Testing and Servicing Fuel Injection Pumps and Nozzles

SERVICE MANUAL
Fuel Pumps & Nozzles
SM2045 (English)

CALIFORNIA
Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

If this product contains a gasoline engine:

⚠ WARNING

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

The State of California requires the above two warnings.

Worldwide Construction And Forestry Division

Pump Affected DB	JDB	JDC	CB	Cause / Correction
				ENGINE STARTS HARD (Cont.)
X	X	X	X	Fuel supply lines clogged, restricted, wrong size, or poorly located. Blow out all lines with filtered air. Replace if damaged. Remove and inspect all flexible lines.
X	X	X	X	Air leaks on suction side of system. Inspect the system for air leaks.
X	X	X	X	Fuel too heavy at low temperature. Drain fuel system. Refill with correct fuel for prevailing temperature.
X	X	X	X	Crankcase oil too heavy at low temperature. See operator's manual.
X	X	X	X	Water in fuel. Drain fuel system and pump housing. Provide new fuel and bleed system.
X	X	X	X	Engine compression poor. Correct compression.
X	X	X	X	Low cetane fuel. Provide fuel per engine specifications.
X	X	X	X	Transfer pump blades worn or broken. Replace.
X	X	X	X	Pressure regulating piston sticking in its bore. Remove piston and sleeve. Inspect for burrs, corrosion, or varnishes. Replace if necessary.
X	X	X	X	Metering valve sticking or closed. Check for governor linkage binding, foreign matter, burrs, etc.
X	X	X		Shut-off device interferring with governor linkage. Check and adjust governor linkage.
X	X	X	X	Governor linkage out of adjustment. Adjust governor.
X	X	X	X	Governor not operating; parts or linkage worn, sticking or binding, or incorrectly assembled. Disassemble, inspect parts, and replace if necessary.
X	X	X	X	Maximum fuel setting at low limit or set too low. Set pump to specifications.
X	X	X	X	Cam shoes or rollers worn. Remove and replace.

Pump Affected DB	JDB	JDC	CB	Cause / Correction
				ENGINE STARTS HARD (Cont.)
X	X	X	X	Plungers sticking. Disassemble and inspect for burrs, corrosion, or varnishes.
X	X	X	X	Excessive fuel leaking past plungers (worn or badly scored). Replace head, rotor, and pump housing.
X	X			Torque screw incorrectly adjusted. Adjust to specifications.
X	X	X	X	Automatic advance faulty or not operating. Remove, inspect, correct and reassemble.
X	X	X	X	Delivery valve retainer screw loose and leaking or incorrectly installed. Inspect delivery valve stop seat for erosion, tighten retainer screw, or replace head and rotor assembly as needed.
X	X	X	X	Nozzles faulty or sticking. Replace or correct nozzles.
X	X	X	X	Rotor badly scored. Replace hydraulic head and rotor assembly.
X	X	X	X	Engine valves faulty or out of adjustment. Correct valves or valve adjustment.
X	X	X	X	Return fuel line or fittings restricted. Remove line, blow clean with filtered air, and assemble. Replace if damaged.
X	X	X	X	Engine cold. Check thermostats. Warm to operating temperature.
				ENGINE STARTS AND STOPS
X	X	X	X	Failure of electric shut-off. Remove, inspect, and adjust parts. Replace parts as necessary.
X	X	X	X	Fuel supply lines clogged, restricted, wrong size or poorly located. Blow out all fuel lines with filtered air. Replace if damaged. Remove and inspect all flexible lines.
X	X	X	X	Water in fuel. Drain fuel system and pump housing, provide new fuel and bleed system.

FUEL FLOW

The operating principles of the Roosa-Master pumps can be understood by following the fuel flow during a complete pump cycle (Fig. 10-5-3).

Fuel is drawn from the supply tank into the pump through the inlet strainer (G) by the vane-type fuel transfer pump (H). Since transfer pump displacement greatly exceeds the injection requirements, a large percentage of fuel is bypassed through the regulating valve (I) back to the inlet side. The quantity of fuel bypassed increases with an increase in pump speed, and the regulating valve is designed so that transfer pump pressure also increases with an increase in pump speed.

Fuel, under transfer pump pressure, is forced through the drilled passage (L) in the hydraulic head into the annulus (N). It then flows around the annulus to the top of the sleeve and through a connecting passage (E) to the metering valve (D). The rotary position of the metering valve, controlled by the governor, regulates the flow of fuel into the charging ring (F) which contains charging ports.

As the rotor revolves, its single charging hole (M) registers with one of the charging ports in the hydraulic head, and fuel, at transfer pump pressure, flows through the angled passage to the pumping cylinder (O). The in-flowing fuel forces the plungers (P) outward a distance proportionate to the quantity of fuel admitted by the position of the metering valve.

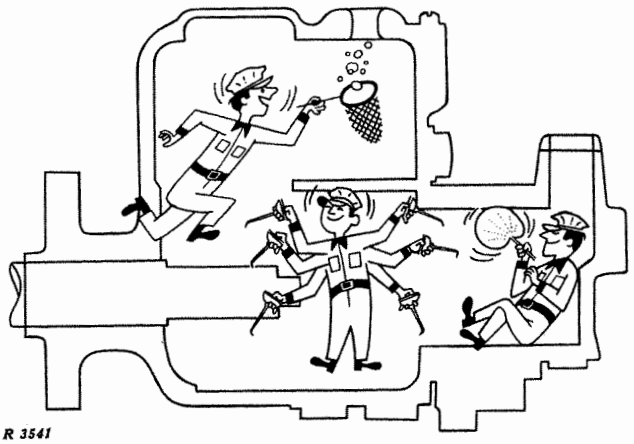
If the metering valve is opened slightly only a small amount of fuel is admitted into the pumping cylinder, as at idling; the plungers move out very little. As additional fuel is admitted, the plunger stroke increases to the maximum quantity as limited by the adjustment of the leaf spring (Q).

At this point of the charging cycle, the rollers (C) are in the "valley" or relieved part of the cam (B) between lobes. The fuel is trapped in the pumping cylinder for a very slight interval after charging is complete.

This is due to the fact that the rotor charging port (M) has passed out of register with the head port (F).

Further rotation of the rotor brings its discharge port (J) into register with an outlet port (K) of the head. At this point, the rollers simultaneously contact the opposing cam lobes, and the plungers are forced toward each other. The fuel trapped between the plungers is forced from the pump through the delivery valve and out one of the head outlet ports to an injection nozzle.

Lubrication of the pump is an inherent characteristic of its design. As fuel, at transfer pump pressure, reaches the charging ring, slots on the rotor shank allow fuel and any trapped air to bleed to a reduced diameter on the shank. This fuel fills the pump housing cavity and acts as a coolant as well as a lubricant, since it is allowed to return to the supply tank via the oil return connection in the pump housing cover. This return line also permits any air present in the fuel, which may have been originally contained in the pump, to be carried out.



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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, which for any reason is carried into the end plate, to bleed back to the fuel tank via the return line (A).

Group 10
SERVICE

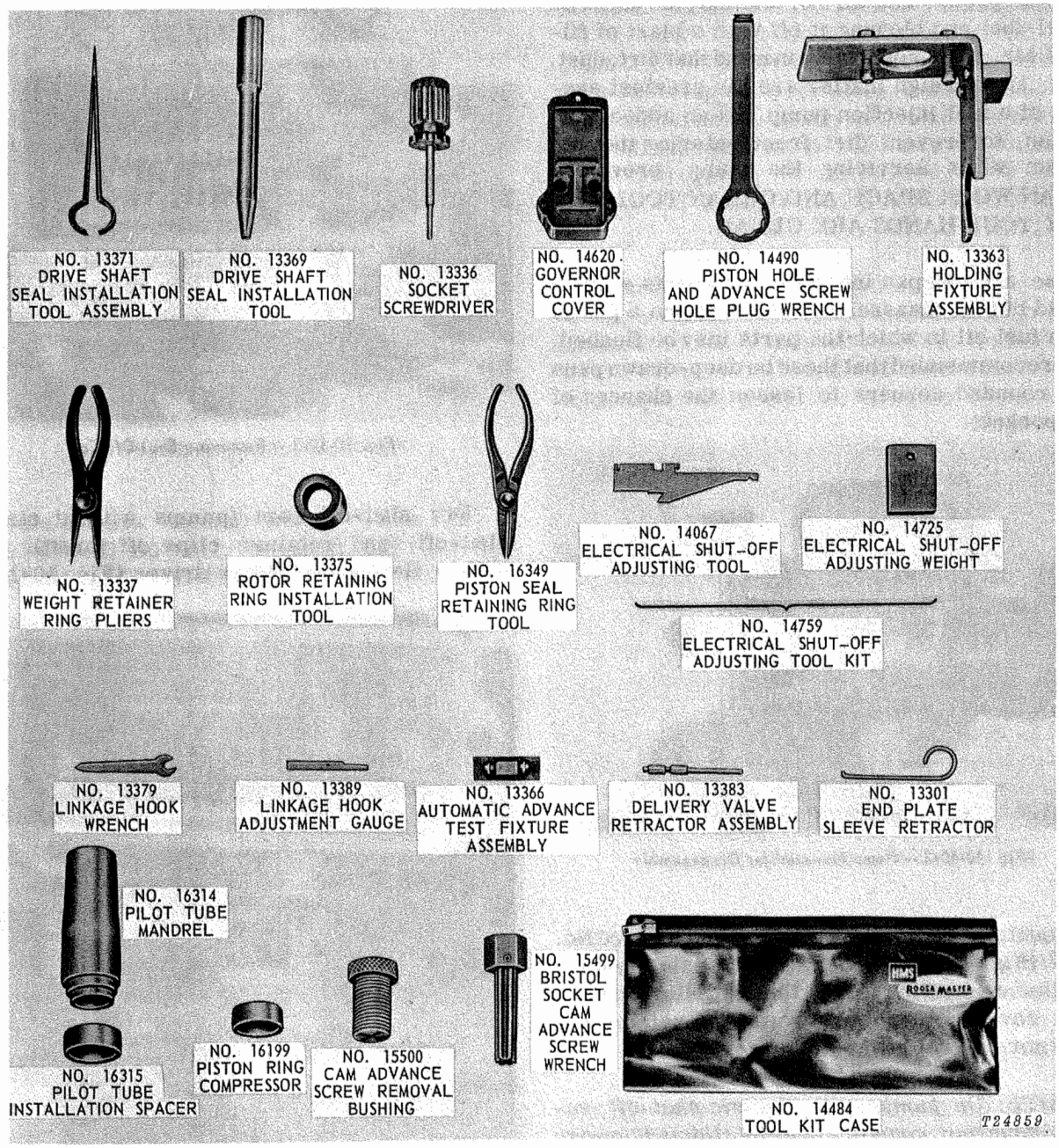

Fig. 10-10-1—Special Tool Kit No. 14754

SPECIAL TOOLS

A special tool kit No. 14754 (Fig. 10-10-1) is required for servicing the Roosa Master Model DB fuel injection pumps. Most of these tools will also be necessary to service the JDB fuel injection pumps. This kit may be ordered from Service Tools Inc., 1901 Indiana Avenue, Chicago, Ill. 60616.

NOTE: Refer to the tractor service manual for instructions on removing and installing the fuel injection pump.

Check for wear at points where the spring contacts the rotor and along the steps that retain the roller shoes (Fig. 10-10-31).

Governor Weights and Retainer

Examine drive pilot tabs in retainer hub, retainer sockets where weights pivot, and pivot points of all weights for wear.

Governor Linkage

Inspect the pivot points of the governor control arm and pivot shaft. Examine the control arm fork for wear where it contacts the thrust sleeve. If wear is in excess of 0.003-inch, discard and replace. Examine the metering valve pin hole in the linkage hook, the spring retainer, throttle shaft lever, and shut-off cam for looseness. Very carefully examine the joint between the throttle and shut-off shaft assemblies for looseness.

Metering Valve and Arm Assembly

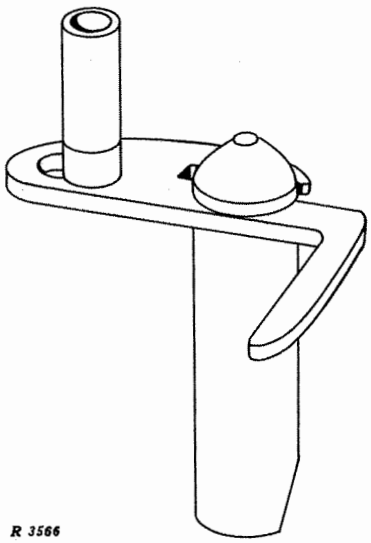

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Fig. 10-10-32–Metering Valve and Arm Assembly

Check the metering valve body (Fig. 10-10-32) 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 breakage or distortion and the metering valve arm pin for wear at its point of contact with the linkage hook.

Cam

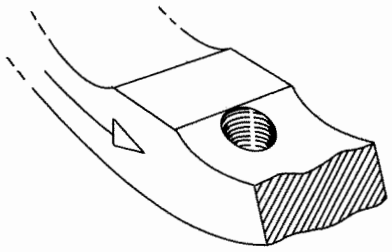

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Fig. 10-10-33–Cam Ring

See Figure 10-10-33. Since only the working portions of the lobes 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 inside of the cam 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.

Drive Shaft

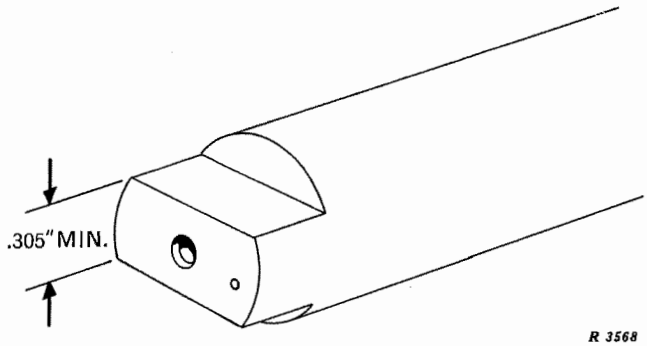

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Fig. 10-10-34–Internal End of Drive Shaft

Inspect the tang (Fig. 10-10-34), being sure that the distance across flats is not less than 0.305-inch. Check the shaft where the governor thrust sleeve slides. The drive shaft seal grooves must be absolutely smooth for the seals to function properly.

End Plate

Check the regulating piston for freedom of movement in the sleeve. Check all threads for damage and the face of the end plate for excessive wear due to end thrust of the transfer pump rotor. Inspect the inlet screen for damage. All dirt or rust must be removed from the assembly. DO NOT ATTEMPT TO REMOVE LINER LOCATING PIN UNLESS OBVIOUSLY DAMAGED.

Automatic Load Advance

See Figure 10-10-11 for exploded view of parts. Check the housing for thread damage and piston hole plugs for extreme wear in the piston bore. Specifically inspect for foreign material or rust in fuel passages and damage to seal seats. Inspect both pistons for wear, especially the piston ends. Check the slide washers for roughness hindering sliding in operation. Replace pistons and washers, if excessive roughness is observed. Examine the advance spring for cracked or broken coils and outside fretting. Replace all O-rings. Carefully inspect the ball end of the cam advance screw for damage or wear. Replace parts as necessary.

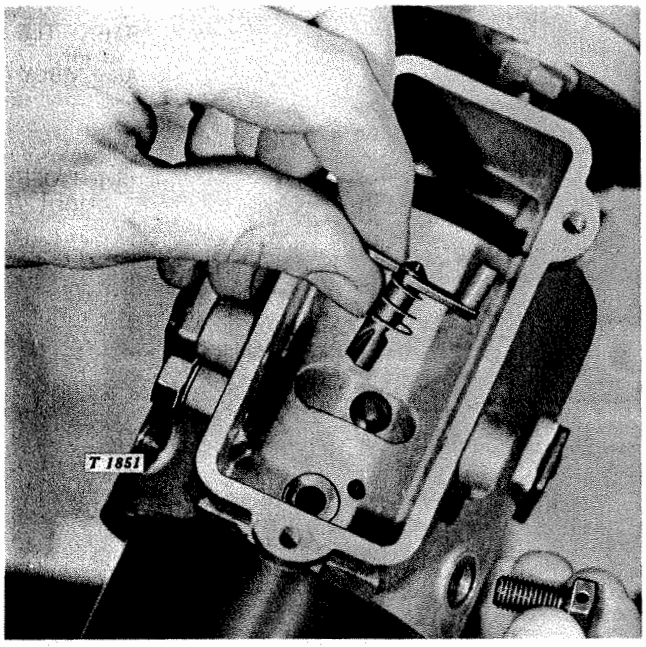


Fig. 10-10-62 – Installing Metering Valve

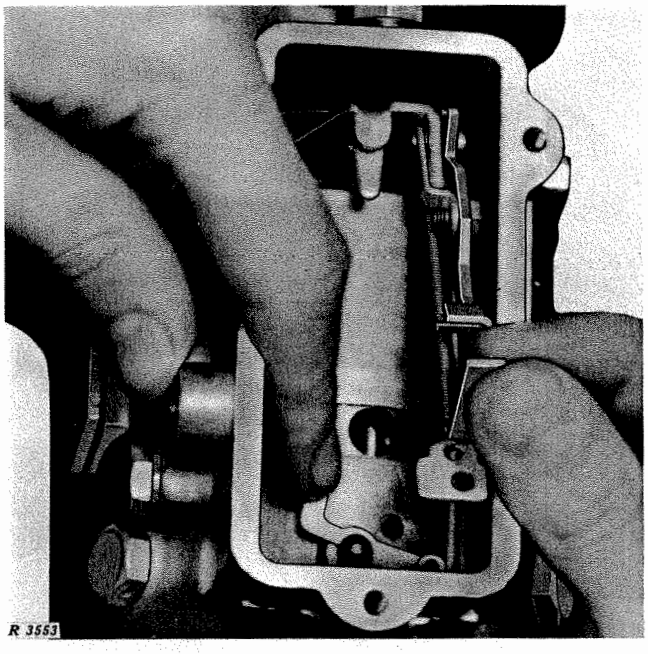


Fig. 10-10-63 – Engaging Governor Linkage Hook

Pull back on the governor linkage hook, stretching the spring just enough to assemble the hook correctly to the fork on the governor arm (Fig. 10-10-63). 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.

NOTE: On pumps with increased length throttle-shaft bushings, it may be necessary to remove the head locating screw and the head locking screws to allow slight rotation of the head. This will make installation of the governor linkage easier and lessen the chance of damage to the linkage.

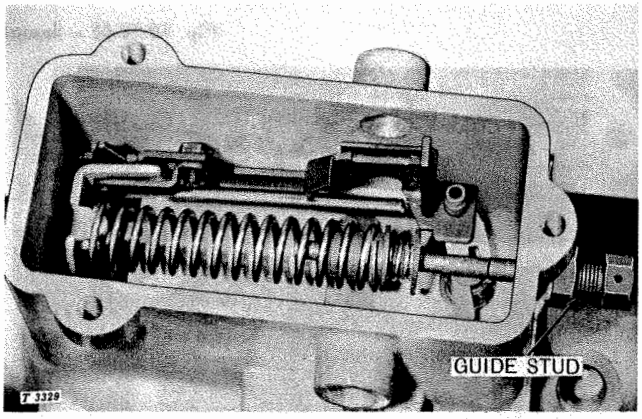


Fig. 10-10-64 – Governor Spring Components Assembled

Assemble the governor spring, spring retainer, idle spring, and idle spring guide between thumb and forefinger and slip 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 idle spring guide, idle spring, spring retainer, and governor spring (Fig. 10-10-64). On pumps not equipped with automatic advance, tighten guide stud to 110-115 in-lbs torque. On pumps equipped with automatic advance, tighten guide stud to 75-80 in-lbs torque.

NOTE: The apparent looseness in the governor parts is normal. Lost motion is immediately taken up as soon as the pump rotates.

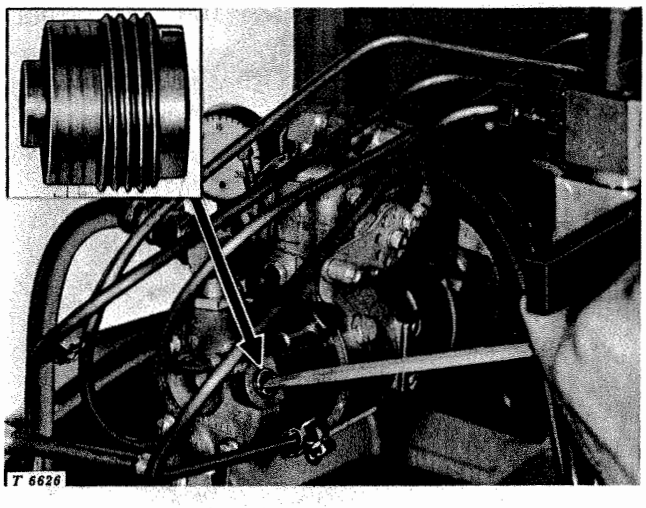


Fig. 10-15-5 – Changing End Plate Plug (Early Model Pumps)

TESTING FUEL DELIVERY

Move stroke counter to "1000" and permit test stand to operate at specified rpm as shown in test data on page 10-15-4. Allow graduates to fill, bleeding air from the stand and wetting glass of graduates.

Observe rate-of-return of oil flowing in return line. At 35 psi transfer pump pressure, rate-of-return should be approximately 100 to 450 cubic centimeters per minute.

Pull drain knob to empty graduates. Set test stand for 1000 strokes and operate stand at pump speeds shown in the test specifications on the following pages. Use speed control handle to increase or decrease pump speed, shift lever to reach "HIGH" or "LOW" speed range, and tachometer on stand to take readings.

Observe the amount of fuel delivered to each graduate (Fig. 10-15-6). The average of these readings should be as listed in the specifications. The difference in the amount delivered to each graduate should not exceed 5 per cent (at full load).

If adjustment is required, adjust the roller-to-roller dimension (see Group 10 of this section).

NOTE: When an injection pump is placed on the test stand for testing purposes and the correct roller-to-roller dimension adjustment has been made, no further roller-to-roller adjustment should be made on the basis of fuel delivery on the test stand. The dimension given in the test specification chart for a specific pump should result in fuel delivery as specified on the chart. Deviations from delivery specifications are a result of other factors (variation in test stands, type of test oil, temperature of test oil, etc.), and NOT THE ROLLER-TO-ROLLER ADJUSTMENT.

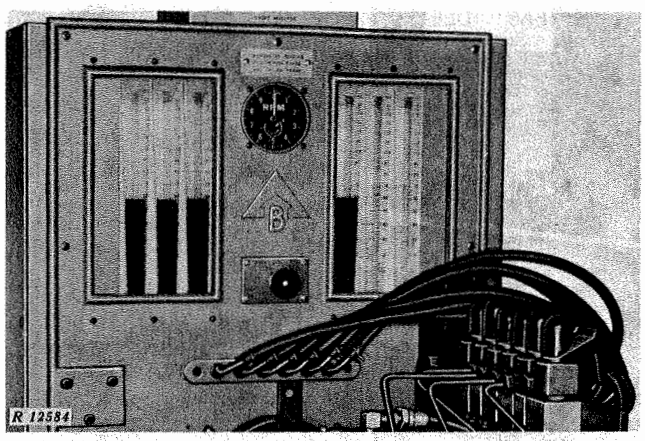


Fig. 10-15-6 – Graduates Filled to Approximately 60 Cubic Centimeters

IMPORTANT: Be sure speed control handle is turned counterclockwise as far as possible before stopping stand drive motor.

MAKING IDLE ADJUSTMENTS

Check mechanical shut-off at slow idle, full load, and fast idle speeds to be certain it is operating properly.

Operate pump on test stand at fast idle (1325 rpm) and adjust fast idle screw (Fig. 10-15-7 or Fig. 10-15-8) until pump delivers quantity given in test specifications.

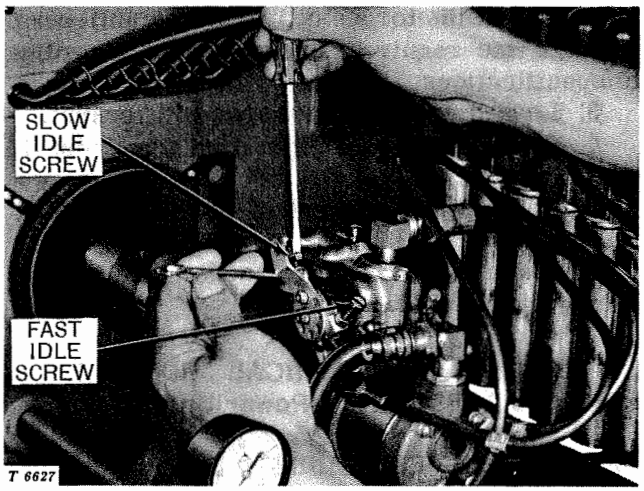
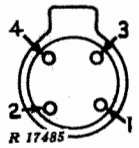
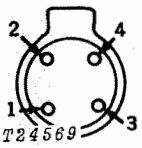
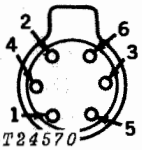
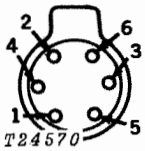


Fig. 10-15-7 – Fast and Slow Idle Adjusting Screws (Double Lever Pump)

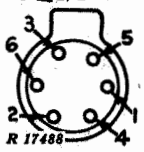
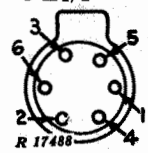
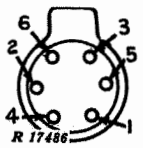
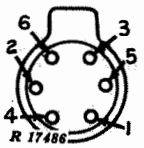
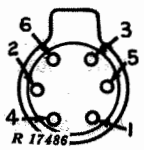
Adjust speed to operate pump at slow idle (see specifications). Adjust slow idle screw (Fig. 10-15-7 or Fig. 10-15-8) until pump delivers quantity given in test specifications.

Install sealing wire. Pump is now ready for removal from stand and installation on engine.

Wire throttle lever in "full fuel" position for shipment or until pump is installed on engine.

MODEL NO.	DBGVC431-1AJ DBGVC431-3AJ	DBGVC431-1J DBGVC431-1K	DBGVC629-1K AT10967	DBGVC631-4AF DBGVC631-11AF
PART NO.	AR32561	AT11769 AT12082		AR26372
Roller-to-roller dimension	1.978 ±0.0005 in.	1.954 ±0.0005 in.	1.968 ±0.0005 in.	1.959 ± 0.0005 in.
ON TEST STAND:				
Automatic advance movement	1° at 625-725 rpm 4° at 1050-1150 rpm 5° by 1250 rpm	Full advance at 1325 rpm* Full retard by 1265 rpm 2° Min. at 350 rpm	Full advance at 1170 rpm* Full retard by 1100 rpm 2° Min. at 400 rpm	
Total advance movement	5°	4°	4°	
Engine delivery sequence (from end plate)	 R 17485	 T24569	 T24570	 T24570
Check point Volume per 1000 strokes (cc) Max. variation between cylinders (cc) Transfer pump pressure (psi)	1250 rpm 63-66 4 80-85	1250 rpm 40-42 70-73	1100 rpm 43-46 66-71	950 rpm 55-57 70-75
Check point Volume per 1000 strokes (cc) Max. variation between cylinders (cc)	750 rpm 67-71 5	750 rpm 41-44 	600 rpm 8-10 	750 rpm 53-57
Check point (part load) Volume per 1000 strokes (cc)		1250 rpm 20-25		
Check point (part load) Volume per 1000 strokes (cc) Max. variation between cylinders (cc)				
High idle (WOT) Volume per 1000 strokes (cc) Max. variation between cylinders (cc)	1325 rpm 11-13 4	1325 rpm 13-15 	1170 rpm 8-10 	1325 rpm 11-13
Governor cut off (1/2 high idle delivery) Volume per 1000 strokes(cc)	1350 rpm 6 Max.	1350 rpm 7	1200 rpm 4 Max.	1350 rpm 6 Max.
Low idle Volume per 1000 strokes (cc) Transfer pump pressure (psi)	300 rpm 15-17 25-32 (200 rpm)	350 rpm 8-10 40-45	400 rpm 8-10 40-45 (350 rpm)	300 rpm 17-19 28-35 (200 rpm)
Check shut-off at Volume per 1000 strokes (cc) Transfer pump pressure (psi)				
Transfer pump (WOT) Volume per 1000 strokes (cc) Pressure (psi)				
Check electrical shut-off at Adjust shut-off (Tool 14067)			200 and 1200 rpm Notch A	
Minimum cranking speed delivery at Volume per 1000 strokes (cc) Transfer pump pressure (psi)	50 rpm 30 5 Min.	50 rpm 20 7 Min.	75 rpm 17 10 Min.	50 rpm 24 Min. 7 Min.
ON ENGINE:				
Advance by (Full Load) No load adjustment Full load adjustment	1250 rpm - 5° 2° at 650 rpm 5° by 1050 rpm 3° at 950 rpm			

*Adjust guide stud for just full advance - add 1/6 turn.

MODEL NO.	JDB633AL2440	JDB633AL2486	JDB633JT2400*	JDB633JT2400**	JDB633JT2400***
PART NO.	AR51825	AR52221	AR50003*	AR50003**	AR50003***
Roller-to-roller dimension	1.959±0.0005 in.	1.958±0.0005 in.	1.974±0.0005 in.	1.974±0.0005 in.	1.980±0.0005 in.
ON TEST STAND:					
Automatic advance movement	1° at 300-500 rpm 5° at 750-850 rpm 5-1/2° Min. by 1000 rpm	1° at 300-500 rpm 5° at 750-850 rpm 5-1/2° Min. by 1000 rpm	1° at 350-550 rpm 5° at 900-1000 rpm 5-1/2° Min. by 1100 rpm	1° at 350-550 rpm 5° at 900-1000 rpm 5-1/2° Min. by 1100 rpm	1° at 400-600 rpm 5° at 900-1000 rpm 5-1/2° Min. by 1100 rpm
Total advance movement	6°≅1/2°	6°±1/2°	6°±1/2°	6°±1/2°	6°±1/2°
Engine delivery sequence (from end plate)	 R 17488	 R 17488	 R 17486	 R 17486	 R 17486
Return oil at 1250 rpm	100-400 cc/min.	100-400 cc/min.	100-400 cc/min.	100-400 cc/min.	100-400 cc/min.
Check point Volume per 1000 strokes (cc)				1250 rpm 80 Min.	
Check point	1250 rpm	1250 rpm	1100 rpm	1100 rpm	1100 rpm
Volume per 1000 strokes (cc)	54-57	53-56	79-83	80-84	85-89
Max. variation between cylinders (cc)	3	3	3	3	4
Transfer pump pressure (psi)	85-90	85-90	85-90	85-90 hold	85-90 hold
Set torque screw at Volume per 1000 strokes (cc) Max. variation between cylinders (cc)					
Check point	750 rpm	750 rpm	750 rpm	750 rpm	750 rpm
Volume per 1000 strokes (cc)	56-60	54-58	83-88	84-89	87-91
Max. variation between cylinders (cc)	4	4	4	6	6
High idle (WOT)	1340 rpm (1220 rpm #)	1340 rpm	1340 rpm	1325 rpm	1325 rpm
Volume per 1000 strokes (cc)	10-12	10-12	10-12	11-13	11-13
Max. variation between cylinders (cc)	4	4	4	3	3
Governor cut off (1/2 high idle delivery)	1350 rpm (1245 rpm#)	1365 rpm	1365 rpm	1350 rpm	1350 rpm
Volume per 1000 strokes (cc)	6 Max.	6 Max.	5 Max.	6 Max.	6 Max.
Low idle	400 rpm	400 rpm	400 rpm	400 rpm	400 rpm
Volume per 1000 strokes (cc)	10-12	10-12	10-12	15-17	15-17
Max. variation between cylinders (cc)	4	4	4	4	4
Governor check point Volume per 1000 strokes (cc)					
Check shut-off at	200 rpm	200 rpm	200 rpm		
Volume per 1000 strokes (cc)	2 Max.	2 Max.	2 Max.		
Adjust shut-off (Tool 14067)	Notch A	Notch A	Notch A		
Minimum cranking speed delivery at	75 rpm	75 rpm	75 rpm	75 rpm	75 rpm
Volume per 1000 strokes (cc)	25	24	30	47	52
Transfer pump pressure (psi)	12 Min.	12 Min.	12 Min.	12 Min.	12 Min.
True end of injection (pump timing mark) (engine)	2° before 4° BTDC	2° before 4° BTDC	2° before 4° BTDC	2° before 4° BTDC	2° before 4° BTDC
ON ENGINE:					
Advance by (full load)	1150 rpm 5-1/2° Min.	1150 rpm 5-1/2° Min.			
No load adjustment	4°±1° at 575 rpm	4°±1° at 575 rpm	5° at 900 rpm	5° at 900 rpm	5° at 900 rpm
Full load adjustment	4° at 750 rpm (Check 4°±1°)	4° at 750 rpm (Check 4°≅1°)	5° at 950 rpm (Check 5°±1°)	5° at 950 rpm (Check 5°±1°)	5° at 950 rpm (Check 5°±1°)

#JD570-A
*Pump serial number (-1,442,919).
**Pump serial number (1,442,920-1,534,752).
***Pump serial number (1,534,753-).

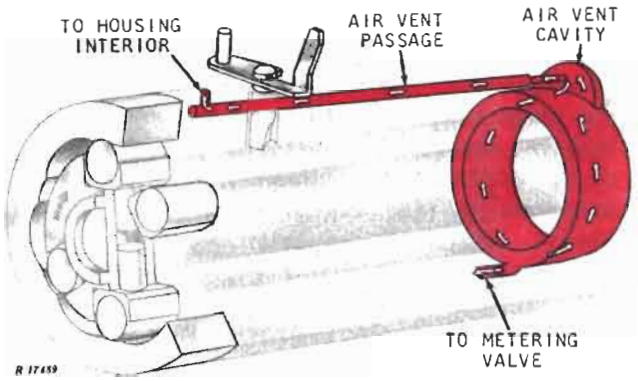


Fig. 11-5-7–Return Oil Circuit

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.

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 passages and house the pressure regulating valve
2. To cover the transfer pump
3. To absorb end thrust transmitted by the drive and governor

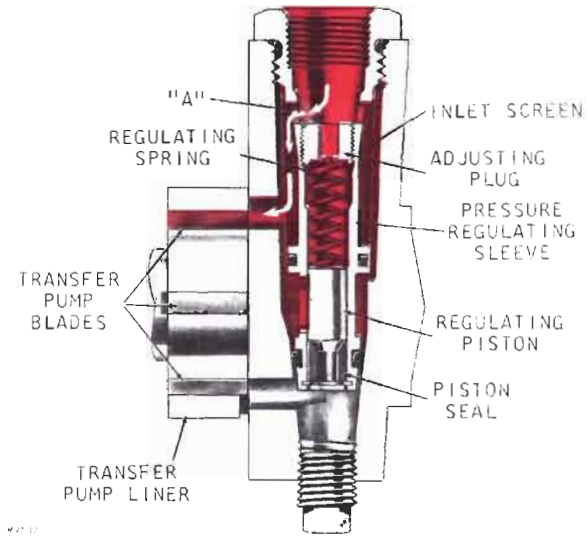


Fig. 11-5-8–End Plate

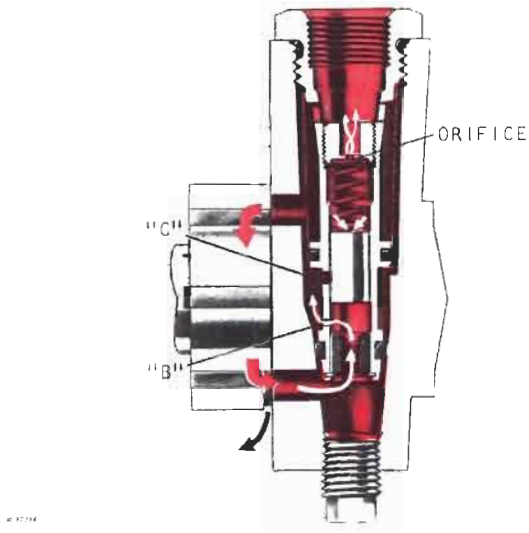


Fig. 11-5-9–Pressure Regulating Valve

During hand priming (Fig. 11-5-8), 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. 11-5-9 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.

VISCOSITY COMPENSATION

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.

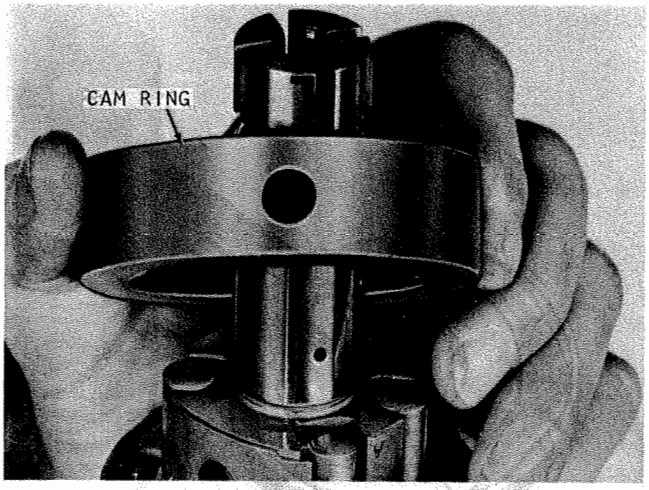


Fig. 11-15-28–Removing Cam Ring

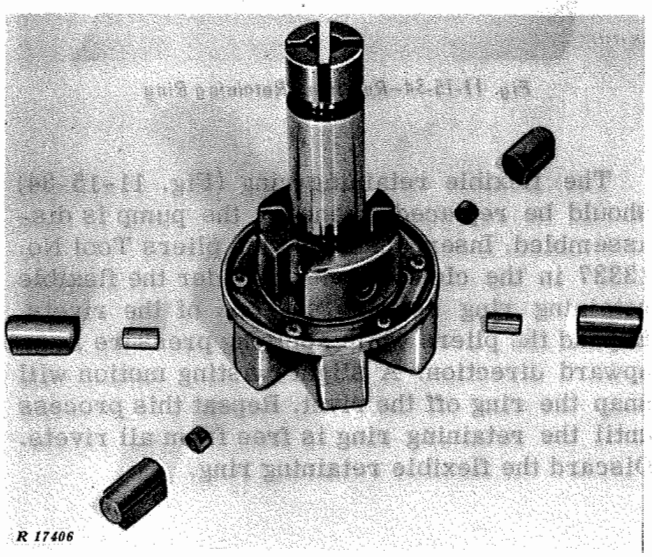


Fig. 11-15-29–Rotor Parts

Lift off cam ring (Fig. 11-15-28).

Check and record roller-to-roller dimension as instructed under "Assembly." Compare this dimension with that called for on the pump specification. Remove rollers and shoes and both sets of plungers (Fig. 11-15-29). 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.

Install the governor weight retainer removal support Tool No. 16313 to the rotor (Fig. 11-15-30) and assemble to the hydraulic head.

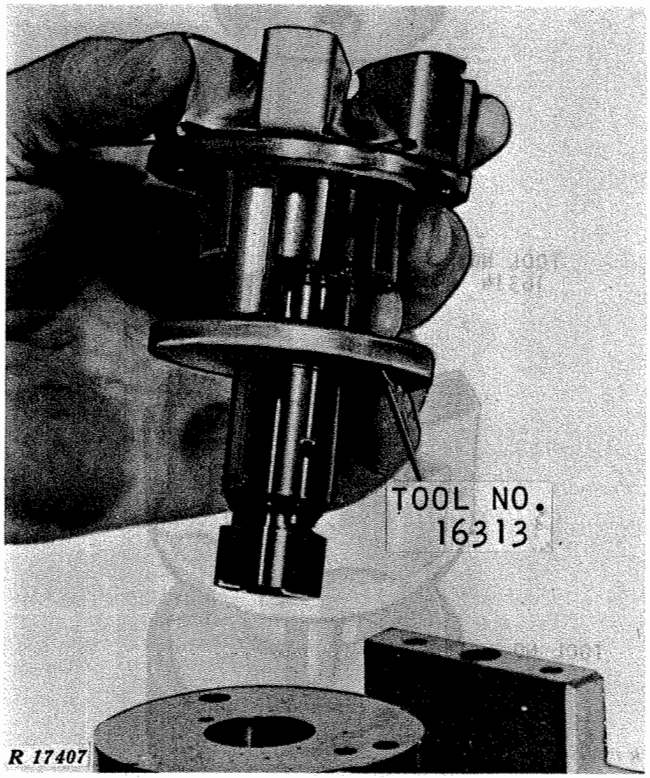


Fig. 11-15-30–Weight Retainer Removal Support

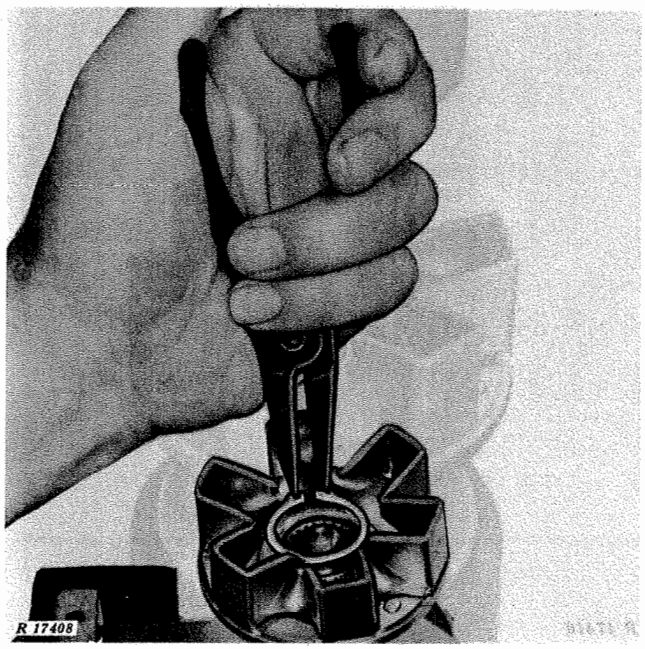


Fig. 11-15-31–Removing Snap Ring

Remove the governor weight retainer snap ring (Fig. 11-15-31).

Torque the end plate screws gradually and alternately to 25-30 inch pounds (Fig. 11-15-58). Check the rotor for free rotation. Binding can result from uneven torque. Tighten inlet fitting to specified torque.

Fig. 11-15-59—Installing Governor

Place head and rotor assembly in holding fixture again, drive-end up. Position the governor weights into the retainer sockets (Fig. 11-15-59). 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. Sight across the assembled weights. They should all be level and collapsed against the thrust sleeve.

Place the governor arm in position with the fork for the governor linkage hook facing the end plate (Fig. 11-15-60). Insert the pivot shaft (knife edge facing the end plate) and assemble the two seals and cap nuts. Tighten the cap nuts successively to 20-25 inch-pounds.

The hydraulic 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 (Fig. 11-15-61). Install a new seal on the hydraulic head.

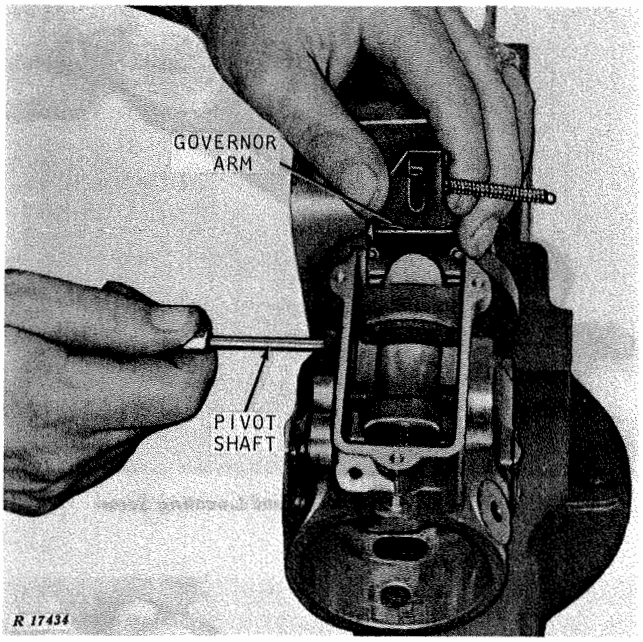


Fig. 11-15-60—Installing Pivot Shaft

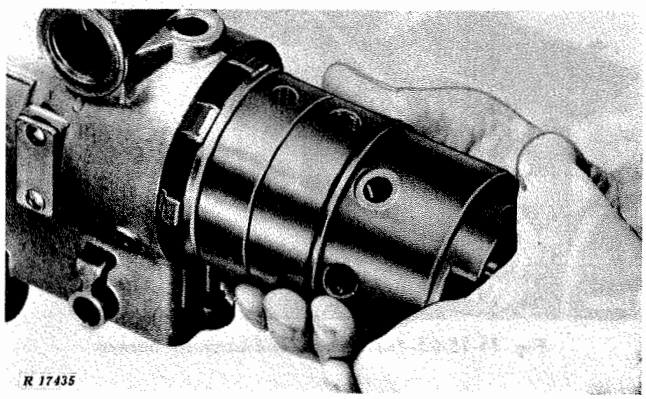


Fig. 11-15-61—Installing Hydraulic Head

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.

NOTE: The throttle lever should be positioned according to specifications after high and low idle settings are made. In some instances the lever must be repositioned before the low idle setting is made because of interference of the transfer pump end cap with the throttle lever.

AUTOMATIC ADVANCE

Check the cam advance pin position at specified points in the speed range. Adjust trimmer screw, as required to obtain proper advance operation.

Record fuel delivery at check points shown on the pump specifications.

Recheck delivery at lowest rpm check point.

Check governor cutoff at specified rpm.

Check electric shut-off at speeds indicated on specifications:

ROLLER-TO-ROLLER DIMENSION

Roller settings should not be adjusted on the test bench. Experience has proved that micrometer measurement provides consistent and accurate adjustment for maximum fuel setting. Variations in test benches, nozzles, lines, and fuels in different areas can cause inaccurate flow readings.

CENTRIFUGAL AIR SEPARATION AND RETURN OIL

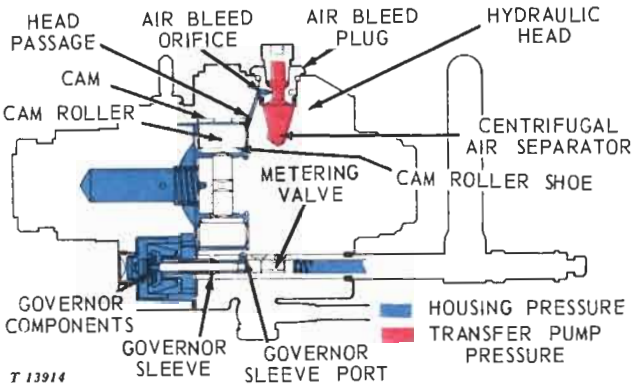


Fig. 15-5-8—Air Separation and Return Oil

Pressurized fuel from the transfer pump enters the centrifugal air separator in the top of the hydraulic head at high velocity. If air enters the pump, it remains in the center of this cavity while centrifugal force swirls the heavier fuel outward. Entrapped air is purged through an orifice in the air bleed plug.

A small quantity of fuel flows through the orifice and a head passage into the pump drive housing. Fuel fills the housing and lubricates the drive shaft, ring gear, cam rollers and shoes, and governor components.

EARLY MODELS

Clearance between the metering valve and the governor sleeve permits a restricted flow of fuel into the governor sleeve.

LATER MODELS

Later pumps (balanced and I.T.O.M. metering) have a flat on the metering valve allowing an unrestricted flow up to the valve land and through the metering valve.

This fuel flows through a drilled passage in the metering valve to lubricate the governor spring components and balance housing pressure on both sides of the metering valve.

ALL MODELS

A port in the governor sleeve directs fuel through a head passage to the return fitting. The flow of return fuel to the tank cools the pump and carries air purged in the separator to the tank where it will dissipate.

TRANSFER PUMP PRESSURE REGULATION

Air-free fuel is ported from the bottom of the air separator to a pressure regulating sleeve in the front of the hydraulic head. The fuel flows around a reduced diameter of the sleeve and enters the sleeve through drilled ports.

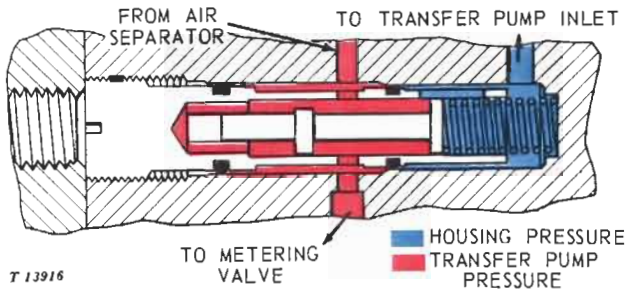


Fig. 15-5-9—Transfer Pump Pressure Regulation—Operating Position (Low Idle)

Fuel pressure within the sleeve pushes the regulating piston rearward against regulating spring force. As the regulating land of the piston opens a spill port (or slot), fuel is allowed to bypass through a head passage back to the transfer pump inlet.

Pressure regulation is controlled by three factors: the number and size of spill ports in the sleeve, regulating spring rate, and sleeve position, which controls the spring preload. The sleeve position can be adjusted by threading in (to increase pressure) or out (to decrease pressure) of the hydraulic head bore.

METERING AND GOVERNING

The quantity of fuel delivered to the pumping cylinder is controlled by the metering valve position in the governor sleeve.

Two types of metering (relative to the metering valve) are used in the Model "C" Fuel Injection Pump. Early models and models using a balanced metering valve use inlet metering. Later models having I.T.O.M. metering valves use outlet metering. Figure 15-10-27 illustrates the basic differences in metering valve design.

INLET METERING

Fuel from the centrifugal air separator enters the governor sleeve through a tapered (triangle) inlet port which is partially restricted by the valve metering land. Metered fuel leaves the governor sleeve through a port to the inlet ball check valve.

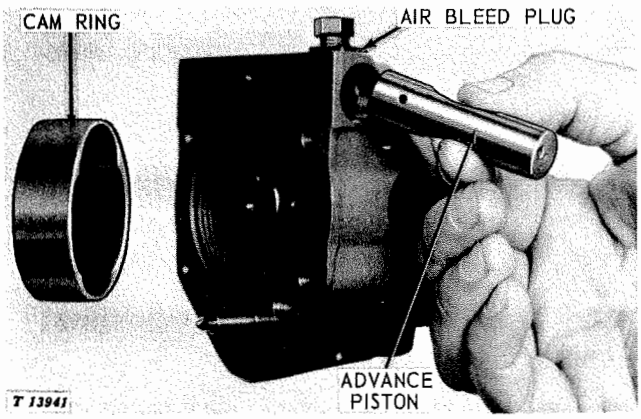


Fig. 15-10-17 – Removing Cam Ring, Advance Piston, and Air Bleed Plug

After the cam ring is removed from the hydraulic head (Fig. 15-10-17), push the advance piston to one side of the bore and remove it.

IMPORTANT: Handle the advance piston at the reduced diameter near the cam advance pin bore and not by the ground surface (Fig. 15-10-17).

Loosen the air bleed plug (Fig. 15-10-17) and remove the air bleed plug, air bleed pipe plug, and both the top and bottom air bleed seals.

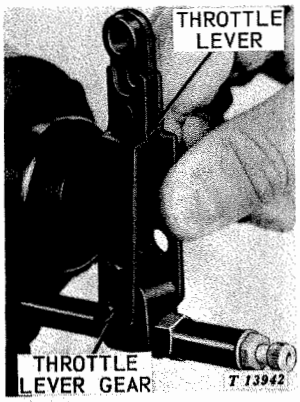


Fig. 15-10-18 – Removing Throttle Lever

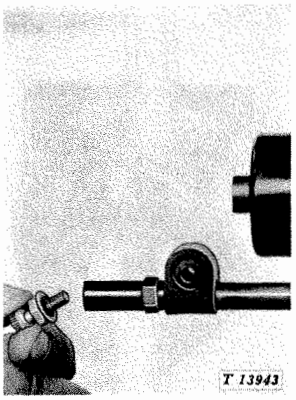


Fig. 15-10-19 – Removing Low Idle Adjusting Screw

Remove the throttle lever. Figure 15-10-18 shows a throttle lever used on early model pumps. Figure 15-10-84 shows exploded views of other throttle levers used.

Loosen and remove the low idle adjusting lock nut and remove the low idle adjusting screw from the throttle control cap (Fig. 15-10-19).

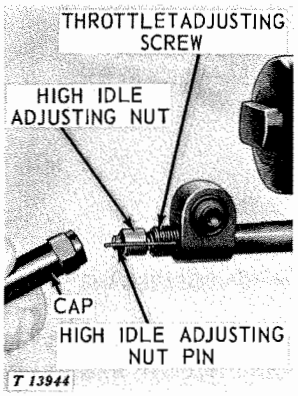


Fig. 15-10-20 – Removing Throttle Control Cap

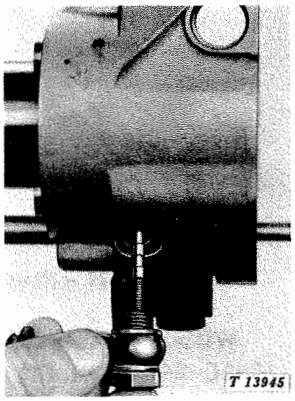


Fig. 15-10-21 – Housing Pressure Regulating Valve (Early Models)

Loosen and remove the throttle control cap (Fig. 15-10-20).

NOTE: The high idle adjusting nut pin (Fig. 15-10-20) is retained only by the cap. Remove the wire after removing throttle control cap to prevent loss.

Loosen the return fitting connector screw, (Fig. 15-10-21) and remove screw, two copper washers, and fitting.

NOTE: Early models of the "C" pump incorporate a housing pressure regulating valve in the connector screw bore. The valve and pressure regulating spring will slide out of this bore as the connector screw is removed. (Fig. 15-10-21).

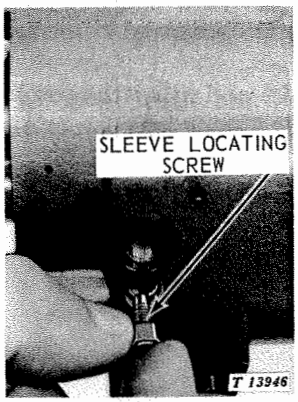


Fig. 15-10-22 – Removing Sleeve Locating Screw

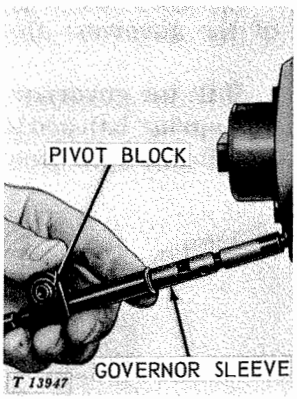


Fig. 15-10-23 – Removing Governor Sleeve Assembly

Use a 5/32" hex. key wrench to loosen and remove the governor sleeve locating screw and seal (Fig. 15-10-22).

Remove the governor sleeve and pivot block as an assembly by sliding from the rear of the pump (Fig. 15-10-23).

ASSEMBLY

NOTE: Use the exploded view in Fig. 15-10-84 as an aid to assembly.

All parts must be thoroughly flushed in clean oil as they are reassembled. Do not wipe dry. Cleanliness will contribute to long life and trouble-free operation. Apply clean grease to all seals to prevent cutting during assembly and to facilitate assembly. *NOTE: Refer to the torque value chart for proper tightening of all fasteners (Fig. 15-10-83).*

All seals and gaskets must be replaced, whether visibly damaged or not.

INSTALLING DELIVERY VALVE PARTS

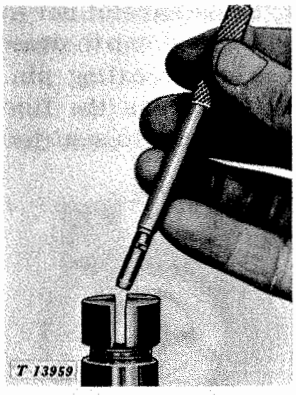


Fig. 15-10-42 – Inserting Delivery Valve

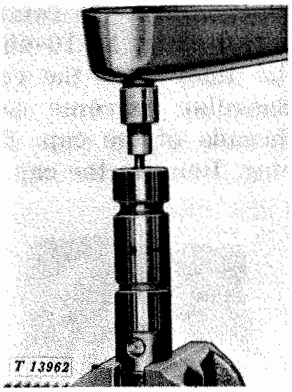


Fig. 15-10-43 – Tightening Delivery Valve Retaining Screw

Handle the rotor carefully and secure it in a vise by the *drive tang* only (Fig. 15-10-43). Install the delivery valve (Fig. 15-10-42), making sure that it operates freely in its bore.

NOTE: Do not mistake slight interference of the retractor collet in the bore for delivery valve sticking. If the valve is not secured straight and tight in the retractor collet, the collet can drag in the rotor bore.

Install the delivery valve spring and a NEW stop. Start the screw into the bore using the hex. end of the retractor tool (No. 13383). Tighten the screw into the bore using the hex. end of the retractor tool. Tighten the screw to the specified torque (Fig. 15-10-83).

IMPORTANT: Excessive tightening of this screw can cause seizure of the hydraulic head and rotor assembly.

DELIVERY VALVE REPLACEMENT

Delivery valves of various retraction values are used for different applications and are so marked (10 or 30). Use only the correct Part No. for replacement.

The letters "OV," etched on the flat section of the rotor, immediately behind the drive tang, indicate a 0.001" oversize delivery required for replacement. The oversize valve is also identified by a blackened tapered end.

INSTALLING PUMPING PLUNGERS

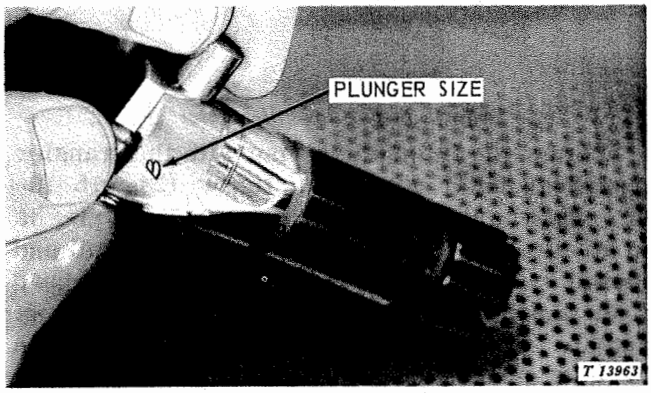


Fig. 15-10-44 – Installing Pumping Plungers

Remove the rotor from the vise and submerge it in clean oil (Fig. 15-10-44). Install the pumping plunger with particular attention to Supplementary Inspection 1. See page 15-10-12. Use retainer T18530T to hold the plungers in the bore during reassembly.

PLUNGER REPLACEMENT

Since the plungers are positioned centrally in the bore during operation and their travel is extremely short (.067" max.), wear of the plunger is virtually non-existent. Replacement, however, may be made in instances where rust or damage in handling has occurred.

Plungers of any given nominal diameter are graded in four select-fit sizes: A, B, C, and D. The rotor is etched with the letter indicating bore size. This mark is found on the round section of the rotor immediately behind the drive tang (see Fig. 15-10-44).

If plunger replacement is required, check the size designation on the rotor and use the plunger of corresponding part number as indicated on individual specifications. *Always* refer to current individual specifications for part numbers.

Thoroughly rinse the hydraulic head in calibrating oil and blow out all passages with clean, filtered air. Mount the head on holding fixture, No. 17357, as given on page 15-10-2.

1 – Drive Gear Retainer Screw (3)
2 – Gear Mounting Screw (1)
3 – Gear Mounting Screw Retainer
4 – Pilot Seal
5 – Drive Housing
6 – Timing Pin
7 – Timing Pin Seal
8 – Drive Housing Seal
9 – Drive Shaft Seal Locating Ring
10 – Drive Shaft Seal Assembly
11 – Pressure Regulating Assembly
12 – Governor Assembly
13 – Governor Thrust Washer
14 – Governor Adjusting Screw Seal
15 – Governor Adjusting Screw
16 – Regulating Sleeve Hole Seal
17 – Regulating Sleeve Access Plug
18 – Drive Housing Mounting Screw (4)
19 – Drive Shaft
20 – Cam Roller Shoe
20A – Cam Roller Shoe*
21 – Cam Roller
22 – Drive Shaft Thrust Spring
23 – Cam Ring
24 – Rotor Retaining Ring
25 – Rotor Plunger
25A – Rotor Plunger*
26 – Rotor
27 – Leaf Spring
28 – Leaf Spring Adjusting Screw
29 – Check Ball
30 – Ball Check Stop
31 – Ball Check Retaining Screw
32 – Hydraulic Head
33 – Cam Advance Pin
34 – Advance Pin Ring
35 – Advance Plug Seal
36 – Advance Plug
37 – Air Bleed Plug Seal (Bottom)
38 – Air Bleed Plug Seal (Top)
39 – Air Bleed Plug
40 – Air Bleed Pipe Plug
41 – Advance Piston
42 – Pilot Piston
43 – Automatic Advance Spring
44 – Piston Hole Plug Seal
45 – Piston Hole Plug (Trimmer)
46 – Advance Adjusting Screw Seal
47 – Advance Adjusting Screw Nut
48 – Advance Adjusting Screw
49 – Advance Adjusting Screw Cap
50 – Piston Hole Plug Seal
51 – Piston Hole Plug (Power)
52 – Transfer Pump Regulator Spring
53 – Transfer Pump Regulator Piston
54 – Transfer Pump Regulator Seal (2)
55 – Transfer Pump Regulator Sleeve
56 – Electric Shut-Off Hole Plug Seal
56A – Electric Shut-Off Hole Plug Seal*
57 – Plunger Seal
57A – Plunger Seal*
58 – Electric Shut-Off Plunger
58A – Electric Shut-Off Plunger*
59 – Electric Shut-Off Spring
59A – Electric Shut-Off Spring*
60 – Electric Shut-Off Solenoid
60A – Electric Shut-Off Solenoid*
61 – Inlet Fitting Washer (2)
62 – Inlet Fitting Assembly
63 – Inlet Fitting Screw
64 – Return Fitting Washer (2)
65 – Return Fitting Assembly
66 – Return Fitting Screw
67 – Housing Pressure Regulator Spring*
68 – Housing Pressure Regulator Piston*
69 – Sleeve Locating Screw Seal
70 – Sleeve Locating Screw
71 – Delivery Valve
72 – Delivery Valve Spring
73 – Delivery Valve Stop
74 – Delivery Valve Screw
75 – End Cap Seal
76 – Rotor Retainer (2)
77 – Liner Locating Pin
78 – Liner Locating Ring
79 – Transfer Pump Liner
79A – Transfer Pump Liner*
80 – Transfer Pump Blade (4)
81 – Transfer Pump Blade Spring (2)
82 – Transfer Pump Thrust Plate
82A – Transfer Pump Thrust Plate*
83 – Spring Washer
83A – Transfer Pump Pivot Plate*
83B – Transfer Pump Pivot Plate*
84 – End Cap
84A – End Cap*
84B – End Cap
85 – Metering Valve Shim
86 – Governor Sleeve
86A – Governor Sleeve*
86B – Governor Sleeve*
87 – High Idle Adjusting Nut Pin
88 – Governor Sleeve Seal
88A – Governor Sleeve Seal Retaining Ring*
89 – Metering Valve
89A – Metering Valve*
89B – Metering Valve*
90 – Governor Spring Ball
91 – Governor Spring Guide
91A – Governor Spring Guide*
92 – Governor Control Spring
92A – Governor Control Spring*
92B – Governor Control Spring*
93 – Governor Spring Spacer
94 – Low Idle Adjusting Screw
95 – Low Idle Adjusting Locknut
96 – Low Idle Adjusting Seal
97 – Throttle Control Cap
98 – High Idle Adjusting Nut
99 – Throttle Adjusting Screw
100 – Throttle Adjusting Screw Seal
101 – Throttle Gear
102 – Throttle Lever Seal
103 – Throttle Lever
104 – Throttle Lever Assembly
105 – Throttle Lever Spring
106 – Throttle Lever Retainer
107 – Throttle Spring Screw
108 – Throttle Lever*
109 – Throttle Lever Gear*
109A – Throttle Lever Gear*
110 – Pivot Block*
111 – Throttle Lever Screw (2)*
112 – Throttle Lever Screw*
113 – Throttle Lever Nut*
114 – Throttle Lever Lockwasher (2)*
115 – Idle Governor Spring
116 – Shim

*Early Models

Legend for Fig. 15-10-84

NOTE: Some pumps may differ slightly from Fig. 15-10-84. If the pump being serviced deviates from the exploded view, note differences during disassembly to aid in assembly.

Group 16
MODEL C PUMP SPECIFCATIONS

SM-2045 (Oct-71) Litho in U.S.A.

6. If position of injection pump was not marked before removal, reverse the timing pin and slowly rotate the injection pump until the timing pin drops into position. Engine should now be at TDC. Tighten mounting stud nuts.

7. Connect all lines.

8. Install radiator lower hose and fill radiator with specified coolant.

SPECIAL TIMING INSTRUCTION

To improve starting, 6-degree advance fuel injection pumps (see pump specifications in Group 20) may be retarded 2 degrees.

First, time the fuel injection pump to engine at TDC (See "Installation and Timing").

Scribe the engine front plate in line with the 4 degree line on the pump. Rotate pump counterclockwise until line on engine front plate lines up with 6 degree line on pump.

BLEEDING INJECTION PUMP

1. Bleed the fuel system (see Operator's Manual).

Additional bleeding, as follows, may be necessary to dispel all air from the injection pump.

2. Use transfer pump primer until a quantity of air-free fuel flows from the injection pump inlet line. Fasten inlet to pump securely.

3. Continue priming until air-free fuel flows from the timing pin hole. Install and tighten the timing pin.

4. Loosen electric shut-off solenoid two full turns and prime until air-free fuel flows from this point.

5. Tighten solenoid and connect terminal wire.

6. Crank the engine and tighten injection line connector screws at the injection pump when fuel flows from them.

7. Tighten connector nuts at nozzles when lines are filled.

ADJUSTMENTS

CAM ADVANCE

1. Be sure that injection pump is static timed to engine.

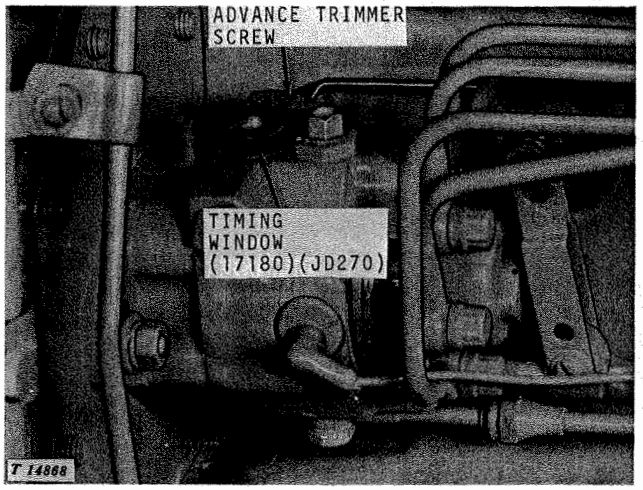


Fig. 15-25-5 – Adjusting Cam Advance

2. Install timing window (Fig. 15-25-5).

3. Bring engine to operating temperature.

4. Adjust cam advance by removing seal cap, loosening lock nut, and turning advance trimmer screw. Turn screw in to retard; turn screw out to advance.

Each circle on the timing window equals 2 degrees advance. Use the hole in the center of the cam pin for reference. When the hole in the center of the cam pin is directly in the center of the bullseye, the injection pump is 5 degrees advanced.

When checking cam advance start at the 5 degree advance position, working out from this center point in both advance and retard directions.

Cam advance positions are given in individual pump specifications starting on page 15-15-4.

5. Tighten lock nut and install seal cap and seal.

If fuel injection pump cam advance cannot be adjusted to specifications, remove pump for adjustment on test stand as described on page 15-15-1.

LUBRICATION AND RETURN OIL

Fuel flow from the air bleed orifice and from designed internal leakages within the pump cools and lubricates all moving parts. Fuel fills the cam counterbore area of the hydraulic head and the area of the drive housing rearward of the drive shaft seal. This fuel flows around the governor weight retainer assembly, lubricating all governing components, and through a drilled passage in the metering valve to the governor spring side of the valve.

A cross hole in the valve at point "A" between the bearing land and metering land allows fuel to flow through a port in the sleeve leading to a passage in the hydraulic head to which the return fitting is connected. Centrifugal pressure, developed by the rotating governor restricts return flow and creates a slight housing pressure. This pressure aids in purging of air from the pump and contributes to smooth governing at high speed, no load operation.

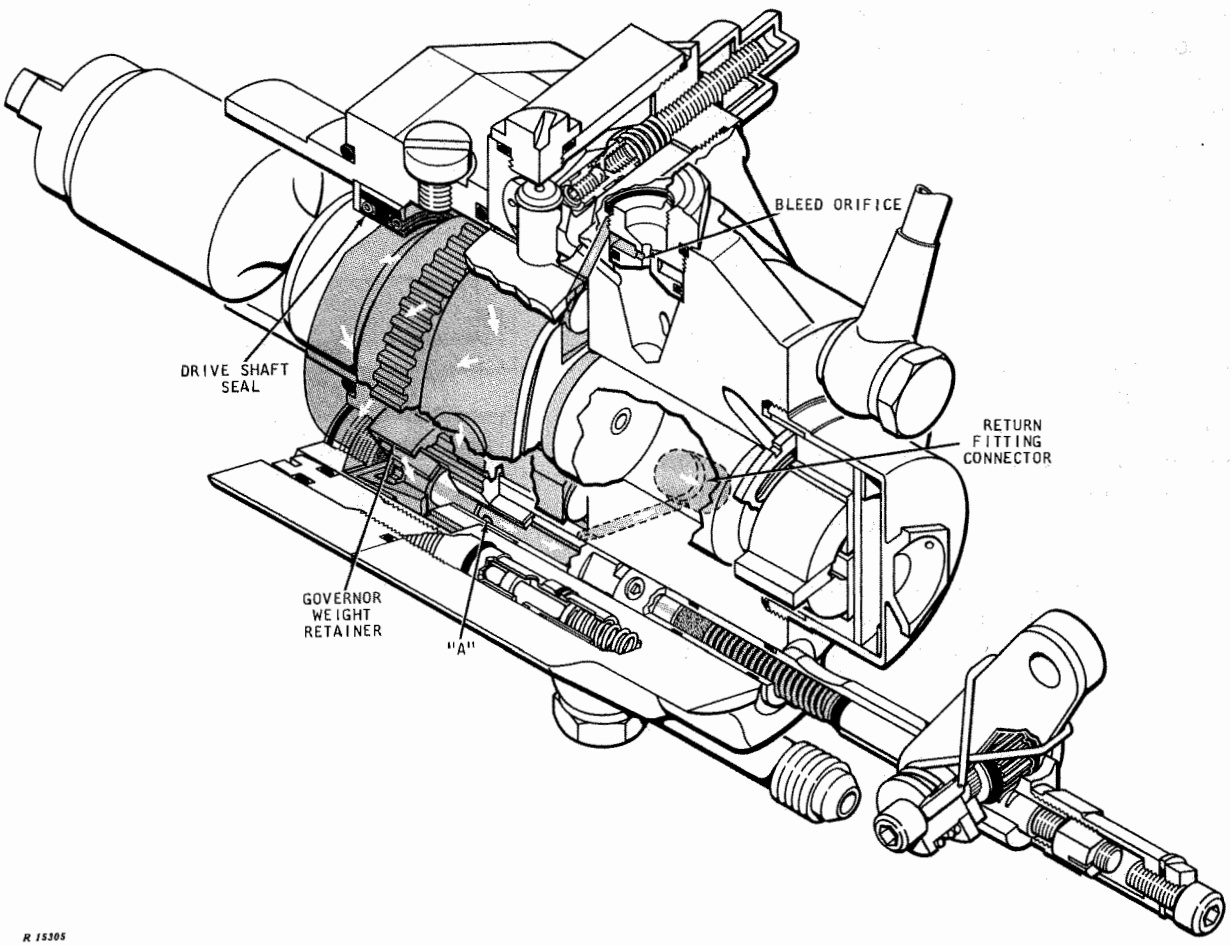


Fig. 16-5-12–Lubrication and Return Oil Circuit

DETAILED INSPECTION

PART GROUP	PART	EXAMINE FOR: Excessive Wear	Foreign Mat. or Rust	Nicks or Chipping	Scratches or Scores	Thread Damage	Cracks	Distortion	Freedom of Movement	SPECIFICALLY INSPECT:
HYDRAULIC HEAD & ROTOR GROUP	Hydraulic Head	X	X	X	X	X	X			See Item 1, Pg. 16-10-8
	Distributor Rotor	X	X	X	X	X	X	X	X	See Item 1, Pg. 16-10-8
	Plungers		X	X	X				X	See Item 2, Pg. 16-10-8
	Delivery Valve	X	X	X	X		X	X	X	
	Delivery Valve Spring	X	X	X			X	X		
	Cam	X	X	X	X		X	X	X	See Item 3, Pg. 16-10-8
	Pressure Reg. Sleeve		X	X	X	X	X	X		Bypass ports for clogging
	Pressure Reg. Piston	X	X	X	X		X	X	X	
	Pressure Reg. Spring	X	X	X	X		X	X		
DRIVE GROUP	Drive Housing	X	X	X	X	X	X	X		
	Drive Shaft and Gov. Drive Gear Assy.	X	X	X	X	X	X		X	
	Cam Rollers & Shoes	X	X	X	X		X		X	See Item 4, Pg. 16-10-8
	Leaf Spring & Screw	X	X	X		X	X	X		Ground ends of spring for wear. Adjusting screw for tightness.
TRANSFER PUMP GROUP	Liner	X	X	X	X					Inside diameter in low pressure area for wear.
	Blades	X	X	X	X		X		X	See Item 5, Pg. 16-10-8
	Pivot Plate	X	X	X	X					
	End Cap		X			X				
GOVERNOR GROUP	Cap	X	X	X			X			See Item 6, Pg. 16-10-8
	Gear	X	X	X			X			See Item 6, Pg. 16-10-8
	Weights	X	X	X			X		X	See Item 6, Pg. 16-10-8
	Thrust Washer	X	X	X	X		X			Contact areas for wear
	Drive Washer	X	X	X			X			
	Sleeve	X	X	X	X		X	X		
	Metering Valve	X	X	X	X			X	X	
	Thrust Insert	X	X	X	X		X			
LINKAGE GROUP	Throttle Gear	X	X	X					X	
	Screw	X	X	X		X			X	
AUTOMATIC ADVANCE GROUP	Adv. Piston	X	X	X	X				X	
	Servo Piston	X	X	X	X		X		X	
	Advance Pin	X	X	X	X					
ELECTRIC SHUT-OFF GROUP	Solenoid	X	X			X				
	Plunger	X	X	X	X				X	

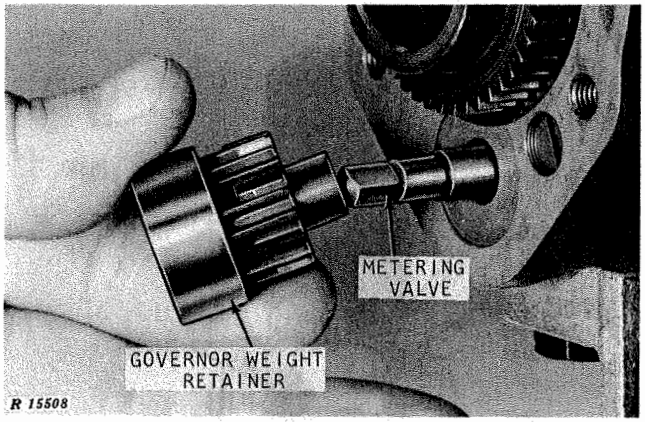


Fig. 16-15-52–Installing Weight Retainer Assembly

Install the governor weight retainer assembly to the front of the governor sleeve with the governor gear fully engaged with the drive gear of the rotor.

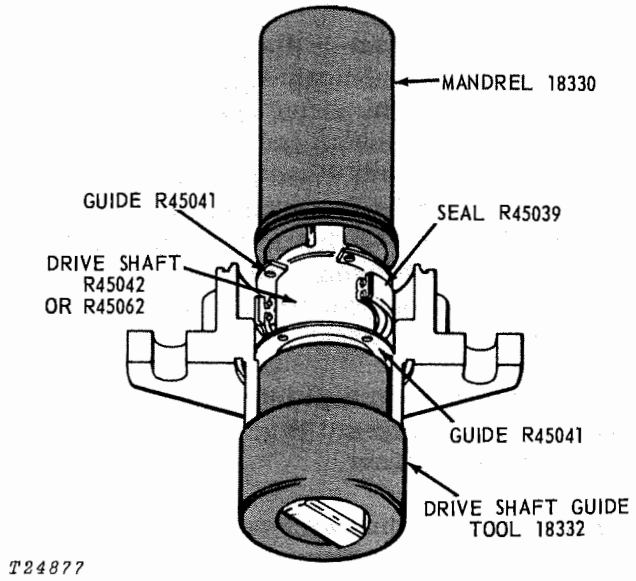


Fig. 16-15-53–Installing Drive Shaft Seal

The new drive shaft seal must be guided to prevent cocking or damage as it is pressed into the drive housing. A drive shaft (R45042 or R45062) of 1-1/8-inch diameter can serve this purpose if installed backwards to the housing. Alternatively a 1-1/8-inch O.D. tube, 3-1/2 to 4 inches long, with the ends rolled inward to prevent seal damage will serve as an installation guide.

Install drive shaft guide tool, 18332, to the drive housing bore as shown in Figure 16-15-53. Insert drive shaft, R45042 or R45062, backwards (drive gear end up) through the guide tool. Tubing as described above or a rod of the same dimensions can be used instead of the drive shaft.

Assemble drive shaft guide R45041, (if used) over the drive shaft as in Figure 16-15-53. Be careful not to cock the guide as it enters the seal counterbore of the housing.

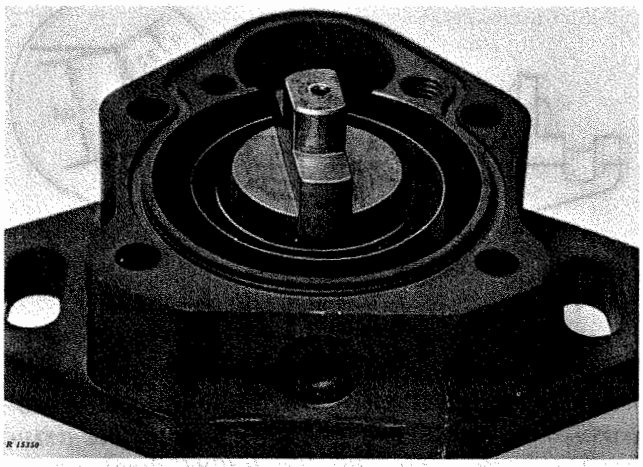


Fig. 16-15-54–Correct Position for Seal

Apply a small amount of non-hardening sealing compound to the outside of the seal jacket. Assemble seal to the drive shaft (or substitute guide) with the rolled edge of seal jacket facing INWARD (Fig. 16-15-54). Push the seal downward until it bottoms against the rear face of the seal counterbore.

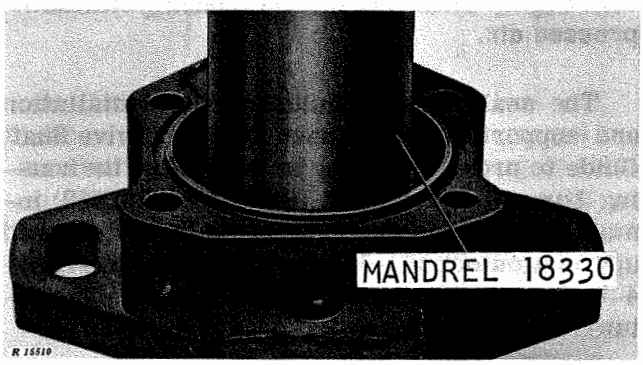


Fig. 16-15-55–Drive Shaft Guide in Place

Install mandrel, 18330, over the drive shaft and press the seal into position. (See Figure 16-15-55). Extreme care must be taken not to cock the seal during installation. A hand arbor press should be used for pressing the seal into its

CALIBRATION PROCEDURE

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

After "warm-up procedure" and before starting calibration tests, check minimum cranking speed delivery. If the value obtained is less than specified it is suggested that the pump be removed from the test stand for disassembly and inspection. Additional running on the test stand will only reduce the value because of higher test fuel and pump temperatures.

Before starting calibration tests, be sure that the injection pump and calibrating oil temperature has been stabilized by operating the injection pump for 15 minutes at high idle as shown on individual pump specifications.

Remove the low idle screw.

Turn in the high idle screw to obtain full metering valve opening at full load speed.

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

Measure return oil and compare to specification.

NOTE: Fuel flow (cc per 1000 strokes) shown in TEST DATA is the average of all cylinders, and not the maximum or minimum for each cylinder.

TRANSFER PUMP PRESSURE

Operate at the specified speeds with wide open throttle and observe transfer pump pressure. Adjust pressure regulating sleeve to raise or lower transfer pump pressure in accordance with specification.

⚠ CAUTION: Do not, under any circumstances, exceed 130 psi at maximum operating rpm when adjusting transfer pump pressure.

To adjust pressure, remove the access plug from the drive adapter and use a screwdriver to adjust the regulating sleeve. Clockwise adjustment increases pressure.

HOUSING PRESSURE

Check housing pressure at speeds indicated in individual specifications.

Check for minimum delivery at cranking speed.

IDLE ADJUSTMENT

Operate at high idle speed and adjust the high idle screw to obtain specified delivery. Clockwise adjustment increases delivery.

Install low idle screw to the throttle control cap. Turn the low idle screw in until specified delivery is obtained at slow idle speed. Clockwise adjustment increases delivery.

NOTE: The throttle lever should be positioned according to specifications after high and low idle settings are made. In some instances the lever must be repositioned before the low idle setting is made because of interference of the transfer pump end cap with the throttle lever.

AUTOMATIC ADVANCE

Check the cam advance pin position at specified points in the speed range. Adjust trimmer screw, as required to obtain proper advance operation. Each circular line on timing window, No. 17180 (JD270), equals two pump degrees. Record fuel delivery at check points shown on the pump specifications.

Recheck delivery at lowest rpm check point.

Check governor cutoff at specified rpm.

Check electric shut-off at speeds indicated on specifications.

IMPORTANT: Transfer pump pressure holds the electric shut-off plunger in the "off" position while the pump is running. The test stand must be stopped for several seconds after checking shut-off. When residual pressure has dissipated, electric current will pull the plunger to the "run position."

ROLLER-TO-ROLLER DIMENSION

Roller settings should not be adjusted on the test bench. Experience has proved that micrometer measurement provides consistent and accurate adjustment for maximum fuel setting. Variations in test benches, nozzles, lines, and fuels in different areas can cause inaccurate flow readings.

TEST COMPLETION

Remove the pump from the test stand.

Install the air bleed pipe plug, timing pin, and transfer pump pressure regulator access plug. Assemble all sealing wires and pilot seal, and cap or plug all openings.

Group 25
REMOVAL AND INSTALLATION

GENERAL INFORMATION

The Roosa Master Model CB Fuel Injection Pump may be mounted horizontally or vertically on the engine. The pump model and characteristics are shown in code form on the pump name plate.

DIAGNOSING INJECTION PUMP MALFUNCTIONS

If fuel system diagnosis has isolated the malfunction to the fuel injection pump, the following guide may be used to determine injection pump malfunction without removing the injection pump from the engine. Malfunctions are listed in three categories — FUEL, ELECTRICAL, and MECHANICAL.

FUEL MALFUNCTIONS

Fuel inlet line clogged or restricted.
Blow out inlet line with filtered air.
Fuel inlet line leaking.
Tighten to specifications. Replace if damaged.
Pump housing not full of fuel.
Operate engine for approximately 5 minutes until pump fills with fuel.
Excessive air in pump housing.
Bleed injection pump.
Fuel injection line connected to wrong cylinder or leaking.
Relocate lines for correct engine firing sequence, tighten to specifications and replace if damaged.
One or more injection line connector screws obstructed.
Clean or replace.
Fuel return line clogged or restricted.
Blow out return line with filtered air.
Fuel leaks at fittings in hydraulic head or drive housing.
Tighten fittings to specifications and replace seals where required.

ELECTRICAL MALFUNCTIONS

Electrical system failure or low voltage at electric solenoid shut-off.
Test electric solenoid circuit.
Electric solenoid failure.
Test solenoid.
Electric solenoid spring or plunger failure.
Test solenoid.
Plunger seal failure.
Replace seal.
Fuel leaking at electric solenoid shut-off.
Tighten to specifications. Replace hole plug seal or solenoid assembly if necessary.

MECHANICAL MALFUNCTIONS

Pump timed incorrectly to engine.
Correct timing, tighten pump mounting nuts.
Throttle arm travel not sufficient.
Check installation and adjust linkage.
Automatic advance faulty or not operating.
Check advance, tighten lock nut.
Slow and fast idle adjustment incorrect.
Adjust to specifications; tighten lock nut.

HORIZONTALLY MOUNTED PUMPS

REMOVAL

Before removing fuel injection pump, thoroughly clean the pump, fittings, and all connections to be disconnected.

IMPORTANT: Shut off engine before cleaning. Never spray cold water on or steam clean a warm injection pump.

Remove solenoid shut-off wiring lead at pump.

Cap or plug each line or outlet as it is removed from the pump.

If possible, the fuel injection pump and engine should be static timed before the pump is removed. (See "INSTALLATION AND TIMING".)

To facilitate injection pump timing when installing the pump, scribe an index line across the injection pump and engine front plate (Fig. 16-25-3).

Remove mounting stud nuts and remove pump from engine.

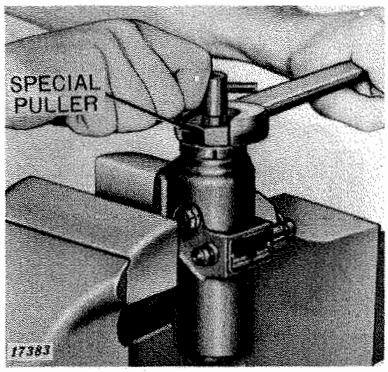


Fig. 20-10-8 -- Pulling Delivery Valve

With special O.T.C. puller, pull the delivery valve seat (Fig. 20-10-8).

NOTE: Use special puller No. ED-1887-B for Scintilla pumps and special puller No. ED-1887-A puller for Bosch pumps. Use No. ED-1887-C puller for Bosch 13 mm pumps.

REMOVING BARREL

Extreme care must be used when handling the plunger and barrel. These parts are lapped to such a close fit that any damage due to dropping or scratching may make them unsuitable for further use.

INSPECTION AND REPAIR

CLEANING

Clean all parts as described previously. Remove dirt, grease, and gummy deposits from all parts.

PUMP BODY

Visually inspect pump body, looking for breaks or cracks which may cause binding or leaks.

PLUNGER AND BARREL ASSEMBLY

Examine plunger and barrel with a magnifying glass. Plungers in good condition are highly polished, free from erosion or scratches. Fine scratches, scuff marks, or a dull gray surface indicate wear, invariably due to abrasives in the fuel. Such wear, particularly on the lapped surface beyond the helix, greatly reduces the accuracy of fuel delivery and will affect engine performance. The plunger shown in the left half of Fig. 20-10-9 is badly worn by abrasives. This plunger and its barrel should be replaced, since these parts are supplied only as an assembly. The plunger shown in the right half of Fig. 20-10-9 has seen considerable service but is still in good operating condition.

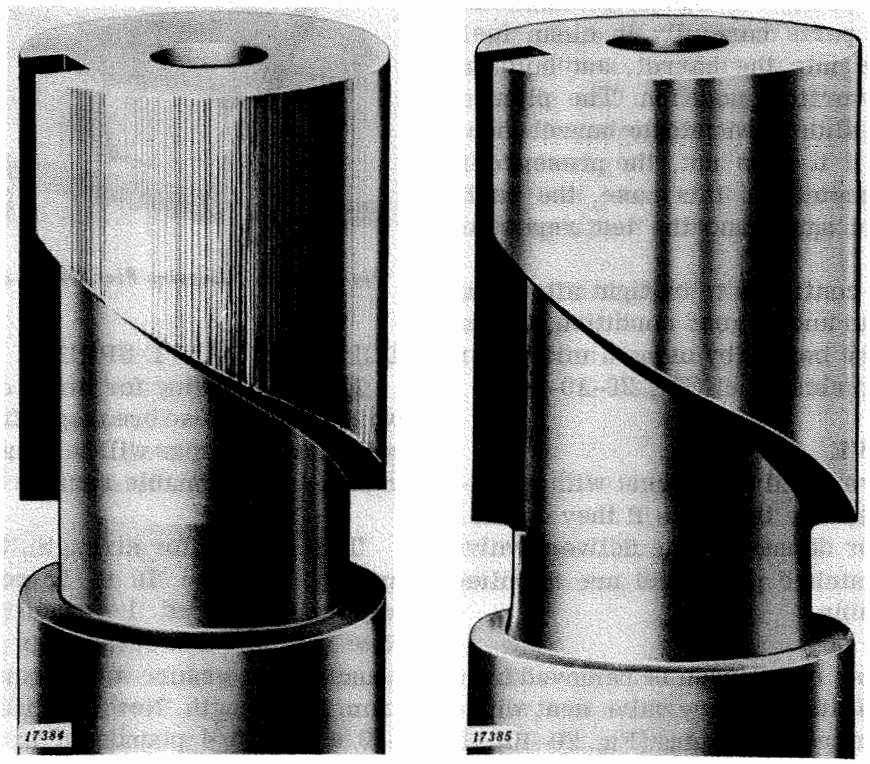


Fig. 20-10-9 -- Appearance of Worn and Serviceable Plungers

Connect fuel delivery lines between injection pump and nozzle. Leave nuts at nozzles finger tight to serve as air vent. When connecting lines for first time, best practice calls for a thorough flushing of both lines before attaching them to nozzles.

FUEL INJECTION PUMP TESTS

PREPARING FOR TESTS

Set range shift lever (on right-hand side of test stand when facing machine) in "HIGH" speed range. Insert spring and guide between mounting bracket pin and pump control rack (Figs. 20-15-7 and 20-15-8).

Note that the right-hand end of both pump racks is graduated in one millimeter steps. By means of the rack-adjusting knob, adjust rack position of No. 1 pump until indicator on side of pump body points to the 10-millimeter graduation on rack (Fig. 20-15-9).

NOTE: The rack setting of No. 2 pump will be ignored for the time being.

It is important that this and all other rack adjustments be made accurately. The width of the indicator and graduation marks make variations in adjustment by different operators possible. So that all operators will make the adjustment the same, line up right-hand surface of indicator with right-hand edge of "10-rack" mark. An inexpensive magnifying glass will assist in reducing error.

Set test stand for clockwise rotation. DO NOT HEAT TEST OIL. Turn on test stand drive motor and use speed control handle to bring speed up to 500 rpm. Operate test stand for several minutes to bleed all trapped air from fuel lines and pumps. Tighten nuts on fuel lines at nozzles and check all connections for leakage.

MAXIMUM DELIVERY TEST

This test is performed by setting the rack of the one pump nearest the operator (No. 1 pump) to a 10-mm (i.e., "10-rack") position and measuring the fuel delivery for a specified number of strokes.

The Bosch and Scintilla pumps from Model R, 70, 80, 820, 830, and 840 Tractors should deliver 103 to 107 cubic centimeters of fuel in 500 strokes at 500-rpm test stand speed with a 10-rack setting on the pumps.

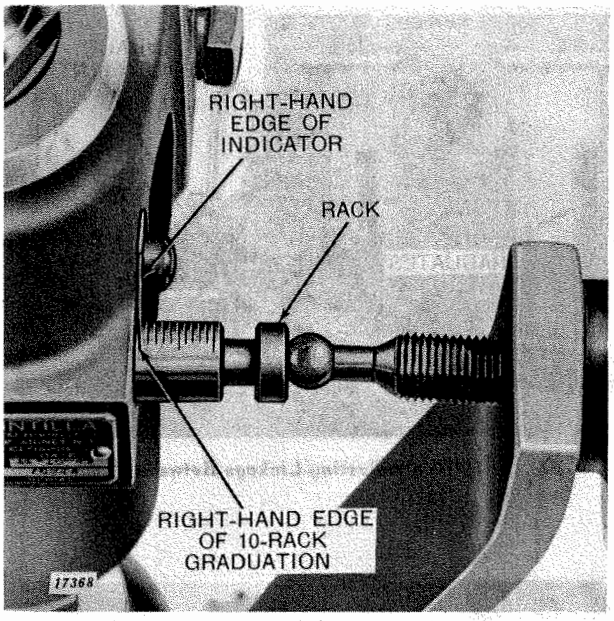


Fig. 20-15-9 -- Pump Rack Set at 10 Millimeters (or 10-Rack Position)

Pumps from Model 720 and 730 Tractors should deliver the same quantity of fuel in 600 strokes (instead of 500) at the above test stand speed and rack setting.

If the No. 1 pump does not deliver the specified quantity of fuel, disregard the rack indicator setting, move the rack slightly to the right or left by means of the rack-adjusting knob, and repeat the above test. Three or four runs should always be made to be certain the fuel delivery is correct.

After No. 1 pump has been calibrated, repeat above test with No. 2 injection pump without disturbing the rack setting of No. 1 pump. If pump does not deliver specified quantity, alter rack adjustment on second pump by loosening linkage between pumps (Fig. 20-15-10). Shorten or lengthen the linkage as required to achieve the correct fuel delivery. Note that No. 2 (right-hand) graduate (Fig. 20-15-10) has delivered less than the specified 103 to 107 cubic centimeters, indicating a need to increase the rack setting on the No. 2 injection pump.

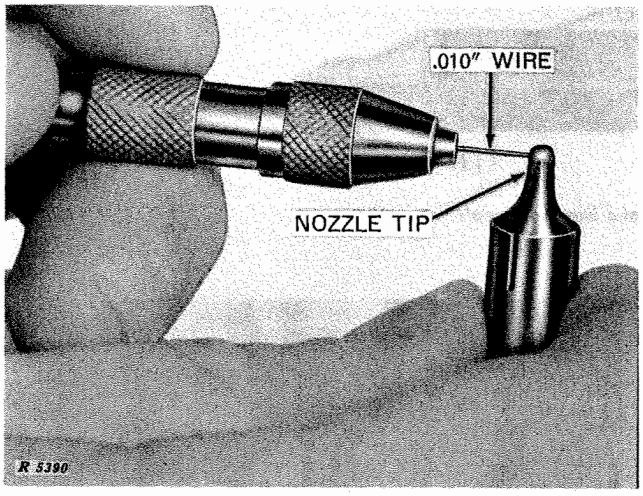


Fig. 30-5-6 -- Opening Holes in Tip

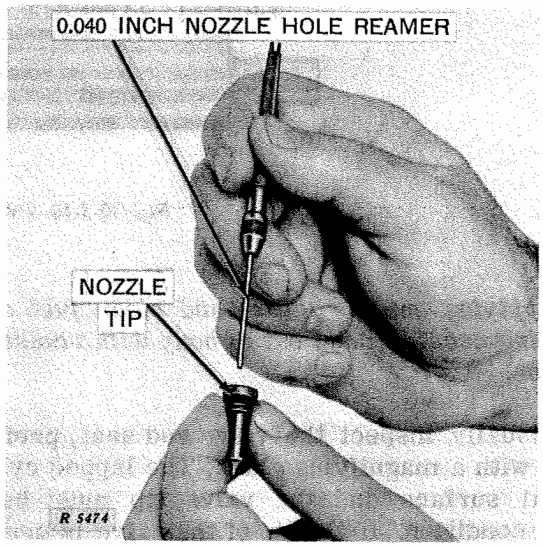


Fig. 30-5-8 -- Cleaning Center Hole in Tip

Fig. 30-5-7 -- Cleaning Tip with Broach

To clean the inside of the tip, use the 0.040-inch nozzle hole reamer (Fig. 30-5-8).

Use the cleaning wire, broach, and nozzle hole reamer several times. Then blow out the tip with dry compressed air, wash it in clean diesel fuel, and blow it out again.

The cleaning wires are also used as gauges to determine the amount of wear in the holes. When a cleaning wire 0.002 inch in diameter larger than the original size of the hole can be inserted, the hole is worn oversize and the tip should be replaced.

NEEDLE VALVE AND SEAT

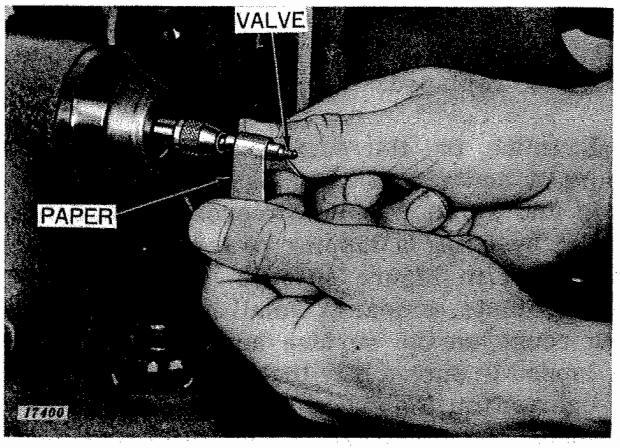


Fig. 30-5-9 -- Cleaning Needle Valve

If a revolving chuck (which does not exceed 100 rpm) is available, remove any remaining gummy deposits from the nozzle valve with mutton tallow and a piece of lintless paper such as a paper towel (Fig. 30-5-9).

NOTE: The chuck of a valve refacing machine can be used for revolving the valve. If a revolving chuck is not available, remove gummy deposit

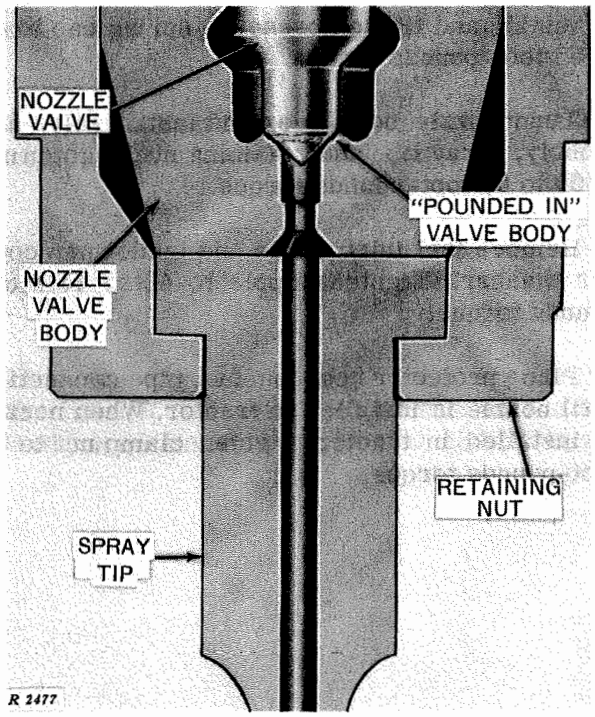


Fig. 30-10-10 -- Valve Seat "Pounded In"

surface and hold the part to be lapped in such a way that even pressure will be exerted on the entire surface (Fig. 30-10-11). Use a motion as though writing a figure "8." After a smooth surface has been obtained, wipe off the valve seat and the plate and repeat the lapping operation, using finishing or polishing rouge. Wash off all traces of rouge when lapping is completed. Wipe the lapping plate clean and store it in its box immediately for safe keeping.

Test fit of nozzle valve and body as follows: Wash both parts in clean fuel. Start valve into the body and hold the assembly in a vertical position. The valve should slide down to its seat under its own weight. If it does not, the presence of dirt can be expected. Thoroughly wash parts again and repeat the test. If the fit of the two parts proves tight, rotate the valve by means of a slowly revolving chuck (such as that on a valve resurfacing machine) and lap the valve into its seat with clean fuel and mutton tallow (Fig. 30-10-12).

NOTE: A chuck with a speed over 100 rpm should never be used.

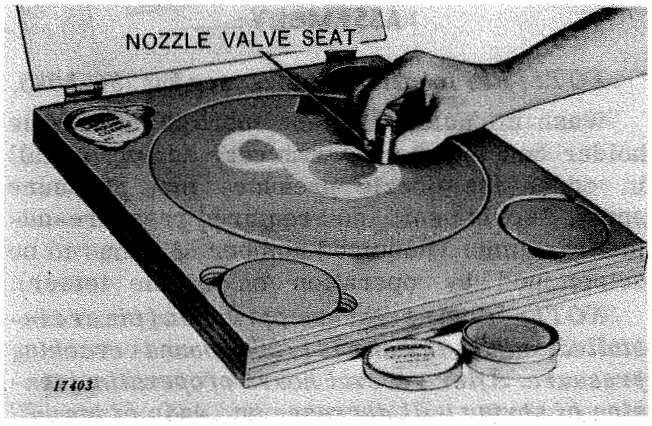


Fig. 30-10-11 -- Lapping Flat Surface of Valve Seat

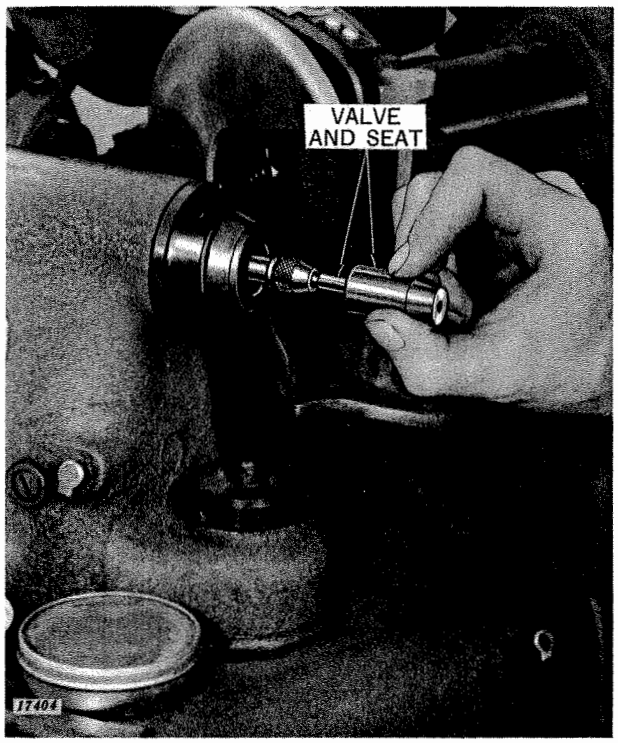


Fig. 30-10-12 -- Lapping Valve in Seat

NOZZLE HOLDER BODY

Examine lapped surface at end of body shank for carbon, scratches, or cracks which might cause an imperfect seal between this surface and the lapped surface of the valve assembly. Remove imperfections by lapping as described previously.

creased. The test oil then emerges from the nozzle with a hissing noise. It is only when the lever movement is accelerated (approximately four to six downward movements) that the nozzle chatters with a shrill whistle.

Until the shrill whistling note is reached, the spray emerges in streams. A divided spray and a flag like formation are without significance within this range. An appraisal of the shape of spray cone is feasible only when the lever movement is accelerated (about four to six downward movements per second). The spray must then be compact the well atomized. (Chattering at full lift of the nozzle needle.)

DISASSEMBLY AND INSPECTION

IMPORTANCE OF CLEANLINESS

Dirt and water are the worst enemies of the fuel injection system. The working area, tools, cleaning solution and cloths must be kept spotlessly clean. When possible, work in an isolated, dustfree area. Cover the work bench with a piece of clean paper. As parts are disassembled, place them immediately in a pan of clean diesel fuel and leave them there until needed. Place a clean paper towel in the bottom of the pan to prevent the parts from striking the pan. Never permit these parts to strike each other. Use a separate pan of clean diesel fuel for washing parts just before final assembly.

NOZZLE CLEANING

Remove anti-corrosive grease completely from new or reconditioned nozzles by washing them thoroughly in diesel fuel. Clean and decarbon used nozzles and wash them in diesel fuel. If parts are coated with hardened carbon or lacquer, it may be necessary to use a brass wire brush.

DISASSEMBLY OF VALVE BODY AND PINTLE VALVE

NOTE: Loosen upper holder nut before removing nozzle nut to relieve pressure on nozzle spring.

Clamp nozzle holder body in a soft jawed vise and remove nozzle nut. Always use correct size box wrench, never use a pipe wrench.

Remove valve body and reinstall the nozzle nut at once to protect the lapped end of the holder body.

Normally, the pintle valve can be easily withdrawn from valve body. However, in some cases it may be necessary to soak the valve in Bendix cleaner, Karbonoff cleaner, acetone, or one of the commercial cleaners sold especially for the purpose. An overnight soaking will sometimes be necessary to free stubborn valves.

⚠ CAUTION: Use these fluids in accordance with the manufacturers' instructions.

The pintle valve and valve body are individually fitted and hand lapped; these two parts should always be kept together as mated parts. Do not permit the lapped surfaces to come in contact with any hard substance.

VISUAL INSPECTION

After cleaning, used nozzles should be visually inspected. Inspect the pintle valve and valve body for nicks or scratches, and the piston (large) portion of pintle valve for scratches or scoring. With a magnifier, inspect valve body for carboned or clogged fuel gallery.

SLIDE TEST

Dip the pintle valve in clean diesel fuel and insert into the valve body. Holding the body almost vertically pull up the valve by one third of its engaged length. When released, the valve should slide down to its seat by its own weight.

Fig. 30-20-4–Slide Test

(c) Grip the top of the valve with retractor No. 16481 and rotate the valve in the guide by turning the retractor. The amount of lapping required can be accomplished in 10-20 turns by hand. The valve should be raised and lowered in the guide every 3-4 revolutions and the direction of rotation changed for best results.

IMPORTANT: NEVER attempt to rotate the valve in a MOTOR DRIVEN CHUCK for this purpose.

(d) Wash the nozzle body and valve thoroughly before reassembly.

Seat leakage may be caused by dirt, carbon, or fuel deposits in the seat area, sticky operation of the valve due to bending, or tightness in the guide. If these conditions have been eliminated as seat leakage causes, inspect the valve seat. Clean valve seat with lapping compound No. 16489.

Place a small amount of compound on the valve tip and insert the valve into the nozzle body. Use retractor No. 16481 to rotate the valve by hand in lapping it to the body seat. Only a very slight polishing (3-5 revolutions by hand) is necessary to clean up the seat. Excessive lapping will decrease the interference angle on the valve, preventing chatter and causing poor atomization.

Valve Replacement

If valve is worn until nozzle will not chatter, has seat leakage, or has a poor spray pattern, valve replacement is necessary.

All nozzles are marked on the banjo inlet fitting with a code letter. Select the replacement valve which covers the code stamped on the nozzle body. FOR EXAMPLE, if nozzle body is stamped with an "A," the nozzle valve covering "A" code must be used for replacement.

IMPORTANT: NEVER lap a new valve to the old valve body tip seat. The valve is precision ground. If previous lapping with the old valve did not clean up the valve tip seat in the nozzle body, lapping of the new valve will not restore it further and will only destroy the angle of the new valve. However, if valve return leakage is not correct, use compound No. 16489 between the valve guide area and guide to increase clearance as explained above.

Valve Adjusting Mechanism

NOTE: Refer to Fig. 30-25-1 for identification of parts.

Inspect lift adjusting screw for bent condition. If screw is bent or otherwise damaged, replace with new part. Examine adjusting screw for damage. Replace if wear or damage is evident.

Inspect pressure adjusting spring. If spring is damaged or broken, replace with new spring.

Inspect spring seats and ballwasher for wear. Replace if necessary.

Examine nozzle locating clamp for bent condition. Replace with new part if necessary.

ASSEMBLY

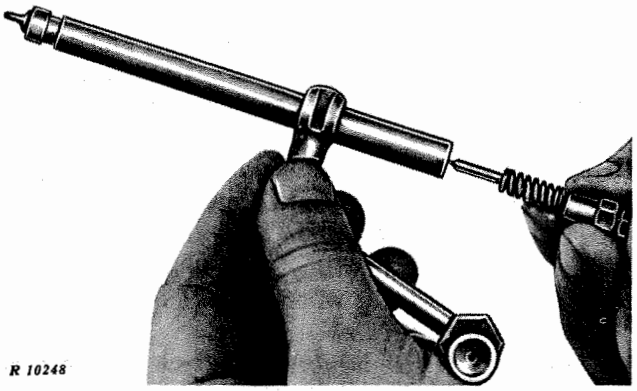


Fig. 30-25-15 – Assembling Nozzle

Slip the nozzle locating clamp (if used) over upper nozzle body with flanges down.

Wet the valve with fuel or calibrating oil and slide it into the nozzle body. Use care when handling valve.

Thread the lift adjusting screw into the pressure adjusting screw until top just enters screw.

Invert adjusting screw assembly and assemble the ballwasher, upper spring seat, spring, and lower spring seat to the lift adjusting screw. Tilt the nozzle body (do not allow valve to slide out) and assemble the spring adjusting screw to the body. Use care not to dislodge the spring or seats during initial assembly. Turn the pressure adjusting screw down, by hand, as far as possible (usually ten full turns).

Group 30
ROBERT BOSCH 21-MILLIMETER NOZZLES

DESCRIPTION

The Robert Bosch nozzle valve used on John Deere engines is an inward opening type which is held on its seat by a heavy spring. A measured amount of fuel from the injection pump enters the nozzle body and goes into a cavity which surrounds the valve. When fuel pressure reaches approximately 3100 psi, the valve is forced from its seat against pressure of the heavy spring, permitting the measured amount of fuel to enter the combustion chamber at high velocity. After the fuel has been injected, the spring closes the valve.

The nozzle holder is used to hold the nozzle in its correct position in the engine cylinder and to provide a means of conducting fuel oil to the nozzle. The holder also contains the necessary spring and means of pressure adjustment to provide proper action of the nozzle valve.

Parts of a typical Robert Bosch nozzle holder are shown in (Fig. 30-30-1). The body has drilled passages for conducting the fuel from the inlet connection to the nozzle and its lower end is provided with an accurately ground and lapped surface which makes a leak-proof and pressure tight seal with the corresponding lapped surface at the upper end of the nozzle.

A certain amount of seepage of fuel between the lapped guide surfaces of the valve and its body is necessary for lubrication. This leakage accumulates around the spindle and in the spring compartment. It drains from this compartment through the leak-off connection which is provided for that purpose.

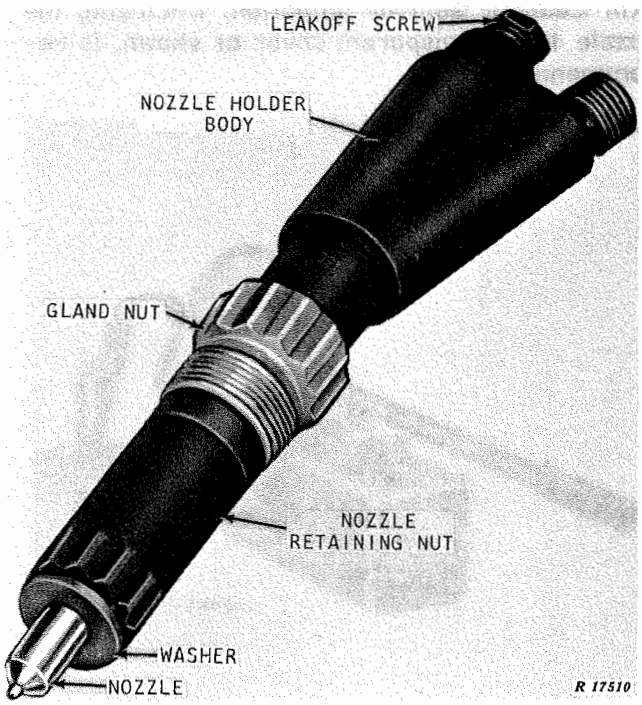
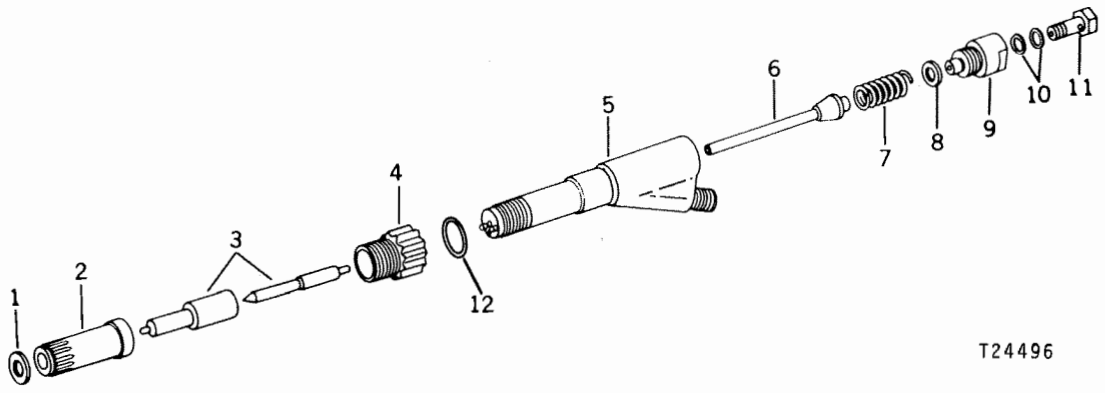


Fig. 30-30-2–Assembled Nozzle



1 – Washer
2 – Nozzle Retaining Nut
3 – Nozzle
4 – Gland Nut
5 – Nozzle Holder Body
6 – Spindle
7 – Spring
8 – Shim
9 – Screw Plug
10 – Gaskets
11 – Leak-Off Screw
12 – O-Ring

Fig. 30-30-1–Robert Bosch 21-Millimeter Nozzle Parts