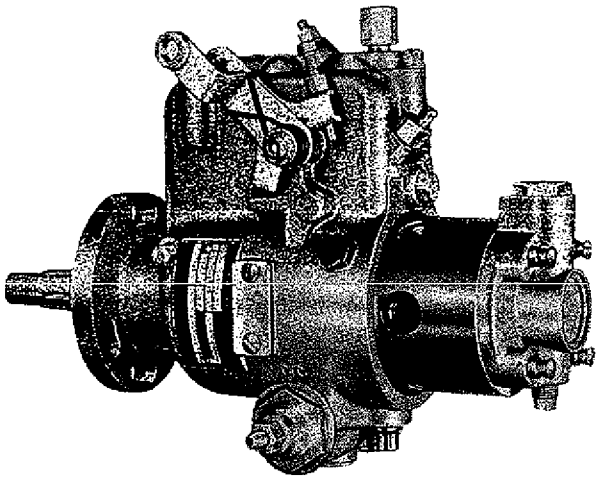
OPERATION AND INSTRUCTION MANUAL
MODEL DC PUMP



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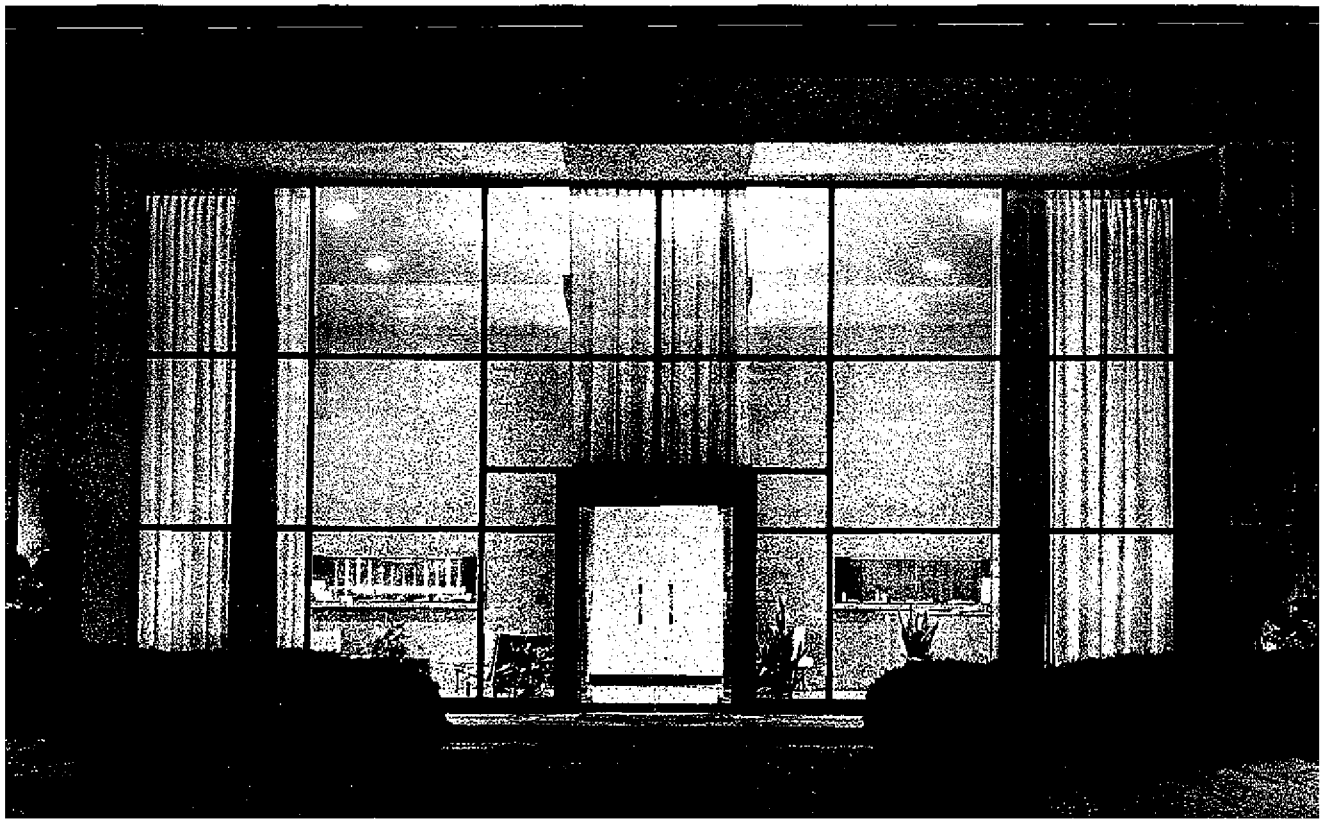
Contents



General

A. PURPOSE OF THE MANUAL

This manual is expressly intended to provide sufficient information for qualified technicians experienced in diesel engines and diesel injection equipment to disassemble and assemble the Roosa Master Fuel Injection Pump and to make such adjustments and parts replacements as may be needed. It is recommended that an inexperienced person refrain from making adjustments and repairs, as such action may result in very extensive damage to the pump and possibly to the engine.

No service should be performed on the pump before making a careful study of this manual and becoming familiar with the principles and instructions which follow.

This manual completely describes the operating principles of the pump and its accessories. *Only through a thorough knowledge of these principles can the service man locate and correct possible operational faults.*

B. MODEL NUMBER SYSTEM

It is necessary to understand the model number system for reference to the proper sections of this manual covering the operation and maintenance of the pump.

EXAMPLE

MODEL NUMBER DCGFC431-8AJ

<table>
<tr>
<td>DC — "C" execution of "D" pump
Incorporates twin cylinder .920" diameter distributor rotor, with spline drive</td>
<td>G — Type of Governor
Mechanical</td>
<td>F — Method of Mounting
F—Flange
V—Vertical</td>
</tr>
<tr>
<td>C — Rotation
(viewed from drive end)
C—Clockwise
CC—Counter-Clockwise</td>
<td>4 — Number of Cylinders
(1st digit in series of 3)
2-2 cylinders 6-6 cylinders
3-3 cylinders 8-8 cylinders
4-4 cylinders</td>
<td>31 — Plunger Diameter
(2nd & 3rd digits in series of 3)
25—.250" 31—.310"
27—.270" 33—.330"</td>
</tr>
<tr>
<td>8 — Specification Number
Be sure to include this in any reference to the pump.</td>
<td colspan="2">AJ — Accessory Code
The code pertains to special accessories such as electrical shut-off, automatic advance, variable speed droop adjustment, and/or combination of these. See the proper service bulletin for operation and construction of these accessories. Also include this in any reference to the pump.</td>
</tr>
</table>

C. GENERAL INFORMATION

In a diesel engine air is drawn into the cylinder through the intake valve and compressed. A metered quantity of fuel is then injected into the cylinder, producing a combustible mixture. The mixture ignites from compression heat, and the expanding gases force the piston downward. The gasoline engine differs from the diesel in that fuel and air are mixed in the carburetor before entering the cylinder, where ignition is caused by an electric spark.

The function of a diesel fuel injection pump is to accurately meter fuel to each cylinder and to inject it at high pressure, through nozzles, into the combustion chamber at precisely timed intervals. The extreme precision necessary can well be appreciated since this cycle must be repeated hundreds of times per minute with virtually no variation in timing or amount of fuel injected. The injection pump is *truly the heart of the diesel.*

ROOSA MASTER PUMP

The "DC" Roosa Master pump is of the twin cylinder, opposed plunger, inlet metering, distributor type. Simplicity, the prime advantage of this design, contributes to greater ease of service, lower maintenance costs, greater dependability, and, easily overlooked, its ability to operate at higher speeds than competitive types.

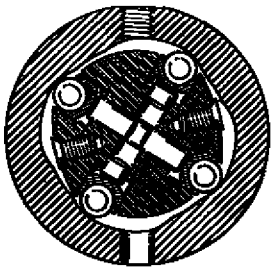
The necessity for cost reduction is more apparent in the small diesel engine where the injection equipment represents a greater percentage of the cost. Since the basic Roosa Master model has but 100 odd parts, and only three main rotating members, there is less chance of part failure. Repairs are generally very simple, resulting in lower service costs. Today's high output engines have created a need for improved, yet low cost injection equipment capable of higher speed operation.

Precise distribution between cylinders, inherent in the pump design, eliminates lengthy periods on the test stand. There are no spring-loaded, lapped surfaces, no ball bearings or gears, and most accessories are built-in. The pump is self-lubricated, contains the same number of parts regardless of the number of cylinders served, and operates in any position.

THE MODEL DC PUMP

This Roosa Master pump is the heaviest duty version in production. Several noteworthy design changes have been incorporated to make this possible:

1. The distributor rotor is similar to previous configurations but now incorporates two pumping cylinders and four plungers. The plungers are actuated by four sets of cam rollers and shoes, with the pumping loads spread over four cam lobes on the internal cam ring instead of two.



Additionally, the distributor rotor incorporates two inlet passages to enable it to better charge both connecting pumping chambers for high speed, high output engines.

2. Drive shaft engagement with the distributor rotor is now accomplished through a splined arrangement in order to absorb the heavy driving torque encountered on high output engines.

3. The transfer pump pressure regulating valve has a unique porting arrangement which provides pressure compensation for viscosity changes in the fuel due either to temperature change or fuel grade.

4. An automatic advance device, either speed or load responsive, can be provided as an integral portion of the main pump housing casting. It is of robust design and simple construction. The actuating piston in the advance device is provided with a piston ring seal for more positive sealing with light fuels.

5. The pump housing casting has been modified to improve load bearing qualities.

Construction and Operation

A. COMPONENTS AND FUNCTIONS

The DC Roosa Master Fuel Injection Pump is described as a twin cylinder, opposed plunger, inlet metering, distributor type.

It is necessary to become familiar with the function of the main components to understand the basic operating principles of the Roosa Master DC pump. See the cutaway view in Fig. 1 for construction details.

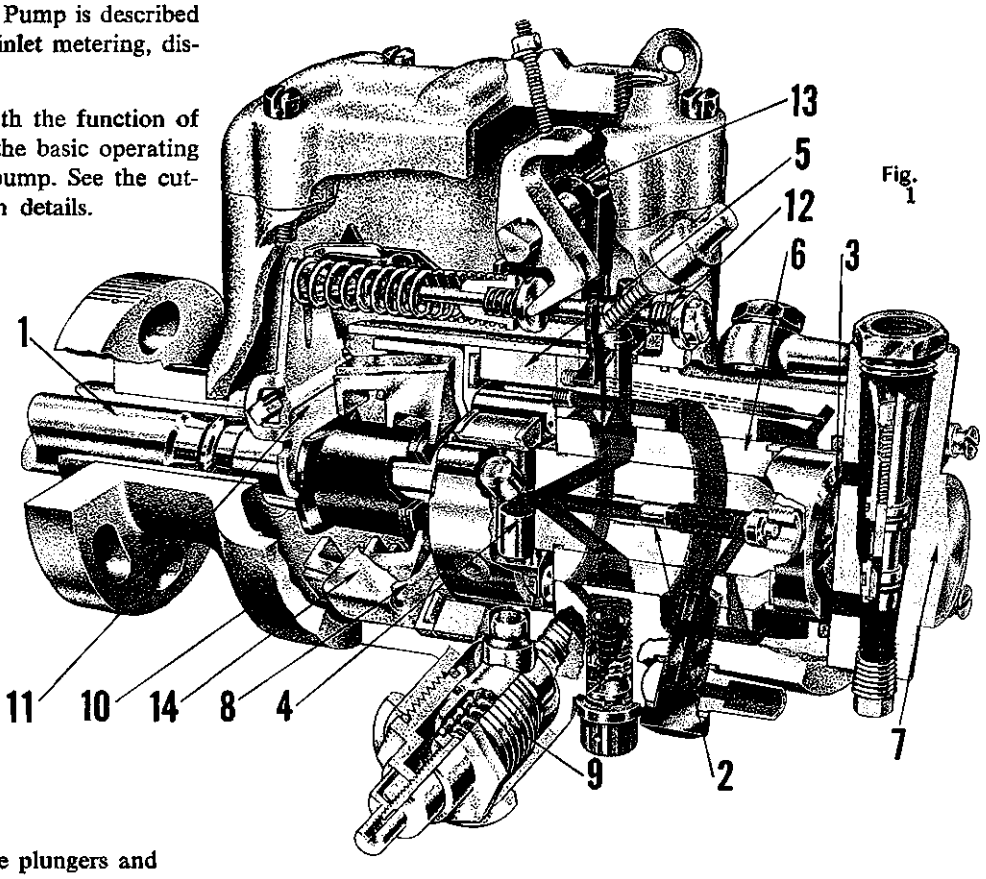


Fig. 1

Main Components

1. Drive Shaft
2. Distributor Rotor
3. Transfer Pump
4. Pumping Plungers
5. Internal Cam Ring
6. Hydraulic Head
7. End Plate
8. Governor
9. Automatic Advance
10. Housing

Rotating Members

The rotating members, Fig. 2, revolve on a common axis, and are:

1. Drive Shaft
2. Distributor Rotor (containing the plungers and mounting the governor)
3. Transfer Pump

With reference to Fig. 1 the drive shaft (1) engages the distributor rotor (2) in the hydraulic head (6). The drive end of the rotor has two cylinder bores, each containing two plungers (4).

The plungers are actuated toward each other simultaneously by an internal cam ring (5) through rollers and shoes which are carried in guide slots in the flanged end of the rotor (See Fig. 2). There are as many lobes as there are cylinders to be served.

The transfer or supply pump (3) in the opposite end of the rotor from the pumping cylinders, is of the positive displacement, vane type and is covered by the end plate (7).

The distributor rotor incorporates two, angled inlet passages for charging and an axial bore to serve all outlets.

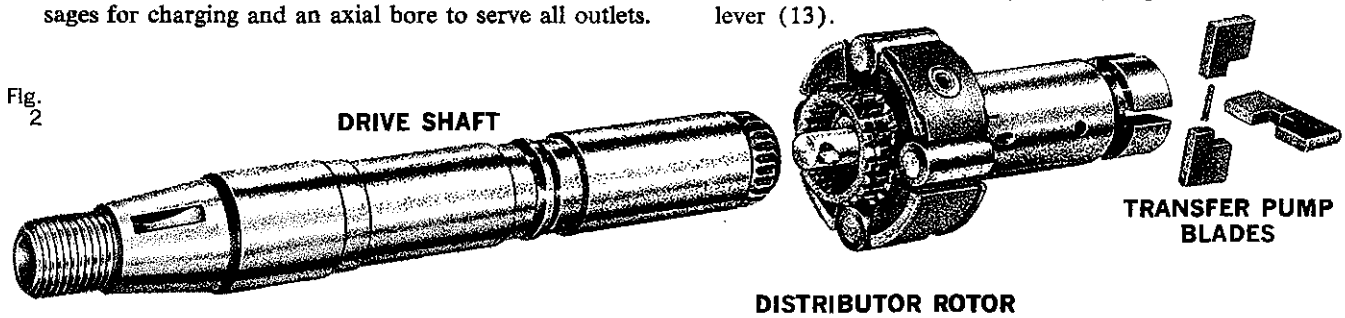
The hydraulic head contains the bore in which the rotor revolves, the metering valve bore, the charging ports and the head outlets. These outlets are connected through appropriate fuel line fittings to the injection pipes which lead to the nozzles.

Covering the transfer pump, on the outer end of the hydraulic head, is the end plate. This assembly houses the fuel inlet connection, fuel strainer and transfer pump pressure regulating valve.

The DC pump contains its own mechanical governor (8), capable of close speed regulation.

The action of the weights in their retainer (14) is transmitted through a sleeve to the governor arm (11) and through a positive linkage to the metering valve (12). The metering valve is closed to shut off fuel through a solid linkage by an independently operated shut-off lever (13).

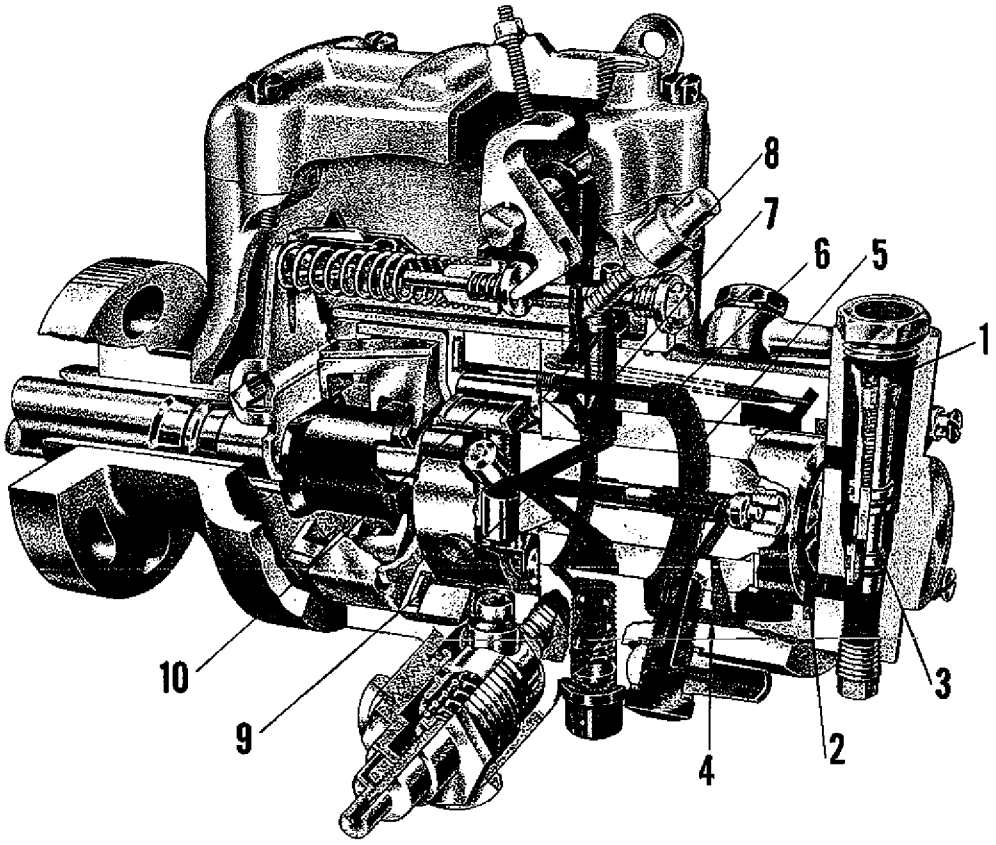
Fig. 2



B. FUEL FLOW

The operating principles of the pump can be understood more readily by following the fuel circuit during a complete pump cycle (See Fig. 3). Fuel is drawn from the supply tank into the pump through the inlet strainer (1) by the vane type fuel transfer pump (2). Since transfer pump displacement greatly exceeds the injection requirements, a large percentage of fuel is by-passed through the regulating valve (3) back to the inlet side. The flow of this positive displacement pump increases with speed and the regulating valve is designed so transfer pump pressure also increases with speed.

Fig. 3



Fuel, under transfer pump pressure, is forced through the drilled passage (4) in the hydraulic head into the annulus (5). It then flows around the annulus to the top of the sleeve and through a connecting passage (6) to the metering valve (7). The radial position of the metering valve, controlled by the governor, regulates the flow of fuel into the charging ring (8) which incorporates the charging ports.

As the rotor revolves, the two inlet passages (9) register with two charging ports in the hydraulic head, allowing fuel to flow into the pumping cylinders. With further rotation the inlet passages move out of registry and the single discharge port of the rotor registers with one of the head outlets. While the discharge port is opened, the rollers (10) contact the cam lobes forcing the plungers together. Fuel trapped between the plungers is then delivered to the nozzle.

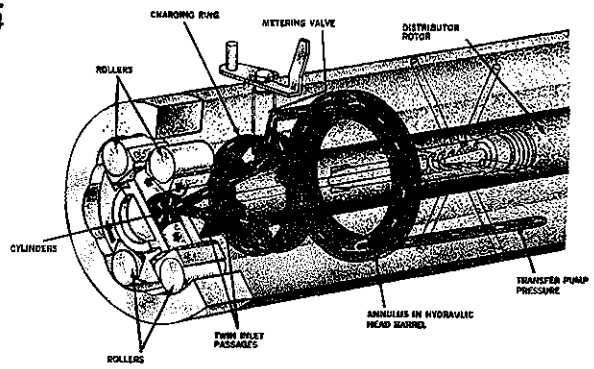
Lubrication of the pump is an inherent characteristic of the Roosa Master design. As fuel at transfer pump pressure reaches the charging ports, slots on the rotor shank allow fuel and any entrapped air to flow into the pump housing cavity.

In addition, an air bleed arrangement is incorporated in the hydraulic head which connects the outlet side of the transfer pump with the pump housing cavity. This allows air and some fuel to be bled back to the fuel tank via the return line. The fuel thus by-passed helps lubricate the internal components.

Construction and Operation

C. CHARGING AND DISCHARGING

Fig. 4

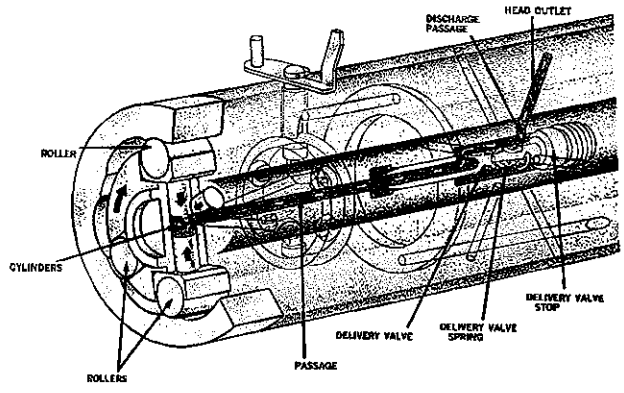


Charging Cycle

As the rotor revolves, Fig. 4, the angled inlet passages in the rotor register with opposite charging ports of the charging ring. Fuel under pressure from the transfer pump and controlled by the opening of the metering valve flows into the pumping cylinders forcing all four plungers apart.

The plungers move outward a distance proportionate to the amount of fuel required for injection on the following stroke. If only a small quantity of fuel is admitted into the pumping cylinders, as at idling, the plungers move out very little. Maximum plunger travel and, consequently, maximum fuel delivery is limited by adjustable leaf springs which contact the edge of the roller shoes. Only when the engine is operating at full load will the plungers move to the most outward position. Note in Fig. 4 that while the angled inlet passages in the rotor are in registry with the ports in the charging ring, the rotor discharge port is not in registry with a head outlet. Note also that the rollers are between the cam lobes. Compare their relative positions in Figs. 4 and 5.

Fig. 5



Discharge Cycle

As the rotor continues to revolve, Fig. 5, the inlet passages move out of registry with the charging ports. For a brief interval the fuel is trapped until the rotor discharge passage registers with one of the head outlets. As this registration takes place, both sets of rollers contact the cam lobes and are forced together. During this stroke the fuel trapped between the plungers is forced through the axial passage of the rotor and flows through the rotor discharge passage to the injection line. Delivery to the line continues until the rollers pass the highest point on the cam lobe and are allowed to move outward. The pressure in the axial passage is then relieved, allowing the injection nozzle to close.

D. DELIVERY VALVE FUNCTION

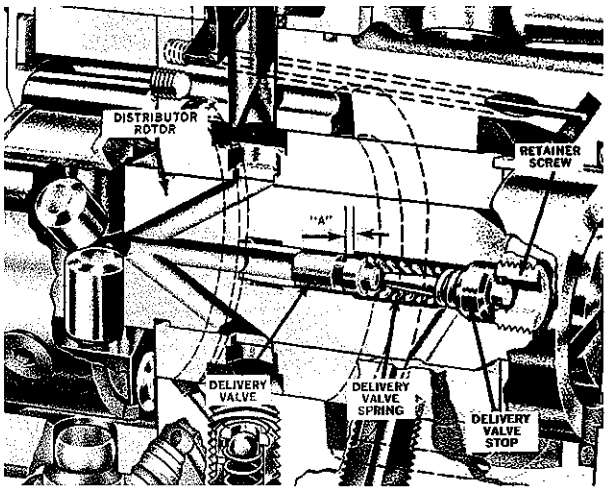
Controlled Line Retraction, the most significant function of the delivery valve, is accomplished by rapidly decreasing the injection line pressure after injection to a predetermined value lower than that of the nozzle closing pressure. This reduction in pressure causes the nozzle valve to return rapidly to its seat, achieving sharp delivery cut-off and preventing dribble of fuel into the combustion chamber.

The delivery valve. which is located and operates in a bore in the center of the distributor rotor, is simply constructed. It requires no seat—only a shoulder to limit travel. Sealing is accomplished by the closely fitted bore into which it fits. Since the same delivery valve performs the function of retraction for each line, the retracted amount will not vary from cylinder to cylinder. This results in an extremely smooth-running engine at all loads and speeds.

When injection starts, fuel pressure moves the delivery valve slightly out of its bore and adds the volume of its displacement section "A" to the enlarged cavity of the rotor occupied by the delivery valve spring. This displaces a similar volume of fuel in the spring cavity before delivery through the valve ports starts.

At the end of injection, the pressure on the plunger side of the delivery valve is quickly reduced by allowing the cam rollers to drop into a retraction step on the cam lobes. Cam retraction value is slightly more than delivery valve retraction value.

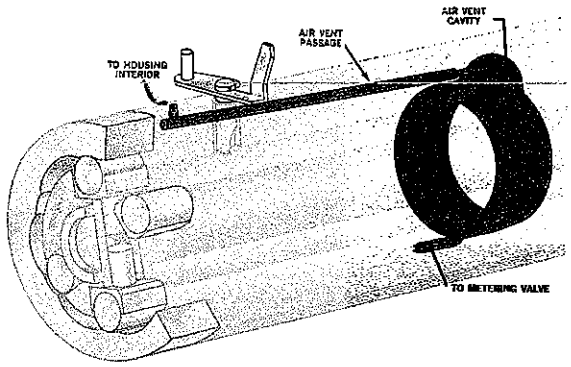
Fig. 6



As the valve returns to its closed position, it removes its displacement section "A" from the spring cavity and, since the rotor discharge port is still partly in registry, fuel rushes back out of the injection line to fill the volume left by the retreating delivery valve.
Following this, the rotor ports close completely and the remaining injection line pressure is trapped.

E. RETURN OIL CIRCUIT

Fig. 7



Fuel under transfer pump pressure is discharged into a cavity in the hydraulic head (See Fig. 7). The upper half of this cavity connects with a vent passage, the volume of which is restricted by a wire to prevent undue pressure loss.

The vent passage is located behind the metering valve bore and connects with a short vertical passage entering the governor linkage compartment.

Should air enter the transfer pump because of suction-side leaks, it immediately passes to the air vent cavity and then to the vent passage as shown. Air and a small quantity of fuel then flow from the housing to the fuel tank via the return line.

F. END PLATE OPERATION

The end plate is common to all models of the pump and varies only slightly between applications. Its three basic functions are:

1. To provide the fuel inlet passage and house the pressure regulating valve
2. To cover the transfer pump
3. To absorb end thrust transmitted by the drive and governor

Fig. 8

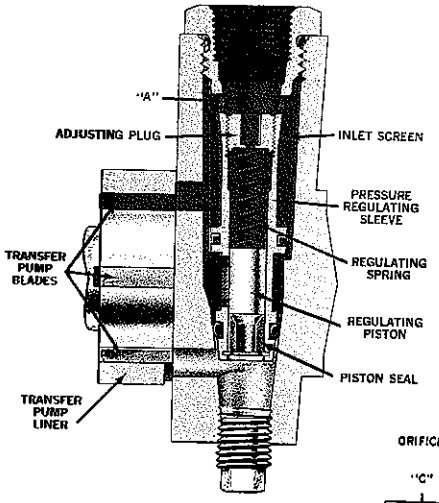
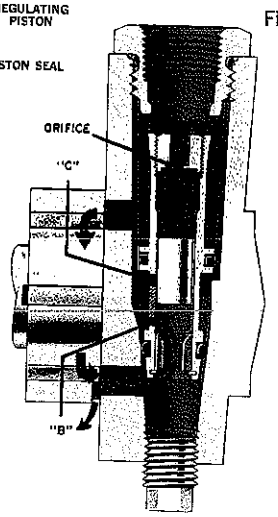


Fig. 9



During hand priming, Fig. 8, the fuel flows into the inlet side of the transfer pump through the port "A". Priming of the rest of the system is accomplished when the pump is rotated by the engine starter or on the test bench.

Fig. 9 shows the operation of the pressure regulating valve while the pump is running. Fuel pressure from the discharge side of the transfer pump forces the piston up the sleeve against the regulating spring. As pressure increases, the regulating spring is compressed slightly until the lower edge of the regulating piston starts to uncover port "B". Since the pressure on the piston is opposed by the regulating spring, the delivery pressure of the transfer pump is controlled by the spring rate and size and number of regulating ports.

A high pressure relief port "C" is incorporated in the sleeve, above the regulating port, to prevent excessively high transfer pump pressures if the engine or pump is accidentally overspeeded.

Construction and Operation

VISCOSITY COMPENSATION

(Refer to Fig. 9.)

The DC pump works equally well with different fuels and varying temperatures which affect fuel viscosity. A unique and simple feature of the regulating device offsets pressure changes caused by viscosity difference. Located in the bottom of the spring adjusting plug is a thin plate containing a sharp edged orifice. This orifice allows fuel leakage by the piston to return to the inlet side of the pump. Flow through such a short orifice is virtually unaffected by viscosity changes. For this reason the fuel pressure on the spring side of the piston will vary with viscosity changes. The pressure exerted on top of the piston is determined by the flow admitted past designed clearance of the piston in the sleeve. With cold or heavy fuels, very little leakage occurs past the piston and flow through the adjusting plug is a function of the orifice size. Downward pressure on the piston is thus very little. With hot (or light) fuels, leakage past the piston increases. Pressure in the spring cavity increases also, since flow through the short orifice remains the same as with cold fuel. Thus, downward pressure, assisting the regulating spring, positions the piston so less regulating port area is uncovered below it. Pressure is thus controlled and may actually over-compensate to offset other leakages in the pump which increase with the thinner fuels.

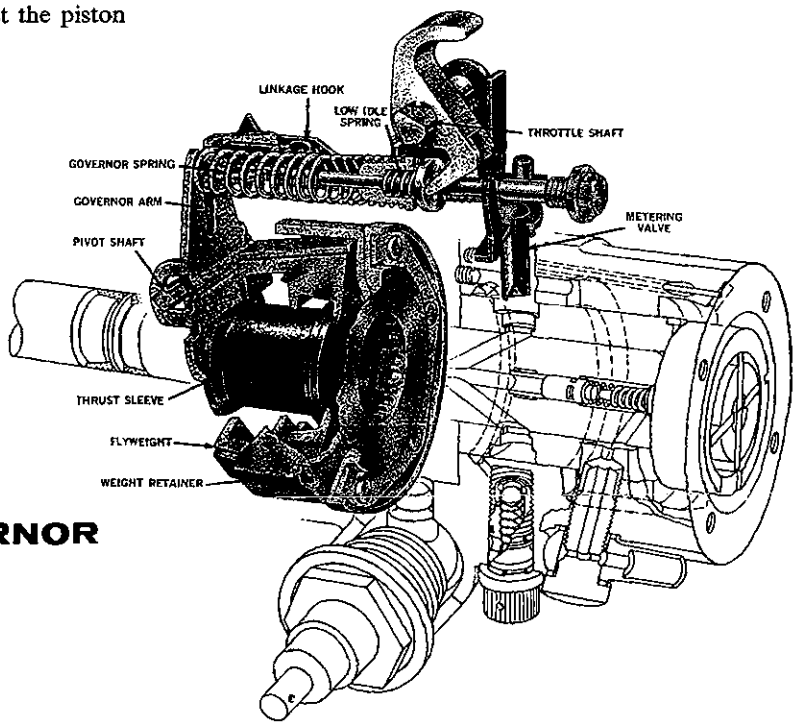


Fig. 10

G. CENTRIFUGAL GOVERNOR

In the centrifugal governor, Fig. 10, the movement of the flyweights against the governor thrust sleeve rotates the metering valve. This rotation varies the registry of the metering valve opening with the passage from the transfer pump, thus controlling the flow to the engine. This type of governor derives its energy from flyweights pivoting on their outer edge in the retainer. Centrifugal force tips them outward, moving the governor thrust sleeve against the governor arm, which pivots on the knife edge of the pivot shaft and, through a simple positive linkage, rotates the metering valve. The force on the governor arm caused by the flyweights is balanced by the compression type governor spring, which is manually controlled by the throttle shaft linkage in regulating engine speed.

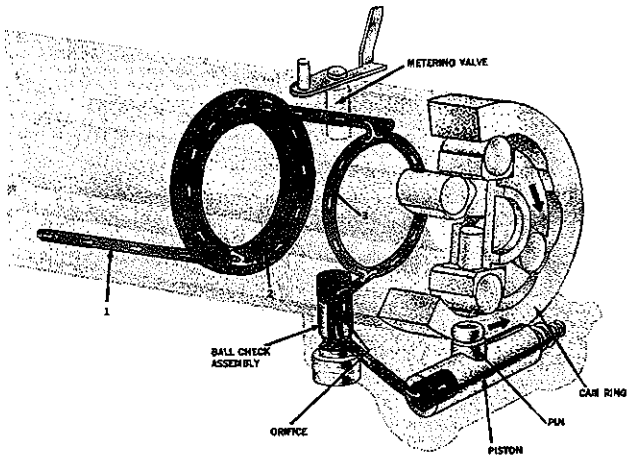
A light idle spring is provided for more sensitive regulation at the low speed range. The limits of throttle travel are set by adjusting screws for proper low idle and high idle positions.

A light tension spring takes up any slack in the linkage joints and also allows the stopping mechanism to close the metering valve without overcoming the governor spring force. Only a very light force is required to rotate the metering valve to the closed position.

H. AUTOMATIC ADVANCE

The Roosa Master design permits the use of a simple, hydraulic servo-mechanism, powered by oil pressure from the transfer pump, to rotate the cam ring and vary injection timing.

Fig. 11



Fuel under transfer pump pressure is forced through the drilled passage (1) located in the hydraulic head to the annular ring (2). It then flows around and to the top of the annular ring where it registers with the bore leading to the metering valve. The metering valve is designed to allow a quantity of fuel to flow into a second annular ring (3), the bottom of which registers with the bore of the head locating screw. Fuel is directed through a spring loaded ball check in the locating screw and ported to the advance piston. Fuel pressure behind the piston must overcome the opposing spring force in order to move the cam to the advanced position. The ball check offsets the normal tendency of the cam to return to the retard position during injection. A small orifice below the ball check allows gradual bleeding of the fuel from behind the piston when the engine requires retarded timing.

Two types of advance are provided to suit various engine designs.

1. SPEED ADVANCE

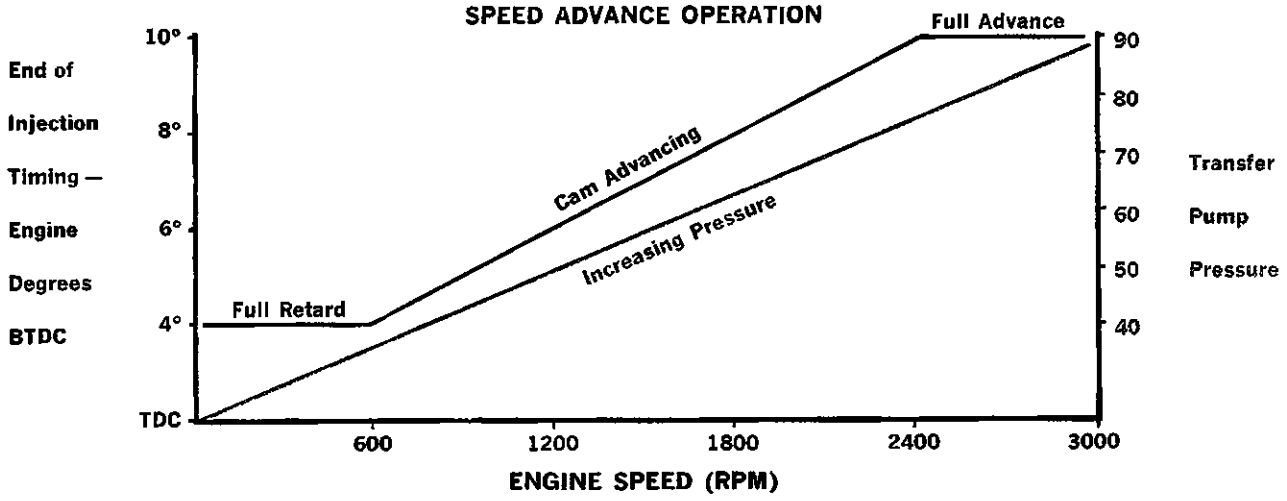
Speed advance advances or retards start of fuel delivery in response to engine speed changes. In most hydraulic injection systems, the actual beginning of injection will begin later (in engine degrees of rotation) as the speed increases.

Compensating for this inherent injection lag will often improve the high end performance of the engine. Speed advance, by starting delivery of fuel to the nozzle earlier when the engine is operating at higher speed, insures that combustion takes place when the piston is in its most effective position to produce maximum power. With speed advance, a secondary port on the metering valve remains open to the advance circuit regardless of the radial position of the valve. The advance piston, therefore, is always exposed to fuel under transfer pump pressure. At low speeds, because transfer pump pressure is comparatively low, the cam remains retarded. When engine speed increases, transfer pump pressure rises, moving the advance piston and rotating the cam against the direction of rotor rotation.

Total movement of the cam advance is limited by the piston length. When engine speed is reduced, the spring returns the cam to the retarded position and fuel behind the piston is allowed to bleed off through the orifice in the ball check assembly.

A "trimmer screw" may be provided to adjust advance spring preload and start of the cam movement. It can be incorporated at either side of the advance device and may be adjusted on the engine while running.

Fig. 12



Construction and Operation

2. LIGHT LOAD ADVANCE

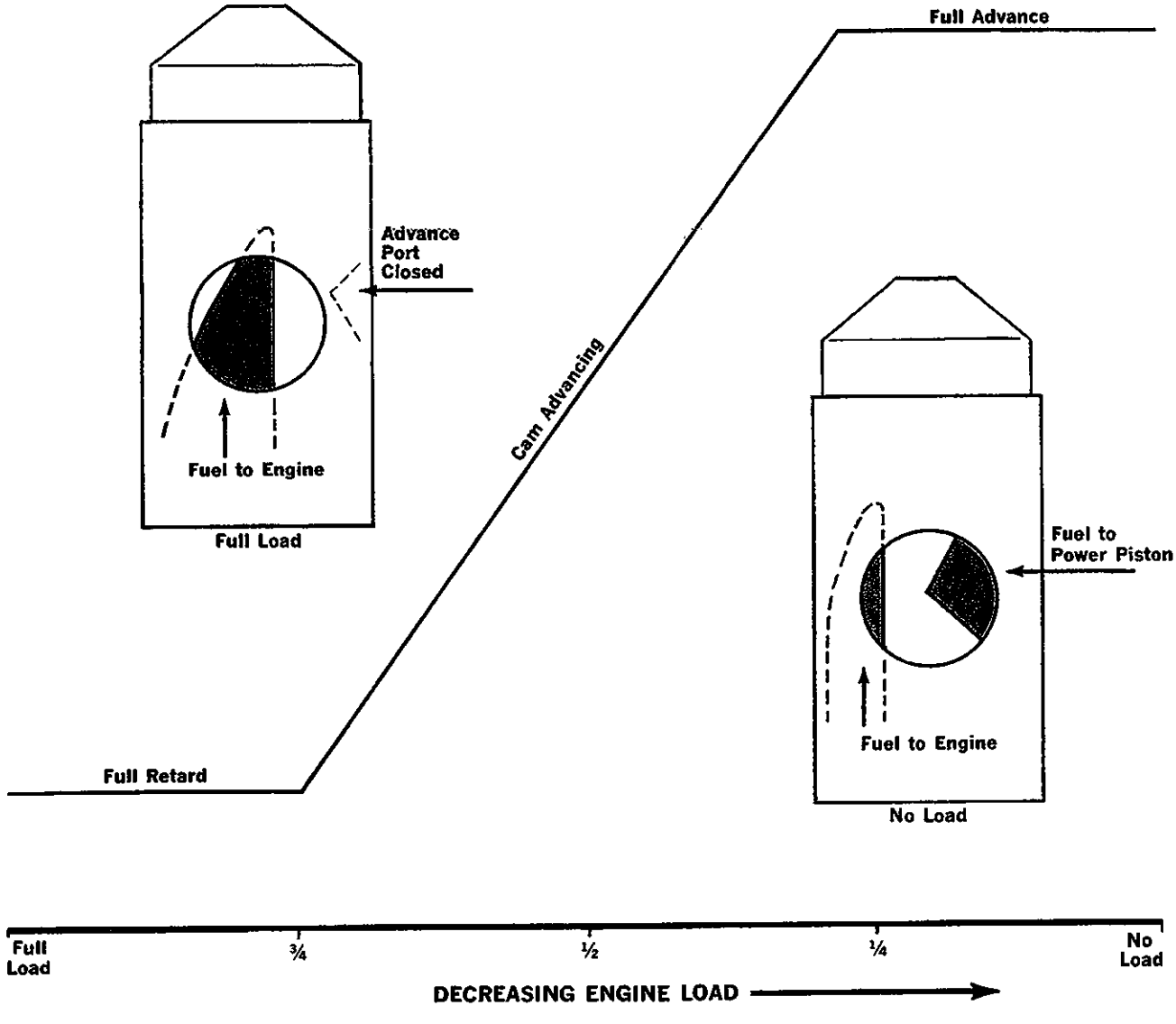
Load advance advances or retards start of fuel delivery in response to engine load changes. An inherent characteristic of inlet metering pumps is the retardation of injection timing as engine load is decreased. This is caused by the fact that during light load operation the plungers move out only part way, and the rollers, which actuate the pumping plungers, contact the lobes of the cam further up the cam ramp.

In some engines this retardation causes missing and exhaust sputter at light engine loads as the combustion chambers have cooled down. This condition is most prevalent with pre-combustion chamber engines.

The purpose of the load advance device is to offset the retardation of timing at light loads by advancing the cam. The metering valve in a light load advance pump contains a secondary port which controls fuel flow to the advance circuit. The amount of port opening will vary depending upon the radial position of the valve. The port is at maximum opening when the governor positions the valve for low fuel delivery to the engine (light load). At this valve position, fuel flow to the piston advances the cam. Total advance movement is limited by piston length. As load is applied to the engine and the governor allows the metering valve to open, the advance port on the valve throttles the fuel passing to the advance piston. The spring force behind the piston will then move the cam back to its retarded position for full load operation. Advance port opening can be varied by changing metering valve height through an external adjustment, providing proper advance motion in each individual pump.

Fig. 13

LOAD ADVANCE CONTROL
(Metering Valve Positions)



Removal From Engine

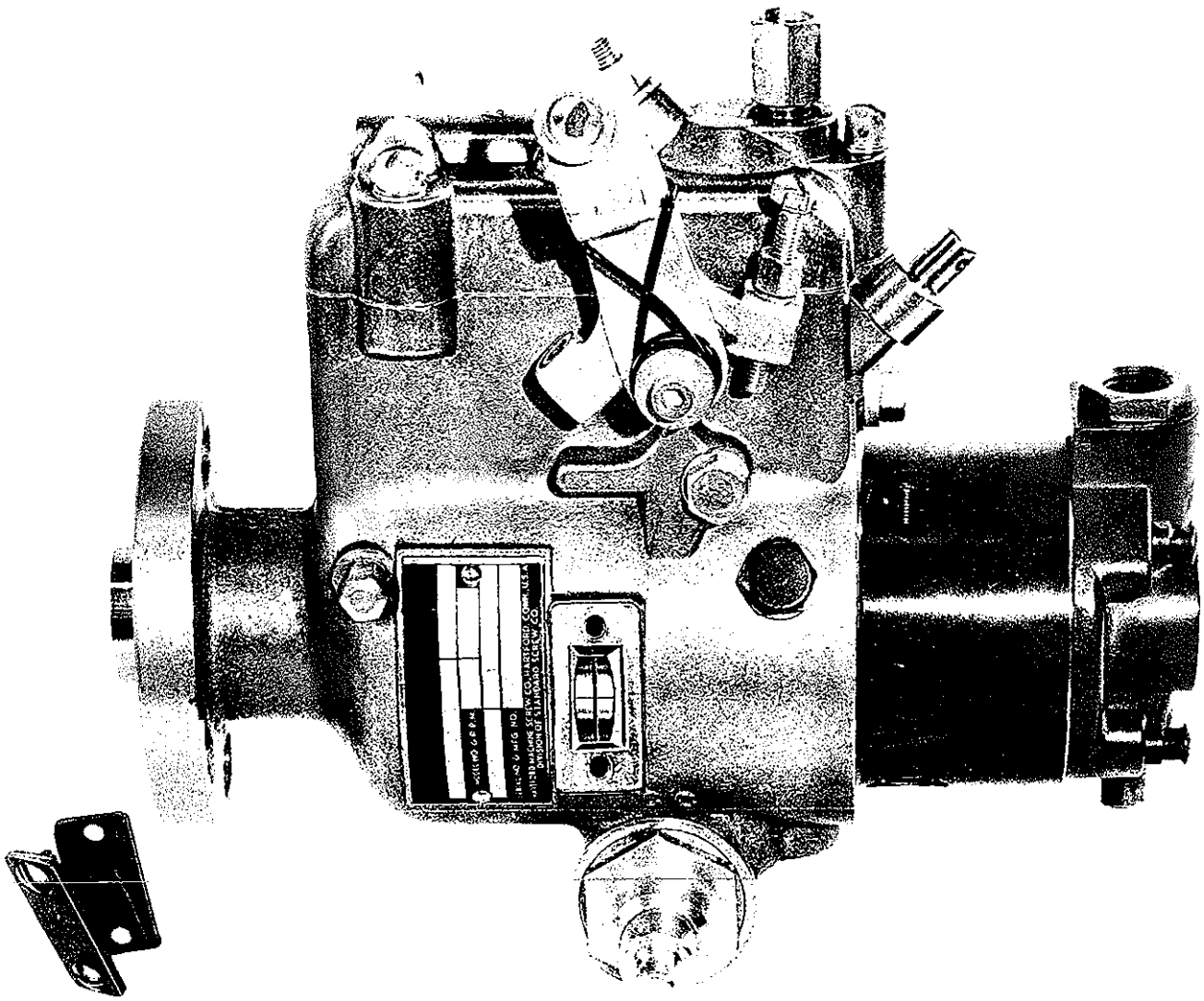


Fig. 14

The procedure described below for removal of the Roosa Master Pump from the engine should be followed in detail to assure ease of pump re-installation.
There are two types of pump installations:

1. Drive shaft part of pump assembly
2. Drive shaft part of engine drive assembly — remains with engine

Refer to your engine manual to determine type of installation.

A. Clean and wash down pump, fittings, and all connections to be broken to eliminate any chance of dirt entering the system when lines are disconnected.

CAUTION: All openings should be temporarily plugged as lines are disconnected.

B. Check the engine manual for proper timing position of crankshaft. Bar the engine in correct direction of rotation until the engine timing mark is indexed and the No. 1 cylinder is on compression stroke. Remove the timing window cover from the outboard side of the pump. The timing line on the governor weight retainer hub should be directly opposite the line on the cam. Engine performance will be poor if these lines are not indexed properly.

C. Disconnect the fuel supply, return, and nozzle leak-off lines and all high pressure lines. Plug all openings.

D. Disconnect throttle and shut-off linkage.

E. Remove mounting nuts on the pump flange.

F. Slide pump gently from location. Be careful not to damage the pilot tube by cocking pump on removal.

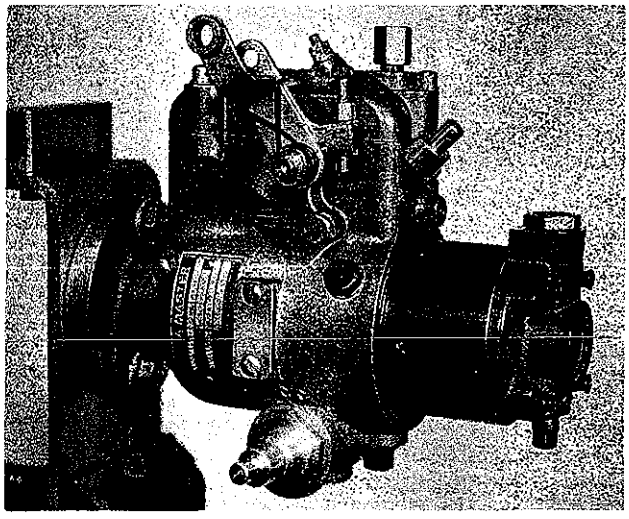
Disassembly

STUDY THE MANUAL FIRST. Before commencing the disassembly of the pump, remove all external grease and dirt by washing the unit with fuel oil and blowing it off with filtered, compressed air. It must be constantly kept in mind that dirt, dust, and foreign matter are the greatest enemies of the fuel injection pump. As an added precaution to prevent dirt from entering the fuel system while servicing the pump, it is recommended that **a clean work-space, clean tools, and clean hands be used.**

A clean pan should be available in which the parts may be placed upon disassembly, and a pan of clean fuel oil should be available in which the parts may be flushed. It is recommended that these be deep drawn pans with rounded corners to lessen the chances of dirt pockets.

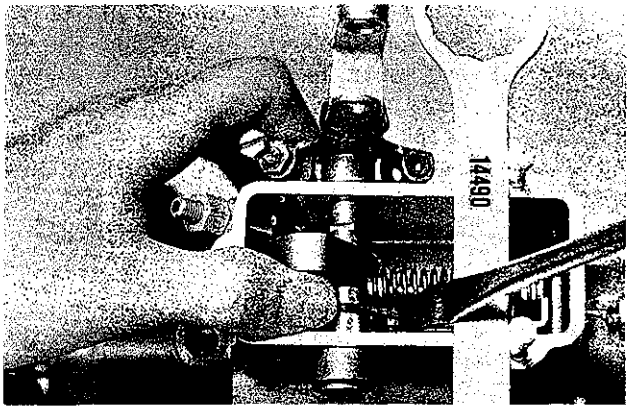
STEP 1 Mount the pump in Roosa Master fixture #13363 as shown. Never clamp the pump in a vise without using the fixture. Remove all seal wires. Unscrew the three cover hold-down screws and remove the governor control cover and cover gasket.

Fig. 15



STEP 2 The shut-off cam or shaft retainer may be removed by using a screwdriver or service tool #13339 as shown. Tool #14490 laid across the top against two cover screws will provide proper leverage.

Fig. 16



STEP 3 Withdraw the shut-off shaft. Slide the throttle shaft lever off the throttle shaft, and using a rotary motion, withdraw the throttle shaft assembly from its position.

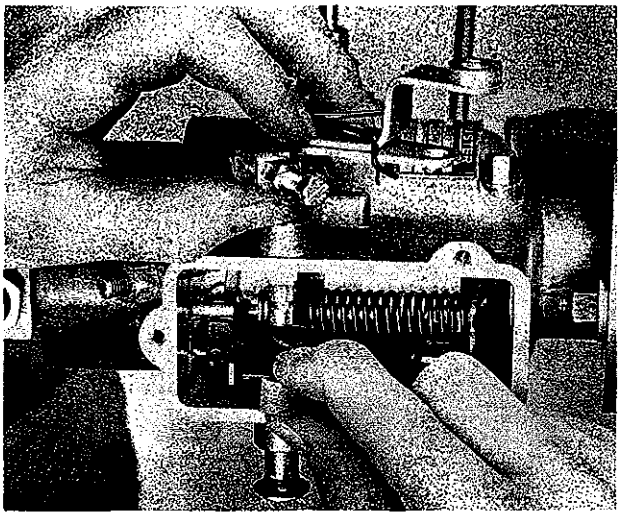


Fig. 17

STEP 4 Hold the governor spring, idle spring guide, idle spring, and spring retainer firmly between the thumb and forefinger. Loosen and remove the guide stud and its washer. Lift out the governor spring components.

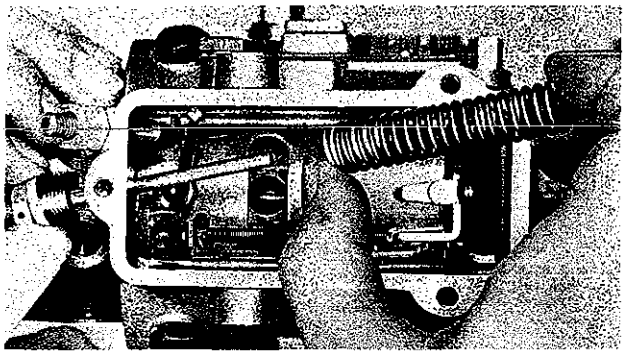


Fig. 18

STEP 5 While depressing the metering valve and holding one finger over damper and spring (if used), raise the governor linkage hook at the metering valve end to clear the metering valve arm pin. Remove the damper and spring. Pull the linkage hook back slightly to disengage it from the governor arm and place it over the side. Do not disengage the linkage spring.

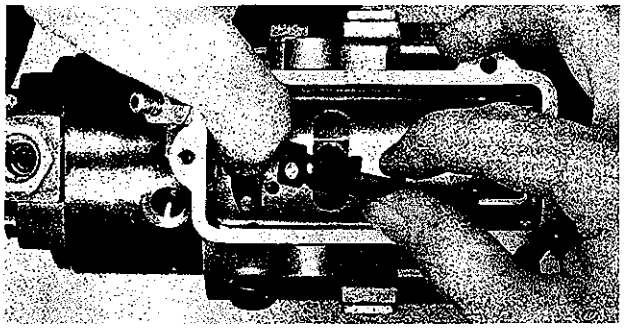
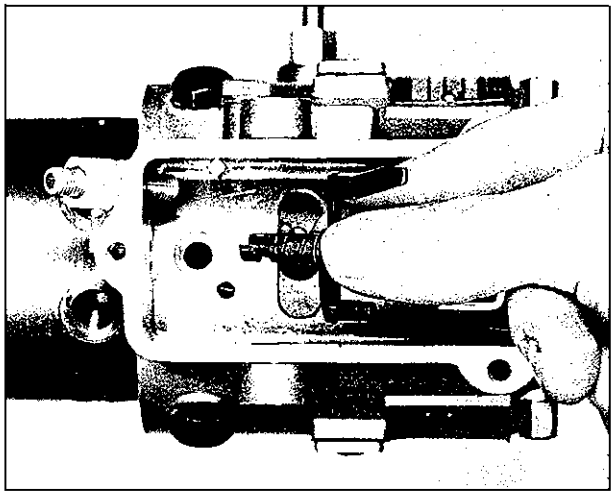


Fig. 19

STEP 6 Remove the metering valve and spring.

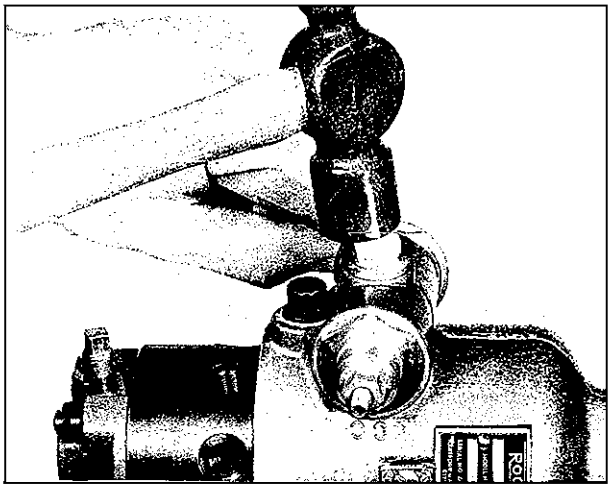
Fig. 20



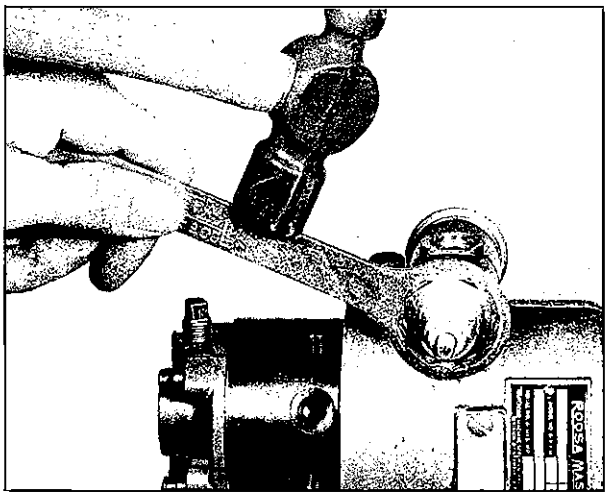
STEP 7 Invert the pump and holding fixture as a unit in the vise. NOTE: If the pump does not employ an auto advance, remove head and cam locating screws and proceed with Step #12.

Fig. 21

a



b



STEP 8 Loosen and remove the cam advance screw hole plug as shown. Loosen the spring side piston hole plug by tapping as shown. Remove the piston hole plug and advance spring components. NOTE: The sides of the housing just above the advance bear a "C" or "CC" marking for pumps of either rotation. The power side of the piston is located on the "C" side of a clockwise rotation pump and vice versa.

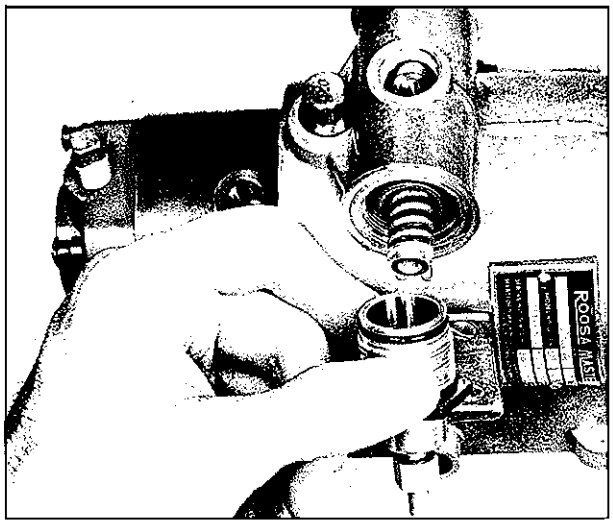


Fig. 22

STEP 9 Using one of the throttle lever adjusting screws as a puller, lift the advance pin. NOTE: If advance parts are rusted or otherwise jammed, a removal tool can be made using a flat washer and bushing #15550 as shown. The throttle adjusting screw can then be used as a puller to withdraw the pin.

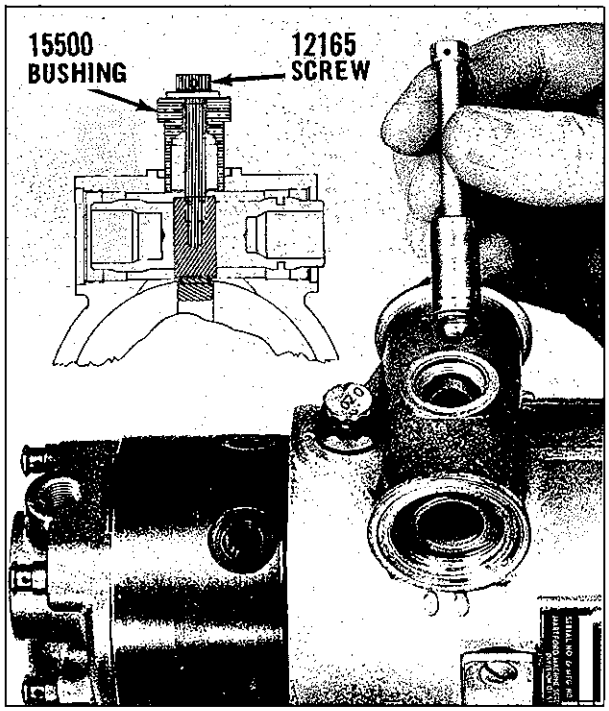
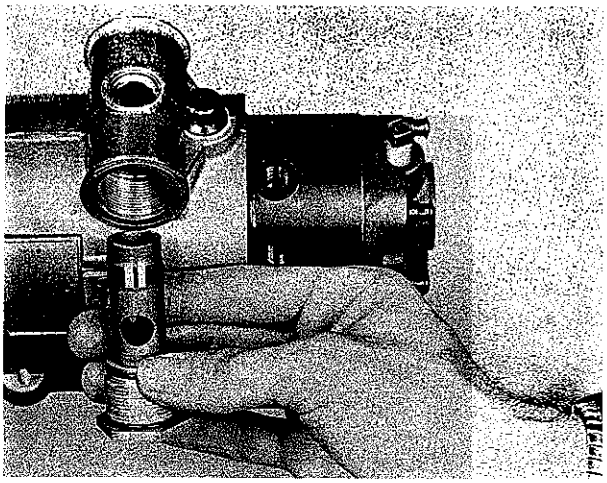


Fig. 23

Disassembly

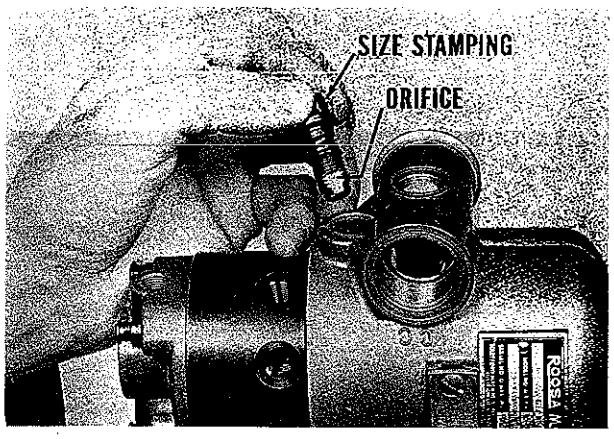
STEP 10 Loosen and remove the power side piston hole plug and advance piston. Withdraw the piston from the piston hole plug. Remove the advance piston ring and seal (if provided). Discard the seal.

Fig. 24



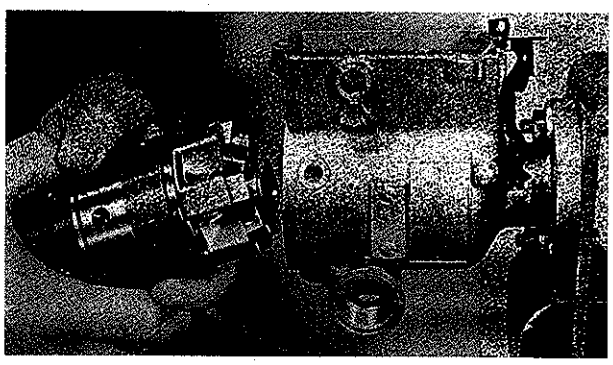
STEP 11 Remove the head locating screw assembly. Do not attempt to disassemble the ball check. If it is damaged, replace new. NOTE: Orifice size will vary with the application and the size is stamped on the screw head. A screw with the same orifice size must be used. Each is identified by part number.

Fig. 25



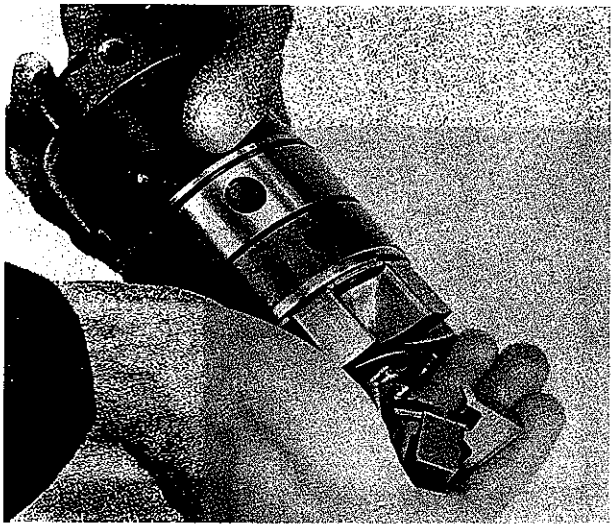
STEP 12 Invert the holding fixture in the vise. Loosen and remove the two head locking screws. Grasp the hydraulic head assembly firmly in both hands and withdraw with a slight rotary motion. Use caution not to drop the governor weights.

Fig. 26



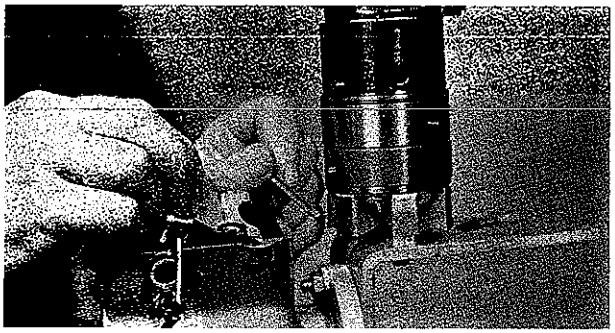
STEP 13 To disassemble the governor, invert the hydraulic head and let weights, governor thrust sleeve, and governor thrust sleeve washer fall into your hand.

Fig. 27



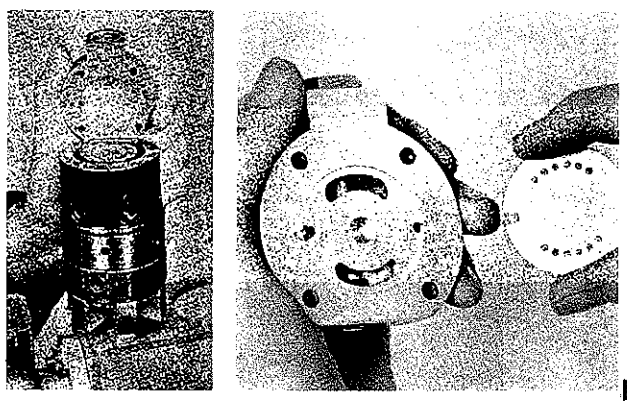
STEP 14 Place the hydraulic head assembly on the pump holding fixture so that the governor weight retainer engages the bar on the fixture. Remove one pivot shaft cap nut and seal and withdraw the pivot shaft from the housing. The governor arm and linkage hook may now be removed.

Fig. 28



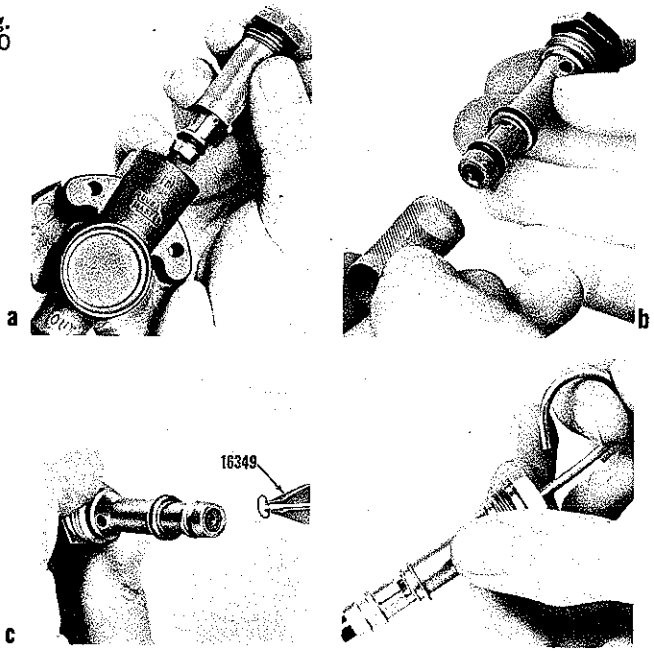
STEP 15 Remove the four end plate screws and lift off the end plate. The end plate has a separate, hardened, thrust disc which can be removed for inspection. *Do not remove the locating pin in the end plate.*

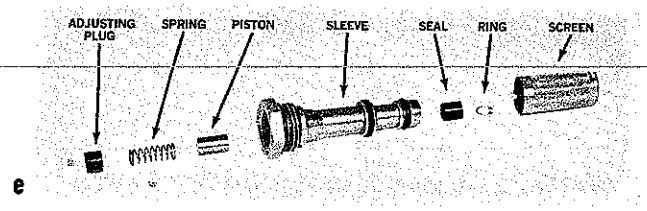
Fig. 29



STEP 16 Remove the pressure regulating sleeve assembly. Slide off the inlet screen. Remove the adjusting plug using tool #13336. Shake out the regulating spring and plunger. Reverse the assembly and remove the retaining ring using tool #16349. The regulating piston seal can then be pushed out using tool #13301.

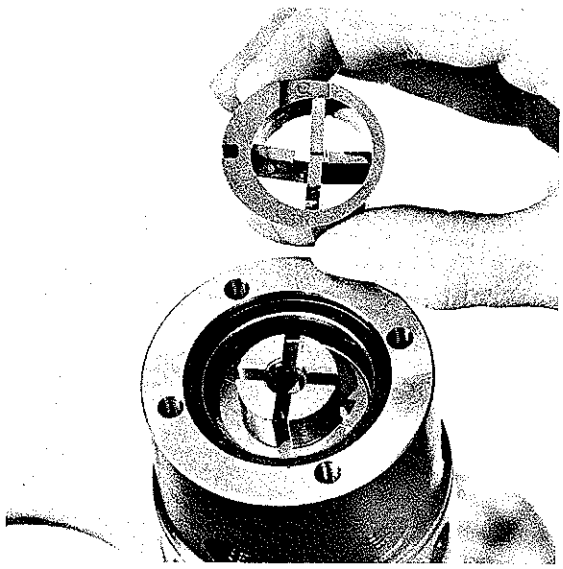
Fig. 30





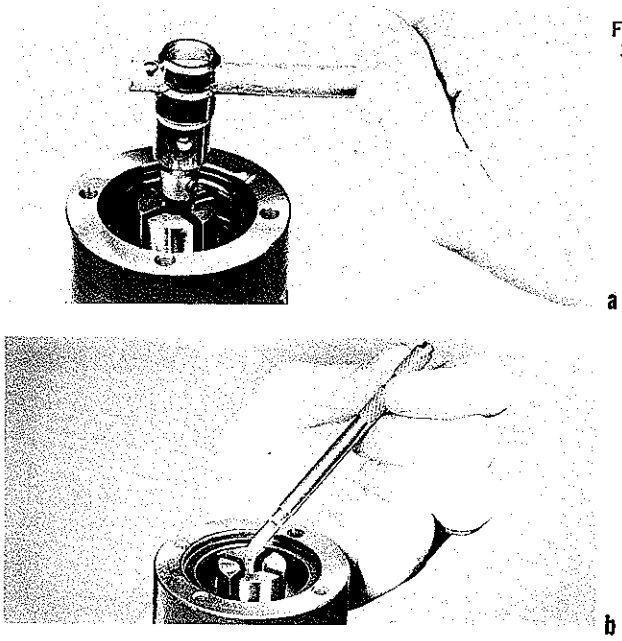
STEP 17 To disassemble the transfer pump, lift out the transfer pump seal, liner, and blades.

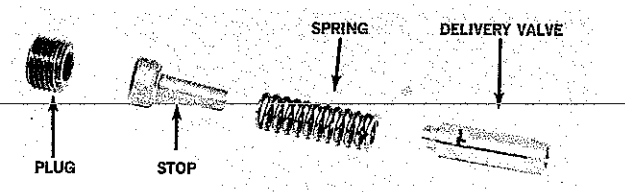
Fig. 31



STEP 18 With a socket set screw wrench, loosen and remove delivery valve retainer screw. Lift head and rotor assembly and shake delivery valve stop, spring, and delivery valve into the hand. If delivery valve sticks in its bore, remove it using delivery valve extractor tool as shown.

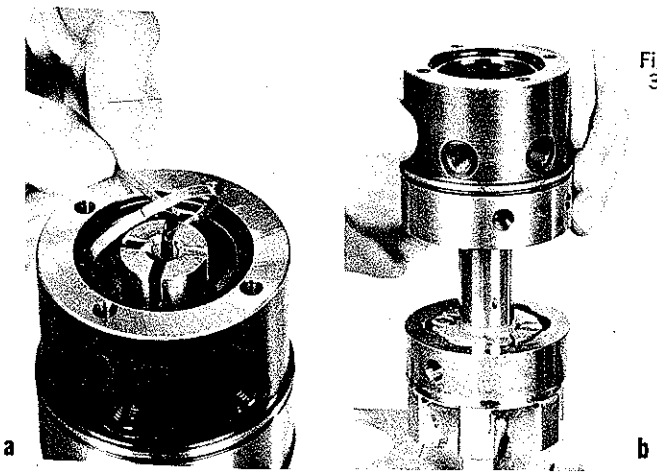
Fig. 32





STEP 19 Using a small-bladed screw driver or a dull scribe, disengage and remove the rotor retainer snap ring. This releases the rotor retainers which should now be moved outward as far as possible to clear the rotor. Gently lift the hydraulic head off the distributor rotor, as shown. Invert the head and shake out the rotor retainers.

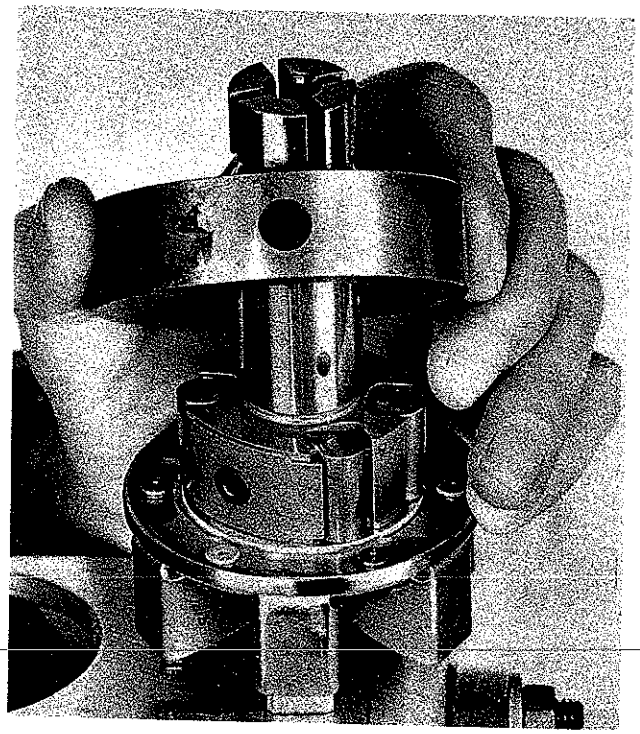
Fig. 33

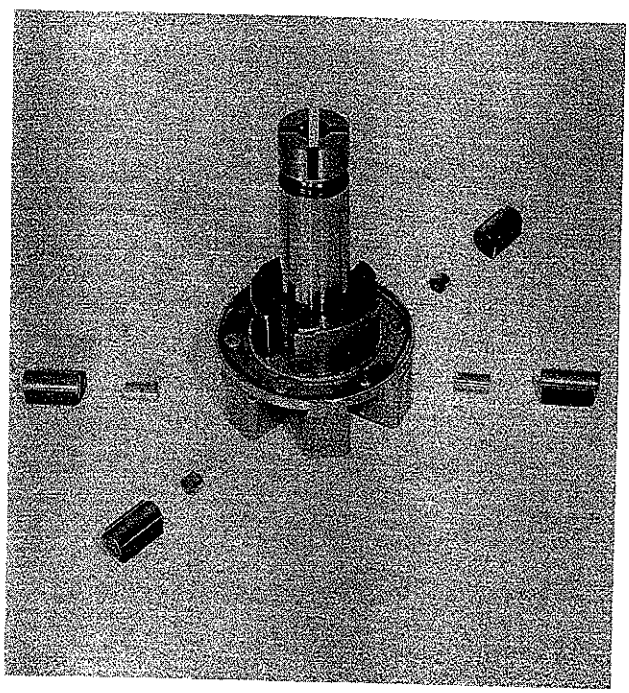


Disassembly

STEP 20 Lift off cam ring. Check and record roller-to-roller dimension as instructed on page 20, Step 6. Compare this dimension with that called for on the pump specification. Remove rollers and shoes and both sets of plungers. Reassembly may be more easily accomplished if the leaf springs are not removed and shoes with rollers are installed in their original positions. Leaf springs, if removed, should first be marked with a dye for original position reassembly. Do not remove locating pin from spline end of rotor.

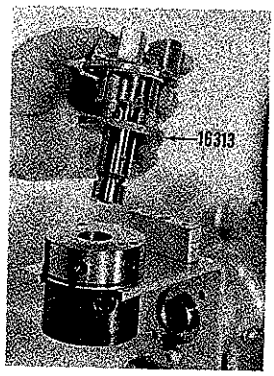
Fig. 34





b

STEP 21 Install the governor weight retainer removal support #16313 to the rotor as shown in Fig. 35 and assemble to the hydraulic head. Remove the governor weight retainer snap ring.

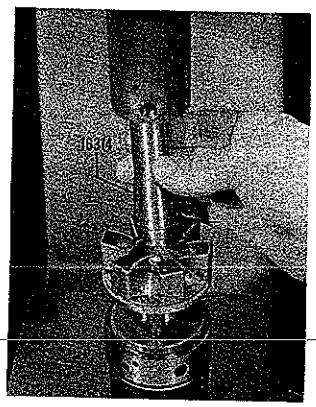


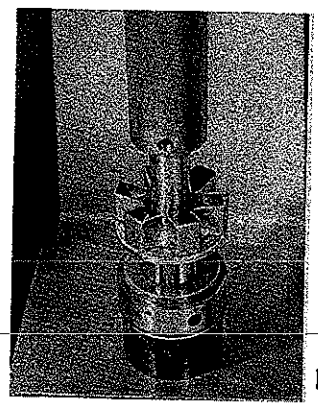
a

b

Fig. 35

STEP 22 Place tool #16314 over the rotor timing pin and, supporting the head on a flat surface, press the rotor from the weight retainer.





b

Fig. 36

STEP 23 The flexible retaining ring should be replaced whenever the pump is disassembled. Insert the snap ring pliers (service tool #13337) in the closed position, under the flexible retaining ring between any two of the rivets. Expand the pliers while applying pressure in an upward direction. A slight twisting motion will snap the ring off the rivet (See Fig. 37). Repeat this process until the retaining ring is free from all rivets. Discard the flexible retaining ring.

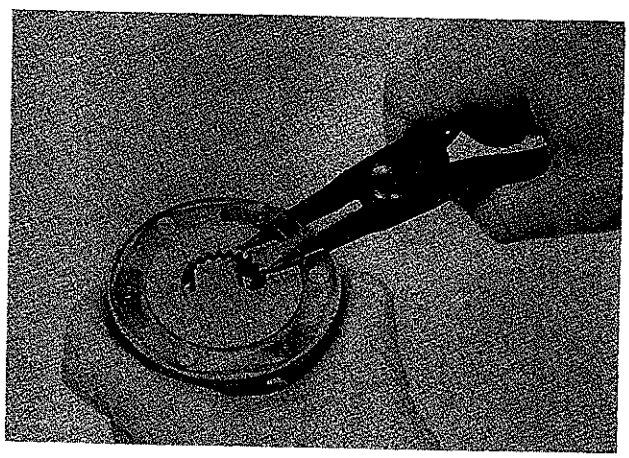


Fig. 37

Parts Inspection

Dirt is the greatest enemy of the fuel injection pump. Keep the work area clean.

Parts should be washed in a suitable solvent and then placed in a clean pan containing fresh fuel or calibrating oil.

Examine all parts carefully in accordance with instructions which follow:

A. GENERAL INSPECTION

Discard all "O"-rings, seals, and gaskets. Replace with appropriate Roosa Master gasket kits. Examine all springs for fretting, wear, distortion, or breakage. Clean and carefully check all bores, grooves, and seal seats for damage or wear of any kind.

Replace damaged or worn parts as necessary.

B. DETAILED INSPECTION

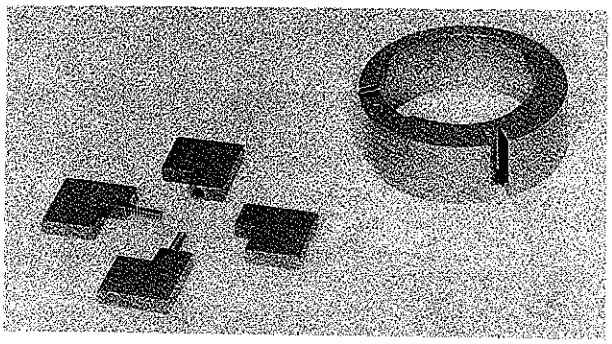
SUB-ASSEMBLY	PART	EXAMINE FOR: Excessive Wear	Foreign Material or Rust	Nicks or Chipping	Scratches or Scores	Thread Damage	Cracks	Distortion	Freedom of Movement	SPECIFICALLY INSPECT:
END PLATE	Regulating Sleeve		X	X	X	X	X	X		By-pass ports for clogging
	Regulating Piston	X	X	X	X				X	
	Thrust Plate	X	X	X	X		X	X		For wear from transfer pump end thrust
	End Plate Adj. Plug	X	X			X	X	X		Tightness in sleeve, plugged hole
	Inlet Strainer		X				X	X		Screen and soldered joint for breakage
TRANSFER PUMP	Liner	X	X	X	X					Inside diameter in low pressure area for wear
	Blades	X	X	X	X		X		X	See Supplementary Inspection 1, page 18
HYDRAULIC HEAD AND ROTOR	Hydraulic Head	X	X	X	X	X	X			Central and metering valve bores and ports
	Vent Wires		X						X	
	Plungers	X	X	X	X				X	See Supplementary Inspection 2, page 18
	Delivery Valve	X	X	X	X		X	X	X	
	Distributor Rotor	X	X	X	X	X	X	X	X	See Supplementary Inspection 3, page 18
	Cam Rollers & Shoes	X	X	X	X		X		X	See Supplementary Inspection 4, page 18
	Maximum Fuel Adj. Leaf Springs & Screws	X	X	X		X	X	X		Ground ends of main leaf spring engaging roller shoes for wear. Adjusting screws for tightness
GOVERNOR	Weights	X	X	X			X		X	See Supplementary Inspection 5, page 19
	Retainer	X	X	X			X	X	X	See Supplementary Inspection 6, page 19
	Thrust Sleeve	X	X	X	X		X	X		Points of contact with gov. arm for wear
	Thrust Washer	X	X	X	X		X	X		Points of contact with gov. wts. for wear
	Pivot Shaft	X	X	X		X	X	X		Chipped knife edge. Worn edge
	Linkage Hook	X	X	X		X	X	X	X	See Supplementary Inspection 7, page 19
	Governor Arm	X	X	X			X	X	X	Points of contact with thrust sleeve for wear
	Metering Valve	X	X	X	X				X	See Supplementary Inspection 8, page 19
	Metering Valve Arm	X	X	X	X		X	X		Pin for Looseness
CAM RING	Cam	X	X	X	X	X	X	X		See Supplementary Inspection 9, page 19
DRIVE SHAFT	Drive Shaft	X	X	X	X	X	X	X		See Supplementary Inspection 10, page 19
HOUSING	Housing	X	X	X	X	X	X	X		All seals, seats, bores and threads

Parts Inspection

C. SUPPLEMENTARY INSPECTION

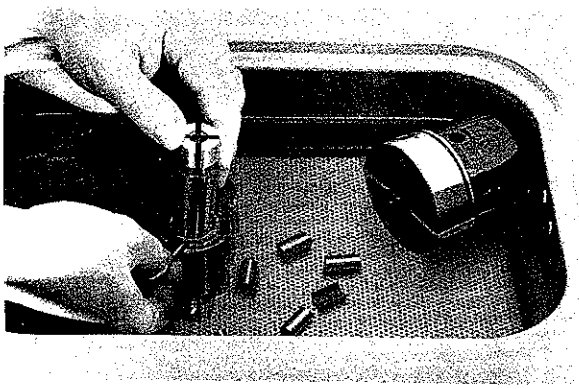
1. Transfer Pump Blades — Inspect with the utmost care. Check for chipping on any of the edges, including spring bore edges, pitting, imbedded foreign particles, or scoring on the rounded ends. Inspect flat surfaces visually for scores. If any discrepancies are noted, replace *both* blade sets.

Fig. 38

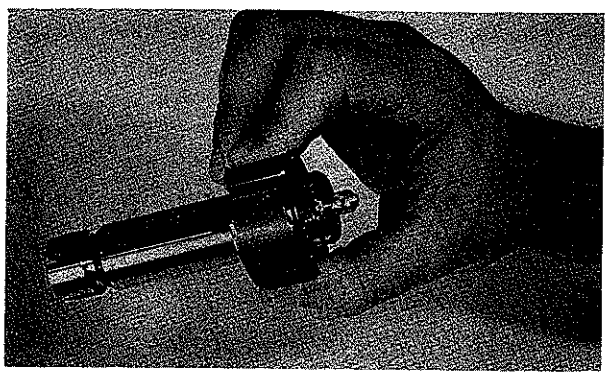


2. Plungers — While holding the rotor under clean oil, insert the longer plungers into their bore. With thumb and forefinger over the guide slots, tilt from side to side several times to insure complete freedom of movement. Interchanging or reversing their individual position may be necessary, as these are matched parts. Repeat with short set without removing first set. If the plungers were sticking, but not visibly damaged, clean both plungers and bore with a soft brush and lacquer-removing solvent such as lacquer thinner or acetone. (Do not force plungers into their bore and do not handle rotor shank.)

Fig. 39



a



b

3. Distributor Head and Rotor — Examine the radii contacted by the leaf springs, and the weight retainer drive spline for wear. Check all slots, charging and discharge ports for chipping or erosion of edges and the rotor shank for scratches. If damage or excessive wear is apparent, the head and rotor must be replaced as a mated unit. Examine the rotor timing pin for damage. Check alignment of tang (at side of rotor locating pin) with center of shoe slot and rotor discharge port. Check the vent wire in the hydraulic head air bleed passage for freedom of movement. If the wire is free, flush the head and blow out all passages with clean, dry air. If vent wire is stuck, replace it after thorough cleaning of the passage.

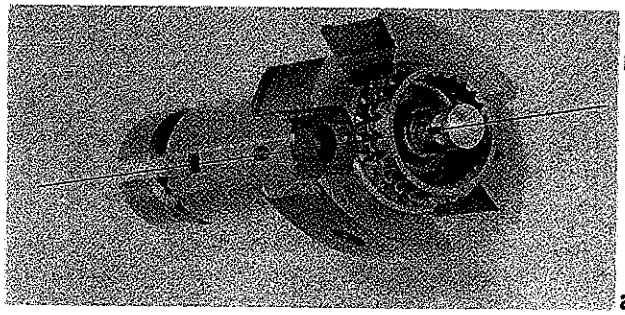
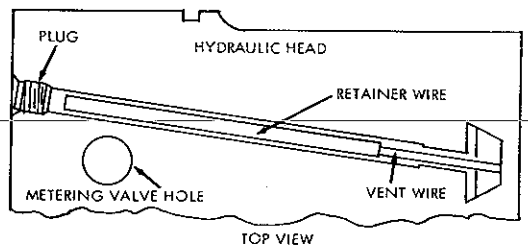


Fig. 40

a



b

4. Cam Rollers and Shoes — Check each roller in its shoe for freedom of rotation, and the top edge of each shoe, where retained by the leaf spring, for chipping or excessive wear. Improved roller surfaces will result from long, normal operation in clean fuel oil.

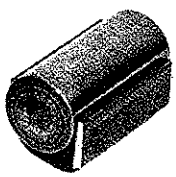


Fig. 41

5. Leaf Springs — Check for wear at points where the spring contacts the radii on the rotor and along the steps that retain the roller shoes.

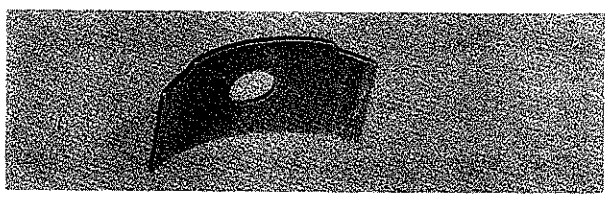


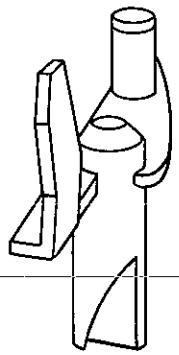
Fig. 42

6. Governor Weights and Retainer — Examine the retainer sockets where weights pivot, and pivot points of all weights for wear. If equipped with the flexible retainer, the elastic member must be replaced. If the retainer can be assembled to the distributor rotor by hand the retainer hub must be replaced. This assembly *must* be a press fit. No free play should be evident when the retainer is assembled to the rotor.

7. Governor Linkage — Inspect the pivot points of the governor arm and pivot shaft. Examine the governor arm tips where they contact the thrust sleeve. If wear is in excess of .003″ on either tip, discard and replace. Examine the metering valve pin hole in the linkage hook, the spring retainer, throttle shaft lever, shut-off cam, and especially the throttle and shut-off shaft assemblies where joined, for looseness or burrs.

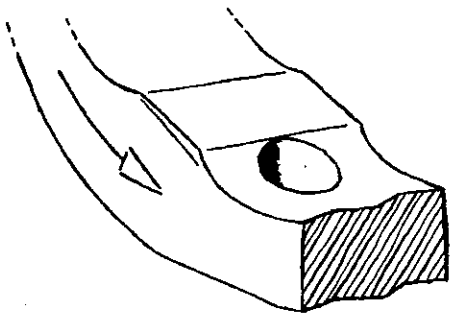
8. Metering Valve and Arm Assembly — Check the metering valve body for wear. Be sure the metering valve arm is well seated and that there is no radial movement of the arm on the valve. Check the metering valve spring for distortion and the metering valve arm pin for wear or looseness.

Fig. 43



9. Cam — Since only the working portions of the lobes on the I.D. are ground, the tool marks between lobes should not be considered damage. The cam finish is mottled from heat treatment rather than operation. Carefully inspect the I.D. and edges of all flat surfaces. If there is evidence of spalling or flaking out, replace with new cam. Improved cam lobe finish will result from long, normal operation in clean fuel oil. No lost motion between the advance pin and its bore in the cam should be apparent.

Fig. 44



10. Drive Shaft — Inspect the spline for undue wear or cracking. Check the shaft diameter where the governor thrust sleeve slides for scoring. The drive shaft seal grooves must be absolutely smooth for the seals to function properly. Check for alignment of timing roll pin as shown.

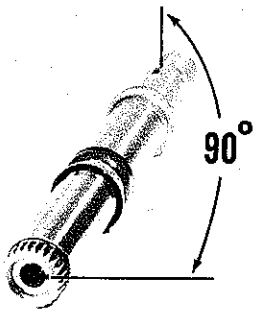


Fig. 45

11. End Plate — Check the regulating piston for freedom of movement in the sleeve. Check all threads for damage. The inlet screen must be inspected for damage. All dirt or rust must be removed from the assembly. **Do not attempt to remove liner locating pin unless obviously damaged.**

Reassembly

All parts must be thoroughly flushed in clean oil as they are being reassembled. Do not wipe dry. Cleanliness will contribute to long life and trouble-free operation. All seals and gaskets must be replaced, whether visibly damaged or not. NOTE: Refer to Torque Value Chart, before assembly.

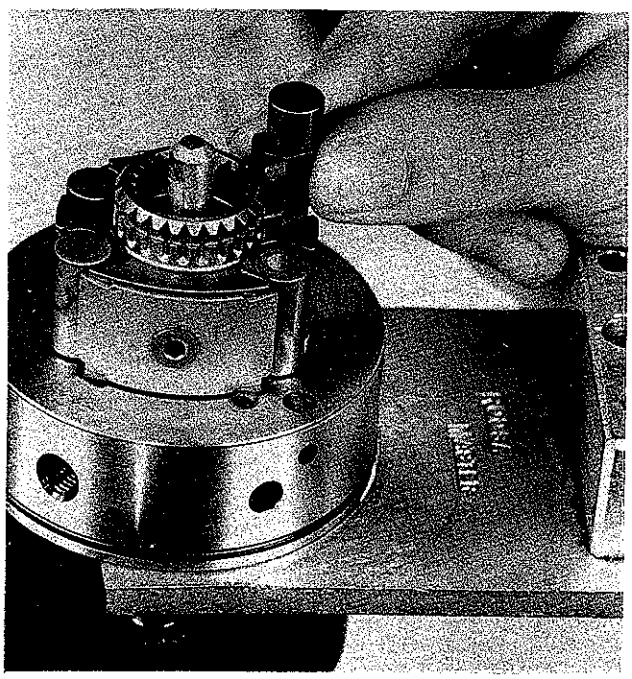
STEP 1 Rinse hydraulic head in clean calibrating oil. Blow out all ports and passages. If it was necessary to remove the vent and retainer wires, install them as shown in Fig. 40. Apply a *hard-setting* pipe compound to each head plug screw. Assemble and tighten securely. They should not protrude beyond the flat face of the hydraulic head.

STEP 2 With particular attention to Supplementary Inspection — 2. Plungers, Page 18, insert the pumping plungers into their bore.

STEP 3 Rinse distributor rotor in calibrating oil and assemble to the bore of the head with a slight rotary motion. Don't use force — binding or stickiness indicates dirt. Remove rotor and rinse once more.

STEP 4 Place the hydraulic head and rotor assembly in the holding fixture as shown and assemble the leaf springs. Insert the rollers and shoes and check for freedom of movement. NOTE: Roller shoes vary in size for different applications and are marked with a number on the end, e.g., "—5," "—15," "+10," etc. All four shoes must bear the same mark. The shoe size for a given application is determined by part number only.

Fig. 46



STEP 5 Install tool #16182, placing the pin in the metering valve bore and securing with a head locking screw. Use a connector screw washer under the head of the screw. Loosen the dial indicator retaining screw and slide the indicator to its outer limit. Install head locating fitting #11370 hand tight and connect to a supply of clean, filtered, compressed air. Regulate the air pressure to 40-100 psi.

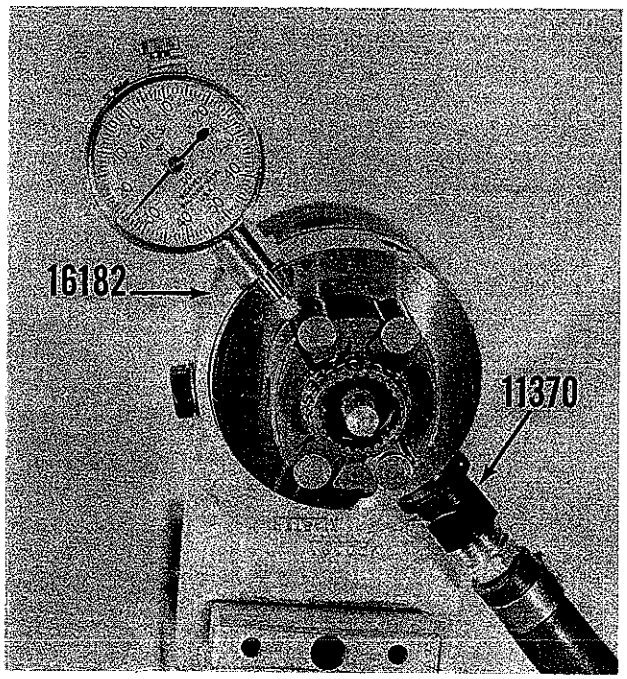


Fig. 47

STEP 6 Refer to specification for correct roller-to-roller dimension. Set *both* sets of rollers as required adjusting each leaf spring alternately. Since each roller-shoe for a given cylinder is controlled by a separate leaf spring, it may be necessary to invert or interchange leaf springs to obtain correct dimensions on both sets of rollers. Roller settings of both cylinders must be within .003" of each other.

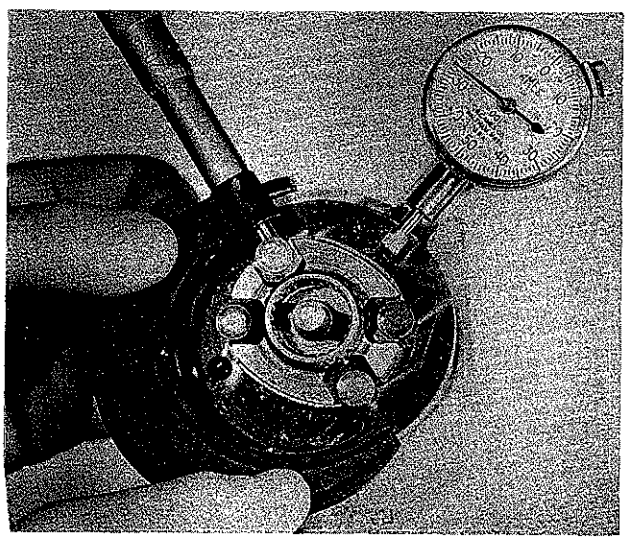
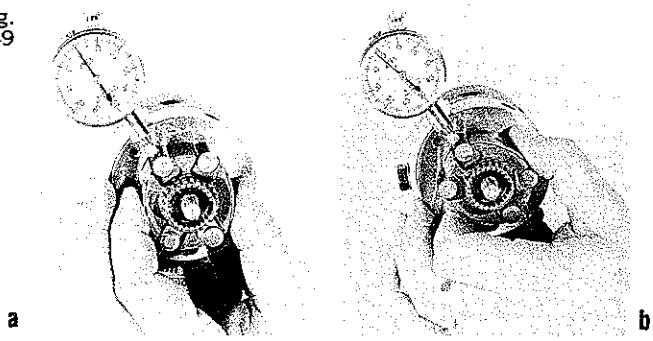


Fig. 48

STEP 7 Check centrality of the rollers (to assure that each one starts its pumping stroke at the same time) as follows: a) Rotate distributor rotor until one roller is aligned with dial indicator plunger. Slide indicator inward until plunger depresses at least .010″. Lock indicator retaining screw. "Zero" indicator on high point of roller by rotating knurled dial. b) Rotate distributor rotor (either direction) until the next roller depresses dial indicator plunger. Allowable centrality is ±.002″ (total .004″). *Before making any correction,* check and record centrality of all four rollers. c) If roller centrality is beyond specified tolerance, rollers and/or shoes can be interchanged. Recheck centrality after each change. Be sure to recheck roller-to-roller dimension as in STEP 6.

Fig. 49



a b

STEP 8 Place the cam ring atop the hydraulic head with the arrow indicating the proper direction of pump rotation facing upward. Remember that pump rotation is always expressed as viewed from the drive end. The pump will not deliver fuel with incorrect assembly of the cam ring.

Fig. 50

STEP 9 Place the weight retainer cage with the three rivets face up on the work bench. Assemble the weight retainer hub on top of the weight cage aligning the rivets on weight retainer cage in the center of the elongated slots in the hub. With the snap ring pliers held at a 45° angle as shown, insert the tips of the pliers into one of the holes in the flexible retaining ring (Fig. 51). Holding the hub and retainer with one hand, squeeze the pliers to expand the hole in retaining ring. Push the pliers over the rivet, catching the back edge of the hole in the ring under the head of the rivet. Pivot the pliers around the rivet until the ring snaps into position under the head of the rivet (Fig. 52). Repeat this process to assemble the retaining ring to the remaining five rivets. NOTE: An old throttle shaft (or similar) "O" ring slipped over the pointed ends of the snap ring pliers will serve as a "return spring."

Fig. 51

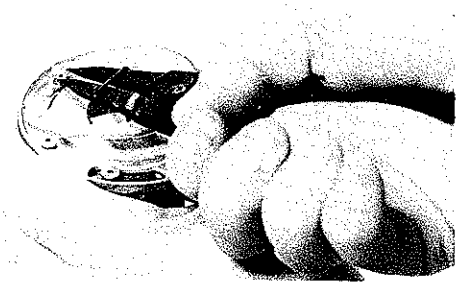
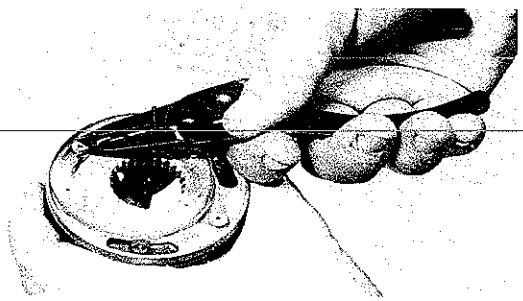
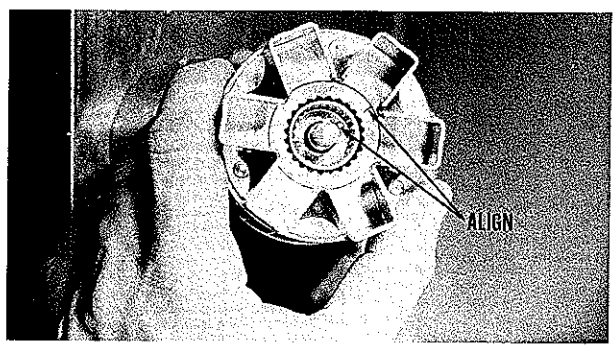


Fig. 52



STEP 10 Fit the governor weight retainer loosely in place on the drive end of the rotor. Make sure the retainer assembly mark is aligned with the rotor locating pin tang as shown. Support the hydraulic head on a flat surface, such as a discarded cam ring. This will prevent possible damage to the transfer pump end of the rotor when the weight retainer is pressed on the spline, as the rotor can protrude beyond the end plate surface of the head.

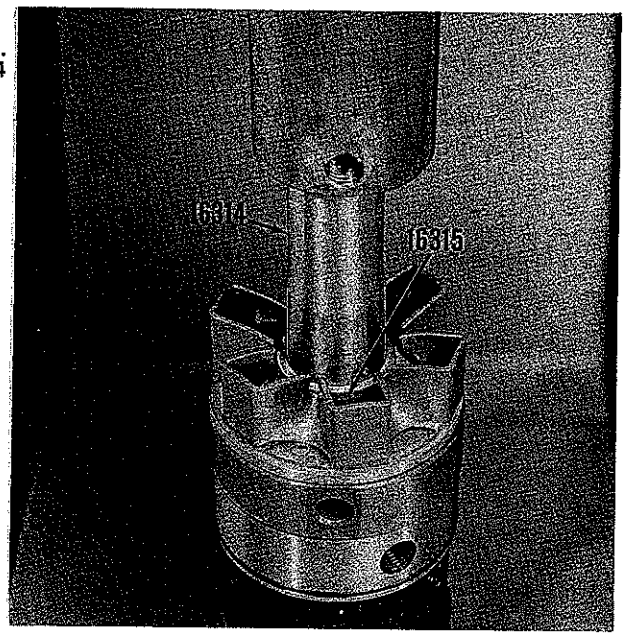
Fig. 53



Reassembly

STEP 11 Place the spacer #16315 over the rotor spline and install tool #16314 to the spacer. Press the weight retainer onto the spline until it bottoms. Assemble snap ring with beveled edge *up*. (If the retainer is not a press fit on the rotor splines, discard the retainer hub and replace new.)

Fig. 54



STEP 12 Invert the assembly carefully so the rotor doesn't fall out of the head. Lift the hydraulic head slightly and insert the two rotor retainers. Position the retainer halves with the outer sleeve of the retaining ring installation tool #13375 and install the retaining ring as shown in Figs. 55 and 56.

Fig. 55

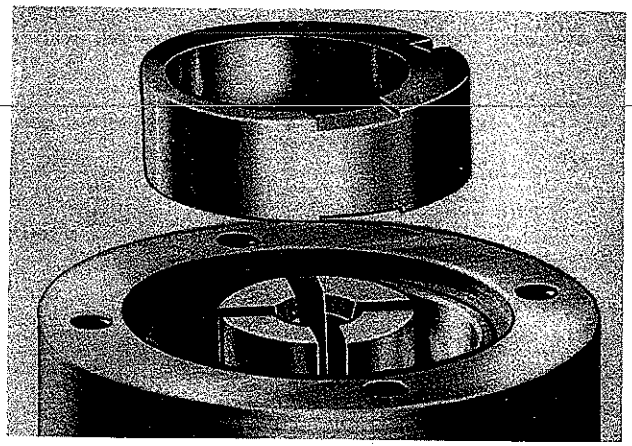
Fig. 56

STEP 13 Install delivery valve making sure that it operates freely in its bore. Install delivery valve spring and a new delivery valve stop. Start the stop screw using hex end of the delivery valve retractor tool (Fig. 57) and finish tightening with a torque wrench to specified torque.

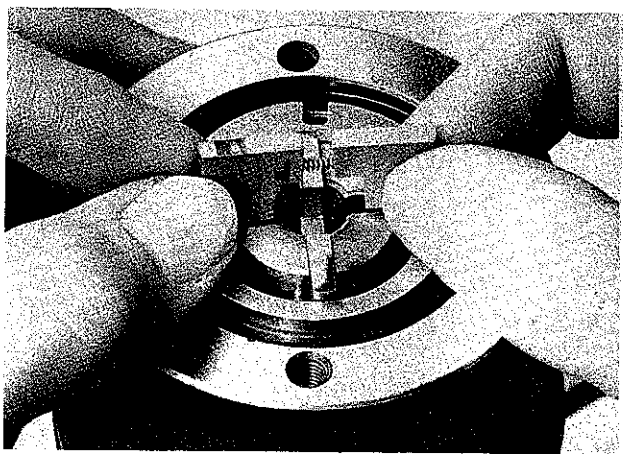
Fig. 57

STEP 14 Insert the transfer pump liner so that the large slot is in line with the head locating screw hole, and the letter signifying correct pump rotation faces up. This will correctly position the liner locating slot to accept the locating pin in the end plate.
Assemble springs to transfer pump blade halves. Install blades in slots of rotor.

Fig. 58



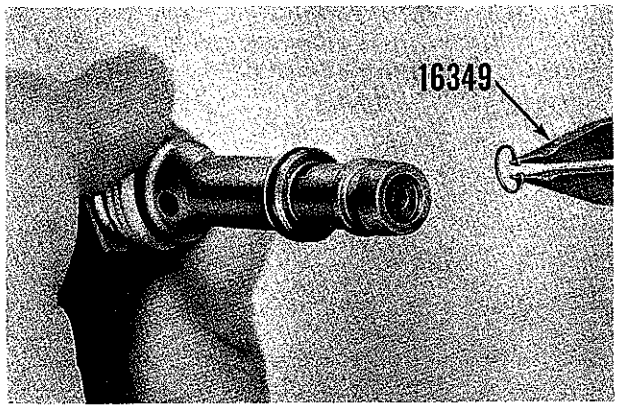
a



b

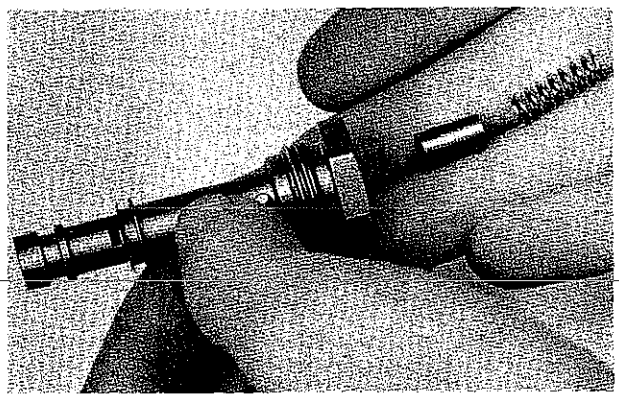
STEP 15 Insert regulating piston seal into the lower end of the regulating sleeve as shown in Fig. 59, far enough to expose retaining ring groove. *Install dry — do not use grease on this seal.* Install retaining ring using tool #16349.

Fig. 59



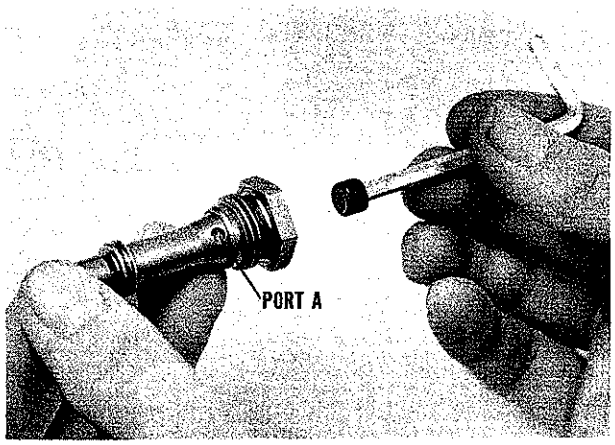
STEP 16 Rinse in clean oil and install regulating piston and spring into the sleeve, making sure that the piston slides to the bottom of the sleeve bore without binding.

Fig. 60



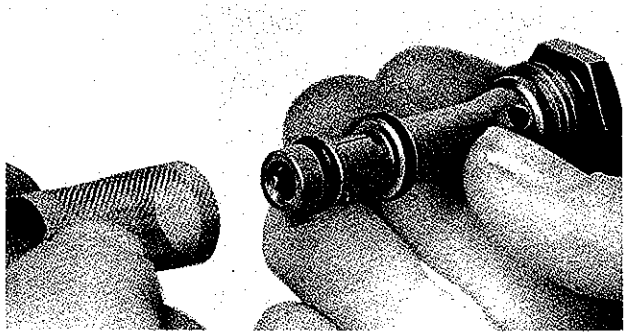
STEP 17 Install end plate adjusting plug, turning in until all threads are just below port "A" (Fig. 61). CAUTION: Check for tightness of the orifice plate and replace adjusting plug if plate is found loose.

Fig. 61



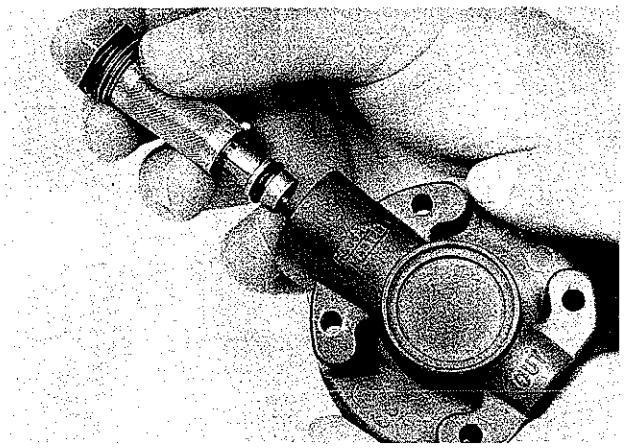
STEP 18 Assemble screen seal and upper and lower end plate sleeve seals as shown in Fig. 62. Install screen, pushing it firmly toward inlet end of sleeve.

Fig. 62



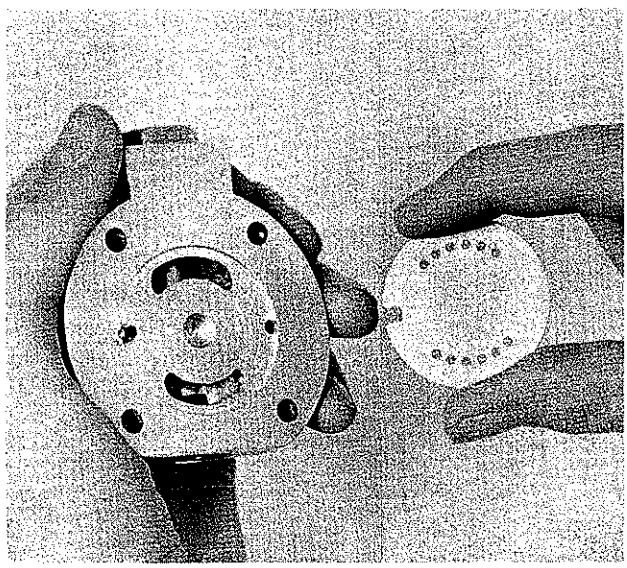
STEP 19 Insert regulating sleeve assembly into its bore in the end plate.

Fig. 63



STEP 20 Fit the transfer pump thrust plate (Fig. 64) to the end plate. The thrust plate may be reversed if one side appears worn or scratched. A dab of grease will hold the plate in position during assembly.

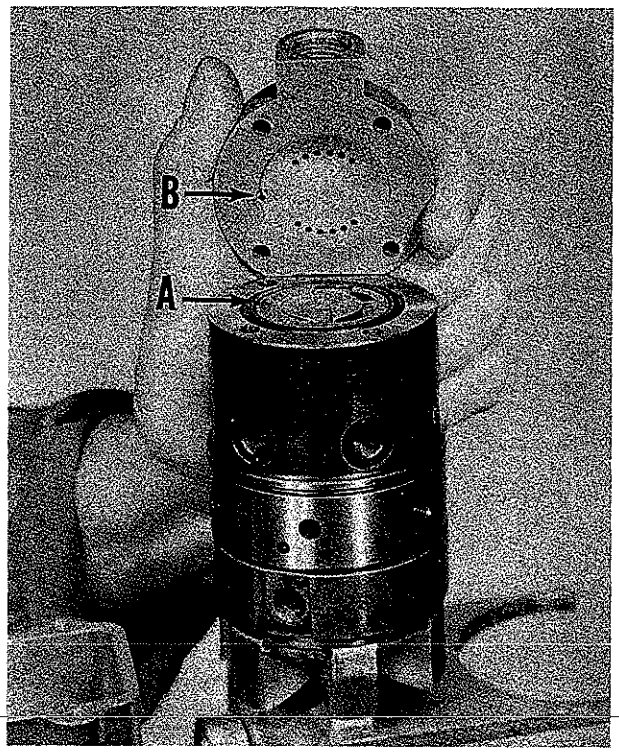
Fig. 64



Reassembly

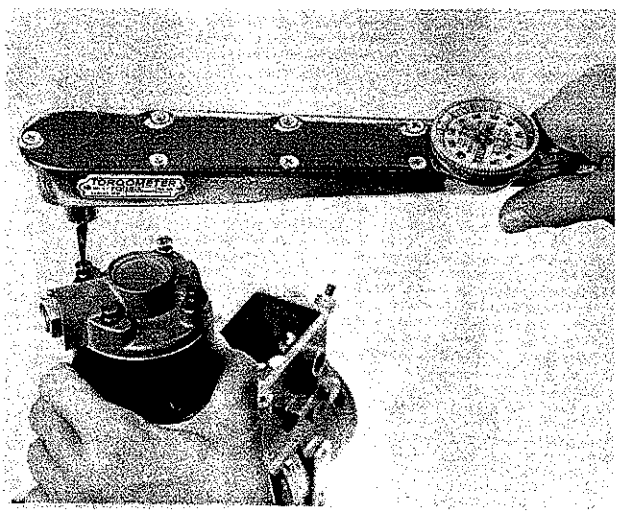
STEP 21 Insert the transfer pump seal and mount the end plate so that the inlet fitting is in line with the metering valve bore. The locating pin "B" will now line up with the locating slot "A" in the liner. If these are 180° out of alignment, check the end plate for correct location of the pin as to pump rotation ("C" and "CC" are marked on the outside of the end plate).

Fig. 65



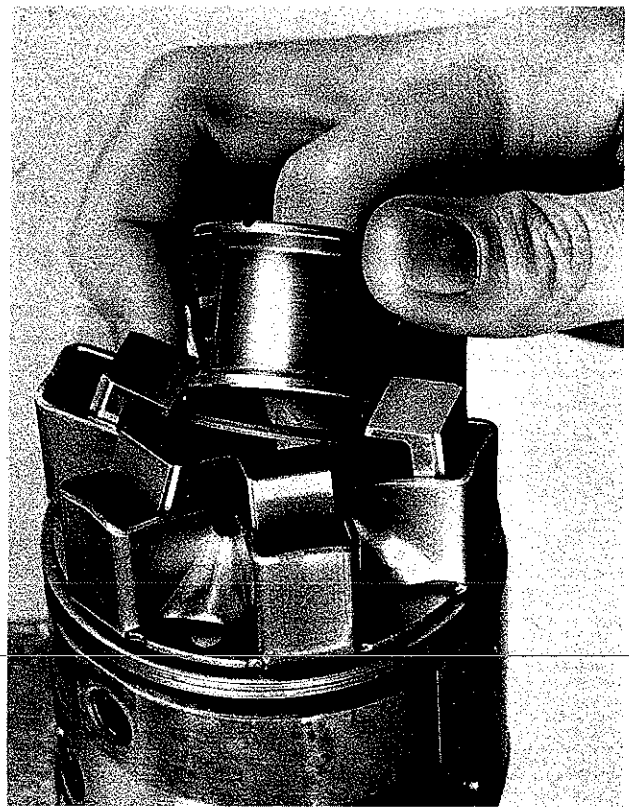
STEP 22 Torque the end plate screws gradually and alternately to 25-30 inch pounds. Check the rotor for free rotation. Binding can result from uneven torque. Tighten inlet fitting to specified torque.

Fig. 66



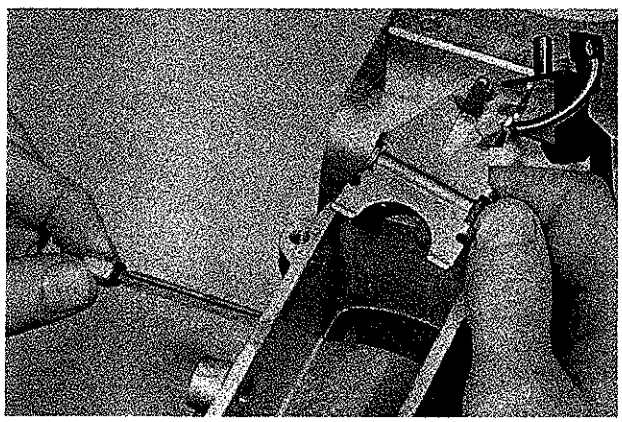
STEP 23 Place head and rotor assembly in holding fixture again, drive-end up. Position the governor weights into the retainer sockets. Insert the governor thrust sleeve and thrust washer into the lower slots of the governor weights, by tilting the weights back slightly. The chamfered edge of the thrust washer must face upward against the circular end of the thrust sleeve as shown in Fig. 67. Sight across the tops of the assembled weights. They should all be level, and collapsed against the thrust sleeve.

Fig. 67



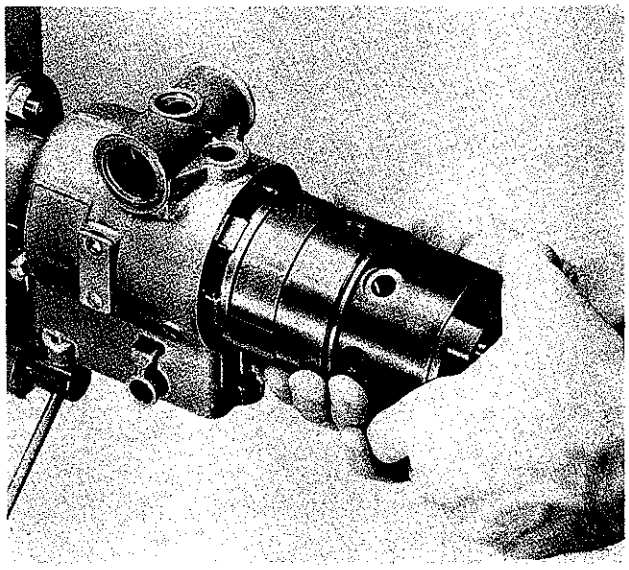
STEP 24 Place the governor arm in position with the fork for the governor linkage hook facing the end plate. Insert the pivot shaft *(knife edge facing end plate)* and assemble the two seals and cap nuts. Tighten the cap nuts successively to 20-25 inch pounds. The hydraulic

Fig. 68



head and rotor assembly, including the transfer pump, cam ring, governor weight retainer, weights, governor thrust sleeve and washer, should now be assembled into the housing. Install a new seal on the hydraulic head.

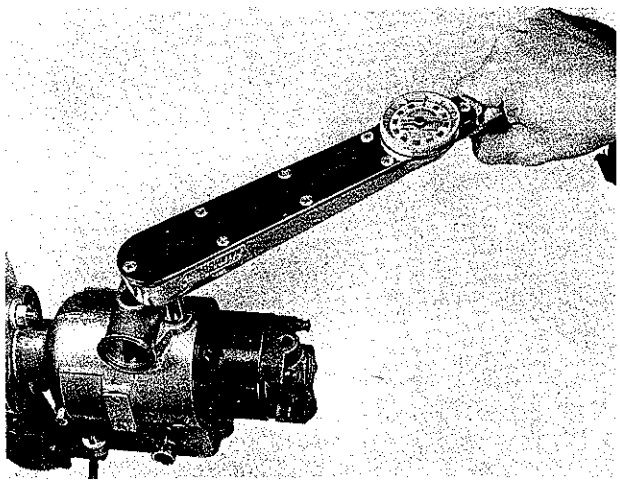
Fig. 69



Rotate the cam ring so that the unthreaded hole is in line with the head locating screw bore. This will insure proper position of the cam. Apply a light film of clean grease around the inside edge of the housing to aid in assembly. Tilt the housing. Grasp the hydraulic head firmly in both hands and insert it into the housing bore with a slight rotary motion. Do not force. If the assembly should cock during insertion, withdraw and start over.

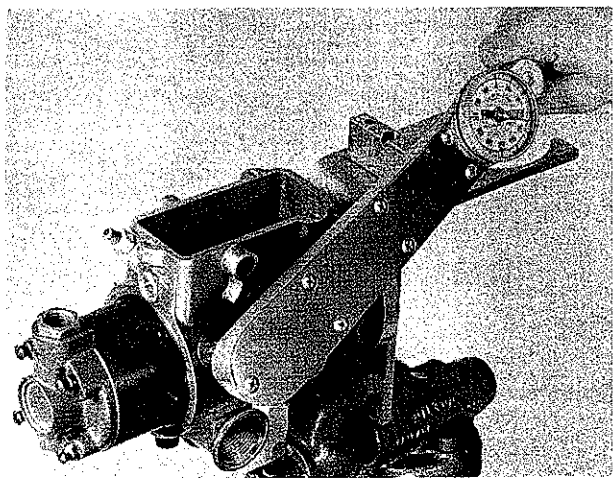
Make sure the assembly is wrung into position past the hydraulic head seal. Failure to do this might cause damage to the seal, resulting in leakage. Rotate it until the head locking screw holes line up with their corresponding holes in the housing.

Fig. 70



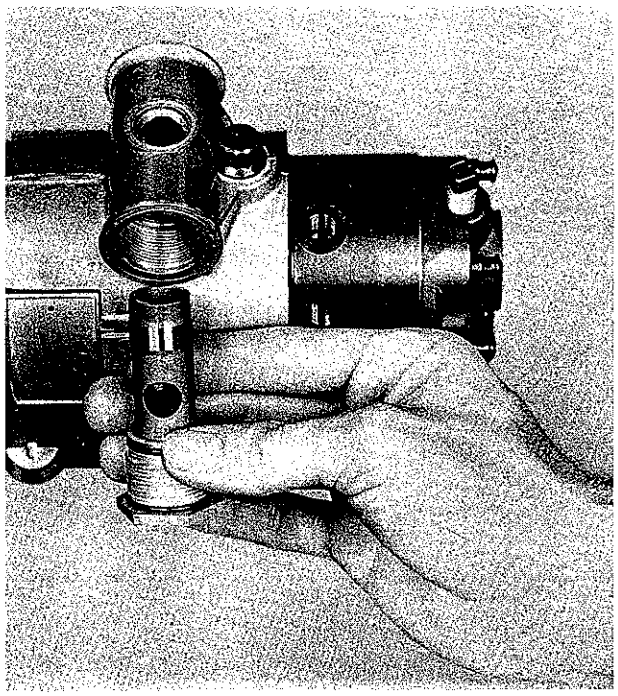
STEP 25 Coat both seals of the head locating screw with grease. Insert and tighten head locating screw assembly to specified torque. Invert pump and holding fixture in vise. Install and tighten two head locking screws to specified torque. Check the cam for freedom of movement. If the cam sticks, tap it or loosen and retorque head locking and locating screws.

Fig. 71



STEP 26 Invert holding fixture in vise. Assemble piston ring seal and piston ring (if provided) to the advance piston. Using tool #16199 to compress the seal, insert advance piston (power end) into the power piston plug. This plug is identified by the elongated openings between the two "O" ring grooves. Install new "O" rings and screw piston plug into the pump housing. The cast letters "C" and "CC" on the housing are assembly references. For clockwise pumps, assemble power piston plug into "C" side, and for counter-clockwise pumps, assemble into "CC" side.

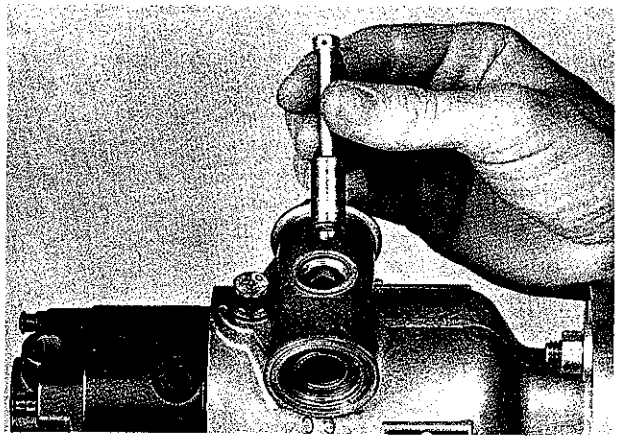
Fig. 72



Reassembly

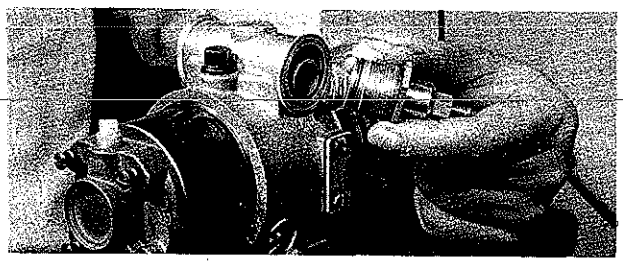
STEP 27 Align advance pin hole in advance piston with the *unthreaded* hole in cam ring. Insert advance pin, ball-end first.

Fig. 73

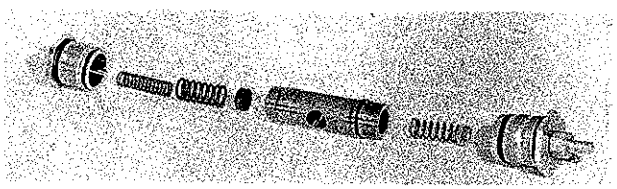


STEP 28 Insert advance spring (some pumps have two — an inner and outer) into spring cavity of the piston. Install new "O" rings to spring piston plug and screw into housing. (NOTE: Some pump specifications may call for an advance "trimmer" screw, which may be on either side of the advance device. When on the power side, the trimmer screw length should be preadjusted before bench testing as indicated on the specification. The trimmer arrangement incorporates additional parts, shown in Fig. 74.) Tighten both piston plugs.

Fig. 74

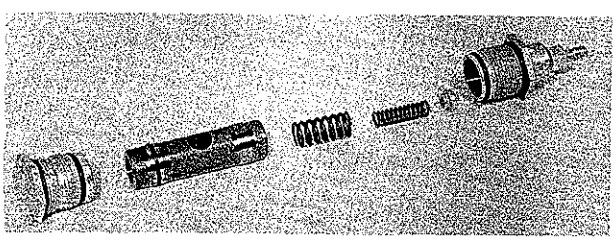


a



b

Trimmer on Power Side



c

Trimmer on Spring Side

STEP 29 Assemble and tighten advance screw hole plug, using a new seal.

STEP 30 Make sure there is a shim on the metering valve under the arm. Place the metering valve spring on the valve and install the assembly into its bore. Depress and rotate the valve several times to insure freedom of movement. If valve sticks, lap it in carefully with tallow. *Never sand or polish off the special surface treatment provided.*

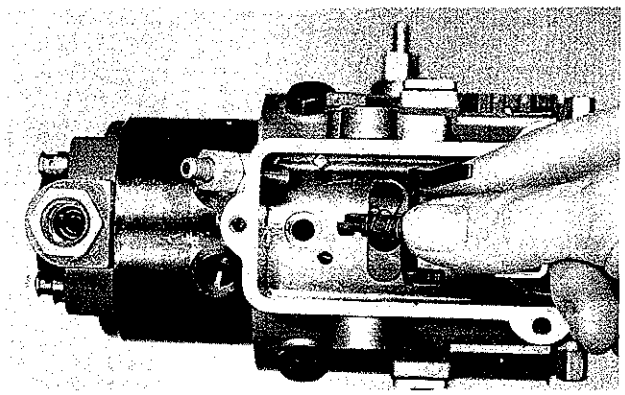


Fig. 75

STEP 31 Pull back on the governor linkage hook, stretching the spring just enough to assemble the hook correctly to the fork on the governor arm. Install the damper spring (if used) and position the opposite end of the hook over the pin on the metering valve arm. Check all of the governor parts again for freedom of movement.

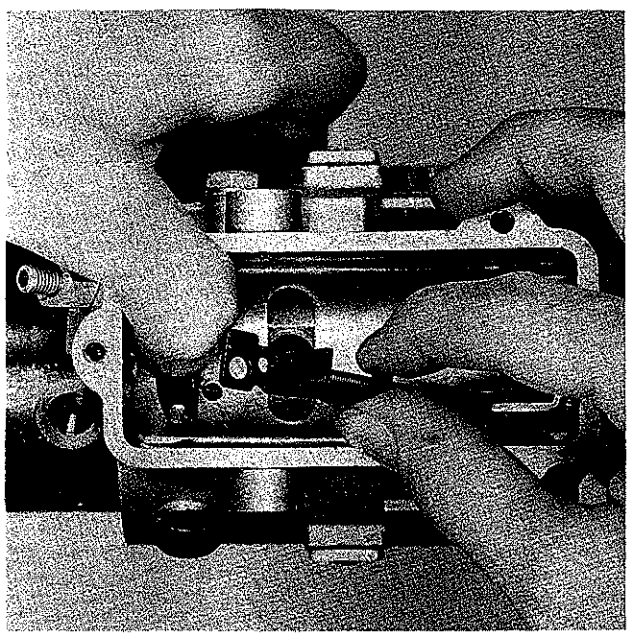
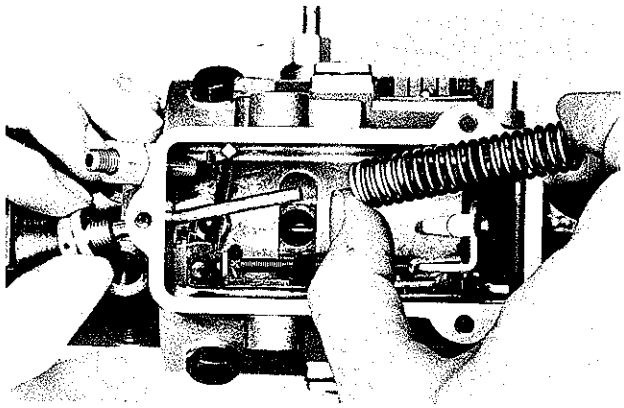


Fig. 76

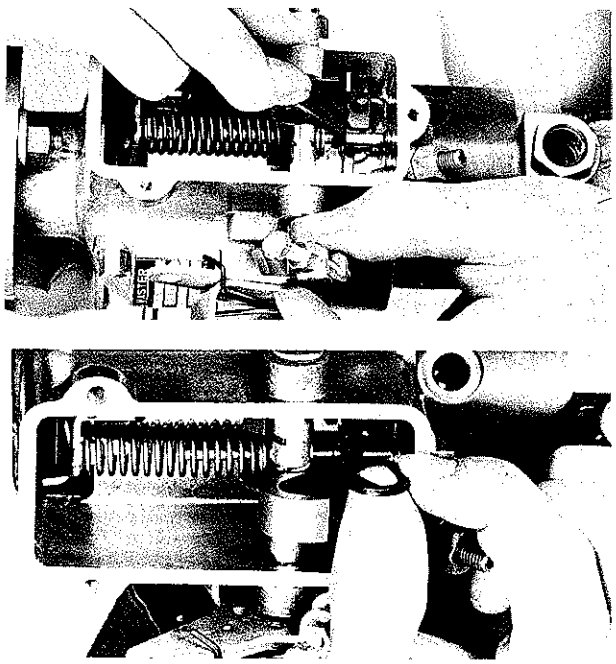
STEP 32 Assemble the governor spring, spring retainer, idle spring, and idle spring guide on the bench. Pick up between thumb and forefinger and engage the governor spring over the formed tabs on the governor arm. Insert the guide stud, with washer, through the tapped hole in the rear of the housing and into the governor spring assembly. Tighten guide stud to specified torque. NOTE: The apparent looseness in the governor parts is normal. Lost motion is immediately taken up as soon as the pump rotates.

Fig. 77



STEP 33 Assemble the throttle shaft and lever assembly partially through its bore in the housing. Slide the spacer bushing (if used) and throttle shaft lever over the throttle shaft so that the projection on the throttle shaft lever bore engages the rear keyway on the shaft. Position the forked end of the throttle lever so that it straddles the guide stud. Apply a light coat of grease to the throttle and shut-off shaft seals. Assemble the shut-off shaft from the opposite side with a slight rotary motion, so as not to damage the seal. Install the shut-off cam with the straight inner edge engaging the slot. The cam should snap into position. If the cam is loose, replace it with a new one.

Fig. 78



b

STEP 34 With the throttle lever held in wide open position with an old "O" ring as shown and the torque screw backed out, use linkage gauge #13389 to check the clearance between the rear of the shut-off shaft "B" and the vertical tab "A" on the linkage hook. Adjustment of this clearance in the pump is made using linkage wrench #13379 by changing the effective length of linkage hook. With adjusting screw (1) tight, apply a slight pressure to tab "A". At the same time rotate pump several complete revolutions to assure that linkage is in full forward position. Loosen adjusting screw (1) and slide linkage to maximum open length. Insert linkage gauge #13389 between vertical tab "A" and shut-off shaft "B" and slide linkage hook together from rear until face of tab is flush against gauge. Tighten adjusting screw (1). Check adjustment and reset if required.

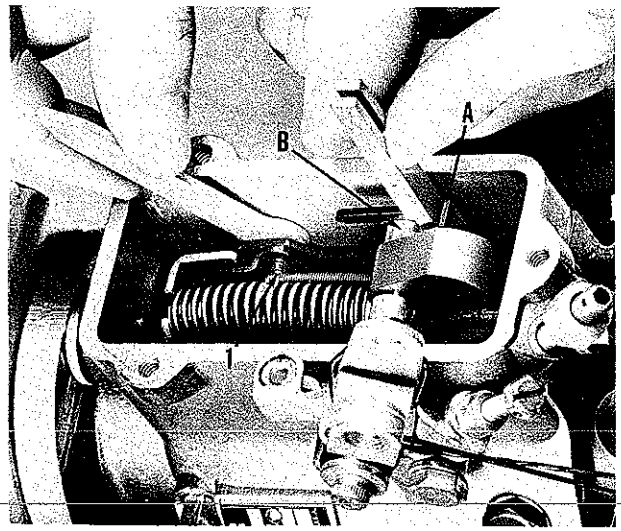


Fig. 79

STEP 35 Check all governor parts for freedom of movement. Assemble a new seal to governor control cover and install cover on pump. Slip the flat washers and lock washers onto the cover screws and tighten securely.

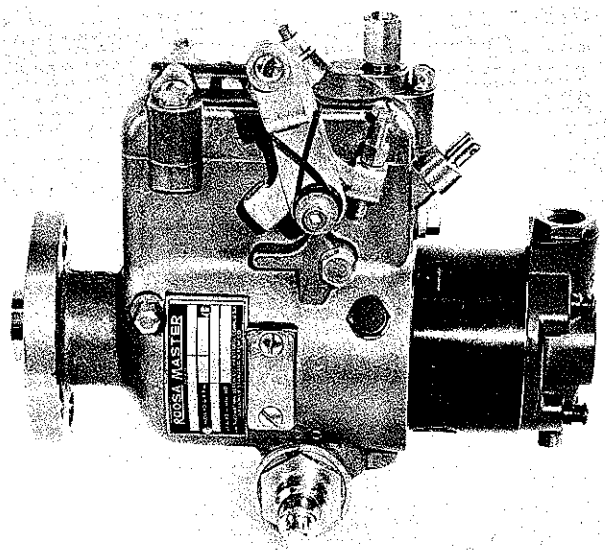


Fig. 80

Accessories

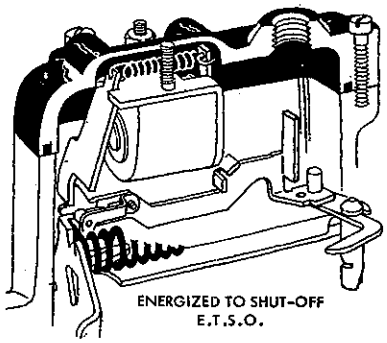
A. ELECTRICAL SHUT-OFF

The Electrical Shut-Off Device may be furnished for "energized to run" or "energized to shut-off" operation. It is available for 12, 24, and 32 volt systems. Since this device is housed within the governor control cover, the external dimensions of the pump do not change.

OPERATION

ENERGIZED TO SHUT-OFF (ETSO): Energizing the coil overcomes the force of the shut-down coil spring, pulling the arm in and causing the tab on its lower end to contact the governor linkage hook. This moves the linkage hook against the governor linkage spring tension, rotating the metering valve to its closed position and cutting off the fuel, Fig. 81. NOTE: Most ETSO applications use a coil with a voltage rating lower than system voltage to provide positive shut-off action. This is allowable since the coil is used under intermittent duty conditions.

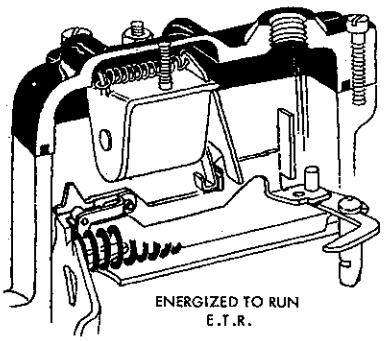
Fig. 81



ENERGIZED TO SHUT-OFF
E.T.S.O.

ENERGIZED TO RUN (ETR): De-energizing the coil allows the shut-down coil spring to release the shut-off arm. The lower end of the arm moves the governor linkage hook, rotating the metering valve to the closed position and cutting off the fuel, Fig. 82. NOTE: Some "Energized To Run" applications of Model "DC" pumps will incorporate a mechanical override device for emergency use if the coil becomes inoperative due to electrical system failure. The override consists of a rod and guide assembly attached to the control cover through a tapped hole at the rear of the cover in a location that aligns the rod with the solenoid arm assembly. When the rod is pushed into the cover to the limit of its travel it contacts the solenoid arm assembly and locks it up against the solenoid, allowing the linkage hook to operate. Shut-off of the pump during an electrical failure is accomplished by pulling out the override rod.

Fig. 82

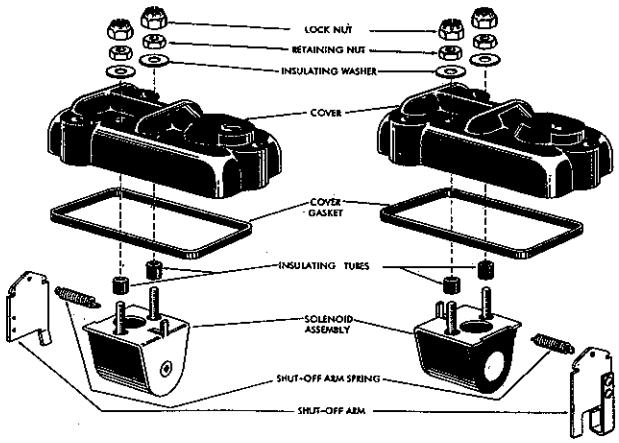


ENERGIZED TO RUN
E.T.R.

DISASSEMBLY

Remove the cover screws, governor control cover, and gasket from pump. Remove the cover contact nuts and washers and work the solenoid assembly out of the cover. Remove the shut-off spring and arm.
Some applications will incorporate a brass cup-shaped washer secured to one contact screw to provide a grounded connection. On these applications a "hot" lead only is required for the opposite terminal.

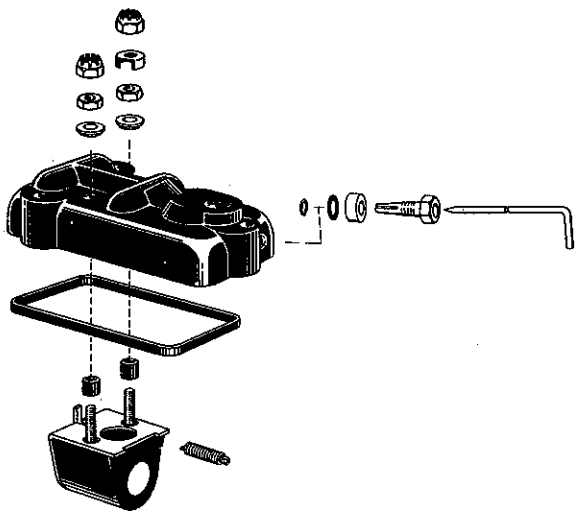
Fig. 83



DISASSEMBLY—MECHANICAL OVERRIDE

1. Remove the governor control cover.
2. Push in the control rod so that the snap ring is away from the inside edge of the guide assembly.
3. Remove the snap ring and pull the control rod out of the guide.
4. Loosen and remove the cover guide, the washer, and the seal.

Fig. 84



MECHANICAL OVERRIDE DEVICE

INSPECTION

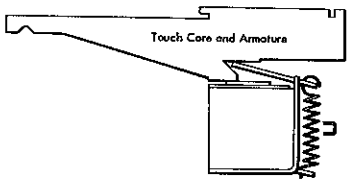
Examine the solenoid visually for cracks and swelling in the encapsulating material and looseness of the contact screws. Check the solenoid for a complete circuit with an ohmmeter.

REASSEMBLY AND ADJUSTMENT

Assemble the shut-off arm and spring to the coil. Before installation of the solenoid assembly to the cover is made, adjustment of the arm travel and spring tension should be carried out as indicated in Figs. 85 through 88 using tools #14067 and 14725. Check the linkage hook adjustment, with reference to Page 27.

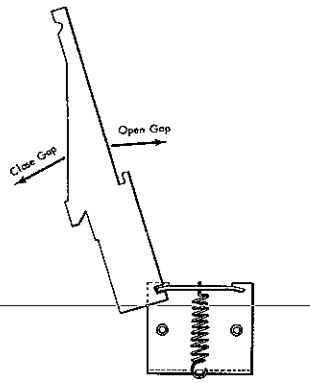
Install new insulating tubes to both contact screws. Insert the assembly into the governor control cover as a unit. Replace the insulating washer and assemble the contact nuts (20-25 inch pounds). Mount the cover assembly, with new cover seal, to the pump and tighten securely.

Fig. 85



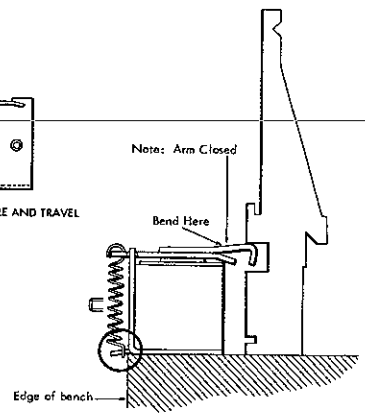
CHECKING ARMATURE TRAVEL

Fig. 86



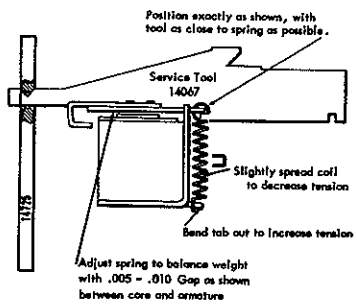
ADJUSTING ARMATURE AND TRAVEL

Fig. 87



ADJUSTING SHUT-OFF TAB
ENERGIZED-TO-RUN ONLY
(Make certain tab (circled) does not interfere with measurement)

Fig. 88



ADJUSTING ARMATURE SPRING TENSION
ENERGIZED-TO-RUN ONLY

REASSEMBLY—MECHANICAL OVERRIDE

1. Screw the guide into the rear of the governor cover, securing the washer and seal.
2. Push in the control rod and secure it from the inside with the snap ring.
3. During normal run conditions when the electric shut-off is in operating position, keep the rod extended to its full outward movement.

TESTING

With the pump mounted on the test bench, the electrical shut-off device must be checked with designated voltage rating (stamped on cover) and wide open throttle at the following speeds:

A. 400 RPM
B. Full load governed speed
C. High idle (shut-off only)

If use of automotive-type batteries is impractical, a good, heavy duty battery charger can be used as long as voltage can be selected and will hold with minimum drop (½ volt max.) during application to the solenoid coil.

Use of small, inexpensive trickle chargers is not recommended, since a voltage drop of 2-3 volts can be expected when current is applied to the coil. This can result in questionable operation and rejection of good coils under some conditions.

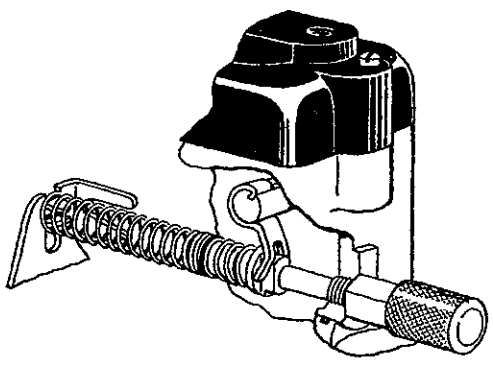
NOTE: Do not attempt to check solenoid operation with the cover removed from the pump. The governor linkage spring aids operation when the cover is assembled.

B. VARIABLE SPEED DROOP DEVICE

(Generator Set Application Only)

An external adjustment screw at the rear of the pump housing provides precise control of governor sensitivity by decreasing or increasing the effective length of the governor control spring. Turning the adjustment screw inward shortens the control spring, making it less sensitive and increasing speed droop. Turning the screw outward has the opposite effect. Regulation of 3-5% can be easily attained and adjustment can be made while the engine is operating.

Fig. 89

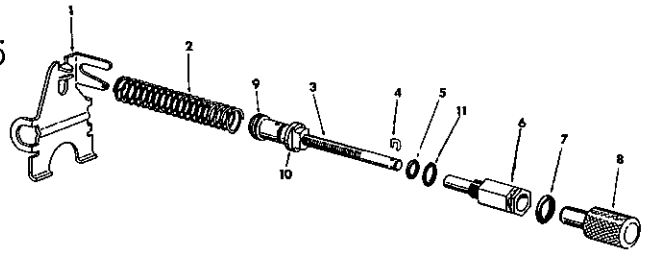


Accessories

DISASSEMBLY

Remove the governor control cover, shut-off cam, shut-off shaft assembly, throttle shaft assembly, throttle shaft lever, and governor linkage hook. Remove the end plate assembly.

Fig. 90



Remove the adjusting cap (8) by pulling to the rear of the pump. With a pair of needle nose pliers, remove the control rod clip (4). *Do not bend the control rod.* Loosen and remove the control rod guide (6) seal (5) and guide washer (11). Disengage the governor spring (2) from the governor arm (1) and remove the governor spring and control rod assembly (3) as a unit.

INSPECTION

Examine the governor spring for distortion and the spring guide and bushing for excessive wear. Replace the two seals on the control rod guide. Check control rod for straightness and replace, if needed.

REASSEMBLY

Insert the control rod assembly (3) through the threaded hole from the inside of the housing. Slide the control rod guide, (6) "O" ring (5) and guide (11) over the end of the control rod (3) and thread into housing. Tighten securely. Insert clip (4) into the control rod end being careful not to bend the rod. Slide the adjusting cap (8) over the new seal on guide (6). Thread five full turns of governor spring (2) onto the spring guide (9) with the spring guide and bushing (10) against each other as shown. Slip the free end of the governor spring over the formed ends of the governor arm (1) with the bent end of spring between the two tabs.

Install the end plate, throttle shaft assembly, throttle shaft lever, shut-off shaft assembly, and shut-off cam. Adjust low idle adjusting screw so bushing (10) just touches rod guide (6) and forked end of throttle shaft lever straddles and engages flats on bushing (10). Replace cover. The speed droop assembly is now positioned for minimum droop.

SPEED DROOP ADJUSTMENT DURING BENCH TEST

1. Make normal check of output, metering, and transfer pump pressure at full load governed speed as called for on the specification. Refer to "Bench Test Procedure," Page 33. High idle adjusting screw should be backed all the way out and throttle held open as far as possible.

2. After normal pump test, check full load governor regulation by moving the throttle lever toward the closed position until the pump is "on governor" at full load speed. This will be indicated by a difference in delivery sound and a slight reduction of fuel delivery (1-2 mm^3) when a "draw" is taken into the graduates. *Hold the throttle in this position* with the standard vernier rack positioner supplied with most test benches. Do *not* position throttle by means of high speed adjusting screw.

3. Increase test stand speed. Record speed where fuel delivery falls to 20-25% of full load output. This speed is known as "no-load" speed and should not be higher than the percentage or the high idle speed indicated on the specification. If, for example, the unit operates at 1800 RPM full load and 3% regulation is required, no-load speed will be

$$1800 \times .03 = 54$$
$$1800 + 54 = 1854 \text{ RPM}$$

At 1854 RPM the pump should not deliver more than 20-25% of full load fuel quantity.

4. If high idle, no-load speed as described above is too low, adjust by means of the knurled knob (8) at the rear of the pump housing. This is the "droop" adjustment. The knob should be turned clockwise to raise the no-load speed. NOTE: After each droop adjustment, check full-load delivery and reposition the throttle lever slightly as needed to compensate for any change in full-load fuel delivery.

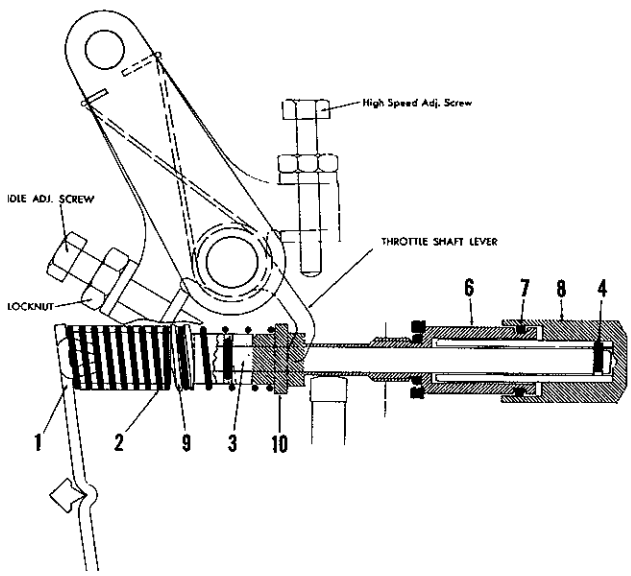
5. Disconnect Vernier Rack Positioner. Hold throttle lever as far open as it will go with high speed adjusting screw backed out. Increase test stand speed to 10% *above* full-load speed.

(Example: 1800 × .10 = 180 + 1800 = *1980* RPM)

6. Turn high idle adjusting screw in (clockwise) until fuel delivery is 20-25% of full-load quantity. Lock adjusting screw in this position. *This prevents accidental overspeeding in the event that speed droop needs further adjustment on engine.* Do not change droop setting.

7. Seal all throttle and shut-off lever adjusting screws with lead plomb.

Fig. 91



SPEED DROOP ADJUSTMENT DURING ENGINE TEST

1. After priming fuel system, start and warm engine to operating temperature. With full load applied and engine operating at rated speed, droop may be determined by removing load and noting no-load speed or frequency. Droop may be adjusted by turning knob (8) clockwise to increase, counter-clockwise to decrease. A minor correction of throttle position will also be necessary. NOTE: If knob (8) is adjusted to maximum or near maximum droop, severe strain will be placed on the throttle and governor linkage parts *unless the throttle cable or linkage is first disconnected* from the pump throttle lever. After final droop setting, throttle linkage length may be readjusted and reinstalled on the pump throttle lever. This precaution is not necessary if the spring-loaded throttle lever shown is incorporated.

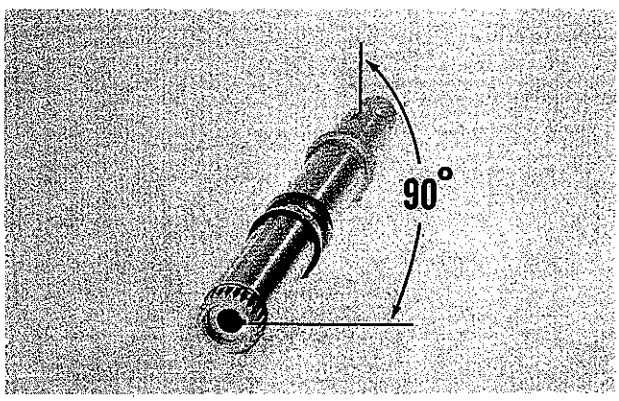
C. DRIVE SHAFT

In most applications, two molded, cup-shaped oil seals are retained in intermediate grooves in the drive shaft. The inner seal prevents fuel from entering the engine lube oil sump while the outer seal prevents contamination of the fuel in the pump. These seals should be replaced whenever a pump is removed from the engine.

INSPECTION

Examine the spline end of the drive shaft, Fig. 92, for excessive wear, and the drive end for thread and key slot damage, or abnormal wear of coupling. A roll pin is pressed into the splined end of the shaft. Its slot engages a small tab on the locating pin in the center of the rotor spline (See Fig. 92). Check the tab for damage. Also examine the roll-pin slot (in drive shaft) and make certain it is 90° from the drive shaft keyway. *If either is damaged or out of position the pump may have been installed out of time on the engine.* Note also the "O" ring assembled adjacent to the spline. The groove is necessary for manufacturing reasons and *the "O" ring prevents the possibility of engine overspeed due to the governor thrust washer lodging in the groove during operation.* Remove and discard drive shaft seals. Examine the seal grooves for smooth finish. Any roughness at these points will cause seal failure.

Fig. 92

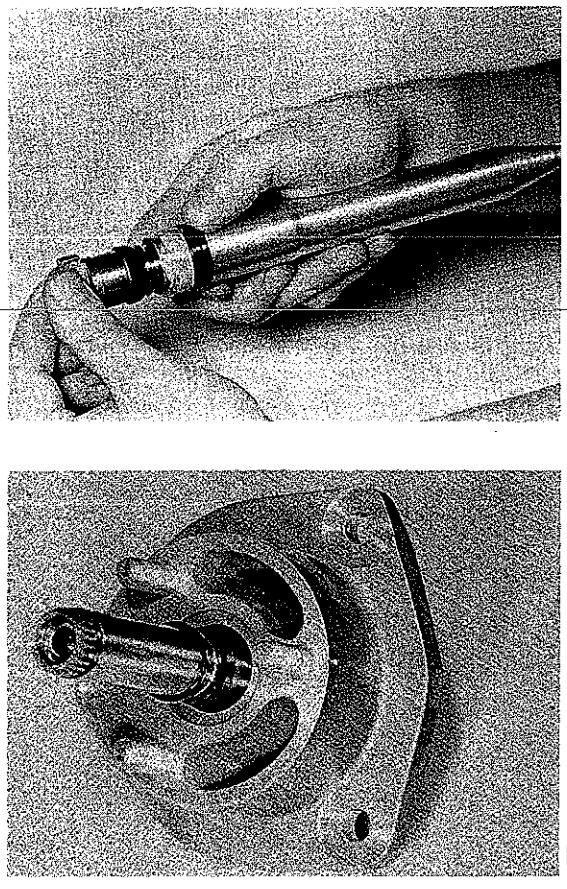


ASSEMBLY DRIVE SHAFT SEALS

Lubricate the shaft seals with light mineral grease and slide into grooves using seal installation tool as shown (Fig. 93). The seals MUST face in opposite directions to separate engine lube oil from fuel oil in the pump. Apply mineral grease liberally around the shaft between the two seals.

Most DC pump applications employ a separate, ball bearing or bushing type drive adapter, which may be returned with the pump for repair. Examine it carefully for damage or wear and repair as needed. During assembly of the pump to the adapter, use drive shaft seal compressor #13371 to start the inner seal properly into the pump pilot tube. If the seal is rolled over, it should be replaced new. The shaft can then be rotated until the timing tab engages the roll-pin slot. Secure mounting screws.

Fig. 93



Typical DC Pump Drive Adaptor

Torque Control

Torque is commonly defined as the turning moment or "lugging ability" of an engine. Maximum torque varies at each speed in the operating range for two reasons: (1) as engine speed increases, friction losses progressively increase and, (2) combustion chamber efficiency drops due to loss of volumetric efficiency (breathing ability of an engine), and due to reduction of time necessary to completely and cleanly burn the fuel in the cylinder. Since torque increases with increased load conditions, a predetermined point at which maximum torque is desired may be selected for any engine. Thus, as engine RPM decreases, the torque generally increases toward this preselected point. This desirable feature is called "Torque Back-Up". In the Roosa Master Pump three basic factors affect Torque Back-Up. These are:

1. Metering valve opening area
2. Time allowed for charging
3. Transfer pump pressure curve

Of these, the only control between engines for purposes of establishing a desired torque curve is the transfer pump pressure curve and metering valve opening, since the other factors involved are common to all engines. Torque control in the Roosa Master Fuel Injection Pump is accomplished in the following manner:

The manufacturer determines at what speed for a specific application he wants his engine to develop its maximum torque. The maximum fuel setting is then adjusted for required delivery during dynamometer test. This delivery must provide acceptable fuel economy. The engine is then brought to full load governed speed. The fuel delivery is then reduced from that determined by the maximum fuel setting by turning in an adjustment or "torque screw," Fig. 95, which moves the metering valve toward the closed position. The engine is now running at full load governed speed. When the engine is operating at high idle speed, no-load, the quantity of fuel delivered is controlled only by governor action through the metering valve. NOTE: At this point, the torque screw and maximum fuel adjustment have no

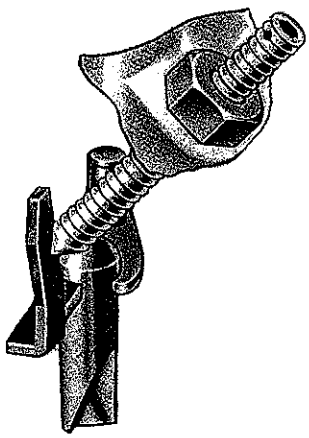
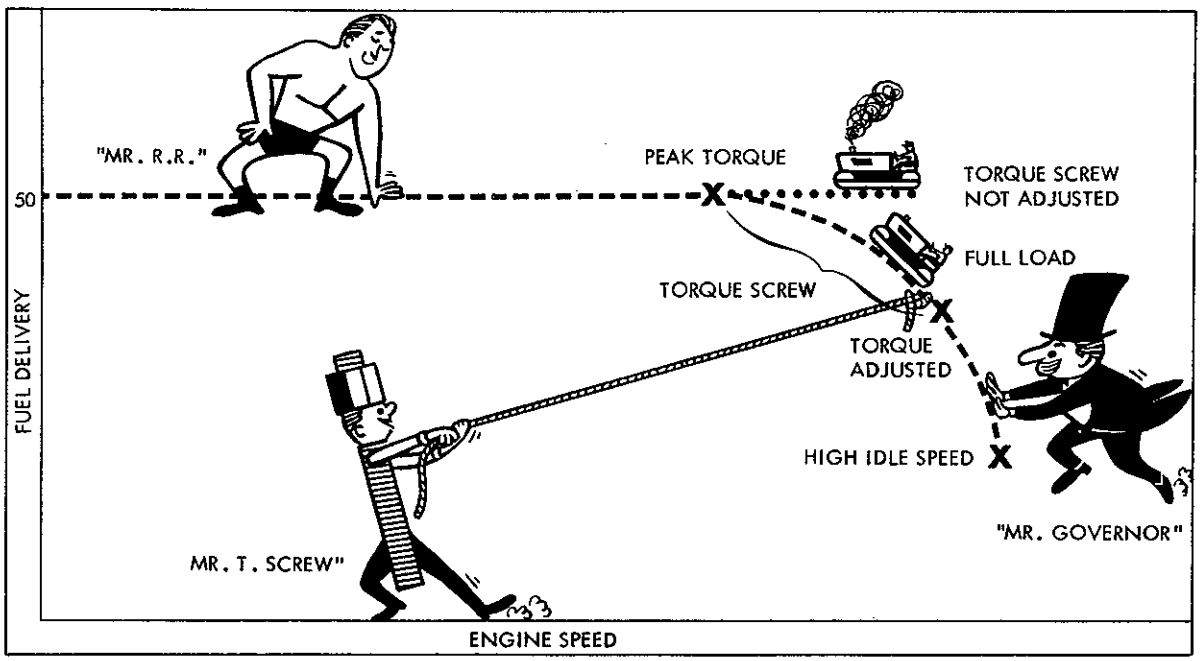


Fig. 95

effect. As load is applied, the quantity of fuel delivered remains dependent on governor action and metering valve position until full-load governed speed is reached. At this point, further opening of the metering valve is prevented by its contact with the previously adjusted torque screw. Thus, the amount of fuel delivered at full-load governed speed is controlled by the torque screw and not by the roller-to-roller dimension. As additional load is applied and engine RPM decreases, a greater quantity of fuel is allowed to pass into the pumping cylinders due to the increased time of registration of the charging ports. During this phase of operation the metering valve position remains unchanged, still being held from further rotation by the torque screw. As engine RPM continues to decrease, the rotor charging ports remain in registry for a longer time period allowing a larger quantity of fuel into the pumping cylinders. Fuel delivery increases until the predetermined point of maximum torque is reached. At this point the quantity of fuel is controlled by the roller-to-roller dimension. It must be remembered that torque adjustment on the Roosa Master Pump may be properly carried out only during dynamometer or bench test. It should not be attempted on a unit in the field without means of determining actual fuel delivery.

Fig. 94



Bench Test Procedure

SPECIAL TEST BENCH REQUIREMENTS

Any test is only as good as the testing equipment employed.

Incorporation of the following features and equipment will reduce testing inaccuracies to a minimum:

a. Injection Lines: Two standard line sizes are employed in our factory tests. These are 1/16" I.D. x 20" long and 3/32" I.D. x 20" long. The applicable line is indicated on the specification.

b. Calibrating Oil: Since most of today's engines use No. 2 diesel fuel, it is imperative that bench tests of Roosa Master Pumps be carried out with calibrating oil of similar viscosity. Official Roosa Master calibrating oil, with closely controlled viscosity (34-36 SSU @ 100° F) has been selected because its viscosity lies in the middle range of No. 2 diesel fuel sold today. Roosa Master calibrating oil also contains preservatives and corrosion inhibitors not found in diesel fuel. This oil is available on request.

c. Calibrating Oil Temperature: Since the temperature of the oil in the test bench will increase after a few hours of use, a standard of 110° - 115° F has been established. The test bench should be equipped with a heater and control to maintain this temperature. This conforms with SAE published standards.

d. Calibrating Nozzles: 12 SD12 nozzle valves adjusted to an opening pressure of 2500 psi (175 ATS).

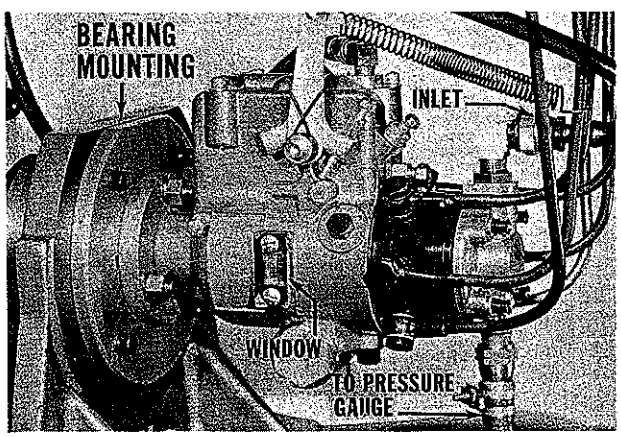
Complete sets of adapters for all models of the Roosa Master Pump are available for the following makes of commercial test benches:

1. American Bosch TSE 4500
2. Bacharach/Unitest GP500C—U7000/U4500
3. Hartridge Majestic—Powermaster
4. Merlin Calimaster M8
5. Robert Bosch EFEP-5C

GENERAL TEST PROCEDURE

A. Mount the pump securely with appropriate adapters. DC pumps employing steel pilot tubes do not support the drive shaft in the housing. A drive adapter, usually with a ball bearing, supports the shaft. These pumps must be tested using an intermediate support bearing (Fig. 96).

Fig. 96



Install high pressure injection lines using new gaskets. Leave fuel line connector screws at pump and injection line nuts at nozzles *loose*. Install inlet and return lines and transfer pump pressure gauge. Use a restriction fitting on the return line if the pump normally uses one.

B. Determine proper direction of rotation from pump name plate ("C" — Clockwise, "CC" — Counter-clockwise). Rotation is determined as viewed from drive end of pump.

C. Start stand at lowest speed. Move throttle to "full-load" position. When transfer pump picks up suction, allow fuel to bleed for several seconds from loosened connector screws. Likewise, allow fuel to bleed from loosened injection line nuts. Tighten securely. Since the Roosa Master Pump is factory tested on stands which measure fuel flow in cubic millimeters, it is necessary to convert the readings on other types of stands which measure in cubic centimeters. See Fig. 97.

Remember also that the test stand tachometer registers *pump* speed. All Roosa Master specification test data refers to engine speed.

Fig. 97

Delivery In Each Graduate (CC s)	Delivery in Cubic Millimeters (MM^3) per Stroke								
	Numbered Strokes								
	25	100	125	200	250	300	400	500	1000
1	40	10	8	5	4	3.3	2.5	2	1 (mm^3)
2	80	20	16	10	8	6.7	5.0	4	2
3	120	30	24	15	12	10.0	7.5	6	3
4	160	40	32	20	16	13.3	10.0	8	4
5	200	50	40	25	20	16.7	12.5	10	5
6	240	60	48	30	24	20.0	15.0	12	6
7	280	70	56	35	28	23.3	17.5	14	7
8	320	80	64	40	32	26.7	20.0	16	8
9	360	90	72	45	36	30.0	22.5	18	9
10	400	100	80	50	40	33.3	25.0	20	10
20		200	160	100	80	66.7	50.0	40	20
30		300	240	150	120	100.0	75.0	60	30
40		400	320	200	160	133.3	100.0	80	40
50			400	250	200	166.7	125.0	100	50
60				300	240	200.0	150.0	120	60
70				350	280	233.3	175.0	140	70
80				400	320	266.7	200.0	160	80
90					360	300.0	225.0	180	90
100					400	333.3	250.0	200	100

D. Operate pump at 1000 RPM for 10 minutes. Dry off completely with compressed air. Observe for leaks and correct as necessary. Back out the high idle stop screw and torque screw (if equipped).

NOTE: The inlet to the transfer pump should never be pressurized during bench testing.

Bench Test Procedure

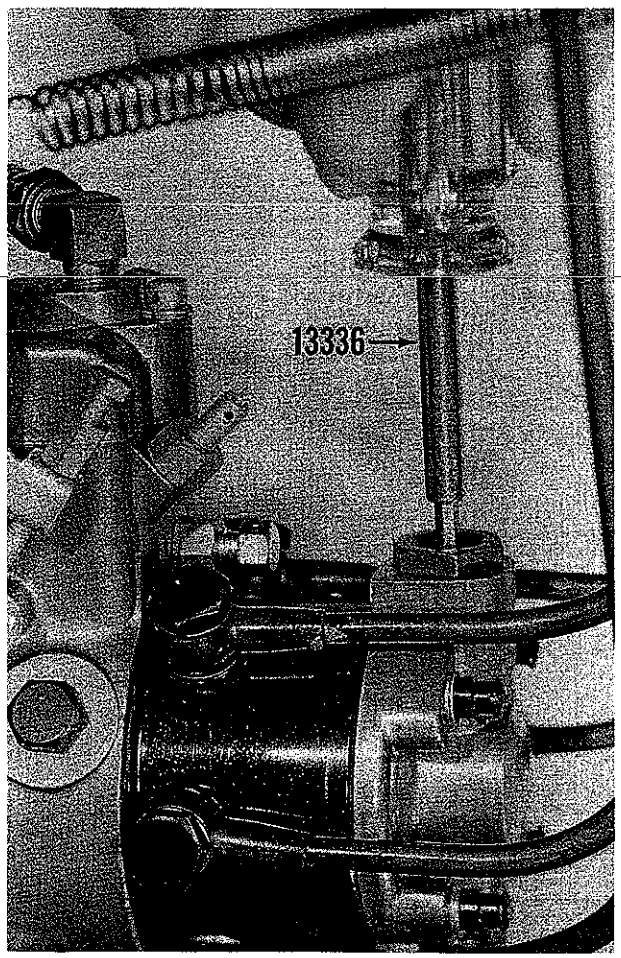
E. Close valve in supply line — transfer pump must pull at least 18" HG at 400 RPM (engine). If it does not, check for air leaks on suction side or malfunction of end plate and transfer pump parts. (If the pump is equipped with an external by-pass, it should be pinched off during this test.)

F. Fill graduates to bleed air from test stand and to wet glass.

G. Observe return oil. Return should be at rate of 100-450 CC/minute @ 35 psi transfer pump pressure. (By-pass equipped pumps will return less fuel.)

H. Operate at the specified speeds with wide open throttle and observe transfer pump pressure. Adjust pressure regulating spring plug to raise or lower transfer pump pressure. *Caution:* Under no circumstances should 130 psi be exceeded

Fig. 98



Transfer Pump Pressure Adjustment

I. Check for minimum delivery at cranking speed.

J. Operate at high idle speed and adjust high idle screw to obtain the specified delivery.

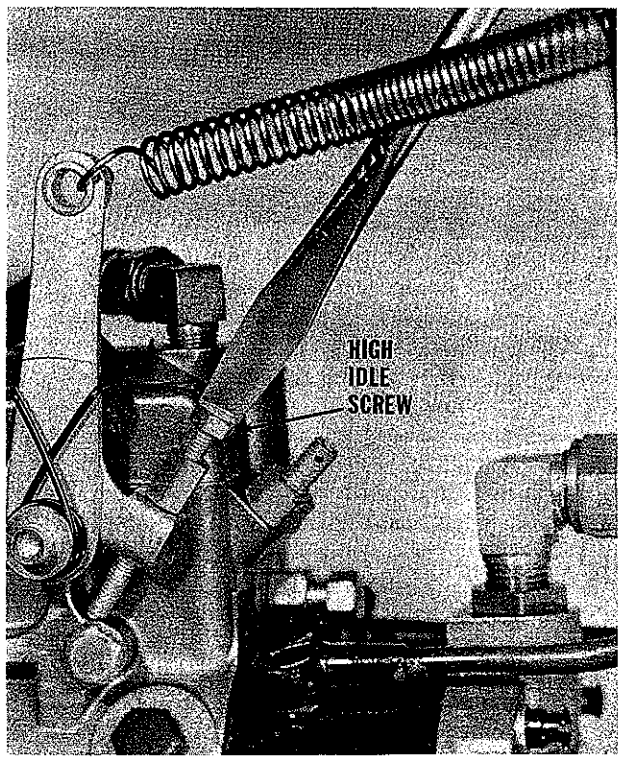


Fig. 99

High Idle Delivery Adjustment

K. Adjust the low idle screw to the correct low idle delivery.

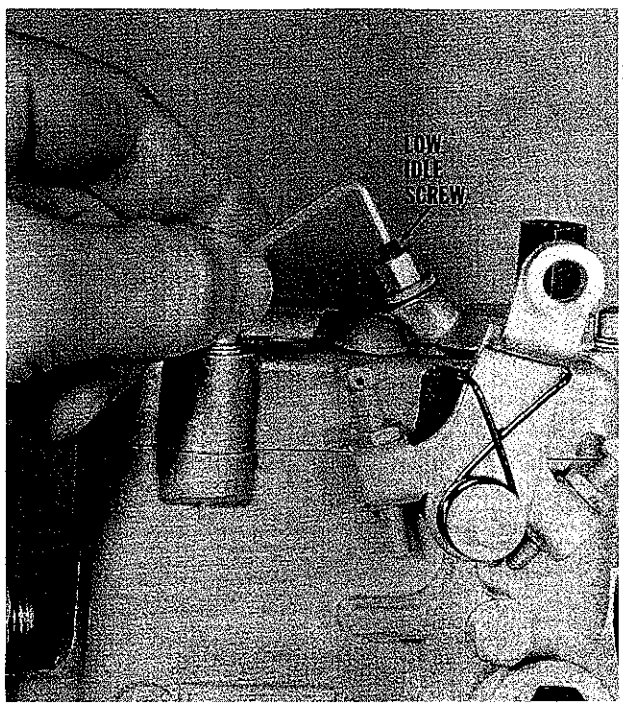


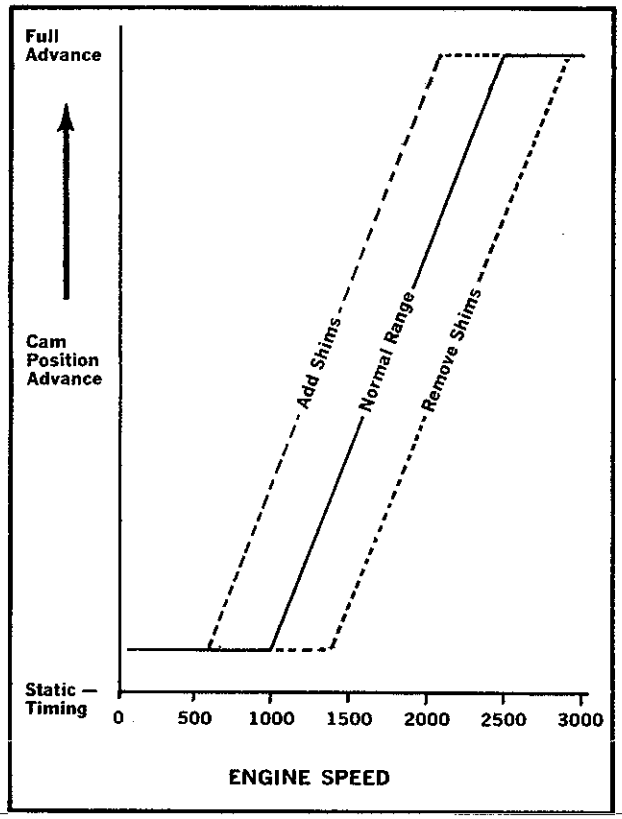
Fig. 100

Low Idle Delivery Adjustment

L. Automatic Advance:

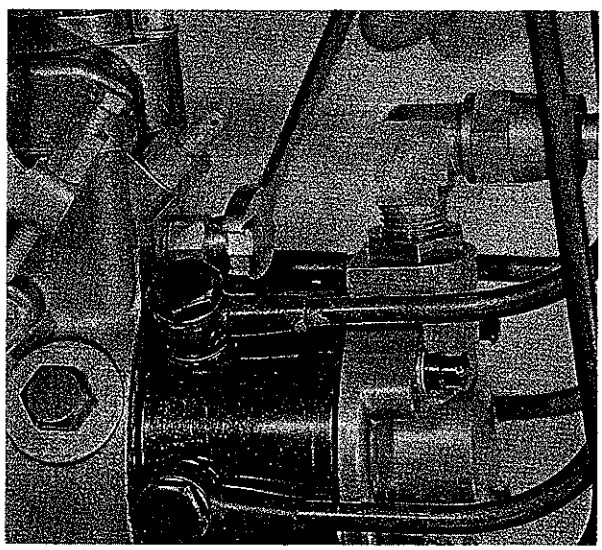
Speed Advance — Check the cam position at specified points in the speed range. Adjust trimmer screw, or shim, as required to obtain proper advance operation.

Fig. 101



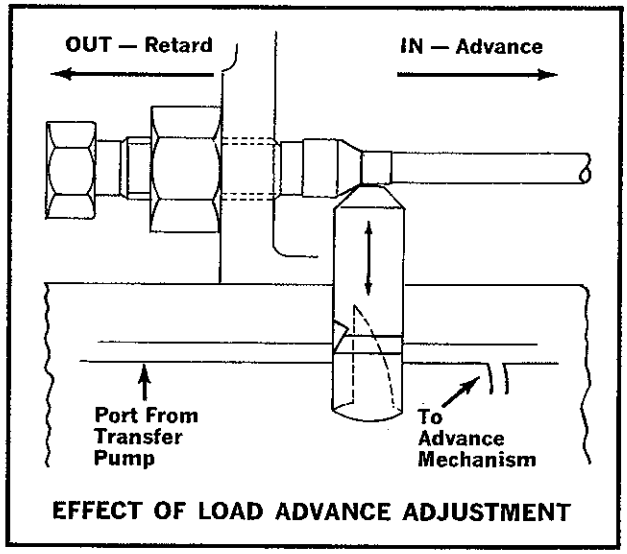
Load Advance — Adjust the test stand speed to the specified part-load delivery. Observe cam position and adjust guide stud for correct cam movement.

Fig. 102



Load Advance Adjustment

Fig. 103

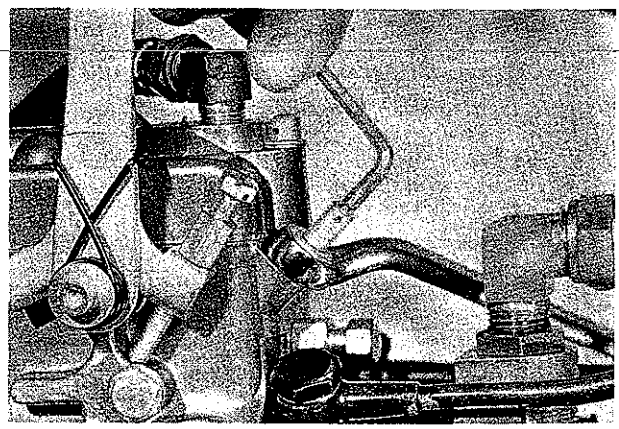


M. Record fuel delivery at check points shown on the pump specification.

ROLLER SETTINGS SHOULD NOT BE READJUSTED ON THE TEST BENCH. Experience has proved that micrometer and dial indicator settings provide more consistent, accurate results in performance. Variations in test benches, nozzles, lines, and fuels in different areas sometime result in inaccurate flow readings.

N. While operating at full-load governed speed set torque screw (if employed) to specified delivery.

Fig. 104



Torque Screw Adjustment

O. Recheck delivery at lowest speed checkpoint.

P. Check governor cutoff at specified speed.

Q. Remove from test stand and assemble all sealing wires. Pump is now ready for installation to engine.

R. If there is no drive shaft with the pump, wire the throttle lever in "full fuel" position for shipment or until installed on engine. Otherwise, mount the pump on drive adaptor with shaft. Check shaft seals with a pressure test on the housing.

Installation

INSTALLING THE PUMP

Note: Pumps marked "Timed Start Inj." or "Timed End Inj." on the timing window cover are timed and installed as follows:

1. Remove outboard timing window cover (Name plate side).

2. With a CLEAN wide bladed screwdriver or the pump drive shaft inserted into the drive end of the pump, rotate the distributor rotor until the timing line on the weight retainer hub registers with the line on the cam O.D. The pump is now correctly positioned for assembly to the engine.

3. Roll the engine in direction of rotation until the flywheel is correctly positioned for fuel pump assembly (See engine manual).

4. Apply a light coat of grease to the drive shaft seals. While compressing the drive shaft seals with the drive shaft installation tool, slide the pump into position over the mounting studs. Assemble and tighten the mounting nuts finger tight. Rotate pump, first in the direction of rotation and then in the opposite direction until timing lines again register, Figs. 105, 106, to take up all back lash. Tighten nuts securely.

   Caution: Drive shaft spline should engage with hand pressure. Do not attempt to "draw up" the pump flange with mounting stud nuts. If spline does not engage, rotate pump slightly to locate timing pin.

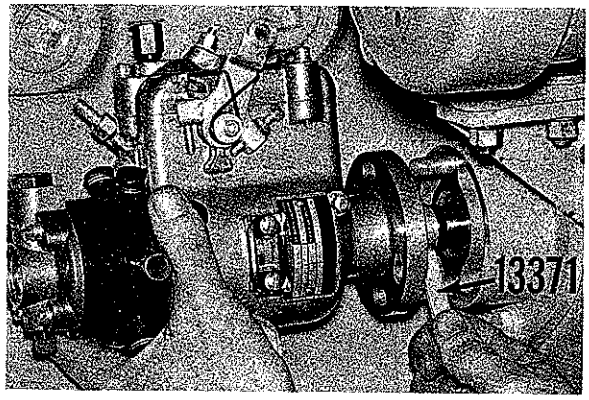


Fig. 105

Back off engine at least ½ revolution and roll it again in the direction of rotation to the proper timing mark. Recheck line marks in the pump and correct if necessary. Repeat procedure to insure proper timing.

Unplug open ends of high pressure lines, assemble with new fuel line connector washers and tighten to specified torque. Assemble and tighten fuel return and nozzle leak-off lines. Open bleed screw on secondary filter, and operate hand primer (if equipped) or allow fuel to flow from tank until all air is dispelled from filter. Close bleed screw. Continue hand priming until a quantity of fuel flows "air-free" at pump inlet line. Fasten the inlet line to the pump. This procedure should also be followed without fail after every filter change. Refer to engine manual for starting instructions before starting engine.

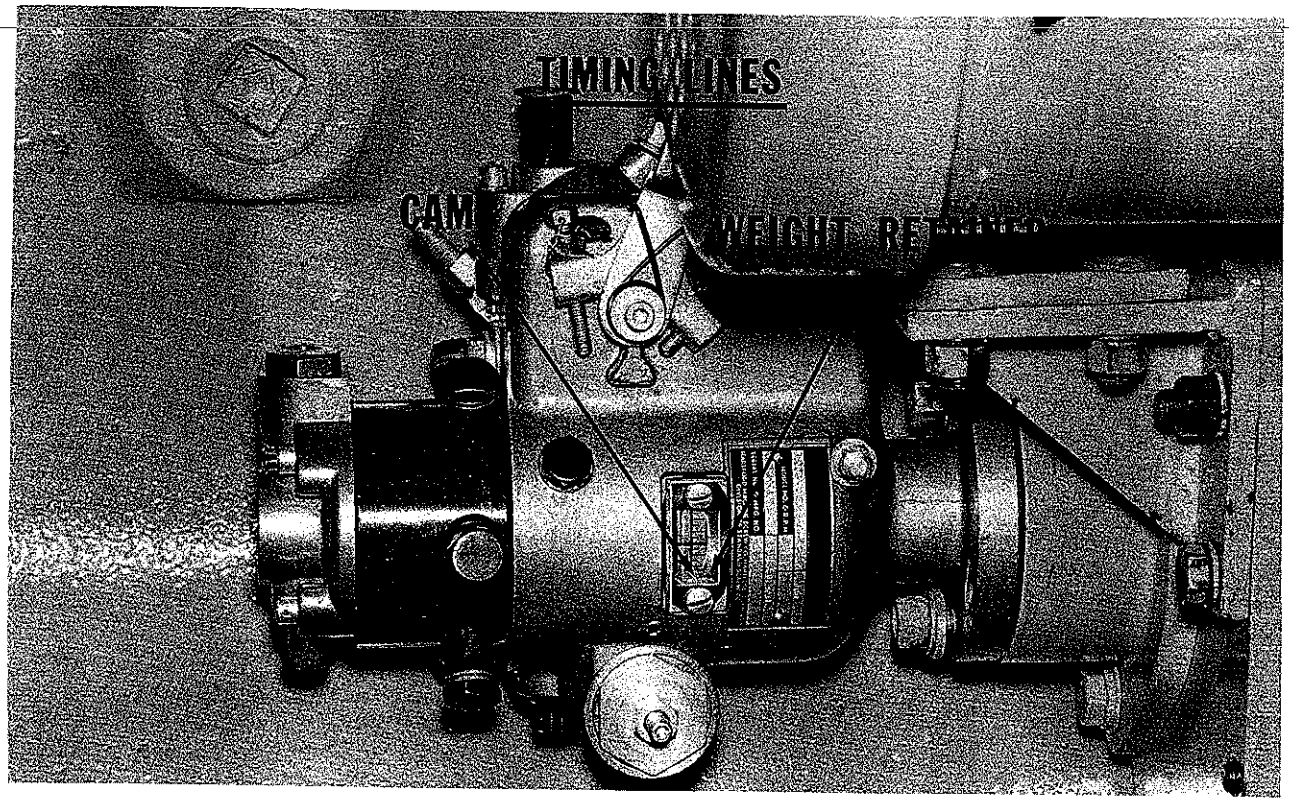


Fig. 106

Fuel Piping and Filtration

The basic requirements of a diesel engine fuel system are adequate piping, proper selection of filters for the application and completely air-tight joints, with a minimum number of fittings to prevent ingress of air, especially in installations with the fuel tank lower than the pump.

MARINE AND INDUSTRIAL ENGINE APPLICATIONS

Marine and industrial engines may require a different piping arrangement to suit application peculiarities and performance demands. Generator sets, for example, are particularly sensitive to air and usually require a separate electrically or mechanically driven auxiliary supply pump to deliver fuel, at low pressure, to the unit day tank. This places a positive head of fuel at the transfer pump and virtually eliminates entrance of air to the system (See Figs. 107 and 108).

Fig. 107

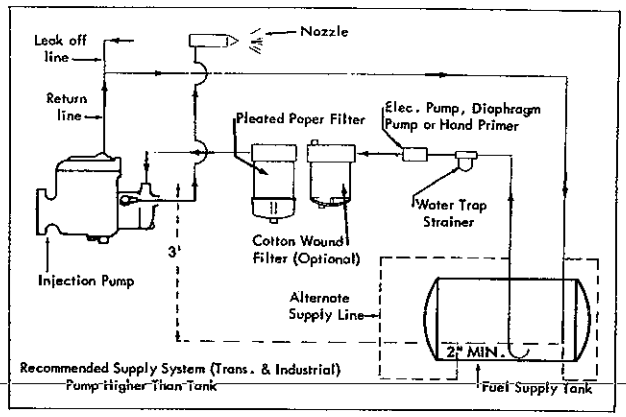
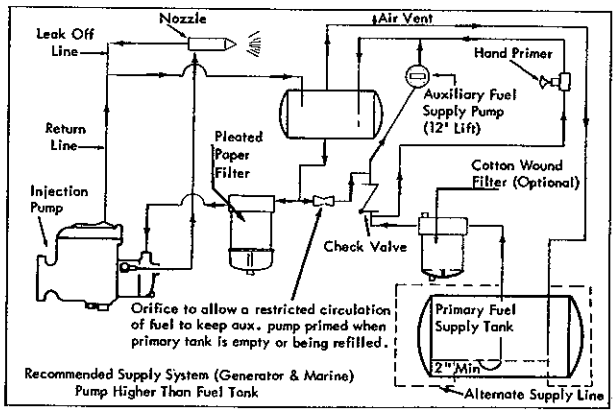


Fig. 108



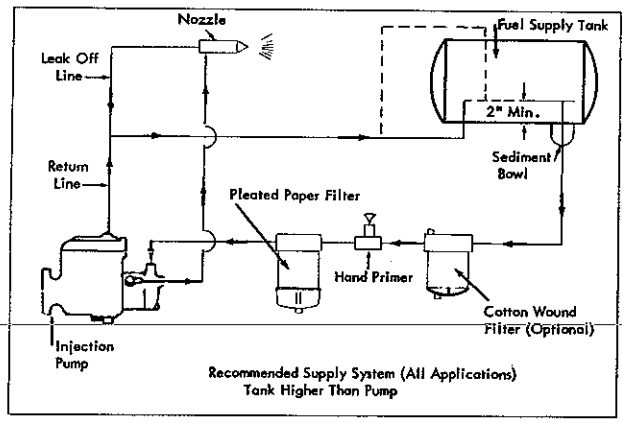
Proper selection of piping sizes, filter capacities and layout of the system must be made to prevent undue restriction which would affect pump and engine performance. Of equal importance, is the necessity for utmost cleanliness of fuel before and during handling. Admission of minute foreign particles, even in small quantities, will seriously wear the close clearances necessary to seal against internal hydraulic leakage.

Outside storage, as well as vehicle and unit tanks, should be guarded against entrance of dirt. They should have drains to remove water and settlings periodically, be adequately vented and kept as full as possible to prevent condensation. Attendant piping should *not* be galvanized. Rigid observance of fuel cleanliness standards from time of purchase to ultimate use will do much to assure trouble-free operation.

VEHICLE APPLICATIONS

Vehicle applications, especially trucks, are subject to unusual vibration and continual agitation of the fuel in the tanks. This causes more than the usual amount of loose fittings and air entrainment which can be difficult to remove at the injection pump.
The following recommendations are listed in the order of their effectiveness.

Fig. 109



1. An electric boost pump at the tank outlet is the most desirable system and is highly recommended. It provides a slight positive pressure during operation for proper filter venting and air-free supply to the pump inlet.
2. A less expensive engine driven diaphragm-type pump can also be used, although results may be less satisfactory. Commonly available types do not have hand priming levers and the engine must be cranked to prime the system. Where hand priming levers do exist, the engine must be spotted on the low side of the eccentric cam and a faulty check valve can render this accessory useless.
3. A hand primer, mounted as recommended in the piping diagrams, can be used if the cost of an auxiliary pump is considered prohibitive. It should be realized, however, that the self priming advantage will not be present.

Farm and industrial tractors usually have the tank mounted above the engine and the piping arrangement is generally as shown in Fig. 109.

Fuel Piping and Filtration

GENERAL RECOMMENDATIONS FOR ALL SYSTEMS

A. MAXIMUM SUCTION LIFT

As a general rule, vacuum at the transfer pump inlet should be avoided.

With clean filters, air-tight piping and the system completely primed, the Roosa Master transfer pump will lift commercial grades of diesel fuel (at average ambient temperatures) 12 feet. However, due to problems of draining during shut down, such a system is not recommended (especially for generator set applications) without the aid of an auxiliary pump at tank level delivering fuel to a day tank above the pump. If a day tank is not used, auxiliary pump pressure should not raise the transfer pump inlet pressure over 5 psi.

Satisfactory performance without an auxiliary pump can be obtained, once the system is fully primed, with a suction lift not greater than three feet. However, to prevent drainback during shutdown periods, a hand primer pump should be installed to utilize its check valves.

B. MAXIMUM LINE LENGTH (for average ambient temperatures)

Once primed, the transfer pump will deliver fuel from a tank 25 feet distant from the pump with the tank at pump level. Again, however, an auxiliary supply pump at the tank is recommended for best performance.

C. SUPPLY LINE SIZE

1. Line lengths under 10 feet:
   3/8" copper or steel tubing or
   5/16" flexible piping.
2. Line lengths over 10 feet:
   1/2" copper or steel tubing or
   7/16" flexible piping.

Supply line sizes under 6 feet long between system components (filters, day tanks, hand primers, etc.) should be 5/16" O.D. tubing or 1/4" flexible piping to keep small air bubbles moving rapidly instead of collecting into large slow-moving voids which the pump may not be able to assimilate.

D. RETURN LINE SIZE

1. Line lengths under 10 feet:
   1/4" copper or steel tubing or
   3/16" flexible tubing.
2. Line lengths over 10 feet:
   5/16" copper or steel tubing or
   1/4" flexible tubing.

NOTE: THE RETURN LINE MUST NEVER BE PIPED BACK TO THE PUMP INLET SIDE, UNLESS SOME MEANS FOR AUTOMATICALLY VENTING AIR IN THE RETURN OIL IS PROVIDED.

E. PIPING TO THE TANK

Pressure at the pump outlet fitting should not exceed 3 psi. (Outlet is considered *after* the restriction fitting, if employed.)

Both supply and return line should be connected to stand pipes in the tank with the opening for each 1½" to 2" from the bottom of the tank to allow space for water and sediment to settle and to help eliminate siphoning problems. If the inlet standpipe is made as shown (Figs. 107 and 108), it greatly reduces the possibility of air entering when fuel, at low level, is sloshing in the tank.

F. FILTER REQUIREMENTS

1. A water trap of generous size (3 oz. or larger).
2. Primary filter: In localities where it is known that the air is dusty or that the fuel contains large dirt particles, resins, gums, tars and varnishes, a cotton wound-type filter should be installed. Locate all filters lower than the tanks for gravity venting. Refer to the piping diagram.
3. Secondary filter: A pleated paper or equivalent type with large area and minimum pressure drop capable of filtering five micron particle sizes is recommended. Refer to piping diagram.

G. MAXIMUM PRESSURE DROP

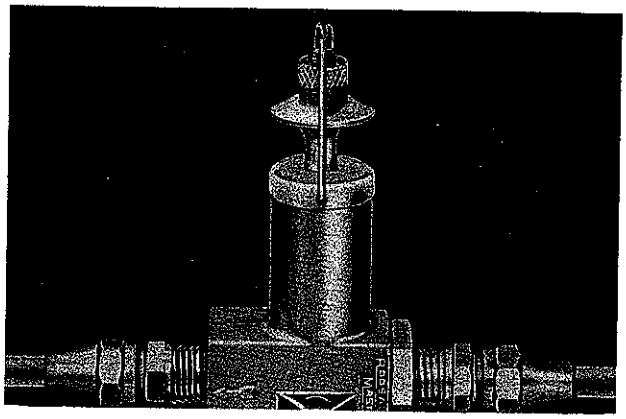
Pressure drop across clean filters should not be more than 1½" to 2½" HG at full load. Pressure drop in the supply system exceeding 10" of mercury because of dirty filters or other restriction usually will affect pump and engine performance (low power, engine stall, erratic operation). A simple, positive check of the supply system for these defects can be performed readily as outlined in the "Trouble Shooting" chart at the end of this manual.

H. THE ROOSA MASTER HAND PRIMER

If, due to piping system peculiarities, the system requires a hand primer, it should be accessible from the operator's position during engine cranking. Whenever possible, protect the inlet valves from fouling by installing after the primary filter if no sediment strainer is used. In gravity systems a primer is not normally required. To eliminate a long suction lift, mount the primer as close as possible to the tanks.

Hand Primer Pump

Fig. 110



HAND PRIMER

The hand primer pump is used primarily for filling the fuel supply system completely after it has been opened for changing filters or servicing the pump. Its secondary function is to prevent fuel from draining out of the system while the engine is not in operation in those applications where the tank is located below the injection pump (See "Fuel Piping").

Operation of the plunger with the connection at the injection pump inlet fitting loosened, purges air from the system. Operate the hand primer *only* until resistance is felt at the plunger. Continued pumping could rupture filter elements and does no further good in priming the injection pump. Complete filling of the pump housing is entirely unnecessary. Presence of air-free fuel at the transfer pump inlet will insure filling of the entire pump shortly after starting the engine.

DISASSEMBLY

Unscrew plunger clamp screw and swing clamp wire off plunger. Spread wire ends to disengage and remove plunger, plunger guide and piston seal as a unit. Place body in a soft-jaw vise. Remove valve nut and seal ring, valve seal and upper valve, retainer spring, second valve and valve gasket (See Fig. 112).

Note: Units of early manufacture will employ two paper valve gaskets instead of one valve gasket and one valve seal. If valve nut is reusable, replace using paper gaskets.

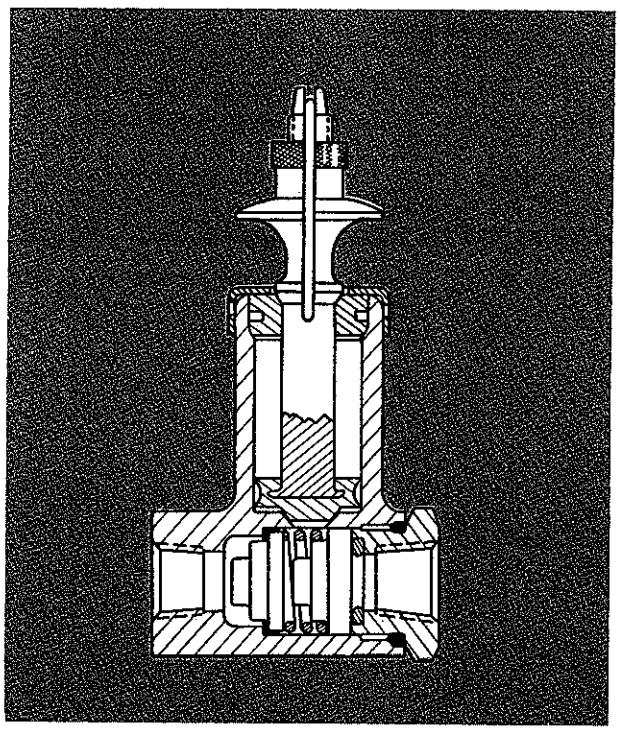
INSPECTION

Examine valve gaskets for tears, and replace as needed. Check the piston seal on the bottom of the plunger for damage, and replace, if necessary. Check for foreign matter in valves and in hand primer body. If rubber plunger guide is worn, cut to remove and slip a new guide, using clean grease to lubricate, over the end of the plunger (chamfer down).

REASSEMBLY

Assemble lower valve gasket, valve, spring, upper valve, valve seal, valve nut and "O" ring seal, plunger and plunger guide. Note: Valves must open in direction of arrow on pump body. Spread clamp wire to fully engage guide slot, swing up and screw clamp nut down.

Fig. 111



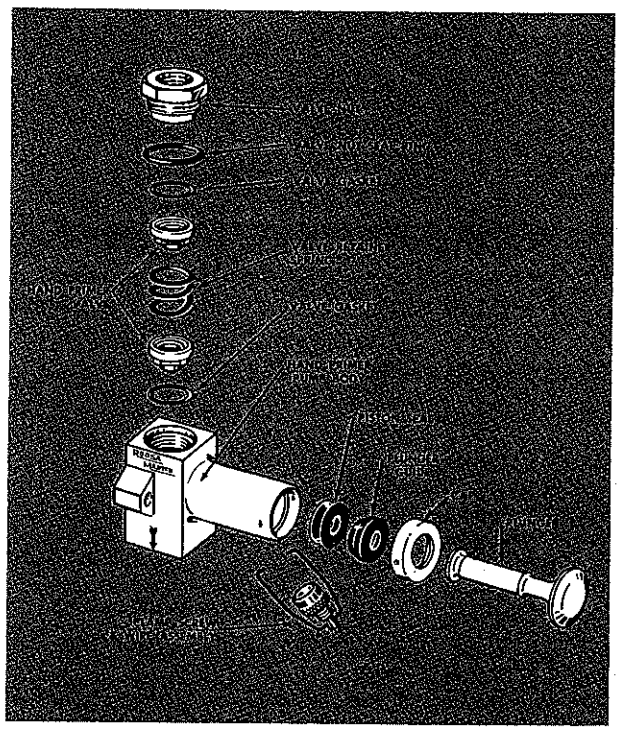


Fig. 112

General Data

The Roosa Master Model DC Fuel Injection Pump operates with all types of combustion chambers. All Model DC Pumps incorporate a built-in centrifugal governor of the flyweight type.

VERSIONS AVAILABLE

The Model DC Fuel Injection Pump is available for: 2, 3, 4, 6 and 8 cylinder, 2 and 4 stroke cycle engines.

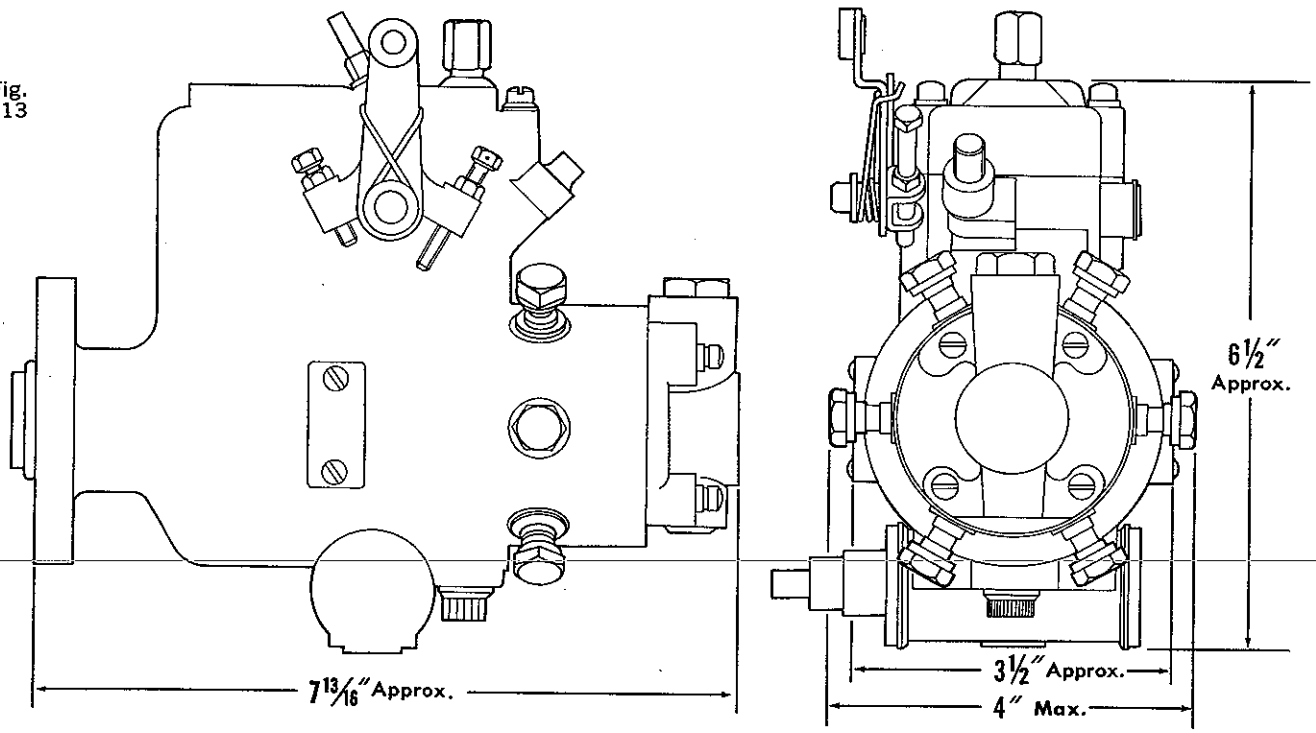
OPERATIONAL DATA

Line pressure (maximum permissible)—8000 PSI
Maximum permissible transfer pump pressure—130 PSI
Transfer pump lift at 200 pump RPM (minimum) — 18″ HG
Pump speed (maximum permissible)—3000 RPM

DIMENSIONAL DATA

Available plunger sizes (diameters) — .250″, .270″, .290″, .310″, .330″
Weight of basic pump, regardless of number of cylinders served—approximately 9 lbs.

Fig. 113

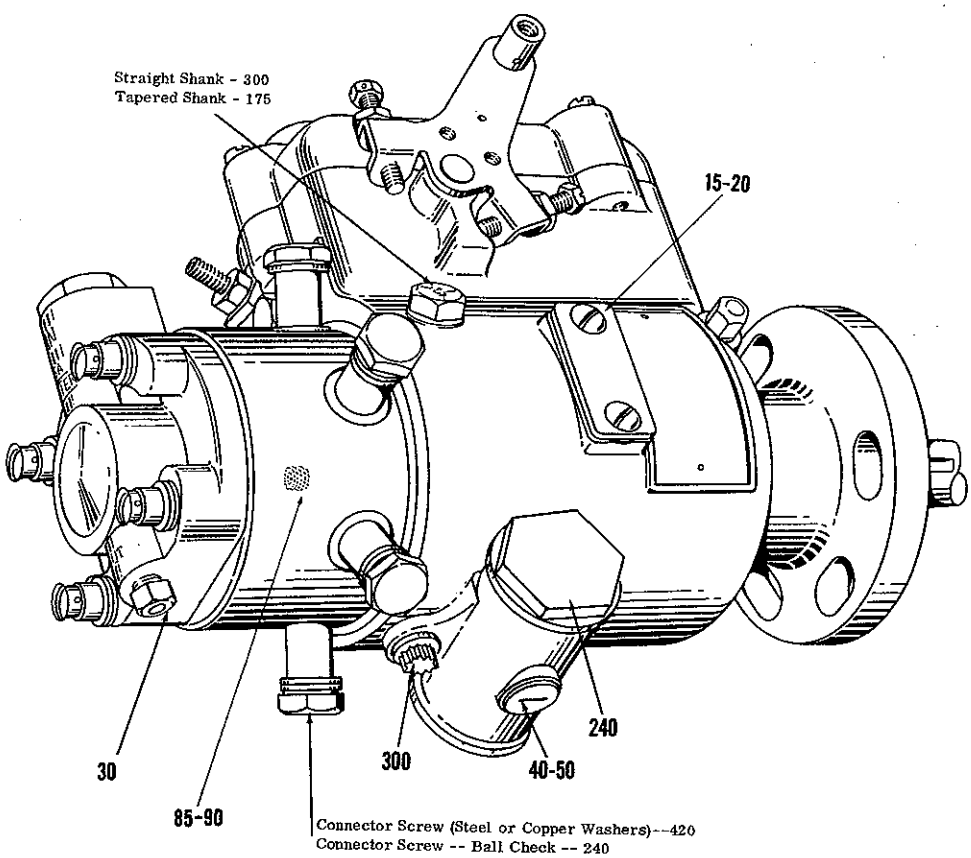


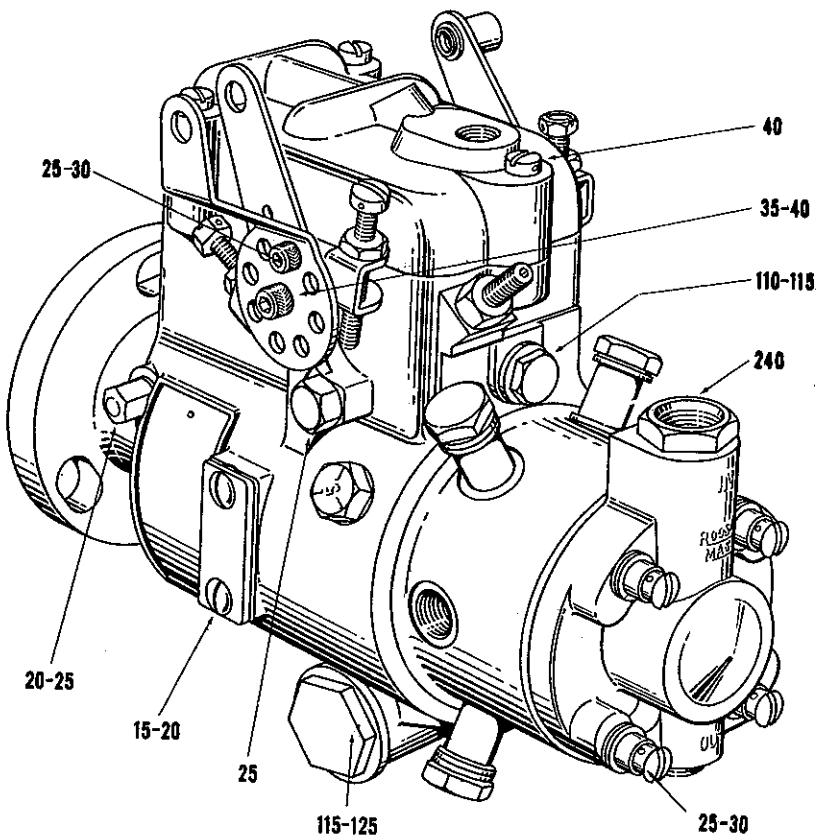
SERVICE TOOLS

Part No.	Nomenclature
13337	Snap ring pliers (gov. weight retaining)
13371	Drive shaft assembly tool
14490	Automatic advance wrench
14067	Electric shut-off adj. tool
14725	Electric shut-off adj. weight
13366	Advance test gauge (timing window)
13379	Linkage hook wrench
13389	Linkage gauge
13383	Delivery valve extractor
13369	Drive shaft seal assy. tool
13301	Sleeve extractor
13336	Socket screw driver
13363	Holding fixture
13375	Rotor ret. ring inst. tool
15500	Cam advance screw bushing
16313	Governor wt. retainer support
16314	Pilot tube remover
16315	Spacer
16199	Piston ring installing tool
16182	Centrality gauge
11370	Adaptor
16349	Snap ring pliers (reg. piston seal ring)
16336	Socket screw driver (R-R)

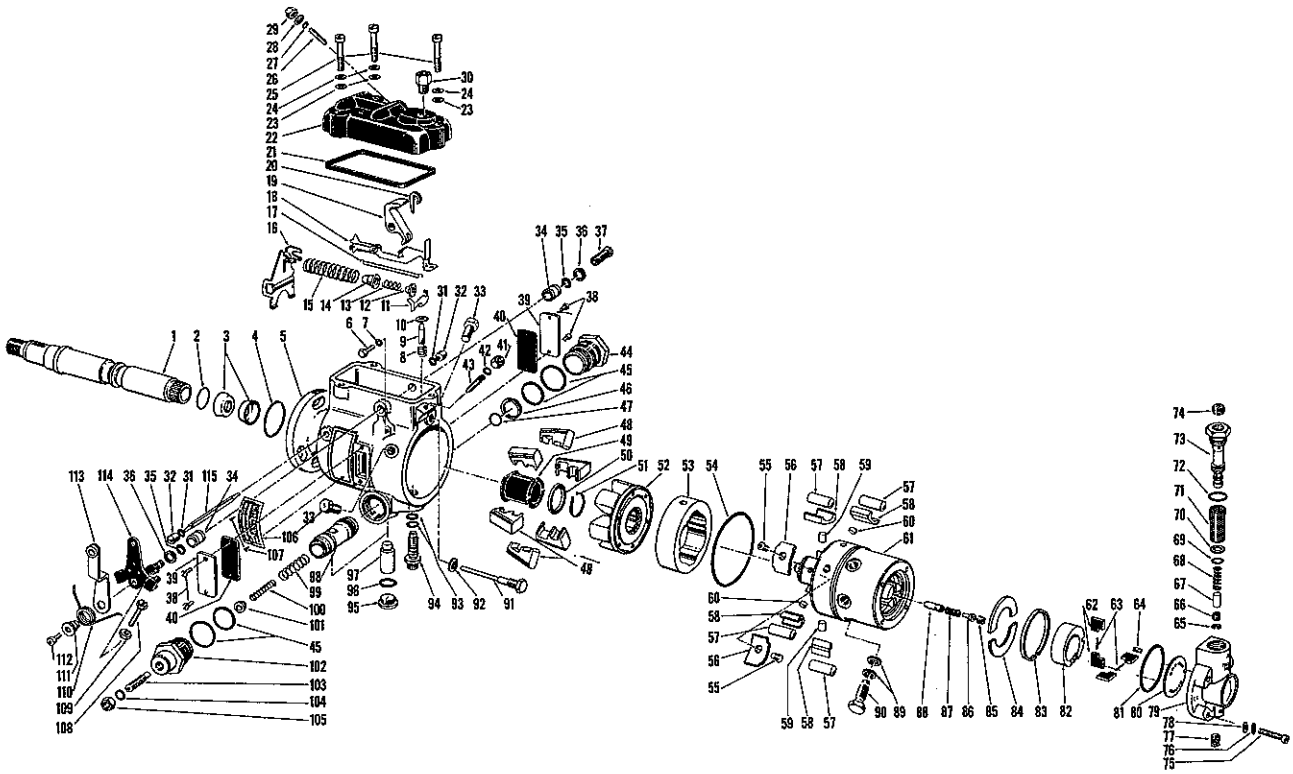
Torque Values

(inch lbs.)





Exploded View



1. SHAFT, drive
2. RING, drive shaft
3. SEAL, drive shaft
4. SEAL, pilot tube
5. HOUSING ASSEMBLY
6. SCREW, torq. scr. hole plug
7. WASHER, torq. screw hole
8. SPRING, metering valve
9. VALVE, metering
10. SHIM, metering valve
11. ARM ASSY., metering valve
12. GUIDE, idling spring
13. SPRING, idling
14. RETAINER, spring
15. SPRING, governor control
16. ARM, governor
17. SPRING, governor linkage
18. HOOK ASSEMBLY, governor linkage
19. LEVER, throttle shaft
20. CAM, shut-off
21. GASKET, governor cover
22. COVER, governor control
23. WASHER, cover hold-down screw
24. LOCKWASHER, cover screw
25. SCREW, cover hold-down
26. SCREW, low idle adj. scr.
27. SEAL, low idle screw
28. WASHER, low idle adj. scr.
29. NUT, low idle adj. screw
30. CONNECTOR ASSY., return line
31. SEAL, pivot shaft
32. NUT, pivot shaft retainer
33. SCREW, head locking
34. BUSHING, throttle shaft
35. SEAL, throttle shaft
36. WASHER, throttle shaft seal
37. SHAFT, shut-off
38. SCREW, timing line cover
39. COVER, timing line
40. GASKET, timing line cover
41. NUT, torque screw
42. SEAL, torque screw
43. SCREW, torque
44. PLUG, piston (power)
45. SEAL, adv. piston hole plug
46. RING, adv. piston
47. SEAL, piston ring
48. WEIGHT, governor
49. SLEEVE, governor thrust
50. WASHER, gov. thrust sleeve
51. RING, gov. cage retaining
52. RETAINER ASSY., weight
53. CAM RING
54. SEAL, hydraulic head
55. SCREW, leaf spring adj.
56. SPRING, leaf
57. ROLLER, cam
58. SHOE, cam roller
59. PLUNGER, rotor
60. PLUNGER, rotor
61. HEAD AND ROTOR, hydraulic
62. BLADE, transfer pump
63. SPRING, trans. pump blade
64. ROLLPIN, end plate loc.
65. RING, retaining
66. SEAL, regulating piston
67. PISTON, regulating
68. SPRING, regulating
69. RING, sleeve seal
70. SEAL, element
71. ELEMENT, filter
72. SEAL, end plate sleeve
73. SLEEVE, end plate
74. PLUG ASSY., end plate adj.
75. SCREW, end plate
76. LOCKWASHER, end plate screw
77. PLUG, end plate pipe
78. WASHER, end plate screw
79. PLATE, end
80. PLATE, thrust
81. SEAL, transfer pump
82. LINER, transfer pump
83. RING, rotor retainer
84. RETAINER, rotor
85. SCREW, delivery valve ret.
86. STOP, delivery valve
87. SPRING, delivery valve
88. VALVE, delivery S. B. 109
89. WASHER, fuel line connector
90. SCREW, fuel line connector
91. STUD, guide
92. WASHER, guide stud
93. SEAL, head loc. screw
94. SCREW ASSY., head loc.
95. PLUG, adv. scr. hole
96. SEAL, adv. scr. hole plug
97. PIN, advance
98. PISTON, advance
99. SPRING, outer advance
100. SPRING, inner advance
101. GUIDE, adv. adj. screw
102. PLUG, piston (spring)
103. SCREW, advance adj.
104. SEAL, adv. adj. screw
105. NUT, adv. adj. screw
106. PLATE, name
107. SCREW, name plate
108. SCREW, throttle lever stop
109. NUT, throttle lever stop scr.
110. SPRING, throttle lever
111. RETAINER, throttle lever spr.
112. SCREW, throttle lever spring
113. LEVER ASSY., throttle
114. SHAFT ASSY., throttle
115. SHAFT, governor arm pivot

Trouble Shooting

PROBLEM MAY OCCUR	CAUSE (Numbers in "Problem" Check Chart indicate order in which to check possible "Causes" of Problem.)	A. Fuel not reaching pump.	B. Fuel delivered from transfer pump but not to nozzles.	C. Fuel reaching nozzles but engine won't start.	D. Engine starts hard.	E. Engine starts and stops.	F. Erratic engine operation — surge, misfiring, poor governor regulation.	G. Engine idles imperfectly.	H. Engine does not develop full power or speed.	I. Engine smokes black.	J. Engine smokes blue or white.	
ON TEST STAND FOLLOWING OVERHAUL	Transfer Pump liner locating pin in wrong hole for correct rotation.	7										Re-install properly.
	Plunger missing.		13									Assemble new plunger.
	Cam backwards in housing.		11									Reassemble correctly.
	Wrong Cam Hole Cover (incorrect cam position).			11	26		12	12	13	9	4	Install correct cover. See pump specifications.
	Metering Valve incorrectly assembled to metering valve arm.		9									Reassemble correctly.
	Delivery Valve Sticking, missing or assembled backwards.				22		26	22	18			Remove, clean or replace as needed.
	Metering valve spring shim missing. (See Spec.)		19				15	8				Install as indicated in reassembly instructions.
	Hydraulic head vent wires missing.		18						29			Install as indicated in reassembly instructions.
	Head plug screws loose or missing.		17	18			28	20	23			Install as indicated in reassembly instructions.
	Idling spring missing, or incorrect.						19	9				Assemble as indicated in reassembly instructions.
FOLLOWING INSTALLATION ON ENGINE	Hand primer installed backwards.	3										Re-install properly.
	One or more Connector Screws obstructed.		3		5				9			Replace.
	Seizure of Distributor Rotor.	2										Check for cause of seizure. Replace hydraulic head and distributor rotor assembly.
	Failure of electrical shut-off.		2			8						Remove, inspect and adjust parts. Replace parts as necessary.
DURING OPERATION	Fuel supply lines clogged, restricted, wrong size or poorly located.	9	10	8	6	1	2	15	4			Blow out all fuel lines with filtered air. Replace if damaged. Remove and inspect all flexible lines.
	Air leaks on suction side of system.	11			7	7	8	3	5			Trouble-shooting the system for air leaks. See Supplementary Inspections in manual.
	Transfer Pump Blades worn or broken.	8			14	10	22	5	15			Replace.
	Delivery Valve Retainer Screw loose and leaking or incorrectly installed.				29		25		26			Inspect Delivery Valve Stop seat for erosion, tighten Retainer Screw, or replace head and rotor assembly as needed.
	End Plate Regulating Piston sticking in "prime" position.	10			16							Remove piston and sleeve and inspect for burrs, corrosion or varnishes. Replace if necessary.
	Shut-off device at "stop" position		1									Move to "run" position.
	Plungers sticking.		14		24	12	30	23	20			Disassemble and inspect for burrs, corrosion or varnishes.
	Metering Valve sticking or closed.		4		17	9	14	7	11			Check for governor linkage binding, foreign matter, burrs, etc.
	Passage from Transfer Pump to Metering Valve clogged with foreign matter.		15									Disassemble and flush out Hydraulic Head.
	Governor Spring worn or broken.		5				17	17				Remove and replace. See pump specifications.
	Governor linkage broken.		6					19				Remove, replace and readjust per specifications.
	Tank valve closed.	1										Open valve.
	Fuel too heavy at low temperature.	6			9							Add kerosene as recommended for 0°, −15° and −30° temperatures.
	Cam Roller Shoes sticking.		12			11	27					Remove, check for size and burrs and reassemble.
	Cranking speed too low.			1	2						8	Charge or replace batteries.
	Lube oil too heavy at low temperature.			21	10							See engine manual.
	Engine engaged with load.			2	1							Disengage load.
	Nozzles faulty or sticking.			12	30		9	11		5		Replace or correct nozzles.
	Intake air temperature low.			5	3							Provide starting aids. See engine manual.
	Engine compression poor.			20	12				30	10	9	Correct compression. See engine manual.
	Pump timed incorrectly to engine.			3	4		4	4	7	4	3	Correct timing. See engine manual.
	Excessive fuel leakage past plungers (worn or badly scored).			17	25			21	21			Replace rotor and hydraulic head assembly.
	Transfer Pump faulty, pressure too low.				15		23		16			*Remove and inspect parts.
	Filters or Inlet Strainer clogged.	5			8	6	3		6			Remove and replace clogged elements. Clean strainer.
	Cam, Shoes or Rollers worn.			16	23				19	11		Remove and replace.
	Automatic advance faulty or not operating.			13	28		13	13	14	7	5	Remove, inspect, correct and reassemble.

Trouble Shooting

PROBLEM MAY OCCUR	CAUSE *Numbers in "Problem" Check Chart indicate order in which to check possible "Causes" of Problem.*	PROBLEM A. Fuel not reaching pump.	B. Fuel delivered from transfer pump but not to nozzles.	C. Fuel reaching nozzles but engine won't start.	D. Engine starts hard.	E. Engine starts and stops.	F. Erratic engine operation — surge, misfiring, poor governor regulation.	G. Engine idles imperfectly.	H. Engine does not develop full power or speed.	I. Engine smokes black.	J. Engine smokes blue or white.	
	Governor linkage out of adjustment.				19		18	10	12			Adjust governor linkage hook.
	Governor not operating; parts or linkage worn, sticking or binding, or incorrectly assembled.		7		20		16	6	10			Disassemble, inspect parts, replace if necessary and reassemble.
	Maximum fuel setting at low limit or too low.			14	21				17			Reset to pump specifications.
	Engine valves faulty or out of adjustment.				32		10	18		6	10	Correct valves or valve adjustment as in engine manual.
	Water in fuel.			6	11	2	5	1	28			Drain fuel system and pump housing, provide new fuel, prime system.
	Return oil line or fittings restricted.				33	4	32	24	8			Remove line, blow clean with filtered air and reassemble. Replace if damaged.
	Engine rotation wrong.	4										Check engine rotation. See engine manual.
	Air intake restricted.					3			31	2		Check. See engine manual.
	Wrong Governor spring.						21		32			Remove and replace with proper spring as in pump specifications.
	Pump housing not full of fuel.						7	2				Operate engine for approximately 5 minutes until pump fills with fuel.
	Low cetane fuel.			15	13		6	16	25	8		Provide fuel per engine specifications.
	Fuel lines incorrect, leaking or connected to wrong cylinders.			7			1		33			Relocate pipes for correct engine firing sequence.
	Nozzle return lines clogged.						11					Remove lines, blowout, inspect and reassemble.
	Tang Drive worn in excess of .0045"						29		22		6	Remove and install new head and rotor assembly and drive shaft as necessary.
	Governor sleeve binding on drive shaft.						20					Remove, inspect for burrs, dirt, etc. Correct and reassemble.
	End Plate Regulating Piston sticking.						24	14				Remove piston and sleeve and inspect for burrs, corrosion or varnishes. Replace if necessary.
	Shut-off device interfering with Governor linkage.			9	18				2			Check and adjust governor linkage dimension
	Governor high-idle adjustment incorrect.								3			Adjust to pump specifications.
	Torque Screw incorrectly adjusted.		8	10	27				27	13		Adjust to specification.
	Throttle Arm travel not sufficient.			4					1			Check installation and adjust throttle linkage.
	Rotor badly scored.		16	19	31				24			Replace hydraulic head and rotor assembly.
	Maximum fuel setting too high.									12		Reset to pump specifications.
	Engine overheating.					5				3		Correct as in engine manual.
	Exceeding rated load.									1		Reduce load on engine.
	Engine cold.				34						1	Check thermostats or shutter controls, warm to operating temperature. See engine manual.
	Lube oil pumping past valve guides or piston rings in engine.										7	Correct as in engine manual.
	Excess lube oil in engine air cleaner.										2	Remove, check and reduce oil quantity to specified level.
	Variable speed droop device incorrectly adjusted or faulty.						31					Replace as necessary.

STANADYNE

Diesel Systems

America's leading manufacturer of
Fuel Injection Systems for Diesel Engines

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