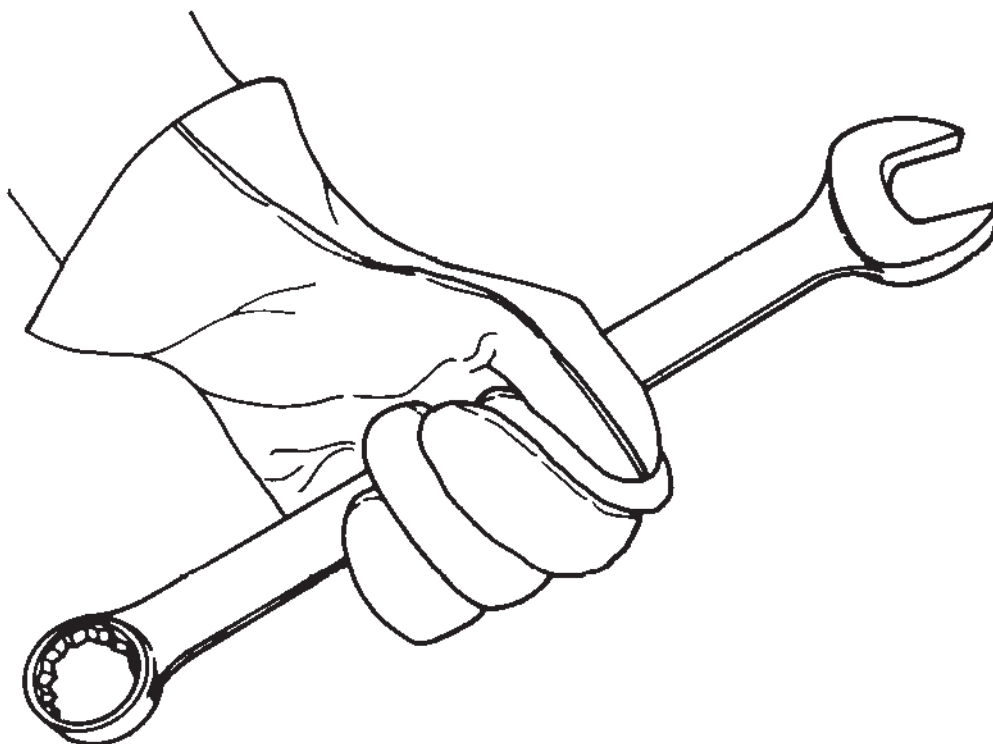




# SUPPLEMENT 444, 500 & EARLY 600

## SERVICE MANUAL



This Manual To Be Used With The 600, 600D,  
610, 611 Service Manual. Publication  
Number 6556276.

**MELROE**  
**INGERSOLL-RAND**

6556520 (7-83) Revised (3-87)



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## HYDRAULIC SYSTEM (444 & 500)

Figure 3 shows hydraulic fluid flow.

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 (Item 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.

### 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 4 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 do to improper seating of the quad-ring seal.

Stop the engine. Remove the high oil level check plug and the hydraulic filter plug (Fig. 5). You will need to add about 2 quarts of fluid to replace the oil that was in the oil filter element. Add type A automatic transmission or Dextron fluid until it runs out the high level check port. Replace the check and fill plugs.

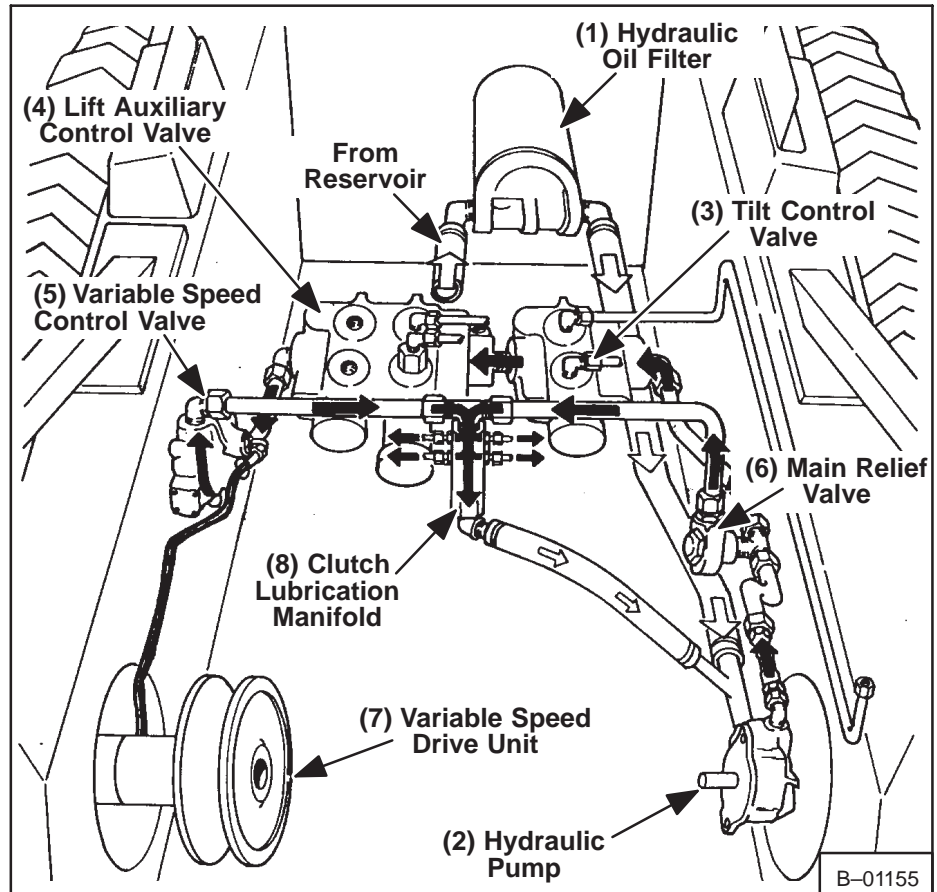


Fig. 3 Hydraulic System (500 & 444 Gasoline & LP Gas)

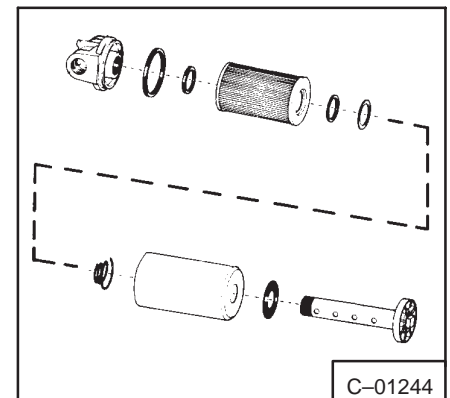


Fig. 4 Hydraulic Oil Filter

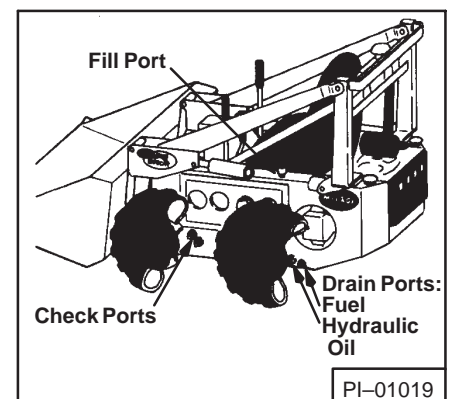


Fig. 5 Check & Fill Ports

2. Install a new seal in the pilot plate. Be sure it is started straight. Press it into its Proper location (Fig. 25).

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 0.0625 inch over the last, progressing outward (Fig. 26).

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.

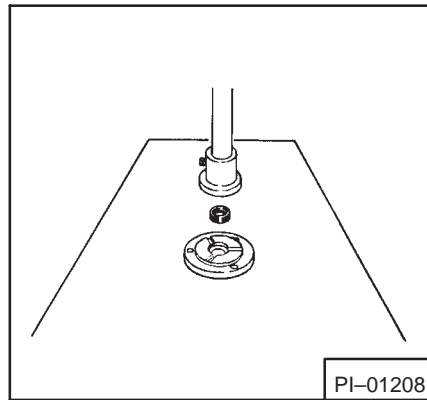


Fig. 25 Installing New Seal in Pilot Plate

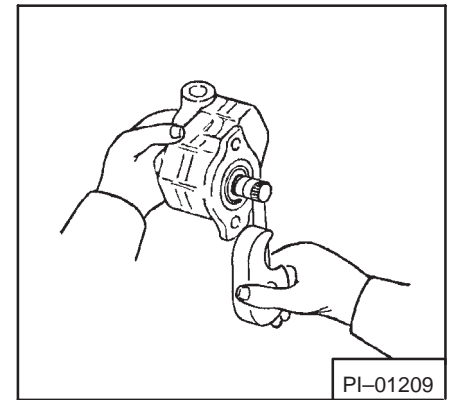


Fig. 26 Wrapping Shaft Spline

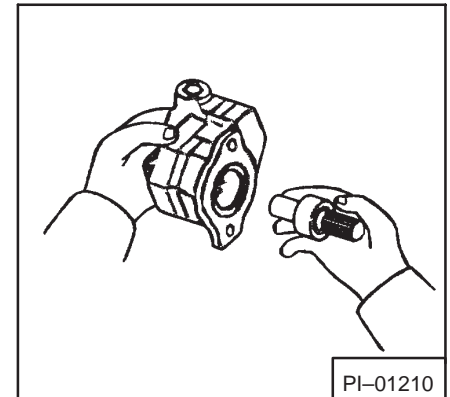


Fig. 27 Pulling Drive Shaft From Pump

### HYDRAULIC PUMP REPAIR (Webster Pump)

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 solvent. 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 (Fig. 24).
3. Pull the pump drive shaft out of the pump (Fig. 27). The ball bearing will come with it.
4. Remove all the screws from the pump body (Fig. 28). 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 (Fig. 29). Tap sharply on the heads of the two screws, alternating between them (Fig. 29). When the dowels are disengaged, remove the screws and separate the plates.

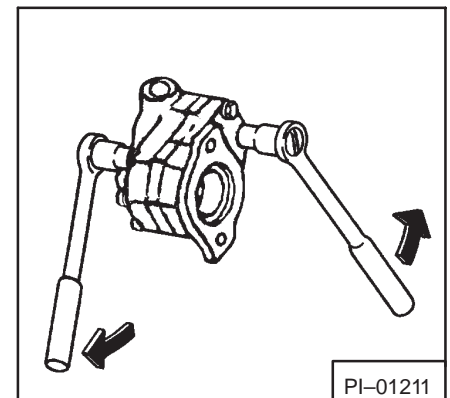


Fig. 28 Removing Pump Body Screws



## WARNING

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

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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.

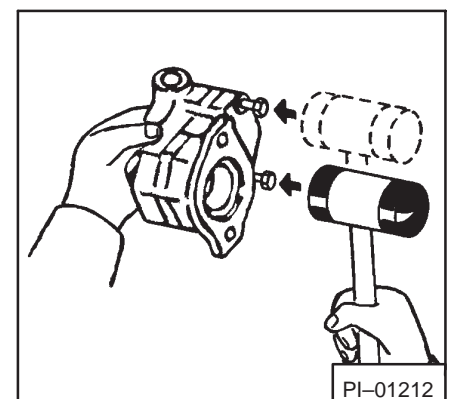


Fig. 29 Separating Pump Plates

Next connect meter to black lead wires. Approximately 0.1 ohms should be your reading here. There should be no ground connections from either winding, nor should there be a connection between windings. If a connection exists between the two windings or to ground, stator assembly should be replaced.

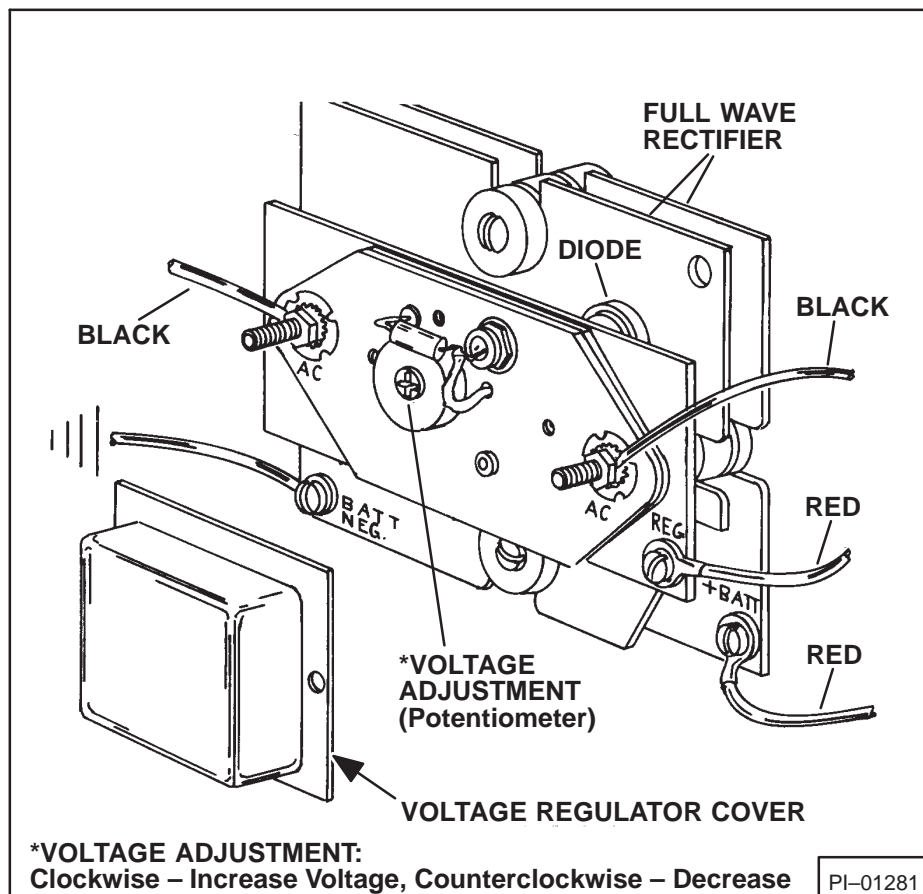
- b. Full Wave Bridge Rectifier: Examine each of four diodes for breakdown by connecting ohmmeter R x 1 scale from AC input connection to positive plate, then move lead to negative plate alternately. Meter should read approximately 10 ohms in proper polarity. A shorted diode will indicate no resistance and would cause a short circuit through the load winding when in operation. An open diode would read infinite resistance and would also indicate that replacement is necessary.
- c. Regulator Assembly: The regulator assembly contains two semiconductors, a silicon controlled rectifier, which is the electronic switch for the control winding, and a zener diode which is the battery voltage sensing device, turning the SCR on when the battery voltage at the predetermined level. To adjust voltage, remove two screws from regulator cover, lift cover off, connect voltmeter to battery terminals. Be sure the battery load is less than alternator output so that unit is regulating. With alternator running at approximately one-half speed, adjust potentiometer to desired voltage (Fig. 44).
- d. Battery Voltage Too Low: Follow previous procedure, turning variable resistor clockwise.
- e. Full Charge Will Not Regulate: Check for broken lead wires at connection to regulator plates. To be sure regulator winding operates properly, connect two red leads together. Start engine. A Maximum of four amperes charge should be noted. This would indicate stator winding is satisfactory. Regulator should be replaced.
- f. Battery Voltage Too High: Remove regulatory cover. Connect voltmeter to battery terminals. Start engine. With a small screwdriver or suitable blade adjust variable resistor counterclockwise until proper voltage is obtained. Replace cover.

**TURN CLOCKWISE TO INCREASE**

**TURN COUNTERCLOCKWISE TO REDUCE**

- g. No Charge: If alternator does not charge when load is applied to battery, shut off engine. Disconnect regulator lead (red) from regulator terminal. Be sure lead is taped or isolated from conducting engine parts. Once again start engine. Alternator should charge to full output. If not assembly should be replaced.

Current rectifiers furnished by the engine manufacturer do not have the voltage adjustment feature. This was eliminated to improve the service life of the unit.



**Fig. 44** Voltage Adjustment (Later M-500 & Early M-600 W/VF4D Engine)

PI-01281

## WISCONSIN ENGINE SERVICE (M-600)

### RESTORING COMPRESSION

On a new engine or on one which has been out of operation for some time, the oil may have drained off the cylinders so that compression will be weak. This may cause difficulty in starting. To remedy this condition, remove the spark plug and pour about a fluid ounce of engine oil through the spark plug hole into each cylinder.

Turn the engine over several times by hand to distribute the oil over the cylinder walls. Then replace the spark plug and compression should be satisfactory.

### GOVERNOR ADJUSTMENT

The control rod between the governor and carburetor must be adjusted to the proper length, or the governor action will be faulty. With the engine at rest, the governor spring will hold the flyweights in, and the control rod must be of such length as to hold the carburetor throttle wide open at this point. The accuracy of this adjustment can be tested by disconnecting the control rod from the governor lever, then pushing the rod toward the carburetor as far as it will go. This will open the throttle wide. The governor lever should then be moved as far as possible in the same direction; all of this being done with the rod disconnected from the lever. Holding both parts in the above position, the rod should be screwed into the swivel block on the carburetor, until the bent end of the rod will register with the hole in the lever.

Then, screw the rod in two more turns. Insert the rod into the hole in the governor lever and insert the cotter pin. With the governor lever pushed toward the carburetor as far as it will go, there should be about 0.0625 inch clearance between the throttle lever and the stop pin on the carburetor. The clearance will cause the lever to bounce back from the stop pin, rather than jam against the pin, when a load is suddenly applied to the idling engine.

The governor lever is furnished with 12 holes (Fig. 66) for attaching the governor spring. For operation in a Bobcat using model VF4 Wisconsin engine, the spring should be hooked into the No. 10 hole in the arm. This would set the engine speed to 2400 RPM under load. For Bobcats using model VH4 Wisconsin engine, the No. 12 hole should be used. This would set the engine speed to 2800 RPM under load (Fig. 67).

### STORAGE OF ENGINES

Clean the exterior of the engine completely

To protect the cylinders, pistons, rings and valves from rusting and sticking, a half and half mixture of kerosene and engine oil should be injected into the pipe tap opening on the intake manifold while the engine is warm and running at moderate speed. About a quarter pint is necessary, or enough so a heavy bluish smoke will appear at the exhaust. Shut the engine off. The fogging operation will give a coating of oil on the above mentioned parts, protecting them from the atmosphere.

Drain the oil from the crankcase.

Drain the fuel system.

TEMPERATURE	VISCOSITY
Below 0° F	SAE 5W-20W
0° F to +15°F	SAE 10W
+15° F to +40°F	SAE 20-20W
+40° F to +120° F	SAE 30

Fig. 65 Oil Specifications

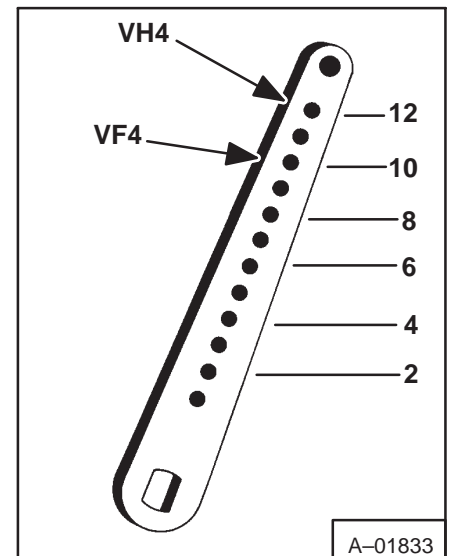


Fig. 66 Governor Lever

RPM		HOLE No.
Load	No Load	
1400	1525	4
1500	1650	5
1600	1725	5
1700	1850	6
1800	1950	7
1900	2025	7
2000	2150	8
2100	2225	8
2200	2350	9
2300	2425	9
2400	2550	10
2500	2625	10
2600	2750	11
2700	2850	12
2800	2925	12

Fig. 67 Governor Adjustment Scale

3. Cover the regulator outlet with a bubble film. Slowly back out the regulator adjusting screw by turning it counterclockwise, until the regulator just begins to leak. Point of leak will be indicated by a slowly expanding bubble at the regulator outlet.
4. Find the point of leak and turn the regulator adjusting screw to the right (Clockwise) 3/4 to one turn from this position.
5. After setting as indicated above, blow sharply into the diaphragm breather hole. This will open and reseal the inlet valve. Repeat this several times. Recheck the setting, following steps 3 and 4.

## LP FUEL FILTER LOCK

To replace the filter element:

1. Close the hand valve on the tank.
2. Remove the filter assembly from the fuel tank.

**NOTE: When you will be cleaning the filter, remove the entire solenoid section first to keep accumulated dirt and scale from entering the solenoid section.**

3. Remove the solenoid by clamping the filter housing (Fig. 79, Item 9) in a vise and carefully loosening the 5/8 inch hex brass body (Item 1). Carefully remove the solenoid section, including all items 1 through 7, 13 and 14.
4. Hold the filter housing (Item 9) in a vise and unscrew the filter inlet (Item 12). It has a 3/4 inch square nut.
5. Remove the filter element and clean any deposits out of the filter housing. Clean the element (Item 10) by blowing compressed air through it, from the inside out. Inspect the O-ring (Item 11) for any cuts or damage.

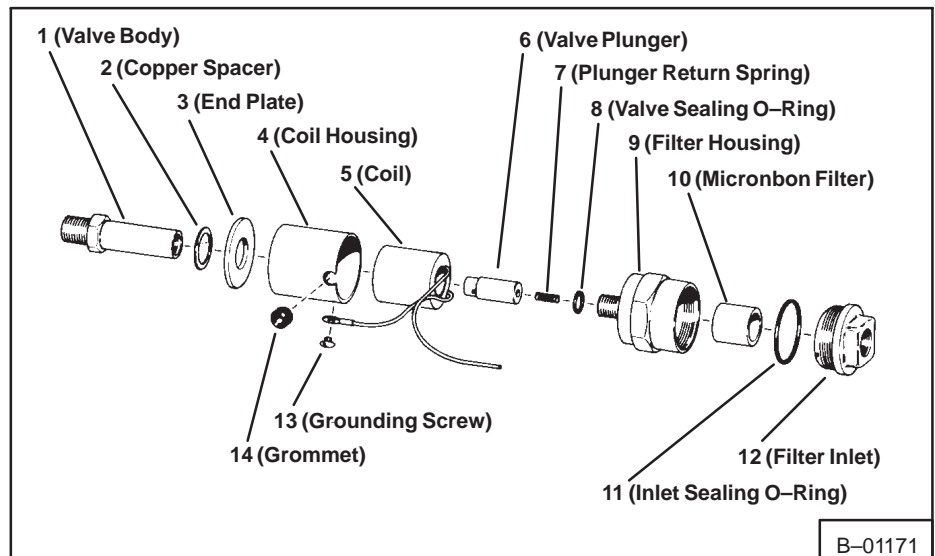


Fig. 79 LP Fuel Filter Lock

6. Replace the cleaned or new filter element in the recess inside the filter element. Be sure it is seated. Lubricate the O-ring with a light mineral oil. Carefully turn the filter inlet completely in by hand then tighten it to 30–40 ft.-lbs. torque.
7. Reassemble the solenoid section to the filter housing using a maximum of 18 ft.-lbs. torque. Oil the O-ring (Item 8) on the filter housing to keep it from being damaged.

## IGNITION TIMING

Locate the DC timing notch on the rotating flywheel screen and make certain that it is located in line with the large DC letters which are stamped on the flywheel proper (behind the screen). Connect the timing light in series with the No. 1 spark plug. With the engine operating at 1800 RPM or over, allow the flash from neon light to illuminate the leading edge of the notch.

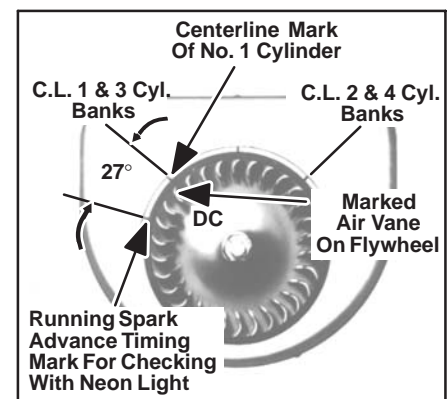


Fig. 79A Timing The Engine

# ENGINE SERVICE

	<b>Page Number</b>
M-444 (ONAN) .....	47
CARBURETOR SERVICE (Gasoline) .....	47
CARBURETOR SYSTEM SERVICE (LPG) .....	48
CRANKCASE BREATHER .....	47
ENGINE OIL .....	47
ENGINE RECONDITIONING .....	53-57
FUEL PUMP .....	48
GOVERNOR & SPEED CONTROL .....	47
IGNITION SYSTEM .....	51
TECHNICAL DATA .....	58
VAPORIZER, Primary Regulator .....	33
VALVE SYSTEM .....	50

**ENGINE SERVICE  
ONAN**

If the head of a lock pin is damaged, remove it and install a new pin. Apply oil to the thrust washer to hold it in place while installing the crankshaft. Oil grooves in the thrust washers must face the crankshaft. The washers must be flat (not bent) and the two notches must fit over the two lock pins to prevent riding on the crankshaft. New camshaft bearings are precision type which do not require line reaming or line boring after installation. Coat the bearing with lubricating oil to reduce friction. Place the bearing on the crankcase over the bearing bore with the elongated hole in proper position and the narrow section facing out (except, in bores without oil holes, install with bearing groove at the top). Be sure to start the bearing straight. Press the rear bearing in flush with the bottom of the counterbore which receives the expansion plug.

### 3. Oil Seals:

Before installing the seals, fill the space between the lips with a fibrous grease or stiff cup grease. This will improve sealing (Fig. 113).

When installing the gear cover oil seal, tap the seal inward until it is 0.968 inch from the mounting face of the cover.

**NOTE: Install a new style, thin, open face seal 1.1093 inch from the mounting face of the cover.**

When installing the bearing plate oil seal, tap the seal into the bearing plate bore to bottom against the shoulder in the plate bore. Use a seal expander or place a piece of shim stock around the end of the crankshaft when replacing the bearing plate to avoid damaging the seal. Remove the shim stock as soon as the plate is in place.

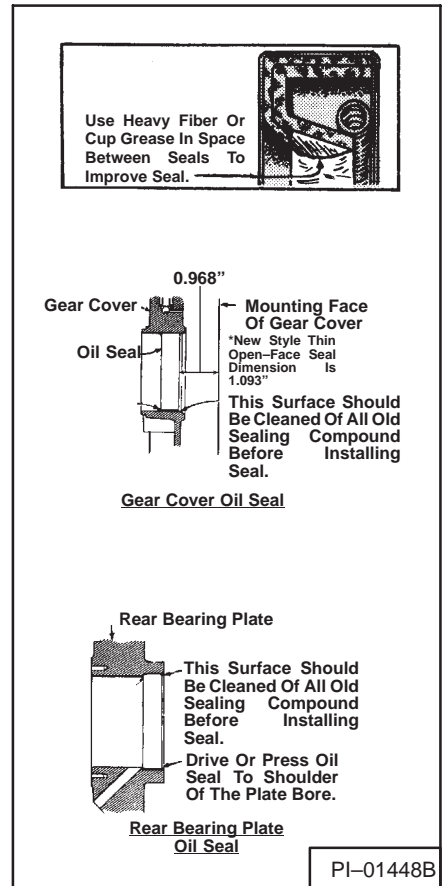


Fig. 113 Installing Oil Seals

### 4. Crankshaft:

Inspect the bearing journals. If they are scored and cannot be smoothed out by dressing down, the bearing journals should be refinished to use the nearest available undersize bearings or a new crankshaft should be installed. If a worn main bearing journal cannot be fitted with an available precision type undersize bearing, then refinish it to the next undersize.

If a worn rod journal cannot be fitted by installing a new bearing insert, refinish it to take the corresponding undersize rod or bearing insert available.

Inspect the drilled passages of the crankshaft. Clean them to remove any foreign material and to assure proper lubrication of the connecting rods.

After the crankshaft is installed, measure end play (Fig. 114).

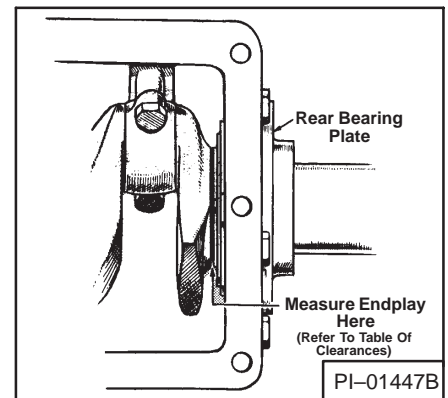


Fig. 114 Crankshaft End Play

### 5. If the pistons are badly scored, very loose in the cylinder, have badly worn ring grooves, or otherwise are not in good condition, install new pistons. Install new pistons if they are so loose on the piston pins that a 0.002 inch oversize pin will not correct it. Handle the pistons carefully to avoid nicking the walls. Any raised surface of this type must be dressed down carefully.

Inspect the rings carefully for fit in the grooves, for tension and for seating on the cylinder walls. If in doubt, install new rings.

Before installing new rings, check the ring gap by placing each ring squarely in its cylinder at a position corresponding with the bottom of its travel (Fig. 115). The gap between the ends of the ring should be as given in the Table of Clearances, See Page 58.

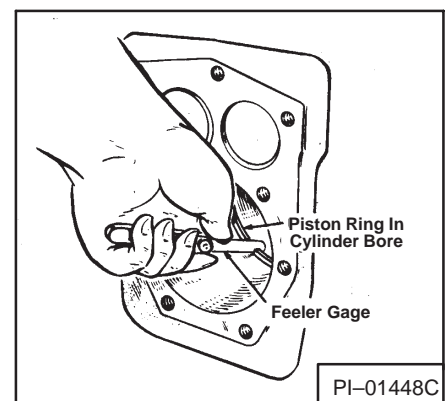


Fig. 115 Ring End Clearance

## ELECTRIC FUEL PUMP SERVICE

To disassemble an electric fuel pump:

1. With a 0.625 inch wrench, release the bottom cover (Fig. 124, Item 1) from the bayonet fittings. Twist the cover by hand to remove it from the pump body.
2. Remove the filter (Item 4) magnet (Item 3) and cover gasket (Item 2). Wash the filter in cleaning solvent and blow out dirt and cleaning solvent with air pressure. Check the cover gasket and replace if deteriorated. Clean the cover.
3. Remove the retainer spring (Item 5) from the plunger (Item 11) using a thin nose plier to spread and remove the ends of the retainer from the tube. Then remove the washer (Item 6), O-ring seal (Item 7), cup valve (Item 8), plunger spring (Item 9) and plunger (Item 10) from the tube (Item 11).
4. Wash the parts in cleaning solvent and blow clear with air pressure. If the plunger does not wash clean or if there are any rough spots, gently clean the surface with crocus cloth. Slosh the pump assembly in cleaning solvent. Blow out the tube with air pressure. To do a complete job, swab the inside of the tube with a cloth wrapped around a stick.

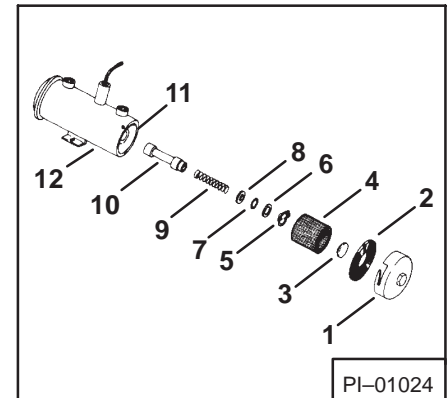


Fig. 124 Electric Fuel Pump

To reassemble an electric fuel pump:

1. Insert the plunger assembly (Item 10) into the tube with the buffer end first. Check the fit by slowly raising and lowering the plunger in the tube. It should move fully without any tendency to stick. If a click cannot be heard, the interrupter assembly is not functioning properly. In this case the pump should be replaced.
2. To complete the assembly, install the plunger spring (Item 9), cup valve (Item 8), O-ring seal (Item 7) and washer (Item 6). Compress the spring (Item 9) and insert the retainer (Item 5) with the ends of the retainer in the side holes of the tube (Item 11).
3. Place the cover gasket and magnet in the bottom cover and assembly and filter and cover assembly. Twist the cover by hand to hold it in position on the pump housing. With a 0.625 inch wrench, securely tighten the bottom cover.

### IMPORTANT

Do not tamper with the seal at the center of the mounting bracket (at the side of the pump) as it retains the dry gas, which surrounds the electrical system, in the upper portion of the pump.

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To inspect and adjust:

Electric fuel pump delivery should be 1.750 PSI maximum. Use a low pressure gauge or water manometer to check this. Pressure can be increased or decreased by stretching or compressing the spring.

## CARBURETOR ADJUSTMENTS (LPG)

1. Turn the high speed needle counterclockwise one and one half turns (from closed position), and start the engine.
2. When the engine reaches normal operating temperature, accelerate and check response. Operate the engine under load and adjust the high speed needle for the leanest mixture which will allow satisfactory acceleration and steady governor operation.

Clean up the grooves and fit new rings.

With rings in place, check with a feeler gauge. If a 0.005 feeler can be inserted between the ring and land, replace the piston.

Piston ring end clearance should be from 0.007 to 0.017 in the cylinder bore (Fig. 136).

Never re-use old rings. Always use heavy duty type rings.

#### 5. Piston Pins:

Very little wear occurs on the piston or in the piston bosses.

After assembly of the piston to the connecting rod, align the rod to the piston so it will be square in the cylinder bore. Use a commercial rod aligner.

#### 6. Valves, Seats and Guides (Fig. 137):

Check the clearance of old valve stems in the guides. If worn, replace the guides and install new valves.

The valve seats are eatonite or stellite. The seating surfaces should be held as nearly as possible to 0.031 inch in width. Seats with more than 0.062 inch seating surface should be reconditioned with 45° and 15° cutters to form the proper seat.

Valve seats can be replaced only by using special tools. Follow instructions given by the tool manufacturer when replacing these seats.

#### 7. Oil Pump:

The oil pump is a positive gear type. Pressure is adjusted at the factory. It should not be necessary to change this adjustment.

A sudden drop in oil pressure may be caused by dirt or foreign particles in the pump check valve. Remove the screw (Fig. 138) and take out the spring and valve. Inspect and clean the seat and valve. Re-install the valve, spring and adjusting screw.

Turning the adjusting screw the same distance into the pump body as before it was removed. If it should be necessary to readjust the oil pressure, turn the screw to the left (counterclockwise) to decrease pressure and to the right (clockwise) to increase pressure. Seal the screw with Permatex or equivalent when adjustment is completed.

When the oil pump is installed, the oil pump drive gear should be checked for backlash and for alignment with the drive gear.

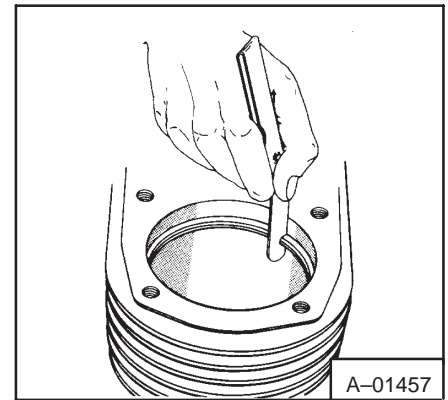


Fig. 136 Ring End Clearance

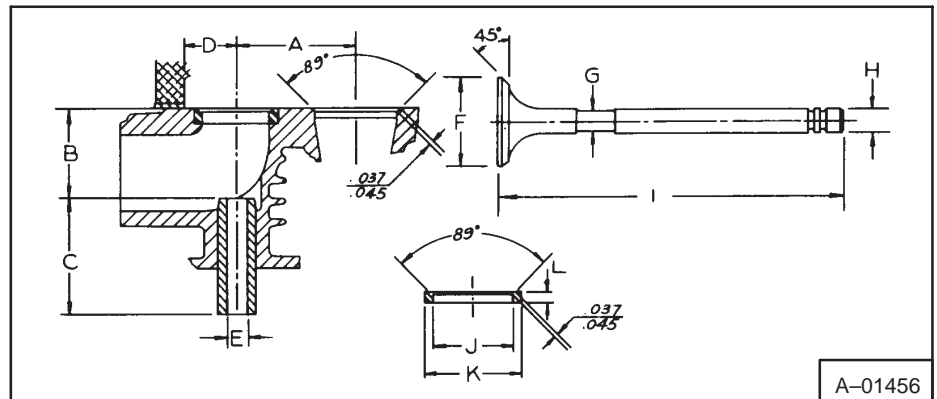


Fig. 137 Valves, Seats and Guides

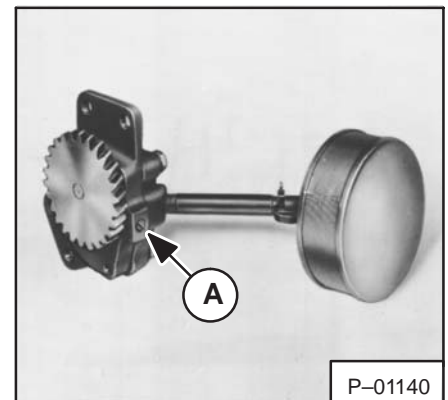


Fig. 138 Oil Pump

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