

## HYDRAULIC SYSTEM

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**HYDRAULIC  
SYSTEM**



## HYDRAULIC SYSTEM

### 4-1 Hydraulic Circuit Operation

The loader is equipped with full-flow positive-pressure lubrication to clutches and drive system. Oil is pulled from reservoir through a filter into the pump. The pump forces it through the control valves and clutches, back to reservoir. This is with hydraulic controls in neutral (Fig. 4-1 & 4-2).

When a control is activated, oil is sent into one end of selected cylinders. Oil flows from other end of cylinders back to valve group through the clutches and into reservoir. When the valve is put in neutral, oil is stopped in cylinder, holding the load in place and the oil again moves from pump through valves and clutches and into reservoir. A release valve in the system prevents an overload in the circuit.

### 4-2 Hydraulic System (600, 610 Gasoline and LP Gas) Fig. 4-7 Hydraulic Fluid Flow

Oil is pulled from reservoir through the hydraulic oil filter (Item 1) by hydraulic pump (Item 2), pump moves fluid to control valves (Item 3, 4 & 5). The main release valve (Item 6) is a valve set to open when a control valve is activated and the cylinders hit the end of their stroke, or when lifting a load larger than the loader's capacity. When moving variable speed control lever forward, oil is moved by variable speed control valve (Item 5) to variable speed cylinder (Item 7). This moves the drive sheaves together, giving faster ground speed. Pulling lever back will slow ground speed. A check valve in the clutch lubrication manifold (Item 8) holds a pressure of 20 PSI (138 kPa) to the drive clutches.

### 4-3 HYDRAULIC SYSTEM (600 and 610 Diesel W/Deutz Engine) (Fig. 4-2 Hydraulic Flow)

Oil flows from the reservoir through the hydraulic oil filter (Item 1) by hydraulic pump (Item 2).

Pump moves fluid to control valve (Item 3, 4 & 5). The main release valve (Item 6) is a valve set to open when a control valve is activated and the cylinders hit the end of their stroke, or when lifting a load larger than the loader's capacity. When moving variable speed control lever forward, oil is moved by variable speed control valve (Item 5) to variable speed cylinder (Item 7). This moves the drive sheaves together, giving faster ground speed. Pulling lever back will slow ground speed. A check valve in the clutch lubrication manifold (Item 8) holds the pressure of 20 PSI (138 kPa) to the drive clutches.

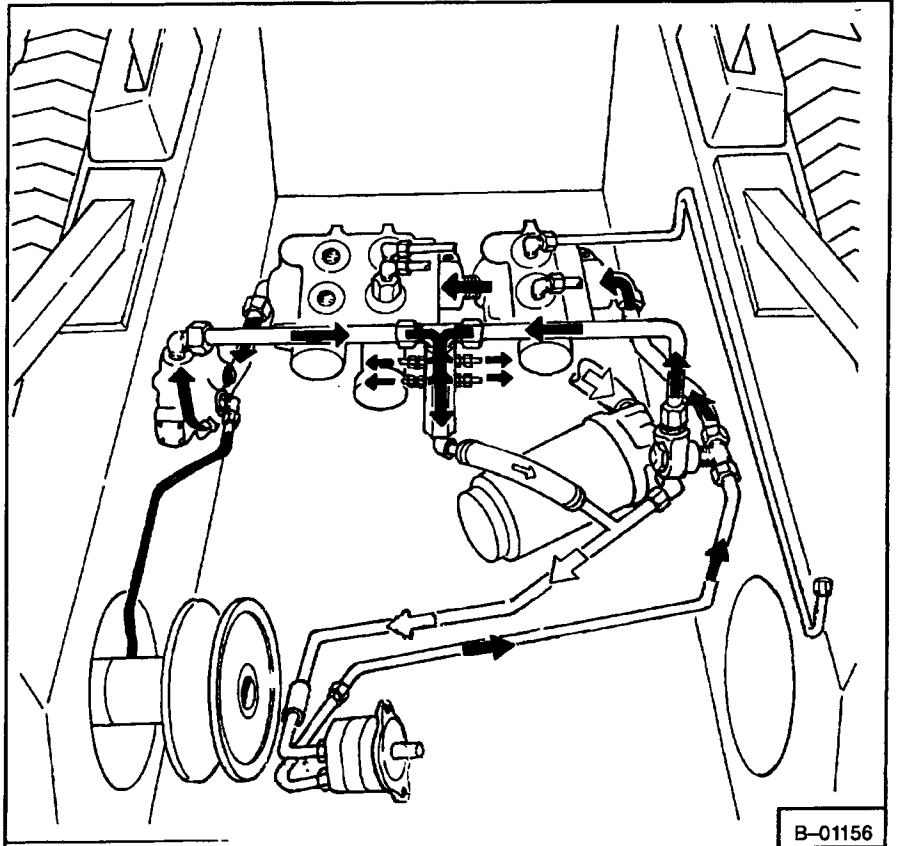


Fig. 4-1 Hydraulic System (600, 610 Loaders)

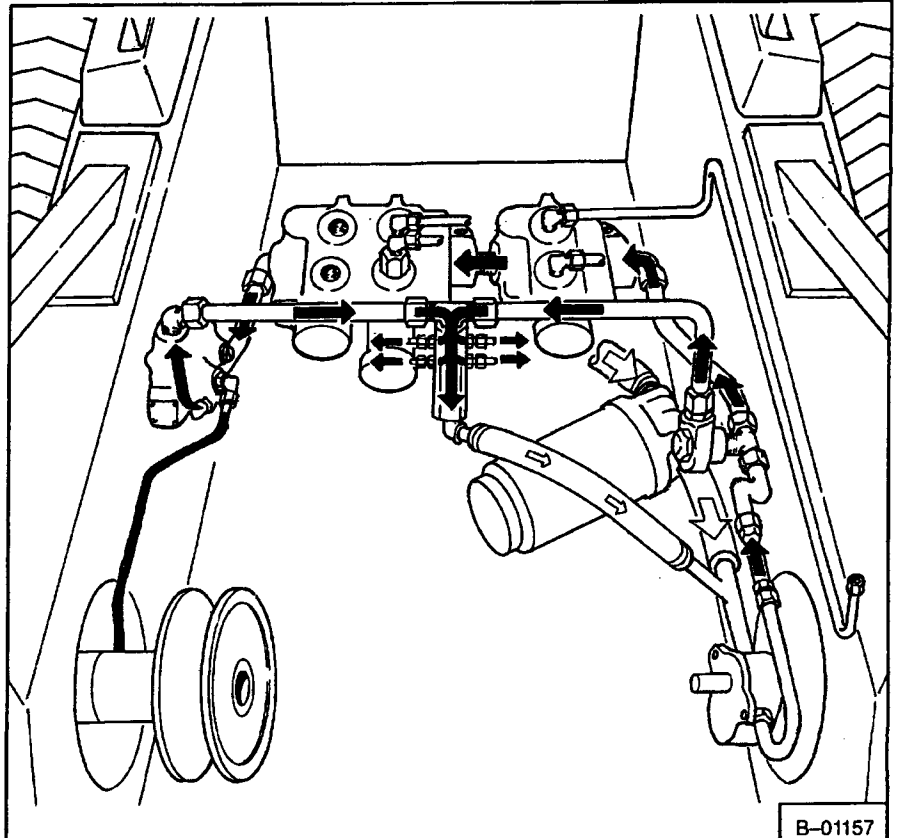


Fig. 4-2 Hydraulic System (600, 610 Deutz)

#### 4-4 HYDRAULIC SYSTEM (600 Electric and 600 Diesel W/Petter Engine) ( Fig. 4-3 Hydraulic Flow)

Oil is pulled from the reservoir, through the hydraulic oil filter by hydraulic pump. Pump moves fluid to control valve. The main release valve is a valve set to open when a control valve is activated and the cylinders hit the end of their stroke, or when lifting a load larger than the loader's capacity. When moving variable speed control lever forward, oil is moved by variable speed control valve to variable speed cylinder. This moves the drive sheaves together, giving faster ground speed. Pulling lever back will slow ground speed. A check valve in the clutch lubrication manifold holds a pressure of 20 PSI (138 kPa) to the drive clutches.

### **WARNING**

Lift all four wheels of the loader off the floor. Put blocks under the frame to support it before starting check.

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#### 4-4a RESTRICTOR FOR TILT HYDRAULIC CIRCUIT (Grapple Operation Only)

This restrictor is installed to slow the flow of hydraulic oil through the tilt cylinders when tilting the Bob-Tach forward. Install as shown in (Fig. 4-4a).

#### 4-5 CHECKING THE CONDITION OF HYDRAULIC SYSTEM

The hydraulic tester must be used to check pump output, release setting, cylinder seals and control valve condition.

1. Connect tester to the auxiliary hydraulic tubelines at rear of loader (Fig. 4-4).
  - a. Connect a hose from rear auxiliary tubelines to outlet opening of tester (Item 1).
  - b. Connect a hose from front tubeline to inlet opening of tester (Item 2).
2. Start the engine.
3. Operate at full throttle.
4. Hold down front of auxiliary control pedal (Item 3).
5. Turn pressure control valve on tester at a slow rate.
6. Check flow reading on tester.
7. Flow reading must be even until master relief valve opens. When valve opens, flow rate will drop suddenly.

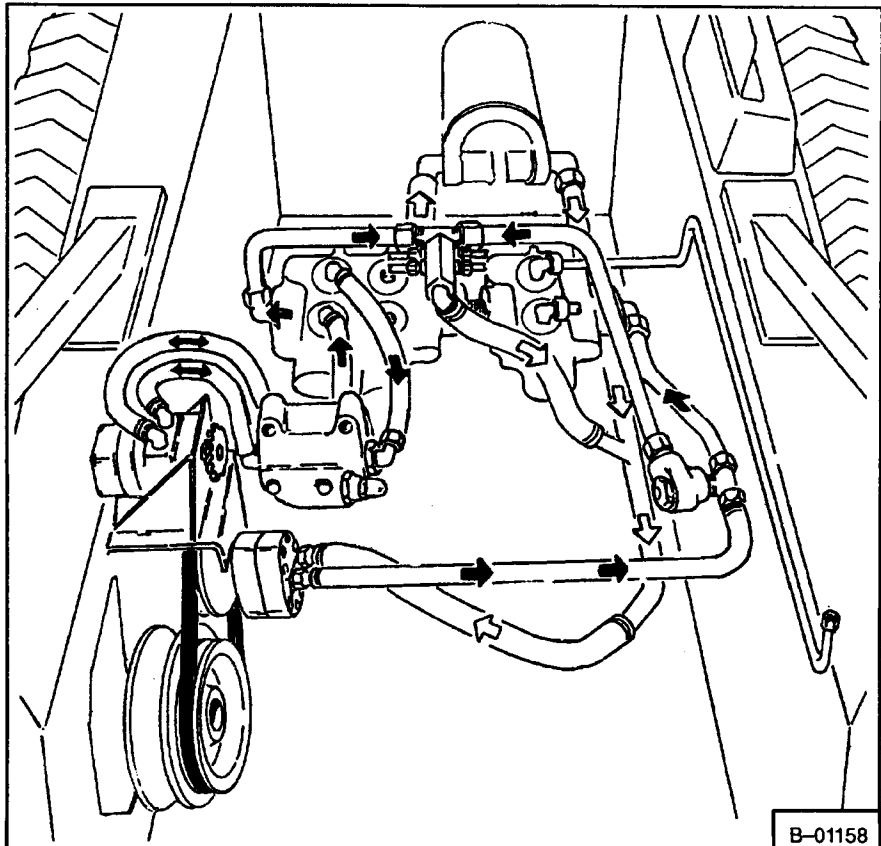


Fig. 4-3 Hydraulic System (600 Petter)

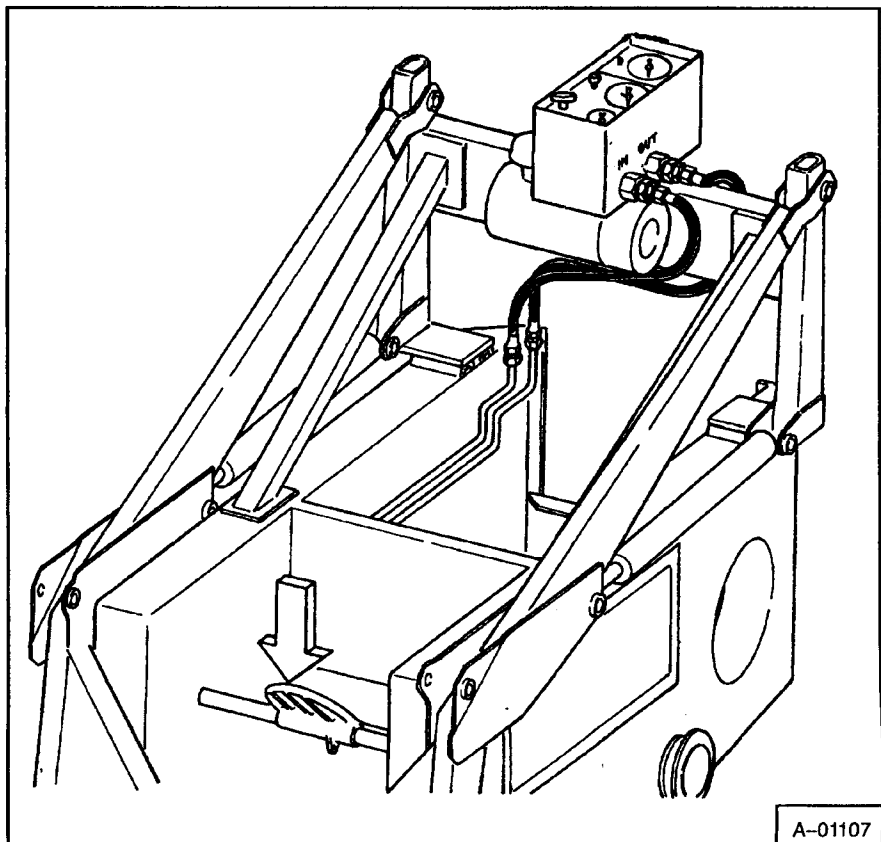


Fig. 4-4 Testing Hydraulic System

- See chart below for volume of oil a new pump will move until master relief valve opens.

### RECOMMENDED HYDRAULIC OIL FLOW RATE

600 (Gasoline or LP Gas)	10 gal/min (38L)
610	11 gal/min (42L)
600 (Diesel)	
Deutz	10 to 11 gal/min (42L)
Petter	10 gal/min (38L) at 300 RPM
600 (Electric)	8 gal/min (30L) at 1750 RPM

- An old pump will show a lower reading.
- Close pressure control valve. Pressure should be between 1700–1750 PSI (11720–12066 kPa).

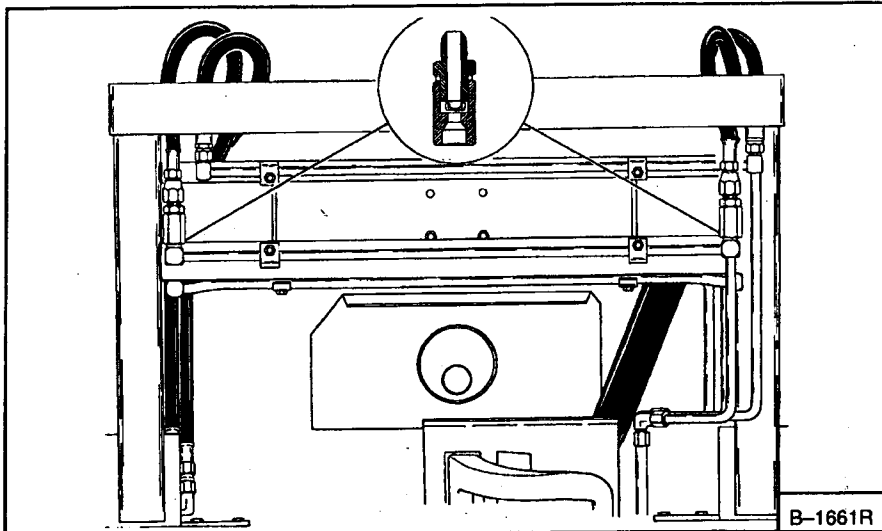


Fig. 4-4a Restrictor

### 4-6 CHECKING CONDITION OF HYDRAULIC PUMP (Fig. 4-5)

- Remove the hoses from the auxiliary tubeline.
- Connect hoses to tilt cylinder tubelines at the rear of loader.
  - Connect hoses from inlet opening of tester to rear tilt tubeline (Item 1).
  - Connect hose from outlet opening of tester to front tilt tubeline (Item 2).
- Place a stop (5/16 by 1" [7,9 mm by 25,4 mm] long carriage bolt) between clutch lubrication manifold tee and master release valve tubeline fitting (Item 3).
- Open pressure control.
- Start the engine and run at low idle.
- Hold back of tilt control pedal down (Item 4).
- Slowly turn the pressure control on tester clockwise to increase the system pressure.

## IMPORTANT

When this method is used there is no relief valve in the system. Closing the pressure control rapidly will cause over maximum pump pressure and can damage the pump or tester. Do not increase the pressure over 2000 PSI (13790 kPa).

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- When reading of pump pressure is above 1850 PSI (17755 kPa) pump is good. Refer to flow chart above.

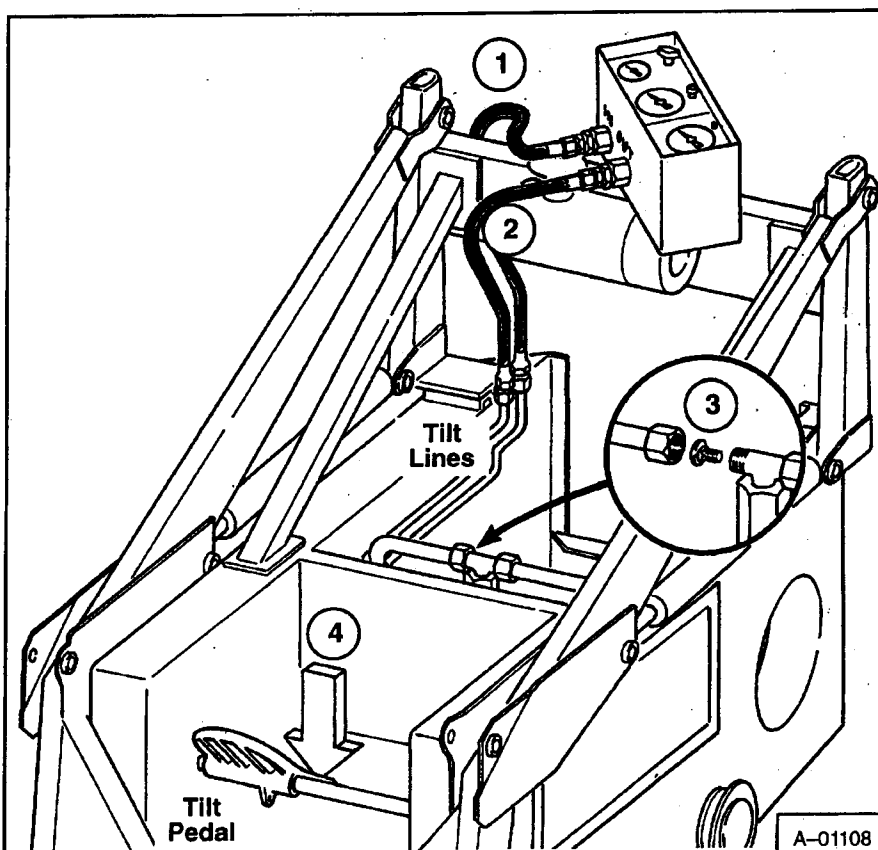
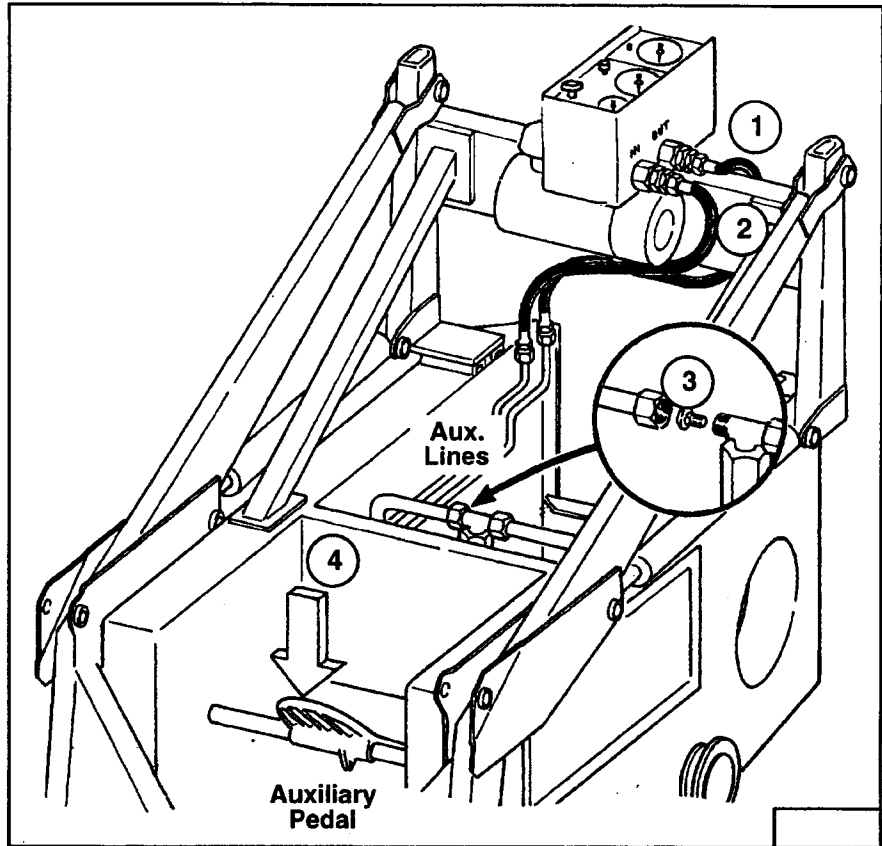


Fig. 4-5 Testing Hydraulic System

**4-7 CHECKING THE PRESSURE SETTING OF THE CARTRIDGE RELEASE (In Lift and Auxiliary Control Valve)**

1. Connect tester to auxiliary tubelines at rear of loader (Fig. 4-6).
  - a. Connect a hose from the rear auxiliary line to outlet opening of tester (Item 1).
  - b. Connect a hose from front auxiliary line to inlet opening of tester (Item 2).
2. Leave the stop (5/16 x 1" [7,9 mm x 25,4 mm] long carriage bolt) between the clutch lubrication manifold tee and master release valve tubeline (Item 3).
3. Open pressure control on tester.
4. Start the engine and run at 1/4 throttle.
5. Hold front of auxiliary control pedal down (Item 4).
6. Turn the pressure control on the tester until cartridge release valve opens. the pressure setting of this cartridge release should be 1800+100 or -100 PSI (12411±690 kPa).



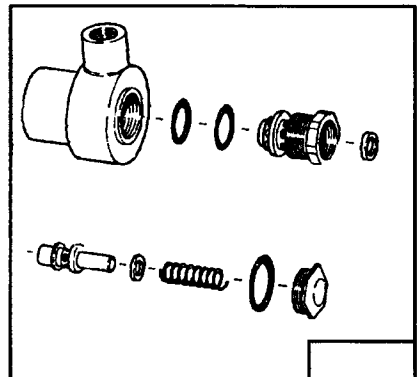
**Fig. 4-6** Checking Lift and Auxiliary Release Pressure

**WARNING**

Do not forget to remove the stop (carriage bolt) from between the clutch lubrication manifold tee and the master release valve tubeline.

**4-8 MASTER RELEASE VALVE ADJUSTMENT**

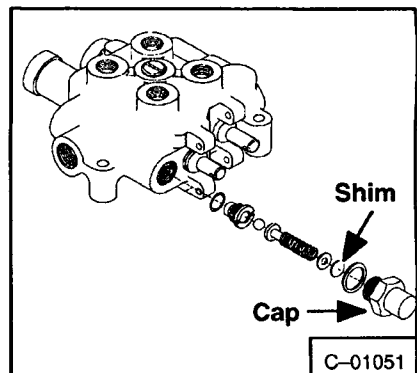
1. Remove hex cap from valve body (Fig. 4-7).
2. Remove spring and shim from behind it (Fig. 4-7).
3. Adding a shim will increase system pressure and installing a thin shim for thick shim will decrease pressure. Adding a .010 (2,5 mm) inch thick shim will increase pressure approximately 100 PSI (690 kPa).
4. Install cap and check pressure. Make further adjustments when needed.



**Fig. 4-7** Release Valve Adjustment

**4-9 CARTRIDGE RELEASE ADJUSTMENT**

1. Remove hex cap from front of valve (Fig. 4-8).
2. Remove shim from behind it.
3. Adding a shim will increase pressure. Installing a thin shim for a thick shim will decrease pressure.
4. Install cap and check pressure. Make further adjustments when needed.



**Fig. 4-8** Remove Hex Cap

## **! WARNING**

Variable speed closing pressure must not be over maximum on variable speed internal roto-swivel (See below). It must never be above the pressure necessary to shift from full low speed to full high speed position in four seconds at full engine RPM.

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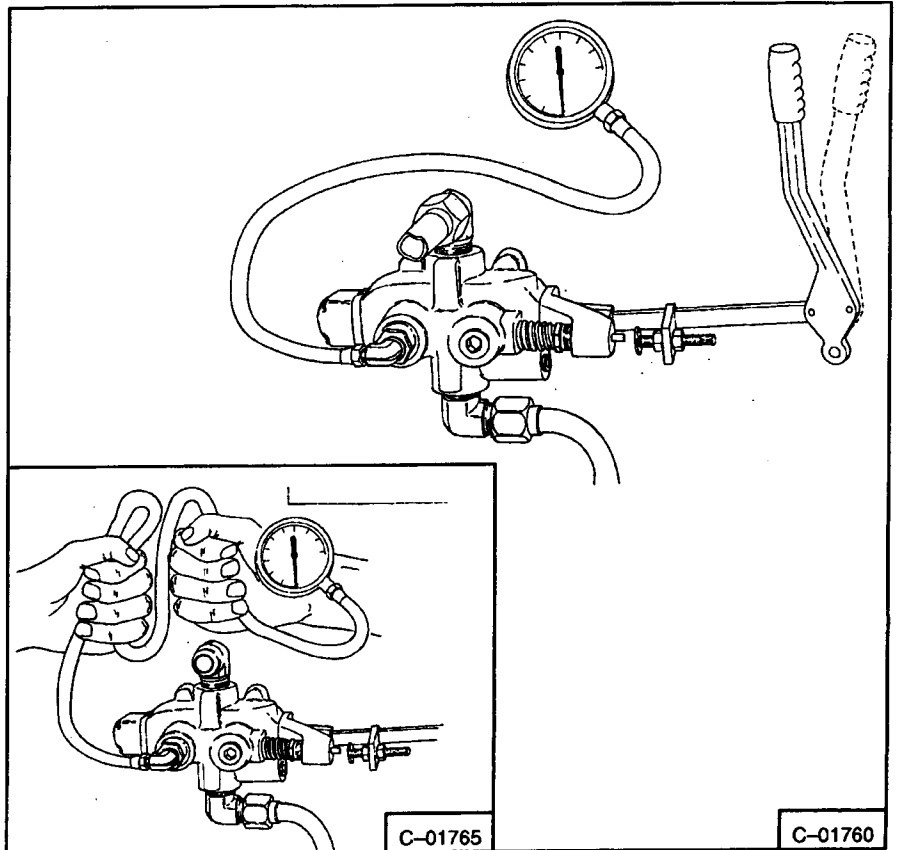
### **4-10 CHECKING VARIABLE SPEED VALVE PRESSURE ADJUSTMENT (Variable Speed Swivel Couplings)**

When making adjustment and checking variable speed closing and holding pressure, it is important first to note which type of swivel coupling is used. The internal roto-swivel type needs a higher closing and holding pressure to operate properly. (See warning note above.)

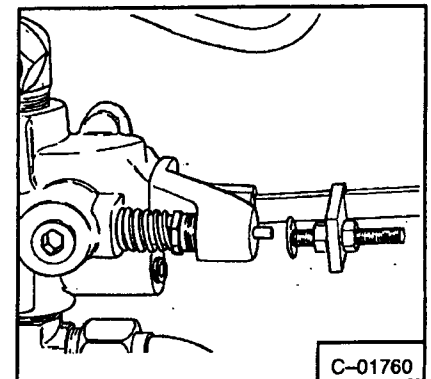
### **4-11 Variable Speed Control Valve With Holding Pressure Release Valve**

The variable speed sheave must close in the drive sheave in four seconds at full engine RPM. When belt comes up faster than four seconds, decrease closing pressure. When belt comes up slower than four seconds, increase the closing pressure. This adjustment is made by turning pressure release valve adjustment in or out (Fig. 4-12). When making this adjustment, do not go over 550 PSI (3792 kPa) pressure. Inspect tension on holding release spring. Plunger must not move in valve body when belt is in high variable speed position with full engine RPM (Fig. 4-10).

1. Install a 1000 PSI (7000 kPa) pressure gauge into the rear opening of variable speed control valve (Fig. 4-9).
2. Start the engine and run at full throttle.
3. Move the variable speed control lever forward to high speed position (Fig. 4-9). Hold it there.
4. The indicator on the gauge should show closing pressure of 350-550 PSI (2400-3800 kPa)
5. Return the lever to neutral.
6. Check holding release valve pressure.
7. Twist the hose to increase pressure to holding release valve. Check pressure increase for maximum reading.
8. The reading should be 750-775 PSI (5170-5340 kPa).



**Fig. 4-9** Adjust Variable Speed Valve



**Fig. 4-10** Variable Speed Valve Spring

#### 4-12 CHECKING PRESSURE ADJUSTMENT (Variable Speed Control Valve with no Holding Pressure Valve ) (Fig. 4-11)

Using this type valve, oil is moved into variable speed cylinder at a variable speed closing pressure of 375-400 PSI (2585-2758 kPa) or 475-500 PSI (3275-3447 kPa) on variable speed with rotor-swivel inside. Check the variable speed closing pressure using same method as when checking the variable speed valve with holding pressure release (Steps 1 through 5).

#### 4-13 VARIABLE SPEED CLOSING PRESSURE ADJUSTMENT (Variable Speed Control Valve with or with no Holding Release Valve) (Fig. 4-12)

1. To increase the closing pressure, turn the set screw plug into the valve a little at a time (Item 1).
2. Turn the plug into maximum pressure of 400 PSI on loaders with variable speed sheave with outside roto-swivel (2758 kPa) turn plug into maximum pressure of 475-500 PSI (3275-3447 kPa) on variable sheave with roto swivel inside.
3. If plug becomes overtight while increasing the pressure, a shim can be added between the set screw plug and spring (Fig. 4-13).
4. To lower the closing pressure, loosen the set screw plug until the pressure is 400 PSI (2758 kPa) or 475-500 PSI (3275-3447 kPa) on variable sheave with roto-swivel inside.
5. If the plug becomes loose, causing an oil leak, shorten the spring by grinding off the end of it. Do not overheat the spring when grinding.

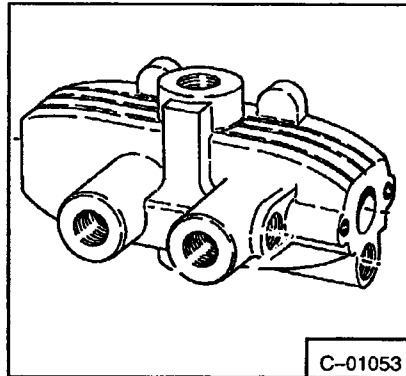


Fig. 4-11 Variable Speed Valve

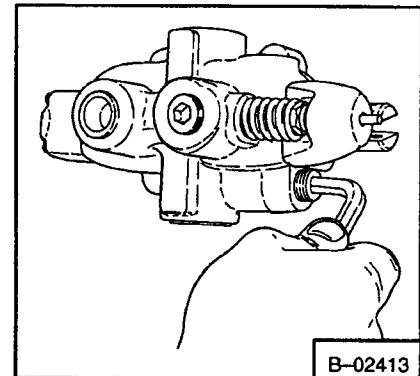


Fig. 4-12 Adjust Closing Pressure

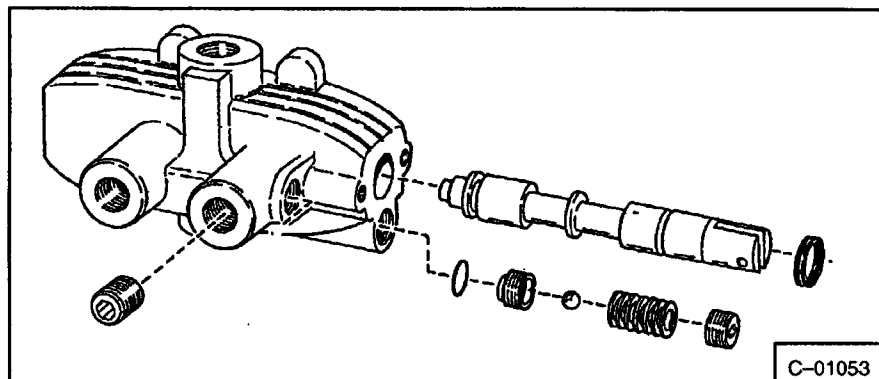


Fig. 4-13 Add Shims To Jet Screw Plug

#### 4-14 VARIABLE SPEED HOLDING RELEASE PRESSURE SETTING (Fig. 4-12) (600 PSI [4137 kPa] Minimum)

1. To increase pressure setting, turn hexagon nut in spring holding bracket so it moves toward spring. Turn nut 1/4 rotation then check pressure setting.
2. If nut runs out of threads, put a washer between nut and spring.
3. To decrease pressure setting, turn hexagon nut so that it moves away from spring.

**NOTE:** A loader used under heavy loads, may require more than 600 PSI (4137 kPa) holding pressure to prevent variable speed leak down and O-ring damage in holding pressure nut. On loaders equipped with variable speed, having roto-swivel inside, holding pressure should be 700 PSI (4826 kPa).



#### 4-15 DISASSEMBLY OF VARIABLE SPEED CONTROL VALVE (Seal Replacement with Control Valve in the Bobcat)

1. Remove seat and seat plate (Fig. 4-14).
2. Remove variable speed control lever linkage rod.
3. Remove temperature release valve bracket (Fig. 4-15, Item 1).
4. Remove push rod guide and push rod (Fig. 4-15, Item 2).
5. Use magnet to remove ball and spring (Fig. 4-15, Item 3).

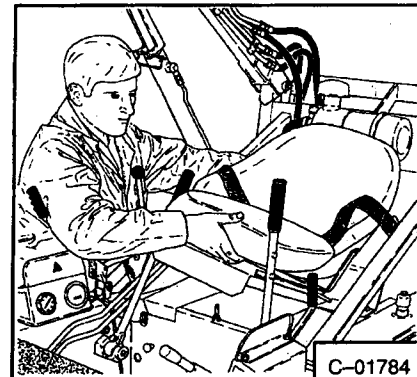


Fig. 4-16 Remove Seat and Plate

6. Remove end cap and spring (Fig. 4-15, Item 4).
7. Install seal on dust cap end of spool (Fig. 4-15, Item 5).
8. Move spool back to install new back seal (Fig. 4-18).
9. Move spool forward to install new seal on clevis end of spool (Fig. 4-17).

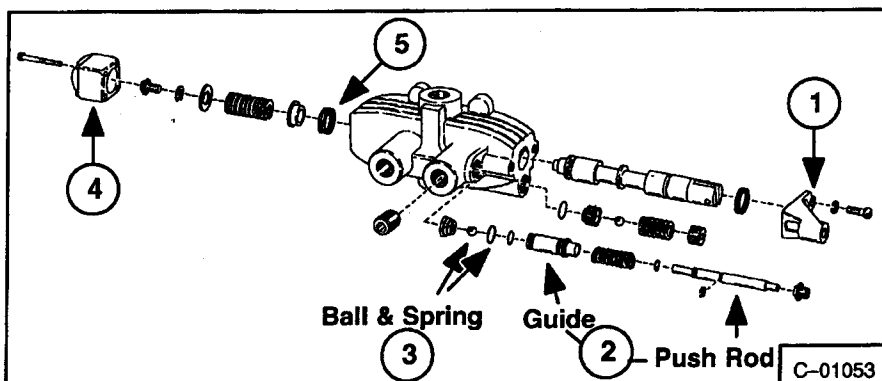


Fig. 4-15 Variable Speed Valve Parts

**NOTE: Do not push spool beyond its limits as this can cause seal to go into groove of valve and result in damage to seal.**

10. Move spool back into normal position.

#### 4-16 ASSEMBLY OF VARIABLE SPEED CONTROL VALVE, SEAL REPLACEMENT WITH CONTROL VALVE IN THE BOBCAT (With Holding Release Valve) (Fig. 4-15)

1. Install spring assembly and end cap (Item 4)
2. Install new seals on push rod and push rod guide (Item 2)
3. Place ball on small round end of spring (Item 3). (Use grease to hold spring and ball to end of rod guide.)
4. Install push rod and rod guide (Item 2).
5. Install push rod bracket (Item 1).
6. Connect variable speed control linkage.
7. Make pressure adjustments. (See Paragraph 4-13 and 4-14).

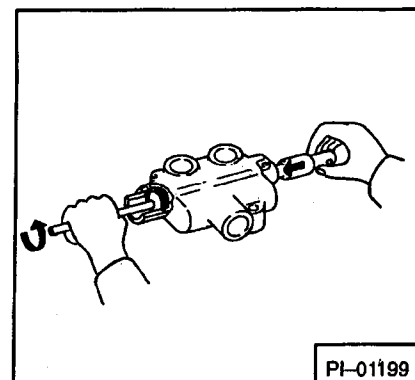


Fig. 4-16 Install Back Seal

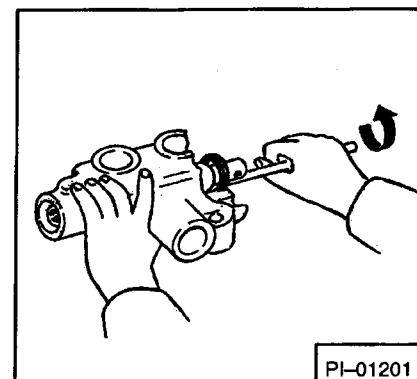
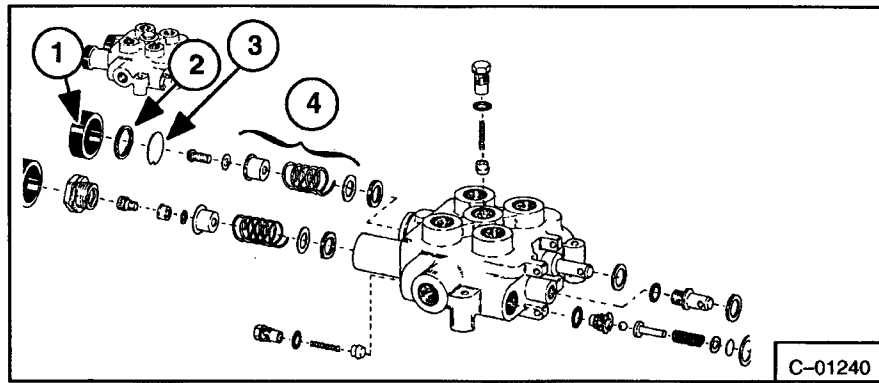


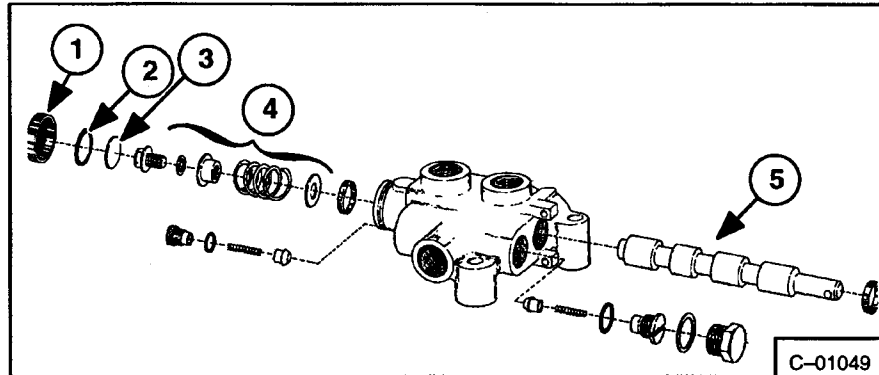
Fig. 4-17 Install Front Seal

**4-17 CONTROL VALVE SEAL INSTALLATION (Fig. 4-18, 4-19) (For Tilt, Lift Valve and Auxiliary Cylinder Control Valve)**

1. Remove rubber cap from back of valve (Item 1).
2. Remove large snap ring and stop disc (Item 2 & 3).
3. Remove spring assembly bolt. Centering spring lock washer, stop collar, spring and stop washer (Item 4).
4. Push spool into housing from front of valve until front seal is out, then remove front seal (Fig. 4-20).
5. Pull spool out of housing from front of valve and remove back seal (Fig. 4-21).
6. Clean both seal grooves.
7. Install spool, through front of housing with spring fastening end of spool first (Fig. 4-19, Item 5).
8. Push spool into valve until end of spool is at back seal groove.



**Fig. 4-18** Lift and Auxiliary Valve Parts

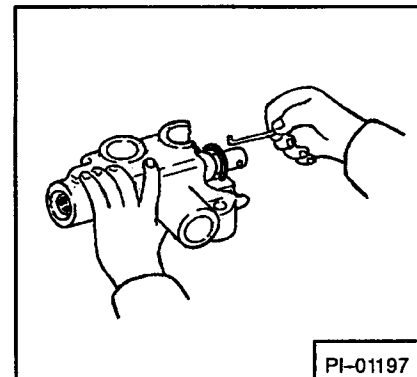


**Fig. 4-19** Tilt Valve Parts

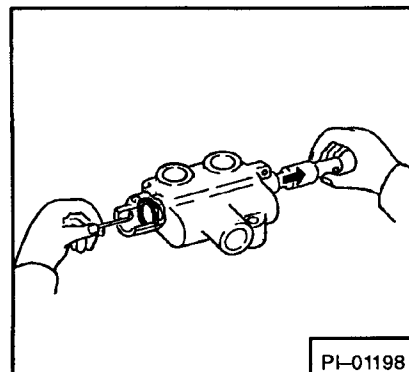
9. Install a new seal in back groove. Place U cup of seal toward valve body (Fig. 4-22).
10. Inspect seal for smooth fit.
11. Push spool into housing from front until front groove can be seen.

**NOTE: Do not push spool back more than necessary or back seal will be damaged.**

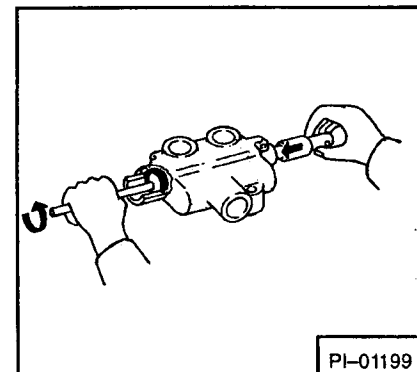
12. Install a new front seal, keep the U cup side of the seal toward valve body (Fig. 4-23).
13. Inspect seal for smooth fit.
14. Push spool through the housing until 1/4 inch of spool surface is shown at front of valve.
15. Install spring assembly bolt, spring, lock washer, stop collar, spring and lock washer (Fig. 4-18, 4-19).
16. Tighten assembly bolt.
17. Install stop disc and snap ring (Fig. 4-18, 4-19, Item 2 & 3).
18. Install rubber cap (Fig. 4-18, 4-19, Item 1).



**Fig. 4-20** Removing Front Seal



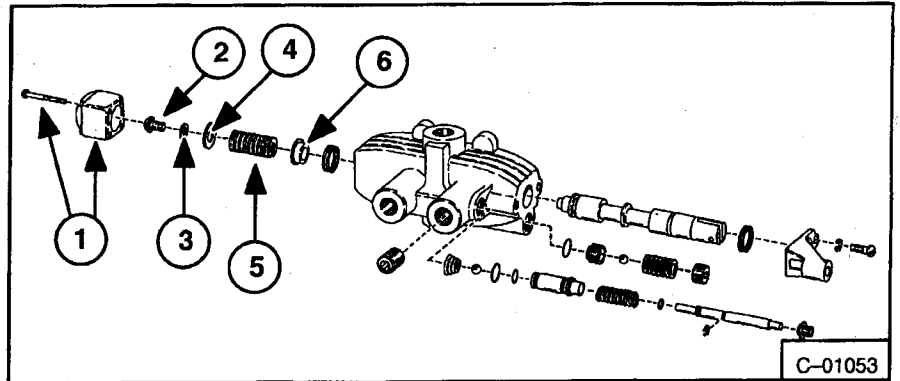
**Fig. 4-21** Removing Spool



**Fig. 4-17** Install Back Seal

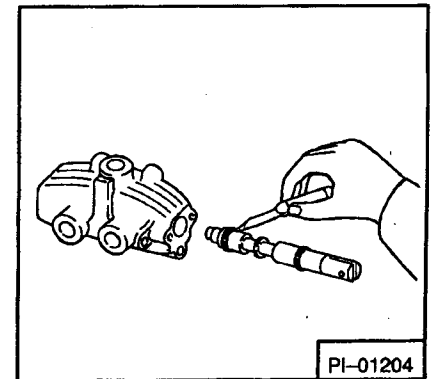
**4-18 INSTALLING VALVE SPOOL SEALS IN THE VARIABLE SPEED CONTROL VALVE**

1. Remove four bolts from valve spring cap (Fig. 4-23, Item 1).
2. Remove screw, lock washer, flat washer, spring and stop collar from end of spool (Fig. 4-23, Items 2, 3, 4, 5 & 6).

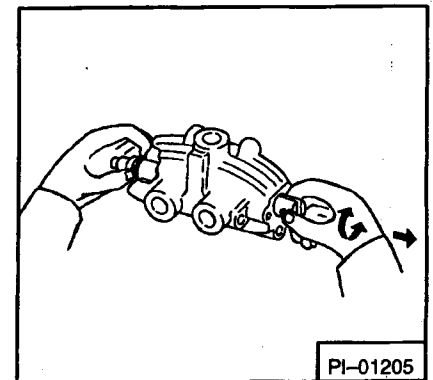


**Fig. 4-23** Variable Speed Valve Parts

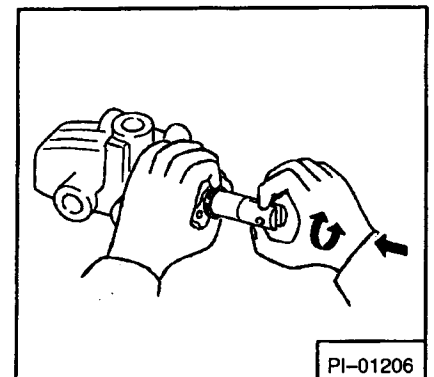
3. Pull valve spool out of housing (Fig. 4-24).
4. Check position of U cup of seals for correct installation of new seals.
5. Remove worn seal (Fig. 4-24).
6. Install spool in housing with no seals. Push spool into housing until seal groove can be seen at cap end of valve.
7. Install a new seal into back groove (Fig. 4-25).
8. Push seal into housing and pull spool into valve housing (Fig. 4-25).
9. Pull valve spool toward control end of valve until front seal groove is visual.
10. Install a new front seal (Fig. 4-26).
11. Push seal into housing and spool into place (Fig 4-26).
12. Install collar, spring, washers and screw. Tighten screw (Fig. 4-23, Items 2, 3, 4, 5 & 6).
13. Check that washer moves free on spool.
14. Install cap and four bolts (Fig. 4-23, Item 1).
15. Check cap for proper alignment. It must be correctly centered over end of spool.



**Fig. 4-24** Remove Valve Spool



**Fig. 4-25** Install Seal On Valve Spool



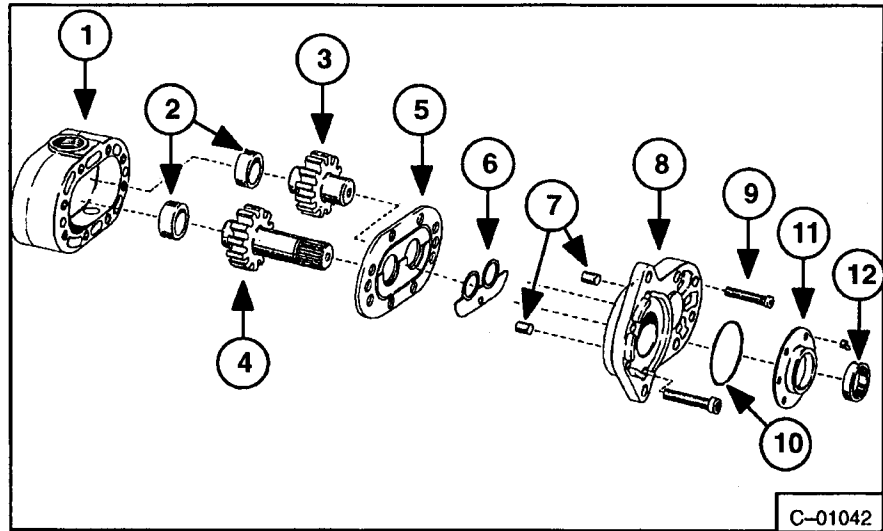
**Fig. 4-26** Install Front Seal

#### 4-19 HYDRAULIC PUMP SERVICE (Webster Pump)

For seal replacement in hydraulic pump, follow the below procedure (Fig. 4-27).

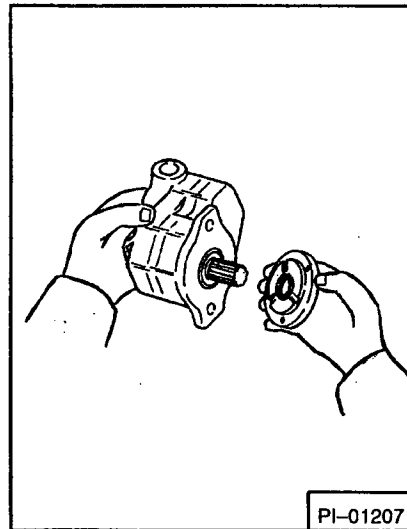
#### 4-20 DISASSEMBLY

1. Clean outside of pump.
2. Make mark on edges of cover so it can be installed again in same position.
3. Remove the pilot plate and seal (Fig. 4-28).

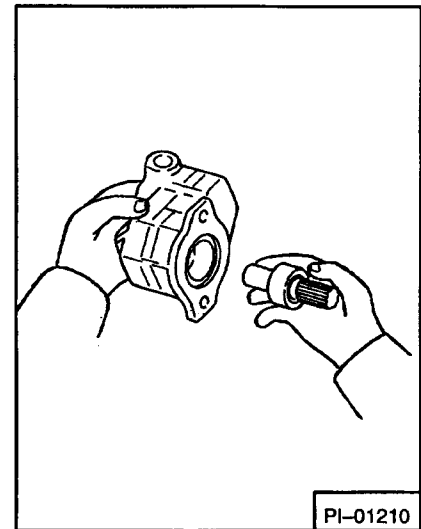


**Fig. 4-27** Hydraulic Pump Breakdown (Webster)

4. Pull the pump drive shaft out of pump (Fig. 4-29). The ball bearing will come with it.
5. Remove all bolts from pump body (Fig. 4-30).

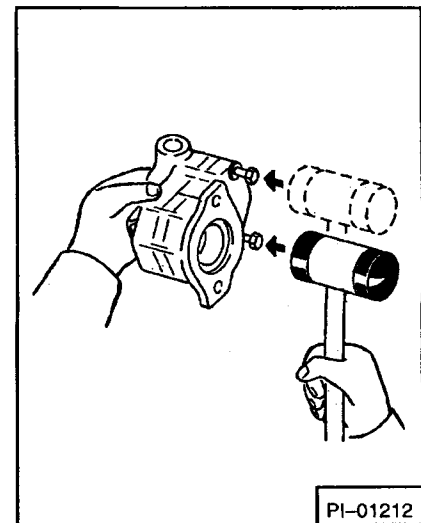


**Fig. 4-28** Remove Pilot Plate and Seal



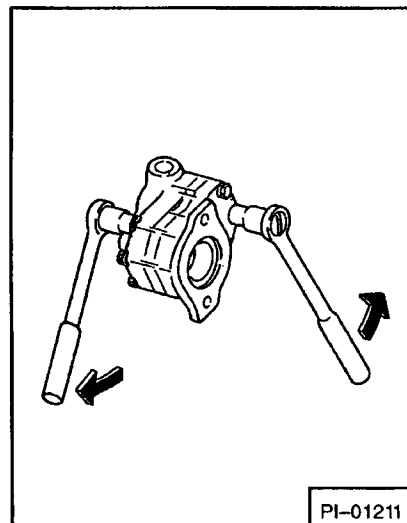
**Fig. 4-29** Remove Drive Shaft

6. Install two bolts into shaft side and turn them in several turns by hand. Hit sharply on heads of two screws, first one, then the other, then first one again (Fig. 4-31). When the dowels are loose, remove the screws and separate the plates.



**Fig. 4-31** Separating Pump Plates

7. Inspect the gears, shafts and bearings.



**Fig. 4-30** Remove Body Bolts

8. When needle bearings are bad remove and install new needle bearings (Fig. 4-32).

9. When cover and body plates are worn, grind them smooth.

10. Install new gears after grinding cover and body.

#### 4-21 ASSEMBLY OF HYDRAULIC PUMP (Webster Pump)

1. Wash off pump parts and dry with air.
2. Install ball bearings to pump drive shaft.
3. Install drive shaft into the body (Fig. 4-29).
4. Make seal replacement in pilot plate (Fig. 4-33).
5. Set pump body with machined face up (Fig. 4-34).
6. Install key in drive shaft and lower drive gear over it (Fig. 4-34).
7. Install idler gear and shaft assembly (Fig. 4-35).
8. Install gear plate over gears and put scratch marks in a line.
9. Install dowel pins through large holes in gear plate (Fig. 4-36).
10. Install cover plate over shaft. Install and tighten the cover bolts, then turn pump over and install and tighten body bolts (Fig. 4-37).
11. Install pilot plate and fasten with machine screws.

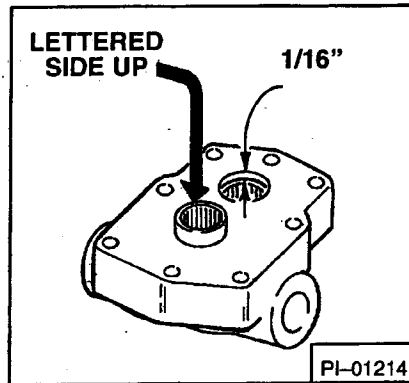


Fig. 4-32 Install New Bearings

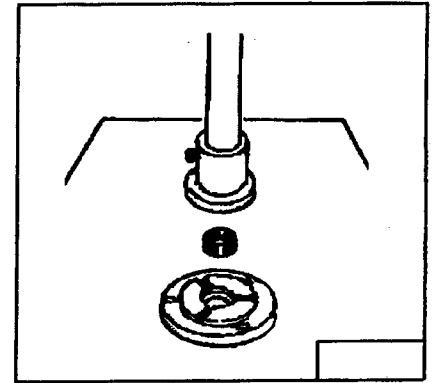


Fig. 4-33 Replace Seal In Pilot Plate

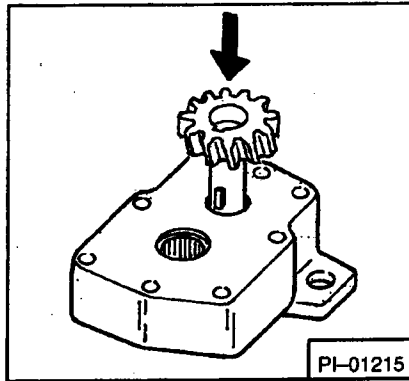


Fig. 4-34 Machined Faced Of Pump

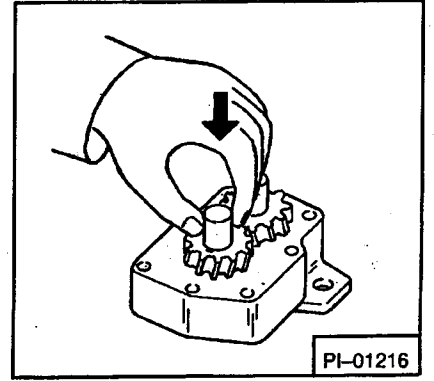


Fig. 4-35 Install Idler Gears

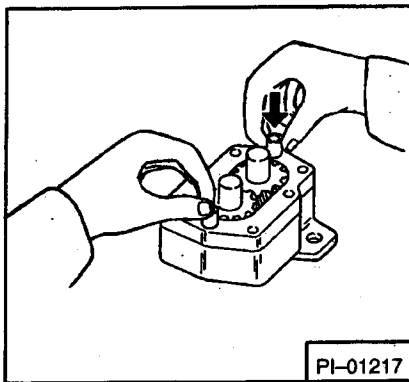


Fig. 4-36 Install Dowel Pins

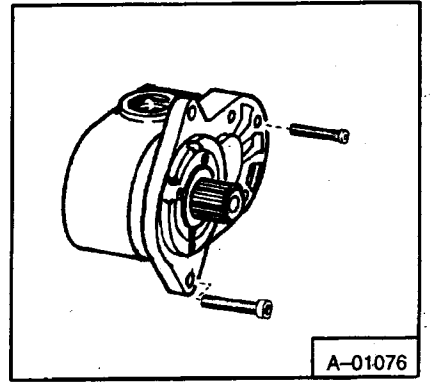


Fig. 4-37 Install Body Bolts

#### 4-22 HYDRAULIC PUMP DISASSEMBLY (Cessna Pump)

1. Remove key from pump drive shaft (Fig. 4-38).
2. Clean outside of pump. Put marks in a line across edges of cover, gear plate and body (Fig. 4-39).
3. Hold pump in a vise shaft down. Remove bolt which holds the pump plates together (Fig. 4-41).
4. Remove pump from vise. Separate pump plates by hitting shaft onto a wooden block (Fig. 4-40).

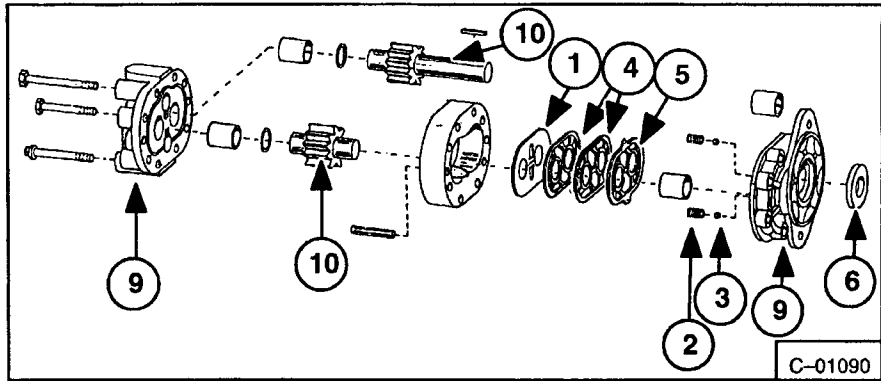


Fig. 4-38 Hydraulic Pump Breakdown (Cessna)

5. Remove these items (Fig. 4-38) from front plate of pump.
  - a. Diaphragm (Item 1)
  - b. Springs (2)\* Steel Balls (2) (Item 2 & 3)
  - c. Gaskets (2) (Item 4)
  - d. Molded V Seal (Item 5)
  - e. Shaft Seal (Item 6)
6. Clean and dry all pump parts.
7. Inspect pump drive shaft for a broken key way. Inspect pump drive shaft and idler gear shaft at bearing points and seal areas. When shaft diameter measures less than .6850 inch (17,5 mm) is in the bearing area, make replacement.
8. Inspect the gear faces for wear. Check with following chart: If gear width is below these figures, replace the gears.
  - a. Pump Model B24387-OBAA .636 inch (16,3 mm)
  - b. Pump Model 15509-OEBA .636 inch (16,3 mm)
  - c. Pump Model 15510-OEBA .767 inch (19,6 mm)
9. Inspect the back plate for wear. When worn more than .0015 inch (.038 mm) install new plate.
10. Check inside diameter of bearings in place. When inside diameter is worn more than .691 inch (17,5 mm) install new plates.
11. Inspect chambers in gear plates for wear. When chamber is worn, more than 1.719 inches (43,6 mm) install new gear plate.

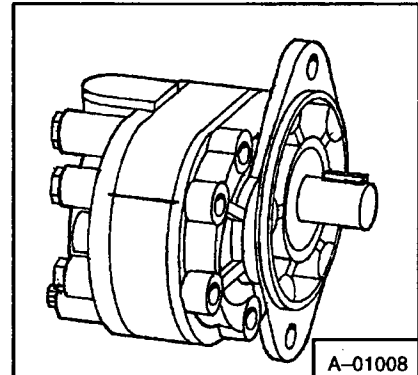


Fig. 4-39 Marking Pump Sections

#### 4-23 HYDRAULIC PUMP ASSEMBLY (Cessna Pump)

1. When assembling install new parts as follows: (Fig. 3-28).
  - a. Diaphragm (Item 1)
  - b. Gaskets (2) (Item 4)
  - c. V Seat (Item 5)
  - d. Shaft Seal (Item 6)
2. Install V seal into groove in front plate. Install seal with open part of V toward plate (Item 5).
3. Put gasket into V seal (Item 4).
4. Drop steel balls into seat and place springs over balls (Item 2 & 3).
5. Place diaphragm over gasket, bronze face up (Item 1).
6. Make sure diaphragm fits inside raised edge of V seal.
7. Put oil on gears and slide them into front plate bearings.
8. Put grease on both faces of gear plates and install plates over gears (Item 9 & 10).

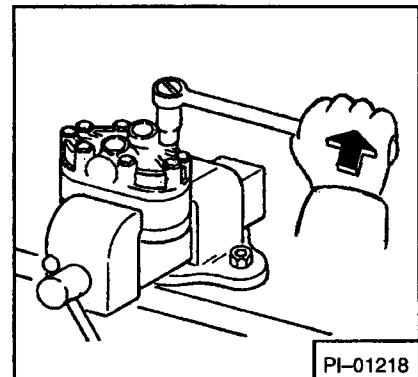


Fig. 4-40 Holding Pump In Vise

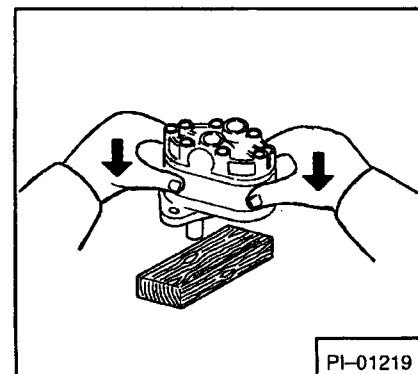


Fig. 4-41 Separating Pump Parts

9. Check marks on side of plates when installing, to be sure they are in alignment (Fig. 4-39).
10. Slide backplate over gear shaft until dowel pins are engaged.
11. Install bolts and tighten them evenly to 25 ft.-lbs. (34 Nm) (Fig. 4-40).
12. Install pump drive shaft seal over shaft being careful not to cut rubber sealing edge.
13. Seat seal with a plastic hammer.

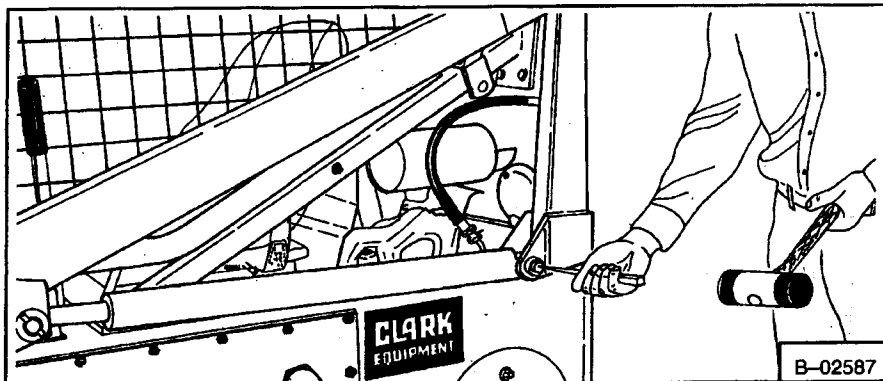


Fig. 4-42 Remove Lift Cylinder

#### 4-24 HYDRAULIC LIFT OR TILT CYLINDER DISASSEMBLY

1. Remove hydraulic cylinder from loader (Fig. 4-42).
2. With spanner wrench, remove head from cylinder (Fig. 4-43).
3. Pull shaft and piston assembly from cylinder housing (Fig. 4-44).

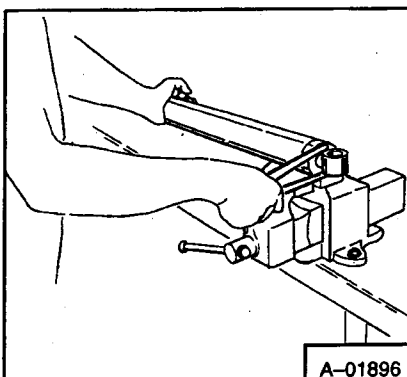


Fig. 4-43 Remove Cylinder Head

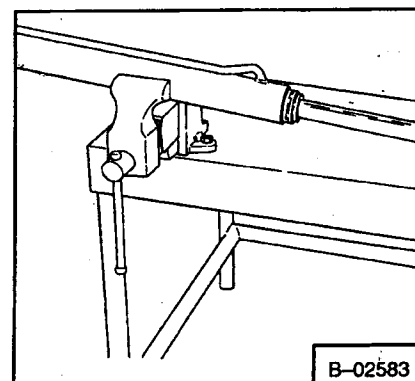


Fig. 4-44 Remove Cylinder Shaft W/Piston

#### 4-25 INSTALLATION OF CYLINDER SEALS

1. File and grind a bevel on shoulder at piston end of cylinder shaft (Fig. 4-45).
2. Remove all rough areas off shaft (Fig. 4-46).
3. Put teflon piston seals in warm oil or water for several minutes before installing.

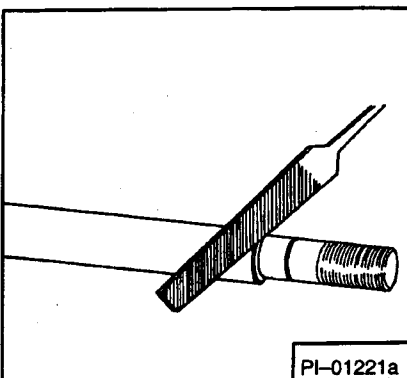


Fig. 4-45 Filing Bevel On Shaft

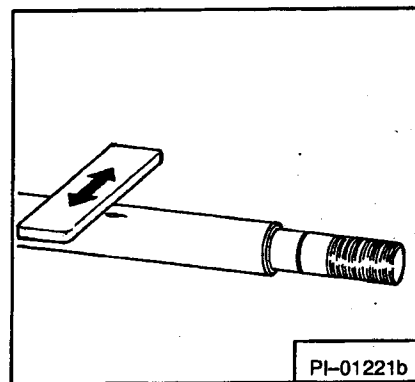


Fig. 4-46 Remove Marks on Shaft

#### 4-26 HYDRAULIC CYLINDER ASSEMBLY (Fig. 4-47)

1. Install cylinder head seals and place cylinder head carefully onto cylinder shaft (Item 1 thru 6).
2. Install bushing onto shaft (lift cylinder only) (Item 7).
3. Install piston seals and place piston onto end of cylinder shaft (Items 8, 9 & 10).
4. Install piston locking nut and tighten it (Item 11).
5. Install piston and shaft into cylinder.
6. Install cylinder head into cylinder case. Be careful not to damage seals.
7. Tighten cylinder head with spanner wrench (Fig. 4-43).

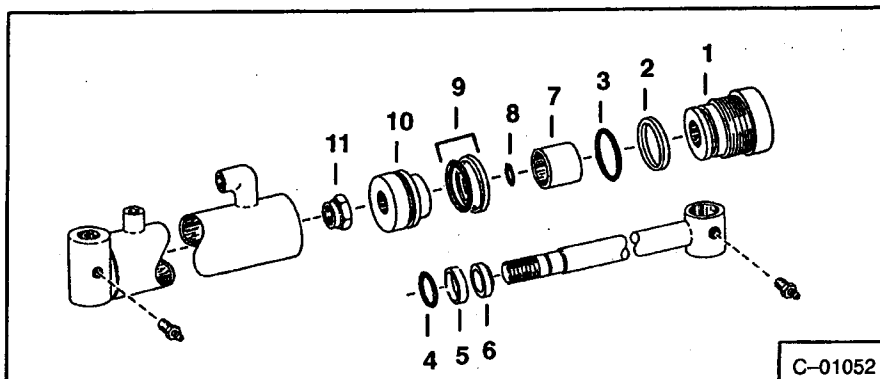


Fig. 4-47 Hydraulic Cylinder Assembly

#### 4-27 HYDRAULIC PUMP ALIGNMENT (500 ELECTRIC)

1. Remove hydraulic pump and pump holding plate from motor housing (Fig. 4-48).
2. Remove two pump holding bolts.
3. Install bolt with lock washers and put nuts on pump side. Tighten nuts and spot weld them to plate (Fig. 4-49).
4. Remove pump from holding plate.
5. With center punch mark 8 drill holes. They should be positioned 2 per every 90° around the bell housing so set screws will seat against four machined bosses on motor housing (Fig. 4-50).
6. Remove bell housing from motor (Fig. 4-50).

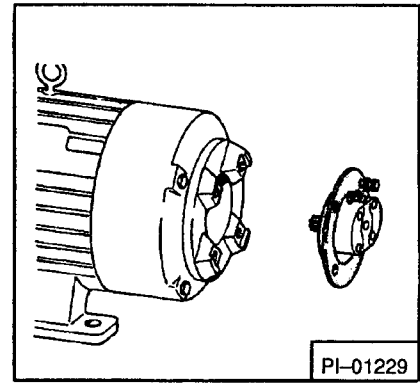


Fig. 4-48 Removing Pump and Plate

7. Drill 8 holes and turn a 1/4 inch (6,4 mm) by 20 tap through them (Fig. 4-50).
8. Start 1/4 inch (6,4 mm) set screws in holes.
9. Remove worn pump drive adapter from motor shaft (Fig. 4-51).
10. Attach bell housing to motor and tighten holding bolts evenly (Fig. 4-52).

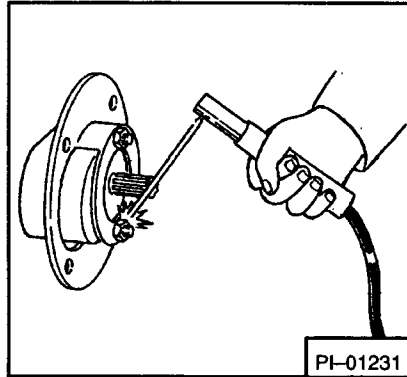


Fig. 4-49 Spot Weld Nuts

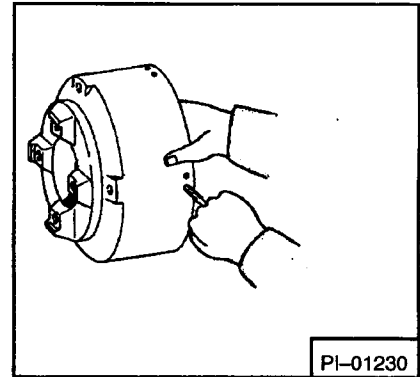


Fig. 4-50 Drilling & Tapping Housing

11. Install pump holding plate to housing (Fig. 4-53).

12. Install a new pump drive adapter into end of motor shaft. Hit bolt lightly with hammer and tighten.
13. Fasten a dial indicator to shaft so that indicator arm slides on inner circumference of holding plate for pump (Fig. 4-54).

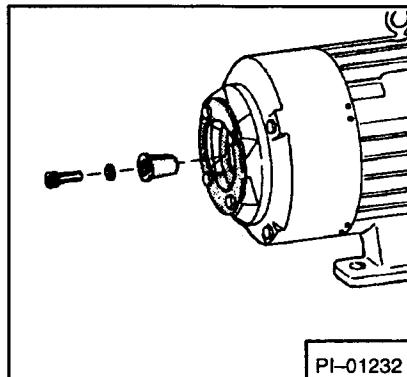


Fig. 4-51 Remove Old Adaptor

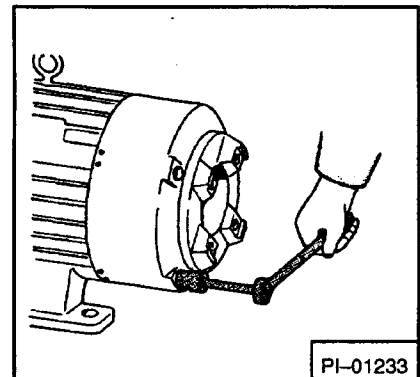


Fig. 4-52 Install Bell Housing

14. Using a long bar, force variable speed drive belt into driven sheave. This will loosen belt in drive sheave so motor shaft may be turned by hand.

15. Turn motor shaft by hand noting dial indicator reading. Make adjustment of 8 set screws to move bell housing until a maximum total indicator reading of .004 inch (.102 mm) is made.

16. Tighten housing holding bolts (Fig. 4-53).

17. Remove dial indicator.

18. Install hydraulic pump on holding plate (Fig. 4-48).

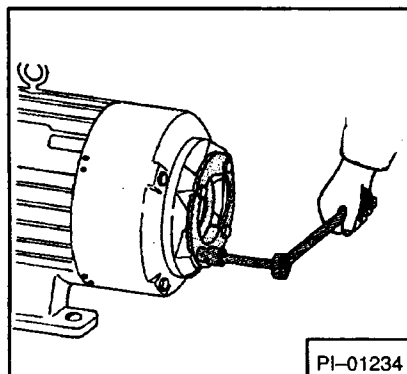


Fig. 4-53 Install Holding Plate

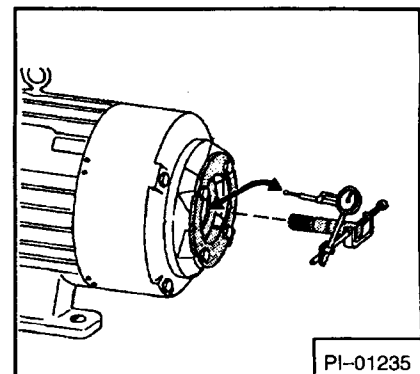


Fig. 4-54 Using Dial Indicator



## 4-28 HYDRAULIC PUMP ALIGNMENT (600 Wisconsin)

**NOTE: Use pump alignment tool. (See parts book for correct tool).**

1. Remove pump and drive coupling from engine (Fig. 4-60).
2. Slip tool over pump shaft to bottom position (Fig. 4-55).
3. Place pump into holding bracket and hold it in position (Fig. 4-56).
4. Slide tool over accessory drive shaft (Fig. 4-56).
5. To make correct alignment do the following:
  - a. Loosen holding bolts for pump bracket and move bracket up or down or rotate on accessories shaft.
  - b. With bracket installed loosely shim between bracket and engine block, or grind off block to make alignment. Tighten bolts (Fig. 4-57).
6. With brackets fastened and pump fastened in place, check alignment between pump and drive shaft from distributor (Fig. 4-58). Add or remove shims or grind away block on engine with alignment is correct.
7. Remove pump tool and install drive coupling half loosely to accessory drive shaft.
8. Install other half coupling loose on pump (do not install rubber), and push pump into bracket. Install and tighten pump fastening bolts.
9. Pull each coupling half together on drive and pump shaft. Check for .025 inch (.63 mm) clearance between each half of coupling. use feelers gauge and check all the way around coupling while not turning shaft (Fig. 4-59).
10. When alignment is correct, remove pump and tighten set screws in drive hub evenly to 9 ft.-lbs. (14 Nm) (Fig. 4-60).
11. Install pump into bracket and hold with fasteners and bolts (Fig. 4-60).
12. Check again for .025 inch (.63 mm) clearance between each coupling half (Fig. 4-59).

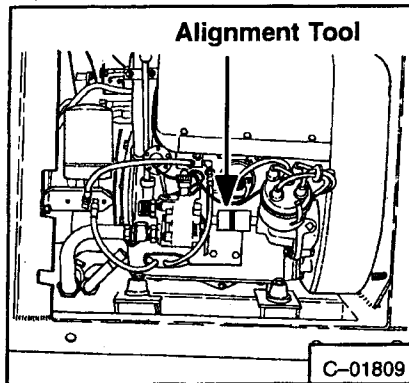


Fig. 4-55 Install Alignment Tool

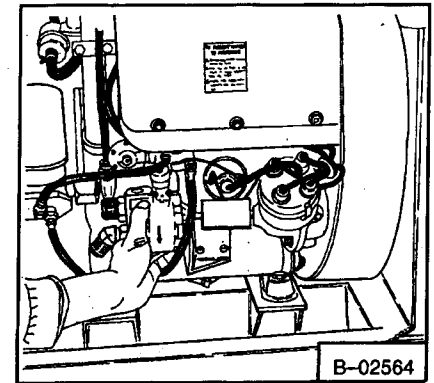


Fig. 4-56 Install Pump and Tool

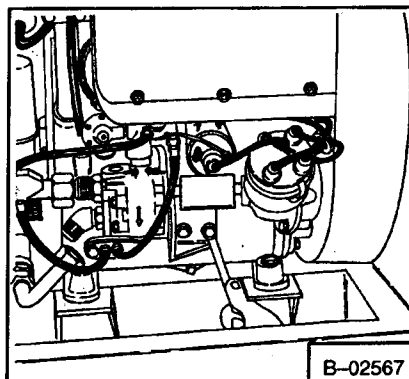


Fig. 4-57 Shimming Holding Bracket

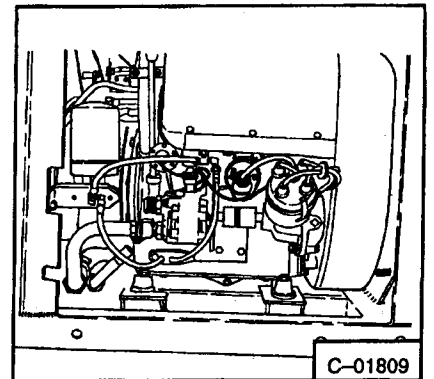


Fig. 4-58 Check Shaft Alignment

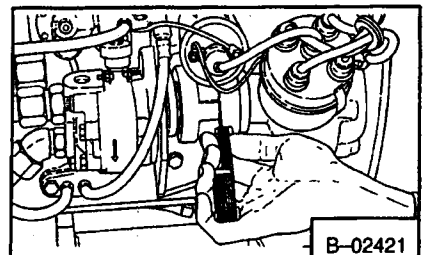


Fig. 4-59 Using Feeler Gauge

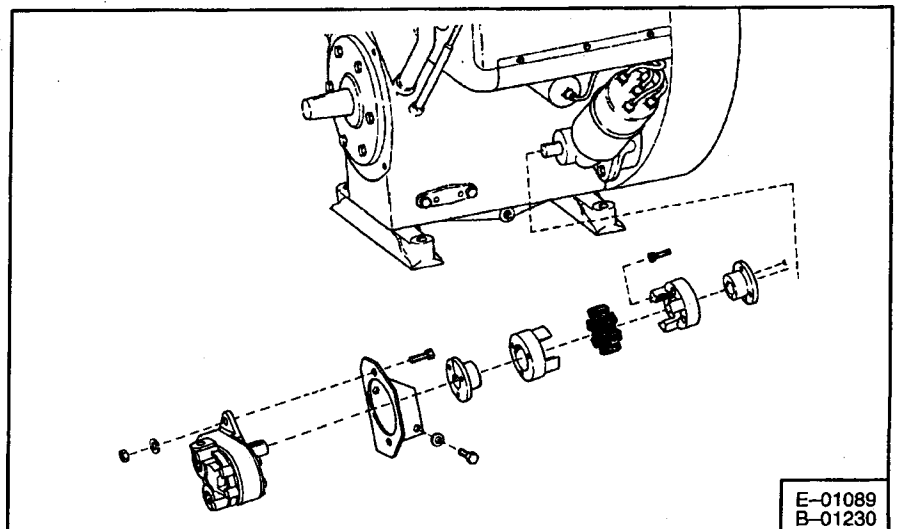


Fig. 4-60 Pump Installation

#### 4-29 37° Flare Connections

Use the following procedure to tighten flare fittings:

- (1) Tighten the nut until it makes contact with the seat.
- (2) Make a line across the *flats* of both the male and female parts of the connection (Fig. 4-61).
- (3) Use chart below to find correct tightness needed.

Fitting Thread Size	Rotate No. Of Hex Flats
9/16-18	2
3/4-16	2
7/8-14	1-1/2-2
1-1/16-12	1
1-5/16-12	3/4-1

#### 4-30 Tubelines and Hoses

Make replacement of tubelines that have damage. A bent tubeline will cause oil to flow at a slow rate and will cause an increase in heat and a decrease in hydraulic action. Make replacement of hoses when wear or damage is present. Use correct clamps to hold tubelines and hoses in position.

#### 4-31 Installing O-Rings

When installing this fitting, lubricate the O-ring with oil. Loosen the jam nut, screw the fitting into place and connect the tubeline first, before tightening the jam nut.

Tighten the jam nut until it and the washer are tight against the face of the opening (Fig. 4-62). The O-ring must be pushed into the space shown.

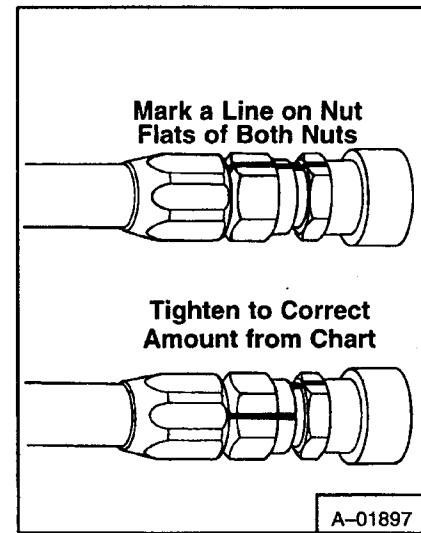


Fig. 4-61 Tightening Flared Fittings

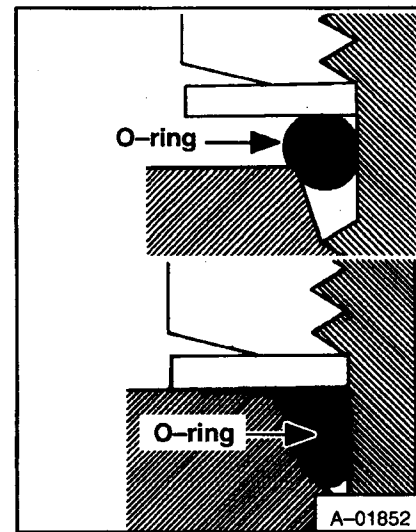


Fig. 4-62 Straight Thread Seal