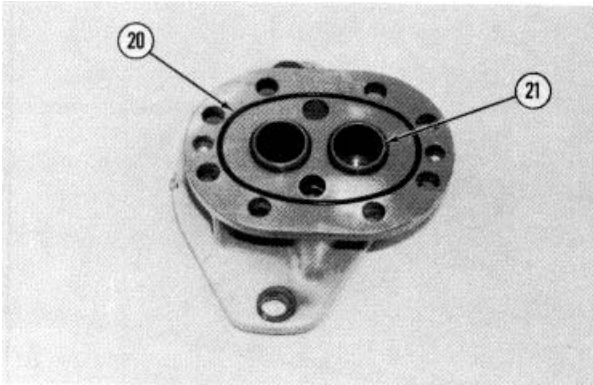
NOTE: Put clean grease on the splines of the front drive gear to prevent damage to the lip type seals in the flange when the flange is removed.

10. Remove O-ring seal (16) from the flange.

11. Remove nuts (17) and flange (15) from the front pump body.

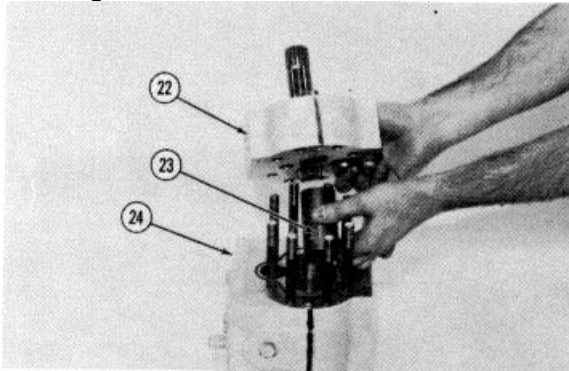


12. If necessary, remove outer lip type seal (18) from the flange. Use tool (A) to remove snap ring (19) and then remove the inner lip type seal.

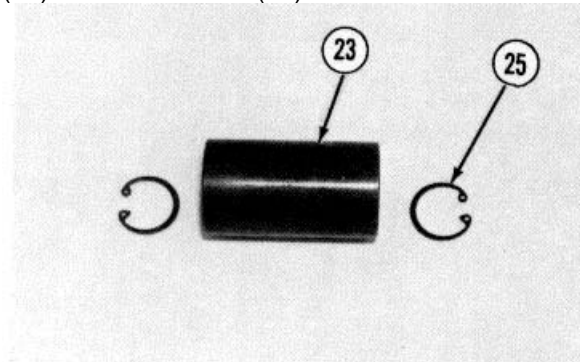


13. Remove O-ring (20) from the flange.

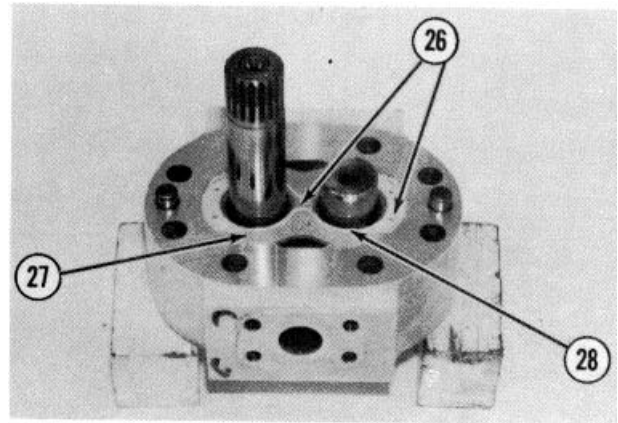
14. Remove the O-ring seals and backup rings (21) from the flange.



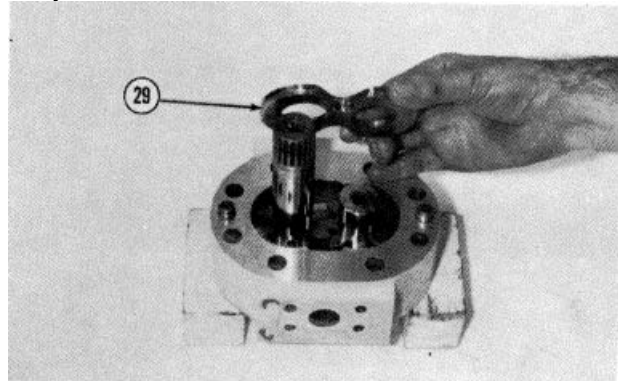
15. Remove front pump body (22) and splined coupling (23) from valve block (24).



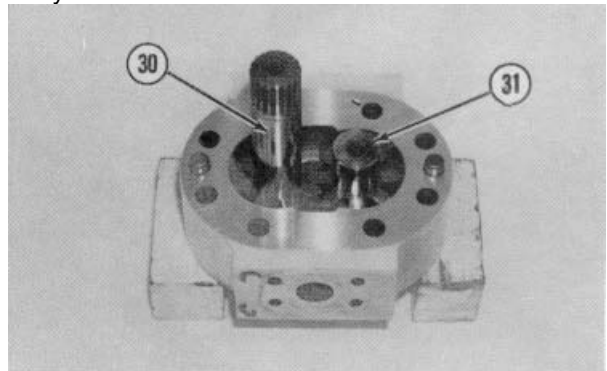
16. Remove two snap rings (25) from the Inside of coupling (23).



17. Remove isolation plates (27), sealing strips (28) and retainers (26) from the pressure plate in the front pump body.



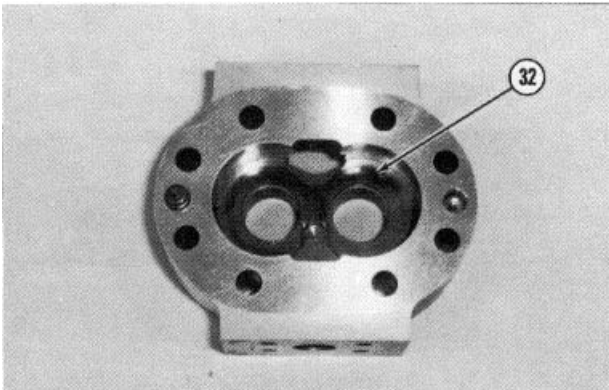
18. Remove pressure plate (29) from the front pump body.



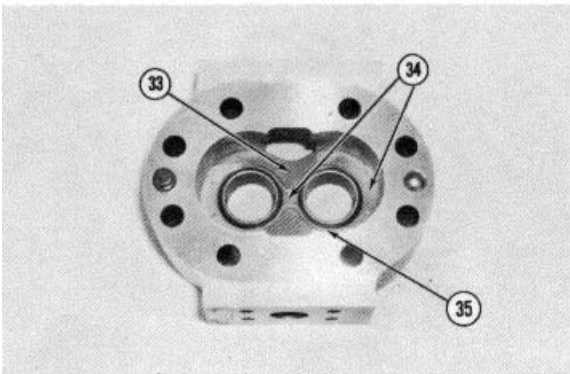
19. Remove front drive gear (30) and front idler (driven) gear (31) from the front pump body.

Vehicle Systems

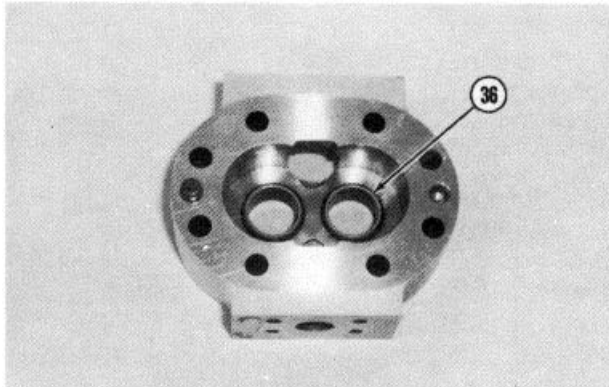
Disassembly and Assembly



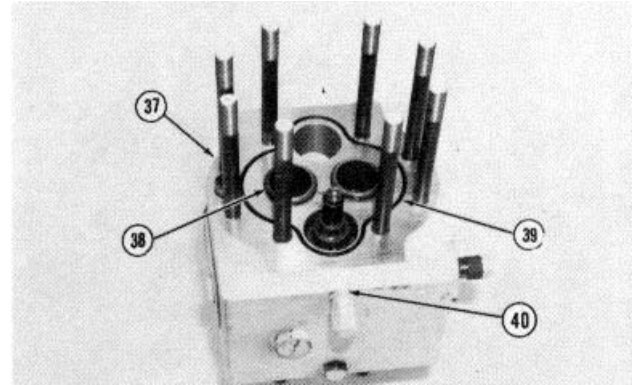
20. Remove pressure plate (32) from the front pump body.



21. Remove isolation plates (33), sealing strips (35) and retainers (34) from the front pump body.

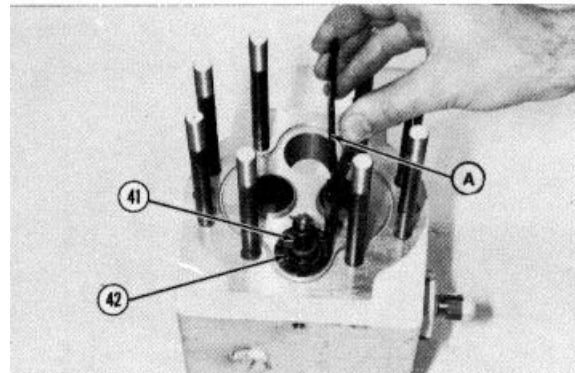


22. Remove the O-ring seals and backup rings (36) from the front pump body.

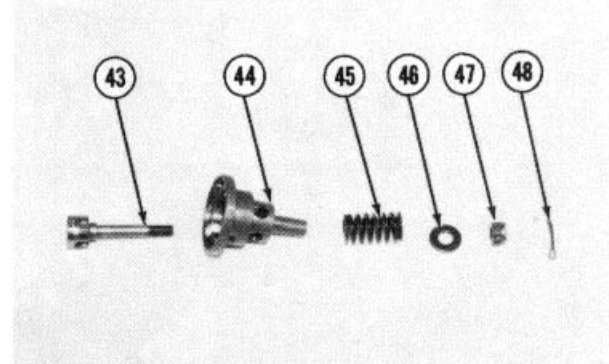


23. Remove O-ring seal (39), O-ring seals and backup rings (38) from valve block (37)

24. Loosen locknut (40) and remove the setscrew from the valve block.



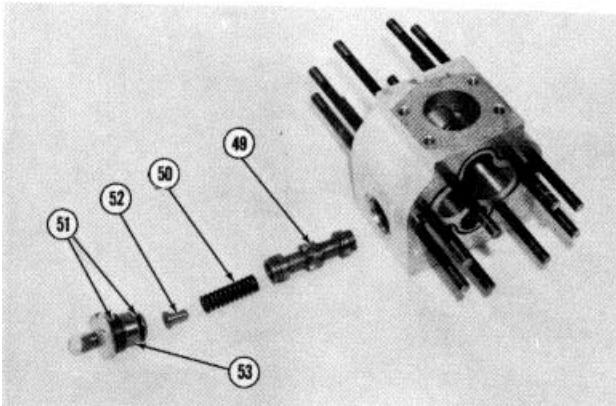
25. Use tool (A) and remove snap ring (42) Remove flow control valve (41) from the valve block.



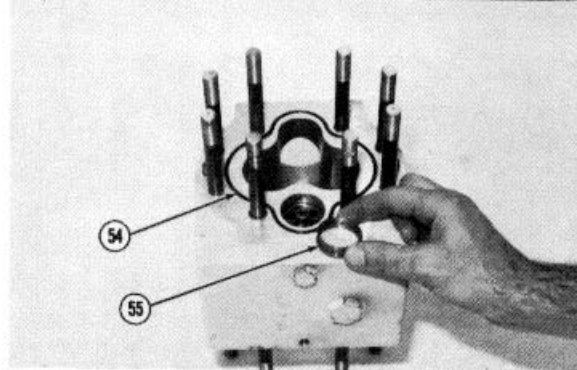
26. Disassemble the flow control valve Remove cotter pin (48), nut (47), washer (46), spring (45) and piston (43) from orifice (44).

Vehicle Systems

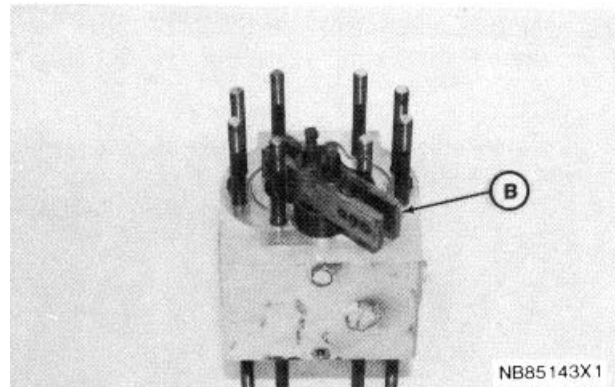
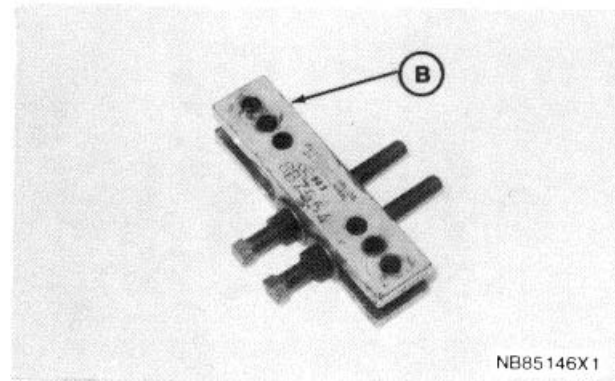
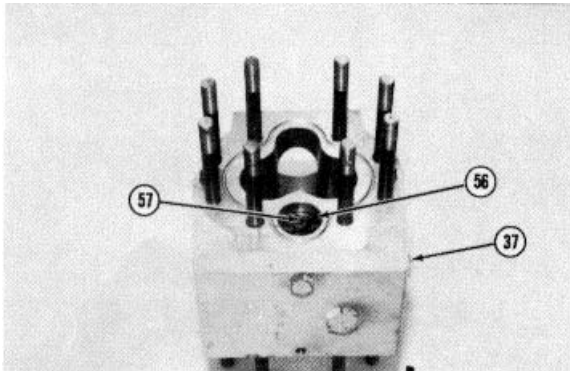
Disassembly and Assembly



27. Remove plug (53), retainer (52), spring (50) and valve spool (49) from the valve block. Remove two O-ring seals (51) and the backup ring from plug (53).



28. Remove O-ring seal (54) and plug (55) from the valve block.



29. Remove retainer (56) from the valve block as follows:

a) Use a 3/8"-16 NC tap and tap two of the holes which are opposite each other in retainer (56). Thoroughly clean all metal chips out of valve block (37). Do not permit any metal chips to enter the pump.

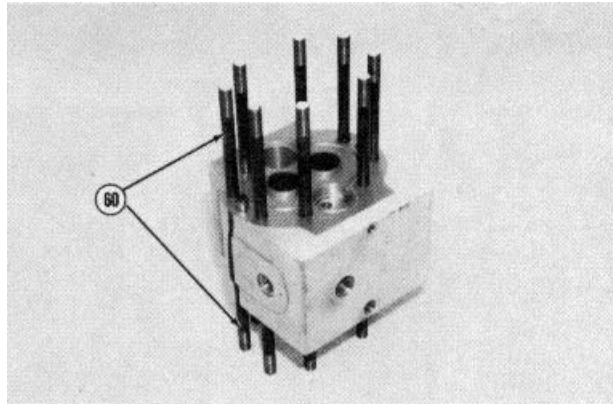
b) Obtain a spacer which has an inside diameter of not less than 34.925 mm (1.375 in.) and a height of 25.4 mm (1 in.). Put the spacer in position on the machined surface of valve block (37) and directly over the center of retainer (56).

c) Obtain two 3/8"-16 NC x 3.50" forcing screws, two 3/8"-16 NC nuts, two 3/8" washers and tool (B). Install a nut and then a washer on each forcing screw. Install one screw through the center hole and the other screw through one of the slots in tool (B). See illustration B85146X1. Put tool (B) and the screws in position on the spacer as shown in illustration B85143X1 and install the forcing screws in the threaded holes in the retainer. Tighten the nut on each forcing screw evenly to pull retainer (56) from the valve block.

Vehicle Systems

Disassembly and Assembly

- 30. Remove piston (57) from the valve block.
- 31. Put suitable snap ring pliers in the bore of the seat and remove the seat from the valve block.
- 32. Remove the O-ring seal from the seat.
- 33. If necessary, remove plugs (58) and (59) from the valve block.



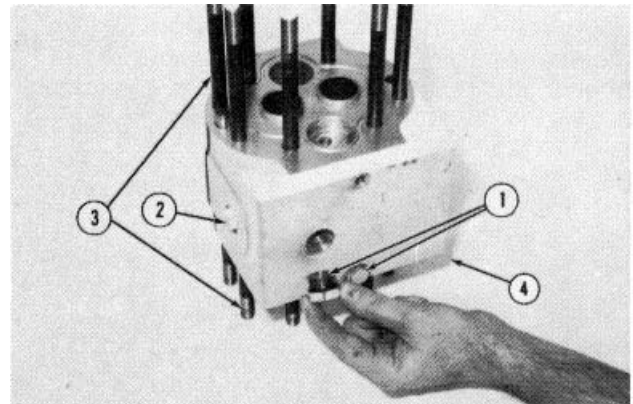
- 34. If necessary, remove studs (60) from the valve block.

Assemble Supplemental Steering Pump 4325-16

Tools Needed		A	B
1P1857	Pliers	1	
1P510	Driver Group		1

- 1. Make an inspection of all O-ring seals and parts of the supplemental steering pump for wear or damage and make a replacement if necessary.

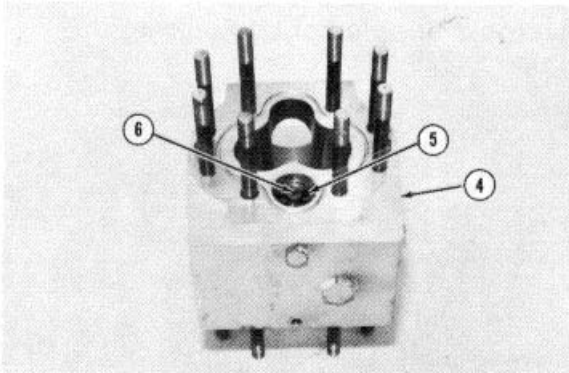
NOTE: Make sure all the parts of the pump are clean and free of dirt and foreign material. Also put clean oil on all pump parts before assembly. The rotation of the pump is counterclockwise as seen from the drive end of the pump.



- 2. Install studs (3) in valve block (4).
- 3. Put the O-ring seals in position on plugs (1) and (2). Install the plugs in the valve block.

Vehicle Systems

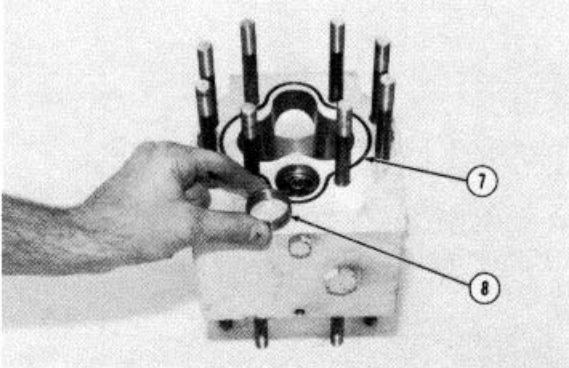
Disassembly and Assembly



4. Install the O-ring seal on the seat and install the seat in valve block (4).

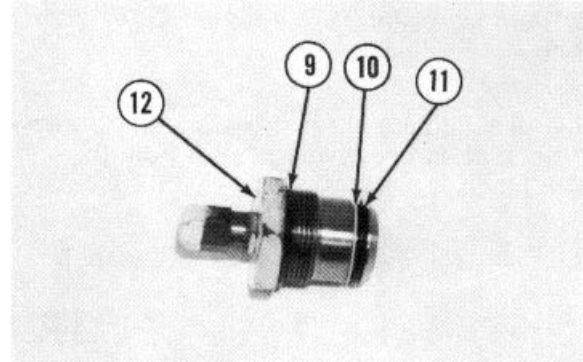
5. Put piston (6) in the bore of the valve block.

6. Put retainer (5) in position in the bore of the valve block. Make sure the stem of the piston is in alignment with the center bore of the retainer 7. Obtain a spacer with an outside diameter of not more than 28.575 mm (1.125 in.) and an inside diameter of not less than 12.7 mm (500 in.). Put the valve block in a press Use the spacer and press to install retainer (5) against the seat in the valve block.

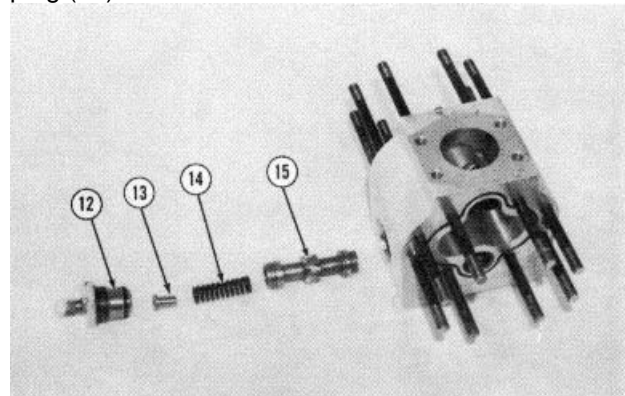


8. Install plug (8) in the valve block.

9. Install O-ring seal (7) in the valve block.

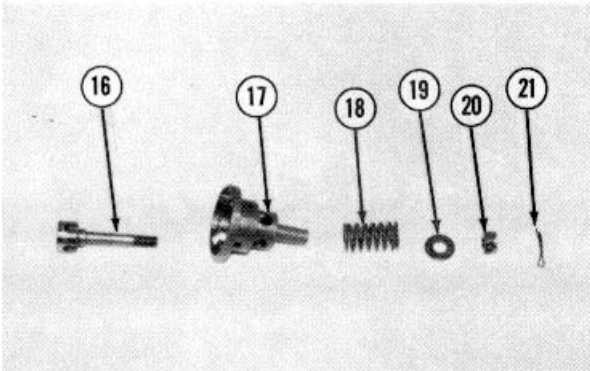


10. Install O-rings (9) and (11) and backup ring (10) on plug (12).

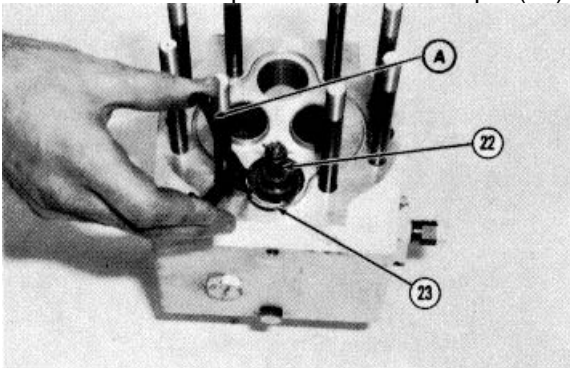


11. Install valve spool (15) in the valve block. Make sure the valve spool moves freely in the bore of the valve block.

12. Install spring (14), retainer (13) and plug (12) in the valve block. Tighten the plug to a torque of 135 ± 14 N•m (100 ± 10 lb. ft).

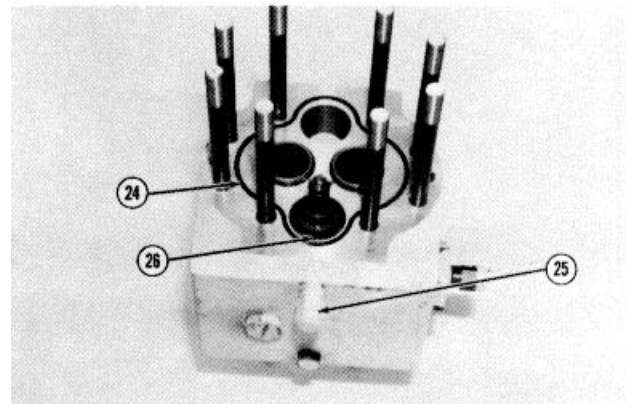


13. Assemble the flow control valve. Install piston (16) in orifice (17). Put spring (18) and washer (19) in position on the orifice and install nut (20) on the piston. Install Nut (20) until one of the grooves (slots) is in alignment with the hole in the piston. Install cotter pin (21).



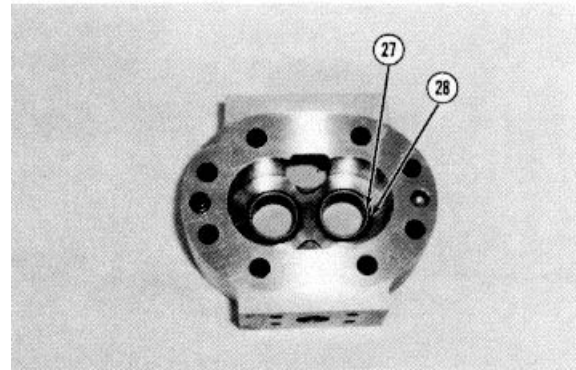
14. Put flow control valve (22) in position in the bore of the valve block. Make sure the hole in the valve is in alignment with the pin in the bore of the valve block.

15. Use tool (A) and install snap ring (23) in the groove (slot) in the bore of the valve block.

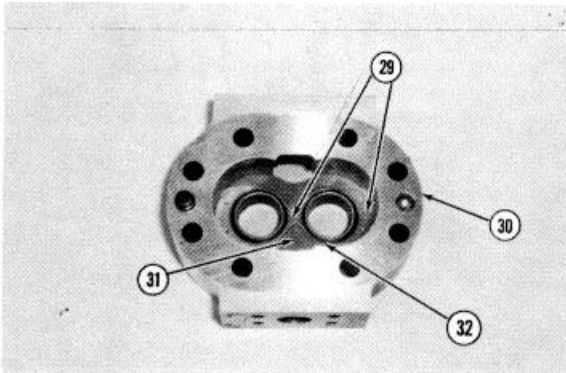


16. Install setscrew (25) in the threaded hole of the valve block. The setscrew must be in alignment with opening (hole) (26) in the flow control valve.

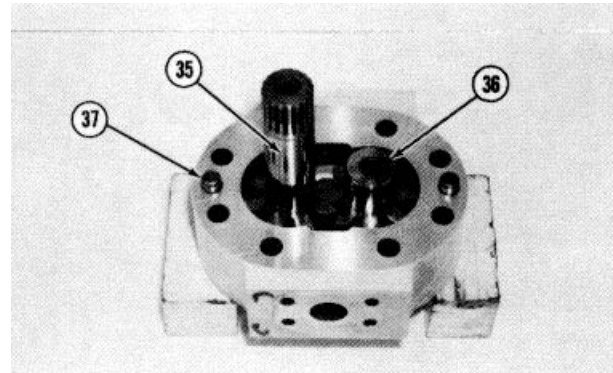
17. Install O-ring seal (24) on the valve block.



18. Install O-ring seals (28) on backup rings 6" (27). Put backup rings (27) in position in the front pump body as shown.

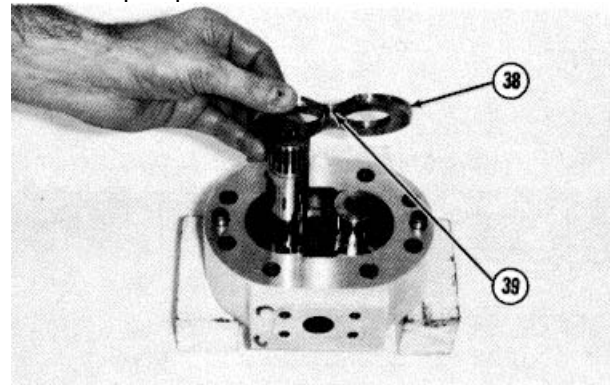


19. Install retainers (29), sealing strips (32) and Isolation plates (31) in front pump body (30) as shown. Make sure that the side of the isolation plates that has a round edge around the outer radius faces down in the bottom of the front pump body.

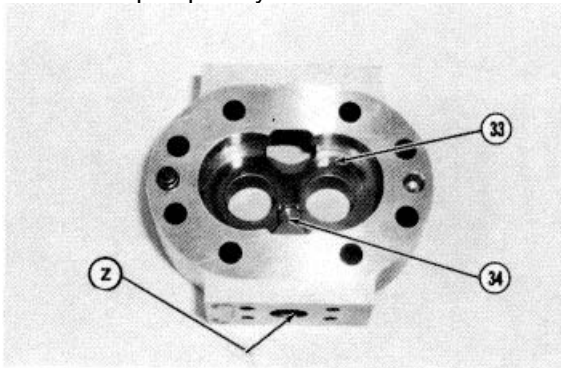


21. Carefully install front drive gear (35) and front idler (driven) gear (36) in the front pump body.

22. The front pump gears and the rear pump gears must be in correct time with each other. Move front drive gear (35) until one of the valleys between two teeth is in alignment with dowel (37). After the alignment has been made, do not move the gears until the complete pump has been assembled. The gear tooth in one pump section must be in alignment with the valley of the gear in the other pump section when assembled.



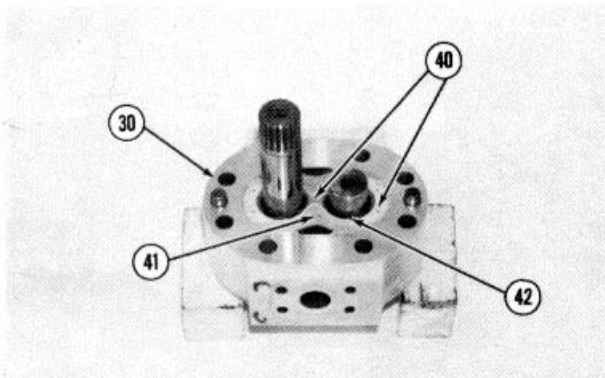
23. Carefully install pressure plate (38) in the front pump body. The bronze side of the pressure plate must be toward the gears and the machined notch (trap) (39) must be toward the outlet side of the pump.



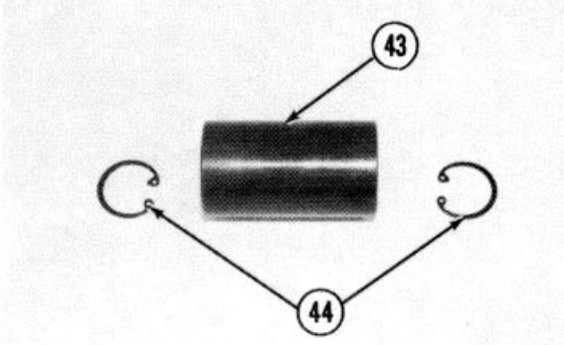
NOTICE

To prevent damage to the pressure plates, do not use force to install them. Hold the plates as level as possible and slide them into position. Do not let the pump gears fall into position in the pump housing.

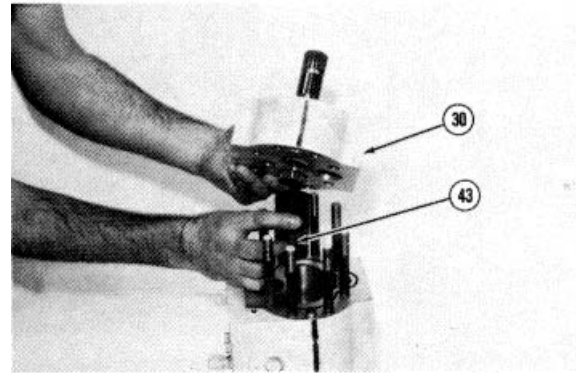
20. Carefully install pressure plate (33) in front pump body (30) The bronze side of the pressure plate must be toward the gears and the machined notch (trap) (34) must be toward the outlet side of the pump as shown. Opening (Z) is the pump outlet.



24. Install retainers (40), sealing strips (42) and isolation plates (41) in front pump body (30) as shown isolation plates (41) have the same type of edge on each side of the outer radius and can be installed either way.

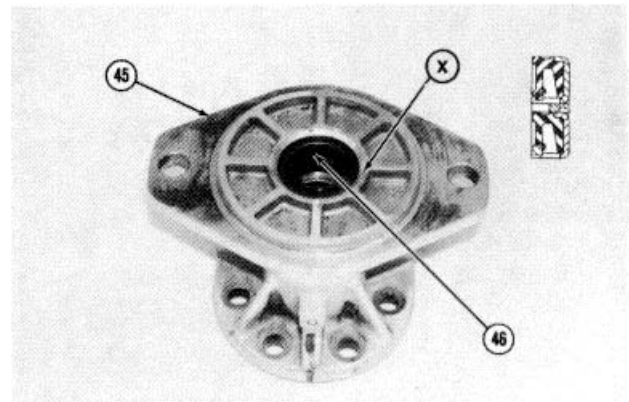


25. Install two snap rings (44) in the inside of coupling (43).



26. Install coupling (43) on the end of the front drive gear as shown.

27. Put front pump body (30) in position on the valve block.



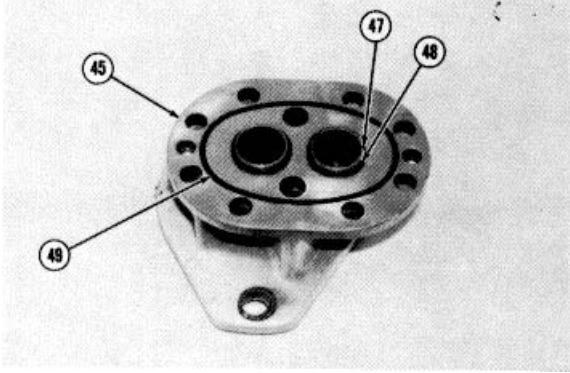
28. Use tool group (B) and install the lower lip type seal in flange (45). Install the seal to a maximum depth of 18.06 mm (.711 in.) below outside surface (X). Make sure the lip of the seal faces down toward the inside of the flange as shown.

29. Use tool (A) and install snap ring (46) in the flange. Make sure the opening of the snap ring is in alignment with oil hole in the bore of the flange.

30. Use tool group (B) and install the outer lip type seal in the flange. Install the seal to a maximum depth of 3.91 mm (.154 in.) below outside surface (X). Make sure the lip of the seal faces up as shown and that both seals are installed straight (square) in the bore.

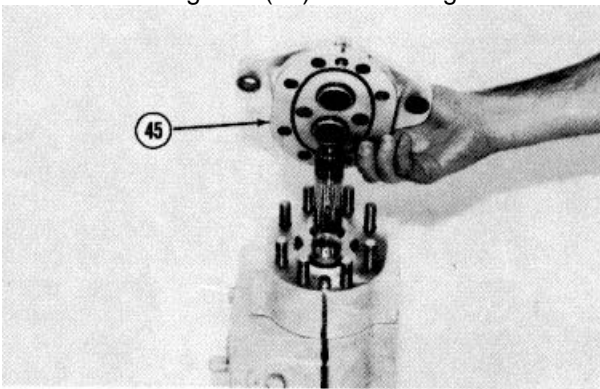
Vehicle Systems

Disassembly and Assembly



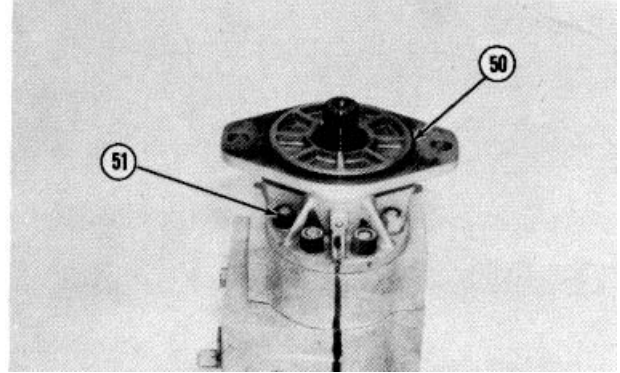
31. Install O-ring seals (48) on backup rings (47). Install backup rings (47) on flange (45).

32. Install O-ring seal (49) on the flange.



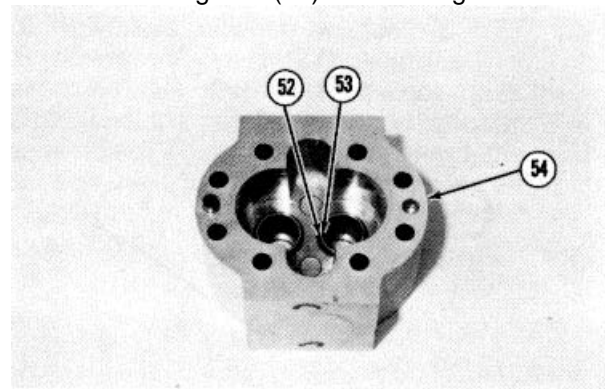
NOTE: Put clean grease on the splines of the drive gear to prevent damage to the lip type seal in the flange when the flange is installed.

33. Carefully install flange (45) in its original position on the front pump body.

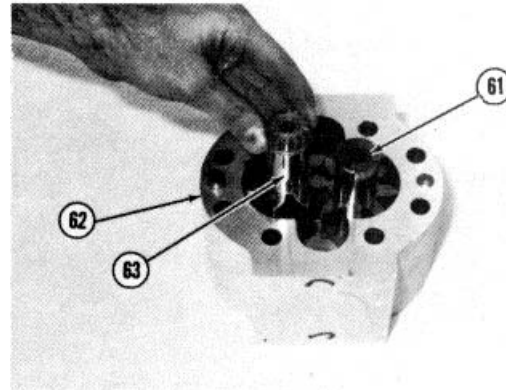
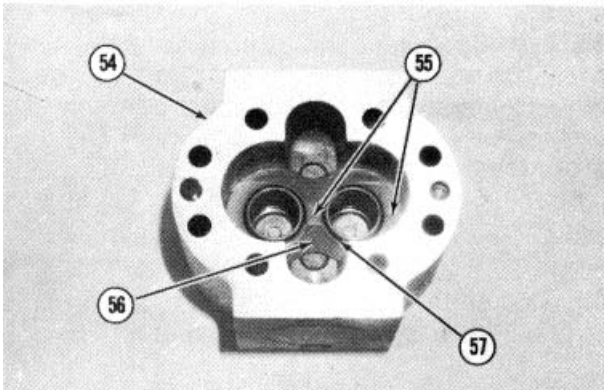


34. Install eight nuts (51) that hold the flange in place and tighten them only finger tight.

35. Install O-ring seal (50) on the flange.



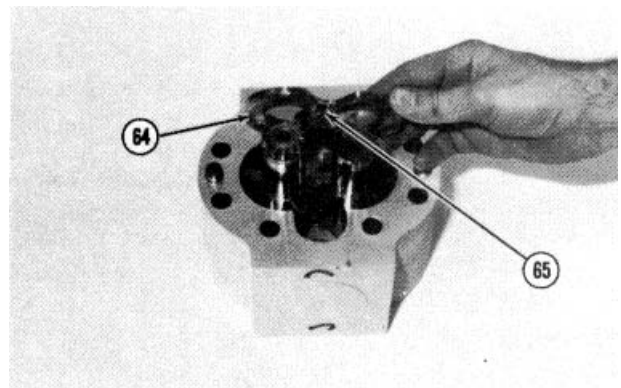
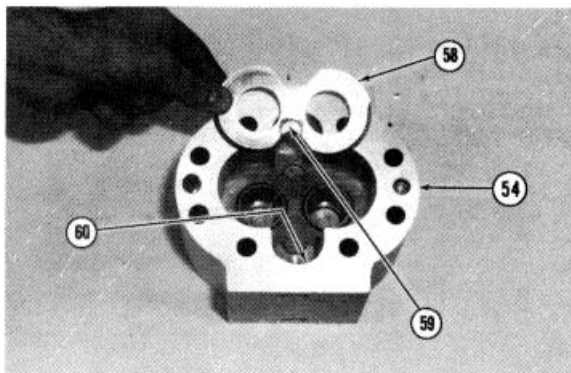
36. Install O-ring seals (52) on backup rings (53). Install backup rings (53) in the rear pump body (54) as shown.



37. Install retainers (55), sealing strips (57) and isolation plates (56) in rear pump body (54) as shown. Make sure that the side of the isolation plates that has a round edge around the outer radius faces down in the bottom of the rear pump body.

39. Carefully install rear drive gear (63) and rear idler (driven) gear (61) in the rear pump body.

40. The front pump gears and the rear pump gears must be in correct time with each other. Move rear drive gear (63) until one of the gear teeth is in alignment with dowel (62). After the alignment has been made, do not move the gears until the complete pump has been assembled. The gear tooth of one pump section must be in alignment with the valley of the gear in the other pump section when assembled.

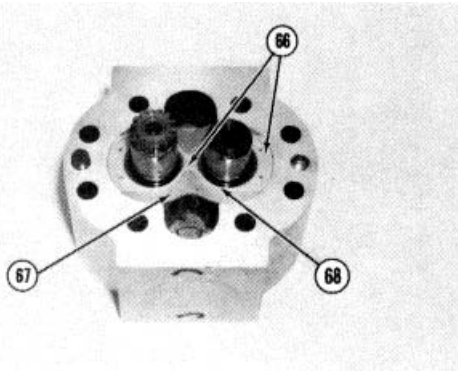


NOTICE

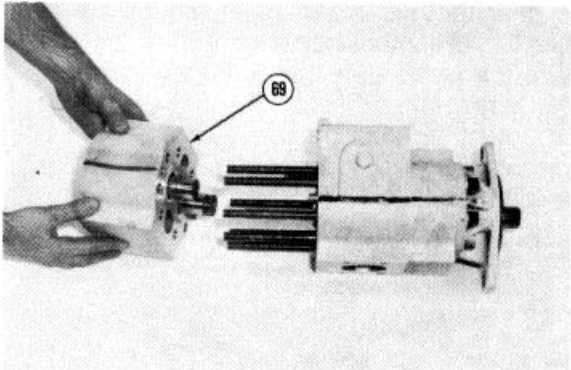
To prevent damage to the pressure plates, do not use force to install them. Hold the plates as level as possible and slide them into position. Do not let the pump gears fall into position in the pump housing.

38. Carefully install pressure plate (58) in rear pump body (54). The bronze side of the pressure plate must be toward the gears and the machined notch (trap) (59) must be toward the outlet side of the pump. Opening (60) is the pump outlet.

41. Carefully install pressure plate (64) in v 3 the rear pump body. The bronze side of the pressure plate must be toward the gears and the machine notch (trap) (65) must be toward the outlet side of the pump.



42. Install retainers (66), sealing strips (68) D and isolation plates (67) in the rear pump body as shown. These isolation plates have the same type of edge on each side of the outer radius and can be installed either way.



43. Put rear pump body (69) in its original position on the valve block. If the splined gear shaft can not be installed into the coupling, move the front drive gear a small amount until the splines engage correctly.

44. Install the nuts that hold the pump together. Tighten the two bolts that are opposite each other (flange end of the pump) to a torque of $115 + 7$ N m (85 + 5 lb. ft.), then do the same at the opposite end of the pump.

45. Turn the output shaft with a torque wrench. The amount of turning torque needed to keep the shaft in rotation must be within a range of 7 to 14 N m (5 to 10 lb. ft.) If the shaft does not turn within the specified range, the pump must be disassembled and inspected.

46. Tighten the remainder of the bolts to a torque of $115 + 7$ N m (85 + 5 lb. ft.).

47. For correct pump adjustments, see Testing And Adjusting.

END BY:

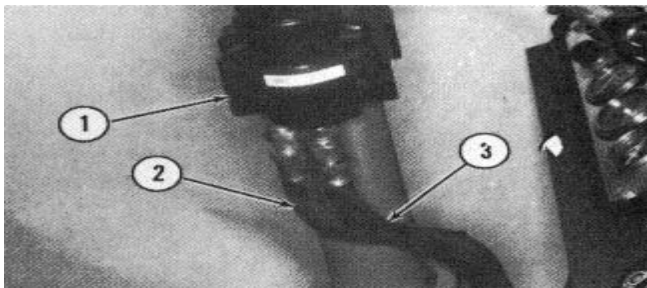
- a) install supplemental steering pump

Retarder Selector Valve

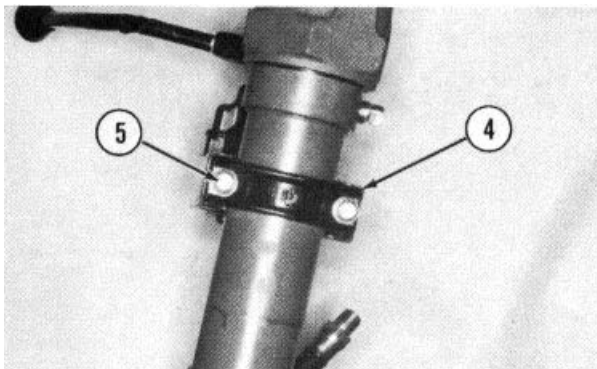
Remove Retarder Selector Valve
3121-11**WARNING**

To prevent possible personal injury, release all the air from the air system before any lines are disconnected.

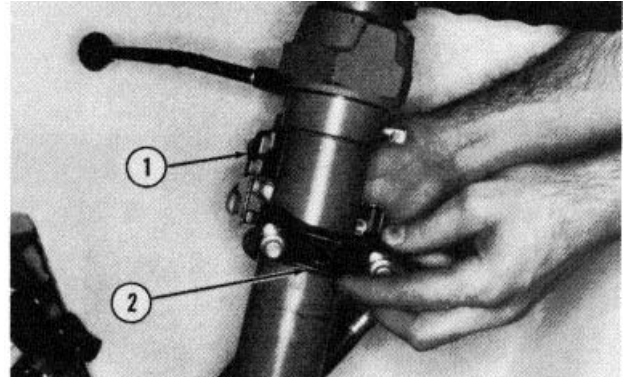
1. Drain the air from the air tanks.



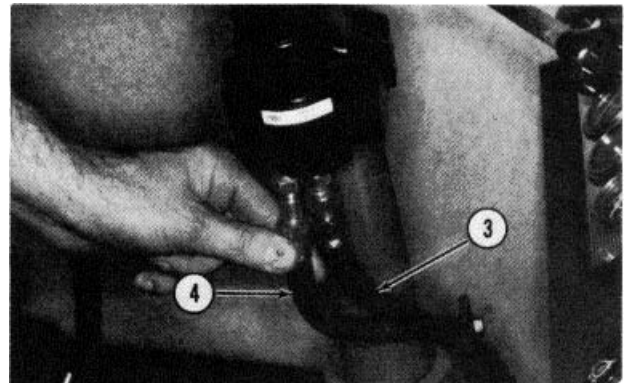
2. Put identification marks on air line (2) and (3). Disconnect the air lines from retarder selector valve (1).



3. Remove screws (5), clamp (4) and the retarder selector valve.

Install Retarder Selector Valve
3121-12

1. Put retarder selector valve (1) in position on the steering column and install clamp (2) and the bolts that hold it in place.



2. Connect air line (3) and (4) to the retarder selector valve.

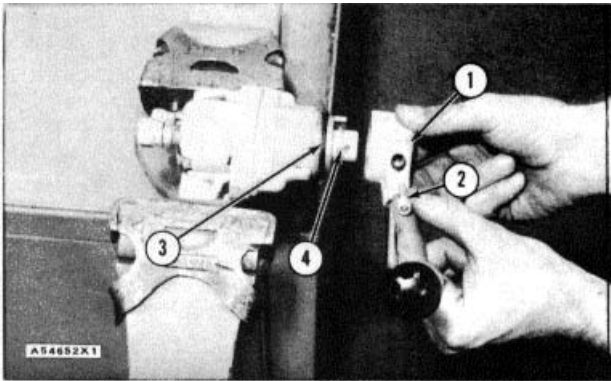
Vehicle Systems

Disassembly and Assembly

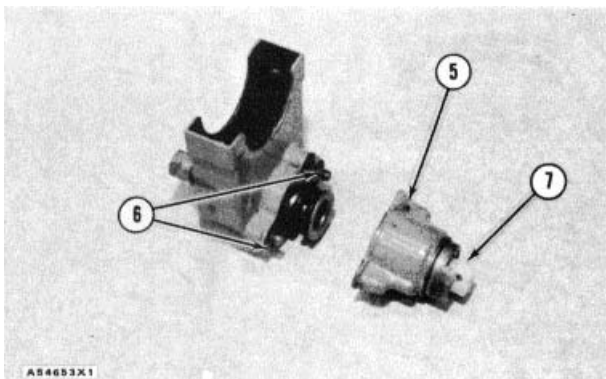
**Disassemble Retarder Selector Valve
3121-15**

START BY:

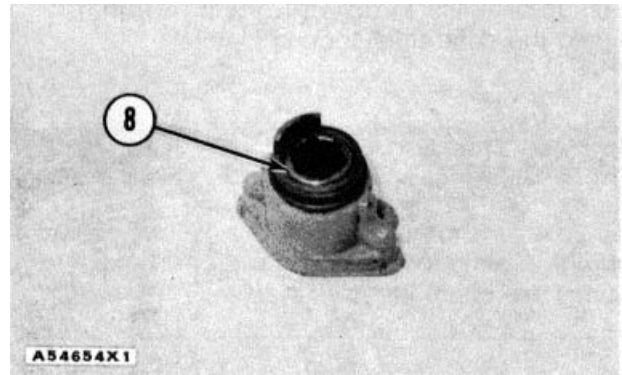
- a) remove retarder selector valve



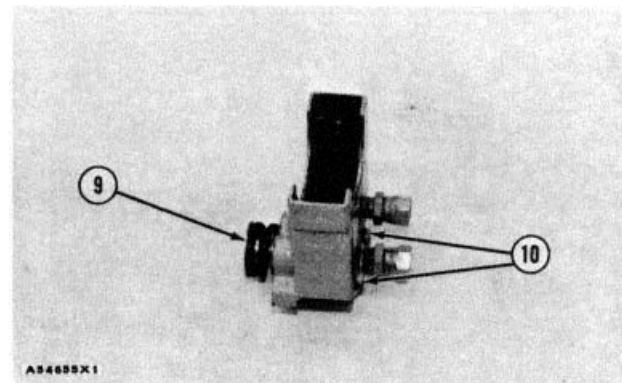
- 1. Remove setscrews (2) and handle (1) from the cam.
- 2. Remove O-ring seal (3) from the cover.
- 3. Remove lockring (4).



- 4. Remove screws (6) and cover (5) from the body.
- 5. Remove cam and follower assembly (7) from the cover.



- 6. Remove adjusting ring (8) from the cover.



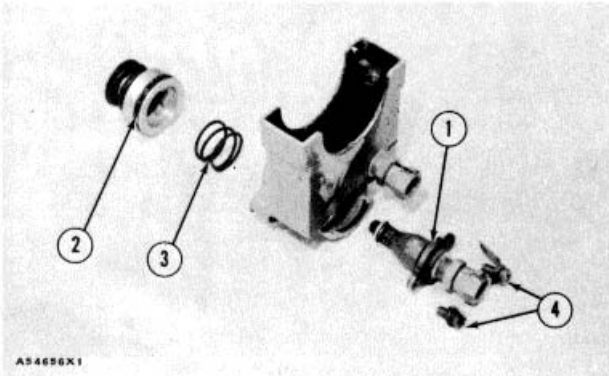
- 7. Remove piston assembly (9) and the 2 spring from the body.
- 8. Remove screws (10) and the valve assembly from the body.
- 9. Remove the O-ring seals from the piston assembly and valve assembly.

Vehicle Systems

Disassembly and Assembly

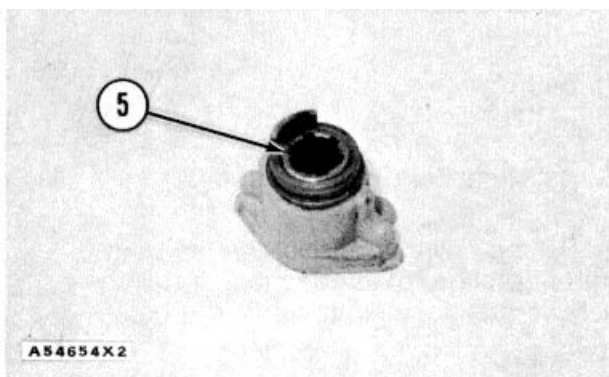
**Assemble Retarder Selector Valve
3121-16**

Tools Needed		A
8M2885	Pressure Gauge	1

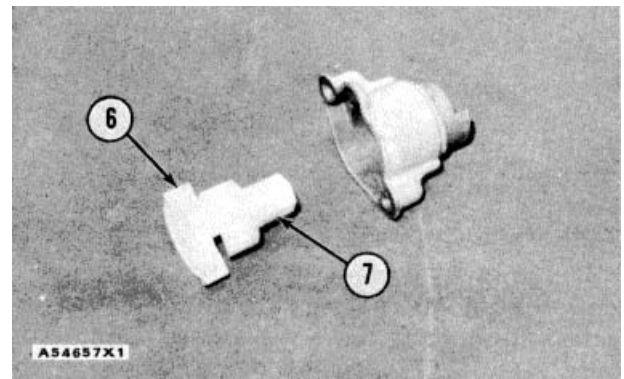


NOTE: Put clean 1P808 General Purpose Lubricant on all valve parts before assembly.

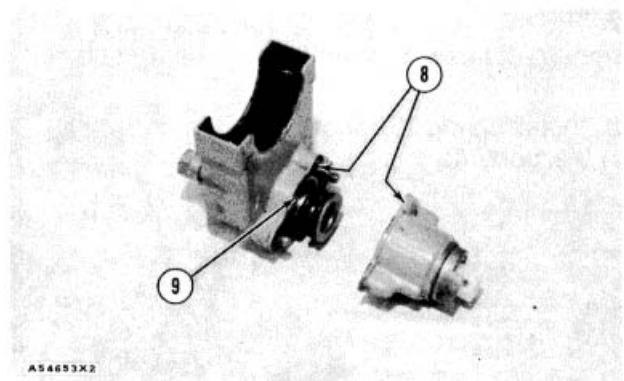
1. Install O-ring seal (1) on the valve assembly and O-ring seal (2) on the piston assembly.
2. Put the valve assembly in position in the body and install screws (4) to hold it in place.
3. Install spring (3) and the piston assembly in the body.



4. Install adjusting ring (5) in the cover so it is even with the top of the cover as shown.



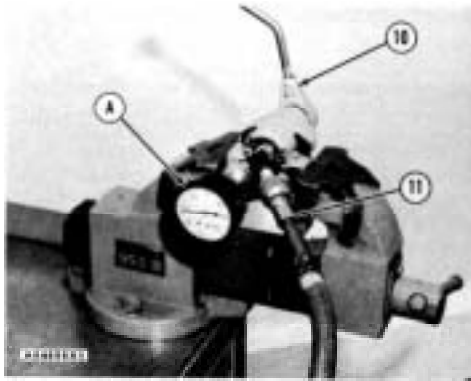
5. Install follower (6) in cam (7). Install the cam and follower assembly in the cover.



6. Install gasket (9) on the body.
7. Put the cover in position on the body with passages (8) in alignment with each other. Install the screws that hold the cover on the body.

Vehicle Systems

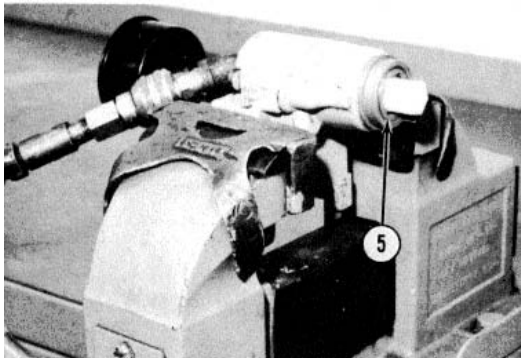
Disassembly and Assembly



8. Remove the two unions from the body.; (Install tool (A) In the delivery passage as shown and connect an air supply (11) to the supply passage.

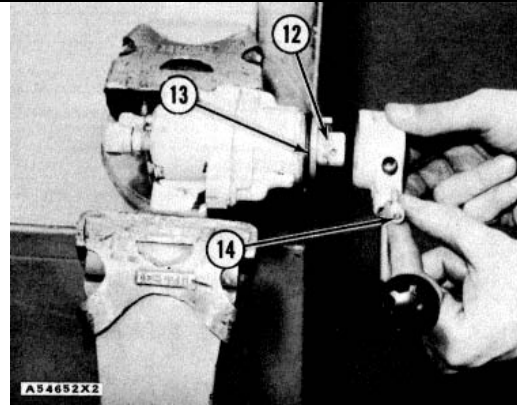
NOTE: The air supply must have at least 620 kPa (90 psi).

9. Use handle (10) to turn the cam and check the first (initial) and last (final) pressure.



10. Remove the handle and adjusting ring (5) until the first (initial) pressure is 190 ± 20 kPa (27 ± 3 psi) and the last (final) pressure is 550 ± 35 kPa (80 ± 5 psi).

11. Remove the air supply and tool (A). Install the unions In their original positions.



12. Install O-ring seal (13) on the cover. Install locking (12) to hold adjusting ring in place.

13. Put the handle in position on the cam and install setscrew (14) to hold it in place.

END BY:

a) install retarder selector control valve.

VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

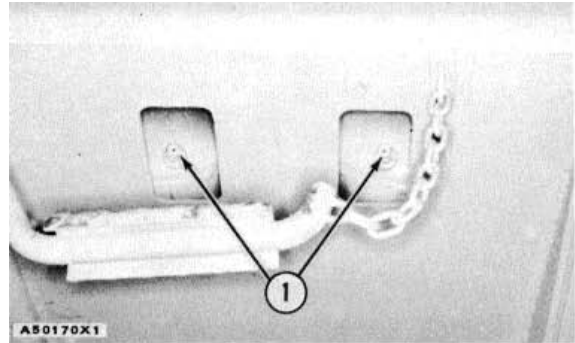
PRESSURE PROTECTION VALVE

REMOVE PRESSURE PROTECTION VALVE

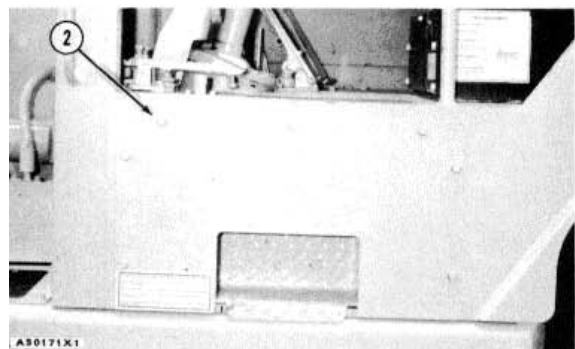


WARNING: Before any air lines are disconnected make sure the air pressure is zero.

1. Loosen two plugs (1) to release the air from the air tanks.



2. Remove plate assembly (2) from the machine.

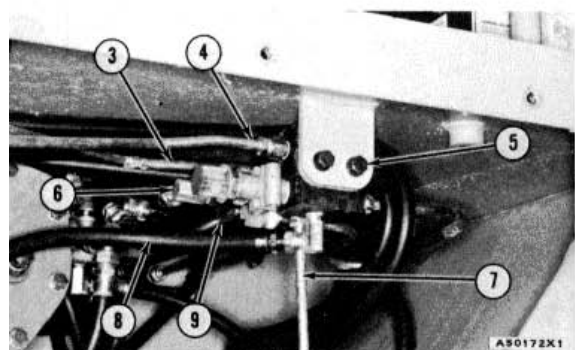


3. Put identification on the tube assemblies and air hoses before they are disconnected from the pressure protection valve for correct installation.

4. Disconnect tube assemblies (3), (4) and (7) from the pressure protection valve.

5. Disconnect hoses (8) and (9) from the valve.

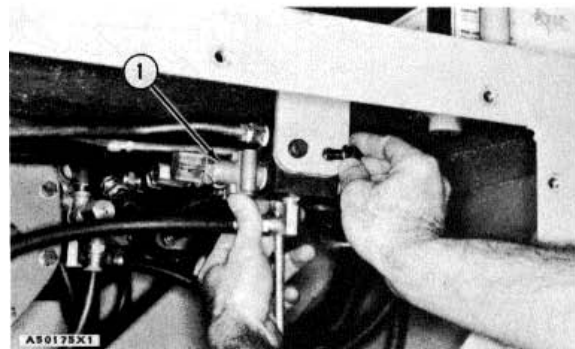
6. Remove two bolts (5) that hold pressure protection valve (6) to the bracket. Remove the valve.



INSTALL PRESSURE PROTECTION VALVE

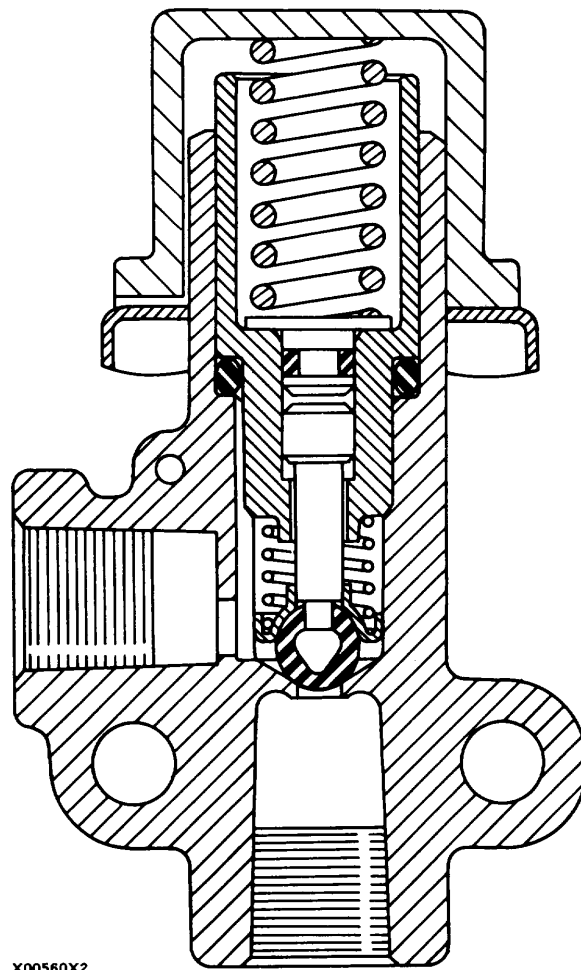
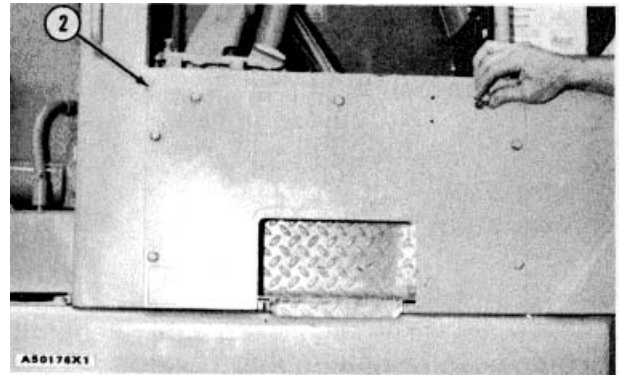
1. Put pressure protection valve (1) in position on the bracket as shown and install the two bolts that hold it.

2. Connect the three tube assemblies and two hoses to the valve. Make sure the hoses and tube assemblies are in the correct positions.



PRESSURE PROTECTION VALVE

3. Install plate assembly (2) over the pressure protection valve.



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

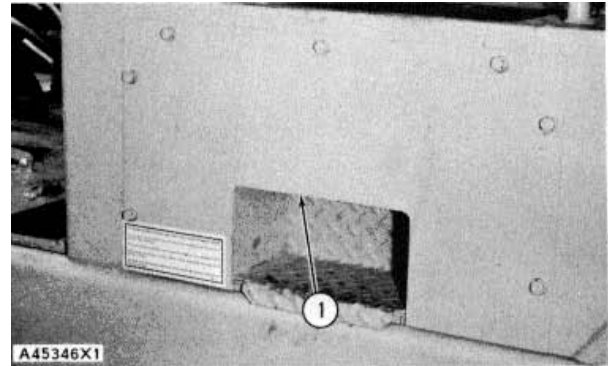
BRAKE CONTROL VALVE

REMOVE BRAKE CONTROL VALVE

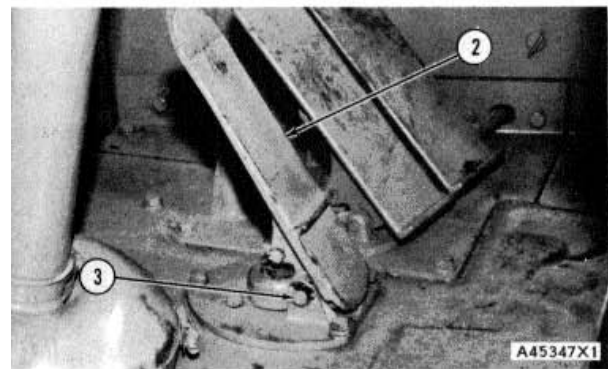


WARNING: Before any air lines are disconnected make sure the air pressure is zero.

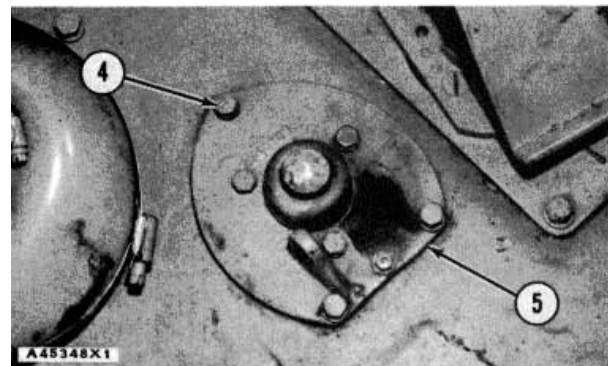
1. Release the air pressure from the air tanks under the operator's station.
2. Remove plate assembly (1).



3. Remove the cotter pin and pin (3) that hold the treadle assembly in position. Remove treadle assembly (2).

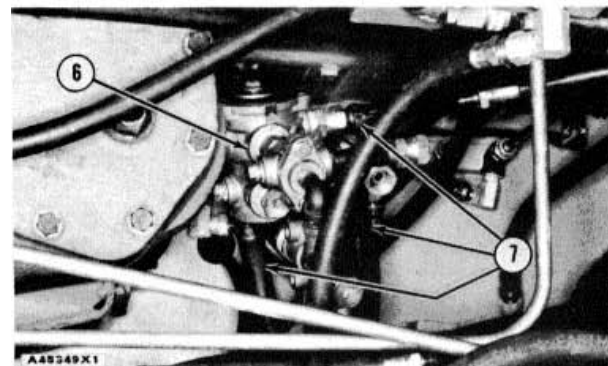


4. Remove six bolts (4) and plate (5).



5. Put identification on the eight hoses that are connected to the brake control valve for correct installation.

6. Disconnect eight hoses (7) from the valve.



7. Remove brake control valve (6).

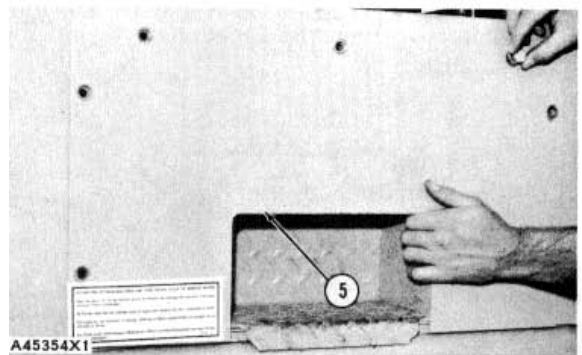
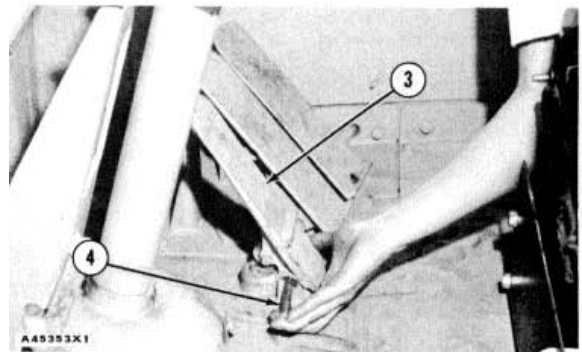
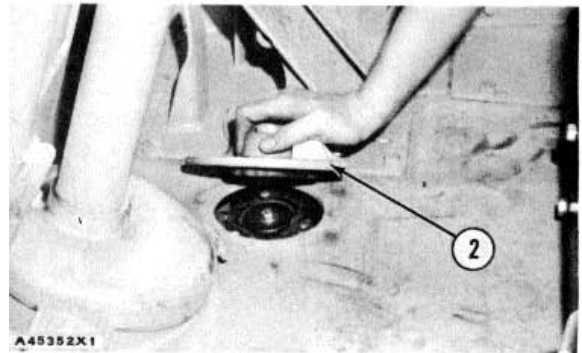
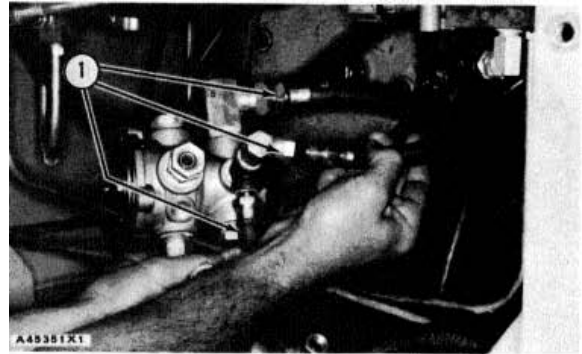
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

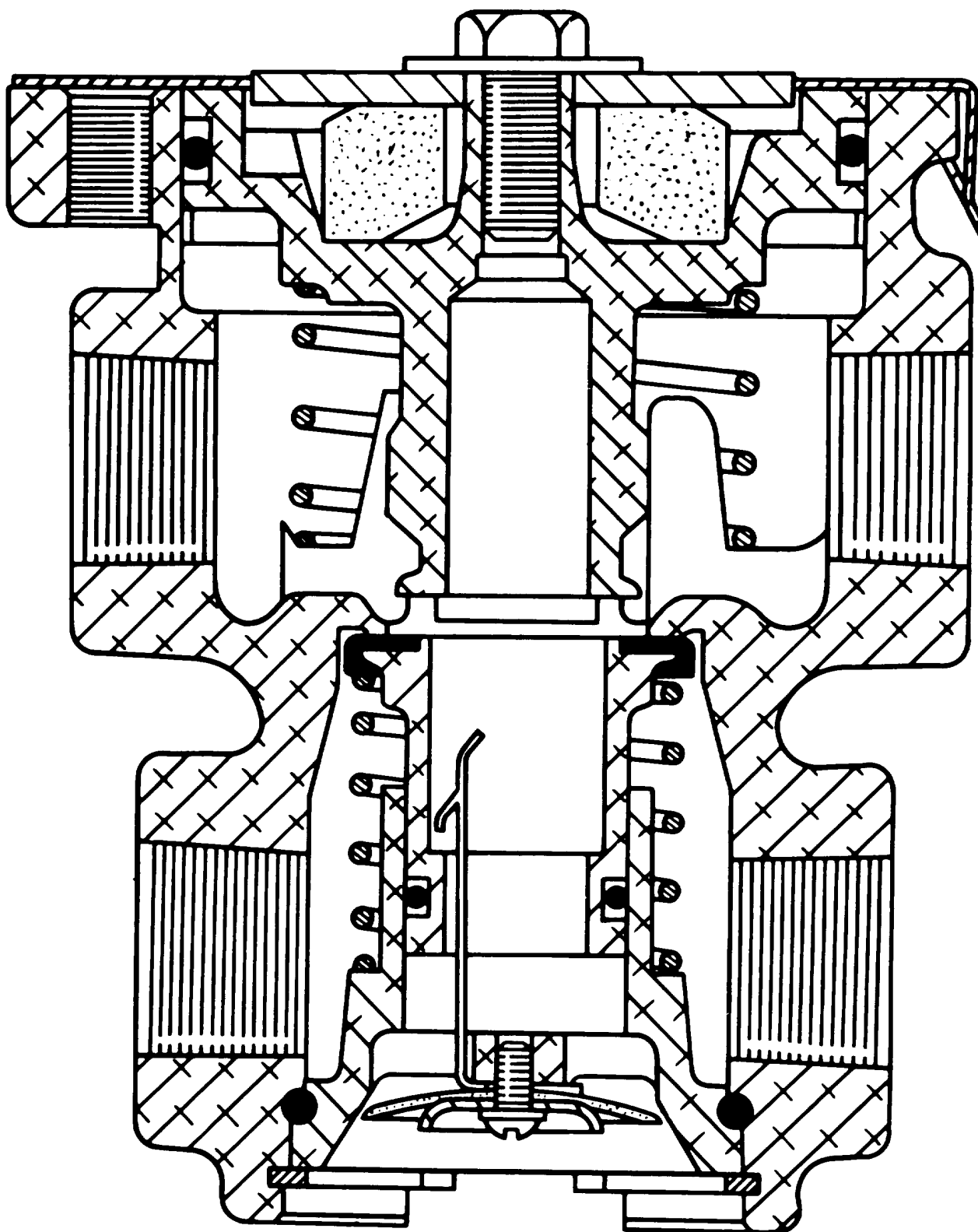
BRAKE CONTROL VALVE

INSTALL BRAKE CONTROL VALVE

1. Connect eight hoses (1) to the brake control valve. Make sure the hoses are in the correct positions.
2. Put the brake control valve in position under the floor plate.
3. Put plate (2) in position over the brake control valve and install the six bolts that hold it.
4. Put treadle assembly (3) in position on the plate. Install pin (4) and the cotter pin that hold it.
5. Install plate assembly (5).



BRAKE CONTROL VALVE



A53105X1

VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

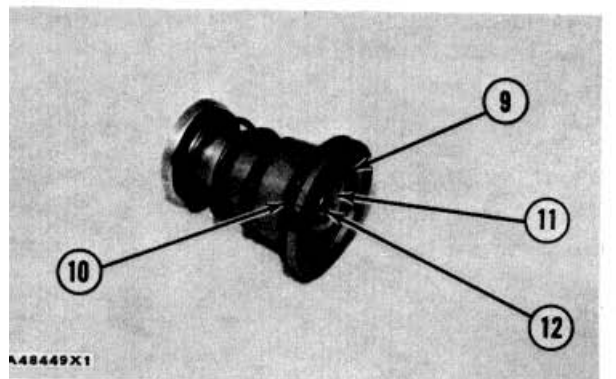
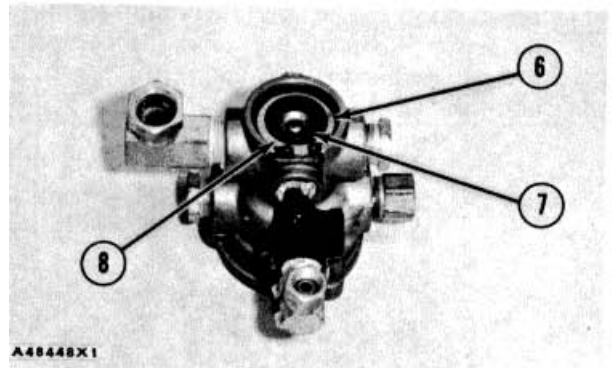
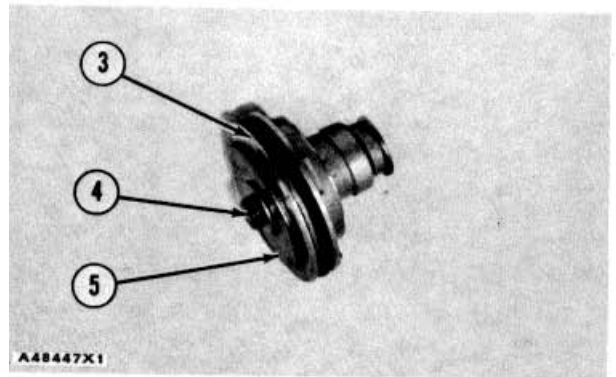
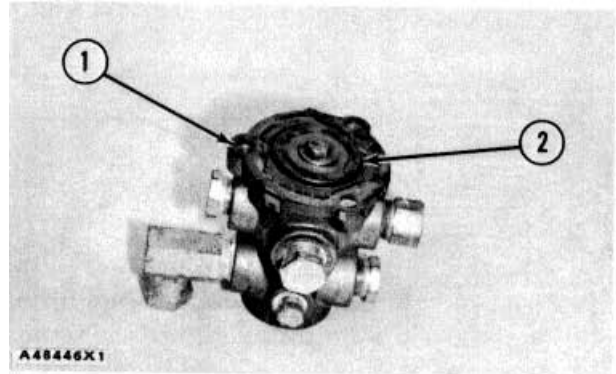
BRAKE CONTROL VALVE

DISASSEMBLE BRAKE CONTROL VALVE

start by:

a) remove brake control valve

1. Remove the emergency pilot valve and the double check valve from the brake control valve.
2. Remove retainer (1) from the valve body.
3. Remove piston assembly (2) from the valve body. Remove the spring under the piston assembly.
4. Remove O-ring seal (3) from the piston assembly. Check the condition of the seal. If the seal has damage, use a new part for replacement.
5. Remove bolt (4), washer and seat (5) from the piston. Remove the rubber spring under the seat.
6. Turn the brake control valve over.
7. Remove snap ring (6), washer (8) and valve assembly (7) from the valve body.
8. Remove O-ring seal (10) from the valve assembly. Check the condition of the seal. If the seal has damage, use a new part for replacement.
9. Remove screw (12), washer (11) and diaphragm (9) from the seat.

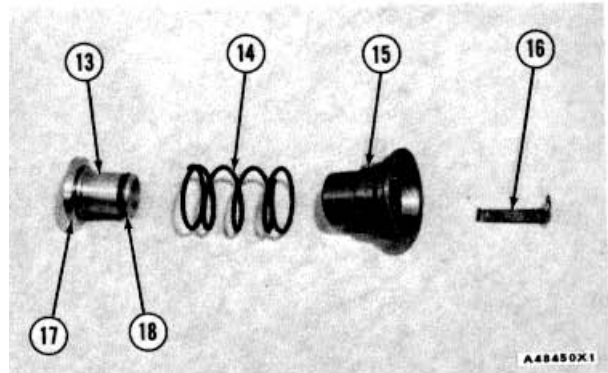


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

BRAKE CONTROL VALVE

10. Put spring (14) under compression and remove lock spring (16). Remove valve (13) and spring (14) from seat (15).

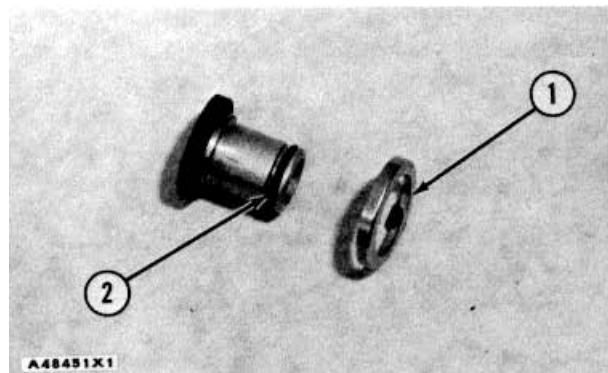


11. Remove retainer (17) from the valve.

12. Remove O-ring seal (18) from the valve. Check the condition of the seal. If the seal has damage, use a new part for replacement.

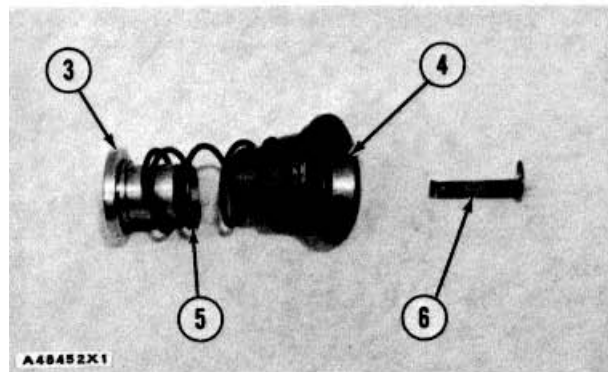
ASSEMBLE BRAKE CONTROL VALVE

1. Make sure all the parts of the brake control valve are clean and free of dirt and foreign material before it is assembled.

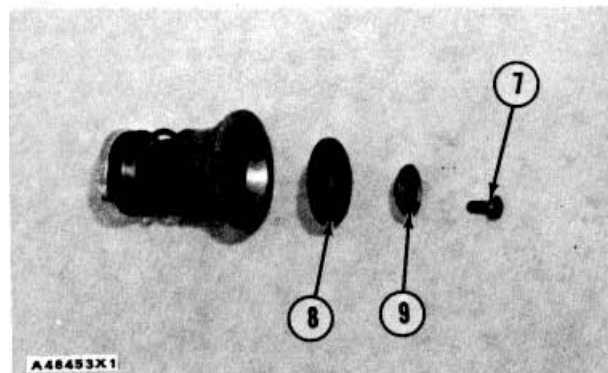


2. Install retainer (1) on the valve. Install a new O-ring seal (2).

3. Install spring (5) on seat (4). Install valve (3) in the spring as shown. Put spring (5) under compression and install lock spring (6) to hold the unit together.



4. Install diaphragm (8) in the seat. Install washer (9) and screw (7) to hold it in position.

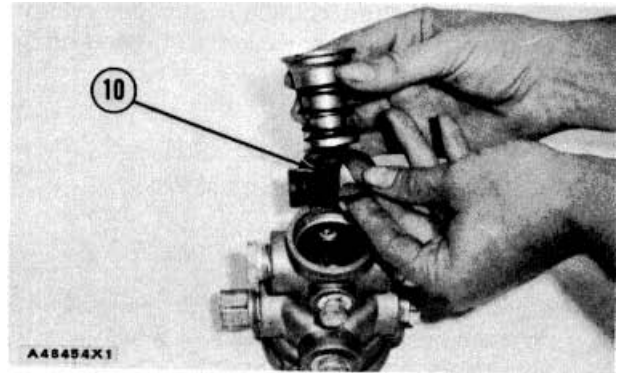


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

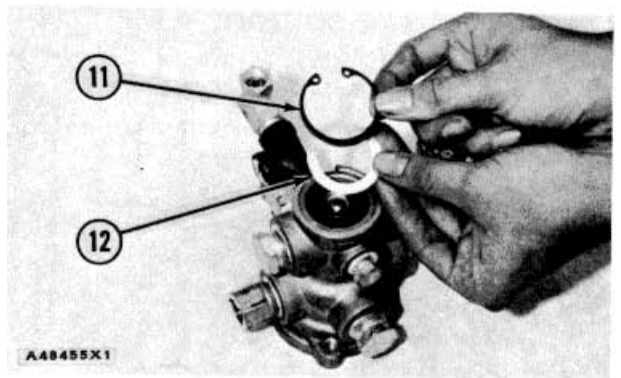
BRAKE CONTROL VALVE

5. Install O-ring seal (10) on the valve assembly.

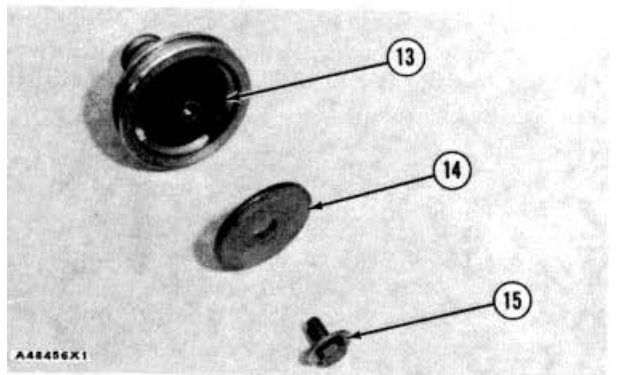


6. Install the valve assembly in the valve body.

7. Install washer (12) and snap ring (11) to hold the valve assembly in the valve body.



8. Install rubber spring (13) in the piston as shown. Install seat (14), washer and bolt (15).



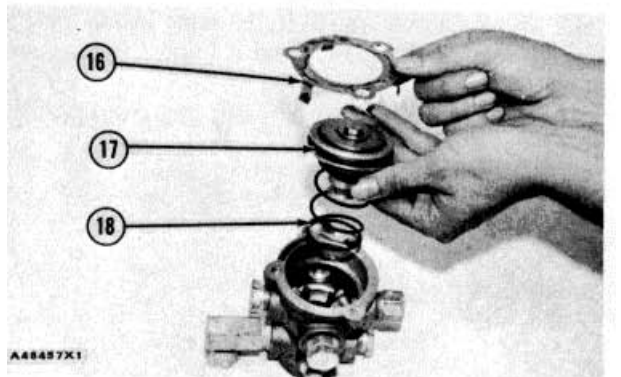
9. Install a new O-ring seal (17) on the piston assembly.

10. Install spring (18), the piston assembly and retainer (16) in the valve body.

11. Install the double check valve and emergency pilot valve in the brake control valve.

end by:

a) install brake control valve



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

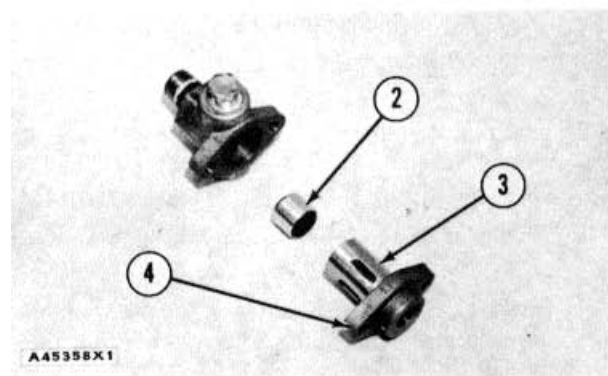
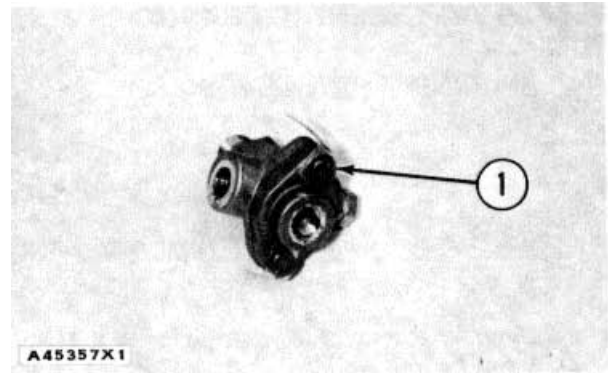
DOUBLE CHECK VALVE

DISASSEMBLE DOUBLE CHECK VALVE

start by:

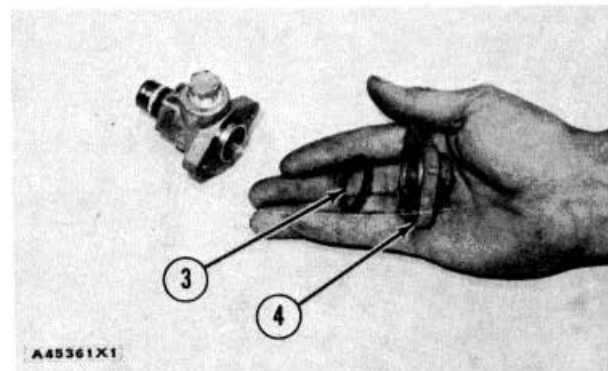
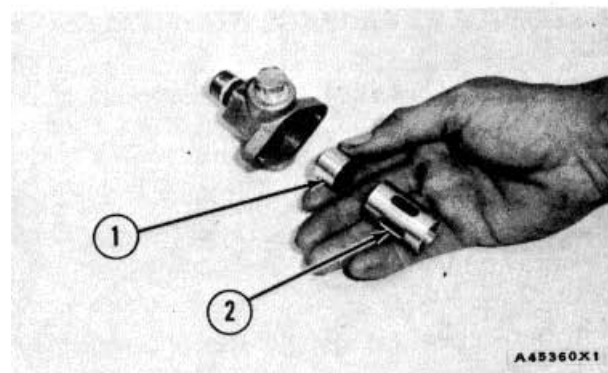
a) remove brake control valve

1. Remove the double check valve from the brake control valve.
2. Remove two bolts (1) and the tags that hold the cap for the valve in position.
3. Remove cap (4) from the valve body. Remove shuttle (2) from the valve body.
4. Remove guide (3) from the cap. Check the condition of the O-ring seal in the cap. If the seal has damage, use a new part for replacement.



ASSEMBLE DOUBLE CHECK VALVE

1. Make sure all the parts of the valve are clean and free of dirt before it is assembled.
 2. Install shuttle (1) and guide (2) in the valve body as shown.
 3. Install O-ring seal (3) in cap (4). Install the cap, two tags and the bolts that hold the cap.
 4. Install the double check valve on the brake control valve.
- end by:
- a) install brake control valve



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

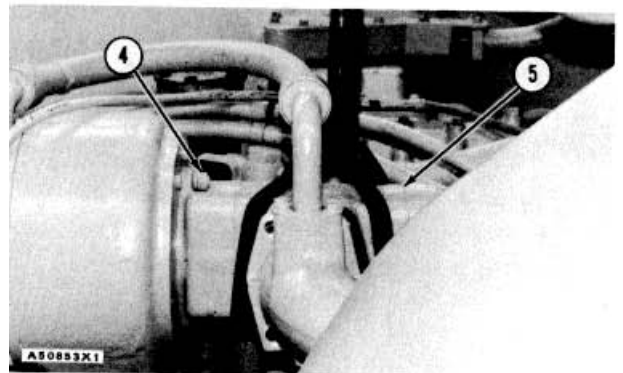
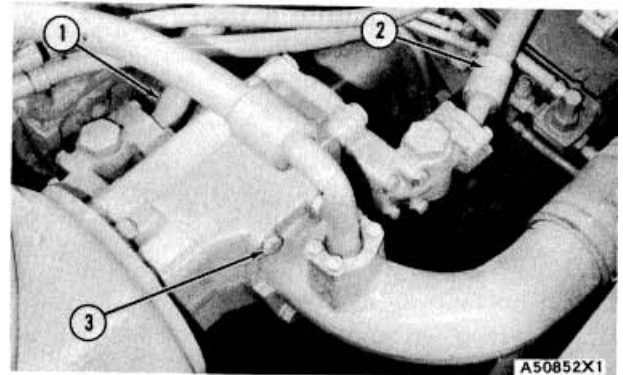
IMPLEMENT HYDRAULIC PUMP

REMOVE IMPLEMENT HYDRAULIC PUMP



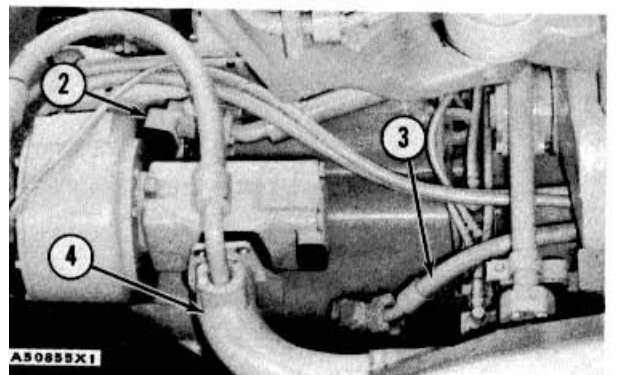
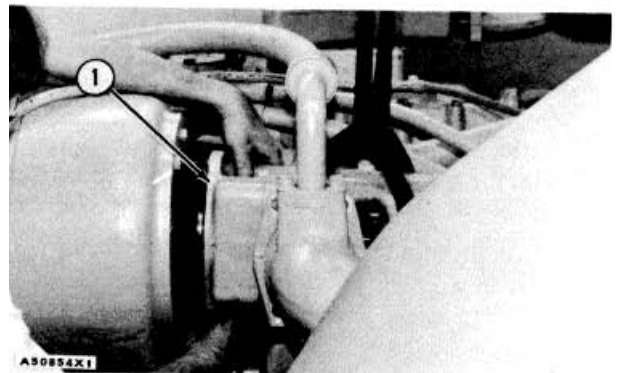
WARNING: Before any hydraulic lines are disconnected from the hydraulic pump, release the pressure in the hydraulic system and drain the hydraulic tank. Start the engine and move the ejector forward all the way. Stop the engine and loosen the cap on the hydraulic tank slowly. Drain the hydraulic tank.

1. Remove four bolts (3) that hold the inlet tube assembly to the pump.
2. Disconnect steering outlet hose assembly (2) from the pump.
3. Disconnect outlet hose (1) for the scraper hydraulic circuit.
4. Fasten a hoist to implement hydraulic pump (5).
5. Remove two nuts (4) that hold the pump in position. Remove the pump. The weight of the pump is 120 lb. (54 kg).



INSTALL IMPLEMENT HYDRAULIC PUMP

1. Fasten a hoist to implement hydraulic pump (1). Make sure the splined drive shaft in the pump is clean and dry before it is installed in the transfer gear case. Install the pump and two nuts that hold it.
2. Connect two outlet hose assemblies (2) and (3) to the pump.
3. Connect inlet tube assembly (4) to the pump.
4. Fill the hydraulic tank with oil to the correct level. See Lubrication and Maintenance Guide.



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

IMPLEMENT HYDRAULIC PUMP

DISASSEMBLE IMPLEMENT HYDRAULIC PUMP

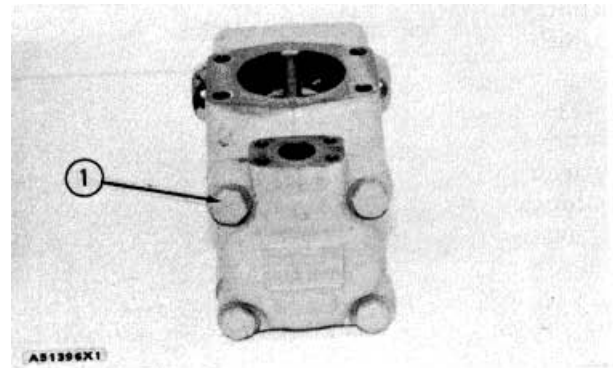
Tools Needed		A
1P1859	Snap Ring Pliers	1

start by:

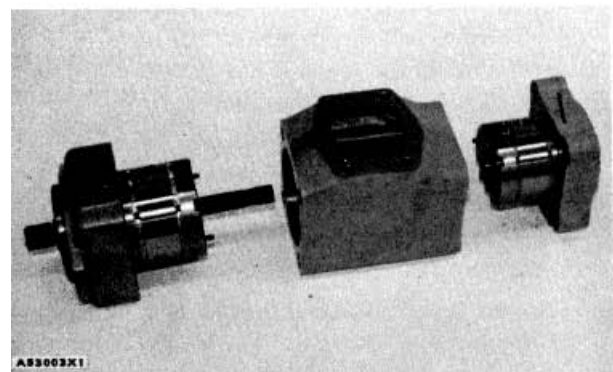
a) remove implement hydraulic pump

NOTE: Make a mark across the cover assembly for correct installation of parts.

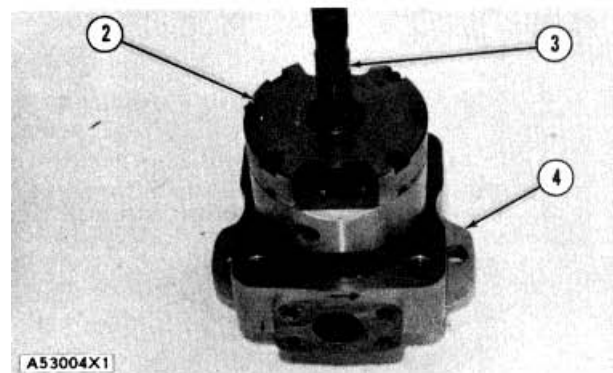
1. Remove four bolts (1) from the cover assembly.



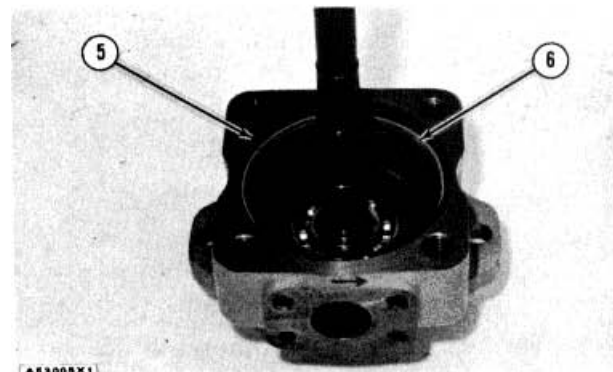
2. Make a separation of the cover assembly.



3. Make a note of the direction of the rotation arrow on the front cartridge (2) cam ring. Make a mark to show the direction of rotation on the front cover (4). Remove cartridge (2) from the front cover (4) and shaft (3).



4. Remove one O-ring seal (5) and two ring seals (6) from the front cover. Remove the outer bearing retainer from the front cover and remove the bearing, shaft and washer.

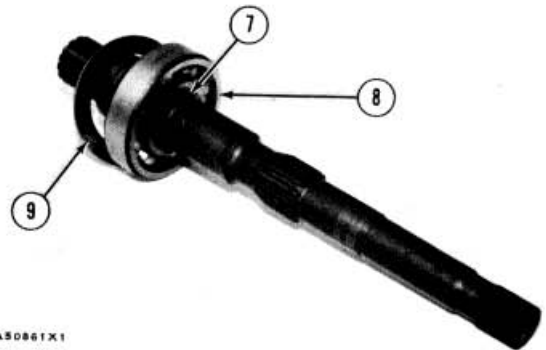


VEHICLE SYSTEMS

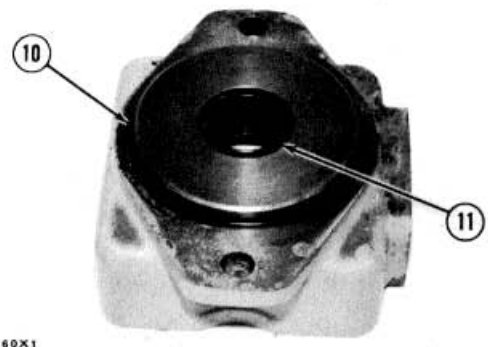
DISASSEMBLY AND ASSEMBLY

IMPLEMENT HYDRAULIC PUMP

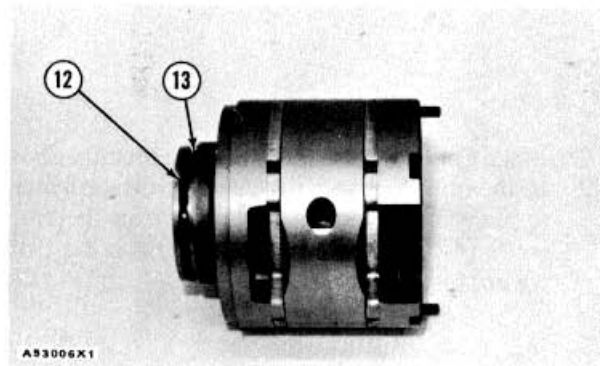
- Remove retainer (7) from the shaft with tool (A).
Remove bearing (8) and washer (9).



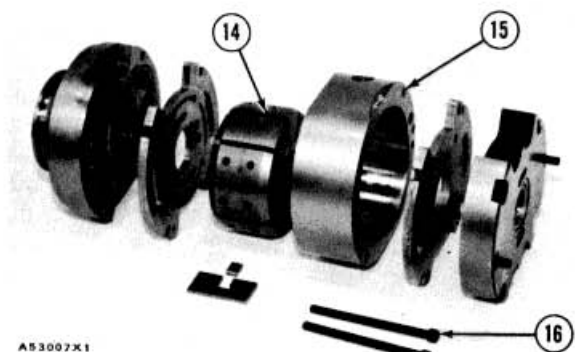
- Remove O-ring seal (10). Remove lip type seal (11 I) from each side of the front cover. Check the condition of the seals. If the parts have damage, use new parts for replacement.



- Remove O-ring seal (13) and seal ring (12) from the cartridge.



- Remove two socket head bolts (16) and make a separation of the cartridge assembly. Make a note of the direction of the rotation arrows on cam ring (15) and rotor (14).

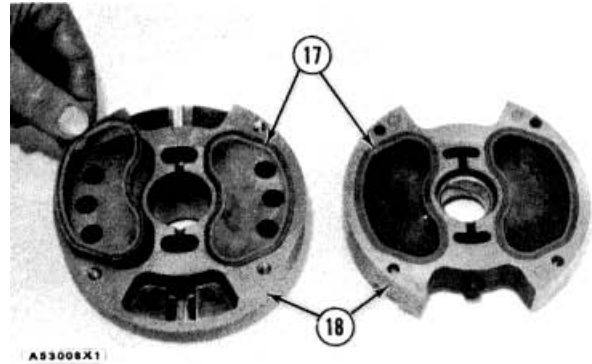


VEHICLE SYSTEMS

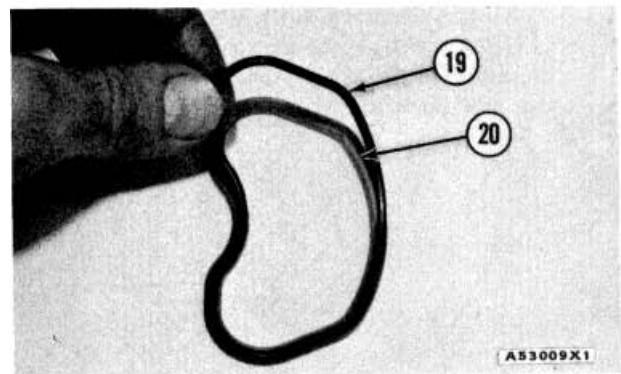
DISASSEMBLY AND ASSEMBLY

IMPLEMENT HYDRAULIC PUMP

9. Remove two seal and retainer assemblies (17) from each end plate (18).

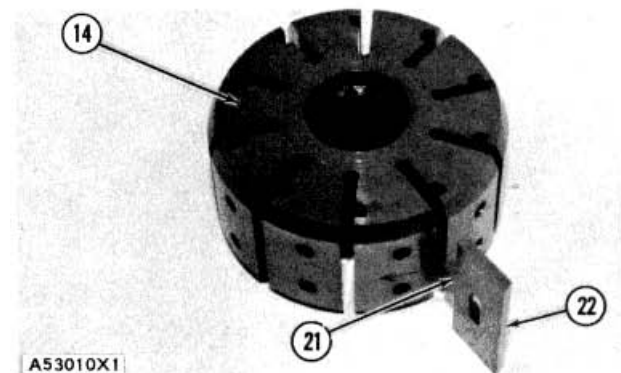


10. Remove and inspect O-ring seal (19) from each retainer (20).

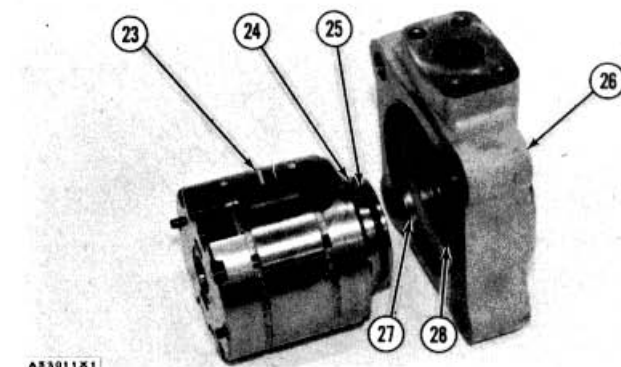


NOTE: The sharp edge of the vane (22) goes toward the direction of rotation of rotor (14).

11. Remove ten vanes (22) and ten vane inserts (21).

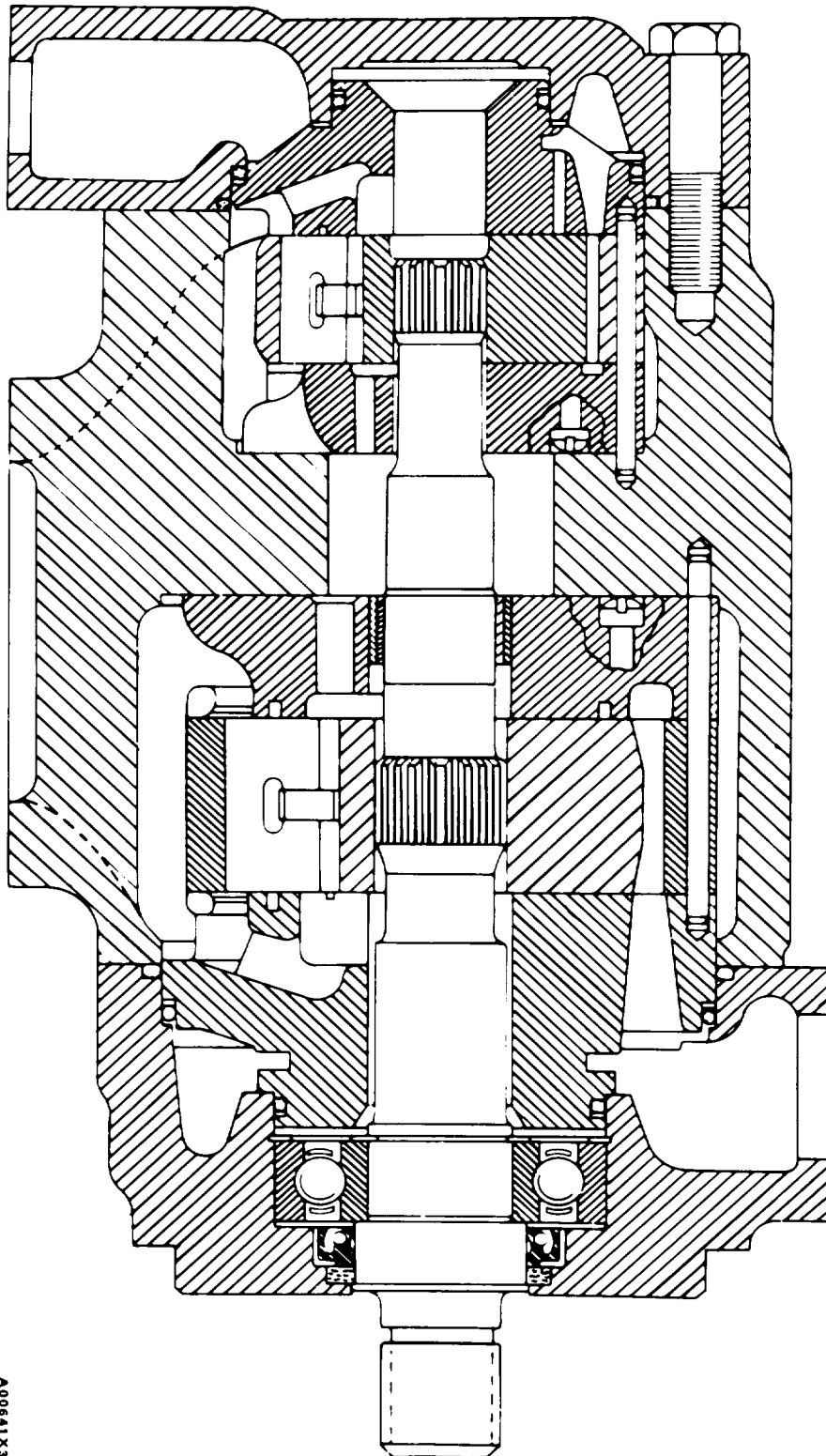


12. Make a note of the direction of rotation arrow on the rear cartridge (23) cam ring. Make a mark on the rear cover (26). Remove O-ring seal (24) and seal ring (25) from the rear cartridge. Remove O-ring seal (27) and two ring seals (28) from the rear cover.



13. Disassemble the rear cartridge assembly (23) as in Steps 8 through 11.

IMPLEMENT HYDRAULIC PUMP



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VEHICLE SYSTEMS

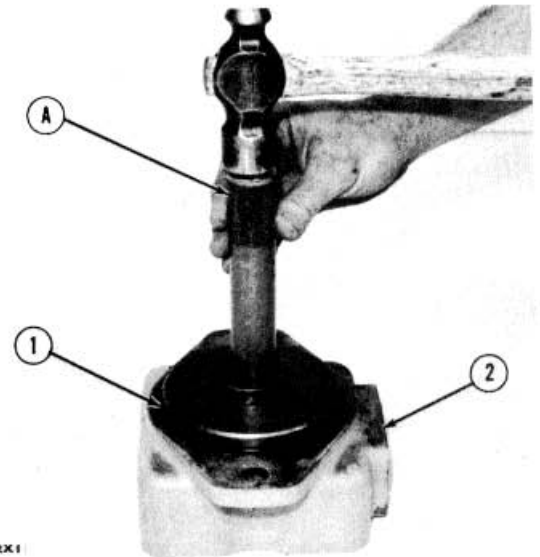
DISASSEMBLY AND ASSEMBLY

IMPLEMENT HYDRAULIC PUMP

ASSEMBLE IMPLEMENT HYDRAULIC PUMP

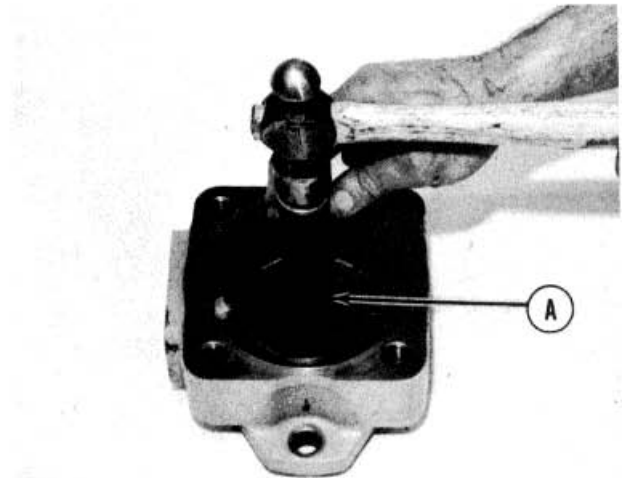
Tools Needed		A	B
1P510	Driver Group	1	
1P1859	Snap Ring Pliers		1

1. Install O-ring seal (1) in front cover (2). Install the small lip type seal in the cover with tooling (A). Install the seal with the lip toward the inside of the pump and until it is even with the outside surface of the front cover.



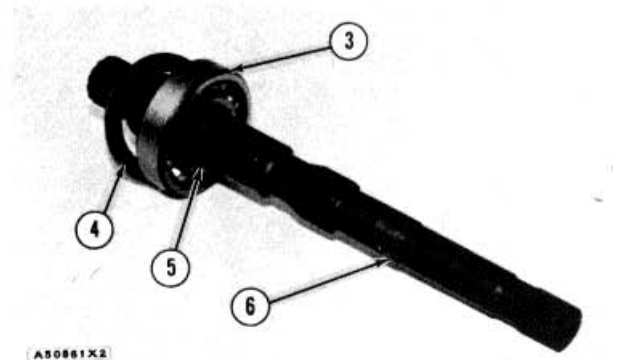
A50862X1

2. Turn the cover over. Install the large lip type seal in the cover with tooling (A). Install the seal with the lip toward the inside of the pump and until it makes contact with the bottom of the counterbore.



A50863X1

3. Heat bearing (3) to a maximum temperature of 275°F (135°C) and install it on shaft (6). Install retainer (5) with tool (B). Install washer (4) on the shaft as shown.



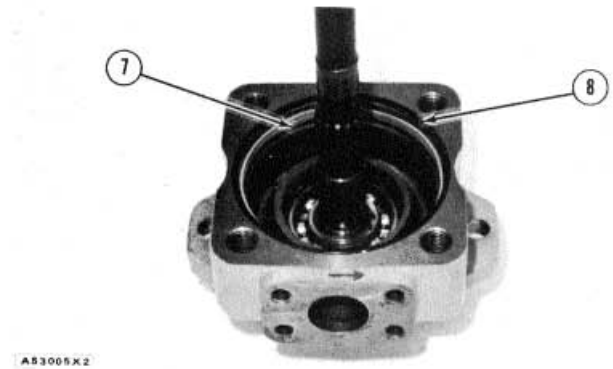
A50861X2

VEHICLE SYSTEMS

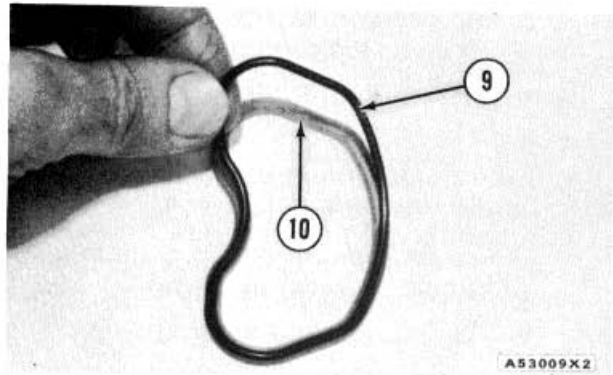
DISASSEMBLY AND ASSEMBLY

IMPLEMENT HYDRAULIC PUMP

4. Install the shaft, bearing and washer in the front cover. Install outer bearing retainer in front cover. Install two ring seals (7) and O-ring seal (8) in front cover.

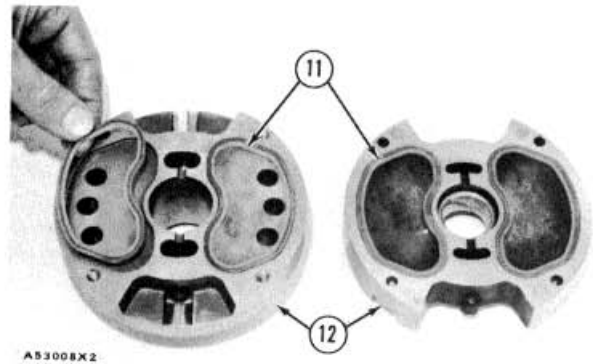


5. Install O-ring seal (9) in each retainer (10).

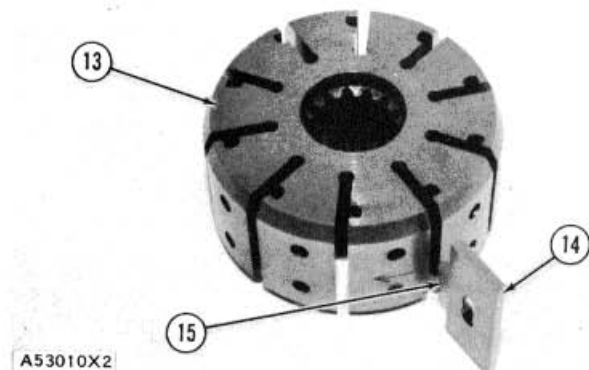


6. Install two seal and retainer assemblies (11) in each end plate (12).

NOTE: The sharp edge of the vanes (14) go toward the direction of rotation of rotor (13).



7. Install vane insert (15) in each vane (14). Install vane and vane insert assemblies in rotor (13) as shown.



VEHICLE SYSTEMS

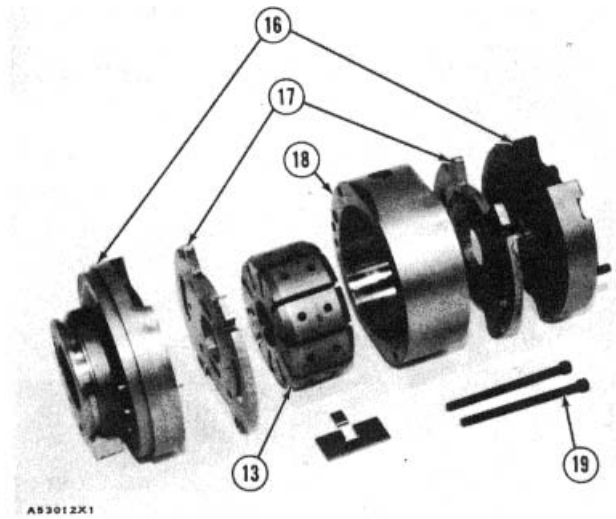
DISASSEMBLY AND ASSEMBLY

IMPLEMENT HYDRAULIC PUMP

8. Assemble the front cartridge as follows:

NOTE: The rotation arrows on cam ring (18) and rotor (13) must be in the same direction.

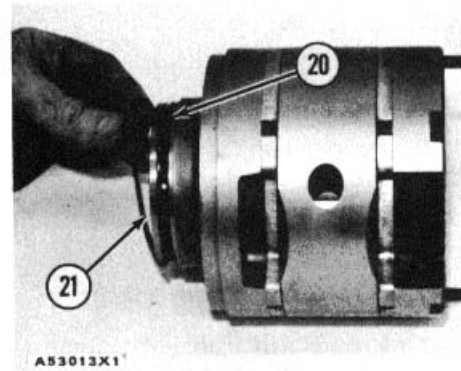
- a) Install the rotor and vane assembly in the cam ring.
- b) Put two wear plates (17) in position with the bronze side of the wear plate toward the cam ring.
- c) Put two end plates (16) in position and install but do not tighten the two socket head bolts (19).



9. Put the cartridge elements in alignment as follows:

- a) Tighten the two bolts (19) by hand to hold the cartridge assembly together.
- b) Put the cartridge in the center cover.
- c) With the cartridge in the center cover, tighten the two socket head bolts (19).

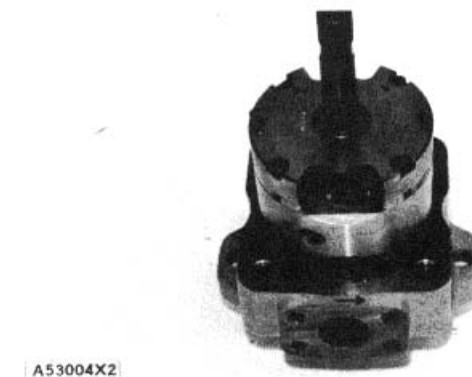
NOTE: The O-ring seal is toward the side of the groove that is toward the center of the cartridge.



10. Install O-ring seal (20) and ring (21) on the cartridge.

NOTE: The marks that show the direction of rotation on the cam ring and the front cover must be installed with the marks in the same direction.

11. Install the cartridge in the shaft and front cover assembly.



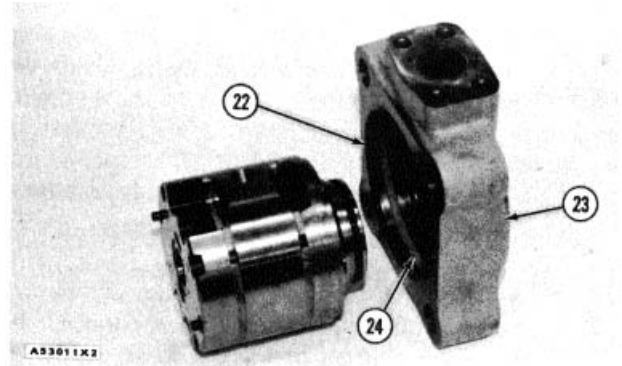
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

IMPLEMENT HYDRAULIC PUMP

12. Assemble the rear cartridge as in Steps 6 through 10.

13. Install two ring seals (24) and O-ring seals (22) in rear cover (23).

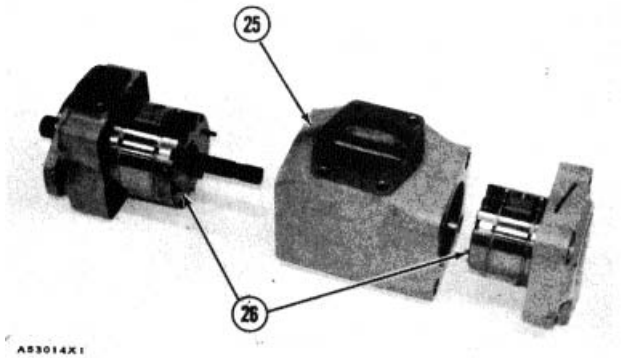


NOTE: The marks that show the direction of rotation on the cam ring and the rear cover must be in the same direction at assembly.

14. Install the rear cartridge in the rear cover.

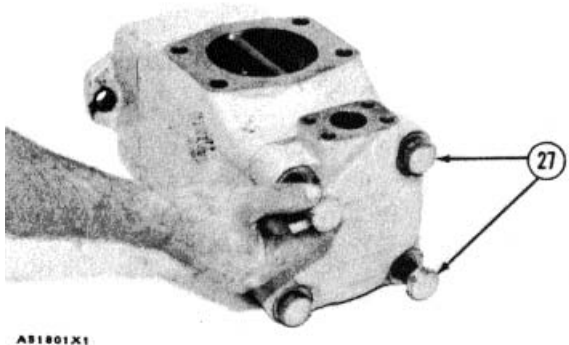
NOTE: Make sure dowels (26) are in alignment with the holes in the center cover (25).

15. Put both front and rear cartridges and cover assemblies in the center cover.



16. Install four bolts (27) that hold the pump together.
end by:

- a) install implement hydraulic pump



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

SCRAPER HYDRAULIC CONTROL VALVE

REMOVE SCRAPER HYDRAULIC CONTROL VALVE



WARNING: Before any hydraulic lines are removed from the scraper hydraulic control valve, release the pressure in the hydraulic system. Start the engine and move the ejector forward all the way. Stop the engine. Move all scraper control levers. Loosen the cap slowly on the hydraulic tank.

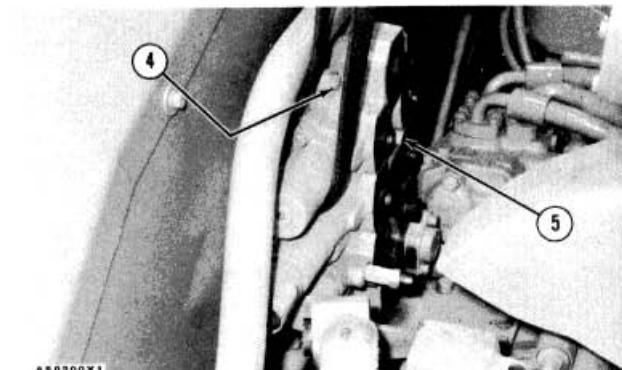
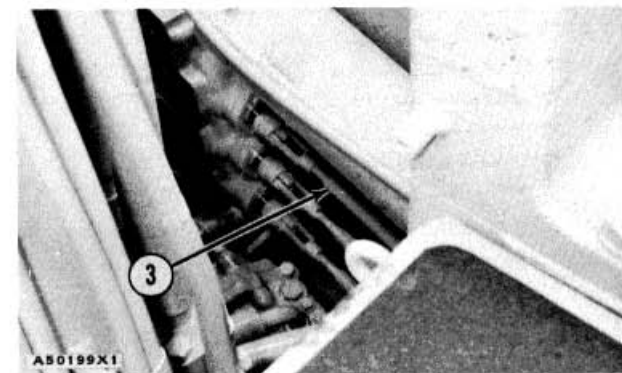
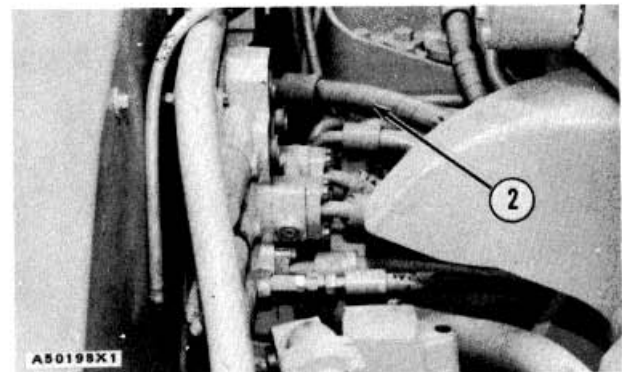
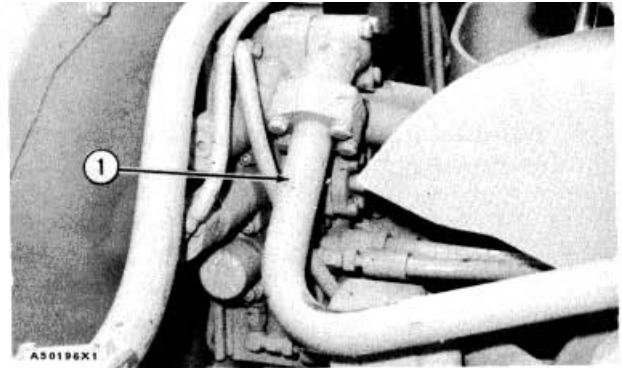


WARNING: Before any air lines are disconnected from the scraper hydraulic control valve make sure the air pressure is zero.

1. Drain the air from the air tanks that are under the operator's station.
2. Disconnect the adapter and tube assembly (1) from the control valve. Move the tube assembly away from the valve.
3. Put identification on all hydraulic lines and air lines that are connected to the control valve.
4. Disconnect hydraulic lines (2) and air lines from the control valve.

NOTE: When the bracket that holds the apron "RAISE" and "LOWER" hydraulic lines is removed the apron sequence valve will come off at this time.

5. Put plugs in the hydraulic lines to keep dirt out.
6. Disconnect three control rod assemblies (3) from the valve.
7. Fasten a hoist to scraper control valve (5). Remove the three bolts (4) that hold the valve in position. Remove the valve. The weight of the valve is 85 lb. (39 kg).



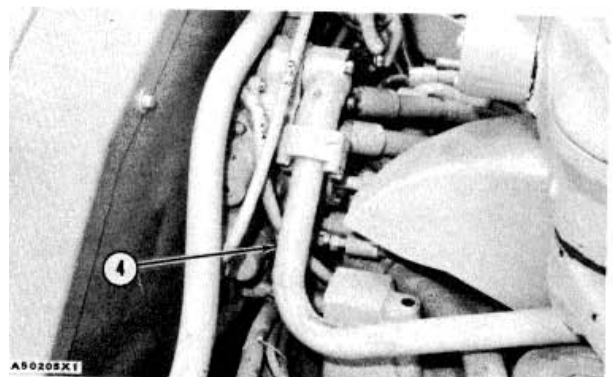
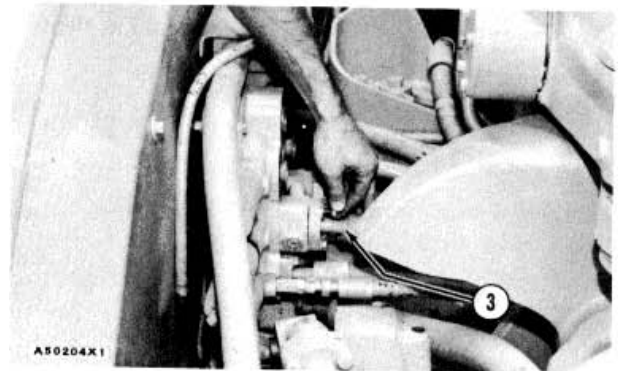
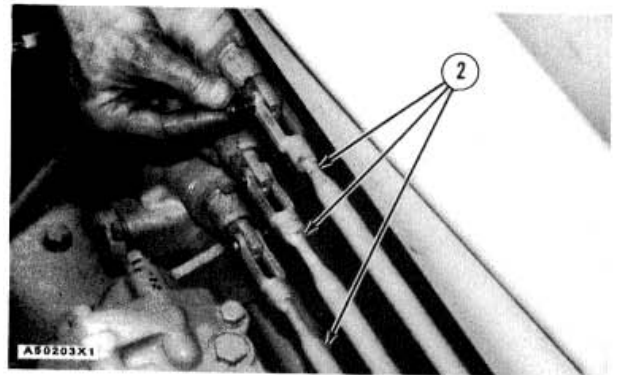
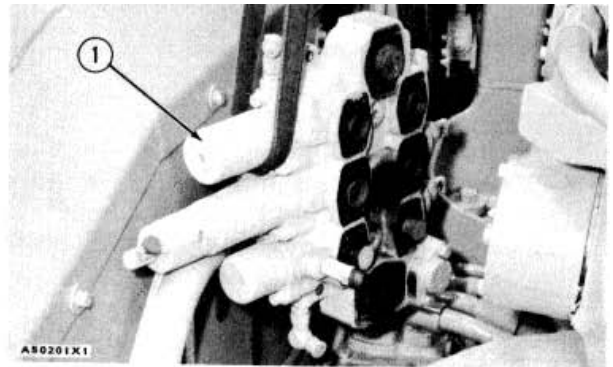
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

SCRAPER HYDRAULIC CONTROL VALVE

INSTALL SCRAPER HYDRAULIC CONTROL VALVE

1. Fasten a hoist to the scraper hydraulic control valve (1) and put it in position in the machine. Install the three bolts that hold it.
2. Connect three control rod assemblies (2) to the control valve.
3. Put the apron sequence valve in position on the scraper hydraulic control valve and connect the "RAISE" and "LOWER" hydraulic lines to it. Make sure the lines are in the correct positions.
4. Connect the other hydraulic lines (3) and air lines to the valve. Make sure the lines are in the correct positions.
5. Connect tube assembly (4) and the adapter to the scraper hydraulic control valve.
6. Make adjustments to the scraper hydraulic control valve for the scraper hydraulic system. See Operation Checks in Testing and Adjusting.



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

SCRAPER HYDRAULIC CONTROL VALVE

DISASSEMBLE SCRAPER HYDRAULIC CONTROL VALVE

Tools Needed		A
1P1857	Snap Ring Pliers	1

start by:

a) remove scraper hydraulic control valve

1. Make sure the outside of the valve is clean and free of dirt and foreign material before it is disassembled.

2. Remove two O-ring seals (1) from the valve body for the apron sequence valve group. Check the condition of the seals. If the seals have damage, use new parts for replacement.

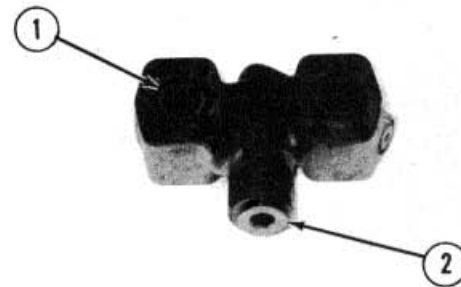
3. Remove plug (2). Check the condition of the O-ring seal on the plug. If the seal has damage, use a new part for replacement.

4. Remove piston (4), shims (3), spring (6) and valve (5) from the valve body.

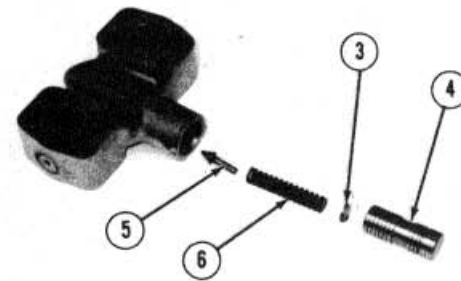
5. Remove two bolts (8). Remove the ejector valve spool and spring housing (7) as a unit from the housing.

6. Pull spring housing (7) off the end of ejector valve spool (9) by hand.

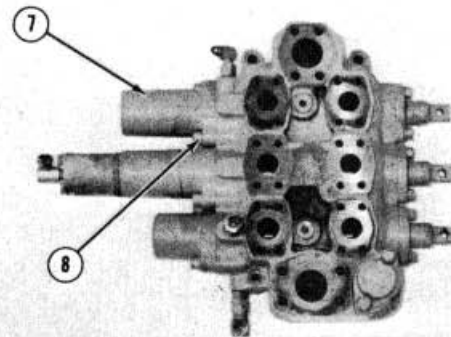
NOTE: Approximately 60 lb. (265 N) of force is needed to remove the spring housing.



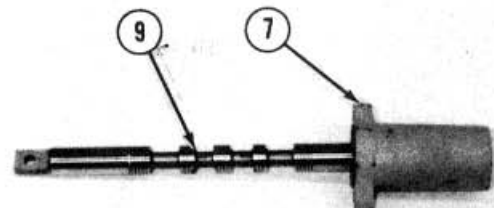
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A50207X1



A50208X1



A50209X1

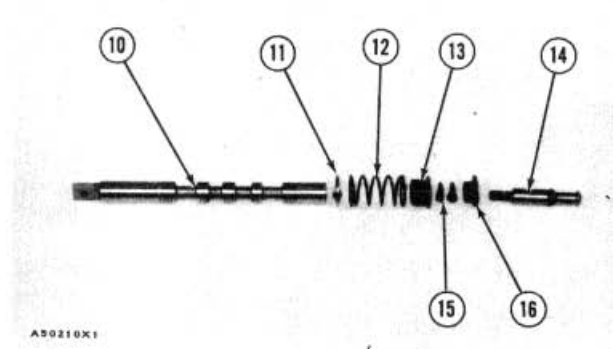
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

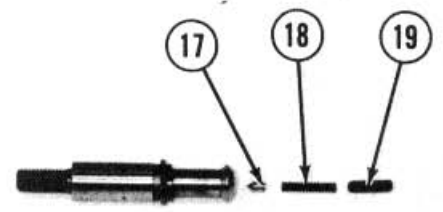
SCRAPER HYDRAULIC CONTROL VALVE

7. Disassemble the ejector valve spool and spring housing as follows:

a) Remove detent (14), retainer (16), two O-ring seals (15) retainer (13), spring (12) and washer (11) from the valve spool (10).

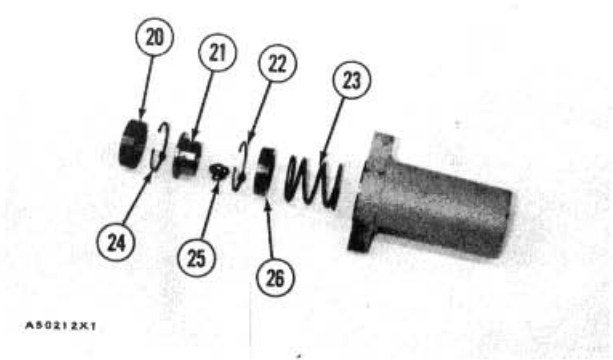


b. Remove screw (19), spring (18) and poppet (17) from the detent.

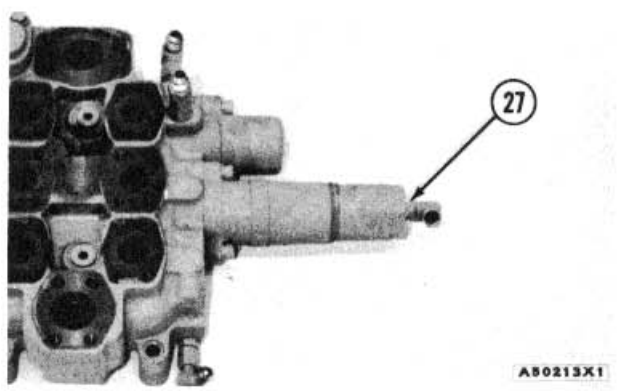


c. Remove spacer (20) from the housing.

d. Remove ring (24) with tool (A). Remove retainer (21) and four balls (25). Remove ring (22) with tool (A) ring (26) and spring (23) from the housing.,



8. Remove air control valve (27). Turn the valve COUNTER CLOCKWISE to remove it.



VEHICLE SYSTEMS

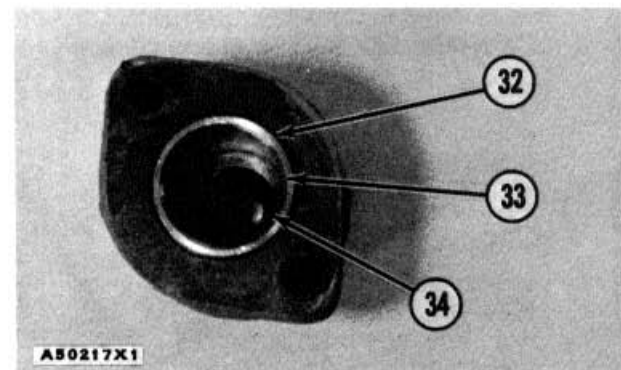
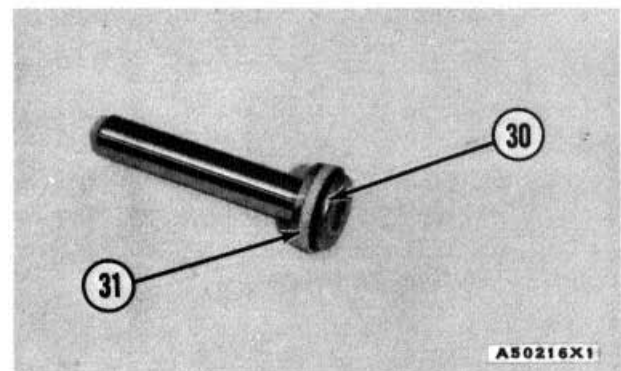
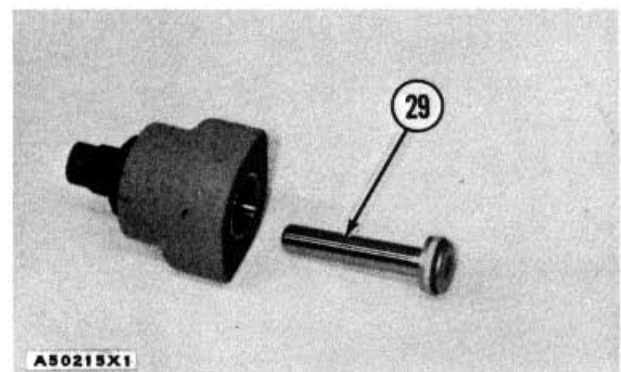
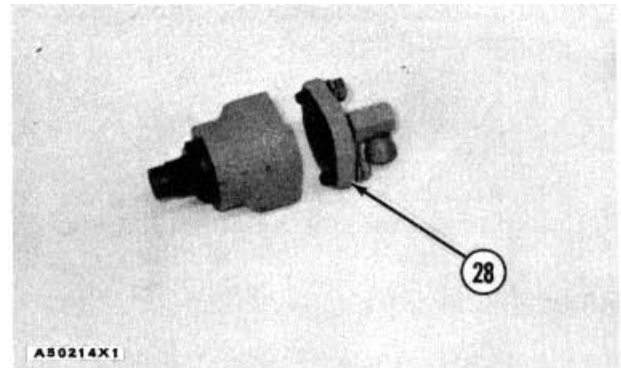
DISASSEMBLY AND ASSEMBLY

SCRAPER HYDRAULIC CONTROL VALVE

9. Remove the O-ring seal from the air control valve. Check the condition of the seal. If the seal has damage, use a new part for replacement.

10. Disassemble the air control valve as follows:

- a) Remove two bolts and cover (28). Check the condition of the O-ring seal in the cover. If the seal has damage, use a new part for replacement.
- b) Remove piston assembly (29) from the valve body.
- c) Remove O-ring seal (30) and seal (31) from the piston.
- d) Remove bushing (32), washer (33) and seal (34) from the valve body.

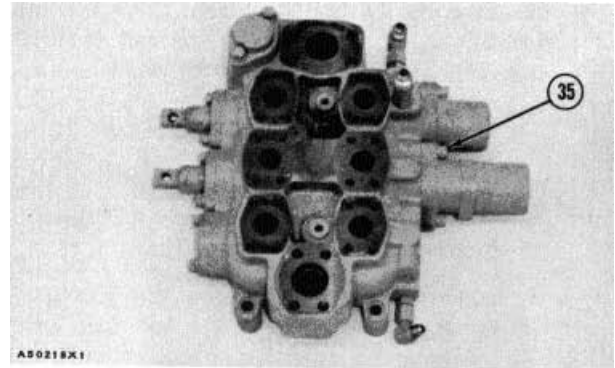


VEHICLE SYSTEMS

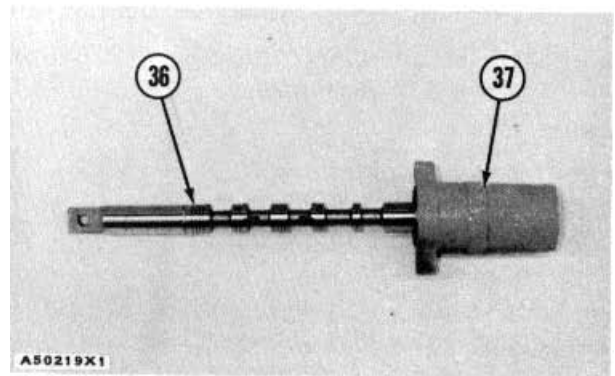
DISASSEMBLY AND ASSEMBLY

SCRAPER HYDRAULIC CONTROL VALVE

11. Remove two bolts (35). Remove the apron cylinder valve spool and spring housing as a unit from the control valve housing.



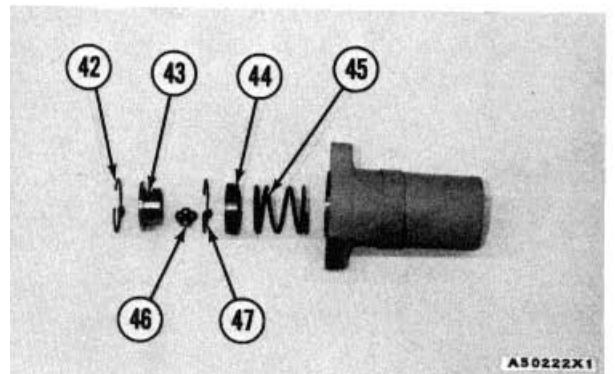
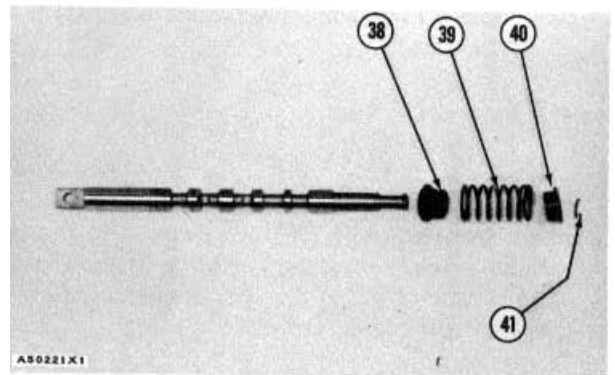
12. Pull spring housing (37) off of apron cylinder spool (36) by hand.



NOTE: Approximately 60 lb. (265 N) of force is needed to remove the spring housing.

13. Disassemble the apron cylinder spool and spring housing as follows:

- a) Put spring (39) under compression until ring (41) can be removed. Release the tension on the spring slowly and remove retainer (40), the spring and retainer (38) from the valve spool.
- b) Remove ring (42) from the housing with tool (A). Remove retainer (43) and four balls (46).
- c) Remove ring (47) with tool (A), retainer (44) and spring (45) from the housing.



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

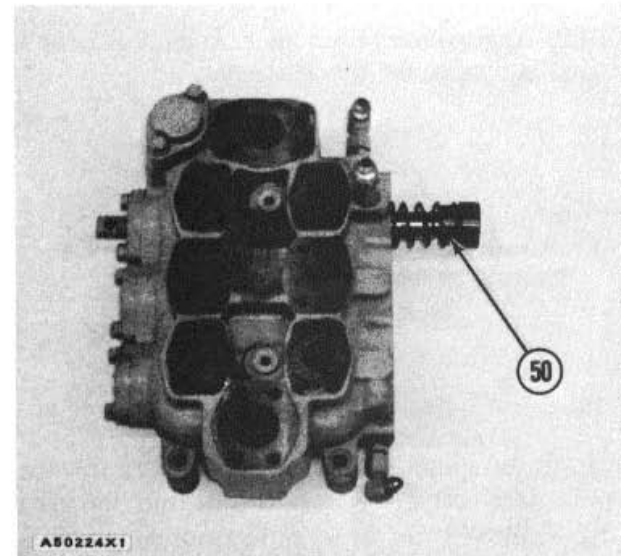
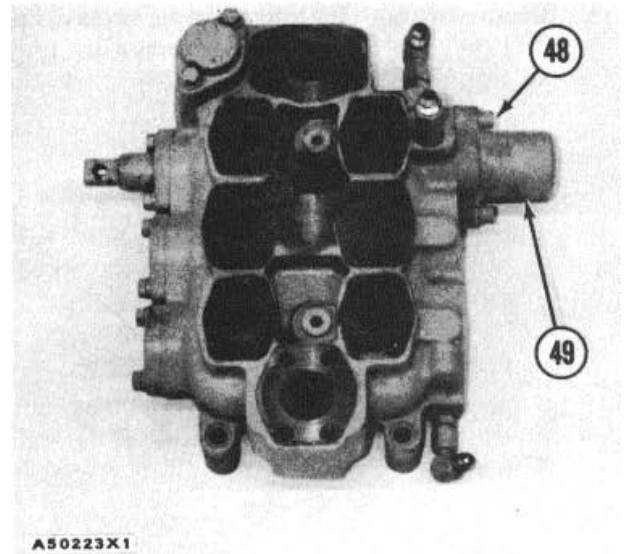
SCRAPER HYDRAULIC CONTROL VALVE

14. Disassemble the bowl cylinder valve spool as follows:

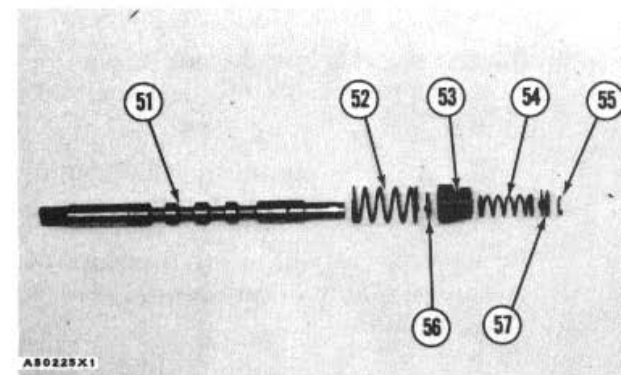
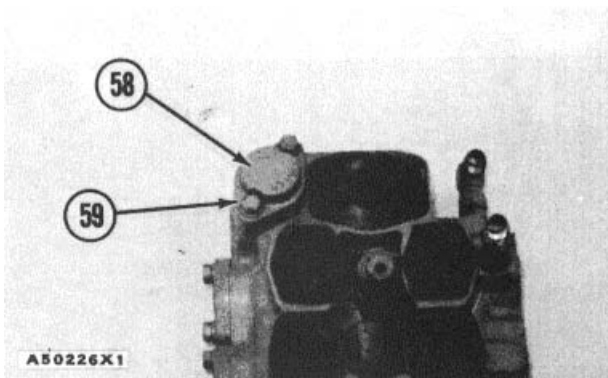
- a) Remove two bolts (48) and housing (49).

- b) Remove bowl spool assembly (50) from the control valve housing.

- c) Put spring (52) under compression and remove ring (55). Release the tension on the spring slowly and remove two spacers (57), spring (54), retainer (53), washer (56) and spring (52) from valve spool (51).



15. Remove two bolts (59) and cover (58) for the relief valve. Check the condition of the O-ring seal in the cover. If the seal has damage, use a new part for replacement.



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

SCRAPER HYDRAULIC CONTROL VALVE

16. Remove spring (60) and relief valve assembly (61) from the control valve housing.

17. Disassemble the relief valve as follows:

- a) Remove the piston assembly from valve (62).
- b) Remove pin (68), cap (65), shims (67), spring (64) and valve (66) from piston (63).

18. Remove three O-ring seals (69) from the control valve housing. Check the condition of the seals. If the seals have damage, use a new part for replacement.

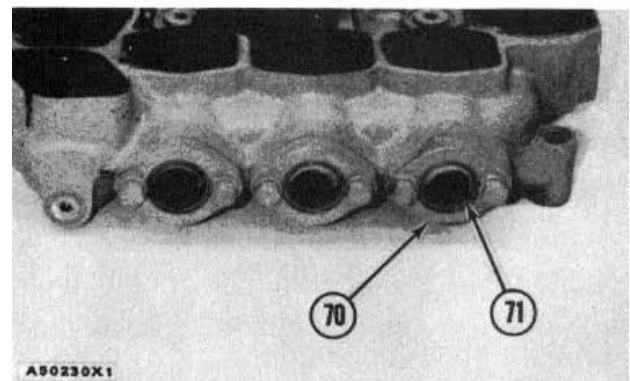
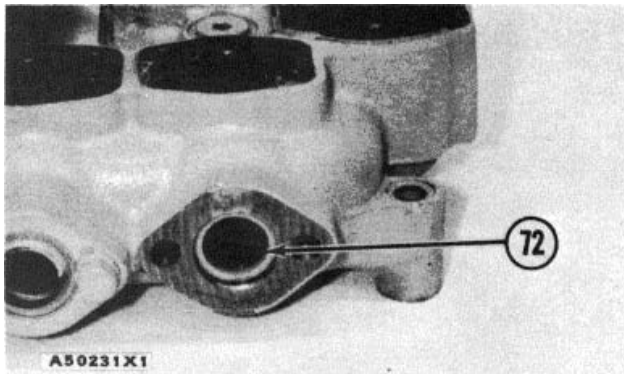
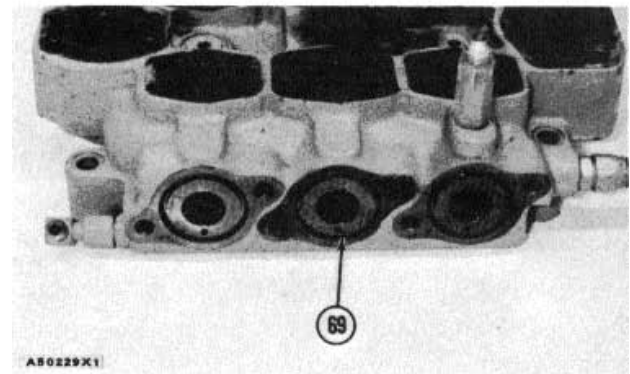
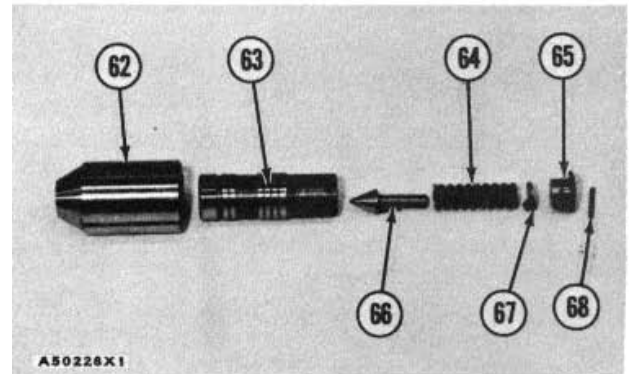
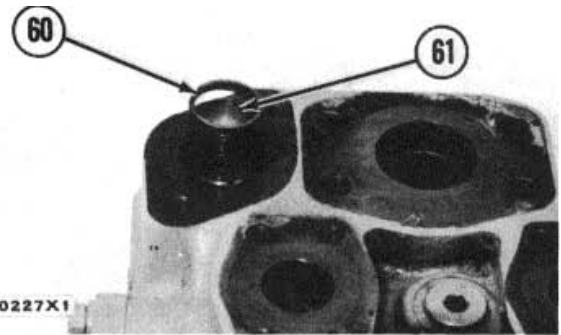
19. Remove cover (70) from the control valve housing.

20. Remove seal (71) from the cover.

21. If necessary, remove the other two covers from the control valve housing.

22. Remove seal (72) from the control valve housing. If necessary, remove the other two seals from the housing.

23.



VEHICLE SYSTEMS

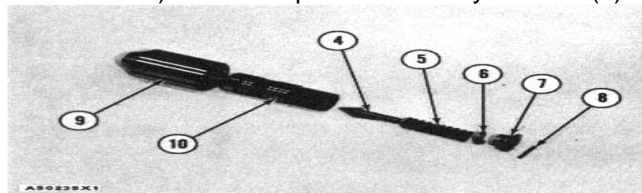
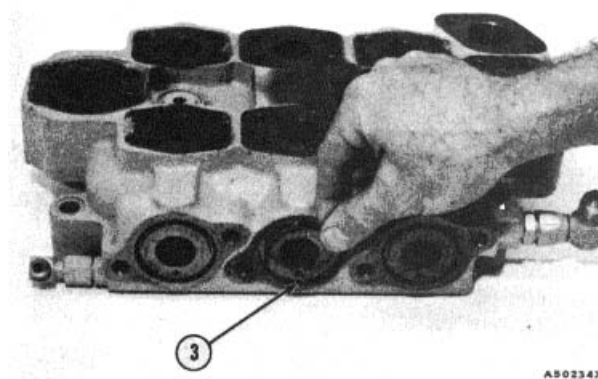
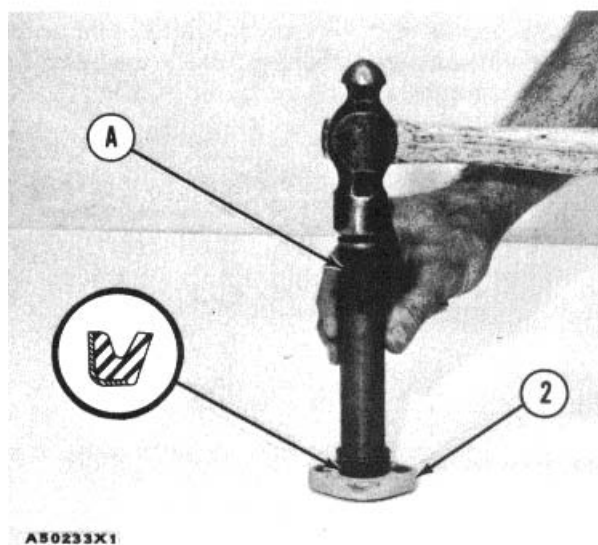
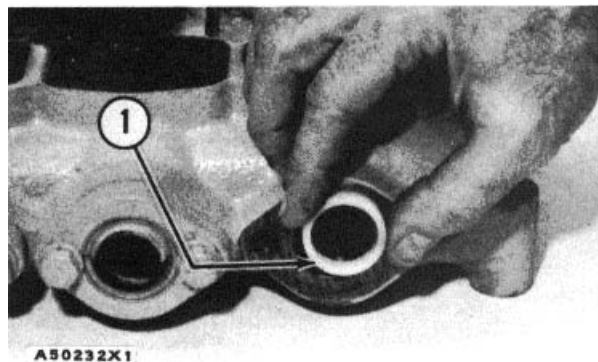
DISASSEMBLY AND ASSEMBLY

SCRAPER HYDRAULIC CONTROL VALVE

ASSEMBLE SCRAPER HYDRAULIC VALVE

Tools Needed		A	B
1P510	Driver Group	1	
1P1857	Snap Ring Pliers		1

1. Make sure all the parts of the scraper hydraulic control valve are clean and free of dirt and foreign material before it is assembled.
2. Install seal (1) in the control valve housing with the lip of the seal toward the inside of the housing. Put clean oil on the lip of the seal.
3. Install the other two seals (1) if they were removed.
4. Install the lip type seal in cover (2) with tooling (A). Install the seal with the lip toward the outside of the cover and until it makes contact with the bottom of the counterbore in the cover.
5. Install cover (2) on the control valve housing and the two bolts hold it. Install the other two covers if they were removed.
6. Put clean oil on the lips of the seals.
7. Install three O-ring seals (3).
8. Assemble the relief valve for the scraper hydraulic control valve as follows:
 - a) Install valve (4) and spring (5) in piston (10).
 - b) Install shims (6) in cap (7). Install the cap in the piston and pin (8) that holds it.
 - c) Install the piston assembly in valve (9).

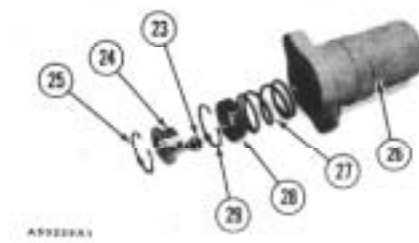
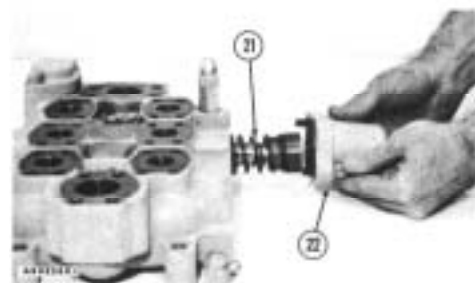
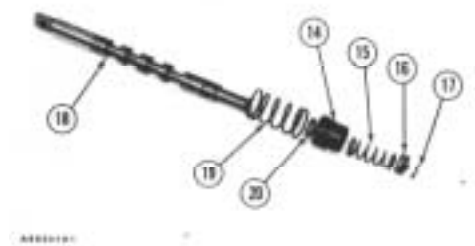
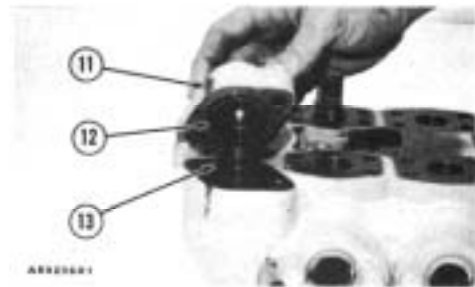


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

SCRAPER HYDRAULIC CONTROL VALVE

9. Install the relief valve and spring (13) in the control valve housing.
10. Install O-ring seal (12) in cover (11). Install the cover and two bolts over the relief valve.
11. Assemble the bowl cylinder valve spool assembly as follows:
 - a) Install spring (19) washer (20) and retainer (14) on valve spool (18).
 - b) Install spring (15) and two spacers (16) in the retainer. Put spring (15) under compression until ring (17) can be installed.
12. Put clean oil on the bowl cylinder valve spool assembly. Install bowl cylinder valve spool assembly (21) in the control valve housing.
13. Install the O-ring seal in housing (22). Put housing (22) in position on the control valve housing and install the two bolts that hold it.
14. Assemble the spring housing for the apron cylinder spool assembly as follows:
 - a) Install spring (27) and retainer (28) in the housing. Put spring (27) under compression and install ring (29) with tool (B).
 - b) Install four balls (23) in retainer (24). Install the retainer in housing (26). Install ring (25) with tool (B).
 - c) Install the O-ring seal in the housing.

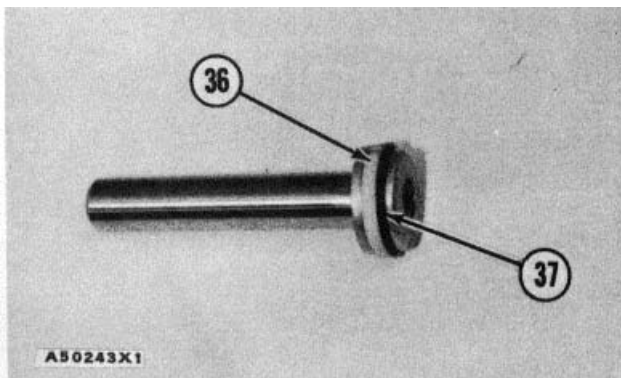
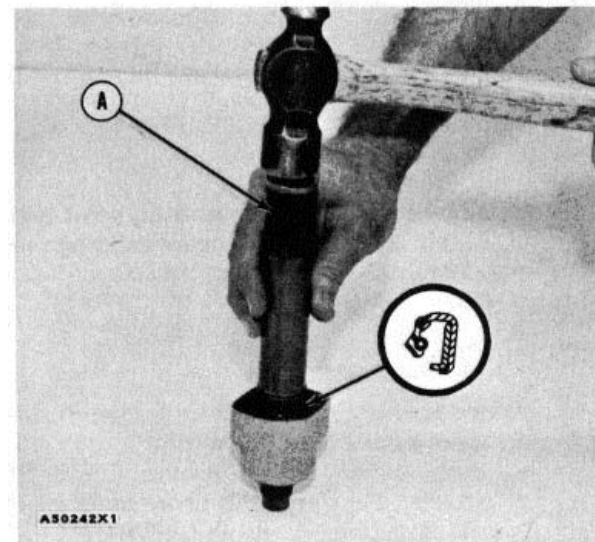
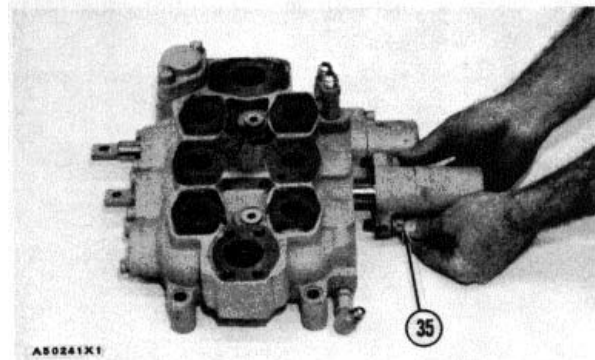
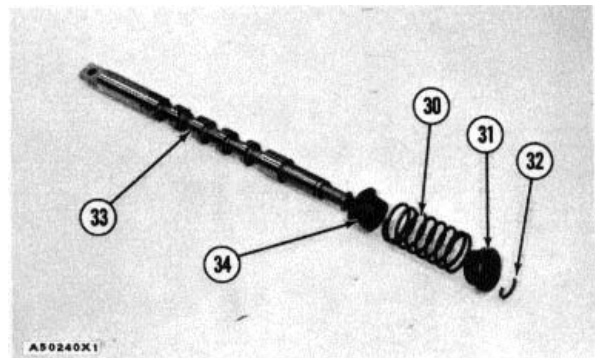


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

SCRAPER HYDRAULIC CONTROL VALVE

15. Assemble the apron cylinder spool assembly as follows:
 - a) Install retainer (34) on valve spool (33) as shown. Install spring (30) and retainer (31). Put spring (30) under compression until ring (32) can be installed.
16. Install the housing assembly on the apron cylinder spool assembly.
17. Put clean oil on the spool assembly. Install the spool assembly and housing assembly in the control valve housing. Install two bolts (35) that hold the unit in position.
18. Assemble the control valve as follows:
 - a) Install the lip type seal in the valve body for the air control valve with tooling (A). Install the seal with the lip toward the end of the valve body that has threads and until the seal makes contact with the bottom of the counterbore in the valve body.
 - b) Install seal (36) and O-ring seal (37) on the piston as shown. Make sure the groove in seal (36) is toward the O-ring seal.

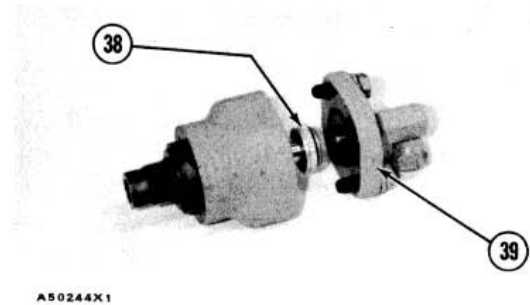


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

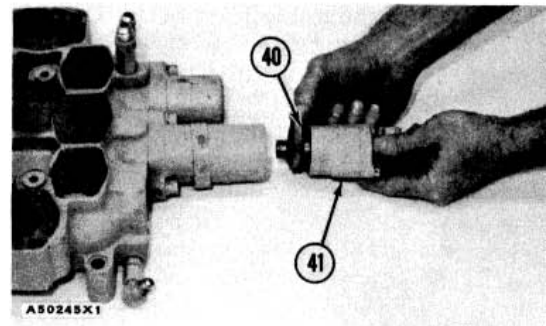
SCRAPER HYDRAULIC CONTROL VALVE

- c) Install piston assembly (38) in the valve body.
- d) Install the O-ring seal in cover (39) Install the cover on the valve body.



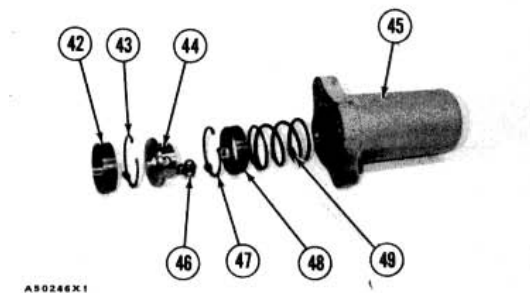
A50244X1

- 19. Install washer (40) and air control valve (41).



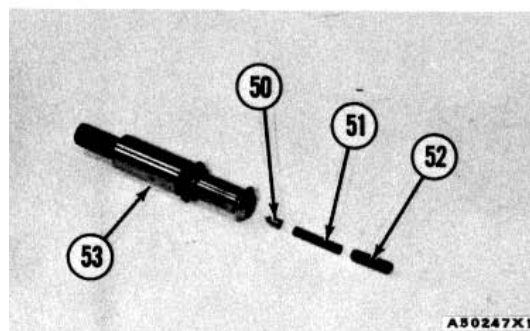
A50245X1

- 20. Assemble the spring housing for the ejector valve spool as follows:
 - a) Install spring (49) and ring (48) in housing (45). Put spring (49) under compression and install ring (47) with tool (B).
 - b) Install four balls (46) in retainer (44). Install the retainer in the housing. Install ring (43) with tool (B). Install spacer (42) in the housing.



A50246X1

- 21. Assemble the ejector valve spool assembly as follows:
 - a) Install poppet (50) spring (51) and screw (52) in detent (53). Install the screw until it is approximately .20 in. (5.1 mm) below the outside surface of the detent. After installation of the Scraper Hydraulic Control Valve Screw (52) make an operational adjustment if necessary. See Operation Checks in Testing and Adjusting.



A50247X1

VEHICLE SYSTEMS

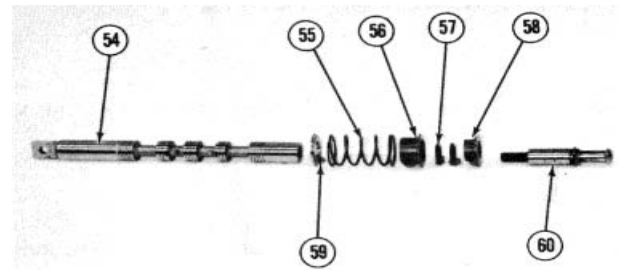
DISASSEMBLY AND ASSEMBLY

SCRAPER HYDRAULIC CONTROL VALVE

22. Assemble the ejector valve spool assembly as follows:

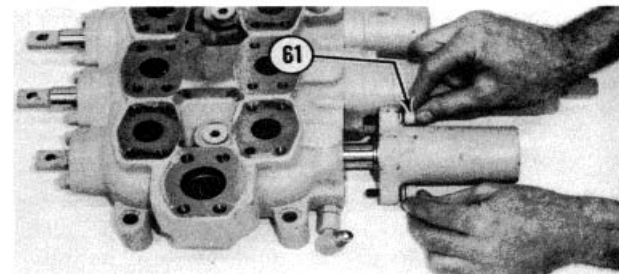
a) Install washer (59) and spring (55) on valve spool (54). Install two O-ring seals (57) in retainer (56). Install retainer (56) and retainer (58) on the valve spool.

b) Install detent assembly (60) in the end of the valve spool. Tighten the detent assembly to a torque of 40 + 5 lb. ft. (55 + 7 N m).



A50248X1

23. Install the housing assembly on the ejector valve spool assembly. Put clean oil on the valve spool and put the unit in the control valve housing. Install two bolts (61) that hold the unit in position.



A50250X1

24. the apron sequence valve as follows:

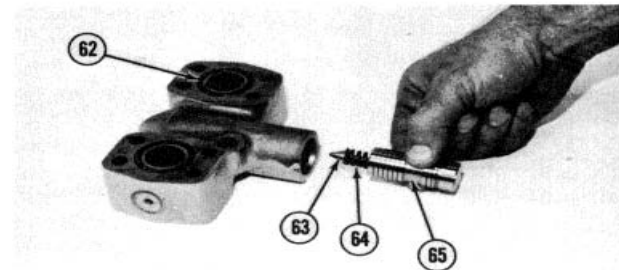
a) Install two O-ring seals (62) in the valve body.

b) Install shims, spring (64) and valve (63) in piston (65). Install the piston assembly in the valve body as shown.

c) Install the O-ring seal and plug over the piston assembly.

end b:

a) install scraper hydraulic control valve



A50252X1

VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

APRON AIR CONTROL VALVE

REMOVE APRON AIR CONTROL VALVE

start by:

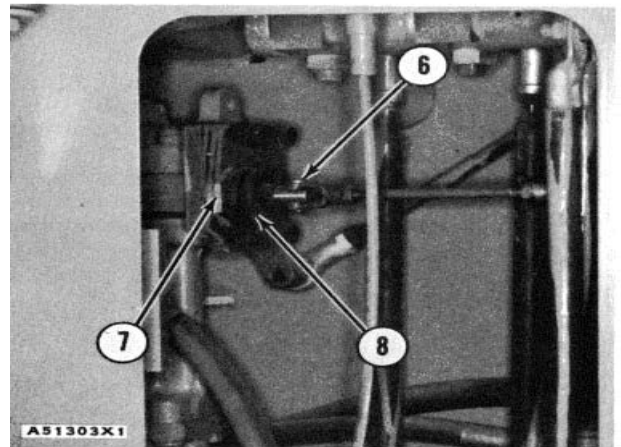
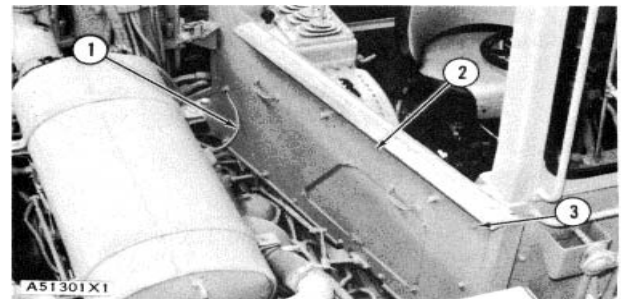
- a) remove hood*

*This operation is in the Engine Disassemble and Assembly Section.



WARNING: Before any air lines are disconnected from the apron air control valve, make sure the air pressure is zero.

1. Drain the air from the air tanks that are under the operator's station until the air pressure is zero.
2. Disconnect ground wire (1) from the panel assembly.
3. Remove bolts (3) that hold the panel assembly. Remove panel assembly (2)
4. Disconnect air hoses (4) and (5) from the apron air control valve.



NOTE: The back-up warning terminal box is removed for better photo illustration of the linkage on the apron air control valve.

5. Remove cotter pin and pin (6). Remove the rod from the apron air control valve.
6. Remove boot (8) and nut (7). Remove the apron air control valve from the bracket on the selector valve.

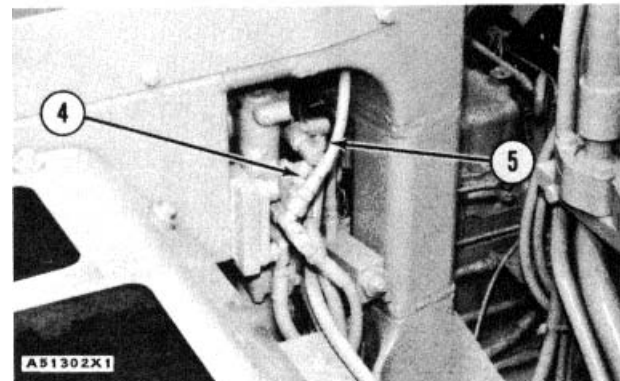
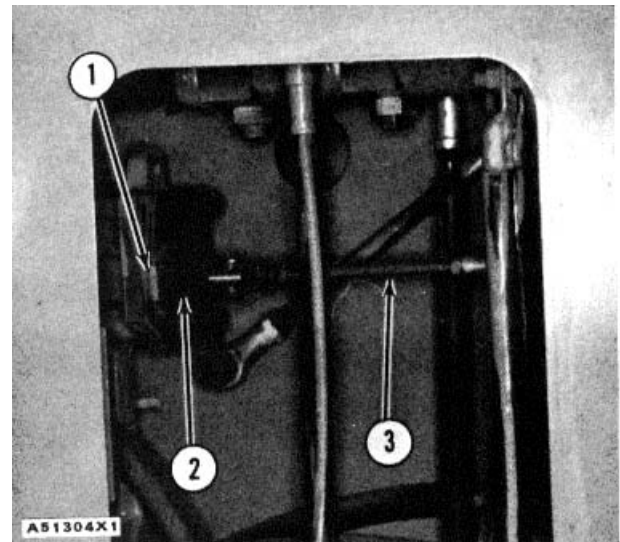
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

APRON AIR CONTROL VALVE

INSTALL APRON AIR CONTROL VALVE

1. Put apron air control valve in position on the bracket that is connected to the selector valve.
2. Install nut (1) and boot (2).
3. Connect rod (3) to the valve.
4. Connect two air hoses (4) and (5) to the apron air control valve.

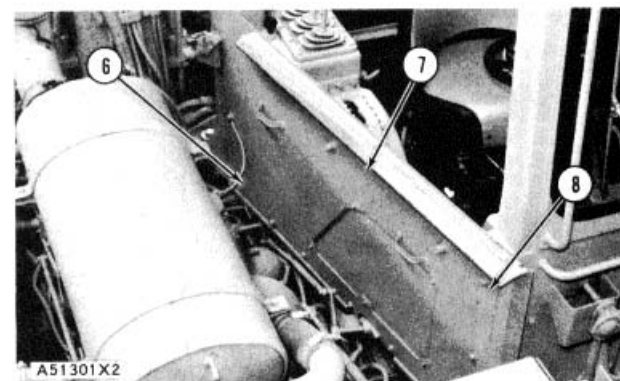


5. Put panel assembly (7) in position and install bolts (8) that hold it.
6. Connect ground wire (6) to the panel assembly.
7. If adjustment to the apron air control valve is necessary, see Scraper Hydraulic System in Testing and Adjusting.

end by:

a) install hood *

*This operation is in the Engine Disassembly and Assembly Section.



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

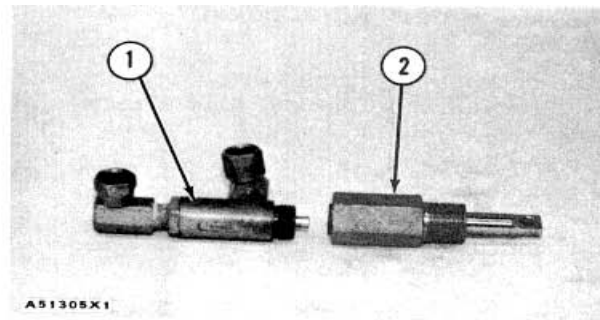
APRON AIR CONTROL VALVE

DISASSEMBLE APRON AIR CONTROL VALVE

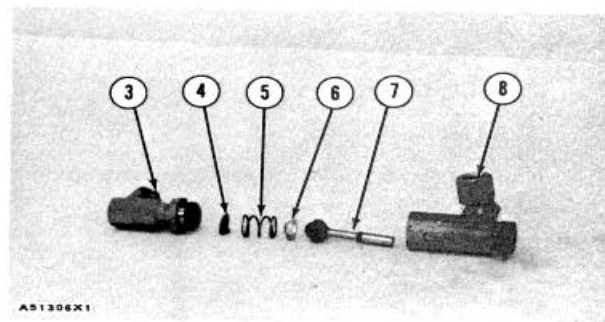
start by:

a) remove apron air control valve

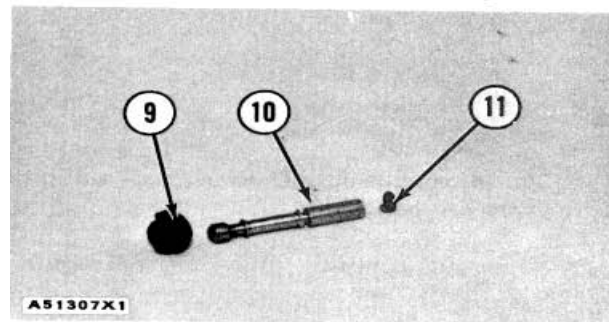
1. Remove adapter assembly (2) from body assembly (1).



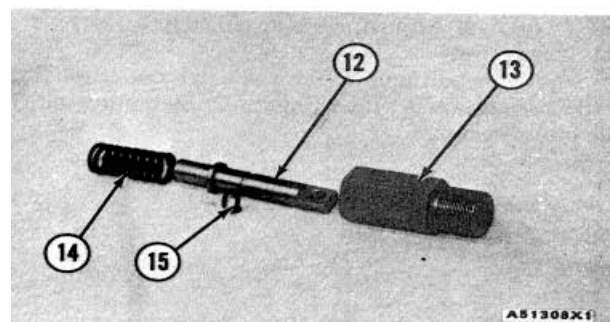
2. Remove union (3), strainer (4), spring (5), seat (6) and valve assembly (7) from body (8).



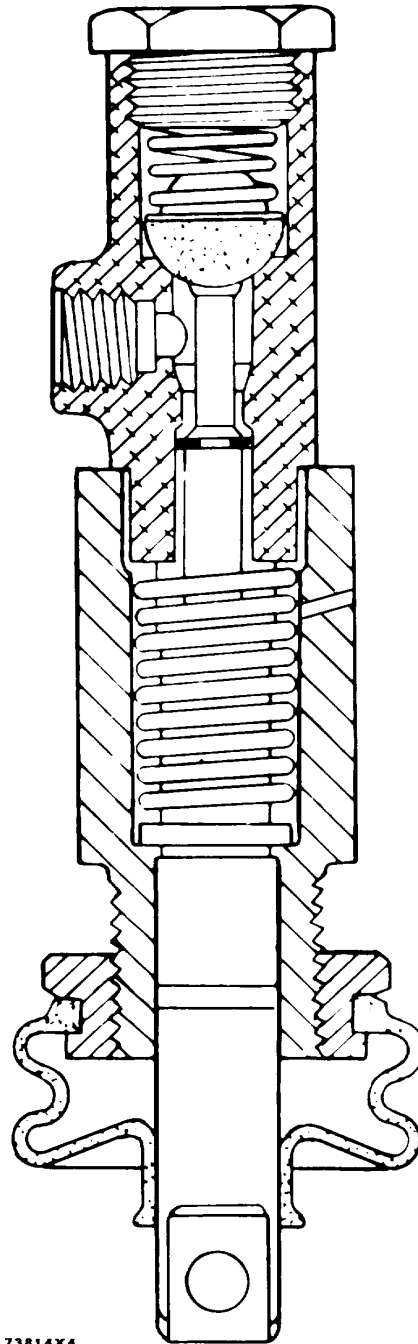
3. Remove valve (9) and O-ring seal (1) from stem (10).



4. Remove spring (14) and plunger (12) from adapter (13). Remove O-ring seal (15) from the plunger.



APRON AIR CONTROL VALVE



73814X4

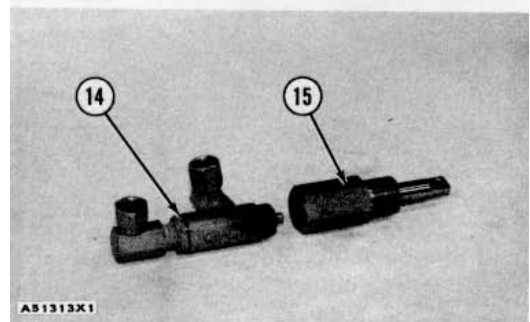
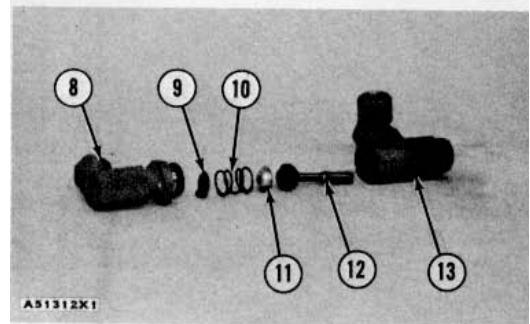
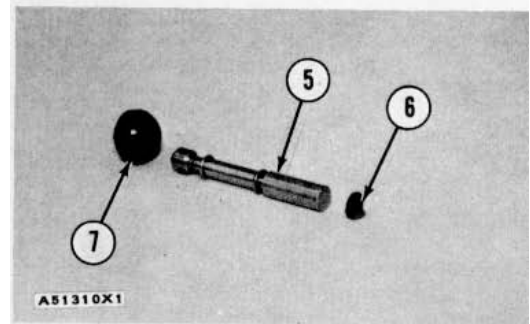
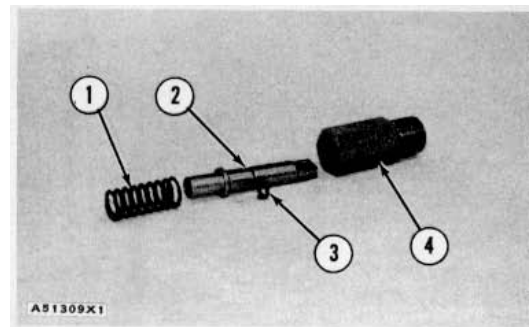
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

APRON AIR CONTROL VALVE

ASSEMBLE APRON AIR CONTROL VALVE

1. Install O-ring seal (3) on plunger (2).
2. Install the plunger and spring (1) in adapter (4).
3. Install O-ring seal (6) on stem (5). Install valve (7) on stem (5).
4. Install valve assembly (12) in body (13) as shown. Install seat (11) and spring (10) on the valve assembly. Install strainer (9) in union (8). Install the union in the body.
5. Install body assembly (14) in adapter assembly (15).
end by:
a) install apron air control valve



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

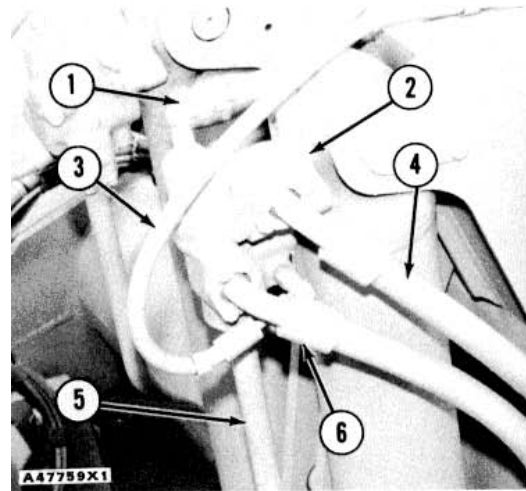
QUICK DROP CHECK VALVES

REMOVE QUICK DROP CHECK VALVES



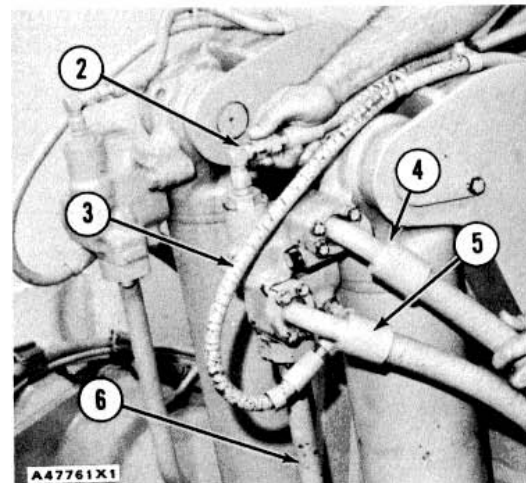
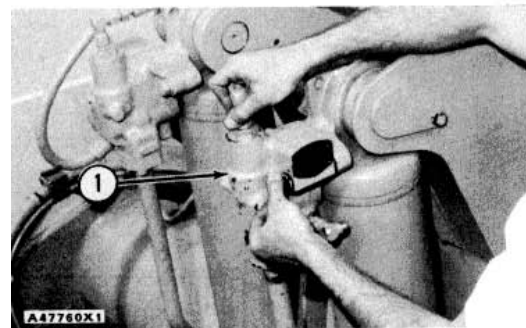
WARNING: Before any hydraulic lines are disconnected from the quick drop check valve, release the pressure in the hydraulic system. Start the engine and move the ejector forward all the way. Lower the bowl all the way. Stop the engine and move all hydraulic control levers. Loosen the cap on the hydraulic tank slowly.

1. Put identification on the four hydraulic hoses that are connected to the quick drop check valve for correct installation.
2. Disconnect four hydraulic hoses (1), (3), (4), and (6) from the valve.
3. Disconnect tube assembly (5) from the valve.
4. Remove the two bolts that hold the valve in position. Remove quick drop check valve (2).

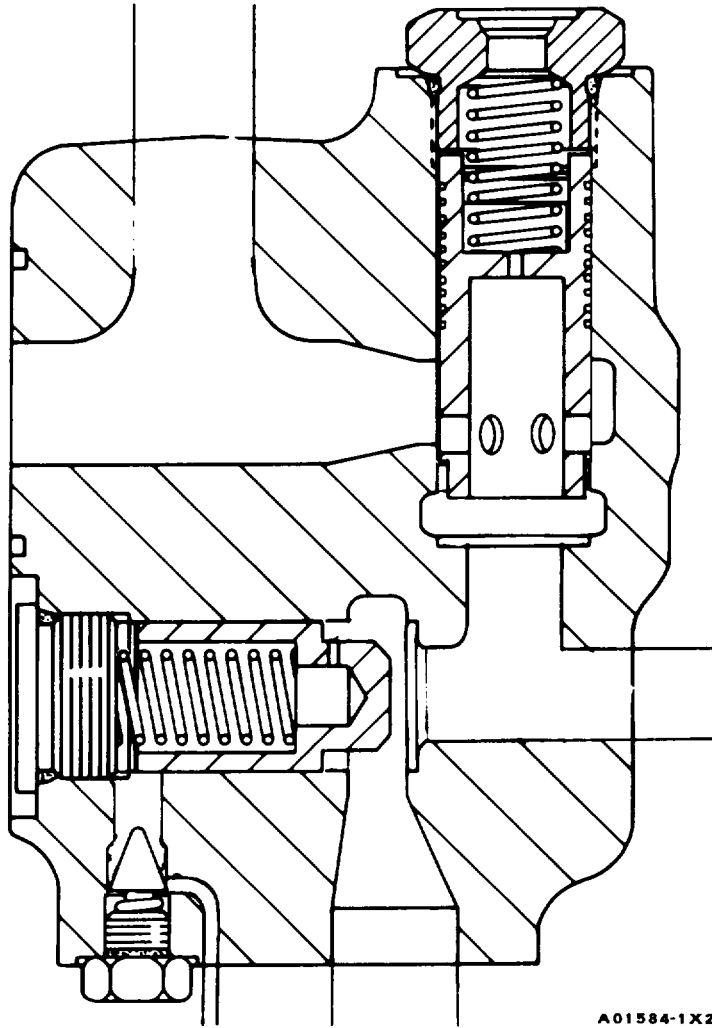


INSTALL QUICK DROP CHECK VALVE

1. Put quick drop check valve (1) in position on the bowl lift cylinder. Install the two bolts that hold it.
2. Connect hydraulic hoses (2), (3), (4), and (5) to the valve. Make sure the hoses are in the correct position. Connect tube assembly (6) to the valve.



QUICK DROP CHECK VALVES



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

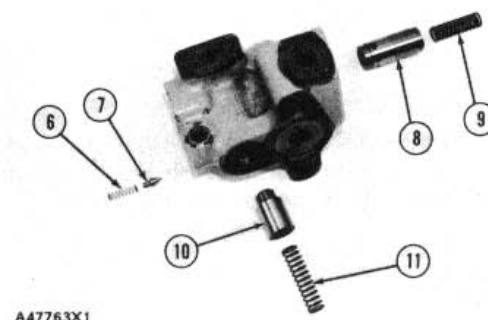
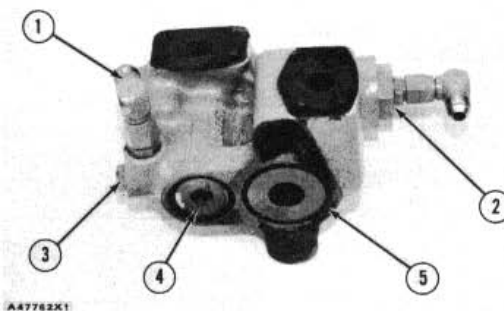
QUICK DROP CHECK VALVES

DISASSEMBLE QUICK DROP CHECK VALVES

start by:

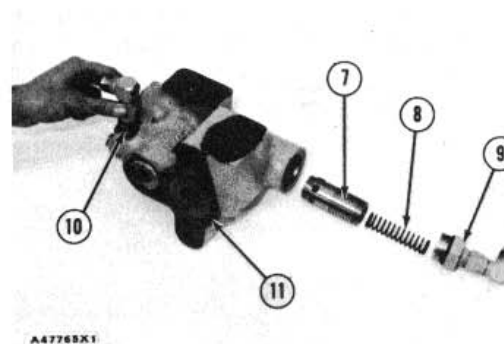
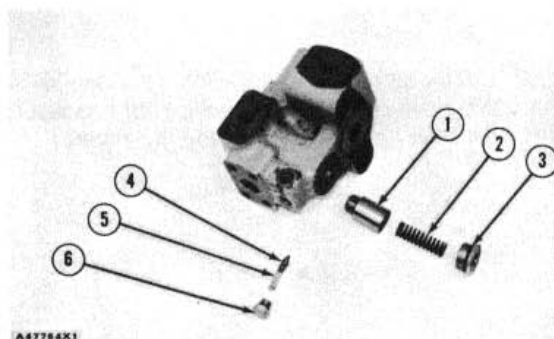
a) remove quick drop check valve

1. Remove O-ring seal (5) from the valve body. Check the condition of the seal. If the seal has damage, use a new part for replacement.
2. Remove hose fitting (1) and plugs (3), (4) and (2) from the valve body.
3. Remove spring (6) and vent valve (7) from the valve body.
4. Remove spring (9) and quick drop valve (8) from the valve body.
5. Remove spring (11) and check valve (10) from the valve body.



ASSEMBLE QUICK DROP CHECK VALVES

1. Make sure all the parts of the quick drop check valve are clean and free of dirt and foreign material. Put clean oil on all the parts.
2. Install check valve (1), spring (2) and plug (3) in the valve body.
3. Install vent valve (4), spring (5) and plug (6) in the valve body.
4. Install quick drop valve (7), spring (8) and plug (9).
5. Install fitting (10) and O-ring seal (11). end by:
 - a) install quick drop check valve



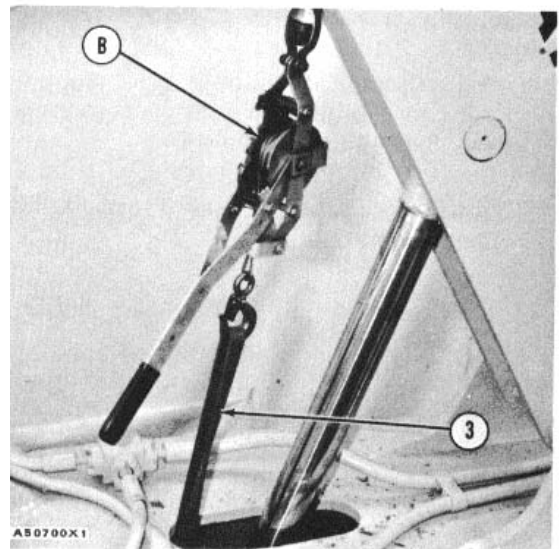
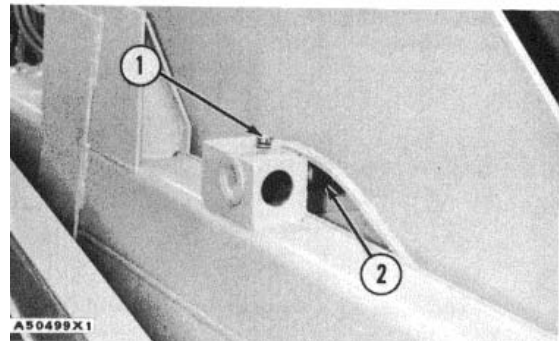
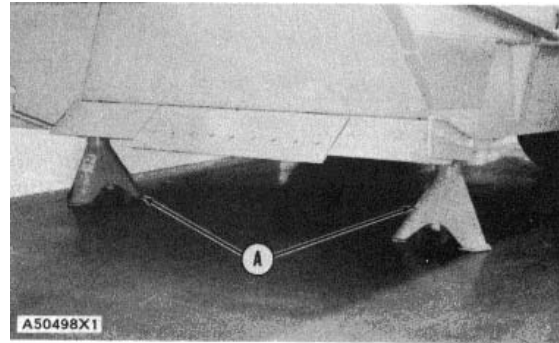
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

APRON CYLINDER

REMOVE APRON CYLINDER

	Tools Needed	A	B	C
8S7640	Stand	2		
8S7611	Tube	2		
8S7615	Pin	2		
8S9906	Ratchet Puller		1	
5P2998	Hydraulic Puller			1
1P544	Nut			1
9S5558	Stud			1
5F9798	Sleeve			1
5P3100	Pump Group			1
1P1835	Adapter			1



1. Start the engine and lift the bowl until tooling (A) can be installed under it as shown. Lower the bowl until the weight of it is on tooling (A).
2. Lift the apron and install safety pin assembly (2) and bolt (1). Lower the apron until it is against the safety pin assembly. Stop the engine.
3. Install lifting strap (3) around the rod end of the apron cylinder. Fasten tool (B) to the apron lift frame assembly and the lifting strap as shown.

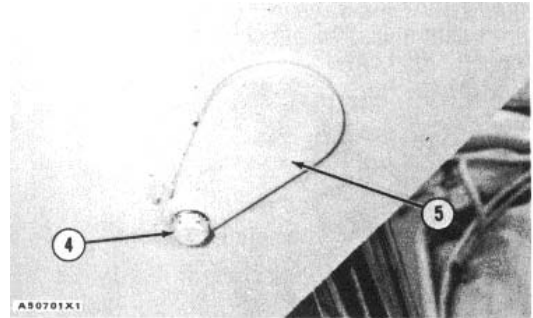
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

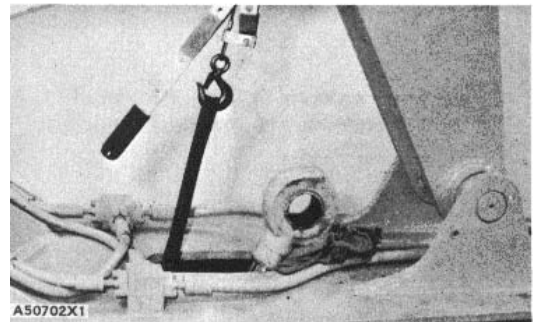
APRON CYLINDER

- Remove bolt (4) and pin assembly (5) from the rod end of the cylinder.

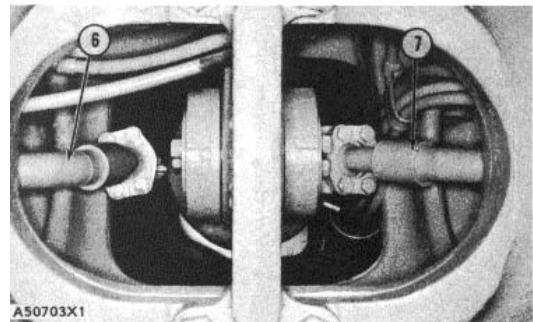
CAUTION: Do not cause damage to the rod in the cylinder when it is retracted into the cylinder.



- Start the engine and move the rod into the cylinder. Stop the engine.



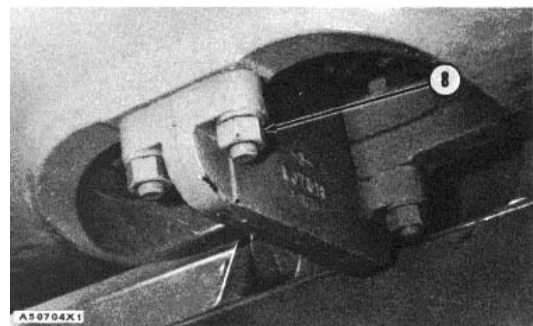
WARNING: Before any hydraulic lines are disconnected from the apron cylinder, release the pressure in the hydraulic system. Move all the hydraulic control levers backward and forward. Loosen the cap on the hydraulic tank slowly.



VIEW FROM UNDER DRAFT FRAME

- Disconnect hydraulic hoses (6) and (7) from the apron cylinder.

- Remove four nuts (8) that hold the bracket assembly for the head end of the apron cylinder to the draft frame.

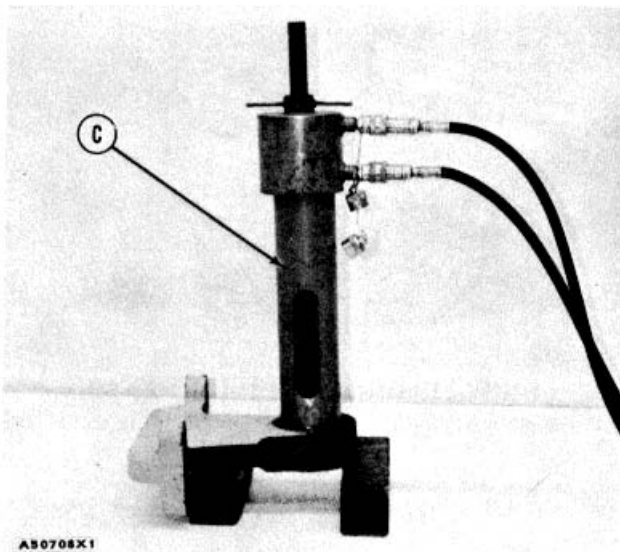
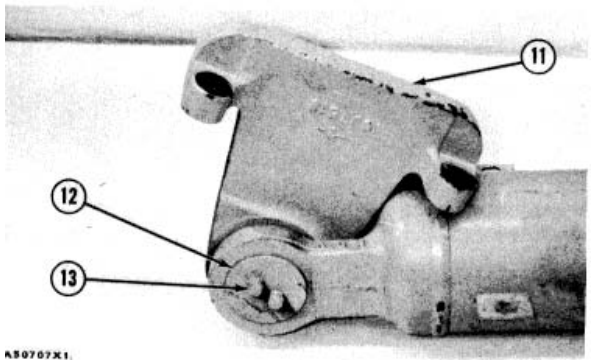
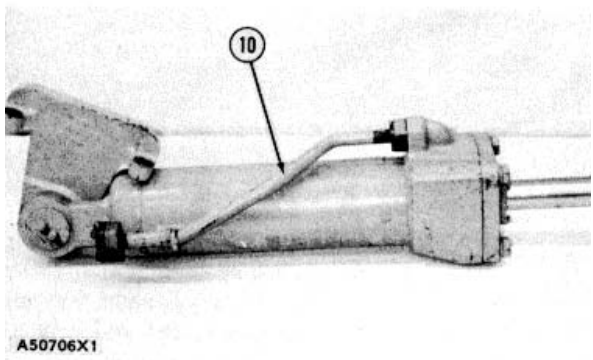
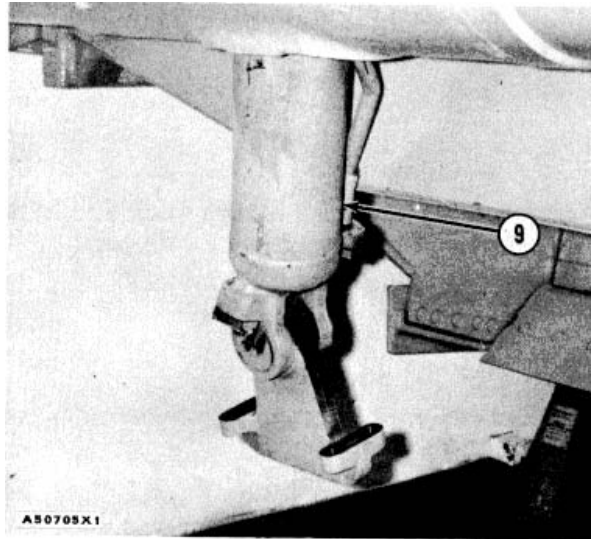


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

APRON CYLINDER

8. Lower apron cylinder (9) out the bottom of the draft frame. Weight of the apron cylinder is 460 lb. (207 kg).
9. Remove tube assembly (10) from the apron cylinder.
10. Remove two bolts (13). Remove pin (12) and bracket assembly (11) from the cylinder.
11. Remove the two bearings from the bracket assembly with tooling (C).



VEHICLE SYSTEMS

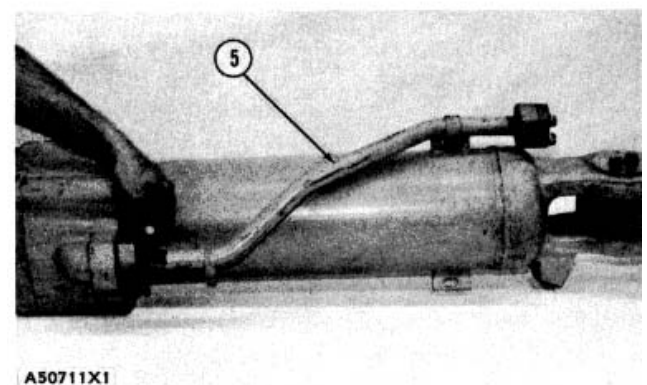
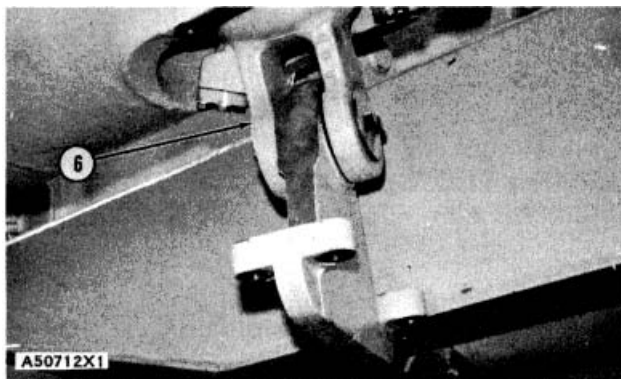
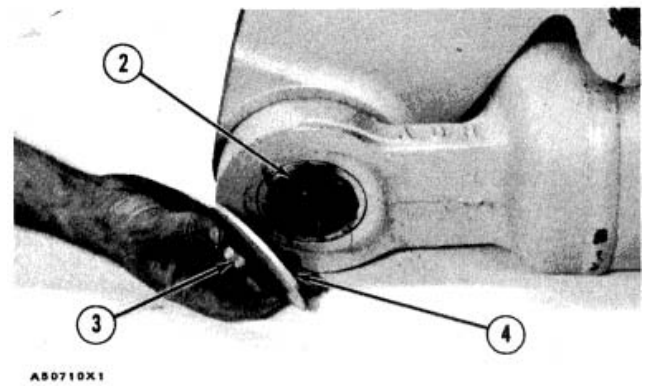
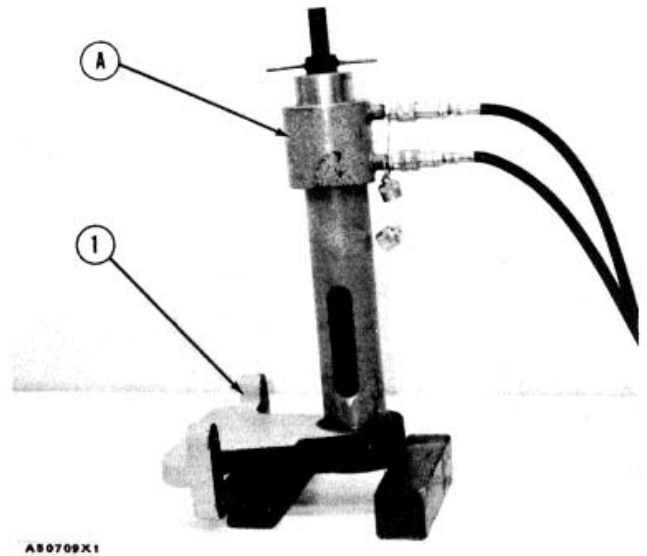
DISASSEMBLY AND ASSEMBLY

APRON CYLINDER

INSTALL APRON CYLINDER

	Tools Needed	A	B	C
5P2998	Hydraulic Puller	1		
1P344	Nut	1		
9S5558	Stud	1		
5F9798	Sleeve	1		
5P3100	Pump Group	1		
1P1853	Adapter	1		
8S9906	Ratchet Puller		1	
8S7640	Stand			2
8S7611	Tube			2
8S7615	Pin			2

1. Install two bearings in bracket assembly (1) with tooling (A). Install the bearings until they are even with the outside surfaces of the bracket assembly.
2. Put the bracket assembly in position on the apron cylinder. Install pin (2), washer (4) and two bolts (3) that hold the pin.
3. Install tube assembly (5) on the apron cylinder.
4. Fasten tool (B) to apron cylinder (6) and put it in position in the draft frame.
5. Pull the cylinder up until the bracket assembly makes contact with the draft frame. Make sure the holes in the bracket assembly are in alignment with the holes in the draft frame.

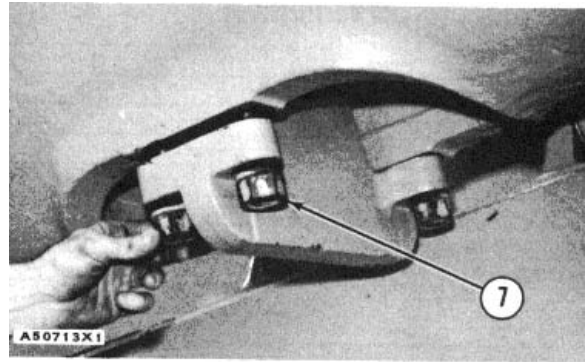


VEHICLE SYSTEMS

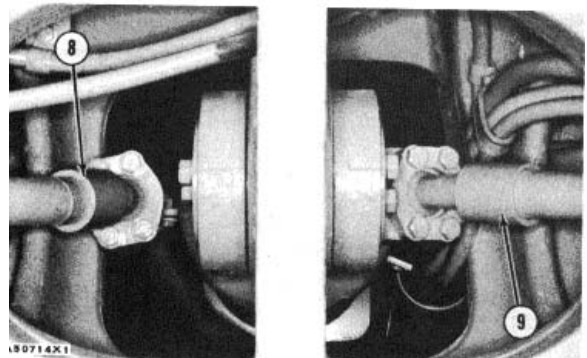
DISASSEMBLY AND ASSEMBLY

APRON CYLINDER

6. Install the four bolts and nuts (7) that hold the bracket assembly to the draft frame.

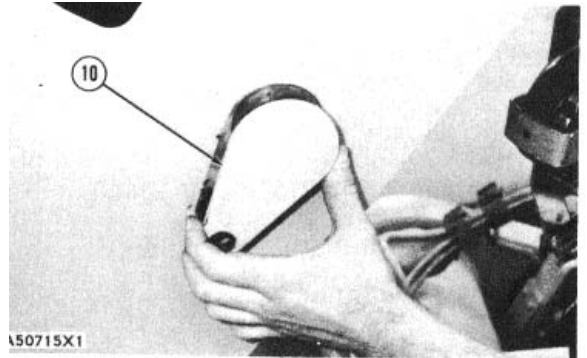


7. Connect hydraulic hoses (8) and (9) to the apron cylinder.



VIEW FROM UNDER DRAFT FRAME

8. Tighten the cap on the hydraulic tank. Start the engine. Move the apron cylinder rod until the hole in the rod end is in alignment with the hole in the apron lift frame assembly. Install pin assembly (10) and the bolt that holds it. Remove tool (B).
9. Lift the apron and remove the safety pin from the block in the bowl. Move the apron up and down to release the air in the apron cylinder.
10. Lift the bowl and remove tooling (C) from under it.



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

APRON CYLINDER

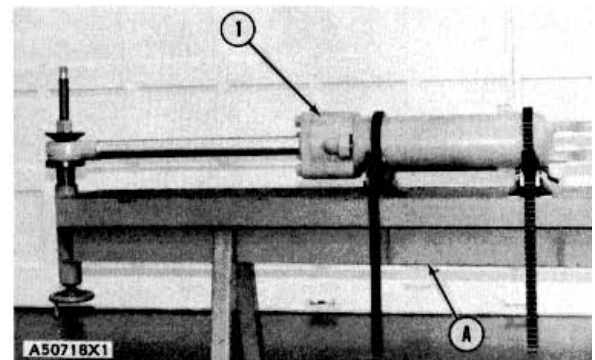
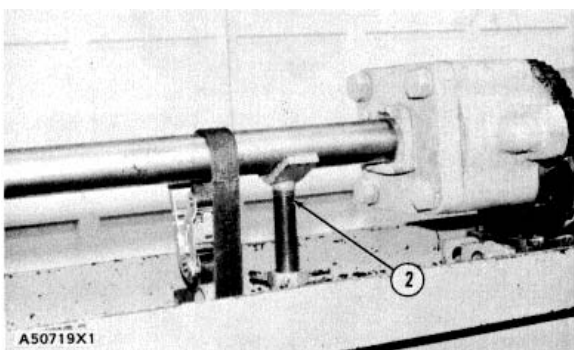
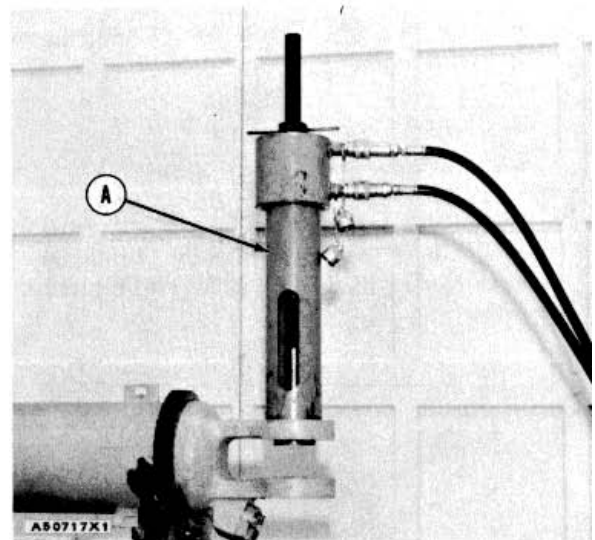
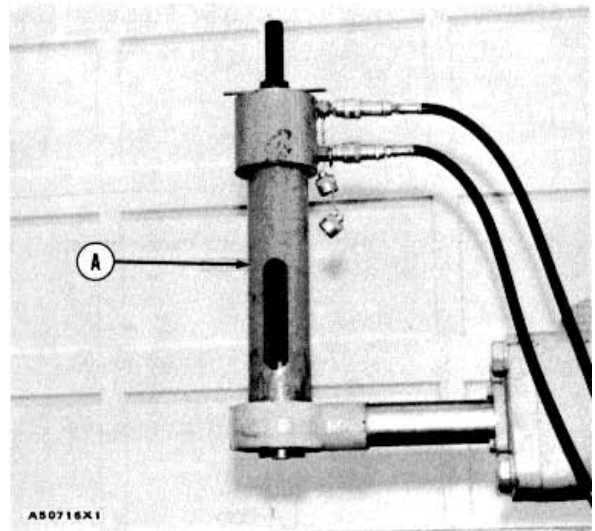
DISASSEMBLE APRON CYLINDER

	Tools Needed	A	B	C
5P2928	Hydraulic Puller	1		
1P544	Nut	1		
9S5558	Stud	1		
5F9798	Sleeve	1		
5P3100	Pump Group	1	1	
1P1853	Adapter	1		
1P1784	Hydraulic Cylinder Repair Stand		1	
1P850	Torque Multiplier			1
5P0303	Socket			1
FT948	Bracket		1	

start by:

a) remove apron cylinder

1. Remove the two bearings from the rod end of the apron cylinder with tooling (A).
2. Remove the two bearings from the head end of the cylinder with tooling (A).
3. Fasten a hoist to apron cylinder (1) and put it in position on tooling (B) as shown with the openings for the hydraulic hoses to the side.
4. Pull the rod out of the cylinder all the way and install support (2) under the rod. Fasten a strap around the rod to hold it in position.

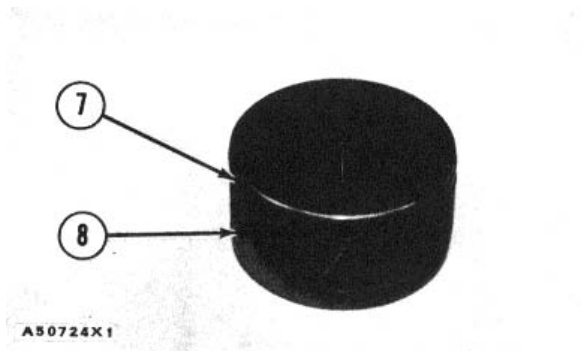
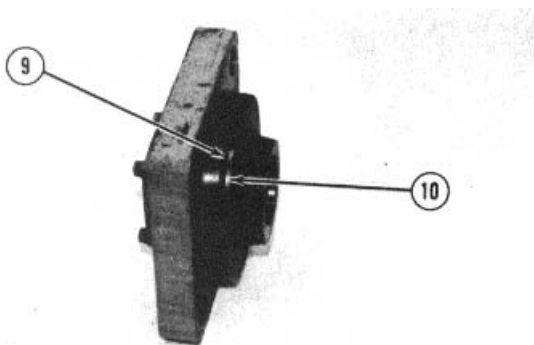
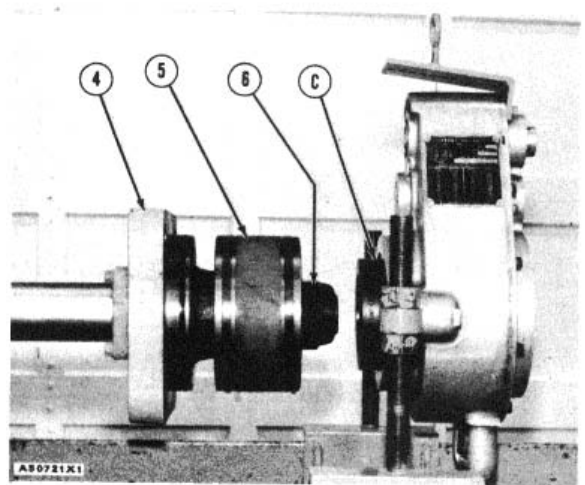
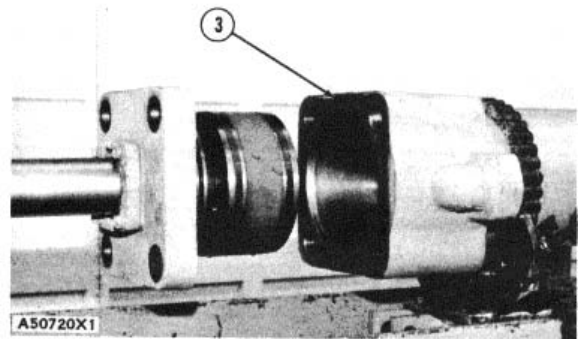


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

APRON CYLINDER

5. Remove the four bolts that hold the head to the cylinder. Pull cylinder (3) off of the piston assembly and rod.
6. Remove nut (6) that holds the piston assembly to the rod with tooling (C).
7. Remove piston assembly (5) and head (4) from the rod.
8. Remove two seal assemblies (7) and ring (8) from the piston.
9. Remove ring (9) and O-ring seal (10) from the head. Check the condition of the O-ring seal. If the seal has damage, use a new part for replacement.

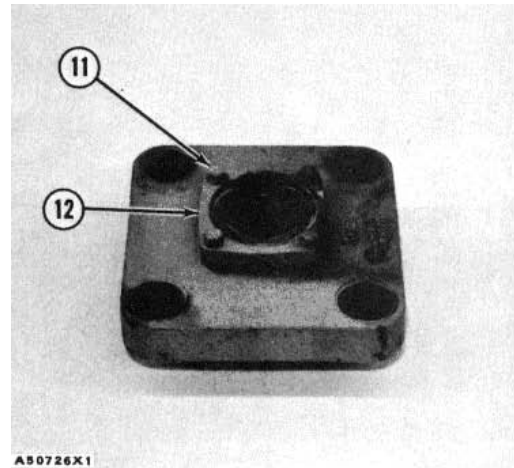


VEHICLE SYSTEMS

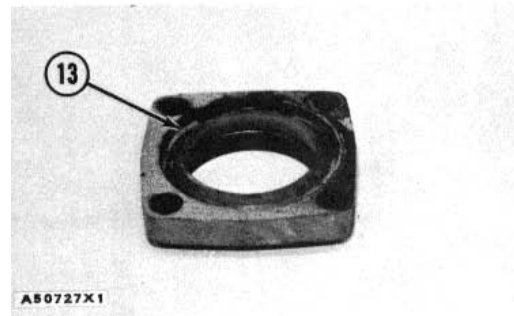
DISASSEMBLY AND ASSEMBLY

APRON CYLINDER

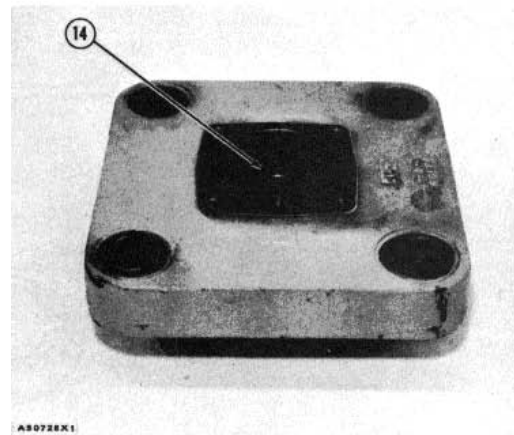
10. Remove four bolts (11), retainer (12) and shims from the head.



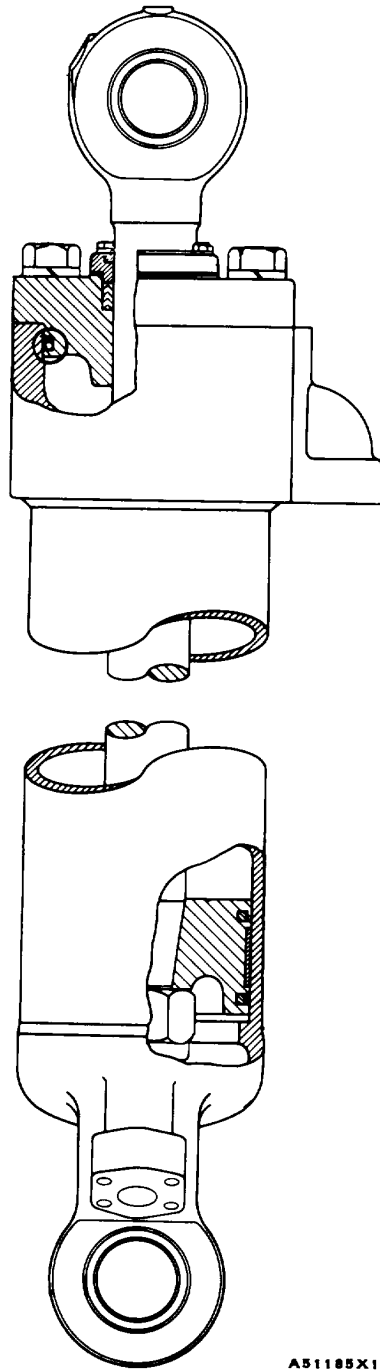
11. Remove seal (13) from the retainer.



12. Remove packing (14) from the head.



APRON CYLINDER



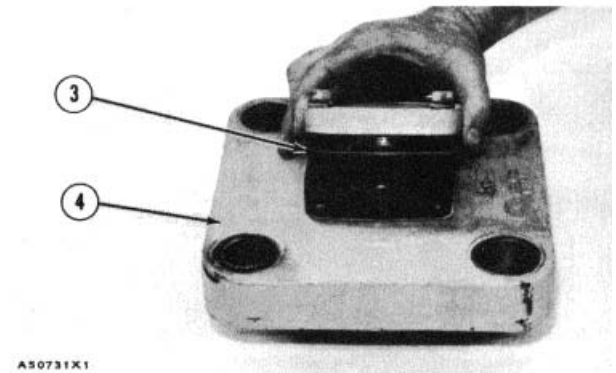
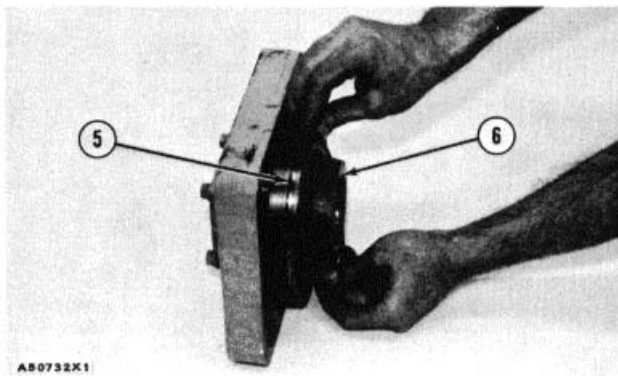
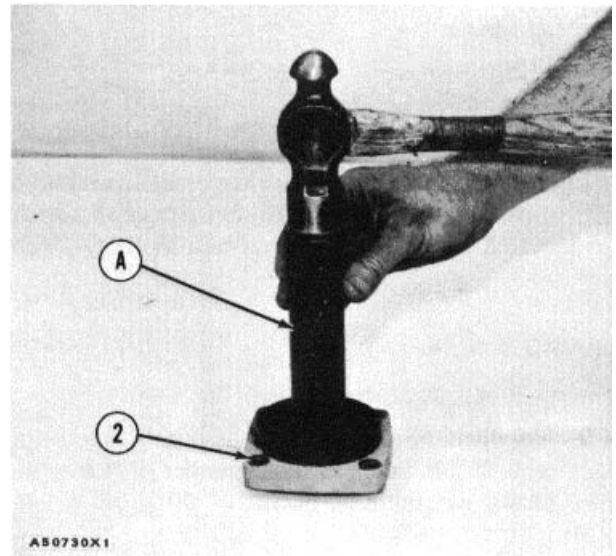
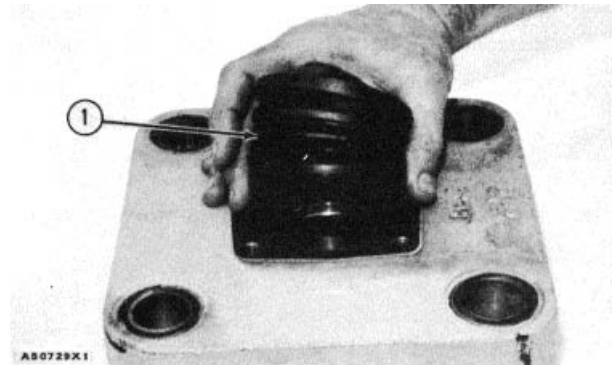
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APRON CYLINDER

ASSEMBLE APRON CYLINDER

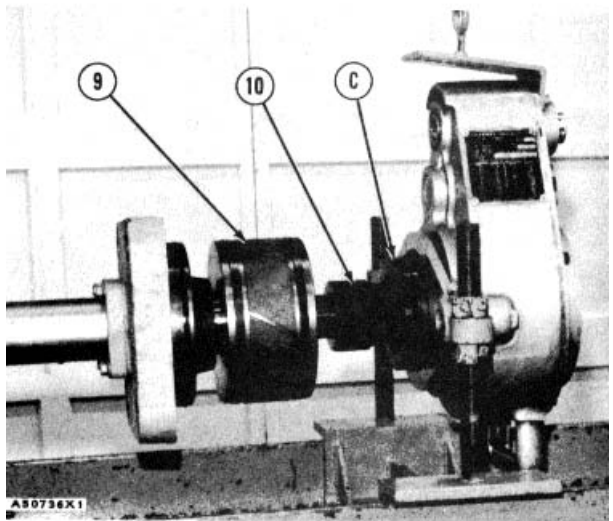
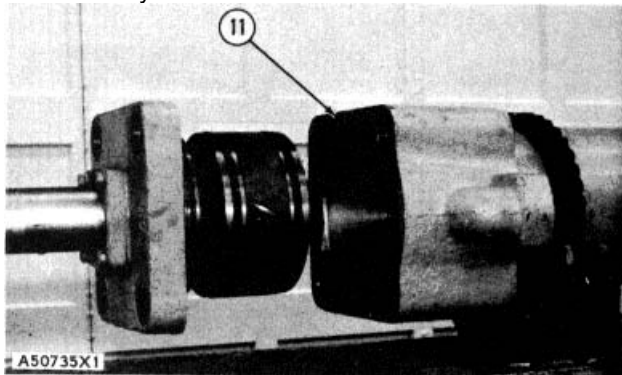
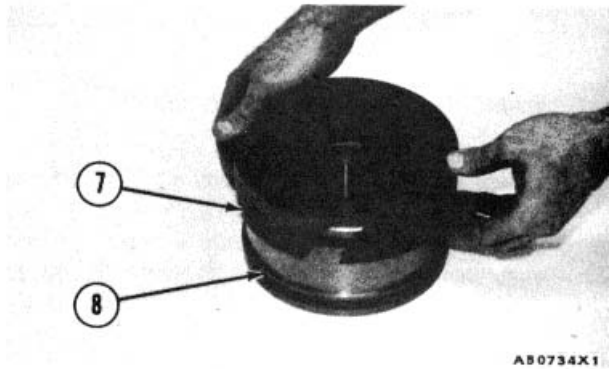
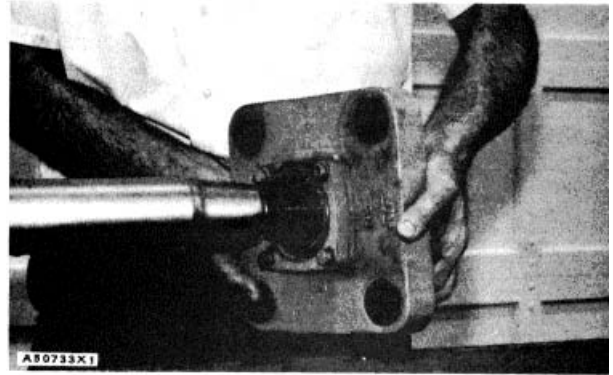
	Tools Needed	A	B	C	D	E
1P520	Driver Group	1				
1P1784	Hydraulic Cylinder					
	Repair Stand		1			
1P850	Torque Multiplier			1		
5P0303	Socket			1		
5P2928	Hydraulic Puller				1	
1P544	Nut				1	
9S5558	Stud				1	
5F9798	Sleeve				1	
5P3100	Pump Group		1		1	
9S7352	Torque Wrench					1
FT948	Bracket		1			

1. Install packing (1) in head as shown.
2. Install the lip type seal in retainer (2) with tool (A). Install the seal with the lip toward the outside of the cylinder and until it makes contact with the bottom of the counterbore in the retainer.
3. Install original amount of shims (3) and the retainer in head (4). Install the four bolts that hold the retainer to the head.
4. Install ring (5) and O-ring seal (6) on the head as shown.



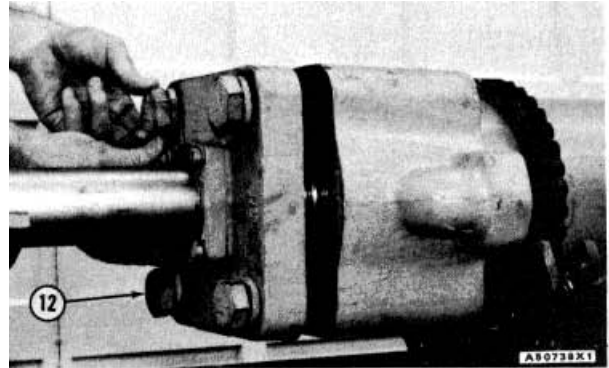
APRON CYLINDER

5. Put clean oil on the lip of the seal in the head. Put the head in position on the cylinder rod as shown.
6. Install ring (7) and two seal assemblies (8) on the piston.
7. Put the piston assembly (9) in position on the rod as shown.
8. Install nut (10) that holds the piston assembly in position. Tighten nut (10) to a torque of 1200 ± 120 lb. ft. (540 ± 54 N•m) with tooling (C) and (E).
9. Put clean oil on the piston assembly and O-ring seal on the head. Install cylinder (11) over the piston assembly and head.

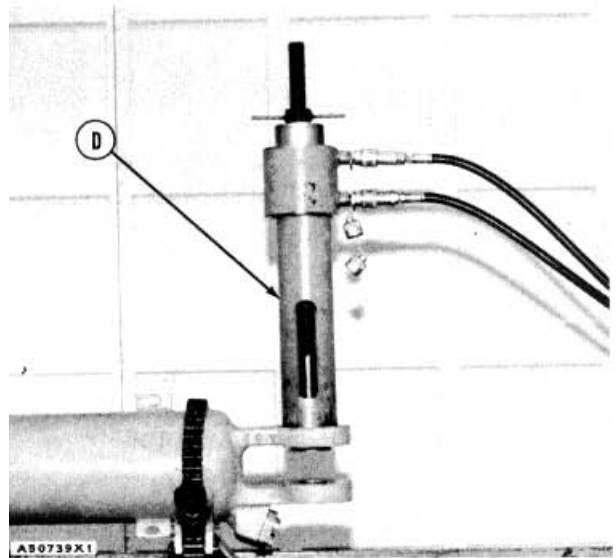


APRON CYLINDER

10. Make sure the rod is fully extended before the bolts that hold the head in position are tightened. Install and tighten four bolts (12) that hold the head to the cylinder.

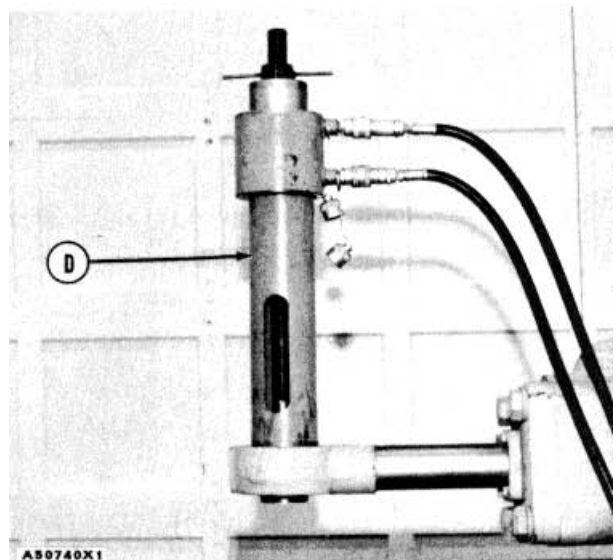


11. Install the two bearings in the head end of the cylinder with tooling (D). Install the bearings even with the outside surfaces of the cylinder.



12. Install the two bearings in the rod end of the cylinder with tooling (D). Install the bearings even with the outside surfaces of the rod.

13. Remove the apron cylinder from tooling (B).
end by:
 - a) install apron cylinder



BOWL LIFT CYLINDERS

REMOVE BOWL LIFT CYLINDERS

start by:

- a) Remove quick drop check valves

1. Disconnect tube assembly (1) from the bowl lift cylinder.

2. Disconnect hose assembly (2) from the bowl lift cylinder.

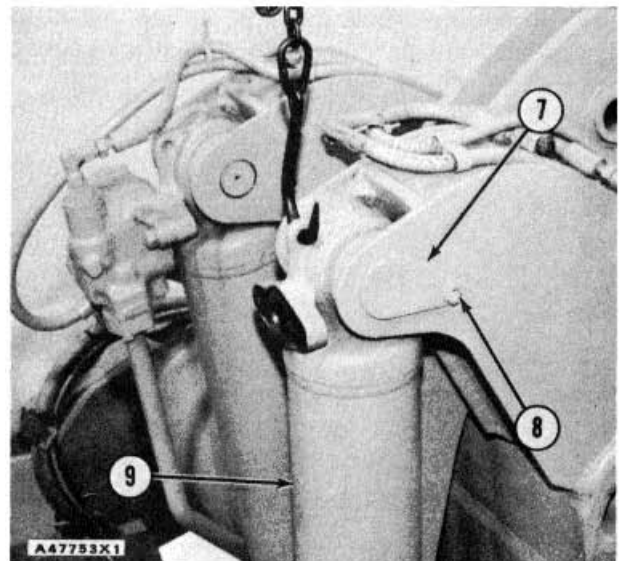
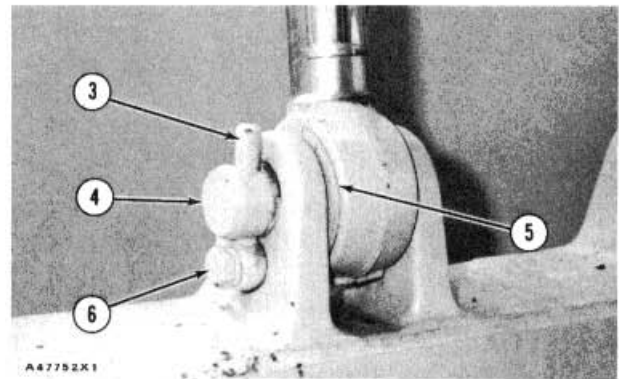
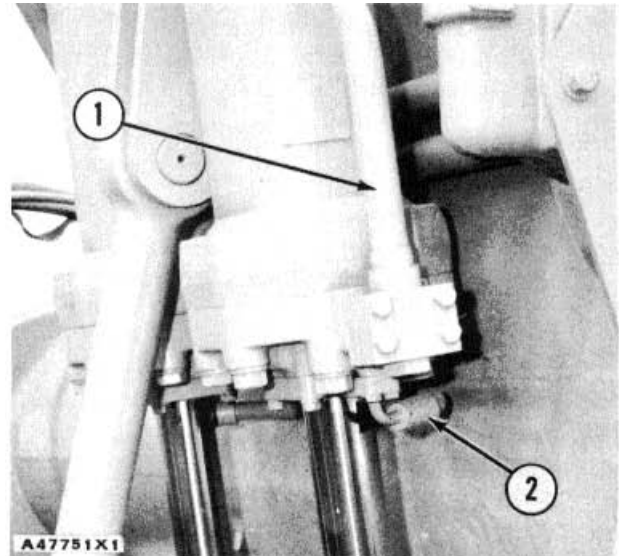
3. Fasten a hoist to the head end of the bowl lift cylinder.

4. Remove bolt (6), washer and pin (3).

5. Remove pin (4) and two spacers (5) from the rod end of the cylinder.

6. Remove bolt (8), pin assembly (7) and washers from the head end of the bowl lift cylinder.

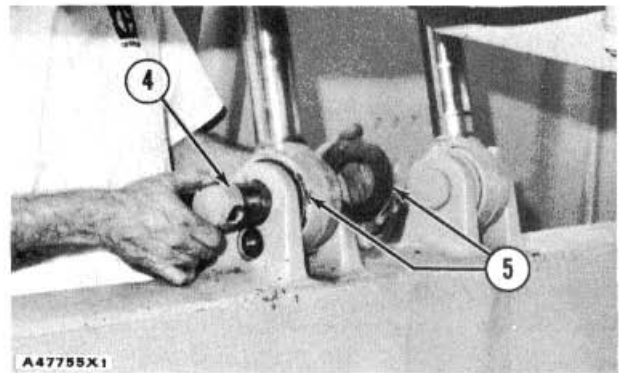
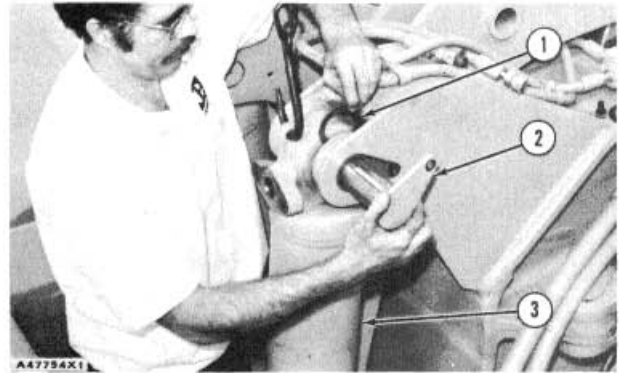
7. Remove bowl lift cylinder (9). The weight of the cylinder is 270 lb. (122 kg).



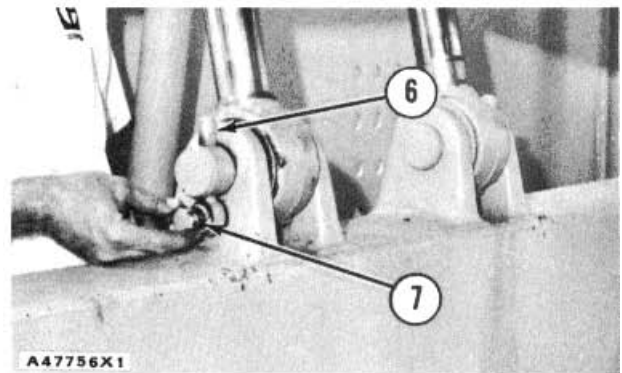
BOWL LIFT CYLINDERS

INSTALL BOWL LIFT
CYLINDERS

1. Fasten a hoist to bowl lift cylinder (3) and put it in position on the bowl and draft frame.
2. Install a washer (1) on each side at the head end of the cylinder as shown. Install pin assembly (2) and the bolt and washer that holds it.
3. Put a spacer (5) on each side of the rod as shown. Put the rod end between the brackets on the bowl as shown. Install pin (4).



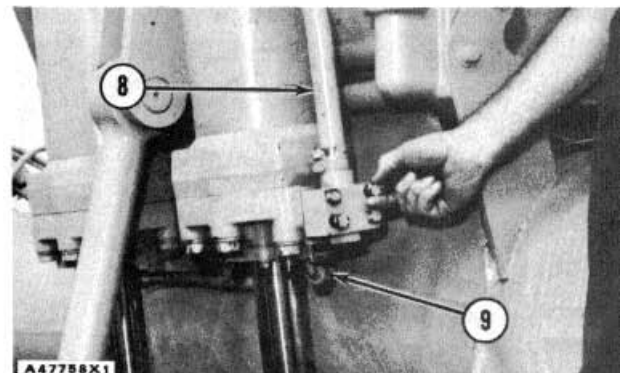
4. Install pin (6) and bolt (7).



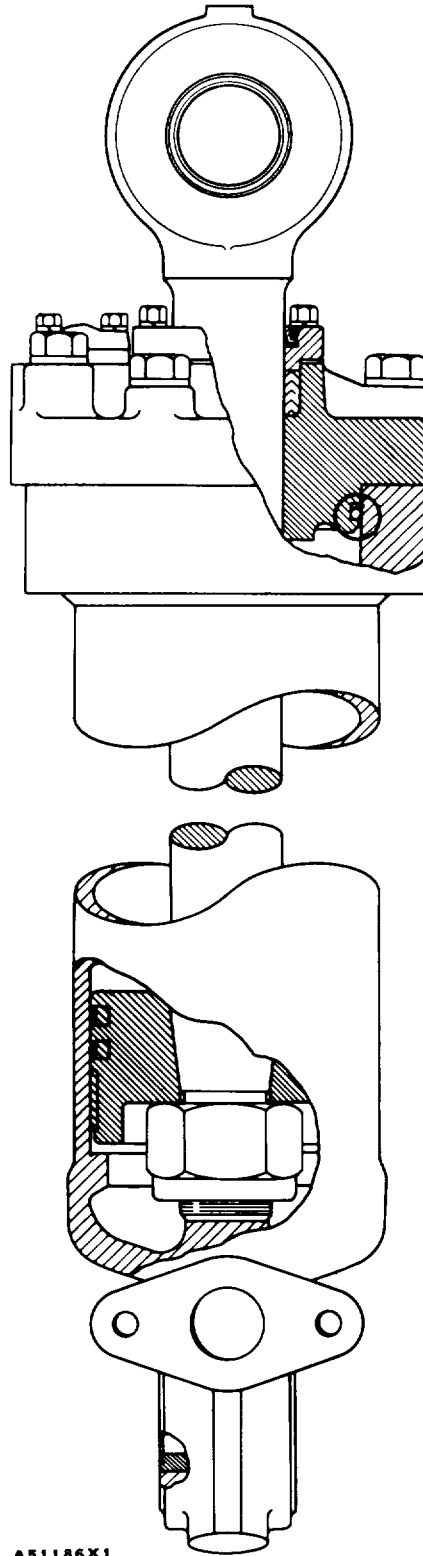
5. Connect tube assembly (8) and hose assembly (9) to the cylinder.

end by:

- a) install quick drop check valve



BOWL LIFT CYLINDERS



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BOWL LIFT CYLINDERS

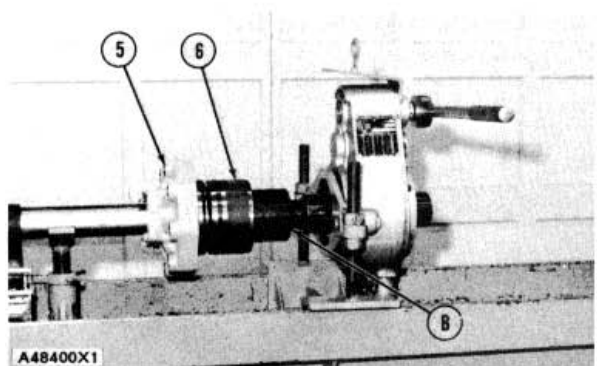
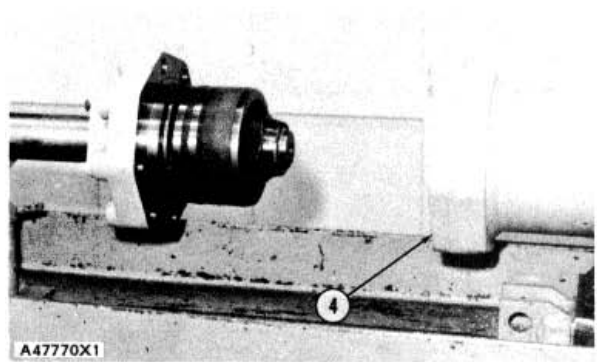
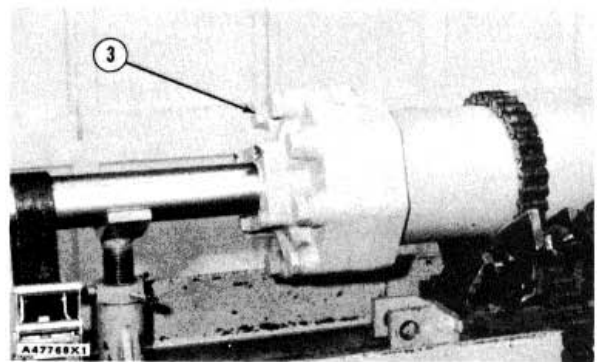
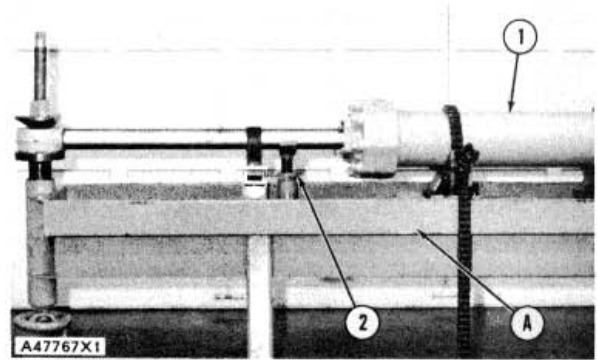
DISASSEMBLE BOWL LIFT CYLINDERS

	Tools Needed	A	B	C
1P1784	Hydraulic Cylinder			
	Repair Stand	1		
5P3100	Pump Group	1		1
1P850	Torque Multiplier		1	
5S6082	Socket		1	
9S5565	Sleeve			1
9S5559	Stud			1
1P543	Nut			1
1P1834	Adapter			1
7S9540	Hydraulic Puller			1
FT948	Bracket	1		

start by:

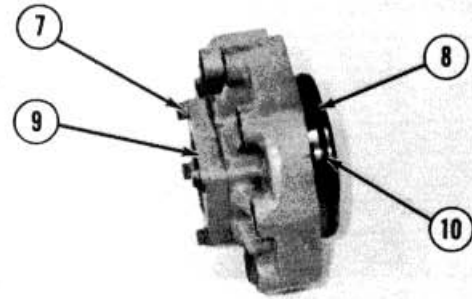
a) remove bowl lift cylinders

1. Fasten a hoist to bowl lift cylinder (1) and put in position on tool (A) as shown with the openings for the hydraulic lines down.
2. Pull the rod out of the cylinder all the way and install support (2) under the rod. Fasten a strap around the rod to hold it in position.
3. Remove eight bolts (3) that hold the head to the cylinder.
4. Pull the cylinder (4) off of the rod and piston assembly with tool (A).
5. Remove the nut that holds the piston assembly to the rod with tooling (B).
6. Remove piston assembly (6) and head (5) from the rod.



BOWL LIFT CYLINDERS

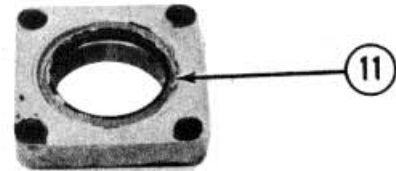
7. Remove four bolts (7) and retainer (9) from the head.



A48401X1

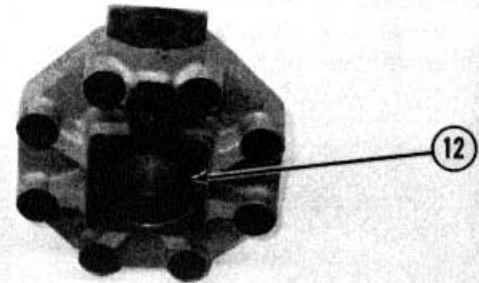
8. Remove O-ring seal (8) and ring (10) from the head.

9. Remove seal (11) from the retainer.



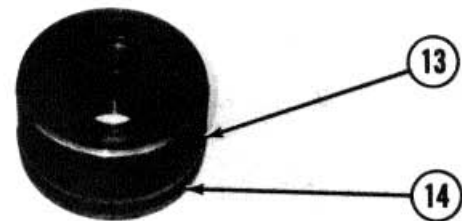
A48402X1

10. Remove packing (12) from the head.



A48403X1

11. Remove ring (13) and seal assembly (14) from the piston.



A48404X1

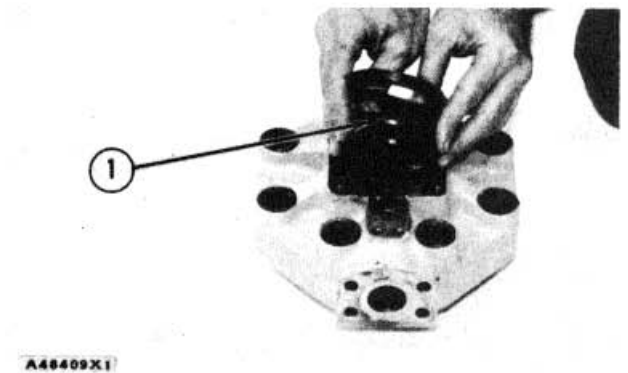
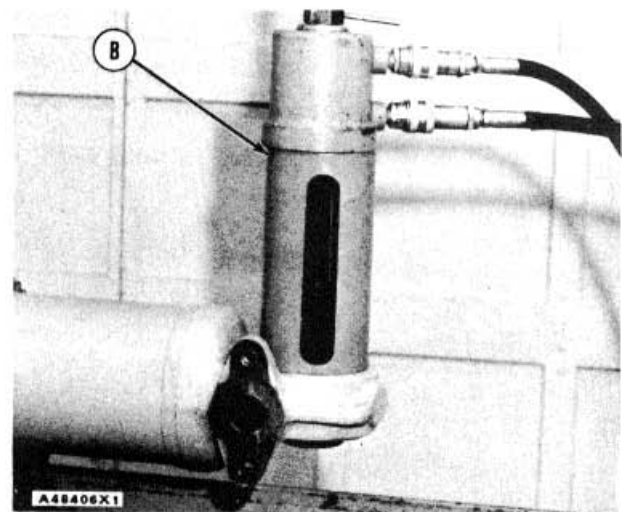
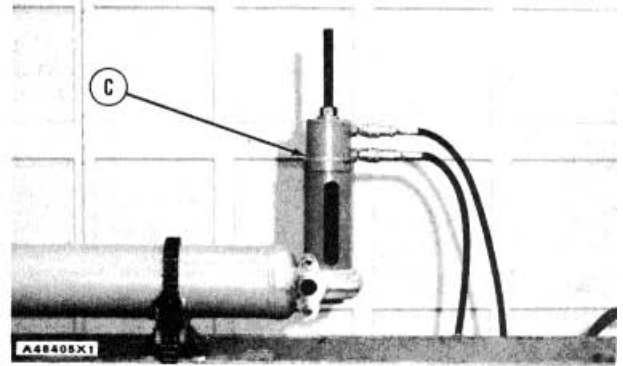
BOWL LIFT CYLINDERS

- Remove the bearings from the cylinder and rod end with tooling (C).

ASSEMBLE BOWL LIFT CYLINDERS

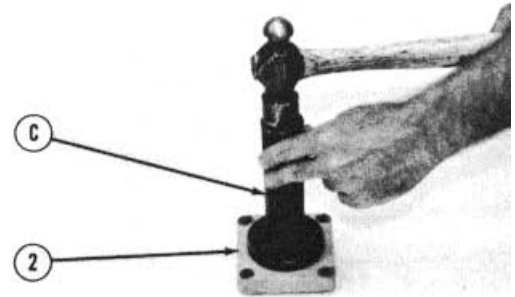
	Tools Needed	A	B	C	D
1P1784	Hydraulic Cylinder				
	Repair Stand	1			
5P3100	Pump Group	1	1		
9S5565	Sleeve		1		
9S5559	Stud		1		
1P543	Nut		1		
1P1834	Adapter		1		
7S9540	Hydraulic Puller			1	
9S7351	Torque Wrench				1
1P850	Torque Multiplier				1
5S6082	Socket				1
FT948	Bracket	1			

- Install the bearings in the cylinder and rod end with tooling (B). Check the inside diameter of the bearings after installation. The minimum diameter must not be more than 2.251 in. (57.18 mm) after installation. Install the bearings even with the outside surfaces of the cylinder and rod.
- Install packing (1) in the head as shown.



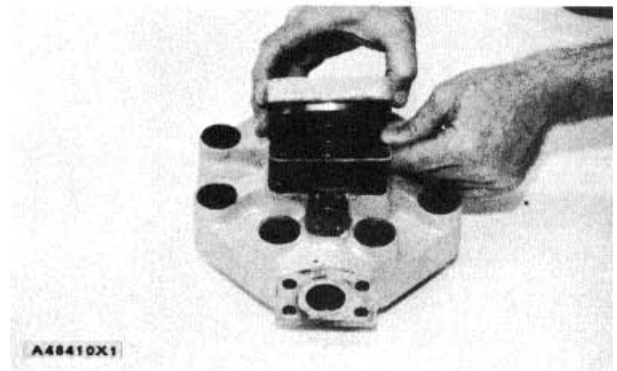
BOWL LIFT CYLINDERS

3. Install the lip type seal in retainer (2) with tool (C). Install the seal with the lip toward the outside of the cylinder and until it makes contact with the bottom of the counterbore in the retainer.



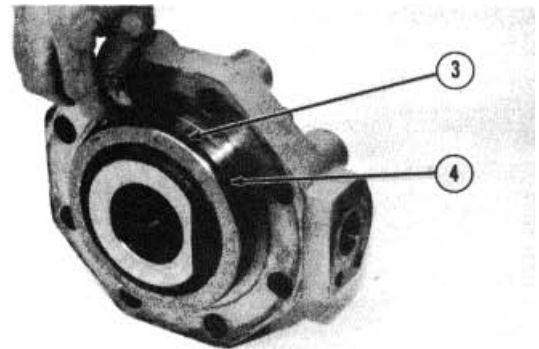
A48407X1

4. Install the gasket and retainer on the head as shown.



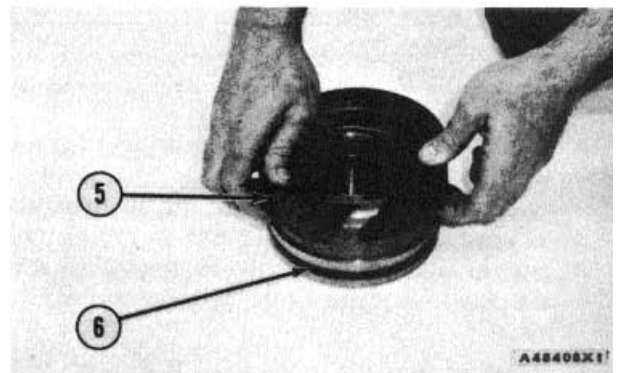
A48410X1

5. Install ring (4) and O-ring seal (3) on the head as shown.



A48411X1

6. Install ring (5) and seal assembly (6) on the piston.



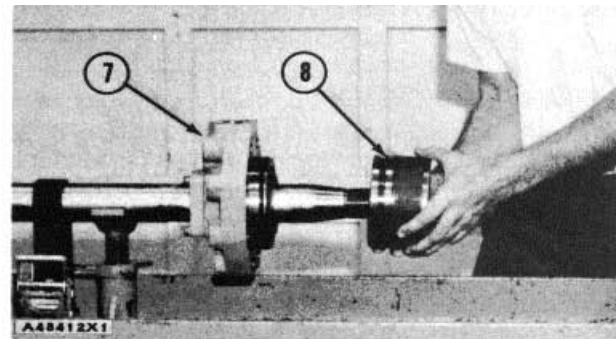
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VEHICLE SYSTEMS

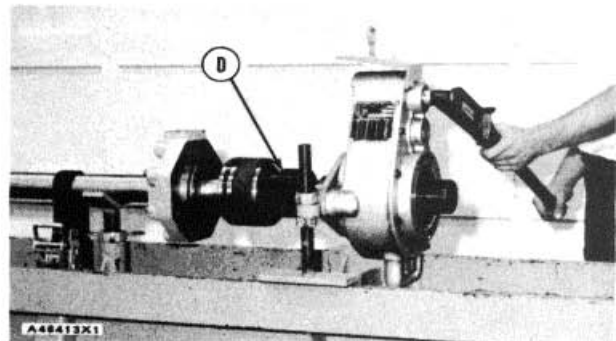
DISASSEMBLY AND ASSEMBLY

BOWL LIFT CYLINDERS

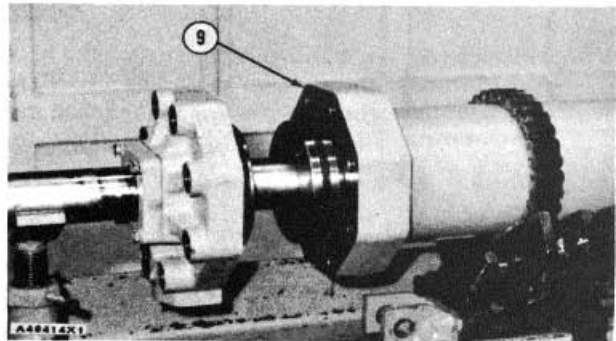
7. Put clean oil on the lip of the seal in head (7). Install the head and piston assembly (8) on the rod as shown.



8. Install the nut that holds the piston assembly in position on the rod. Tighten the nut with tooling (D) to a torque of 1200 + 100 lb. ft. (1620 + 135 N m).



9. Put clean oil on the piston assembly and O-ring seal on the head. Install cylinder (9) over the piston assembly and head.

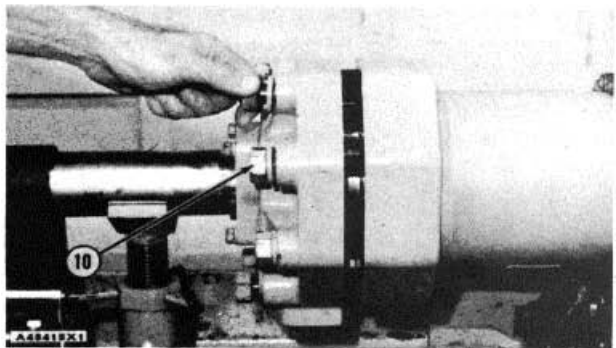


10. Install eight bolts (10) that hold the head to the cylinder. Make sure the rod is fully extended and tighten the bolts to a torque of 300 + 35 lb. ft. (410 + 45 N m).

11. Remove the cylinder from tool (A).

end by:

- a) install bowl lift cylinder



VEHICLE SYSTEMS

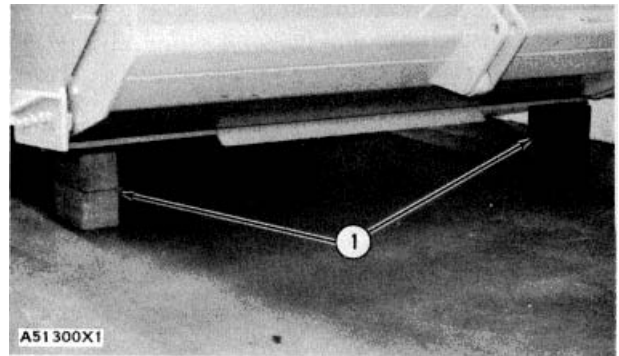
DISASSEMBLY AND ASSEMBLY

EJECTOR CYLINDER

REMOVE EJECTOR CYLINDER

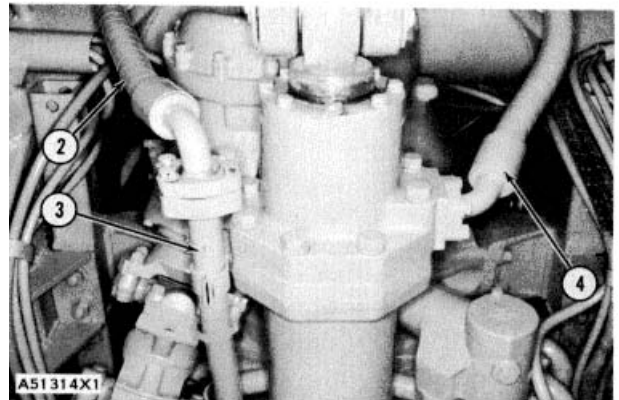
Tools Needed		A
8S9906	Ratchet Puller	1

1. Start the engine and lift the bowl until it is level. Put wood blocks (1) under the bowl to hold it in position.
2. Retract the ejector fully. Stop the engine.

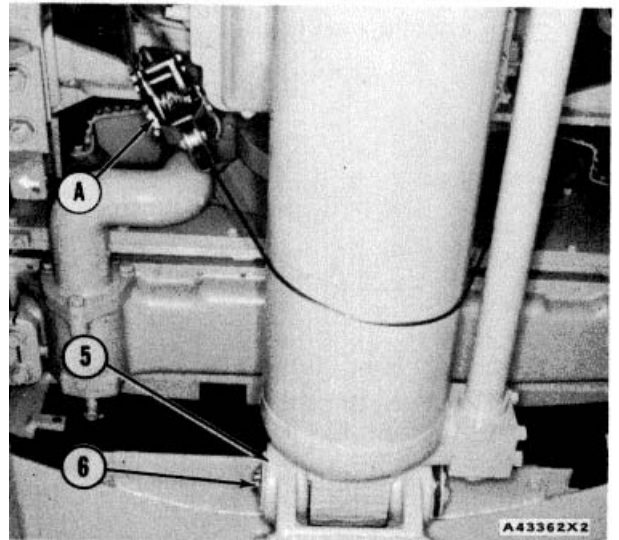


NOTE: Oil will drain out of the ejector cylinder when the hydraulic hoses are disconnected from it. Put plugs in the hoses and cylinder as they are disconnected.

3. Disconnect hose (4) from the rod end of the cylinder.
4. Disconnect hose (2) from the tube assembly. Remove the clip from the tube assembly.
5. Remove tube assembly (3).
6. Put tool (A) and a lifting strap around the head end of the ejector cylinder as shown. Tool (A) will hold the cylinder up when the rear pin that holds the cylinder is removed.
7. Remove two bolts (6) and lock, washer (5) and the pin that holds the head end of the cylinder in position.



VIEW FROM UNDER SCRAPER



VIEW FROM UNDER SCRAPER
TYPICAL EXAMPLE

VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

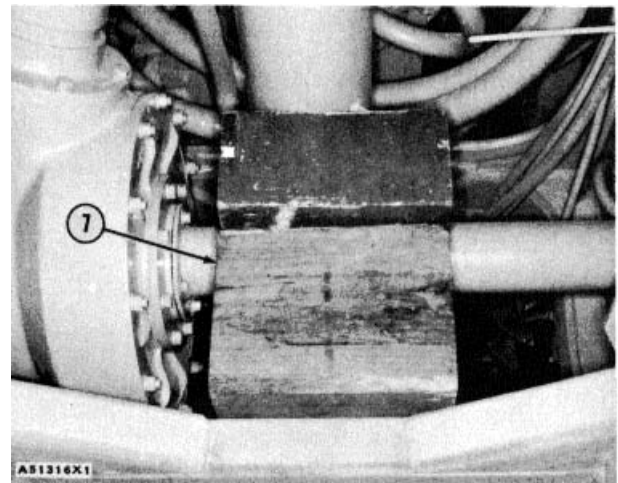
EJECTOR CYLINDER

8. Put wood blocks (7) on the crossmember of the bowl as shown. Make sure the blocks are under the ejector cylinder.
9. Lower the cylinder on the wood blocks with tool (A). Remove tool (A) from around the cylinder.
10. Install lifting straps around the ejector as shown.
11. Install tool (A) on the apron and the lifting straps as shown.

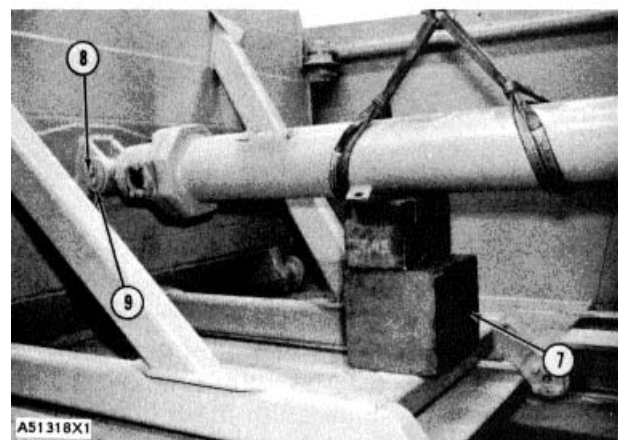
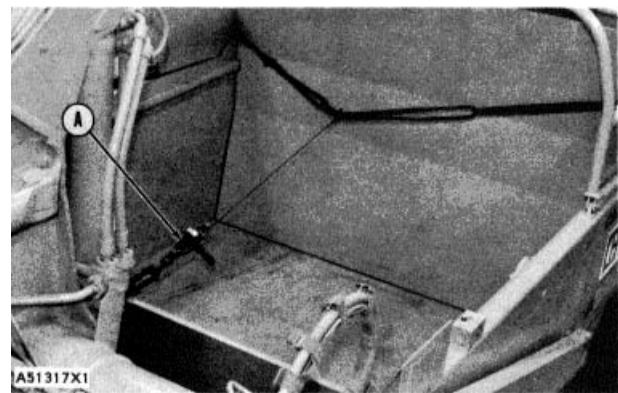


WARNING: When the ejector is pulled forward with tool (A) make sure the cylinder does not fall off of the wood blocks. Keep away from the area of the ejector cylinder when the ejector is pulled forward.

12. Pull the ejector forward with tool (A). Do not pull the ejector too far forward. The ejector cylinder will fall off the wood blocks on the crossmember.
13. After the ejector cylinder is out from under the power pack, use wood blocks (7) as a support for the center of the cylinder as shown.
14. Fasten tool (A) and lifting straps to the ejector overflow guard. Fasten tool (A) and the lifting straps to the ejector cylinder as shown.
15. Remove two bolts (8), lock and washer (9) and the pin that holds the ejector cylinder to the ejector.
16. Lift the cylinder with tool (A) and turn it 90° in the bowl. Lower the cylinder on the frame of the ejector. Remove tool (A) and the lifting straps.



VIEW FROM UNDER SCRAPER

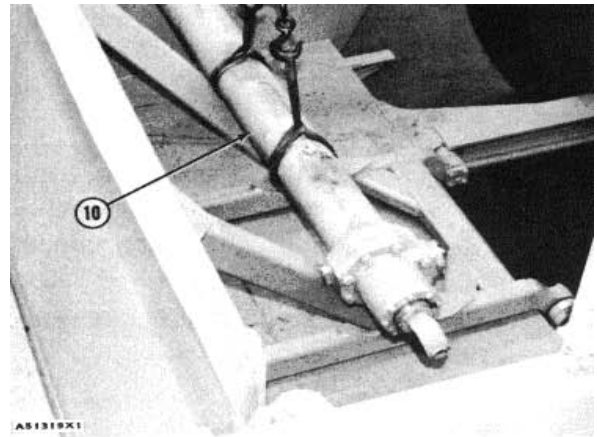


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

EJECTOR CYLINDER

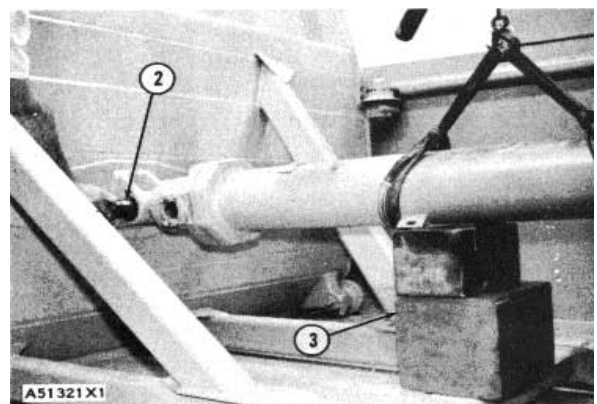
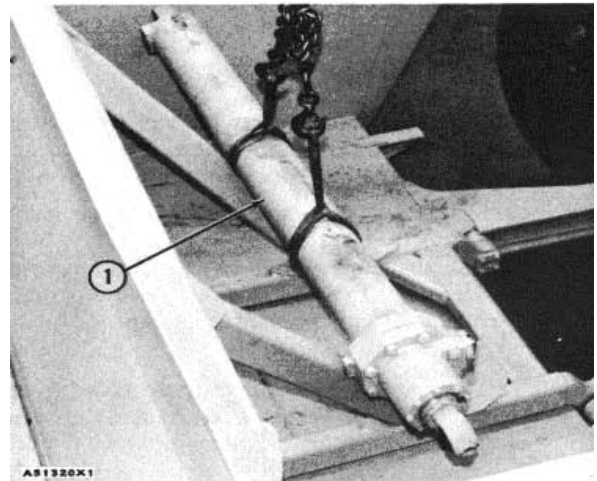
17. Fasten a hoist to ejector cylinder (10) and remove it from the machine. The weight of the cylinder is 456 lb. (205 kg).



INSTALL EJECTOR CYLINDER

Tools Needed		A
8S9906	Ratchet Puller	1

1. Fasten a hoist to ejector cylinder (1) and put it in position on the frame of the ejector as shown. Remove the hoist.
2. Fasten tool (A) and lifting straps to the ejector overflow guard. Fasten the lifting straps to the ejector cylinder. Lift the cylinder and put it on wood blocks (3) as shown. Move the cylinder into position until the hole in the rod end is in alignment with the holes in the bracket on the ejector. Install pin (2), the washer, lock and two bolts that hold pin (2) in position.
3. Put wood blocks on the crossmember of the bowl at the head end of the cylinder.
4. Lower the cylinder on to the wood blocks. Remove tool (A) and the lifting straps from the cylinder.



VEHICLE SYSTEMS

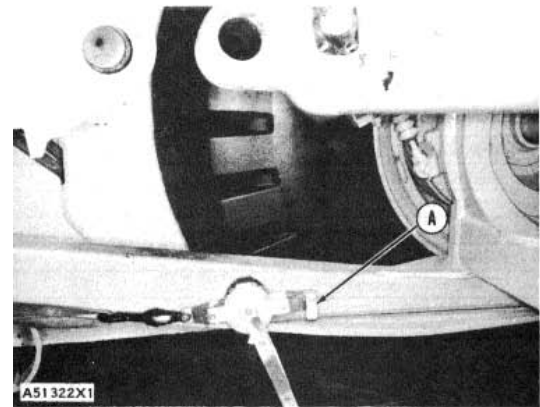
DISASSEMBLY AND ASSEMBLY

EJECTOR CYLINDER

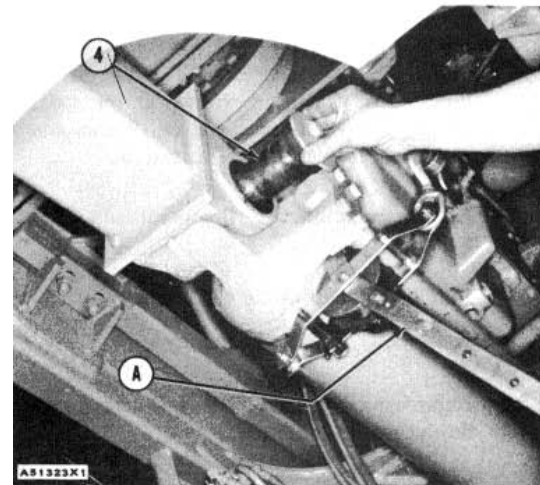


WARNING: Keep away from the area of the ejector cylinder when it is pulled into position under the power pack with tool (A). The cylinder can fall off the wood blocks.

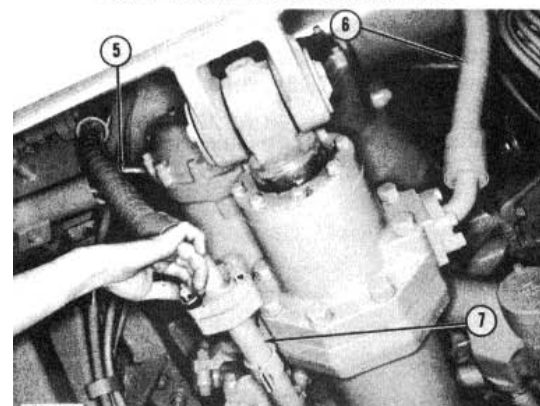
5. Fasten tool (A) to the rear of the ejector frame and to the frame of the bowl. Pull the ejector and cylinder to the rear until the hole in the head end of the cylinder is in alignment with the holes in the bracket in the frame of the bowl. Remove tool (A).
6. Fasten tool (A) and a lifting strap around the head end of the cylinder as shown. Tool (A) is used to move the cylinder up or down.
7. Lift or lower the cylinder until pin (4) can be installed. Install the pin, washer, lock and two bolts that hold the pin in position. Remove tool (A). Remove all wood blocks.
8. Install tube assembly (7) and the clip.
9. Connect hose (6) to the cylinder.
10. Connect hose (5) to the tube assembly.
11. Start the engine and lift the bowl. Remove the wood blocks from under it.
12. Move the ejector fully forward and back to the rear several times to release the air in the cylinder.
13. Fill the hydraulic tank with oil to the correct level. See Lubrication and Maintenance Guide.



VIEW FROM UNDER SCRAPER



VIEW FROM UNDER SCRAPER



VIEW FROM UNDER SCRAPER

VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

EJECTOR CYLINDER

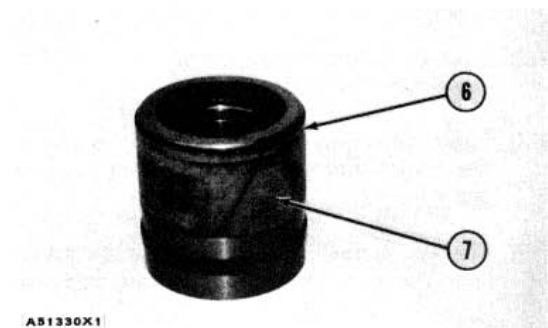
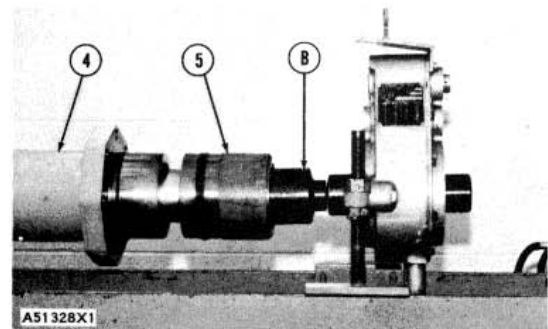
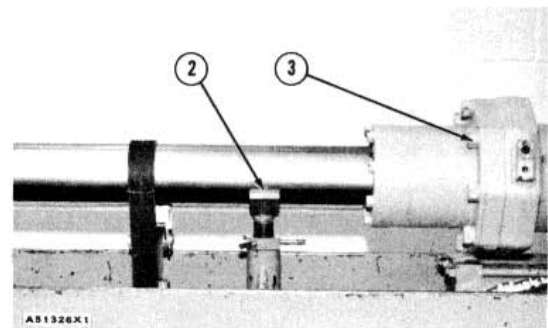
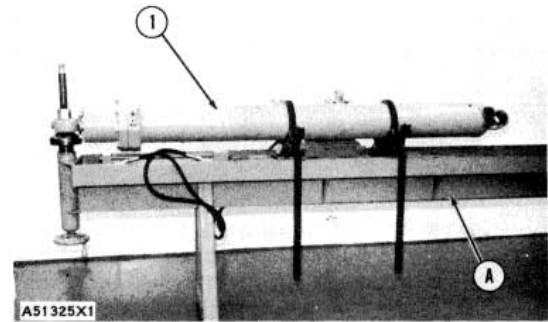
DISASSEMBLE EJECTOR CYLINDER

Tools Needed		A	B
1P1784	Hydraulic Repair Stand	1	
5P3100	Pump Group	1	
586082	Socket		1
1P850	Torque Multiplier		1
1P851	Adapter		1
1P852	Adapter		1
FT948	Bracket		1

start by:

a) ejector cylinder

- Put ejector cylinder (1) in position on tool (A) as shown.
- Pull the rod out of the cylinder all the way and install support (2) under the rod. Fasten a strap around the rod to hold it in position.
- Remove eight bolts (3) that hold the head to the cylinder.
- Pull the cylinder off the piston assembly and rod with tool (A).
- Remove the nut that holds the piston assembly on the rod with tooling (B).
- Remove piston assembly (5) from the rod. The weight of the piston is 35 lb. (16 kg). Fasten a hoist to head (4) and remove it from the rod. The weight of the head is 80 lb. (36 kg).
- Remove two seal assemblies (6) and wear ring (7) from the piston.

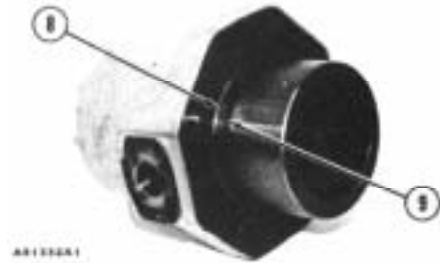


VEHICLE SYSTEMS

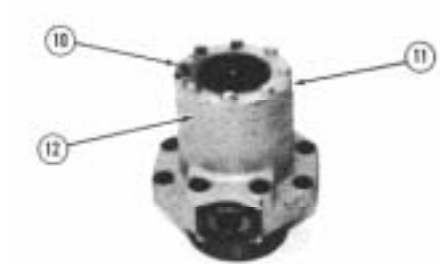
DISASSEMBLY AND ASSEMBLY

EJECTOR CYLINDER

8. Remove ring (8) and seal (9) from the head.



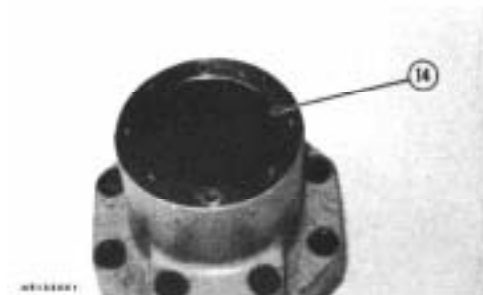
9. Remove eight bolts (10), retainer (11) and shims (12) from the head.



10. Remove wiper (13) from the retainer.

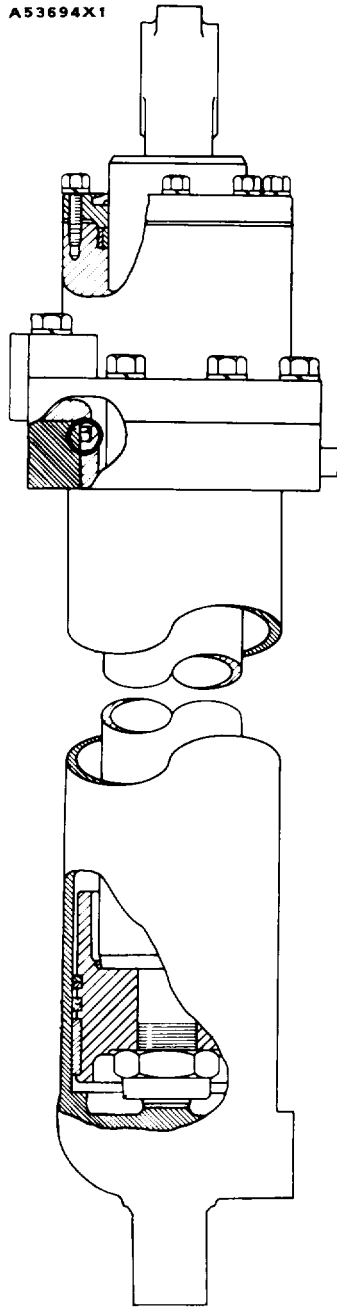


11. Remove packing (14) from the head.



EJECTOR CYLINDER

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VEHICLE SYSTEMS

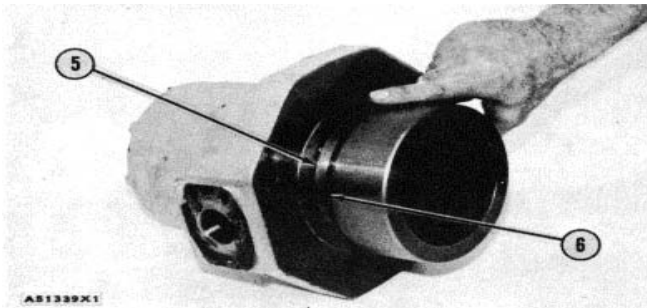
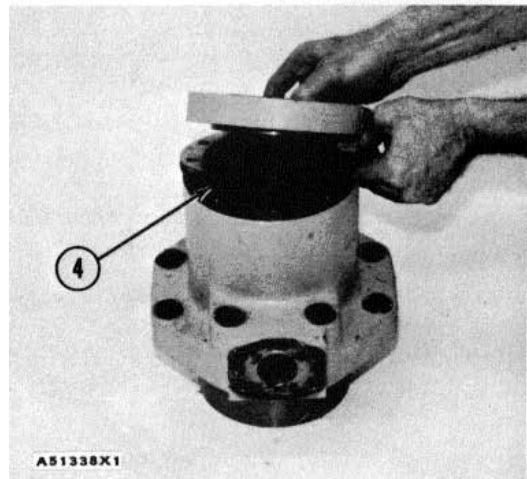
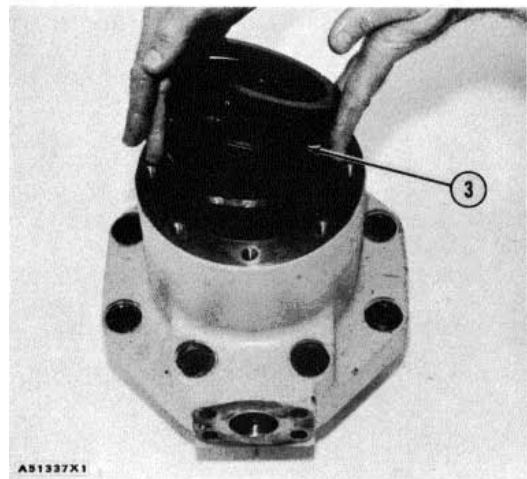
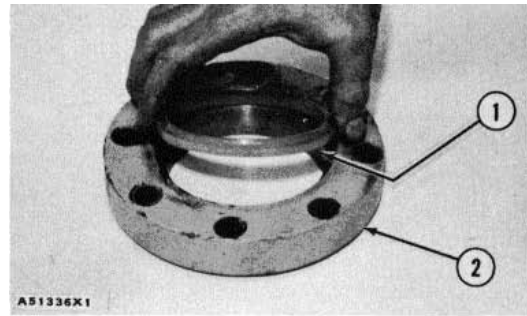
DISASSEMBLY AND ASSEMBLY

EJECTOR CYLINDER

ASSEMBLE EJECTOR CYLINDER

	Tools Needed	A	B	C
1P1784	Hydraulic Cylinder			
	Repair Stand	1		
5P3100	Pump Group	1		
5S6082	Socket		1	
1P850	Torque Multiplier		1	
1P851	Adapter		1	
1P852	Adapter		1	
9S7352	Torque Wrench			1
FT948	Bracket	1		

1. Install wiper (1) in retainer (2) with the lip on the wiper toward the outside as shown.
2. Install packing (3) in the head as shown.
3. Install original amount of shims (4) and the retainer on the head. Install the bolts that hold the retainer in position.
4. Install ring (5) and O-ring seal (6) on the head as shown.

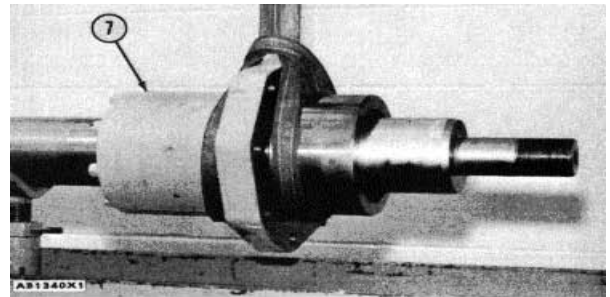


VEHICLE SYSTEMS

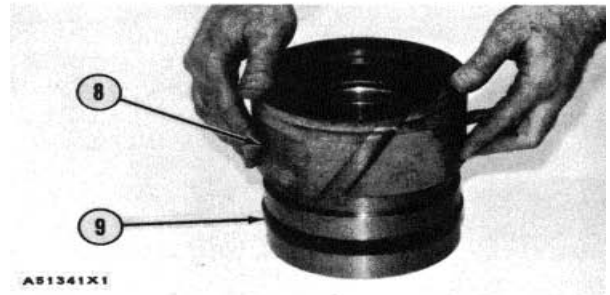
DISASSEMBLY AND ASSEMBLY

EJECTOR CYLINDER

5. Put clean oil on the lip of the wiper and the packing. Fasten a hoist to head (7) and put it in position over the rod as shown.

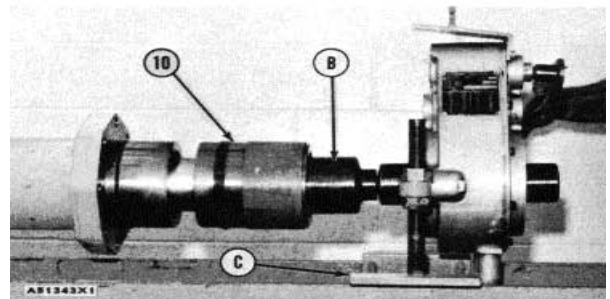


6. Install seal assembly (9) and wear ring (8) on the piston.



7. Install piston assembly (10) on the rod as shown.

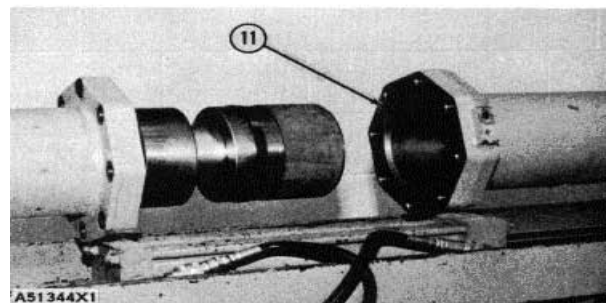
8. Install the nut that holds the piston assembly in position on the rod. Tighten the nut with tooling (B) and (C) to a torque of $800 + 75$ lb. ft. ($1090 + 100$ N m).



9. Put clean oil on the O-ring seal in the head and on the piston assembly.

10. Install cylinder (11) over the piston assembly.

11. Install the eight bolts that hold the head to the cylinder. Make sure the rod is extended when the bolts are tightened.



12. Retract the rod into the cylinder.

end by:

- a) install ejector cylinder

VEHICLE SYSTEMS

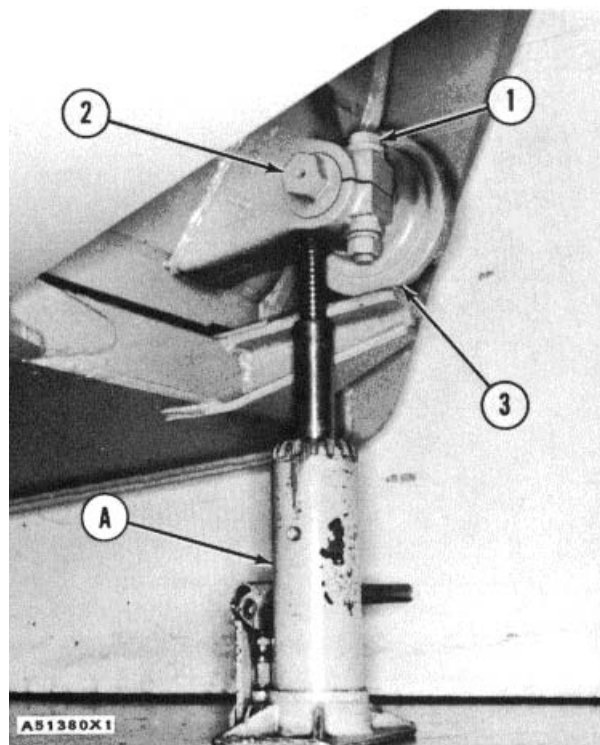
DISASSEMBLY AND ASSEMBLY

EJECTOR CARRIER ROLLERS (LOWER FRONT)

REMOVE EJECTOR CARRIER ROLLERS (LOWER FRONT)

	Tools Needed	A
2B9886	Hydraulic Jack	1

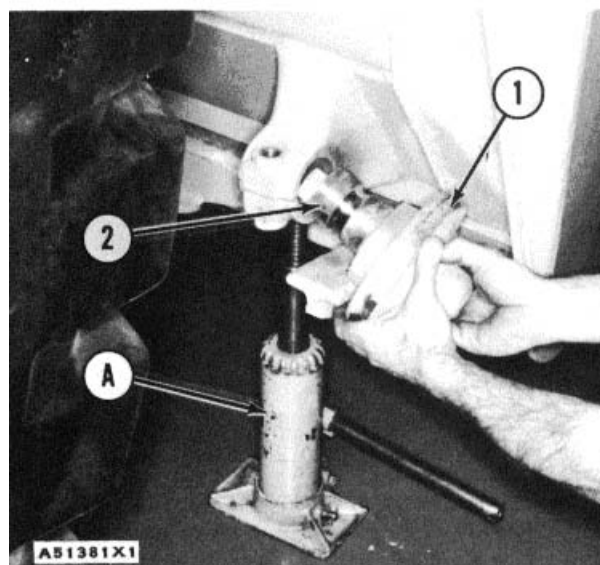
1. Start the engine and move the ejector to the rear all the way. Stop the engine.
2. Put tool (A) in position under the bracket on the ejector as shown. Tool (A) is used as a support.
3. Remove lock bolt (1) and the nut that holds the ejector carrier roller in position.
4. Turn shaft (2) until the roller is clear of the bowl. Remove ejector carrier roller (3).



INSTALL EJECTOR CARRIER ROLLERS (LOWER FRONT)

	Tools Needed	A
2B9886	Hydraulic Jack	1

1. Put ejector carrier roller (1) in position in the bracket on the ejector as shown.
2. Make an adjustment to the ejector carrier roller for the correct distance between the ejector and the bottom of the bowl as follows:
 - a) Turn shaft (2) until the minimum distance between the ejector and the bottom of the bowl is .03 in. (0.8 mm). The maximum clearance between the ejector and the bottom of the bowl must not be more than .50 in. (12.7 mm).
3. Install the lock bolt and nut in the bracket.
4. Remove tool (A).



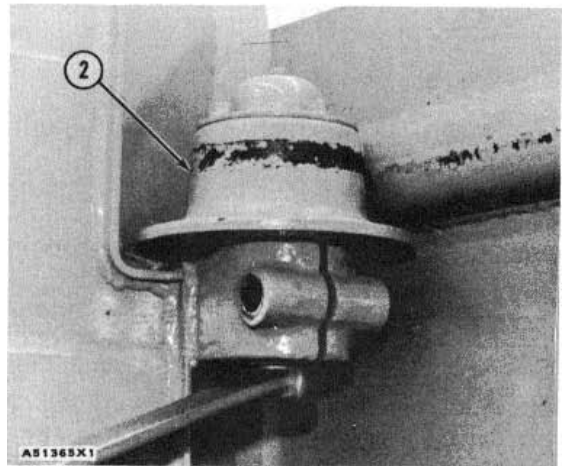
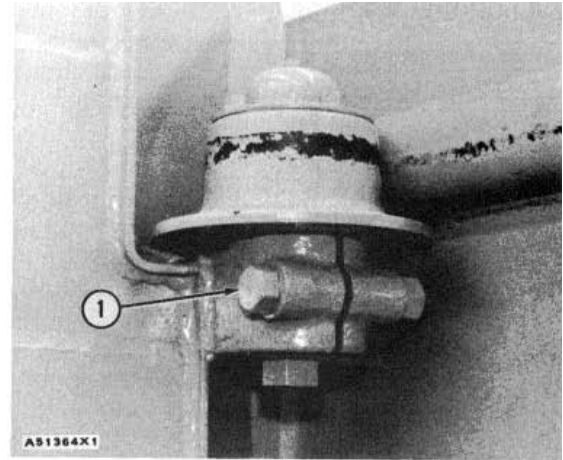
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

EJECTOR GUIDE ROLLERS

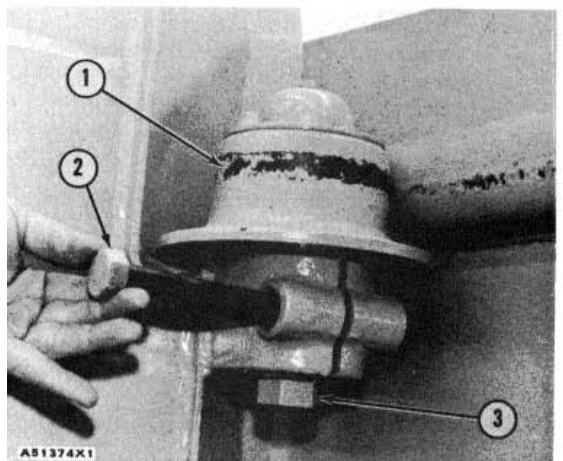
REMOVE EJECTOR GUIDE ROLLERS

1. Start the engine and move the ejector forward all the way. Stop the engine.
2. Remove lock bolt (1) and nut that hold the guide roller in position.
3. Turn the shaft in the guide roller until there is clearance between the rail assembly and roller. Remove ejector guide roller (2).



INSTALL EJECTOR GUIDE ROLLERS

1. Put the ejector guide bolts (1) in position in the bracket on the ejector.
2. Make an adjustment to the ejector guide roller for the correct distance between the sides of the ejector and the sides of the bowl as follows:
 - a) Turn shaft (3) until the minimum distance between the side of the ejector and the side of the bowl is .12 in. (3 mm). The maximum clearance between the side of the ejector and the side of the bowl must not be more than .75 in. (19 mm).
3. Install lock bolt (2) and the nut.



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

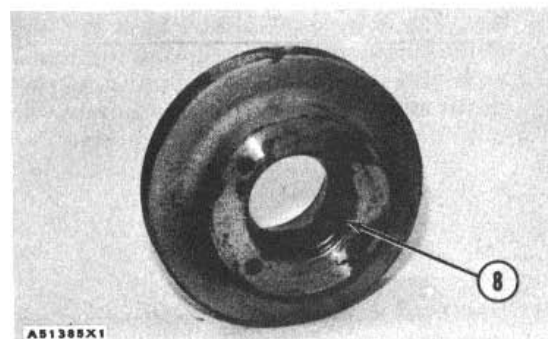
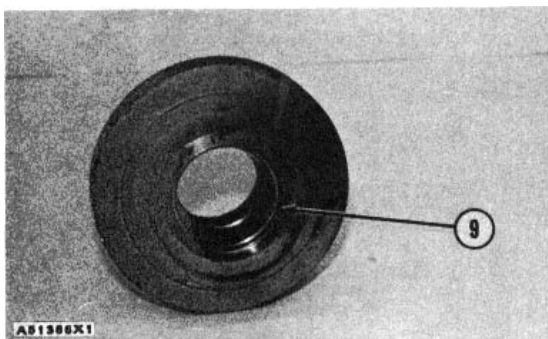
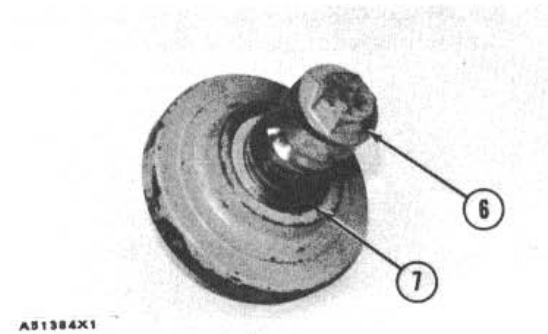
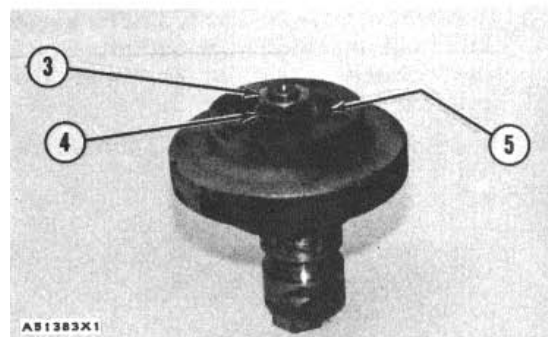
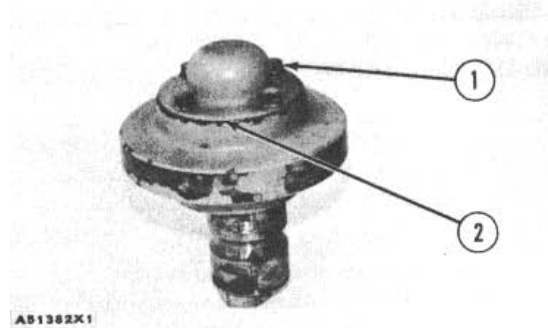
EJECTOR CARRIER ROLLERS (LOWER FRONT)
AND EJECTOR GUIDE ROLLERS

DISASSEMBLE EJECTOR CARRIER ROLLERS
(LOWER FRONT) AND EJECTOR
GUIDE ROLLERS

start by:

- a) remove ejector carrier rollers (lower)
- b) remove ejector guide rollers

1. Remove four bolts (1), cap (2) and the gasket from the roller.
2. Remove nut (3), lock and washer (4) from the shaft.
3. Remove bearing cone (5) from the roller.
4. Remove shaft (6), seal (7) and the bearing cone from the roller.
5. Remove bearing cup (8) from the roller with a hammer and a brass punch.
6. Remove bearing cup (9) from the roller with a hammer and a brass punch.

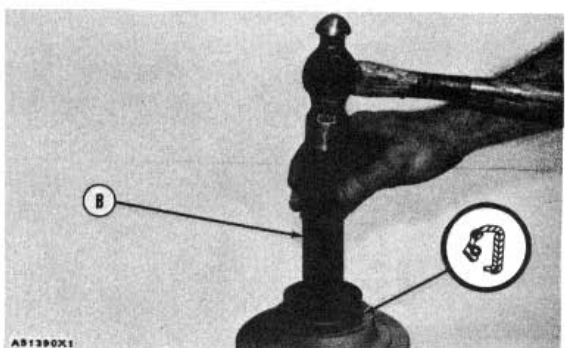
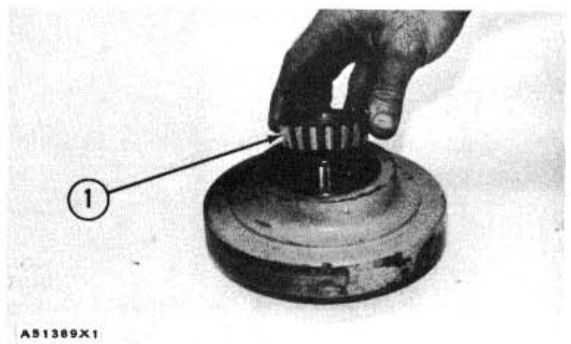
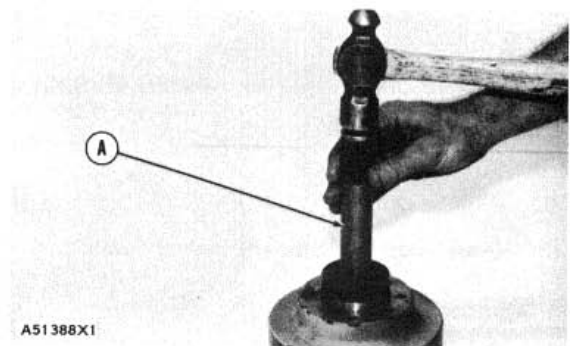
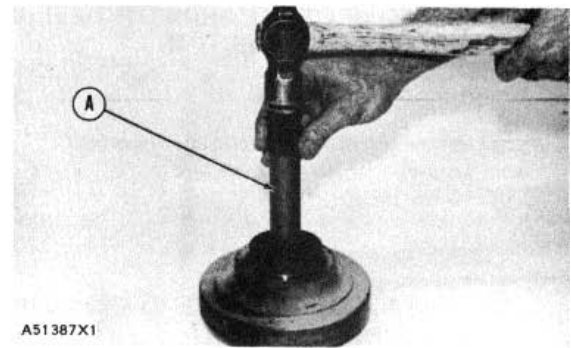


**EJECTOR CARRIER ROLLERS (LOWER FRONT)
AND EJECTOR GUIDE ROLLERS**

**ASSEMBLE EJECTOR CARRIER ROLLERS
(LOWER FRONT) AND EJECTOR
GUIDE ROLLERS**

	Tools Needed	A	B
1P510	Driver Group	1	
1P520	Driver Group		1

1. Install the large bearing cup in the roller with tooling (A). Install the bearing cup until it makes contact with the counterbore in the roller.
2. Turn the roller over. Install the small bearing cup in the roller with tool (A). Install the bearing cup until it makes contact with the bottom of the counterbore in the roller.
3. Put 5P960 Multipurpose Type Grease on the large bearing cone. Install bearing cone (1) in the roller.
4. Install the lip type seal in the roller with tooling (B). Install the seal with the lip toward the inside of the roller and until the seal makes contact with the bottom of the counterbore in the roller.
5. Put 5P960 Multipurpose Type Grease on the lip of the seal.

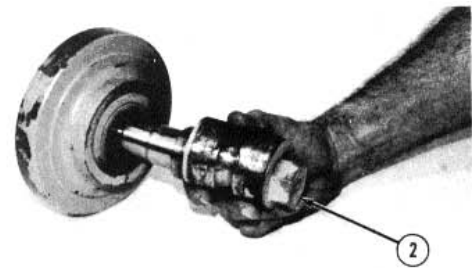


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

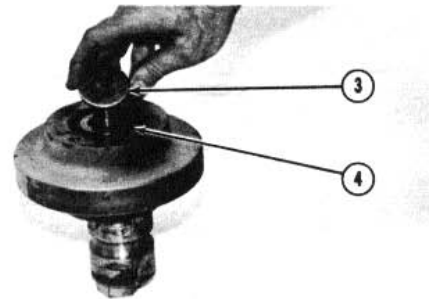
EJECTOR CARRIER ROLLERS (LOWER FRONT)
AND EJECTOR GUIDE ROLLERS

6. Install shaft (2) in the roller as shown.



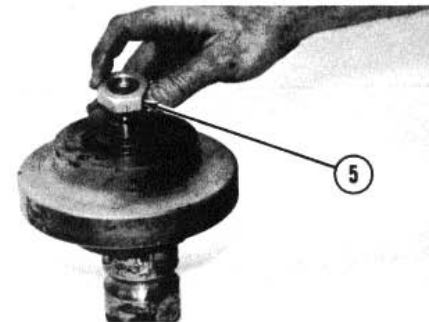
A51391X1

7. Put 5P960 Multipurpose Type Grease inside the roller and on bearing cone (4). Install bearing cone and washer (3).



A51392X1

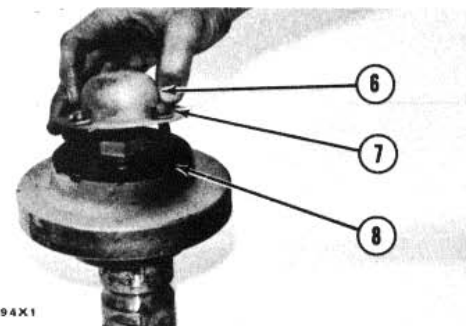
8. Install nut (5). Tighten the nut until the roller will not turn by hand. Loosen the nut 1/16 of one turn.



A51393X1

9. Install gasket (8) and cap (6). Install bolts (7) that hold the cap end by:

- a) install ejector carrier rollers (lower)
- b) install ejector guide rollers



A51394X1

VEHICLE SYSTEMS

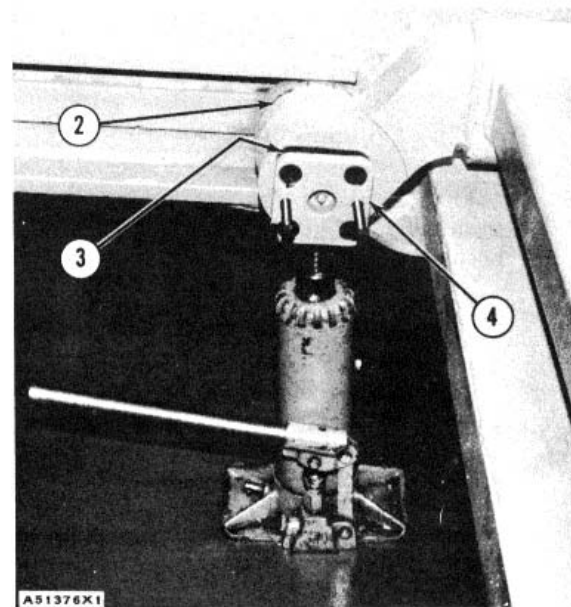
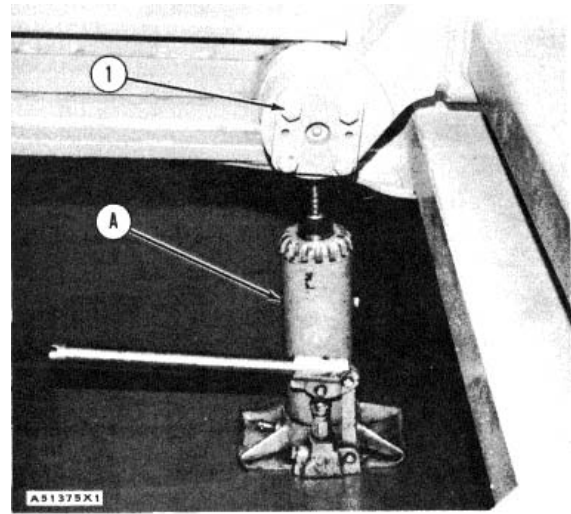
DISASSEMBLY AND ASSEMBLY

EJECTOR CARRIER ROLLERS (REAR)

REMOVE EJECTOR CARRIER ROLLERS (REAR)

Tools Needed		A
2B9886	Hydraulic Jack	1

1. Start the engine and move the ejector forward all the way. Stop the engine.
2. Put tool (A) under the bracket at the rear of the ejector. Tool (A) is used as a support when the carrier roller is removed.
3. Remove four bolts (1).
4. Install two 3/8"-16 NC forcing screws in shaft (4). Tighten the screws evenly until the shaft is loose. Remove the shaft, shims (3) and carrier roller (2).



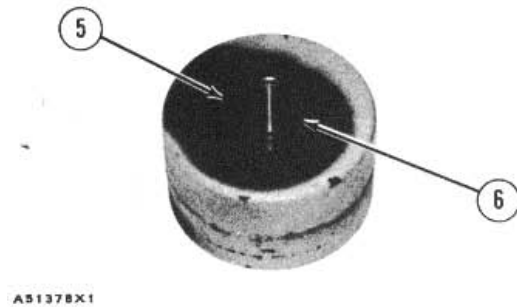
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

EJECTOR CARRIER ROLLERS (REAR)

5. Remove lip type seal (5) from the ejector carrier roller.

6. Remove bearing (6) from the roller with a hammer and punch.



A51378X1

INSTALL EJECTOR CARRIER ROLLERS (REAR)

Tools Needed	A	B
2B9886	Hydraulic Jack	1
1P510	Driver Group	1

1. Install the bearing in the roller with tooling (B). Install the bearing in the roller until it makes contact with the bottom of the bore.

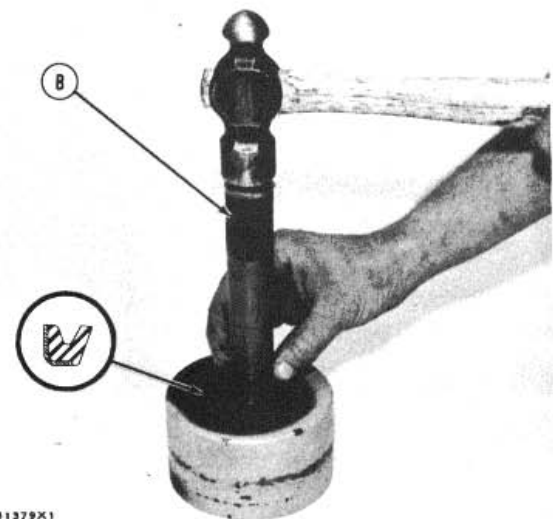
2. Install the lip type seal in the roller with tool (B). Install seal with the lip toward the outside of the roller and until it makes contact with the bearing.

3. Put ejector carrier roller (1) in position in the guide track. Install shims (2) and shaft (3).

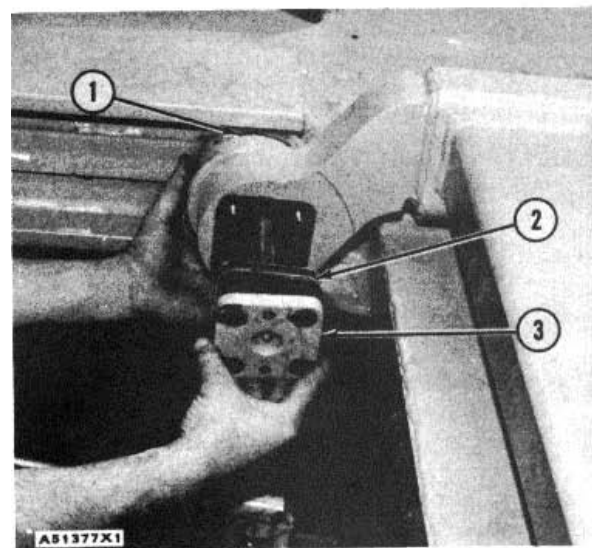
4. Make an adjustment to the ejector carrier roller until the total horizontal clearance between the rollers and the guide track is .12 - .12 in. (3.0 + 3.0 mm). Add or remove shims until the clearance is correct.

5. Install the four bolts that hold the shaft.

6. Remove tool (A).



A51379X1



A51377X1

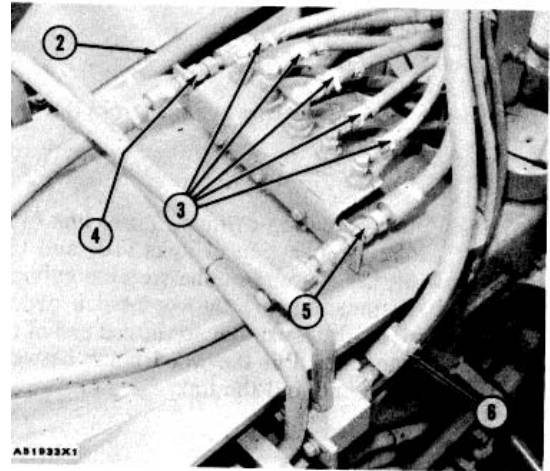
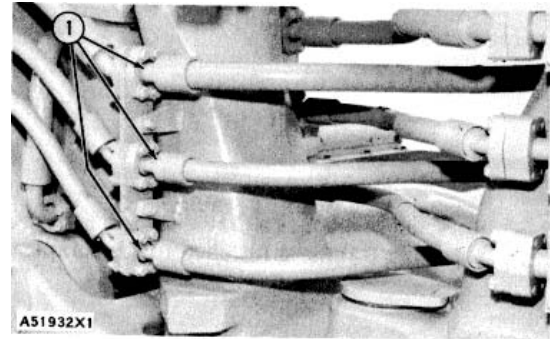
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

TRACTOR AND SCRAPER

SEPARATION OF TRACTOR AND SCRAPER

Tools Needed		A	B	C
8S7630	Stand	2	2	
8S7625	Collar	2		
8S8048	Saddle	2	2	
8S7631	Tube	2		
8S7621	Tube		2	
8S7650	Cylinder	2		
8S7615	Pin	4	2	
8S7645	Hose Group	1		
5P3100	Pump Group (or electric)	1		
2G2827	Block Assembly			2
1D4609	Bolt			2
1D5119	Nut			2



⚠ WARNING

Before any hydraulic lines or air lines are disconnected, make sure the pressure in the hydraulic tank is released and the air pressure is zero. Start the engine and move the ejector forward all the way. Lower the bowl. Stop the engine and loosen the cap on the hydraulic tank slowly. Drain the air from the air tanks under the operator's station.

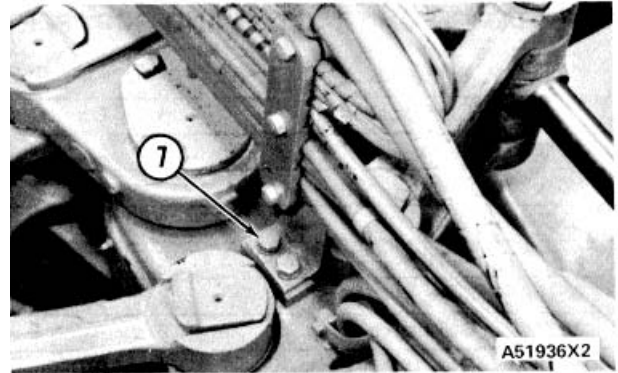
1. Loosen the lock screw and turn the worm shaft on the slack adjuster until the brakes on the tractor part of the machine release.
2. Put identification on six hose assemblies (1) for correct installation. Disconnect the hoses at the tractor. Put plugs in the hoses to keep dirt out.
3. Put identification marks on the nine hose assemblies that are connected above the draft frame. For assembly purposes, disconnect hose assemblies (2), (3), (4), (5) and (6).

VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

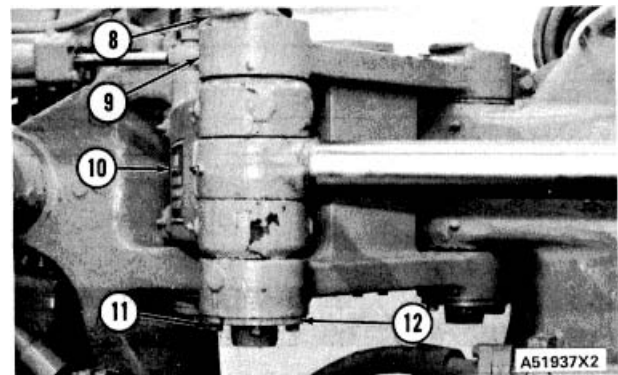
TRACTOR AND SCRAPER

4. Remove two bolts (7). Move the hydraulic hoses and bracket as a unit away from the area where the tractor is fastened to the scraper.



TYPICAL EXAMPLE

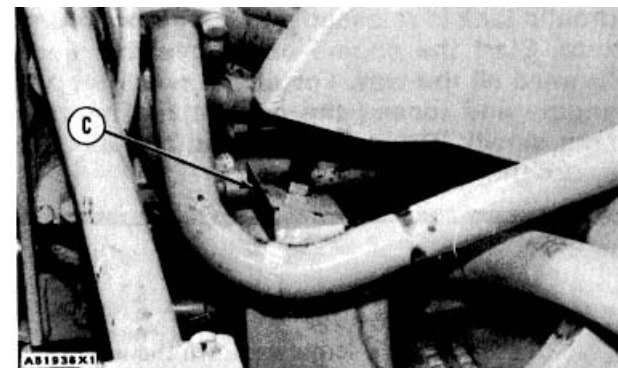
5. Disconnect the steering cylinder from the links as follows:
- Remove bolts (11) and two yokes (12). Remove pin (8).
 - Pull the steering cylinder out of link (10). Make a separation of links (10) and (9). Push the rod end of the steering cylinder back into link (9). A wood block can be used as a support to hold the rod end of the cylinder up. Put the wood block between the rod end and the link.



TYPICAL EXAMPLE

6. Disconnect the other steering cylinder from the links as in Steps 5a and 5b.

7. Put tool (C) in position between the hitch assembly and the frame assembly stop as shown. Install tool (C) between the other frame assembly stop and the hitch assembly. Tooling (C) is used to hold the hitch assembly so it can not move from side to side. Make sure the bolts in tooling (C) are tight against the hitch assembly.

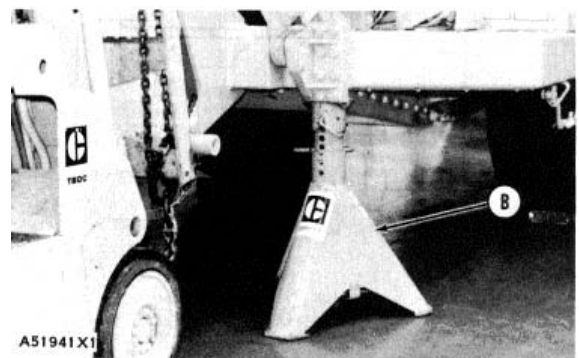
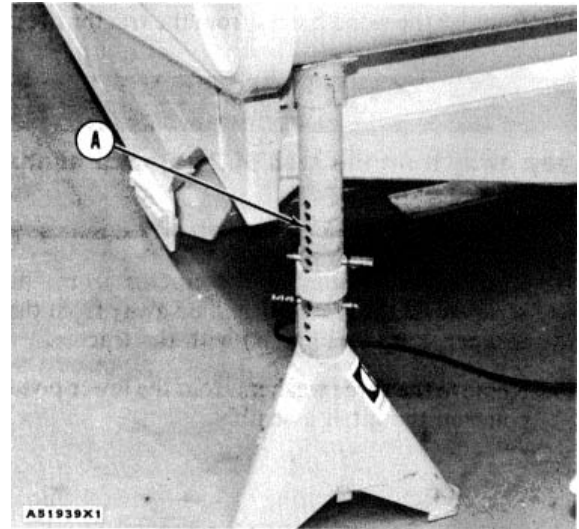


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

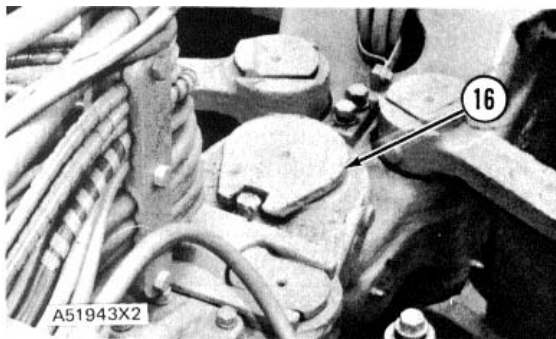
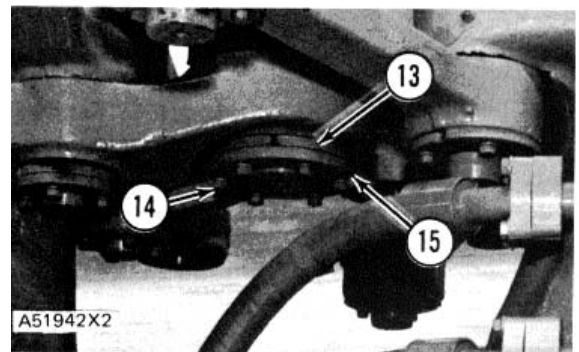
TRACTOR AND SCRAPER

8. Put wood blocks in front and behind all four tires.
9. Put tooling (A) in position under the draft frame on each side of the machine as shown.
10. Lift the draft frame with tooling (A) until the weight of the draft frame is off of the hitch at the connection points.
11. Put tooling (B) in position under both sides of the push-pull support assembly.



NOTE: The lift truck used in the following steps must have the capacity to safely hold a weight of approximately 7000 lb. (3150 kg).

12. Fasten the lift truck to the push-pull plate. Make sure the forks of the lift truck are against the bottom of the plate.
13. Remove six bolts (14) and washers, plate (15) and two yokes (13) from the upper pin assembly.
14. Remove upper pin assembly (16). If necessary move the tractor up and down with the lift truck until the pin assembly is free.



15. Remove the six bolts, plate and two yokes that hold the lower pin assembly in position. Remove lower pin assembly (17). If necessary move the tractor up and down with the lift truck until the pin assembly is free.

16. Remove washer (18).

VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

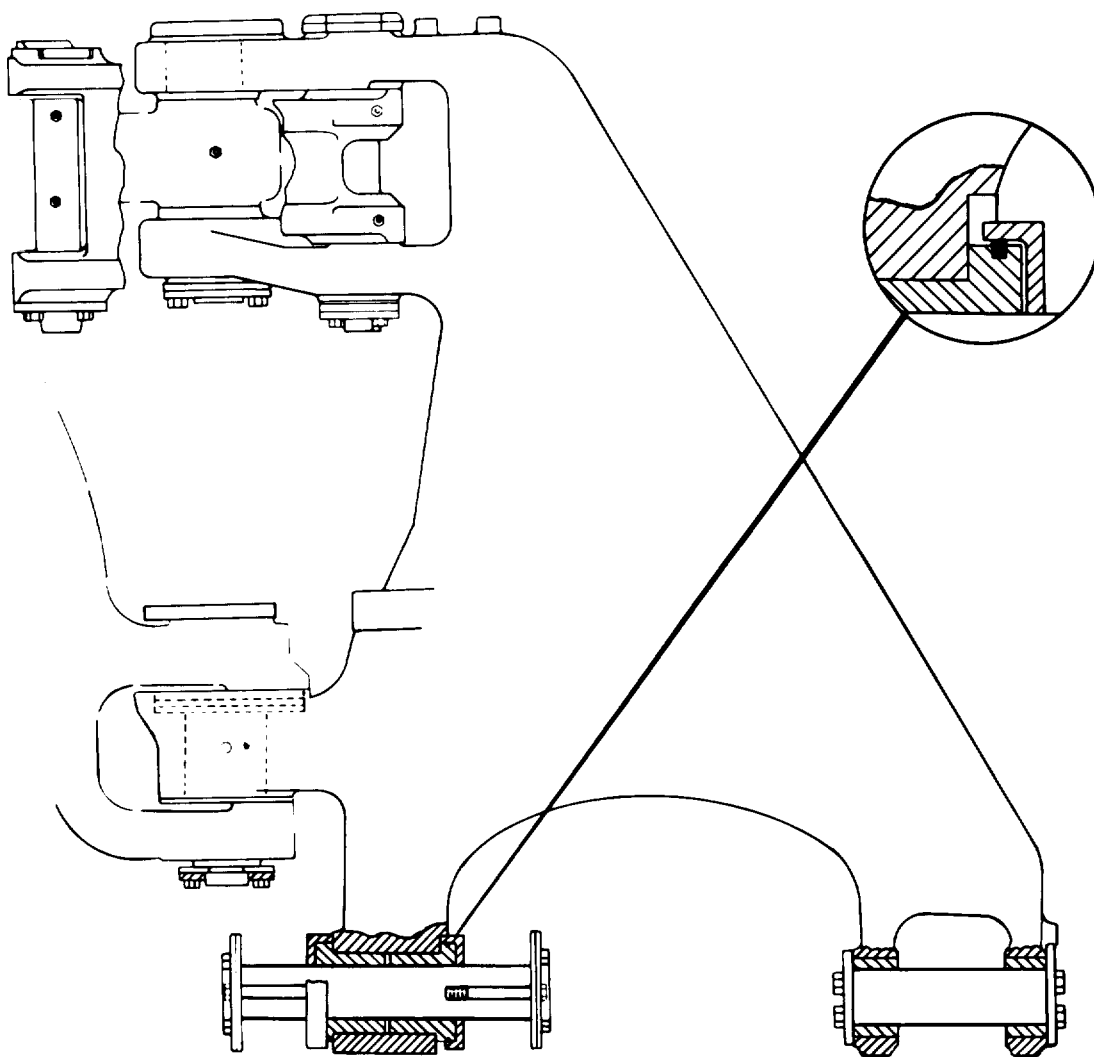
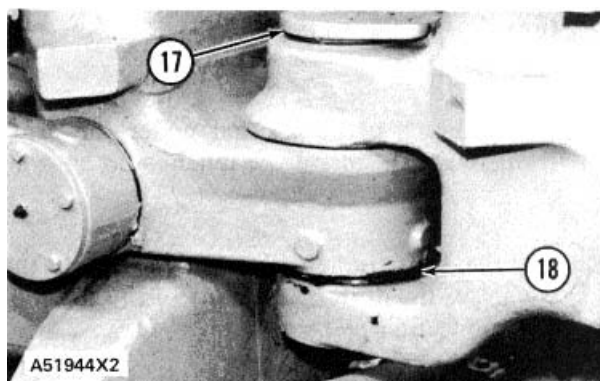
TRACTOR AND SCRAPER

17. Remove the wood blocks from the tractor tires.

⚠ WARNING

Keep away from the area of the tractor as the machine is pulled apart.

18. Make a separation of the tractor from the scraper. As the tractor is pulled away from the scraper, keep tooling (B) with the tractor.
19. Remove the three washers from the lower pivot point on the hitch assembly.



B30851X1

ENGINE

DISASSEMBLY AND ASSEMBLY

TRACTOR AND SCRAPER

CONNECTION OF TRACTOR AND SCRAPER

	Tools Needed	A	B	C
8S7630	Stand	2	2	
8S7625	Collar	2		
8S8048	Saddle	2	2	
8S7631	Tube	2		
8S7621	Tube		2	
8S7650	Cylinder	2		
8S7615	Pin	4	2	
8S7645	Hose Group	1		
5P3100	Pump Group (or electric)	1		
2G2827	Block Assembly			2
1D4609	Bolt			2
1D05119	Nut			2

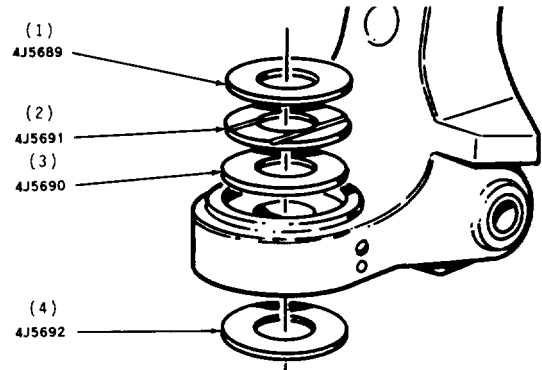
WARNING

Make sure tooling (C) is in position before the tractor is connected to the scraper.

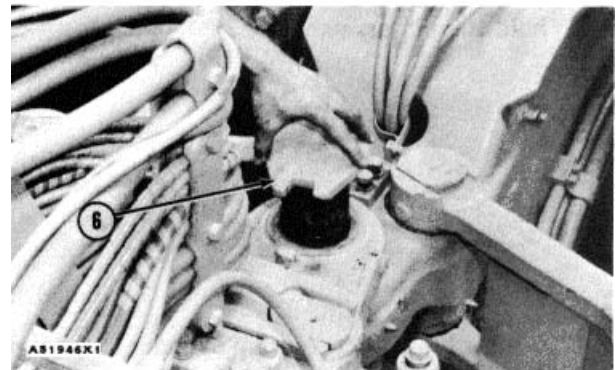
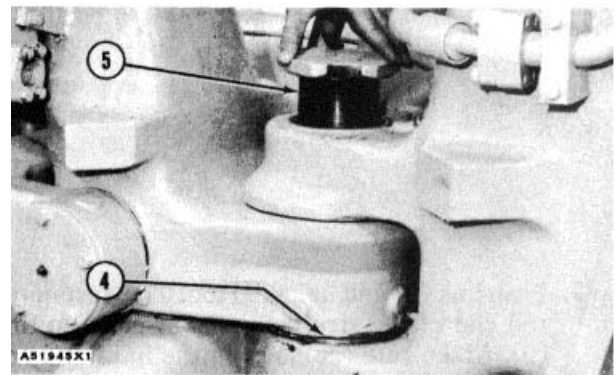
1. Install the three washers in the lower pivot of the hitch assembly as follows: a) Install 4J5690 Drilled Steel Washer (3).
b) Install 4J5691 Drilled Bronze Washer (2).
c) Install 4J5689 Plain Steel Washer (1).

NOTE: The 4J5692 Washer (4) is installed after the tractor is pushed into position on the scraper.

2. Push the tractor in position on the scraper. Make sure the pivot holes in the hitch assembly are in alignment with the pivot holes in the draft frame. If necessary, move the tractor up and down and from side to side to put the pivot holes in alignment with each other.
3. Install lower pin assembly (5) part of the way into the draft frame and hitch assembly. Install washer (4). Install the pin assembly all the way.
4. Install upper pin assembly (6). If necessary, move the tractor up and down with the lift truck to install the pin.



36269X2

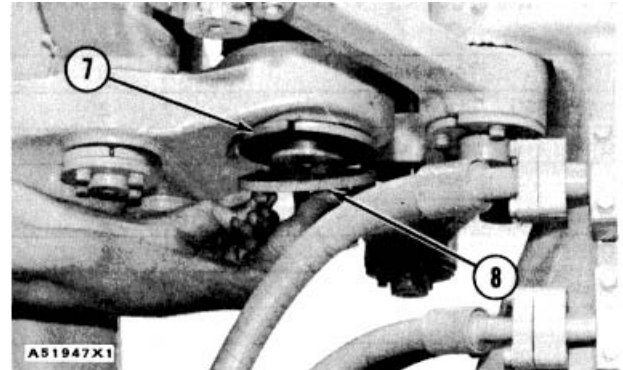


VEHICLE SYSTEMS

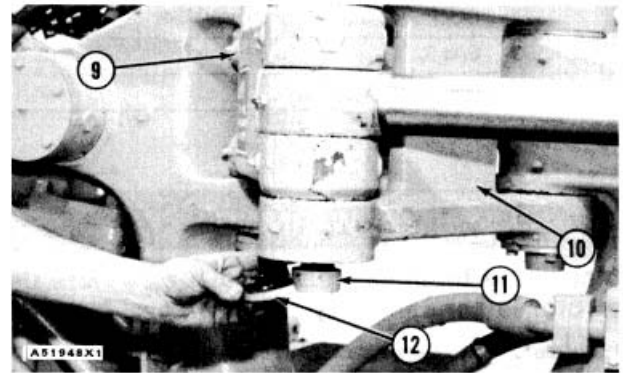
DISASSEMBLY AND ASSEMBLY

TRACTOR AND SCRAPER

5. Install two yokes (7), plate (8) and the bolts that hold the upper pin assembly in position.

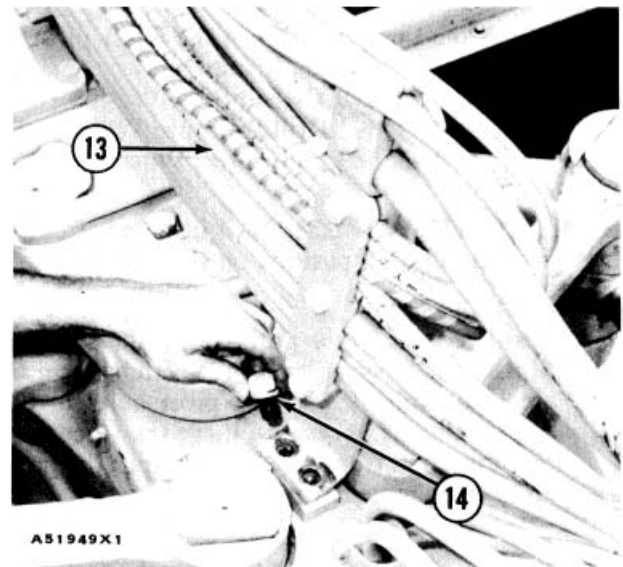


6. Install the two yokes, plate and bolts that hold the lower pin assembly in position.



7. Push link (9) and link (10) together. Install the rod end of the steering cylinder between link (9). Make sure the holes in the links and rod end are all in alignment. Install pin assembly (11). Install two yokes (12) and the bolts that hold the pin assembly.

8. Connect the other steering cylinder to the links as in Step 7.



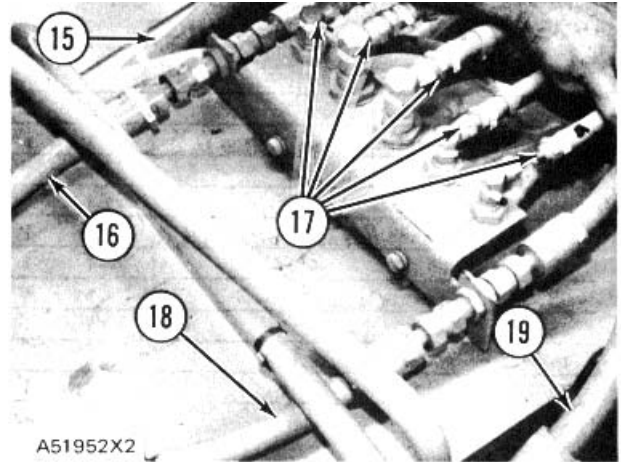
9. Put all small hydraulic hoses (13) and the bracket that holds them in position above the draft frame. Install two bolts (14) that hold the bracket.

VEHICLE SYSTEMS

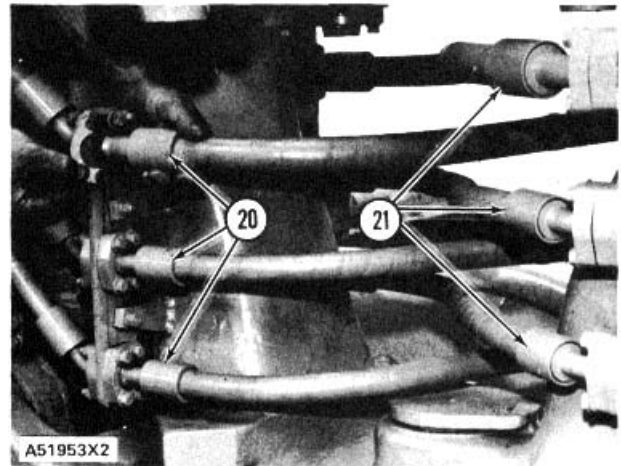
DISASSEMBLY AND ASSEMBLY

TRACTOR AND SCRAPER

10. Connect hose assemblies (15), (16), (17), (18) and (19) at the top of the draft frame. Make sure all the hoses are in the correct positions.



11. Connect six hose assemblies (20) and (21) to the tractor. Make sure the hoses are in the correct positions.



12. Lower the draft frame with tooling (A). Remove tooling (A) and (B) from under the machine.

13. Remove tooling (C) from the hitch assembly.

14. Check the level of oil in the hydraulic tank. See LUBRICATION AND MAINTENANCE GUIDE.

15. Make an adjustment to the brakes.

VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

DRAFT FRAME AND HITCH ASSEMBLY VERTICAL BEARINGS

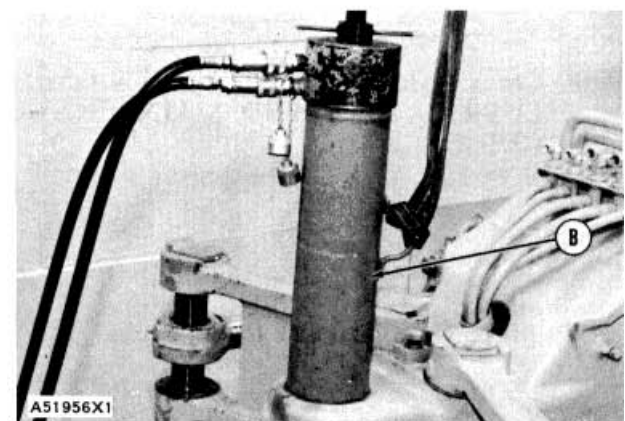
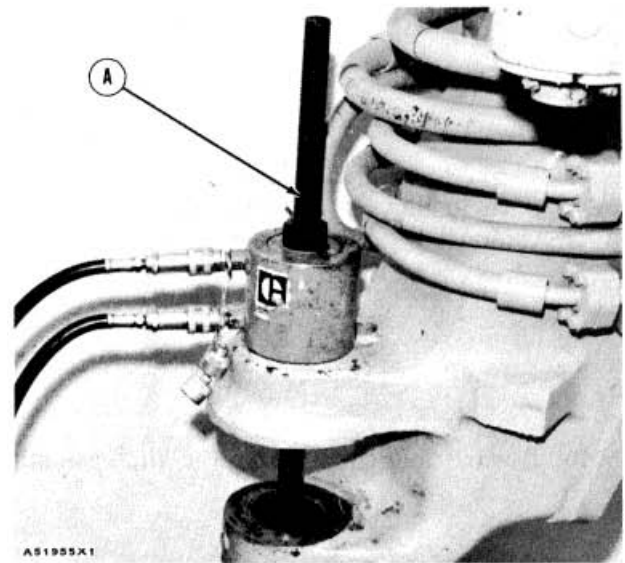
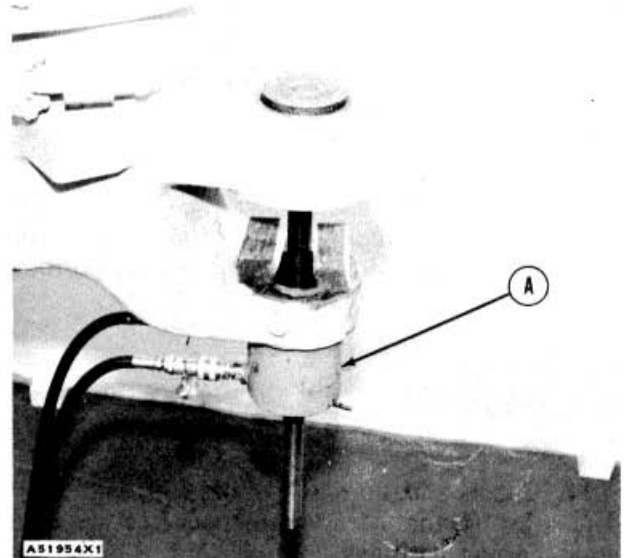
REMOVE DRAFT FRAME AND HITCH ASSEMBLY VERTICAL BEARINGS

	Tools Needed	A	B	C
5P3100	Pump Group (or electric)	1	1	1
5P2998	Puller Assembly	1		1
5P2997	Puller Assembly		1	
1P1840	Bearing Pulling Adapter	1	1	1
1P544	Nut	1	1	1
9S5564	Sleeve Assembly		1	
9S5558	Stud	1	1	1
1M6756	Sleeve Assembly			1
7F5283	Head			1

start by:

a) separation of tractor and scraper

1. Install tooling (A) on the center draft frame bearing as shown. Put small wood blocks below the center draft frame connection. The wood blocks will prevent damage to the lower draft frame connection when the bearing is removed.
2. Remove center draft frame bearing with tooling (A).
3. Install tooling (A) on the lower draft frame bearing as shown.
4. Remove the lower draft frame bearing with tooling (A).
5. Install tooling (B) on the upper draft frame bearing as shown. Fasten a hoist to the tooling.
6. Remove the upper draft frame bearing with tooling (B).

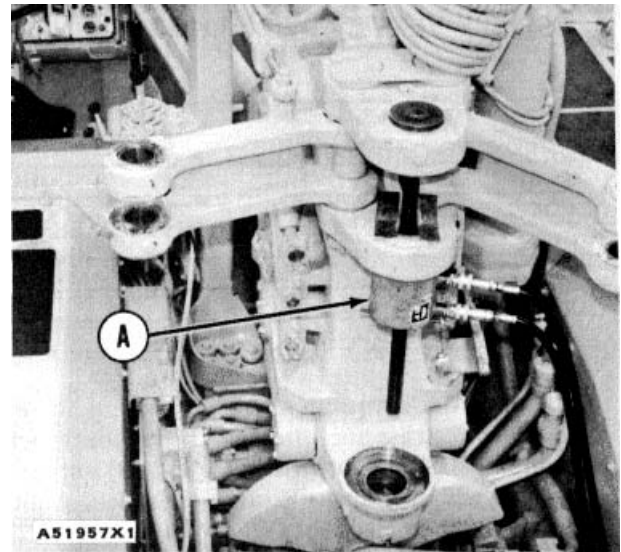


VEHICLE SYSTEMS

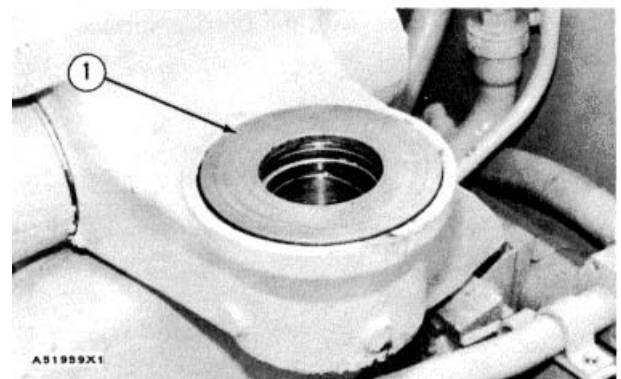
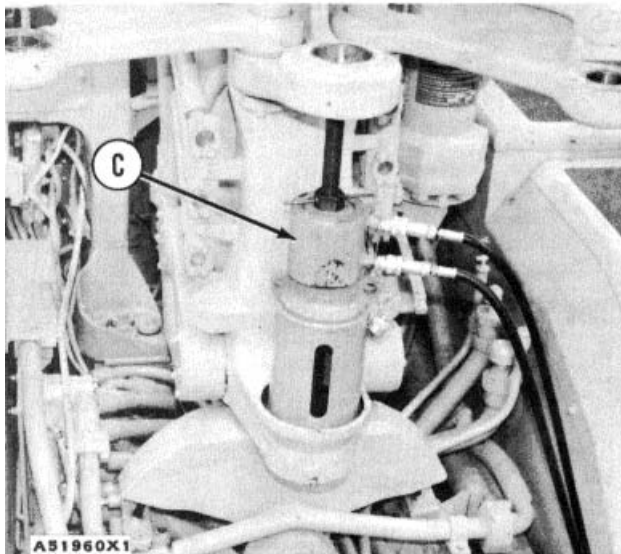
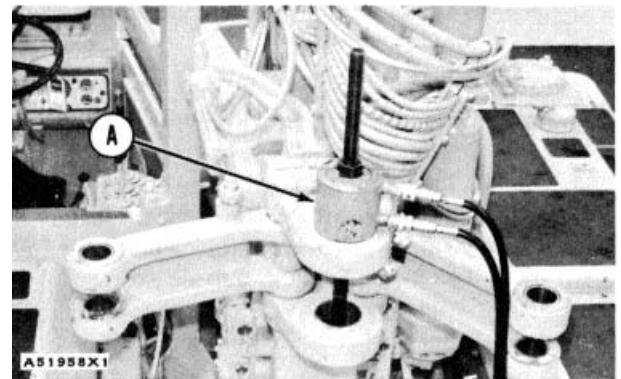
DISASSEMBLY AND ASSEMBLY

DRAFT FRAME AND HITCH ASSEMBLY VERTICAL BEARINGS

7. Install tooling (A) on the upper hitch assembly bearing as shown. Put small wood blocks below the upper hitch assembly connection. The wood blocks will prevent damage to the center hitch assembly connection when the upper bearing is removed.
8. Remove the upper hitch assembly bearing with tooling (A).
9. Install tooling (A) on the center hitch assembly bearing as shown.
10. Remove the center hitch assembly bearing with tooling (A).
11. Put identification on the three washers in the lower hitch assembly connection for correct installation. Remove three washers (I).
12. Fasten tooling (C) to the lower hitch connection.
13. Remove the bearing from the lower hitch connection with tooling (C).



TYPICAL EXAMPLE



VEHICLE SYSTEMS

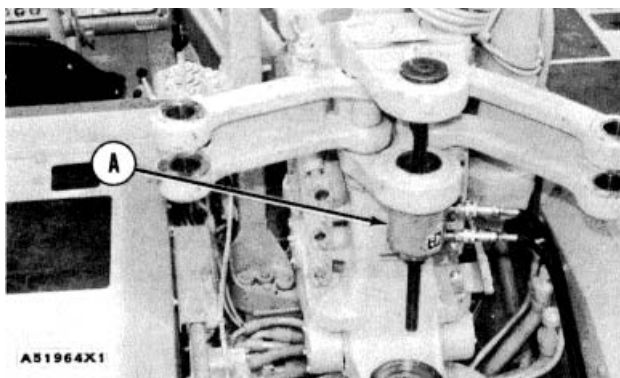
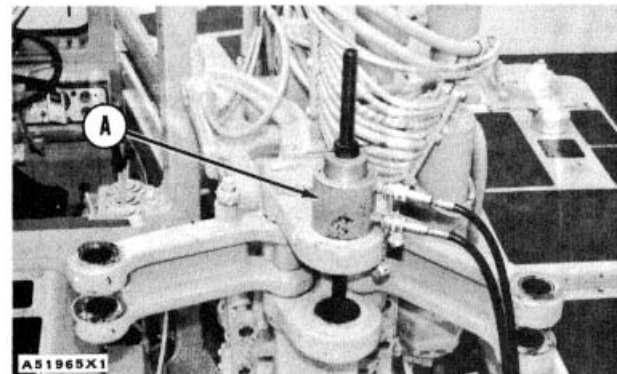
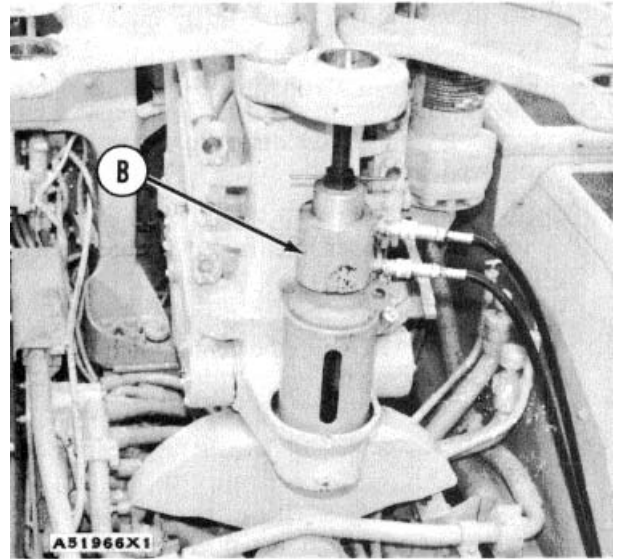
DISASSEMBLY AND ASSEMBLY

DRAFT FRAME AND HITCH ASSEMBLY VERTICAL BEARINGS

INSTALL DRAFT FRAME AND HITCH ASSEMBLY VERTICAL BEARINGS

Tools Needed		A	B
5P3100	Pump Group (or electric)	1	1
5P2998	Puller Assembly	1	1
1P184C	Bearing Pulling Adapter	1	1
1P544	Nut	1	1
9S5558	Stud	1	1
1M6756	Sleeve Assembly		1
7F5283	Head		1

1. Lower the temperature of the bearing for the lower hitch assembly bearing. Install the bearing in the hitch assembly with tooling (B) until it is even with the outside surface of the lower hitch assembly connection.
 2. Install three washers (1) in the lower hitch assembly connection. Make sure the washers are in the correct positions.
- NOTE:** If the washers become mixed, see Connection of Tractor and Scraper for the correct installation procedure.
3. Lower the temperature of the bearing for the center hitch assembly connection. Install the bearing on the hitch assembly with tooling (A) until it is even with the outside surface of the center connection.
 4. Lower the temperature of the bearing for the upper hitch assembly connection. Install the bearing in the hitch assembly with tooling (A) until it is even with the outside surface of the upper connection.



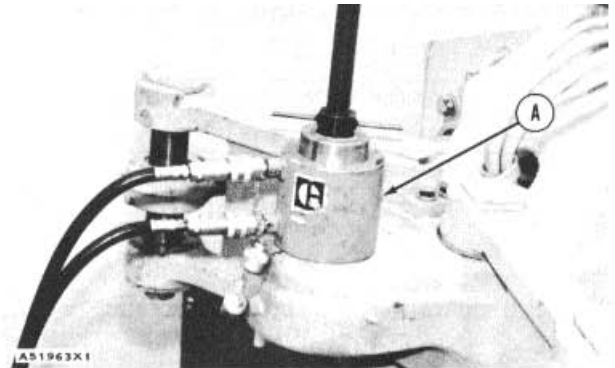
TYPICAL EXAMPLE

VEHICLE SYSTEMS

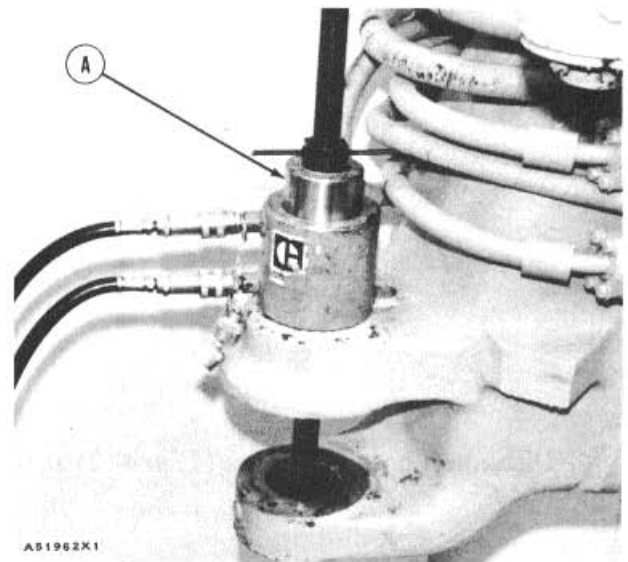
DISASSEMBLY AND ASSEMBLY

DRAFT FRAME AND HITCH ASSEMBLY VERTICAL BEARINGS

5. Lower the temperature of the bearing for the upper draft frame connection. Install the bearing in the draft frame with tooling (A) until it is even with the outside surface of the connection.

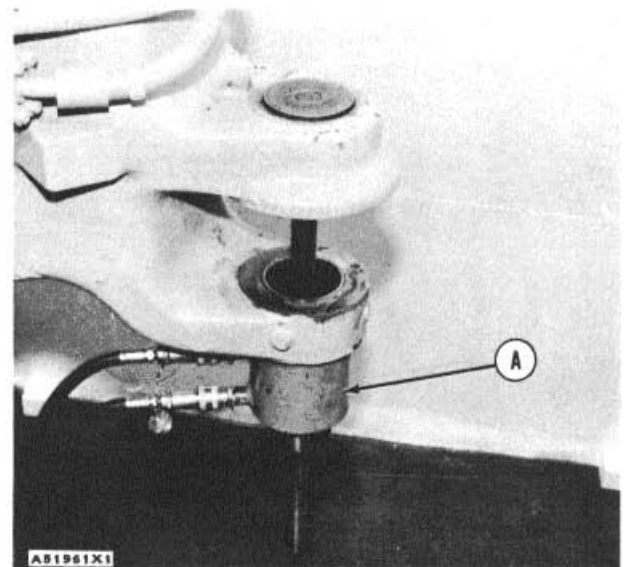


6. Lower the temperature of the bearing for the center draft frame connection. Install the bearing in the draft frame with tooling (A) until it is even with the outside surface of the connection.



7. Lower the temperature of the bearing for the lower draft frame connection. Install the bearing in the draft frame with tooling (A) until it is even with the outside surface of the connection.
end by:

a) connection of tractor and scraper



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

HITCH

REMOVE HITCH

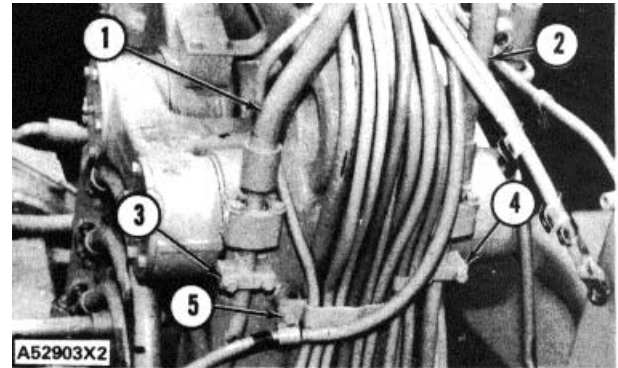
7107-11

Tools Needed		A	B
5P7367	Socket	1	
8S7650	Cylinder		1
5P3100	Pump Group (or electric)	1	

start by:

a) separation of tractor and scraper

1. Drain the oil from the hydraulic tank.



2. Disconnect hose assemblies (1) and (2) at the hitch.

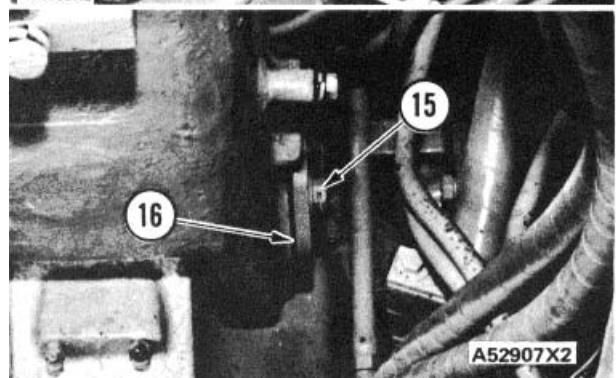
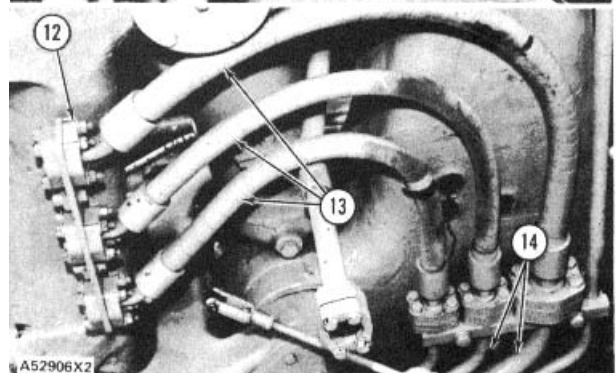
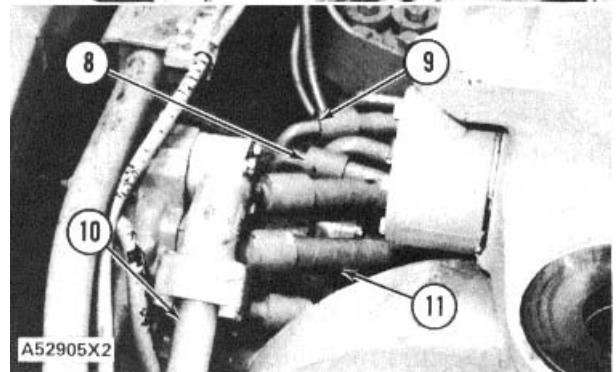
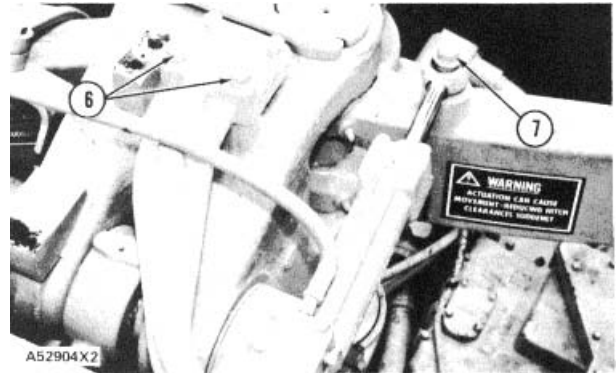
3. Remove two clamps (3) and (4).

4. Remove all clamps (5) that hold the hydraulic hoses to the hitch. Move all the hoses away from the hitch.

VEHICLE SYSTEMS DISASSEMBLY AND ASSEMBLY

HITCH

5. Remove bolt (7) from the rod end of the steering cylinder (servo-sender). Remove four bolts (6). Move the cylinder, bracket, hoses and cables to the side of the hitch.
6. Put identification on hoses (8) and (9) that are connected to the steering control valve for correct installation. Disconnect the two hoses from the valve.
7. Disconnect tube assembly (10) from the scraper hydraulic control valve.
8. Put identification on the hose assemblies that are connected to the scraper hydraulic control valve for correct installation. Disconnect all hoses (11) from the valve.
9. Put identification on all hose assemblies (13) and tube assemblies (14) that are connected on each side of the hitch for correct installation.
10. Remove all clips, clamps and brackets that hold the hoses and tube assemblies to the hitch. Remove tube assemblies (17), hose assemblies (14) with brackets as a unit.
11. Remove the clamp that holds the tube assemblies under the hitch.
12. Remove the lockwire, bolts (15), washers and retainer (16) from the hitch forward pin.

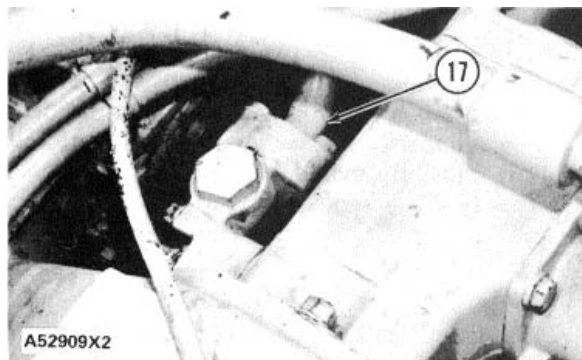


VEHICLE SYSTEMS

HITCH

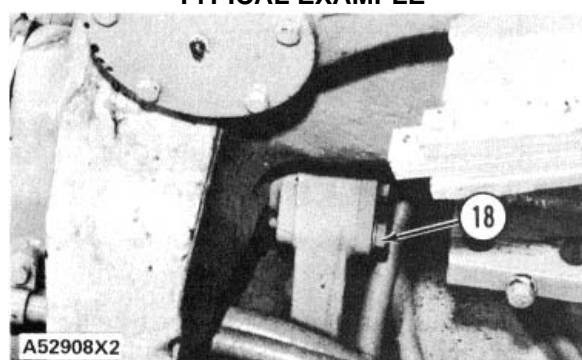
DISASSEMBLY AND ASSEMBLY

13. Disconnect tube assembly (17) from the implement hydraulic pump.



TYPICAL EXAMPLE

14. Remove retainer (18) from the front of the hitch rear pin.

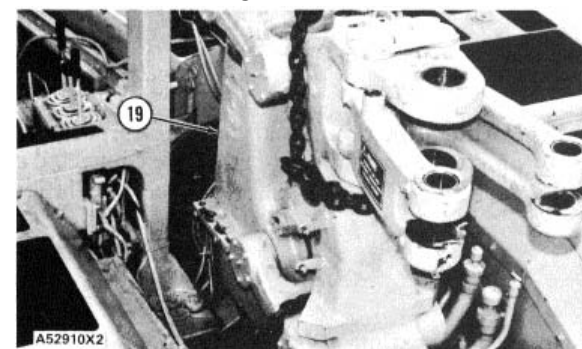


TYPICAL EXAMPLE

15. Remove the large nut from the front of the rear hitch pin with tool (A).

NOTE: If the hitch rear pin is free to turn, either nut on each side of the pin can come off. If the pin is free to turn it can be removed from either direction.

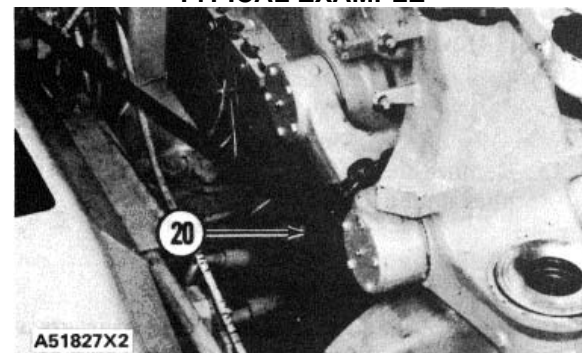
16. Fasten a hoist to hitch (19).



TYPICAL EXAMPLE

17. Lift the weight of the hitch off the pins that hold it to the tractor.

18. Remove hitch front pin (20) with a pry bar.



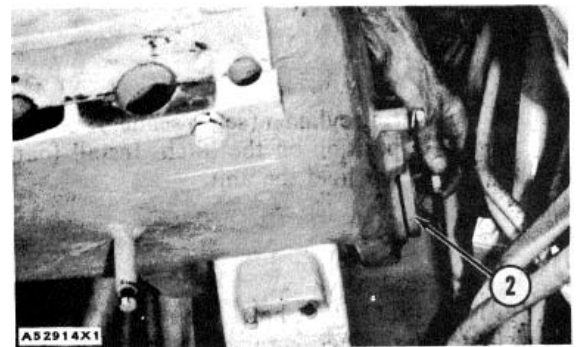
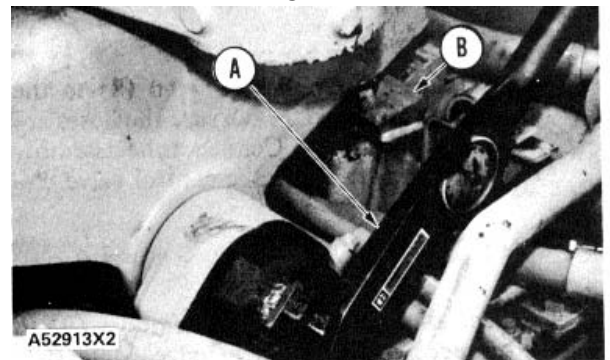
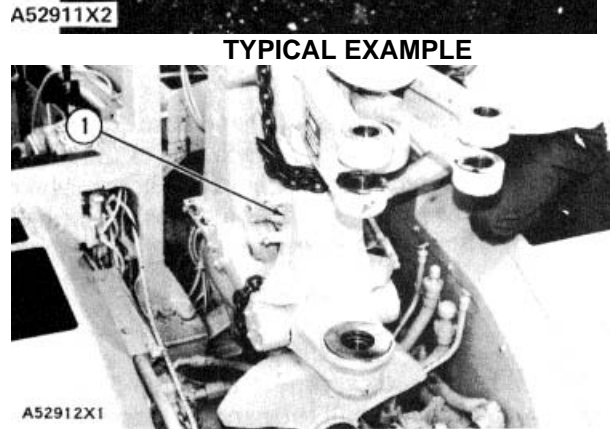
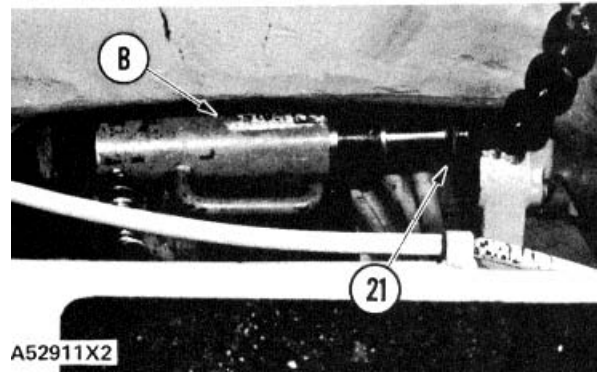
TYPICAL EXAMPLE

VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

HITCH

19. Remove hitch rear pin (21) with tooling (B). Install a wood block and tooling (B) as shown and push the pin out the rear of the hitch.
20. Remove the hitch from the machine. The weight of the hitch is 1500 lb. (675 kg).



INSTALL HITCH

7107-12

Tools Needed		A	B
5P7367	Socket	1	
9S7351	Torque Wrench	1	
7S4134	Torque Multiplier	1	
2G2827	Block Assembly		2
1D4609	Bolt		2
1D5119	Nut		2

1. Fasten a hoist to hitch (1) and put it in position on the tractor.
2. Install one large nut on the rear pin that holds the hitch in position. Install the pin from the rear of the hitch. Install the front rear pin nut, retainer and the bolts that hold the retainer. Tighten the rear pin nut with tooling (A) to a torque of 550 lb. ft. (750 N•m). Install the retainer over the rear nut and the bolts that hold it.
3. Install the front pin in the hitch.
4. Install retainer (2) and the bolts that hold it. Install the lockwire in the bolts.
5. Install tooling (B) under the stops on the hitch. Tooling (B) will prevent side to side movement of the hitch.

⚠ WARNING

Do not remove the hoist from the hitch until tooling (B) is installed.

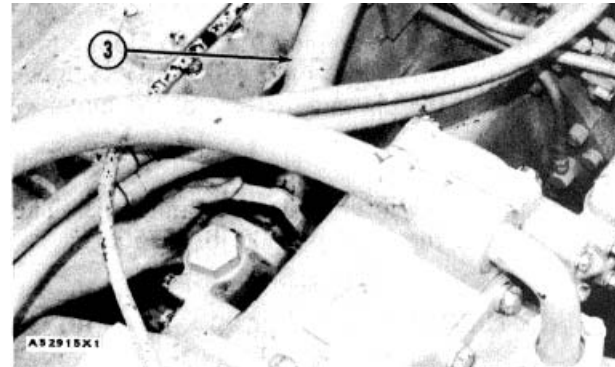
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

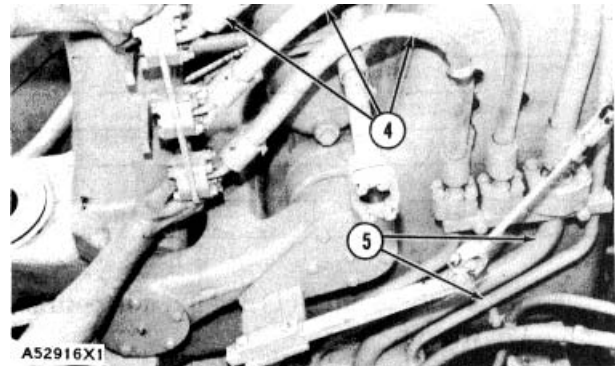
HITCH

6. Connect tube assembly (3) to the implement hydraulic pump.
7. Install the clamp under the hitch that holds the tube assemblies.
8. Install tube assemblies (5) and hose assemblies (4) with the brackets on each side of the hitch. Install all the clips that hold the hoses. Make sure all the tube assemblies and hose assemblies are in the correct positions.

NOTE: If necessary move the hitch from side to side to connect all tube and hose assemblies.

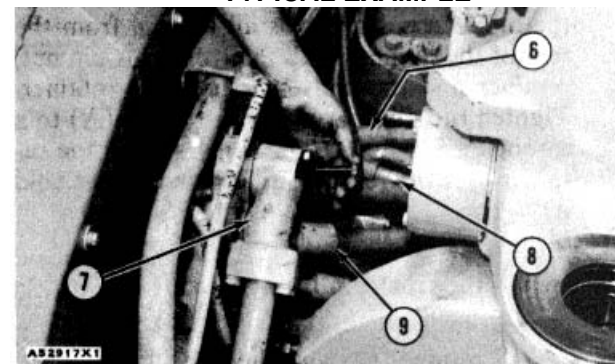


TYPICAL EXAMPLE



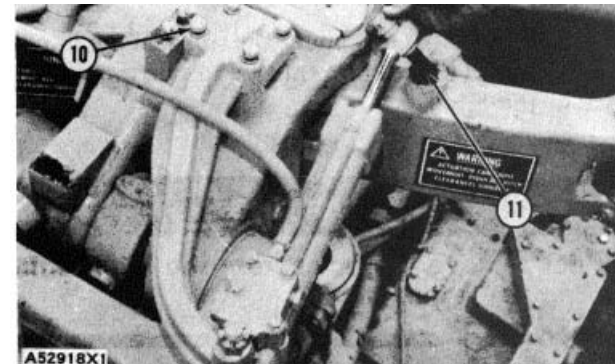
TYPICAL EXAMPLE

9. Connect hose assemblies (6) and (8) to the steering control valve. Make sure the hoses are in the correct position. Connect tube assembly (7) to the scraper hydraulic control valve.
10. Connect all hydraulic hose assemblies (9) to the scraper hydraulic control valve. Make sure the hoses are in the correct position.



TYPICAL EXAMPLE

11. Put the steering cylinder (servo-sender) and the bracket in position on the hitch. Install four bolts (10) that hold the unit.
12. Install bolt (11) that holds the rod end of the cylinder to the steering link.

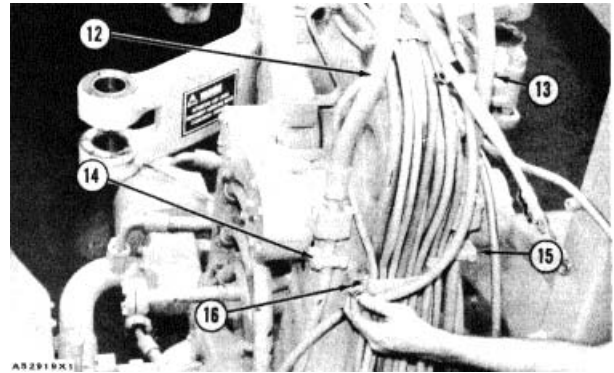


TYPICAL EXAMPLE

VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

HITCH



13. Put all the hydraulic hoses and the cable assembly in position on the hitch as shown. Install the clamps (16) that hold them.

14. Install two clamps (14) and (15).

15. Connect hose assemblies (12) and (13) at the hitch. Make sure these hoses are in the correct positions.

16. Fill the hydraulic tank with oil to the correct level. See LUBRICATION AND MAINTENANCE GUIDE.
end by:
 - a) connection of tractor and scraper

VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

HORIZONTAL HITCH BEARINGS

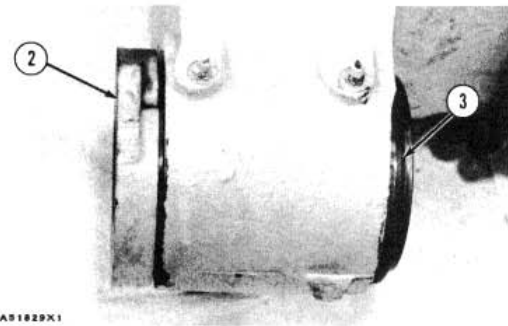
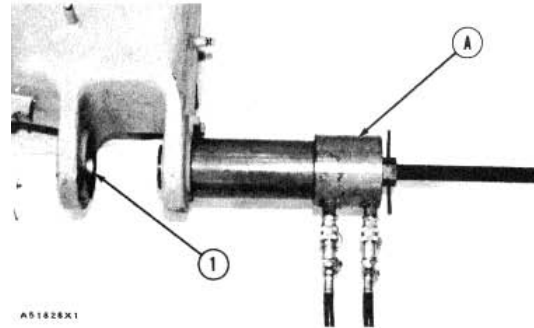
REMOVE HORIZONTAL HITCH BEARINGS

Tools Needed		A
1P1837	Bearing Pulling Adapter	1
1P544	Nut	1
9S5558	Stud	1
5P2998	Puller Assembly	1
5P3100	Pump Group (or electric)	1
7F6068	Sleeve Assembly	1

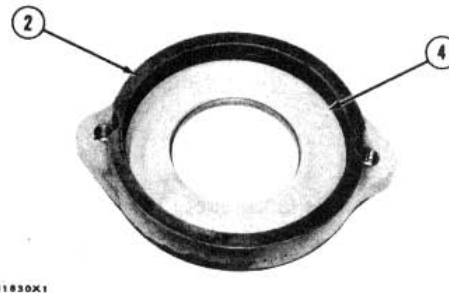
start by:

a) remove hitch

1. Remove two forward horizontal hitch bearings (19) with tooling (A) as follows: a) Remove one bearing with tooling (A) as shown.
b) Install tooling (A) on the other bearing support as in Step 1a.
c) Remove the other bearing with tooling (A).

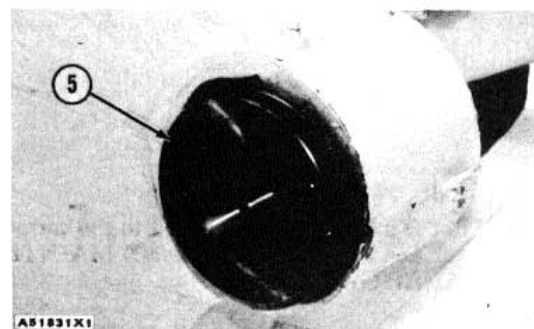


2. Remove two bearings (2) and two seal rings (3) from the hitch.



3. Remove washer (4) from each bearing (2).

4. Remove two bearings (5) from the hitch.

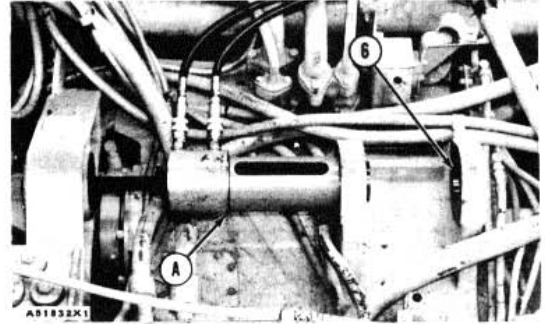


VEHICLE SYSTEMS

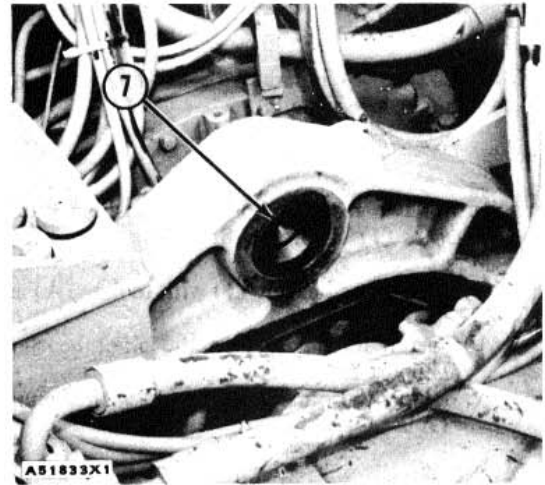
DISASSEMBLY AND ASSEMBLY

HORIZONTAL HITCH BEARINGS

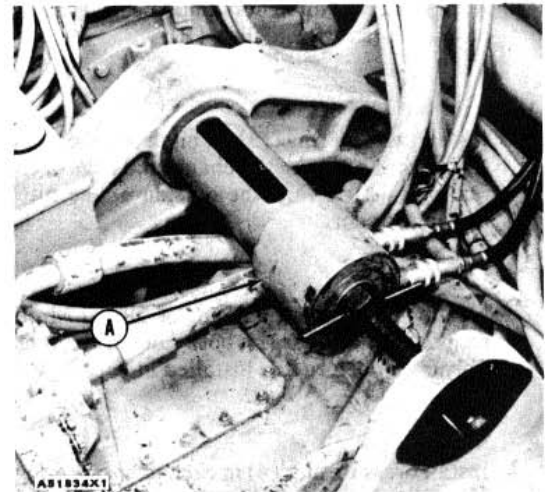
5. Remove two bearings (6) from hitch rear support with tooling (A) as follows:
 - a) Remove one bearing (6) with tooling (A) as shown.
 - b) Install tooling (A) on the other bearing support as in Step 5a.
 - c) Remove the other bearing (6) with tooling (A).



6. Remove two seals (7) from forward horizontal hitch support.



7. Remove two bearings from horizontal hitch forward support with tooling (A).



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

HORIZONTAL HITCH BEARINGS

INSTALL HORIZONTAL HITCH BEARINGS

	Tools Needed	A	B	C
1P1837	Bearing Pulling Adapter	1	1	
1P544	Nut	1	1	
9S5558	Stud	1	1	
5P2998	Puller Assembly	1	1	
5P3100	Pump Group (or electric)	1	1	
7F6068	Sleeve Assembly	1		
1P520	Driver Group			1

NOTE: Lower the temperature of all hitch horizontal bearings before installation.

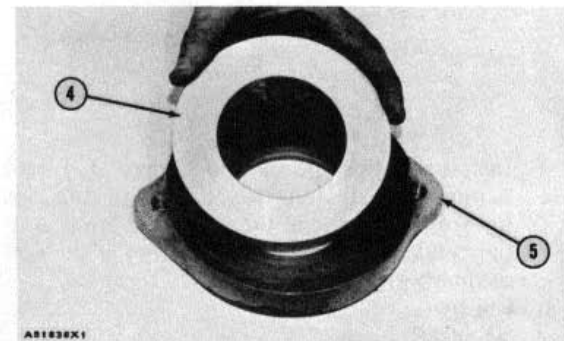
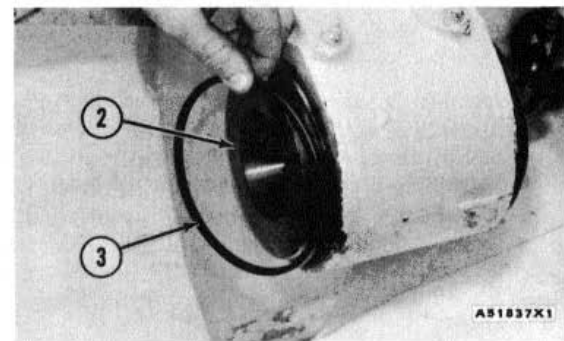
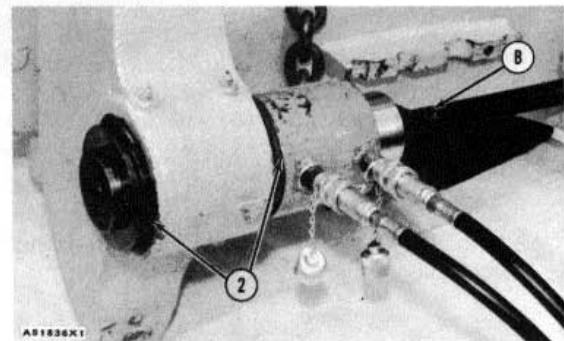
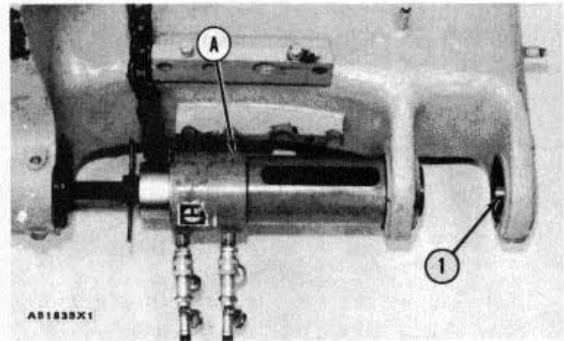
1. Install two forward horizontal cushion hitch bearings (1) in hitch with tooling (A) as follows:
 - a) Install one bearing (1) with tooling (A) as shown.
 - b) Install tooling (A) on the other bearing support as in Step 1a.
 - c) Install the other bearing (1) with tooling (A).

2. Install two rear hitch horizontal bearings (2) in cushion hitch with tooling (B).

3. Install two seal rings (3) on hitch rear horizontal bearings (2) with the chamfered edge of the seal ring (3) toward the outside of the hitch bearing support.

NOTE: Put a small amount of 5P960 Multipurpose Type Grease on both sides of the brass washer (4) before it is installed in bearing (5).

4. Install brass washer (4) in each of two bearings (5) with chamfered side of brass washer (4) toward the inside of bearing (5).

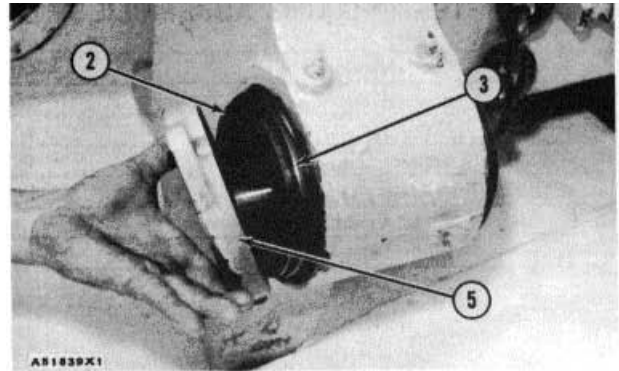


VEHICLE SYSTEMS

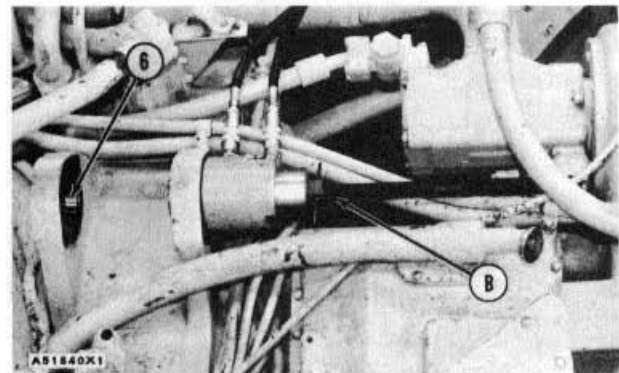
DISASSEMBLY AND ASSEMBLY

HORIZONTAL HITCH BEARINGS

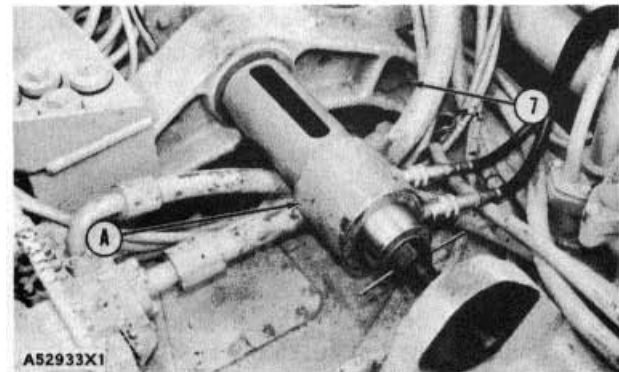
5. Install two bearings (5) over bearings (2) and ring seals (3).



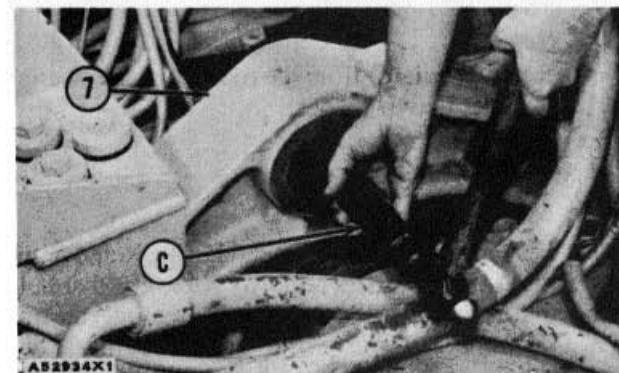
6. Install two bearings (6) in hitch rear horizontal supports with tooling (B) as follows:
- Install one bearing (6) with tooling (B) as shown.
 - Install tooling (B) on the other bearing support as in Step 6a.
 - Install the other bearing (6) with tooling (B).



7. Install two bearings in hitch forward horizontal support (7) with tooling (A) as follows:
- Pull rear bearing through support (7) with tooling (A) until the bearing is even with the rear seal counterbore in support (7).
 - Pull forward bearing into support (7) with tooling (A) until the bearing is even with the forward seal counterbore in support (7).



8. Install two lip type seals in support (7) with tooling (C). Install the seals with the lips toward the outside of the support (7) and until they make contact with the bottom of the seal counterbores in support (7). end by:
- install hitch



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

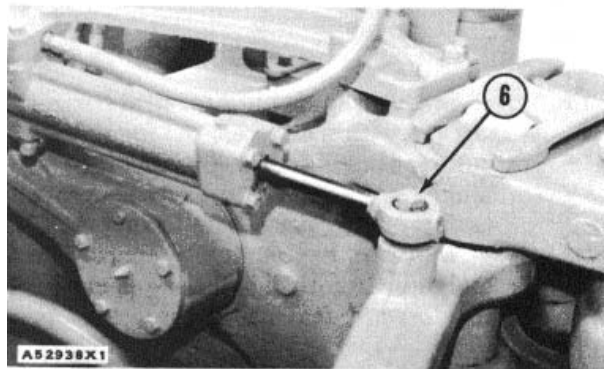
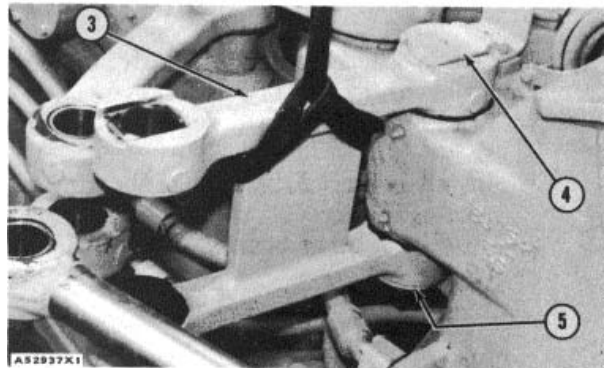
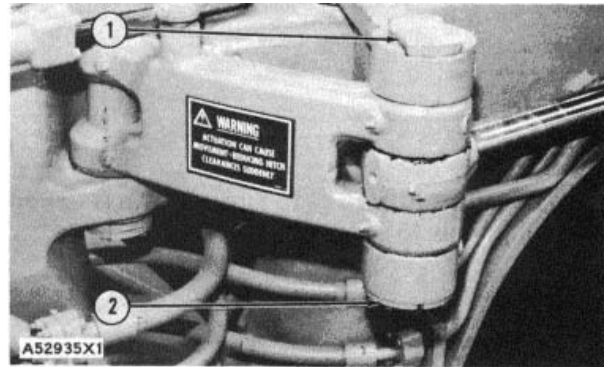
STEERING LINK ASSEMBLIES

REMOVE STEERING LINK ASSEMBLIES

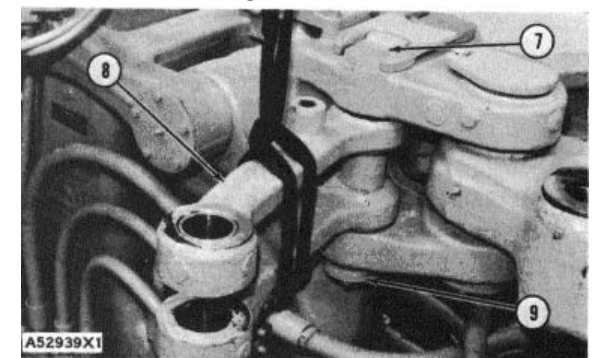
	Tools Needed	A
5P3100	Pump Group (or electric)	1
1P544	Nut	1
7F6068	Sleeve Assembly	1
1P1835	Bearing Pulling Adapter	1
5P2998	Puller Assembly	1
9S5558	Stud	1

NOTE: The steering link assemblies on the left and right sides of the machine are removed the same way. The only difference is the steering cylinder (servosender) must be disconnected on the left side of the machine.

1. Remove the four bolts, washers and two yokes (2) that hold pin assembly (1) in position.
2. Remove pin assembly (1) and make a separation of the steering cylinder rod end and the two link assemblies.
3. Fasten a hoist to link assembly (3). Remove the four bolts, washers and two yokes (5) that hold pin assembly (4) in position. Remove the pin assembly. Remove the link assembly. The weight of the link assembly is 90 lb. (41 kg).
4. Remove bolt (6) from the rod end of the steering cylinder (servo-sender).
5. Fasten a hoist to link assembly (8). Remove the four bolts, washers and two yokes (9) that hold pin assembly (7) in position. Remove the pin assembly. Remove the link assembly. The weight of the link assembly is 100 lb. (45 kg).



TYPICAL EXAMPLE



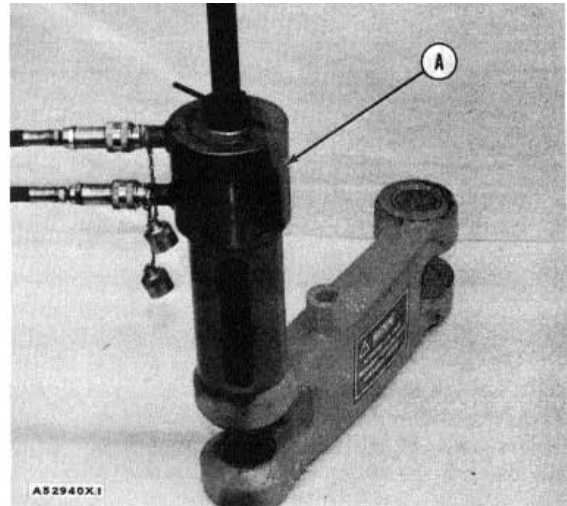
TYPICAL EXAMPLE

VEHICLE SYSTEMS


STEERING LINK ASSEMBLIES

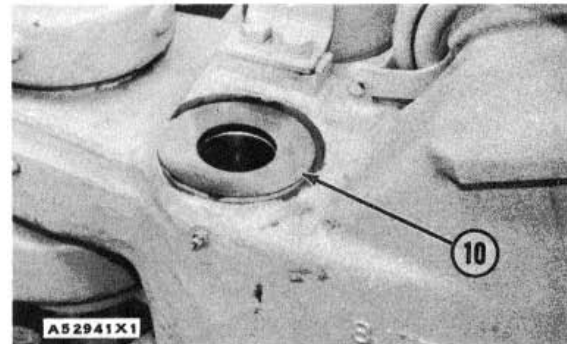
DISASSEMBLY AND ASSEMBLY

6. Remove the bearings from the two steering link assemblies with tooling (A).



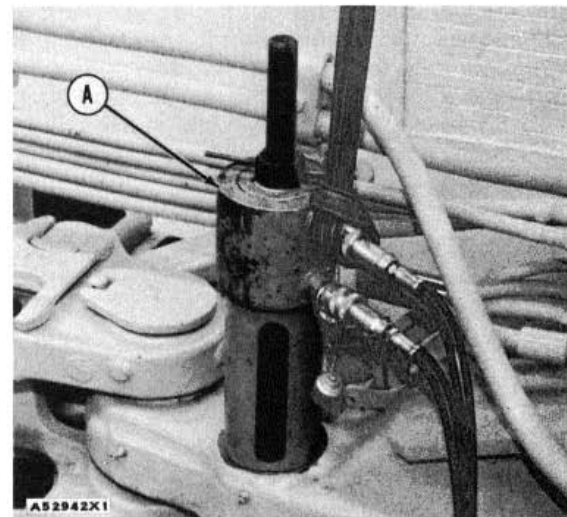
7. Remove washer (10) from the draft frame.

 **WARNING:** Fasten a hoist to tooling (A) before the bearings and spacer on the draft frame are removed. The tooling will fall after removal of the bearings and spacer.



8. Install tooling (A) on the draft frame as shown. Fasten a hoist to tooling (A).
9. Remove the two bearings and spacer from the draft frame.
10. Remove the other steering link assemblies from the right side of the machine as in Steps 1 through 9.

NOTE: For removal of the other bearings in the draft frame, see Remove Steering Cylinder.



VEHICLE SYSTEMS

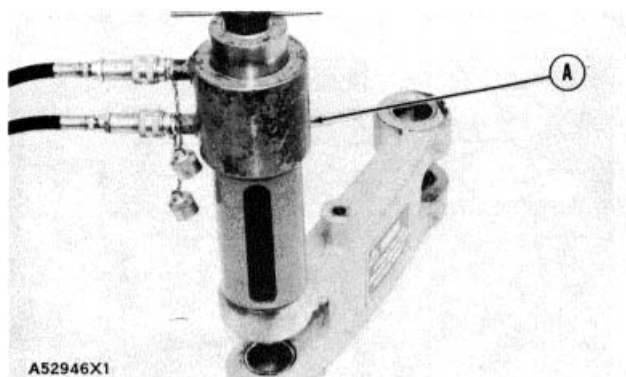
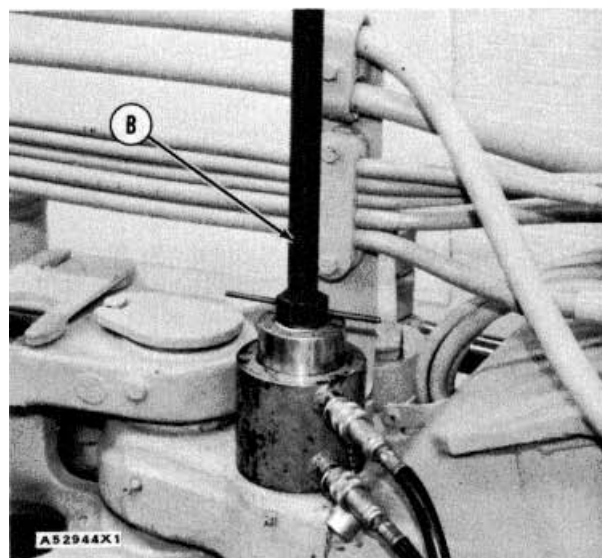
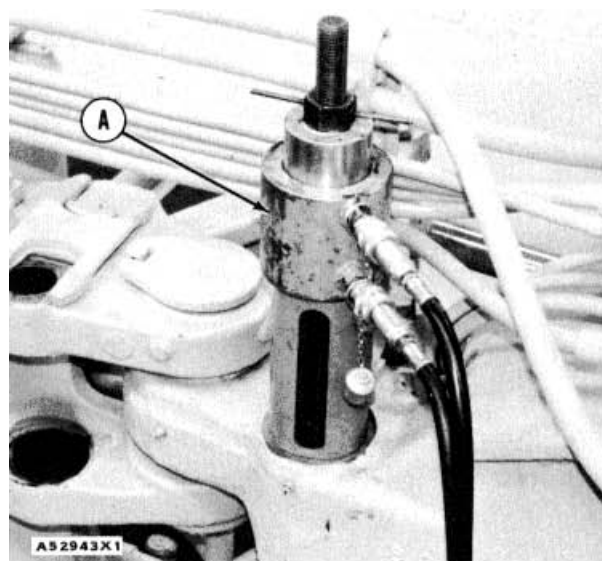
DISASSEMBLY AND ASSEMBLY

STEERING LINK ASSEMBLIES

INSTALL STEERING LINK ASSEMBLIES

Tools Needed		A	B
5P3100	Pump Group (or electric)	1	1
1P544	Nut	\$	1
7F6068	Sleeve Assembly	1	
1P1835	Bearing Pulling Adapter	1	
5P2998	Puller Assembly	1	1
9S5558	Stud	1	1
1P1840	Adapter	1	

1. Make sure the bearing bore in the draft frame is clean.
2. Pull the lower bearing into the draft frame with tooling (A) until it is even with the outside surface of the draft frame.
3. Install the spacer in the bearing bore. Push the upper bearing into the draft frame with tooling (B) until the bearing makes contact with the spacer. The bearing will be even with the machined surface in the draft frame.
4. Install washer (1) in the draft frame.
5. Install the other two bearings and spacer in the draft frame as in Steps 1 through 4.
6. Install all the bearings in the link assemblies with tooling (A). Install the bearings until they are even with the outside surface of the links.

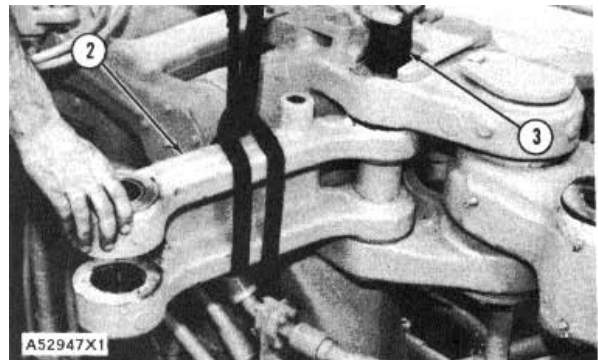


VEHICLE SYSTEMS

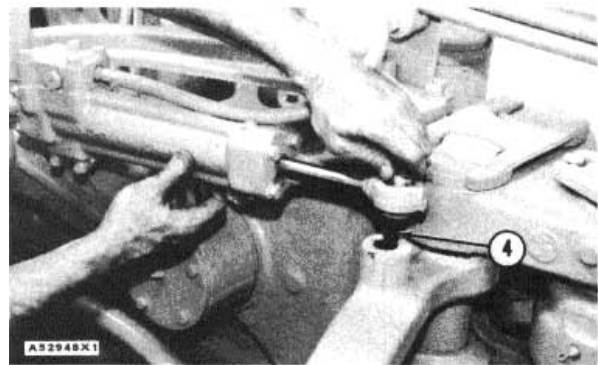
DISASSEMBLY AND ASSEMBLY

STEERING LINK ASSEMBLIES

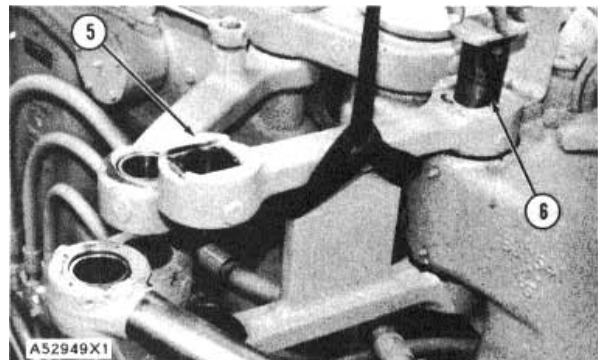
7. Fasten a hoist to link assembly (2) and put it in position on the cushion hitch as shown. Install pin assembly (3) that holds it. Install the two yokes, bolts and washers that hold the pin assembly in position.



8. Connect the steering cylinder (servo-sender) to link assembly (2) with bolt (4).

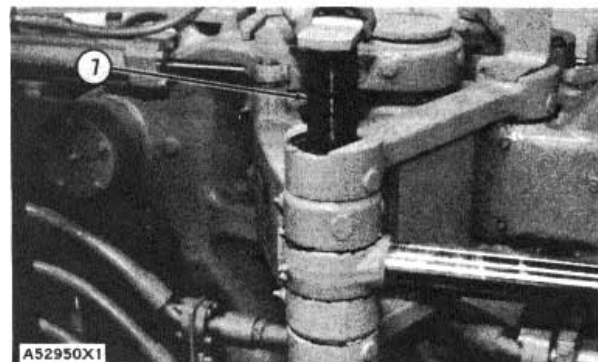


9. Fasten a hoist to link assembly (5) and put it in position on the draft frame as shown. Install pin assembly (6). Install the two yokes, bolts and washers that hold the pin assembly.



NOTE: For installation of the other bearings in the draft frame, see Install Steering Cylinder.

10. Put the two link assemblies and the rod end of the steering cylinder in alignment with each other as shown.



11. Install pin assembly (7). Install the two yokes, bolts and washers that hold the pin assembly in position.

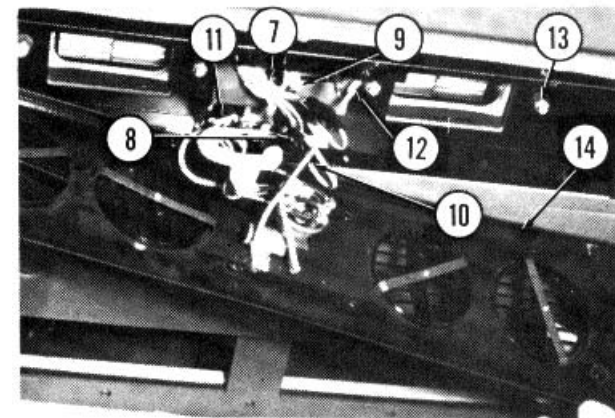
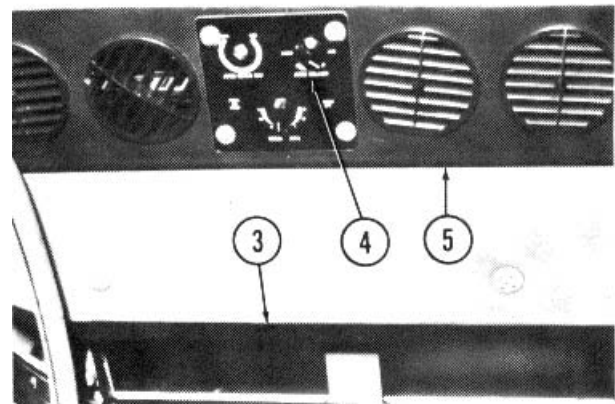
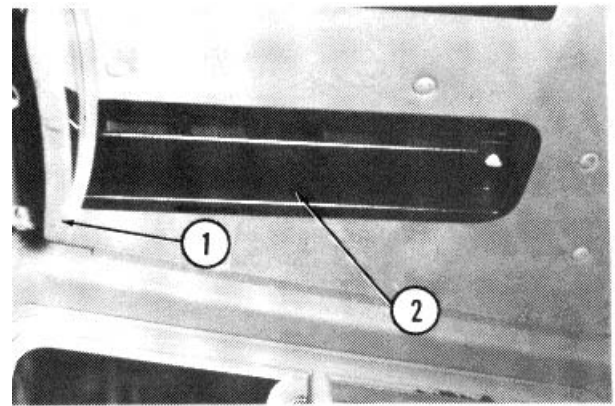
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

CAB HEATER

REMOVE CAB HEATER

1. Remove the rear view mirror (1).
2. Loosen the two thumb screws on cover (2). Remove cover (2) and the two filters.
3. Remove the eight bolts and washers securing flange (3). Remove the flange.
4. Loosen the set screw in knob (4) and remove the knob.
5. Remove the eight bolts and washers securing cover (5). Lower the cover.
6. Disconnect the heater harness (7) from the blower switch connector (8).
7. Disconnect the cab harness (9) from the heater connector (10).
8. Disconnect the wires from the circuit breaker (11).
9. Disconnect ground wire (12) from cab roof and remove cover (5).
10. Remove the three remaining nuts (13) and remove duct (14).

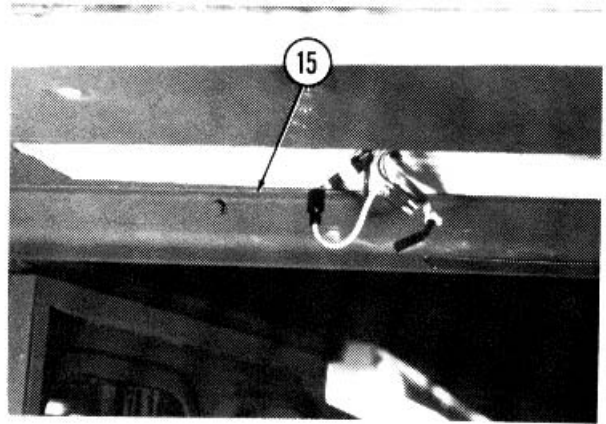


VEHICLE SYSTEMS

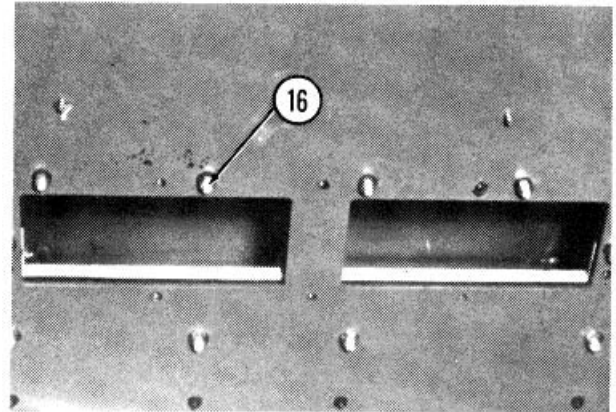
DISASSEMBLY AND ASSEMBLY

CAB HEATER

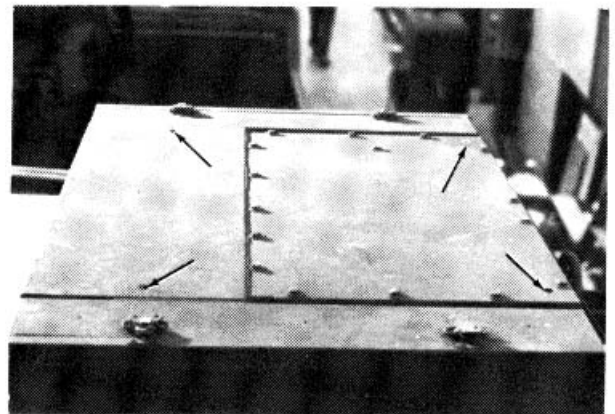
11. Remove the three bolts securing angle (15) and remove the angle.
12. Remove the five button plugs and the headliner.



13. Remove the ten nuts (16).



14. Remove the clip securing the heater hoses to the cab roof.
15. Install four 3/8 "-16 eyebolts at the locations shown.
16. Attach a hoist and apply slight tension. Loosen the sponge seals from the roof.

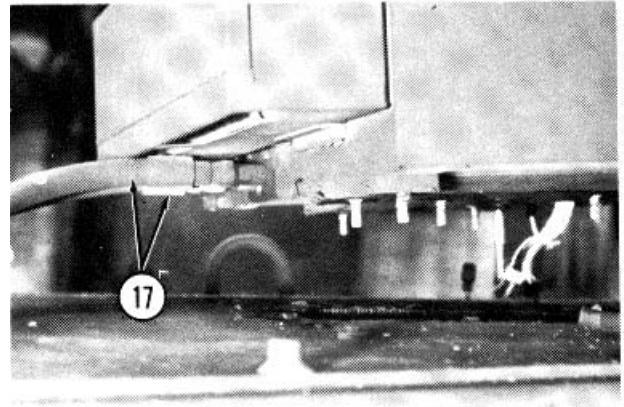


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

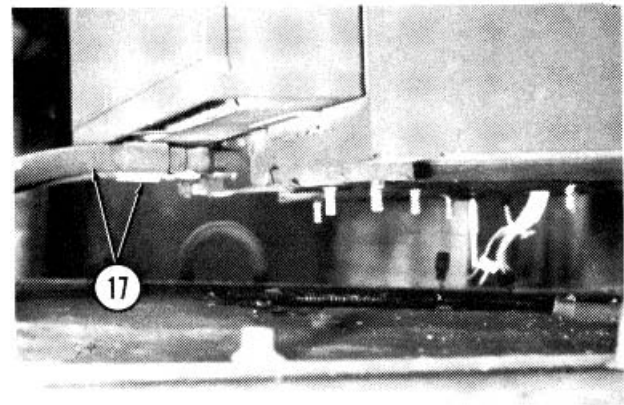
CAB HEATER

17. Raise the heater and disconnect the heater hoses (17) from the heater.
18. Remove the heater.

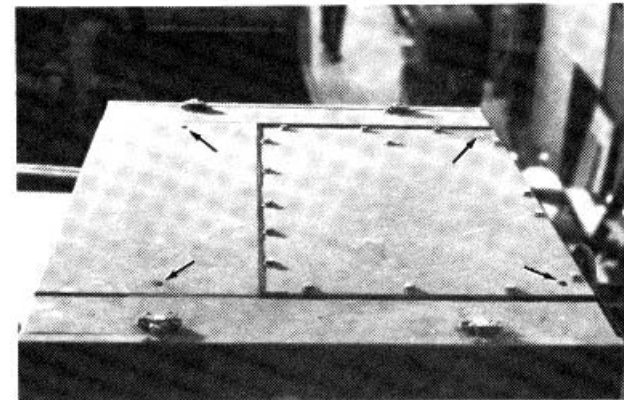


INSTALL THE CAB HEATER

1. Apply silicone sealant on the sponge seals and the top of the cab.
2. Position the heater over the cab and connect hoses (17).



3. Lower the heater on the roof. Remove the hoist and the eyebolts.
4. Install the clip on the heater hoses and secure to the roof.

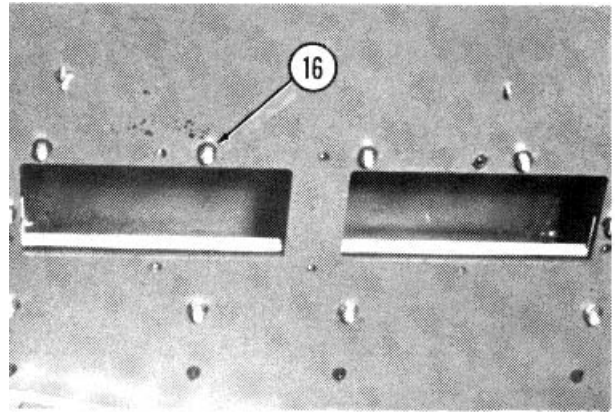


VEHICLE SYSTEMS

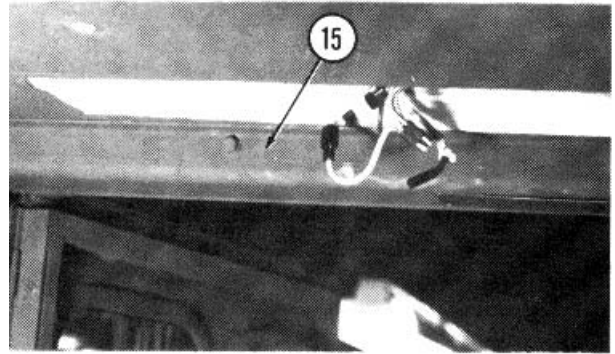
DISASSEMBLY AND ASSEMBLY

CAB HEATER

5. Install the ten nuts (16) and torque to 12 ± 3 lb. ft. (16 ± 4 N•m).



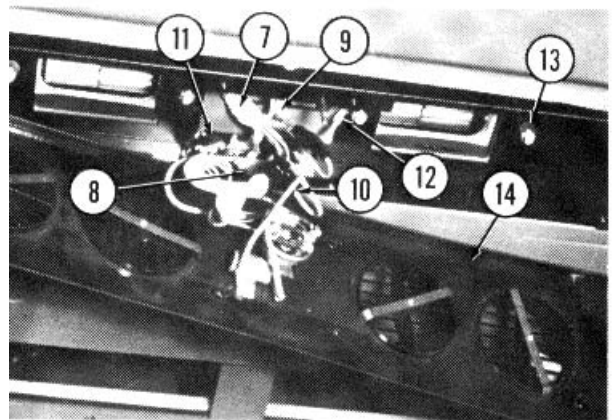
6. Position the headliner in the cab and install angle (15). Be sure the cab harness is in position as shown.



7. Install the five button plugs.

8. Position duct (14) in the headliner so the cab harness is running through the hole in the side of the duct. Install three of the nuts and torque to 12 ± 3 lb. ft. (16 ± 4 N•m).

9. Lift cover (5) in position as shown and connect the ground wire (12) to the cab roof. Torque the nut to 12 ± 3 lb. ft. (16 ± 4 N•m).



10. Reconnect the wires to circuit breaker (11).

11. Reconnect the cab harness (9) to the heater connector (10).

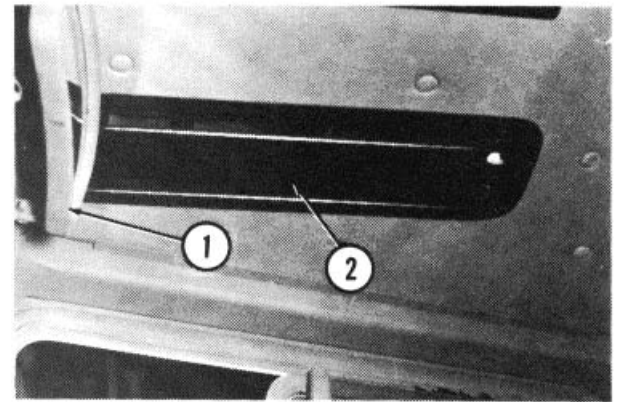
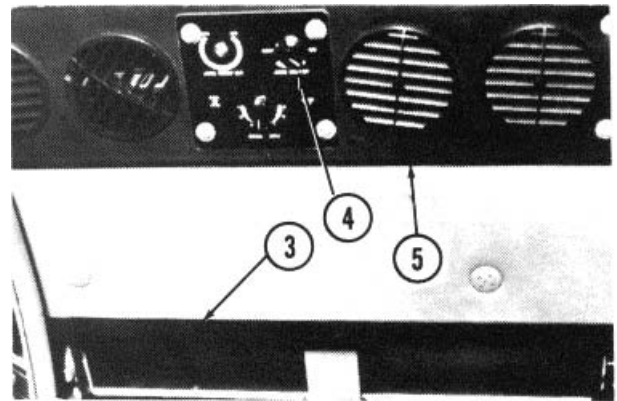
12. Reconnect the heater harness (7) to the blower switch connector (8).

VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

CAB HEATER

13. Raise cover (5) into position and install the eight bolts and washers. Torque the bolts to 66 + 15 lb. in. (7.4 + 1.7 N-m).
14. Install knob (4) and secure with the set screw.
15. Install flange (3) and secure with the eight bolts and washers.
16. Install cover (2) with the two filters.
17. Install the rear view mirror(l).



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

HYDRAULIC TANK

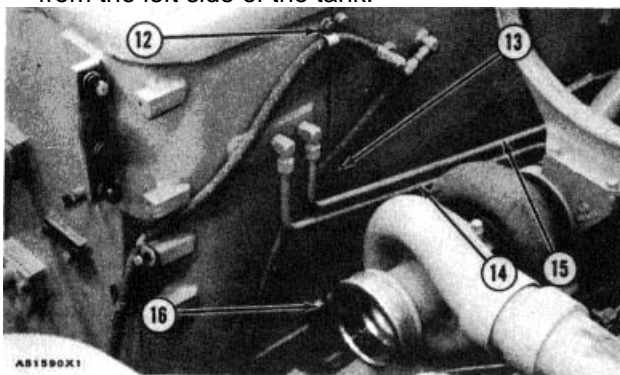
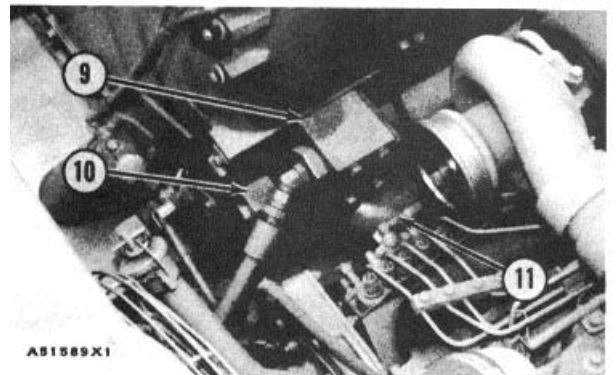
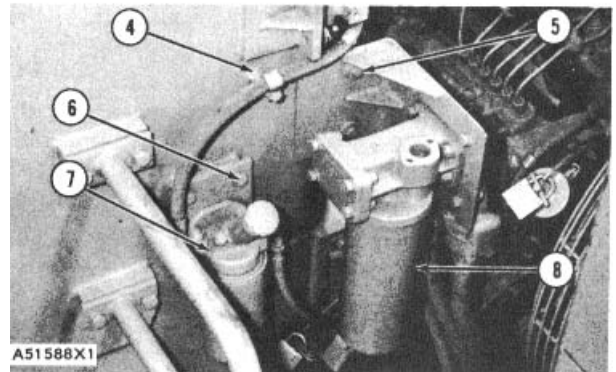
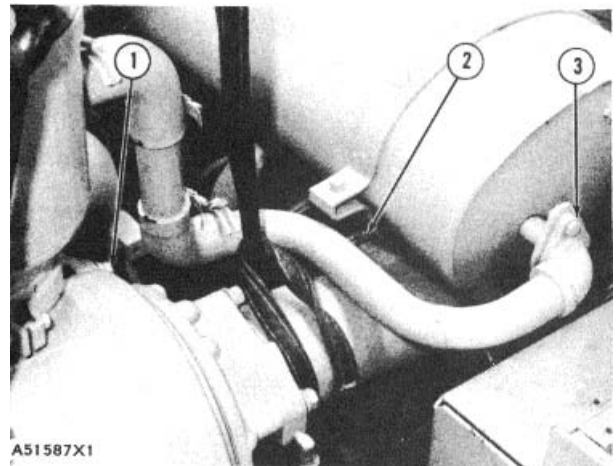
REMOVE HYDRAULIC TANK

start by:

- a) remove hood *

*This operation is in the Engine Disassembly and Assembly Section.

1. Drain the oil from the hydraulic tank.
2. Fasten a hoist to the air cleaner assembly. Remove three bolts (1) from support bracket. Remove two bolts (3). Remove two clamps (2). Remove the air cleaner assembly from the machine. The weight of the air cleaner assembly is 85 lb. (39 kg).
3. Remove two bolts (5). Move oil filter group (8) away from the hydraulic tank.
4. Remove clip (4). Remove two bolts (6) and move fuel filter group (7) away from the hydraulic tank.
5. Disconnect tube assembly (9) from the hydraulic tank. Disconnect elbow (11) from the hydraulic tank. Disconnect tube assembly (10) from the hydraulic tank.
6. Disconnect two tube assemblies (14) and (15) from the hydraulic tank. Remove two clips (12) and (13) from the hydraulic tank.
7. Remove bolt (16). Do not remove the bottom bolt from the left side of the tank.

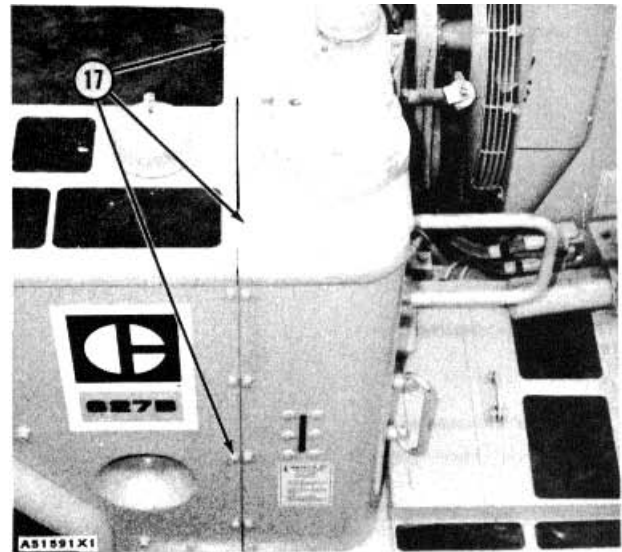


VEHICLE SYSTEMS

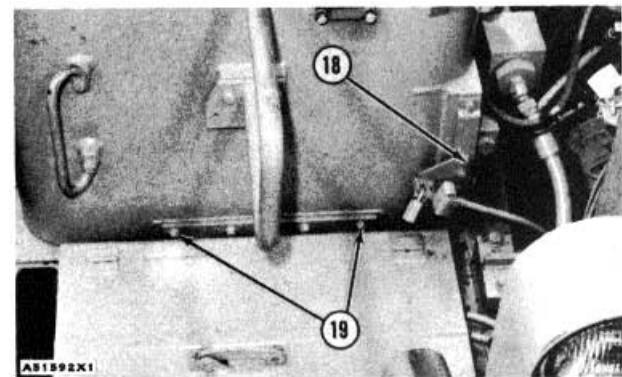
DISASSEMBLY AND ASSEMBLY

HYDRAULIC TANK

8. Remove sixteen bolts (17) from the top and right sides of the fuel tank. Move the hydraulic tank away from the fuel tank with a pry bar so the two strips between the fuel tank and the hydraulic tank can be removed. These strips must be removed so eyebolts can be installed in the top of the tank for removal of the tank.



9. Remove four bolts (19). Remove two bolts (18) that hold the bracket for the oil level gauge to the hydraulic tank.



10. Install two 3/8"16 NC forged eyebolts with nuts and washers in the hydraulic tank as shown. Fasten a hoist to hydraulic tank (20) and remove it. The weight of the hydraulic tank (empty) is 570 lb. (257 kg).



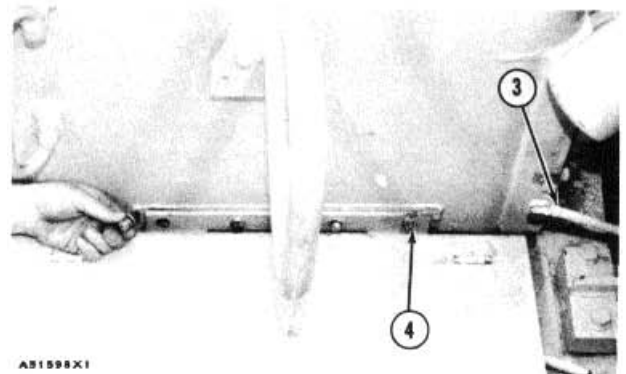
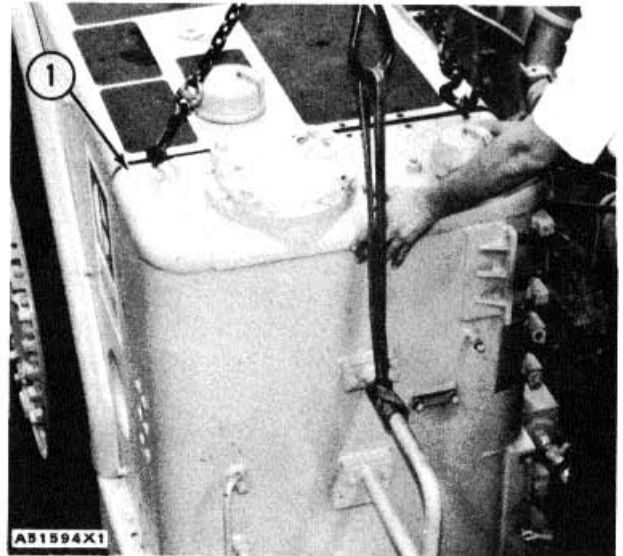
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

HYDRAULIC TANK

INSTALL HYDRAULIC TANK

1. Fasten a hoist to hydraulic tank (1) and put it in position on the machine.
2. Make a separation of the hydraulic tank from the fuel tank with a pry bar and install strip (2) on the side of the tank. Install two bolts to hold the strip. Install the strip across the top of the hydraulic tank and install two bolts to hold it.
3. Put the two tanks together and install the remainder of the sixteen bolts that hold them.
4. Fasten the bracket for the oil level gauge (3) to the hydraulic tank.
5. Install four bolts (4).

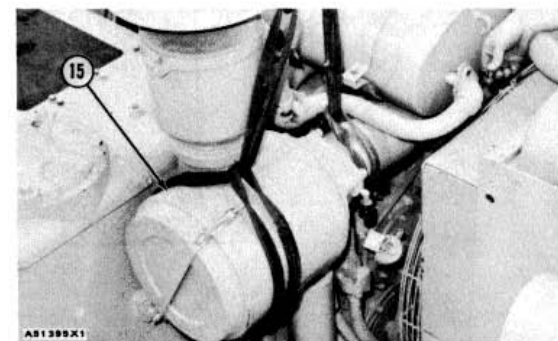
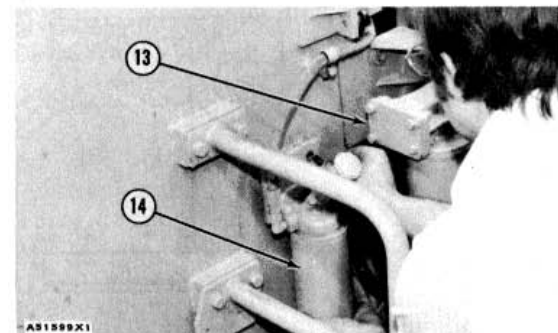
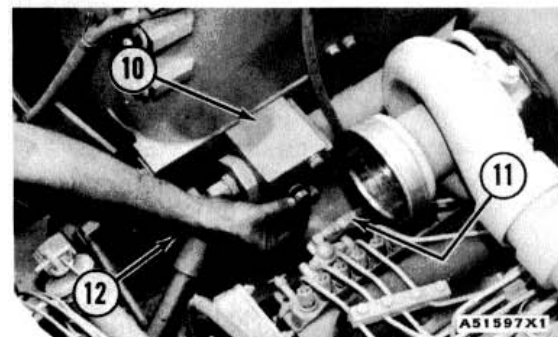
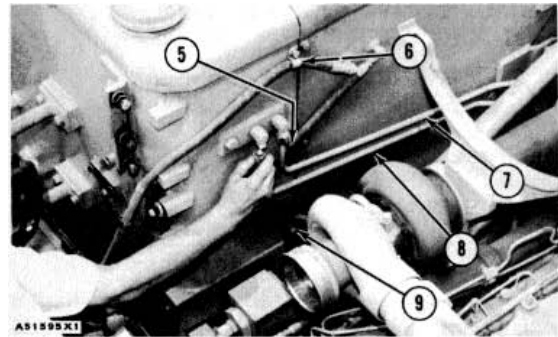


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

HYDRAULIC TANK

6. Install bolt (9) and clips (5) and (6).
7. Connect tube assemblies (7) and (8) to the hydraulic tank.
8. Connect tube assemblies (10) and (12) to the hydraulic tank.
9. Connect elbow (11) to the hydraulic tank.
10. Install oil filter group (13) and fuel filter group (14) on the hydraulic tank.
11. Fasten a hoist to air cleaner assembly (15) and put it in position on the machine. Install the bolts and clamps that hold it.
12. Fill the hydraulic tank with oil to the correct level. See Lubrication and Maintenance Guide.
end by:
 - a) install hood*



*This operation is in the Engine Disassembly and Assembly Section.

VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

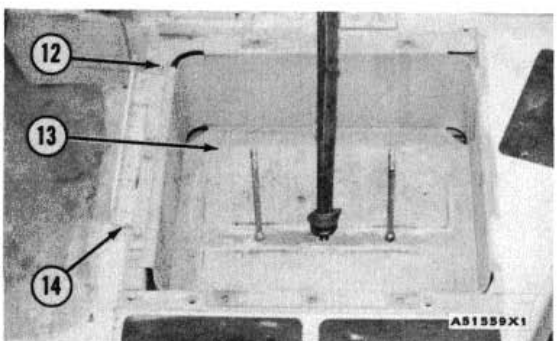
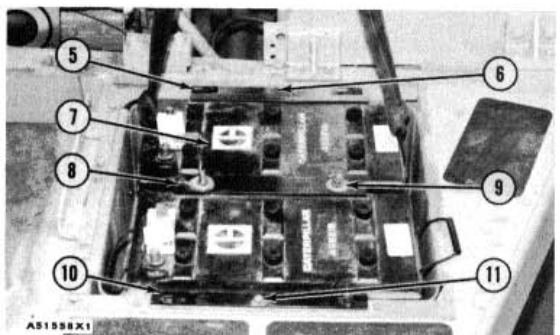
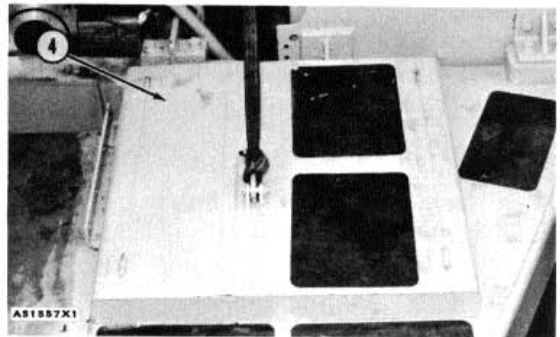
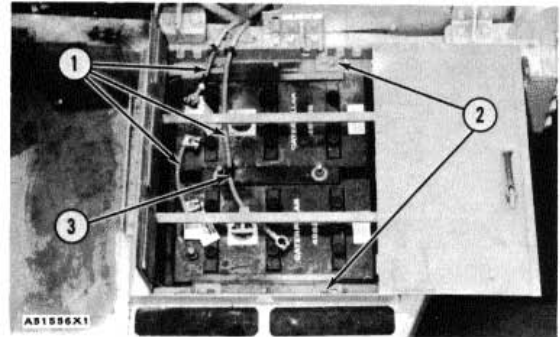
FUEL TANK

REMOVE FUEL TANK
(TRACTOR)

start by:

a) remove hydraulic tank

1. Drain the fuel from the fuel tank.
2. Remove clip (3). Remove three battery cables (1). Move the two long battery cables away from the batteries and fuel tank.
3. Remove four bolts (2).
4. Fasten a hoist to cover assembly (4) and remove it from the machine.
5. Remove bolt (6) and holddown (5). Remove bolt (11) and holddown (10). Remove nut (9) and two washers. Remove holddown assembly (8).
6. Fasten a hoist to battery (7) and remove it. Fasten a hoist to the other battery and remove it. The weight of each battery is 160 lb. (72 kg).
7. Remove five bolts (12) and bracket (14).
8. Install a 1/2"- 13 NC forged eyebolt in box assembly (13). Fasten a hoist to the box assembly and remove it. The weight of the box assembly is 52 lb. (24 kg).

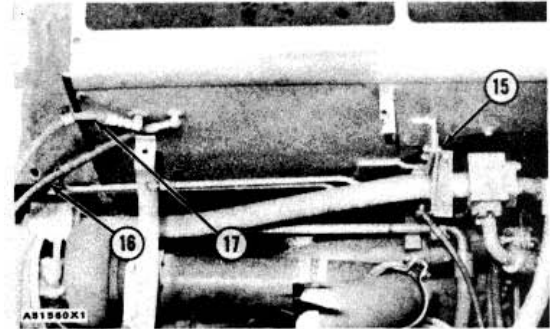


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

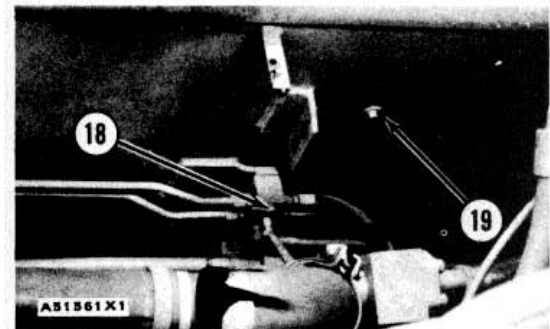
FUEL TANK

9. Put identification on hoses (16) and (17) for correct installation. Disconnect the hoses from the fuel tank.

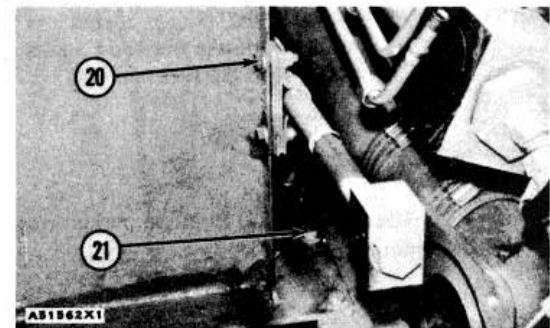


10. Remove two bolts (15).

11. Remove two bolts (18) from the manifold that is connected to the fuel tank. Remove three bolts (19) that hold the inner fender to the fuel tank.

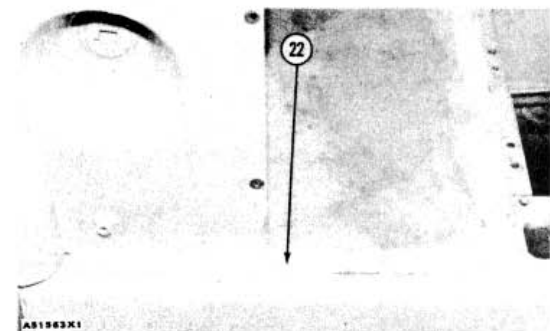


12. Remove two bolts (20), nuts, shims and clamp that hold the tube assembly for the hydraulic tank in position.



13. Remove three bolts (21).

14. Remove five bolts (22) from the lower right side of the fuel tank.

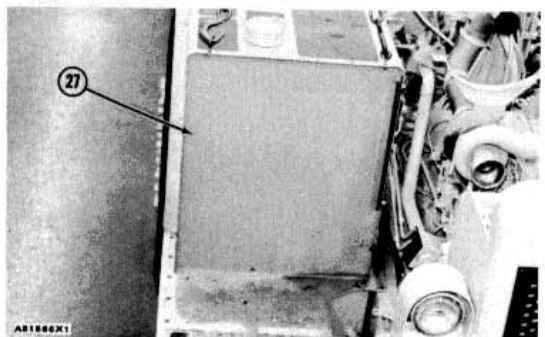
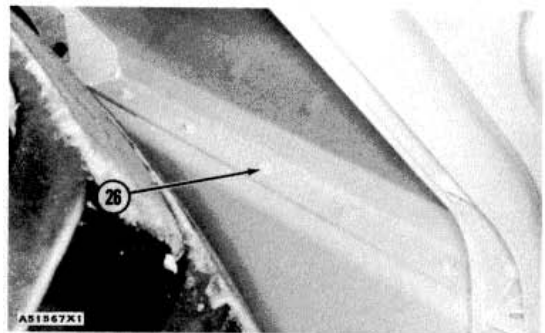
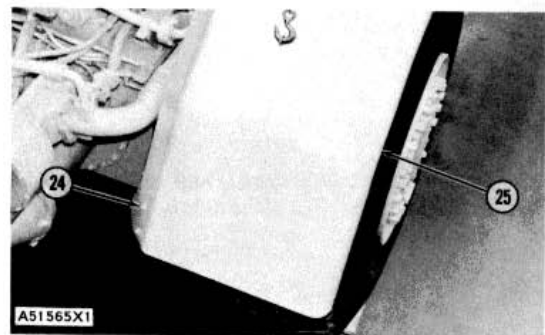
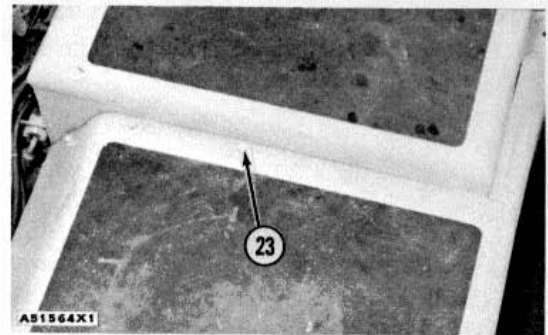


VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLE

FUEL TANK

15. Remove five bolts (23) that hold the fender to the fuel tank.
16. Remove the one bolt that holds the top of the fuel tank fender lip to the fender.
17. Install two 5/16-18 NC forged eyebolts in the fender. Fasten a hoist to the fender.
18. Remove nine bolts (24) from the rear of the fender. Remove fender (25). The weight of the fender is 170 lb. (77 kg).
19. Install three 3/8"-16 NC forged eyebolts in the fuel tank. Install two in the front and one at the rear. Fasten a hoist to the fuel tank.
20. Remove five bolts (26) from the bottom rear of the fuel tank.
21. Drain the fuel from the fuel tank. Remove fuel tank (27). Weight of the fuel tank (empty) is 500 lb. (225 kg).



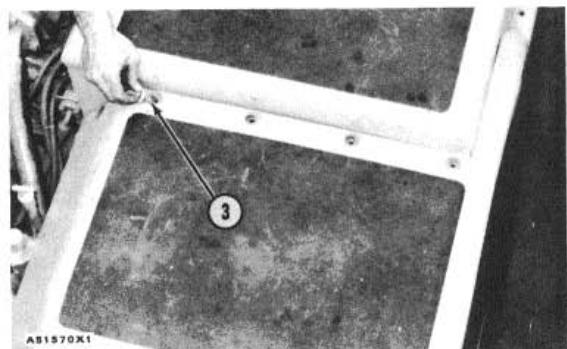
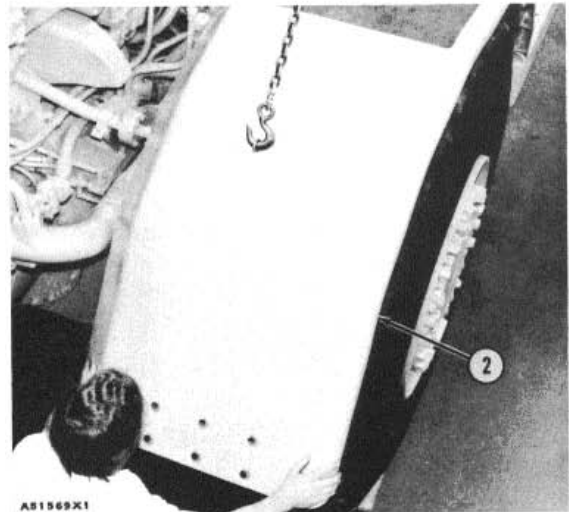
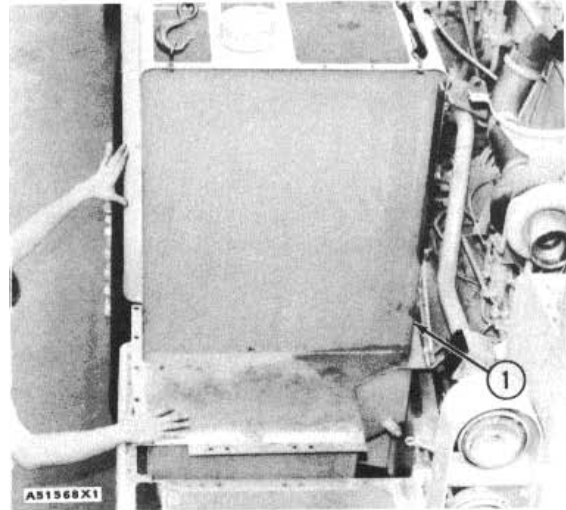
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

FUEL TANK

INSTALL FUEL TANK

1. Fasten a hoist to fuel tank (1) and put it in position on the tractor.
2. Install the five bolts that hold the tank at the bottom rear.
3. Fasten a hoist to fender (2) and put it in position on the machine. Install the nine bolts that hold the rear of the fender in position.
4. Install bolts (3) that hold the top of the fender to the fuel tank.

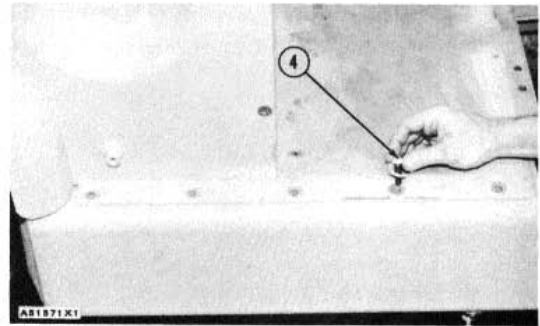


VEHICLE SYSTEMS

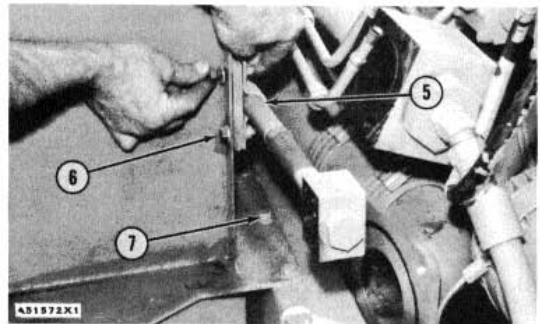
DISASSEMBLY AND ASSEMBLY

FUEL TANK

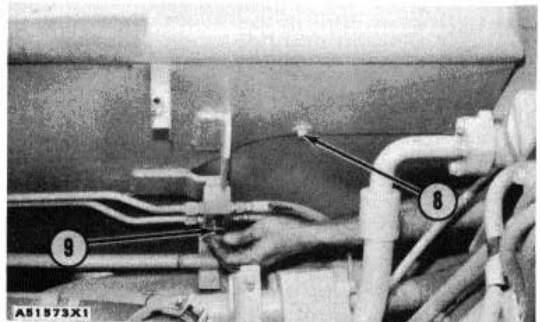
5. Install five bolts (4) at the lower right side of the fuel tank.



6. Install two bolts (6), shims, nuts and clamp (5) that hold the tube assembly to the fuel tank. Install three bolts (7).

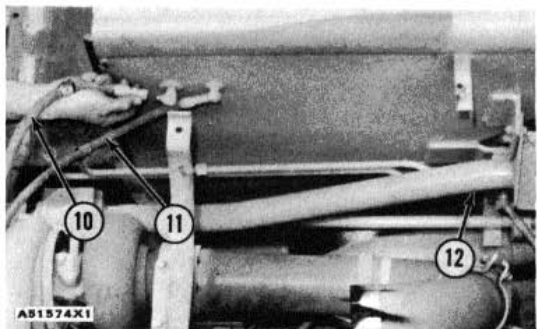


7. Install two bolts (9) that hold the manifold to the fuel tank.



8. Install three bolts (8) that hold the inner fender to the fuel tank.

9. Connect hoses (10) and (11) to the fuel tank. Make sure the hoses are in the correct positions.



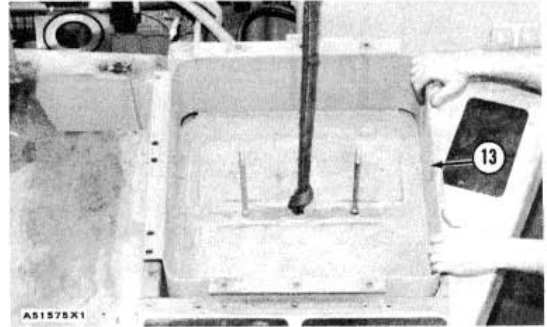
10. Connect tube assembly (12) to the bracket on the fuel tank.

VEHICLE SYSTEMS

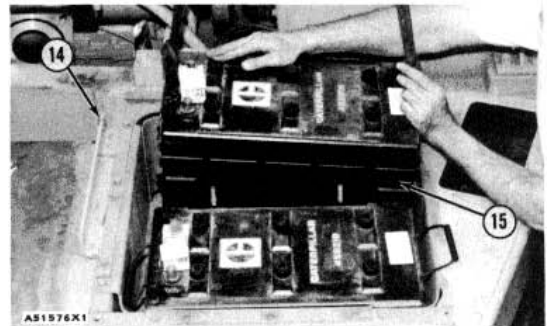
DISASSEMBLY AND ASSEMBLY

FUEL TANK

11. Fasten a hoist to box assembly (13) and put it in position on the tractor as shown.



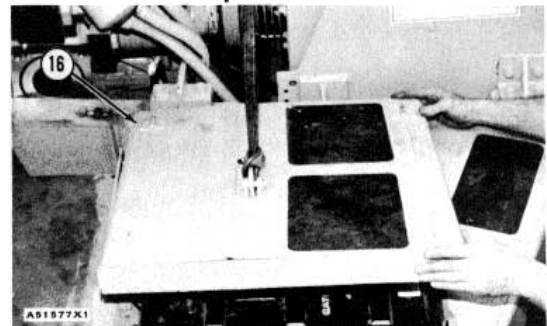
12. Install bracket (14) and the bolts that hold it.



13. Fasten a hoist to batteries (15) and install them in the battery box assembly as shown.

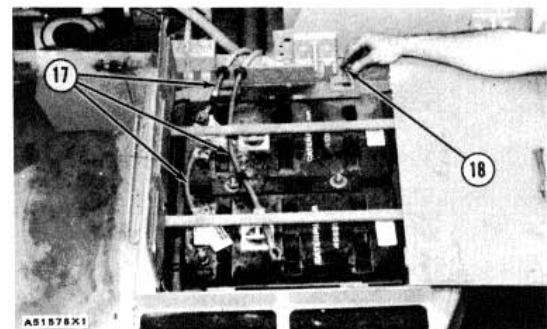
14. Install three holddown strips that hold the batteries in position.

15. Fasten a hoist to cover assembly (16) and put it in position over the batteries.



16. Install bolts (18) that hold the cover assembly in position.

17. Install battery cables (17).
 - a) install hydraulic tank



VEHICLE SYSTEMS

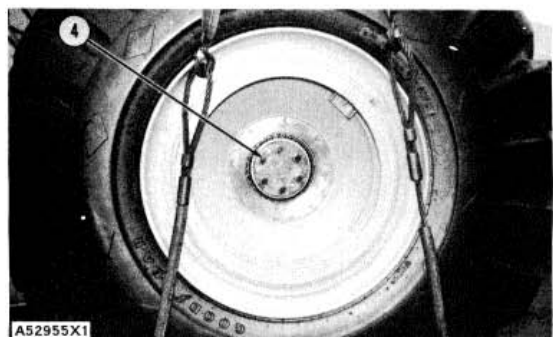
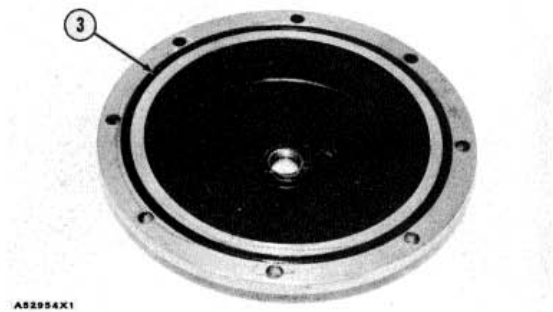
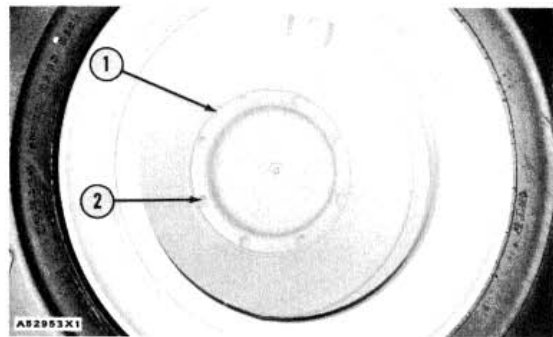
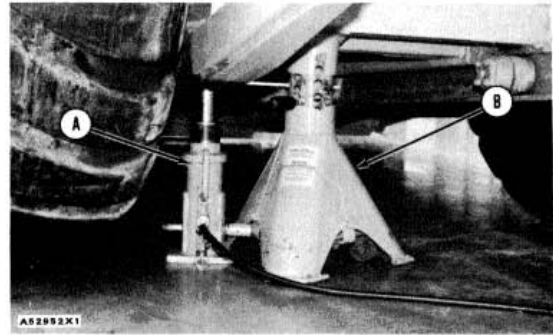
DISASSEMBLY AND ASSEMBLY

TIRES AND WHEELS, WHEEL BEARINGS AND DUO-CONE SEALS

REMOVE TIRES AND WHEELS,
WHEEL BEARINGS AND
DUO-CONE SEALS

	Tools Needed	A	B
8S7610	Base Assembly	1	
8S7650	Cylinder Assembly	1	
8S7615	Pin	1	1
5P3100	Pump Group	1	
8S7640	Stand		1
8S7611	Tube		1
8S8048	Saddle		1

1. Release the brakes on the rear wheel. Turn the slack adjuster until the brakes release.
2. Put tooling (A) under the frame of the scraper as shown. Lift the scraper with tooling (A) until the tire is off the floor. Put tooling (B) under the support of the scraper as shown. Lower the scraper until the support makes contact with tooling (B). Make sure the tire is still off the floor.
3. Loosen eight nuts (2) a small amount. Do not remove the nuts. Pull cap (1) away from the wheel to drain the oil from the wheel assembly.
4. Remove the eight nuts and cap.
5. Remove O-ring seal (3) from the cap. Check the condition of the seal. If the seal has damage, use a new part for replacement.
6. Fasten a hoist to the tire and wheel as shown.
7. Remove six bolts (4).



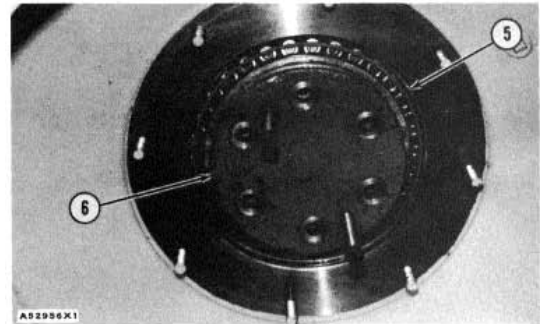
VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

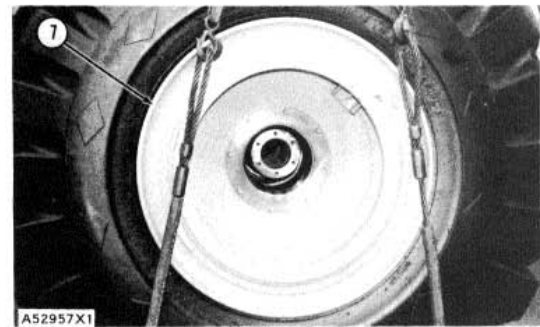
TIRES AND WHEELS, WHEEL BEARINGS AND DUO-CONE SEALS

8. Install two 1/2"-13 NC forcing screws in retainer (6). Tighten the screws evenly to remove the retainer.

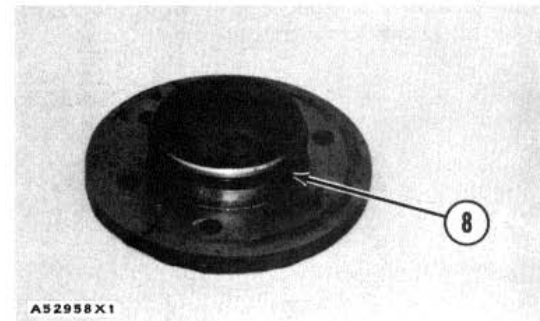
9. Remove the shims and outer bearing cone (5) from the axle housing.



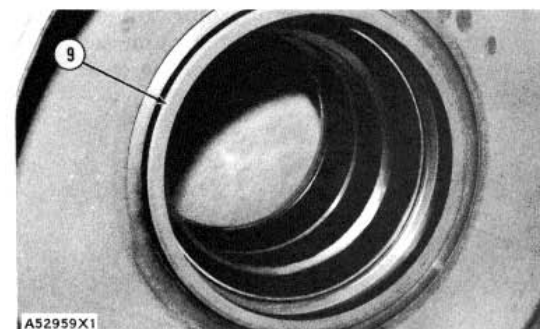
10. Remove tire and wheel (7). The weight of the tire and wheel is 2500 lb. (1125 kg).



11. Remove O-ring seal (8) from the retainer. Check the condition of the seal. If the seal has damage, use a new part for replacement.



12. Remove Duo-Cone seal (9) from the wheel.

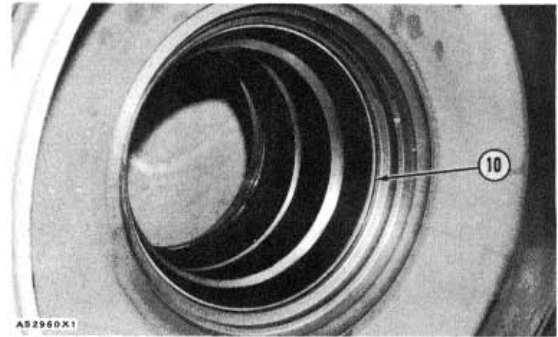


VEHICLE SYSTEMS

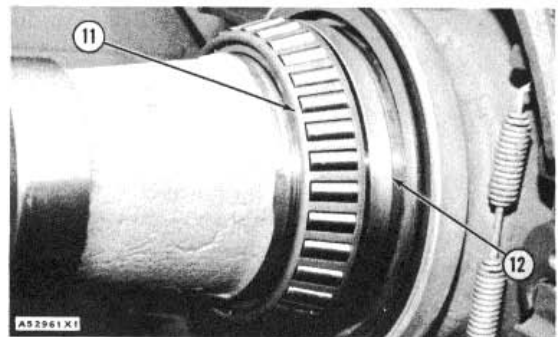
DISASSEMBLY AND ASSEMBLY

TIRES AND WHEELS, WHEEL BEARINGS AND DUO-CONE SEALS

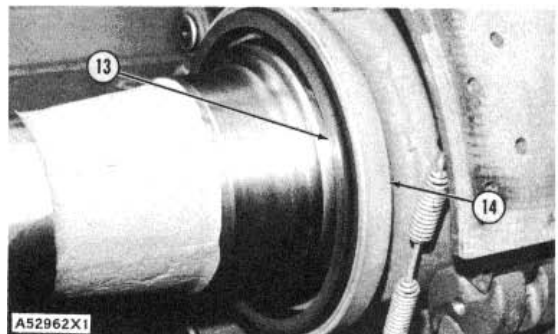
13. Remove bearing cup (10) from the wheel.



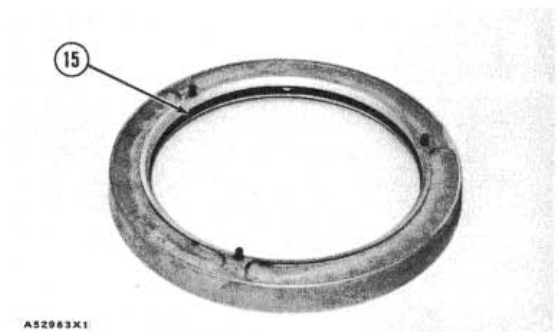
14. Remove bearing cone (11) and spacer (12) from the axle housing.



15. Remove Duo-Cone seal (13) and retainer assembly (14) from the axle housing.



16. Remove O-ring seal (15) from the retainer assembly. Check the condition of the seal. If the seal has damage, use a new part for replacement.



VEHICLE SYSTEMS

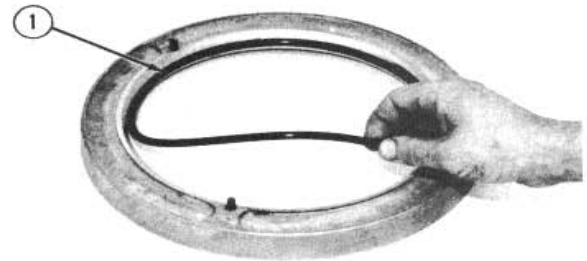
DISASSEMBLY AND ASSEMBLY

TIRES AND WHEELS, WHEEL BEARINGS AND DUO-CONE SEALS

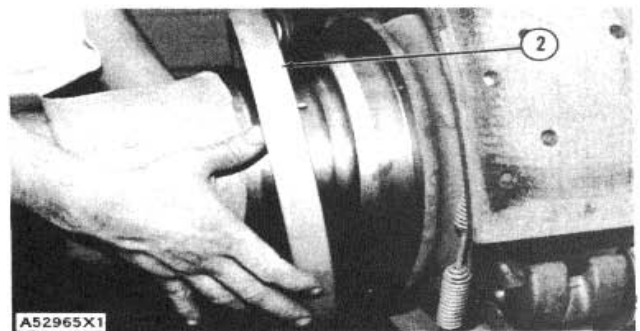
INSTALL TIRES AND WHEELS,
WHEEL BEARINGS AND DUO-CONE
SEALS

	Tools Needed	A	B	C	D
8S7610	Base Assembly	1			
8S7650	Cylinder Assembly	1			
8S7615	Pin	1	1		
5P3100	Pump Group	1			
8S7640	Stand		1		
8S7611	Tube		1		
8S8048	Saddle		1		
8M7912	Seal Installer			1	
6F6922	Depth Gauge				1

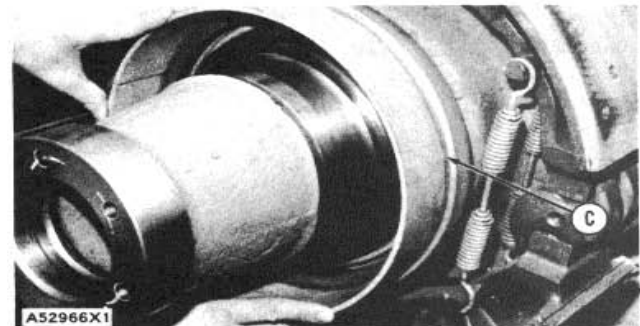
1. Install O-ring seal (1) in the retainer assembly.
2. Install retainer assembly (2) on the axle housing as shown.
3. Make sure the Duo-Cone seal is clean and dry. Make sure the metal surfaces that the seals make contact with are clean and dry. Put clean oil on the contact surface of the metal seals after the seal is installed.
4. Install the Duo-Cone seal in the retainer assembly with tool (C).
5. Install spacer (4) on the axle housing as shown.
6. Install bearing cone (3) on the axle housing as shown.



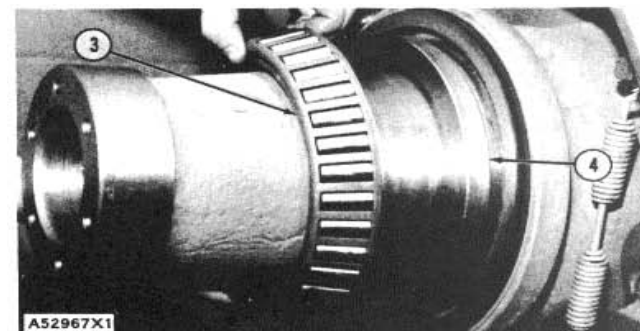
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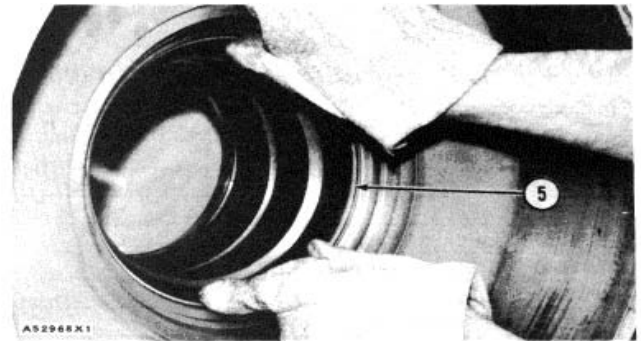
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VEHICLE SYSTEMS

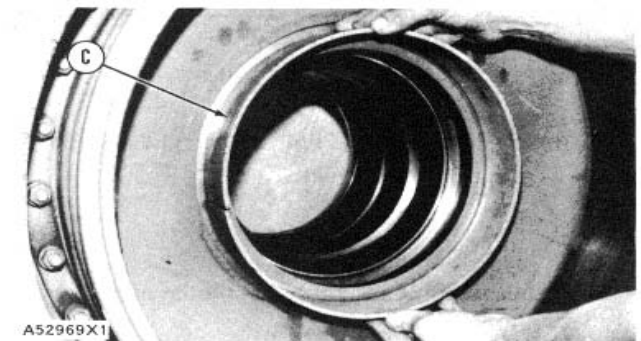
DISASSEMBLY AND ASSEMBLY

TIRES AND WHEELS, WHEEL BEARINGS AND DUO-CONE SEALS

7. Lower the temperature of bearing cup (5) and install it in the wheel until it makes contact with the bottom of the counterbore in the wheel.

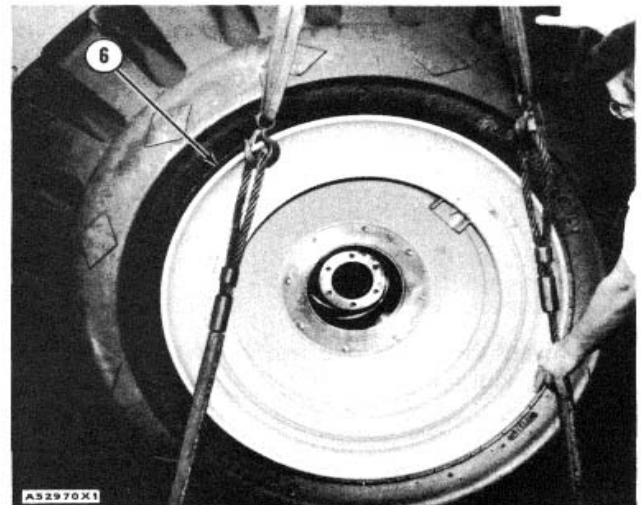


8. Make sure the Duo-Cone seal is clean and dry. Make sure the metal surfaces that the seal makes contact with are clean and dry. Put clean oil on the contact surface of the metal seal after it is installed.



9. Install the Duo-Cone seal in the wheel with tool (C).

10. Fasten a hoist to tire and wheel (6) and put it in position on the axle housing.



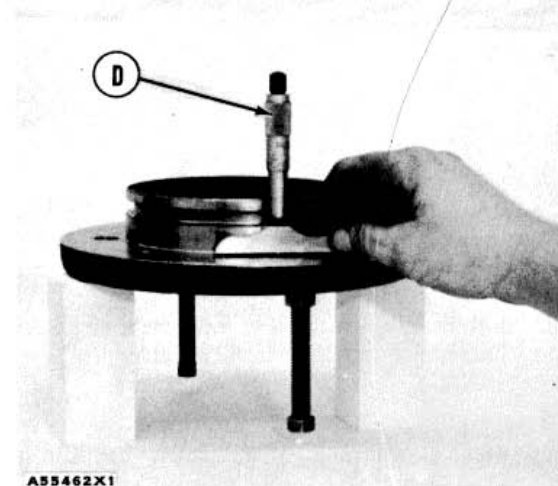
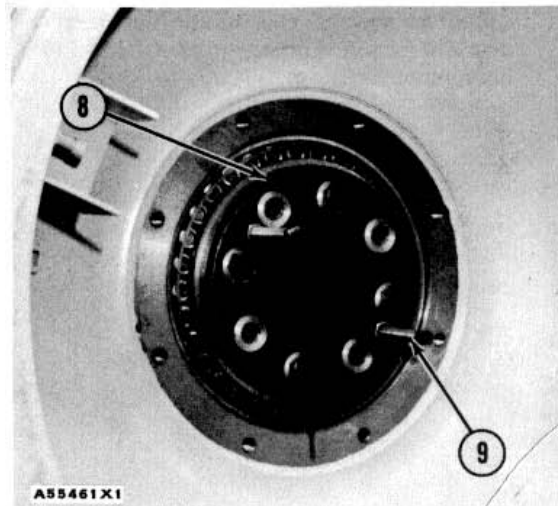
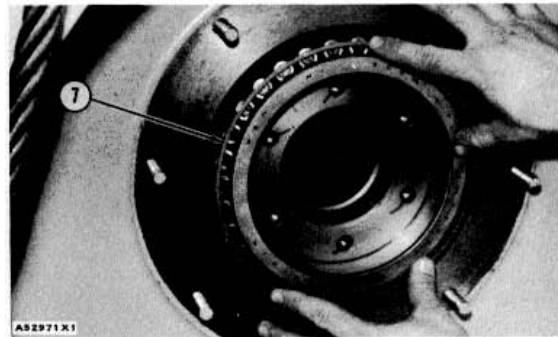
CAUTION: Do not cause damage to the Duo-Cone seals when the wheel is put into position over the axle housing.

VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

TIRES AND WHEELS, WHEEL BEARINGS AND DUO-CONE SEALS

11. Install outer bearing cone (7) on the axle housing.
12. Install retainer (8) without an O-ring seal and shims.
13. Install three bolts the same distance apart to hold the retainer in position.
14. Tighten the bolts to a torque of 50 + 5 lb. ft. (70 + 7 N m). While the wheel and tire is turned tighten the bolts again to a torque of 50 + 5 lb. ft. (70 + 7 N m).
15. Install two 1/2"-13 NC forcing screws and nuts (9) in the retainer and tighten them by hand until they make contact with the end of the axle housing. Tighten the two nuts on the screws.
16. Remove the retainer from the end of the axle housing. Measure the distance from the end of the forcing screw to the machined surface of the retainer as shown with tool (D). Keep tool (D) close to the forcing screws when the distances are measured. Make a record of this dimension.

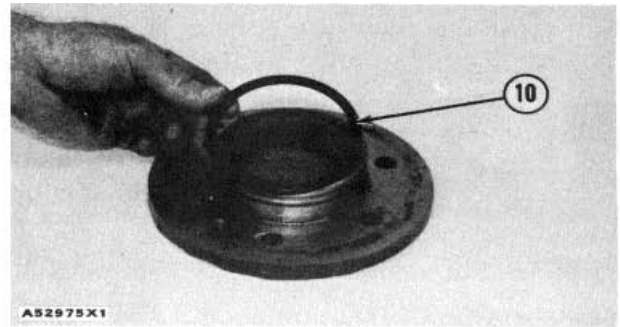


VEHICLE SYSTEMS

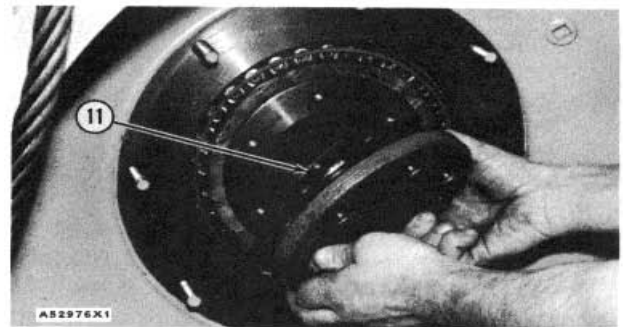
DISASSEMBLY AND ASSEMBLY

TIRES AND WHEELS, WHEEL BEARINGS AND DUO-CONE SEALS

17. Install O-ring seal (10) on the retainer.

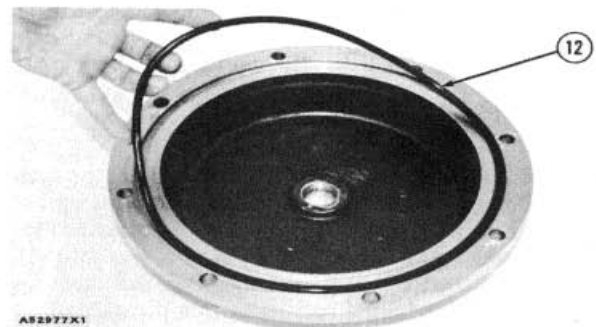


18. Install the retainer and a thickness of shims (11) that was measured in Step 16 plus .015 in. (0.38 mm) more shims.



19. Install the six bolts that hold the retainer. While the wheel is turned tighten the bolts evenly to a torque of 100 + 10 lb. ft. (135 +- 14 N m).

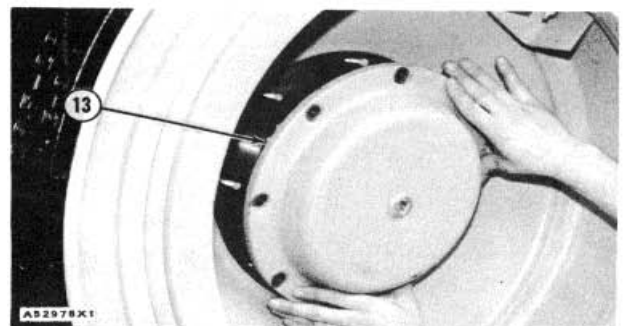
20. Install O-ring seal (12) in the cap.



21. Install cap (13) and the eight nuts that hold it.

22. Fill the wheel with oil to the correct level. See Lubrication and Maintenance Guide.

23. Make an adjustment to the brakes. See Adjustment of Brakes.



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

BRAKE SHOES AND BRAKE DRUMS

REMOVE BRAKE SHOES AND
BRAKE DRUMS

		Tools Needed	A
1P541		Brake Spring Pliers	1

start by:

a) remove tires and wheels, wheel bearings and Duo-Cone seals (621B Scraper)

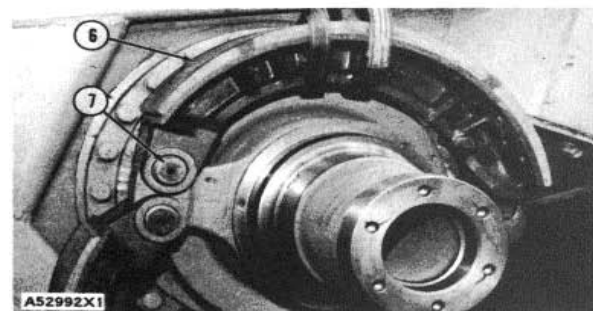
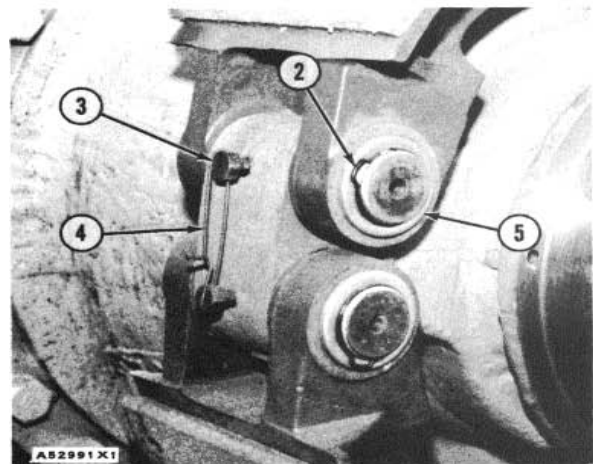
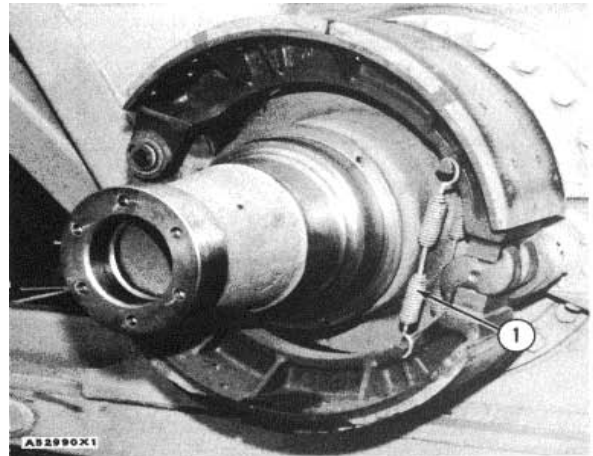
1. Remove brake spring (1) with tool (A).

2. Cut lockwire (4) and remove two bolts (3).

3. Remove snap ring (2), retainer (5) and the felt washer from each pin that holds the brake shoes to the axle housing.

4. Fasten a hoist to brake shoes (6). Remove pin (7). Remove the brake shoe. The weight of the brake shoe is 50 lb. (23 kg).

5. Fasten a hoist to the lower brake shoe and remove it as in Step 4.

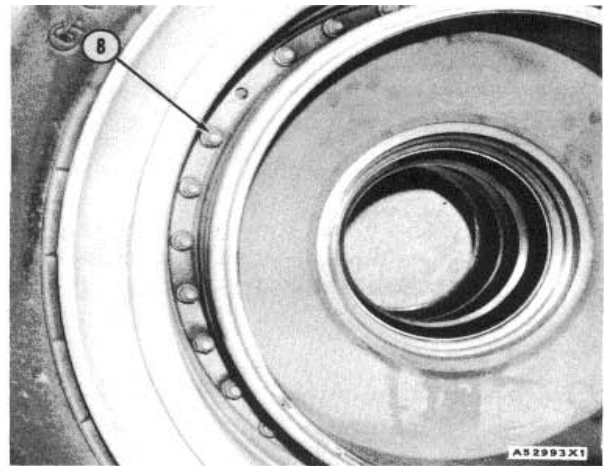


VEHICLE SYSTEMS

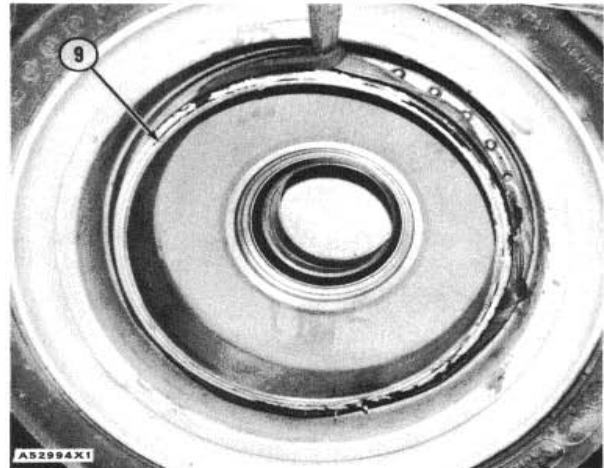
DISASSEMBLY AND ASSEMBLY

BRAKE SHOES AND BRAKE DRUMS

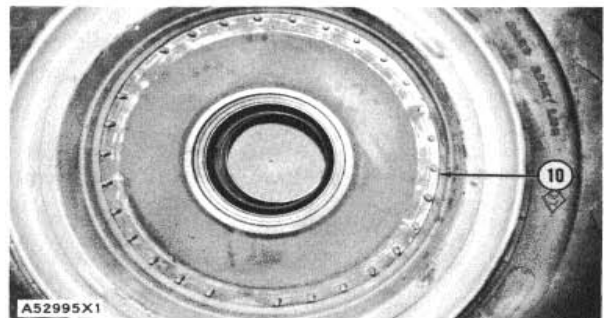
- Remove twenty-seven nuts (8) and washers that hold the brake drum and guard in the wheel.



- Fasten a hoist to brake drum (9) and remove it from the wheel. The weight of the brake drum is 120 lb. (54 kg).



- Remove guard (10) from the wheel.



VEHICLE SYSTEMS

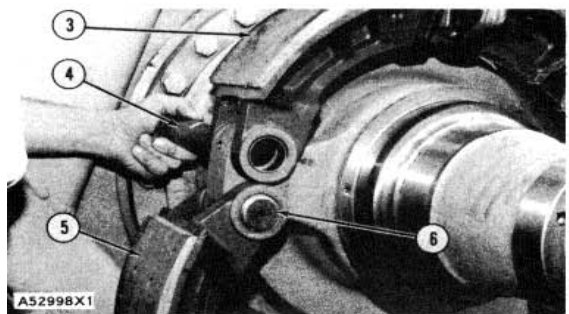
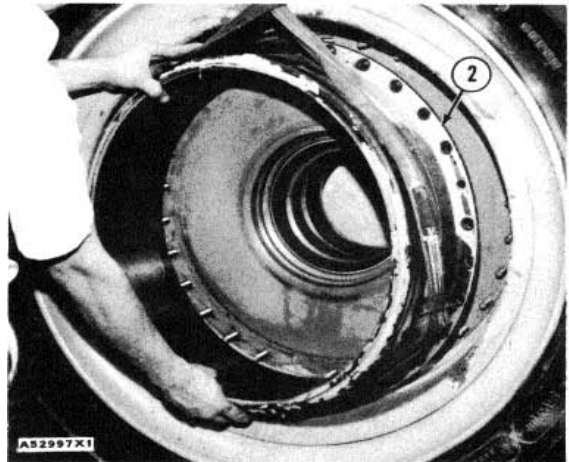
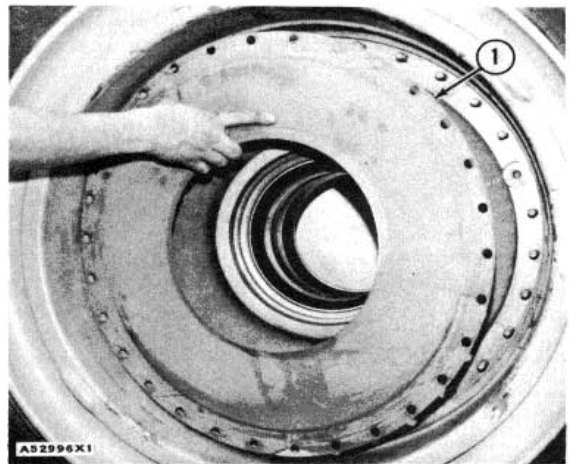
DISASSEMBLY AND ASSEMBLY

BRAKE SHOES AND BRAKE DRUMS

INSTALL BRAKE SHOES AND
BRAKE DRUMS

	Tools Needed	A
5P167	Brake Spring Installer	1

1. Put guard (1) in position in the wheel.
2. Fasten a hoist to brake drum (2) and put it in position in the wheel. Install the twenty-seven washers and nuts that hold the guard and brake drum in the wheel.
3. Put lower brake shoe (5) in position on the axle housing and install pin (6) that holds it.
4. Put upper brake shoe (3) in position on the axle housing and install pin (4) that holds it.

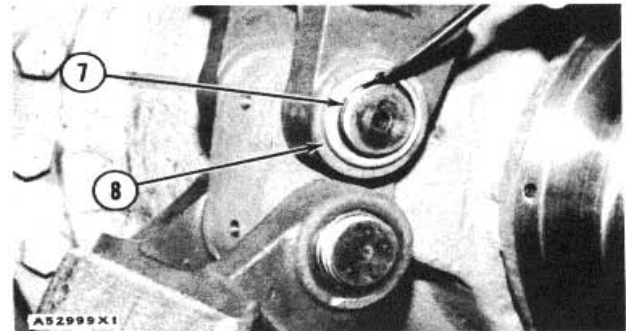


VEHICLE SYSTEMS

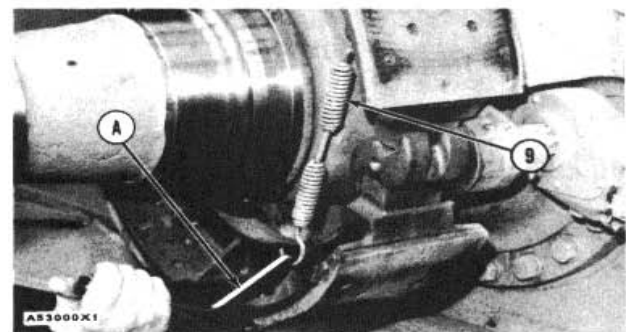
DISASSEMBLY AND ASSEMBLY

BRAKE SHOES AND BRAKE DRUMS, AXLE HOUSINGS

5. Install the felt washer, retainer (8) and snap ring (7) that holds the pivot pins for the brake shoes.



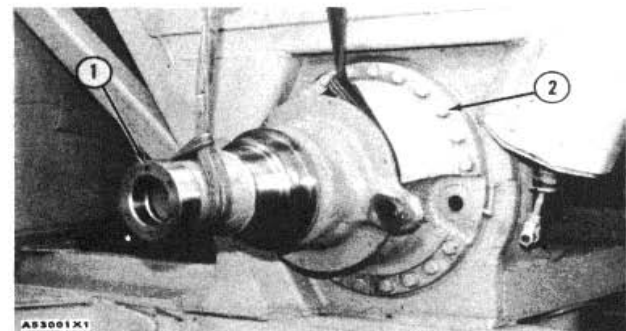
6. Install brake spring (9) with tool (A).
end by:
 - a) tires and wheels, wheel bearings and Duo-Cone seals



REMOVE AXLE HOUSINGS

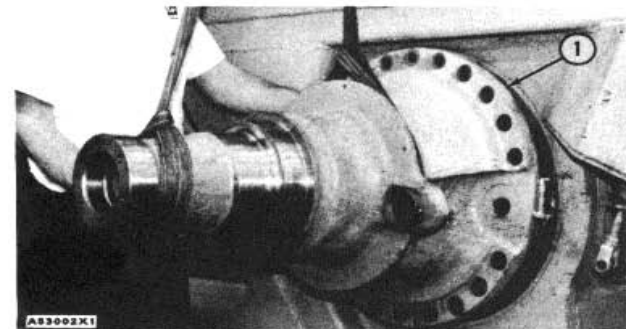
- start by:
- a) brake camshafts and slack adjusters

1. Fasten a hoist to axle housing (1).
2. Remove twenty-two bolts (2) and nuts that hold the housing. Remove the housing. The weight of the axle housing is 340 lb. (153 kg).



INSTALL AXLE HOUSING

1. Fasten a hoist to axle housing (1) and put it in position on the scraper frame.
2. Install the twenty-two bolts and nuts that hold it.
end by:
 - a) install brake camshafts and slack adjusters



VEHICLE SYSTEMS

DISASSEMBLY AND ASSEMBLY

BRAKE CAMSHAFTS AND SLACK ADJUSTERS

REMOVE BRAKE CAMSHAFT AND SLACK ADJUSTER

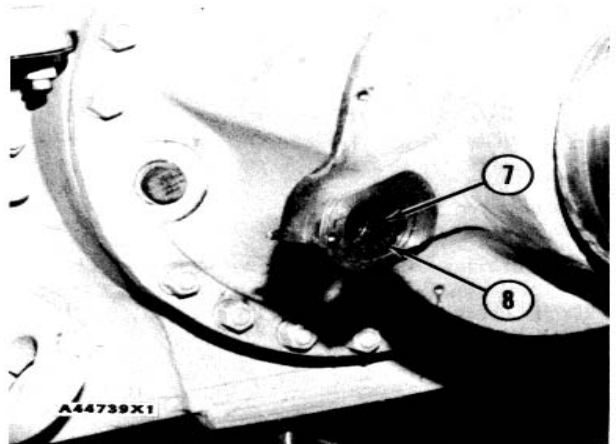
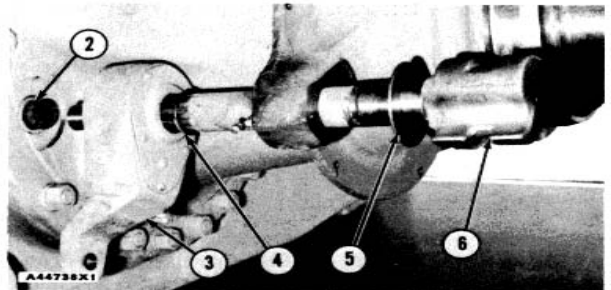
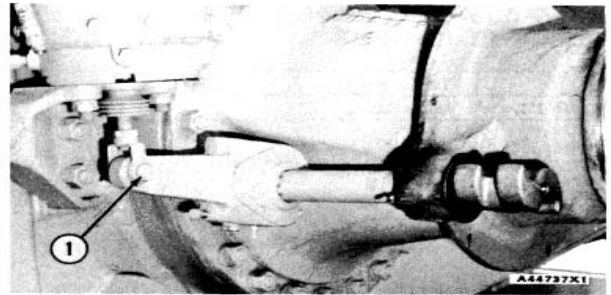
1. Remove the tire and wheel. See Remove Tires and Wheels, Wheel Bearings and Duo-Cone Seals.

NOTE: The brake shoes are removed for better photo illustration of the brake camshaft and slack adjuster.

2. Put small wood blocks between the brake shoes and axle housing before the brake camshaft and slack adjuster is removed. The wood blocks will hold the brake shoes in position.
3. Remove pin (1) to disconnect the adjuster assembly from the brake rotochamber.
4. Remove ring (4) from the groove in the camshaft.
5. Pull camshaft (6) out of the axle housing as shown.

NOTE: Oil will drain out of location (2) when the camshaft is pulled out of the differential case and axle housing.

6. Remove the camshaft and slack adjuster (3).
7. Remove washer (5) from the camshaft.
8. Remove three seals (8) and two bearings (7) from the axle housing.



VEHICLE SYSTEMS

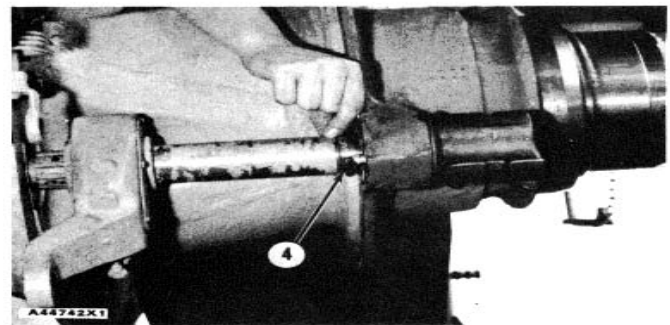
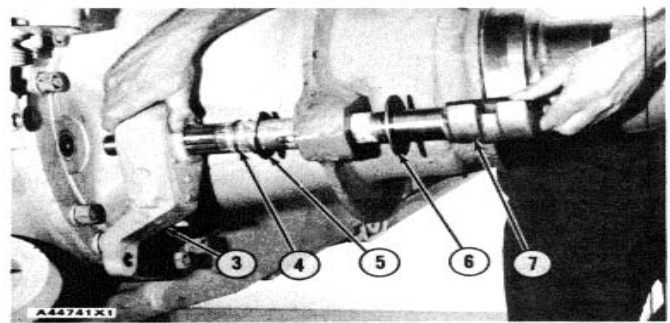
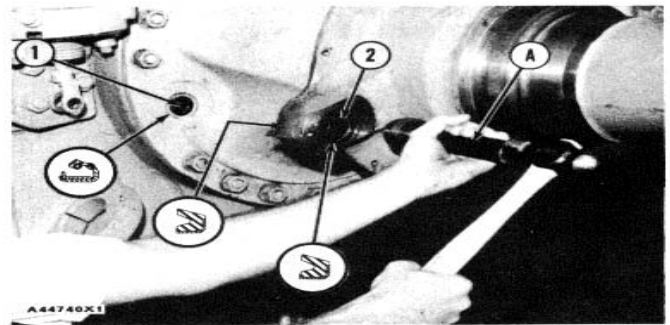
DISASSEMBLY AND ASSEMBLY

BRAKE CAMSHAFTS AND SLACK ADJUSTERS

INSTALL BRAKE CAMSHAFTS AND SLACK ADJUSTERS

	Tools Needed	A
1P510	Drive Group	1

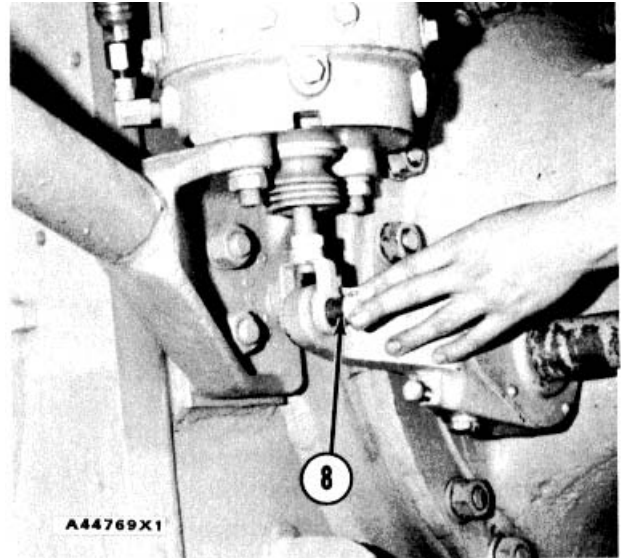
1. Install bearing (1) in the axle housing with tool (A).
2. Install the lip type seal in the axle housing with tooling (A). Install the seal with the lip of the seal toward the differential case as shown.
3. Install bearing (2) in the axle housing with tooling (A). Install the bearing until it is .281 in. (7.14 mm) below the outside surface of the axle housing.
4. Install the two lip type seals on each side of bearing (2) with tooling (A). Install the seals even with the outside surface of the axle housing and with the lips of the seals toward the differential case as shown.
5. Install washer (6) on camshaft (7). Slide the camshaft through the axle housing and install washer (5) and ring (4) on the camshaft.
6. Put slack adjuster (3) in position on the camshaft and install the end of the camshaft in the axle housing.
7. Put ring (4) in the groove on the camshaft.



BRAKE CAMSHAFT AND SLACK ADJUSTERS,

ADJUSTMENT OF BRAKES

8. Put the slack adjuster in position in the rod of the brake rotochamber. Install pin (8) and the cotter pin.

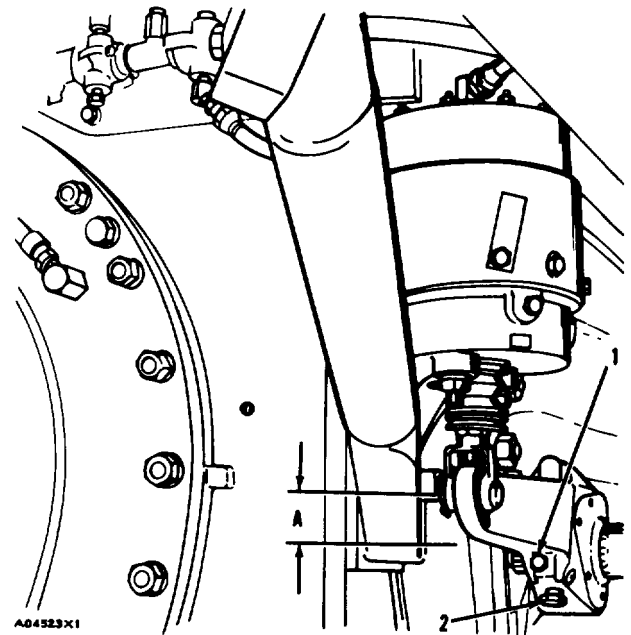


9. Install the tires and wheels. See Install Tire and Wheels, Wheel Bearings and Duo-Cone Seals.

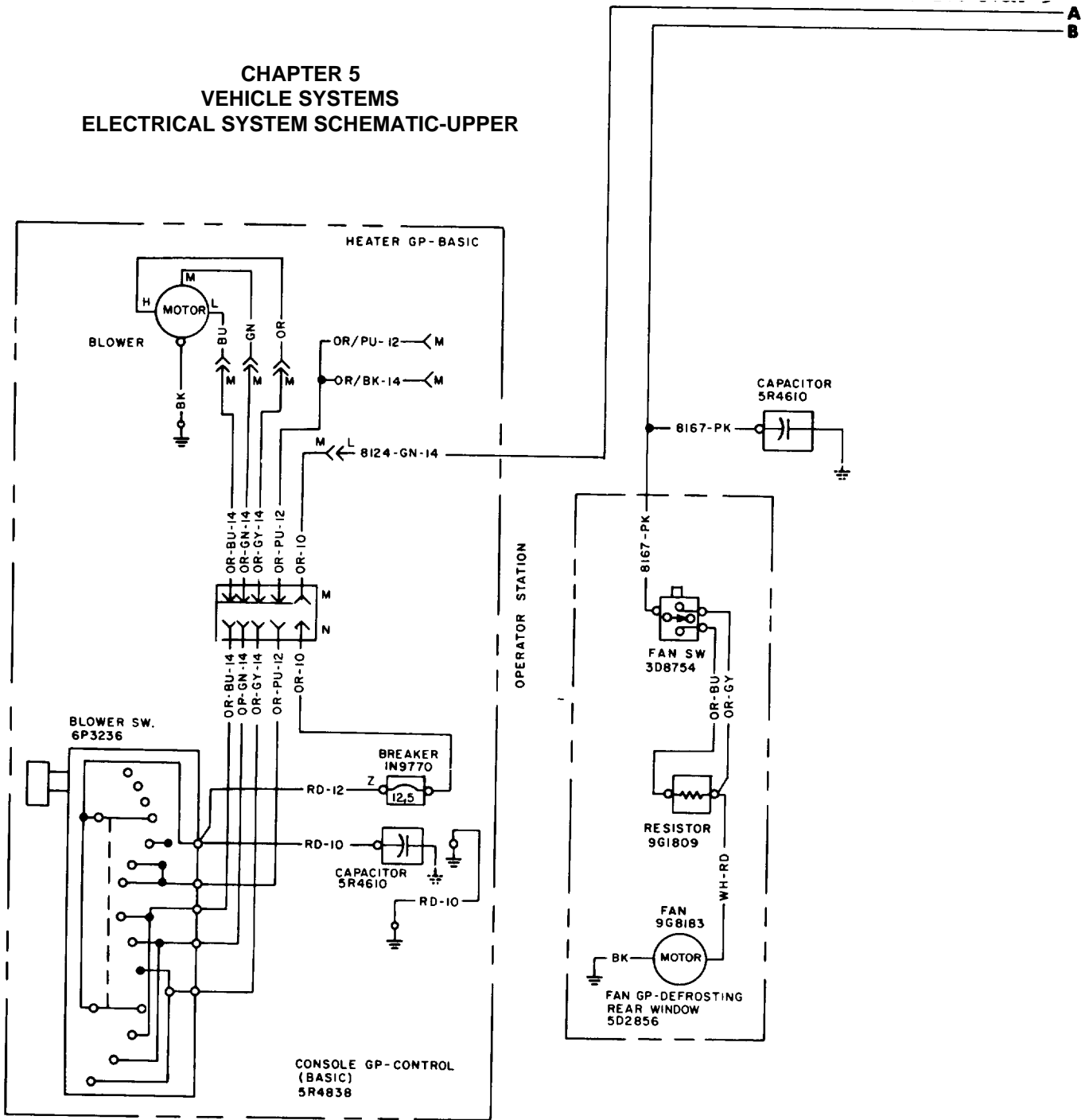
ADJUSTMENT OF BRAKES

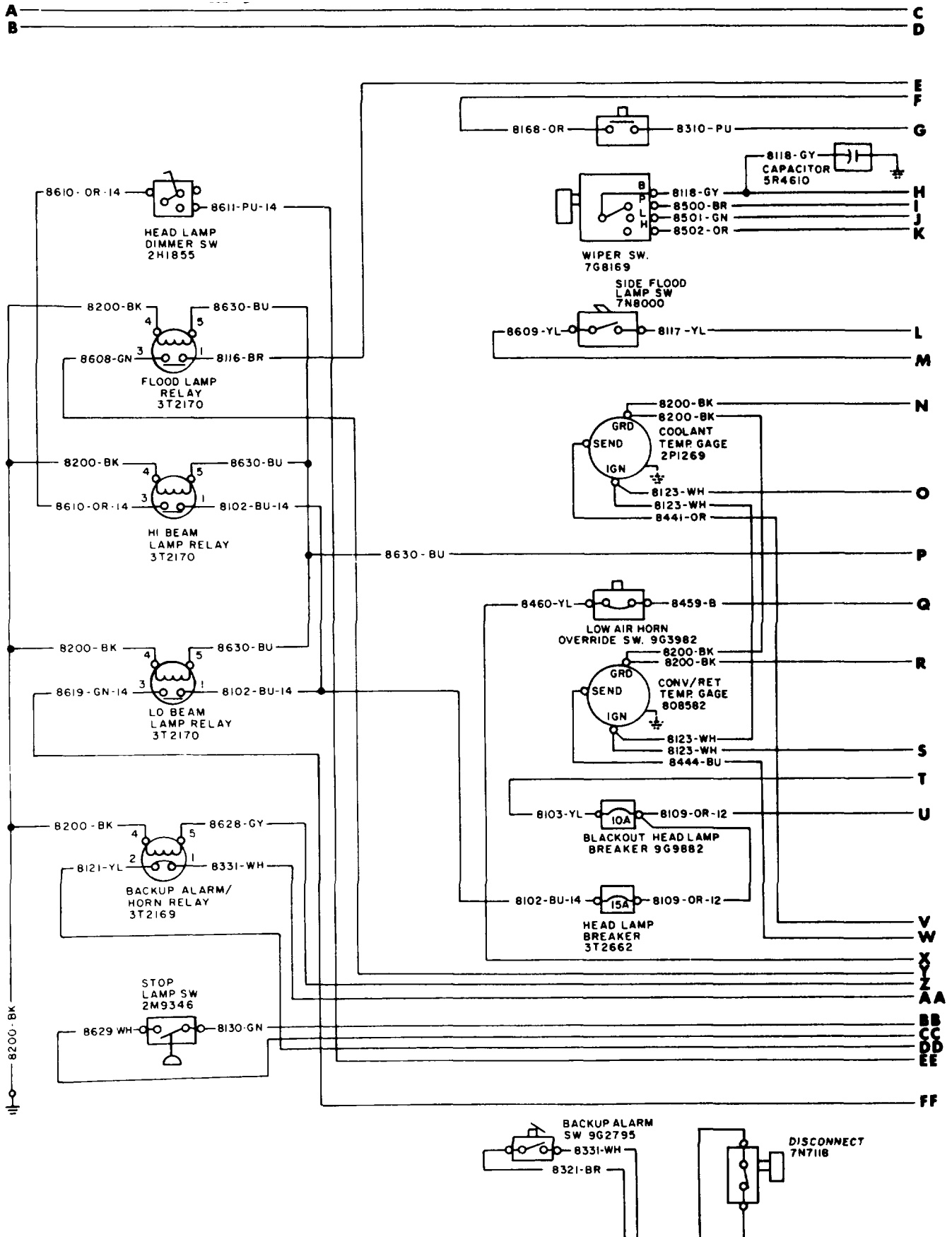
NOTE: The maximum amount of movement [distance (A)] of the rod before adjustment is needed is 3.00 in. (76.2 mm).

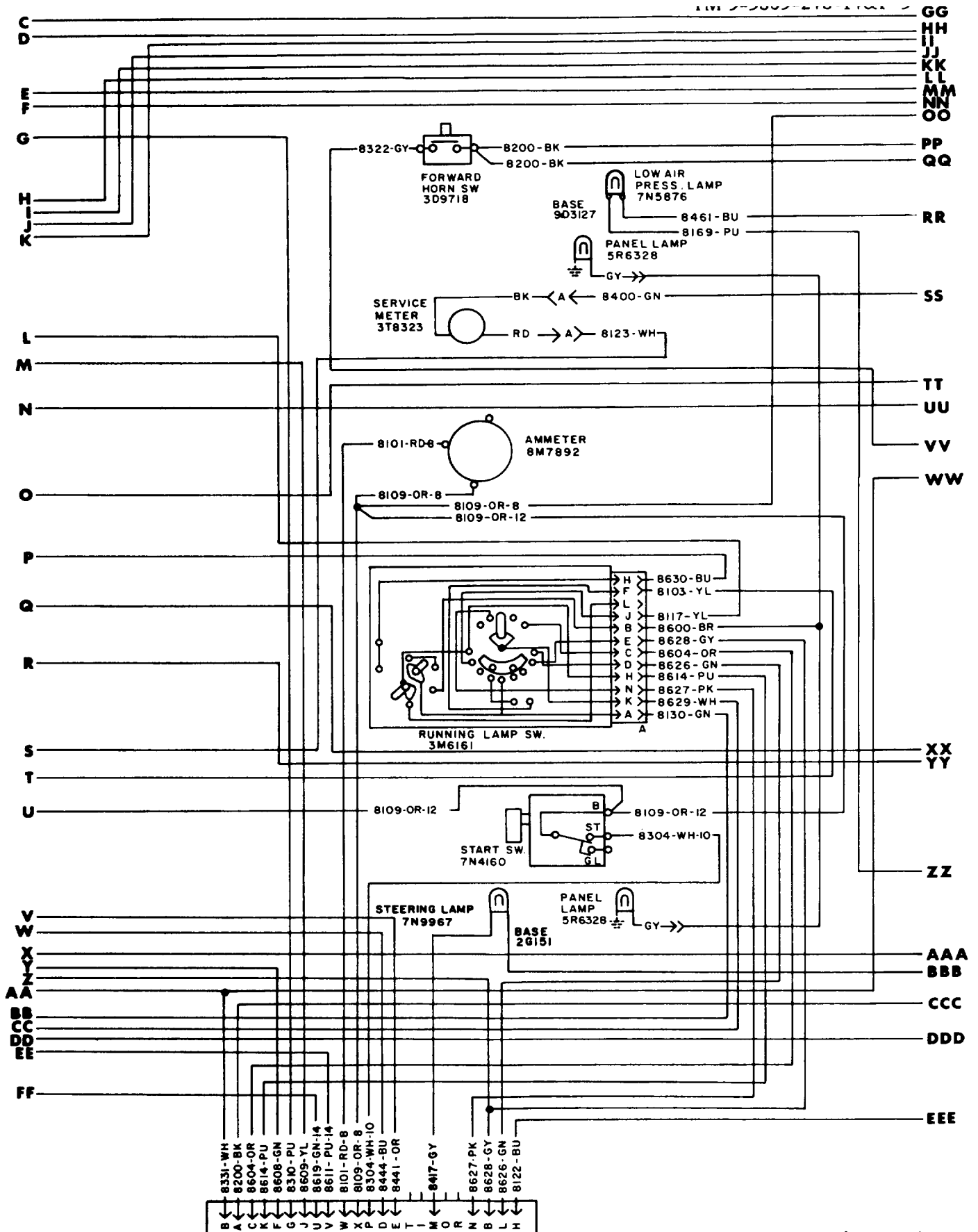
1. Loosen screw (1).
2. Turn shaft (2) until the movement of the rod is 1.62 in. (41.1 mm) (cold) when the brakes are engaged.
3. Tighten screw (1).

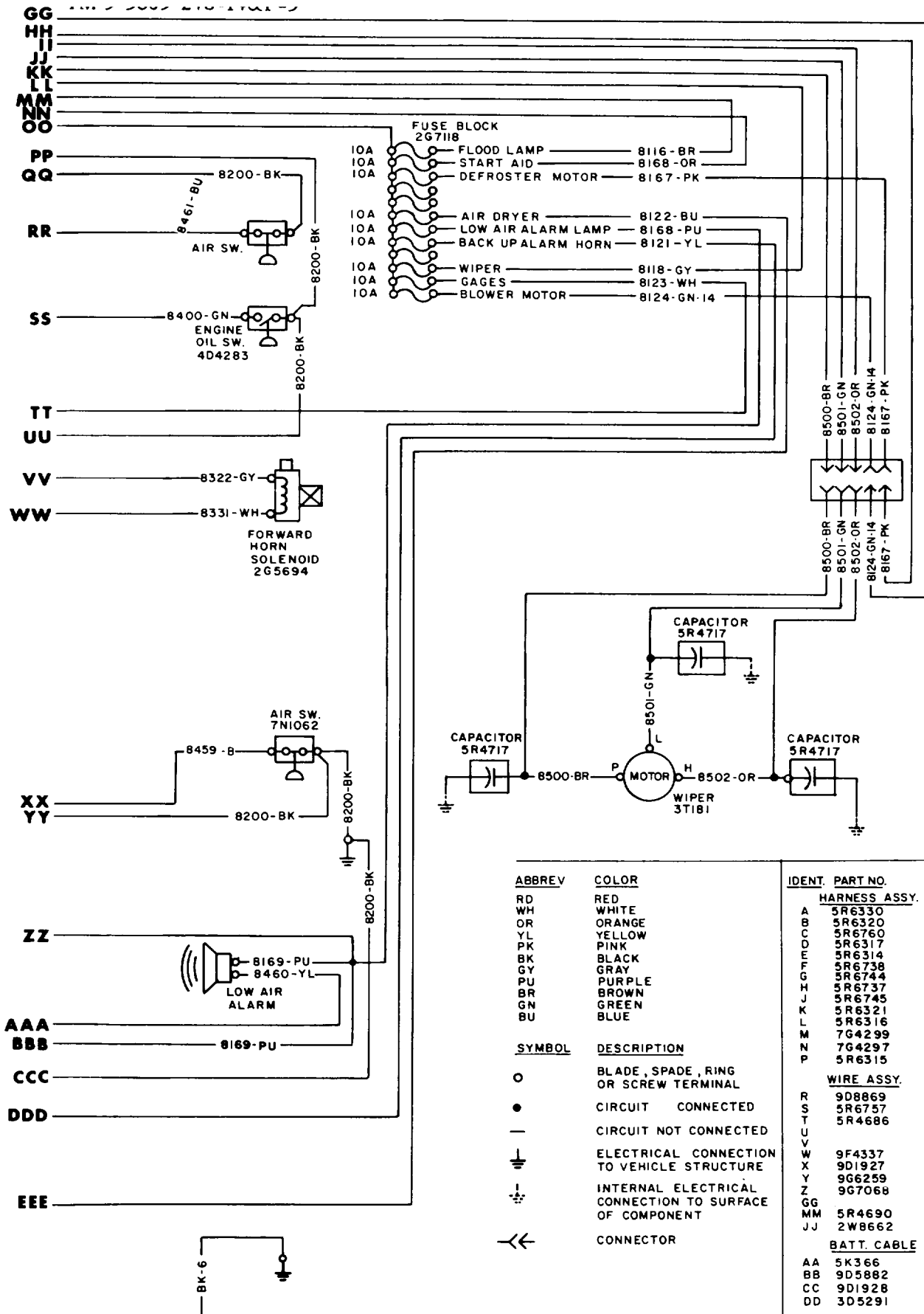


CHAPTER 5
VEHICLE SYSTEMS
ELECTRICAL SYSTEM SCHEMATIC-UPPER





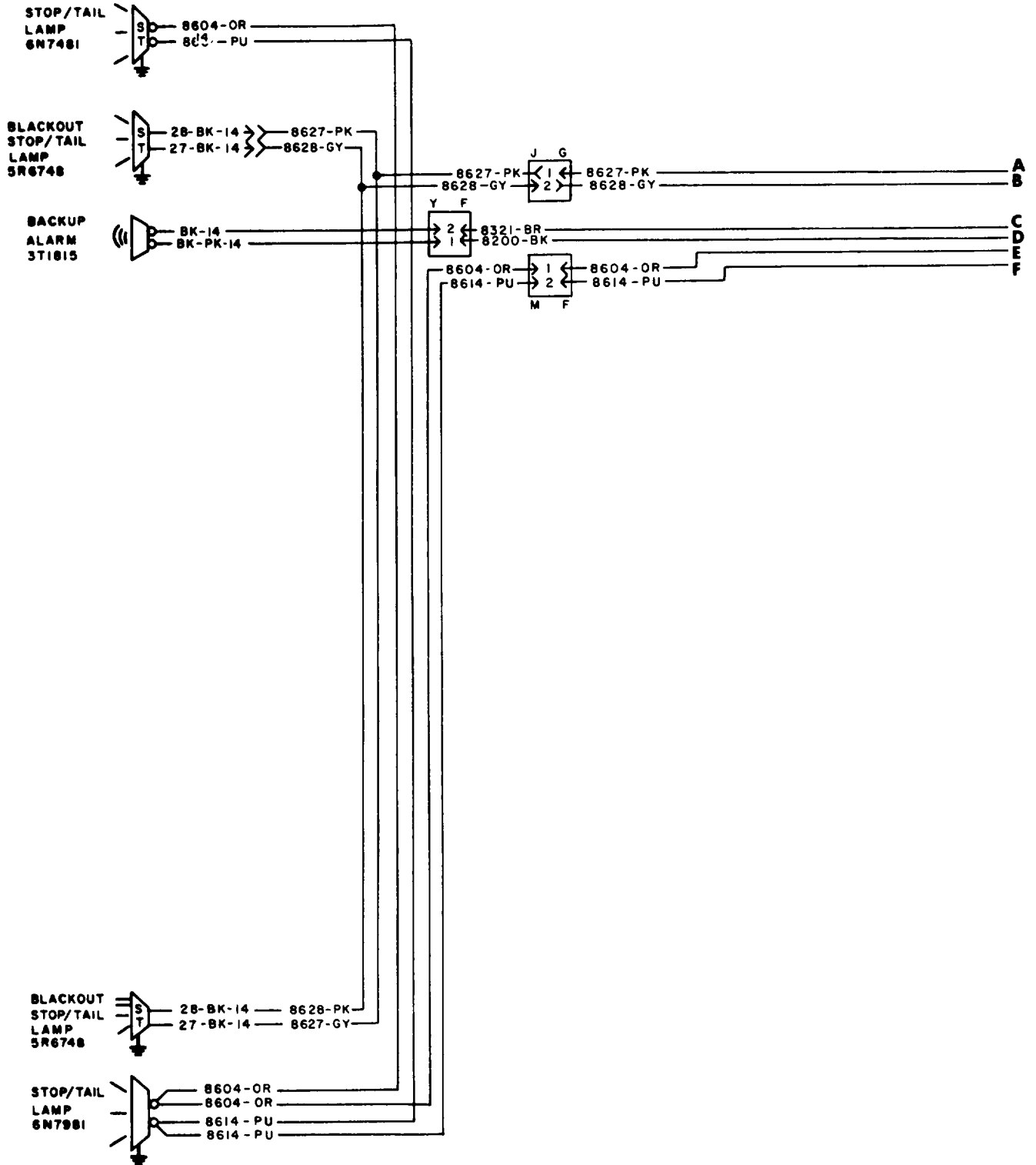


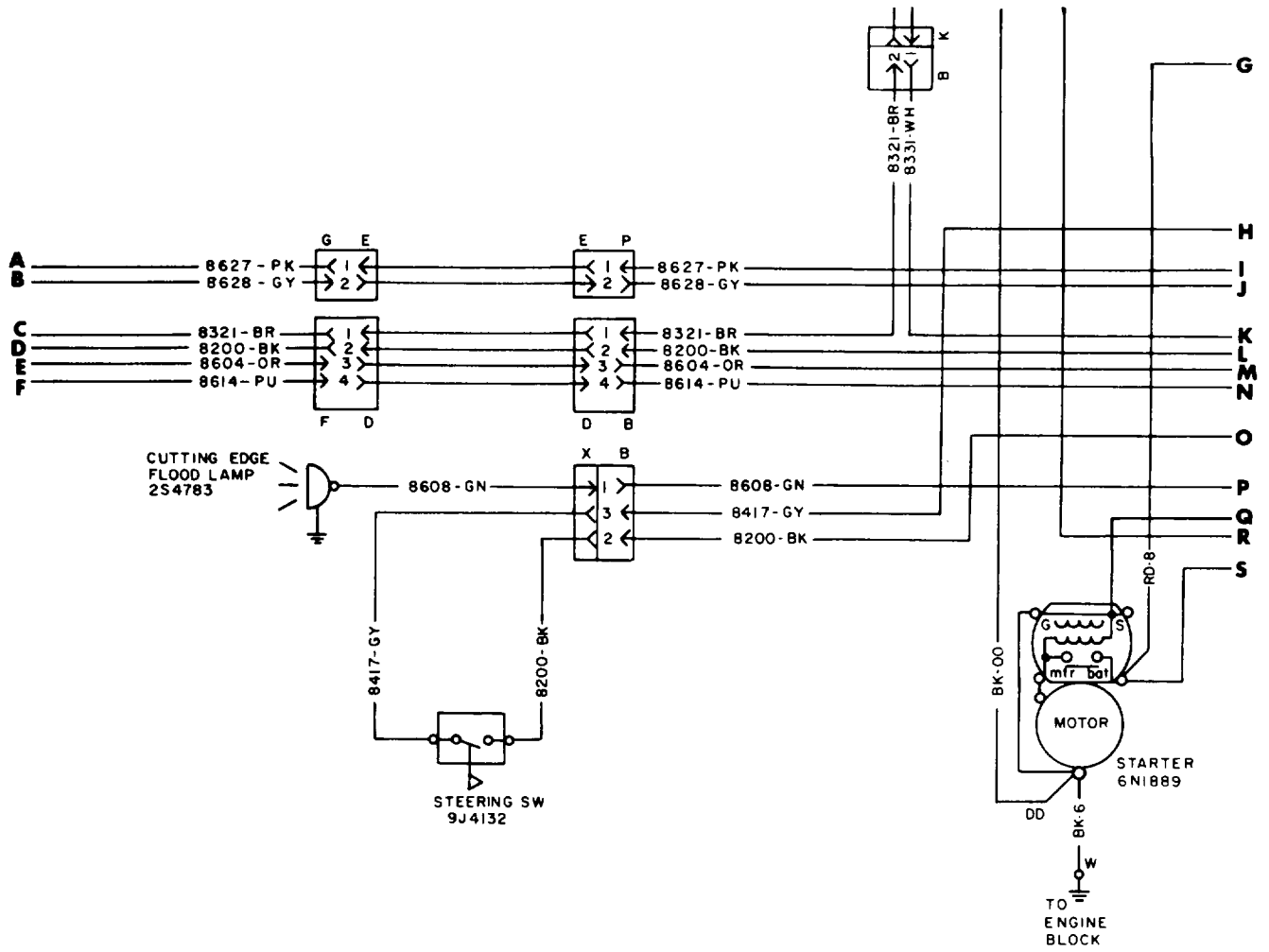


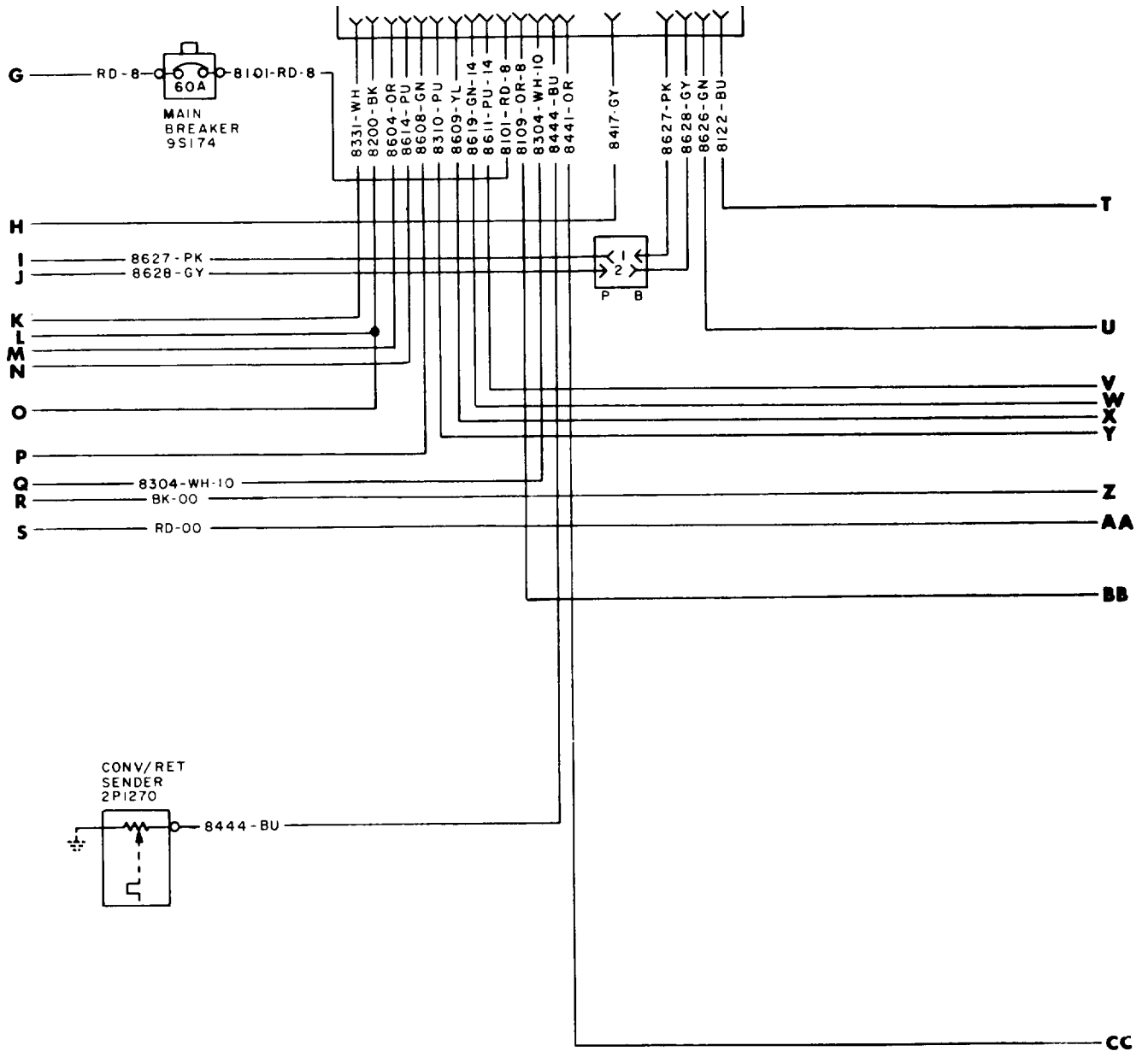
ABBREVIATION	COLOR	IDENT.	PART NO.
RD	RED	A	5R6330
WH	WHITE	B	5R6320
OR	ORANGE	C	5R6760
YL	YELLOW	D	5R6317
PK	PINK	E	5R6314
BK	BLACK	F	5R6738
GY	GRAY	G	5R6744
PU	PURPLE	H	5R6737
BR	BROWN	J	5R6745
GN	GREEN	K	5R6321
BU	BLUE	L	5R6316
		M	7G4299
		N	7G4297
		P	5R6315
			WIRE ASSY.
		R	9D8869
		S	5R6757
		T	5R4686
		U	
		V	
		W	9F4337
		X	9D1927
		Y	9G6259
		Z	9G7068
		GG	5R4690
		MM	2W8662
		JJ	
			BATT. CABLE
		AA	5K366
		BB	9D5882
		CC	9D1928
		DD	3D5291

SYMBOL	DESCRIPTION
○	BLADE, SPADE, RING OR SCREW TERMINAL
●	CIRCUIT CONNECTED
—	CIRCUIT NOT CONNECTED
⊥	ELECTRICAL CONNECTION TO VEHICLE STRUCTURE
⊥	INTERNAL ELECTRICAL CONNECTION TO SURFACE OF COMPONENT
⇐	CONNECTOR

ELECTRICAL SYSTEM SCHEMATIC-LOWER







CHAPTER 6
VEHICLE SYSTEMS
MAINTENANCE

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Every 250 Service Hours or Monthly	3-414
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Every 1000 Service Hours or 6 Months	3-433
Every 2000 Service Hours or 1 Year	3-437

Safety



Lubrication, maintenance or repair of this machine can be dangerous unless (Ho) performed properly. Each person must satisfy himself that he has the necessary skill and information, proper tools and equipment, and that his work method is safe and correct.

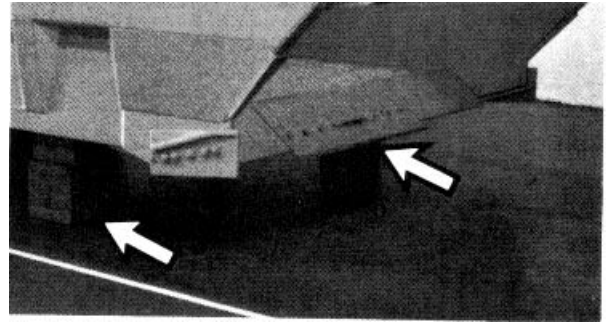
Perform all maintenance operations, unless otherwise specified, with all equipment lowered, the transmission lever in NEUTRAL with the lock applied, the parking brake applied, the engine stopped, and the electrical disconnect key removed.

There are certain hazards which must be recognized as potential causes of personal Injury Be aware of these hazards and follow the recommendations which are listed below.

Crushing or Cutting

Never attempt adjustments while the machine is moving or the engine is running.

Any implement can fall if a control is moved, or a hydraulic line breaks.



Block the bowl when changing cutting edges or router bits.

Support equipment when working beneath it. Do not depend on hydraulic cylinders to hold it up.

To avoid possible weakening of the ROPS (Rollover Protective Structure), do not alter the ROPS in any way. The protection offered by the ROPS will be impaired if it has been subjected to structural damage, or has been involved in an overturn Incident.

The fan blades will throw or cut any object or tool that falls or is pushed Into them Drive shaft and universal joints can catch loose clothing, wipe cloths, or hair.

Do not use kinked or frayed cable, it is weakened. Wear gloves when handling cable.

Chips can fly from a steel object or hammer. Wear protective glasses when hammering on steel, drifts, punches or chisels. Never strike a punch, drift, or chisel that has a mushroomed head.

Safety

Burns

The radiator and all lines to heaters or an engine contain hot water or steam.

Never remove a radiator cap when the coolant is hot.

Check the coolant level ONLY when the engine is stopped, and the radiator cap is cool enough to touch with your hand.

Allow cooling system components to cool before draining the coolant.

Lubricants will be hot enough to cause serious burns after machine compartments are up to normal operating temperature.

Allow compartments to cool before draining lubricant.

The hydraulic system will be pressurized, by hot air in the top of the tank, when the system is at operating temperature.

Never remove the hydraulic tank cap when the oil is hot. Remove it slowly to relieve tank pressure. Allow the tank to cool before draining oil.

Fire or Explosion

Explosions of air-inflated earthmoving tires can result from heat-induced gas combustion inside the tires. The heat generated by welding or heating rim components, external fire, or excessive use of brakes can cause gaseous combustion.

A tire explosion is much more violent than a blowout. The explosion can propel the tire, rim, and final drive components as far as 460 m (1500 feet) or more from the machine.

Both the force of the explosion and the flying debris can cause personal injury or death, and property damage.

Although the risk of an explosion is very low, the hazard is very great, particularly with large tires used on wheel tractor-scrappers.

All personnel should be made aware of this danger and the actions to take to minimize the risk.

Usually, burned bead causes loss of air, and the tire goes flat without hazard to anyone in the vicinity.

However, bead burning can result in the release of an explosive gaseous mixture inside the tire. In some cases the gaseous mixture inside the tire ignites.

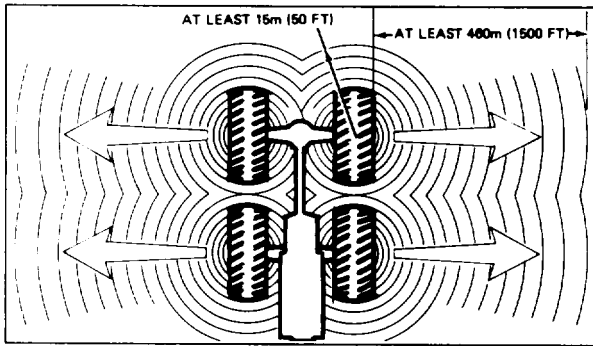
The internal burning causes a rapid increase in pressure, which can result in a violent tire explosion.

The explosion produces a blowout at the tire bead, which reacts against the machine to propel the tire, rim assembly and final drive components a considerable distance from the machine.

The danger of a tire explosion is greater after the machine stops, because of the loss of the cooling effect caused by rotation of the wheel.

If smoke, excessive heat, the smell of burning rubber or other indications of tire bead burning or hot brakes are noticed, move the machine to a remote area, if it can be done without endangering the operator or other personnel in the area

Remove all personnel from the area where the machine is located.



Do not approach a tire closer than the outside of the area represented by the shaded area in the drawing.

If it is absolutely necessary to approach a machine with a suspected tire, stay at least 15 m (50 feet) away from the tires at the front or rear of the machine, or 460 m (1500 feet) away from the side of the tire. The above drawing illustrates the high risk areas to avoid when approaching the machine.

Do not approach any tire on the machine if there is a brake fire, burning rubber or other indications that excessive heat was generated by the brakes. Brake-generated heat probably affects all other tires on the machine, even though the visual evidence is only at one tire.

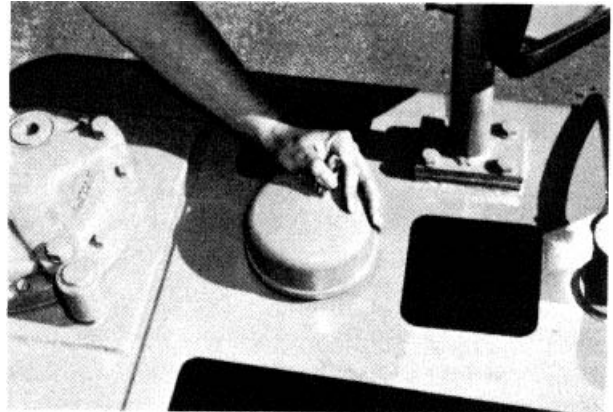
If there is evidence of a brake fire or the smell of burning rubber, don't go near the machine. **FIGHT THESE FIRES FROM A REMOTE LOCATION.** (Too often, the immediate response to a fire involving tires or brakes, is for people to grab a hand-held fire extinguisher and rush up close to the machine to help put out the fire.) Stay away from the machine until the tires cool. Allow at least eight hours for the tires to cool before approaching the machine.

Keep observers out of the area, and at least 460 meters (1500 feet) away from the side of the tire, and 15 meters (50 feet) from the front or rear of the machine.

See the above drawing.

There is no absolutely safe approach when fighting a tire or brake fire. Approach only at the front or the rear of the machine, and use a large dozer as a shield.

Diesel fuel and all lubricants are flammable. Do not weld or flame cut or, pipes or tubes that contain oil. Clean them thoroughly with nonflammable solvent before welding or flame cutting on them.



Do not smoke when refueling, or when working in areas containing fuels.

To avoid fires, clean up oil spills, and steam clean the machine.

Loose or damaged lines, tubes, and hoses, which leak, can cause fires.

Do not bend or strike high pressure lines.

Do not install bent or damaged lines, tubes, or hoses.

To prevent vibration, rubbing against other parts, or excessive heat during operation, inspect all lines, tubes, and hoses, carefully.

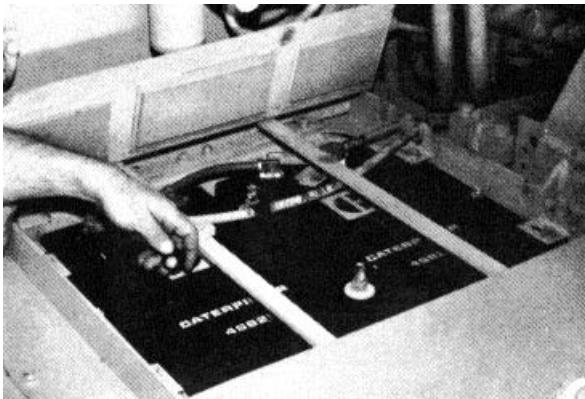
Tighten all connections to the recommended torque. Make sure all clamps, guards, and heat shields, are installed correctly.

Fire may result, from lubricating oil or fuel sprayed on hot surfaces, causing personal injury or property damage.

Safety

Keep all exhaust manifold and turbocharger shields in place to reduce fire hazards.

The vapor, hydrogen gas, from a charging battery is explosive. Do not smoke when checking batteries, or working around them. Make certain the disconnect switch is off when working around batteries.



Batteries can give off explosive fumes (hydrogen gas). A spark at a connection or near a battery can cause an explosion. See the "Operation Guide" for special precautions when boost starting

Fluids

Cooling system conditioners contain alkali, do not drink them or get them in eyes.

Battery electrolyte is an acid and will harm skin and eyes.

Keep all lubricants stored in properly marked containers and away from children.

Never put maintenance fluids in glass bottles or glasses.

Safety Equipment

Wear a hard hat, protective shoes and protective glasses when performing lubrication and maintenance operations.

Limit air pressure to 205 kPa (30 psi) when cleaning with air.

Never point an air nozzle toward anyone

Know the rating on cable, chains and slings before using them. Wear gloves when handling cable.



If engine start-up could cause injury, attach a "DO NOT OPERATE," or similar warning tag, to the machine start switch when working on the machine.

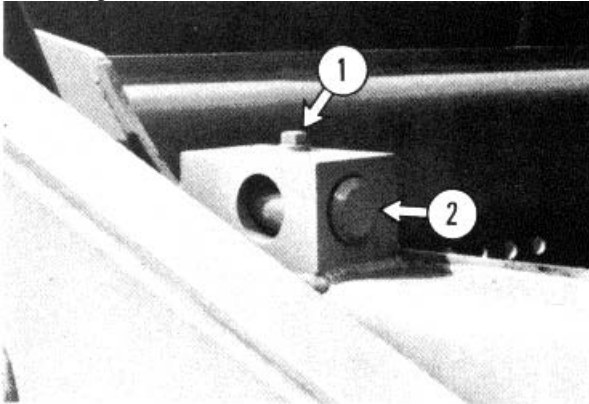
Store rags that have oil, or other flammable material on them, in a container, away from open fires, welding or flame cutting areas.

If at all possible, operate the engine only in a well ventilated area. If it is necessary to operate in a closed area, vent the exhaust to the outside.

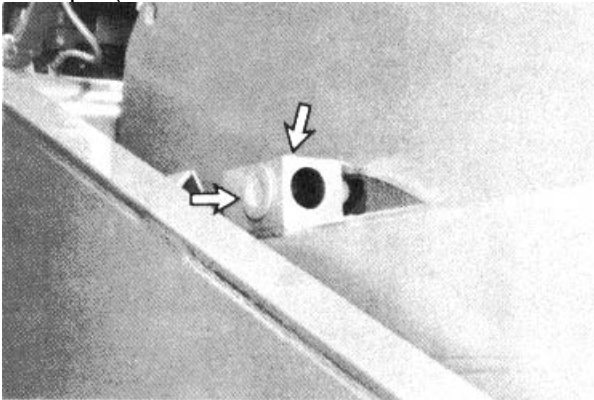
Blocking the Apron

Block the apron when it is necessary to make adjustments or perform maintenance in the bowl area. Block the apron as follows:

1. With the tractor engine running, lower the bowl. Move the apron to the upper (open) position. Stop the engine.

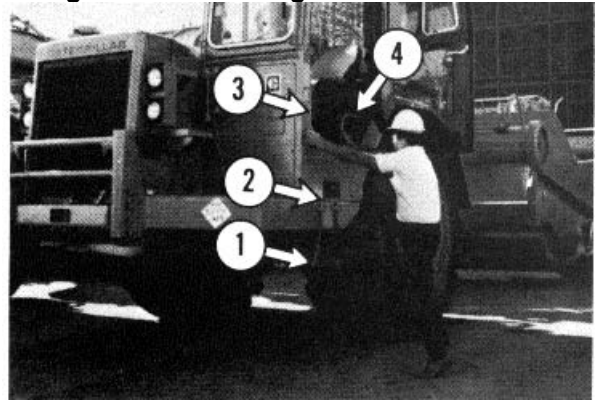


2. Remove the blocking pin retaining bolt. Remove the pin from the block.



3. Turn the pin 90 degrees. Insert it through the block, under the raised apron. Install the retaining bolt. Lower the apron onto the pin.

Mounting and Dismounting



Use steps (1), (2), and hand holds (3) and (4) when mounting or dismounting the machine.

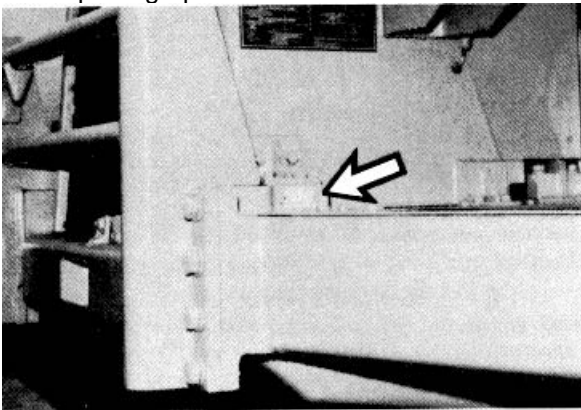
Face the machine when mounting or dismounting.

Do not use the steering wheel as a hand hold. The machine could articulate.

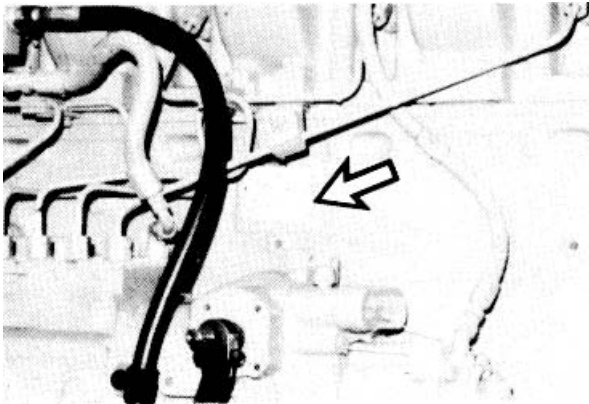
Do not jump off the machine.

Serial Number Locations

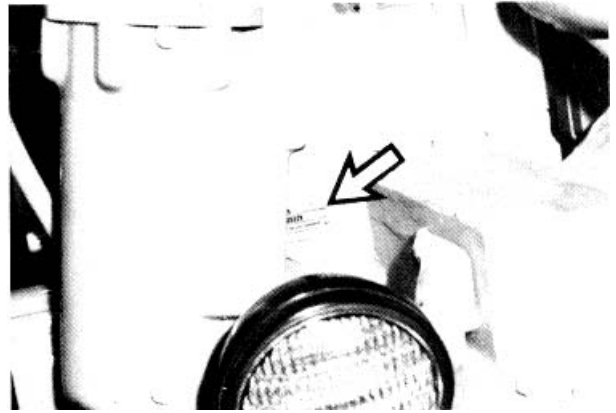
For quick reference, record your machine's serial numbers in the spaces provided below the photographs.



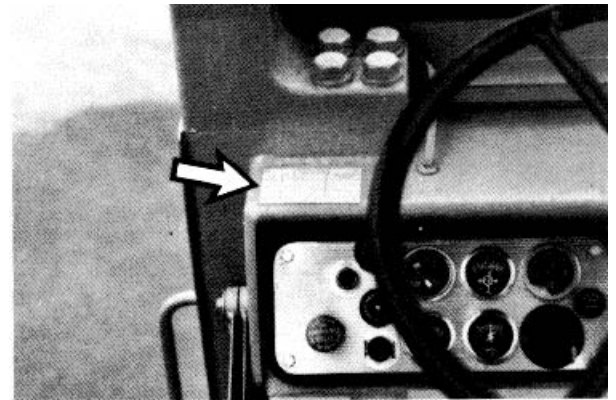
Tractor Serial Number



Tractor Engine Serial Number



Tractor Transmission Serial Number



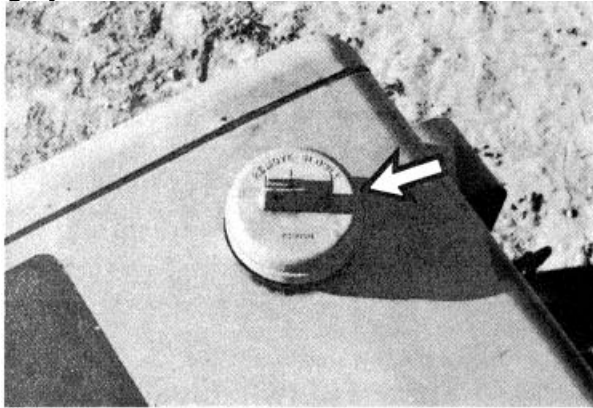
Combined Tractor and Engine Serial Number Plate



Scraper Serial No.

Maintenance Recommendations

Cooling System



CAUTION

Never add coolant to an overheated engine; allow the engine to cool first.

Check the specific gravity of the antifreeze solution frequently in cold weather to ensure adequate protection.

If the machine is to be stored in, or shipped to, an area with below freezing temperatures; the cooling system must be protected against freezing to the lowest expected outside temperature.

All water is corrosive at engine operating temperature. The cooling system should be protected with conditioner at all times regardless of the concentration of antifreeze. This can be done by using coolant conditioner elements. Use a precharge element when filling the system or changing coolant. Install a new maintenance element every 250 service hours during operation.

Do not use coolant conditioner elements with Dowtherm 209 Full-Fill coolant. Follow the instructions provided with the Dowtherm 209 Full-Fill coolant.

Coolant should be drained and replaced "Every 2000 Service Hours or 1 Year." However, when Coolant Conditioner Maintenance Elements are replaced every 250 service hours as recommended, the drain period can be extended to "4000 Service Hours or 2 Years."

Premix antifreeze solution to provide protection to the lowest expected outside temperature. Pure undiluted antifreeze will freeze at -23°C (-10°F).

Use clean water that is low in scale forming mineral. Do not use softened water.

Filling at over 20 liters (5 U.S. gallons) per minute can cause air pockets in the cooling system.

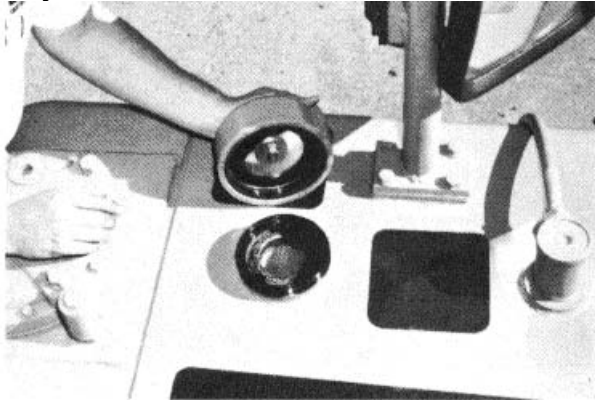
After draining and refilling the cooling system, run the engine with the filler cap off until the coolant level stabilizes. Add coolant as necessary to fill the system.

The engine cooling system is protected to -28°C (-20°F), with permanent type antifreeze, when shipped from the factory.

Operate with a thermostat in the cooling system all year-round. Cooling system problems can arise without a thermostat.

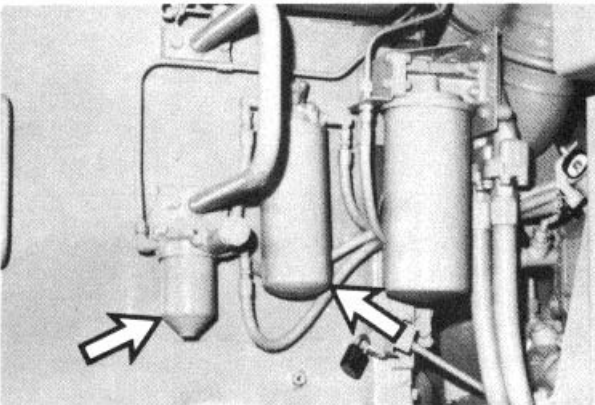
**Maintenance
Recommendations**

Fuel System



CAUTION

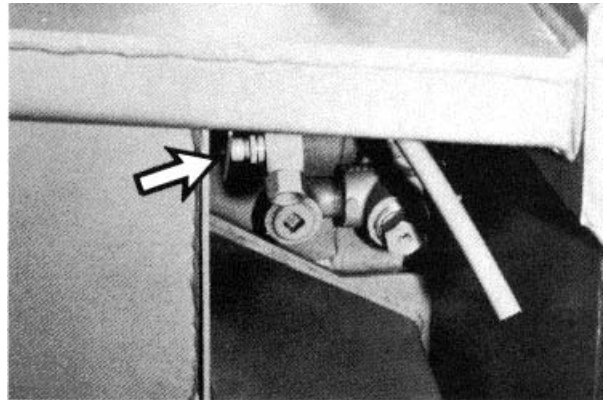
Fill the fuel tank at the end of each day of operation to drive out moist air and to prevent condensation. Do not fill the tank to the top. The fuel expands as it gets warm and may overflow.



CAUTION

Do not fill fuel filters with fuel before installing them. Contaminated fuel will cause accelerated wear to fuel system parts.

Check the fuel level with the dipstick in the filler opening.



Drain the fuel tank of water and sediment as required by prevailing conditions.

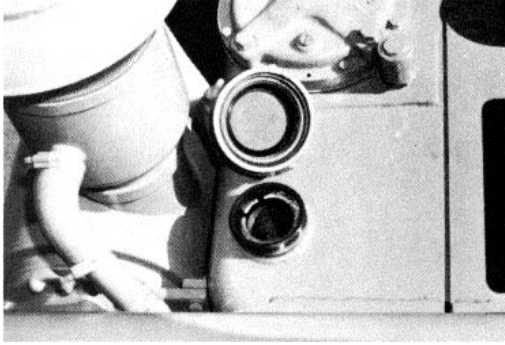
Water and sediment should be drained from the fuel tank at the start of a shift or after the fuel tank has been filled and allowed to stand for 5 to 10 minutes.

After changing fuel filters, always bleed the fuel system to remove air bubbles from system.

Drain water and sediment from any fuel storage tank weekly, and before the tank is refilled. This will help prevent water or sediment from being pumped from the storage tank into the machine fuel tank.

Use only fuel as recommended in the "Fuel, Coolant and Lubricant" Section of this Guide.

Hydraulic System



CAUTION

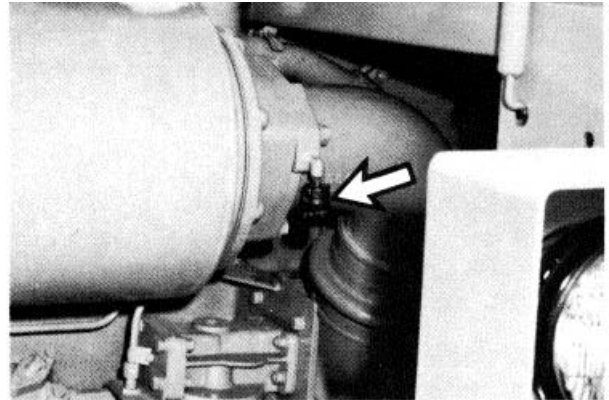
Make-up oil added to the hydraulic system must mix with the oil already in the tank. Use only petroleum products unless the system is equipped for use with special products.

Water or air can cause pump failure. If hydraulic oil becomes cloudy, then water or air is entering the system. Drain fluid, retighten hydraulic suction line clamps, purge and refill the system.

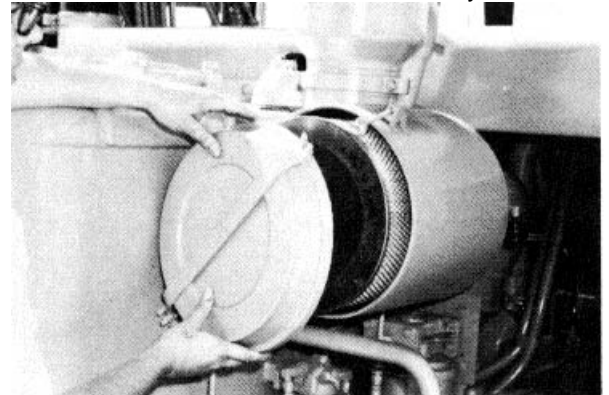
Air Intake System



Check precleaner screen daily for accumulation of dust and debris.



Service the air cleaner when the YELLOW piston in the indicator reaches the RED zone. The indicator is marked in 5 inch of H₂O increments to show the amount of air cleaner restriction at any time



The primary filter element can be cleaned up to 6 times before replacement. The element, when cleaned, should be thoroughly checked for rips or tears in the filter material. Replace the primary filter element every year even though it has not been cleaned 6 times.

The secondary filter element should be replaced at the time the primary filter element is serviced, if the yellow piston in the filter indicator enters the red zone after installation of a clean primary element or, if the exhaust smoke is still black.

Maintenance Recommendations

Electrical System

CAUTION

When boost starting the engine, follow the instructions in the Operation Guide to properly start the machine.

When using an external electrical source to start the engine, turn the disconnect switch off and remove the key before attaching the booster cables.

This machine has a 24 Volt starting system. Use only an equal voltage for boost starting. The use of a welder or higher voltage will damage the electrical system.

Scheduled Oil Sampling

Use scheduled oil sampling to monitor machine condition and maintenance requirements. Each oil sample should be taken when the oil is hot and well mixed, to ensure the sample is representative of the oil in the compartment

S.O.S. Interval Chart	
Compartment	Interval
Engine Oil	250 Hours
Transmission Oil	500 Hours
Hydraulic Oil	500 Hours
Final Drive Oil	500 Hours

General



CAUTION

Accumulated grease and oil on a machine is a fire hazard. Remove this debris with steam cleaning or high pressure water, at least every 1000 hours or each time any significant quantity of oil is spilled on a machine.

Wipe all fittings, caps and plugs before servicing.

Keep a close watch for leaks. If leaking is observed, find and correct the source of the leak.

Check the fluid levels more frequently than the recommended periods if leaking is suspected or observed.

Ground Engaging Tool Bolt Torques

Bolt Size	Recommended Torque*	
	N-m	lb.ft
5/8	265 ± 35	195 ± 25
3/4	475 ± 70	350 ± 50
7/8	765 ± 115	565 ± 85
1	1220 ± 150	900 ± 110

*These bolt torques apply only to ground engaging tool fasteners.

Tire Inflation Information

Inflation of Tires with Nitrogen

Use dry nitrogen (N₂) gas for both tire inflation, and tire pressure adjustments on all current and past production machines. Nitrogen is an inert gas and will not support combustion inside the tire

⚠ WARNING

Proper nitrogen inflation equipment and training in its use are necessary to avoid overinflation. A tire blowout or rim failure can result from improper or misused equipment.

Because a fully charged nitrogen cylinder's pressure is approximately 15 000 kPa (2200 psi), a tire blowout and/or rim failure can occur if the inflation equipment is not used correctly.

In addition to reducing the risk of an explosion, using nitrogen instead of air to inflate tires lessens the slow oxidation of the rubber and the accompanying gradual tire deterioration. This is especially important for tires that have an expected long service life (4 or more years). It also reduces the corrosion of rim components and the resultant disassembly problems.

Nitrogen Inflation Information



⚠ WARNING

Stand behind the tread when inflating a tire.

CAUTION

Set the tire inflation equipment regulator at no more than 140 kPa (20 psi) over the recommended tire pressure.

Use only part number 6V4040 nitrogen tire inflation group, or equivalent, to inflate tires from a nitrogen gas cylinder

Use the same tire pressures for nitrogen inflation as is used for air inflation. Consult your tire dealer for operating pressures.

Tire Inflation Information

CAUTION

Proper tire inflation is the correct application of the "Ton/mph" principle. That is, as tire weight loadings increase, tire inflation pressure MUST be increased, and hauling speed and hauling distance MUST be decreased.

Based on a rated load of 48,000 pounds, tire inflation pressures for the tractor-scraper will be

Tractor-55 psi
Scraper-45 psi

NOTE

Tire inflation pressures of 55 psi for the tractor and 45 psi for the scraper are based on a maximum hauling speed of 20 mph, for a distance NOT TO EXCEED two and one-half miles.

When traveling long distances without a load, stop for 30 minutes every three hours or 25 miles traveled, to permit tires to cool.

Adjusted Inflation Pressures

A tire inflated in a warm shop area will be underinflated if the machine works in freezing temperatures. Use this chart when inflating tires indoors at 18° to 21°C (65° to 70°F).

Tractor-Scraper

Recommended Inflation Pressure		Adjusted Inflation Pressure for Outside Operating Temperatures of:							
		-1°C (30°F)		-18°C (0°F)		-29°C (-20°F)		-40°C (-40°F)	
kPa	psi	kPa	psi	kPa	psi	kPa	psi	kPa	psi
205	30	230	33	250	36	270	39	285	41
240	35	260	42	290	42	310	45	325	47
280	40	305	44	330	48	350	51	370	54
310	45	340	49	365	53	395	57	415	60
345	50	380	55	405	59	430	62	460	66
380	55	415	60	450	65	470	68	500	72
415	60	450	65	490	71	510	74	550	79
450	65	490	71	520	76	550	80	590	85
480	70	520	76	570	82	590	86	630	91
520	75	560	81	610	88	630	92	670	97
550	80	600	87	640	93	680	98	720	104
590	85	630	92	680	99	720	104	760	110
620	90	670	97	725	105	760	110	800	116
660	95	710	103	760	110	800	116	840	122
690	100	745	108	800	116	840	122	890	129
725	105	780	113	840	122	885	128	930	135
760	110	820	119	885	128	925	134	980	142
795	115	855	124	925	134	965	140	1030	149
830	120	890	129	965	140	1005	146	1060	154

Fuel, Coolant, and Lubricant Specifications

Fuel Specifications

Types of Fuel

Diesel engines have the ability to burn a wide variety of fuels. These fuels are divided into two general groups, preferred and permissible.

The preferred fuels provide maximum engine service life and performance. They are distillate fuels. They are commonly called fuel oil, furnace oil, diesel fuel, gas oil, or kerosene.

The permissible fuels are crude oils or blended fuels. Use of these fuels can result in higher maintenance costs and reduced engine service life.

Cetane Requirement

The minimum cetane number recommended for the engine is 40.

Fuel Cloud Point

Fuel waxing can plug the fuel filters in cold weather. The fuel cloud point must be below the temperature of the surrounding air to prevent filter waxing and power loss. Fuel heating attachments are available to minimize fuel filter waxing.

Fuel Sulfur Content

The percent of sulfur in the fuel will affect the engine oil recommendations. If the fuel has over 0.5% sulfur content, the CD engine oil must have a TBN of 20 times the percent of fuel sulfur. Your oil supplier should be able to furnish the correct oils.

Coolant Specifications

CAUTION

Always use conditioner elements. Never use plain water only.

Use a mixture of fill water and antifreeze, and a coolant conditioner element.

CAUTION

Do not use cooling system conditioner elements with Dowtherm 209 Full-Fill coolant. Follow the instructions provided with the Dowtherm 209 Full-Fill coolant.

Fill Water

Acceptable water for use in the ethylene glycol-type antifreeze and water mixture is shown on the chart below:

Acceptable Water		
Water Content	50% or More Antifreeze	Less Than 50% Antifreeze
chlorides	100 ppm or less	50 ppm or less
Sulfates	100 ppm or less	50 ppm or less
Hardness as CaCO ₃	200 ppm or less	100 ppm or less
Dissolved Solids	500 ppm or less	250 ppm or less
pH	6.5 or higher	6.5 or higher

ppm = parts per million

Antifreeze

Use ethylene glycol-type antifreeze Use the correct amount to provide freeze protection to the lowest expected outside temperature.

Coolant Conditioner Elements

Coolant conditioner elements should be used to maintain a 3% to 6% concentration of conditioner in the coolant. Use a precharge element when filling the system or changing coolant. Install a new maintenance element every 250 service hours during operation. Use the coolant conditioner elements shown in the chart.

Coolant Conditioner Elements		
Type	Qty.	Part Number
Precharge	1	1W5518
Maintenance	1	9N6123

Wheel Coolant Specifications (WC)

Use a mixture of 20% ethylene glycol type antifreeze and 80% water in the wheel coolant compartments to help prevent overheating of tires.

Lubricant Specifications

The abbreviations listed below except LO follow S.A.E. J754 nomenclature. The classifications follow S.A.E. J183 classifications. The MIL specifications are U.S.A. Military Specifications. These definitions will be of assistance in purchasing. The specific classifications for this machine are found on the "Recommended Lubricants" Chart.

Transmission and Clutch Oils (CD/TO-2)

Use Service Classification CD oils that have satisfactory performance.

Engine Oils (CD)

Use oils that meet Engine Service Classification CD (MIL-L-2104C).

The percent of sulfur in the fuel will affect the engine oil recommendations. If the fuel has over 0.5% sulfur content, the CD engine oil must have a TBN of 20 times the percent of fuel sulfur. Your oil supplier should be able to furnish the correct oils.

Hydraulic Oils (HYDO)

Use Engine Service Classification CC (MIL-L-2104B), or (MIL-L-46152), CD, or industrial-type hydraulic oils that are certified by the supplier as having antiwear, antifoam, antirust, and antioxidation additive properties for heavy duty use.

Multipurpose-type Gear Lubricant (MPL)

Use Gear Lubricant Classification GL-5 (MIL-L-2105B) Multipurpose-type Gear Lubricant (MPL).

Lubricating Grease (MPG)

Use Multipurpose-type Grease (MPG). Multipurpose-type grease which contains 3% to 5% molybdenum disulfide is preferred. NLGI No. 2 Grade is suitable for most temperatures. Use NLGI No. 1 or No. 0 Grade for extremely low temperatures.

Refill Capacity Chart

Compartment or System	Liters	U.S. Gallons	Imperial Gallons
Engine Crankcase	34	9	7.5
Transmission	83	22	18
Transmission - Retarder Equipped	102	27	22
Differential and Final Drives	159	42	35
Hydraulic Tank	110	29	24
Steering Gear	3.3	3.5 qt.	3.1 qt.
Cooling System	76	20	17
Fuel Tank	511	135	112
Scraper Wheel Bearings (each)	2	2 qt.	1.7 qt.
Wheel Coolant' (each wheel)	45	12	10

Recommended Lubricant Viscosities										
For Use At Outside Temperatures From -30°C (-22°F) to +50°C (+122°F)*										
Outside Temperature	°C	-30	-20	-10	0	+10	+20	+30	+40	+50
Outside Temperature	°F	-22	-4	+14	+32	+50	+68	+86	+104	+122
Engines CD	SAE SPC5W-20									
	SAE 5W-20									
	SAE 10W									
	SAE 10W-30									
	SAE 15W-40									
	SAE 30									
	SAE 40									
Transmissions CD/TO-2	SAE SPC5W-20									
	SAE 5W-20									
	SAE 10W									
	SAE 10W-30									
	SAE 15W-40									
	SAE 30									
	SAE 40									
Hydraulic System HYDO	SAE SPC5W-20									
	SAE 5W-20									
	SAE 10W									
	SAE 10W-30									
	SAE 15W-40									
	SAE 30									
Steering Gear Housing CD	SAE SPC5W-20									
	SAE 10W									
	SAE 30									
Scraper Wheel Bearings, Differential and Final Drives MPL	SAE SPC75W-90									
	SAE 80W									
	SAE 80W-90									
	SAE 85W-140									
SAE 90										
Outside Temperature	°C	-30	-20	-10	0	+10	+20	+30	+40	+50
Outside Temperature	°F	-22	-4	+14	+32	+50	+68	+86	+104	+122

*When operating below -30°C (-22°F) refer to the Cold Weather Operation Guide, Form SEBU5338, available from your caterpillar dealer.

Lubrication and Maintenance Chart

Item	Service	Lube.	Page
When Required			
Air Cleaner	Service the air cleaner when the yellow piston in the indicator reaches the red zone.		3-389
Fuel System	Service the fuel filters if the engine lacks power.		3-393
Cooling System	Drain and clean if the engine overheats or the coolant solution is dirty.		3-393
Cooling System Relief Valve	Clean or replace if the engine overheats or coolant loss is experienced.		3-396
Brakes	Inspect brake shoes, drums, and cams if the brakes become noisy.		3-397
Ejector Guide and Carrier Rollers	Adjust if the ejector does not operate freely.		3-397
Differential and Final Drives	Check the lubricant level if leakage develops or is suspected.	MPL	3-398
Transmission System	Check the lubricant level if leakage develops or is suspected.	CD/TO-2	3-399
Cutting Edges and Router Bits	Change before the mounting surfaces become worn.		3-400
Circuit Breaker and Fuses	Reset the circuit breaker or change fuses if an electrical system does not function.		3-401
Windshield Wiper	Change wiper blades if they are worn or streaking.		3-402
Hydraulic System	Check the oil level frequently if leakage develops or is suspected.	HYDO	3-403
Operator's Seat Accumulator	Check precharge pressure if suspension becomes stiff or unadjustable.		3-403
Ether Cylinder	Replace the cylinder if it is empty.		3-403
Heater Filters	Check the heater filters as conditions require. Change the filter when dirty.		3-404

Lubrication and Maintenance Chart

Item	Service	Lube.	Page
Every 10 Service Hours or Daily			
(1) Radiator	Check coolant level.	CD	3-405
(2) Air Inlet Screen	Inspect and clean.		3-406
(3) Engine Crankcase	Check oil level.		3-406
(4) Air Reservoirs	Drain moisture.		3-407
(5) Fuel Tank	Drain moisture and sediment.		3-408
(6) Tires	Visually check inflation.	MPG	3-408
(7) Horizontal Pivot Bearings	Lubricate 4 fittings.		3-409
(8) Low Air Pressure Warning Horn	Test.		3-409
(9) Back-up Alarm	Test.		3-409
Every 50 Service Hours or Weekly			
(10) Kingbolt Bearings	Lubricate 3 fittings.	MPG	3-410
(11) Steering Cylinders and Link Bearings	Lubricate 14 fittings.		MPG
(13) Hydraulic System	Check oil level.	HYDO	3-411
(14) Batteries	Check electrolyte levels.		3-412
(15) Tires	Check inflation pressures.	MPG	3-413
(16) Ejector Channel Rollers	Lubricate 2 fittings.		3-413
Transmission System	Do item number (26) on new or rebuilt machines after the first 50 service hours.		
Every 250 Service Hours or Monthly			
(17) Engine Crankcase (see note)	Change oil and filter. The percent of sulfur in the fuel will affect the engine oil recommendations. If the fuel has over 0.5% sulfur content, the CD engine oil must have a TBN of 20 times the percent of fuel sulfur. Your oil supplier should be able to furnish the correct oils.	CD	3-414
(18) Fan Bearing	Lubricate 1 fitting.	MPG	3-415
(19) Fan Belt Tightener	Lubricate 1 fitting.		MPG
(20) Brakes	Inspect - adjust.		3-415
(21) Cooling System	Change conditioner element.		3-420
(22) Fan and Alternator Belts	Inspect - adjust.		3-421
(24) Air Dryer	Inspect the air system for moisture.		3-423

NOTE: Oil and filter do not have to be changed every month. Change every 250 service hours or every three months, whichever comes first.

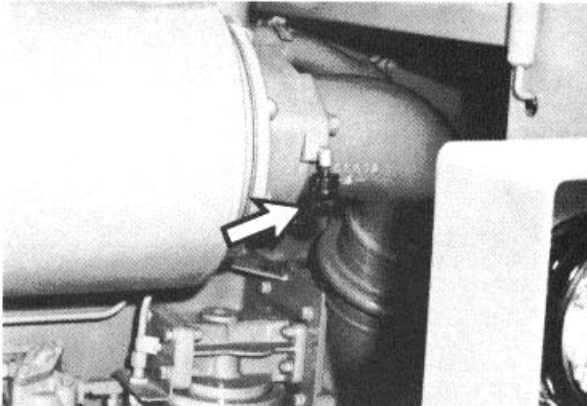
Item	Service	Lube.	Page
Every 500 Service Hours or 3 Months			
(25) Hydraulic System	Change filter elements.	HYDO CD/TO-2	3-424
(26) Transmission System	Change filter element - clean magnetic strainer.		3-425
(27) Engine Crankcase	Wash breather.	MPG	3-428
(28) Fuel Filler Cap and Screen	Wash cap - inspect seal - oil element - clean strainer.		3-428
(29) Fuel System	Service filters.		3-429
(30) Brake Camshafts	Lubricate 8 fittings.	MPG	3-431
(31) Seat Belt	Inspect - replace at least every 3 years.		3-431
Every 1000 Service Hours or 6 Months			
(32) Transmission System (change oil anytime it becomes thick)	Change oil - wash screens and breather.	CD/TO-2	3-433
(33) Differential and Final Drives	Wash breather.		3-435
(34) Wheels	Check wheel coolant level.	WC	3-436
(35) ROPS Bolts	Tighten.		3-436
(36) Air Dryer	Change desiccant.		3-436
Every 2000 Service Hours or Yearly			
(37) Hydraulic System	Change oil - wash filler strainer - inspect suction hoses.	HYDO	3-437
(38) Engine Valve Lash	Measure and adjust if necessary.		3-439
(39) Brakes	Inspect.		3-439
(40) Differential and Final Drives	Change lubricant.	MPL	3-440
(41) Cooling System	Change coolant.		3-441
(42) Ejector Guide and Carrier Rollers	Pack bearings.	MPG	3-444
(43) Steering Gear Sector Housing	Check oil level.	CD	3-446
(44) Steering Column Bearings	Lubricate 1 fitting - oil lower bearing.	MPG	3-446
(45) Scraper Wheel Bearings	Check lubricant level.	MPL	3-447
(46) Hitch Pins	Check for wear.		3-447
(48) Operator's Seat	Check the accumulator precharge pressure - clean the screen.		3-448

When Required

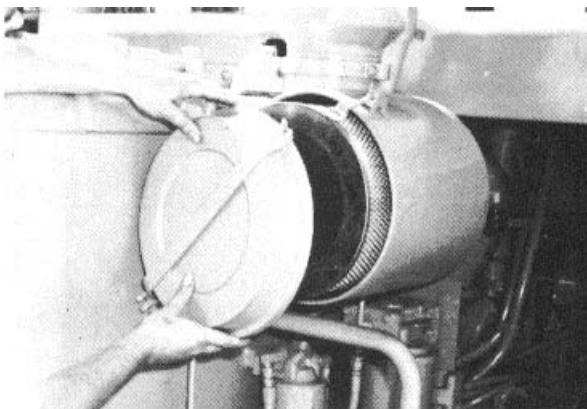
Air Cleaner

Service Elements

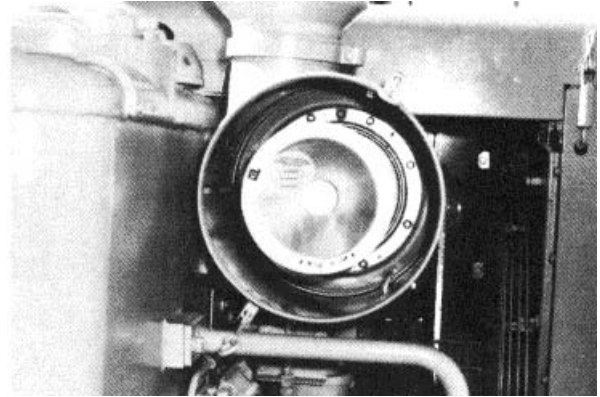
Servicing the Primary Element



Service the primary element when the YELLOW piston in the filter service indicator reaches the red zone.



1. Remove the air cleaner cover. Remove the primary filter element from the filter housing.



2. Clean the inside of the air cleaner housing.
3. Clean and inspect the primary element. See "Cleaning Air Cleaner Elements."
4. Install a clean element and the cover. Tighten the cover bolts finger tight to 4 N•m (3 lb ft).

CAUTION
Do not use a tool to tighten them.

5. Reset the filter service indicator.

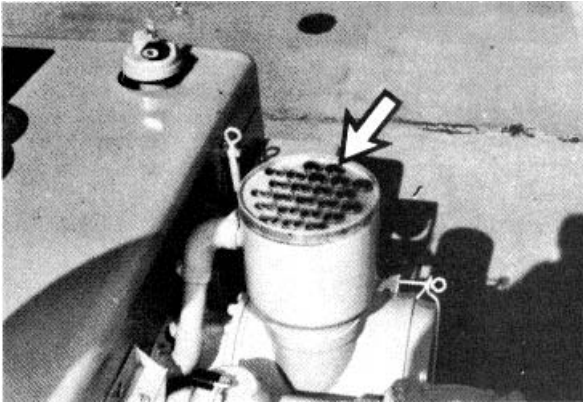
The primary element should be replaced after being cleaned a maximum of 6 times, or at least once a year.

If the indicator shows in the red zone shortly after installation of a clean primary element, and the element has been cleaned 6 times, change to another clean element.

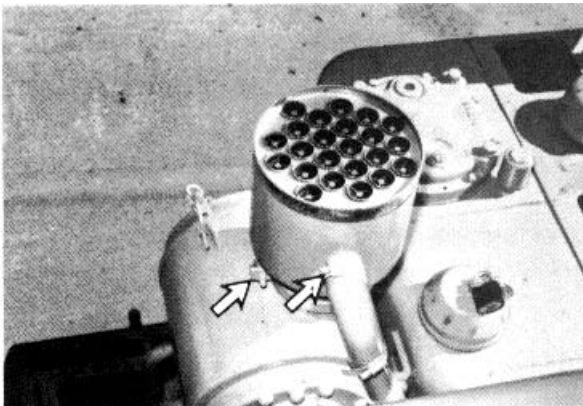
If the indicator still shows in the red zone, service the secondary element.

Change the secondary element at the time the primary element is cleaned for the third time, or if the exhaust smoke is still black.

Replacing the Secondary Element



1. Remove the precleaner screen. Inspect the precleaner tube openings for dirt and debris. Clean the tubes if necessary.



2. To clean the precleaner, loosen the clamp at the bottom. Loosen the dust ejector hose clamp. Remove the precleaner.

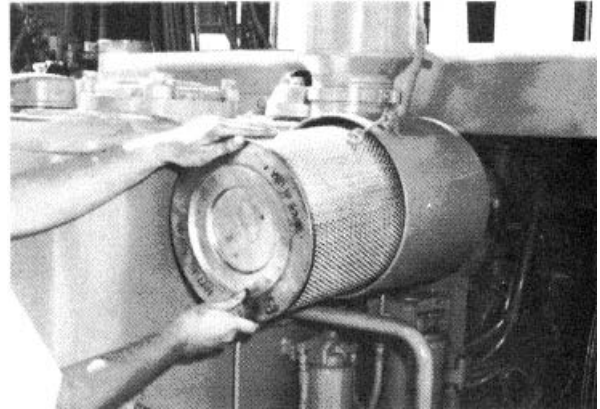
WARNING

When using pressure air for cleaning, wear a face shield and protective clothing.

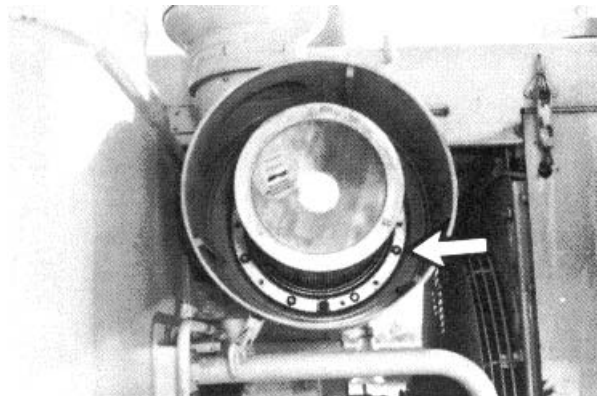
Use a maximum air pressure of 205 kPa (30 psi) for cleaning purposes.

3. Clean the precleaner with pressure air, or wash it in clean warm water.

4. Install the precleaner. Tighten the clamp. Connect the dust ejector hose and tighten the clamp. Install the screen and the cap.

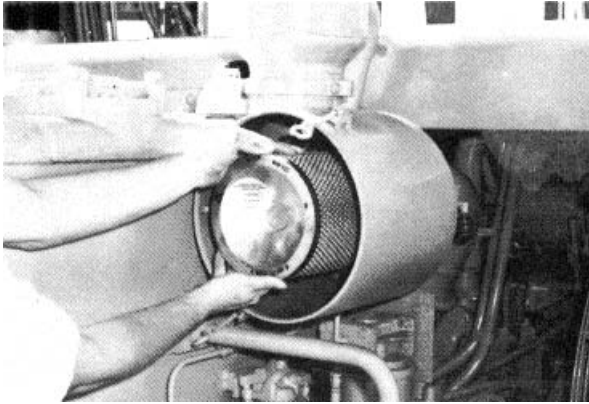


5. Remove the air cleaner cover. Remove the primary element from the air cleaner housing.

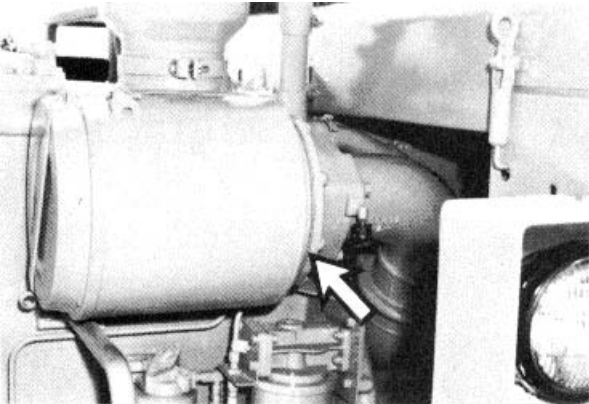


6. Remove the 10 nuts holding the secondary element. Leave one bolt at the top, and one at the bottom of the flange in place.

When Required



7. Remove and discard the secondary element. Cover the air inlet opening. Clean the inside of the housing.



8. Inspect the gasket between the housing and the air inlet pipe.

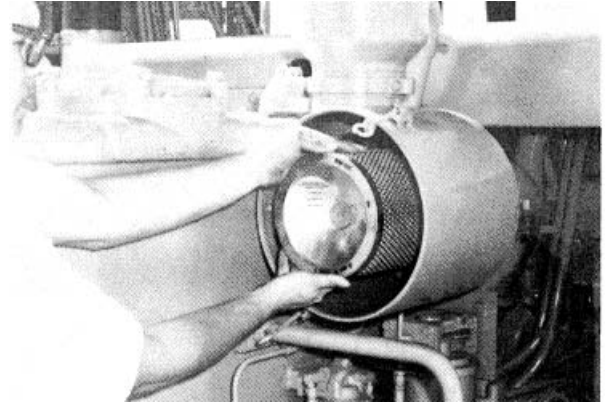
9. Replace the gasket if the housing has moved, or the gasket is damaged.

To replace the gasket, remove the two bolts inside of the filter housing and remove the housing.

Clean the mounting surfaces of the filter housing and the air inlet pipe. Install a new gasket and install the housing.

CAUTION

Always replace the secondary element. Never attempt to reuse a secondary element by cleaning it.



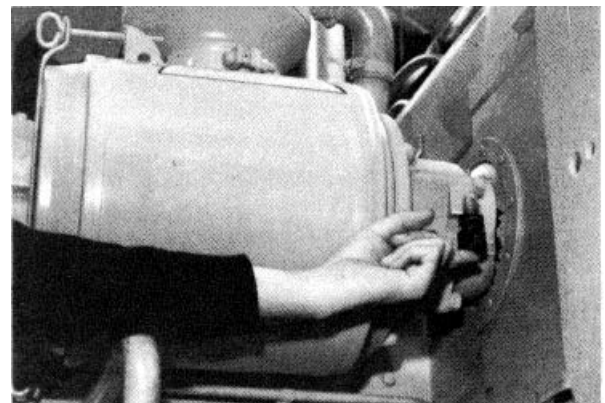
10. Uncover the air inlet opening and install a new secondary element.

11. Install the 10 secondary element retaining nuts. Torque them to $27 \pm 4 \text{ N}\cdot\text{m}$ ($20 \pm 3 \text{ lb ft}$).

12. Install the primary element and the cover. Tighten the cover bolts finger tight, to $4 \text{ N}\cdot\text{m}$ (3 lb ft).

CAUTION

Do not use a tool to tighten them.



13. Reset the filter change indicator.

Cleaning Air Cleaner Elements

WARNING

When using pressure air for cleaning, wear a face shield and protective clothing.

Use a maximum air pressure of 205 kPa (30 psi) for cleaning purposes.

CAUTION

To clean with pressure water, use 280 kPa (40 psi) maximum pressure to prevent element damage.

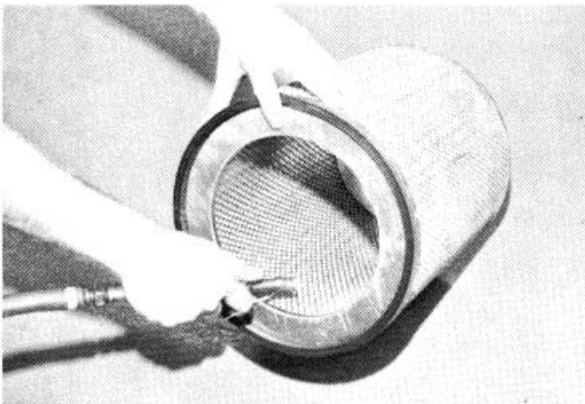
Do not clean elements by bumping or tapping them on hard objects.

Inspect elements after cleaning them. Do not use elements with damaged pleats, gaskets or seals.

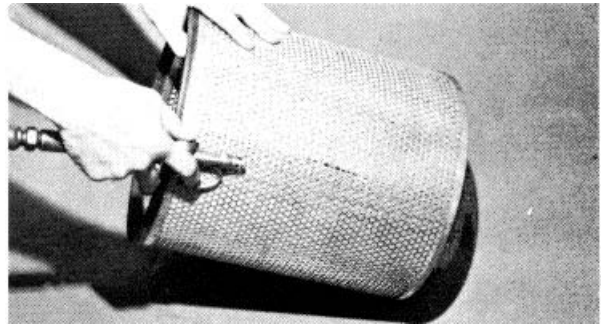
Have spare elements on hand to use when cleaning used ones

Elements can be cleaned with pressure air, water, or detergent

Pressure Air - 205 kPa (30 psi) Maximum

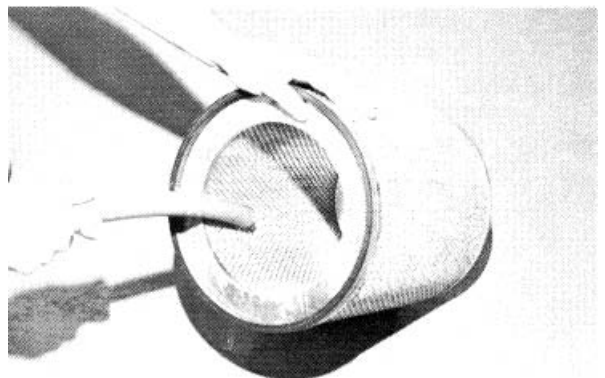


1. Direct air inside the element along the length of the pleats.

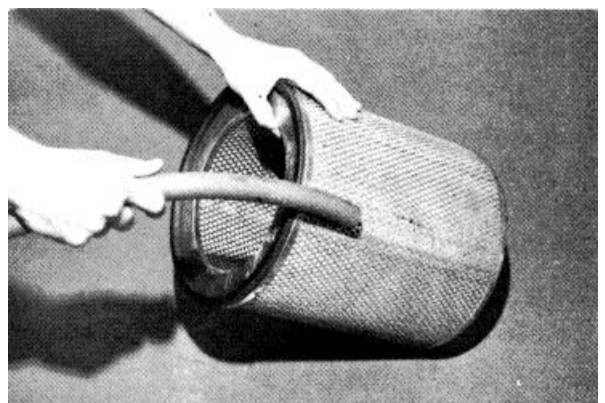


2. Direct air outside along the length of the pleats. Direct air inside along the length of the pleats. Inspect the element.

Water - 280 kPa (40 psi) Maximum



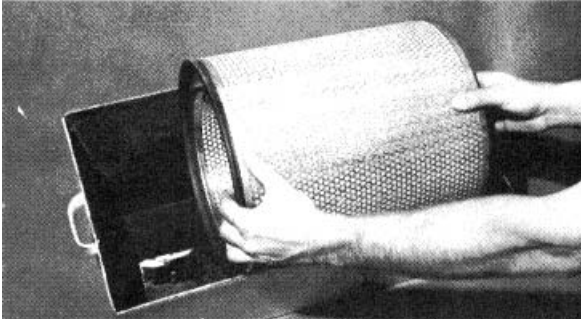
1. Direct water inside the element along the length of the pleats.



2. Direct water outside along the length of the pleats. Air dry and inspect the element.

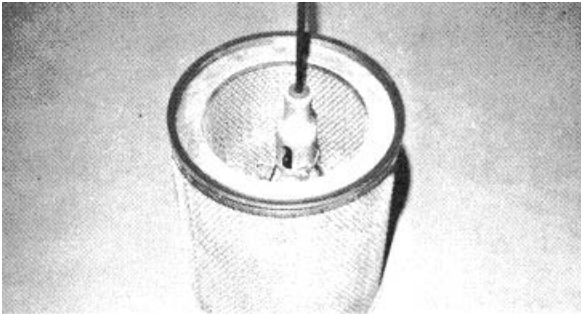
When Required

Detergent



1. Wash the element in warm water and a nonsudsing household detergent solution.
2. Rinse it thoroughly with clean water.
3. Air dry and inspect the element.

Inspecting the Element



1. Insert a light inside a clean and dry element. Discard the element if rips or tears are found.



2. Wrap and store clean, undamaged elements in a clean, dry place.

Fuel System

Service Filters

Service the fuel filters if the engine lacks power. See "Fuel System" at "Every 500 Service Hours or 3 Months."

Cooling System

Cleaning



At operating temperature, the engine coolant is hot and under pressure.

Steam can cause personal injury.

Check the coolant level ONLY when the engine is stopped and the radiator fill cap is cool enough to touch with your hand.

Remove the fill cap slowly to relieve pressure.

Cooling System Conditioner contains alkali. Avoid contact with skin and eyes to prevent personal injury.

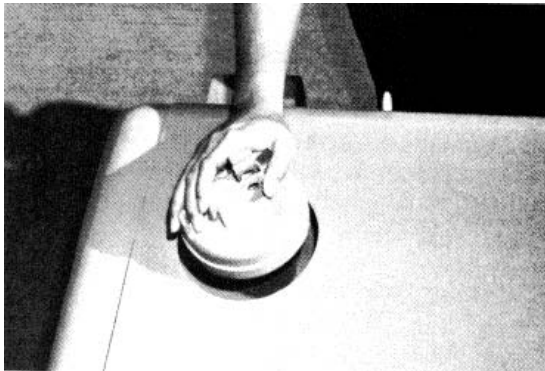
CAUTION

All water is corrosive at engine operating temperature. Use coolant conditioner elements to treat either plain water or ethylene glycol solution.

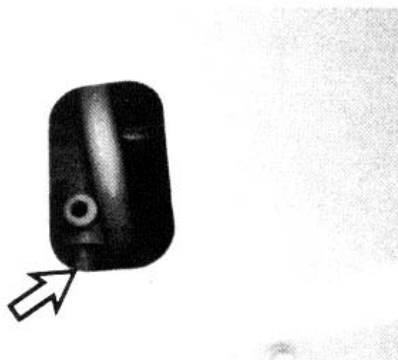
Do not use both coolant conditioner element and liquid conditioner at the same time.

Do not use coolant conditioner elements with Dowtherm 209 Full-Fill coolant. Follow the recommendations provided with the Dowtherm 209 Full-Fill coolant.

Clean the cooling system if it is contaminated, if the engine overheats, or if foaming is observed in the radiator.



1. Remove the radiator cap slowly to relieve pressure.



2. Open the cooling system drain valve and allow the coolant to drain. Drainage may be speeded by removing oil cooler drain plugs.

3. Close the drain valve and install the drain plugs. Fill the system with cleaning solution. Use a commercially available cleaner or 1 kg (2 lb) sodium bisulphate (NaHSO₄) per 40 liters (10 gal) of water as a cleaner.

4. Start and operate the engine for 1/2 hour. Stop the engine and drain the cleaning solution.

5. With the engine off, flush the system with water until the draining water is clear.

6. Close the drain valve. Fill the system with a neutralizer. Use a commercially available neutralizer or 250 grams (1/2 lb) sodium carbonate crystals (NaCO₃·10H₂O) per 40 liters (10 gal) of water.

7. Operate the engine for 10 minutes. Stop the engine and drain the neutralizer.

8. With the engine off, flush the system until the draining water is clear. Close the drain valve.

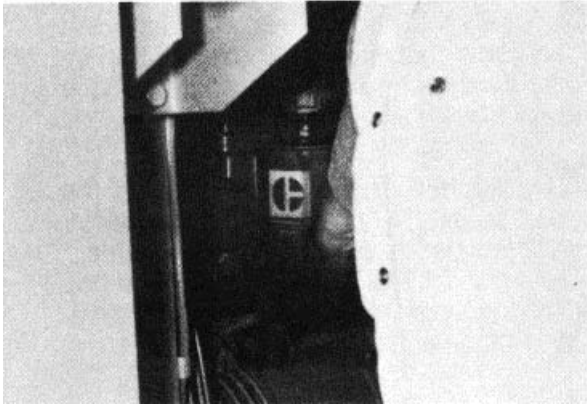
9. Fill the system with clean water and operate the engine for 5 minutes. Stop the engine and drain the water.

10. Repeat step 9 several times, if necessary, until the drained water is nearly colorless.

11. Mix the antifreeze solution to provide protection to the lowest expected outside temperature.

12. To avoid air locks, add the coolant slowly at 20 liters (5 U.S. gallons) per minute or less. See "Refill Capacities."

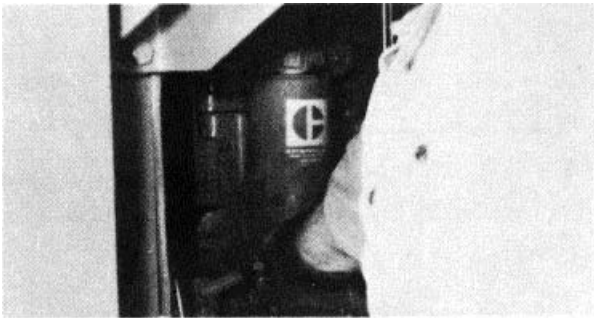
When Required



13. Install a new coolant conditioner element. See "To Change Elements."
14. Start and operate the engine with the radiator cap off. When the level stabilizes, add coolant, if necessary, to cover the low level plate
15. Clean and inspect the radiator cap. Replace the cap gasket if it is damaged. Install the cap.

To Change Elements

1. Close the inlet valve and the outlet valve at the element base. Turn clockwise to close both valves.

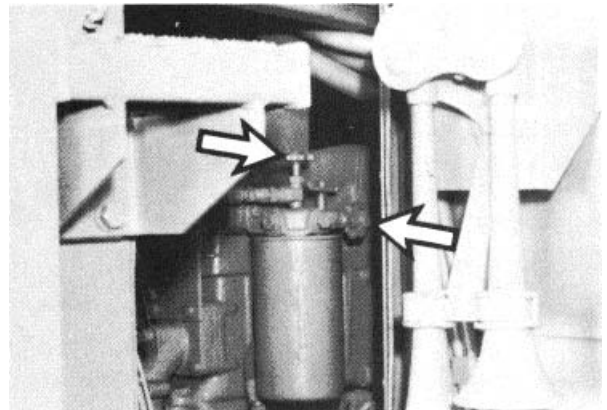


2. Remove the coolant conditioner element. Discard the element.

3. Clean the element mounting base. Make certain all of the old element gasket material is removed.



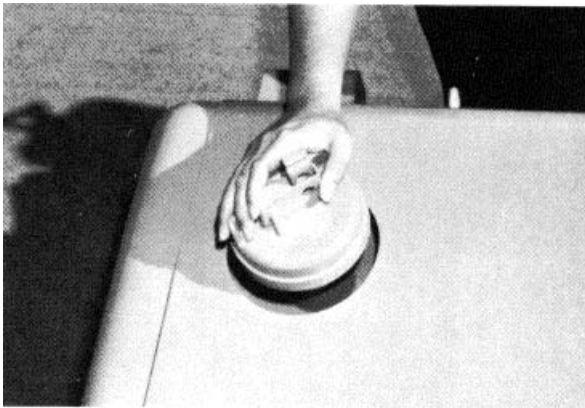
4. Coat the seal of the new element with a thin film of clean engine oil or antifreeze.
5. Install the element by hand. When the seal contacts the base, tighten it an additional 3/4 turn.



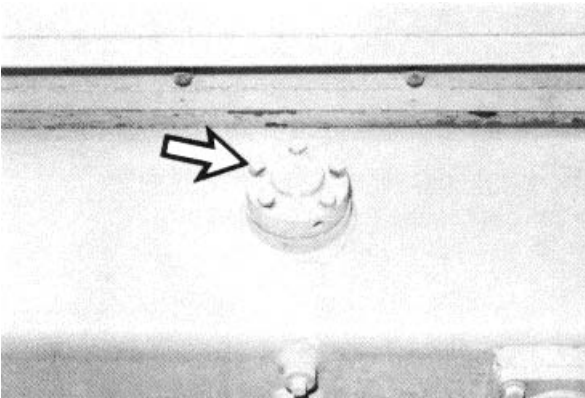
6. Open the inlet valve and the outlet valve. Start the engine and check for leaks

Cooling System Relief Valve

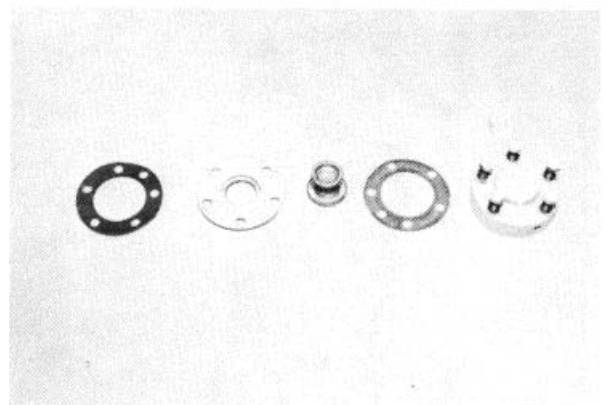
Clean or Replace



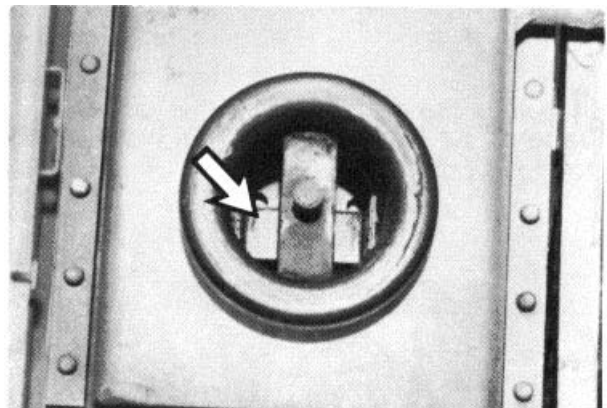
1. Remove the radiator cap slowly to relieve pressure.



2. Remove the hood. Remove five bolts and the cap from the relief valve. Remove the valve parts.



3. Inspect the valve, the spring, and the seal for damage or deposits.
4. Clean the valve with a clean cloth, or replace it if necessary.
5. Clean the valve cap. Replace the gaskets if they are damaged. Assemble and install the valve.
6. Install the hood.

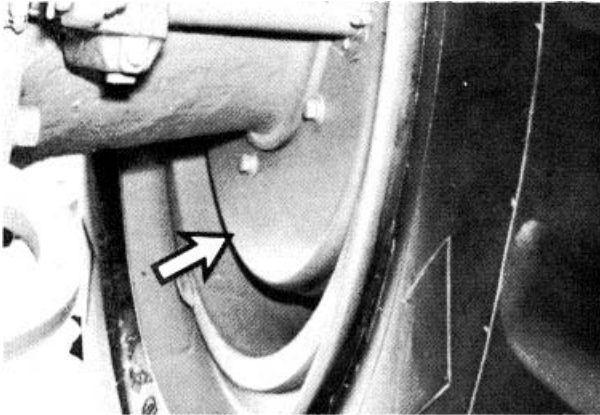


7. Maintain the coolant level above the low level plate.
8. Replace the radiator cap gasket if it is damaged. Install the cap.

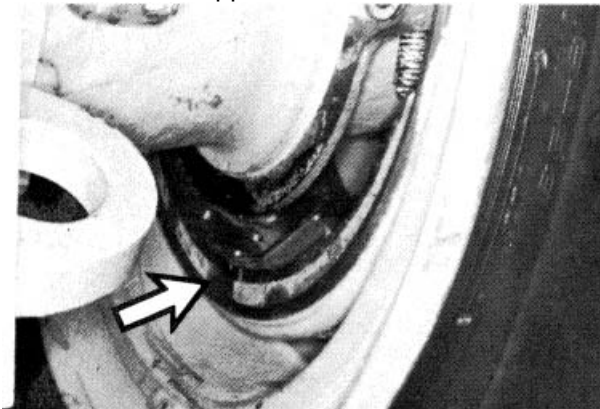
When Required
Brakes

Inspect

The machine must be level with the bowl and apron lowered, the parking brake applied and the engine stopped. Block the wheels.



1. Remove the upper and lower brake shields.

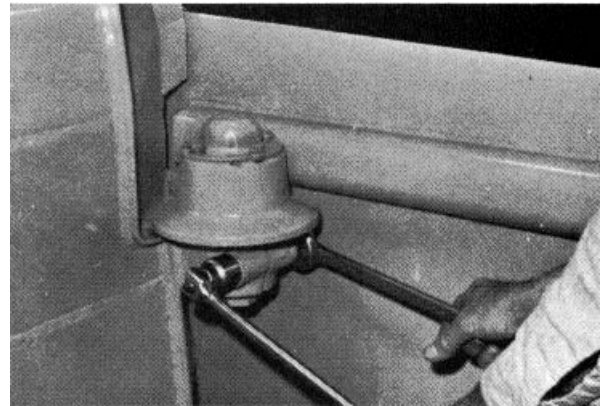


2. Inspect the brake drum, shoes, and camshaft for wear or damage. Check for correct brake adjustment. See "Brakes" at "Every 250 Service Hours or Monthly" for adjustment.

3. Replace damaged or worn brake parts before operating the machine. Install the brake shields.

Ejector Guide and Carrier
Rollers

Adjust



1. The ejector should operate freely without binding. To adjust the guide rollers, loosen the roller shaft clamping bolt.



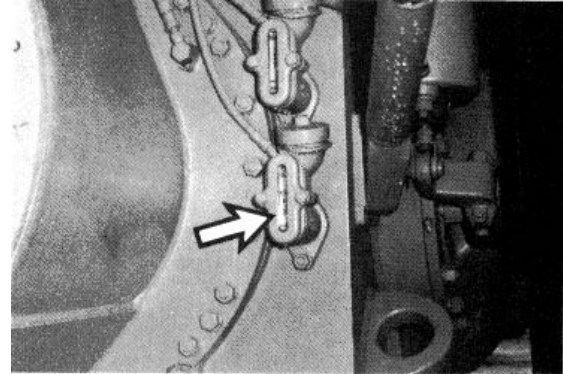
2. Turn the roller (eccentric) shaft to position the roller. Tighten the clamping bolt.

Differential and Final Drives

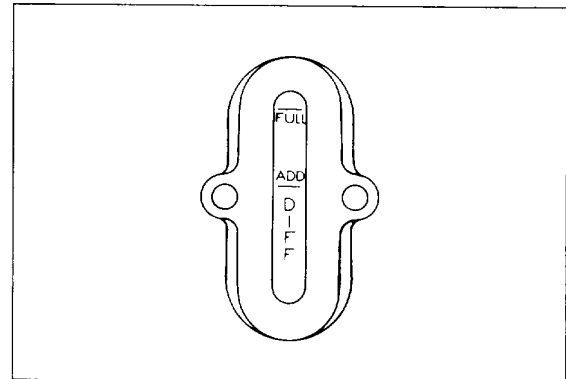
Check Lubricant Level

Operate the machine on level ground for a few minutes. Park the machine on the level, lower the bowl, apply the parking brake and stop the engine.

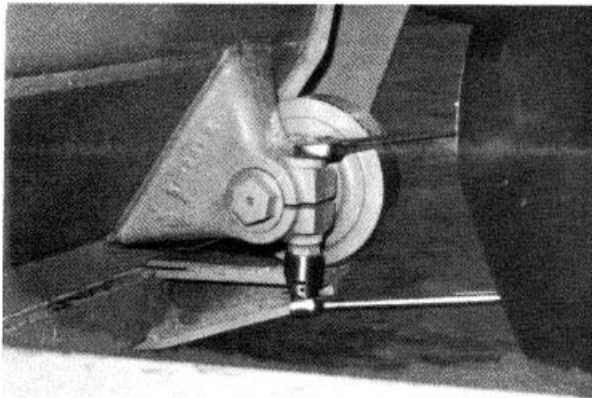
Differential



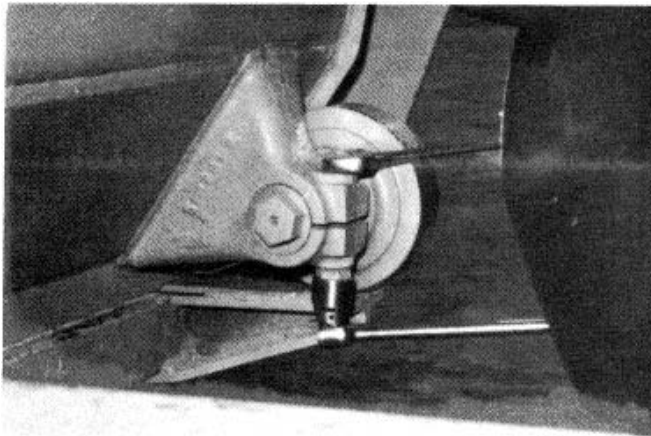
Check oil level in the sight gauge.



Maintain the oil level in the area between the ADD and FULL marks on the sight gauge.

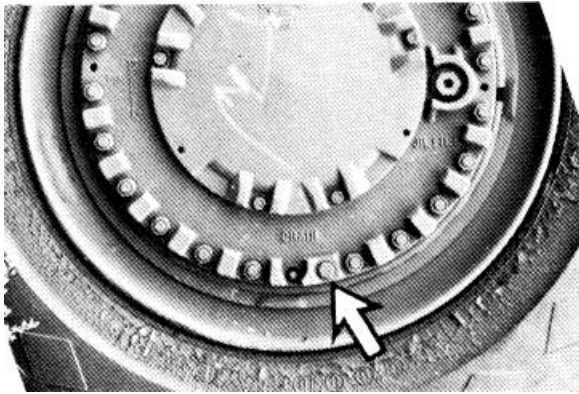


3. The ejector should operate freely without dragging. To adjust the carrier rollers, loosen the clamping bolt.

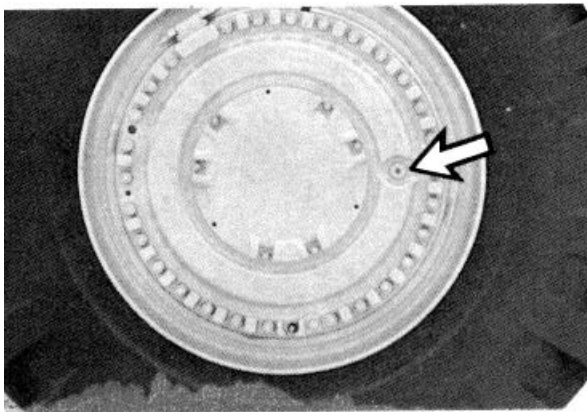


4. Turn the roller (eccentric) shaft to position the roller. Tighten the clamping bolt.

When Required
Final Drives



Position each tractor wheel with the drain plug at the bottom.

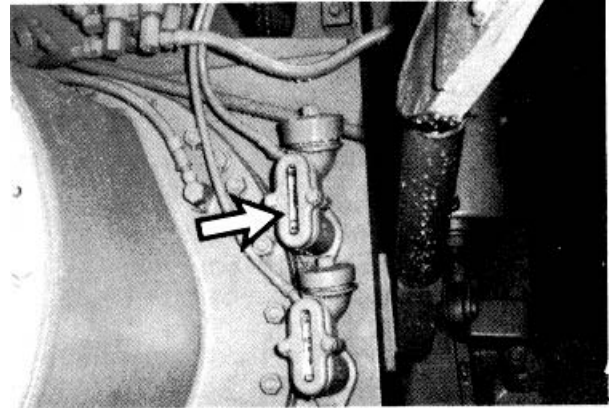


Remove the fill plug. Maintain the lubricant level to the bottom of the plug opening.

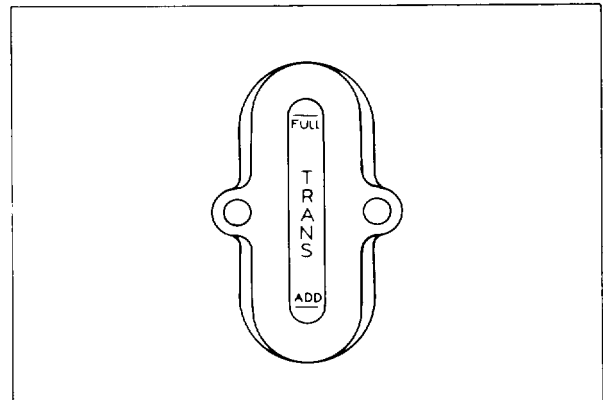
Transmission System

Check Oil Level

The machine must be level with the bowl and apron lowered, the transmission in NEUTRAL, the parking brake applied and the engine running at low idle.



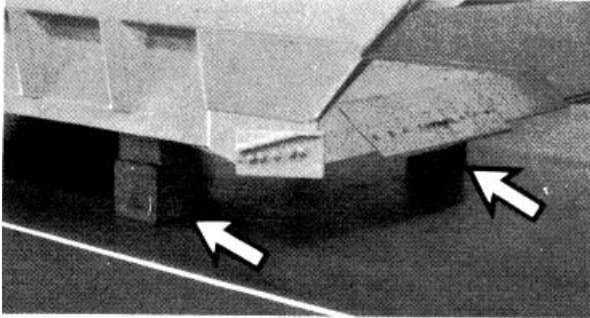
Check the oil level in the sight gauge.



Maintain the oil level in the area between the ADD and FULL marks on the sight gauge

Cutting Edges and Router Bits

Change or Rotate



⚠ WARNING

Block the bowl and apron when performing maintenance in the bowl area.

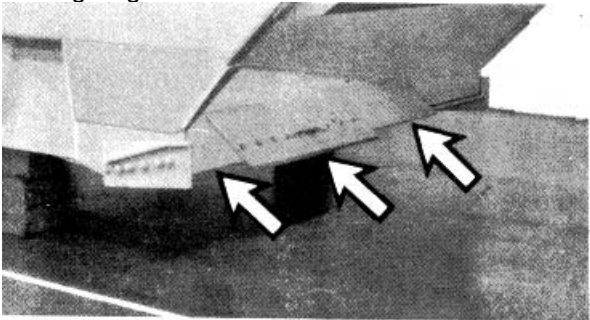
Support the cutting edges before removing the mounting bolts.

CAUTION

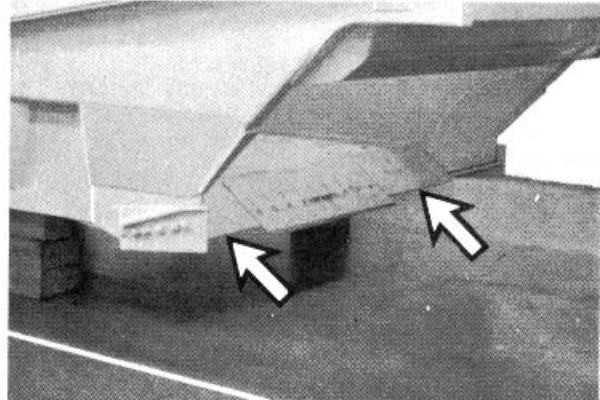
Do not attempt to increase wear life by welding on cutting edges. This could result in premature failures.

Change or rotate the cutting edges, or router bits, before the mounting surfaces become worn.

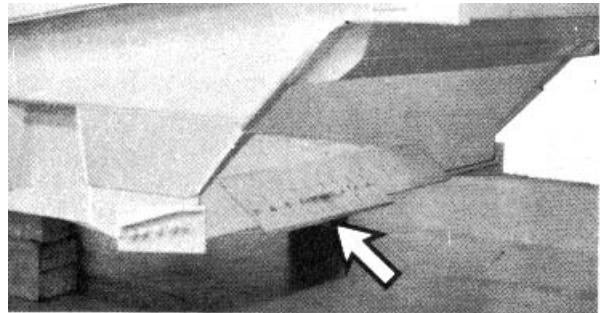
Cutting Edges



There are two edges to each section. Double wear can be obtained by rotating each edge 180°



By exchanging sides, the two end sections can be used four times.



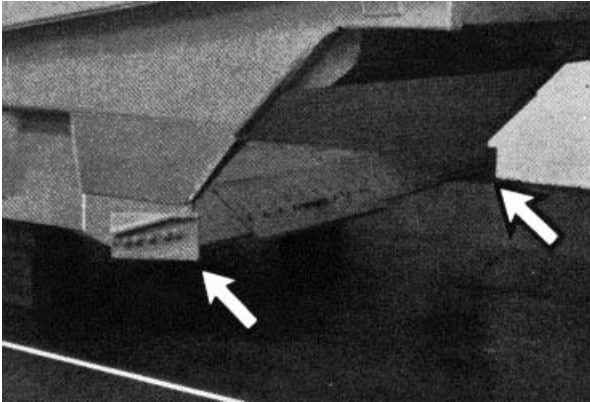
1. Support the cutting edge and remove the mounting bolts.
2. Remove the edge.
3. Clean all mounting surfaces.
4. Change or rotate the cutting edges.

NOTE: To align the cutting edges for finish work, use the front mounting holes in the center section. If better penetration is required, extend the center edge forward by using the rear holes for mounting.

5. Install the new or rotated edge and all of the mounting bolts.
6. See "Bolt Torques for Ground Engaging Tools" for the correct bolt torque.

When Required

Router Bits

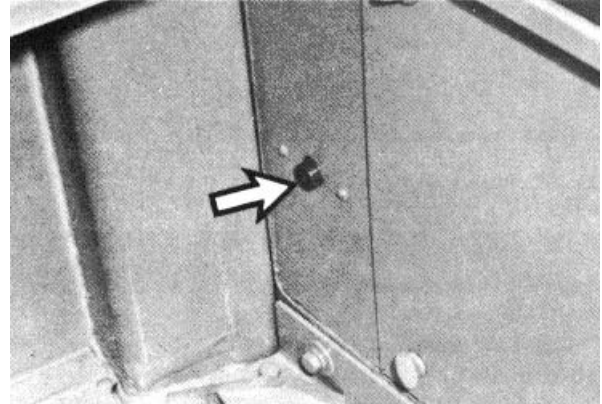


1. Double wear can be obtained by rotating and installing the router bits on opposite sides.
2. Remove the router bit mounting bolts. Remove the bits.
3. Clean all mounting surfaces.
4. Install new or rotated router bits. See "Bolt Torques for Ground Engaging Tools" for the correct bolt torque.

Circuit Breaker and Fuses

Reset or Change

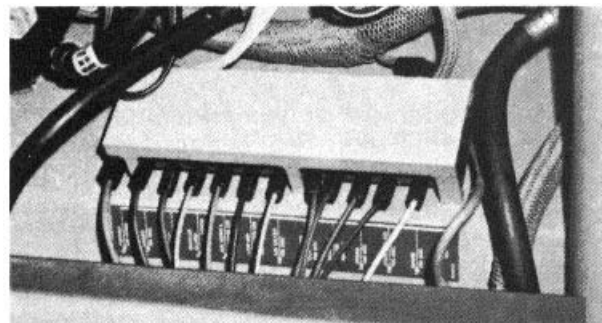
If an electrical system fails, reset the circuit breaker if it opens, or replace fuses that have separated elements.



Push the button to reset the main circuit breaker. If the breaker opens again, have the circuit checked.

CAUTION

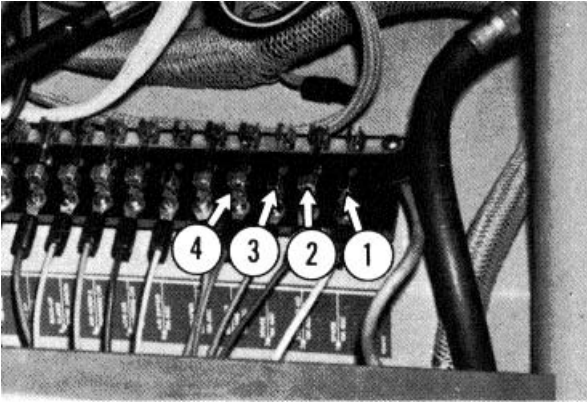
Always replace fuses with the same type and capacity fuse that was removed.



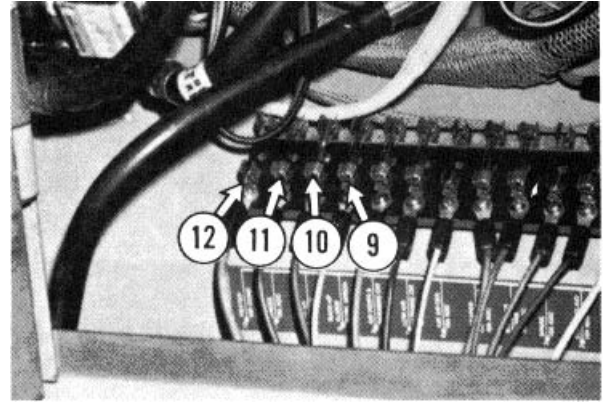
The fuse block is located behind the panel at the front of the operator's compartment. To gain access to the fuses, open the door on the panel. Replace fuses that have separated elements.

If the element of a new fuse separates, have the circuit checked.

The fuses for the various circuits are identified as follows:



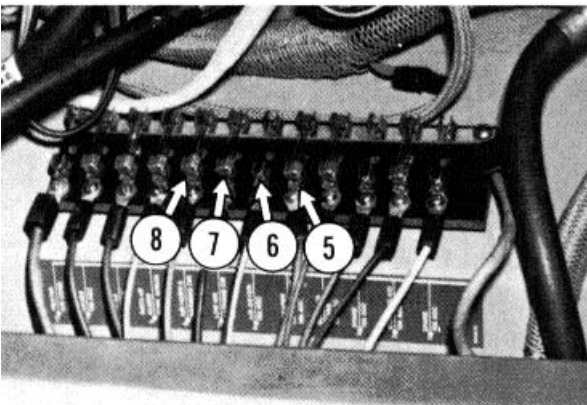
1. Rear Flood-10A AGC
2. Starting Aid-10A AGC
3. Defroster Fan--10A AGC
4. Spare



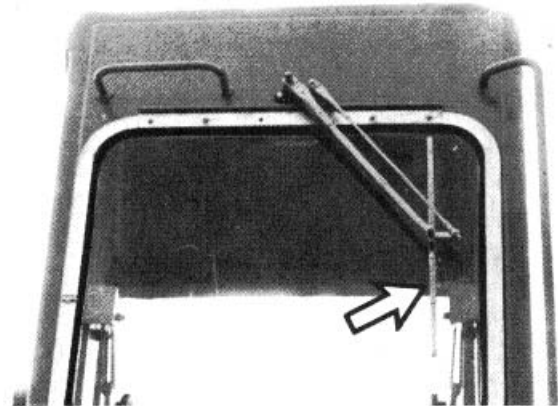
9. Spare
10. Wiper-10A AGC
11. Gages-10A AGC
12. Heater-15A AGC

Windshield Wiper

Change Wiper Blades



5. Spare
6. Air Dryer-10A AGC
7. Low Air Alarm-10A AGC
8. Backup Alarm and Air Horn-10A AGC



Inspect the windshield wiper blade . If is worn or damaged, or if streaking occurs, replace It

When Required
Hydraulic System

Check Oil Level

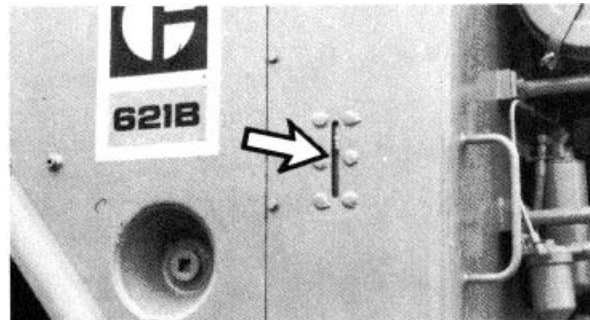


Hot oil can cause burns.

At operating temperature, the hydraulic tank is hot and under pressure.

Remove the fill cap **ONLY** when the engine is stopped and the cap is cool enough to touch with your hand. Remove the fill cap slowly to relieve pressure.

The machine must be level with the bowl lowered and the ejector forward. Apply the parking brake and stop the engine.



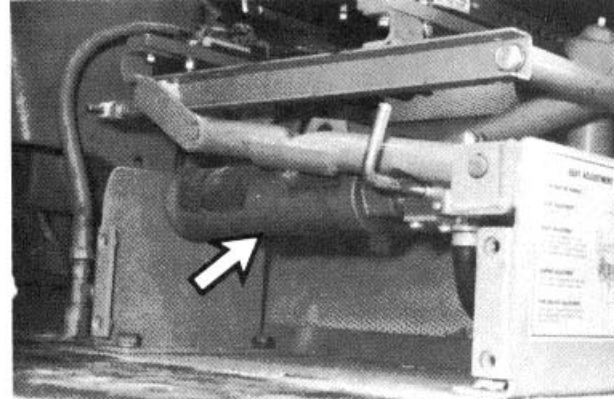
1. The hydraulic oil level should be between the ADD and FULL marks on the sight gauge or ...



2.between the ADD and FULL marks on the dipstick in the fill opening.

**Operator's Seat
 Accumulator**

Check Precharge Pressure



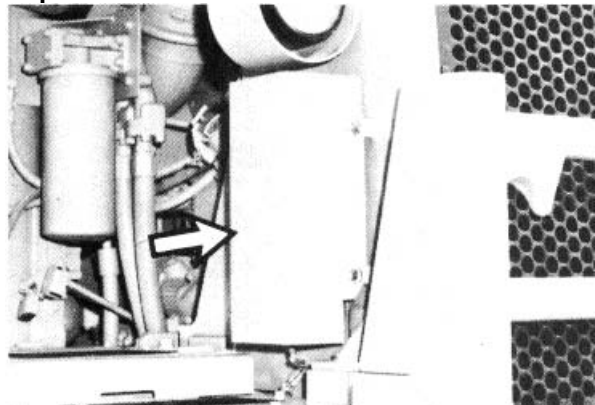
Check the nitrogen precharge pressure.

Consult your Caterpillar dealer for the correct test procedure, and the recommended pressure.

NOTE: The machine is shipped from the factory with the accumulator uncharged. Have it charged before machine operation.

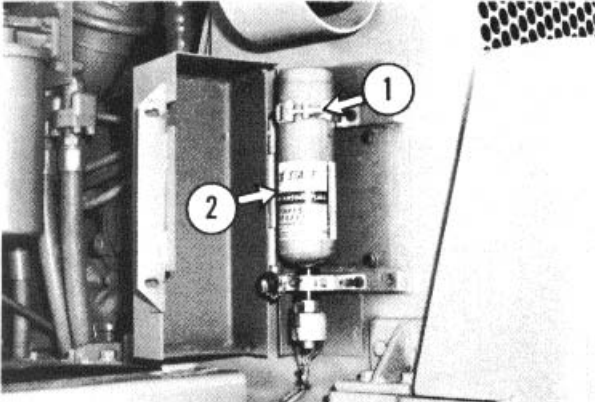
Ether Cylinder

Replace

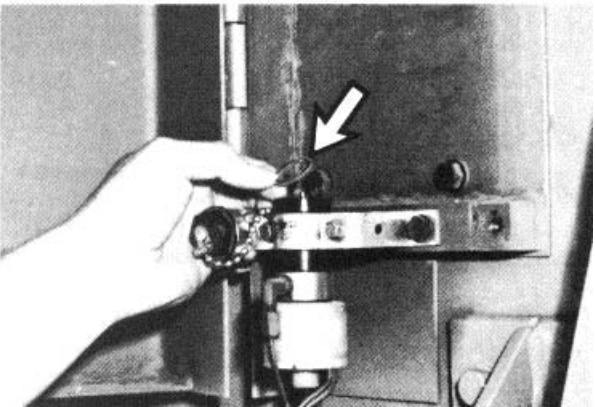


1. Open the cover at the right side front of the machine.

When Required



2. Loosen clamp (1) and unscrew the ether cylinder (2).

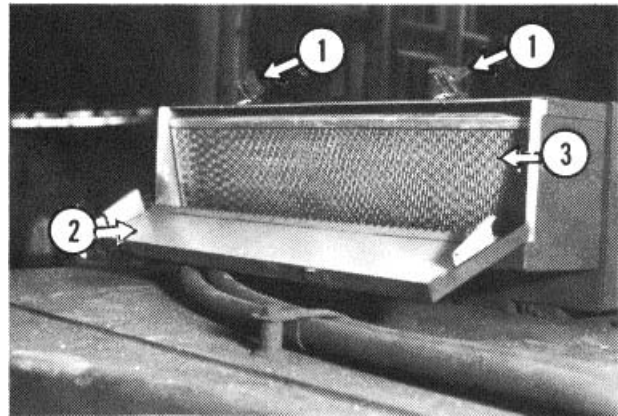


3. Remove the used gasket and install the new gasket provided with each new cylinder.

4. Install a new cylinder, part number 7N296. Tighten the cylinder hand tight. Refasten the cylinder clamp securely around the cylinder. Close the cover.

Heater Filters

Replace



1. Lift up the tabs on latches (1) and turn 180°.
2. Open door (2) and remove filter (3).
3. Install new filter, close door and secure latch.
4. Repeat steps 1 through 3 for the remaining filter.

Every 10 Service Hours or Daily
(1) Radiator

Check Coolant Level



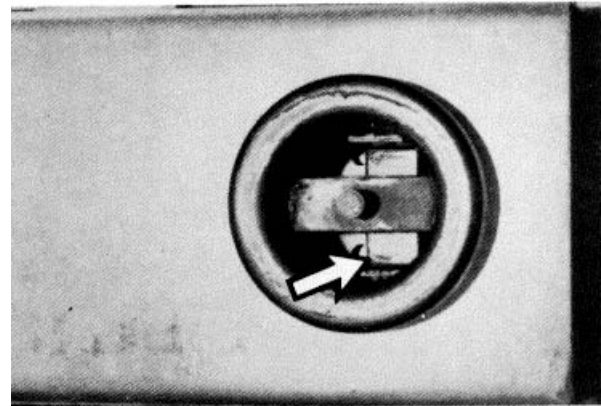
At operating temperature, the engine coolant is hot and under pressure.

Steam can cause personal injury.

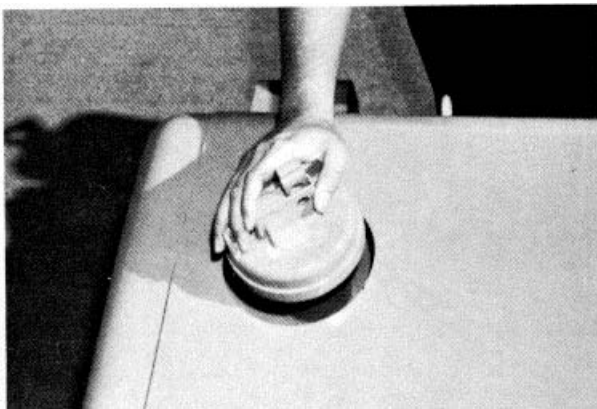
Check the coolant level **ONLY** when the engine is stopped and the radiator fill cap is cool enough to touch with your hand.

Remove the fill cap slowly to relieve pressure.

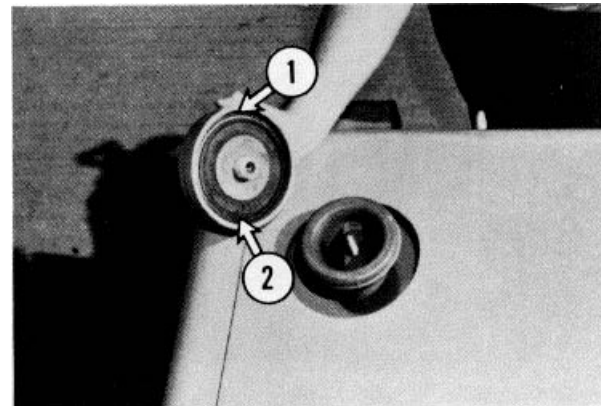
Cooling system conditioner contains alkali. Avoid contact with skin and eyes to prevent personal injury.



2. Maintain the coolant level above low level plate. If it is necessary to add coolant daily, check for leaks.



1. Remove the radiator cap slowly to relieve pressure.

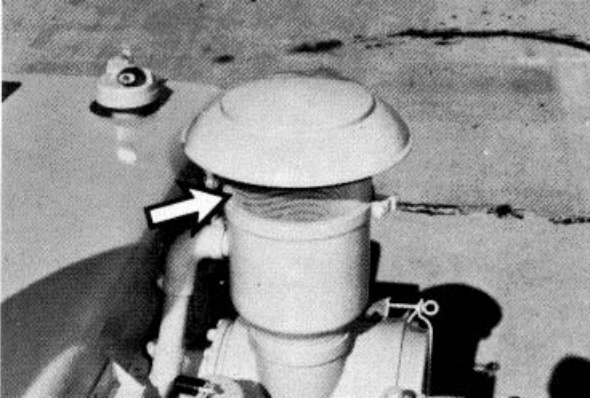


3. Clean and inspect the cap. If the gasket is damaged, remove the ring (1) to disassemble the cap. Replace the damaged gasket (2). Assemble and install the cap.

Every 10 Service Hours or Daily

(2) Air Inlet Screen

Inspect and Clean



Inspect the air inlet screen for dirt and debris.

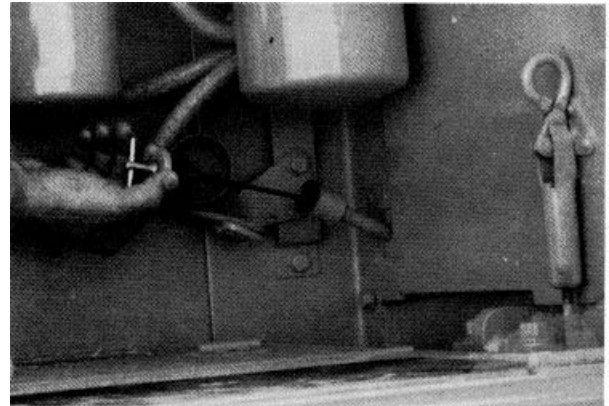


If necessary, loosen the clamp, remove and clean the screen.

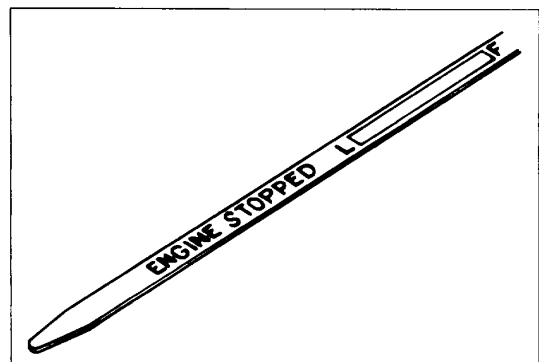
(3) Engine Crankcase

Check Oil Level

The machine must be level with the bowl lowered and the parking brake applied.

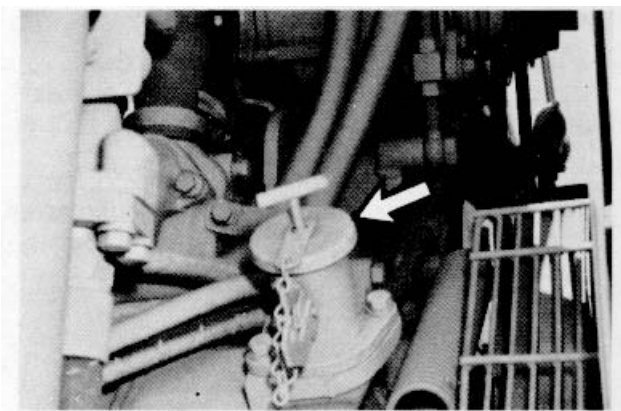


Check the engine oil level on the dipstick.



1. The engine oil level can be measured with the engine stopped. The level must be in the range indicated on the ENGINE STOPPED side of dipstick.

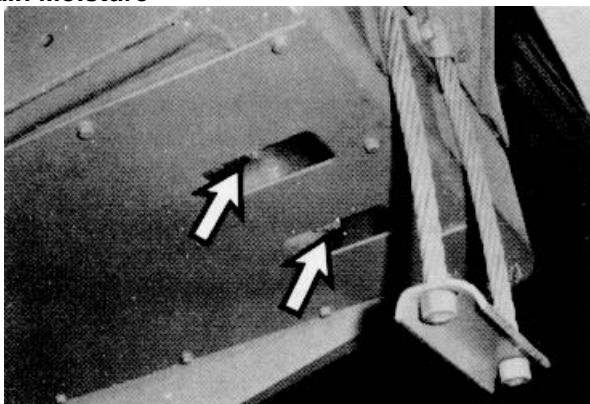
The level can be measured with the engine running. The level must be in the range indicated on the LOW IDLE side of the dipstick.



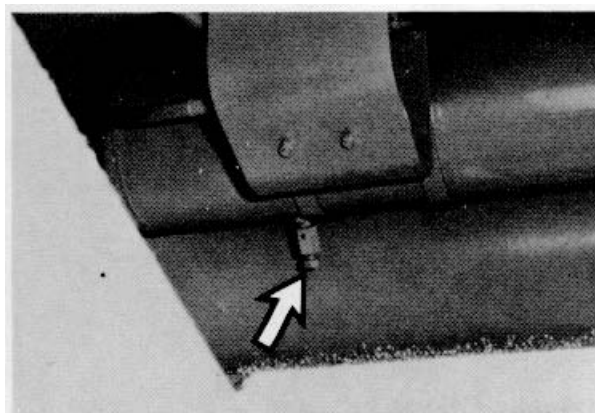
2. Stop the engine, remove the fill plug and add oil if necessary
3. Clean and install the fill plug.

(4) Air Reservoirs

Drain Moisture



Open the two tractor air reservoir bleed screws. Allow the moisture to drain. Close the bleed valves 8a

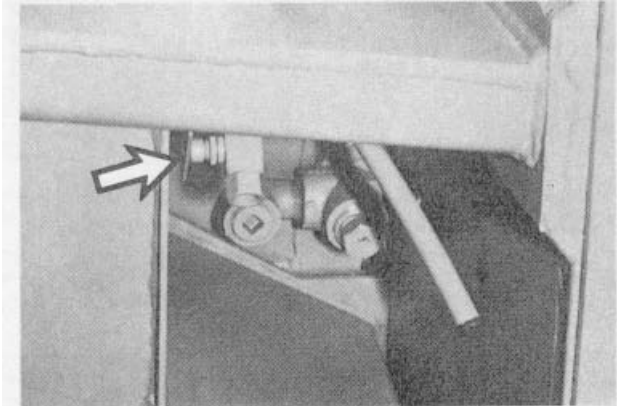


Open one scraper air reservoir bleed valve. Allow the moisture to drain. Close the bleed valve.

(5) Fuel Tank

Drain Moisture and Sediment

Drain moisture and sediment from the fuel tank at the start of each shift, or after the tank is filled and allowed to stand 5 to 10 minutes



Open the fuel tank drain valve located under the fuel tank. Allow moisture and sediment to drain. Close the valve. 1,3

(6) Tires

Visually Check Inflation

⚠ WARNING

Improperly inflated tires can cause excessive heat buildup. This will result in blowouts.

CAUTION

Over or under inflated tires can cause a drastic reduction in tire and rim life.

Keep the valve caps on to prevent dirt from entering the valves. Otherwise, valve damage can occur.



Visually inspect the tires for proper inflation, and for cuts, gouges, blisters or tread separation

Check the tire pressure If a tire appears over or under inflated. Check the tire pressure with the tires cold and at the same outside (ambient) temperature in which the machine will operate. Use a tire pressure gauge.

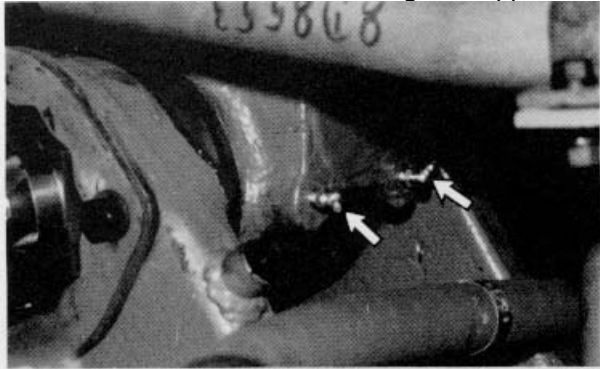
Nitrogen is recommended for both inflation and pressure adjustment of tires on all past and present production machines.

See "Tire Inflation Information."

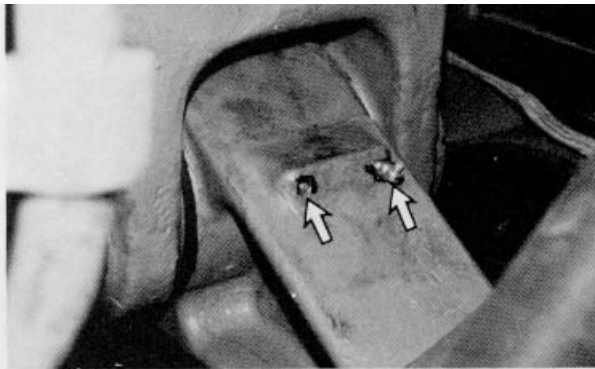
(7) Horizontal Pivot Bearings-Lubricate

Lubricate 8 Fittings

The bowl must be lowered and the engine stopped.



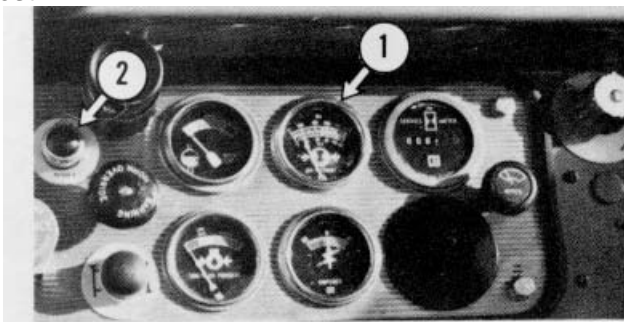
Lubricate 2 fittings at the front bearings from the right side of the hitch



Lubricate 2 fittings at the rear bearings from the right side of the hitch

(8) Low Air Pressure Warning Horn

Test



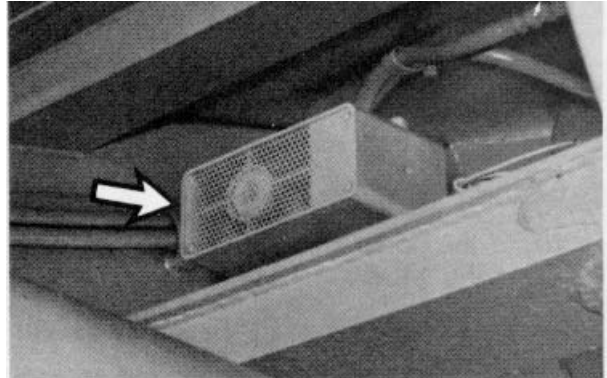
1. Start the engine and allow the air pressure to reach the normal (GREEN) range on the gauge (1)

2. With the engine running at low idle, pump the service brakes rapidly. When air pressure drops below 415 kPa (60 psi) the warning horn and light (2) should go on.

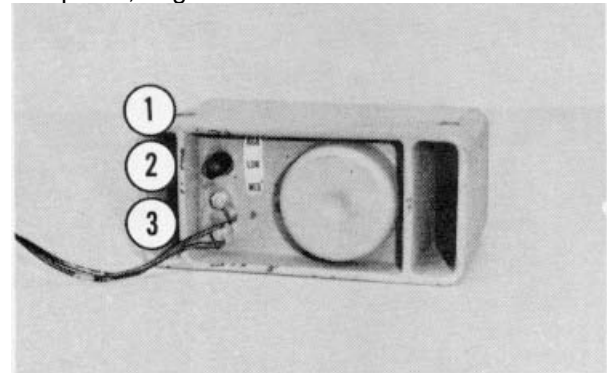
(9) Backup Alarm

Test

1. Start the engine. Apply the service brake. Unlock the transmission control lever and move it to the reverse position.



2. The backup alarm, located at the rear of the scraper, should sound. Move the transmission lever to neutral and stop the engine.



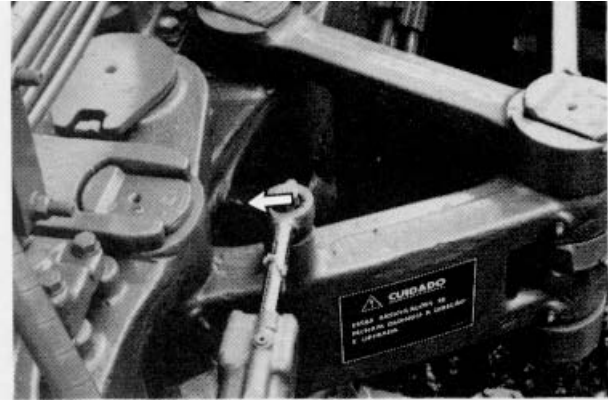
3. The alarm can be adjusted to one of three sound levels with the switch on the (-) back of the alarm.

(1) HIGH (2) LOW (3) MEDIUM

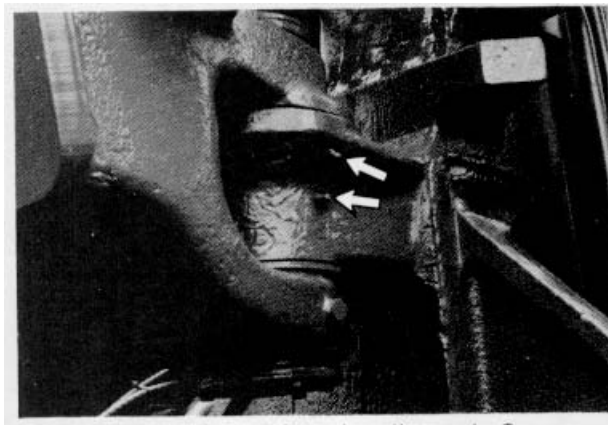
The alarm is usually set at the (HIGH sound level at the factory. Adjust it, if necessary, to meet job requirements

Every 50 Service Hours or Weekly

**(10) Kingbolt Bearings-
Lubricate**

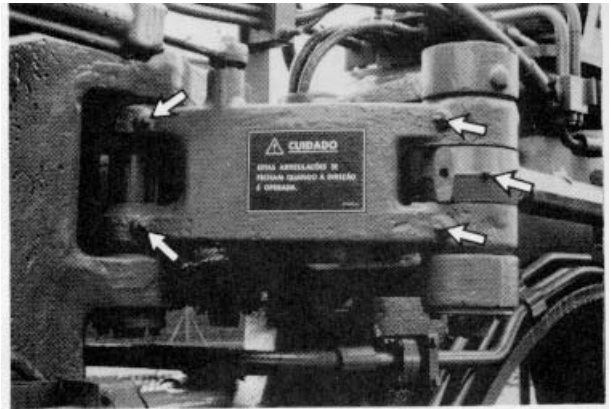


Lubricate the upper bearing through one fitting on the right side of the hitch.

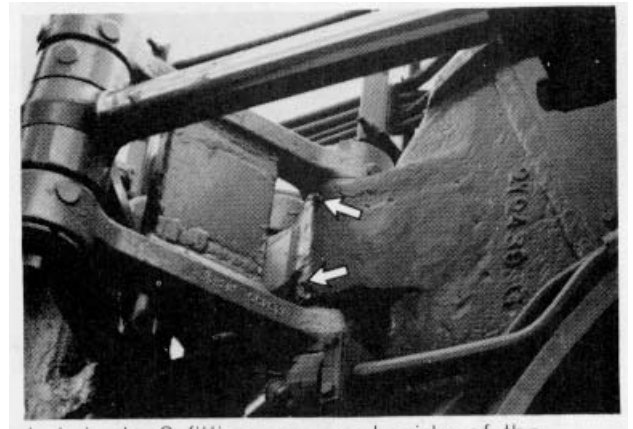


Lubricate the lower bearing through 2 fittings on the right side of the hitch.

**(11) Steering Cylinders and
Link Bearings-Lubricate**



Lubricate b fittings on each side of the hitch.



Lubricate 2 fittings on each side of the hitch

(13) Hydraulic System

Check Oil Level

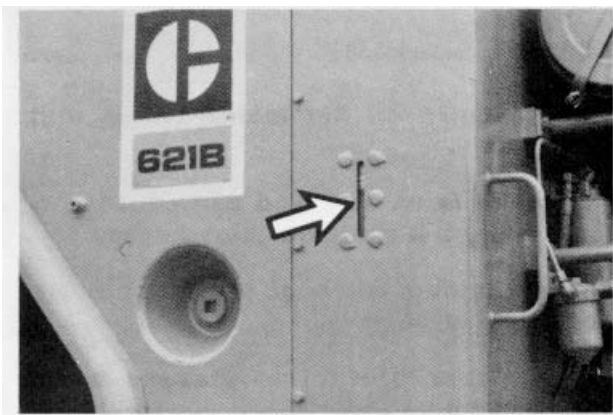
⚠ WARNING

Hot oil can cause burns.

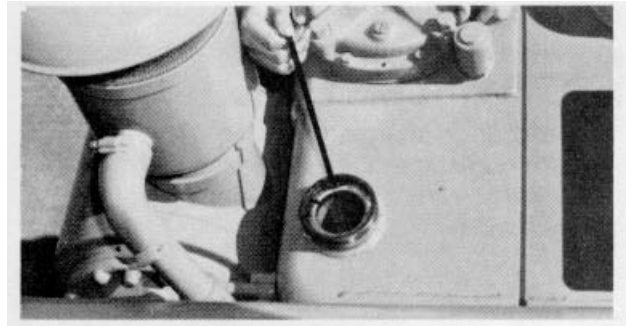
At operating temperature, the hydraulic tank is hot and under pressure.

Remove the fill cap **ONLY** when the engine is stopped and the cap is cool enough to touch with your hand. Remove the fill cap slowly to relieve pressure.

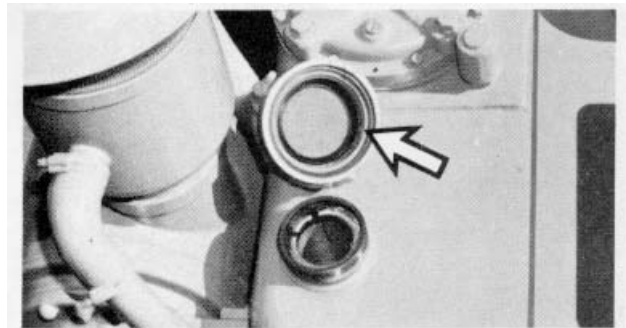
The machine must be level with the bowl and apron lowered, and the ejector forward. Apply the parking brake and stop the engine



1. The oil level should be between the ADD and FULL marks on the sight gauge.



2. The hydraulic oil level can also be measured on the dipstick in the fill opening. Maintain the level between the ADD and FULL marks on the dipstick. Add oil if necessary.



3. Clean the fill cap and inspect the seal. Replace the seal if it is damaged. Install the cap.

Every 50 Service Hours or Weekly

(14) Batteries

Check Electrolyte Level

⚠ WARNING

Batteries give off flammable fumes that can explode.

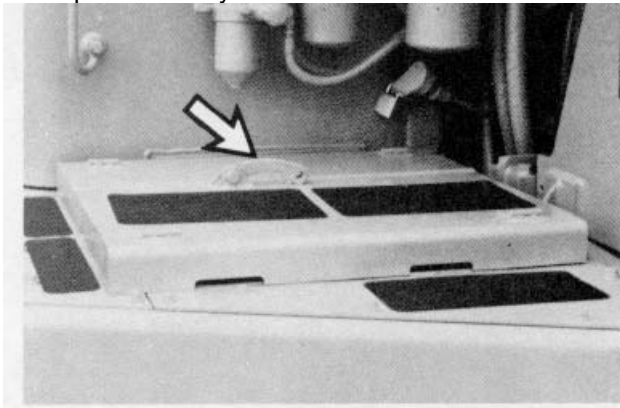
Electrolyte is an acid and can cause personal injury if it contacts skin or eyes.

Do not smoke when observing battery electrolyte level.

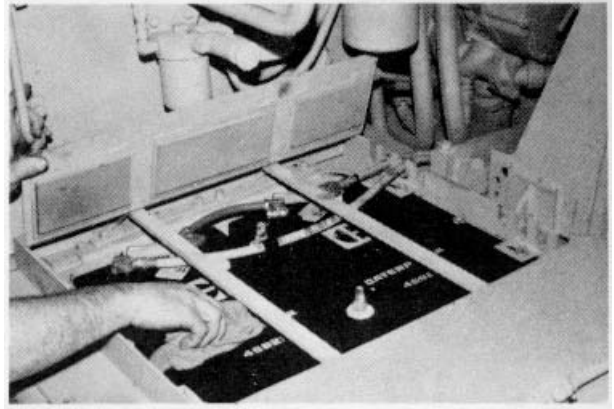
Always wear protective glasses when working with batteries.

NOTE: The batteries should be charged to a specific gravity of 1.250 or above, for adequate cranking power when the engine is cold.

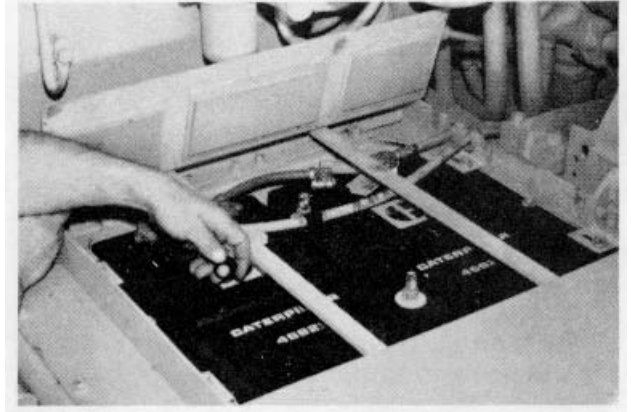
At the proper charging rate, in a moderate climate, the battery should not require more than 30 cc (1 oz) of water per cell every week.



1. Unlatch and open the battery box cover.



2. Clean the top of the batteries with a clean cloth. Keep the terminals clean and coated with petroleum jelly.



3. Inspect the electrolyte level in each cell of each battery. Maintain the level to the bottom of the fill openings with distilled water. Close the cover.

(15) Tires

Check Inflation Pressures

Check the inflation pressure with the tires cold, and at the same outside (ambient) temperature in which the machine will operate. Use a tire pressure gauge.

Caterpillar recommends using nitrogen to inflate tires or adjust tire pressures.

Inflation

⚠ WARNING

Proper nitrogen inflation equipment, and training in its use, are necessary to avoid possible over inflation. A tire blowout or rim failure can result from improper or misused equipment.



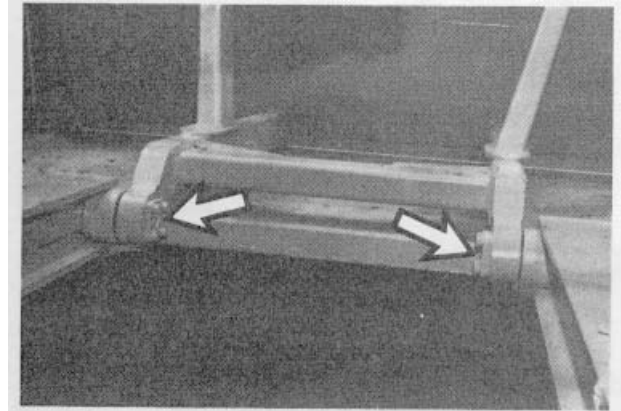
⚠ WARNING

Stand behind the tread when inflating tires.

See the "Tire Inflation Information" section if tire inflation is necessary.

(16) Ejector Channel Rollers

Lubricate 2 Fittings



Lubricate one fitting on each roller.

Every 250 Service Hours or Monthly

(17) Engine Crankcase

Change Oil and Filter

NOTE: Oil and filter do not have to be changed every month. Change every 250 service hours or every 3 months, whichever comes first.

WARNING

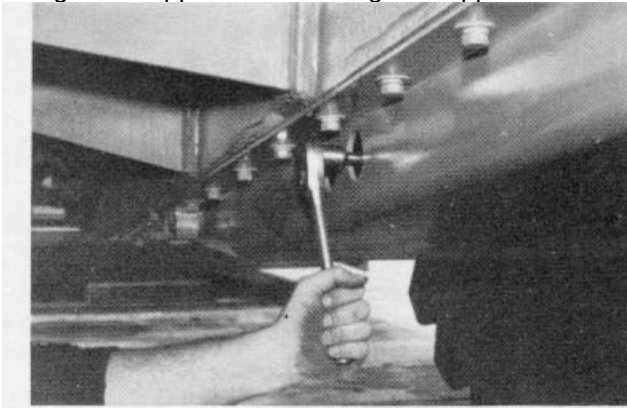
Hot oil and components can cause personal injury. Do not allow hot oil or components to contact skin.

Oil and filter change periods are directly related to the fuel sulphur content. Refer to the chart that follows.

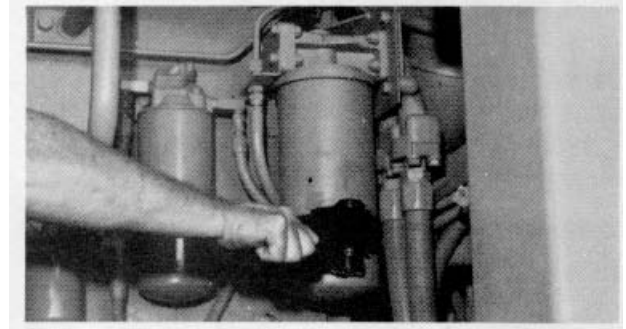
Fuel Sulfur Content

The percent of sulfur in the fuel will affect the engine oil recommendations. If the fuel has over 0.5% sulfur content, the CD engine oil must have a TBN of 20 times the percent of fuel sulfur. Your oil supplier should be able to furnish the correct oils.

The machine must be level with the bowl lowered, the parking brake applied and the engine stopped.



1. Open the crankcase drain valve. Allow the oil to drain. Close the drain valve.

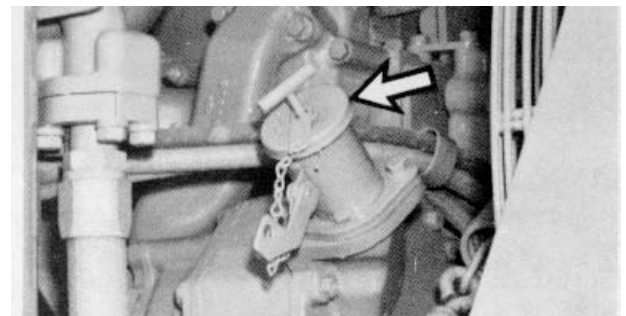


2. Remove the used oil filter.
3. Clean the filter base. Be sure all of the used filter seal is removed.
4. Coat the seal of the new filter with clean engine oil.
5. Install the new filter by hand. When the seal contacts the base, tighten an additional 3/4 turn.

CAUTION

Do not overtighten the filter.

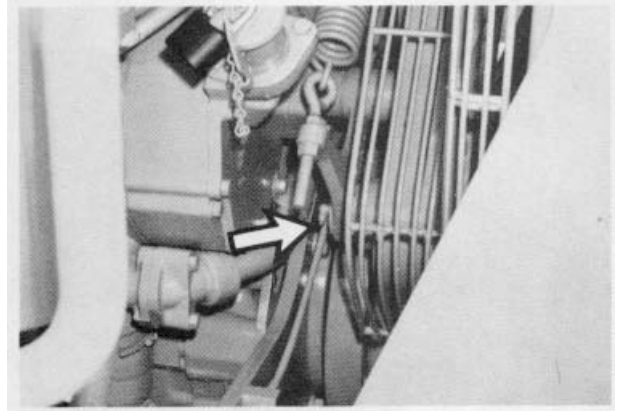
NOTE: Use the rotation index marks on the filter as a guide for proper tightening



6. Remove the fill plug. Fill the crankcase with oil. See "Refill Capacities." Clean and install the fill plug.
7. Start the engine and operate it at low idle. Check for leaks. Measure the oil level.

(19) Fan Belt Tightener

Lubricate 1 Fitting



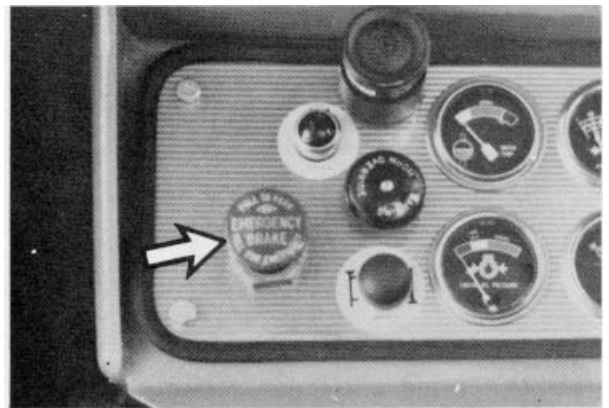
Lubricate 1 fitting on the tightener.

(20) Brakes

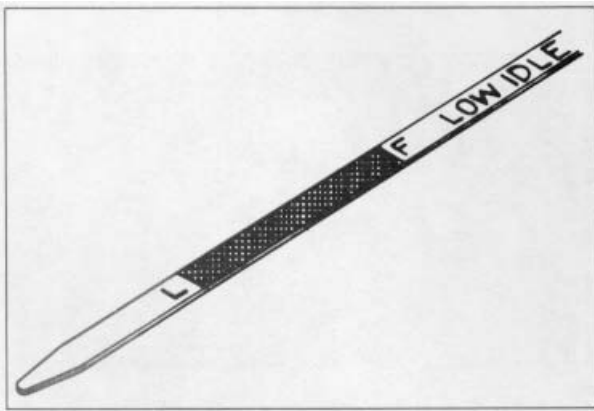
Inspect - Adjust

The machine must be level, the bowl lowered, and the parking brake applied.

1. Block the wheels securely
2. Start the engine.



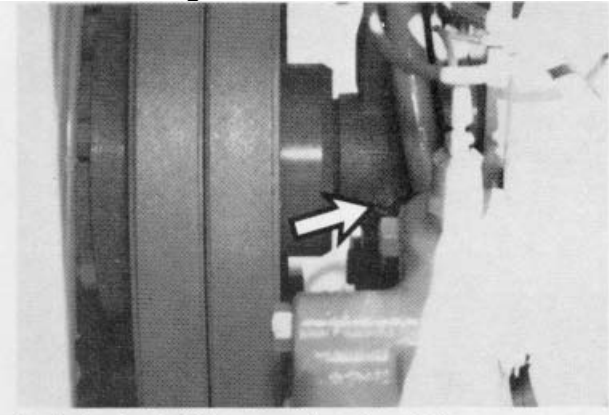
3. When the air pressure reaches the NORMAL range, stop the engine Release the parking/emergency brake.



Maintain the level between the ADD and FULL marks on the LOW IDLE side of the dipstick. Stop the engine.

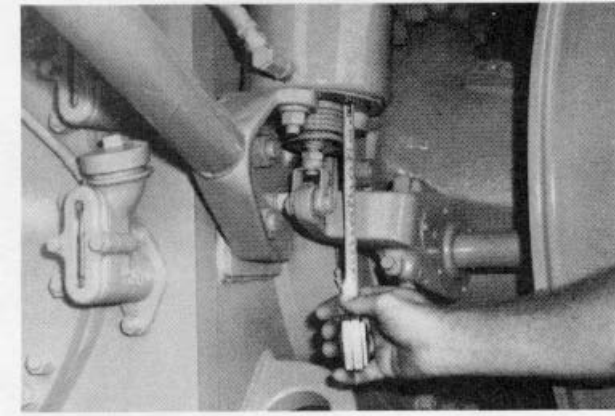
(18) Fan Bearing

Lubricate 1 Fitting



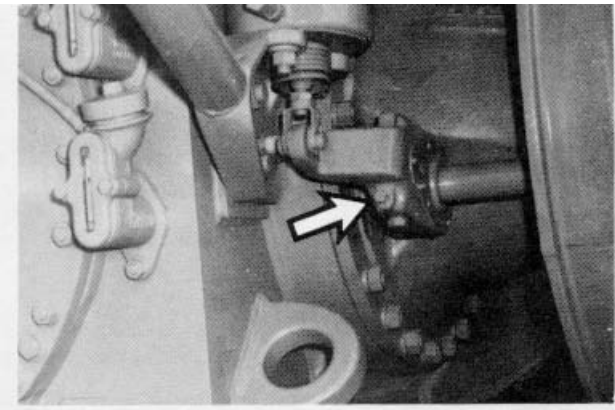
Lubricate 1 fitting on the fan drive bracket.

Every 250 Service Hours or Monthly

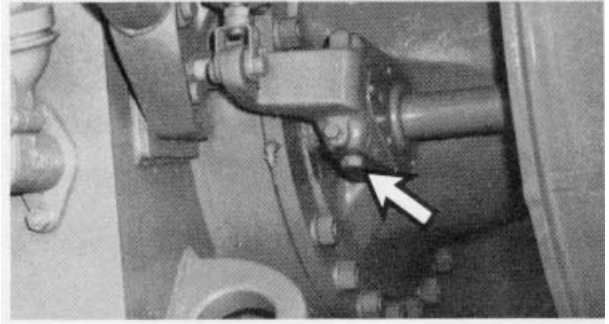


4. Measure the distance from the rotochamber to the slack adjuster clevis retaining pin.
5. Apply the service brake and measure the amount of travel of the rod. If the travel is 63.5 mm (2-1/2 inches) or more, adjust the brake.
6. Measure the brake rotochamber rod travel of all 4 wheel brakes. Adjust the travel as necessary. Scraper rotochambers are located inside the push frame.

To Adjust:



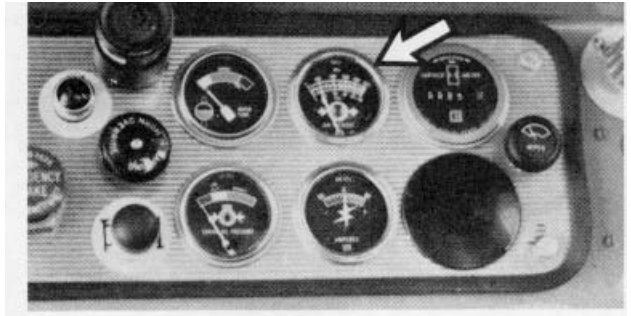
1. Loosen the adjustment locking bolt.



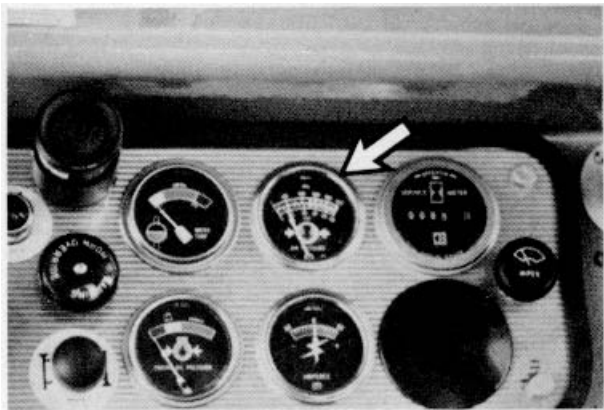
2. Turn the adjusting bolt, as required, until the travel is 41 mm (1-5/8 inches). Tighten the locking bolt.



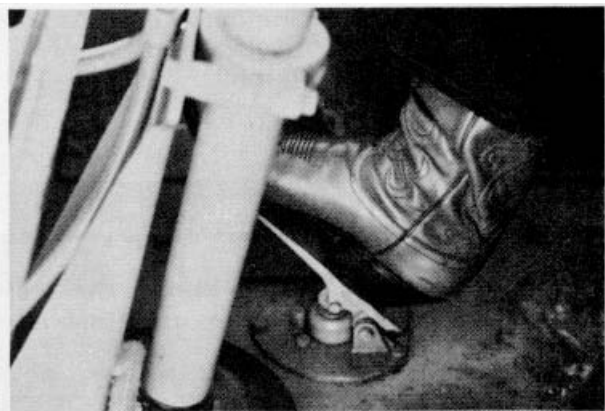
3. Apply and release the brakes, watching the rotochamber rod for binding. Observe the diaphragm for leaks.



4. Start the engine and allow air pressure to reach the NORMAL range on the air pressure gauge. Apply the parking brake. Stop the engine.
5. Remove the blocking from the wheels.

To Check the Air System for Leaks:

1. Start the engine and allow the air pressure to reach NORMAL on the gauge.



2. Apply the service brakes and hold them in the applied condition. Stop the engine.
3. With the brakes applied, watch the air pressure gauge. The pressure should drop no more than 35 kPa (5 psi) in 10 minutes.
4. If the air pressure loss is greater than 35 kPa (5 psi), inspect the air lines and connections. Make any necessary repairs.

To Test Brakes

⚠ WARNING

Be sure the area around the vehicle is clear of personnel and obstructions.

Fasten the seat belt before operating the vehicle.

Test the brakes on a dry, level surface.

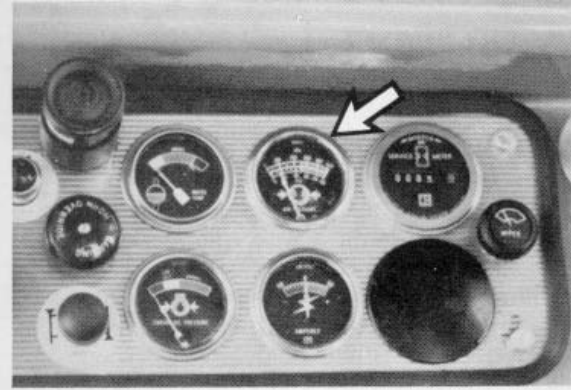
The vehicle must be on a dry, level surface, the bowl lowered and the parking brake applied.

The following tests are to determine if the service brake or parking/emergency brake is functional. These tests are not intended to measure maximum brake holding effort. Brake holding effort required to hold a vehicle at a specific engine rpm will vary from vehicle to vehicle due to differences in engine setting, power train efficiency, etc., as well as differences in brake holding ability. Engine rpm at beginning of vehicle movement, with service or parking/emergency brake applied, should be compared against the engine rpm your specific vehicle was able to hold on a prior test, as an indication of system deterioration.

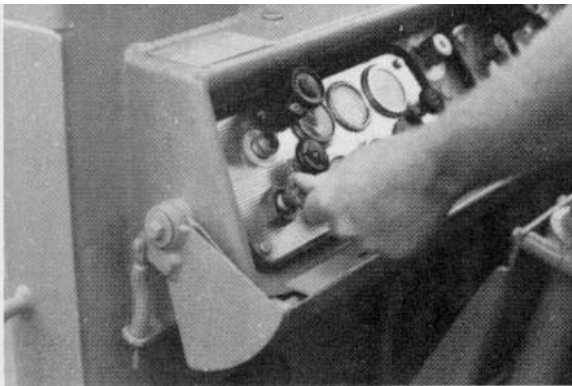
Every 250 Service Hours or Monthly

Service Brake

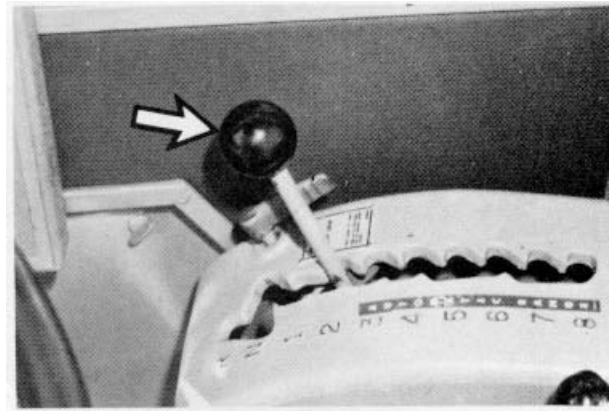
1. Start the engine. Allow the engine to reach the normal operating temperature.



2. When air pressure registers 690 kPa (100 psi) or is in the green range on the M gauge, apply the service brakes. Raise the bowl.



3. Depress the button to release the parking/emergency brake. Be sure the button stays in.



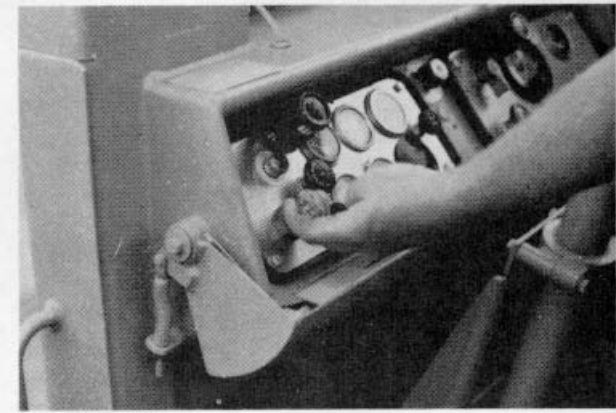
4. Move the transmission control to second speed.
5. With the service brake applied, gradually increase engine rpm. The service brakes should prevent vehicle movement at 1500 ± 100 engine rpm.

WARNING

When the vehicle moves during the test, reduce the engine speed immediately, and apply the parking brake.

The expected engine rpm should be 1500 ± 100 rpm or higher. Record the actual engine rpm obtained during the test and use this for future comparison. If rpm obtained is lower than 1400 rpm, inspect, and repair.

6. Reduce the engine rpm, shift to neutral, lower the bowl and stop the engine.



7. Pull the button out to apply the parking/emergency brake. Release the O0 service brake.

⚠ WARNING

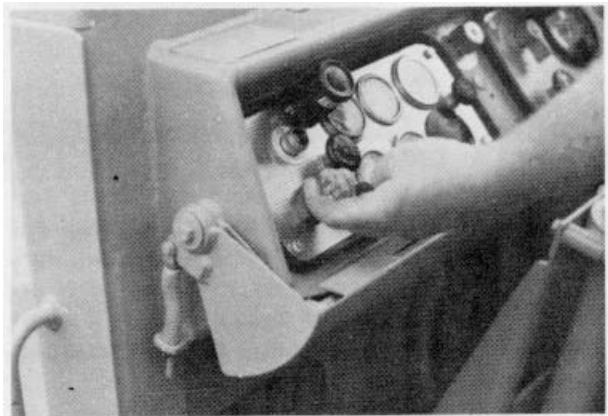
If the vehicle moved at a much lower engine rpm than specified or previously obtained while testing the brakes, inspect brakes, and repair. Damaged brakes must be repaired before returning the vehicle to operation.

Parking / Emergency Brake

1. Start the engine. Allow the engine to reach the normal operating temperature.



2. When air pressure registers 690 kPa (100 psi) or is in the green range on the gauge, apply the service brakes. Raise the bowl.



3. Pull the button out to apply the parking/emergency brake.

4. Move the transmission control to second speed.

5. Release the service brake.

6. With the parking/emergency brake applied, gradually increase the engine rpm. The parking/emergency brake should prevent vehicle movement at 1000 ± 100 engine rpm.

Every 250 Service Hours or Monthly

⚠ WARNING

When the vehicle moves during the test, reduce the engine speed immediately, and apply the parking brake.

The expected engine rpm should be 1000 ± 100 rpm or higher. Record the actual engine rpm obtained during the test and use this for future comparison. If rpm obtained is lower than 900 rpm, inspect, and repair.

7. Reduce engine rpm, shift to neutral, lower the bowl and stop the engine.

⚠ WARNING

If the vehicle moved at a much lower engine rpm than specified or previously obtained while testing the brakes, inspect brakes, and repair. Damaged brakes must be repaired before returning the vehicle to operation.

(21) Cooling System

Change Conditioner Element

⚠ WARNING

At operating temperature, the engine coolant is hot and under pressure.

Steam can cause personal injury.

Check the coolant level ONLY when the engine is stopped and the radiator fill cap is cool enough to touch with your hand.

Remove the fill cap slowly to relieve pressure.

Cooling System Conditioner contains alkali. Avoid contact with skin and eyes to prevent personal injury.

CAUTION

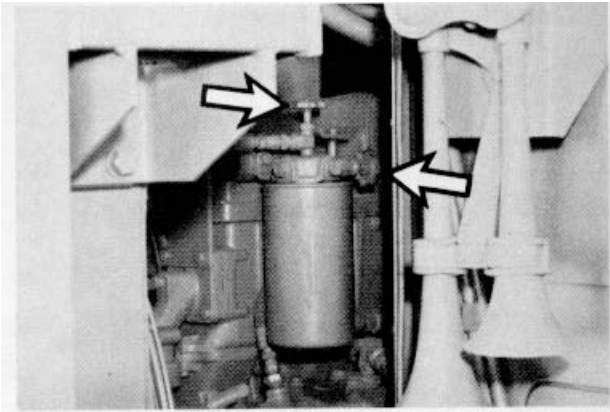
All water is corrosive at engine operating temperature. Use a coolant conditioner element to treat either plain water or an ethylene glycol solution.

Do not use both the liquid cooling system conditioner and the coolant conditioner element at the same time.

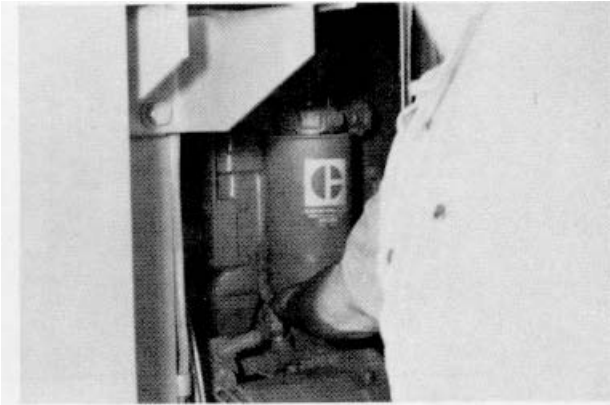
Do not use conditioner elements with Dowtherm 209 Full-Fill Coolant.

Use the correct maintenance element for your cooling system. Maintenance elements are sized to the coolant system capacity. For this machine, use a part number 9N3368 maintenance element

To Change Elements:



1. Close the inlet valve and the outlet valve at the element base. Turn clockwise C to close both valves.

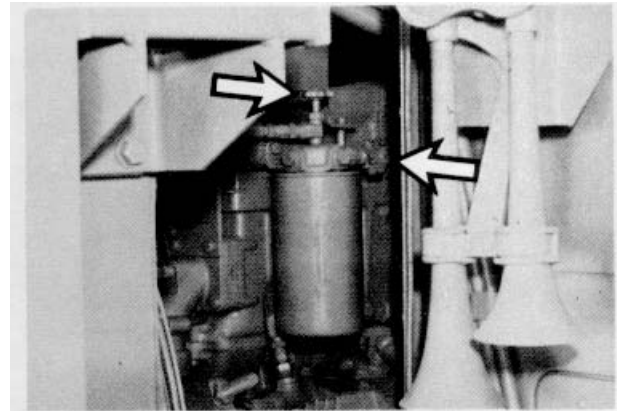


2. Remove the coolant conditioner element. Discard the element.

3. Clean the element mounting base. Make certain all of the old element seal material is removed.

4. Coat the seal of the new element with a thin film of clean engine oil or antifreeze.

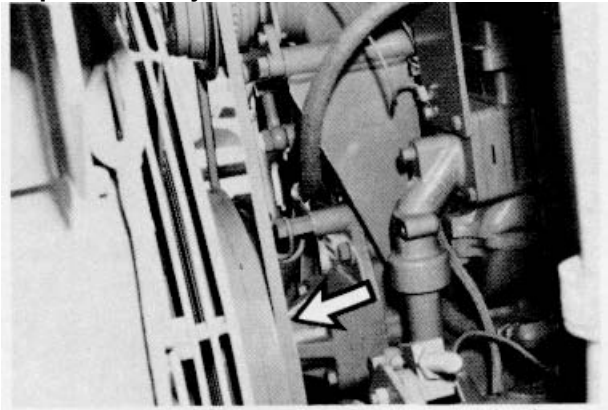
5. Install the element by hand. When the seal contacts the base, tighten it an additional 3/4 turn.



6. Open the inlet valve and the outlet valve. Start the engine and check for leaks.

(22) Fan and Alternator Belts

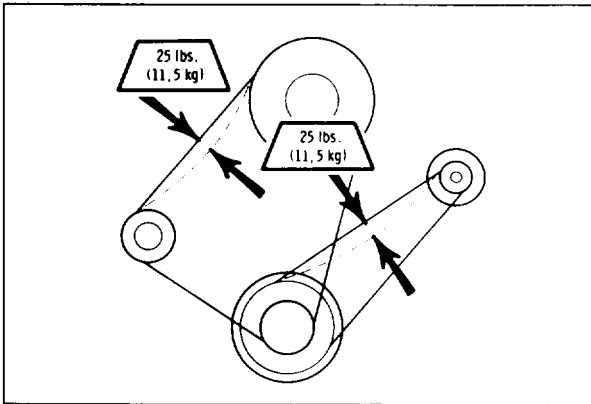
Inspect and Adjust



Inspect the condition and adjustment of the belts. Replace the belts if they are cracked or frayed. Replace the belts in sets if a belt is damaged.

Every 250 Service Hours or Monthly

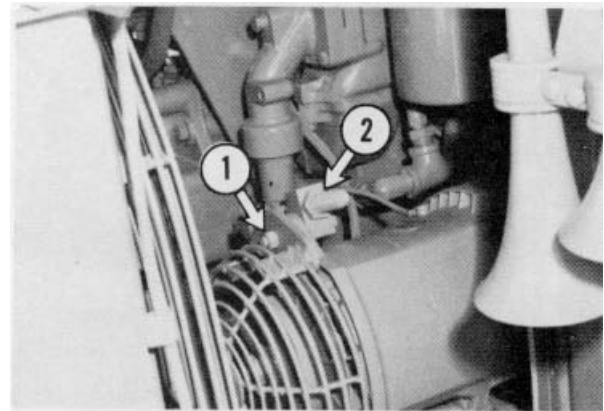
Alternator Belt Adjustment



Apply a 110 N (25 lbs) force on each belt midway between the pulleys. Each belt should deflect 14 to 20 mm (9/16 to 13/16 inch).

Fan Belt Adjustor

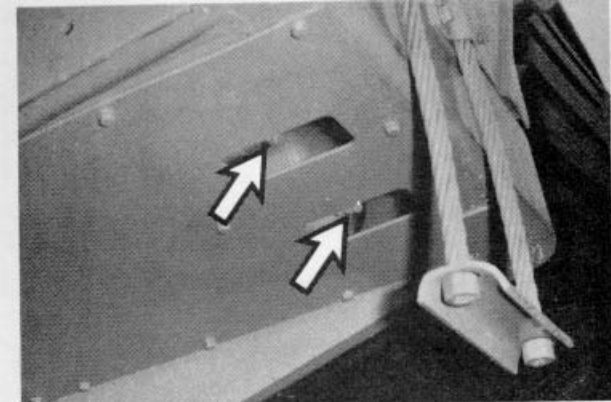
1. The belt tension is maintained by a spring.
2. If the correct belt tension is not maintained, replace the entire belt set.



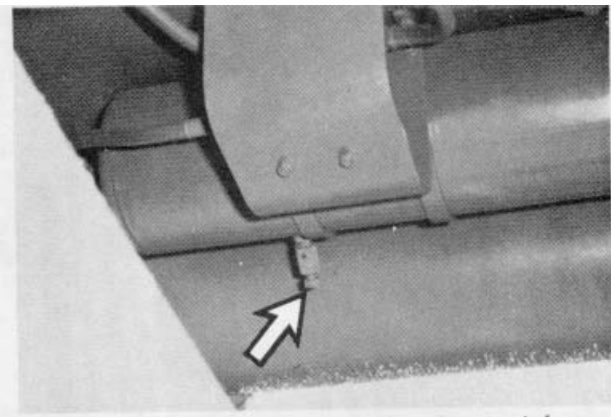
1. Loosen the mounting bolt (1) and the adjustment locking nut (2).
2. Turn the adjusting nut as required to obtain the correct adjustment. Tighten the locking nut and the mounting bolt. Recheck the adjustment.

Every 250 Service Hours or Monthly
(24) Air Dryer

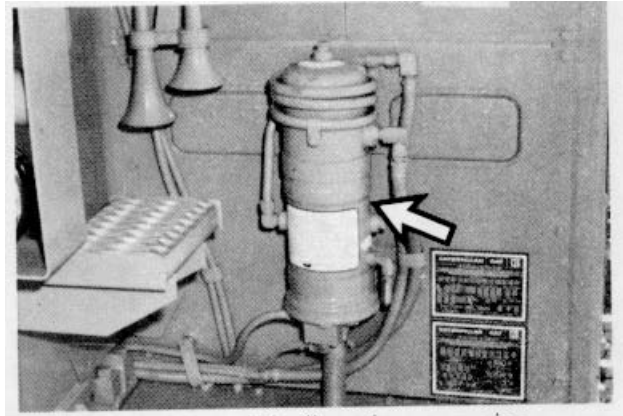
Inspect the Air System for Moisture



Loosen two tractor air reservoir bleed valves. Inspect for moisture in the reservoirs. Tighten the valves.



Open one scraper bleed valve. Inspect for moisture in the reservoir. Close the valve.



If water is present in the air reservoirs, the desiccant cartridge in the air dryer should be rebuilt or replaced.

A small amount of moisture may be present due to condensation in the system.

Moisture may be present if an air dryer was installed on a machine that had been used without an air dryer. Several weeks may be required to completely dry the system.

Every 500 Service Hours or 3 Months
(25) Hydraulic System

Change Filter Elements

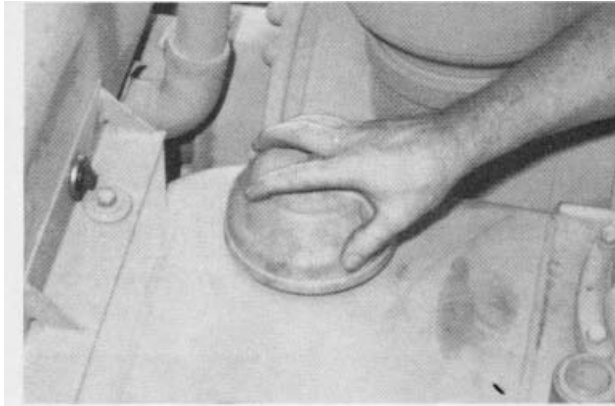
⚠ WARNING

Hot oil can cause burns.

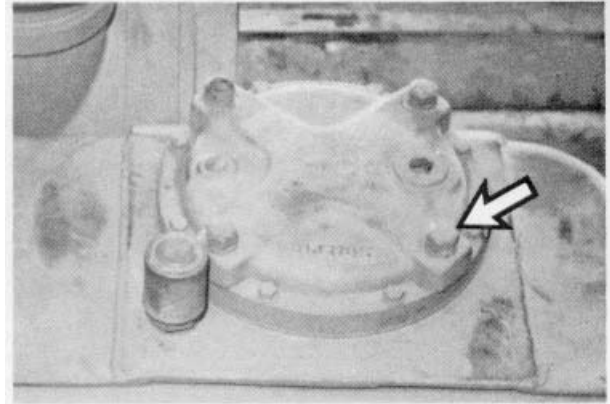
At operating temperature, the hydraulic tank is hot and under pressure.

Remove the fill cap **ONLY** when the engine is stopped and the cap is cool enough to touch with your hand. Remove the fill cap slowly to relieve pressure.

The machine must be level with the bowl and apron lowered, the ejector forward, the parking brake applied, and the engine stopped



1. Remove the hydraulic tank fill cap slowly to relieve any pressure in the tank.



2. Remove four bolts from filter cover



3. Remove filter cover from filter housing.



4. Remove the two used elements and the screen. Wash the screen and cover in clean nonflammable solvent. Install the screen and two new elements.

(26) Transmission System

Change Filter and Clean Magnetic Strainer

⚠ WARNING

Hot oil and components can cause personal injury. Do not allow hot oil or components to contact skin.

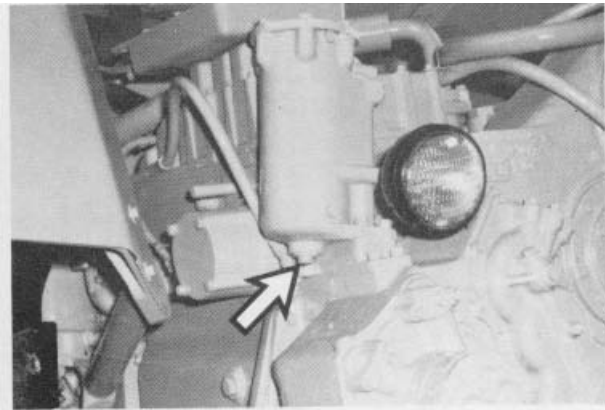
The machine must be level with the bowl and apron lowered, the parking brake applied, and the engine stopped



5. Inspect the cover seal. Use a new seal if the used one is damaged. Coat the seal with clean hydraulic oil. Install the cover carefully to prevent seal damage. Tighten the bolts evenly.
6. Install the fill cap.
7. Start the engine and operate it at low idle to fill the filters.
8. Check for leaks.



9. Stop the engine. Maintain the hydraulic oil level between the ADD and FULL marks on the sight gauge.

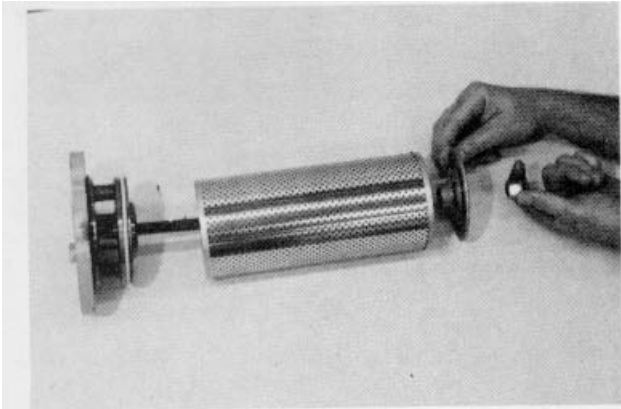


1. Remove the transmission filter housing drain plug. Allow the oil to drain.



2. Remove the cover and element assembly.
3. Clean the housing. Clean and Install the drain plug. Torque it to 45 ± 7 N m (35 ± 5 lb ft)

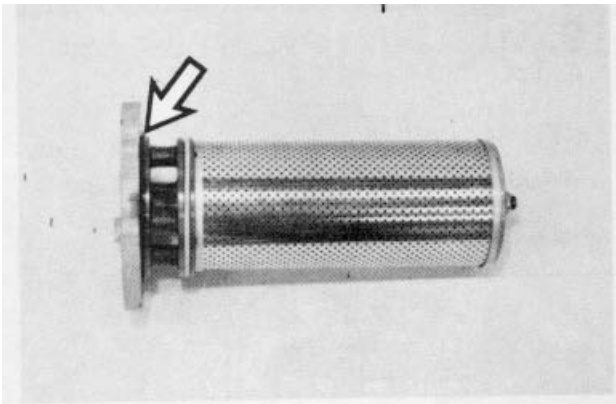
Magnetic Screen



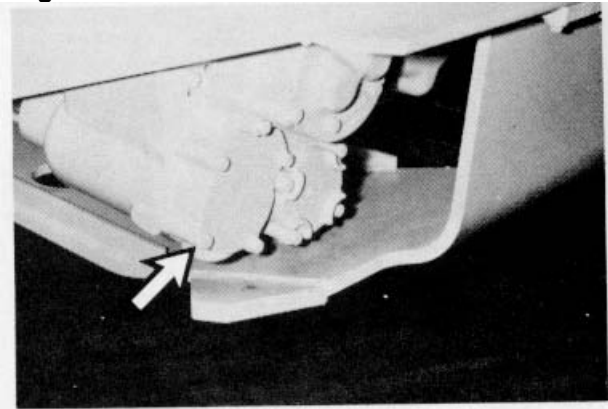
4. Remove the element retaining nut and the retainer. Remove the filter element from the cover.

5. Wash the cover in clean nonflammable solvent and allow it to dry.

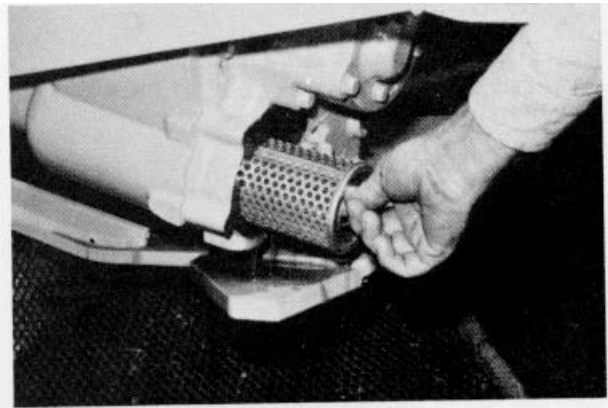
6. Install a new filter element on the cover. Install the retainer. Install the retaining nut. Torque it to 14 ± 3 N•m (10 ± 2 lb ft).



7. Replace the cover seal if it is damaged. Coat the seal with clean transmission oil. Install the cover and the element assembly carefully to avoid seal damage.



1. Loosen the housing cover slowly. Allow the oil to drain. Remove the cover.



2. Remove the screen and magnet assembly.

Every 500 Service Hours or 3 Months

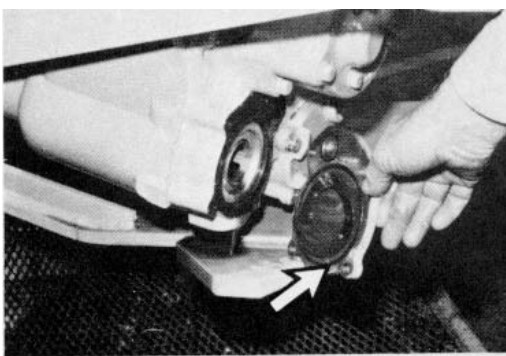


3. Separate the magnet and tube assembly from the screen. Wash the screen, magnet, and tube assembly in clean nonflammable solvent.

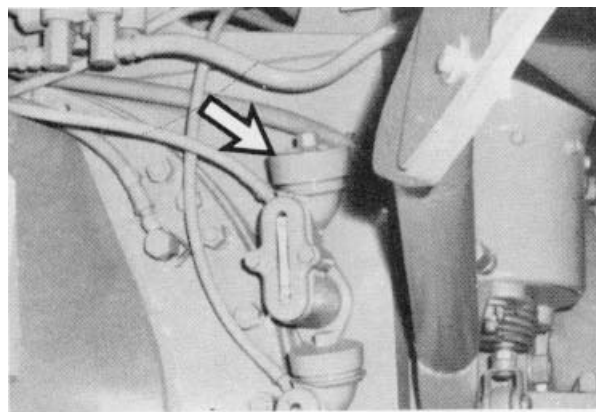
CAUTION

Do not drop or rap magnets on hard objects. Replace damaged magnets.

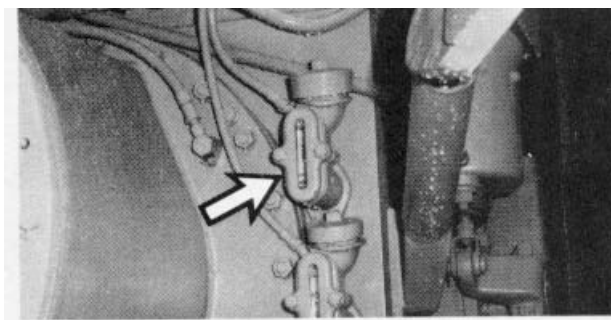
4. Clean the magnets with a cloth or stiff brush.
5. Allow the parts to dry. Insert the magnet and tube assembly into the screen.
6. Install the screen assembly.



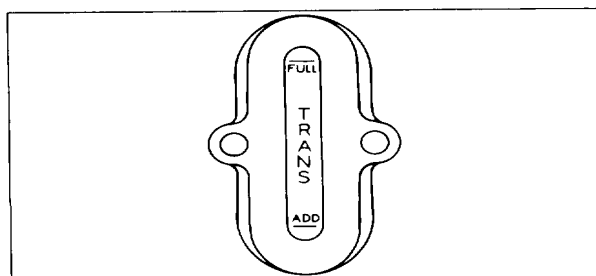
7. Inspect the cover seal. Install a new seal if it is damaged. Install the cover.



8. Remove the transmission fill cap.



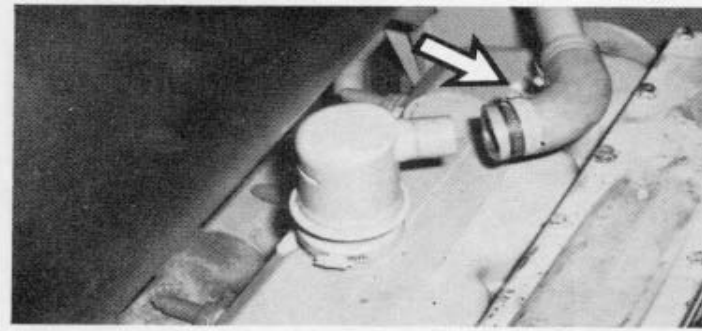
9. Add oil until oil is visible in the sight gauge.
10. Start the engine and operate it at low idle to fill the filter. Check for leaks.



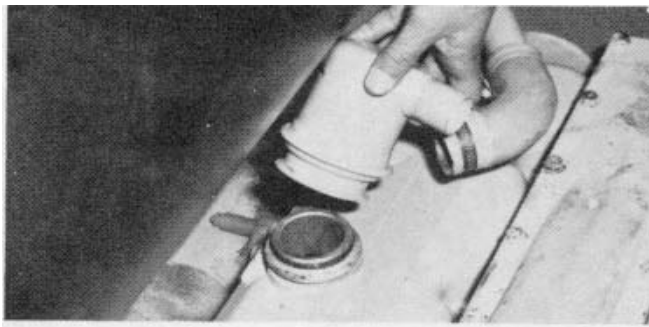
11. Check the oil level with the engine running at low idle. The oil level must be between ADD and FULL marks on the sight gauge.

(27) Engine Crankcase

Wash Breather



1. Stop the engine. Loosen the clamp and disconnect the outlet hose.



2. Loosen the clamp at the base of the breather and remove the breather
3. Wash the breather in clean nonflammable solvent Shake It and allow it to dry



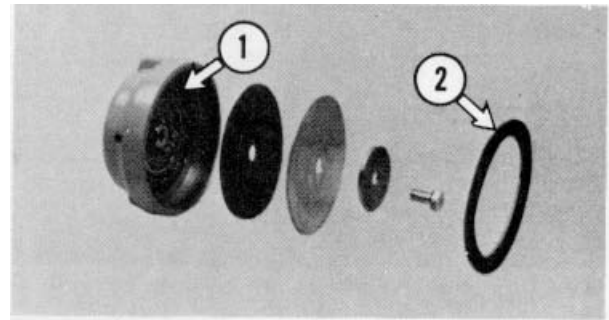
4. Inspect the breather seal Replace it if it is damaged.
5. Install the breather and connect the outlet hose.

(28) Fuel Filler Cap and Screen

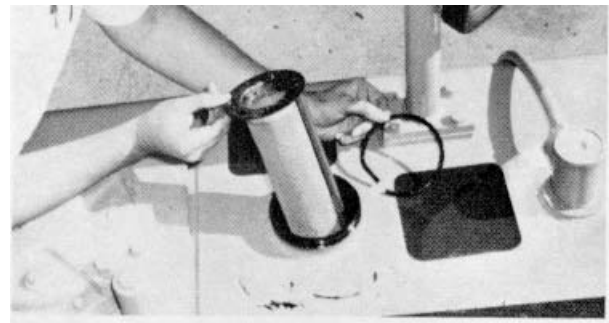
Wash



1. Remove the fuel tank cap. Disassemble the cap and wash the parts in clean nonflammable solvent.



2. Squeeze the element (1) dry and oil it lightly. Inspect the seal (2). Replace the seal if it is damaged. Reassemble the cap.



3. Remove the strainer lock ring. Remove the strainer from the fill opening. Wash the strainer in clean nonflammable solvent.
4. Install the strainer and lock ring install the tank cap.

Every 500 Service Hours or 3 Months

(29) Fuel System

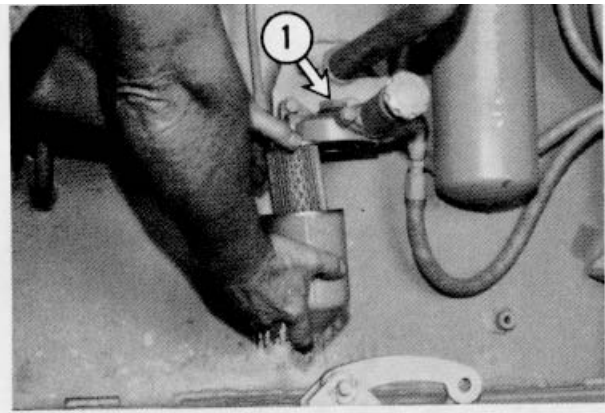
Service Filters

⚠ WARNING

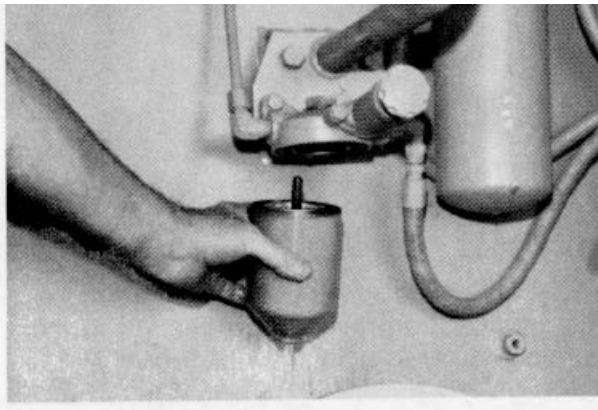
Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire.

Disconnect the battery (turn disconnect switch OFF) when changing fuel filters.

Cleaning the Primary Filter Element

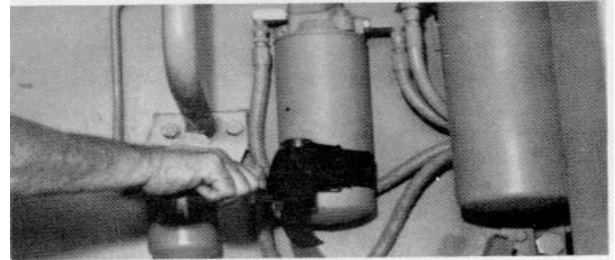


1. With the engine stopped, loosen the bolt (1) at the top of the base. Remove the case and the element.
2. Wash the case and the element in clean nonflammable solvent.

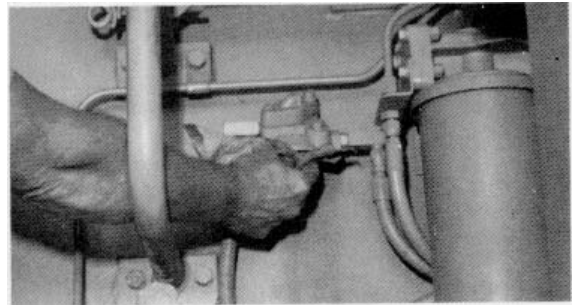


3. Clean the filter base. Replace the gasket if it is damaged. Install the filter element and the case

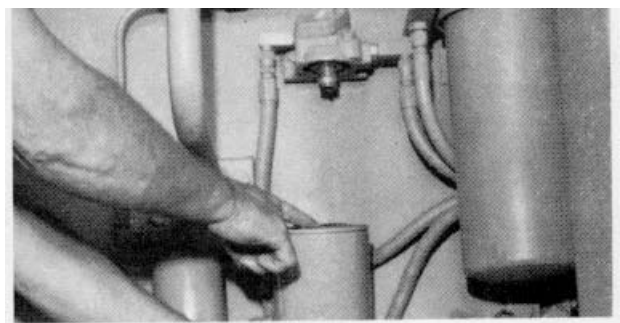
Changing Secondary Filter



1. Remove the used filter with strap-type 6 wrench and discard it.

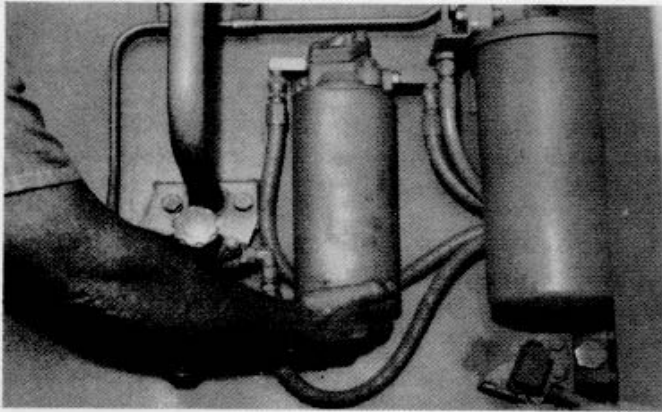


2. Clean the filter base. Make sure all of the used seal is removed



3. Coat the seal of a new filter with clean diesel fuel.

CAUTION
Do not overtighten the filter.

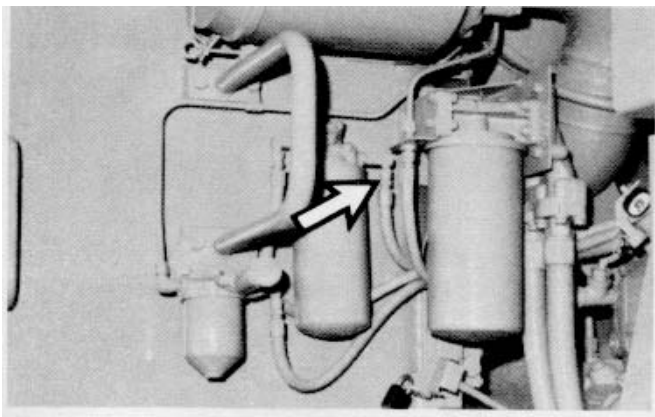


4. Install the new filter by hand. When the seal contacts filter base, tighten 3/4 turn more.

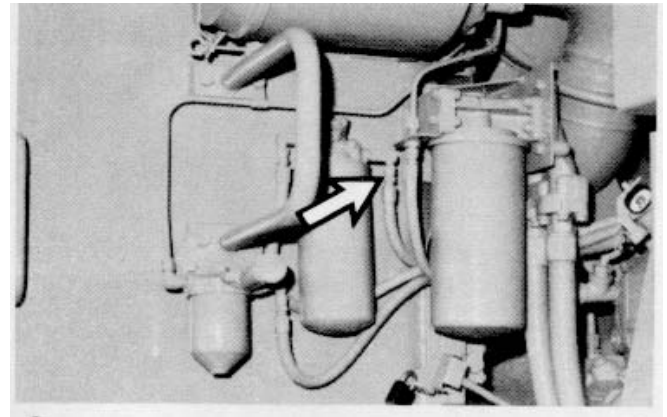
NOTE: Use the rotation index marks on the filter as a guide for proper tightening.

5. Prime the fuel system (see "Priming the Fuel System"). Start the engine and inspect for leaks.

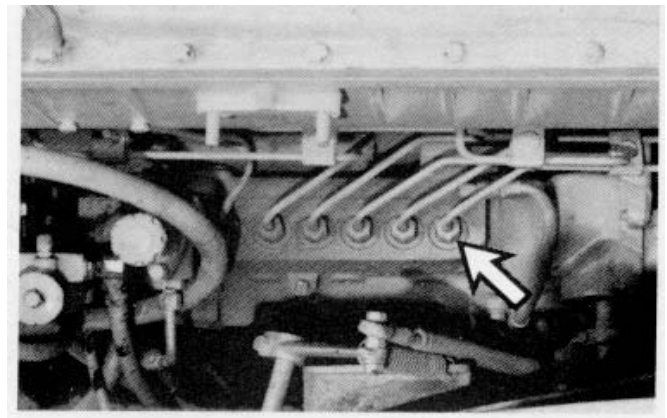
Priming the Fuel System



1. Move the accelerator pedal to the OFF position. Loosen the nut at the outlet & of the secondary fuel filter.



2. Unlock the priming pump plunger located on the primary fuel filter base. Operate the pump until fuel flows free of air bubbles. Lock the pump. Tighten the nut.

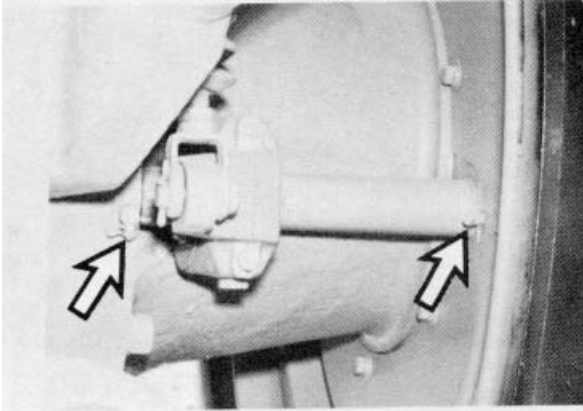


3. If removing air from the fuel Injection lines is necessary, loosen the nuts on the fuel injection lines.
4. the accelerator to low Idle position (out of stopped detent). Crank the engine with the starting motor.
5. When fuel flows from the lines free of air, tighten the nuts.

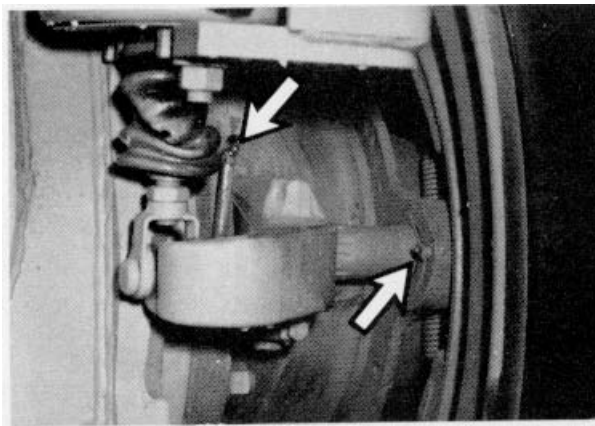
Every 500 Service Hours or 3 Months

(30) Brake Camshafts

Lubricate 8 Fittings



Lubricate two fittings inside of each tractor wheel.



Lubricate two fittings inside of each scraper wheel.

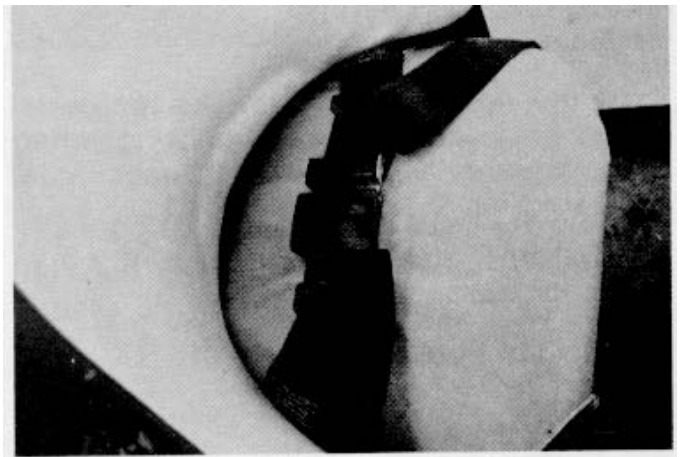
(31) Seat Belt

Inspect

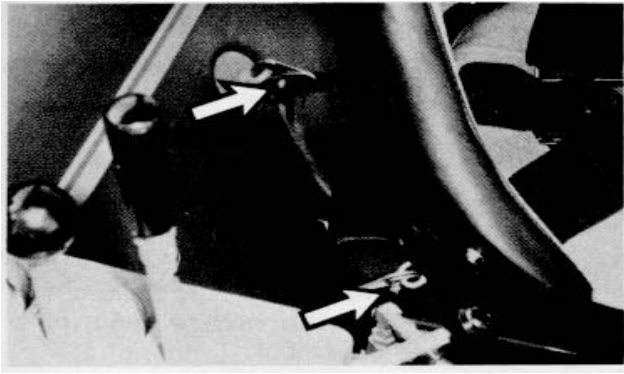


Always check the condition of the seat belt and mounting hardware before operating the machine.

Replace the seat belt at least once every three years, regardless of appearance. A date is sewn onto each belt to determine the age of the belt.



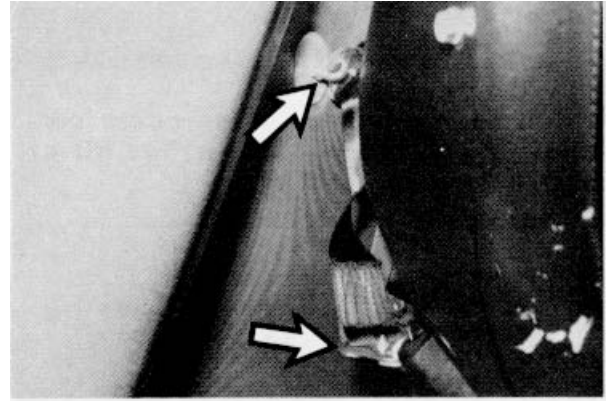
Inspect the belt, buckle, and anticreep slides. Replace the belt or parts if damage exists, or if the belt is frayed.



⚠ WARNING

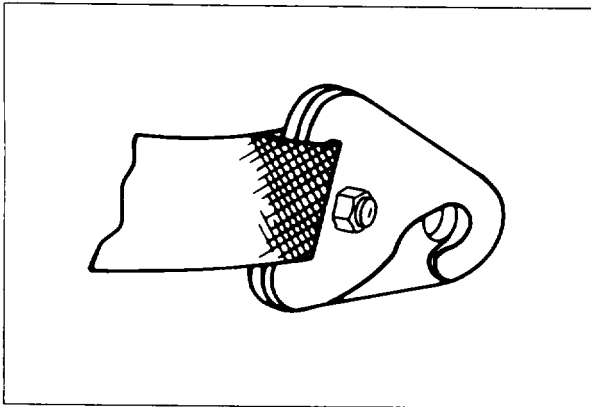
If the bolt and nut that holds the two parts of the seat belt mounting hooks together are not correctly installed, the hooks can separate from their mounting.

Inspect the hooks of each half of the belt to make sure the bolt and nut are secure and correctly installed. See illustration.



Inspect the seat belt mounting hardware.

Replace the mounting eye bolts or the snap fasteners if they are worn or damaged. Be sure all mounting bolts are tight.



Every 1000 Service Hours or 6 Months

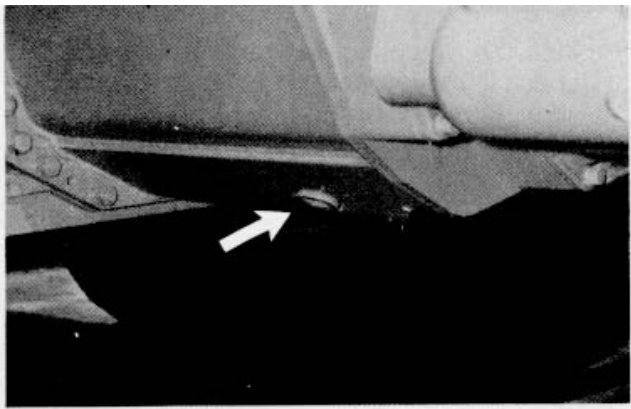
(32) Transmission System

Change Oil Wash Screens and Breather

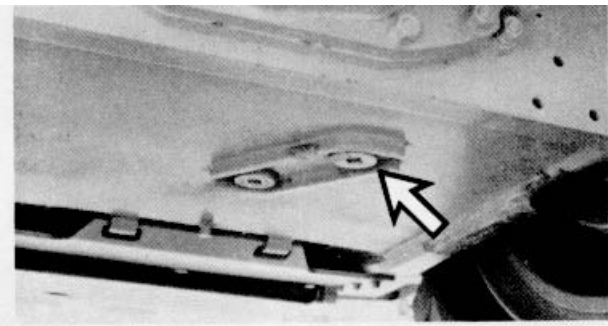


Hot oil and components can cause personal injury. Do not allow hot oil or components to contact skin.

The machine must be level with the bowl and apron lowered, the parking brake applied and the engine stopped.

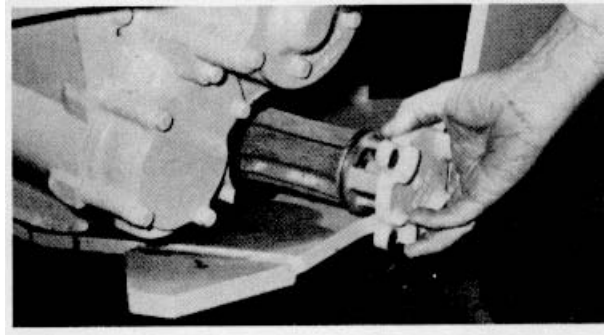


1. Remove the transmission drain plug. Allow the oil to drain.

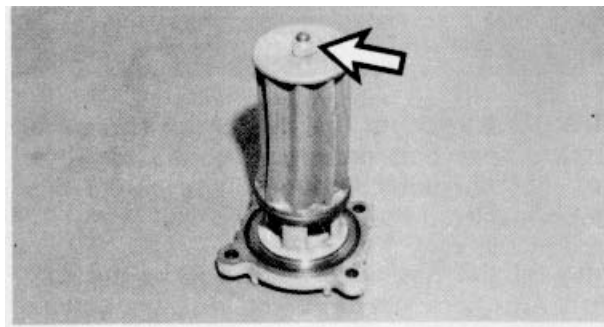


2. Remove the oil sump drain plug. Allow the oil to drain. Change the transmission oil filter element and clean the magnetic strainer. See "Transmission System" at "Every 500 Service Hours or 3 Months."

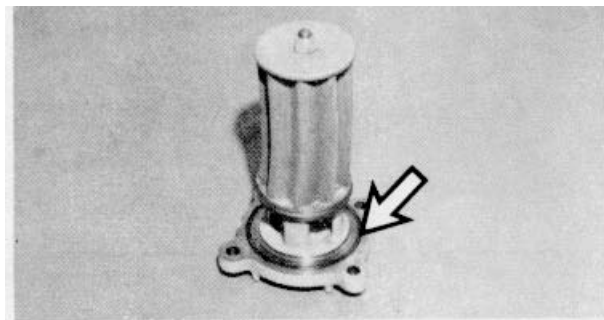
Transmission Sump Screen



1. Remove the transmission case sump screen and cover assembly.

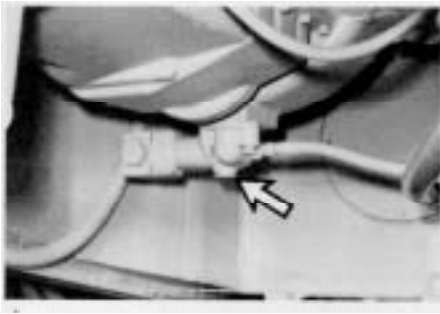


2. Remove the retaining nut and separate the screen from the cover.
3. Wash the screen and cover in clean nonflammable solvent. Allow the parts to dry.

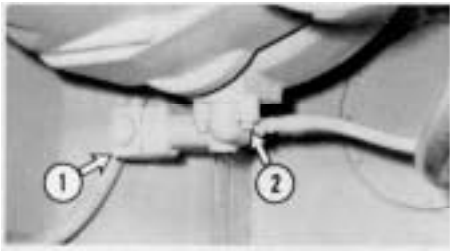


4. Install the screen and retaining nut on the cover. Inspect the cover seal. Replace the seal if it is damaged. Install the cover and screen assembly.

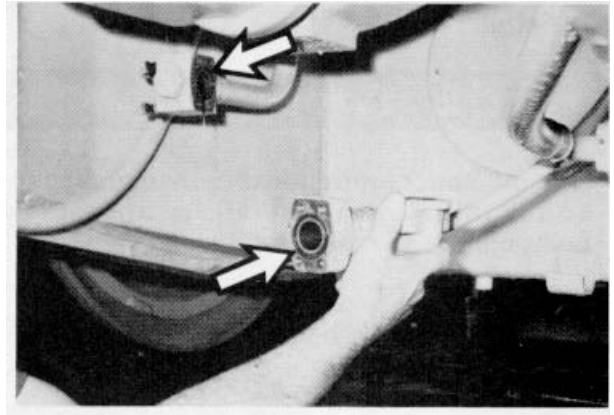
Flywheel Housing Sump Screen



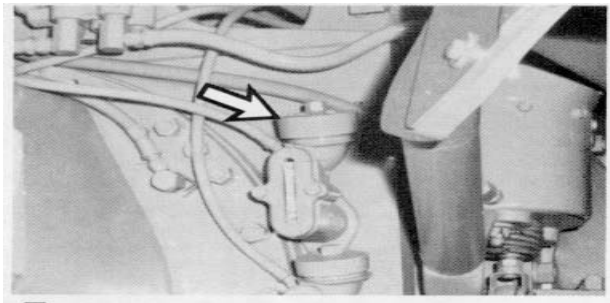
1. the flywheel housing sump drain plug. Allow the oil to drain.



2. Disconnect the sump tube (1) from the end of the screen housing. Remove the bolts (2) holding the housing to the drive shaft housing.
3. Lower the housing. Remove the screen. Wash it in clean nonflammable solvent.

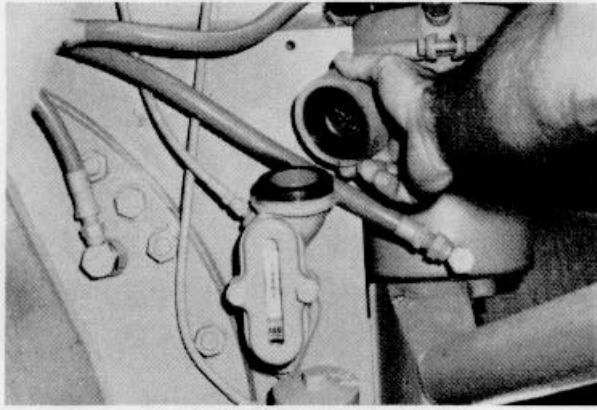


4. Inspect the seals on the housing and on the tube assembly. Replace any seals that are damaged.
5. Install the screen. Install the housing and connect the tube.
6. Clean and Install all of the drain plugs.

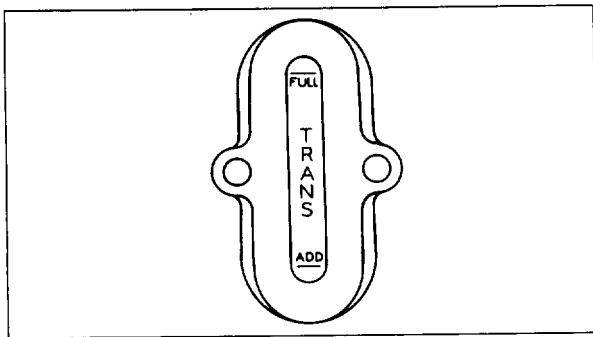


7. the fill cap Fill the transmission with oil. See "Refill Capacity" Chart.

Every 1000 Service Hours or 6 Months

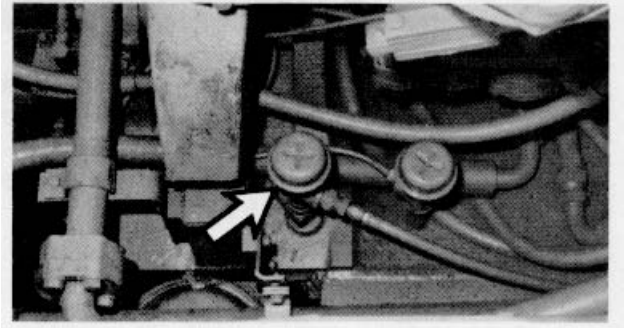


8. Clean and install the cap.
9. Start the engine and allow the oil to warm and fill the filter. Check for leaks.
- 10 Check the oil level with the engine running at low idle



Maintain the level in the area between the ADD and FULL marks on the sight gauge Stop the engine and add oil if necessary.

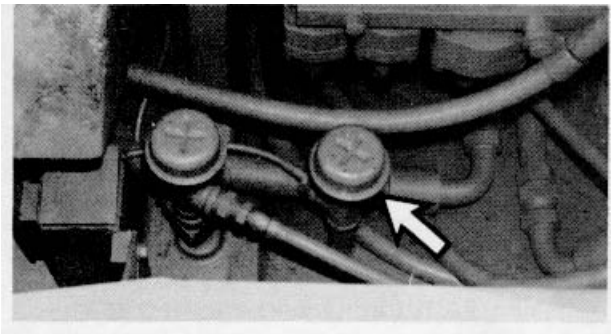
Breather



1. Unscrew and remove the transmission breather from the top of the differential case.
2. Wash the breather in clean nonflammable solvent. Shake it to remove excess solvent and allow it to dry.
3. Install the breather.

(33) Differentials and Final Drives

Wash Breather



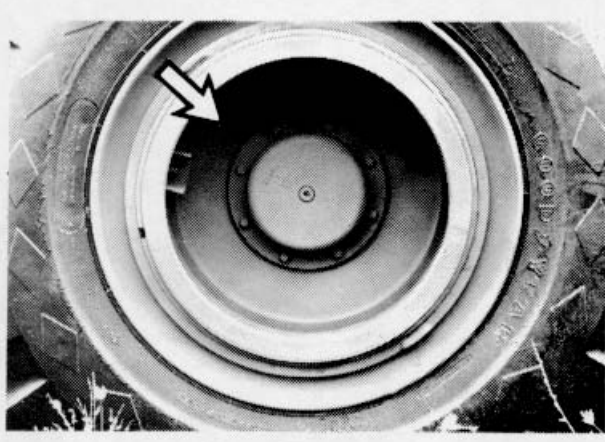
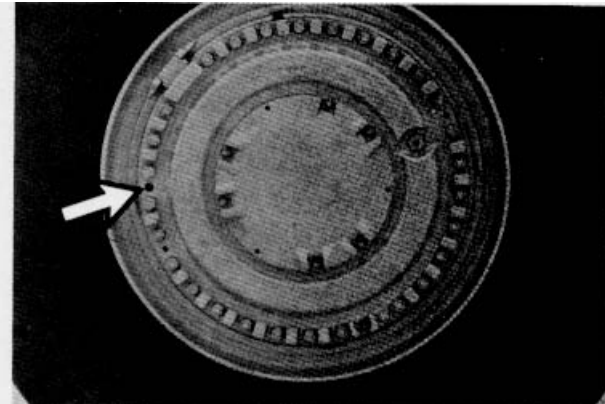
1. Remove the differential and final drive breather from the top of the differential case.
2. Wash the breather in clean nonflammable solvent. Shake it and allow it to dry.
3. Install the breather.

(34) Wheels

Check Wheel Coolant Levels

⚠ WARNING

With a lack of wheel coolant, the brakes can generate enough heat to burn the tire bead. A burning bead produces gases inside the tire that can explode, endangering personnel within 460 meters (1500 ft).

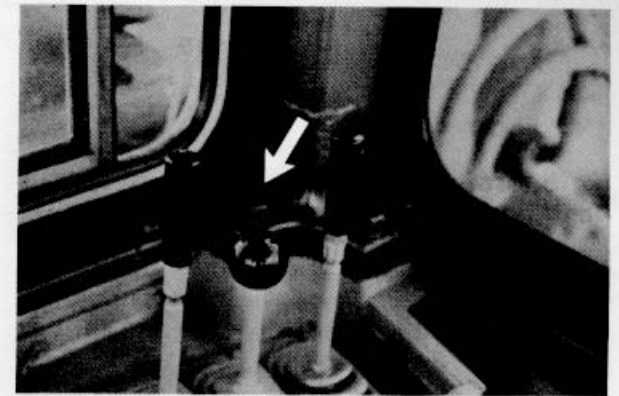


Position each tractor and each scraper wheel so the coolant fill plug is level with the center of the axle.

Remove the plug. Maintain the wheel coolant level to the bottom of the plug opening with an 80% water and 20% ethylene glycoltype antifreeze solution. Clean and install the plug.

(35) ROPS Bolts

Tighten



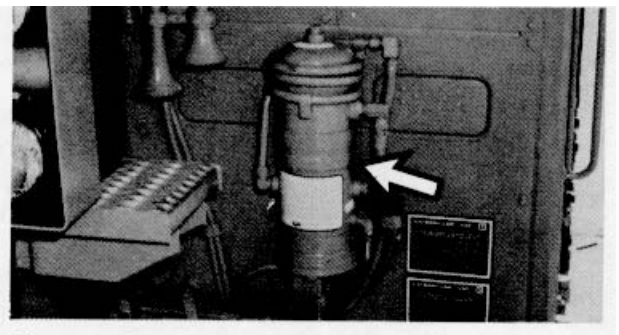
Tighten the 16 mountings bolts (4 in each corner) of the ROPS (Rollover Protective Structure). Torque the bolts to 740 ± 25 N m (545 ± 20 lb ft).

(36) Air Dryer

Change Desiccant

⚠ WARNING

Drain the air system before performing maintenance on the air dryer.



Change the desiccant in the air dryer.

Every 2000 Service Hours or 1 Year

(37) Hydraulic System

Change Oil

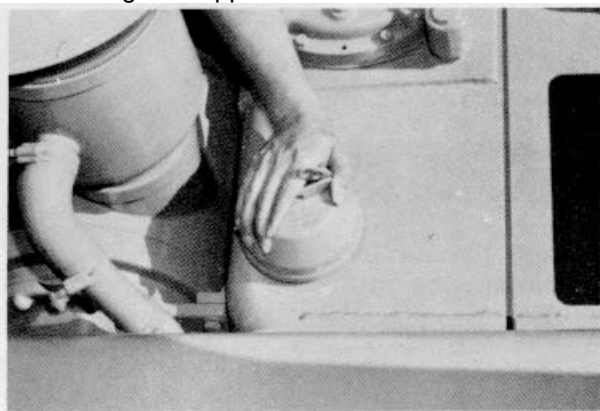
⚠ WARNING

Hot oil can cause burns.

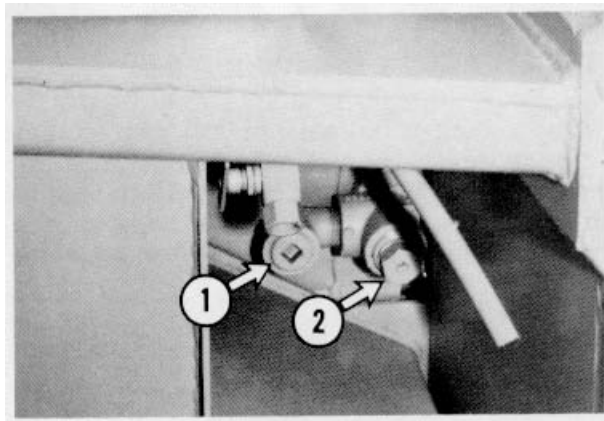
At operating temperature, the hydraulic tank is hot and under pressure.

Remove the fill cap **ONLY** when the engine is stopped and the cap is cool enough to touch with your hand. Remove the fill cap slowly to relieve pressure.

The machine must be level, with the bowl and apron lowered, the ejector forward, the parking brake applied and the engine stopped.



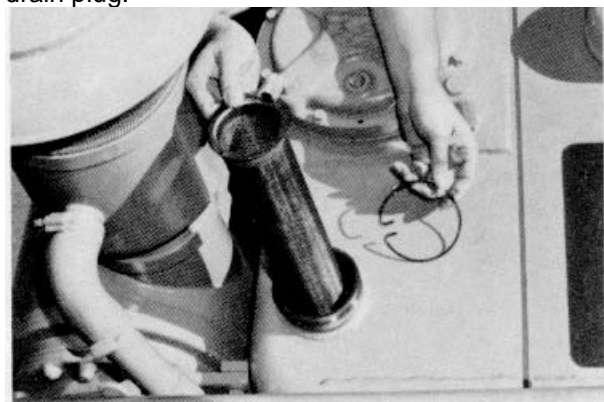
1. Remove the hydraulic tank cap slowly to relieve pressure in the tank.



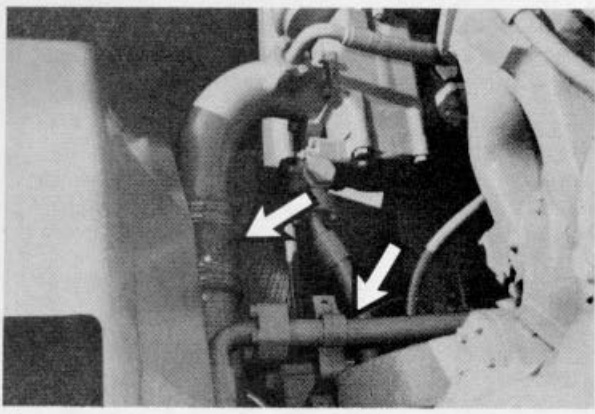
2. Remove the hydraulic tank drain valve plug (1). Open the drain valve (2) and allow the oil to drain.

3. Change the hydraulic oil filter elements. See "Hydraulic System" at "Every 500 Service Hours or 3 Months."

4. Close the tank drain valve. Clean and install the drain plug.

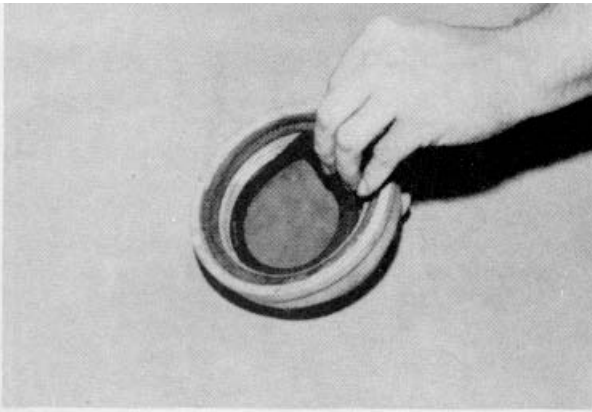


5. Remove the lock ring and the screen from the fill opening. Wash the screen in clean nonflammable solvent. Install the screen and the lock ring.

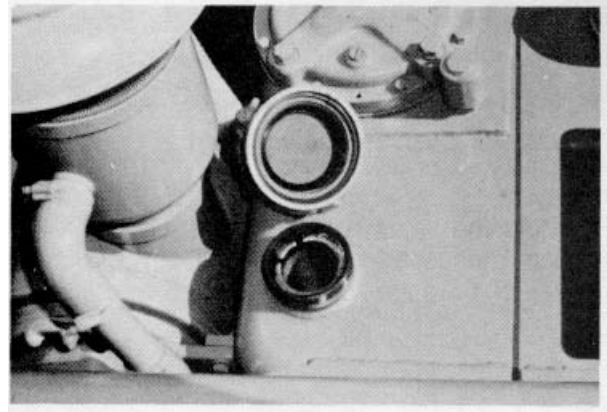


6. Inspect the suction and return line hoses and clamps.

7. Replace swollen or cracked hoses. Tighten all hose clamps to 11.3 N•m (100 lb in).



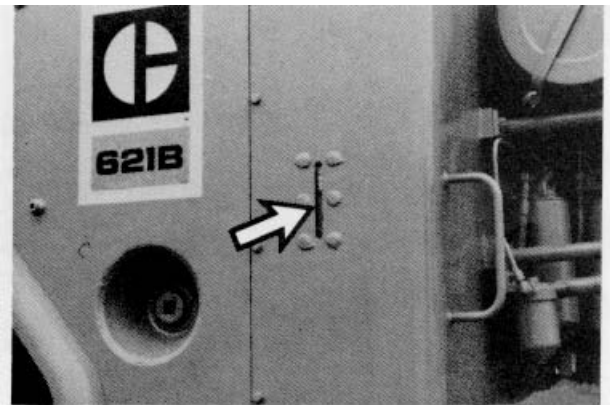
8. Clean the fill cap. Inspect the fill cap seal. Replace if it is damaged.



9. Fill the hydraulic tank with oil. See "Refill Capacity" Chart. Install the cap.

10. Start the engine and operate it at low idle to fill the filters.

The machine must be level, the bowl and apron lowered, the ejector forward and the parking brake applied.



11. Stop the engine. Observe the hydraulic oil level. The level must be maintained between the ADD and FULL marks on the sight gauge.

Every 2000 Service Hours or Yearly

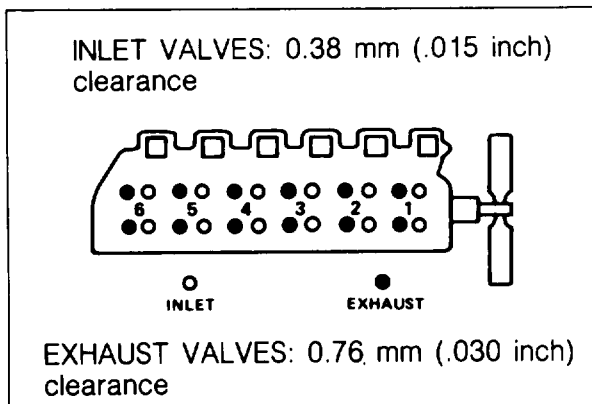
(38) Engine Valve Lash

Measure and Adjust

Use part number 9S9082 Engine Turning Tool to turn the flywheel.

See the "621B Tractor-Scraper Service Manual" for the valve adjustment procedure.

Resetting the valve lash is not required if the lash measured is within 0.08 mm (.003 inches) of the lash listed below.

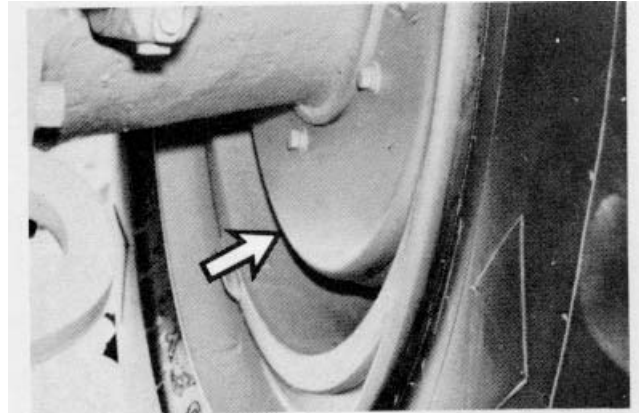


VALVE LASH SETTINGS

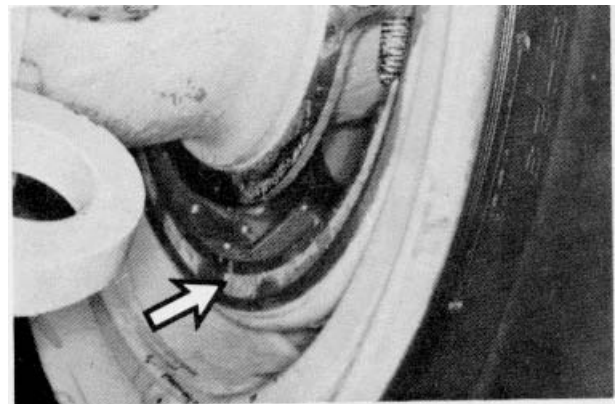
(39) Brakes

Inspect

The machine must be level with the bowl lowered, the parking brake applied and the engine stopped. Block the wheels.



1. Remove the upper and lower brake shields at each tractor and scraper wheel.



2. Inspect the brake drums, linings, and cams for wear or damage.

3. If excessive wear on the brake drums or linings exists, or the brake cam cannot be adjusted, have the drums or linings replaced as necessary.

4. If damage exists, have repairs made.

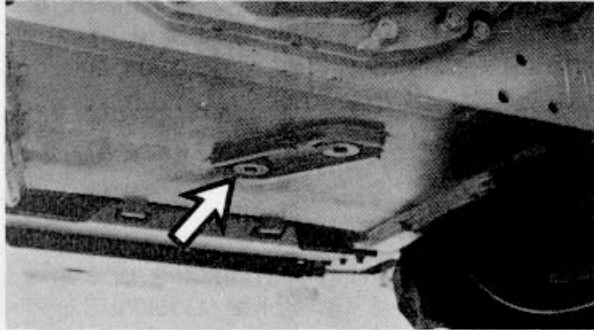
(40) Differential and Final Drives

Change Lubricant

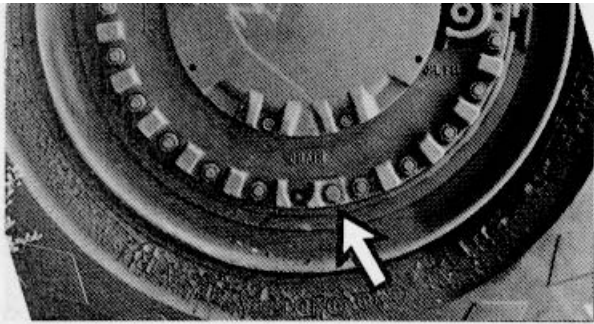
⚠ WARNING

Hot oil and components can cause personal injury. Do not allow hot oil or components to contact skin.

The machine must be level with the bowl lowered, the parking brake applied and the engine stopped.



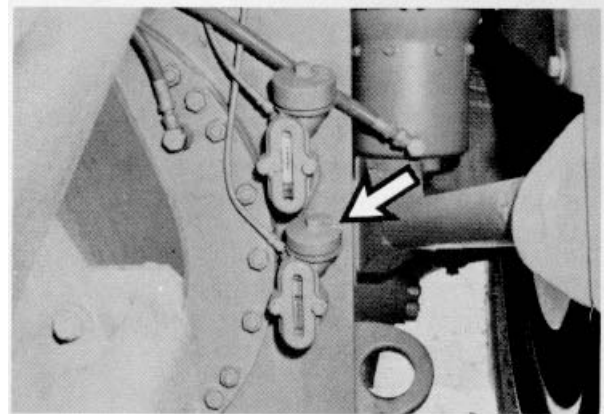
1. Remove the differential drain plug and allow the lubricant to drain. Clean and install the plug.



2. Position the tractor wheels with the final drive drain plugs at the bottom.

3. Remove the plugs and allow the lubricant to drain.

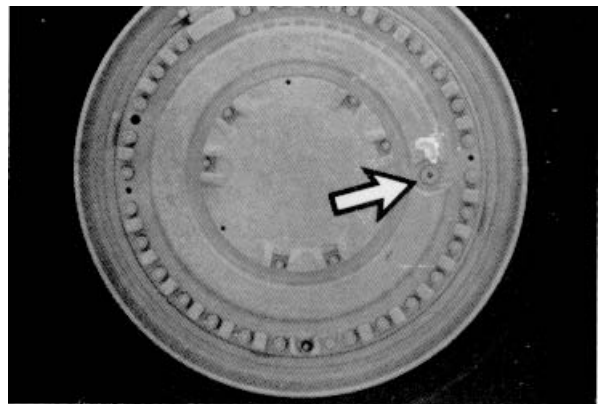
4. Clean and install the drain plugs.



5. Remove the differential fill cap.

6. Fill the differential and final drives with lubricant. See "Refill Capacity" Chart.

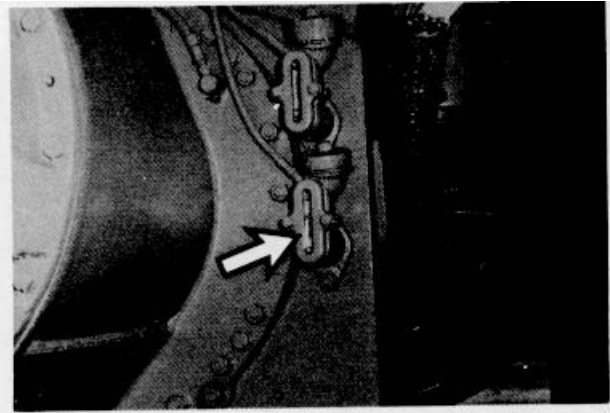
7. To speed filling, add lubricant at the final drives.



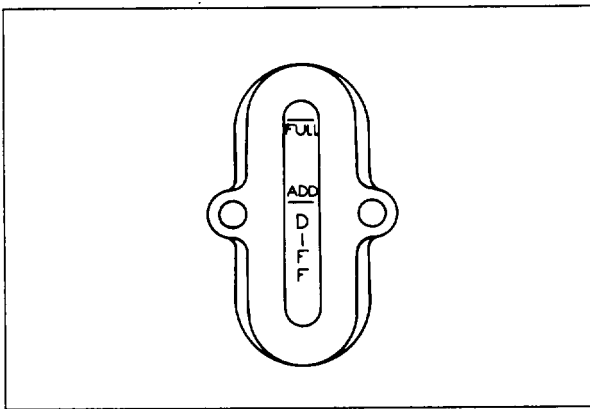
8. Position the wheels with the drain plugs at the bottom. Remove the fill plugs and add lubricant. Fill to the level of the bottom of the fill plug opening.

9. Clean and install the final drive fill plugs and differential fill cap.

Every 2000 Service Hours or Yearly



10. Observe the lubricant level after a few hours of operation.



11. Maintain the level in the area between the ADD and FULL marks on the sight gauge.

(41) Cooling System

Change Coolant

⚠ WARNING

At operating temperature, the engine coolant is hot and under pressure.

Steam can cause personal injury.

Check the coolant level **ONLY** when the engine is stopped and the radiator fill cap is cool enough to touch with your hand.

Remove the fill cap slowly to relieve pressure.

Cooling system conditioner contains alkali. Avoid contact with skin and eyes to prevent personal injury.

CAUTION

All water is corrosive at engine operating temperature. Use coolant conditioner elements to treat either plain water or ethylene glycol solution.

Do not use both the liquid cooling system conditioner and the coolant conditioner element at the same time.

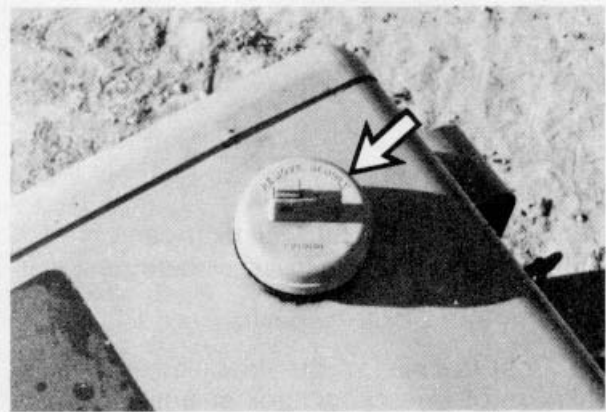
Flush the cooling system if it is contaminated, if the engine overheats, or if contamination is observed in the radiator. See "Cooling System" under "When Required."

When changing antifreeze solution, replace the maintenance conditioner element with the correct precharge element.

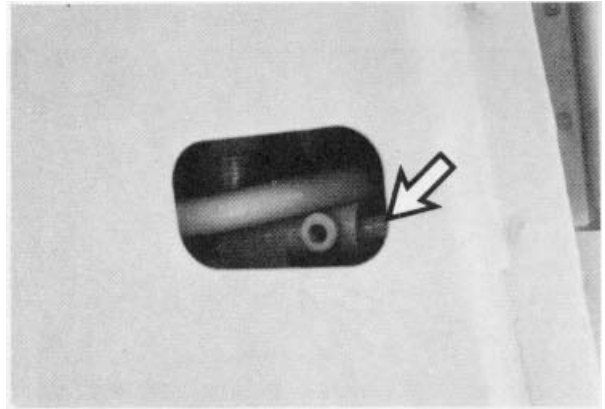
If conditioner elements have been used regularly, the change period for engine coolant can be extended to 4000 Hours or 2 Years.

When fresh engine coolant consisting of either plain water or water and antifreeze is Installed, a precharge element, should be Installed for use until the first normal element change period.

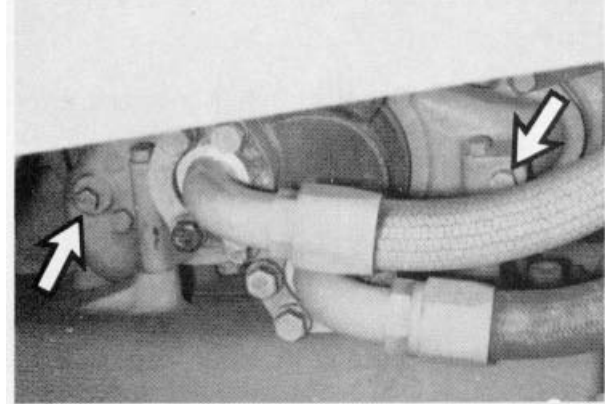
The machine must be level with the bowl lowered, the parking brake applied and the engines stopped.



1. Remove the radiator cap slowly to relieve pressure.

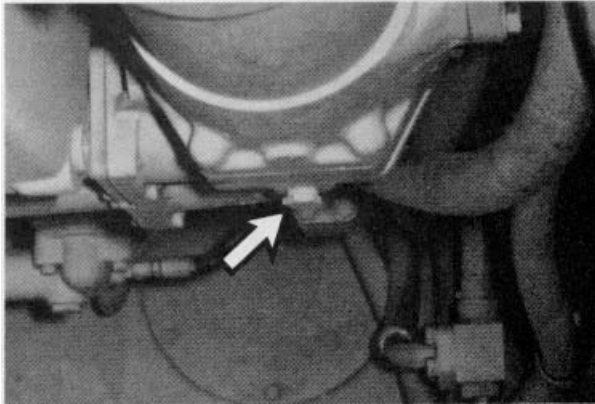


2. Open the drain valve. Allow the coolant to drain.



3. Remove two drain plugs from the engine oil cooler. Allow the coolant to drain.

Every 2000 Service Hours or Year



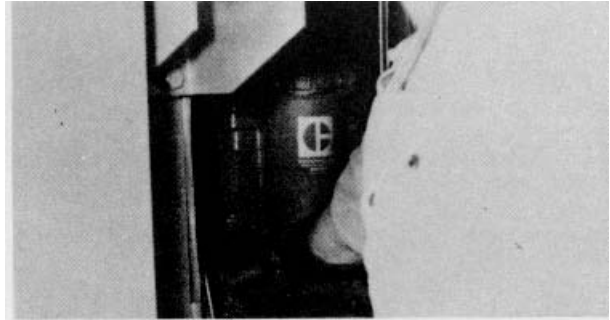
4. Remove the plug from the retarder oil cooler, if equipped. Allow the coolant to drain.
5. Close the drain valve and install all drain plugs.
6. Change the coolant conditioner element. Install a new part number 1W5518 coolant conditioner element. See "To Change Elements."

Filling the Cooling System

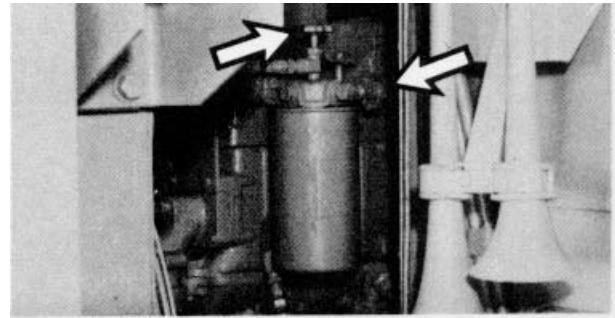
1. Mix antifreeze and fill water to provide protection to the lowest expected outside temperature.
2. To help avoid air locks, add coolant slowly at 20 liters (5 U.S. gallons) per minute or less. See "Refill Capacities."
3. Bring the coolant level to within 1 cm (1/2 inch) of the bottom of the fill pipe.
4. Start and operate the engine with the radiator cap off. Add coolant, if necessary, after the level stabilizes.
5. Clean and inspect the cap. Replace the seal if it is damaged. Install the cap.

To Change Elements

1. Close the inlet valve and the outlet valve at the element base. Turn clockwise to close both valves.



2. Remove the coolant conditioner element. Discard the element.
3. Clean the element mounting base. Make certain all of the old element gasket material is removed.
4. Coat the seal of the new element with a thin film of clean engine oil or antifreeze.
5. Install the element by hand. When the seal contacts the base, tighten it an additional 3/4 turn.

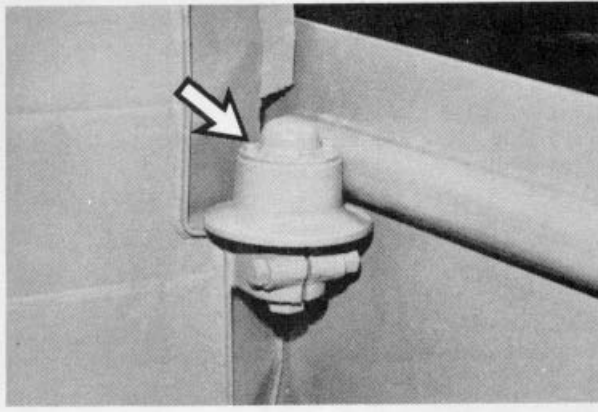


6. Open the inlet valve and the outlet a valve. Start the engine and check for leaks.

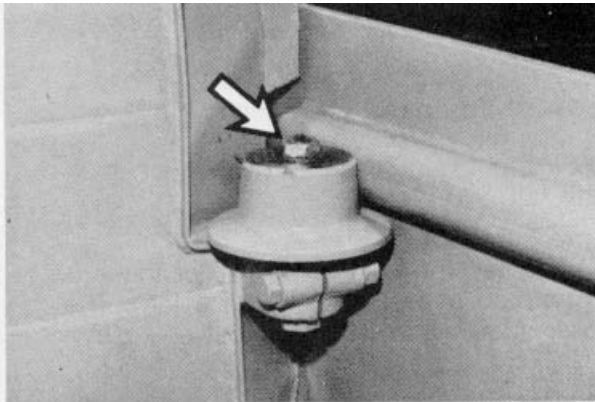
(42) Ejector Guide and Carrier Rollers

Pack Bearings

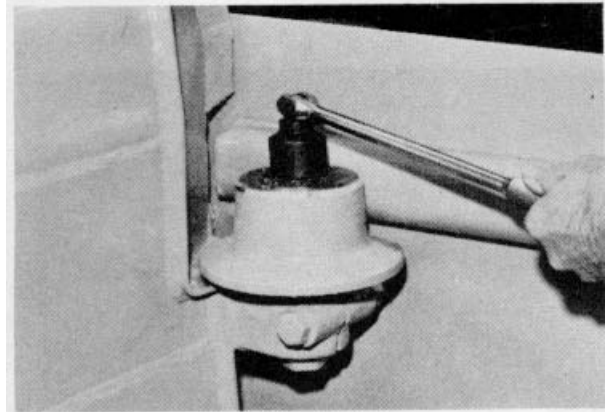
Guide Rollers:



1. Remove four bolts and remove the cap from the roller.



2. Remove the nut, lock, and washer from the shaft.



3. Remove the upper bearing cone from the carrier shaft.

4. Pack the cavity between the bearings with grease. Pack the upper bearing cone thoroughly.

5. Install the upper bearing, washer, lock, and nut.

6. Tighten the nut until the roller locks. Then back the nut off 1/6 of a turn. The roller should turn freely without end play.

7. Crimp the lock against the nut.

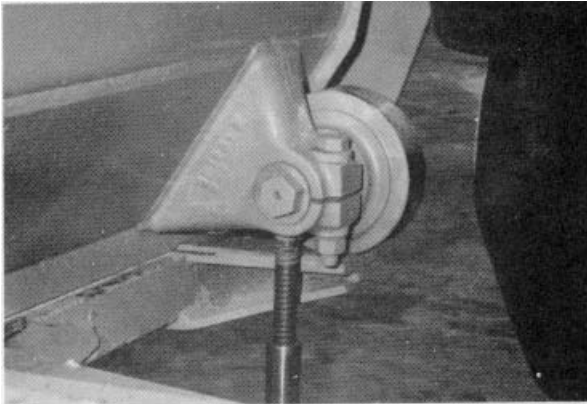
8. Pack the cap with grease and install it.

9. Repeat the procedure for the roller on the opposite side.

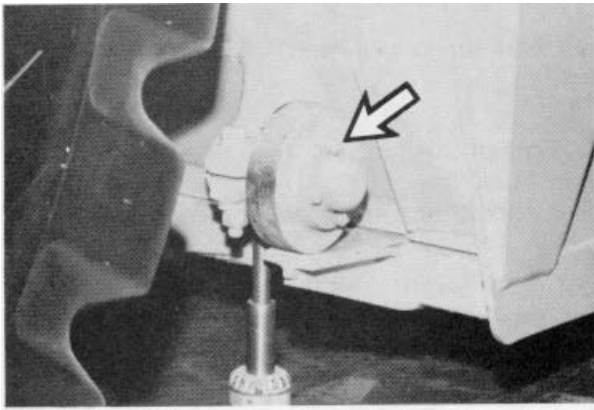
10. Position the guide roller to allow the ejector to operate freely. See "Ejector Guide Rollers" in the "When Required" Section for adjustment.

Every 2000 Service Hours or 1 Year

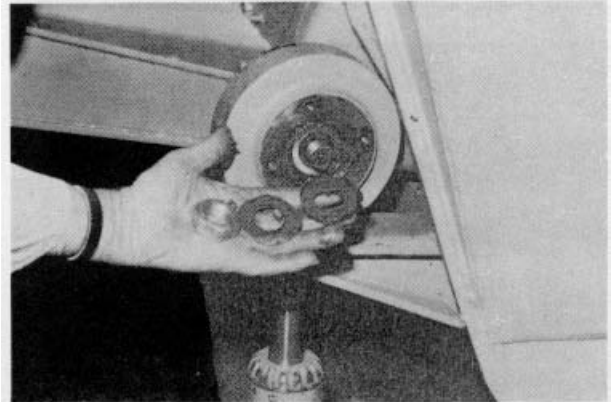
Carrier Rollers:



1. Raise and block the ejector to relieve the weight on a carrier roller.



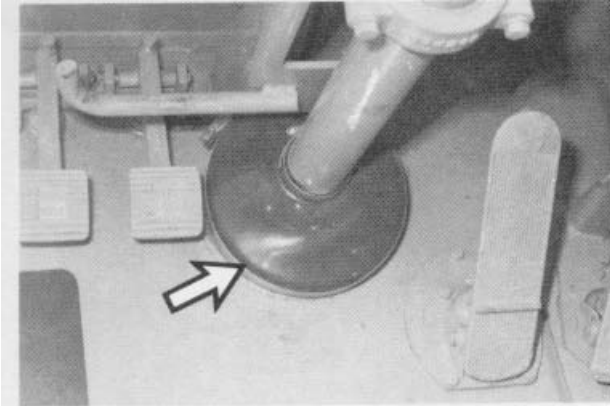
2. Remove four bolts and remove the cap from the roller.



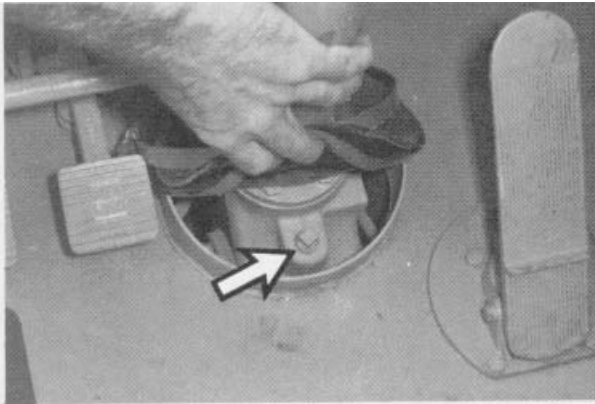
3. Remove the nut, lock and washer from the shaft.
4. Remove the outer bearing cone from the carrier shaft.
5. Pack the cavity between the bearings with grease. Pack the outer bearing cone thoroughly.
6. Install the outer bearing, washer, lock and nut.
7. Tighten the nut until the roller locks. Then back the nut off 1/6 of a turn. The roller should turn freely without end play.
8. Pack the cap with grease and install it.
9. Repeat the procedure for the opposite roller.
10. The ejector should move freely without dragging on the floor of the bowl. Adjust the rollers if necessary. See "Ejector Carrier Rollers" in the "When Required" Section for adjustment.

(43) Steering Gear Sector Housing

Check Oil Level



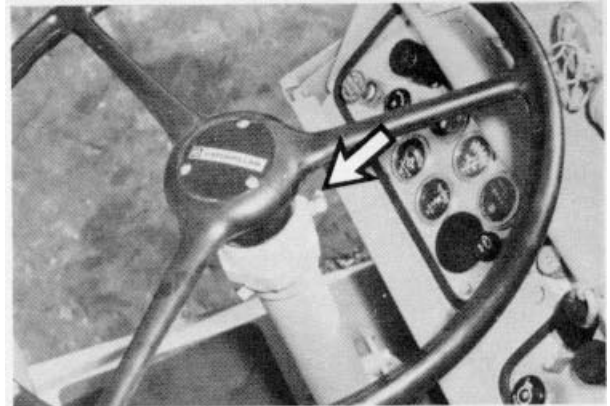
Loosen the clamps and remove the boot at the bottom of the steering column.



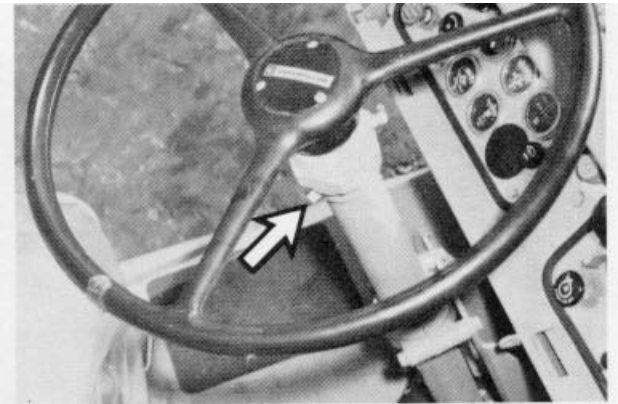
Remove the plug on the housing. Maintain the oil level to the bottom of the plug opening. Install the plug and the boot.

(44) Steering Column Bearings

Lubricate



Lubricate 1 fitting for the upper bearing.

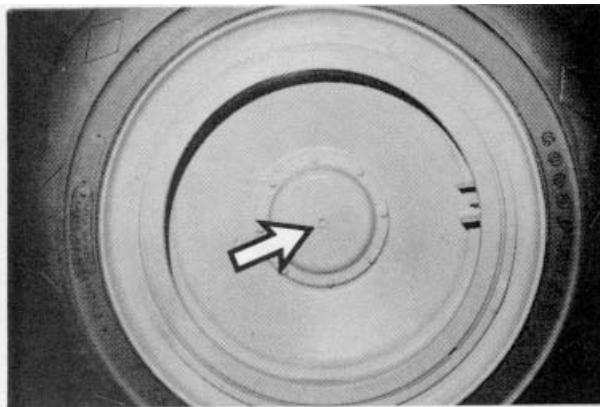


Remove the plug. Lubricate the lower bearing through the plug opening with '2 or 3 squirts of oil. Install the plug.

Every 2000 Service Hours or 1 Year

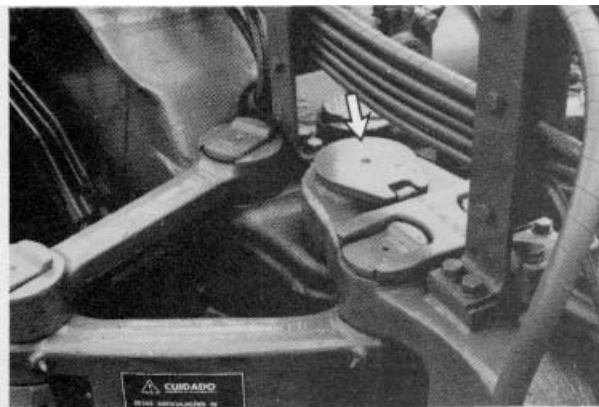
(45) Scraper Wheel Bearings

Check Lubricant Level



Remove the fill plug from each bearing cap. Maintain the lubricant level to the bottom of the plug opening.

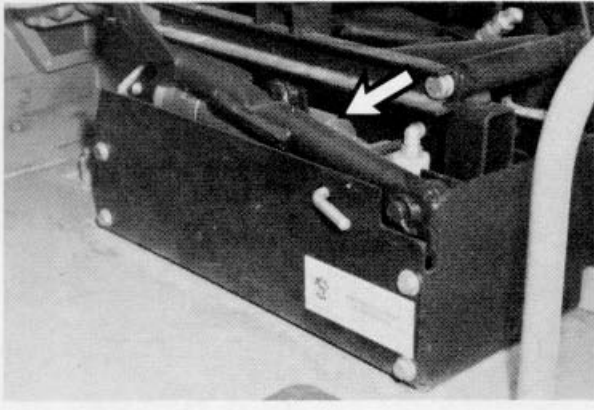
(46) Hitch Pins-Check for Wear



Inspect the kingbolt pins and bearings for wear.



Inspect the horizontal pivot pins and bearings for wear.

(48) Operator's Seat**Check Precharge Pressure**

Check the nitrogen precharge pressure.

Add nitrogen, if necessary. Consult your Caterpillar dealer for the correct checking and filling procedure.

Machines are shipped from the factory with the accumulator not charged. Have it charged before machine operation.

Clean the Screen

1. With the engine stopped, loosen the fitting on the right side of the operator's seat and disconnect the line.
2. Remove the screen.
3. Wash the screen in clean nonflammable solvent. Allow it to dry.
4. Install the screen. Connect the line.

SUPPLEMENTAL OPERATING MAINTENANCE

AND

REPAIR PARTS INSTRUCTIONS

FOR

SCRAPER, SELF PROPELLED, DED,

14 CUBIC YARD

CATERPILLAR MODEL 621B

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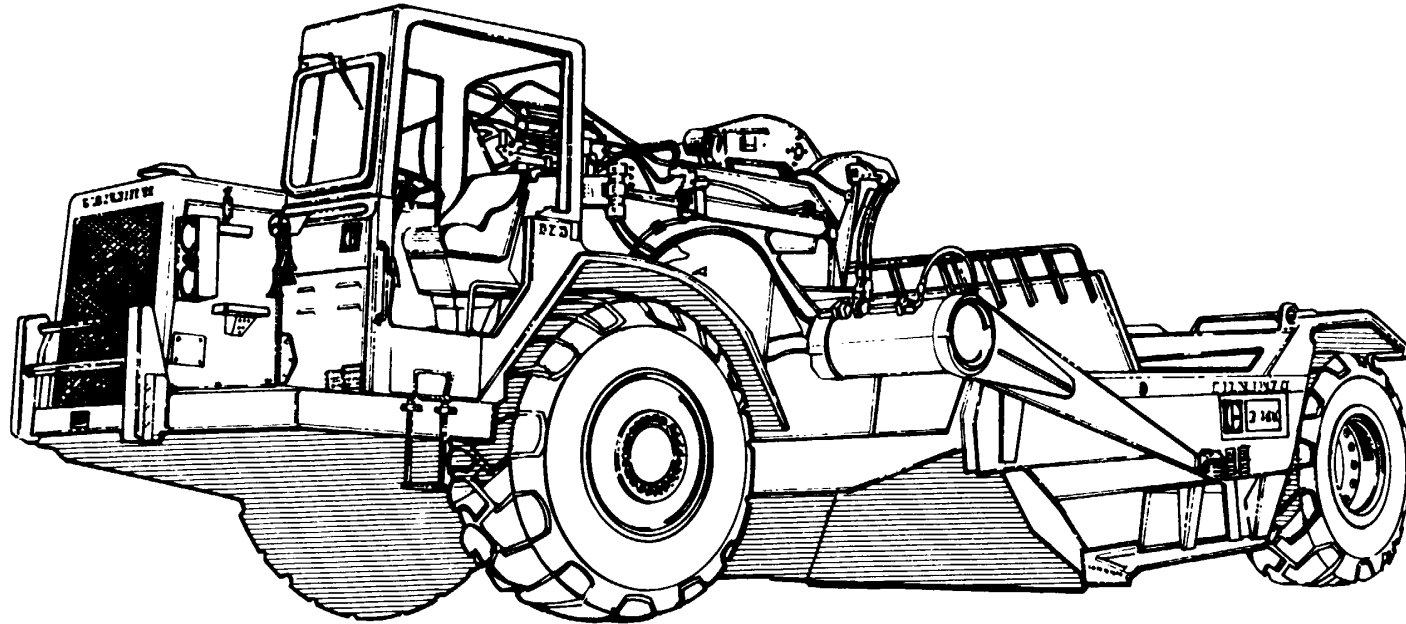
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E		Maintenance and Operating Supply List
F		Lubrication Conversion Symbol Chart
G		Troop Installed Item List
H		ASL/PLL Repair Part Stockage Lists
I		This page left intentionally blank
J		This page left intentionally blank
K		Sample Format, MILSTRIP Requisitions (NSN)
L		Sample Format, MILSTRIP Requisitions (Non-NSN)
M		Sample Format, MILSTRIP Requisitions (Non-NSN) (Manual)
N		Requisition Format, Non-NSN Requisition Format
O		This page left intentionally blank
P		Source Code Index
Q		Manufacturer List of Dealers



CATERPILLAR MODEL 621B NSN 3805-01-153-1854

SECTION I

GENERAL

1. Purpose: To provide user and support personnel Supplemental Maintenance and Repair Parts Instructions that have special application to Commercial Construction Equipment.
2. Scope: This publication applies to Department of the Army Units, organizations/ activities that use and support the Caterpillar Scraper, Self-Propelled, 14 Cubic Yard, Model 621B. The expected life of this scraper is 20 years.
3. Non-Developmental Item: This publication refers to a commercial item of construction equipment that has been approved and is procured and supported by commercial/military publications and repair parts supplied by the military supply system.
4. Description: This scraper is self-propelled, 14 Cubic Yard, Model 621B, and is manufactured by Caterpillar Manufacturing Co. The scraper has double-acting hydraulics for positive cutting edge penetration, apron closure and material ejection. The engine is a model 3406 and provides 246KW/330 HP flywheel power and features automatic fuel injection timing advance for performance at all RPM. The transmission is eight speeds forward. The brakes are air actuated, camoperated with expanding shoes.
5. Publications: Initial publications are commercial manuals and are overpacked with each item. (See Appendix C). Department of the Army publications will be forthcoming and will be available through your normal Department of the Army publications pin point distribution system.
6. Military Load Classification Numbers: The military load classification is to be displayed on the vehicle; 57 empty and 93 with a 24 ton payload.
7. Transportability: The transportability study is not completed. Any transportability data required by the users of this end item may contact the system manager at the US Army Tank-Automotive Command ATTN: AMSTA-NVB, Warren, IMI 48090, AUTOVON 786-8298.
8. Personnel: Military Occupational Specialty (MOS) for this scraper is as follows:
 - a. Tractor Scraper Operator 62E
 - b. Organizational Mechanic 62B
 - c. Direct/General Support Mechanic 62B

9. Training: Currently, training has not been finalized. However, operator, organizational, direct and general support maintenance training will be conducted by New Equipment Training Teams (NETT) as required. Using units and Support Units should make their training requirements known to the Commander, US Army Tank-Automotive Command (TACOM), ATTN: AMSTA-ML, Warren, MI 48090.

10. Warranty Period: 15 months from date of acceptance or 1,500 hours of operation, whichever occurs first. The warranty period for this end item will begin upon its acceptance, or if placed in storage, six months from date of acceptance or when taken out of storage and placed in service, whichever occurs first. Warranty procedures are explained in APPENDIX D.

11. Common Hardware: All common hardware (consisting of cap screws, nut and washers) are grade 8 throughout this scraper. Exceptions to this are indicated in the shop/parts commercial manuals.

SECTION II**MAINTENANCE****12. Maintenance Concept:**

a. Operator: The operator is limited to performing operator/crew preventive maintenance checks and services (See Appendix B1).

b. Organizational Maintenance: Organizational Maintenance consists of scheduled preventive maintenance services, minor repairs and adjustments/tests in accordance with the Maintenance Allocation Chart (See Appendix B2).

c. Direct Support Maintenance: Direct Support Maintenance consists of repairs on-site or in direct support unit's shop. Repairs are accomplished with a minimum of tools and test equipment. Maintenance is performed on a repair-and-return-to-user basis, and organizational maintenance repair parts are supplied to using units.

d. General Support Maintenance: General Support maintenance will repair and return to the supply system designated assembled modules which overflow from or exceed the capability of Direct Support Maintenance.

13. Maintenance Allocation Chart: Maintenance will be performed as necessary by the category indicated in the Maintenance Allocation Chart to retain or restore serviceability. Higher categories will perform the maintenance functions of lower categories when required or directed by the appropriate commanders. Using the support units may exceed their authorized scope and functions in the MAC when approval is granted by the next higher support maintenance commander. The MAC is found in Appendix A.

14. Shipment and Storage: Refer to the manufacturer's operator's instructions and service manuals and the following guidance to ship and store this end item:

a. Transportability Study.

b. TB740-97-2, Preservation of Mechanical Equipment.

c. TB740-90-1, Administrative Storage of Equipment.

15. Destruction to Prevent Enemy Use: Refer to TM750-444-3 for instructions governing destruction of equipment to prevent enemy use.

16. Special Tools and Equipment: This end item is equipped to provide the operator with equipment to air its own tires. These items will be listed in functional group 9129 of the repair parts manual and in Section III of the MAC.

17. Maintenance and Operating Supply List: The list of maintenance and operating supplies is shown as Appendix E.

18. Maintenance Forms and Records: Refer to DA Pamphlet 738-750, the Army Maintenance Management System (TAMMS).

19. Lubrication: The lubrication recommended by the National Maintenance Point is based on operation of the machine for a period not to exceed eight hours per day, five days a week. If a machine is operated in excess of the above time per day or week, lubrication schedules must be adjusted accordingly. A conversion chart of manufacturer's symbols to military symbols is enclosed as enclosure F.

20. Basic Issue Items: There are not Basic Issue Items.

21. Troop Installed Item List: See Appendix G.

22. Quality Deficiency Report (QDR): Reporting of equipment quality related problems, such as new materiel received that is unsatisfactory due to a quality defect/workmanship of materiel. Generally, these are found during inspection or while performing maintenance and repair functions. See DA Pamphlet 738-750.

23. Equipment Improvement Recommendations (EIR): EIRs are used to report/ suggest any improvements that are found to be needed on the equipment. See DA Pamphlet 738-750 for reporting procedures and follow the instructions carefully for prompt action.

24. Fuel System Icing Inhibitor: Fuel system icing inhibitor will be blended into the fuel in amounts not to exceed 0.15 percent by volume. Icing inhibitor will be added only to diesel fuel regular grade DF-2 and below 32° F.

SECTION III**REPAIR PARTS SUPPLY**25. General:

a. The basic policies and procedures in AR710-2 and AR725-50 are generally applicable to repair parts management for this item.

b. Manufacturer's parts manuals are furnished with this item instead of Department of the Army Repair Parts and Special Tools List (RPSTL).

c. National Stock Numbers (NSN) will be assigned to all repair parts expected to be replaced at any maintenance level.

d. Prior to submitting requisitions for repair parts, the Federal Supply Code for Manufacturers (FSCM) and the part number must be edited to identify possible NSNs.

e. Repair parts not immediately available through the Department of Defense Supply System may be locally purchased IAW AR725-50, paragraph 3-29.

26. Prescribed Load/Authorized Stockage List (PLL/ASL) (See Appendix H):

a. The PLL is a 15 day supply of parts recommended for initial stockage at the organizational level of maintenance. Management of PLL items is governed by AR 710-2 and local command procedures. PLL will be on hand at the using organization on receipt of the end item. Selection of PLL parts for overseas is based upon the receiving command's recommendations after review of TACOM prepared list in Appendix H. CONUS commanders receiving this end item will establish stock through normal requisitioning process.

b. The ASL is an estimated 45 days supply of repair parts for support units and activities. ASL will be on hand at the support activity in sufficient time to allow using organizations time to request PLL supply to support this end item. ASL selection for overseas is based upon the support of PLL which was on the receiving command's recommendations. CONUS commanders in support of this item will establish stocks through normal processes.

SECTION III (cont'd)

27. Requisitioning Repair Parts:

a. Using organizations request repair parts using DA Form 2765 Series and will be prepared according to AR 710-2 and local command directives.

b. Support activities will use normal MILSTRIP format (DD Form 1348 Series). The support of NDI equipment will include project codes, (see Appendixes L,M, and N).

28. Submitting requisitions through the Defense Automated Addressing System (DAAS) for NSN parts: DAAS is used to forward support activities MILSTRIP requisitions for NSN parts to the managing supply support activity. Requisitions for part numbered parts will be forwarded through DAAS to the Defense Construction Supply Center (DCSC) (S9C). See Appendix N.

NOTE: When the manufacturer's part number and Federal Supply Code for Manufacturer (FSCM) exceed the space in card columns 8 through 22 of A02/AOB requisitions, prepare an A05/AOE requisition DD Form 1348-6) and mail it to: Commander Defense Construction Supply Center, ATTN: DCSC-OSR, Columbus, OH 43215.

29. Source Codes: are defined on Appendix P.

APPENDIX A
MAINTENANCE ALLOCATION CHART
FOR
SCRAPER, OPEN BOWL, SELF-PROPELLED
CATERPILLAR MODEL 621B

Section I Introduction

1. **General:** This Maintenance Allocation Chart (MAC) designates responsibility for performance of maintenance functions to specific maintenance categories.
2. **Maintenance Functions:** Maintenance functions will be limited to and defined as follows:
 - a. **Inspect:** To determine the serviceability of an item and detect incipient failure by comparing its physical, mechanical and/or electrical characteristics with established standards through examination.
 - b. **Test:** To verify serviceability and detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.
 - c. **Service:** Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.
 - d. **Adjust:** To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.
 - e. **Align:** To adjust specified variable elements of an item to bring about optimum or desired performance.
 - f. **Calibrate:** To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement consists of comparison of two instruments, one which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.
 - g. **Install:** The act of emplacing, seating, or fixing into position an item, part or module (Component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. Replace: The act of substituting a serviceable like-type part, subassembly, or module (component or subassembly) for an unserviceable counterpart.

i. Repair: The application of maintenance services (inspect, test, service, adjust, align, calibrate, or replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul: That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild: Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipment/components.

3. Column Entries: Columns used in the Maintenance Allocation Chart and entries for these columns are explained below:

a. Column 1; Group Number: Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2; Component/Assembly: Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3; Maintenance Functions: Column 3 lists the functions to be formed on the item listed in Column 2.

d. Column 4; Maintenance Category: Column 4 specifies, by the listing of a "work time" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in Column 3. This figure represents the active time required to perform the maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "work time" figures will be shown for each category. The number of man-hours specified by the "work time" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the Maintenance Allocation Chart.

e. Column 5; Tools and Equipment: Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6; Remarks: Column 6 contains an alphabetical code which leads to the remark in Section IV, Remarks, which are pertinent to the item opposite the particular code.

SECTION II. MAINTENANCE ALLOCATION CHART									
GROUP NUMBER (1)	COMPONENT ASSEMBLY (2)	MAINTENANCE FUNCTION (3)	MAINT CAT* (4)					TOOLS & EQUIP (5)	REMARKS (6)
			C	O	F	H	D		
01 0100	ENGINE Engine Assembly: Engine Assembly	Inspect Test Service Adjust Replace Repair Overhaul	0.1 0.3	2.0	1.5 0.5 14.0	40.0	110.0	1	A
0101	Engine Support, Trunnion CRANKCASE, BLOCK, CYLINDER HEAD Cylinder Head Assembly	Inspect Replace	0.1	1.3	2.0			1	
0102	Engine Block, Crankcase CRANKSHAFT: Crankshaft	Repair Overhaul Replace Repair			1.0	2.3 6.0	8.0		
0103	Bearings Seals Pulley & Dampers FLYWHEEL ASSEMBLY: Flywheel Assembly	Replace Replace Replace			0.5 1.3	2.5	1	1	
0104	Housing Flywheel PISTONS, CONNECTING: RODS Connecting Rod Assembly Piston Assembly	Replace Repair Replace Repair				0.9 8.0 2.0 2.0 2.0 3.0		1	

*MAINTENANCE CATEGORIES:

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SECTION II. MAINTENANCE ALLOCATION CHART										
GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINT CAT*					TOOLS & EQUIP	REMARKS	
			C	O	F	H	D			
(1)	(2)	(3)	(4)					(5)	(6)	
0105	VALVES, CAMSHAFTS AND TIMING SYSTEM Valves, Guides, Springs Pushrods, Rocker Arms Rotocoils Covers, Valve Lifters, Valve Bridges Camshaft Bearings, Camshaft Timing Gear Cover Timing Gears & Plate	Replace			6.9				1	B
		Adjust			1.1					
		Repair				0.5				
		Replace			1.4					
		Repair				0.5				
		Inspect			0.1					
		Replace			0.8					
		Replace			1.0					
		Replace			1.2					
		Replace			0.8					
		Adjust			0.3					
		Replace				1.0				
		Repair				6.0				
		Replace				2.0				
		Replace				2.0				
0106	ENGINE LUBRICATION SYSTEM Oil Pump & Relief Valve Oil Filter Oil Filter Base Oil Pan Oil Lines & Fittings Oil Cooler	Replace						1	C	
		Inspect				0.1				
		Replace				0.4				
		Repair				3.1				
		Test				0.9				
		Replace		0.2						
		Replace		1.0						
		Repair			1.1					
		Replace			2.0					
		Repair			1.2					
Inspect	0.1									
Replace		0.7								
Replace			1.5							

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SECTION II. MAINTENANCE ALLOCATION CHART									
GROUP NUMBER (1)	COMPONENT ASSEMBLY (2)	MAINTENANCE FUNCTION (3)	MAINT CAT* (4)					TOOLS & EQUIP (5)	REMARKS (6)
			C	O	F	H	D		
0108	MANIFOLDS: Exhaust	Inspect Replace			0.1 0.5			1	
0109	ACCESSORY DRAWING MECHANISMS: Front Accessory Drive Gp	Replace Repair		0.3	1.2				
03 0301	FUEL SYSTEM FUEL INJECTOR Nozzles, Fuel Injector	Inspect Test Adjust Replace Repair			0.1 0.5 0.3 0.7 1.1			1,2,5	
0302	Lines, Fuel Injection FUEL PUMPS Pump, Fuel Injection	Inspect Test Service Adjust Replace Repair	0.1						
	Automatic Timing Advance Unit Pump, Transfer	Inspect Test Service Adjust Replace Repair	0.1						
0304	Lines and Fittings AIR CLEANER Air Cleaner Assembly Precleaner	Replace Replace Repair Test Replace Service Replace Repair Service Replace Repair		0.1					D
				0.2 0.4 1.1 0.2 0.3 0.8					
					1.2 2.0 3.0				
					0.6 1.0				
							1		

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SECTION II. MAINTENANCE ALLOCATION CHART									
GROUP NUMBER (1)	COMPONENT ASSEMBLY (2)	MAINTENANCE FUNCTION (3)	MAINT CAT* (4)					TOOLS & EQUIP (5)	REMARKS (6)
			C	O	F	H	D		
0305	TURBOCHARGER Turbocharger	Replace			0.7			1	
	After Cooler	Repair				4.0			
		Replace			1.5				
		Repair				3.2			
0306	TANKS, LINES, FITTINGS AND HEADERS Tank, Fuel	Inspect	0.1					1	
		Service	0.3						
		Replace		9.6					
	Lines, Fuel	Repair			6.4				
		Inspect		0.2					E
		Replace		0.7					
0308	ENGINE SPEED GOVERNOR AND CONTROLS Governor Assembly	Adjust			1.0			1	
		Replace			2.0				F
		Repair				8.0			
	Governor Controls	Adjust			0.5				F
		Replace			0.7				
	Air-Fuel Ratio Control	Adjust			0.3				
		Replace			0.3				
	Governor and Fuel Pump Drive	Replace			0.5				
		Repair			1.3				
0309	FUEL FILTERS Fuel Filter, Final	Replace		0.2				1	
	Fuel Filter, Primary	Service		0.1					
		Replace		0.2					
		Repair		1.0					
0311	ENGINE STARTING AIDS Ether Start Group	Service	0.1					1	
		Replace		0.2					
	Fuel Priming Pump	Test	0.1						
		Replace		0.3					

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GROUP NUMBER (1)	COMPONENT ASSEMBLY (2)	MAINTENANCE FUNCTION (3)	MAINT CAT* (4)					TOOLS & EQUIP (5)	REMARKS (6)
			C	O	F	H	D		
04 0401	EXHAUST SYSTEM MUFFLER AND PIPES Muffler and Exhaust Pipe	Inspect Replace	0.1	0.3				1	
05 0501	COOLING SYSTEM RADIATOR Radiator	Inspect Service Test Replace Repair	0.1 0.2		0.3 3.0 12.0			1	
	Radiator Cap Assembly	Inspect Replace Repair	0.1	0.1 0.3					
0502	COWLING, DEFLECTORS AIR DUCTS, SHROUDS, ETC. Radiator Guard	Replace Repair		1.5	1.0			1	
0503	WATER MANIFOLD, HEADERS, THERMOSTATS AND HOUSING GASKET Thermostat	Test Replace Inspect Replace		1.0 0.4				1	
	Hoses, Coolant	Inspect Replace	0.1	0.8					
0504	WATER PUMP Water Pump	Inspect Replace Repair	0.1	1.7	3.0			1	G
0505	FAN ASSEMBLY Fan and Fan Drive	Inspect Replace Repair	0.1		1.0 1.5		1		
	Fan Belts	Inspect Adjust Replace Replace	0.1	0.2 0.8					H
	Fan Pulley	Replace			1.0				

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SECTION II. MAINTENANCE ALLOCATION CHART									
GROUP NUMBER (1)	COMPONENT ASSEMBLY (2)	MAINTENANCE FUNCTION (3)	MAINT CAT* (4)					TOOLS & EQUIP (5)	REMARKS (6)
			C	O	F	H	D		
06 0601	ELECTRICAL SYSTEM GENERATOR, ALTERNATOR Alternator	Test Replace			0.5			1,2,4	I
	Alternator Vee Belt	Repair Inspect	0.1	0.4	4.0				
		Adjust Replace		0.1 0.3					H
0603	STARTING MOTOR Starting Motor	Test Replace			0.2			1,2,4	J
	Starting Control Switch	Repair Test			8.0				
	Starter Solenoid	Test Replace Repair			0.2 0.5				
0607	INSTRUMENT OR ENGINE CONTROL PANEL Switches	Test Replace			8.0			1,2,4	
	Wiring	Inspect Test Replace	0.1	0.2	1.4				
	Gauges, Electrical	Inspect Replace	0.1	1.0					
	Lamps Meters	Test Replace Inspect		0.5 1.6	0.2				
		Test Replace	0.1	0.4 1.8					
0608	MISCELLANEOUS ITEMS Fuses & Fuse Holders	Inspect Replace	0.1	0.2					
	Circuit Breakers	Inspect Replace	0.1	0.2					

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GROUP NUMBER (1)	COMPONENT ASSEMBLY (2)	MAINTENANCE FUNCTION (3)	MAINT CAT* (4)					TOOLS & EQUIP (5)	REMARKS (6)
			C	O	F	H	D		
0609	LIGHTS Headlamp, Flood-Lamp, Tail Lights, Etc	Inspect Replace	0.1	0.2					1
0610	SENDING UNITS AND WARNING SWITCHES Oil & Water Temp Senders	Inspect Replace		0.1 0.2					1
0611	Low Air Warning Pressure Switch Replace	Inspect Replace		0.1 0.2					
0612	HORN: Back-up Alarm	Replace		1.4				1,4	
0612	BATTERIES, STORAGE Battery Service	Inspect Service	0.1 0.2						
	Box, Battery	Test Replace		0.4 0.7					
		Service Replace Repair	0.2	1.0 2.0					
	Cable, Battery	Inspect Service Replace Repair	0.1 0.2	0.3 0.5					
0613	HULL OR CHASSIS WIRING HARNESS Harness, Tractor	Inspect Test Replace Repair		0.2 1.0 4.2 1.0				1,4	
	Harness, Scraper	Inspect Test Replace Repair		0.2 1.0 3.5 1.0					
0615	RADIO INTERFERENCE SUPPRESION Capacitor	Replace		0.3					

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GROUP NUMBER (1)	COMPONENT ASSEMBLY (2)	MAINTENANCE FUNCTION (3)	MAINT CAT* (4)					TOOLS & EQUIP (5)	REMARKS (6)
			C	O	F	H	D		
07 0705	TRANSMISSION TRANSMISSION SHIFTING COMPONENTS Hydraulic Controls	Test Adjust Replace Repair		1.0 1.5 3.5		2.5			1,2
	Control Linkage and Arms, Shift Lever, Pedals, Etc	Adjust Replace Repair		1.1 2.1		2.2			
0708	TORQUE CONVERTOR Torque Convertor Repair	Replace					6.0 4.0		1,2,3
0710	TRANSMISSION ASSEMBLY AND ASSOCIATED PARTS Transmission	Inspect Service Test Adjust Replace Repair Overhaul	0.1	0.3	1.5 0.5 7.0		16. 36.0		
0719	REDUCTION OR TRANSFER GEARS SHAFTS AND BEARINGS Transfer Gears	Replace Repair					1.0 8.0		1,2
0721	COOLER, PUMPS, MOTORS Oil Pump, Scavenge Replace Repair	Test Replace Repair					0.5 1.0 1.5		1,2,3
	Oil Pump, Transmission Replace Repair	Test Replace Repair					0.5 1.1 1.7		
	Oil Pump, Differential Replace Repair	Test Replace Repair					0.5 1.0 1.5		
	Oil Filter Replace	Service Replace		0.3 0.5					
	Magnetic Screen Replace	Service		0.3 0.5					

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GROUP NUMBER (1)	COMPONENT ASSEMBLY (2)	MAINTENANCE FUNCTION (3)	MAINT CAT* (4)					TOOLS & EQUIP (5)	REMARKS (6)
			C	O	F	H	D		
0726	Oil Cooler, Transmission	Replace		1.5					1,2,3
	Transmission Oil Cooler Lines	Inspect		0.1					
	Replace		0.5						
	BRAKES (SPECIAL)								
	Hydraulic Retarder	Replace			6.0				
		Repair				4.0			
	Oil Cooler, Brake	Replace		1.5					
	Brake Oil Cooler Lines	Inspect		0.1					
		Replace		0.5					
	Retarder Oil Lines	Inspect		0.2					
	Replace		0.5						
	Hand Air Valve	Replace		0.5					
		Repair		0.8					
	Air Lines & Fittings	Inspect		0.1					
		Replace		0.4					
	Brake Control Valve	Replace		1.0					
		Repair		1.5					
	Regulator, Air Pressure	Replace		0.5					
09	PROPELLER, PROPELLER SHAFTS, UNIVERSAL JOINTS, COUPLER AND CLAMP ASSEMBLY							1	
0900	PROPELLER SHAFTS Drive Shaft	Replace			3.0				
		Repair			1.5				
10	FRONT AXLE							1	
1000	FRONT AXLE Axle	Replace			0.8				
		Repair			1.0				
	Axle Housing	Replace			1.1				
	Repair				1.5				
1002	DIFFERENTIAL Differential and Bevel Gear	Service	0.2					1	
		Adjust				2.0			
		Replace			1.5				
		Repair				6.0			

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SECTION II. MAINTENANCE ALLOCATION CHART									
GROUP NUMBER (1)	COMPONENT ASSEMBLY (2)	MAINTENANCE FUNCTION (3)	MAINT CAT* (4)					TOOLS & EQUIP (5)	REMARKS (6)
			C	O	F	H	D		
1003	Breather PLANETARY OR FINAL DRIVE Final Drives	Service		0.3					
		Service	0.2					1	
		Replace			2.5				
		Repair				4.0			
11	REAR AXLE								
1100	REAR AXLE ASSEMBLY Axle Housing	Replace			1.1			1	
		Repair				4.0			
12	BRAKES								
1201	HAND BRAKES Valve, Park & Emergency	Inspect	0.1					1	
		Replace		0.2					
	Hose and Fittings	Inspect	0.1						
	Replace			0.2					
1202	SERVICE BRAKES Shoe Assembly	Replace		0.8				1	
	Repair			1.1					
	Brake Camshafts and Slack Adjusters	Adjust			0.5				
	Repair	Replace		1.2					
	Brake Linings	Inspect		1.8					
		Replace		0.4					
		Replace		3.0					
1206	MECHANICAL BRAKE SYSTEM Brake Pedal	Replace		0.4				1	
	Transmission Hold and Differential Lock Pedals	Adjust		0.2					
1208	AIR BRAKE SYSTEM Brake Actuator	Replace		0.4				1	
		Replace		2.1					
		Repair		3.0					
	Air Tanks	Inspect	0.1						
		Service	0.2						
		Replace		2.1					
	Brake Control Valve	Replace		2.2					
	Repair				2.0				

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SECTION II. MAINTENANCE ALLOCATION CHART										
GROUP NUMBER (1)	COMPONENT ASSEMBLY (2)	MAINTENANCE FUNCTION (3)	MAINT CAT* (4)					TOOLS & EQUIP (5)	REMARKS (6)	
			C	O	F	H	D			
1209	Quick Release Valve Double Check Valve Horn Valve Low Air Brake Warning Horn	Replace		1.1						
		Replace		1.4						
		Replace		1.0						
		Test	0.1							
		Replace		1.0						
	Air Regulator Emergency Reservoir	Replace		1.0						
		Inspect		0.2						
		Replace		1.5						
	Lines and Fittings	Inspect		0.1						
		Replace		1.1						
	Air Dryer	Service		0.2						
		Replace		0.7						
	AIR COMPRESSOR ASSEMBLY	Air Compressor	Repair			2.0			1	
			Inspect	0.1						L
13	Governor, Air Compressor	Service	0.2							
		Replace		1.0						
		Repair			3.0					
		Overhaul				8.0				
		Adjust		0.3						
1311	WHEELS AND TRACKS WHEEL ASSEMBLY	Replace		1.2						
		Inspect	0.1							
		Replace		1.1						
1313	WHEELS AND TRACKS WHEEL ASSEMBLY	Wheels		0.2						
		Inspect		1.0						
		Replace		1.0						
		Adjust		1.0						
		Replace		1.1						
1313	TIRES, TUBES, TIRE CHAINS	Wheel Bearings & Seals		1.1						
		Brake Drums		0.1						
		Inspect		1.0						
1313	TIRES, TUBES, TIRE CHAINS	Replace		1.0						
		Repair		3.0						
1313	TIRES, TUBES, TIRE CHAINS	Tires		0.1						
		Inspect	0.1						M	
		Service	0.2							

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SECTION II. MAINTENANCE ALLOCATION CHART									
GROUP NUMBER (1)	COMPONENT ASSEMBLY (2)	MAINTENANCE FUNCTION (3)	MAINT CAT* (4)					TOOLS & EQUIP (5)	REMARKS (6)
			C	O	F	H	D		
14 1401	Tires (cont'd)	Replace		3.0					
		Repair			1.0				
1410	STEERING MECHANICAL STEERING GEAR ASSEMBLY Steering Gear	Service		0.2				1	
		Adjust		0.3					
	Replace			4.5					
	Repair			5.0					
1410	Steering Wheel Steering Link Assemblies	Replace		0.6				1,2,3	
		Adjust		0.3					
	Replace		3.0						
	Repair			1.0					
1411	HYDRAULIC PUMP OR FLUID MOTOR ASSEMBLY Supplemental Steering Pump and Valve	Inspect		0.2				1,2,3	
		Test			0.5				
	Adjust			0.2					
	Replace		1.0						
1412	HOSES, LINES, FITTINGS	Repair			4.0			1	
		Inspect		0.2					
1412	HYDRAULIC OR AIR CYLINDERS Steering Cylinders	Replace		0.5				1,2,3	
		Repair		1.4					
	Test		3.0						
	Replace		0.5						
	Repair		4.2						
	Test		3.0						
Cylinder, Follow-Up (Receiver)	Test		0.5						
	Replace		3.0						
Cylinder, Follow-Up (Receiver)	Test		0.5						
	Replace		0.6						
	Repair		2.0						

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SECTION II. MAINTENANCE ALLOCATION CHART									
GROUP NUMBER (1)	COMPONENT ASSEMBLY (2)	MAINTENANCE FUNCTION (3)	MAINT CAT* (4)					TOOLS & EQUIP (5)	REMARKS (6)
			C	O	F	H	D		
1413 1	TANKS, RESERVOIRS Hydraulic Tank	Inspect Replace		0.2	9.6				
	Oil Filter	Repair Inspect			4.0				
1414	STEER SYSTEM VALVES Steering Control Valve	Service Replace		0.1 0.2				1, 2, 3	
	Pressure Reducing Valve	Replace Repair		0.3	1.0				
15	FRAME, TOWING ATTACHMENTS, DRAWBARS AND ARTICULATED	Inspect Test Replace Repair		0.1 0.5 2.4					
1503 1503	PINTLES AND TOWING SYSTEMS PINTLES AND TOWING ATTACH- MENTS	Separate			6.0			1, 2	
	Articulation System Connect King Bolt Bearings (Hitch)	Service Replace	0.1		10.0				
	Hitch Link Bearings	Service	0.2		0.5				
18	BODY, CAB, HOOD & HULL	Replace			0.5			1, 6	
1801	BODY, CAB, HOOD & HULL ASSEMBLIES Cab, ROPS	Inspect Service Replace	0.1	0.3 3.5					
	Hood	Inspect Replace	0.1		0.5				
	Door	Repair Inspect Replace Repair	0.1	1.0 0.5	1.0				

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GROUP NUMBER (1)	COMPONENT ASSEMBLY (2)	MAINTENANCE FUNCTION (3)	MAINT CAT* (4)					TOOLS & EQUIP (5)	REMARKS (6)
			C	O	F	H	D		
1802	Engine Compartment Shield	Inspect	0.1						
		Replace		0.7					
		Repair			1.0				
	Crankcase Guards	Inspect	0.1						
		Replace		2.0					
1805	FENDERS, WINDSHIELD, GLASS, ETC. Fenders	Inspect	0.1						
		Replace		0.8					
		Repair		0.5					
	Windshield	Inspect	0.1						
		Replace		1.0					
1806	Cab Window	Inspect	0.1						
		Replace		1.0					
		Repair		1.0					
	FLOORS Floor, Plates, Etc	Inspect	0.1						
		Replace		0.7					
1806	UPHOLSTERY SEATS Seat	Inspect	0.1						
		Replace		1.2					
		Repair			0.8				
	Seat Belts	Inspect	0.1						
		Replace		0.5					
	Seat Suspension	Adjust		0.5					
		Replace		1.2					
		Repair			1.0				
	Seat Cylinder	Replace		0.5					
	Seat Accumulator	Service		0.2					
1806	Ride Control Valve	Replace		0.5					
		Adjust		0.2					
	Linkage	Replace		0.5					
		Adjust		0.2					
	Replace		0.5						

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GROUP NUMBER (1)	COMPONENT ASSEMBLY (2)	MAINTENANCE FUNCTION (3)	MAINT CAT* (4)					TOOLS & EQUIP (5)	REMARKS (6)
			C	O	F	H	D		
1808	TOOL BOX, STOWAGE BOX, STOWAGE RACK, ETC								
22	Stowage Compartment	Service	0.1						
2202	BODY, CHASSIS AND HULL ACCESSORY ITEMS								
	ACCESSORY ITEMS								
	Mirror Assemblies			0.3					
	Windshield Wiper & Washer	Service	0.1						
	Air Horns	Replace		1.0					
	Horn Switch	Replace		1.0					
2207	WINTERIZATION EQUIPMENT	Replace		0.5					
	Heater	Inspect	0.1						
		Replace		2.4					
		Repair			1.5				
2208	DATA PLATES & INSTRUCTION HOLDERS								
	Data Plates	Inspect	0.1						
		Replace		0.2					
24	HYDRAULIC & FLUID SYSTEMS								
2400	SCRAPER HYDRAULIC SYSTEM								1,2
	Systems Operation	Test	0.2						
2401	PUMP AND FMOTOR								1,3
	Implement Hydraulic Pump	Test			0.5				
	Replace				1.0				
	Repair				2.1				
2402	MANIFOLD AND/OR CONTROL VALVES								1,2,3
	Control Valve, Scraper	Test			0.2				
		Replace			3.8				
		Repair			1.9				
	Quick Drop Valve (Bowl)	Test			0.2				
		Replace			1.1				
		Repair			1.5				
	Sequence Valve (Apron)	Test			0.2				
		Replace			1.5				
		Repair			1.2				

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SECTION II. MAINTENANCE ALLOCATION CHART									
(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQUIPMENT REFERENCE CODE	(6) REMARKS
			C	O	F	H	D		
2403	HYDRAULIC CONTROLS AND/OR MANUAL CONTROLS Control Levers and Linkage	Adjust Replace Repair		1.2	2.1 2.2			1,3	
2406	STRAINERS, FILTERS, LINES AND FITTINGS Filter Elements Strainers Lines and Fittings	Replace Service Inspect Replace	0.1	0.4 0.2 1.0					
2407	HYDRAULIC CYLINDERS Bowl Lift Cylinder Apron Cylinder Ejector Cylinder	Test Replace Repair Test Replace Repair Test Replace Repair		0.3 2.2 0.4 3.5 0.2 4.5	2.2 3.0 4.0			1, 2, 3	
2408	LIQUID TANKS OR RESERVOIRS Hydraulic Tank	Inspect Service Replace Repair	0.1 0.3	4.0	4.0				
47	GAUGES (NON-ELECTRICAL), WEIGHING AND MEASURING DEVICES								
4701	INSTRUMENTS (SPEED AND DISTANCE:) Tachometer Tachometer Drive Cable	Replace Replace		0.5 1.0					
4702	GAUGES, MOUNTINGS, LINES AND FITTINGS Oil Pressure Gauge	Inspect Replace	0.1	0.5					
*MAINTENANCE CATEGORIES: C - OPERATOR/CREW F - DIRECT SUPPORT D - DEPOT O - ORGANIZATIONAL H - GENERAL SUPPORT									

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SECTION II. MAINTENANCE ALLOCATION CHART									
(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQUIPMENT REFERENCE CODE	(6) REMARKS
			C	O	F	H	D		
4703	HOURMETER Hourmeter Assembly	Inspect Replace	0.1	0.6				1	
74	EARTHMOVING EQUIP- MENT COMPONENTS								
7448	BOWL AND DISCHARGE COMPONENTS								
	Bowl Assembly	Replace Repair				8.0 4.0			
	Ejector	Replace Repair				4.0 2.0			
	Cutting Edges	Inspect Replace	0.1	2.0					
	Apron Assembly	Replace Repair				3.0 1, 5			
*MAINTENANCE CATEGORIES: C - OPERATOR/CREW F - DIRECT SUPPORT D - DEPOT O - ORGANIZATIONAL H - GENERAL SUPPORT									

**Maintenance Allocation Chart
FOR**

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOL OR TEST EQUIPMENT REFERENCE CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER	FSCM
	UNLESS OTHERWISE NOTED, ALL MAINTENANCE FUNCTIONS CAN BE ACCOMPLISHED WITH TOOLS CONTAINED IN THE FOLLOWING COMMON TOOL SETS:				
1	O, F, H	Shop Equip Contact Maint, Trk Mtd SC4940-95-CL-B04	4940-00-294-9518	T10138	
1	O, F, H	Shop Equip Org Repair Light Trk Mtd SC4940-95-CL-B03	4940-00-294-9516	T13152	
1	O, F, H	Tool Kit Automotive Maint, Org Maint Common # 1 SC4910-95-CL-A74	4910-00-754-0654	W32593	
1	O, F, H,	General Mechanic's Auto Tool Kit SC5180-90-CL-N26	5180-00-177-7033	W33004	
1	O, F, H	Tool Kit Automotive Maint, Org Maint Common #2 SC4910-95-CL-A72	4910-00-754-0650	W32730	
1	O, F, H	Shop Equip Auto Maint & Rpr, Org Maint Suppl # 1 SC4910-95-CL-A73	4910-00-754-0653	W32867	
1	O, F, H	Shop Equip Weld Field Maint SC3470-95-CL-A08	3470-00-357-7268	T16714	
1	O, F, H	Wrench Torque:3/4" Drive, 500 Lb Cap.	5120-00-542-5577	Y84966	
2	F, H	Shop Equip Gen Purp Repair, Semitr Mtd SC4940-95-CL-B02	4940-00-287-4894	T10549	

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**Maintenance Allocation Chart
FOR**

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOL OR TEST EQUIPMENT REFERENCE CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER	FSCM
2	F, H	Tool Kit Automotive Fuel & Elec. Sys Repair SC4910-95-CL-A50	5180-00-754-0655	W32456	
2	F, H	Wrench Set, 3/4" Drive Hex Type	5130-00-351-5135	Y75239	
2	F, H	Tool Kit, Master Mechanic: Equip Maint & Repair SC5180-95-CL-N05	5180-00-699-5273	W45060	
2	F, H	Shop Set Fuel & Elec. Sys: Field Maint, Basic, Less Power SC4910-95-CL-A01	4910-00-754-0714	T30414	
2	F, H	Shop Set, Fuel & Elec. Sys: Field Maint, Supply #2 Less Power SC4910-95-CL-A65	4910-00-390-7275	T30688	
2	F, H	Shop Equip: Machine Shop, Field Maint, Basic, Less Power SC3470-95-CL-A02	3470-00-754-0708	T15644	
2	F, H	Tool Outfit Hyd Sys Test & Repair, 3/4 Ton Trlr Mtd SC4940-95-CL-B07	4940-01-036-5784	T30377	
2	F, H	Shop Equip: Machine Shop, Shelter Mtd SC4940-95-CL-A62	4940-00-209-6238	T15655	

**Maintenance Allocation Chart
FOR**

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOL OR TEST EQUIPMENT REFERENCE CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER	FSCM
2	F, H	Measuring & Layout Tool Set, Machine List's SC5280-95-CL-A02	5820-00-511-1950	W44512	
3	F, H	Pressure Checking Kit	4910-00-792-8304	3005456	24076
4	F, H	Multimeter AN/USM-223	6625-00-999-7465	M80242	
5	F, H	Test Set, Diesel Injector SC4910-IL	4910-00-317-8265	V73742	
6	F, H	Wrench, Torque 2, 500 lb-ft, Model PD2501	5120-00-482-2543	Y81747	

APPENDIX A

SECTION IV, MAINTENANCE ALLOCATION CHART

FOR

	REMARKS
A	Test includes operation and compression.
B	Valve Clearance - engine stopped. Exhaust - .027-.033 in. (0.69-0.84mm) Intake - .012-.018 in (0.30-0.46mm)
C	Oil Pressure Test: with the engine running at 2100 RPM and the oil temperature at 200+100F (93+6 C), pressure measured at rear of the oil manifold will be 60psi (415kPa).
D	Fuel Pressure Test: at starting RPM, minimum fuel pressure must be 5psi (35kPa). If less, change the fuel filter element. At full load speed the outlet pressure must be 30psi (205kPa). If lower than 20psi (140kPa), install a new fuel filter element. In both tests if fuel pressure is still low, install a new fuel transfer pump.
E	Replace time includes remove and install hydraulic tank.
F	A mechanic with training in governor adjustments is the only one authorize(to make adjustments to the low idle and high idle RPM.
G	Water pump repair kit is available.
H	Correct adjustment allows 9/16 to 13/16 in (14-20mm) deflection midway between pulleys.
I	Alternator repair kits are available.
J	Starter motor repair kits are available.
K	Brake actuator repair kits are available.
L	Air compressor repair kits are available.
M	Do not mount or demount tires without proper training.

APPENDIX B**PART 1
OPERATOR/CREW
PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)****GENERAL**

Every mission begins and ends with the paperwork. There isn't much of it, but you have to keep it up. The forms and records you fill out have several uses. They are a permanent record of the services, repairs, and modifications made on your vehicle. They are reports to organizational maintenance and to your commander. And they are a checklist for you when you want to know what is wrong with the vehicle after its last use, and whether those faults have been fixed. For the information you need on forms and records, see DA PAM 738-750.

OPERATOR/CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES.

1. Do your before (B) PREVENTIVE MAINTENANCE just before you operate the vehicle. Pay attention to the CAUTIONS and WARNINGS.
2. DURING (D) checks and services of PREVENTIVE MAINTENANCE will be performed while the equipment and/or its component systems are in operation. Pay attention to the CAUTIONS and WARNINGS.
3. Do your after (A) PREVENTIVE MAINTENANCE right after operating the vehicle. Pay attention to the CAUTIONS and WARNINGS.
4. Do your weekly (W) PREVENTIVE MAINTENANCE weekly.
5. Do your monthly (M) PREVENTIVE MAINTENANCE once a month.
6. If something doesn't work, troubleshoot it with the instructions in this manual or notify your supervisor.
7. Always do your PREVENTIVE MAINTENANCE in the same order so it gets to be a habit. Once you've had some practice, you'll spot anything wrong in a hurry.
8. When you do your PREVENTIVE MAINTENANCE, take along a rag or two.
9. While performing PMCS observe caution notes and warning paragraphs preceding those operations which could endanger your safety or result in damage to the equipment.

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in well ventilated area. Avoid contact with skin, eyes and clothes and don't breathe vapors. Do not use near open flame or excessive heat. If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with skin or clothing is made, flush with water. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

10. If anything looks wrong and you can't fix it, write it on your DA Form 2404. The number column is the source for the numbers used on the TM Number Column on DA Form 2404. If you find something seriously wrong, report it to organizational maintenance RIGHT NOW.

a. Keep it clean: Dirt, grease, oil and debris only get in the way and may cover up a serious problem. Clean as you work and as needed. Use water when you clean rubber or plastic material.

b. Bolts, nuts and screws: Check that they are not loose, missing, bent or broken. You can't try them all with a tool, of course, but look for chipped paint, bare metal or rust around bolt heads. Tighten Any that you find loose. Report it to organizational maintenance if you can't tighten it.

c. Welds: Look for loose or chipped paint, rust or gaps where parts are welded together. If you find a bad weld, report it to organizational maintenance.

d. Electric wires and connectors: Look for cracked or broken insulation, bare wires and loose or broken connectors. Report damaged or loose wiring to organizational maintenance.

e. Hoses and fluid lines: Look for wear, damage and leaks. Make sure clamps and fittings are tight. Wet spots show leaks, of course, but a stain around a fitting or connector can mean a leak. If a leak comes from a loose fitting or connector, tighten it. If something is broken or worn out report it to organizational maintenance (refer to Maintenance Allocation Chart).

11. It is necessary for you to know how fluid leaks affect the status of your equipment. The following are definitions of the types/classes of leakage you need to know to be able to determine the status of your equipment. Learn and be familiar with them and REMEMBER - When in doubt, notify your supervisor.

LEAKAGE DEFINITIONS FOR OPERATOR/CREW PMCS

- Class I Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
- Class II Leakage of fluid great enough to form drops, but not enough to cause drops to drip from the item being checked/inspected.
- Class III Leakage of fluid great enough to form drops that fall from the item being check/inspected.

CAUTION

Equipment operation is allowable with minor leakages (Class I or II). Of course, consideration must be given to the fluid capacity in the item/system being checked/inspected. When operating with Class I or II leaks, continue to check fluid levels as required on your PMCS. Class III leaks should be reported to your supervisor or Organizational Maintenance.

OPERATOR/CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES

B - BEFORE D - DURING A - AFTER W - WEEKLY M - MONTHLY

ITEM NO	INTERVAL					ITEM TO BE INSPECTED PROCEDURE:CHECK FOR AND HAVE REPAIRED, FILLED, OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/AVAILABLE IF:
	B	D	A	W	M		
1	X					<p style="text-align: center;"><u>IMPORTANT</u></p> <p>Perform daily PMCS if: 1. You are the assigned operator. 2. You are the assistant operator.</p> <p style="text-align: center;"><u>WARNING</u></p> <p>For personal safety before PMCS insure the machine is on level ground. Insure that all equipment is lowered to the ground. Move the transmission control to neutral and engage the lock. Engage the parking brake.</p> <p>Exterior walk around checks.</p> <p><u>ROLLOVER PROTECTION STRUCTURE (ROPS)</u></p> <p>a. Check for bent, cracked or damaged structure</p> <p>b. Check for loose mounting bolts</p> <p><u>HITCH</u> Check castings and stops for damage.</p> <p><u>FLOODLIGHT</u> Check for damage (broken lens)</p>	<p>cracked or damaged structure</p> <p>Loose bolts</p> <p>Damaged castings or stops.</p>
2	X						
3	X						

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OPERATOR/CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES

B - BEFORE D - DURING A - AFTER W - WEEKLY M - MONTHLY

ITEM NO	INTERVAL					ITEM TO BE INSPECTED PROCEDURE:CHECK FOR AND HAVE REPAIRED, FILLED, OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/AVAILABLE IF:
	B	D	A	W	M		
4	X X					<u>CUTTING EDGES</u> a. Check for broken or damaged cutting edges b. Check for excessive wear, when the cutting edges reach the moldboard	Broken edges Cutting edge is worn to approximately one inch, cutting edge is worn near the moldboard.
5	X X					<u>EJECTOR</u> a. Check for damaged or distorted ejector b. Ejectors should operate freely	Damaged or distorted Not operating freely
6	X					<u>TAIL AND BLACKOUT LIGHTS REAR</u> Check for damaged tail and blackout lights	
7		X				<u>BACKUP ALARM</u> Check to be sure that the alarm sound level is set on high <p style="text-align: center;"><u>WARNING</u></p> <p style="text-align: center;">Improperly inflated tires can cause excessive heat buildup resulting in blowouts causing personal injury or death.</p>	

OPERATOR/CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES

B - BEFORE D - DURING A - AFTER W - WEEKLY M - MONTHLY

ITEM NO	INTERVAL					ITEM TO BE INSPECTED PROCEDURE:CHECK FOR AND HAVE REPAIRED, FILLED, OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/AVAILABLE IF:
	B	D	A	W	M		
8	X					<p align="center"><u>CAUTION</u></p> <p align="center">Over inflated or under inflated tires can cause excessive or uneven tire wear or rim damage.</p> <p><u>TIRES</u></p> <ul style="list-style-type: none"> a. Check tires for cuts, gouges, nails or other foreign objects. b. Check for missing valve caps. c. Check for proper inflation pressure. Tire pressure should be 60 PSI for the tractor and 40 PSI for the scraper. 	Damage which could cause tire failure during operation.
9	X					<p><u>WHEELS</u></p> <ul style="list-style-type: none"> a. Check wheel flanges for bends or other irregularities. b. Check for loose or missing lug nuts 	Lug nuts loose or missing
10	X					<p><u>DIFFERENTIAL OIL LEVEL</u></p> <p>Maintain oil level between ADD and FULL marks on the sight gage.</p>	
11	X					<p><u>HYDRAULIC TANK</u></p> <p>Maintain the oil level between the ADD and FULL marks on the sight glass.</p>	

OPERATOR/CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES							
B - BEFORE D - DURING A - AFTER W - WEEKLY M - MONTHLY							
ITEM NO	INTERVAL					ITEM TO BE INSPECTED PROCEDURE:CHECK FOR AND HAVE REPAIRED, FILLED, OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/AVAILABLE IF:
	B	D	A	W	M		
12				X		<p align="center"><u>WARNING</u></p> <p>Batteries give off flammable fumes that can explode. Electrolyte is an acid and can cause personal injury if it contacts skin or eyes. Do not smoke when observing battery electrolyte levels.</p> <p>Always wear protective glasses when working with batteries.</p> <p align="center"><u>CAUTION</u></p> <p>In cold weather operation, charge batteries immediately after adding water. Water must combine with the electrolyte by means of charging. Delay in charging can result in freezing water. Be careful not to overfill when servicing batteries.</p> <p><u>BATTERIES</u></p> <ul style="list-style-type: none"> a. Maintain electrolyte levels to full ring. b. Check for secure terminal connections c. Check battery hold downs for security. 	Battery missing or un-serviceable.

OPERATOR/CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES

B - BEFORE D - DURING A - AFTER W - WEEKLY M - MONTHLY

ITEM NO	INTERVAL					ITEM TO BE INSPECTED PROCEDURE:CHECK FOR AND HAVE REPAIRED, FILLED, OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/AVAILABLE IF:
	B	D	A	W	M		
13	X					<u>FUEL TANK SEDIMENT VALVE</u> Open valve, drain all moisture and sediment from fuel tank. Close valve securely.	Red is visable.
14						<u>HEADLIGHTS, FLOODLIGHTS AND BLACKOUT DRIVE</u> Check for damaged lights.	
15	X X					<u>AIR CLEANER/PRECLEANER</u> Ref: Daily check in manufacturer's manual, page 3-358. a. Check and clean precleaner screen. b. Check air indicator on air cleaner for red indication.	
<p style="text-align: center;"><u>WARNING</u></p> <p style="text-align: center;">The cooling system is pressurized. Personal injury may result when removing the radiator cap after operating temperature is reached. If it becomes necessary to check the coolant level during operation, use proper protection when removing the radiator cap.</p>							

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OPERATOR/CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES

B - BEFORE D - DURING A - AFTER W - WEEKLY M - MONTHLY

ITEM NO	INTERVAL					ITEM TO BE INSPECTED PROCEDURE:CHECK FOR AND HAVE REPAIRED, FILLED, OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/AVAILABLE IF:
	B	D	A	W	M		
16				X		<u>RADIATOR</u> a. Check radiator for leaks and any visable damage. b. Check hoses and clamps for security. c. Maintain coolant level to within one half inch of bottom of fill pipe.	Damage, or Class III leaks. Loose hoses or clamps or Class III leaks.
17	X			X		<u>ENGINE OIL LEVEL</u> The level should be in area indicated on the engine stopped side of the dip stick. Maintain oil level between the L and F marks on the dipstick.	
18	X		X			<u>TRACTOR/SCRAPER AIR RESERVOIRS</u> a. Check reservoirs valve and insure it is closed. b. Open air reservoirs valves.	
19	X					<u>OPERATORS SEAT/SEAT BELTS</u> Check operation of seat and seat belts. Operator must be able to reach all hand operated/foot operated controls START THE ENGINE:	Inoperative seat or seat belt, or missing seat belt.

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OPERATOR/CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES							
B - BEFORE D - DURING A - AFTER W - WEEKLY M - MONTHLY							
ITEM NO	INTERVAL					ITEM TO BE INSPECTED PROCEDURE:CHECK FOR AND HAVE REPAIRED, FILLED, OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/AVAILABLE IF:
	B	D	A	W	M		
20		X				<u>WARNING SYSTEMS</u> Check for low air pressure busser operation and light on panel. Check backup alarm when placing transmission in reverse.	Busser or light not operable. No alarm
21		X				<u>INDICATORS AND GAUGES</u> a. Tachometer: Check for normal operating range of 1200-2200 RPM (Green) b. Converter/retarder temperature gauge: normal range is green. c. Engine coolant temperature gauge: Normal range is green d. Air pressure gauge: Normal range is in the green e. Engine Oil pressure gauge: Normal is white range at low idle, green range at operating speed. f. Ammeter: should read zero soon after engine starts.	Not in green Not in green Not in green Not in green Not in normal range.
22		X				<u>TRANSMISSION OIL LEVEL</u> While the engine is at low idle: check the transmission oil level. Maintain oil level.	

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OPERATOR/CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES

B - BEFORE D - DURING A - AFTER W - WEEKLY M - MONTHLY

ITEM NO	INTERVAL					ITEM TO BE INSPECTED PROCEDURE:CHECK FOR AND HAVE REPAIRED, FILLED, OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/AVAILABLE IF:
	B	D	A	W	M		
23		X				<p><u>OPERATIONAL CONTROLS</u></p> <p>a. Check for proper steering</p> <p style="text-align: center;"><u>WARNING</u></p> <p>When the vehicle moves during the brake test, reduce the engine speed immediately, and apply the parking brake.</p> <p>b. Check service brakes: with air pressure at 100PSI or in green range on the gauge, apply the service brakes Raise the bowl, release the emergency brake, place transmission in second speed and increase engine RPM. The brakes should prevent movement at 1500 ⁺ 100 engine RPM.</p> <p>c. Emergency Brake: with engine running, apply parking brakes Place transmission in second speed, release the service brakes. Increase engine RPM. The brake should hold at 1000 [±] 100 RPM.</p> <p>d. Bowl Control: raise, lower, drop, hold, float, close and open the apron. Move the ejector forward and return detent.</p>	<p>Will not steer or have erratic operation.</p> <p>Brakes do not hold vehicle with engine speed lower than 1400 RPM.</p> <p>Brake will not hold vehicle with engine speed lower than 900 RPM.</p> <p>Any one function not operational.</p>

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APPENDIX B

PART 2

**ORGANIZATIONAL
PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)**

GENERAL

To make sure that your vehicle is ready for operation at all times, inspect it systematically so you can discover any defects and have them corrected before they result in serious damage or failure. The charts on the next few pages contain your organizational PMCS. The item numbers indicate the sequence of minimum inspection requirements. If you're operating the vehicle and notice something wrong which could damage the equipment if you continue operation, stop operation immediately.

Record all deficiencies and shortcomings, along with the corrective action taken, on DA Form 2404. The Item Number column is the source for the numbers used on the TM Number column on DA Form 2404.

ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

1. The item numbers of the table indicate the sequence of the PMCS. Perform at the intervals shown below:
 - (a) Do your (Q) PREVENTIVE MAINTENANCE quarterly (every three months).
 - (b) Do your (S) PREVENTIVE MAINTENANCE semiannually (every six months).
 - (c) Do your (A) PREVENTIVE MAINTENANCE annually (once every year).
 - (d) Do your (B) PREVENTIVE MAINTENANCE biannually (once every two years).
 - (e) Do your (H) PREVENTIVE MAINTENANCE at the hour interval listed.
 - (f) Do your (MI) PREVENTIVE MAINTENANCE at the mile interval listed.
2. If something doesn't work, troubleshoot it with the instructions in this manual or notify your supervisor.
3. Always do your preventive maintenance in the same order, so it gets to be a habit. Once you've had some practice, you'll spot anything wrong in a hurry.
4. If anything looks wrong and you can't fix it, write it down on your DA Form 2404. If you find something seriously wrong, report it to direct support as soon as possible.

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in well ventilated area. Avoid contact with skin, eyes and clothes and don't breathe vapors. Do not use near open flame or excessive heat. If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with skin or clothing is made, flush with water. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

(a) Keep it clean: Dirt, grease, oil and debris only get in the way and may cover up a serious problem. Clean as you work and as needed. Use dry cleaning solvent (P-D-680) to clean metal surfaces. Use soap and water when you clean rubber or plastic material.

(b) Bolts, nuts and screws: Check that they are not loose, missing, bent or broken. You can't try them all with a tool, of course, but look for chipped paint, bare metal or rust around bolt heads. Tighten any that you find loose.

(c) Welds: Look for loose or chipped paint, rust or gaps where parts are welded together. If you find a bad weld, report it to direct support.

(d) Electric wires and connectors: Look for cracked or broken insulation, bare wires and loose or broken connectors. Tighten loose or broken connectors. Tighten loose connections and make sure the wires are in good condition.

(e) Hoses and fluid lines: Look for wear, damage and leaks. Make sure clamps and fittings are tight. Wet spots show leaks, of course, but a stain around a fitting or connector can mean a leak. If a leak comes from a loose fitting or connector, tighten it. If something is broken or worn out, either correct it or report it to direct support (refer to MAC Chart).

5. It is necessary for you to know how fluid leaks affect the status of your equipment. The following are definitions of the types/classes of leakage you need to know to be able to determine the status of your equipment. Learn and be familiar with them and REMEMBER, when in doubt, notify your supervisor.

LEAKAGE DEFINITIONS FOR ORGANIZATIONAL PMCS

Class I	Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
Class II	Leakage of fluid great enough to form drops, but not enough to cause drops to drip from the item being checked/inspected.
Class III	Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

Q - QUARTERLY S - SEMIANNUALLY A - ANNUALLY B - BIENNIALLY H - HOURS M - MILES

ITEM NO	INTERVAL						ITEM TO BE INSPECTED PROCEDURE: CHECK FOR AND HAVE REPAIRED, FILLED, OR ADJUSTED AS NEEDED <u>PERFORM ALL OPERATOR PMCS FIRST</u>
	Q	S	A	B	H	M	
							<p>Perform operator/crew PMCS prior to or in conjunction with organizational PMCS if:</p> <ul style="list-style-type: none"> a. There is a delay between the daily operation of equipment and the organizational PMCS. b. Regular operator is not assisting/participating. <p style="text-align: center;">NOTE</p> <p>For Army Oil Analysis Program (AOAP), refer to TB 43-0210. The AOAP laboratory recommendation to change oil and filter will apply: However oil and filter changes will not exceed the change interval (calendar, miles or hours) established by the manufacturer during the warranty period.</p> <p>The AOAP sampling interval for the hydraulic system is scheduled to be published in the next change to TB 43-0210, Appendix F.</p>

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ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

Q - QUARTERLY S - SEMIANNUALLY A - ANNUALLY B - BIENNIALLY H - HOURS M - MILES

ITEM NO	INTERVAL						ITEM TO BE INSPECTED PROCEDURE: CHECK FOR AND HAVE REPAIRED, FILLED, OR ADJUSTED AS NEEDED <u>PERFORM ALL OPERATOR PMCS FIRST</u>
	Q	S	A	B	H	M	
1					250		<p>WARNING</p> <p>Explosions of air inflated earthmoving tires have resulted from heat induced gas combustion inside the tires. The heat generated by welding or heating rim components, external fire or excessive use of brakes can cause gaseous combustion. A tire explosion is much more violent than a blowout. The explosion can propel the tire rim and final drive components as far as 460M (1500 feet) or more from the machine. Both the force of the explosion and the flying debris can cause personal injury or death and property damage. All personnel should be aware of this danger and the actions to take to minimize the risk. Reference: Operators Manual, page five.</p> <p>WARNING</p> <p>Proper air inflation equipment and training in its use are necessary to avoid possible over-inflation. A tire blowout or rim failure can result from improper or misused equipment.</p> <p>TIRES</p> <p>Check and service. Reference: Manufacturer's Manual page 3-332. Operators Manual page five. Proper inflation pressure is 60 psi for the tractor or 40 psi for the scraper. Reference: TM 9-2610-200-20.</p>
2					250		<p><u>FAN ASSEMBLY</u></p> <p>Fan/alternator belts; check and adjust. Reference: Manufacturer's Manual page 3-374. Apply a 25 lb. force midway on belt. Deflect should be 14-20 mm or 9/16-13/16 inch.</p>

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ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

Q - QUARTERLY S - SEMIANNUALLY A - ANNUALLY B - BIENNIALLY H - HOURS M - MILES

ITEM NO	INTERVAL						ITEM TO BE INSPECTED PROCEDURE: CHECK FOR AND HAVE REPAIRED, FILLED, OR ADJUSTED AS NEEDED <u>PERFORM ALL OPERATOR PMCS FIRST</u>
	Q	S	A	B	H	M	
3					250		<p><u>WARNING</u> Never disconnect any charging unit circuit or battery circuit cable from battery when the charging unit is operated. A spark can cause an explosion from the flammable vapor mixture of hydrogen and oxygen that is released from the electrolyte through the battery outlets. Injury to personnel can be the result.</p> <p><u>BATTERIES</u> Check and preform battery. Reference: Manufacturer's Manual page 1-72. TM 9-6140-200-14.</p>
4					250		<p><u>HEAD LAMPS, TAIL LAMPS, BLACKOUT LIGHTS, FLOODLIGHTS</u> Inspect for operation.</p>
5					250		<p><u>HYDRAULIC CONTROL VALVES</u> Inspect valves and linkages. Look for bent levers and control arms and worn bushings. Reference: Manufacturer's Manual page 3-233.</p>
6					250		<p><u>CARRIER ROLLERS</u> Adjust and service. Reference: Manufacturer's Manual page 3-349 and page 3-363.</p>
7					250		<p><u>WARNING</u> Block the bowl and apron when performing maintenance in the bowl area. Support the cutting edges before removing the mounting bolts.</p> <p><u>EJECTOR, DRAFT AINS, GOOSENECK/CROSSTUBE FRAME</u> Check for damage or distortion. The clearance between the draft arm wear plates and bowl side must not exceed .25 inch, total, for both sides.</p>

STA FORM 667
1 NOV 83

ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

Q - QUARTERLY S - SEMIANNUALLY A - ANNUALLY B - BIENNIALLY H - HOURS M - MILES

ITEM NO	INTERVAL						ITEM TO BE INSPECTED PROCEDURE: CHECK FOR AND HAVE REPAIRED, FILLED, OR ADJUSTED AS NEEDED <u>PERFORM ALL OPERATOR PMCS FIRST</u>
	Q	S	A	B	H	M	
8					500		<p align="center"><u>WARNING</u></p> <p>Hot oil can cause burns.</p> <p>At operating temperature, the hydraulic tank is hot and under pressure.</p> <p>Remove the fill cap ONLY when the engine is stopped and the cap is cool enough to touch with your hand. Remove the fill cap slowly to relieve pressure.</p> <p><u>HYDRAULIC TANK</u></p> <p>Inspect and service tank for leaks, broken fittings, cracked welds, or missing parts. Replenish fluid level if needed. Take oil sample. Reference: TB 43-0210, Oil Analysis Program.</p>
9					500		<p><u>TRANSMISSION</u></p> <p>Take oil sample. Reference: TB 43-0210, Oil Analysis Program.</p> <p align="center"><u>WARNING</u></p> <p>The cooling system is pressurized. Personal injury may result when removing the radiator cap after operating temperature is reached. If it becomes necessary to check the coolant level during operation, use proper protection when removing the radiator cap.</p>
10				500			<p><u>COOLING SYSTEM</u></p> <p>Check and replace; thermostat or antifreeze, if required. Reference: Manufacturer's Manual page 3-357 and page 1-14. Reference: TB 750-651.</p>

STA FORM 667
1 NOV

ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

Q - QUARTERLY S - SEMIANNUALLY A - ANNUALLY B - BIENNIALY H - HOURS M - MILES

ITEM NO	INTERVAL						ITEM TO BE INSPECTED PROCEDURE: CHECK FOR AND HAVE REPAIRED, FILLED, OR ADJUSTED AS NEEDED <u>PERFORM ALL OPERATOR PMCS FIRST</u>
	Q	S	A	B	H	M	
11							<u>ENGINE, OIL</u> Take oil sample. Reference TB 43-0210, Oil Analysis Program.
12					500		<u>CYLINDERS, STEERING/BOWL/APRON AND EJECTORS</u> Test cylinders for worn piston seals. Reference: Manufacturer's Manual page 3-64 and page 3-96.
13					2000		<u>ROPS</u> Retorque bolts to 740+ 25 N-M (545+ 20 lb ft).

STA FORM 667
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APPENDIX C

PUBLICATIONS

DA EQUIPMENT PUBLICATIONS		
NOMENCLATURE	EQUIPMENT PUBLICATION	DATE AVAILABLE
Operator's Manual	TM 5-3805-248-10	Mar 1985
ORG, DS/GS Maint Manual	TM 5-3810-248-24	Mar 1985
Repair Parts & Special Tools List	TM5-3810-248-24P	Mar 1985
OTHER THAN OFFICIAL DA EQUIPMENT PUBLICATIONS		
NOMENCLATURE	EQUIPMENT PUBLICATION	LOCATION AND SOURCE
Operation	Operator's Manual OPTECH SEBU5459-01 Safety Handbook CIMA GEG02130	Overpack with each Scraper DCSC DCSC
Organizational Maintenance	Shop Manual MAINT SEBU5749	Overpack with each Scraper DCSC
Direct & General	Shop Manual S.I. SMHS6721 S.I. SMHS7867	Overpack with each Scraper DCSC
Repair Parts	Parts Manual PTSBK SEBP1266 PTSBK UEG080S	Overpack with each Scraper DCSC

For additional information regarding ordering of publications, see continuation.

APPENDIX C

PUBLICATIONS

Additional commercial manuals may be obtained by requisitioning from Defense Construction Supply Center (DCSC). Requests should be submitted the same as a repair part, using the Federal Supply Code for Manufacturers (FSCM) and manual number listed above. If requesting by mail, send request to Commander, Defense Construction Supply Center, ATTN: DCSC-OSR, Columbus, OH 43215.

APPENDIX D

WARRANTY GUIDELINES

1. A warranty period of 15 months or 1500 hours, whichever occurs first, applies to the scraper, self propelled, 14 cu yd Model 621B, manufactured by Caterpillar Equipment Co., after delivery to the Government. This warranty applies to the end item, components and all supplies furnished under the contract.

2. Overseas using units in addition to following the implementation of warranty procedures on pages 54 and 55 must do the following: Mail DA Form 2407 to the Maintenance Directorate, TACOM, at the following address: US Army Tank-Automotive Command, ATTN: AMSTA-MVB, Warren, MI 48090. To expedite actions you may call the information to AUTOVON 786-8298, with the information from your DA 2407, section 1, block 1 through 11, blocks 16, 17, 18 and 20.

3. General information:

a. DA Form 2407 (prepared in accordance with warranty claim action in DA Pam 738-750) will be used to submit warranty claims actions for end items when components, parts or assemblies are defective and are covered by a manufacturer's warranty. End items under warranty are identified by a decal plate and/or warranty statement included in the operator's and maintenance manual for the end item. All warranty actions settled or unsettled will be reported to the National Maintenance Point (NMP) on DA Form 2407. For warranties settled locally, the DA Form 2407 will contain a statement "For Information Only" in block 35.

b. Maintenance activities in support of organizational maintenance are the responsible points of contact between the originator of warranty claims and the National Maintenance Point (NMP) (US Army Tank-Automotive Command, ATTN: AMSTAMVB, AUTOVON 786-8298, Warren, MI 48090) which serves as the DA Representative with the contractor in warranty matters.

NOTE: In certain instances, the originating organization and the support activity are one and the same.

c. Before you take your equipment to a dealer for repair whether or not it was necessary for you to go through the NMP (TACOM), check with your local procurement office to see if a funds commitment document is needed. Sometimes, even though the majority of the repairs are covered by the warranty, there may be a small charge for normal maintenance costs, i.e., oil filters, oil, etc. Further, the cause of damage could be determined by the dealer to be directly related to "operator abuse". In that case, the Government may be obligated to pay for teardown services even if the repairs are no longer desired, or for the completed cost if repairs are to be completed by the dealer.

d. When the equipment is given to the dealer for repairs, find out how long the work will take, the extent of the problem, if possible, and the charges, if any, which may be involved. Leave the name and telephone number of the person to be contacted for pickup of the equipment and specifically state that he should be telephoned if unexpected problems, costs, and/or delays are encountered. Get the name and telephone number of the Service Manager, for any required follow-up purposes. A list of dealers is provided in Appendix Q.

e. When you arrive to pick up your equipment after completion of services, make certain that you know exactly what repairs were performed and/or parts replaced. This is required for overall problem trend evaluation by the NMP and must be identified upon completion of warranty services.

f. Telephone the NMP at TACOM, AUTOVON 786-8298, if:

(1) Your equipment required repairs and you cannot obtain these services using the procedures listed above.

(2) The length of time required for repairs may seriously hamper your mission, or if the dealer's overall response to your requirement is not satisfactory.

(3) You have any questions regarding warranty procedures - either in general or about a specific job. Do not wait until your problems become critical.

g. Do not attempt to conduct negotiations regarding a breach of warranty. This is a function of the Contracting Officer, through the NMP at TACOM.

APPENDIX D**EQUIPMENT WARRANTY**

a. The contractor shall warrant that all end items, parts, and accessories delivered under this contract are free from defects in design, material and workmanship and will conform with the specifications and all other requirements of the contract for a period of 15 months from date of acceptance or for 1500 hours of operation (whichever occurs first). Such warranty period will commence on the date of acceptance of each vehicle as shown on the Material Inspection and Receiving Report (DD Form 250). However, if the government, prior to placing vehicles in storage, the contractor agrees that the time period of the warranty will not begin to run for the stored vehicles until each vehicle is withdrawn from storage or until six months from date of acceptance, whichever occurs first. The government must identify and inform the contractor when any vehicles are placed in storage and when they are withdrawn.

b. With respect to defective end items, parts and accessories, the warranty shall include replacing, at no cost to the government, parts that proves to be defective within the warranty period. The contractor provided representatives, in West Germany and South Korea, will coordinate resolution of all warranty claims reported with those locations. (See page 55, paragraphs 4a and 4b). Replacement parts furnished to the government for continental US (CONUS), under provisions of the warranty will be delivered to the military location where the defective vehicles is /are located. On all government owned vehicles shipped outside CONUS, the contractor's liability regarding warranty is limited to furnishing replacement parts F. O. B. CONUS port of debarkation for those parts which prove to be defective in material or workmanship.

c. It is the government's option of returning the vehicle(s) or defective parts to the contractor's facility for correction(s), or the problem can be corrected by the government. With respect to the defective parts, when the government elects to correct them itself, the cost of labor involved in correction of the defects will be borne by the contractor. If the government elects to have warranty repairs or replacement performed by the contractor, the government shall deliver the vehicle to the contractor's dealer facility for corrective repair or replacement.

d. If any breach of the warranty is suspected, contact this command, AMSTA-MVE, AUTOVON 786-7349 or 786-7383.

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IMPLEMENTATION OF WARRANTY

The following procedures will be followed to implement the warranty requirements.

Procedures for Warranty Corrections:

1. CONUS - Repair Through Caterpillar Dealer: Caterpillar Defense Service will send warranty authorization to local Caterpillar Dealers as vehicles are shipped to the field. The dealer will provide parts and labor to repair warrantable failures on vehicles returned to the dealer by the using unit. The dealer will submit claims to Caterpillar for the cost of these warranty repairs. U.S. Caterpillar dealers are listed in Appendix Q. Caterpillar Defense Service, Peoria, IL should be contacted for authorization and direction to the correct dealer prior to warranty corrections.

2. CONUS - Warranty Repairs by Army.

- A. User determines parts required for warranty correction. Caterpillar Defense Service, Peoria, IL may be contacted for technical guidance.
- B. Authorized individual in the supporting Army Direct Support or General Support unit or other Army representative would contact Caterpillar Defense Service, Peoria, IL, by phone, (309) 675-6962, 6963, 6964 or through mail, to request replacement for defective parts. The Army contact will provide the following details:
 - (1) Unit serial number, hours of operation, etc.
 - (2) Part number of part responsible for failure.
 - (3) Brief details on method of operation, and other relevant information on failure (including description of failed parts).
 - (4) Part numbers of parts required for warranty correction and address where parts should be shipped.

C. In most situations Caterpillar Defense Service will order the replacements immediately for direct no charge shipment to the user. Collect return shipment of damaged parts for inspection may be requested occasionally.

D. Claims for Army warranty labor would be directed through Army channels to Caterpillar Defense Service.

3. OCONUS - Except For Germany And Korea. Same as CONUS (paragraph 2) except overseas Army support unit would contact stateside government control point with list of parts needed and the information requested in paragraph 2 (B1-4). The stateside control point would contact Caterpillar Defense Service with details to be provided in paragraph 2 (B1-4) and Caterpillar Tractor Company would ship warranty replacement parts to designated CONUS port of embarkation.

4. OCONUS - Korea And Germany. Same as CONUS (paragraph 2) except Army support units in Germany or Korea would contact the designated Caterpillar representative listed below with a list of the parts needed and the information requested in paragraph 2 (B1-4). The overseas Caterpillar representative would evaluate the request and forward valid requests to Defense Service, Peoria, IL. Defense Service would ship warranty replacement parts to port of embarkation.

A. German: Zeppelin-Metallwerke GmbH
Mainzer Strasse 55
6520 WORMS am RHEIN
Phone: (624) 6961/69

B. Korea: Hae Nin Tractor Company Ltd.
Hae Nin Building, 2d Floor,
31, 1-Ka, Jangchung-Dong
Chung-Ku, Seoul
Mail Address; Central P.O. Box 1201
Phone: 272-9131/8

APPENDIX E

MAINTENANCE AND OPERATING SUPPLY LIST

NOMENCLATURE: Scraper, Self-Propelled		MAKE: Caterpillar			MODEL: 621B	
MFR PART NO:		NSN: 3805-01-153-1854		SERIAL NO RANGE: TO		DATE:
(1) COMPONENT APPLICATION	(2) MFR PART NO OR NAT'L STOCK NO.	(3) DESCRIPTION	(4) QTY REQ F/INITIAL OPN	(5) QTY REQ F/8 HRS OPN	(6) NOTES	
Oil Sampling	8125-01-082-9697	Bottle, Sampling				
Oil Sampling	6515-00-727-0008	Syringe				
Oil Sampling	4720-00-580-6055	Tubing, 3/8 inch Diameter				
Oil Sampling	8105-00-290-0340	Sack, Shipping				
Oil Sampling	8105-00-837-7754	Bag, Plastic				
Air Precleaner	7920-00-148-9666	Rags, 50 pound Bale			As required	

APPENDIX E

Hydraulic Oil Fluid (SAE)

Military (OE/HDO)

<u>Specification</u>	<u>Range</u>	<u>Wt.</u>	<u>Container</u>	<u>NSN</u>
MIL-L-2104C	-13°F to 95°F	10	qt.	9150-00-189-6727
			5 Gal.	9150-00-186-6668
			55 Gal.	9150-00-191-2772
	140°F & above	30	qt.	9150-00-186-6681
			5 Gal.	9150-00-188-9858
			55 Gal.	9150-00-188-9859

Oil Engine Lubrication (CD)

Military (OE/HDO)

<u>Specification</u>	<u>Range</u>	<u>Wt.</u>	<u>Container</u>	<u>NSN</u>
MIL-L-2104	-13°F to 95°F	10	qt.	9150-00-189-6727
			5 Gal.	9150-00-186-6668
			55 Gal.	9150-00-191-2772
	14°F & above	30	qt.	9150-00-186-6681
			5 Gal.	9150-00-188-9858
			55 Gal.	9150-00-188-9859
MIL-L-46167	-13°F & below		qt.	9150-00-402-4478
			5 Gal.	9150-00-402-2372
			55 Gal.	9150-00-491-7197

APPENDIX E

Cooling System Treatment

<u>Specification</u>	<u>Container</u>	<u>NSN</u>
Antifreeze, Engine Cooling System MIL-A-46153B used 32°F to -40°F	1 Gal.	6850-00-181-7929
	5 Gal.	6850-00-181-7933
	55 Gal.	6850-00-181-7940
MIL-11755D used -40°F to -90°F	55 Gal.	6850-00-174-1806
Federal Spec: 0-1-490 Corrosion inhibitor, Cooling System	6 oz. Can	6850-00-753-4967
	8.5 oz. Can	6850-00-584-2707
	12 oz. Can	6850-01-076-8810

Gear Oil (MPL)

Military (GO)

<u>Specification</u>	<u>Range</u>	<u>Wt.</u>	<u>Container</u>	<u>NSN</u>
MIL-L-2105C	-10° & below	75W	qt.	9150-01-035-5390
			5 Gal.	9150-01-035-5391
			55 Gal.	9150-01-035-5394
	010° & above	80W-90	qt.	9150-01-035-5392
			5 Gal.	9150-01-035-5393
			55 Gal.	9150-01-035-5394
	above 90°F	85W-140	qt.	9150-01-048-4591
			5 Gal.	9150-01-035-5395
			55 Gal.	9150-01-035-5396

APPENDIX E

PETROLEUM SUPPLY LIST

Grease, Multipurpose Auto (MPG)

Military (GAA)

<u>Specification</u>	<u>Range</u>	<u>Container</u>	<u>NSN</u>
MIL-G-10924	-12° C to 52°C	Cart - 14 oz.	9150-00-935-1017
		Can 1.75 lb.	9150-00-190-0904
		Can 6.5 lb.	9150-00-190-0905
		Can 35 lb.	9150-00-190-0907
		DR 120 lb.	9150-00-530-7369

Diesel Fuel (Grade 2)

32° and above

<u>Specification</u>	<u>Range</u>	<u>Container</u>	<u>NSN</u>
Federal Spec.	32°F & above	Bulk	9140-00-286-5294
VVF800		5 Gal.	9140-00-286-5295
Graded F2RE		55 Gal.	9140-00-286-5297
For Winter use below 32°F use Fuel Grade 1 or add De-Icing additive			
Graded DF-1WI, Winter use below 32°F		Bulk	9140-00-286-5286
		5 Gal.	9140-00-286-5287
		55 Gal.	9140-00-286-5289
Additive Fuel De-Icing		4 oz. Aerosol	6850-01-016-1914
MIL-I-27686, NATO Code S-748		5 Gal Can	6850-00-753-5061
Use with Fuel Grade 2 only		55 Gal Drum	6850-00-060-5312

APPENDIX F

CONVERSION CHART

	Manufacturer	Military
Hydraulic Oil-SAE	HYDO	OE/HDO
Motor Oil	CD	OE/HDO
Multi-Purpose Gear Lube	MPL/GL-5	GO
Multi-Purpose Grease	MPG	GAA
Transmission and Clutch Oil	CD/TO-2	OE/HDO

APPENDIX G

TROOP INSTALLED ITEM LIST

	NOMENCLATURE: Scraper, Self-Propelled, 14-18 Cu Yd NSN 3805-01-153-1854. Manufactured by Caterpillar		MODEL 621B	
	NSN	UNIT OF MEASURE		AUTH
Tire Gage	4910-00-204-3170	Ea		1
Goggles, Eye Protective	4240-00-052-3776	Pr		1
Pliers, Slipjoint, 10"	5120-00-278-0352	Ea		1
Screwdriver, 5"	5120-00-227-7338	Ea		1
Wrench, Adj, 8"	5120-00-240-5328	Ea		1
Grease Gun	4930-00-253-2478	Ea		1
Adapter, Grease Gun Flex	4930-00-288-1511	Ea		1
Case, Maintenance	7520-00-559-9618	Ea		1
Fire Extinguisher	4210-00-555-8837	Ea		1

**INITIAL RECOMMENDATION
PRESCRIBED LOAD LIST (PLL)
AUTHORIZED STOCKAGE LIST (ASL)
APPENDIX H**

END ITEM: Wheel, Tractor-Scraper				MAKE: Caterpillar	MODEL: 621B				
MFR PART NO: 5R7128		NSN: 3805-01-153-1854		SERIAL NUMBER RANGE — TO —	DATE: 3 Feb 84				
SMR CODE	NSN	P/N	FSCM	PART DESCRIPTION	U/M	QTY OF PARTS REQ'D FOR NO. OF END ITEMS			
						PLL		ASL	
						1-5	1-5	6-20	1-50
PAOZZ	3030-01-050-8147	4N8278	11083	Belts, Fan Set (3)	SET	1	1	2	2
PAOZZ	2940-00-125-9544	PH3335	73370	Filter Element, Fluid, Oil	EA	2	6	8	10
PAOZZ	2940-01-018-4872	PA2358	12658	Element A-Primary, Air	EA	2	6	8	10
PAOZZ	2940-01-018-4873	PA2359	12658	Element A-Secondary, Air	EA	2	6	8	10
PAOZZ	5330-00-585-4284	BH2778	11083	Gasket-Pri Fuel Filter	EA	1	1	2	4
PAOZZ	2910-00-989-3388	9M2341	11083	Element A-Pri Fuel Filter	EA	1	1	2	4
PAOZZ	2910-01-051-2341	4N5823	11083	Filter A-Fuel, 2nd	EA	1	1	2	4
PAOZZ	2920-01-066-0589	7N5876	11083	Lamp, Lighting GP	EA	1	1	2	5
PAOZZ	5920-00-243-3787	F03A250V10AS	81349	Fuse (10 AMP)	EA	3	3	6	10
PAOZZ	6240-01-178-5604	5S5150	11083	Sealed Unit-Head Lamp	EA	4	4	8	12
PAOZZ	6240-00-643-0687	MS15165-4578	96906	Lamp, Inc.-Flood Lamp	EA		1	2	4
PAOZZ	3030-01-053-4704	6N73	11083	Belt-to-Pulley (Altrntr)	EA	1	1	2	4
PAOZZ	2910-00-740-3593	9M9740	11083	Element-Trans Filter	EA	1	2	4	6
PAOZZ	4330-01-061-0246	EP-305	81321	Element A-Filter Hyd Tank	EA	2	2	4	6
PAOZZ	3830-00-828-7053	4J8662	11083	Bit-Routing, Bowl	EA	*	*	2	4
PAOZZ	3805-01-178-3177	4T6612	11083	Edge-End	EA	*	*	2	4
PAOZZ	3805-01-178-3178	4T6568	11083	Edge-Center	EA	*	*	1	2
PAOZZ	2930-01-053-4582	4N1400	11083	Element, Water Filter	EA	2	6	8	10

APPENDIX I

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APPENDIX J

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APPENDIX K

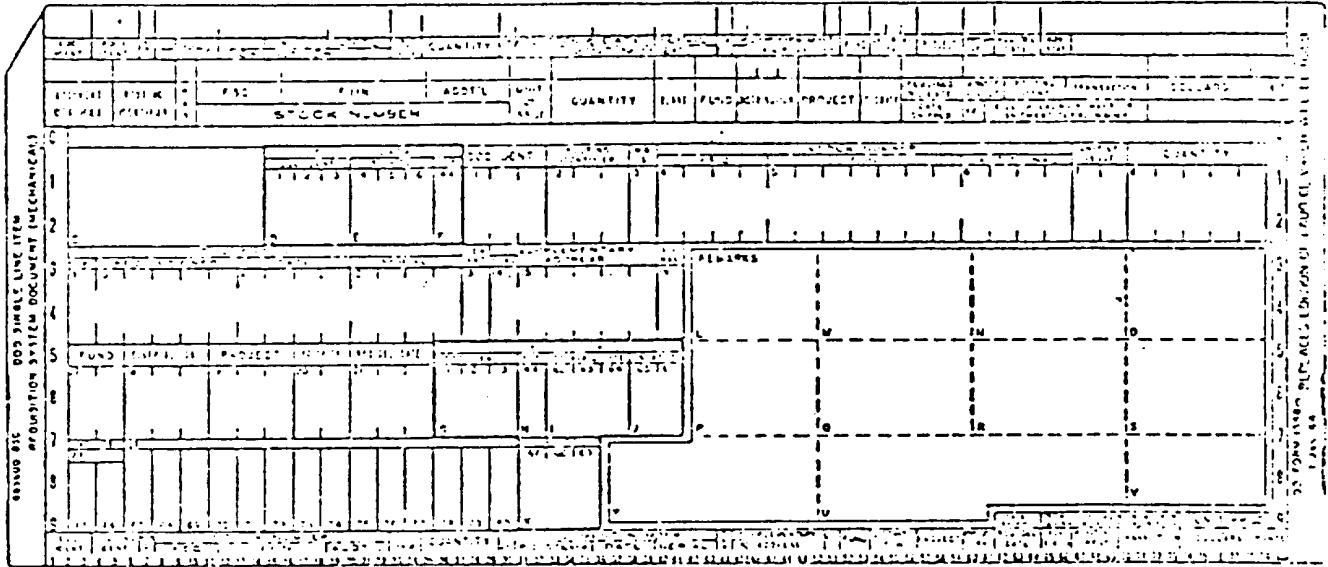
SAMPLE FORMAT - MILSTRIP REQUISTION (NSN)

<u>Card Column</u>	<u>Description of Data</u>	<u>Mandatory Entry for CCE</u>
1-3	Document Identifier Code	A0A - CONUS A01 - OCONUS
4-6	Routing Identifier Code	
7	Media/Status Code	
S-2.2	NSN	
23-24	Unit of Issue	
25-29	Quantity	
30-43	Document Number	
44	Demand Code	
45-50	Supplementary Address	
51	Signal Code	
52-53	Fund Code	
54-56	Distribution Code CC-54	
	CC-55-56	see AR 725-50 for OCONUS
57-59	Project Code	
60-61	Priority Code	
62-64	Required Delivery Date	
65-66	Advice Code	

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APPENDIX L

SAMPLE FORMAT - MILSTRIP REQUISTION FOR (NON-NSN)



<u>Card Column</u>	<u>Description of Data</u>	<u>Mandatory Entry for CCE</u>
1-3	Document Identifier Code	A0B - CONUS A02 - OCONUS
4-6	Routing Identifier Code	Always S9C
7	Media/Status Code	
8-22	FSCM and Part Number	
23-24	Unit of Issue	
25-29	Quantity	
30-43	Document Number	
44	Demand Code	
45-50	Supplementary Address	
51	Signal Code	
52-53	Fund Code	
54-56	Distribution Code CC-54	
		see AR 725-50 for OCONUS
57-59	Project Code CC-55-56	"JZC" (CONUS) "BGW" (CONUS)
60-61	Priority Code	
62-64	Required Delivery Date	
65-66	Advice Code	

APPENDIX L

<u>CARD COLUMN</u>	<u>DESCRIPTION OF DATA</u>	<u>MANDATORY ENTRY</u>
67-69	Blank	
70	Identification code applicable to entry in cc 71-80. A - Technical order or Technical Manual B - End Item Identification C - Noun Description D - Drawing or Specification No.	
71-80	Reference Identification	Identification of reference specified in cc 70

APPENDIX M

INSTRUCTIONS

This form will only be used in those cases where the manufacturer's code and part number exceed the spaces allocated in card columns 8 - 22 of the requisition.

<u>CARD COLUMN</u>	<u>DESCRIPTION OF DATA</u>	<u>MANDATORY ENTRY FOR CCE</u>
1 - 3	Document Identifier Code	A0E - CONUS
4 - 6	Routing Identifier Code	A05 - OVERSEAS
7	Media Status Code	Always S9C
8 - 22	FSCM and Part Number	Leave Blank Enter in Block 1 under Identification Data
23 - 24	Unit of Issue	
25 - 29	Quantity	
30 - 43	Document Number	
44	Demand Code	
45 - 50	Supplementary Address	
51	Signal Code'	
52 - 53	Fund Code	
54 - 56	Distribution Code CC 54	(See AR 725-50 for overseas.)
	CC-55-56	
57 - 59	Project Code	"BGWCODE" (CONUS) "JZC" (OCON!US)
60 - 61	Priority Code	
62 - 64	Required Delivery Date	
65 - 66	Advice Code	
67 - 80		Blank

IDENTIFICATION DATA - Lower half of DD Form 1348-6, complete blocks 1 thru 9.

APPENDIX N
REQUISITION FORMAT

NON-NSN REQUISITION FORMAT

CARD COLUMN	DESCRIPTION	ENTRY	
		CONUS	OCONUS
1-3	Document Identifier Code	A0B	A02
4-6	Routing Identifier Code	S9C	S9C
8-22	Part Number	Enter the Federal Supply Code for the Manufacturer, followed by the part number.	
54-56	Distribution Code:		
54	Control Activity	F	AR 725-50
55-56			
57-59	Project Code	BGW	JZC

APPENDIX O

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APPENDIX P

Source Codes Below Are Defined As Follows:

<u>CODE</u>	<u>DEFINITION</u>
PA	Item procured and stocked for anticipated or known usage.
PB	Item procured and stocked for insurance purposes because essentiality dictates that a minimum quantity be available in the supply systems.
PC	Item procured and stocked and which otherwise would be coded PA except that it is deteriorative in nature.
PD	Support item, excluding support equipment, procured for initial issue or outfitting and stocked only for subsequent or additional initial issues or outfittings. Not subject to automatic replenishment.
PE	Support equipment procured and stocked for initial issue or outfitting to specified maintenance repair activities.
PF	Support equipment which will not be stocked but which will be centrally procured on demand.
PG	Item procured and stocked to provide for sustained support for the life of the equipment. It is applied to an item peculiar to the equipment which because of probable discontinuance or shutdown of production facilities would prove uneconomical to reproduce at a later time.
KD	An item of depot overhaul/repair kit and not purchased separately. Depot kit defined as a kit that provides items required at the time of overhaul or repairs.
KF	An item of a maintenance kit and not purchased separately. Maintenance kit defined as a kit that provides an item that can be replaced at organizational or intermediate levels of maintenance.
KB	Item included in both a depot overhaul/repair kit and a maintenance kit.
MO	Item to be manufactured or fabricated at organizational level.
MF	Item to be manufactured or fabricated at Direct Support maintenance levels.

APPENDIX P

<u>CODE</u>	<u>DEFINITION</u>
MH	Item to be manufactured or fabricated at General Support maintenance levels.
MD	Item to be manufactured or fabricated at Depot maintenance level.
AO	Item to be assembled at organizational level.
AF	Item to be assembled at Direct Support maintenance levels.
AH	Item to be assembled at General Support maintenance levels.
AD	Item to be assembled at Depot maintenance levels.
XA	Item is not procured or stocked because the requirements for the item will result in the replacement of the next higher assembly.
XB	Item is not procured or stocked. If not available through salvage, requisition.
XC	Installation drawing, diagram, instruction sheet, field service drawing, that is identified by manufacturers drawing/part number.
Col. T. Group	Enter the functional group number for each part in accordance with TB 750-93-1, Functional Grouping Codes: Combat, Tactical, and Support Vehicles and Special Purpose Equipment.

APPENDIX Q



U.S. COMMERCIAL DIVISION DEALERS

ADMINISTRATION BUILDING

PEORIA, ILLINOIS 61629

DIRECT DISTANCE DIALING CENTREX
 AREA CODE 309-PREFIX 675-EXT.NO.-EXAMPLE: 309, 675-4117

U.S. COMMERCIAL DIVISION

VICE PRESIDENT..... 5106

DEALER ADMINISTRATION

MANAGER 4694
 Northeastern Division Manager 4682
 Southeastern Division Manager 5321
 Central Division Manager 4425
 Western Division Manager 4878
 Dealer Promotion Manager 4463

FINANCE

MANAGER 4601
 Northeastern Division Manager 4423
 Southeastern Division Manager 4892
 Central Division Manager 4647
 Western Division Manager 4700
 Finance Services Manager 4099

MACHINE SALES

MANAGER 4095
 Northeastern Division Manager 4668
 Southeastern Division Manager 4666
 Central Division Manager 4097
 Western Division Manager 4458
 National Sales Division Manager 4701

PARTS SALES

MANAGER 5165
 Northeastern Division Manager 4260
 Southeastern Division Manager 4779
 Central Division Manager 4781
 Western Division Manager 4783
 Parts Operations Division Manager 4891

SERVICE

MANAGER 4603
 Northeastern Division Manager 4003
 Southeastern Division Manager 4606
 Central Division Manager 4018
 Western Division Manager 4089
 National Service 5040

ALABAMA

- D060** MONTGOMERY
Burford Equipment Co.
I-85 East, Mt. Meigs-Mitylene Exit II
-ZIP 36102
Mail Address: P.O. Box 1591-
ZIP 36102
Phone: Area 205, 277-7000
- D061** MOBILE
Burford Equipment Co.
2521 Halls Mill Road-ZIP 36601
Mail Address: P.O. Box 2083-ZIP 36601
Phone: Area 205, 473-8632
Branch:
Marianna, Florida
- D430** BIRMINGHAM
Thompson Tractor Co., Inc.
2401 Pinson Highway-ZIP 35217
(Tarrant, AL)
Mail Address: P.O. Box 10367-
ZIP 35202
Phone: Area 205, 841-8601
- D433** ANNISTON
Thompson Tractor Co., Inc.
2300 Highway 21, South (Oxford) Shipping-
ZIP 36203
P.O. Box 1648, Oxford, AL-ZIP 36202-Mail
Phone: Area 205, 831-4104
- D431** DECATUR
Thompson Tractor Co., Inc.
U.S. Highway 31 North-ZIP 35601
P.O. Box No. 1603-ZIP 35602
Phone: Area 205, 353-7721
- D432** TUSCALOOSA
Thompson Tractor Co., Inc.
3537 Skyland Blvd. East (U.S. 11 Bypass)-
ZIP 35405
P.O. Box 5268-ZIP 35405
Phone: Area 205, 553-5511

ALASKA**Branches of *N C MACHINERY CO. in Alaska**

- H342** ANCHORAGE
*N C Machinery Co.
6450 Arctic Boulevard-ZIP 99502
P.O. Box 6148-ZIP 99502
Phone: Area 907, 278-1531
- H345** FAIRBANKS
*N C Machinery Co.
Steese Highway & Trainer Gate Road
-ZIP 99707
P O. Box 1539-ZIP 99707
Phone: Area 907, 452-7251
- H344** JUNEAU
*N C Machinery Co.
8550 Airport Blvd., Crest Avenue-ZIP 99803
P.O. Box 2138-ZIP 99803
Phone: Area 907, 789-0181

*Division of Northern Commercial Company

ALASKA (Continued)

- H343** KETCHIKAN
*N C Machinery Co.
126 Washington Street-ZIP 99901
P.O. Box 7358-ZIP 99901
Phone: Area 907, 225-61 11
Main Office:
Seattle, Washington
Branches:
Mt. Vernon, Washington
Chehalls, Washington

ARIZONA

- H040** YUMA
Braden Machinery Co.
400 E. 16th St.-ZIP 85364
P.O. Box 1631--ZIP 85364
Phone: Area 602, 783-7866
- H041** WELLTON
Braden Machinery Co.
East Highway 80-ZIP 85356
P.O. Box 188-ZIP 85356
Phone: Area 602, 785-3391
Branches:
Blythe, California
Imperial, California
Mexicali, Baja California, Mexico
San Luis, R.C. Sonora, Mexico
- H160** PHOENIX
Empire Machinery Co.
1725 S. Country Club Drive
Mesa, Arizona 85202-Shipping
Phone: Area 602, 834-3600
Telex: 668-407
MAILING ADDRESS:
P.O. Box 2985
Phoenix, Arizona 85062
- H162** FLAGSTAFF
Empire Machinery Co.
Industrial Park 86001-ZIP 86002
P.O. Box 340-ZIP 86002
Phone: Area 602, 526-2800
- H163** TUCSON
Empire Machinery Co.
7600 South Nogales Highway-ZIP 85706
P.O. Box 11250-ZIP 85734
Phone: Area 602, 7461441
- H165** KINGMAN
Empire Machinery Co.
3140 Airway Ave.-ZIP 86401
P.O. Box 1069-ZIP 86401
Phone: Area 602, 753-5284
Subsidiary:
Cananea, Sonora, Mexico
Nacozari, Sonora, Mexico

Main offices in larger-faced type

Branches in smaller-faced type

Alpha-Numerics designate Dealer Code

ARKANSAS

- D310** LITTLE ROCK
 J.A. Riggs Tractor Company
 7701 New Benton Highway-
 ZIP 72203
 P.O. Box 1399-ZIP 72203
 Phone: Area 501, 568-1021
 Telex: 053-6477
- D312** FORT SMITH
 J.A. Riggs Tractor Company
 South 71 Highway at Fort Chaffee Road
 -ZIP 72902
 P.O. Box 1444-ZIP 72902
 Phone: Area 501, 646-4755
 Telex: 053-7431
- D313** McGEHEE
 J.A. Riggs Tractor Company
 Highway 65 South-ZIP 71654
 P.O. Box 411-ZIP 71654
 Phone: Area 501, 222-3566
 Telex: 053-6236
- D314** TEXARKANA
 J.A. Riggs Tractor Company
 Highway 67 North-ZIP 75504
 P.O. Box 2042-ZIP 75504
 Phone: Area 501, 773-5621
 Telex: 053-6231
- D311** WEST MEMPHIS
 J.A. Riggs Tractor Company
 2108 E. Broadway-ZIP 72301
 P.O. Box 1956-ZIP 72301
 Phone: Area 501, 735-2563
 Telex: 053-3105
- D282** HARRISON
 E.A. Martin Machinery Company
 U.S. Highway 65 North-ZIP 72601
 P.O. Box 250-ZIP 72601
 Phone: Area 501, 741-8251
 Main Office:
 Springfield, Missouri
 Branches:
 Joplin, Missouri
 West Plains, Missouri

CALIFORNIA

- H020** NAPA
 Berglund Inc.
 150 Camino Dorado--Z1P 94558
 P.O. Box 2089-ZIP 94558
 Phone: Area 707, 252-2222
- H021** WILLITS
 Berglund Inc.
 1600 So. Main Street-ZIP 95490
 P O. Box 627-ZIP 95490
 Phone: Area 707, 459-5575
- H043** BLYTHE
 Braden Machinery Co.
 13120 South Intake Boulevard-ZIP 92226
 P.O. Box R-ZIP 92226
 Phone: Area 714, 922-2192

CALIFORNIA (Continued)

- H044** IMPERIAL
 Braden Machinery Co.
 3393 Highway 86-ZIP 92251
 P.O. Box 936-ZIP 92251
 Phone: Area 714, 355-2443
 Main Office:
 Yuma, Arizona
- H366** CRESCENT CITY
 Pape Bros., Inc.
 800 Northcrest Drive-ZIP 99531
 P.O. Box 386-ZIP 99531
 Phone: Area 707, 464-2126
 Main Office:
 Eugene, Oregon
- H190** SAN DIEGO
 Hawthorne Machinery Co.
 4200 Kearney Mesa Rd.-92111
 P.O. Box 708-ZIP 92112
 Phone: Area 714, 277-2260
 Telex: 695022
- H192** SAN DIEGO
 (e) Hawthorne Engine Systems
 8050 Othello St.-ZIP 92111
 P.O. Box 708-ZIP 92112
 Phone: Area 714, 277-2260
 Telex: 695022
 Branch:
 Tijuana, B.C., Mexico
- H200** STOCKTON
 Holt Bros.
 1521 W. Charter Way-ZIP 95206
 P.O. Box 8130-ZIP 95208
 Phone: Area 209, 466-6000
 Telex: 359428 EXSPEC HOLT STO
- H202** LOS BANOS
 Holt Bros.
 3440 E. Pacheco Blvd.-ZIP 93635
 P O. Box 1028-ZIP 93635
 Phone: Area 209, 826-4919
- H270** RIVERSIDE
 Johnson Tractor Co.
 800 East La Cadena Drive-ZIP 92501
 P.O. Box 351--ZIP 92502
 Phone: Area 714, 686-4560
- H273** RIVERSIDE
 (e) Johnson Industrial
 A Division of Johnson Tractor Co.
 656 East La Cadena Drive-ZIP 92501
 P.O. Box 351--ZIP 92502
 Phone: Area 714, 686-4560

(e) Engines Only

Main offices in larger-faced type
 Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

CALIFORNIA (Continued)

H370 SAN LEANDRO
Peterson Tractor Co.
955 Marina Blvd.-ZIP 94577
P.O. Box 5258-ZIP 94577
Phone: Area 415, 357-6200

H371 CHICO
Peterson Tractor Co.
Highway 99E South-ZIP 95926
P.O. Box 340-ZIP 95926
Phone: Area 916, 343-1911

H373 EUREKA
Peterson Tractor Co.
3990 Broadway-ZIP 95501
P O. Box P 95501
Phone: Area 707, 443-1653

H372 REDDING
Peterson Tractor Co.
5100 Caterpillar Road-ZIP 96001
P.O. Box 940-ZIP 96001
Phone: Area 916, 243-5410

H374 SAN LEANDRO
(e) Peterson Power Center
2828 Teagarden Street-ZIP 94577
Phone: 415, 8958400

H390 FRESNO
Quinn Company
Old Highway 99 Fresno County
-ZIP 93662
P.O. Box 12625-ZIP 93778
Phone: Area 209, 896-4040

H395 FRESNO
(e) Quinn Company
Old Highway 99 South-ZIP 93778
Phone: Area 209, 896-4040

H392 SALINAS
Quinn Company
1300 Abbott Street-ZIP 93901
P.O. Box 1908-ZIP 93901
Phone: Area 408, 758-8461

H430 LOS ANGELES
Shepherd Machinery Co.
10006 at Rose Hills Road (Whittier)
-ZIP 90601
Box 6789, Los Angeles-ZIP 90022
Phones: Area 213, 723-7191
and 692-3751
Telex: 67-0459

H432 IRVINE
Shepherd Machinery Corp.
6565 Laguna Road-ZIP 92650
Box 16, East Irvine-ZIP 92650
Phone: Area 714, 551-4161

H431 LANCASTER
Shepherd Tractor Corp
46117 N. Sierra Highway--ZIP 93534
Phone: Area 805, 942-1'77

CALIFORNIA (Continued)

H380 LOS ANGELES
(e) POWER SYSTEMS Associates
100 Industry Street
(City of Industry) 91743
Box 7044, Los Angeles-ZIP 90022
Phone: Area 213, 685-5630

H440 SACRAMENTO
TENCO TRACTOR, INC.
Pacific Ave. & Riego Road
Pleasant Grove, CA 95668
P.O. Box X-ZIP 95813
Phone: Area 916, 655-3131

H441 WEST SACRAMENTO
TENCO TRACTOR, INC.
2801 Evergreen Ave.-ZIP 95813
P.O. Box X-ZIP 95813
Phone: Area 916, 372-7000

H490 OXNARD
Wallace Machinery Co.
Highway 101 & Rose Ave.
-ZIP 93030
P.O. Box 5992-ZIP 93031
Phone: Area 805, 485-2171

H493 BAKERSFIELD
Wallace Machinery Co.
2200 Pegasus Road-ZIP 93302
P.O. Box 256-ZIP 93307
Phone: Area 805, 393-5800

H494 CORCORAN
Wallace Machinery Co.
Central Valley Highway 43 at Pickerell
Avenue-ZIP 93212
P.O. Box 578-ZIP 93212
Phone: Area 209, 992-2193

H492 PASO ROBLES
Wallace Machinery Co.
2 mi. East of Town on Hiway 46-ZIP 93446
P.O. Box 276-ZIP 93446
Phone: Area 805, 2384811

H491 SANTA MARIA
Wallace Machinery Co.
1655 Carlotti Drive
U.S. 101 at Donovan Road-ZIP 93454
P.O. Box 1220-ZIP 93456
Phone: Area 805, 925-8611

H570 COLUSA
I.G. Zumwalt Co.
850 Market St.-ZIP 95932
Mail: P.O. Box 149-ZIP 95932
Phone: Area 916, 458-2135

H571 WILLOWS
I.G. Zumwalt Co.
311 N. Butte St.-ZIP 95988
P.O. Box 907-ZIP 95988
Phone: Area 916, 934-5427

Main offices in larger-faced type
Branches In smaller-faced type
Alpha-Numerics designate Dealer Code

COLORADO

E250 DENVER

Wagner Equipment Co.
6000 Dahlia Street, Commerce City
-ZIP 80022
P.O. Box 5188-ZIP 80217
Phone: Area 303, 289-6111

E251 DURANGO

Wagner Equipment Co.
112 Turner Drive-ZIP 81301
P.O. Box 2079-ZIP 81301
Phone: Area 303, 259-2001

E252 GRAND JUNCTION

Wagner Equipment Co.
2707 U.S. Hwy. 50, Orchard Mesa
-ZIP 81503
P.O. Box 2009-ZIP 81502
Phone: Area 303, 242-2834

E253 PUEBLO

Wagner Equipment Co.
214 E. Ilex-ZIP 81002
P.O. Box 496-ZIP 81002
Phone: Area 303, 544-4433

E254 HAYDEN

Wagner Equipment Co.
777 W. Jefferson-ZIP 81639
P.O. Box II-ZIP 81639
Phone: Area 303, 276-3781

CONNECTICUT

B374 NEWINGTON

H.O. Penn Machinery Company, Inc.
225 Richard St.-ZIP 06111
Phone: Area 203, 666-8401
Telex: 99336

Main Office:

Armonk, New York

Branches:

Bronx, New York

Poughkeepsie, New York

Tuxedo, New York

Westbury, LI, New York

DELAWARE

B191 BEAR (Wilmington Area)

Giles & Ransome, Inc.
720 Pulaski Hwy.-ZIP '9701
P.O. Box 66-ZIP 19701
Phone: Area 302, 328-4131

Main Office:

Bensalem, Pennsylvania

DISTRICT OF COLUMBIA

See Springfield, Va., Alban Tractor Co., Inc

FLORIDA

D260

MIAMI
Kelly Tractor Co.
8255 N.W. 58th Street-ZIP 33152
P.O. Box 520775-ZIP 33152
Phone: Area 305, 592-5360
Telex: 51-8823

D262

CLEWISTON
Kelly Tractor Co.
800 E. Sugarland Highway-ZIP 33440
Phone: Area 813, 983-8177

D263

FT. MYERS
Kelly Tractor Co.
Route 13, Box 1500-ZIP 33908
Phone: Area 813, 481-3733

D264

KEY WEST
Kelly Tractor Co.
Truman Annex Bldg. 149-ZIP 33040
P.O. Box 1238-ZIP 33040
Phone: Area 305, 683-1231

D261

WEST PALM BEACH
Kelly Tractor Co.
5460 Okeechobee Blvd.-ZIP 33409
Phone: Area 305, 683-1231

D350

JACKSONVILLE
Ring Power Corporation
8050 Phillips Highway-ZIP 32216
P.O. Box 17600-ZIP 32216
Phone: Area 904, 737-7730
Telex: 056-8472

D351

OCALA
Ring Power Corporation
6200 North U.S. 301/441-ZIP 32678
P.O. Box 850-ZIP 32678
Phone: Area 904, 732-2800

D353

OCALA
(e) Ring Power Corporation
Truck Engine Repair Facility
6200 North U.S. 3011441--ZIP 32678
P.O. Box 850-ZIP 32678
Phone: Area 904, 732-4600

D352

TALLAHASSEE
Ring Power Corporation
4760 Capital Circle, N.W.-ZIP 32302
P.O. Box 869-ZIP 32302
Phone: Area 904, 386-2121

D360

TAMPA
Rozier Machinery Company
1219 North Highway 301-ZIP 33601
P.O. Box 1872-ZIP 33601
Phone: Area 813, 621-5851

D363

BROOKSVILLE
Rozier Machinery Company
U.S. 98 North-ZIP 33512
P.O. Box 248-ZIP 33512
Phone: Area 904, 796-4978

(e) Engines Only

Main offices in larger-faced type
Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

FLORIDA (Continued)

D361 ORLANDO
 Rozier Machinery Company
 1250 W Landstreet Road-ZIP 32809
 P.O. Box 13177-A-ZIP 32809
 Phone: Area 305, 859-5600

D062 MARIANNA
 Burford Equipment Co.
 U.S. Highway 90, West-ZIP 32446
 P.O. Box 637-ZIP 32446
 Phone: Area 904, 526-2241
 Main Office:
 Montgomery, Alabama

GEORGIA

D080 ALBANY
 Carlton Company
 P.O. Box 1087-ZIP 31703
 1604 South Slappey Blvd. ZIP: 31701
 Phone: Area 912, 435-6262
 TWX: 810 781 5103

D081 BRUNSWICK
 Carlton Company
 106 Perry Lane Rd.-ZIP 31520
 P O. Box 310-ZIP 31521
 Phone: Area 912, 265-5010
 TWX: 810-782-5065

D082 DUBLIN
 Carlton Company
 Macon Road, Highway 80 West-ZIP 31021
 P O. Box 909-ZIP 31021
 Phone: Area 912, 272-1661
 TWX: 810-788-5243

D083 SAVANNAH
 Carlton Company
 Highway 80 West-ZIP 31408
 P O. Box 1056-ZIP 31402
 Phone Area 912, 964-7150
 TWX: 810-784-5643

D085 ALBANY
 (e) Carlton Company
 Engine Division
 P O. Box 1087-ZIP 31703
 5730 Newton Road-ZIP 31702
 Phone: Area 912, 435-6262

D500 ATLANTA
 Yancey Bros. Co.
 P.O. Box 43326-ZIP 30378
 7333 Lee Industrial Blvd.
 Austell, Georgia-ZIP 30001
 (Shipping)
 Phone: Area 404, 941-2300

D501 AUGUSTA
 Yancey Bros Co
 3825 Highway 56 South-ZIP 30906
 Phone: Area 404, 790-1300

D502 MACON
 Yancey Bros. Co
 4660 Broadway-ZIP 31206
 Phone: Area 912, 788-1773

GUAM

H143 AGANA
 PACIFIC MACHINERY
 Division of Theo. H. Davies & Co., Ltd.
 P.O. Box DT-ZIP 96910
 Phone: Guam 646-4479
 Cable Address: PAMACAT,
 AGANA, GUAM
 Telex: RCA 721152
 Main Office:
 Waipahu, Oahu, Hawaii

HAWAII

H140 WAIPAHU, OAHU
 PACIFIC MACHINERY
 Division of Theo. H. Davies & Co., Ltd.
 94-025 Farrington Highway-
 ZIP 96797
 Phone: Area 808, 677-9111
 Cable Address: PAMACAT,
 WAIPAHU
 Telex: RCA 723397
 Western Union Hawaii:
 (AC 709) 392441

H144 HILO
 PACIFIC MACHINERY
 Division of Theo. H. Davies & Co. Ltd.
 456 Kalaniana'ole Avenue-ZIP 96720
 Phone: (808) 961-3437
 Cable Address: PAMACAT, HILO
 Telex: Western Union of Hawaii:
 (AC 709) 392407

H141 KAHULUI, MAUI
 PACIFIC MACHINERY
 Division of Theo. H. Davies & Co. Ltd.
 470 South Hana Highway-ZIP 96732
 Phone: (808) 877-6538
 Cable Address: PAMACAT, MAUI
 Telex: Western Union of Hawaii:
 (AC 709) 392467

H142 LIHUE, KAUAI
 PACIFIC MACHINERY
 Division of Theo H. Davies & Co., Ltd.
 P.O. Box 1528-ZIP 96766
 Phone: (808) 245-4057
 Cable Address: PAMACAT, KAUAI
 Telex: Western Union of Hawaii:
 (AC 709) 392477

IDAHO

H603 GRANGEVILLE
 (A) Brown Motors, Inc.
 West 118 South St.-ZIP 83530
 P.O. Box 232-ZIP 83530
 Phone: Area 208, 983-1730

H320 LEWISTON
 Nez Perce Tractor Co.
 Highway 12 East-ZIP 83501
 P.O. Box 1127-ZIP 83501
 Phone: Area 208, 746-3301

(e) Engines Only
 (A) Agricultural Dealer

Main offices In larger-faced type
 Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

IDAHO (Continued)

- H510** BOISE
Western Equipment Company
4009 Fairview Avenue-ZIP 83706
Mail Address: P.O. Box 38
-ZIP 83707
Phone: Area 208, 343-5401
- H511** POCATELLO
Western Equipment Company
2405 U.S. Highway 30 West-ZIP 83201
P O. Box 4640-ZIP 83201
Phone: Area 208, 232-2640
Branches:
John Day, Oregon
LaGrande, Oregon

ILLINOIS

- B130** SPRINGFIELD
Capitol Machinery Co.
Interstate 55 and Toronto Road
-ZIP 62705
P.O. Box 2008-ZIP 62705
Phone: Area 217, 529-5541
- B131** CHAMPAIGN
Capitol Machinery Co.
Interstate 74 at Lincoln Interchange
-ZIP 61820
P O. Box 156-ZIP 61820
Phone: Area 217, 359-1671
- D123** MARION
Fabick Machinery Co.
Highway 13 East-ZIP 62959
P O. Box 166-ZIP 62959
Phone: Area 618, 993-2191
- D124** SALEM
Fabick Tractor Company
U.S. Highway 50 West-ZIP 62881
Mail Address: P O. Box 530-ZIP 62881
Phone: Area 618. 548-1400
TWX: 910-996-2690
- D125** CROSSVILLE
Fabick Tractor Company
Intersection Hwy 460 & 1-ZIP 62827
Phone: Area 618, 966-3880
Main Office:
Fenton, St. Louis County, Missouri
Branches:
Jefferson City, Missouri
Sikeston, Missouri
- B350** ELMHURST
Patten Industries, Inc.
635 W. Lake Street-ZIP 60126
Phone: Area 312, 279-4400
(Suburban)
Phone: Chicago: Area 312, 626-1860
- B353** OGLESBY
Patten Industries, Inc.
590 Mayers St.-ZIP 61348
Phone: Area 815, 883-3336

ILLINOIS (Continued)

- B352** ROCKFORD
Patten Industries, Inc.
5055 South Main Street-ZIP 61102
Phone: Area 815, 965-8631
Branch:
Hammond, Indiana
- B360** ELMHURST
(e) Patten Energy Systems Inc.
615 West Lake Street-ZIP 60126
Phone: Area 312, 530-2200
- B390** PEORIA
Peoria Tractor & Equipment Co.
2319 E. War Memorial Drive
-ZIP 61614
P.O. Box 419-ZIP 61651
Phone: Area 309, 682-5481
Telex: 181160 US
- INDIANA**
- B270** INDIANAPOLIS
MacAllister Machinery Co., Inc.
P.O. Box 1941--ZIP 46206
7515 E. 30th Street-ZIP 46219
Phone: Area 317, 545-2151
- B272** ELKHART
MacAllister Machinery Co., Inc.
2019 West Luther Ave.-ZIP 46517
Phone: Area 219, 294-7402
- B271** FORT WAYNE
MacAllister Machinery Co., Inc.
2418 W. Coliseum Blvd.-ZIP 46818
P O. Box 10276-ZIP 46851
Phone: Area 219, 483-6469
- B273** WASHINGTON
MacAllister Machinery Co., Inc.
1407 South State Road --ZIP 47501
P O. Box 69-ZIP 47501
Phone: Area 812, 254-1712
- B274** INDIANAPOLIS
MacAllister Machinery Co., Inc.
7575 E. 30th St.-ZIP 46219
P O. Box 1941--ZIP 46206
Phone: Area 317, 545-2151
- B351** HAMMOND
Patten Industries, Inc.
6400 Indianapolis Blvd.-ZIP 46320
Phone: Chicago: Area 312, 721-6977
Phone: Area 219, 932-6600
(Suburban)
Main Office'
Elmhurst, Illinois

(e) Engines Only

Main offices in larger-faced type
Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

INDIANA (Continued)

D485 EVANSVILLE
 Whayne Supply Company
 2420 E. Lynch Rd.-ZIP 47711 (For UPS)
 P O. Box 969-ZIP 47706
 Phone: Area 812, 425-4651
 Main Office:
 Louisville, Kentucky
 Branches:
 Ashland, Kentucky
 Bowling Green, Kentucky
 Corbin, Kentucky
 Lexington, Kentucky
 Paducah, Kentucky
 Pikeville, Kentucky

IOWA

B030 CEDAR RAPIDS
 Altorfer Machinery Company
 2600 6th St., S.W.-ZIP 52406
 P.O. Box 1347-ZIP 52406
 Phone: Area 319, 365-0551

B031 DAVENPORT
 Altorfer Machinery Company
 4712 Buckeye Street-ZIP 52808
 P.O. Box 3007-ZIP 52808
 Phone: Area 319, 324-1935
 Branch:
 Hannibal, Mo.

E160DES MOINES
 Gibbs-Cook Equipment Co.
 10315 Hickman Road at 104th Street
 -ZIP 50322
 P.O. Box 936-ZIP 50304
 Phone: 515, 270-2800
 Telex: 910-520-2695

E161FORT DODGE
 Gibbs-Cook Equipment Co.
 3366 Fifth Ave South-ZIP 50501
 P.O. Box 1013-ZIP 50501
 Phone: Area 515, 576-3161

E162MASON CITY
 Gibbs-Cook Equipment Co.
 Highway 18 West-ZIP 50401
 P.O. Box 1037-ZIP 50401
 Phone: Area 515, 423-7240

E163POSTVILLE
 Gibbs-Cook Equipment Co.
 308 N. Lawler-ZIP 52162
 P.O. Box 549-ZIP 52162
 Phone: Area 319, 864-7461

E291SIOUX CITY
 Missouri Valley Machinery Co.
 5001 Gordon Drive East-ZIP 51106
 P.O. Box 208-ZIP 51102
 Phone: Area 712, 276-2431
 Main Office:
 Omaha, Nebraska

KANSAS

E130WICHITA
 Foley Tractor Co.
 1550 South West Street-ZIP 67213
 Phone: Area 316, 943-4211

E134DODGE CITY
 Foley Tractor Co
 1600 E. Wyatt Earp Blvd.-ZIP 67801
 P.O. Box 1268-ZIP 67801
 Phone: Area 316, 225-4121

E131GREAT BEND
 Foley Tractor Co.
 3701 West 10th Street-ZIP 67530
 P.O. Box 310-ZIP 67530
 Phone: Area 316, 792-5246

E133SALINA
 Foley Tractor Co.
 529 North Broadway-ZIP 67401
 P.O. Box 147-ZIP 67401
 Phone: Area 913, 825-4661

E270TOPEKA
 Martin Tractor Company, Inc.
 1737 Southwest 42nd Street
 -ZIP 66601
 P.O. Box 1698-ZIP 66601
 Phone: Area 913, 266-5770

E271CHANUTE
 Martin Tractor Company, Inc.
 501 W. 35th Street-ZIP 66720
 P O. Box 683-ZIP 66720
 Phone: Area 316, 431-3600

E273COLBY
 Martin Tractor Company, Inc.
 1080 South Range-ZIP 67701
 P.O. Box 385-ZIP 67701
 Phone: Area 913, 462-3913

E272CONCORDIA
 Martin Tractor Company, Inc.
 1805 Lincoln Street-ZIP 66901
 P O. Box 447-ZIP 66901
 Phone: Area 913, 243-1960

E274TOPEKA
 (e) Martin Tractor Company, Inc.
 Engine Division
 1637 S.W. 42nd St.-ZIP 56609
 P O. Box 1698--ZIP 66601
 Phone: Area 913, 266-5784

KENTUCKY

D480 LOUISVILLE
 Whayne Supply Company
 1400 S. 43rd Street-ZIP 40211
 (For UPS)
 P.O. Box 35900-ZIP 40232
 Phone: Area 502, 774-4441
 Telex: 20-4222

(e) Engines Only

Main offices in larger-faced type
 Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

KENTUCKY (Continued)

- D481** ASHLAND
 Whayne Supply Company
 12251 US 60-ZIP 41101
 P.O. Box 1178-ZIP 41101
 Phone: Area 606, 928-3444
- D482** BOWLING GREEN
 Whayne Supply Company
 U.S. Highway 31 -W By-Pass-ZIP 42101
 P.O. Box 1093-ZIP 42101
 Phone: Area 502, 843-3275
- D483** CORBIN
 Whayne Supply Company
 2200 S. Kentucky St. S.W.-ZIP 40701
 P.O. Box 536-ZIP 40701
 Phone: Area 606, 528-3140
- D486** LEXINGTON
 Whayne Supply Company
 195 Lisle Road-ZIP 40505
 P.O. Box 1123-ZIP 40589
 Phone: Area 606, 254-2756
- D484** PADUCAH
 Whayne Supply Company
 1600 North 8th Street-ZIP 42001
 P.O. Box 2355-ZIP 42001
 Phone: Area 502, 443-3631
- D487** PIKEVILLE
 Whayne Supply Company
 U.S. 23 South-ZIP 41501
 P.O. Box 2559-ZIP 41501
 Phone: Area 606, 437-6265
 Branch:
 Evansville, Indiana

LOUISIANA

- D030** RESERVE
 Boyce Machinery Corporation
 100 Airline Highway-ZIP 70084
 P.O. Drawer AJ-ZIP 70084
 Phone: Area 504, 536-1121
 Telex: 58371
- D031** LAKE CHARLES
 Boyce Machinery Corporation
 5415 East Broad Street-ZIP 70604
 P.O. Box 1227-ZIP 70604
 Phone: Area 318, 439-3601
- D032** MORGAN CITY
 Boyce Machinery Corporation
 Highway 90, East-ZIP 70380
 P.O. Box 310-ZIP 70380
 Phone: Area 504, 631-0561
- D033** NEW ORLEANS
 Boyce Machinery Corporation
 824 Distributors Row-ZIP 70123
 Phone: Area 504, 733-4748

LOUISIANA (Continued)

- D270** MONROE
 Louisiana Machinery Company, Inc
 U.S. Highway 165 By-Pass South
 -ZIP 71203
 Mail Address: P.O. Drawer 4888
 -ZIP 71203
 Phone: Area 318, 323-1345
- D272** ALEXANDRIA
 Louisiana Machinery Company, Inc
 MacArthur at Masonic Drive-ZIP 71301
 P.O. Box 5544-ZIP 71301
 Phone: Area 318, 443-2577
- D271** BOSSIER CITY
 Louisiana Machinery Company, Inc.
 2430 East Texas Ave.-ZIP 71111
 P.O. Box 5375-ZIP 71111
 Phone: Area 318, 746-2341
- D273** VIDALIA
 Louisiana Machinery Company, Inc.
 400 Carter St.-ZIP 71373
 Phone: Area 318, 336-4243
- D274** SHREVEPORT
 Louisiana Machinery Company, Inc.
 521 North Market Street-ZIP 71107
 Phone: Area 318, 227-8835

MAINE

- B050** PORTLAND
 Arnold Machinery Co.
 173 Presumpscot Street-ZIP 04103
 P.O. Box 1080-ZIP 04104
 Phone: Area 207, 775-3121
- B051** BANGOR
 Arnold Machinery Co.
 1070 Hammond Street-ZIP 04401
 P.O. Box 783-ZIP 04401
 Phone: Area 207, 942-4666

MARYLAND

- B010** BALTIMORE
 Alban Tractor Co., Inc.
 8531 Pulaski Highway-ZIP 21237
 P.O. Box 9595-ZIP 21237
 Phone: Area 301, 686-7777
- B011** MYERSVILLE
 Alban Tractor Co. Inc.
 Interstate 70 at Myersville Interchange
 -ZIP 21773
 P.O. Box 48-ZIP 21773
 Phone: Area 301, 293-2377
- B012** SALISBURY
 Alban Tractor Co., Inc.
 Route 6, Box 419-ZIP 21801
 Phone: Area 301, 749-0156
 Branch
 Springfield, Virginia'

Main offices in larger-faced type
 Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

MARYLAND (Continued)**B020 BALTIMORE**

(e) Alban Engine Power, Inc.
6455 Washington Blvd.-ZIP 21227
Phone: Area 301, 796-8000
Telex: 87-545

B021 BALTIMORE

(e) Alban Engine Power, Inc.
1401 Cherry Hill Road-ZIP 21225
Phone: Area 301, 355-6700

MASSACHUSETTS**B450 HOPKINTON**

Witt Equipment Co.
80 South Street-ZIP 01748
21 B Exit off Rt. 495
Phone: Area 617, 435-6321
Telex: 948492

B451 MATTAPOISETT

Witt Equipment Co.
7-Industrial Drive off North Street
Interchange-ZIP 92739
P.O. Box 728-ZIP 92739
Phone: Area 617, 758-4933

B452 SOUTH HADLEY

Witt Equipment Co.
600 New Ludlow Road-ZIP 01075
Phone: Area 617, 536-4580

MEXICO (USCD Territory Portion)**H045 MEXICALI, B.C. MEXICO**

Braden Machinery Co.
Maquinana Frontera, S.A. de C.V.
Carretera A San Luis Km. 3-1/2
Aparatado Postal 638
Phone: Area 903, 767-2085
U.S. Address:
P O. Box 89
Calexico, California 92231
Main Office, Yuma, Arizona

H042 SAN LUIS R.C., SONORA, MEXICO

Braden Machinery Co.
Maquinaria Agricola del Colorado,
S.A. de C.V.
Carretera a Riito Km. 3
Apartado Postal 65
Phone. Area 903, 794-2252
U S. Address:
P O. Box 2100
San Luis. Arizona 85349
Main Office: Yuma, Arizona

H166 CANANEA. SONORA, MEXICO

Empire Machinery Co.
Maquinaria Imperial. S.A. (Subsidiary)
Av Obregon, No. 222
APDO 143
Phone: 2-1400

MEXICO (USCD Territory Portion) (Continued)

P.O. Box 1817 (Parcel Post)
Bisbee, Arizona 85603
Main Office:
Phoenix, Arizona
Nacozari, Sonora, Mexico
Maquinaria Imperial, S.A. (Subsidiary)

H191 TIJUANA, B.C., MEXICO

Hawthorne Machinery Co.
Maquinaria de Baja California, S.A. de C.V
Apartado No. 106
Blvd. Salinas y Paniagua
Phone: Area 903, 386-1460
Main Office:
San Diego, California

MICHIGAN**B261 MARQUETTE**

Kramer Machinery Inc.
6 miles west on Highway 41-ZIP 49855
P.O. Box 638-ZIP 49855
Phone: Area 906, 475-4191
Mall Office:
Green Bay, Wisconsin

B290 NOVI

Michigan Tractor & Machinery Co.
24800 Novi Road-ZIP 48050
P.O. Box 354-ZIP 48050
Phone: Area 313, 349-4800
Telex: 23-5491

B291 GRAND RAPIDS

Michigan Tractor & Machinery Co.
4350 Clyde Park Avenue. S.W -ZIP 49509
P O. Box 9220-ZIP 49509
Phone: Area 616, 532-3635
Telex: 22-6446

B292 KALKASKA

Michigan Tractor & Machinery Co.
3990 U.S. 131-Route #4-ZIP 49646
Phone: Area 616, 258-8674

B293 NOVI

(e) Michigan Engine Power
Division of Michigan Tractor &
Machinery Co.
25000 Novi Road-ZIP 48050
P.O Box 354-ZIP 48050
Phone: Area 313. 349-7050

MINNESOTA**E500 MINNEAPOLIS**

ZIEGLER INC.
901 W. 94th Street (Bloomington)
-ZIP 55420
Phone: Area 612, 888-4121

E503

BUHL
ZIEGLER INC.
East Highway #169-ZIP 55713
Phone: Area 218. 258-3222

(e) Engines Only

Main offices in larger-faced type
Branches In smaller-faced type
Alpha-Numeric designate Dealer Code

MINNESOTA (Continued)

- E501 CROOKSTON**
ZIEGLER INC.
1115 South Main Street-ZIP 56716
Phone: Area 218, 281-4245
- E507 DULUTH**
ZIEGLER INC.
210 Garfield Avenue-ZIP 55802
Phone: Area 218, 722-6628
- E502 HIBBING**
(e) ZIEGLER INC.
505 West 37th Street-ZIP 55746
Phone: Area 218, 262-5231
- E504 MARSHALL**
ZIEGLER INC.
Highway 59 North-ZIP 56253
Phone: Area 507, 532-4403
- E506 MINNEAPOLIS**
(e) ZIEGLER INC.
ENGINE DIVISION
901 W. 94th Street-ZIP 55420
Phone- Area 612, 888-4121
Telex: 29-0905

MISSISSIPPI

- D410 GREENWOOD**
Stribling-Clements, Inc.
1208 Highway 82 West-ZIP 38930
P.O. Box 676-ZIP 38930
Phone: Area 601, 453-5233
Telex: 585 352 STRIBCLEM GRWD
- D411 COLUMBUS**
Stribling-Clements, Inc.
2101 Hwy 82 West-ZIP 39701
P Box 1047-ZIP 39701
Phone: Area 601, 327-3083
- D440 JACKSON**
Stribling-Puckett, Inc.
3263 Highway 80 West-ZIP 39207
P.O. Box 3170-ZIP 39207
Phone: Area 601, 969-6000
- D441 GULFPORT**
Stribling-Puckett, Inc.
Highway 49 North-ZIP 39503
P O. Box 2579-ZIP 39503
Phone Area 601. 832-1711
- D443 MERIDIAN**
Stribling-Puckett, Inc.
1710 Tom Bailey Drive-ZIP 39301
P O Box 5467-ZIP 39301
Phone. Area 601, 483-4511
- D442 NATCHEZ**
Stribling-Puckett, Inc.
Highway 61 North-ZIP 39120
P O Box 883-ZIP 39120
Phone' Area 601. 442-1633

(e) Engines Only

MISSISSIPPI (Continued)

- D445 HATTIESBURG**
Stribling-Puckett, Inc.
4124 Highway 49 North-ZIP 39401
P.O Box 1568-ZIP 39401
Phone: Area 601. 545-8500
- D446 RICHLAND (Jackson)**
(e) Stribling-Puckett, Inc.
Engine Division
Highway 49 South-ZIP 39207
P O. Box 3170-ZIP 39207
Phone: Area 601, 939-6000
- D461 CLARKSDALE**
Taylor Machinery Company
Highway 322 South-ZIP 38614
P O. Box 247-ZIP 38614
Phone: Area 601, 624-2581
- D462 TUPELO**
Taylor Machinery Company
723 Westmoreland Drive, R.R.8
-ZIP 38801
Phone: Area 601, 844-1634
- D464 BURNSVILLE**
Taylor Machinery Company
6.7 Mt. Gilead Road-ZIP 38012
Rt. 1 Box 142 B 1--Mail
Luka, Mississippi 38852
Phone: Area 601, 423-3473
Main Office:
Memphis, Tennessee

MISSOURI

- B032 HANNIBAL**
Altorfer Machinery Company
3520 Moberly Avenue-ZIP 63401
P.O. Box 70-ZIP 63401
Phone: Area 314, 221-8600
Main Office:
Cedar Rapids, Iowa
- E100 KANSAS CITY**
Dean Machinery Co.
1201 West 31st Street-ZIP 64108
P.O. Box 1176-ZIP 64141
Phone: Area 816, 753-5300
- E102 CHILLICOTHE**
Dean Machinery Co.
Highway 65, South-ZIP 64601
P O Box D-ZIP 64601
Phone: Area 816. 646-2080
- E103 ST. JOSEPH**
Dean Machinery Co.
Highway 59 & Belt South-ZIP 64503
P O. Box 87, Station A-ZIP 64503
Phone: Area 816, 233-2516
- E104 SEDALIA**
Dean Machinery Co.
1620 West Main-ZIP 65301
P O Box 1087-ZIP 65301

Phone Area 816, 827-2455

Main offices in larger-faced type
Branches -n smaller-faced type
Alpha-Numeric designate Dealer Code

MISSOURI (Continued)**D120 FENTON, ST. LOUIS COUNTY**

John Fabick Tractor Company
 One Fabick Drive-ZIP 63026
 P.O. Box 5901--ZIP 63026
 Phone: Area 314, 343-5900
 Telex: 0447325

D121 JEFFERSON CITY

Fabick and Company
 2009 Missouri Blvd. -ZIP 65101
 Phone: Area 314, 636-3184

D122 SIKESTON

Fabick Bros. Equipment Co.
 912 South Main St.-ZIP 63801
 Phone: Area 314, 471-5941
 Branches:
 Marion, Illinois
 Salem, Illinois
 Crossville, Illinois

D280 SPRINGFIELD

E.A. Martin Machinery Company
 2222 East Kearney Street-ZIP 65801
 P.O. Box 988, Jewell Station
 -ZIP 65801
 Phone: Area 417, 866-6651

D281 JOPLIN

E.A. Martin Machinery Company
 3534 E. 20th Street-ZIP 64801
 P O. Box 820-ZIP 64801
 Phone: Area 417, 624-3010

D283 WEST PLAINS

E.A. Martin Machinery Company
 U.S. Highway 63, North-ZIP 65775
 P O. Box F-Z;P 65775
 Phone Area 417, 256-6138
 Branch:
 Harrison, Arkansas

MONTANA**E030 GREAT FALLS**

ABBCO, INC.
 4001 Highway 87 NE Bypass
 -ZIP 59401
 P O. Box 2147-ZIP 59403
 Phone: Area 406, 761-7900

E601 CONRAD

(A) Conrad Implement Co.
 23 Second Avenue S.E.-ZIP 59425
 P.O Box 1207-ZIP 59425
 Phone: Area 406, 278-5531

E400 BILLINGS

Tractor & Equipment Co.
 1835 Harnish Blvd.. ZIP 59101
 P.O. Box 30158-ZIP 59107
 Phone: Area 406, 656-0202

MONTANA (Continued)**E401 SIDNEY**

Tractor & Equipment Co
 201 North Central Avenue-ZIP 59270
 P.O Box 152-ZIP 59270
 Phone: Area 406, 482-2430
 Branch:
 Williston, North DaKota

H400 MISSOULA

Long Machinery
 3760 N. Reserve-ZIP 59801
 P.O. Box 5508-ZIP 59806
 Phone: Area 406, 721-4050

H401 KALISPELL

Long Machinery
 3500 Highway 93 South-ZIP 59901
 P O. Box 1717-ZIP 59901
 Phone: Area 406. 257-5664

H404 MISSOULA

(e) Long Machinery
 3115 W Broadway-ZIP 59801
 P.O Box 5508-ZIP 59806
 Phone' Area 406. 721-4050

NEBRASKA**E220 LINCOLN**

Lincoln Equipment Company
 930 West O Street-ZIP 68501
 P.O. Box 81528-ZIP 68501
 Phone: Area 402, 474-5566

E221 DONIPHAN

Lincoln Equipment Company
 U.S Highway 281-ZIP 68832
 P O Box L-ZIP 68832
 Phone' Area 402, 845-6503

E290 OMAHA

Missouri Valley Machinery Co.
 401 North 12th St.-ZIP 68102
 Phone: Area 402, 346-6500
 Branch:
 Sioux City, Iowa

E330 NORTH PLATTE

Nebraska Machinery Company
 1 80 and South Highway 83
 -ZIP 69101
 P.O. Box 809-ZIP 69101
 Phone: Area 308, 532-3100

E331 SCOTTSBLUFF

Nebraska Machinery Company
 1504-08 South Broadway-ZIP 69361
 PO Box 519-ZIP 69361
 Phone: Area 308, 632-6163

(e) Engines Only
 (A) Agricultural Dealer

Main offices in larger-faced type
 Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

NEVADA

H070 LAS VEGAS

Cashman Equipment Company
1132 West Bonanza Road-ZIP 89106
P.O. Box 4217, Annex-ZIP 89106
Phone: Area 702, 382-8891

H071 RENO

Cashman Equipment Company
600 Glendale Road-ZIP 89510
P O. Box 7520-ZIP 89510
Phone: Area 702, 358-5111

NEW HAMPSHIRE

B250 HOPKINTON

Jordan Milton Machinery, Inc.
Exit 6, Interstate No. 89-ZIP 03301
Phone: Area 603, 746-4611
P.O. Box 206 (Mail)
Concord, New Hampshire 03301
Branch:
Montpelier, Vermont

NEW JERSEY

B170 PISCATAWAY

Foley Machinery Co.
855 Centennial Avenue-ZIP 08854
P.O. Box 637-ZIP 08854
Phone: Area 201, 885-5555
Telex: 833-358

B193 TOMS RIVER

Giles & Ransome, Inc.
2110 East Washington Street, Route 37
-ZIP 08753
Phone: Area 201, 270-9600
Main Office:
Bensalem, Pennsylvania

NEW MEXICO

E350 ALBUQUERQUE

Rust Tractor Co.
4000 Osuna Rd. NE-ZIP 87109
P.O. Box 25007-ZIP 87125
Phone: Area 505, 345-8411

E351 FARMINGTON

Rust Tractor Co.
1000 Troy King Road-ZIP 87401
P.O. Box 2020-ZIP 87401
Phone: Area 505. 327-5331

E353 HOBBS

Rust Tractor
W Sanger and Truck Bypass-ZIP 88240
P O Box 856-ZIP 88240
Phone: Area 505, 393-2148
Branch:
El Paso, Texas

NEW YORK

B370 ARMONK

H.O. Penn Machinery Company, Inc.
1-684 at Route 22-ZIP 10504
Phone: Area 914, 273-9800 and
212, 292-4800
Telex: 99-6512

B375 BRONX

H.O Penn Machinery Company, Inc.
699 Brush Avenue-ZIP 10465
Phone: Area 212, 863-3800
Telex: 12-5232

B371 POUGHKEEPSIE

H.O. Penn Machinery Company. Inc.
R.D. 2-Noxon-Road-ZIP 12603
P.O. Box 3238-ZIP 12603
Phone. Area 914, 452-1200
Telex: 92-6409

B376 TUXEDO

H.O. Penn Machinery Company, Inc.
Route 17, Orange Turnpike-ZIP 10987
Phone: Area 914, 351-4771

B373 WESTBURY, LONG ISLAND

H.O. Penn Machinery Company, Inc.
1561 Stewart Avenue-ZIP 11590
Phone: Area 516, 832-8000
Telex: 96-1438
Branch:
Newington, Connecticut

B410 ALBANY

Southworth Machinery, Inc.
Hart's Lane-Menands-ZIP 12204
P.O. Box 4045-Patroun Station
-ZIP 12204
Phone: Area 518, 465-5255

B430 SYRACUSE

Syracuse Supply Company
294 Ainsley Drive-ZIP 13205
P.O. Box 37, Colvin Station
-ZIP 13205
(Construction Div.)
Phone: Area 315, 476-9981
(Main Office-Court St.)
Phone: Area 315, 463-9511
Telex: 93-7319

B431 BUFFALO

Syracuse Supply Company
2140 Military Road-ZIP 14150
Tonawanda, NY
P O Box 147 (Mall), Kenmore, NY
-ZIP 14217
Phone: Area 716, 694-7200
Telex- 91.317

B434 MASSENA

Syracuse Supply Company
Highland Road-ZIP 13662
P.O. Box 177-ZIP 13662
Phone: Area 315. 769-3521

Main offices In larger-faced type
Branches In smaller-faced type
Alpha-Numerics designate Dealer Code

NEW YORK (Continued)

B435 PLATTSBURGH

Syracuse Supply Company
4 MacDonough Street-ZIP 12901
P.O. Box 398-ZIP 12901
Phone: Area 518, 561-7700

B432 ROCHESTER

Syracuse Supply Company
55 Manufacturers Blvd.-ZIP 14623
P.O. Box 9787-South Town Branch
-ZIP 14623
Phone: Area 716, 475-1330
Telex: 978479

B433 VESTAL

Syracuse Supply Company
2909 Vestal Road-ZIP 13850
P.O. Box 7 (Mall) Southern Tier Branch
-ZIP 13850
Phone: Area 607, 729-9121
Telex: 93-2434

B436 WATERTOWN

Syracuse Supply Company
Bowmax Circle-ZIP 13601
P.O. Box 297-ZIP 13601
Phone: Area 315, 788-2180

NORTH CAROLINA

D090 CHARLOTTE

Carolina Tractor & Equipment Co.
U.S. 21 North, Reames Road Exit-I-77
-ZIP 28213
P.O. Box 26665-ZIP 28213
Phone: Area 704, 596-8790

D091 ASHEVILLE

Carolina Tractor & Equipment Co.
Fairview Road-ZIP 28803
P.O. Box 5637, Biltmore Station-ZIP
28803
Phone: Area 704, 274-7961

D092 GREENSBORO

Carolina Tractor & Equipment Co.
1-40 at N.C. 68-ZIP 27409
P.O. Box 11435-ZIP 27409
Phone: Area 919, 668-2476

D093 HICKORY

Carolina Tractor & Equipment Co.
903 1st. Ave. N.W -ZIP 28601
P.O. Box 2392-ZIP 28601
Phone: Area 704, 322-7360

D180 RALEIGH

Gregory Poole Equipment Company
4807 Beryl Road-ZIP 27607
P.O. Box 469-ZIP 27602
Phone: Area 919, 828-0641
TWX: 510-928-0536

NORTH CAROLINA (Continued)

D186 EDENTON

Gregory Poole Equipment Company
P.O. Box 50-ZIP 27932
Airport Road--ZIP 27932
Phone: Area 919, 482-8408
TWX: 710-873-8107

D184 FAYETTEVILLE

Gregory Poole Equipment Company
U.S. 301 South at NC 59-ZIP 28348
P.O. Box 387-ZIP 28348
(Hope Mills, NC)
Phone: Area 919, 424-4400
TWX: 510-938-0122

D181 WASHINGTON

Gregory Poole Equipment Company
P.O. Box 1178-ZIP 27889
U.S. 17 North & Spring Road-ZIP 27889
Phone: Area 919, 946-1081
TWX: 510-924-1811

D182 WILMINGTON

Gregory Poole Equipment Company
U.S. 17 South-ZIP 28401
P.O. Box 839-ZIP 28401
Phone: Area 919, 371-6301
TWX: 510-937-0207

NORTH DAKOTA

E070 FARGO

Butler Machinery Company
3500 W. Main Avenue-ZIP 58103
Box 2587-ZIP 58108
Phone: Area 701, 280-3100

E072 BISMARCK

Butler Machinery Company
3630 Miriam Ave.-ZIP 58502
P.O. Box 757-ZIP 58502
Phone: Area 701, 2230890

E071 GRAND FORKS

Butler Machinery Company
111 Gateway Drive-ZIP 58201
P.O. Box 280-ZIP 58201
Phone: Area 701, 775-4238

E073 MINOT

Butler Machinery Co.
Highway 2, Bypass East-ZIP 58701
P.O. Box 1056-ZIP 58701
Phone: Area 701, 852-3508

E402 WILLISTON

Tractor & Equipment Co.
P.O. Box 610-ZIP 58801
Phone: Area 701, 572-8377
Main Office:
Billings. Montana

Main offices in larger-faced type
Branches in smaller-faced type
Alpha-Numeric designate Dealer Code

OHIO

B070 COLUMBUS

Barry Equipment Co.
P.O. Box 27040-ZIP 43227
3765 East Livingston Avenue
Phone: Area 614, 237-7491

B071 PERRYSBURG

Barry Equipment Co.
25970 U.S. Highway 25 South-ZIP 43551
P O. Box 192-ZIP 43551
Phone: Area 419, 874-7972

B210 CINCINNATI

The Highway Equipment Company
3625 Hauck Road-ZIP 45241
Phone: Area 513, 563-2800
Telex: 21-4361

B211 PIKETON

The Highway Equipment Company
4407 U S. 23-ZIP 45661
P O. Box 517 -ZIP 45661
Phone: Area 614, 2892383

B213 DAYTON

The Highway Equipment Company
1639 Stanley Avenue-ZIP 45404
Phone. Area 513, 228-6404

B330 BROADVIEW HEIGHTS (Cleveland)

Ohio Machinery Co.
3993 E. Royalton Road-ZIP 44147
(IR 77 at SR 82)
Phone: Area 216, 526-6200
Telex: 98 5563 OMCO CLV

B331 CADIZ

Ohio Machinery Co.
U.S. Route 250-R.D. #1--ZIP 43907
P.O. Box 220-ZIP 43907
Phone: Area 614, 942-4626

B333 SOUTH ZANESVILLE

Ohio Machinery Co.
3415 East Pike (IR 70 East)-ZIP 43701
P O. Box 2428-ZIP 43701
Phone: Area 614. 453-0563

B332 YOUNGSTOWN

Ohio Machinery Co.
,000 Lake Park Road-ZIP 44501
P O. Box 1467-ZIP 44501
Phone: Area 216, 782-8161

B334 BROADVIEW HEIGHTS [Cleveland]

(e) Ohio Machinery Co.
Truck Engine Division
900 Kenmar Drive-ZIP 44147
Phone: Area 216. 526-0520

OKLAHOMA

E010 TULSA

Albert Equipment Co., Inc.
7794 East 42nd Place-ZIP 74145
P.O. Box 45688-ZIP 74145
Phone: Area 918, 627-4500
Telex: 49-2441

E040 OKLAHOMA CITY

Boecking Machinery, Inc.
4501 W. Reno-ZIP 73127
P.O. Box 25947-ZIP 73125
Phone: Area 405, 947-6771
Telex: 74-7205

OREGON

H180 PORTLAND

Halton Tractor Co.
4421 N.E. Columbia Blvd.-97218
P.O. Box 3377-ZIP 97208
Phone: Area 503, 288-6411
Telex: 36-0272

H181 SALEM

Halton Tractor Co.
2465 S.E. Madrona Ave.-ZIP 97302
Phone: Area 503, 585-7170

H183 THE DALLES

Halton Tractor Co.
1238 W. 2nd St.-ZIP 97068
P O Box B-ZIP 97068
Phone: Area 503, 296-4642
Branch:
Longview, Washington

H360 COBURG

Pape Bros., Inc.
Corporate Headquarters
91434 Coburg Industrial Way
-ZIP 97440
P.O. Box 407-ZIP 97440
Phone: 503, 342-1234

H360 EUGENE

Pape Bros., Inc.
2300 Henderson Avenue-I 5 South
at Glenwood Exit-ZIP 97440
P.O. Box 407-ZIP 97440
Phone: Area 503, 342-1234

H362 COOS BAY

Pape Bros., Inc.
1625 N 7th Street & Kingwood Street
-ZIP 97420
P O Box 396-ZIP 97420
Phone: Area 503, 267-2101

H363 KLAMATH FALLS

Pape' Bros. Inc.
1410 S. Sixth St.-ZIP 9760t
P.O. Box 1000-ZIP 97601
Phone: Area 503, 882-2544

(E) Engines Only

Main offices in larger-faced type
Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

OREGON (Continued)

H364 MEDFORD

Pape Bros., Inc.
2600 Biddle Road-ZIP 97501
P O. Box 519-ZIP 97501
Phone Area 503, 773-7514

H365 REDMOND

Pape Bros., Inc.
838 No. 5th-ZIP 97756
P O. Box 698-ZIP 97756
Phone. Area 503, 548-2175

H361 ROSEBURG

Pape Bros., Inc.
3339 Old Hwy 99 South-ZIP 97470
P.O. Box 1107-ZIP 97470
Phone: Area 503, 679-6711
Branch:
Crescent City, California

H253 PENDLETON

Inland Machinery Co.
1849 Westgate-ZIP 97801
P.O. Box 249-ZIP 97801
Phone: Area 503, 276-5812
Main Office:
Yakima, Washington
Branches:
Pasco, Washington
Walla Walla, Washington

H513 JOHN DAY

Western Equipment Company
323 Canyon City Blvd.-ZIP 97845
P O. Box 377-ZIP 97845
Phone: Area 503, 575-1301

H512 LAGRANDE

Western Equipment Company
1805 Adams Avenue-ZIP 97850
P O. Box 400-ZIP 97850
Phone: Area 503, 963-3101
Main Office:
Boise, Idaho

PENNSYLVANIA

B090 PITTSBURGH

Beckwith Machinery Co.
Route 22 East-Murrysville
-ZIP 15668
P.O. Box 8718-ZIP 15221
Phone: Area 412, 327-1300, 243-0300
Teletype: 510-468-3405

B091 BRADFORD

Beckwith Machinery Co
361-369 Congress Street-ZIP 16701
Phone, Area 814, 368-3166

B092 CLEARFIELD

Beckwith Machinery Co
Old Town Road-ZIP 16830
P O Box 510--ZIP 16830
Phone. Area 814, 765-1611

PENNSYLVANIA (Continued)

B098 DUNCANSVILLE [Altoona]

Beckwith Machinery Co
Rte. 22 at Wye Switches-ZIP 16635
P O. Box 277-ZIP 16635
Phone: Area 814, 696-0201

B093 ERIE

Beckwith Machinery Co.
1356 East 12th Street-ZIP 16512
Phone: Area 814, 454-2494

B096 INDIANA

Beckwith Machinery Co.
13th Street Extension-ZIP 15701
P.O. Box 236-ZIP 15701
Phone: Area 412, 463-8743

B097 SHIPPENVILLE

Beckwith Machinery Co.
Rte. 66 N & 180
R.D. 2-ZIP 16254
P O. Box 720-ZIP 16254
Phone: Area 814, 226-4601

B095 SOMERSET

Beckwith Machinery Co.
1001 North Center Avenue-ZIP 15501
P O. Box 630-ZIP 15501
Phone' Area 814, 445-7915
Branch:
Bridgeport, West Virginia

B150 HARRISBURG

Cleveland Brothers Equipment Co., Inc.
5300 Paxton St.-ZIP 17105
P.O. Box 2535-ZIP 17105
Phone: Area 717, 564-2121

B156 HARRISBURG

(e) Cleveland Brothers Equipment Co Inc.
Engine Division (Truck Engine Service)
4491 Chamber Hill Road (Shipping)
P.O. Box 2535 (Mail)
Phone: Area 717, 564-3763

B151 FRACKVILLE

Cleveland Brothers Equipment Co. Inc.
State Route 61-ZIP 17931
P O. Box 4-ZIP 17931
Phone: Area 717, 874-3560

B155 MANSFIELD

Cleveland Brothers Equipment Co . Inc.
R.D. 43-ZIP 16933
P O Box 264-ZIP 16933
Phone: Area 717, 662-7171

B152 PHILIPSBURG

Cleveland Brothers Equipment Co :Inc.
307 Alder Street-ZIP 16866
P O. Box 431--ZIP 16866
Phone. Area 814. 342-4210

B154 WHITE DEERE

Cleveland Brothers Equipment Co Inc.
Old Route 15-ZIP 178867
PO Box 139-ZIP 17887
Phone: Area 717. 538-2551

(e) Engines Only

Main offices In larger-faced type
Branches In smaller-faced type
Alpha-Numerics designate Dealer Code

PENNSYLVANIA (Continued)

B153 WILKES-BARRE
 Cleveland Brothers Equipment Co., Inc.
 970 Wilkes-Barre Township Blvd.
 -ZIP 18703
 P O. Box 1132-ZIP 18703
 Phone: Area 717, 822-8141

B190 BENSALEM (Philadelphia)
 Giles & Ransome. Inc.
 2975 Galloway Road-ZIP 19020
 Phone: Area 215, 639-4300
 Telex: 510-667-1554

B192 FOGELSVILLE
 Giles & Ransome, Inc.
 Route 22 & Snowdrift Road-ZIP 18051
 Phone: Area 215, 3950321
 Branches:
 Bear, Delaware
 Toms River, New Jersey

B194 Bensalem (Philadelphia)
 (e) Ransome Engine Power
 777 American Drive-ZIP 19020
 Wes-Port Industrial Park-ZIP 19020
 Phone: Area 215, 244-0600

RHODE ISLAND

See Hopkinton, Massachusetts, Dealer

SOUTH CAROLINA

D210 COLUMBIA
 Jeff Hunt Machinery Company
 3151 Charleston Highway W.
 Columbia-ZIP 29169
 P.O. Box 328-ZIP 29202
 Phone: Area 803, 791-7100

D211 SUMMERVILLE (Charleston)
 Jeff Hunt Machinery Company
 Frontage Road 1-26, Exit 17 A-ZIP 29483
 P O. Box 1330-ZIP 29483
 Phone: Area 803. 871-2000

D212 GREENVILLE
 Jeff Hunt Machinery Company.,
 Neely Ferry Road, Rte. 3
 Simpsonville 29681
 P O. Box 5095, Station B-ZIP 29606
 Phone: Area 803, 271-9760 (Greenville)
 Area 803, 963-3645 (Simpsonville)

SOUTH DAKOTA

E210 SIOUX FALLS
 Kearns Machinery Co.
 3201 No. Louise Ave.-ZIP 57107
 Exit 81 N. Highway 1-29
 P.O. Box 1307-ZIP 57101
 Phone: Area 605, 336-3010

(e)Engines Only

SOUTH DAKOTA (Continued)

E211 ABERDEEN
 Kearns Machinery Co.
 4950 East Highway 12-ZIP 57401
 P.O Box 36-ZIP 57401
 Phone- Area 605, 225-6240

E212 RAPID CITY
 Kearns Machinery Co
 417 Pine Avenue-ZIP 57701
 P O Box 2070-ZIP 57709
 Phone Area 605, 342-4850

TENNESSEE

D390 KNOXVILLE
 Stowers Machinery Corporation
 6301 Rutledge Pike-ZIP 37914
 P.O. Box 6030-ZIP 37914
 Phone: Area 615, 546-1414

D391 CHATTANOOGA
 Stowers Machinery Corporation
 4066 South Access Road-ZIP 37406
 P O Box 70-ZIP 37401
 Phone: Area 615, 698-6943

D392 JOHNSON CITY
 Stowers Machinery Corporation
 2908 Oakland Avenue-ZIP 37601
 P O. Box 3460, CRS-ZIP 37601
 Phone: Area 615, 282-2000

D460 MEMPHIS
 Taylor Machinery Company
 1291 Corporate Avenue-ZIP 38132
 P.O. Box 16992-ZIP 38116
 Phone: Area 901, 332-3051
 Telex: 5-3963

D466 CAMDEN
 Taylor Machinery Company
 Route 2
 Box 78 A
 Phone Area 901. 584-2732

D463 MEMPHIS
 (e) Taylor Machinery Company
 Truck Engine Division
 1289 Corporate Avenue-ZIP 38116
 Phone- Area 901, 332-3640
 Branches.
 Clarksdale, Mississippi
 Burnsville, Mississippi
 Tupelo, Mississippi

D420 NASHVILLE
 Thompson & Green Machinery Co.. Inc.
 1245 Firestone Boulevard-Lavergne
 -ZIP 37086
 Phone: Area 615, 793-6861 (Lavergne)
 Phone: Area 615, 256-2424 (Nashville)

Main offices In larger-faced type
 Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

TENNESSEE (Continued)

D421 COOKEVILLE

Thompson & Green Machinery Co, Inc.
1410 Interstate Drive-ZIP 38501
Phone. Area 615, 528-8421
(All billings & shipments to Nashville
address (Lavergne)

TEXAS

E090 DALLAS

Darr Equipment Co.
2000 Airport Freeway East-Irving
-ZIP 75062
P O. Box 20737-ZIP 75220
Phone: Area 214, 579-2000
Telex: 73-2396
Metro No.: 445-0060

E091 LONGVIEW

Darr Equipment Co.
Farm Road 1845-ZIP 75607
P O. Box 7070-ZIP 75607
Phone. Area 214, 758-6175

E094 TEXARKANA

Darr Equipment Co
2712 W. Seventh Street-ZIP 75501
P O. Box 1901--ZIP 75501
Phone: Area 214, 793-5582

E092 WACO

Darr Equipment Co.
1700 West Loop 340W-ZIP 76710
P O Box 2411--ZIP 76703
Phone. Area 817, 662-4911

E093 WICHITA FALLS

Darr Equipment Co.
1909 Jacksboro Highway-ZIP 76301
P O Box 1151--ZIP 76307
Phone: Area 817, 767-4384

E095 FORT WORTH

Darr Equipment Co
525 N Jim Wright Freeway-ZIP 76108
P O Box 5067-ZIP 76108
Phone. Area 817, 246-5591

E190 CORPUS CHRISTI

B.D. Holt Co.
1325 S. Padre Island Dr.-ZIP 78403
P.O. Box 1979-ZIP 78403
Phone: Area 512. 853-9933
Telex: 767-544

E194 ARANSAS PASS

B 3 Holt CO
Shrimp Basin
281 Bieglow-ZIP 78336
P O Box Drawer --ZIP 78336
Phone- Area 512. 758-3288

E192 ROWNSVILLE

B D Holt Co
Shrimp Turning Basin
Star Route Box 22-ZIP 78520
Phone- Area 512, 831-9336

TEXAS (Continued)

E193 VICTRO.IA

B D Holt Co
Highway 59 East-ZIP 77901
P O Box 3454-ZIP 77901
Phone Area 512. 573-2438

E191 WESLACO

B D Holt Co
500 E State Highway--ZIP .8596t
P O 80x 3043--ZIP 8596
Phone Area 512. 96e-2181

E200 SAN ANTONIO

Holt Machinery Co.
Holt Avenue and W.W. White Rd.
-ZIP 78293
P.O. Box 658-ZIP 78293
Phone: Area 512, 648-1111
Telex: 76-7444

E201 AUSTIN

Holt Machinery Co.
9601 S Interregional Highway-ZIP 78767
P O. Box 1604-ZIP 78767
Phone Area 512. 282-2011

E202 LAREDO

Holt Machinery Co
Old Mines Road (FM 1472)-ZIP 78041
P.O. Box 3347-ZIP 78041
Phone: Area 512, 722-0075

E300 HOUSTON

Mustang Tractor & Equipment Company
12800 Northwest Freeway, U.S. 290
-ZIP 77040
P.O. Box 1373-ZIP 77001
Phone: Area 713, 460-2000
TWX: 910-881-3624
(Answer Back: MUSTANG 1-HOU)

E310 HOUSTON

(e) Mustang Power Products, Inc.
7777 Washington Avenue
-ZIP 77007
P O. Box 3488-ZIP 77001
Phone: Area 713, 868-6700
Telex: 76-2188
Answer Back "CAT-POWER-HOU"
TWX: 910-881-3624
Answer Back Mustang 1 Hou
Tele-Quip, dial 713-460-2000. ext. 275

E303 BEAUMONT

Mustang Tractor & Equipment Company
7990 Eastex Freeway-ZIP 77706
P O Box 5383-ZIP 77706
Phone Area 713, 392-8412

(e) Engines Only

Main offices In larger-faced type
Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

TEXAS (Continued)**E301 EL CAMPO**

Mustang Tractor & Equipment Company
Hwy 71 North--ZIP 77437
P O Box 48-ZIP 77437
Phone Area 713, 543-3389

E302 LUFKIN

Mustang Tractor & Equipment Company
U S Hwy 69 S E -ZIP 75901
P O Box 1703-ZIP 75901
Phone Area 7,3. 639-5551

E304 BRYAN

Mustang Tractor & Equipment Company
3605 South College St.-ZIP 77801
P C Box 3759-ZIP 77801
Phone:713, 846-7761

E352 EL PASO

Rust Tractor
10501 Dyer St -ZIP 79924
P O Box 4827-ZIP 79914
Phone Area 915, 821-7651
Main Office.
Albuquerque, New Mexico
Branches.
Farmington, New Mexico
Hobbs. New Mexico

E440 ABILENE

Treanor Equipment Company
3601 So. Treadaway Blvd.-ZIP 79602
Phone: Area 915, 692-1600

E441 ODESSA

Treanor Equipment Company
815 West Murphy-ZIP 79763
Phone Area 915, 337-5521

E443 ODESSA

(e) Treanor Equipment Co.
2301 Production Ave.-ZIP 79763
Phone Area 915. 332-1681

E470 AMARILLO

West Texas Equipment Company
1-40 E. & FM 1912--ZIP 79120
P.O. Box 31360-ZIP 79120
Phone: Area 806, 335-1511
Telex: 73-84444

E471 LUBBOCK

West Texas Equipment Company
702 Slaton Road East-ZIP 79408
P O Box 369-ZIP 79408
Phone Area 806. 745-4495
UTAH

E480 SALT LAKE CITY

Wheeler Machinery Co.
4901 West 21st. South-ZIP 84120
Phone: Area 801, 974-0511

E481 SALT LAKE CITY

Wheeler Machinery Co
ICM Division
4899 West 21st South-ZIP 84120
Phone Area 801 974-0388

VERMONT**MONTPELIER**

Jordan-Milton Machinery, Inc.
Northfield Road, Route 12 Berlin
-ZIP 05602
P O Box 429-ZIP 05602
Phone. Area 802, 223-2356
Main Office
Concord. New Hampshire

VIRGINIA**B013 SPRINGFIELD**

Alban Tractor Co.. Inc.
7940 Alban Road-ZIP 22150
1-95 at Fort Belvoir-Newington Exit
P.O. Box 646-ZIP 22150
Phone Area 703. 451-8410
Main Office
Baltimore, Maryland
Branches:
Myersville, Maryland
Salisbury, Maryland

D100 SALEM

Carter Machinery Company, Inc.
1330 Lynchburg Turnpike-ZIP 24153
P.O. box 1096-ZIP 24153
Phone: Area 703, 387-1111
Telex: 82-9311

D105 DANVILLE

Carter Machinery Company, Inc.
Route 2-ZIP 24541
P O. Box 3657-ZIP 24541
Phone: Area 804, 793-7900

D102 NORTON

Carter Machinery Company, Inc.
310 Kentucky Ave. -ZIP 24273
P O Box 349-ZIP 24273
Phone Area 703, 679-1010

D104 OAKWOOD

Carter Machinery Company, Inc.
Rte 460-ZIP 24631
P O. Box 356-ZIP 24631
Phone Area 703, 498-4586
Branches'
Bluefield, West Virginia
Lewisburg, West Virginia

D450 RICHMOND

Virginia Tractor Co., Inc.
1901 Westwood Ave.-ZIP23261
P.O. Box 27306-ZIP 23261
Phone: Area 804, 353-2701
Telex: 828348

D451 CHESAPEAKE

Virginia Tractor Co., Inc.
1712 S. Military Highway-ZIP 23320
P O. Box 1547-ZIP 23320
Phone: Area 804. 424-1444

D452 FISHERVILLE

Virginia Tractor Co., Inc.
Routes 250 and 608-ZIP 22980
P O Box 908 Waynesboro-ZIP 22980
Phone area 703, 949-8111

Main offices in larger-faced type
Branches in smaller-faced type

Alpha-Numerics designate Dealer Code

(e) Engines Only

VIRGINIA (Continued)

D453 HAYMARKET
Virginia Tractor Co., Inc.
15151 Washington Street-ZIP 22069
P O. Box 42-ZIP 22069
Phone: Area 703, 754-7195

D454 RICHMOND
(e) Power Systems and Controls
Subsidiary of Virginia Tractor Co., Inc.
3206 Landale Ave.-ZIP 23230
P.O. Box 27306-ZIP 23261
Phone: Area 804, 355-2803

WASHINGTON

H600 COLFAX
(A) Arrow Industries, Inc.
Highway 195, 5 miles North of
Colfax-ZIP 99111
P.O. Box 70-ZIP 99111
Phone: Area 509, 397-4377

H604 ST JOHN
(A) Arrow Equipment Co
Main & Front Streets-ZIP 99171
PO Box 235-ZIP 99171
Phone: Area 509, 648-3344

H601 LACROSSE
(A) B.E.K. Machinery Co.
W/S Main Street-ZIP 99143
P.O. Box 48-ZIP 99143
Phone: Area 509, 549-3557

H530 SPOKANE
Western States Equipment Company
East 4625 Trent-ZIP 99206
P O. Box 3668-ZIP 99220
Phone: Area 509, 535-1744

H607 TEKOA
(A) Cash Hardware Co., Inc.
S. 102 Ramsey Highway 274
-ZIP 99033
P.O. Box 1019-Zip 99033
Phone: Area 509, 284-2501

H609 FAIRFIELD
(A) Cornwall Machinery Co.
1st & Hamilton-ZIP 99012
P.O. Box 335-ZIP 99012
Phone: Area 509, 283-2212

H612 POMEROY
(A) General Tractor & Implement Co.
1919 East Main-ZIP 99347
P.O. Box 306-ZIP 99347
Phone: Area 509, 843-1691

WASHINGTON (Continued)

H182 LONGVIEW
Halton Tractor Co
1205 Baltimore Street-ZIP 98632
P O Box 536-ZIP 98632
Phone: Area 206, 423-5760
Main Office.
Portland. Oregon
Branches.
The Dalles, Oregon
Salem. Oregon

H250 YAKIMA
Inland Machinery Co.
2100 Terrace Heights Drive
-ZIP 98907
P.O. Box 1669-ZIP.98907
.Phone: Area 509, 248-2371

H251 PASCO
Inland Machinery Co.
1907 E. James Street-ZIP 99301
P.O. Box 2467-ZIP 99301
Phone: Area 509, 547-9541

H252 WALLA WALLA
Inland Machinery Co
102 E Poplar Street--ZIP 99362
P O. Box 1667-ZIP 99362
Phone: Area 509, 525-4740
Branch:
Pendleton, Oregon

H330 SEATTLE
*N C Machinery Co.
Corporate Offices
2715 East Marginal Way South
(Pier 28) ZIP 98134
P.O. Box 3562-ZIP 98124
Phone: Area 206, 583-8700
Cable-Norcom, Seattle
Telex: 32-1245
Shipments to:
17025 West Valley Highway
(Tukwila)-ZIP 98188
P.O. Box 88786 (Tukwila)
-ZIP 98188
Phone: Area 206, 251-5800

H334 CHEHALIS
•N C Machinery Co
1178 Northwest Maryland Avenue
-ZIP 98532
P.O. Box 712-ZIP 98532
Phone: Area 206. 748-8845

H333 MOUNT VERNON
N C Machinery Co
2020 Freeway Drive-ZIP 98273
P.O Box 130-ZIP 98273
Phone: Area 206, 424-4293

(e) Engines Only
(A) Agricultural Dealer

Main offices In larger-faced type
Branches In smaller-faced type
Alpha-Numerics designate Dealer Code

WASHINGTON (Continued)

H331 SEATTLE

*(e) N C Marine
 2500 Westlake Avenue North-ZIP 98109
 Phone' Area 206, 282-6800
 Branches:
 Anchorage, Alaska
 Fairbanks, Alaska
 Juneau, Alaska
 Ketchikan, Alaska
 *Division of Northern Commercial
 Company

H633 ODESSA

(A) Wenz Tractor and Implement
 Company
 8 South Division-ZIP 99159
 P.O. Box 217-ZIP 99159
 Phone: Area 509, 982-2542

WEST VIRGINIA

B094 BRIDGEPORT

Beckwith Machinery Co.
 Route 76-ZIP 26330
 P O. Box 570-ZIP 26330
 Phone: Area 304, 623-2981

D101 Bluefield

Carter Machinery Company, Inc.
 Route 52 North-ZIP 24701
 P O. Box 1538-ZIP 24701
 Phone: Area 304, 325-5411

D103 LEWISBURG

Carter Machinery Company, Inc.
 Rt. 60 West-ZIP 24901
 Rt. 5, Box 23-ZIP 24901
 Phone: Area 304, 645-6440
 Main Office:
 Salem, Virginia
 Branches:
 Danville, Virginia
 Norton, Virginia
 Oakwood, Virginia

D470 CHARLESTON

Cecil I. Walker Machinery Co.
 Route 60 East (Belle, W.Va.)
 ZIP 25015
 P.O. Box 2427-ZIP 25329
 Phone: Area 304, 949-6400
 Telex: 710-938-1674

D473 BECKLEY

Cecil I Walker Machinery Co
 Route 16 South (Crab Orchard)
 -ZIP 25827
 P O Box 1640--ZIP 25801
 Phone Area 304. 253-2701

D476 LOGAN

Cecil I Walker Machinery Co.
 Route 10-ZIP 25601
 P O Box 146 (Earling) ZIP 25619
 Phone: Area 304, 752-0300

WEST VIRGINIA (Continued)

D471

PARKERSBURG
 Cecil I. Walker Machinery Co
 4010 Emerson Avenue-ZIP 26101
 P O. Box 4128-ZIP 26101
 Phone: Area 304, 485-4547

D475

SUMMERSVILLE
 Cecil I. Walker Machinery Co.
 815 Main Street-ZIP 26651
 P O. Drawer D-ZIP 26651
 Phone: Area 304. 872-4303

WISCONSIN

B260

GREEN BAY
 Kramer Machinery Inc.
 600 Hansen Rd. (Highway 41)
 -ZIP 54304
 P.O. Box 1976-ZIP 54305
 Phone: Area 414, 499-0611
 Branch:
 Marquette, Michigan

B310

MADISON
 Nagle-Hart Inc.
 1111 Applegate Road-ZIP 53713
 P.O. Box 9040-ZIP 53715
 Phone: Area 608, 271-6200

8311

EAU CLAIRE
 Nagle-Hart Inc.
 1211 Menomonie Street-ZIP 54701
 Phone: Area 715, 832-6647

8312

MILWAUKEE
 Nagle-Hart Inc.
 11200 W Silver Spring Road-ZIP 53225
 Phone: Area 414, 461-9100

WYOMING

E490

CASPER
 Wyoming Machinery Company
 5050 Old Yellowstone Highway
 -ZIP 82601
 P.O. Box 2335-ZIP 82602
 Phone: Area 307, 265-1000

E491

CHEYENNE
 Wyoming Machinery Company
 1700 Ringsby Road-ZIP 82001
 P O. Box 987-ZIP 82001
 Phone. Area 307, 634-1561

E493

GILLETTE
 Wyoming Machinery Company
 4 miles S on Highway 59-ZIP 82716
 P.O. Box 1238-ZIP 82716
 Phone: Area 307. 686-1500

(e) Engines Only
 (A) Agricultural Dealer

Main offices in larger-faced type
 Branches in smaller-faced type
Alph-Numerics designate Deal Code

PARTS DEPARTMENT

Caterpillar Tractor Co
P.O. Box 16023
Denver, Colorado 80216

Caterpillar Tractor Co
P.O. Box 339
Morton, Illinois 61550

Caterpillar Tractor Co
P.O. Box 18610
Memphis, Tennessee 38118

Caterpillar Tractor Co.
P.O. Box 787
York, Pennsylvania 17405

PARTS DEPOTS

CALIFORNIA

LOS ANGELES

Caterpillar Tractor Co.
2110 S. Davie Ave.-ZIP 90040
Phone: Area 213, 726-6777
Telex: 677-164

HAYWARD

Caterpillar Tractor Co.
25972 Eden Landing Road-ZIP 94545
Phone: Area 415, 783-2550

FLORIDA

MIAMI LAKES

Caterpillar Tractor Co.
15550 N.W. 59th Ave.-ZIP 33014
P.O. Box 4850-ZIP 33014
Phone: Area 305, 557-3180
Telex: 519-288

GEORGIA

ATLANTA

Caterpillar Tractor Co.
1259 Seaboard Industrial Blvd. N.W.
-ZIP 30318
Mail Address: Station N., Box 19776
-ZIP 30325
Phone: Area 404, 351-6160-1-2

INDIANA

INDIANAPOLIS

Caterpillar Tractor Co.
2000 Executive Drive, Park Fletcher
-ZIP 46241
P.O. Box 41314-ZIP 46241
Phone: Area 317, 244-6831-2

LOUISIANA

NEW ORLEANS

Caterpillar Tractor Co.
801 Edwards Avenue
Harahan Industrial Development
-ZIP 70123
P.O. Box 23218-ZIP 70183
Phone: Area 504, 733-7047-8-9
Telex: 58-7400

MINNESOTA

ROSEVILLE

Caterpillar Tractor Co.
1901 West County Road B2-ZIP 55113
Phone: Area 612, 636-1444-5-6

MISSOURI

KANSAS CITY North

Caterpillar Tractor Co.
3512 N.E. 33rd Terrace-ZIP 64117
Phone: Area 816, 453-6302

NEW YORK

ALBANY

Caterpillar Tractor Co., Inc.
37 Warehouse Row-ZIP 12205
Phone: Area 518, 459-3030-31-32

TEXAS

DALLAS

Caterpillar Tractor Co.
2300 Carl Road
Irving, Texas 75062
Phone: Area 214, 438-1424
Telex: 073-237,

WASHINGTON

SPOKANE

Caterpillar Tractor Co.
6811 E. Mission Ave.-ZIP 99206
P.O. Box 11837-ZIP 99211
Phone: Area 509. 924-5700-1-2

**ALPHABETICAL LIST OF DEALERS
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CATERPILLAR U.S. DEALERS

TM 5-3805-248-14&P-3

Main Store

Code No. CENTRAL DIVISION

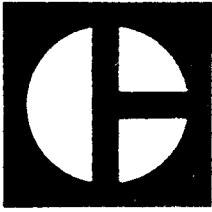
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*N C Machinery Coand N C Marine are alde names used by this dealer for operations in the States of Alaska and Washington

APPENDIX



CATERPILLAR DEALERS
OUTSIDE THE U.S.A.

]

CATERPILLAR TRACTOR CO.
CATERPILLAR AMERICAS CO.
CATERPILLAR OF AUSTRALIA LTD.
CATERPILLAR BRASIL S.A.
CATERPILLAR FAR EAST LTD.
CATERPILLAR MITSUBISHI LTD.
CATERPILLAR OVERSEAS S.A.

THERE IS A CATERPILLAR DEALER NEAR YOU

**CATERPILLAR TRACTOR CO.
100 N.E. Adams
Peoria, Illinois 61629, U.S.A.
Phone: Area 309, 6751000
Telex: 404435**

Caterpillar Tractor Co.
Suite 925, International Square
1850 K Street, N.W.
Washington, D.C. 20006
Phone: Area 202, 466-5090
Telex: 710 822-0198

Caterpillar offices are at all times at the service of our friends when they are visiting each area. The telephone numbers of such offices are listed in the telephone books.

**CATERPILLAR AMERICAS CO.
PEORIA, ILLINOIS U.S.A. 61629**

Caterpillar of Canada Ltd.
1550 Caterpillar Rd.
Mississauga, ON, Canada L4X 1E7
Phone: (416) 279-9901

Telex No.: 06-9611491961151 (From U.S.)

Caterpillar Brasil S.A.
04795-Av. Das Nacoes Unidas, 22.540 (S. Amaro)
Mail Address: Caixa Postal, 8239
01.000-SAO PAULO-SP-BRAZIL
Phones: 247-10111591911100
Cable Address: CATERPILAR SP, BRAZIL
Telex No.: 391-01122824
391-1121496

Caterpillar- Brasil S.A.
Caixa Postal 330
CEP 13400
Piracicaba, SP. Brazil

Caterpillar Brasil S.A.
SBS-Edificio Casa de Sao Paulo
Office No. 9011902
70.000 Brasilia D.F.. Brazil
Telephone: 23-0446 or 260843
Telex No.: 611282

Caterpillar Mexicana S.A. de C.V.
P.O. Box 2781
Monterrey, N.L, Mexico
Phones: 46-45-32133134135
Telex No.: 038-794 (From U.S.)

ARGENTINA

R430 BUENOS AIRES

(INC LT) MACROSA Crothers
Maquinarias
S.A.C.I.F.
Avda. Fondo de la Legua 1232
Martinez (Partido San Isidro)
Mail Address: Casilla de Correo 693
Correo Central
Phones: 792-0021 through 29
Cable Address: MACROSA BAIRES
Telex No.: 012-1739

R434 COMODORO RIVADAVIA. CHUBUT

MACROSA Crothers Maquinarias
S.A.C.I.F.
Alvear 347
Phone: 2324
Telex No.: 015-741

R431 ORDOBA

MACROSA Crothers Mequinarias
S.A.C.I.F.
Avda. Pueyrredon 15418
Phone: 26332
Telex No.: 046-866

R432 MENDOZA

MACROSA Crothers Maquinarias
S.A.C.I.F.
Carril Rodriguez Pena y Urquiza
Zona Industrial Mendoza
5601-Godoy Cruz, Mendoza
Phones: 22-0241/4373
Telex No.: 043-815

R438 NEUQUEN

MACROSA Crothers Maquinarias
S.A.C.I.F.
Intendente Linares. esq. Felix San
Martin
Phone: 2693
Telex No.: 015-84122

ARGENTINA (Cont.)

R437 POSADAS, MISIONES

MACROSA Crother Maquinarias
S.A.C.I.F.
Avda Uruguay esq. Medosa
Phone. 7084
Telex No.: 076125

R433 SALTA

MACROSA Crothers Maquinarias
S.A.C.I.F.
12 de Octubre 793
Phones: 17996, 14127
Tel No.: 044-883
43 TUCUMAN
MACROSA Crothers Maquinarias
S.A.C.I.F.
Avda. General San Martin 102
Banda del Rio Sali
Phone: 21250
Telex No.: 044-880

BAHAMAS

P070 NASSAU

(INC LT) Atlantic Equipment & Power
Ltd.
P.O. Box N-3238
Cable Address: ATLANTIC
Phone: DIRECT DIAL:
1-809-323-5701
Telex No.: NS125

**P071 FREEPORT, GRAND BAHAMA
ISLAND**

Atlantic Equipment & Power Ltd.
P.O. Box F-128
Phone (809) 352-6646

Main offices in larger-faced type
Branches in smaller,-faced type

BOLIVIA**H180** LA PAZ

(INC LT(International Machinery Co.
(Bolivia) S.A.
1075 Calle Mercado
Mail Address: Casilla 852
Phones: 53787, 27535, 56040
Cable Address: INTERMACO LA
PAZ
Telex No.: 5227

R181 COCHABAMBA

International Machinery Co. (Bolivia)
S.A.
Casilla 495
Phone: 24702
ORURO
International Machinery Co. (Bolivia)
S.A.
Casilla 106
Phone 50323

R182 SANTA CRUZ

International Machinery Co. (Bolivia)
S.A.
Casilla 83
Phones: 33957. 24221
TARIJA ·
International Machinery Co. (Bolivia)
S.A.
Casilla
Phone: 3485

BRAZIL**AMORIM****U010** 50.000 RECIFE - PERNAMBUCO

Oscar Amorim Comercio S.A.
Rua Imperial, 1600
Mail Address: Caixa Postal, 564
Phone: 231-0222 Area Code: 081
Cable Address: AMORINS RECIFE
PERNAMBUCO
BRASIL
Telex No.: 081-1045

U013 57.000 MACEI - ALAGOAS

Oscar Amorim Comercio S.A.
Av. Durval de Goes Monteiro, 2545
Tabuleiro dos Martins
Mail Address: Caixa Postal, 1060
Phone: 241-2418, 241.2118
Area Code: 082
Cable Address: AMORINS
MACEIO. ALAGOAS
BRASIL
Telex No.: 082-2171

BRAZIL (Cont.)**BAHEMA****U020** 40.000 SALVADOR - BAHIA

BAHEMA S.A. Tratores e Maquinas
Km. O da Rodovia BR-324 (Retiro)
Mail Address: Caixa Postal, 1370
Phones: 244-4855, 244-4034-244-4434,
244-4234 Area Code: 071
Cable Address: BAHENGI
SALVADOR,
BAHIA, BRASIL
Telex No.: 071-1392-071-1314

U021 49.000 ARACAJU - SERGIPE

BAHEMA S.A. Tratores e Maquinas
Km. 3 da BR-235
Phones: 222-8277. 222-8637/8
Area Code: 079
Cable Address: BAHENGI ARACAJUI
SERGIPE. BRASIL
Telex No.: 079-2132
45.600 ITABUNA - BAHIA
BAHEMA S.A. Tratores e Maquinas
Av. Ibicarai. 858 - Bairro Juca Leao
Phones: 211-3474, 211-2713
Area Code: 073
Cable Address: BAHENGI
FIBUNA. ITABUNA
BAHIA. BRASIL
Telex No.: 073-2142

**48.900 JUAZEIRO - BAHIA -
BRASIL**

BAHEMA S.A. Tratores e Maquinas
Km. 6 da BR 407
Lote No. 2 - Quadra II-A
Distrito Industrial de Sto Francisco
Phone: 2182 Area Code: 081
Telex No.: 811791
45.990 TEIXEIRA DE FREITAS -
(Alcobaca) - BAHIA - BRASIL
BAHEMA S.A. Tratores e Maquinas
Km. 359 da BR 101
65.000 SAO LUIZ - MARANHAO -
BRASIL

BAHEMA S.A. Tratores e Maquinas
Av. Santos Dumont. 380 - Tirirical
Mail Address: Caixa Postal. 502
Phones: 225-1262. 225-1360
Area Code: 098
Telex No.: 098-2296

64.000 TERESINA - PIAUI - BRASIL
BAHEMA S.A. Tratores e Maquinas
Av. Barao de Gurgueia. 27505
Mail Address: Caixa Postal. 355 and 517
Phone: 222-8912 Area Code: 086
Telex No.: 086-2148

BRAZIL (Cont.)**FIGUERAS****U090**90.000 PORTO ALEGRE - RS

Figueras S.A.
 Av. Assis Brasil, 164
 Mail Address: Caixa Postal, 245
 Phones: 42-4877, 42-4078,
 42-4678, 42-4576
 Area Code: 0512
 Cable Address: FIGERSA P.
 ALEGRE, RIO
 GRANDE DO
 SUL, BRASIL
 Telex No.: 051-1252

89.100 BLUMENAU - SANTA
CATARINA

Figueras S.A.
 Rua S4o Paulo, 2711
 Mail Address: Caixa Postal, 819
 Phone: 22-4588. 22-4378
 Area Code: 0473
 Cable Address: FIGERSA -
 BLUMENAU SANTA
 CATARINA. BRASIL
 Telex No.: 047-3178

96.500 CACHOEIRA DO SUL - RS

Figueras S.A.
 Rua Marcilio Dias, 767
 Mail Address: Caixa Postal. 182
 Phones: 22-2450. 22-2550
 Area Code: 0517
 Cable Address: FIGERSA
 CACHOEIRA DO SUL
 RS. BRASIL
 Telex No.: (052) 1795

U10096.100 PELOTAS - RS

Rua Princess Isabel, 207'211
 Mail Address: Caixa Postal, 315
 Phone: 22-7065, 22-1366. 22-5368
 Area Code: 0532
 Cable Address: FIGERSA PELOTAS
 RIO GRANDE
 DO SUL. BRASIL
 Telex No.' 053-2154

97.500 URUGUAIANA - RS

FIGUERAS S.A.
 Rua Duque de Caxias. 2757
 Mail Address: Caixa Postal. 90
 Phones: 412-1870, 412-1613
 Area Code: 055
 Cable Address: FIGERSA
 URUGUAIANA. RIO
 GRANDE DO
 SUL. BRASIL
 Telex No.: 055-2167

89.800 CHAPECO - SC

Figueras S.A.
 Rodovia SC-22-K.4
 Bairro Efapi
 Phone: 22-0857 Area Code: 0497
 Cable Address: FIGERSA CHAPECO
 SANTA

CATARINA. BRASIL

Telex No. 047-3313

BRAZIL (Cont.)**U091**88.000 FLORIANOPOLIS - SC

Figueras S.A.
 Rua Felipe Schmidt 58 - Gal.
 Comasa - L18
 Mail Address: Caixa Postal - 444
 Phone: 22-5036 Area Code: 0482
 Cable Address: FIGERSA
 FLORIANOPOLIS
 SANTA
 CATARINA. BRASIL
 LION

U13001.000 SAO PAULO - SP

Lion S.A. Engenharia e Importacao
 Praqo 9 de Julho, 100
 Mail Address: Caixa Postal, 44
 Phones: 278-0211, 278-1666
 Area Code: 011
 Cable Address: LIONN SAO PAULO,
 SAO PAULO,
 BRASIL
 Telex No.: (011) 24-230, (011) 21-184
 (Parts)/(I011) 21-786 (Parts)

U13316.900 ANDRADINA - SAO PAULO

Lion S.A. Engenharia e Importacao
 Rua Paes Lame, 1039
 Mail Address: Caixa Postal. 95
 Phones: 22-3151. 22-3152, 22-3153
 Area Code:0187
 Cable Address: LIONFILIAL
 ANDRADINA.
 SAO PAULO
 BRASIL

U13217.100 BAURU - SAO PAULO

Lion S.A. Engenharia e Importacao
 Rua Cel. Gustavo Maciel. 6-26
 Mail Address: Caixa Postal. 25
 Phone: 22-6654 Area Code'-: 0142
 Cable Address: LIONFILIAL
 BAURU. SAO
 PAULO, BRASIL
 Telex No.: 014-2134
 14.100 RIBEIRAO PRETO - SAO
 PAULO

Lion S.A. Engenharia e Importacao
 Rua Henrique Dumont. 1465
 Mail Address: Caixa Postal. 502
 Phone: 25-2565 Area Code: 0166
 Cable Address: LIONFILIAL
 RIBEIRAO PRETO
 SAO PAULO. BRASIL
 Telex No.: 016-6174

U14111.100 SANTOS - SAO PAULO

Lion S.A. Engenharia e Importacao
 Av. Dr. Waldemar Leao. 70
 Mail Address: Caixa Postal 80
 Phone: 32-4233 Area Code: 0132
 Cable Address:
 LIONFILIAL SANTOS. SAO
 PAULO, BRASIL, Telex No.. 013-1141

Main offices in larger-faced type
 Branches in smaller-faced type

BRAZIL (Cont.)

- U143** 1.100 SAO JOSE DO RIO PRETO-
SAO PAULO
Lion S.A. Engenharia e Importacao
Av. Tarraf. 2710
Mail Address: Caixa Postal, 576
Phone: 32-8111 Area Code: 0172
Cable Address:
LIONFILIAL - SXO JOSE DO
RIO PRETO
SAO PAULO. BRASIL
Telex No.: 0172-103
- U131** 79.100 CAMPO GRANDE-
MATO GROSSO DO SUL
Lion S.A. Engenharia e Importacao
Rua 7 de Setembro, 234
Mail Address: Caixa Postal, 441
Phones: 624-4424, 624-4428
Area Code: 067
Cable Address: LIONFILIAL
CAMPO GRANDE.
MATO GROSSO DO SUL.
BRASIL
Telex No.: 067-2134
- U135** 78.000 CUIABA - MATO GROSSO
Lion S.A. Engenharia e Importacao
Av. Perimetral sin
Bairro Pico do Amor
Mail Address: Caixa Postal. 145
Phones: 2074. 2926, 3832 Area Code:
065
Cable Address: LIONFILIAL
CUIABA. MATO
GROSSO. BRASIL
Telex No.: 065-2120
- U134** 13.100 CAMPINAS - SXO PAULO
Lion S.A. Engenharia e Importacao
Av. Orozimbo Maia, 1062
Mail Address: Caixa Postal, 1650
Phone: 51-2555 Area Code: 0192
Cable Address: LIONFILIAL
CAMPINAS. SAO
PAULO, BRASIL
Telex No.: 019-1064
- 19.100 PRESIDENTE PRUDENTE-
SAO PAULO
Lion S.A. Engenharia e Importacao
Av. Manoel Goulart. 1655
Vila Charlotte
Mail Address: Caixa Postal. 614
Phones: 33-2822. 33-2208 Area Code:
0182
Cable Address: LIONFILIAL
PRESIDENTE
PRUDENTE SAO PAULO, BRASIL
Telex No.: 0182-112
- U142** 12.200 SAO JOSE DOS CAMPOS
SAO PAULO
Lion S.A. Engenharia e Importacao
Av. Dinamarca. 225

Mail Address: Caixa Postal. 1037
Phone: 21-6800 Area Code: 0123
Cable Address: LIONFILIAL
SAO JOSE
DOS CAMPOS
SAO PAULO. BRASIL, Telex No.. 011-25111

BRAZIL (Cont.)

- LION AMAZONIA S.A.
(LION S.A. SUBSIDIARY)
69.000 MANAUS - AMAZONAS-
BRASIL
Lion Amazonia S.A.
Rodovia Torquato Tapaj6s, 3280 Km. 4
Mail Address: Caixa Postal, 578
Phones: 234-5865, 236-2200
Area Code: 092
Telex No.: 092-2264
78.900 PORTO VELHO - TERRITORIO
FEDERAL DE RONDONIA-BRASIL
Lion Amazonia S.A.
Rua Dom Pedro II. 1190
Phones: 221-3194, 221-3478, 221-2269
Area Code: 069
Telex No.: 069-2121
MARCOSA
- U150** 60.000 FORTALEZA - CEARA
Marcosa S.A. Maquinas e
Equipamentos
Rua Dr. Joao Moreira, 359161
Mail Address: Caixa Postal, 538
Phones: 231-1088, 231-1987, 231-1656
231-1413 Area Code: 085
Pres.: 231-1540
V. Pres.: 231-1219
Cable Address: CEMARCOSA
FORTALEZA,
CEARA, BRASIL
Telex No.: 085-1166
58.000 JOAO PESSOA - PARAIBA
Marcosa S.A. Maquinas e Equipamentos
BR-101. no.: 235 - Distrito Industrial
Mail Address: Caixa Postal. 191
Phone: 221-310 Area Code: 083
Cable Address: JOIARCOSA
JOAO PESSOA.
PARAIBA. BRASIL
Telex No.: 083-2121
59.000 NATAL
RIO GRANDE DO NORTE
Marcosa S.A. Maquinas e Equipamentos
Rua Antonio Basilio. 1370
Logoa Nova
Mail Address: Caixa Postal - 317
Phones: 231-3383. 231-4262
Area Code: 084
Cable Address: NORMARCOSA NATAL
RIO GRANDE
DO NORTE. BRASIL
Telex No.: 0842-190

Main offices in larger-faced type
Branch- In smaller-faced type

BRAZIL (Cont.)**PARANA****U17080.000 CURITIBA - PARANA**

Parana Equipamentos S.A.
Rodovia Regis Bittencourt,
BR-116. Km. 404
Mail Address: Caixa Postal, 929
Phone: 76-1011 Area Code: 0412
Cable Address: EQUIPAMENTO
CURITIBA, PARANA, BRASIL
Telex No.: 041-5195, 041-5020

U17285.800 CASCAVEL - PARANA

Parana Equipamentos S.A.
Rodovia Federal (BR-277) - Km. 400
Mail Address: Caixa Postal. 122
Phones: 23-9322, 23-9383 Area Code: 0452
Cable Address: EQUIPAMENTO
CASCAVEL. PARANA, BRASIL
Telex No.: 0452-134

U17186.100 LONDRINA-PARANA

Parana Equipamentos S.A.
Rodovia Londrina-Cambe BR-369) Km. 4
Jardim Jockey Club
Mail Address: Caixa Postal 1614
Phones: 27-2044, 27-2711. 27-2843
Area Code: 0432
Cable Address: LAGARTO
LONDRINA. PARANA, BRASIL
Telex No.: 043-2169

SOTREQ**U19020.000 RIO DE JANEIRO -**

RIO DE JANEIRO
Sotreq S.A. de Tratores e
Equipamentos
Av. Brasil. 7200
Mail Address: Caixa Postal, 20
(Centro)
Phones: 270-4712, 260-5236. 260-9036
Cable Address: SOTREQ-RIO
DE JANEIRO
RIO DE JANEIRO,
BRASIL
Telex No.: 021-21973121608

U19729.000 VITORIA - ESPIRITO SANTO

Sotreq S.A. de Tratores e Equipamentos
Av. Vit6na. 2518 -- Horto
Mail Address: Caixa Postal 483
Phones: 223-4311. 223-3763. 223-4372
Area Code: 027
Cable Address: SOTREQ-
VITORIA ESPIRITO
SANTO. BRASIL
Telex No.: 027-2153

**U19130.000 BELO HORIZONTE-
MINAS GERAIS**

Sotreq S.A. de Tratores e Equipamentos
Rua Prof. Jerson Martins, 166
Pampulha
Mail Address: Caixa Postal, 858

Phones: 441-2822, 441-4755
Area Code: 031
Cable Address: SOTREQMINAS
B. HORIZONTE.
MINAS GERAIS, BRASIL
Telex No.: 031-1388

U19638.400 UBERLANDIA-MINAS GERAIS

Sotreq S.A. de Tratores e Equipamentos
Av. Vasconcelos Costa. 1646
Mail Address: Caixa Postal. 370
Phones: 235-2300 Area Code: 034
Cable Address: SOT.REQ-
Uberlandia M.,BRASIL
Telex No.: 034-3176

U19474.000 GOIANIA -- GOIAS

Sotreq S.A. de Tratores e Equipamentos
Av. Meia Ponte. 3080
Bairro de Sta. Genoveva
Mail Address: Caixa Postal 312
Phones: 261-2000, 261-2140. 261-1031
Area Code 062
Cable Address: SOTREQ
GOIANIA GOIAS, BRASIL
Telex No.: 062-2134

U19370.000 BRASILIA - DISTRITO

FEDERAL
Sotreq S.A. de Tratores e Equipamentos
Setor Industrial A. Trecho 2. Lotes
5101520
Phones: 233-3145. 233-1432, 233-1575
Area Code: 061
Cable Address: SOTREQ-
BRASILIA DISTRITO
FEDERAL. BRASIL
Telex No.: 061-1436

U19266.000 BELEM - PARA - BRASIL

Sotreq S.A. de Tratores e Equipamentos
Av. Almirante Barroso 3864
Phones: 231-4911. 2310212, 231-4812
Area Code: 091
Telex No.. 091-1021
CANADA

N170 EDMONTON, ALBERTA T5J 2S1

(INC LT) R. Angus Alberta Limited
16900 107 Avenue
Mail Address: P.O. Box 2405
Phone: 483-3636 Area Code: 403
Telex No.: Rangusalta EDM 037-2467
(New Building) 037-3336

N171 PEACE RIVER, ALBERTA TOH 2X0

R. Angus Alberta Limited
Industrial Park
Mail Address: P O Box 220
Phone 624-1550 Area Code: 403
Telex No. 037-51527

(INC LT) Including Lift Trucks

Main offices in larger-faced type
Branches in smaller-faced type

CANADA (Cont.)

- N172** GRAND PRAIRIE, ALBERTA T8V 3J9
R. Angus Alberta Limited
11115-100 Avenue
Mail Address: P.O. Box 336
Phone: 523-8811 Area Code: 403
Telex No.: 036-7438
- N173** FORT MCMURRAY, ALBERTA TOA 1KO
R. Angus Alberta Limited
P.O. Box 5663
Phone: 743-2218 Area Code: 403
Telex No.: 037-5413
- N174** CALGARY, ALBERTA T2H 1W9
R. Angus Alberta Limited
4015 Eighth St. S.E.
Mail Address: Postal Station "A"
Phone: 243-2751 Area Code: 403
Telex No.: CGY 0038-22546
- N175** LETHBRIDGE, ALBERTA T1J 4A4
R. Angus Alberta Limited
717 Fifth Avenue North
Mail Address: P.O. Box 1178
Phone: 328-3366 Area Code: 403
Telex No.: 038-49213
N176 RED DEER, ALBERTA P4P 1A9
R. Angus Alberta Limited
6740-67 Avenue
Mail Address: P.O. Box 525
Phone: 347-1107 Area Code: 403
Telex No.: 03-83149
- N177** INUVIK, NORTHWEST
TERRITORIES XOE OTO
R. Angus Alberta Limited
P.O. Box 1278
Phone: 979-2551 Area Code: 403
Telex No.: 034-44542
- N178** HAY RIVER, NORTHWEST
TERRITORIES
XOE ORO
R. Angus Alberta Limited
P.O. Box 1336
Phone: 874-6537 Area Code: 403
Telex No.: 034-4255
- N030** VANCOUVER, BRITISH
COLUMBIA V5T 1E2
(INC LT) Finning Tractor &
Equipment Company Limited
555 Great Northern Way
Phone: 872-4444 Area Code: 604
Telex No.: Finning VCR 04-508717
- N032** CRANBROOK, BRITISH
COLUMBIA V1C 3S2
Finning Tractor & Equipment
Company Limited
815 Cranbrook Street
Phone: 426-6631 Area Code: 604
Telex No.: CBK 041-45224
- N033** DAWSON CREEK, BRITISH
COLUMBIA V2C .5K
Finning Tractor & Equipment
Company Limited
P O Box 39
Phone: -82-5841 Area Code. 604
Telex No DCK 036-77147

CANADA (Cont.)

- 1034 NELSON, BRITISH COLUMBIA
VIL 5R3
Finning Tractor & Equipment
Company Limited
P O. Box 510
Phone: 352-662213 Area Code: 604
Telex No.. NLSN 041-545
- N035** PRINCE GEORGE, BRITISH
COLUMBIA V2N 2K8
Finning Tractor & Equipment
Company Limited
1100 Pacific Street
Phone: 563-0331 Area Code: 604
Telex No.: PGEO 047-8720
- N036** TERRACE, BRITISH
COLUMBIA V8G 1K3
Finning Tractor & Equipment
Company Limited
4621 Keith Road
Phone: 635-7144 Area Code: 604
Telex No.: TERR 610-987-6007
- N037** VERNON, BRITISH
COLUMBIA V1T 6M4
Finning Tractor & Equipment
Company Limited
P. O. Box 459
Phone: 545-2321 Area Code: 604
Telex No.: VRN 610-985-8320
- N039** WILLIAMS LAKE, BRITISH
COLUMBIA V2G 1C9
Finning Tractor & Equipment
Company Limited
450 Mackenzie Avenue South
Phone: 392-3381 Area Code: 604
Telex No.: WMSLK 610-968-2010
- N061** SPARWOOD, BRITISH
COLUMBIA VOB 2G0
Finning Tractor & Equipment
Company Limited
P O. Box 1300
Phone. 425-6282 Area Code: 604
Telex No.: NTL 610-973-6096
- N064** KAMLOOPS, BRITISH
COLUMBIA V2C 5K7
Finning Tractor & Equipment
Company Limited
P. O. Box 180
Phone: 372-9552 Area Code: 604
Telex No.. KAM 048-8276
- N065** WHITEHORSE, YUKON
TERRITORY Y1A 3S9
Finning Tractor & Equipment
Company Limited
143 Industrial Road
Mail Address: P. O Box 4038
Phone: 667-6451 Area Code' 403
Telex No: WHSE 036-8221
- N087** HOUSTON, BRITISH
COLUMBIA VOJ 1Z0
Finning Tractor & Equipment
Company Limited
P O Box 700
Phone: 845-2213 Area Code: 604
Telex No.. HSTN 610-988-9405

(INC LT) Including lift Trucks

Main offices in larger-faced type
Branches in smaller-faced type

CANADA (Cont.)

VICTORIA. BRITISH
 COLUMBIA VSZ 1S4
 Finning Tractor & Equipment
 Company Limited
 27 Crease Avenue
 Phone: 384-414415 Area Code: 604
 Telex No.: VIC 04-508717

CAMPBELL RIVER, BRITISH
 COLUMBIA V9W 3M7
 Finning Tractor & Equipment
 Company Limited
 1604 Willow Street
 Phone: 287-749415 Area Code: 604
 Telex No.: CMRVR 04-508717

NANAIMO. BRITISH
 COLUMBIA V9S 4M8
 Finning Tractor & Equipment
 Company Limited
 2298 McCulloch Road
 Phone: 758-5237/8 Area Code: 604
 Telex No.: NAN 610-942-4011

PORT HARDY, BRITISH
 COLUMBIA VON 2PO
 Finning Tractor & Equipment
 Company Limited
 P. O. Box 310
 Phone: 949-6121 Area Code: 604
 Telex No.: 610 975-7015

CHILLIWACK., BRITISH
 COLUMBIA V2P 6J4
 Finning Tractor & Equipment
 Company Limited
 44375 Yale Road West
 Mail Address: P. O. Box 362
 Phone: 692-1918 Area Code: 604
 Telex No.: 610-922-6024

N063 QUESNEL, BRITISH
 COLUMBIA V2J 378
 Finning Tractor & Equipment
 Company Limited
 P. O. Box 4610
 Phone: 992-7051 Area Code: 604
 Telex No.: 047-82554

NO68 MACKENZIE. BRITISH
 COLUMBIA VOJ 2C0
 Finning Tractor & Equipment
 Company Limited
 PGE Industrial Site
 Mail Address: P. O. Box 309
 Phone: 977-3216 Area Code: 604
 Telex No.: 610-972-3007

N082 REVELSTOKE. BRITISH
 COLUMBIA VOE 2SO
 Finning Tractor & Equipment
 Company Limited
 .33 Highway 23
 Mail Address: P.O. Box 1920
 Phone: 837-5201 Area Code: 604
 Telex No.: 048-87533

LANGLEY. BRITISH COLUMBIA
 V3A 5K7
 Finning Tractor & Equipment
 Company Limited
 20150 No. 10 Langley Bypass
 Phone: (604) 533-1244
 Telex: 610-963-394i

CANADA (Cont.)

MANITOBA
N120 WINNIPEG, MANITOBA R3T IL8
 (INC LT) Powell Equipment Limited
 1455 Buffalo Place
 Phone: 453-4343 Area Code: 204
 Telex No.: POWCO WPG 03-5550

N121 BRANDON. MANITOBA R7B OR9
 Powell Equipment Limited
 1906 Park Avenue
 Phone: 727-2418 Area Code: 204
 Telex No.: 502749

N126 THOMPSON, MANITOBA R8N IM4
 Powell Equipment Limited
 108 Hayes Road
 Phone: 788-7004 Area Code: 204
 Telex No.: 033-4520

NA90 WINNIPEG, MANITOBA R3T OM8
 (LT) POWLIFT TRUCKS & SYSTEMS
 100 Otter Street
 Phone: 475-2720 Area Code: 204
 Telex No. 07-587886

NEW BRUNSWICK

N160 FREDERICTON,
 NEW BRUNSWICK E3B 5E4
 (INC LT) Tractors & Equipment (1962)
 Limited
 471 Smythe Street
 Mail Address: P.O. Box 1326
 Phone: 454-6651 Area Code: 506
 Telex No.: 014-46116

NEWFOUNDLAND

N090 ST. JOHN'S, NEW-
 FOUNDLAND A1B 3S2
 (INC LT) Newfoundland Tractor &
 Equipment Co., Ltd.
 P.O. Box 8940, Station "A"
 Phone: 722-5660 Area Code: 709
 Telex No.: 016-4575

N091 CORNER BROOK,
 NEWFOUNDLAND A2H 6E3
 Newfoundland Tractor & Equipment
 Co.. Ltd.
 P O. Box 430
 Phone: 634-8258 Area Code: 709
 Telex No.: 016-44157

N092 GRAND FALLS. NEWFOUNDLAND
 A2A 2J3
 Newfoundland Tractor & Equipment
 Co.. Ltd.
 P O. Box 100
 Phone: 489-2131 Area Code: 709
 Telex No.: 016-4232

(INC LT) Including Lift Trucks

Main offices in larger-faced type
 Branches Lm smaller-faced type

CANADA (Cont.)

N094 GOOSEBAY, LABRADOR
Newfoundland Tractor & Equipment Co.,
Ltd.
P.O. Box 510
Goosebay Airport
Phone: 896-5864 Area Code: 709
Telex No.: 016-2255

NOVA SCOTIA

N140 HALIFAX, NOVA SCOTIA B3K 5J2
(INC LT) N.S. Tractors & Equipment
Ltd.
3575 Kempt Road
Mail Address: P.O. Box 1420
Phone: 4566-0581 Area Code: 902
Telex No.: 019-21761
SYDNEY, NOVA SCOTIA
N.S. Tractors & Equipment Ltd.
P.O. Box 1202
Phone: (902) 564-8166
Telex: 019-35165

PRINCE EDWARD ISLAND

N110 CHARLOTTETOWN, PRINCE
EDWARD ISLAND CIA 7L1
(INC LT) A. Pickard Machinery (1971)
Limited
P.O. Box 545
Phone: 894-7329 Area Code: 902
Telex No.: 014-4411
ONTARIO

N020 CONCORD, ONTARIO L4K 1E2
(INC LT) Crothers Limited
One Crothers Drive, Highway 7
& Jane
Mail Address: P.O. Box 5511
Phone: 667-5511 Area Code: 416
Telex No.: TOR 06-964654

N022 STONEY CREEK, HAMILTON,
ONTARIO L5E 2P8
Crothers Limited
460 South Service Road Const. Esq.)
Phone: 561-5901 Area Code: 416
Telex No.: 021-781

NB34 STONEY CREEK, HAMILTON,
ONTARIO L8E 3H6
ILT) Crothers Limited
180 South Service Road
Phone: 561-6771 Area Code: 416
Telex No.: 021-8428

N023 OTTAWA IHAZELDEAN),
ONTARIO K2L 1V7
Crothers Limited
5 Edgewater Street
Mail Address: P.O. Box 190
Phone: 836-5171 Area Code: 613
Telex No.: 012-3291

CANADA (Cont.)

N025 SUDBURY, ONTARIO P3A 4R9
Crothers Limited
1818 Falconbridge Road
Mail Address: P.O. Box 2184
Phone: 566-1911 Area Code: 705
Telex No.: 027-7421

N026 TIMMINS, ONTARIO P4N 7H6
Crothers Limited
24 Government Road
Mail Address: P.O. Box 1002
Phone: 264-5297 Area Code: 705
Telex No.: 02-277429

N027 LONDON, ONTARIO N6A 4C5
Crothers Limited
50 Enterprise Drive
Pond Mills Industrial Park
Phone: 681-1900 Area Code: 519
Telex No.: 024477

NB37 LONDON, ONTARIO N6E 1P6
(LT) Crothers Limited
1044 Hargrieve Road
Phone: 681-7820 Area Code: 519

N028 SAULT STE. MARIE, ONTARIO
P3A 4R9
Crothers Limited
1207 Great Northern Road
Mail Address: P.O. Box 533
Phone: 949-93001930319304
Area Code: 706

ORILLIA, ONTARIO L3V 6H8
Crothers Limited Orillia Industrial Park
Mail Address: P.O. Box 968
Phone: 325-7473 Area Code: 705
Telex No.: 02-29968
HEARST, ONTARIO POL 1N0
Crothers Limited Highway No. 11 East
Mail Address: P.O. Box 1810
Phone: 362-4276 Area Code: 705

PETERBOROUGH, ONTARIO
Crothers Limited
R.R. #3 Highway #7 By-Pass
South Service Road
P.O. Box 1136
Phone: (705) 743-9622

NB30 MALTON, ONTARIO L4V IB3
(LT) Crothers Lift
3210 American Drive
Phone: 678-7111 Area Code: 416
Telex No.: CROLFT MALTON 610-492-
2609

N124 THUNDER BAY, ONTARIO P7C 4Y3
Powell Equipment Limited
620 Beaverhall Place
Mail Address: P.O. Box 1500
Phone: 577-5701 Area Code: S07
Telex No.: 033-213
QUEBEC NOSO MONTREAL, QUEBEC
H9R IB8
(INC LT) Hewitt Equipment Limited
5001 Trans-Canada Highway,
Pointe Claire
Mail Address: P.O. Box 1200
H9R 4R6
Phone: 697-6911 Area Code: 514
Telex No.: 058-21625

(INC LT) Including Lift Trucks

Main offices in larger-faced type
Branches in smaller-faced type

CANADA (Cont.)

- N051** QUEBEC CITY. QUEBEC G01 3E0
Hewitt Equipment Limited
Parc Industriel Metropolitan de Quebec
Mail Address: P.O. Box 1125 GIK 7C4
Phone: 878-3000 Area Code: 418
Telex No.: 011-3090
- N052** SEVEN ISLANDS, QUEBEC G4R 4K6
Hewitt Equipment Limited
400 Laure Boulevard
Mail Address: P.O. Box 400
Phone: 962-7791 Area Code: 418
Telex No.: 011-8473
- N053** VAL D'OR. QUEBEC J9P 4P8
Hewitt Equipment Limited
400 Lamaque Boulevard
Mail Address: P.O. Box 787
Phone: 824-2783 Area Code: 819
Telex No.: 057-45545
- N054** JAMES BAY, QUEBEC JOY 2V0
Hewitt Equipment Limited
Industrial Park LG2
Phone: 638-8381 Area Code: 819
Telex No.: 057-3515
- N055** CHICOUTIMI, QUEBEC G7H 5B3
Hewitt Equipment Limited
820, Route 170
Mail Address: P.O. Box 5050
Phone: 545-1560 Area Code: 514
Telex No.: 011-36156
- N054** HULL, QUEBEC J8Y 352
Hewitt Equipment Limited
40 Boulevard J. Adrien Robert
Phone: 770-1601 Area Code: 819
Telex No.: 053-3182
- NA40** ST. LAURENT. QUEBEC H4S 1K4
Hewitt Equipment Limited
Material Handling Division
3000 Pitfield Blvd.
Phone: (514) 334-5260
Telex No.: 05-825580
- SASKATCHEWAN
- N070** REGINA, SASKATCHEWAN
S4P 3A8
(INC LT) Kramer Tractor Ltd.
Pasqua Street North at Highway 11
Mail Address: P.O. Box 707
Phone: 545-3311 Area Code: 306
Telex No.: 031-2221
- N071** SASKATOON. SASKATCHEWAN
S7K 3K4
Kramer Tractor Ltd.
3502-11th St. West
Mail Address: P.O. Box 140
Phone: 382-3550 Area Code: 306
Telex No.: 074-2284
- N072** TISDALE, SASKATCHEWAN SOE ITO
Kramer Tractor Ltd.
P.O. Box 420
Phone: 873-2613 Area Code: 306
Telex No.: 074-2284
- ESTEVAN. SASKATCHEWAN S4A 2A6
Kramer Tractor Ltd.
P.O. Box 607
Phone: 1306) 634-3311
Telex: 20516

CHILE

- R120** SANTIAGO
(INC LT) Gildemeister S.A.C.
Aminatogui 178
Mail Address: Casilla 99-D
Phone: 82525
Cable Address: GILDEMEIST
SANTIAGO.
CHILE
Telex Nos.: 40588, 40589
- R123** ANTOFAGASTA
Gildemeister S.A.C.
Casilla 770
- R121** ARICA
Gildemeister S.A.C.
Casilla 19-D
CHILLAN
Gildemeister S.A.C.
Casilla 25-D
CONCEPCION
Gildemeister S.A.C.
Casilla 38-C
- R124** COQUIMBO
Gildemeister S.A.C.
Casilla 12-D
- R122** IQUIQUE
Gildemeister S.A.C.
Casilla 5-D
- LOS ANGELES
Gildemeister S.A.C.
Casilla 637
- OSORNO
Gildemeister S.A.C.
Casilla 44-0
- OVALLE
Gildemeister S.A.C.
Casilla 213
- PUERTO VARAS
Gildemeister S.A.C.
Casilla 1695
- R125** PUNTA ARENAS
Gildemeister S.A.C.
Casilla 21-D
- RANCAGUA
Gildemeister S.A.C.
Casilla 282
- SAN FERNANDO
Gildemeister S.A.C.
Casilla 141
- TALCA
Gildemeister S.A.C.
Casilla 552
- TEMUCO
Gildemeister S.A.C.
Casilla 29-D
- VALDIVIA
Gildemeister S.A.C.
Casilla 63-D
- R128** VALPARAISO
Gildemeister S.A.C.
Casilla 87-V

Main offices in larger-faced type
Branches in smaller-faced type

COLOMBIA

R460 BOGOTA

(INC LT) General Electric de Colombia S.A.
 Km. 7 Carretera a Bosa
 Mail Address: Apartado Aereo 3644 y 6799
 Phones: 38-20-40; 38-40-20 (Machinery Department)
 Cable Address: GECOLSA BOGOTA
 Telex No.: 044-7041 044-809
 (Internacional) AGUACHICA
 Carrera 12 No. 3-104
 Apartado Aereo 102
 Phone: 06

R461 BARRANQUILLA

General Electric de Colombia S.A.
 Carrera 46 No. 34-146
 Mail Address: Apartado Aereo 100 or 2740
 Phones: 319387, 324487, 313898, 315580
 Cable Address: GECOLSA BARRANQUILLA
 Telex No.: 033352

R464 BUCARAMANGA

General Electric de Colombia S.A.
 Ave. Quebrada Seca No. 33A-55
 Mail Address: Apartado Aereo 401
 Phone: 56243-55993-56154
 Cable Address: GECOLSA BUCARAMANGA
 Telex No.: 077764
 BUENAVENTURA
 General Electric de Colombia S.A.
 Kilometro 4 Via El Pinal Locales Arpecol
 Mail Address: Apartado Aereo 827
 Phone: 2469
 Cable Address: GECOLSA BUENAVENTURA

R482 CALI

General Electric de Colombia S.A.
 Kilometro 4 Carretera Cali-Yumbo
 Mail Address: Apartado Aereo 36
 Phones: 682101, 213-641580
 Cable Address: GECOLSA CALI
 Telex No.: 055560

CARTAGENA

Urbamrziaci6n Club Campestre
 Sector Ceballos. Carretera A
 Mamonal Carrera 56 No. 12-63
 Phones: 85358-85025
 Apartado Aereo 3596

CUCUTA

Calle 7 No. 1-60
 Phone: 43085
 Apartado Aereo 1064

R466 IBAGUE

General Electric de Colombia S.A.
 Kilometro 3 Via Armero, Barrio El Jordan
 Mail Address: Apartado Aereo 779
 Phone: 33139-33322
 Cable Address: GECOLSA IBAGUE
 Telex No.: 047160

COLONMBIA (Cont.)

R483 MEDEI,LIN

General Electric de Colombia S.A.
 Carrera 50 No. 32-182
 Mail Address- Apartado Aereo 778
 Phones: 350329, 320707. 321147-321267
 Cable Address: GECOLSA MEDELLIN
 Telex No.: 06709

NEIVA

General Electric de Colombia S.A.
 Carrera 5 No. i0-80
 Mail Address: Apartado Aereo 263
 Phone: 23001
 Cable Address: GECOLSA NEIVA
 Telex No.: 049754

PEREIRA

General Electric de Colombia S.A.
 Calle 17 No. 16B-09
 Mail Address: Apartado Aereo 537
 Phone: 42574-49955
 Telex. 08875

R465 SINCELEJO

General Electric de Colombia S.A.
 Calle 38 No. 31-527
 Mail Address: Apartado Aereo 279
 Phones: 21106, 20102
 Cable Address: GECOLSA SINCELEJO
 Telex No.: 03669

R487 VALLEDUPAR

General Electric de Colombia S.A.
 Km. 1 Carretera A. Fundacion
 Mail Address: Apartado Aereo 170
 Phone: 5264, 51,1
 Cable Address: GECOLSA

VALEDUPAR

Telex No.: 03060

R450 U.S. OFFICE

General Electric Company
 Machinery Sales Operation
 175 Fountainbleau Blvd.
 Miami, FL 33172
 Phone: 1305) 551-5130
 COSTA RICA
 P210 SAN JOSE
 (INC LT) Machinery & Tractors Ltd.
 La Uruca
 Mail Address: P.O. Box 426
 Cable Address: MATRA, SANJOSE
 Phone: 21-00-01
 Direct Dial: 011-506-21-00-01
 Telex No.: 2110

DOMINICAN REPUBLIC

P160 SANTO DOMINGO

(INC LT) Implementos y Maquinarias,
 C. por A.
 Carretera Duarte, Kilometro 5
 Mail Address: Apartado 171
 Cable Address: IMCA,
 SANTODOMINGO
 Phone: 809-566-5171
 Direct Dial: 1-809-566-5171
 Telex No.: RCA: 4183 IMCA
 ITT (AACR): 3460035

Main offices in larger-faced type
 Branches in smaller-faced type

ECUADOR**R440 GUAYAQUIL**

(INC LT) Importadora Industrial
Agricola S.A.
Av. Jaun Tanca M., Km. 3
Mail Address: P.O. Box 562
Phone: 384-700
Cable Address: ROSAL
GUAYAQUIL
Telex No.: 3215 ROSAL ED

R441 QUITO

Importadora Industrial Agricola S.A.
Panamericana Norte Km 7.5
Mail Address: P.O. Box 2030
Phone: 534032
Cable Address: ROSAL QUITO
Telex No.: 2164 ROSAL ED

FRENCH GUIANA (Guyane Francaise)

R420 97300 CAYENNE

(INC LT) Yves Massel & Cie.
1.5 Km route de Montabo
Mail Address: Boite Postale No. 171
Cayenne 97300
Guyane Francaise
Phone: 31-29-48
Cable Address: MASSELCO
CAYENNE
Telex No.: 030 527 FG

FRENCH WEST INDIES

P220 GUADELOUPE
97156 POINTE-A-PITRE
(INC LT) Yves Massel & Cie.
Route de Raizet
Mail Address: P.O. Box 210
Cable Address: MASSELY,
POINTEAPITRE
Phone: 82-15-36
Telex No.: 029791GL

MARTINIQUE

P110 97207 FORT-DE-FRANCE
Ets. Louis Crocquet
38 Avenue Duparquet
Mail Address: Boite Postale 579
Cable Address: AMGARAGE,
FORTDEFRANCE
Phone: 71-54-54
Telex No.: 029635 MR

GUATEMALA, C.A.**P300 GUATEMALA CITY**

(INC LT) Mayatrac, S.A.
Kilometro 11, Carretera a Amatitlan
Mail Address: Apartado Postal 1793
Cable Address: MAYATRAC,
GUATEMALACITY-
VIA TROPICAL
RADIO
Phone: 481061162163164165
Direct Dial: 011-502-2-481061
Telex No.: 273 MATRAC GU

GUYANA**R380 GEORGETOWN**

(INC LT) Guyana Tractor & Equipment
Company
A Division of Guyana National
Engineering
Corporation Limited
Providence, East Bank, Demerara
Mail Address: P.O. Box 604
Phones: 0661236712518/27951
27961279712798
Cable Address: GUYTRAC

GEORGETOWN

Telex No.: GY238

HAITI**P140 PORT-AU-PRINCE**

(INC LT) Haytian Tractor & Equipment
Company., S.A.
Ave. Haile Selassie
Mail Address: P.O. Box 1318
Cable Address: HAYTRACTOR,
PORTAUPRINCE
Phones: 61836161840/61848 & 61849
Telex No.: 3490074

HONDURAS**P341 SAN PEDRO SULA**

(INC LT) Casa Comercial Mathews, S.A.
Mail Address: P.O. Box 37
Phone: (504) 52-2072173.52-2166
Direct Dial: 011-504-52-2072
Cable Address: CEMCOL
SANPEDROSULA
Telex No.: 5509 CEMCOL HT

P340 TEGUCIGALPA

Casa Comercial Mathews, S.A.
Barrio La Boise
Comayaguella. D.C.
Mail Address: P.O. Box 39
Cable Address: CEMCOL.
TEGUCIGALPA
Phone: 33-3164 Thur 33-3169
Telex No.: 1109 CEMCOL HT

Main offices in larger-faced type
Branches in smaller-faced type

JAMAICA, W.I.**P190 KINGSTON**

(INC LT) Jamaica Tractor & Equipment Company
 379 Spanish Town Road
 Mail Address: P.O. Box 213
 Cable Address: JAMTRAC,
 KINGSTON
 Phone: 923-9251
 Direct Dial: 1-809-923-9251
 Telex No.: 2135 ALPROJAM

P192 WESTMORELAND

Jamaica Tractor & Equipment Company
 Savanna-la-Mar
 Mail Address: P.O. Box 60

MEXICO**P260 CHIHUAHUA, CHIHUAHUA**

Maquinaria, S.A.
 Carretera a Avalos y Calle 2A (wires)
 Mail Address: Apartado Postal 394
 (all mail)
 Phone: 5-00-49 and 5-00-51 (52-141)
 Direct Dial: 011-52-141-5-00-49
 Telex No.: MAQSA CHI-034837

P261 DURANGO, DURANGO

Maquinaria, S.A.
 20 de Noviembre 1401 Ote.
 Mail Address: Apartado Postal 106
 Phone: 32-05 and 35-80
 Telex No.: 066-618

P262 TORREON, COAHUILA

Maquinaria, S.A.
 Apartado 412
 Blvd. Independencia No. 427 Ote.
 Phone: 3-44-48 & 3-43-44
 Telex No.: 032-864

P280 CIUDAD OBREGON, SONORA

Maquinaria General del Occidente,
 S.A.
 Sufragio Efectivo y Calle Norte (wires)
 Mail Address: Apartado Postal No. 24
 (all mail)
 Phone: 3-68-80
 Direct Dial: 011-52-641-3-68-80
 Telex No.: 055807

P281 CULIACAN, SINALOA

Maquinaria General del Occidente, S.A.
 Carretera a Navolato Km. 5
 Mail Address: Apartado No. 9
 Phone: 2-05-80

P286 GUAYMAS, SONORA

Maquinaria General del Occidente, S.A.
 Blvd. No. 227, Colonia Aurora
 Mail Address: Apartado No. 343
 Phone: 2-03-05

P282 HERMOSILLO, SONORA

Maquinaria General del Occidente, S.A.
 Carretera Bahia Kino
 Mail Address: Apartado Postal No. 75
 Phone: 4-00-51 & 4-01-55

MEXICO (Cont.)**P283 LOS MOCHIS, SINALOA**

Maquinaria General del Occidente, S.A.
 Avenida Bienestar
 Mail Address: Apartado No. 54
 Phone: 2-38-37

P288 NOGALES, SONORA

Maquinaria General del Occidente, S.A.
 Avenida Obregon No. 1738
 Mail Address: Apartado Postal No. 584
 Phone: 2-10-15

P287 VILLA CONSTITUCION, BAJA CALIFORNIA SUR

Maquinaria General del Occidente, S.A.
 Apartado Postal 150
 Phone: 2-04-17

P020 GUADALAJARA, JALISCO

(INC LT) Tractores y Maquinaria del Centro, S.A.
 Calzada J. Gonzalez Gallo 1335
 Mail Address: P.O. Box 1-3777
 Cable Address: TRACSA,
 GUADALAJARA
 Phone: 35-92-57
 Direct Dial: 011-52-36-35-92-57
 Telex No.: 068-1848

P021 CELAYA, GUANAJUATO

Tractores y Maquinaria del Centro, S.A.
 Av. Hidalgo 706
 Phone: 2-02-96
 Telex No.: 012-820

P024 COLIMA, COLIMA

Tractores y Maquinaria del Centro, S.A.
 Zaragoza 402
 Phone: 2-10-05

P025 LAZARO CARDENAS, MICHOACAN

Tractores Maquinaria del Centro, S.A.
 Lerdo de Tejada 3

P026 SAN LUIS POTOSI, S.L.P.

Tractores y Maquinaria del Centro, S.A.
 Cuauhtemoc 603-B
 Phone: 2-76-09

P022 URUAPAN, MICHOACAN

Tractores y Maquinaria del Centro, S.A.
 Lazaro Cardenas Sur 740
 Phone: 2-16-30

P023 ZACATECAS, ZACATECAS

Tractores y Maquinaria del Centro, S.A.
 Av. Gral. Gonzalez Ortega 404
 Phone: 2-08-41

P510 MAZATLAN, SINALOA

(E) Distribuidora Rice, S.A.
 Carnaval and Nicaragua
 Phone: 1-40-39
 Telex No.: 006852

(INC LT Including Lift Trucks)

Main offices in larger-faced type
Branches in smaller-faced type

MEXICO (Cont.)**P320 MEXICO 9, D.F.**

Mexicana de Tractores y Maquinaria,
S.A.
Blvd. Puerto Central Aereo No. 34
(wires)
Mail Address: Apartado Postal 118
Bis. (all mail)
Phone: (905) 571-2000
Telex No.: 017-71373

P328 CAMPECHE, CAMPECHE

Mexicana de Tractores y Maquinaria,
S.A.
Ave. Lopez Mateos No. 308
Mail Address: Apartado Postal 288
Phone: 43-33

P323 CD. DEL CARMEN, CAMPECHE

Mexicana de Tractores y Maquinaria,
S.A.
Carle 20 No. 90
Phone: 2-13-32

P324 COATZACOALCOS, VERACRUZ

Mexicana de Tractores y Maquinaria,
S.A.
Carretera Coatzacoalcos-Minatitlan
Kilometer 7
Phone: 2-05-6 & 2-05-77

P326 CORDOBA, VERACRUZ

Mexicana de Tractores y Maquinaria,
S.A.
Ave. 1 No. 1800
Phone: 2-26-10, 2-21-66 & 2-21-83

P321 MERIDA, YUCATAN

Mexicana de Tractores y Maquinaria,
S.A.
Ave. Nachi-Cocom No. 488
Phone- 2-25-01 & 2-11-11

P325 POZA RICA, VERACRUZ

Mexicana de Tractores y Maquinaria,
S.A.
Blvd. Lazaro Gardenas No. 1402
Col. Morelos
Phone: 2-05-55 & 2-09-68

P327 SALINA CRUZ, OAXACA

Mexicans de Tractores y Maquinara,
S.A.
Tampico No. 39
Phone: 39
TUXTLA GUTIERREZ, CHIAPAS
Mexicana de Tractores y Maquinana,
S.A.
Avenida Central Pte. 1144
Phone: 2-22-05

P320 MONTERREY, N.L.

(INC LT) Maquinaria Diesel, S.A.
Ave. Eugenio Garza Sada No. 2425
Sur (wires)
Mail Address: P.O. Box 692 (all mail)
Phone: 58-23-00
Direct Mail: 011-52-83-58-23-00
Telex No.: 038-793

MEXICO (Cont.)**P231 MATAMOROS, TAMAULIPAS**

Maquinana Diesel, S.A.
Carretera a C. Victoria Km. 1
Mail Address: P O Box 11
Phones: 3-38-59 & 3-05-41

P235 MONCLOVA, COAHUILA

Maquinaria Diesel, S.A.
Carretera 57 y Bravo No 350
Mail Address: P.O Box 371
Phone: 3-20-07 & 3-27-60

P233 TAMPICO, TAMAULIPAS

Maquinaria Diesel, S.A.
Carretera Mante-Tampico Km. 148
Mail Address: P.O Box 45
Phone: 3-13-09 & 3-03-08

P234 CIUDAD MANTE, TAMAULIPAS

Maquinaria Diesel, S.A.
Juarez No 801 OTE.-
Phone: 2-12-94

P236 REYNOSA, TAMAULIPAS

Maquinaria Diesel, S.A.
Blvd. Morelos y Jalapa
Col. Rodriguez
Phone: 2-1940

P232 SABINAS, COAHUILA

Maquinaria Diesel, S.A.
Calle Francisco, I. Madero No. 864
Phone- 2-25-25
CIUDAD VALLES, SAN LUIS POTOSI
Maquinaria Diesel, S.A.
Galeana No. 44
Phone: 2-04-64

NETHERLANDS ANTILLES**R040 CURACAO**

(INC LT) PBC Machines &
Services, Inc.
Schottegat Weg Oost 215
Mail Address: P.O. Box 157
Phones: 43037, 44126
Cable Address: EQUIPMENT
CURACAO
Telex Nos.: 1159 INBA NA,
3308 PLAIZ NA
NICARAGUA, C.A.

P370 MANAGUA

(INC LT) Nicaragua Machinery
Company
Mail Address: P.O. Box 469
Cable Address: NIMAC, MANAGUA
Phone: 3151 & 3159
Telex No.: 5811

P371 CHINANDEGA

Nicaragua Machinery Company
Sucursal Chinandega
Phone. 0341-647

P372 LEON

Nicaragua Machinery Company
Sucursal Leon
Phone: 031-3114

(INC LT) Including Lift Trucks

Main offices in larger-faced type
Branches in smaller-faced type

NICARAGUA, C~A. (Cont.)

P374 OCOTAL
Nicaragua Machinery Company
Sucursal Ocotol
Phone: 158

PANAMA**P050 PANAMA**

(INC LT) Cardoze & Lindo, S.A.
Calle 85 y Transistemica
Mail Address: Apartado 7342
Cable Address: CARLINDO,
PANAMA R.
DE PANAMA
Phone: 60-1155
Telex No.: TRT-PA2106,
COMSA/UWI
368715

PARAGUAY**R200 ASUNCION**

S.A.C.I.H. Petersen
Avenida Gral. Artigas, Km. 2 1/2
Mail Address: Casilla de Correo 592
Phones: 26-755, 26-756, 202-615,
202-616, 202-617
Cable Address: PARGTRADE
ASUNCION
(PARAGUAY)
Telex No.: 263 PY H. Peterson

PERU**R080 LIMA**

(INC LT) Enrique Ferreyros & Cia. S.A.
Av. Industrial 675
Mail Address: Apartado 150
Phone: 52-30-70
Cable Address: FERREYCO LIMA
Telex Nos.: 25447, 20102

R083 CHICLAYO

Enrique Ferreyros & Cia. S.A.
Mail Address: P.O. Box 173

R084 CHIMBOTE

Enrique Ferreyros & Cia. S.A.
Jose Galvez 245

R085 CUZCO

Enrique Ferreyros & Cia. S.A.
Mail Address: P.O. Box 139

R082 ICA

Enrique Ferreyros & Cia. S.A.
Mail Address: P.O. Box 187

R086 IQUITOS

Organization Victoria S.A. (ORVISA)
Av. La Marina 2393
Malecon Tarapaca 314
Mail Address: P.O. Box 439
Phone: 2390
Cable Address: ORVISA IQUITOS

PERU (Cont.)**R081 PIURA**

Enrique Ferreyros & Cia. S.A.
Mail Address: P.O. Box 136

PUERTO RICO**R420 SAN JUAN 00936**

USI Puerto Rico, Inc.
John F. Kennedy Avenue
Mail Address: G.P.O. Box 2529
Cable Address: USIPRI
SANJUAN VIA
RCA
Phone: (809) 782-4100
Telex No.: 325-2330 (RCA)
U.S. Office:
U.S. Industries. Inc.
250 Park Avenue
New York, New York 10017
Cable Address: STEELCAR, NEWYORK

P450 SAN JUAN 00936

(LT) Garcia Machinery, Inc.
G.P.O. Box 3368
Cable Address: GARMAC
SANJUAN
Phone: 783-3066, Area Code: 809
783-4861
Telex No.: 365358

SALVADOR, EL**P120 SAN SALVADOR**

(INC LT) Compania General de
Eauipos, S.A. de C.V.
Klm. 5 Carretera a Sta. Tecla
Mail Address: Apartado (06) 1000
Cable Address: COGESA,
SANSALVADOR
Phone: 23-23-23
Telex No.: COGESA-20074,
Area Code 301

SURINAM**R350 PARAMARIBO**

(INC LT) Surinaamse Machinehandel
N.V.
Slangenhoutstraat 57-65
Mail Address: P.O. Box 1808
Phone: 82222
Cable Address: SURMAC
PARAMARIBO
Telex No.: SME 182 SURMAC

Main offices in larger-faced type
Branches in smaller-faced type

TRINIDAD

R310 PORT-OF-SPAIN

Tractors and Machinery (Trinidad)
Ltd.
Mail Address: P.O. Box 945
Phones: 31431, 31432,
31433, 31545,
31546, 31547,
31548

Cable Address: TRACMAC
PORTOFSPAIN
TRINIDAD

Telex No.: 308

URUGUAY

R100 MONTEVIDEO

(INC LT) General Machinery Co. S.A.
Avenida Joaquin Suarez 2856
Phones: 20-9921122123124125
Cable Address: GEMCOSA
MONTEVIDEO

Telex No.: 21284, GEMCOSA UY 730

VENEZUELA

R400 CARACAS 106

(INC LT) General Electric de Venezuela
S.A. (Invoices, Machine Shipping
Orders & other legal documents)

Apartado 66.819

(ALL OTHER CORRESPONDENCE)

VENEQUIP - EQUIPOS DE
VENEZUELA

(General Electric de Venezuela S.A.)

Av. Pcal de Maracuy

Esq. Rio de Janeiro

Torre California - Piso 7

Mail Address: Apartado 66.819

Phones: 22-75-55, 22-77-11

Cable Address: INGENETRIC
CARACAS

Telex No.: 25260

R404 BARQUISIMETO. EDO. LARA

VENEQUIP-EQUIPOS DE
VENEZUELA

(General Electric de Venezuela S.A.)

Mail Address: Apartado 618

Phones: 2601011 ;12'13/14

Cable Address: INGENETRIC
BARQUISIMETO

Telex No.: 51116 GE-BTO

R401 MARACAIBO. EDO. ZULIA

VENEQUIP-EQUIPOS DE
VENEZUELA

(General Electric de Venezuela S.A.)

Avenida Bella Vista

Mail Address: Apartado 292

Phones: 72600 through 609

Cable Address: INGENETRIC
MARACAIBO

Telex No.: 61144 GEVENSA

VENEZUELA (Cont.)

R402 PUERTO LA CRUZ. EDO.

ANZOATEGUI
VENEQUIP-EQUIPOS DE
VENEZUELA
(General Electric de Venezuela S.A.)
Mail Address: Apartado 4023
Phone: 63033
Cable Address: INGENETRIC

PUERTOLACRUZ

Telex No.: 81136 GECOPLC

R405 PUERTO ORDAZ, EDO. BOLIVAR

VENEQUIP-EQUIPOS DE
VENEZUELA

(General Electric de Venezuela S.A.)

Mail Address: Apartado 62

Phones: 25213, 25222

Cable Address: INGENETRIC
PUERTOORDAZ

Telex No.: 86232 GEVENSA

R407 SAN CRISTOBAL, EDO. TACHIRA

VENEQUIP-EQUIPOS DE
VENEZUELA

(General Electric de Venezuela S.A.)

Mail Address: Apartado 424

Phones: 31763, 33128

Cable Address: INGENETRIC
SAN CRISTOBAL

Telex No.: 76126

R406 SANTA BARBARA, EDO. ZULIA

VENEQUIP-EQUIPOS DE
VENEZUELA

(General Electric de Venezuela S.A.)

Avenida 8 No. 7-349

Phone: 91997

Cable Address: INGENETRIC
SANTA BARBARA

R403 VALENCIA. EDO. CARABOBO

VENEQUIP-EQUIPOS DE
VENEZUELA

(General Electric de Venezuela S.A.)

Mail Address: Apartado 252 or 529

Phone: 302011

Cable Address: INGENETRIC
VALENCIA

Telex No.: 41156 - MANGEPAR

R410 U. S. Office:

General Electric Company
Machinery Sales Operation
175 Fountainbleau Blvd.
Miami, FL 33172
Phone: 1305) 551-5130

WEST INDIES

P150 ST. MICHAEL, BARBADOS
PLANTRAC INDUSTRIES, LTD.

Eagle Hall

Mail Address: P.O. Box 867E

Cable Address: PLANTRAC
EAGLE HALL
ST. MICHAEL
BARBADOS

Phone: 6-5072

Direct Dial: 1-809-42-65702

Telex No.: 333PLANTRAC WB

**CATERPILLAR OF AUSTRALIA LTD.
P.O. BOX 35, NIDDRIE, MELBOURNE
VICTORIA, AUSTRALIA 3042**

AUSTRALIA

T010 NORTH CLAYTON, VICTORIA 3168
(INC LT) William Adams Tractors Pty.
Limited
Nantilla Road
Mail Address: P.O. Box 164,
Clayton 3168
Phone: 560 8222
Cable Address: ADAMTRAC,
MELBOURNE
Telex No.: 30244 ADAMS

BAIRNSDALE. VICTORIA 3875
William Adams Tractors Pty. Limited.
Cnr. Princess Hwy. & Lindenow Rd.
Mail Address: P.O. Box 467,
Bairnsdale 3875
Phone: 52302617
Cable Address: ADAMDALE,
BAIRNSDALE
Telex No.: 55270 ADAMS

HORSHAM, VICTORIA 3400
William Adams Tractors Pty. Limited,
Dimboola Road,
Mail Address: P.O. Box 642. Horsham
3400
Phone: 82007112
Cable Address: ADAMWIMM,
HORSHAM
Telex No.: 55672 ADAMS

SWAN HILL. VICTORIA 3585
William Adams Tractors Pty. Limited.
Murray Valley Highway
Mail Address: P.O. Box 479,
Swan Hill 3585
Phone: 321161i2
Cable Address: ADAMSWAN.
SWAN HILL
Telex No.: 55469 ADAMS

TRAR.ALGON, VICTORIA 3844
William Adams Tractors Pty. Limited
Argyle Street
Mail Address: P.O. Box 474.
Traralgon 3844
Phone: 64520415

T011 BERRIEDALE, TASMANIA 7011
(INC LT) William Adams Tractors Pty.
Limited,
8 Berriedale Road.
Mail Address: P.O. Box 124.
Glenorchy 7010
Phone: 491066
Cable Address: ADAMHOB. HOBART
Telex No.: 58016 ADA.MHOB

AUSTRALIA (Cont.)

BURNIE. TASMANIA 7320
William Adams Tractors Pty. Limited.
Old Surrey Road,
Mail Address: P.O. Box 370,
Burnie 7320
Phone: 314422
Cable Address: ADAMWES. BURNIE
Telex No.: 59076 ADAMWES

LAUNCESTON, TASMANIA 7250
William Adams Tractors Pty. Limited.
345 Hobart Road. Youngtown,
Mail Address: P.O. Box 589,
Launceston 7250
Phone: 445311
Cable Address: ADAMLAN.
LAUNCESTON
Telex No.: 58613 ADAMLAN

T070 ENFIELD, SOUTH AUSTRALIA 5085
(INC LT) Cavill Power Products Pty.
Ltd.,
315 Main North Road,
Mail Address: P.O. Box 84,
Blair Athol 5084
Phone: 449011
Cable Address: CAVPOWER,
ADELAIDE
Telex No.: 82196 CAVPOWER

NARACOORTE. SOUTH
AUSTRALIA 5271
Cavill Power Products Pty Ltd.,
24 MacDonnell Street.
Mail Address: P.O. Box 218,
Naracoorte 5271
Phone: 621322
Telex No.: 80533 CAVPOWER

WHYALLA, SOUTH AUSTRALIA 5660
Cavill Power Products Pty. Ltd.,
Shiell Street.
Mail Address: P.O. Box 498.
Whyalla 5660
Phone: 458988
Telex No.: 80407 CAVPOWER

T150 SOUTH GUILDFORD, WESTERN
AUSTRALIA 6055
(INC LT) Wigmores Tractors Pty. Ltd.,
128-134 Great Eastern Highway
Mail Address: P.O. Box 83B,
Perth 6001
Phone: 2790011 (Area Code 09)
Cable Address: WIGTRAC, PERTH
Telex No.: 92012 WIGTRAC

(INC LT) Including Lift Trunks

Main offices in larger-faced type
Branches in smaller-faced type

AUSTRALIA (Cont.)

BUNBURY, WESTERN
AUSTRALIA 6230
Wigmores Tractors Pty. Ltd
Wilson Road.
Phone: 215166 (Area Code 6230)
Telex No.: 93900 WIGTRAC

GERALDTON, WESTERN
AUSTRALIA 6530
Wigmores Tractors Pty. Ltd.,
Urch Street,
Phone: 212088 (Area Code 099)
Telex No.: 91658 WIGTRAC

KALGOORLIE, WESTERN
AUSTRALIA 6430
Wigmores Tractors Pty. Ltd.
Great Eastern Highway,
Phone: 211266 (Area Code 090)
Telex No.: 91340 WIGTRAC

KATANNINGO, WESTERN
AUSTRALIA 6317
Wigmores Tractors Pty. Ltd
Dore Street.
Phone: 211866 (Area Code 098)

MERREDIN, WESTERN
AUSTRALIA 6415
Wigmores Tractors Pty. Ltd.,
Barrack Street
Phone: 411222 (Area Code 090)

PORT HEDLAND, WESTERN
AUSTRALIA 6721
Wigmores Tractors Pty. Ltd
North West Coastal Highway.
Phone: 721055 (Area Code 091)
Telex No.: 99280

T130 ALEXANDRIA, NEW SOUTH

WALES 2015
(INC LT) Waugh & Josephson Pty.
Ltd.,
Mitchell Road, Alexandria
Mail Address: P.O. Box 83,
Alexandria 2015
Phone: 5194144 (Area Code 02)
Cable Address: SEPARATOR,
SYDNEY

Telex No.: 20112
CANBERRA A.C.T.

Waugh & Josephson Pty. Limited,
10 Ipswich St., Fyshwick 2600
Mail Address: P.O. Box 318.
Kingston 2604

Phone: 805644 Area Code 062)
Cable Address: SEPARATOR.

CANBERRA
Telex No.: 62072 WAUJOS

DUBBO, NEW SOUTH WALES 2830
Waugh & Josephson Pty. Limited.
Wellington Road,
Mail Address: P.O. Box 584.
Dubbo 2830

Phone: 824933 (Area Code 068)
Cable Address: SEPARATOR. DUBBO
Telex No.: 63959 WAUJOS
(INC LT) Including Lift Trucks

AUSTRALIA (Cont.)

HUNTER VALLEY, NEW SOUTH
WALES 2415
Waugh & Josephson Pty Limited.
Lemington Road. Ravensworth 2415
Mail Address: P O. Box 318.
Singleton 2330

Phone: 761113 (Area Code 065)
Cable Address: SEPARATOR,
SINGLETON

Telex No.: 25293 WAUJOS

INVERELL, NEW SOUTH WALES 2360
Waugh & Josephson Pty. Limited.
Warialda Road,

Mail Address: P.O. Box 320
Inverell 2360

Phone: 221400 (Area Code 067)
Cable Address: SEPARATOR.
INVERELL

Telex No.: 66044 WAUJOS

NEWCASTLE, NEW SOUTH

WALES 2285

Waugh & Josephson Pty. Limited.
Nelson Road. Cardiff

Mail Address: P O. Box 63.
Cardiff Newcastle 2285

Phone: 548788 (Area Code 049)
Cable Address: SEPARATOR.

NEWCASTLE

Telex No.: 28251 WAUJOS

SOUTH GRAFTON, NEW SOUTH

WALES 2461

Waugh & Josephson Pty. Limited,
11 Schwinghammer Street

Mail Address: P.O. Box 113,
South. Grafton 2461

Phone: 421888 (Area Code 066)
Cable Address: SEPARATOR.

SOUTH GRAFTON

Telex No.: 66967 WAUJOS

WAGGA WAGGA, NEW SOUTH

WALES 2660

Waugh & Josephson Pty. Limited.
39-41 Dobney Avenue

Mail Address: P.O. Box S143,
Wagga Wagga 2650

Phone: 253666 (Area Code 069)
Cable Address: SEPARATOR.

WAGGA WAGGA

Telex No.: 69026 WAUJOS

WAUCHOPE, NEW SOUTH

WALES 2446

Waugh & Josephson Pty. Limited.
8 Carrington Street

Mail Address: P O. Box 124.
Wauchope 2446

Phone: Wauchope 278

(Area Code 065 8811)

Cable Address: SEPARATOR.

WAUCHOPE

Telex No.: 63245 WAUJOS

WOLLONGONG, NEW SOUTH

WALES 2519

Waugh & Josephson Pty. Limited.
Montague Street. Fairy Meadow

Mail Address: P.O. Box 207
Fairy Meadow 2519

Phone: 296622 (Area Code 0421)
Cable Address: SEPARATOR.

WOLLONGONG

Telex No.: 29135 WAUJOS

Main offices in larger-faced type
Branches in smaller-faced type

AUSTRALIA (Cont.)**T030 ARCHERFIELD, QUEENSLAND**

4108
 (INC LT) Hastings Deering
 (Queensland) Pty. Ltd.,
 Hastings Park,
 Kerry Road
 Mail Address: P.O. Box 46,
 Rocklea 4106
 Phone: (07) 2759229
 Cable Address: HASTDEERING,
 BRISBANE
 Telex No.: 40197 HASDEER

CAIRNS, QUEENSLAND 4870

Hastings Deering (Queensland) Pty.
 Ltd.,
 Cnr. Fearnley & Kenny Streets
 Mail Address: P.O. Box 942 Cairns 4870
 Phone: (070) 513455
 Cable Address: HASTDEERING
 CAIRNS

Telex No.: 48453 HASDEER

DALBY, QUEENSLAND 4405

Hastings Deering (Queensland) Pty. Ltd.,
 Bell Street
 Mail Address: P.O. Box 136, Dalby 4405
 Phone: 622722
 Cable Address: HASTDEERING,
 DALBY

INNISFAIL, QUEENSLAND 4860

Hastings Deering (Queensland) Pty. Ltd
 Ernest Street
 Mail Address: P.O. Box 743,
 Innisfail 4860
 Phone: 8612344
 Cable Address: HASTDEERING,
 INNISFAIL

Telex No.: 48848 HASDEER

MACKAY, QUEENSLAND 4740

Hastings Deering (Queensland) Pty. Ltd
 Milton Street
 Mail Address: P.O. Box 452, Mackay
 4740
 Phone: 572484
 Cable Address: HASTDEERING
 MACKAY

Telex No.: 48108 HASDEER

MT. ISA, QUEENSLAND 4825

Hastings Deering (Queensland) Pty. Ltd
 Kolongo Cres
 Mail Address: P.O. Box 304,
 Mt. Isa 4825
 Phone: 433288
 Cable Address: HASTDEERING
 MOUNT ISA

Telex No.: 49565 HASDEER

ROCKHAMPTON, QUEENSLAND 4700

Hastings Deering (Queensland) Pty. Ltd.,
 Port Curtis Road
 Mail Address: P.O. Box 116, North
 Rockhampton 4701
 Phone: 275888
 Cable Address: HASTDEERING,
 ROCKHAMPTON
 Telex No. 9131 HASDEER

AUSTRALIA (Cont.)**TOOWOOMBA, QUEENSLAND 4350**

Hastings Deering (Queensland) Pty. Ltd
 Carrington Road, Torrington
 Mail Address: P.O. Box 3114, Town Hall,
 Toowoomba
 Phone: 341187
 Cable Address: HASTDEERING,
 TOOWOOMBA

Telex No.: 40037 HASDEER

TOWNSVILLE, QUEENSLAND 4810

Hastings Deering (Queensland) Pty. Ltd
 Woolcock Street, Garbutt
 Mail Address: P.O. Box 60,
 Hermit Park 4812
 Phone: 795099
 Cable Address: HASTDEERING,
 TOWNSVILLE

Telex No.: 47056 HASDEER

T050 DARWIN, NORTHERN**TERRITORY 5790**

(INC LT) Hastings Deering (N.T.) Pty.
 Limited
 Darwin (Head Office)
 19 Goyder Road, Darwin 5790
 Mail Address: P.O. Box 654,
 Darwin 5794
 Phone: 818033 (Area Code 089)
 Cable Address: HASTDEERING,
 DARWIN

Telex No.: 85015

ALICE SPRINGS, NORTHERN

TERRITORY 5790
 Hastings Deering (N.T.) Pty. Limited.
 Alice Springs
 Brown Street, Alice Springs 5790
 Mail Address: P.O. Box 63,
 Alice Springs

Phone: 521888

Telex No.: 81241

GOVE, NORTHERN TERRITORY 5797

Hastings Deering (N.T.) Pty. Limited,
 Gove
 Industrial Area
 Mail Address: P.O. Box 135,
 Nhulunby 5797
 Phone: 871478 (Area Code 089)
 Telex No.: 85428

FIJI

(Administered by Caterpillar of
 Australia, Ltd.)

T230 SUVA

CARPTRAC
 Carpenter Street, Raiwai
 Mail Address: Private Mail Bag, Suva
 Cable Address: CARPTRAC, SUVA
 Telex No.: 2190

T231 LAUTOKA

Carptrac
 Mail Address: P O. Box 763, Lautoka
 LABASA
 Carptrac
 Mail Address: Private Mail Bag, Labasa

FIJI (Cont.)**T232 WESTERN SAMOA**

Carpenters Tractor & Equipment
 Mail Address: P.O. Box 189, . Apia
 Cable Address: MORRISHED SX
 Telex No.: 24

NEW CALEDONIA

(Administered by Caterpillar of
 Australia, Ltd.)

T250 NOUMEA

Societe Caledonienne des Tracteurs
 Caltrac S.A.
 Complex Edouard Pentecost -
 PK5 Magenta
 Mail Address: B. P. C2 Noumea Cedex
 Cable Address: PENOCEAN 051 NM

T251 PAPEETE

Tahitibull Papeete. Tahiti

NEW ZEALAND

(Administered by Caterpillar of
 Australia, Ltd.)

T210 CHRISTCHURCH

Gough, Gough & Hamer Ltd.
 24-26 Amyes Road, Hornby
 Mail Address: P.O. Box 16-168,
 Hornby 8030

Phone: 495-199

Telex No.: GOUGHS NZ 4889

T213 AUCKLAND

Gough, Gough & Hamer Ltd.
 Kerrs Road Wiri
 Mail Address: P.O. Box 23076.
 Papatoetoe 1734

HAMILTON

Gough, Gough & Hamer Ltd.
 39 Ellis Street, Frankston Junction
 Mail Address: P O. Box 5139,
 Frankston Junction 2031

ROTORUA

Gough. Gough. & Hamer Ltd.
 84 Old Taupo Road
 Mail Address: P O. Box 1140,
 Rotorua 3200

T212 PALMERSTON NORTH

Gough. Gough & Hamer Ltd.
 Bennett Street
 Mail Address: P.O. Box 1141.
 Palmerston North 5300

HASTINGS

Gough. Gough & Hamer Ltd.
 Cnr. Omrnahu & Chatham Roads
 Mail Address: P.O. Box 2039.
 Stortford Lodge 4200

NEW ZEALAND (Cont.)**T215 WELLINGTON**

Gough. Gough & Hamer Ltd.
 1-8 Horlor Street, Naenae
 Mail Address: P.O. Box 360596,
 Nae Nae 6330

CHRISTCHURCH

Gough, Gough & Hamer Ltd.
 25 Branston Street
 Mail Address: P.O. Box 16077
 Hornby 8030

TWIZEL

Gough. Gough & Hamer Ltd.
 Ostler Road
 Mail Address: P.O. Box 57, Twizel 8773

T214 DUNEDIN

Gough. Gough & Hamer Ltd.
 New Wharf Street
 Mail Address: P.O. Box 543.
 Dunedin 9000

INVERCARGILL

Gough Gough & Hamer Ltd.
 23 Gimblet Street
 Mail Address: P.O. Box 356.
 Invercargill 9600

PAPUA NEW GUINEA**T040 LAE, P.N.G.**

(INC LT) Hastings Deering (Pacific)
 Limited,
 Milford Haven Road
 Mail Address: P.O. Box 385, LAE
 Phone: 422355
 Cable Address: HASDEER, LAE
 Telex No.: NE 42501
BOUGAINVILLE, KIETA. P.N.G.
 Hastings Deering (Pacific) Limited,
 Itakara Industrial Park
 Mail Address: P.O. Box 503-Via Arawa
 Phone: 959004
 Cable Address: HASDEER. KIETA
 Telex No.: NE 95820
PORT MORESBY. P.N.G.
 Hastings Deering (Pacific) Limited.
 Morata St Gortons. Port Moresby
 Mail Address: P.O. Box 6308. Boroko
 Phone: 256650
 Cable Address: HASDEER. PORT
 MORESBY
 Telex No.: NE 22149

Main offices in larger-faced type
 Branches in smaller-faced type

(INC LT) Including Lift Trucks

CATERPILLAR FAR EAST LTD.
P.O. BOX 3069
HONG KONG
Cable Address: CATFAREAST HKG
Telex No.: HX3305 CFEL
Telephone: 5.256187
Parts Dept:
Caterpillar Far East Ltd.
14 Tractor Road
Jurong Town
Singapore 22
Republic of Singapore
Mail Address: P.O. Box 105

BANGLADESH

J060 DACCA
 Greenland Engineers & Tractors
 Company Ltd.
 7 Shantibagh, Dacca-17 Bangladesh
 Mail Address: G.P.O. Box 541
 Phones: 401834, 403697
 Cable Address: TRACTORS DACCA
 BANGLADESH
 Telex No.: GETCO DAC 773

BRUNEI

J289 KUALA BELAIT
 Tractor Malaysia Berhad
 Jalan Setia DiRaja
 Kuala Belait. Brunei
 Mail Address: P.O. Box 268

BANDAR SERI BEGAWAN

Tractors Malaysia Berhad
 4-1/2 Miles Jalan Tutong
 Bandar Seri Begawan
 Brunei
 Mail Address: P.O. Box 1027

BURMA

Contact: RANGOON
 Tractors India Limited
 33 Golden Hill Avenue
 Shwegondaing P.O.
 Rangoon, Burma
 Cable Address: RANGREP
 RANGOON

HONG KONG

J010 C.E. Construction Equipment Ltd.,
 2-12, Lung Tang Road,
 Tsing Lung Tau,
 Tsuen Wan, N.T.,
 Hong Kong
 Mail Address: P.O. Box 42,
 TSUEN WAN, N.T.
 HONG KONG
 Cable Address: CONSEQUIP
 HONG KONG
 Telex No.: 74865 CQCEL HX
 Parts Depot
 19B, Cheung Shun Street, G/F.,
 Yeung Yiu Chung (No. 6) Ind. Bldg.,
 Kowloon

INDIA**J140 BOMBAY**

Larsen & Toubro Limited
 L & T House
 Ballard Estate
 Bombay 400 038
 Mail Address: P.O. Box 278
 Cable Address: LARSEN BRO
 BOMBAY
 Telex No.: 2246
 AHMEDABAD. 9
 Larsen & Toubro Limited
 Karaka Building
 Ashram Road
 Ahmedabad 380 009
 Mail Address: P.O. Box 4051
 Cable Address: LARSEN BRO
 AHMEDABAD
 Telex No.: 212

Main offices in larger-faced type
 Branches in smaller-faced type

INDIA (Cont.)

BANGALORE. I
Larsen & Toubro Limited
20. Promenade Road
Frazer Town
Bangalore-560 005
Mail Address: P.O. Box 5098
Cable Address: LARSEN BRO
BANGALORE

Telex No.: 275

BHOPAL

Larsen & Toubro Limited
1st Floor. Eastern Office Block
Roshanpura Shopping Complex
Bhopal M.P.) 462 003
Mail Address: P.O. Box 329
Cable Address: LARSEN BRO BHOPAL
Telex No.: 205

COCHIN, 16

Larsen & Toubro Limited
Ravipuram Junction
Ernakulam
Cochin 682 016
Mad Address: P.O. Box 1723
Cable Address: LARSEN BRO COCHIN

HYDERABAD, 4

Larsen & Toubro Limited
5-10-173 Fateh Maidan Road
Hyderabad 500 004
Mail Address: P.O. Box 12
Cable Address: LARSEN BRO
HYDERABAD

J141 MADRAS. 2

Larsen & Toubro Limited
4/5 Club House Road
Mount Road
Madras 600 002
Mail Address: P.O. Box 5247
Cable Address: LARSEN BRO
MADRAS

Telex No.: 270

J142 NEW DELHI. 15

Larsen & Toubro Limited
32, Najafgarh Road
New Delhi 110 015
Mail Address: P.O. Box 6223
Cable Address: WILLBUZ, DELHI
Telex No.: 2207, 2327

PANAJI (Goa)

Larsen & Toubro Limited
E-139 D. B. Bandodkar Marg
Miramar, Panjim
Goa-403001
Mail Address: P.O. Box 109
Cable Address: LARSEN BRO GOA
Telex No.: 0194-234

J250 CALCUTTA, 24

Tractors India Limited
1 Taratolla Road, Garden Reach
Calcutta 700 024
Mail Address: P.O. Box 323
Cable Address: DIESELS,
CALCUTTA

J251 LUCKNOW

Tractors India Limited
15 Ashok Marg
Lucknow 226 001
Mail Address: P O. Box 66
Cable Address: DIESELS. LUCKNOW

INDIA (Cont.)**NEW DELHI**

Tractors India Limited
302 Ansal Bhavan
Kasturba Gaandhi Marg
New Delhi 110 001
Mail Address: P.O. Box 74
Cable Address: TILIMITED,
NEW DELHI

GUAHATI

Tractors India Limited
Promotesh Barua Road
Rehabari. Gauhati - 8
Cable Address: DIESELS. GAUHATI

JAMSHEDPUR

Tractors India Limited
Jogendra Niwas
Khrkai Link Road
Jamsbedpur 1
Cable A:drees: DIESELS,
JAMSHEDPUR

INDONESIA**J210 JAKARTA**

P. T. Trakindo Utama
Cilandak Commercial Estate
Mail Address: P.O. Box 2282
JAKARTA
Phone: 781093 (7 lines)
Cable Address: TRAKTAMA
JAKARTA

Telex No.: 47136
SURABAYA

P. T Trakindo Utama
J1. R.A. Kartini 59
Mail Address: P.O. Box 332
Cable Address: TRAKTAMA
SURABAYA

SEMARANG

P T. Trakindo Utama
J1. Gajah Mada 69
Mail Address: Tromol POS 248 SM
Cable Address: TRAKTAMA
SEMARANG

UJUNG PANDANG

P. T. Trakindo Utam,
J 1. Gowa Jaya. Panaikang
Mail Address: P.O. Box 121
Cable Address: TRAKTAMA
UJUNG PANDANG
Telex No.: 7178

MANADO

P. T. Trakindo Utama
J1. Bethesda 72
Mail Address: P.O. Box 125
Cable Address: TRAKTAMA
MANADO

TERNATE

P. T. Trakindo Utama
J1. Muh Katidja 7
Mal Address: P O. Box 17
Cable Address: TRAKTAMA

SORONG

P T. Trakindo Utama
J1. Irian 24 (Kampung Baru)
Mail Address: P O. Box 529
Cable Address: TRAKTAMA

Main offices in larger-faced type
Branches in smaller-faced type

INDONESIA (Cont.)**J212 MEDAN**

P. T. Trakindo Utama
 J1. Tanjung Morawa KM9
 Kamp Timban Deli
 Mail Address: P Box 475
 Cable Address: TRAKTA.MA MEDAN
 Telex No.: 51108

J216 PADANG

P. T. Trakindo Utama
 J1. Ulak Karang
 Mail Address: P.O. Box 113
 Cable Address: TRAKTAMA PADANG
 Telex No.: 5563

J215 PEKANBARU

P.T. Trakindo Utama
 J1. HOS Cokroaminoto 96-98
 Mail Address: P.O. Box 70
 Cable Address: TRAKTAMA
 PEKANBARU
 Telex No.: 56127

JAMBI

P.T. Trakindo Utama
 J1. Jend. Sudiran 80
 Telex No.: 27340

J214 PALEMBANG

P.T. Trakindo Utama
 J1. Raya Talangbetutu KM 8-1/2
 Mail Address: P.O. Box 105
 Cable Address: TRAKTAMA
 PALEMBANG

J211 BALIKPAPAN

P.T. Trakindo Utama
 J1. K. S. Tubun
 Mail Address: P.O. Box 29
 Cable Address: TRAKTAMA
 BALI KPAPAN
 Telex No.: 45527

J217 BANJARMASIN

P. T. Trakindo Utama
 J1. A. Yani 155A
 Mail Address: P O. Box 48
 Cable Address: TRAKTAMA
 BANJARMASIN

J218 SAMARINDA

P. T. Trakindo Utama
 J1. H.A. Salim SKI/VII
 Mail Address: P.O. Box 67
 Cable Address: TRAKTAMA
 SAMARINDA

J219 TARAKAN

P. T. Trakindo Utama
 J1. Mulawarman
 Mail Address: Tromol Pos 1
 Cable Address: TRAKTAMA
 TARAKAN

PONTIANAK

P. T. Trakindo Utama
 J1. Jend. Urip 4
 Mail Address: P.O. Box 91
 Cable Address: TRAKTAMA
 PONTIANAK

BATAM

P. T. Trakhndo Utama
 Sei Baloi Simpang Tiga
 Batuampar 4 8Km

INDONESIA (Cont.)**AMBON**

P. T. Trakindo Utama
 J1. Pahlawan Revolusi SK 818
 Mail Address: KOTAK POS 67
 Cable Address: TRAKTAMA
 AMBON

LHOK-SEUMAWE

P. T. Trakindo Utama
 KP Tambon Baroh, Kruengguekueh
 Kecamatan Dewantoro
 Mail Address: P.O. Box 10

JAYAPURA

P. T. Trakindo Utama
 J1. Matahanri 2

SAMPIT

P. T. Trakindo Utama
 J1. Kuburan Muslimin

PANGKAL PINANG

P. T. Trakijtdo Utama
 J1. Dipati Amir 7
 Mail Address: P.O. Box 61

KOREA, Republic of**J080 SEOUL**

Hae Nin Tractor Co. Ltd.
 Hae Nin Building, 2nd Floor,
 31, 1-KA, Jangchung-Dong,
 Chung-Ku, Seoul
 Mail Address: Central P.O. Box 1201
 Cable Address: HNTRACTOR,
 SEOUL
 Telex No.: HAE NIN K24172

MALAYSIA**J261 PETALING JAYA**

Tractors Malaysia Berhad
 Sharidal Complex
 Jalan Yong Shook Lin
 Section 7
 Mail Address: G.P.O. Box 2465
 Kuala Lumpur
 Telex: MA 37594

J291 ALOR STAR

Tractors Malaysia Berhad
 4th Mile, Seberang Jalan Putra
 Mail Address: P O. Box 158

J284 BUTTERWORTH

Tractors Malaysia Berhad
 4212. Pantai Road
 Mail Address: P.O. Box 24
 Telex No.: MA40071

J292 IPOH

Tractors Malaysia Berhad
 Batu 4, Jalan Lahat
 Mail Address: P.O. Box 289
 Telex No.: MA44098

Main offices in larger-faced type
 Branches in smaller-faced type

MALAYSIA (Cont.)**J288 JOHOR BARU**

Tractors Malaysia Berhad
 Plot 6
 Pasir Gudang
 Industrial Estate
 Town Office:
 1 Jalan Perisai
 Taman Sri Tebrau
 Peti Surat T.S.T. No. 7
 Telex No.: MA60750

J286 KLUANG

Tractors Malaysia Berhad
 9, Jalan Jati
 Mail Address: P.O. Box 39

J269 KOTA BARU

Tractors Malaysia Berhad
 Lot No. 1413
 Jalan Pasir Putih
 Mail Address: P.O. Box 82

J267 KOTA KINABALU

Tractors Malaysia Berhad
 Mile 5, Tuaran Road. Likas
 Mail Address: P.O. Box 1044
 Telex No.: MA80079

J293 KUALA TRENGGANU

Tractors Malaysia Berhad
 36A. Jalan Bukit Kecil
 Mail Address: P. O. Box 86

J287 KUANTAN

Tractors Malaysia Berhad
 Lot 139 Kawasan
 Perindustrian Semambu
 Telex No.: MA50227

J262 KUCHING

Tractors Malaysia Berhad
 2-1/2 Milestone. Pending Road
 Tanah Puteh
 Mail Address: P.O. Box 1051
 Telex No.: 70106

J285 LAHAD DATU

Tractors Malaysia Berhad
 Ground Floor, MDLD0591
 Jalan Teratai
 Mail Address: P.O. Box 294

J282 .MELAKA

Tractors Malaysia Berhad
 Lot 20 & 21
 Air Keroh Industrial Estate
 Mail Address: P.O. Box 219
 Telex No.: MA62801

J281 MIRI

Tractors Malaysia Berhad
 Piasau Road
 Mail Address: P O. Box 352
 Telex No.: MA74234

J261 PETALING JAYA

Tractors Malaysia Berhad
 Jalan 205
 Mail Address: G.P.O. Box 2
 Telex No.: MA37610

J263 SANDAKAN

Tractors Malaysia Berhad
 Mile 3-1;2 North Road
 Mail Address: P O. Box 1007
 Telex No: MA82003

MALAYSIA (Cont.)**J283 SIBU**

Tractors Malaysia Berhad
 17, Khoo Peng Loong Road
 Mail Address: P.O. Box 426
 Telex No.: 72057

J265 TAWAU

Tractors Malaysia Berhad
 Mile 4, Apas Road
 Mail Address: P.O. Box 780
 Telex No.: MA83131

BINTULU

Tractors Malaysia Berhad
 18 New Commercial Center
 Jalan Abang Galau
 Mail Address: P.O. Box 210

NEPAL**Contact:**

Tractors India Limited
 2/24 Baneswar Heights
 Kathmandu
 Mail Address: Post Box 924,
 Kathmandu
 Cable Address: DIESELS,
 KATHMANDU

PHILIPPINES**J310 MAKATI, METRO MANILA**

USIPHIL Inc.
 P.O. Box 55 MCC
 Makati Metro Manila
 Cable Address: USIPHIL MANILA
 Telex No.: EPTI 3550
 Phone: 89-20-61

J312 BACOLOD CITY

USIPHIL Inc.
 P.O. Box 206
 Bacolod City

J313 BUTUAN CITY

USIPHIL Inc
 Rm No. 2 National Highway
 Butuan City

CAGAYAN DE ORO CITY

USIPHIL Inc.
 Philam Life Building
 Don Apolinar Velez Street
 Cagayan De Oro City

J314 CEBU CITY

USIPHIL Inc.
 Sea Transport Bldg.
 209 M. J. Cuenco Ave.
 Cebu City

or

P.O. Box 258, Cebu City

COTABATO CITY

USIPHIL Inc
 Viola Building
 Quezon Avenue
 Cotabato City

Main offices in larger-faced type
 Branches in smaller-faced type

DENMARK (Cont.)

LA10 2650 HVIDOVRE, COPENHAGEN
 (LT) Brodrene Vestergaard
 Stamholmen 165
 Telex: 15856116356
 Cable: VESTERVAERK
 Phone: (1) 78-66-66
 4100 RINGSTED. SJAELLAND
 Broene Vesterpard
 Rugveenpget 6
 Phone: (31 61 17 82
 6000 KOLDING. JUTLAND
 Brodrene Vestergard
 Agtrup per
 6091 Bjert
 Phone: (5) 57 22 66
 8200 ARHUS N, JUTLAND
 Brhdrene Vestergurd
 Trojborgvej 8
 Phone: (6) 16 00 66

DJIBOUTI, Republic of**K211** DJIBOUTI

KG11 (INC LT) Anciens Comptoirs Ries
 B. P. 2106
 Rue Marchand
 Telex: 823 FS
 Cable: RIES
 Phone: 2467/2455

K210 Geneva Office:**KG10** Near East Financial Corp.

c/o Hentsch & Cie
 15, rue Corraaterie
 1204 Geneva
 Switzerland
 Phone: (022) 21 90 11

EGYPT, Arab Republic of**Q620** ALEXANDRIA

QA20 (INC LT) MANTRAC
 P.O. Box 1054
 22 Amin Fikrv Street
 Telex: 54336 MANT UN
 Cable: MANTRAC
 Phone: 807897

Q621 CAIRO

QA21 MANTRAC
 11 Brazil Street
 Zamalek
 Phone: 801240

EQUATORIAL GUINEA (RIO MUNI)**M180** MADRID 14, SPAIN

MB40 (INC LT) Finanzauto S.A.
 Plaza de las Cortes 6
 Telex: 27752
 Cable: FINANZAUTO
 Phone: (91) 448-2700/445-7150

ETHIOPIA**K212** ADDIS ABABA

KG12 (INC LT) Ries Engineering Share Co.
 P.O. Box 1116
 Debrezeit Road
 Telex: 21082
 Cable: RIESTRAC
 Phone: 15 11 33
 ASMARA, ERITREA
 Paul Ries & Sons (Ethiopia)
 Limited
 P.O. Box 738
 Cable: RIES

K210 Geneva Office:**KG10** Near East Financial Corp.

c/o Hentsch & Cie
 15, rue Corraaterie
 1204 Geneva
 Switzerland
 Phone: (022) 21 90 11

FERNANDO PO**M180** MADRID 14, SPAIN**M840** (INC LT) Finanzauto S.A.

Plaza de las Cortes 6
 Telex: 27752
 Cable: FINANZAUTO
 Phone: (91) 448-2700/445-7150

FINLAND**L390** SF-01530 HELSINKI-VANTAA-**LB90** LENTO

(INC LT) Wihuri Oy Witraktor
 Telex: 124618
 Cable: WITRAKTOR
 Phone: (80) 826-311

L393 SF-90550 OULU 55**L893** Wihuri Oy Witraktor

Moreenitie 6
 Cable: WITRAKTOR
 Phone: (981) 361-344

L391 SF-96100 ROVANIEMI 10**LB91** Wihuri Oy Witraktor

Varastotie 14
 Telex: 37226
 Cable: WITRAKTOR
 Phone: (991) 15-271

L392 SF-33880 SAAKSJARVI/TAMPERE**LB92** Wihuri Oy Witraktor

Telex: 22226
 Cable: WITRAKTOR
 Phone: (931) 670-200

FRANCE**L030** 75008 PARIS

Hy. Bergerat, Monnoyeur S.A.
 6, rue Christophe Colomb
 Telex: 660-911
 Cable: TIBI
 Phone: (1) 723-61-321723-61-34

(INC LT) Including Lift Trucks

Main offices in larger-faced type
Branches in smaller-faced type

FRANCE (Cont.)

LC10 94380 BONNEUIL-SUR-MARNE (Lift Trucks)
Hy. Bergerat, Monnoyeur S.A.
2, rue du Moulin Bateau
Telex: 230601
Phone: (1) 886-11-12

91310 MONTLHERY (Engines)
Hy. Bergerat, Monnoyeur S.A.
Rue de Longpont
Telex: 600450
Phone: (1) 901-09-71/901-52-15

29110 CONCARNEAU
Societe Maritime Hy. Bergerat.
Monnoyeur S.A.R.L.
Zone Industrielle du Moros
Telex: 940466
Phone: 498) 97-13-88197-18-62

93212 LA PLAINE SAINT-DENIS (Parts/Service)
Hy. Bergerat, Monnoyeur S.A.
35, rue Proud'hon
B. P. 53
Telex: 620210
Cable: TIBI PLNDI
Phone: (1) 203-43-301202-04-69

78480 VERNEUIL-SUR-SEINE (Training)
Hy. Bergerat, Monnoyeur S.A.
Le Pont du Rouillard
Telex: 698075
Phone: (1) 971-56-56

L032 59350 ST. ANDRE-LEZ-LILLE

LC12 Societe Lilloise Hy. Bergerat,
Monnoyeur S.A.R.L.
70, rue Pasteur
Telex: 810097
Phone: (20) 51-92-01

L037 69200 VENISSIEUX

LC17 Societe Lyonnaise Hy. Bergera,
Monnoyeur S.A.R.L.
30. rue Eugene Henaff
B. P. 544
Telex: 340933
Phone: (78) 20-81-23

L034 13480 CABRIES

LC14 Societe Marseillaise Hy.
Bergerat. Monnoyeur S.A.R.L.
Route de Gardanne
B.P No. 1
Telex: 410932
Phone: 142) 22-9825

L036 54840 GONDREVILLE

LC16 Societe Nanceinne Hy. Bergerat.
Monnoyeur S.A.R.L.
Route Nationale 4
Telex: 961266
Phone: 183) 43-48-30

FRANCE (Cont.)

L038 78480 VERNEUIL-SUR-SEINE

LC18 Societe Normande Hy.
Bergerat Monnoyeur S.A.R.L.
Le Pont du Rouillard
Telex: 698075
Phone: (1) 971-56-56

L039 94380 BONNEUIL-SUR-MARNE

LC19 Societe Parisienne Hy.
Bergerat, Monnoyeur S.A.R.L.
2. rue du Moulin Bateau
Telex: 220298
Phone: (1) 886-11-21

L035 35530 NOYAL-SUR.VILAINE

LC15 Societe Rennaise Hy.
Bergerrt. Monnoyeur S.A.R.L.
La Croix Mulon
B. P. No. 2
Telex: 730097
Phone: 199) 00-52-22

L031 31029 TOULOUSE

LC11 Societe Sud-Ouest Hy.
Bergerat. Monnoyeur S.A.R.L.
37, chemin de la Butte
B. P. No. 4055
Telex: 531988
Phone: 61) 80-74-14

GABONESE REPUBLIC

K630 LIBREVILLE

KF10 (INC LT) S.H.O. Gabon
Departement Tractafric
B. P. 2147
Telex: 5210
Cable: TRACTAFRIC
Phone: 72-01-40172-04-99172-11-77

K631 PORTGENTIL

KD40 S.H.O. Gabon
Departement Tractafric
B. P. 520
Cable: TRACTAFRIC

K600 Paris Office:

KB20 Compagnie Optorg
Arago-D9fense
5. rue Bellini
92806 Puteaux
France
Telex: 620554F ALTGO
Cable: OPTORGPO
Phone: 775-35-431775-32-46

GAMBIA

K360 DAKAR, SENEGAL

KE50 (INC LT) Manutention Africaine
Dept. LABORAFRIQUE
B. P. 173
Telex: 606 MEA SG
Cable: MEA
Phone: 360-041361-541222-71

K310 Bordeaux Office:

KB30 J. A. Delmas Export S.A.
17. rue Vauban
33075 Bordeaux Cedx
France
Telex: 560615
Cable: IMEA
Phone: (56) 90-93-70

GERMANY, Federal Republic of
L240 8046 GARCHING bei MUNCHEN
LB10 (INC LT) ZEPPELIN-METALLWERKE GmbH
 Zeppelinstrasse 1-5
 Postfach 2003
 Telex: 05215-821
 Cable: ZEPPELINMETALL
 Phone: (89) 3-20-001
L249 6320 ALSFELD
LB19 Zeppelin-Metallwerke GmbH
 Karl Broger-Strasse 8
 Telex: 049-426
 Phone: 16631) 844-846
L243 2807 ACHIM
LB13 Zeppelin-, Metallwerke GmbH
 Zeppelinstrasse
 Telex: 249403
 Phone: (4202) 6060
L251 1000 BERLIN 49
LB51 Zeppelin-Metallwerke GmbH
 Topchiner Weg 189-199
 Telex: 0183-411
 Phone: (1301) 74560-6162
L245 7030 BOBLINGEN
LB15 Zeppelin-Metallwerke GmbH
 Hanns-Klemm-Strasse
 Telex: 07-265-67
 Phone: 17031) 22-30-74
L245 8520 ERLANGEN
LB15 Zeppelin-Metallwerke GmbH
 Graf-Zeppelin-Strasse 5-7
 Telex: 06-29-821
 Phone: (9131) 61-51/55
L252 2085 HAMBURG
LB52 Zeppelin-Metallwerke GmbH
 Zeppelinstrasse 1
 Telex: 02-12-588
 Phone: (4106) 71031
L248 4700 HAMM
LB16 Zeppelin-Metallwerke GmbH
 Zeppelinstrasse 4
 Telex: 08-28 601
 Phone: (2385) 4841488
L253 6450 HANAU
LA51 Zeppelin-Metallwerke GmbH
 Donastrasse 26
 Telex: 04184189
 Phone: (6181) 1833
L256 6688 ILLINGEN 2
LA56 Zeppelin-Metallwerke GmbH
 Zeppelinstrasse
 Telex: 04 44115
 Phone: 168251 2043/47
L241 5000 KOLN 90 (Porz)
LB11 Zeppelin-Metallwerke GmbH
 Graf Zeppelin-Strasse
 Postfach 900860
 Telex: 08-874-451
 Phone: (2203) 741
L250 3014 LAATZEN 4
LB50 Zeppehn-Metallwerke GmbH
 Postfach 40
 Oesselser Strasse 36
 Telex: 09-23-693
 Phone: (51021) 851

(INC LT) Including Lift Trucks

GERMANY, Federal Republic (Cont.)
L254 5403 MULHEIM-KARLICH BEI
LA54 KOBLENZ
 Zeppelin-Metallwerke GmbH
 Industriestrasse
 Telex: 0867828
 Phone: 12637) 62081185
L255 4200 OBERHAUSEN
LA55 Zeppelin-Metallwerke GmbH
 Lindnerstrasse 45
 Postfach 101880
 Telex: 0856988
 Phone: (208) 6-58-01/05
L244 7913 SENDEN
LB14 Zeppelin-Metallwerke GmbH
 Berliner Strasse 30
 Telex: 0712287
 Phone: (7307) 5005
L247 6520 WORMS am RHEIN
LB17 Zeppelin-Metallwerke GmbH
 Mainzer Strasse 55
 Telex: 046-78-37
 Phone: (6241) 6961/69

GERMANY, Democratic Republic of
X840 (INC LT) COSA Geneva

GHANA

K680 ACCRA
KA90 (INC LT) Tractor & Equipment
 Division of UAC of Ghana Ltd.
 P.O. Box 5207
 Telex: 2008
 Cable: MACHTRAC
 Phone: 21900
 KUMASI
 Tractor & Equipment
 Division of UAC of Ghana Ltd.
 P.O. Box 3000
 Cable: MACHTRAC
 Phone: 3307
K666 London Office:
KC80 Unatrac Division of UAC Ltd.
 Maidenhead Road
 Windsor, Berks. SL4 5HH
 England
 Telex: 848881
 Cable: UNATRAC
 Phone: (7535) 55441

GREECE

M010 ATHENS
MC40 (INC LT) AVRAS S.A.
 Athinon and Kifissou 162 Aves.
 P.O. Box 1250
 Omonia
 Telex: 21-4661/21-4662
 Cable: AVRATRAC
 Phone: 571-6611/572-7011

Main offices in larger-faced type
 Branches In smaller-faced type

GREECE (Cont.)**M011** THESSALONIKI

MC41 AVRAS S.A.
297 Monastiriou Street
Telex: 041-446
Cable: AVRAS
Phone: 516-626

GUINEA BISSAU**M380** LISBON, PORTUGAL

MA50 (INC LT) STET-Sociedade Tecnica
de Equipamentos e Tractores S.a.r.l.
Apartado 50
2686 Sacavem Codex
Telex: 12778
Cable: STETRA SACAVEM
Phone: 251-1011

GUINEE, Republic of**K390** CONAKRY

KE70 (INC LT) Manutention Guineenne
B. P. 336
Phone: 621-42

K310 Bordeaux Office:

KB30 J. A. Delmas Export S.A.
17. rue Vauban
33075 Bordeaux Cedex
France
Telex: 560615
Cable. MEA
Phone: t56) 90 93 70

HUNGARY

Main Office:
1364 BUDAPEST
Universal Company Ltd
P O Box 54
Telex 22_534,
Cable. UNIVERSAL
Phone: 175-433

Caterpillar Office:

X450 1135 BUDAPEST
Universal Company Ltd.
Jasz Utca 85
Phone: (1) 402 9401202 250
(LT) COSA Geneva

ICELAND**L130** REYKJAVIK

LB40 (INC LT) HEKLA Ltd.
Laugavegur 170-172
P O Box 5310
Telex: 201 8
Cable: HEKLA
Phone: 21240

IRAN**M231** TEHERAN**MC31** (INC LT) Mashinhave Rahsazi

Company Limited
Av. Saadi 168
P.O. Box 3390
Telex: 212357 MARC-IR
Cable: MARCOLI
Phone: (021) 314001/10

Parts & Service Main Facility:

TEHERAN

Mashinhave Rahsazi Co. Ltd.
Karadj Road km 11
P.O. Box 3390
Telex: 212357
Cable: MARCOLI
Phone: (021) 97006216 & 94339013
TEHERAN (Teheran Branch)
Mashinhave Rahsazi Co. Ltd.
Serahe Azari
P.O. Box 3390
Cable: MARCOLI
Phone: 10211 950712

M232 AHWAZ (Khuzestan Branch)

MC32 Mashinhave Rahsazi Co. Ltd.
Khorramshahr Road km 8
P.O. Box 101
Telex: 612012
Cable: MARCOLI
Phone: (061) 33016-18

M236 KERMAN (Kerman Branch)

Mashinhave Rahuazi Co. Ltd.
Teheran Road km 4
P.O. Box 319
Cable: MARCOLI
Phone: (0341) 677011

M233 SHIRAZ (Fars Branch)

MC33 Mashmhave Rahsazi Co. Ltd.
Bushir Road km 2
PO Box 168
Cable: MARCOLI
Phone. 103311 33993. 36664

M234 ESFAHAN (Esfahan Branch)

MC34 Mashmhave Rahsazr Co Ltd.
Teheran Road km
P O Box 156
Cable: MARCOLI
Phone: (031) 37674. 30031

M237 MASHAD (Khorrasan Branch)

Mashmhave Rahsazi Co. Ltd.
Cento Road km 9
Cable: MARCOLI
Phone 10511 35008

M230 European Liaison Office:

MC30 AFIWA S.A.
118, rue du Rhone
Case Rive 60
1211 Geneva 3
Switzerland
Telex: 22168
Phone. 1022) 35-74-55

IRAQ**X360** (INC LT) COSA Geneva

(INC LT) Including Lift Trucks

Main offices in larger-faced type
Branches In smaller-faced type

IRELAND, Republic of
M680 CLONDALKIN, CO. DUBLIN
ME80 (INC LT) McCormick Macnaughton Ltd.
 Naas Road
 Telex: 5179
 Cable: SA.MAC DUBLIN
 Phone: 514222

M681 CORK

ME81 McCormick Macnaughton Ltd.
 Tivoli
 Telex: 6119
 Cable: SAMAC
 Phone: 52252

ISRAEL**M080** HOLON

Israel Tractors and
 Equipment Co. Ltd.
 8 Hamanor Street
 P.O. Box 214
 Telex: 35547
 Cable: ISRAELEQIP
 Phone: (03) 807-722

M082 HAIFA

Israel Tractors and
 Equipment Co. Ltd.
 Harcharodshet Street
 Corner Hamasger Street
 P.O. Box 1191
 Industrial District
 Kiryat Biyalik
 Haifa
 Telex: 45130
 Cable: ISRAELEQIP
 Phone: (04) 733984

MA70 31033 HAIFA

(LT) EL SAKER LTD.
 33 Haatzmauth Road
 P.O. Box 33091
 Telex: 46678
 Cable: SAKEREL
 Phone: (04) 641-704

ITALY**M040** 20123 MILANO

MA30 (INC LT) Compagnia Generale
 Trattori S.p.A.
 Direzione Generale
 Via San Vittore 37
 Telex: 39073
 Cable: COGETRATTORI
 Phone: (02) 49-94

M041 20061 MILANO CARUGATE

MA31 Compagnia Generale
 Tratto S.p.A.
 Strada Provinciale 121
 P.O. Box 4047
 Telex: 36478. 36179
 Cable: COGETRATTORI
 Phone: (02) 904-39-43

(INC LT) Including Lift Trucks

ITALY (Cont.)**M042** 13100 VERCELLI

MA32 Compagnia Generale
 Trattori S.p.A.
 Casella Postale 205
 Via Torino 45
 Telex: 20127
 Cable: COGETRATTORI
 Phone: (0161) 391-265

M046 35030 PADOVA SARMEOLA

MA36 Compagnia Generale
 Tratto S.p.A.
 Via della Provvidenza 129
 Telex: 43209
 Cable: COGETRATTORI
 Phone: (049) 63-01-88

M043 16149 GENOVA

MA33 Compagnia Generale
 Trattori S.p.A.
 Via R. Rigola 3
 Telex: 27331
 Cable: COGETRATTORI
 Phone: (010) 25-70-11i12113

M044 40012 BOLOGNA CALDERARA DI

MA34 RENO
 Compagnia Generale
 Tratto S.p.A.
 Via Persicetana 4
 Telex: 51151
 Cable: COGETRATTORI
 Phone: (051) 72-77-25

M045 52040 AREZZO SAN GIULIANO

MA35 Compagnia Generale
 Tratto S.p.A.
 Via Piero Calamandrei 305
 Telex: 57174
 Cable: COGETRATTORI
 Phone: (0575) 3508-61

M340 00137 ROME

Macchine Agricole Industriali
 Automezzi MAIA S.p.A.
 Via Nomentana 995
 Telex: 61463, 61404
 Cable: MAIAROM
 Phone: (06) 828-0241/4
 824-941

M341 70100 BARI

MA61 Macchine Agricole Industriali
 Automezzi MAIA S.p.A.
 Zona Industriale
 S.S. 96. km 118
 Telex: 81029
 Cable: MAIABA
 Phone: (0801) 451-255

M346 09100 CAGLIARI ISARDINIAI

Macchine Agricole Industriali
 Automezzi MAIA S.p.A.
 S.S. 131, km 5500
 Telex: 79047
 Cable: MAIASARD
 Phone: (070) 284-821

M343 95030 CATANIA (SICILY)

Macchine Agricole Industriali
 Automezzi MAIA S.p.A.
 Zona Industriale Contrada
 Palma
 Telex: 97012
 Cable: MAIACAT
 Phone: (095) 344-388

Main offices in larger-faced type
 Branches in smaller-faced type

ITALY (Cont.)**M342** 81025 MARCIANISE (CASERTA)**MA62** Macchine Agricole Industriali
Automezzi MAIA S.p.A.
S.S. 87 Sennitica km 21.035
Telex: 71108
Cable: MAIANAP
Phone: 10823) 83-21-33**M344** 90146 PALERMO ISICILY)
Macchine Agricole Industriali
Automezzi MAIA S.p.A.
Viale Resurrezione 90/92A
Telex: 91048
Cable: MAIASIC
Phone: 10911 4639-18**M347** 65013 CITTA S. ANGELO-PESCARA
Macchine Agricole Industriali
Automezzi MAIA S. p. a.
Via Nazionale Adriatica Nord
km 439
Telex: 60175
Cable: MAIAPE
Phone (085) 96-80-54**M345** 87100 COSENZA
Macchine Agricole Industriali
Automezzi MAIA S. P. A.
Via Panebianco 282
Telex: 80026
Cable MAIA CS
Phone: (0984) 36-100

Engines and Lift Trucks:

M350 MONTEROTONDO SCALO (ROME)**MA60** MAIA DPI
S.S. Salaria km 24, 400
Phone: 900-40-29t9001-42**IVORY COAST****K350** ABIDJAN 01**KE40** (INC LT) Manutention Africaine
01 B. P. 1299
Telex: 675 & 2275
Cable: MEA
Phone: 37-33-65**K310** Bordeaux Office:**KB30** J. A. Delmas Export S.A.
71. rue Vauban
33075 Bordeaux C
France
Telex: 560615
Cable: MEA
Phone: (56) 90-93-70**JORDAN****Q210** AMMAN**QB20** (INC LT) Jordan Tractor & Equipment
Company Limited
P.O. Box 313
Telex: 1226
Cable: JALAD
Phone: 61141/42143**KENYA****K270** NAIROBI**KA80** (INC LT) Construction Equipment
(Div. of Gailey & Roberts Ltd.)
P.O. Box 30331
Cable: AFRITRAK
Phone: 55-71-88

ELDORET

Construction Equipment
(Div. of Gailey & Roberts
Ltd.)
P.O. Box 27
Cable: AFRITRAK
Phone: 2726

KISUMU

Construction Equipment
(Div. of Gailey & Roberts)
Ltd.)
P.O. Box 1341
Cable: AFRITRAK
Phone: 2037

MOMBASA

Construction Equipment
(Div. of Gailey Robert
Ltd.)
P.O. Bo 80692
Cable: AFRITRAK
Phone: 491392

NAKURU

Construction Equipment
(Div. of Gailey Robert
Ltd.)
P.O. Box 1282
Cable: AFRITRAK**K666** London Office:**KC60** Unatrac Division of UAC Ltd.
Maidenhead Road
Windsor, Berks. SL4 5HH
England
Telex: 848881
Cable: UNATRAC
Phone: (7535) 5441**KUWAIT****Q300** KUWAIT**QB10** (INC LT) MOHAMED
ABDULRAHMAN AL BAHAR
Equipment Division
P.O. Box 148 Safat
Telex: 2302 KT
Cable: MOATASIM
Phone: 810-855156**LEBANON****Q160** BEIRUT**QB50** (INC LT) M. Ezzat Jallad & Fils
P.O. Box 110208 & 112556
Telex: JAMLA 21614 & 26124 LE
Cable: JAMLA
Phone: 932 522 (5 lines)

(INC LT) Including Lift Trucks

Main offices in larger-faced type
Branches in smaller-faced type

- LESOTHO**, Kingdom of
MASERU
 Maluti Tractors (Pty) Ltd.
 Box MS 201
 Cable: SHIPMENTS
 Phone: 2643
- LIBERIA**
K320 MONROVIA
K850 (INC LT) Liberia Tractor and
 Equipment Company
 United Nations Drive
 P.O. Box 299
 Telex: 4282
 Cable: LIBTRACO
 Phone: 222279/222057
- K580** New York Office:
KD90 INTRACO MARKETING
 CORPORATION
 485 Lexington Avenue
 New York, N. Y. 10017 U. S. A.
 Telex: 234790
 Cable: INTRAMARCO
 Phone: (212) 949-9030
- PEOPLE'S SOCIALIST LIBYAN
 ARAB JAMAHIRIYA**
Q360 TRIPOLI
QB80 (INC LT) General Company for Farm
 Equipment and Agricultural
 Necessities (GISMET-EME)
 Sidi Masri
 P.O. Box 148
 Telex: 20022
 Cable: METRADE
 Phone: 32520, 41237
- Q350** BENGHAZI
QB60 General Company for Firm
 Equipment and Agricultural
 Necessities (GISMET-EME)
 P.O. Box 2094
 Telex: 40129
 Cable: METRADE
 Phone: 92329
- LIECHTENSTEIN**, Principality of
L010 4900 LANGENTHAL,
 SWITZERLAND
LB20 (INC LT) ULRICH AMMANN
 Baumaschinen AG
 Telex: 68385
 Cable: AMMANNAG
 Phone: (063) 29-61-61
- LUXEMBOURG**, Grand Duchy of
L410 LUXEMBOURG
L010 (INC LT) Bergerat Dutchy S.A.
 Zone Industrielle
 Howald
 Telex: 2543
 Cable: BEDUTRY
 Phone: 48-12-21122
- MADEIRA ISLANDS**
M380 LISBON, PORTUGAL
MA53 (INC LT) STET-Sociedade Tecnica
 de Equipamentos e Tractores
 S. a. r. l.
 Apartado 50
 2686 Sacavem Codex
 Telex: 12778
 Cable: STETRA SACAVEM
 Phone: 251-1011
- MALAGASY REPUBLIC**
K232 TANANARIVE
KA32 (INC LT) Henri Fraise File & Cie S.A.
 Route des Hydrocarbures
 B. P. 28
 Telex: 22218
 Cable: FRAISENRI
 Phone: 227-21/24
- MALAWI**
K581 BLANTYRE
KD91 (INC LT) CESCO Ltd.
 Stadium Road
 P.O. Box 526
 Telex: 4140
 Cable: CESCO
 Phone: 30166/7/8
 LILONGWE
 CESCO Ltd.
 Kamuzu Procession Road
 Plot 7. 8 & 9. Are 29
 P.O. Box 478
 Telex: 4109
 Phone: 30944
- K580** New York Office:
KD90 INTRACO MARKETING
 CORPORATION
 485 Lexington Avenue
 New York, N. Y. 10017 U. S. A.
 Telex: 234790
 Cable: INTRAMARCO
 Phone: (212) 9499030

(INC LT) Including Lift Trucks

Main offices in larger faced type
Branches in smaller-faced type

MALI REPUBLIC**K380** BA.MAKO**KE60** (INC LT) SOMAR

B.P 143

Telex: 565

Cable: MEA

Phone: 22957122549

K310 Bordeaux Office:**KB30** J A. Delmas Export S.A.

17. rue Vauban

33075 Bordeaux Cedex

France

Telex: 560615

Cable: MEA

Phone: 1561 90-93-70

MALTA

(INC LT) COSA Geneva

MAURITIUS**K120** PORT LOUIS

Blyth Brothers & Co. Ltd.

P. O. Box 56

Telex: 1W 211

Cable: IBEL MAURITIUS

Phone: 2-0265

MAURITANIA**K300** NOUAKCHOTT**KE20** (INC L.T) SOMATRAC

B.P 164

Telex: 571

Phone: 52188

K310 Bordeaux Office:**KB30** J. A. Delmas Export S.A.

17. rue Vauban

33075 Bordeaux Cedex

France

Telex: 560615

Cable MEA

Phone: 156) 90-93-70

MAYOTTE, Department of**K232** TANANARIVE, MALAGASY**KA32** REPUBLIC

(INC LT) Henri Fraise Fils & Cie S.A.

Route des Hydrocarbures

B. P. 28

Telex: 22218

Cable: FRAISENRI

Phone: 227-21/24

MOROCCO**K370** CASABLANCA**KF40** (INC LT) Societe Marocaine des

Etablissements P. Parrenin

145. Boulevard de la Resistance

Telex: 21733

Cable: PARAGRI

Phone: 30-56-75 & 30-45-43

MOZAMBIQUE, Popular and
Democratic Republic of**K460** MAPUTO**KA40** (INC LT) Sociedade Tecnica de

Equipamentos Industriais e

Agricolas Lda. (STEIA)

P.O. Box 2864

Telex: 6241 (393)

Cable: REMOTERRA

Phone: 21308124254

K463 BEIRA

Sociedade Tecnica de

Equipamentos Industriais

e Agricolas (Biera) Lda.

PO Box 929

Telex: 2341

Cable: STEIA

Phone: 24062/22462

K462 NAMPULA

Sociedade Tecnica de

Equipamentos Industriais

e Agricolas (Nampula) Lda

P.O. Box 416

Cable: STEIA

Phone: 3006/9

MOZAMBIQUE, Popular and
Democratic Republic of (Cont.)**K461** TETE

Sociedade Tecnica de

Equipamentos Industriais

e Agricolas (Tete) Lda.

P O. Box 169

Cable: STEIA

Phone: 20 and 312

NETHERLANDS

Earthmoving and Parts Divisions:

L110 1009 AB AMSTERDAM

Geveke Motoren en Grondverzet B. V.

Spaklerweg 45

Industrieterrein Amstel

Postbus 4091

Telex: 13106

Cable: GLOBETRACT

Phone: (020) 94-32-32

(INC LT) Including Lift Trucks

Main offices in larger-faced type
Branches in smaller-faced type

- NETHERLANDS, (Cont.)**
 Engine Division:
L120 1000 BE AMSTERDAM
 Geveke Motoren en Grondverzet B. V.
 Divisie Motoren
 Kabelweg 25
 Postbus 1225
 Telex: 12219
 Phone: 1020) 80-28-02
 Parts and Service Main
 Facility/Engine Division:
L122 3356 LE PAPENDRECHT
 Geveke Motoren en
 Grondverzet B. V.
 Ketelweg 20
 Postbus 61
 Telex: 29401
 Phone: 10781 5-05-55
- VALKENSWAARD**
 Geveke Motoren en
 Grondverzet B V
 J.F Kennedy Lean 40
 Industrierrein
 Deschaapsloop
 Phone: 0490218158
- LA40** ROTTERDAM 22
 (LT) Handelsonderneming Mageon B. V.
 Sluisjesdijk 70
 Telex: 23483
 Cable: MAGEON
 Phone: (010) 29-29-55
- NIGER**
K410 NIAMEY
KE80 (INC LT) Manutention Africaine
 B. P. 10.387
 Telex: 5234
 Phone: 72-20-11172-20-12
- K310** Bordeaux Office:
KB30 J A. Delmas Export S.A.
 17. rue Vauban
 33075 Bordeaux C6dex
 France
 Telex: 560615
 Cable: MEA
 Phone: (56) 90-93-70
- NIGERIA**
K660 LAGOS
KB91 (INC LT) Tractor & Equipment
 Division of UAC of Nigeria Ltd.
 Private Mail Bag No. 1015
 Ebute-Metta
 Telex: 21233
 Cable: UNATRAC
 Phone: 843310
- KADUNA**
 Tractor & Equipment
 Division of LAC of Nigeria Ltd.
 P O. Box 7
 Telex: 71170
 Cable: UNATRAC
 Phone: 43121
- NIGERIA (Cont.)**
 PORT HARCOURT
 Tractor & Equipment
 Division of UAC of Nigeria Ltd.
 Trans Amadi Estate
 P O. Box 6
 Cable: UNATRAC
 Phone: 2162718
- WARRI**
 Tractor & Equipment
 Division of UAC of Nigeria Ltd.
 P.O. Box 543
 Cable: UNATRAC
 Phone: 287
- KANO**
 Tractor & Equipment
 Division of UAC of Nigeria Ltd
 P.O. Box 2049
 Cable: UNATRAC
 Phone: 6191
- K616** London Office:
KC70 Unatrac Division of UAC Ltd.
 Maidenhead Road
 Windsor. Berks. SL4 5HH
 England
 Telex: 848881
 Cable: UNATRAC
 Phone: 17535) 55441
- NORWAY**
L310 OSLO 5
LC20 (INC LT) Pay & Brinck AIS
 Brobekkveien 62B
 P.O. Box 65, Rislokka
 Telex: 11631
 Cable: PABRIMAS
 Phone: (2) 15-92-50
- L312** 5091 NYBORG i ASANEIBERGEN
LC22 Pay & Brinck A/S
 Liavn. 8
 P O. Box 87
 Telex: 42536
 Phone: (61 18 47 50
- 2380** BRUMUNDDAL
 Pay & Brinck A/9
 Masetwegen 2
 Telex: 19405
 Phone: (651 40-511112
- L313** 4601 KRISTIANSAND S
LC23 Pay & Brinck A/S
 Aegirsvei 3
 P.O. Box 1041
 Telex: 18202
 Phone: 1421 92-655
- L314** 8501 NARVIK
LC24 Pay & Brinck A/S
 Fagernesveien 3
 P.O. Box 278
 Telex: 64276
 Phone: {821 44-135
- L315** 7001 TRONDHEIM-GRANA SLIA
LC25 Pay & Brinck A/S
 Bromstadveien 70
 P O. Box 3723
 Telex: 55136
 Phone: (75) 15-740

(INC) Including Lift Trucks

Main offices in larger-faced type
Branches in smaller type

OMAN, Sultanate of**Q305** MUSCAT

QB15 (INC LT) Oasis Trading & Equipment
Company
P.O. Box 1002
Mutrah
Telex: 3329 ALFAIHA MB
Phone: 702865

PAKISTAN**M130** KARACHI 1

M030 (INC LT) Allied Engineering and
Services Ltd.
G.P.O. Box 940
Telex: 3623 PHPL PW
Cable: BULLWORK
Phone: 292800 & 293493
LAHORE
Allied Engineering and Services Ltd.
59 Main Gulberg
Phone: 880641
RAWALPINDI
Allied Engineering and Services Ltd.
39 Al-Abbas Square
Adamji Road
Phone: 63132

POLAND

Administration:

X330 CANNOCK, STAFFS. WS11 3LL, U. K.

XA30 (INC LT) Bowmaker (Plant) Ltd.
Polish Operations Division
Watling Street
Telex: 337548
Cable: BOWPLANT
Phone: (05435) 2551

X331 00-020 WARSZAWA

Bowmaker (Plant) Ltd.
Biuro Informacji Technicznej
Ul. Szpitalna 1P V1
Telex: 814899
Phone: 27 64 21 & 27 76 26
Consignment Stock Parts Warehouse:
UMULTOWO K. POZNANIA
Bowmaker Service Station
Hydrobudowa 7
Ul. Zielona 6
Telex: 04-15-574 BOWMA PL
Phone: 5-44-55

PORTUGAL**M380** LISBON

MA50 (INC LT) STET-Sociedade Tecnica de
Equipamentos e Tractores S.a.r.l.
Apartado 50
2686 Sacavem Codex
Telex: 12778
Cable: STETRA SACAVEM
Phone: 251-1011

PORTUGAL (Cont.)**M381** PORTO

MA51 Sociedade Tecnica de Equipamentos e
Tractores S. a. r. L
Apartado No. 48
4471 Main Codex
Telex: 25151
Cable: STETRA PORTO
Phone: 948-1560

M382 2403 LEIRIA

MA55 Sociedade Tecnica de Equipamentos a
Tractores S. a. r. L
Apartado 207
Phone: 25055

7800 BEJA

Sociedade Tecnica de Equipamentos e
Tractores S. A .r. L
Rua d. Alfonso III
Telex: 18250
Phone: 24075

COIMBRA

Sociedade Tecnica de Equipamentos a
Tractors S. a. r. L
Av. Fernao de Magalhaes 151-2B
Phone: 27976

FARO, ALGARVE

Sociedade Tecnica de Equipamentos e
Tractores S. a. r. L
Vale de Servos
Estrada Nacional 125
Phone: 5 32 65

PRINCIPE, People's Republic of**K541** LUANDA, ANGOLA**KB41** (INC LT) Sorel S. a. r. l.

P.O. Box 408
Telex: 3229 SOREL AN
Cable: SOREL
Phone: 7060015

QATAR, ARABIAN GULF**0303** DOHA**0813** (INC LT) MOHAMED

ABDULRAHMAN AL BAHAR
P.O. Box 2171
Telex: 4255 BAHAR DH
Cable: BAHAR
Phone: 321706

REUNION ISLAND**K340** 97462 ST. DENIS**KC30** (INC LT) Ets. Camille Mace S.A.

46, rue de la Bourdonnais
B. P. 57
Telex: 096138 RE
Cable: CEMACE
Phone: 21-06-59

(INC) Including Lift Trucks

Main offices in larger-faced type
Branches in smaller-faced type

RIO DE ORO (Western Sahara)
M180 MADRID 14
MB40 (INC LT) Finanzauto S.A.
 Plaza de las Cortes 6
 Telex: 27752
 Cable: FINANZAUTO
 Phone: (91) 448-27001445-7150

RUMANIA

X940 (INC LT) COSA Geneva

RWANDA

K170 BUJUMBURA, BURUNDI

KC10 (INC LT) CHANIC

B. P. 930

Telex: 54 ALTECO

Cable: CHANUSA

Phone: 3254

Kinshasa Office:

CHANIC

Direction G6n6ral

B. P. 8512

Kinshasa

Republic of Zaire

Telex: 21163

Cable: CHAMAT

Phone: 59815159819

K240 Brussels Office:

KC20 CHANIC S.A.

Chaussee de la Hulpe 177

1170 Brussels

Belgium

Telex: 23078

Cable: CHANIC

Phone: (02) 67346110

SAO TOME, People's Republic of

K541 LUANDA, ANGOLA

KB41 (INC LT) Sorel S.a.r.l.

P.O. Box 408

Telex: 3229 SOREL AN

Cable: SOREL

Phone: 70600/5

SAUDI ARABIA

Q630 JEDDAH

QD30 (INC LT) Zahid Tractor & Heavy
 Machinery Company Ltd.

P.O. Box 1588

Telex: 401042 ZATRAC SJ

Cable: ZAHIDTRACTOR

Phone: 77010, 76366, 76420,

75610, 77581, 77586,

71004

(INC LT) Including Lift Trucks

SAUDI ARABIA (Cont.)

Q633 DAMMAM

QD33 Zahid Tractor & Heavy

Machinery Company Ltd.

P.O. Box 579

Telex: 601080 ZATRAC SJ

Cable: ZAHIDTRACTOR

Phone: 22593, 22595, 26559

Q632 RIYADH

QD32 Zahid Tractor & Heavy

Machinery Company Ltd.

P.O. Box 814

Telex: 201129 ZATRAC SJ

Cable: ZAHIDTRACTOR

Phone: 62994, 60721

SENEGAL, Republic of

K360 DAKAR

KE50 (INC LT) Manutention Africaine

Departement LABORAFRIQUE

B. P. 173

Telex: 606 MEA SG

Cable: MEA

Phone: 360-04, 361-54, 222-71

K310 Bordeaux Office:

KB30 J. A. Delmas Export S.A.

17, rue Vauban

33075 Bordeaux Cedex

France

Telex: 560615

Cable: MEA

Phone: (56) 90-93-70

SEYCHELLES ISLANDS

K233 TANANARIVE, MALAGASY

KA33 REPUBLIC

(INC LT) Henri Fraise Fils & Cie S.A.

Route des Hydrocarbures

B. P. 28

Telex: 22218

Cable: FRAISENRI

Phone: 227-21/24

SIERRA LEONE

K690 FREETOWN

KC90 (INC LT) Tractor & Equipment

Division of UAC of Sierra

Leone Ltd.

P.O. Box 127

Cable: UNATEC

Phone: 50852/50777

K666 London Office:

KC60 Unatrac Division of UAC Ltd.

Maidenhead Road

Windsor, Berks. SL4 5HH

England

Telex: 848881

Cable: UNATRAC

Phone: 17535) 55441

(INC LT) Including Lift Trucks

Main offices in larger-faced type

Branches in smaller-faced type

SOMALI DEMOCRATIC REPUBLIC**MOGADISCIO**

S.I.C.A. BOERO S.p.A.
P.O. Box 418
Telex: 711 TRACSO
Cable: MURRI
Phone: 80997

K130 Rome Office:

S.I.C.A. BOERO S.p.A.
Via Brenta 2
00198 Rome
Italy
Telex: 680351 MIKFOX I
Cable: MURRIFRER
Phone: 86-74-68

SOUTH AFRICA, Republic of**K030 JOHANNESBURG 2000**

Barlow's Tractor Division
Division of Barlow Rand Ltd.
29 De Beer Street
Braamfontein 2001
P.O. Box 4862
Telex: 4-22450
Cable: BARWING
Phone: (011) 39-4511

K040 ISANDO 1600

Barlow's Tractor & Machinery Co.
Electron Avenue Extension
P.O. Box 11
Telex: 8-7872, 8-7940, 8-8507
Cable: SHIPMENTS
Phone: (011) 36-3011

K110 SILVERTON 0127

Barlow-Noordelik Masjinerie
Maatskappy
316 Mundt Street
Waltloo
Pretoria P.O. Box 518
Telex: 3-0321
Cable: SHIPMENTS PRETORIA
Phone: (012) 83-1171

K11 NELSPRUIT 1200

Barlow's Tractor & Machinery Co.
Heyneke Str.
P O. Box 254
Industrial Sites
Telex: 58-7950
Cable: SHIPMENTS
Phone: 101311) 4668

K112 PHALABORWA 1390

Barlow's Noordelik Masj. Mpy.
Mansvelt Str
P O. Box 106
Telex: 3-420
Cable: SHIPMENTS
Phone: (01524) 4541/2

SOUTH AFRICA (Cont.)**K113 PIETERSBURG 0700**

Barlow's Noordelik Masj. Mpy.
22nd Street, Industrial Township
P O Box 976
Telex: 3-404
Cable: SHIPMENTS
Phone: (015211 7102217106011

LICHTENBURG 2740

Barlow's Noordelik Masj. Mpy.
121 Scholtz Str.
Telex: 58-4358
Cable: SHIPMENTS
Phone: 101441) 6027

K050 NEW GERMANY, NATAL 3620

Thos. Barlow & Sons (Natal) Ltd.
21 Shepstone Road
P.O. Box 74
Telex: 6-7605
Cable: SHIPMENTS DURBAN
Phone: (031) 72-1341

EMPANGENI, ZULULAND 3880

Thos. Barlow & Sons (Natal) Ltd.
1 Lead Avenue, Kuleka Township
P.O. Box 76
Telex: 6-2080
Cable: SHIPMENTS
Phone: 10351) 21144

VRYHEID, NATAL 3100

Thos. Barlow & Sons (Natal) Ltd.
149 President Str.
P.O. Box 705
Telex: 6-3782
Cable: SHIPMENTS
Phone: (0381) 3011

K080 PORT ELIZABETH 6056

Barlow's (Eastern Province) Ltd.
Struanway
Struandale
P.O. Box 2006
Telex: 74-7521/74-7522
Cable: SHIPMENTS
Phone: 1041) 42-1001

K085 EAST LONDON 520j

Barlow's Earthmoving Equip.
Co. (Border) (Pty) Ltd.
28 Osmond Road. Wilsonia
P.O. Box 1001
Telex: 75733
Phone: 10431) 45-1713

KOKSTAD, CAPE 4700

Barlow's Earthmoving Equip.
Co. (Border) (Pty) Ltd.
Cnr. Groom & Hawthorne Str.
P O. Box 94
Telex: 63095
Cable: SHIPMENTS
Phone: (0372) 370

GEORGE, CAPE 6530

Barlow's IE.P.I Ltd.
Albert Road
P O. Box 23
Telex: 557-6484
Phone: (0441) 4937

Main offices in larger-faced type
Branches in smaller-faced type

- SOUTH AFRICA (Cont.)**
- K060** BELLVILLE, CAPE 7530
Barlow's (Cape) Limited
Kasselsvlei Road
P.O. Box 332
Telex: 57-7968157-7969
Cable: SHIPMENTS CAPE TOWN
Phone: (021) 97-5931
- K100** SPRINGBOK. C.P. 8240
Barlow's (Cape) Ltd.
Inry Street
P.O. Box 57
Telex: 57-7199
Cable: SHIPMENTS
Phone: 102732) 426
- K010** KIMBERLEY 8300
Barlow's Northern Cape Ltd.
Hendrik van Eck Road
Kimbustria
P.O. Box 791
Telex: 58674
Cable: SHIPMENTS
Phone: (0531) 23157
- K070** BLOEMFONTEIN 9300
Barlow's (O.F.S.) Ltd.
Cnr. Nuffield and Blackwood Road
Hamilton
P.O. Box 1088
Telex: B361 (A) and B361 (B)
Cable: SHIPMENTS
Phone: (051) 82721
- KROONSTAD 9500
Barlow's (O.F.S.) Ltd.
24 Ninth Street
P.O. Box 1935
Phone: 101411) 6300
- SOUTH WEST AFRICA (Namibia)**
- K090** WINDHOEK 9100
Barlow's S.W.A. Tractor Co.
123 Republic Road
P.O. Box 216
Telex: 56-725
Cable: SHIPMENTS
Phone: (061) 32026
- WALVIS BAY 9190
Barlow's S.W.A. Tractor Co.
4th Street East
P.O. Box 201
Telex: 48-096
Cable: SHIPMENTS
Phone: iC642) 4391
- OTJIWARONGO 9210
Barlow's S.W.A. Tractor Co.
Bahnhof Street
P.O. Box 452
Phone: (0651) 2655
- SPAIN**
- M180** MADRID 14
- MB40** (INC LT) Finanzauto S.A.
Plaza de las Cortes 6
Telex: 27752
Cable: FINANZAUTO
Phone: (91) 448-27001445-7150
- M181** ARGANDA
- MB41** Finanzauto S.A.
Arganda del Rey (Madrid)
Teletypes: 10031133136149
Telex: 23200
Phone: (91) 8712612
- M182** BARCELONA
- MB42** Finanzauto S.A.
Sta. Perpetua de Moguda
(Barcelona)
Teletype: 10050
Phone: (93) 560029815600090
- M185** BILBAO
- MB45** Finanzauto S.A.
Amorebieta (Vizcaya)
Teletype: 10040
Phone: (94) 6730500/4334101
- M186** LA CORUNA
- MB46** Finanzauto S.A.
Bergondo (La Coruna)
Teletype: 10043
Phone: (981) 780126
- M188** LAS PALMAS. CANARY ISLANDS
- MB48** Finanzauto S.A.
Parcelacion Industrial
"El Goro"
Telde (Gran Canaria)
Telex: 95124
Phone: (928) 692850
- M198** LERIDA
- MA98** Finanzauto S.A.
Poligono Industrial
"El Segre"
Teletype: 10045
Phone: 1973) 200594
- M190** MALAGA
- MA90** Finanzauto S.A.
Poligono Industrial
"Santa Teresa"
(Malaga)
Teletype: 10035
Telex: 77197
Phone: (952) 27045012716!4
- M191** OVIEDO
- MA91** Finanzauto S.A.
Lugones (Asturias)
Teletype: 10037
Phone: (985) 260250
- M195** PALMA DE MALLORCA
- MA95** Finanzauto S.A.
Poligono Industrial
"La Victoria"
"Son Castello"
Teletype: 10034
Phone: (971) 2560561255819
- M183** SEVILLA
- MB43** Finanzauto S.A.
Dos Hermanas (Sevilla)
Teletype: 10038
Telex: 72230
Phone: (954) 721350

Including Lift Trucks

Main offices in larger-faced type
Branches in smaller-faced type

SPAIN (Cont.)

M189 TENERIFE. CANARY ISLANDS

MB49 Finanzauto S.A.
Sta. Cruz de Tenerife
Telex: 92117
Phone: (922) 613100/610358

M184 VALENCIA

MB44 Finanzauto S.A.
Chive (Valencia)
Teletype: 10042
Phone: (96) 2520275

M193 ZARAGOZA

MA93 Finanzauto S.A.
Poligono Industrial de
Cogullada
Avda. Fco. Caballero 29
Teletype: 10032
Phone: (976) 295320/390400

SUDAN

Q390 KHARTOUM

Sudanese Tractor Company Ltd.
74 Barlaman Avenue
P.O. Box 1840
Telex: 511 TRACTORS KM
Cable: TRACTORS
Phone: 72828

Q391 WAD MEDANI

Sudanese Tractor Company Ltd.
P.O. Box 301
Cable: TRACTORS
Phone: 639 and 2416

SWAZILAND

MANZINI

Barlow's (Swaziland) (Pty) Ltd.
Mancishana Street
P.O. Box 120
Telex: SMX 2063
Cable: SHIPMENTS
Phone: (0194) 52366/7

SWEDEN

L100 S-172 20 SUNDBYBERG

LB30 (INC LT) ENGSON

Engstrom & Nilson Maskin AB
Fack
Telex: 1544 (General)
1506 (Parts)
Cable: ENGSON STOCKHOLM
Phone: (8) 28-25-60
Parts and Service:

L105 19400 UPPLANDS-VASBY

LB35 Engstrim & Nilson Maskin AB

Jupitervagen 10
Telex: 13540
Phone: (760) 86020

(INC LT) Including Lift Trucks

SWEDEN (Cont.)

L103 96100 BODEN

LB33 Engstrom & Nilson Maskin AB
Hantverkaregatan 2
Telex: 8306
Cable: ENGSON
Phone: (921) 1-36-60

L101 24100 ESLOV

LB31 Engstrom & Nilson Maskin AB
Jarnvagsgatan 4
Box 38
Telex: 3143
Cable: ENGSON
Phone: 1413) 1-30-70

L102 40252 GOTEBOG 13

LB32 Engstrom & Nilson Maskin AB
P.O. Box 13071
Telex: 2393
Cable: ENGSON
Phone: {31} 44-72-00

L104 85253 SUNDSVALL

LB34 Engstrom & Nilson Maskin AB
Verkstadsgatan 2
Box 808
Telex: 71006
Cable: ENGSON
Phone: (60) 15-03-40

L107 67400 VETLANDA

LB37 Engstrom & Nilson Maskin AB
Brogardsgatan
P.O. Box 64
Telex: 3706
Cable: ENGSON
Phone: (3831) 13Q10

SWITZERLAND

L010 4900 LANGENTHAL

LB20 (INC LT) ULRICH AMMANN

Baumaschinen AG
Telex: 68385
Cable: AMMANNAG
Phone: (063) 29-61-61

L011 1604 PUIDOUX

LB21 ULRICH AMMANN
Service S.A.
Phone: 1021) 56-20-o2/83
7302 LANDQUART
ULRICH AMMANN
Service AG
Phone: 1081) 51-26-31

SYRIA

Q170 DAMASCUS

QC50 (INC LT) M. EZZAT JALLAD & FILS

Pour le Commerce et la
Representation
(M. DUREID JALLAD & CIE)
Aleppo Street
Al-Qaboun
P.O. Box 23
Telex: 19148 SY
Cable: JALLAD
Phone: 550-321/555-012

(INC LT) Including Lift Trucks

Main offices in larger-faced type
Branches in smaller-faced type

- SYRIA (Cont.)**
ALEPPO
M. EZZAT JALLAD & FILS
Pour le Commerce et la
Representation
(M. DUREID JALLAD & CIE)
Seif-el-Dawia Street
P.O. Box 630
Cable: JALLAD
- TANZANIA**
K260 DAR ES SALAAM
KB80 (INC LT) Construction Equipment
Division of UAC of Tanzania Ltd.
P.O. Box 2568
Cable: AFRITRAK
Phone: 64531
MOSHI
Construction Equipment
Division of UAC of Tanzania Ltd.
P.O. Box 3034
Cable: AFRITRAK
TANGA
Construction Equipment
Division of UAC of Tanzania Ltd.
P.O. Box 981
Cable: AFRITRAK
K666 London Office:
KC60 Unatrac Division of UAC Ltd.
Maidenhead Road
Windsor. Berks. SL4 5HH
England
Telex: 848881
Cable: UNATRAC WINDSOR
Phone: (7535) 56441
- TCHAD, Republic of**
K650 N'DJAMENA
KD50 (INC LT) S.H.O. Tchad
Department Tractafric
B. P. 450
Telex: 5214
Cable: TRACTAFRIC
Phone: 2451
K600 Paris Office:
KB20 Compagnie Optorg
Arago Defense
5, rue Bellini
92806 Puteaux
France
Telex: 620554F ALTGO
Cable: OPTORGPO PARIS
Phone: 775-35-43, 775-32-46
- TOGO**
K470 LOME
KD60 (INC LT) GASTONEGRE S.A.
P.O. Box 134
Telex: 5231
Phone: 22-81/82
- TOGO (Cont.)**
K310 Bordeaux Office:
KB30 J. A. Delmas Export S.A.
17, rue Vauban
33075 Bordeaux Cedex
France
Telex: 560615
Cable: MEA
Phone: 156) 90-93-70
- TRANSKEI, Republic of**
UMTATA
Transkei Tractors (Pty) Ltd.
- TUNISIA**
K400 TUNIS
KG40 (INC LT) PARENIN
Parc d'Engins Industriels
et Agricoles S.A.
91, Avenue de Carthage
Telex: 12422
Cable: PARNIN
Phone: 256577
- TURKEY**
M140 ISTANBUL
MB30 (INC LT) Cukurova Ithalat ve
Ihracat T.A.S.
Buyukdere Caddesi 14
P.O. Box 124
Sisli
Telex: 22693
Cable: CUKURTAS
Phone: 47-48-30
ADANA
Cukurova Ithalat ve
Ihracat T.A.S.
Hava Alani Karsisi No. 420
P.O. Box 82
Telex: 62156
Phone: 14723
M146 ANKARA
Cukurova Ithalat ve
Ihracat T.A.S.
Eskisehir Yolu 9 km No. 80/1
Telex: 42364
Cable: CUKURTAS
Phone: 23-11-00
IZMIR
Cukurova Ithalat ve
Ihracat T.A.S.
Gazi Bulvari No. 29
P.O. Box 608
Telex: 52325
Phone: 149159
DIYARBAKIR
Cukurova Ithalat ve
Ihracat T.A.S.
Inonu Cad. No. 451B
Phone: 3015

(INC LT) Including Lift Trucks

Main offices in larger-faced type
Branches in smaller-faced type

- UGANDA**
K290 KAMPALA
KC80 (INC LT) Construction Equipment
 Division of Galley & Roberts
 (Uganda) Ltd.
 P.O. Box 7123
 Cable: AFRITRAK
 Phone: 59441
K666 London Office:
KC60 Unatrac Division of UAC Ltd.
 Maidenhead Road
 Windsor, Berks. SL4 5HH
 England
 Telex: 848881
 Cable: UNATRAC WINDSOR
 Phone: (7535) 55441
- UNITED ARAB EMIRATES**
 (Abu Dhabi. Dubai, Shariah, Ajman,
 Umm-al-Qaiwain, Ras-el-Khbimeh,
 Fujairah)
Q302 ABU DHABI
QB12 (INC LT) MOHAMED
 ABDULRAHMAN AL BAHAR
 P.O. Box 441
 Telex: 2988 EM
 Cable: BAHAR
 Phone: 54200
Q301 DUBAI
QB11 (INC LT) MOHAMED
 ABDULRAHMAN AL BAHAR
 P.O. Box 1170
 Deira
 Telex: 5445 DB
 Cable: BAHAR
 Phone: 660255
- UNITED KINGDOM**
 (England, Wales, Northern Ireland,
 Scotland)
M650 WINDSOR, BERKS. SL4 5HH
ME50 (INC LT) H. Leverton & Co. Ltd.
 Maidenhead Road
 Telex: 848881
 Cable: LEV WINDSOR
 Phone: (07535) 68121
M656 ASHFORD, KENT
ME56 H. Leverton & Co. Ltd
 Cobbs Wood Estate
 Chart Road
 Phone: 102331 24751
M653 ASHTON-IN-MAKERFIELD, LANCS.
ME53 H. Leverton & Co. Ltd.
 615 Wigan Road
 Telex: 67629
 Phone: (0942) 76161
- UNITED KINGDOM (Cont.)**
M662 BIRTLEY. CO. DURHAM DH3 2DB
ME52 H. Leverton & Co. Ltd.
 Durham Road
 Telex: 53119
 Phone: (0632) 402683
- M615 LEEDS. YORKS. LS27 7JS**
ME51 H. Leverton & Co. Ltd.
 Geldard Road
 Gildersome
 Telex: 56170
 Phone: (05321) 534221
M659 SILVERTOWN, LONDON E16 2BY
ME59 H. Leverton & Co. Ltd.
 Charles Street
 Phone: (01) 474 0927
M654 SPALDING, LINCS. PE 1 2AZ
ME54 H. Leverton & Co. Ltd.
 Westlode Street
 Telex: 32227
 Phone: (0775) 61100
M655 Halstead, Essex
ME55 H. Leverton & Co. Ltd.
 Blue Bridge Estate
 Colchester Road
 Telex: 1.987828
 Phone: 2678
M658 GREAT YARMOUTH, NORFOLK
ME55 H. Leverton & Co. Ltd.
 ABC Wharf
 South Quay
 Phone: (0493) 58641
M610 CANNOCK, STAFFS. WS11 3LL
ME10 (INC LT) Bowmaker (Plant) Limited
 Watling Street
 Telex: 338523
 Cable: BOWPLANT
 Phone: (05435) 2551
M612 CLAY CROSS, DERBYSHIRE
ME12 Bowmaker (Plant) Limited
 Chesterfield Road
 Telex: 54235
 Cable: BOWPLANT
 Phone: (0246) 862571
M613 HIGHBRIDGE. SOMERSET
ME13 Bowmaker (Plant) Limited
 Walrow Industrial Estate
 Telex: 46397
 Cable: BOWPLANT
 Phone: (027878) 4991
M619 WILTSHIRE, NR. SALISBURY
ME19 Bowmaker (Plant) Limited
 Lopcombe Corner
 Phone: 1026478) 678
M614 ST. AUSTELL, CORNWALL
ME14 Bowmaker (Plant) Limited
 Bridge Road
 Telex: 46695
 Cable: BOWPLANT
 Phone: (0726) 2422
M618 WINSFORD, CHESHIRE
ME18 Bowmaker (Plant) Limited
 Winsford Industrial Estate
 Telex: 667618
 Cable: BOWPLANT
 Phone: 106065) 4311

(INC LT) Including Lift Trucks

Main offices in larger-faced type
 Branches in smaller-faced type

UNITED KINGDOM (Cont.)**M611** CARDIFF, GLAMORGAN. WALES**ME11** Bowmaker (Plant) Limited
Culverhouse Cross
Telex: 49217
Cable: BOWPLANT
Phone: (0222) 591411**M670** BELFAST, NORTHERN IRELAND**ME70** BT5 6RT(INC LT) McCormick Macnaughton
(N.I.) Limited
Prince Regent Road
Castlereagh
Telex: 74671
Cable: SAMAC
Phone: (0232) 59251**M630** GLASGOW G69 7TX, SCOTLAND**ME30** (INC LT) Caledonian Tractor & Equip-
ment Co. Ltd.
Baillieston
Telex: 77243
Cable: TRACKIPIN
Phone: (0236) 20111**M631** PERTH. PERTSHIRE**ME31** Caledonian Tractor & Equipment Co.
Ltd.
Lairwell Kinfauns
Telex: 76145
Cable: TRACKIPIN
Phone: 23181

Lift Truck Division:

AIRDRIE ML6 9HT. LANARKSHIRE
Caledonian Tractor & Equipment Co.
Ltd.Bellsdyke Lane
Off Cairnhill Road
Phone: (02366) 51111**M637** CALDERCRUIX. LANARKSHIRE**ME37** Caledonian Tractor & Equipment Co.
Ltd.
Airdrie Road
Phone: (0236) 843133**M632** FRASERBURGH. ABERDEENSHIRE**ME32** Caledonian Tractor & Equipment Co.
Ltd.
Shore Street
Balaclava
Phone: Fraserburgh 3931**M634** MUIR-OF-ORD, ROSS-SHIRE**ME34** Caledonian Tractor & Equipment Co.
Ltd.
Industrial Estate
Great North Road
Phone: i0463821 575**M633** ABERDEEN. ABERDEENSHIRE**ME33** Caledonian Tractor & Equipment Co.
Ltd.
Seaforth Center
Waterloo Quay
Phone: 10224) 51201**UPPER VOLTA****K330** OUAGADOUGOU**KE30** (INC LT) Manutention Africaine
B. P. 636
Telex: 5230
Phone: 32155132176**K310** Bordeaux Office:**KB30** J. A. Delmas Export S.A.
17, rue Vauban
33075 Bordeaux Cedex
France
Telex: 580615
Cable: MEA
Phone: (561 90-93-70)**U. S. S. R.****X380** (INC LT) COSA GenevaMoscow Office:
Caterpillar Overseas S.A.
Pokrovsky Boulevard 4117
Apartment 13
Moscow 101000
Telex: 7802 CAT SU
Phone: 207-56581207-1007
207-26251207-2982**YEMEN**, People's Democratic
Republic of**X430** CRATER, ADENNational Company for Foreign Trade
P.O. Box 90
Telex: ADN 211 + ADN 266
Cable: FOREIGNTRADE
Phone: 51347151348**YEMEN ARAB REPUBLIC****Q550** HODEIDAH**QA50** (INC LT) The Tehama Trading Co. Ltd.
P.O. Box 3337
Telex: 5598 TRADCO YE
Cable: TRADCO
Phone: 240613177**YEMEN ARAB REPUBLIC** (Cont.)SANAA
The Tehama Trading Co. Ltd.
P.O. Box 73
Telex: 2218 HODSHIP YE
Cable: HODSHIP SANAA
Phone: 5890/2598

TAIZ

The Tehama Trading Co. Ltd.
Near Central Market
Phone: 2410

(INC LT) Including Lift Trucks

Main offices in larger-faced type
Branches In smaller-faced type

YUGOSLAVIA

X290 11080 BELGRADE

XA90 (INC LT) OMNIKOMERC

Batajnicksi put bb
 B. P. 637
 Telex: 12223
 Cable: OMNIKOMERC
 Phone: (011) 214-903
 210-66554/6

41000 ZAGREB
 OMNIKOMERC
 Rade Koncara 29
 Phone: (041) 56-018
 56-50-54

ZAIRE, Republic of
 KINSHASA

(INC LT) CHANIC
 Direction Generale
 B. P. 8512
 Telex: 21163
 Cable: CHAMAT
 Phone: 59815159819

K160 KINSHASA

KB10 (INC LT) CHANIMAT (Main Store)

B. P. 11 197
 Telex: 21163
 Cable: CHANIMAT
 Phone: 59811159818

BOMA
 CHANIMAT
 B. P. 90
 Cable: CHANIMAT

KISANGANI
 CHANIMAT
 B. P. 10
 Cable: CHASTAN

BUKAVU
 CHANIMAT
 B. P. 2374
 Cable: CHANIMAT

K180 LUBUMBASHI

KC50 (INC LT) SODIMAT

B. P. 447
 Telex: 267
 Cable: SODIMAT
 Phone: 311113112

K240 Brussels Office:

KC20 CHANIC S.A.
 Chaussee de la Hulpe 177
 1170 Brussels
 Belgium
 Telex: 23078
 Cable: CHANIC
 Phone: (021 673-61-10)

ZAMBIA

Head Office Operations:

K532 KITWE

KD82 (INC LT) Mazembe Tractor Co. Ltd.
 P.O. Box 2792
 Telex: ZA 52121
 Cable: WATTEAU
 Phone: 339214463

Head Office Administration:

K531 LUSAKA

KD81 (INC LT) Mazembe Tractor Co. Ltd.
 Chibote House
 ChaChaCha Road
 P.O. Box 3450
 Telex: ZA 4292
 Cable: ASSAIL
 Phone: 75168

LUSAKA

Mazembe Tractor Co. Ltd.
 P.O. Box 3450
 Telex: ZA 4123
 Phone: 7206112. 73572

KITWE

Mazembe Tractor Co. Ltd.
 P.O. Box 189
 Telex: ZA 52121
 Phone: 3392. 4463

K530 New York Office:

KD80 INTRACO MARKETING
 CORPORATION
 485 Lexington Avenue
 New York. N. Y. 10017
 U. S. A.
 Telex: 234790
 Cable: INTRAMARCO
 Phone: (212) 949-9030

ZIMBABWE (Rhodesia)

K500 SALISBURY

Barlow's Tractor & Equipment Co.
 Ltd.
 Harrow Road
 Msasa
 P.O. Box 1537
 Telex: 3152
 Cable: TRACTOR
 Phone: (01910) 47321, 47341

BULAWAYO

Barlow's Tractor & Equipment Co. Ltd.
 5 Dunlop Road
 Donnington
 P.O. Box 1192
 Telex: 3152
 Cable: TRACTOR
 Phone: (01919) 69006

(INC LT) Including Lift Trucks

Main offices in larger-faced type
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By Order of the Secretary of the Army:

Official:

DONALD J. DELANDRO
Brigadier General, United States Army
The Adjutant General

JOHN A. WICKHAM, JR
General, United States Army
Chief of Staff

Distribution:

To be distributed in accordance with DA Form 12-25 B-R (Quantity required blocks 405, 406, 407) Operator's, Organizational, Direct Support and General Support Maintenance Manual Requirements for Scrapers, Earth Moving.

THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
 1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
 1 Kilometer = 1000 Meters = 0.621 Miles

SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches
 1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet
 1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
 1 Kilogram = 1000 Grams = 2.2 Lb
 1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

CUBIC MEASURE

1 Cu Centimeter = 1000 Cu Millimeters = 0.06 Cu Inches
 1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
 1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

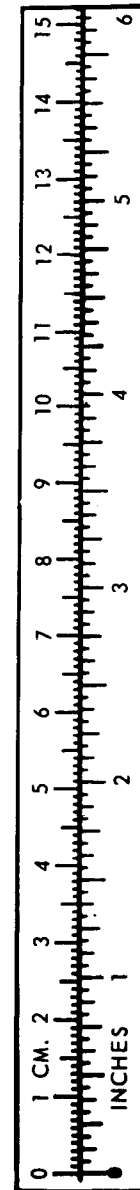
TEMPERATURE

$5.9 (^{\circ}\text{F} - 32) = ^{\circ}\text{C}$
 212^o Fahrenheit is equivalent to 100^o Celsius
 90^o Fahrenheit is equivalent to 32.2^o Celsius
 32^o Fahrenheit is equivalent to 0^o Celsius
 $9.5 \text{ C}^{\circ} + 32 = \text{F}^{\circ}$

APPROXIMATE CONVERSION FACTORS

<u>TO CHANGE</u>	<u>TO</u>	<u>MULTIPLY BY</u>
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

<u>TO CHANGE</u>	<u>TO</u>	<u>MULTIPLY BY</u>
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	Miles per Hour	0.621



TA089991

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