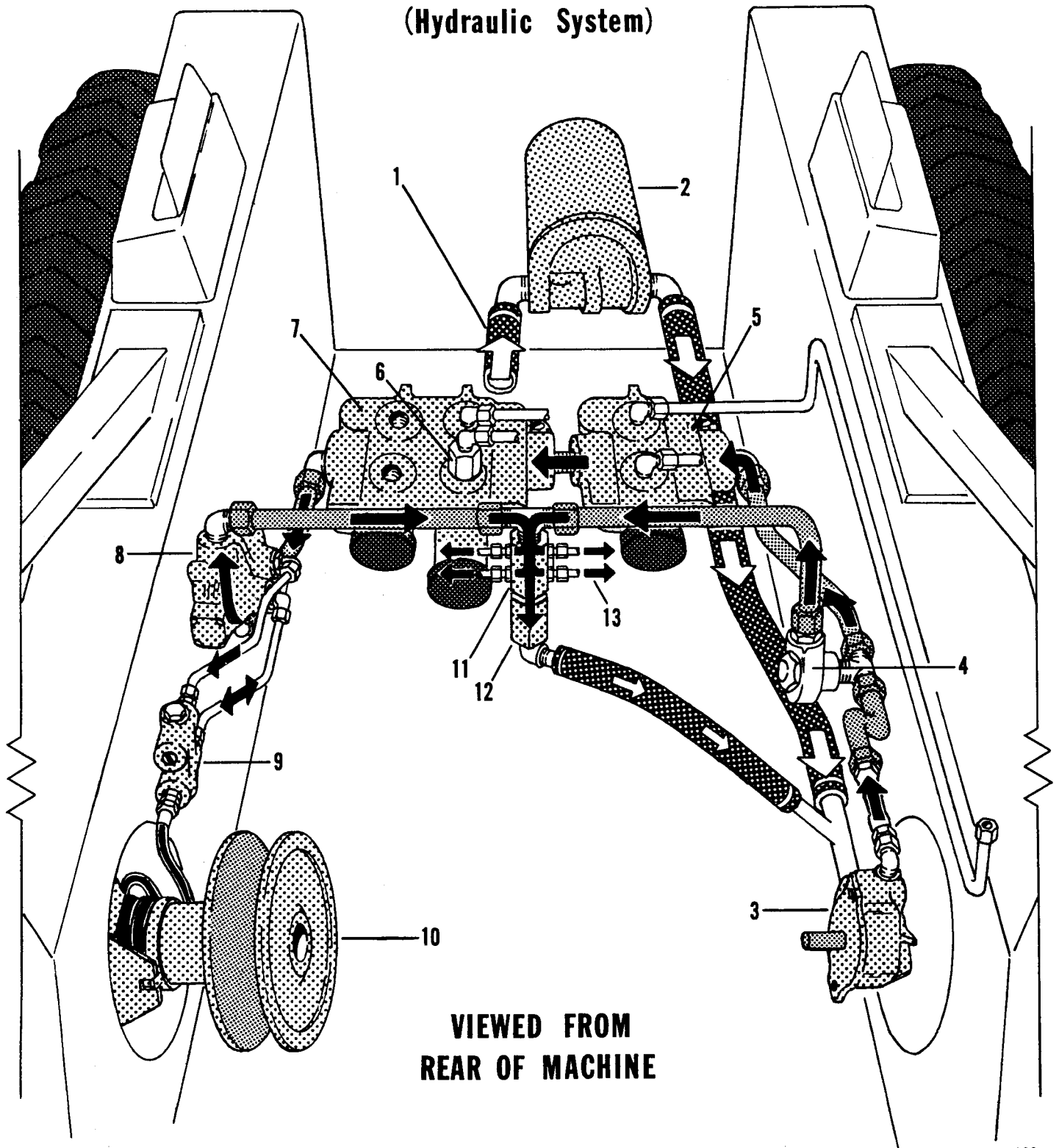


HYDRAULIC SYSTEM SERVICE

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HYDRAULIC
SYSTEM

PICTORIAL SCHEMATIC (Hydraulic System)



**VIEWED FROM
REAR OF MACHINE**

PI-1022

- | | |
|-------------------------------------|--|
| 1. Hose From Reservoir To Filter | 8. Variable Speed Control Valve |
| 2. Hydraulic Oil Filter | 9. Variable Speed Check Valve |
| 3. Hydraulic Pump | 10. Variable Speed Drive Sheave Assembly |
| 4. Master Relief Valve | 11. Clutch Lubrication Manifold |
| 5. Tilt Control Valve | 12. Clutch Pressure Relief Valve |
| 6. Restrictor | 13. Oil Flow To Clutch Pins |
| 7. Lift And Auxiliary Control Valve | |

HYDRAULIC SYSTEM

CHANGING AND ADDING HYDRAULIC OIL

If oil does not run from the lower check port, replace the lower check plug and add type "A" automatic transmission or Dexron fluid until it runs out the upper check port. For fill port location, see Figure 107.

The hydraulic fluid should not need changing unless the machine is run under very corrosive conditions for long periods, or if the fluid takes on a gray milky appearance. If this happens the fluid should be changed every 1000 hours, preferably in the spring or fall.

NOTE: The reservoir may be slightly overfilled without interfering with the function or operation of the machine.

DRAINING CONDENSATION

Condensation should be drained from both reservoirs at least every 1000 hours.

With the boom, raise the front wheels of the loader several inches from the ground. Allow the Bobcat to set for 3 to 4 hours, then remove the drain plugs, located behind the rear wheels (Figure 107) just long enough to allow accumulated water to drain out.

DESCRIPTION OF HYDRAULIC CIRCUIT

This machine is equipped with full-flow, positive-pressure lubrication to the clutches and drive mechanism. The oil is drawn from the reservoir through a filter into the hydraulic pump. The pump forces it through the control valves and clutches, back into the reservoir. This occurs as long as the hydraulic controls are in neutral.

Figures 109 thru 112 show the main frame hydraulic circuit of your Bobcat Loader. The arrows show the direction of flow of hydraulic fluid.

When a control is actuated, the oil is diverted into one end of the selected cylinders. Oil flows from the other end of the cylinders back to the valve bank, through the clutches and into the reservoir. When the valve is returned to neutral, oil is trapped in the cylinder, holding the load in place, and the fluid again passes from the pump, through the valves and clutches and back to the reservoir.

When a cylinder reaches the limit of its stroke, or when an attempt is made to lift more than the machine's rated capacity, a relief valve allows the oil to by-pass the over-loaded circuit and return to the reservoir. This valve should be set between 1700 and 1750 PSI at full engine RPM.

OIL FILTRATION

The oil is always filtered before being circulated through the hydraulic system. The filter is equipped with a 33 micron paper element, which requires periodic changing.

The filter condition indicator is mounted in the right instrument panel (Figure 108); its dial is calibrated from "0" to "30". Beyond "7" is the danger zone, marked in red. When the indicator nears the danger zone, it is time to change the filter element. This may come early during the machine break-in period due to the normal wear-in of parts.

A replacement filter element is furnished free with every new Bobcat. The element in the filter should be discarded and replaced at the end of the initial 50 operating hours. Thereafter, replace the filter element whenever the condition indicator needle nears the Red Zone. When the gauge needle enters the Red Zone, oil can no longer pass through the filter element and a by-pass valve opens. This allows only partial filtration of oil or no filtration at all.

WARNING

The condition indicator should always read about "2" under normal operating conditions. The indicator may operate in the Red Zone for a short time after starting the machine in cold weather. If there is no reading refer to the troubleshooting section of this manual.

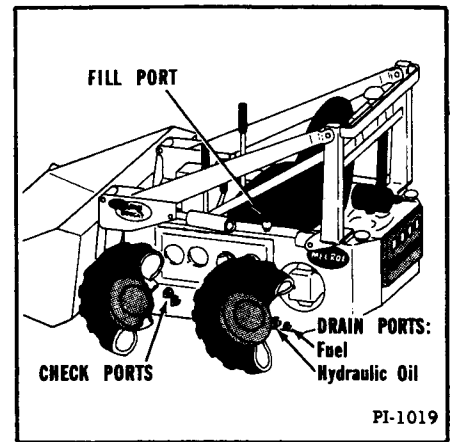


Fig. 107 Check & Fill Ports

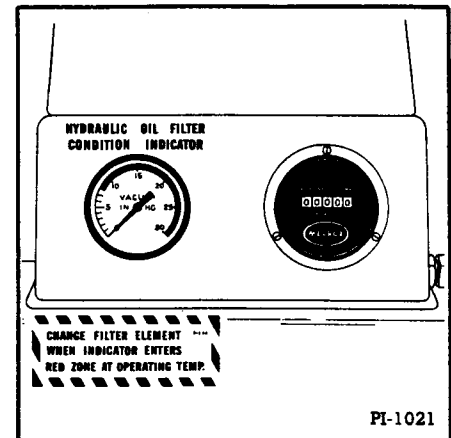
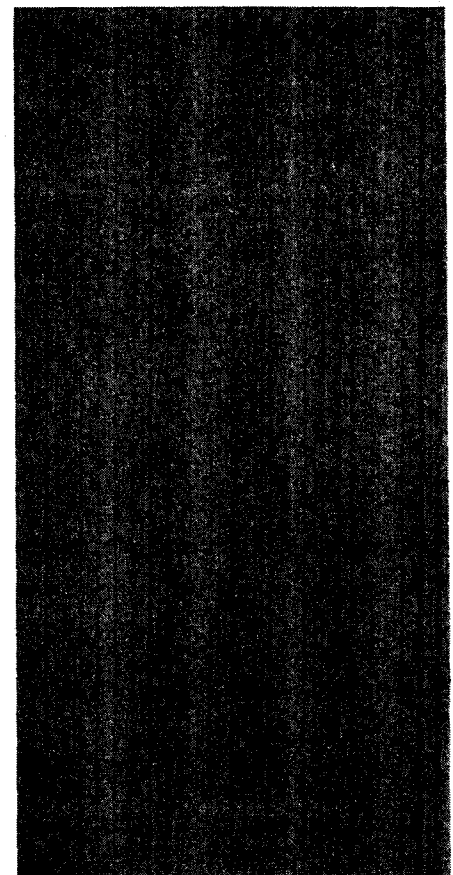


Fig. 108 Right Instrument Panel



HYDRAULIC SYSTEM (M-600 Gasoline & LP Gas)

Figure 109 shows hydraulic fluid flow.

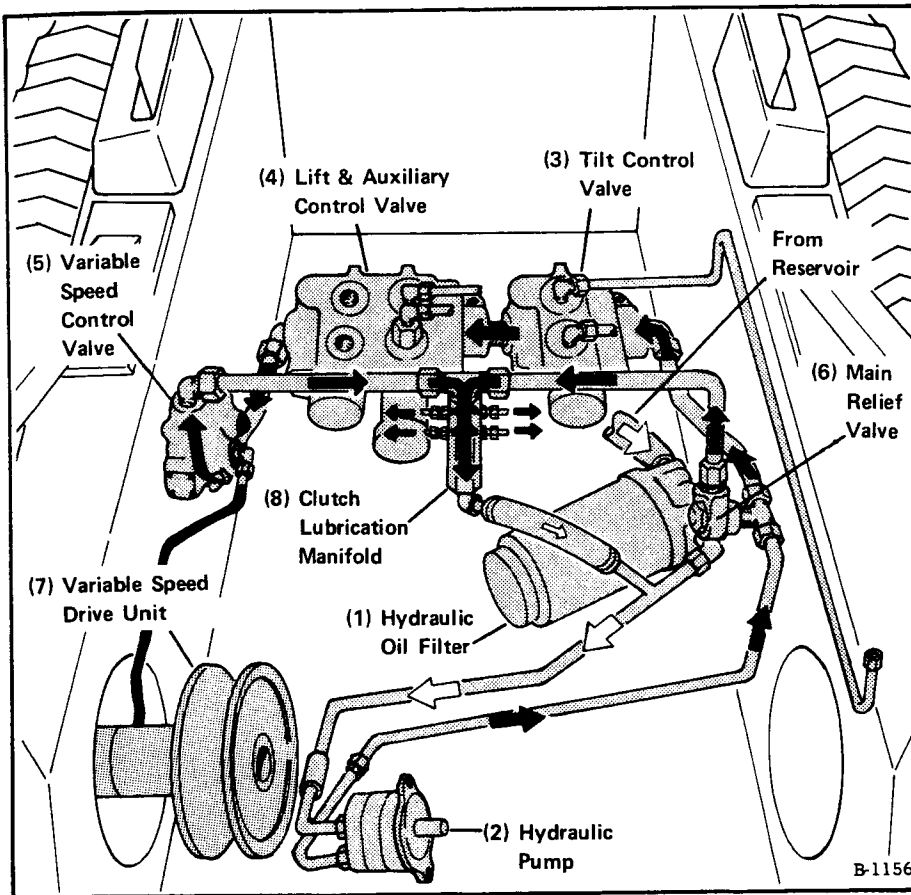


Fig. 109 Hydraulic System (M-600 Gasoline & LP Gas)

Fluid drawn from the reservoir, through the hydraulic oil filter (Item 1) by the hydraulic pump (Item 2). The pump delivers fluid to the control valves (Items 3, 4 & 5). The main relief valve (Item 6) is a diversion valve set to open when a control valve is actuated and the corresponding cylinders reach the end of their stroke, or when you attempt to lift a load greater than the machine's capacity. When you move the variable speed control lever forward, oil is diverted by the variable speed control valve (Item 5) to the variable speed cylinder (Item 7). This moves the drive sheaves together, giving you a faster ground speed. Pulling the lever back decreases ground speed. A restrictor in the clutch lubrication manifold (Item 8) maintains a constant pressure of 20 PSI to the drive clutches. The small arrows show oil flow through tube lines (not shown) to the clutch pins.

HYDRAULIC SYSTEM (M-444 & M-500)

Figure 110 shows hydraulic fluid flow.

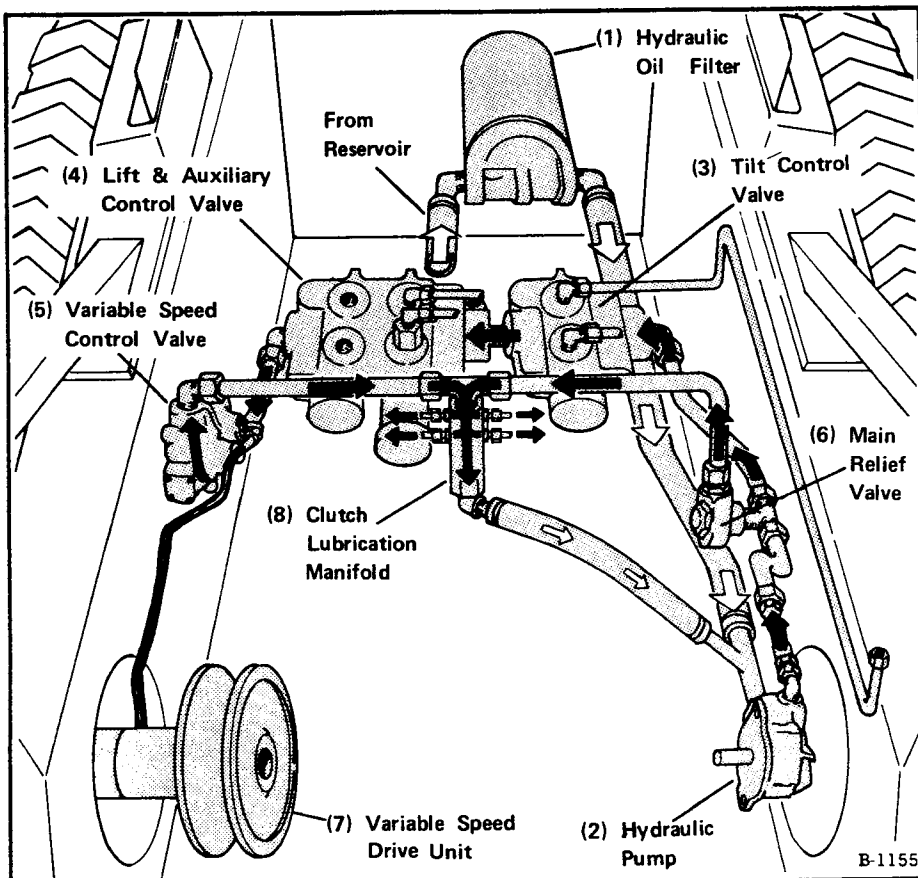


Fig. 110 Hydraulic System (M-500 & M-444 Gasoline & LP Gas)

Fluid drawn from the reservoir, through the hydraulic oil filter (Item 1) by the hydraulic pump (Item 2). The pump delivers fluid to the control valves (Items 3, 4 & 5). The main relief valve (Item 6) is a diversion valve set to open when a control valve is actuated and the corresponding cylinders reach the end of their stroke, or when you attempt to lift a load greater than the machine's capacity. When you move the variable speed control lever forward, oil is diverted by the variable speed control valve (Item 5) to the variable speed cylinder (Item 7). This moves the drive sheaves together, giving you a faster ground speed. Pulling the lever back decreases ground speed. A restrictor in the clutch lubrication manifold (Item 8) maintains a constant pressure of 20 PSI to the drive clutches. The small arrows show oil flow through tube lines (not shown) to the clutch pins.

HYDRAULIC SYSTEM (M-600 Diesel W/Deutz Engine)

Figure 111 shows hydraulic fluid flow.

Fluid is drawn from the reservoir, through the hydraulic oil filter (Item 1) by the hydraulic pump (Item 2). The pump delivers fluid to the control valves (Items 3, 4 & 5). The main relief valve (Item 6) is a diversion valve set to open when a control valve is actuated and the corresponding cylinders reach the end of their stroke, or when you attempt to lift a load greater than the machine's capacity. When you move the variable speed control lever forward, oil is diverted by the variable speed control valve (Item 5) to the variable speed cylinder (Item 7). This moves the drive sheaves together, giving you a faster ground speed. Pulling the lever back decreases ground speed. A restrictor in the clutch lubrication manifold (Item 8) maintains a constant pressure of 20 PSI to the drive clutches. The small arrows show oil flow through tube lines (not shown) to the clutch pins.

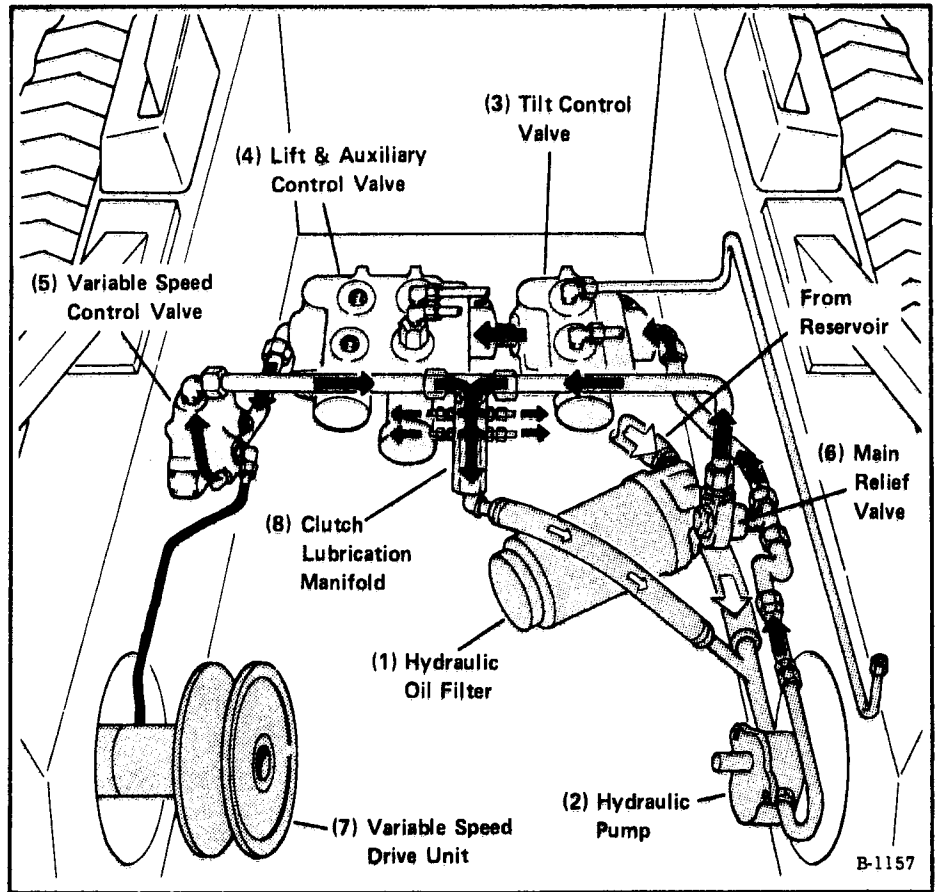


Fig. 111 Hydraulic System (M-600 Diesel W/Deutz Engine)

HYDRAULIC SYSTEM (M-600 Electric & M-600 Diesel W/Petter Engine)

Figure 112 shows hydraulic fluid flow.

Fluid is drawn from the reservoir, through the hydraulic oil filter (Item 1) by the hydraulic pump (Item 2). The pump delivers fluid to the control valves (Items 3, 4 & 5). The main relief valve (Item 6) is a diversion valve set to open when a control valve is actuated and the corresponding cylinders reach the end of their stroke, or when you attempt to lift a load greater than the machine's capacity. When you move the variable speed control lever forward, oil is diverted by the variable speed control valve (Item 5) to the variable speed cylinder (Item 7). This moves the drive sheaves together, giving you a faster ground speed. Pulling the lever back decreases ground speed. A restrictor in the clutch lubrication manifold (Item 8) maintains a constant pressure of 20 PSI to the drive clutches. The small arrows show oil flow through tube lines (not shown) to the clutch pins.

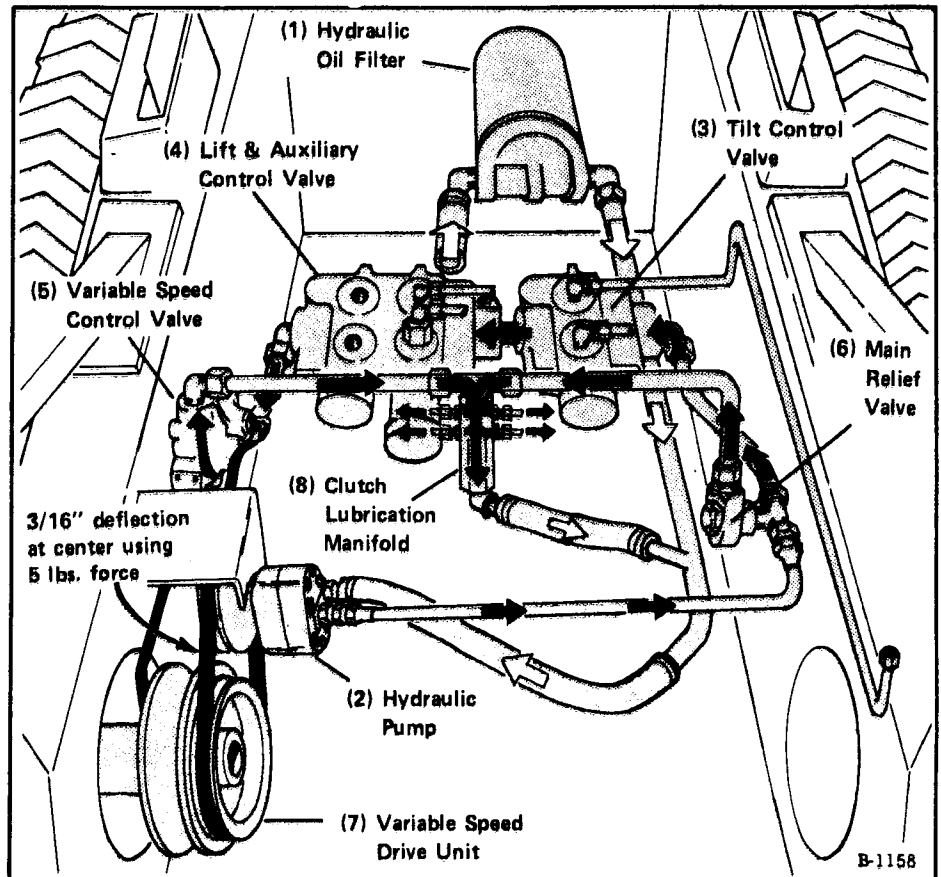


Fig. 112 Hydraulic System (M-600 Electric & M-600 Diesel W/Petter Engine)

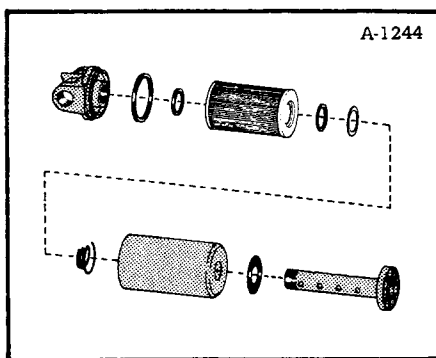


Fig. 113 Hydraulic Oil Filter

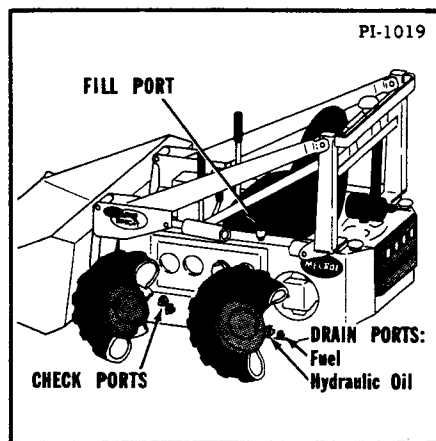


Fig. 114 Check & Fill Ports

CHANGING HYDRAULIC OIL FILTER ELEMENT (Filter Located at Front of Machine, Under Floor Panels)

1. Raise the FRONT of the machine 5 to 6 inches to prevent the oil in the reservoir from running out when you remove the filter.
2. Disconnect the control pedal linkages at the pedals and remove the floor panels.
NOTE: To remove the floor panels and the filter element, it is NOT necessary to remove the control pedals.
3. Remove the element, seals and spring from the can. Remove the seal gasket from the center post.
4. Clean the seals, spring, center post and can in a suitable solvent. Dry them with compressed air.
Discard the oil filter element.
5. Reassemble the filter on the filter head. Figure 113 shows the relationship of parts. Check the quad-ring seal on the filter head for damage before reinstalling the can.

The housing, center post and quad-ring seal must be free of foreign material to insure good sealing. Tighten the large nut on the end of the center post to 12 ft. lbs. (maximum).

6. Lower the front of the machine. Make sure the machine is setting level. Start the engine and let it idle until the hydraulic system works smoothly (when the boom will raise and lower without jerking). Watch the filter can for leaks due to improper seating of the quad-ring seal.

Stop the engine. Remove the high oil level check plug and the hydraulic oil filler plug (Figure 114). You will need to add about 2 quarts of fluid to replace the oil that was in the old filter element. Add type "A" automatic transmission or Dexron fluid until it runs out the high level check port. Replace the check and fill plugs.

7. After you have filled the reservoir and are sure that there is no leakage around the filter can seals, put the floor panels back in place and reconnect the control pedal linkages.

CHANGING HYDRAULIC OIL FILTER ELEMENT (Filter Located at Rear of Machine, In Engine Compartment)

1. Raise the REAR of the machine 5 to 6 inches to prevent the oil in the reservoir from running out when you remove the filter.
2. Remove the seat and engine cover.
3. Remove the element, seals and spring from the can. Remove the seal gasket from the center post.
4. Clean the seals, spring, center post and can in a suitable solvent. Dry them with compressed air.
Discard the oil filter element.

5. Reassemble the filter on the filter head. Figure 113 shows the relationship of parts. Check the quad-ring seal on the filter head for damage before reinstalling the can.

The housing, center post and quad-ring seal must be free of foreign material to insure good sealing. Tighten the large nut on the end of the center post to 12 ft. lbs. torque (maximum).

6. Lower the rear of the machine.

Make sure the machine is setting level. Start the engine and let it idle until the hydraulic system works smoothly (when the boom will raise and lower without jerking). Watch the filter can for leaks due to improper seating of the quad-ring seal.

Stop the engine. Remove the high oil level check plug and the hydraulic oil filler plug (Figure 114). You will need to add about 2 quarts of fluid to replace the oil that was in the old filter element. Add type "A" automatic transmission or Dexron fluid until it runs out of the high level check port. Replace the check and fill plugs.

7. After you have filled the reservoir and are sure that there is no leakage around the filter can seals, put the engine cover and seat back in place.



Since you will be running the engine during service, raise all four wheels of the machine fully off the floor. Place blocks under the frame to support it securely.

CHECKING THE OVERALL CONDITION OF HYDRAULIC SYSTEM

NOTE: The pressure adjustments are made using the OTC Y-90 (or comparable) tester. The tester reads hydraulic flow in gallons per minute (GPM), pressure in pounds per square inch (PSI), and oil temperature in Degrees Fahrenheit.

The tester can be used to check pump output, relief setting, cylinder seals and valve problems. To check the general condition of the hydraulic system, proceed as follows:

1. Connect the tester to the auxiliary tubelines at the rear of the machine. Connect a hose from the rear auxiliary tubeline to the outlet port of the tester. Connect a hose from the front tubeline to the inlet port of the tester (Figure 115).
2. Start the engine and run it at full throttle.
3. Press down and hold the toe of the auxiliary control pedal (Figure 115).
4. Turn the pressure control valve on the tester in (clockwise) slowly. Watch the flow reading on the tester. The flow reading should be relatively stable until the master relief valve opens. When this occurs, the flow rate will drop suddenly. A new pump will deliver about these volumes of oil until the master relief valve opens.

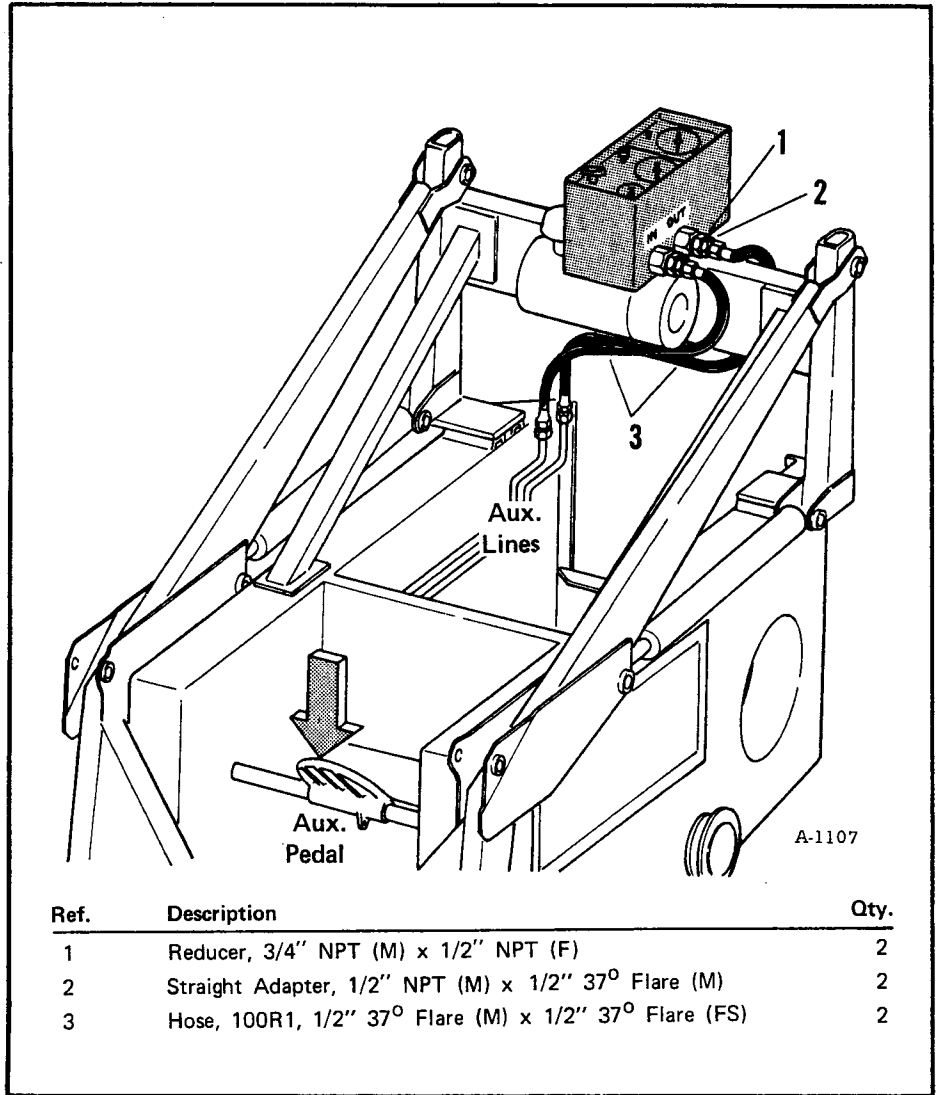
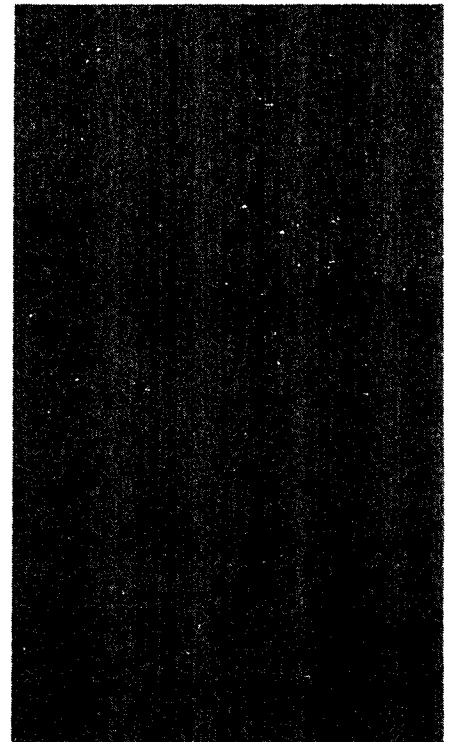


Fig. 115 Checking Overall Condition of Hydraulic System

RECOMMENDED HYDRAULIC OIL FLOW RATE

M-444 (gasoline or LP gas)	8 GPM @ 3000 RPM
M-500 (gasoline or LP gas)	8 GPM @ 3000 RPM
M-500 (diesel)	8 GPM @ 2700 RPM
M-500 (electric)	5.5 GPM @ 1750 RPM
M-600 (gasoline or LP gas)	9 - 10 GPM @ 2400 RPM
M-600 (diesel) Deutz	10 - 11 GPM @ 2700 RPM
Petter	10 GPM @ 3000 RPM
M-600 (electric)	8 GPM @ 1750 RPM



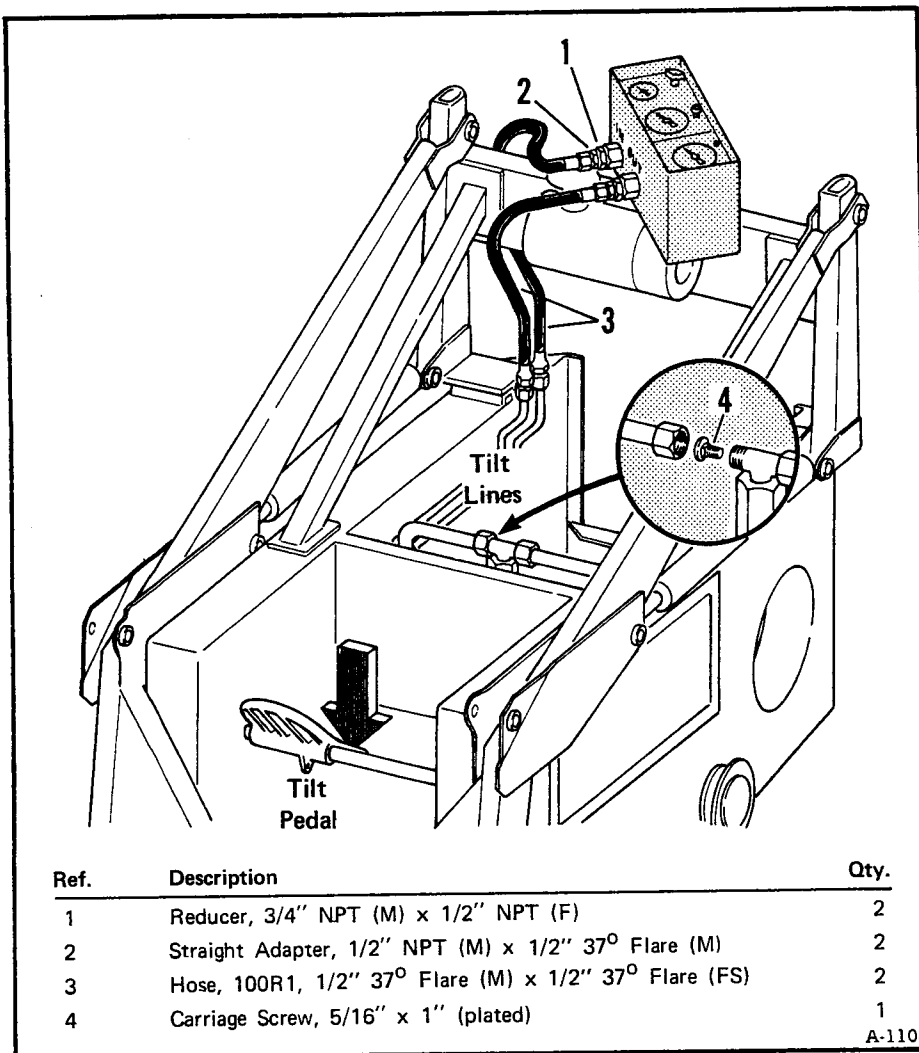


Fig. 116 Checking Condition of Hydraulic Pump

An older pump will show a lower reading according to wear.

When the flow is less than 10 GPM You can press the small "low flow reading control" button to get a more accurate flow reading.

- Turning the "pressure control valve" knob in as far as it will go (clockwise) will give you the system pressure. It should be between 1700 and 1750 PSI.

If it is between 1650 and 1700 PSI, no further check is necessary.

If the pressure gauge reads less than 1650 PSI with the "pressure control valve" knob at its maximum clockwise position, one of the following is occurring:

- The master relief valve setting is too low or the valve is being held partially open by foreign material.
- The hydraulic pump is worn and not capable of delivering the desired pressure.
- The cartridge relief setting in the lift and auxiliary control valve is too low.

To check the condition of the hydraulic pump:

- Remove the hoses from the auxiliary tubelines and connect them to the tilt cylinder tubelines at the rear of the machine. Connect the hose from the inlet port of the tester to the rear tilt tubeline. Connect the hose from the outlet port of the tester to the front tilt tubeline (Figure 116).
- Place a stopper (5/16" x 1" long carriage bolt) between the clutch lubrication manifold tee and the master relief valve tubeline fitting (Figure 116).
- Be sure the "pressure control valve" knob on the tester is turned out (counterclockwise) as far as it will go.
- Start the engine and run it at low idle.
- Press the heel of the tilt control pedal down and hold it (Figure 116).
- Slowly turn the "pressure control valve" knob on the tester clockwise to increase the system pressure.

WARNING

You now have no relief valve in the system. Closing the "pressure control valve" knob too fast may cause the hydraulic pump or the tester pressure cap to fail because of excessive pressure. Increase the pressure only to 2000 PSI. Do not try to check the maximum pump output.

If you get a higher pressure reading (above 1700 PSI) with the master relief valve blocked, the relief valve setting was too low. If you get the same reading as before (below 1700 PSI) one of the following is occurring:

1. The cartridge relief setting in the lift and auxiliary control valve is too low.
2. The hydraulic pump is worn and not delivering as much oil as it should.

To check the pressure setting of the cartridge relief in the lift and auxiliary control valve, follow this procedure:

1. Reconnect the tester to the auxiliary tubelines at the rear of the machine. Connect a hose from the rear auxiliary line to the outlet port of the tester. Connect a hose from the front auxiliary line to the inlet port of the tester (Figure 117).
2. Leave the stopper (5/16" x 1" long carriage bolt) between the clutch lubrication manifold tee and the master relief valve tubeline fitting.

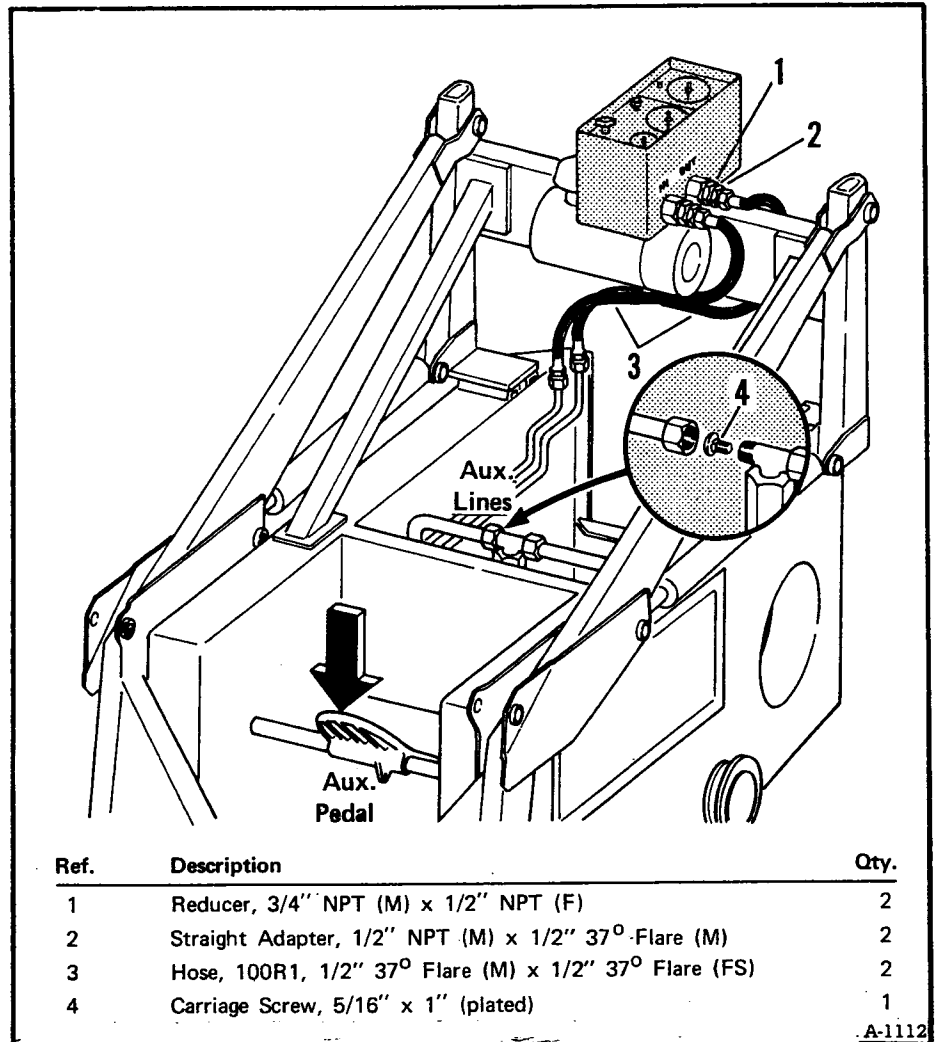


Fig. 117 Checking Cartridge Relief Pressure Setting

3. Be sure the "pressure control valve" knob on the tester is turned out (counterclockwise) as far as it will go.
4. Start the engine and run it at 1/4 throttle.
5. Press the toe of the auxiliary control pedal down and hold it (Figure 117).
6. Turn the "pressure control valve" knob on the tester in (clockwise) until the cartridge relief valve opens. The pressure setting of this cartridge relief should be about $1800 \begin{smallmatrix} +100 \\ -0 \end{smallmatrix}$ PSI.

If this pressure relief is set correctly ($1800 \begin{smallmatrix} +100 \\ -0 \end{smallmatrix}$) the system pressure is low because the hydraulic pump is worn. Repair or replace it.

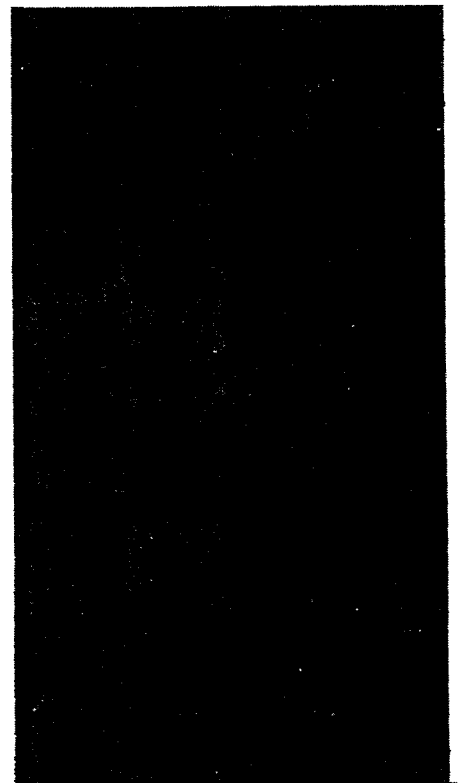
WARNING

Be sure to remove the stopper (carriage bolt) from between the clutch lubrication manifold tee and the master relief valve tubeline fitting.

CHANGING MASTER RELIEF SETTING

To change the master relief valve setting:

1. Remove the hex cap from the valve body.
2. Extract the spring and shim from behind it.



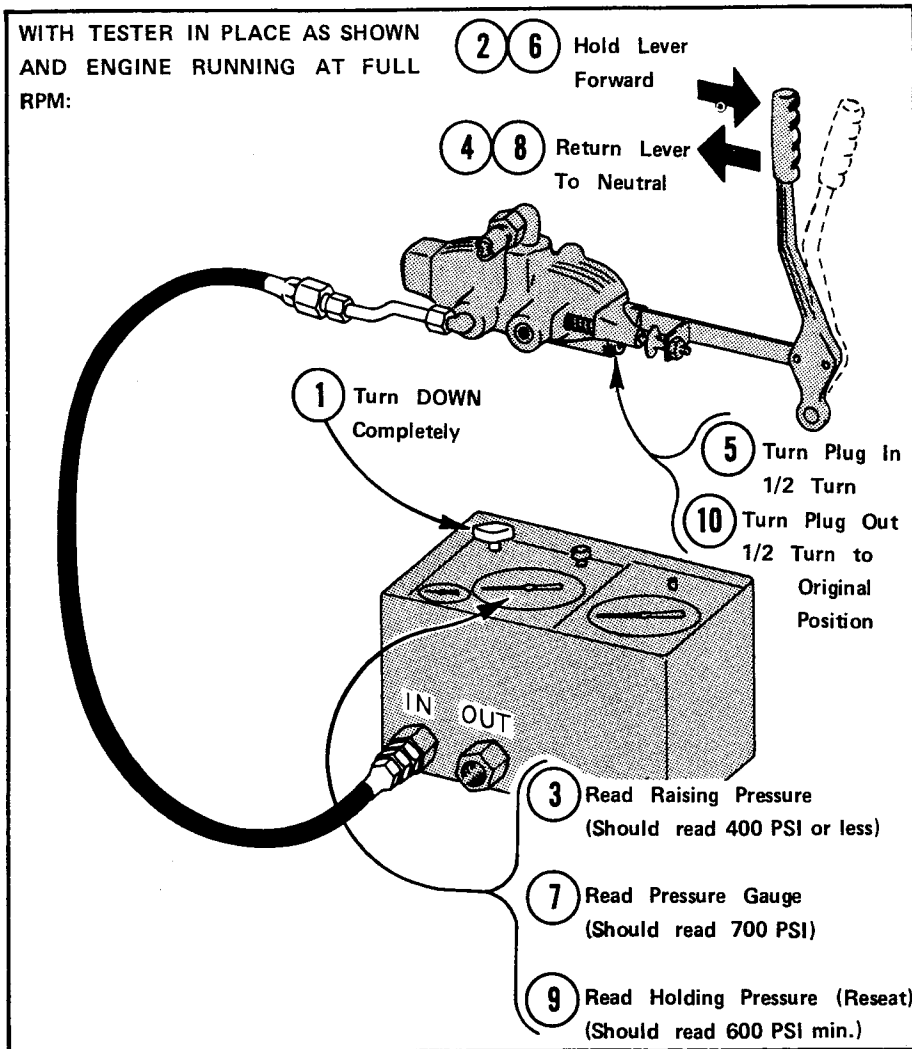


Fig. 118 Checking Variable Speed Raising and Holding Pressure Settings

3. Adding another shim will increase system pressure and substituting with a thin shim will decrease pressure. Adding a .010" thick shim will increase pressure approximately 100 PSI.
4. Replace the spring and cap and recheck the pressure. Adjust further if required.

CARTRIDGE RELIEF PRESSURE SETTING

To change the pressure setting of the cartridge relief valve in the lift and auxiliary control valve:

1. Remove the hex cap from the front of the valve.
2. Extract the shim from behind it.
3. Adding another shim will increase the pressure setting.

Substituting with a thin shim will decrease the pressure setting.

4. Replace the cap and recheck the pressure. Adjust further if required.

WARNING

Variable speed raising pressure should be a maximum of 400. It should never exceed the pressure necessary to shift from full low speed to full high speed position in four seconds at full engine RPM. A shift faster than 4 seconds will cause belt and sheave damage. A system properly lubricated should shift at 300 - 400 PSI, or less.

CHECKING PRESSURE ADJUSTMENT (Variable Speed Control Valve With Thermal Pressure Relief)

Using this type valve, oil is diverted into the variable speed cylinder at a variable speed raising pressure of 400 PSI. The oil trapped in the variable speed cylinder is subjected to thermal expansion because of the heat generated by friction between the variable speed drive sheave and the drive belt. When the thermal pressure reaches 600 PSI the thermal pressure relief valve opens.

To check the raising pressure of the valve:

Connect a hose from the inlet port of the tester to the rear port of the variable speed control valve (Figure 118).

1. Turn the "pressure control valve" knob on the tester in (clockwise) as far as it will go. Start the engine and run it at full throttle.
2. Push the variable speed control lever forward to "high speed" position (Figure 118). Hold it there.
3. The pressure gauge on the tester should show the raising pressure setting of 400. PSI. (See Variable Speed Raising Pressure Setting).
4. Return the lever to neutral.

To check the thermal relief valve reseal pressure:

NOTE: The tester will be connected the same way as it was for checking the raising pressure.

5. Turn the socket head plug (located at the bottom front of the variable speed valve) into the valve body only far enough to increase the raising pressure to 600-700 PSI. Turn it about 1/2 turn.
6. Hold the variable speed lever forward (Figure 118).
7. Check your variable speed raising pressure by pushing the variable speed control lever forward and noting the reading on the hydraulic tester. You should have increased the raising pressure to 700 PSI for this test (Step 1).
8. Release the variable speed control lever so it returns to neutral.
9. Note the reading on the tester. It is the holding pressure. Holding pressure should be 600 PSI (See Variable Speed Thermal Relief Setting).
10. Return the socket head plug to its original position. Repeat steps 1-4 to be sure you have it right. If not, readjust.

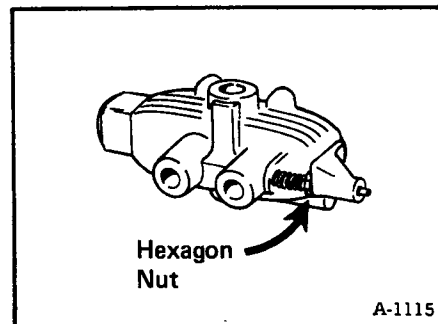


Fig. 119 Variable Speed Thermal Relief Setting

CHECKING PRESSURE ADJUSTMENT (Variable Speed Control Valve Without Thermal Pressure Relief)

Using this type valve, oil is diverted into the variable speed cylinder at a variable speed raising pressure of 375-400 PSI. Check the variable speed raising pressure as you would when checking the variable speed valve with thermal pressure relief, steps 1 through 4 only.

VARIABLE SPEED RAISING PRESSURE SETTING (Variable Speed Control Valve With or Without Thermal Relief)

Change the raising pressure setting of the variable speed control valve as follows:

1. To increase the raising pressure turn the socket head plug (located at the bottom front of the variable speed valve) into the valve a little at a time. Turn the plug in only as far as necessary to set the pressure reading at 400 PSI.

NOTE: If the plug becomes overtight when attempting to increase the pressure a spacer (washer or shim) may be added between the plug and spring.

Recheck the pressure setting and adjust as needed.

2. To decrease the raising pressure loosen the socket head plug until the pressure is correct.

NOTE: If the plug becomes loose (causing an oil leak) when attempting to decrease pressure, shorten the spring by grinding several thousandths of an inch off the end of it. Be careful not to overheat the spring when grinding.

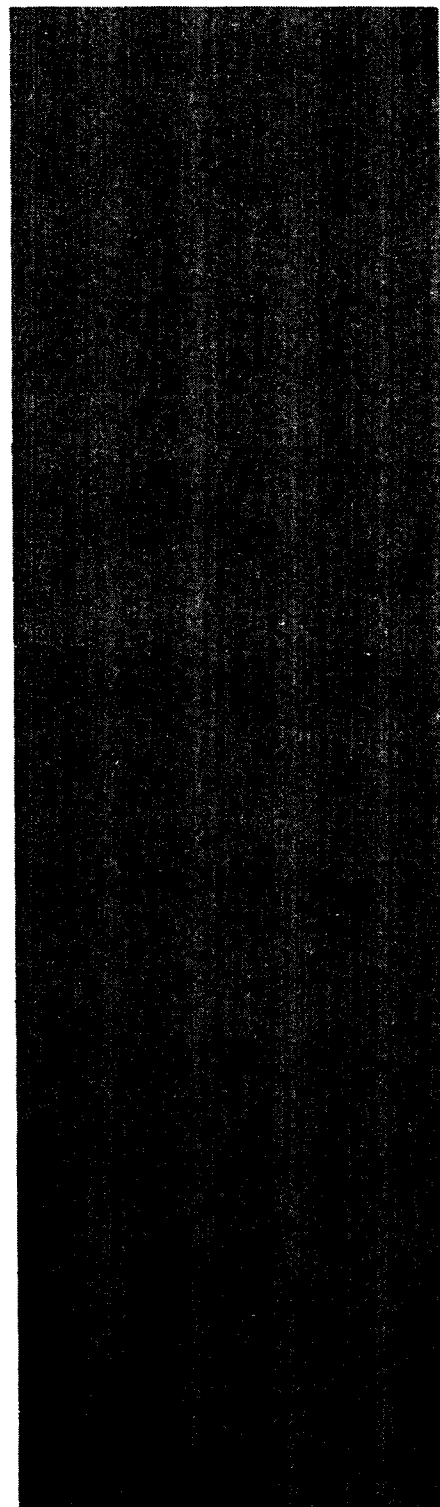
Recheck the pressure setting and adjust as needed.

VARIABLE SPEED THERMAL RELIEF (HOLDING PRESSURE) SETTING (Variable Speed Control Valve With Thermal Relief) (600 PSI Minimum)

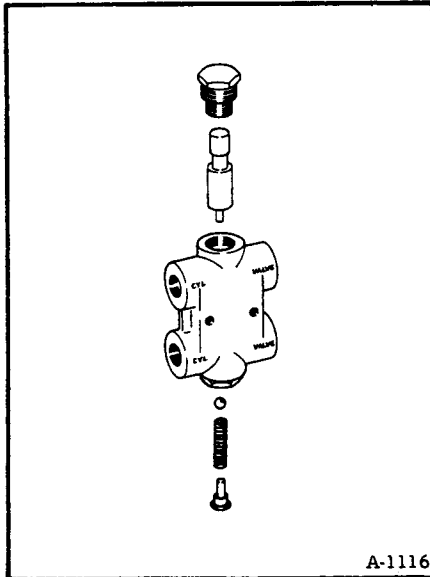
Change the variable speed thermal relief pressure setting as follows:

1. To increase the pressure setting turn the hexagon nut in the cast spring holding bracket so it moves toward the spring, compressing it. Turn the nut 1/4 turn, then recheck the pressure setting. Repeat if necessary (Figure 119). If the nut runs out of threads, place a washer between the nut and spring.
2. To decrease the pressure setting turn the hexagon nut so it moves away from the spring, releasing compression from it (Figure 119).

NOTE: A machine used for excavating, or any machine running under heavy loads continuously, may require more than 600 PSI holding pressure to prevent variable speed leak down and o-ring damage in the holding pressure unit.

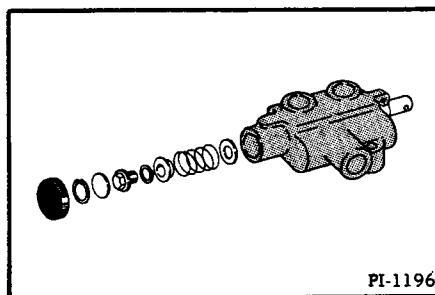


SEE THE TROUBLESHOOTING SECTION OF THIS MANUAL FOR CORRECTION OF HYDRAULIC SYSTEM PROBLEMS.



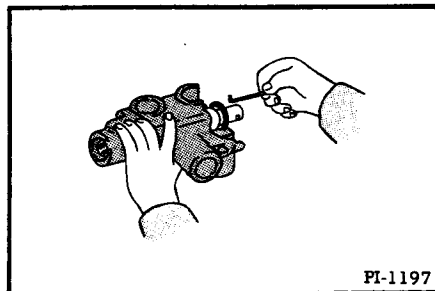
A-1116

Fig. 120 Variable Speed Check Valve



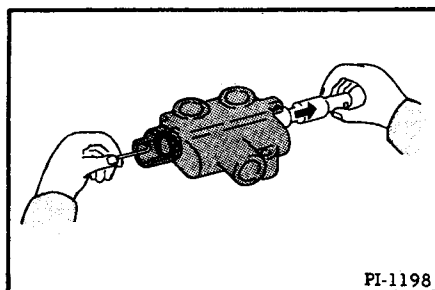
PI-1196

Fig. 121 Removing the Internal Parts



PI-1197

Fig. 122 Removing the Front Seal



PI-1198

Fig. 123 Removing Back Seal

VARIABLE SPEED CHECK (LOCK) VALVE

A check valve is used between the variable speed control valve and the variable speed cylinder on some Bobcats. This check valve prevents the variable speed cylinder from gradually leaking toward low speed position.

If the loader is continuously operated at a high variable speed setting, the oil trapped in the variable speed cylinder will be subjected to a heat and pressure buildup. This excess pressure causes carbon seal failure in rotary swivels, blown snap rings and damaged cylinder seals. If this occurs, check the maximum variable speed pressure at the rear of the check valve. This pressure should be between 375 and 400 PSI. This pressure can be adjusted at the variable speed control valve (See Checking Pressure Adjustment—Variable Speed Control Valve Without Thermal Pressure Relief).

Thermal pressure buildup in the variable speed cylinder side of the check valve may make it impossible to release the oil from the cylinder. Nothing will happen when the variable speed control lever is moved back to low speed position. To remedy this:

1. Wait until the oil cools, or:
2. Loosen the hydraulic hose fitting at the rear of the check valve to release some of the pressure from the hose.

If the operator insists on a continuous high speed operation, follow this procedure:

1. Remove the small plug from the bottom port of the check valve (Figure 120).
2. Remove the check spring and check ball.
3. Replace the small plug in the bottom port of the valve.
4. Remove the large plug from the top port of the valve.
5. Remove the piston from this port.
6. Replace the large plug in the top port.
7. Remove the top tubeline between the check valve and the variable speed control valve and turn plugs tightly into the two ports.

CLUTCH PRESSURE RELIEF VALVE

The clutch pressure relief valve, located below the clutch lubrication manifold, is not adjustable. Its function is to assure clutch lubrication and to prevent air backup through the clutch pins to the hydraulic pump. If this relief valve becomes blocked (open) the hydraulic pump will draw air through the clutch pins, causing a complete loss of hydraulic action.

If this occurs, remove and disassemble the valve. Check for foreign material in the valve body. Reassemble and reinstall the valve.

CONTROL VALVE SEAL REPLACEMENT [1.5 hr./spool W/valve in machine]

To replace the valve spool seals in the tilt cylinder control valve or in the lift cylinder and auxiliary control valve, follow this procedure:

NOTE: A special tool can be used to change the seals in these valves.

1. From the back of the valve remove the rubber bonnet, the large snap ring and the stop disc (Figure 121).
2. Remove the spring assembly screw, the centering spring lock washer, the stop collar, the centering spring and the stop washer (Figure 121).
3. Push the spool into the housing from the front of the valve until the front seal is exposed, then remove the front seal (Figure 122). A length of bent wire works well for this. Be careful not to damage the spool or housing.

Pull the spool out of the housing from the front of the valve, being very careful not to damage either the spool or housing (Figure 123).

4. Remove the back seal (Figure 123).
5. Clean both seal grooves thoroughly.
6. Replace the spool, through the front of the housing, being sure that the end having the spring assembly mounting (tapped) hole enters the housing first (Figure 124). Push the spool into the valve until the spool end touches the back seal groove. Insert a new seal in the back groove, being careful that the "U" cup of the seal is placed in toward the valve body. It will be very helpful to pinch one side of the seal, causing the seal to bend into a shape slightly smaller than the seal groove in the valve. When the seal has been properly placed in the seal groove, straighten the seal by running a smooth rod around the exposed surface of the seal until you have a perfect fit (Figure 124). To check this, run your finger around the exposed edge of the seal. You should have a smooth perfect fit.
7. Insert the special seal tool into the spool housing from the back of the valve and through the new seal until the shoulder of the special tool touches the valve housing (Figure 125). The purpose of the special tool is to guide the spool through the new seal without damaging it.
8. Push the spool into the housing from the front, keeping a firm grip on the special tool in back until you have forced the front of the spool into the housing and the front groove is visible. In pushing the spool through the housing, twisting the spool and special tool will assist the movement (Figure 125).

WARNING

Do not push the spool too far, as this may allow the back seal to enter the grooves of the spool. If this happens, the seal may be cut or damaged.

9. Install a new front seal, being sure to keep the "U" cup side of the seal toward the valve body (Figure 126). Insert and check this seal as you did the other.
10. Again insert the special tool into the spool housing, into the front this time, and with a twisting motion carefully push the tool through the new seal until it is stopped by the spool shoulder. With a twisting motion, push the spool (from the back) against the special tool (Figure 127), until 1/4" of the polished surface of the spool remains exposed at the front of the valve. Remove the special tool from the front of the valve.
11. At the back of the valve, install the parts removed in step 2. Be sure the assembly screw is tightened securely.
12. Replace the stop disc and snap ring. Be sure the ring is properly seated in its groove. Replace the rubber bonnet.

To replace the valve spool seals in the variable speed control valve, follow these steps: [2 hr.]

1. Remove the four cap screws from the valve bonnet and remove it (Figure 128).
2. Remove the round head screw, lock washer, flat washer, spring and stop collar from the end of the spool (Figure 128).
3. Pull the valve spool out of the housing.
4. Observe the positioning of the "U" cup seals for proper replacement. Remove the worn seals by inserting the point of a small knife and prying upward (Figure 129). Extreme caution should be taken when removing the seals to prevent damage to the spool.

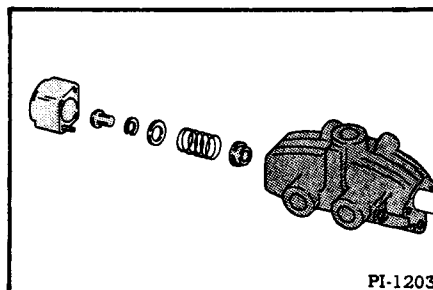


Fig. 128 Removing the Internal Parts

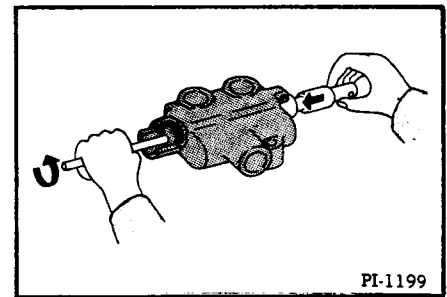


Fig. 124 Installing New Back Seal

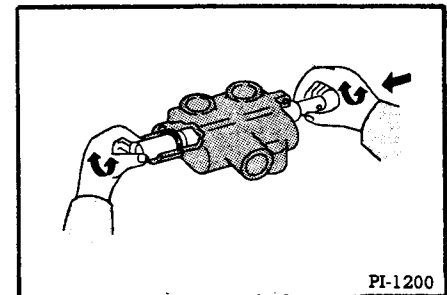


Fig. 125 Pushing Spool Through Seal

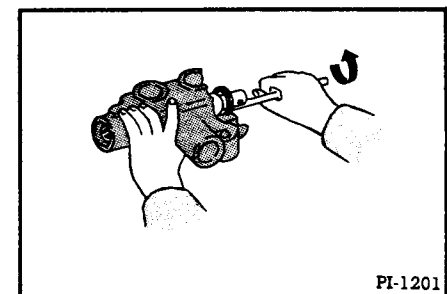


Fig. 126 Installing New Front Seal

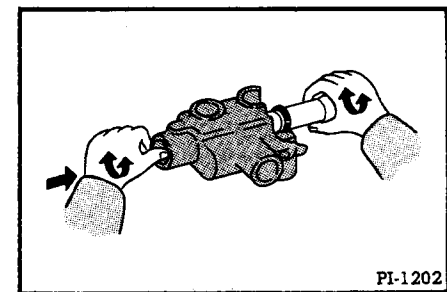


Fig. 127 Pushing Spool Through Seal

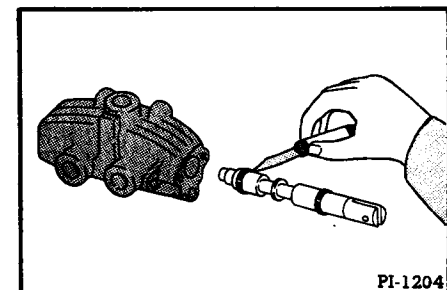
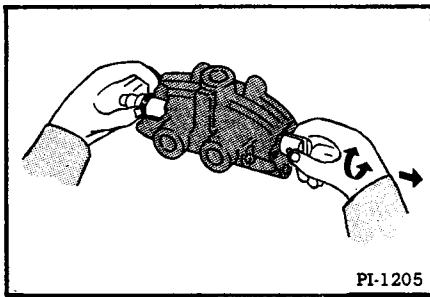
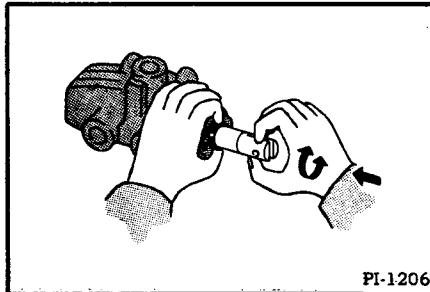


Fig. 129 Removing Seals from Grooves



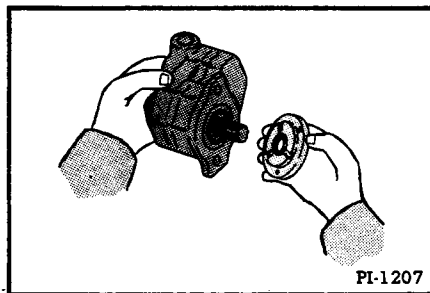
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Fig. 130 Installing a New Back Seal



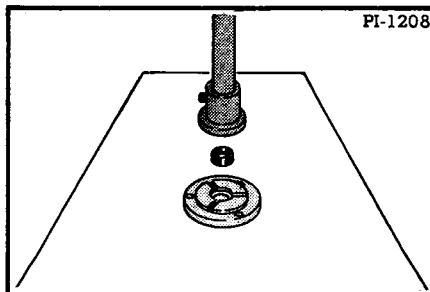
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Fig. 131 Installing a New Front Seal



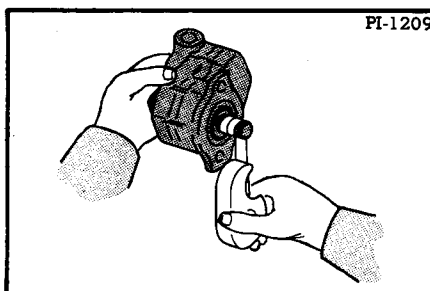
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Fig. 132 Removing the Pilot Plate



PI-1208

Fig. 133 Installing New Seal in Pilot Plate



PI-1209

Fig. 134 Wrapping the Shaft Splines

5. Replace the spool in the housing without any seals on it. Push the spool into the housing until the seal groove is completely exposed at the bonnet end of the valve.

WARNING

Do not push the spool more than is necessary to expose the seal groove.

6. Carefully install a new seal into the groove (Figure 130). After the seal is in place, carefully squeeze the seal into the housing while turning and lightly pulling the spool into the valve body (Figure 130).
7. Pull the valve spool toward the control end of the valve until the front seal groove is exposed.

WARNING

Do not pull the spool more than is necessary to expose the seal ring.

8. Carefully install a new seal (Figure 131). After the seal is in place, carefully squeeze the seal into the housing while twisting and lightly pushing the spool into place (Figure 131).
9. Replace the collar, spring, washer and round head screw. Tighten the round head screw securely.
10. After tightening the round head screw, make sure the washer can slide freely on the spool.
11. Replace the bonnet and the four cap screws.

WARNING

If the spool will not move freely, loosen the four cap screws in the bonnet and retighten them. The bonnet must be properly centered over the spool end.

HYDRAULIC PUMP SEAL REPLACEMENT (Webster Pump) [2 hr.]

For seal replacement in Webster Hydraulic Pumps, follow this procedure:

NOTE: The seal is a synthetic lip type, press fitted into the pilot plate, which is fastened to the pump body by three screws.

1. Remove the pilot plate (Figure 132). Note the position of the seal in the pilot plate. Press the old seal out.
2. Install a new seal in the pilot plate. Be sure it is started straight. Press it into its proper location (Figure 133).
3. Inspect the pump drive shaft for wear at the seal seat. If the wear is no more than a smooth groove several thousandths of an inch deep, the seal should function satisfactorily. If wear has roughened the seat, it is possible to polish it with emery cloth if the wear is not too deep. This should be only a temporary repair. If possible, the seal seat should be ground on a cylindrical grinder and polished, or the shaft should be replaced with a new one.
4. Neatly wrap the shaft with one layer of transparent tape to prevent the shaft splines or keyways from damaging the new seal when it is being installed. Start wrapping at the seal seat, overlapping each turn about 1/16" over the last, progressing outward (Figure 134).

5. The seal should be lubricated with grease to make it slide easily into place.
6. With the pilot plate in place, reinstall and tighten the pilot plate mounting screws.

HYDRAULIC PUMP REPAIR (Webster Pump) [2 hr.]

When a Webster Pump can no longer deliver 1650 PSI at full engine RPM, the gears in the pump are worn too severely and the pump must be replaced or repaired.

To disassemble a Webster Hydraulic Pump, proceed as follows:

1. Wash the outside of the pump with gasoline. With a sharp scribe, scratch a line across the edges of the cover, gear plate and body to aid in reassembly.
2. Remove the pilot plate and seal (Figure 132).
3. Pull the pump drive shaft out of the pump (Figure 135). The ball bearing will come with it.
4. Remove all the screws from the pump body (Figure 136). Some of them enter from the shaft end and some from the cover end.
5. Replace two screws in the shaft side and turn them in several turns by hand (Figure 137). Tap sharply on the heads of the two screws, alternating between them (Figure 137). When the dowels are disengaged, remove the screws and separate the plates.

WARNING

Do not attempt to hold the pump in a vise, as this will damage the mating surfaces of the pump plates.

6. Inspect the gears, shafts and bearings. If the bearing surfaces of the shafts, gear ends and the body have a dull look (not shiny) there may have been abrasive material in the oil. This may have caused serious damage to the needle bearings.

Under clean oil conditions the needle bearings should not show wear even after several thousand hours of operation.

7. If the needle bearings must be replaced, it is usually possible to start them out of the bearing wells by using a piece of drill rod of shaft diameter. Fill the bearing with heavy grease and drive the drill rod into the bearing with a hammer. The rod acts as a plunger, and the grease forces the bearing up out of the bearing well (Figure 138). The drain holes in the bearing wells must first be plugged to make this process effective.

When inserting new needle bearings, the lettered ends must be exposed and the bearings pressed in so they are under flush by 1/16" (Figure 139):

8. If the cover and body plates are worn where they come in contact with the gears, they should be resurfaced on a surface grinder.

Replace the gears with new ones if the cover and body are resurfaced.

9. Normally, the shafts do not need replacement unless extreme shock loads or high pressure operation have caused a keyway failure in the drive shaft.

To reassemble:

1. Carefully clean up the bench area to be used.
2. Wash all pump parts with gasoline and dry them with air.
3. Assemble the ball bearing to the pump drive shaft, insert the assembly into the body and install the pilot plate and seal according to steps 4, 5 and 6 under Hydraulic Pump Seal Replacement (Webster Pump).
4. Set the pump body with the ground face upward.

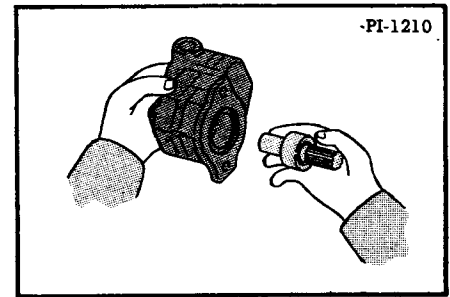


Fig. 135 Pulling Drive Shaft from Pump

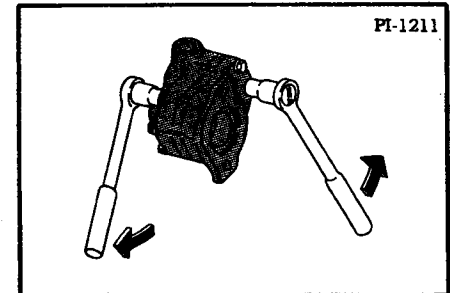


Fig. 136 Removing Pump Body Screws

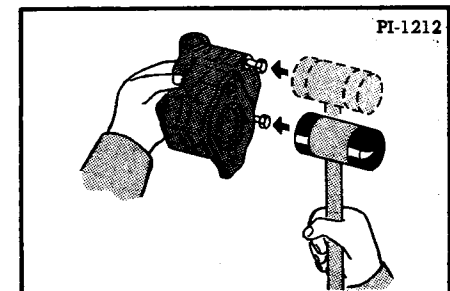


Fig. 137 Separating the Pump Plates

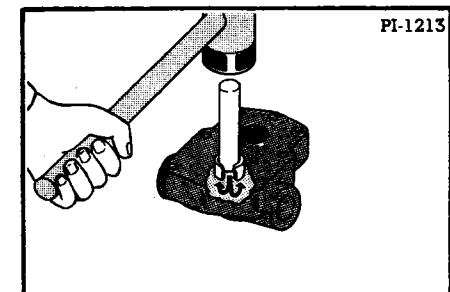


Fig. 138 Forcing out the Bearings

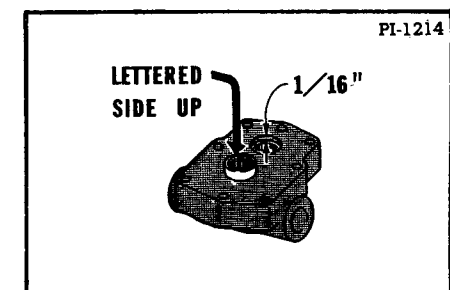


Fig. 139 Inserting New Bearings

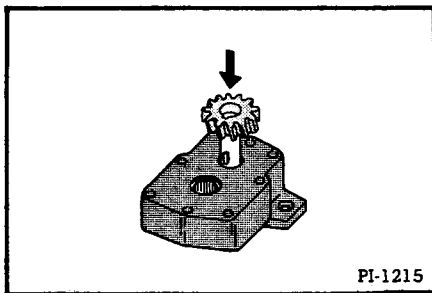


Fig. 140 Installing Drive Gear

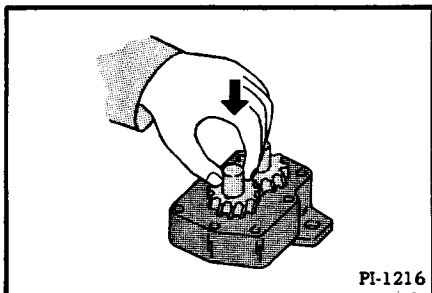


Fig. 141 Installing Idler Gear Assembly

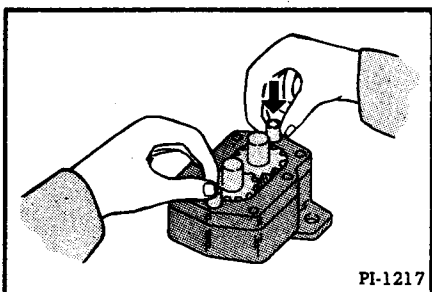


Fig. 142 Inserting the Dowel Pins

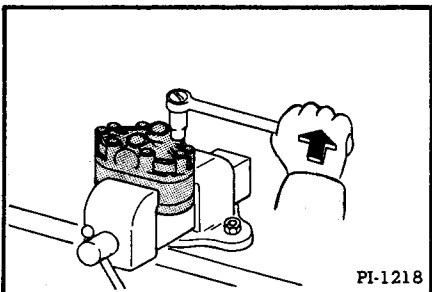


Fig. 143 Removing the Cap Screws

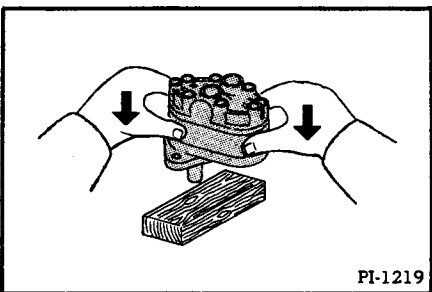


Fig. 144 Removing the Internal Parts

5. Place a key in the drive shaft and lower the drive gear over it (Figure 140) making sure the key enters the gear properly.
6. Insert the idler gear and shaft assembly (Figure 141).
7. Place the gear plate over the gears, observing the scratch marks on the sides of the plate and body to be sure the pump is being reassembled properly.
8. Insert the dowel pins through the large holes in the gear plate (Figure 142).
9. Insert the cover plate over the shafts. Check the scratch marks on the sides of the plates to be sure the pump is being reassembled properly.
10. Insert and tighten the cover screws, then turn the pump over and insert and tighten the body screws.

You should be able to turn the pump shaft by hand if the pump has been properly assembled.

HYDRAULIC PUMP REPAIR (Cessna Pump) [2 hr.]

When a Cessna Pump can no longer deliver 1650 PSI at full engine RPM, the gears in the pump are worn too severely and the pump must be replaced or repaired.

To disassemble a Cessna Hydraulic Pump, proceed as follows:

1. Remove the key from the pump drive shaft.
2. Clean the outside of the pump thoroughly. With a sharp scriber, scratch a line across the edges of the cover, gear plate and body to aid in reassembly.
3. Clamp the pump in a vise, shaft down. Remove the cap screws which hold the pump plates together (Figure 143).
4. Remove the pump from the vise. Separate the pump plates by striking the shaft onto a wooden block (Figure 144).
5. Remove these items (Figure 145) from the front plate (shaft end) of the pump:
 - A. Diaphragm
 - B. Springs (2) and steel balls (2)
 - C. Phenolic gasket
 - D. Protector gasket
 - E. Molded "V" seal
 - F. Shaft seal
6. Clean and dry all the pump parts.

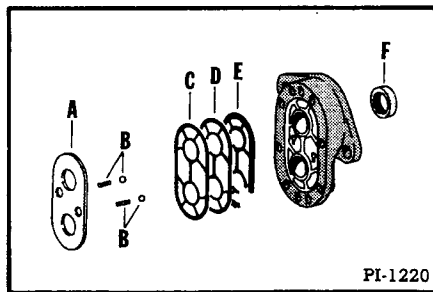


Fig. 145 Removing the Internal Parts

7. Inspect the pump drive shaft for a broken keyway. Inspect the pump drive shaft and the idler gear shaft at the bearing points and seal areas. Rough surfaces or wear may be found at these points. If the shafts measure less than .6850" in the bearing areas, they should be replaced.

8. Inspect the gear faces for scoring and excessive wear.

If gear width is below the following figures, replace the gears:

- A. Pump Model B24387 — OBAA636"
- B. Pump Model 15509 — OEBA636"
- C. Pump Model 15510 — OEBA767"

9. Inspect the back (port end) plate for scoring or wear. If wear exceeds .0015" replace the back plate with a new one.

If the inside diameters of the bearings in either the front or back plate exceed .691", replace the plate. (Bearings are not available as separate items).

10. Inspect the gear pockets (in the gear plate) for excessive wear and scoring.

If the diameter of the gear pockets in the gear plate exceed 1.719" the gear plate should be replaced with a new one.

To reassemble the pump:

NOTE: The diaphragm, phenolic gasket, protector gasket, molded "V" seal and shaft seal should be replaced as new parts.

- 1. Place the molded "V" seal into the grooves in the front plate. Insert the seal with the open part of the "V" toward the plate.
- 2. Press the protector gasket and the phenolic gasket into the molded "V" seal.
- 3. Drop the steel balls into their seats and place the springs over the balls.
- 4. Place the diaphragm over the phenolic gasket, bronze face up.

NOTE: The entire diaphragm must fit inside the raised rim of the molded "V" seal.

- 5. Dip the gear assemblies into oil and slip them into the front plate bearings.
- 6. Apply a thin coat of heavy grease to both faces of the gear plate and place the gear plate over the gears. Check the scratch marks on the sides of the plates to be sure the pump is being reassembled properly.
- 7. Slide the back plate over the gear shafts until the dowel pins are engaged. Check the scratch marks on the sides of the plates to be sure the pump is being reassembled properly.
- 8. Install the assembly screws and tighten them evenly to 25 ft. lbs. torque.
- 9. Install the pump drive shaft seal over the shaft being careful not to cut the rubber sealing edge. Oiling the seal will aid in installing it.

Seat the seal by tapping it with a plastic hammer.

You should be able to turn the pump shaft by hand if the pump has been properly assembled.

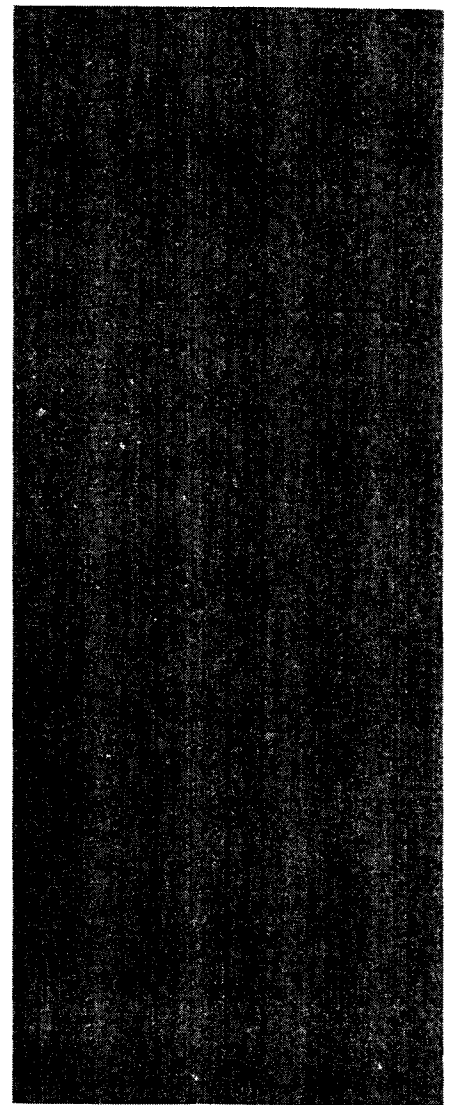
HYDRAULIC CYLINDER REPAIR [1 hr.]

There are several conditions which can cause a hydraulic cylinder failure. They are:

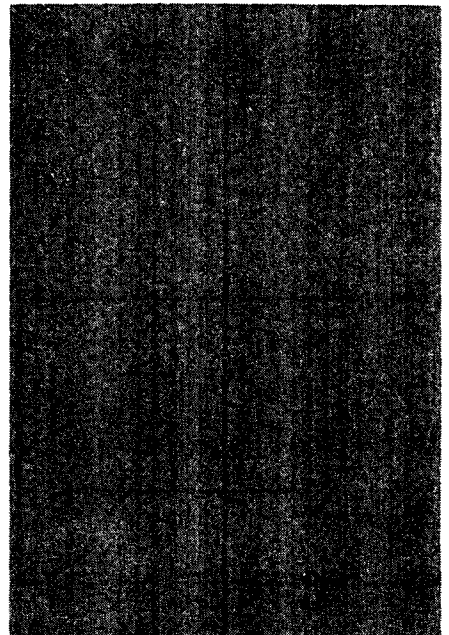
- 1. A nick on a cylinder shaft can cause seal damage and external leakage.

Instruct the operator to inspect the cylinder shafts occasionally. He can do this by running his hand up and down the length of the shaft with the shaft fully extended. This is very important when handling gravel, stone, or scrap metal. Shaft inspection can detect nicks or scratches before they are large enough to damage the cylinder head seals. Carefully dress down any nicks or scratches on a cylinder shaft with a fine carborundum stone.

- 2. Pinholes at either of the cylinder ports can cause external leakage.



CHECK THE ASSEMBLY OF A HYDRAULIC PUMP OR CONTROL VALVE IF IT DOES NOT FUNCTION PROPERLY.



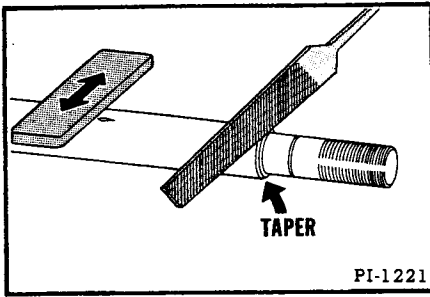


Fig. 146 Shaft Preparation

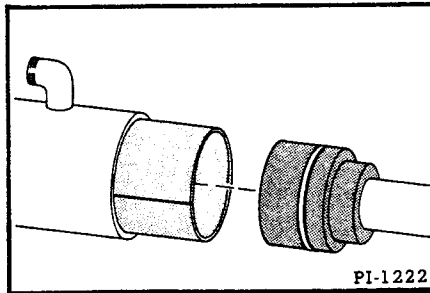


Fig. 147 Using the Cylinder Repair Tool

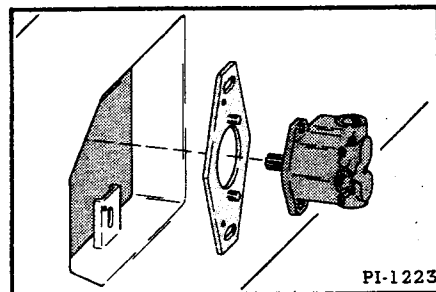


Fig. 148 Removing Pump from Machine

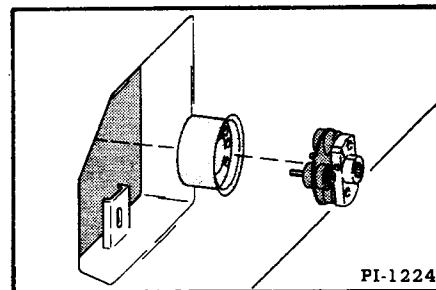


Fig. 149 Removing Coupling & Adapter

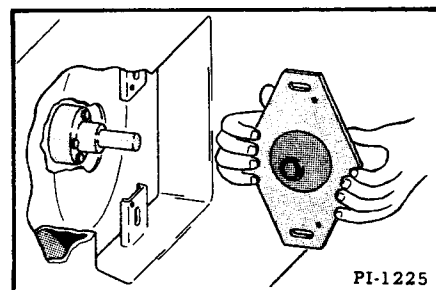


Fig. 150 Mounting Pump Aligning Tools

Pinholes can be welded shut by gas or electric arc welding. If you will be welding a cylinder at the pivot end, the cylinder shaft should be extended to prevent heating and weakening the piston seals. If you will be welding at the head end of the cylinder, the cylinder should be disassembled to prevent damage to the seals in the head. If you will be using an electric arc welder, do not apply the ground clamp to the cylinder shaft, as this will cause a burned spot on the shaft.

3. A dented cylinder case can cause the piston to be worn flat and allow internal leakage. If a cylinder case has been dented and the piston worn flat, it is not economical to repair the cylinder in most cases. Replace the cylinder with a new one.
4. Foreign material in the cylinder case can cause scoring of the cylinder wall and internal leakage. Improper hydraulic filter service can cause foreign material to be circulated through the hydraulic system. A dirty (blocked) filter cartridge will cause the filter bypass to open and allow unfiltered oil to pass through. This can cause excessive wear to the hydraulic pump and to all control valves and cylinders.

To disassemble a hydraulic lift or tilt cylinder:

1. Remove the hydraulic cylinder from the machine.
2. With the special spanner wrench, remove the head from the cylinder.
3. Pull the shaft and piston assembly from the cylinder case.

To replace the cylinder seals:

1. File or grind a slight bevel on the shoulder at the piston end of the cylinder shaft (Figure 146). This will allow the seals to be installed over the shoulder without damaging them. Dress all nicks off the shaft (Figure 146). Do not use a power grinder or a file for this purpose.
2. Soak the teflon piston seal in warm oil or water for several minutes before installing it. This will make it softer and easier to install.

To reassemble the hydraulic cylinder:

1. Install the cylinder head seals and place the cylinder head carefully onto the cylinder shaft.
2. Install the spacer onto the shaft (lift cylinder only).
3. Install the piston seals and place the piston onto the end of the cylinder shaft.
4. Install the piston locking nut and tighten it securely.
5. Use the special cylinder repair tool (Figure 147) when installing the piston into the cylinder. This tool will prevent the threads in the end of the cylinder case from damaging the piston seals.
6. Use extreme caution, when inserting the cylinder head into the cylinder case, to prevent "O" ring damage.
7. Tighten the cylinder head with the special spanner wrench.

HYDRAULIC PUMP ALIGNMENT (M-500 and M-444 Gasoline or LP Gas)

Proper alignment of the hydraulic pump with the engine crankshaft is necessary to prevent excessive pump drive adapter wear.

To properly align a hydraulic pump with the crankshaft of the loader engine, proceed as follows:

1. Remove the hydraulic pump and pump mounting plate from the machine (Figure 148).
2. Remove the pump coupling and pump drive adapter from the machine (Figure 149).
3. Mount the engine adapter to the engine crankshaft (Figure 150).

4. Mount the pump aligning hub to the pump mounting plate in place of the pump (Figure 150).
5. Loosen the engine mounting bolts (Figure 151).
6. Slide the pump mounting plate and hub over the aligning shaft. The pump mounting plate should rest flatly against the pump mounting brackets (welded to the Bobcat frame). Insert 1/4" aligning pins through the drilled aligning holes in the pump mounting plate and the mounting brackets (Figure 152). You may find it necessary to shift the engine slightly or to bend the pump mounting brackets to secure a flat contact between the mounting plate and brackets.
7. Bolt the pump mounting plate securely in place (Figure 153). Bolt the engine securely to its mountings.
8. Remove the spark plugs from the engine and turn the engine through a full revolution to check the alignment. If resistance to rotation is felt, move the engine or bend the pump mounting brackets to realign.
9. Remove the 1/4" aligning pins.
10. Remove the pump mounting plate from the machine.
11. Install the hydraulic pump on the pump mounting plate in place of the aligning hub.
12. Install the pump drive adapter in place of the aligning shaft on the engine flywheel.
13. Install the pump and its mounting plate and secure the plate in position with the aligning pins (Figure 152). Bolt the pump mounting plate securely in place (Figure 153). The pump drive adapter and the pump drive shaft must be secured together.

HYDRAULIC PUMP ALIGNMENT (M-600 and M-500 Electric) [3 hr.]

Proper alignment of the hydraulic pump with the motor shaft is necessary to prevent excessive pump drive adapter wear.

On electric Bobcats, if the pump drive adapter fails before 500 hours service, follow this procedure:

1. Remove the hydraulic pump and pump mounting plate from the motor bell housing (Figure 154).
2. Remove the two pump mounting screws and reinstall them with the screws and lock washers on the pump side and the nuts on the mounting plate side. Tighten securely and arc or gas weld the nuts to the plate to anchor them (Figure 155). Do not overheat the cast mounting plate, or it may crack.
3. Separate the pump from the mounting plate.
4. With a center punch, locate eight number 7 (.201") drill holes. They should be positioned every 90 degrees around the bell housing so set screws will bear on the four machined bosses on the motor frame.
5. Remove the bell housing from the motor.
6. Drill the eight holes with a number 7 (.201") drill and run a 1/4" by 20 tap through them (Figure 156). Start 1/4" set screws in the holes, but be sure they do not extend inside the bell housing.
7. Remove worn pump drive adapter from the motor shaft (Figure 157).

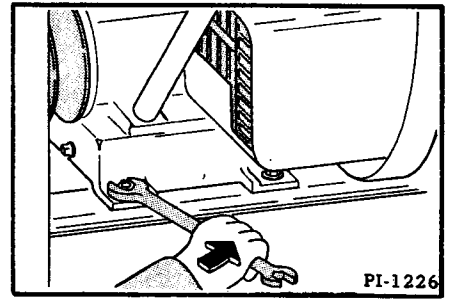


Fig. 151 Loosen the Engine Mounting

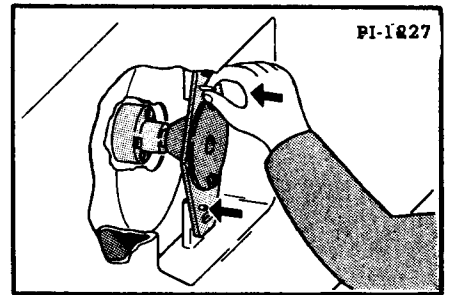


Fig. 152 Insert the Aligning Pins

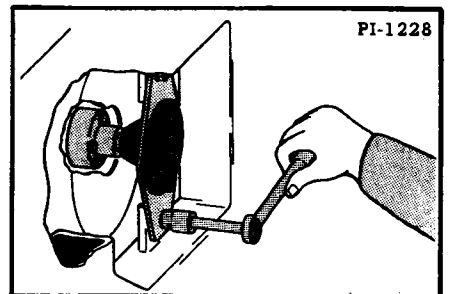


Fig. 153 Bolt Mounting Plate in Place.

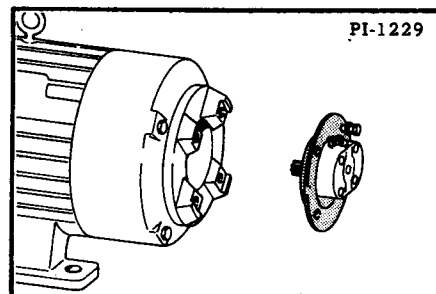


Fig. 154 Removing Pump from Motor

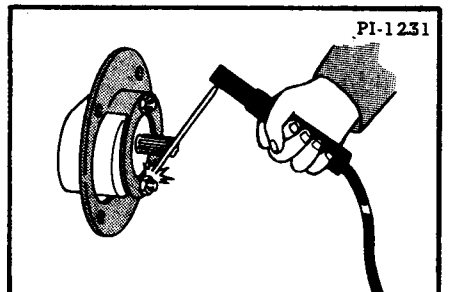


Fig. 155 Welding Nuts to Plate

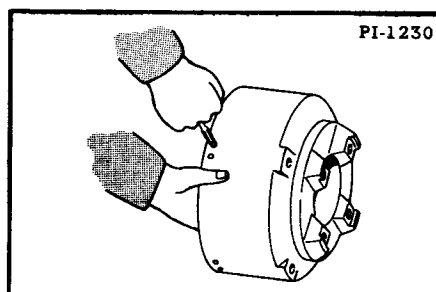


Fig. 156 Tapping Set Screw Holes

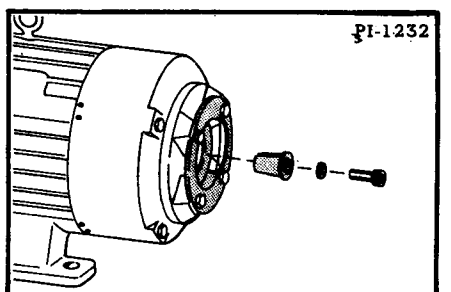


Fig. 157 Pump Drive Adapter Removal

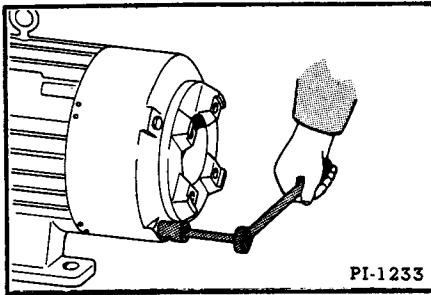


Fig. 158 Attaching Bell Housing to Motor

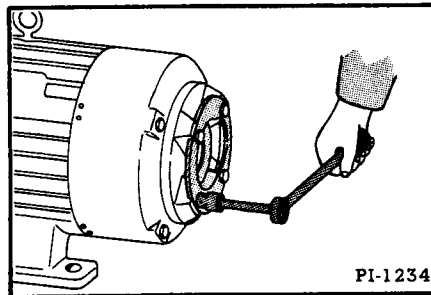


Fig. 159 Attaching Mounting Plate to Motor

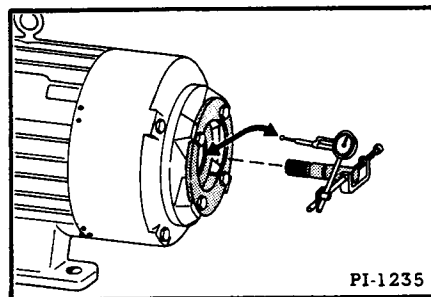


Fig. 160 Attaching Dial Indicator to Shaft

8. Attach the bell housing to the motor (Figure 158). Draw the mounting screws down evenly, but not too tightly.
9. Assemble the pump mounting plate to the bell housing (Figure 159).
10. Install a new (unworn) pump drive adapter into the end of the motor shaft. Alternately tap lightly and tighten the socket head screw.
11. Using a fine steel wire in a shaft spline, jam a used pump shaft into the splined adapter. The shaft need not be centered in the adapter, but must fit tightly.
12. Attach a dial indicator to the shaft so the follower runs on the inner circumference of the pump mounting plate (Figure 160).
13. Using a long bar, pull the variable speed drive belt into the driven (spring loaded) sheave. This will loosen the belt in the drive (motor) sheave so the motor shaft may be turned freely by hand.
14. Rotate the motor shaft by hand, noting the dial indicator reading. Adjust the eight set screws to move the bell housing until a maximum total indicator reading of .004" is obtained. Tighten the bell housing mounting screws securely. Recheck and readjust as required.
15. Remove the dial indicator and the used pump shaft.
16. Reinstall the hydraulic pump on the mounting plate.

NOTE: The inlet and outlet fittings must be located and tightened on the pump before the pump is mounted on the plate. This prevents destroying the alignment.

ALIGNING THE HYDRAULIC PUMP (M-600 Wisconsin)

1. Insert a Woodruff key (Figure 161, Item 6) into the pump drive shaft on the engine (at the distributor).

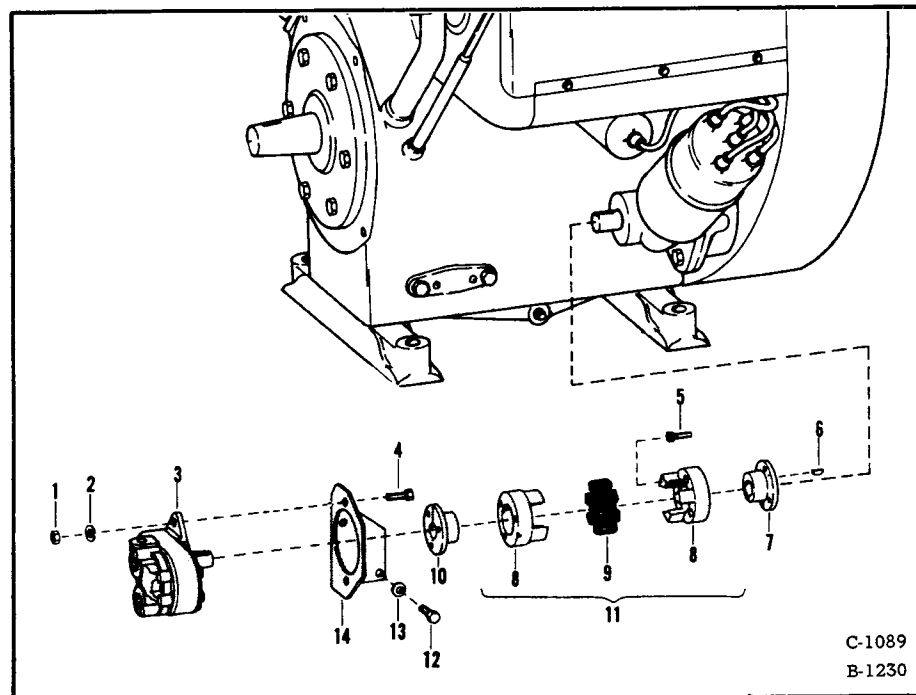


Fig. 161 Aligning Hydraulic Pump to Engine Drive Shaft

2. Loosely assemble a coupler half (Item 8) to the 5/8" bore hub (Item 7). Drive the assembly onto the pump drive shaft using a brass drift pin. Do not tighten the screws yet.
3. Fasten the pump mounting bracket (Item 14) to the side of the engine. Be sure to include the sealing washer (Item 13) outside the mounting bracket. Tighten the screws.
4. Assemble the 11/16" bore hub (Item 10) and coupler half (Item 8) to the hydraulic pump. Drive the hub on flush with the end of the pump shaft. Be sure to include the pump shaft key. Tighten the coupler screws evenly and securely.

5. Hold the pump in place against its mounting bracket. With a large screwdriver, pry the 5/8" bore hub (Item 7) outward on the shaft until the ears of the inner coupler half touch the body of the outer one.
6. Remove the pump. Tighten the capscrews (Item 5) to lock the inner coupler in place. Hold the pump in place. Note the clearance between the ears of the inner coupler half and the body of the outer coupler half (Inset A). It should be .020 - .025. Measure the clearance. Check all the way around (without rotating the coupler).
7. If the clearance is over .025, remove the pump. Loosen the capscrews (Item 5) and pry the coupler half (Item 8) slightly away from the hub (Item 7) so it is loose on the hub. Pry the hub (Item 7) outward on the shaft a distance equal to any excess clearance you measured in step 6.
8. Tighten the capscrews (Item 5) locking the hub in place on the shaft. Hold the pump into place to recheck the clearance. If still incorrect, readjust. If correct, insert the rubber coupler disc (Item 9) into place and attach the pump to its mounting bracket.
9. Turn the engine over several times to check for any apparent binding or severe misalignment of the coupling.

MOUNTING INSTRUCTIONS - AUXILIARY HYDRAULIC CONTROL KIT

(Frame Mounted - One Unit Control - M-600 Gasoline, LP Gas & M-500 Diesel)

1. Before installing an auxiliary hydraulic control kit, make sure the machine is not running and the auxiliary control pedal (center foot pedal) is in neutral position.

NOTE: Make sure all fittings are free of dust and dirt.

2. With two 1/2" NPT x 1/2" 37° Flare straight adapters, connect the male half of the quick coupler (Figure 162, Item 1) to the longer tube (Item 2) and the female half of the quick coupler (Item 3) to the shorter tube (Item 4) and tighten securely.
3. Remove the screw from the right side of the foot pedal guard and install the tubeline mounting bracket. Replace and tighten the screw (Item 5).
4. Position the tubelines against the bracket with the longer one on top. Arrange the tubelines so one is on either side of the retainer screw. Loosely fasten the retainer strap to the tubeline mounting bracket using a 3/8" x 1" hex screw and self locking hex nut (Item 6). DO NOT TIGHTEN.
5. Remove the two plugs from the auxiliary hydraulic ports at the rear of the machine (Items 7 & 8). Connect the shorter tubeline (Item 4) to the front port (Item 7) and the longer tubeline (Item 2) to the rear port (Item 8) using 1/2" 37° Flare 90° elbows. Tighten securely.
6. With the tubelines properly secured, tighten the retaining strap (Item 6).
7. Snap quick coupler dust caps into place whenever the couplers are not in use.

MOUNTING INSTRUCTIONS - AUXILIARY HYDRAULIC CONTROL KIT

(Frame Mounted - Two Unit Control - M-600 Gasoline, LP Gas & Diesel)

1. Before installing an auxiliary hydraulic control kit, make sure the machine is not running and the auxiliary control pedal (center foot pedal) is in neutral position.

NOTE: Make sure all fittings are free of dust and dirt.

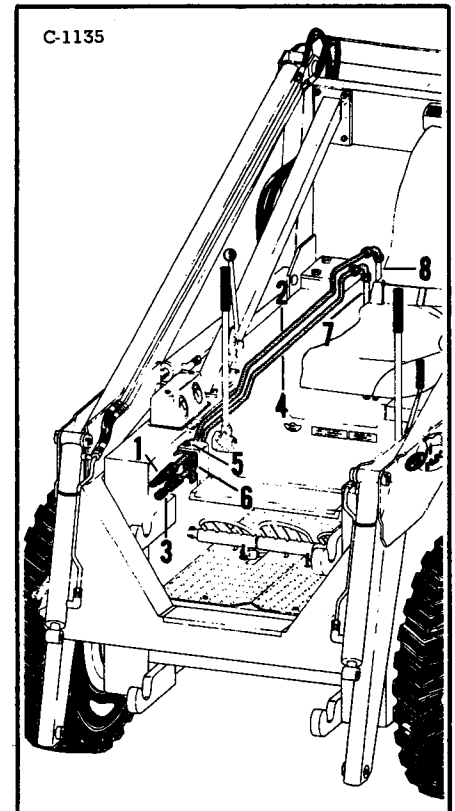
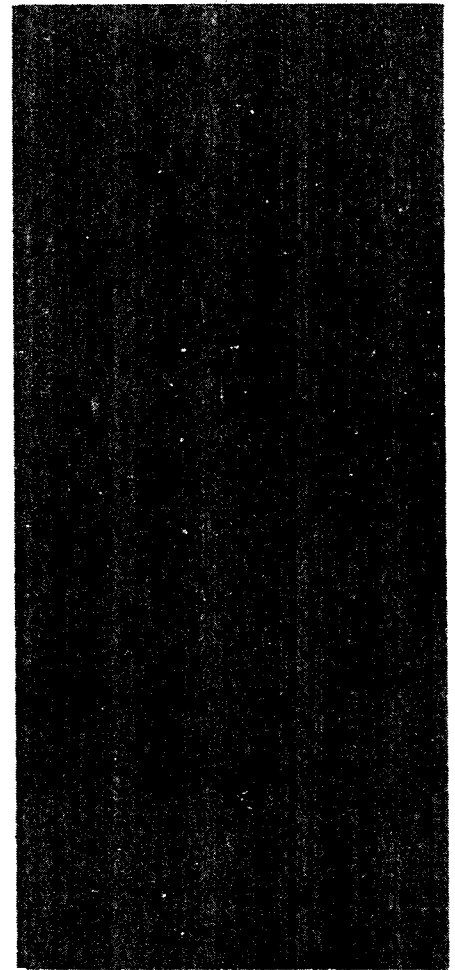


Fig. 162 Mounting Auxiliary Kit

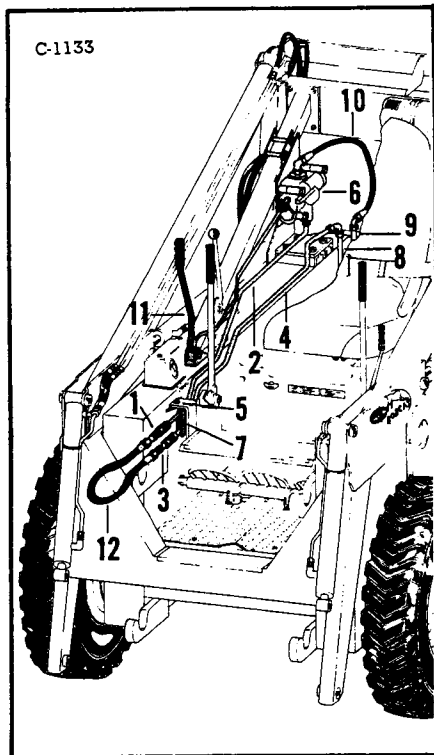


Fig. 163 Mounting Auxiliary Kit

2. With two NPT x 1/2" 37° Flare straight adapters, connect the male half of the quick coupler (Figure 163, Item 1) to the shorter tube (Item 2) and the female half of the quick coupler (Item 3) to the longer tube (Item 4) and tighten securely.
3. Remove the screw from the right side of the foot pedal guard and install the tubeline mounting bracket. Replace and tighten the screw (Item 5).
4. Mount the hydraulic valve assembly (Item 6) to the valve mounting plate using three 3/8" x 3-3/4" hex screws, spacers and self locking hex nuts.
5. Loosely bolt the valve and mounting plate the upright brace, approximately 9" from the top, using two 3/8" x 2-1/2" hex screws and self locking hex nuts.
6. Position the tubelines against the tube mounting bracket with the shorter one on top. Arrange the tubelines so one is on either side of the retainer screw. Loosely fasten the retainer strap to the tubeline mounting bracket using a 3/8" x 1" hex screw and self locking hex nut (Item 7). DO NOT TIGHTEN.
7. Remove the two plugs from the auxiliary hydraulic ports at the rear of the machine (Items 8 & 9). Connect the longer tubeline (Item 4) to the front port (Item 8) and the 17-1/2" long hydraulic hose (Item 10) to the rear port (Item 9) using 1/2" 37° Flare 90° elbows. Tighten securely.
8. To the top port of the hydraulic valve assembly (Item 6) connect the hydraulic hose (Item 10). Use one 1/2" NPT x 1/2" 37° Flare 90° elbow and one 3/4" to 1/2" NPT straight reducer bushing.

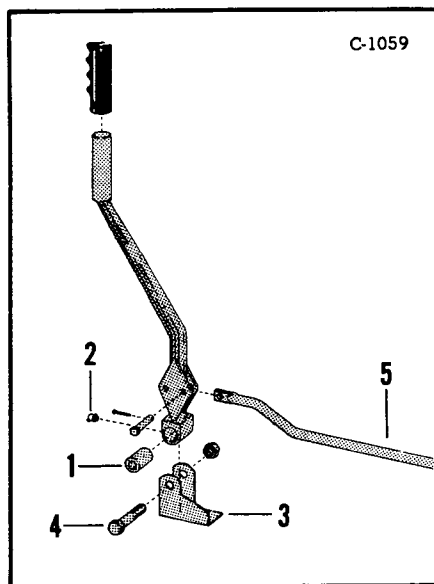


Fig. 164 Mounting Auxiliary Control

NOTE: The hydraulic valve assembly mounting plate may need to be moved either up or down on the upright brace until proper alignment is obtained.

9. Connect the short front tubeline (Item 2) to the bottom port of the hydraulic valve assembly. Use one 3/4" to 1/2" NPT straight reducer bushing and one 1/2" NPT x 1/2" 37° Flare 90° elbow.
10. Assemble the auxiliary hydraulic control in the following manner:

Insert the pivot bushing into the base of the lever (Figure 164, Item 1).

Install the grease fitting into the base of the lever (Item 2).

Slip the lever into the mounting bracket (Item 3) and secure with one 3/8" x 1-3/4" hex screw and self locking hex nut (Item 4).
11. From the right upright brace remove the inside front hex nut and attach the control lever. Be sure the lever angle is toward the front of the machine.
12. Insert the punched end of the control valve linkage rod (Figure 164, Item 5) into the control lever with the bend of the linkage rod toward the machine center. Fasten using a 1/4" x 1-1/8" flat head hinge pin and a 3/32" x 1-1/8" cotter pin.
13. Adjust the yoke on the linkage rod and connect it to the hydraulic valve assembly. Fasten using a 1/4" x 1-1/4" flat head hinge pin and a 3/32" x 3/4" cotter pin.
14. Slip the rubber hand grip over the control lever with the formed edge toward the front of the machine.
15. Attach the ends of a hydraulic jumper hose to the quick couplers to complete the circuit (Figure 163, Item 12).

- With all tubes properly in place, tighten all fittings and connections. Check the port side of the hydraulic valve assembly to be sure that the unused ports are properly plumbed for an attachment. If an attachment is not connected, plug the ports to prevent dirt entry and fluid loss.

MOUNTING INSTRUCTIONS - AUXILIARY HYDRAULIC CONTROL KIT (Boom Mounted - One Unit Control - M-600 Gasoline, LP Gas & Diesel)

- Before installing an auxiliary hydraulic control kit, make sure the machine is not running and the auxiliary control pedal (center foot pedal) is in neutral position.

NOTE: Make sure all fittings are free of dust and dirt.

- With two 1/2" NPT x 1/2" 37° Flare straight adapters connect the male half of the quick coupler (Figure 165, Item 1) to the longer tube (Item 2) and the female half of the quick coupler (Item 3) to the shorter tube (Item 4) and tighten securely.
- Using hand pressure, slightly bend the top ends of the tilt cylinder boom lines down and toward the operator's seat, allowing sufficient room to make connections.
- Connect the two hydraulic hoses (Items 5) to the auxiliary boom lines. Slip the auxiliary boom lines into place behind the tilt cylinder hoses and along the boom arm.
- Remove the two lower tubeline mounting clamps. Relocate the tilt cylinder boom lines to the bottom side of the clamp mounting studs and position the auxiliary lines along the top. Loosely clamp all four tubes to the boom arm with the two large clamps (Item 6).

- Remove the two plugs from the auxiliary hydraulic ports at the rear of the machine (Items 7 & 8). Connect the lower hydraulic hose to the front port (Item 7) and the upper hydraulic hose to the rear port (Item 8) using 1/2" 37° Flare straight adapters.
- Secure the hydraulic hoses to the back of the upright using two clamps, one spacer, one 3/8" x 2-1/2" hex screw and one hex nut.
- With the hoses secured, adjust the auxiliary tubelines for best fit and tighten the clamps (Item 6). With the tubes properly located, drill a 5/16" hole in the right side of the boom crossmember and tap with a 3/8" NC threaded tap. Using a 3/8" x 1" hex screw and tube clamp, secure the lower portion of the tubes to the boom (Item 9).
- Snap quick coupler dust caps into place whenever the couplers are not in use.

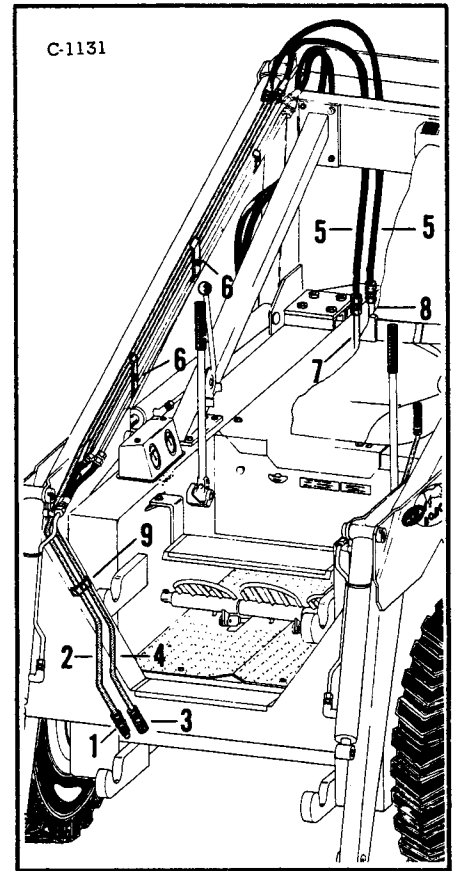


Fig. 165 Mounting Auxiliary Kit

MOUNTING INSTRUCTIONS - AUXILIARY HYDRAULIC CONTROL KIT (Frame Mounted - One Unit Control - M-500 Gasoline, LP Gas, Electric & M-600 Electric)

- Before installing an auxiliary hydraulic control kit, make sure the machine is not running and the auxiliary control pedal (center foot pedal) is in neutral position.

NOTE: Make sure all fittings are free of dust and dirt.

- With two 1/2" NPT x 1/2" 37° Flare straight adapters connect the male half of the quick coupler (Figure 166, Item 1) to the longer tube (Item 2) and the female half of the quick coupler (Item 3) to the shorter tube (Item 4) and tighten securely.
- Remove the screw from the right side of the foot pedal guard and install the tubeline mounting bracket. Replace and tighten the screw (Item 5).

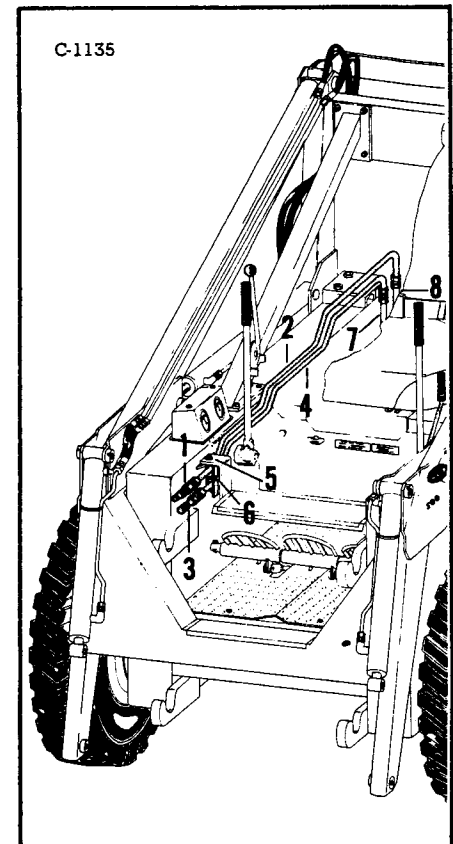


Fig. 166 Mounting Auxiliary Kit

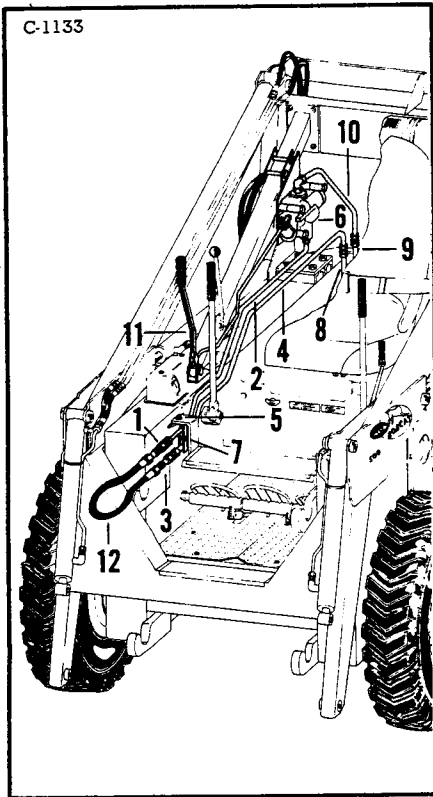


Fig. 167 Mounting Auxiliary Kit

4. Position the tubelines against the tube mounting bracket with the longer one on top. Arrange the tubelines so one is on either side of the retainer screw. Loosely fasten the retainer strap to the tubeline mounting bracket using a 3/8" x 1" hex screw and self locking hex nut (Item 6). **DO NOT TIGHTEN.**
5. Remove the two plugs from the auxiliary hydraulic ports at the rear of the machine (Items 7 & 8). Connect the shorter tubeline (Item 4) to the front port (Item 7) and the longer tubeline (Item 2) to the rear port (Item 8) using 1/2" 37° Flare straight adapters. Tighten securely.
6. With the tubelines properly secured, tighten the retaining strap (Item 6).
7. Snap quick coupler dust caps into place whenever the couplers are not in use.

MOUNTING INSTRUCTIONS - AUXILIARY HYDRAULIC CONTROL KIT (Frame Mounted - Two Unit Control - M-500 Gasoline, LP Gas, Electric & M-600 Electric)

1. Before installing an auxiliary hydraulic control kit, make sure the machine is not running and the auxiliary control pedal (center foot pedal) is in neutral position.

NOTE: Make sure all fittings are free of dust and dirt.

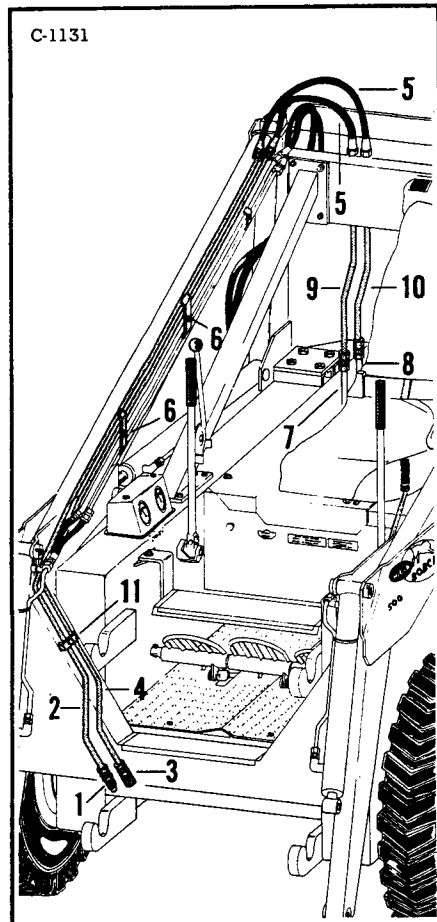


Fig. 168 Mounting Auxiliary Kit

2. With two 1/2" NPT x 1/2" 37° Flare straight adapters connect the male half of the quick coupler (Figure 167, Item 1) to the shorter tube (Item 2) and the female half of the quick coupler (Item 3) to the longer tube (Item 4) and tighten securely.
3. Remove the screw from the right side of the foot pedal guard and install the tubeline mounting bracket. Replace and tighten the screw (Item 5).
4. Mount the hydraulic valve assembly (Item 6) to the valve mounting plate using three 3/8" x 3-3/4" hex screws, spacers and self locking hex nuts.
5. Loosely bolt the valve and mounting plate to the upright brace, approximately 9" from the top, using two 3/8" x 2-1/2" hex screws and self locking hex nuts.
6. Position the tubelines against the tube mounting bracket with the shorter one on top. Arrange the tubelines so one is on either side of the retainer screw. Loosely fasten the retainer strap to the tubeline mounting bracket using a 3/8" x 1" hex screw and self locking hex nut (Item 7). **DO NOT TIGHTEN.**
7. Remove the two plugs from the auxiliary hydraulic ports at the rear of the machine (Items 8 & 9). Connect the longer tubeline (Item 4) to the front port (Item 8) and the short upright tube (Item 10) to the rear port (Item 9) using 1/2" 37° Flare straight adapters.
8. To the top port of the hydraulic valve assembly (Item 6) connect the hydraulic tubeline (Item 10) using one 1/2" NPT x 1/2" 37° Flare 90° elbow and one 3/4" to 1/2" NPT straight reducer bushing.

NOTE: The hydraulic valve assembly mounting plate may need to be moved either up or down on the upright brace until proper alignment is obtained.

9. Connect the short front tubeline (Item 2) to the bottom port of the hydraulic valve assembly. Use one 3/4" to 1/2" NPT straight reducer bushing and one 1/2" NPT x 1/2" 37° Flare 90° elbow.
10. Assemble the auxiliary hydraulic control in the following manner:

Insert the pivot bushing into the base of the lever (Figure 164, Item 1).

Install the grease fitting into the base of the lever (Item 2).

Slip the lever into the mounting bracket (Item 3) and secure with one 3/8" x 1-3/4" hex screw and self locking hex nut (Item 4).

11. From the right upright brace remove the inside front hex nut and attach the control lever. Be sure the lever angle is toward the front of the machine.
12. Insert the punched end of the control valve linkage rod (Figure 164, Item 5) into the control lever with the bend of the linkage rod toward the machine center. Fasten using a 1/4" x 1-1/8" flat head hinge pin and a 3/32" x 1-1/8" cotter pin.
13. Adjust the yoke on the linkage rod and connect it to the hydraulic valve assembly. Fasten using a 1/4" x 1-1/4" flat head hinge pin and a 3/32" x 3/4" cotter pin.
14. Slip the rubber hand grip over the control lever with the formed edge toward the front of the machine.
15. Attach the ends of a hydraulic jumper hose to the quick couplers to complete the circuit (Figure 167, Item 12).
16. With all tubes properly in place, tighten all fittings and connections. Check the port side of the hydraulic valve assembly to be sure that the unused ports are properly plumbed for an attachment. If an attachment is not connected, plug the ports to prevent dirt entry and fluid loss.

MOUNTING INSTRUCTIONS - AUXILIARY HYDRAULIC CONTROL KIT (Boom Mounted - One Unit Control - M-500 Gasoline, LP Gas, Electric & M-600 Electric)

1. Before installing an auxiliary hydraulic control kit, make sure the machine is not running and the auxiliary control pedal (center foot pedal) is in neutral position.

NOTE: Make sure all fittings are free of dust and dirt.

2. With two 1/2" NPT x 1/2" 37° Flare straight adapters connect the male half of the quick coupler (Figure 168, Item 1) to the longer tube (Item 2) and the female half of the quick coupler (Item 3) to the shorter tube (Item 4) and tighten securely.
3. Using hand pressure, slightly bend the top ends of the tilt cylinder boom lines down and toward the operator's seat, allowing sufficient room to make connections.
4. Connect the two hydraulic hoses (Item 5) to the auxiliary boom lines. Slip the auxiliary boom lines into place behind the tilt cylinder hoses and along the boom arm.
5. Remove the two lower tubeline mounting clamps. Relocate the tilt cylinder boom lines to the bottom side of the clamp mounting studs and position the auxiliary lines along the top. Loosely clamp all four tubes to the boom arm with the two large clamps (Item 6).
6. Remove the two plugs from the auxiliary hydraulic ports at the rear of the machine (Items 7 & 8). Connect the two extension tubelines to the auxiliary ports using 1/2" 37° Flare straight adapters. Connect the longer tube to the front port and the shorter tube to the rear port (Items 9 & 10).

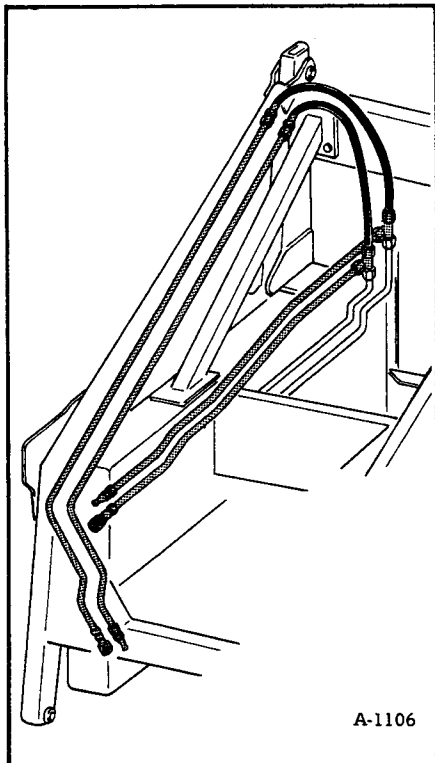


Fig. 169 Two Unit Control

7. Secure the top ends of the extension tubelines to the back of the upright using two clamps, one spacer, one 3/8" x 2-1/2" hex screw and one hex nut.
8. Connect the lower hose to the front extension tube. Connect the upper hose to the rear extension tube.
9. With the hoses secured, adjust the auxiliary tubelines for best fit and tighten the clamps (Item 6). With the tubes properly located, drill a 5/16" hole in the right side of the boom crossmember and tap with a 3/8" NC threaded tap. Using a 3/8" x 1" hex screw and tube clamp, secure the lower portion of the tubes to the boom (Item 11).
10. Snap quick coupler dust caps into place whenever the couplers are not in use.

TWO UNIT AUXILIARY CONTROL (Frame Mounted and Boom Mounted Lines)

In some applications it may be necessary to have frame mounted and boom mounted auxiliary lines on a Bobcat at the same time. This would make it possible for an operator to use either of the following without changing any auxiliary lines:

1. A frame mounted auxiliary unit.
2. A boom mounted auxiliary unit.

See Figure 169 for connection of two sets of front mounted auxiliary lines.

THREE UNIT AUXILIARY CONTROL

In some applications it may be necessary to have frame mounted, boom mounted and rear mounted auxiliary lines on a Bobcat at the same time. This would make it possible for an operator to use either of the following without changing any auxiliary lines:

1. A rear mounted and a frame mounted auxiliary unit.
2. A rear mounted and a boom mounted auxiliary unit.

See Figure 170 for a three unit auxiliary connection.

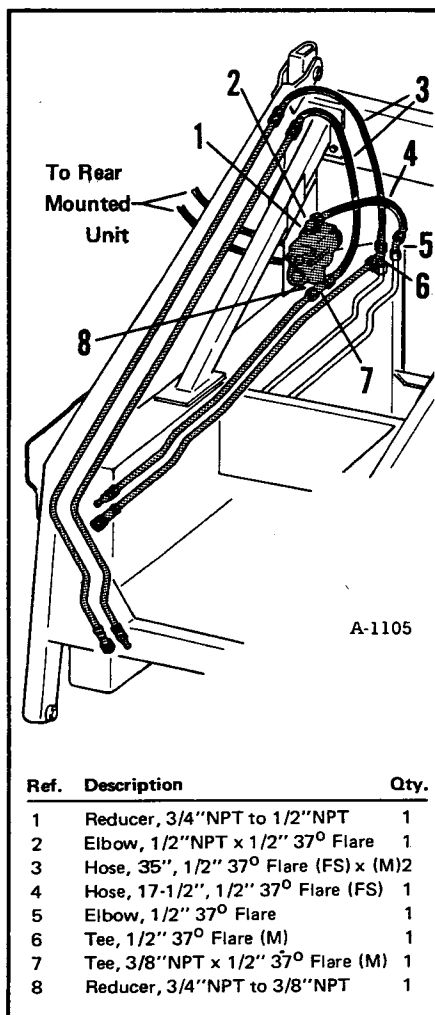


Fig. 170 Three Unit Control

Ref.	Description	Qty.
1	Reducer, 3/4" NPT to 1/2" NPT	1
2	Elbow, 1/2" NPT x 1/2" 37° Flare	1
3	Hose, 35", 1/2" 37° Flare (FS) x (M)2	1
4	Hose, 17-1/2", 1/2" 37° Flare (FS)	1
5	Elbow, 1/2" 37° Flare	1
6	Tee, 1/2" 37° Flare (M)	1
7	Tee, 3/8" NPT x 1/2" 37° Flare (M)	1
8	Reducer, 3/4" NPT to 3/8" NPT	1

TROUBLESHOOTING THE HYDRAULIC SYSTEM

PROBLEM	POSSIBLE CAUSE	POSSIBLE CORRECTION	PAGE
The hydraulic system fails to respond.	The oil level in the reservoir is low.	Check the hydraulic oil level and fill to the top check port.	
	The hydraulic pump is not driving.	Check the condition of the pump coupling.	54
		Check the pump for internal damage.	50
	The master relief valve is stuck open.	Clean the master relief valve. Readjust to 1700 \pm 25 PSI.	45
	There is foreign material in the clutch manifold relief valve, locking it open.	Remove the valve and clean it.	48
Jerky hydraulic action.	Air is trapped somewhere in the hydraulic system.	Bleed the air out of the tubelines and cylinders by extending the cylinders as far as they will go in both directions, continuing to depress the pedal for about 10 seconds each way.	
	There is a leak between the reservoir and hydraulic pump, causing air to enter the pump.	Check all fittings and clamps for tightness. Check to make sure the fittings on back of the vacuum gauge (hydraulic oil filter condition indicator) on the right instrument panel are tight.	
	There is foreign material in the clutch manifold relief valve, holding it open so that air is sucked into the hydraulic pump through the clutch pins.	Remove the valve and clean it. Bleed the air out of the cylinders.	48
	The hydraulic oil filter is blocked, causing high vacuum and cavitation.	Change the hydraulic oil filter whenever the indicator needle on the gauge nears the red zone.	
	The large nut on the end of the filter container is not tightened properly.	Tighten the large nut to only 12 ft. lbs. Do not overtighten.	
	Air is entering the hydraulic pump past the shaft seal.	Replace the seal	50
Air leak in the suction line between the hydraulic oil reservoir and the hydraulic pump. NOTE: To check for a leaking suction line, plug one of the tank breather and fill ports. Insert an air valve in the other fill port and pressurize the tank 5 to 8 PSI for 15 to 20 minutes. Applying a little soap solution to the connection points will help locate air leaks.	Loose hose clamps.	Tighten clamps securely.	
	Loose tube line connections on vacuum line (filter to gauge.)	Tighten all connections securely.	
	Hole in suction hose.	Replace hose.	
	The large nut on the end of the filter container is not tightened properly.	Tighten the large nut to only 12 ft. lbs.	

PROBLEM	POSSIBLE CAUSE	POSSIBLE CORRECTION	PAGE
Boom raises slowly at full engine RPM	Attempting to lift more than the machine's rated capacity.	Decrease the size of the loads.	
	There is an oil leak past the seals in one or both of the lift cylinders.	<p>Check the condition of the piston seals.</p> <ol style="list-style-type: none"> 1. Raise the boom and secure it with a chain hoist. 2. Remove the tube lines from the front ports of both lift cylinders. 3. After the fluid has drained from the ports, clean up the area. 4. Lower the boom slowly with the chain hoist. If fluid begins running from either open cylinder port the seals in that cylinder need replacement. 5. If fluid does not run from either open cylinder port, and the boom will not lower, there is no need for. If there is leakage past the shaft seal, replace the seal. 	
	The lift control linkage is adjusted improperly.	Adjust the control linkage so the spool centers properly in the valve in neutral position.	
	There is an oil leak past the spool inside the lift cylinder valve.	If the spool is not centered in the valve with the pedal in neutral position, adjust the linkage.	
		If the spool or valve body is cracked or scored, replace the valve.	
	The hydraulic pump is worn and not delivering its rated volume of oil.	Check the condition of the pump and repair or replace it.	50
Fluid may have been used to fill the hydraulic system of a new attachment.	Replace lost hydraulic oil.		
Boom lowers extremely slow even with bucket empty.	The restrictor at the lift control valve is blocked.	Remove and clean the restrictor.	
	The lift control linkage is adjusted improperly.	Adjust the control linkage so the spool centers properly in the valve in neutral position.	
Sticky control valve action.	The control pedals are sticking because of improper lubrication.	Relubricate, cleaning away old grease if necessary.	7
	The spool centering spring inside the valve is broken.	Replace with a new spring.	
	The control valve body is warped because of improper mounting.	Mount the valve bank with only the three outside bolts, laying shims under the valve on the bolts to mount it away from the plate.	

PROBLEM	POSSIBLE CAUSE	POSSIBLE CORRECTION	PAGE
Loss of hydraulic fluid somewhere in hydraulic system. (external)	Oil may be leaking past any of these seals or gaskets: 1. Clutch pin caps 2. Gearcase covers 3. Axles 4. Upper jackshaft 5. Lower jackshaft mounting 6. Steering lever pivots. 7. Clutch pins mounting.	Check all bolts and nuts for looseness which may be allowing leakage past the seals or gaskets. Replace lost oil	
		Check all seals and gaskets and replace any allowing oil loss. Replace lost oil.	
	Fluid may have been used to fill the hydraulic system of a new attachment.	Replace lost hydraulic oil.	
	Oil leak through a slag pinhole on a welded tank joint.	To check for leaks in the frame tanks, plug one of the tank breather and fill ports. Insert an air valve in the other fill port and pressurize the tank to 5 to 8 PSI for 15 to 20 minutes . Applying a little soap solution to the tank welds will help locate leaks. If a leak is found in the tanks, it may be possible to peen it shut with a punch if it is small. A large leak may have to be welded shut.	
	Oil is leaking past the lift or tilt cylinder shaft seals.	Replace the shaft seals and inspect the cylinder shafts for damage. Replace lost oil.	53
	Loose hydraulic connections anywhere in the hydraulic system.	Tighten the connections or replace them if they don't seal. Replace lost oil.	
	Oil is leaking through pinholes at the cylinder ports.	Remove the cylinder and weld the pinholes shut. Replace lost oil.	53
	Oil is leaking past the variable speed drive swivel seals.	Replace the seals. Replace lost oil.	
Hydraulic cylinder leaks (internal)	The case is dented, causing the piston to be worn flat and the seal to by-pass oil.	Replace the cylinder.	53
	The case is scored inside, causing oil to by-pass the piston at that point. It may be caused by abrasive foreign material entering the cylinder.	Replace the cylinder case and piston seals. The hydraulic oil filter may not have been serviced properly, causing unfiltered oil to enter the cylinders.	53
Hydraulic cylinder leaks (external) (Cont'd)	The shaft is nicked, causing oil loss along the shaft due to shaft seal failure.	Dress down the shaft nicks carefully. With a fine carborundum stone and replace the shaft seals. Replace lost oil.	53
	There is a leaking oil line or fitting.	Tighten or replace. Replace lost oil.	53

PROBLEM	POSSIBLE CAUSE	POSSIBLE CORRECTION	PAGE
Hydraulic cylinder leaks (external) (Cont'd)	There is a pinhole and oil leak at the top or bottom port.	Remove, strip and clean the cylinder. Weld the leaks shut. Reassemble. Replace lost oil.	53
	There is a leaking cylinder head.	Replace the static "O" ring. Replace lost oil.	53
	There is a hole in the cylinder case.	Remove the cylinder and weld it if possible, or replace the case. Replace lost oil.	53
	Seals are damaged.	Dress nicks from rod & change seals.	
Hydraulic control valve leaks (external)	The valve body is cracked.	Replace the valve. Replace lost oil.	
	There is a sand hole in the valve body casting.	Replace the valve. Replace lost oil.	
Hydraulic control valve leaks (internal)	The control linkage is not adjusted properly.	Adjust the linkage so the spool is centered in the valve body with the control pedal in neutral position.	
	The valve spool is scored.	Replace the valve.	
	The valve body is scored.	Replace the valve.	
Boom will not leak down, but will drop slightly when an attempt is made to raise it slowly.	The load check poppet is improperly seated.	Clean and replace any parts necessary.	
Variable speed cylinder swivel carbon seal failure.	When the variable speed is run at a continuously high variable speed position, thermal pressure buildup in the cylinder can cause carbon seal failure.	Do not run continuously at one variable speed setting.	
		Replace the variable speed control valve with one having a pressure relief valve, properly adjusted.	
The variable speed cylinder will not remain in high speed position (model equipped with variable speed control valve with thermal pressure relief.)	The plunger in the thermal relief valve (holding) portion of the control valve is too long. It will not allow the check ball to seat properly.	Place shims behind the cast spring retaining bracket. The shims should be placed over the mounting screws and should be approximately .020" thick. The relief pressure will have to be readjusted to 600 PSI.	
	Worn o-rings in the plunger.	Replace.	
Nothing happens when the variable speed control lever is placed in low speed position (on machines with a check valve)	There is a high thermal pressure buildup in the variable speed cylinder.	Let the machine cool.	
		Loosen the hydraulic hose fitting at the check valve to release some of the pressure.	
		Replace the variable speed control valve with one having a pressure relief valve.	

PROBLEM	POSSIBLE CAUSE	POSSIBLE CORRECTION	PAGE
Tilt control valve body cracking.	Casting stress, due to warping of the mounting plate.	Mount the valve bank with only the three outside bolts, laying shims under the valve on the bolts to mount it away from the plate.	
		Replace with new, heavier valve.	
	The relief valve in the lift and auxiliary valve is set at a too high pressure setting.	Lower the relief setting to 1800 $\begin{smallmatrix} +100 \\ - 0 \end{smallmatrix}$ PSI.	46
The bucket will not remain tilted back with the control in neutral position.	There is an external oil leak between the tilt control valve and the cylinders.	Check for external leaks and correct as required.	
	The spool is not centering in the valve body when the control pedal is released.	Adjust the control linkage so the spool will be properly centered with the pedal in neutral position.	
		Check for sticky spool or pedal action.	
		Check for a broken spool centering spring in the valve.	
	Oil is leaking past the piston inside either or both of the tilt cylinders.	<p>Check the condition of the piston seals as follows:</p> <ol style="list-style-type: none"> 1. Lift the front of the Bobcat with the bucket, being sure the bucket is not allowed back overcenter. 2. Place a hydraulic jack under the front of the Bobcat to take the weight of the machine off the bucket. 3. Remove the tube-lines from the bottom ports of both tilt cylinders. 4. After the fluid has drained from the ports, clean up the area. 5. Lower the Bobcat with the hydraulic jack and observe whether any additional fluid runs from either open cylinder port. 6. If oil runs from a cylinder port, the seals in that cylinder need replacement. 7. If oil does not run from either open cylinder port, there is no internal cylinder leak. 	
Oil is leaking between the valve spool and the valve body with the spool centering properly.	Replace the valve.		

PROBLEM	POSSIBLE CAUSE	POSSIBLE CORRECTION	PAGE
The boom will not remain raised with the lift control pedal in neutral position.	There is an external oil leak between the lift control valve and cylinders.	Check for external leaks and correct as required.	
	The spool is not centering in the valve body when the control pedal is released.	Adjust the control linkage so the spool will be properly centered with the pedal in neutral position.	
		Check for sticky spool or pedal action.	
		Check for a broken spool centering spring in the valve.	
	Oil is leaking between the valve spool and the valve body with the spool centering properly.	Replace the valve. Check condition of cylinder seals before replacing the valve.	
The lift cylinder seals are leaking (under a load).	Replace the seals.		
The hydraulic oil filter condition indicator (vacuum gauge) shows no reading at full engine RPM.	There is a hole in the filter element.	Replace the filter element.	
	The cork and steel gaskets have not been reinstalled on the ends of the filter element during service.	Secure new cork and steel gaskets and insert. These gaskets do not require replacement at every filter service.	
	The by-pass valve in the filter container is stuck open.	Check the by-pass valve and clean it if necessary.	
	There is a leak in the vacuum line (between the filter and gauge).	Check all connections for tightness.	
	The vacuum line (between the filter and gauge) is plugged.	Clear the line.	
	The hydraulic oil filter container has not been properly tightened.	Tighten the large nut on the end of the filter container to 12 ft. lbs. torque.	
	The condition indicator gauge is faulty.	Replace the gauge.	
Excessive hydraulic pump wear (M-600 gasoline or L.P. gas models) (all models)	There is not enough clearance between the pump drive adapter halves, causing excessive thrust on the pump drive shaft.	Adjust the adapter to secure .015 to .030 inches clearance between the adapter halves. Rotate to check for even clearance.	
	Contaminated hydraulic oil.	Drain reservoirs and replace with clean oil.	
	Pump drive misalignment.	Check. Realign if necessary.	56
Noisy hydraulic pump action. (Cont'd)	Oil supply is low (hydraulic oil)	Fill the reservoir to the upper check port.	

PROBLEM	POSSIBLE CAUSE	POSSIBLE CORRECTION	PAGE
Noisy hydraulic pump action. (Cont'd)	Oil is too heavy.	Change to a proper weight oil.	
	The oil filter is plugged.	Change the filter element.	
	The suction line (between the reservoir and pump) is plugged.	Remove and clean the suction line.	
	There is an air leak between the reservoir and pump.	Check for and correct any air leaks.	
	Worn pump coupling.	Replace coupling.	
The hydraulic oil is heating.	Oil supply is low (hydraulic oil).	Fill the reservoir to the upper check port.	
	The oil is contaminated.	Drain the reservoir and refill with clean oil.	
	The master relief valve setting is too low.	Check the pressure and set to proper relief setting (1700 \pm 25 PSI).	
	Lift & auxiliary valve body relief is too low.	Set to 1800 $\begin{matrix} +100 \\ - 0 \end{matrix}$ PSI.	
	Oil is too light.	Drain the reservoir and change to proper weight oil.	
	Worn hydraulic pump	Repair or replace the pump.	50
Hydraulic pump seal leakage.	Worn shaft seal.	Replace the shaft seal.	50
	Broken moulded "v" seal or phenolic gasket.	Replace the seal or gasket.	52
	The bearings are out of position.	Replace the bearings.	52
	There is excessive internal wear.	Replace any worn parts.	52
Foaming hydraulic oil. (Cont'd)	The oil supply is low.	Fill the reservoir to the upper check ports.	
	Air is leaking into the suction line (between the reservoir and hydraulic pump).	Check all fittings and clamps and tighten if necessary.	
		Check to be sure the fittings on back of the vacuum gauge (hydraulic oil filter condition indicator) on the right instrument panel are tight.	
		Check to be sure all connections at the hydraulic oil filter are secure.	
		Check for air leaking into the hydraulic pump past the shaft seals and replace the seals if necessary.	
		Check the clutch manifold relief valve for foreign material holding the check poppet open.	

PROBLEM	POSSIBLE CAUSE	POSSIBLE CORRECTION	PAGE
Foaming hydraulic oil. (Cont'd)	Using the wrong kind of oil	Drain the reservoir and fill to upper check port with non-foaming oil.	
Excessive hydraulic pump coupling wear.	Poor alignment between engine and pump.	Realign the pump to the engine.	54
The auxiliary or lift control pedals will not remain in an overcenter position.	The control linkage is not adjusted properly.	Adjust the linkage, being sure the spool will center properly in the valve body.	