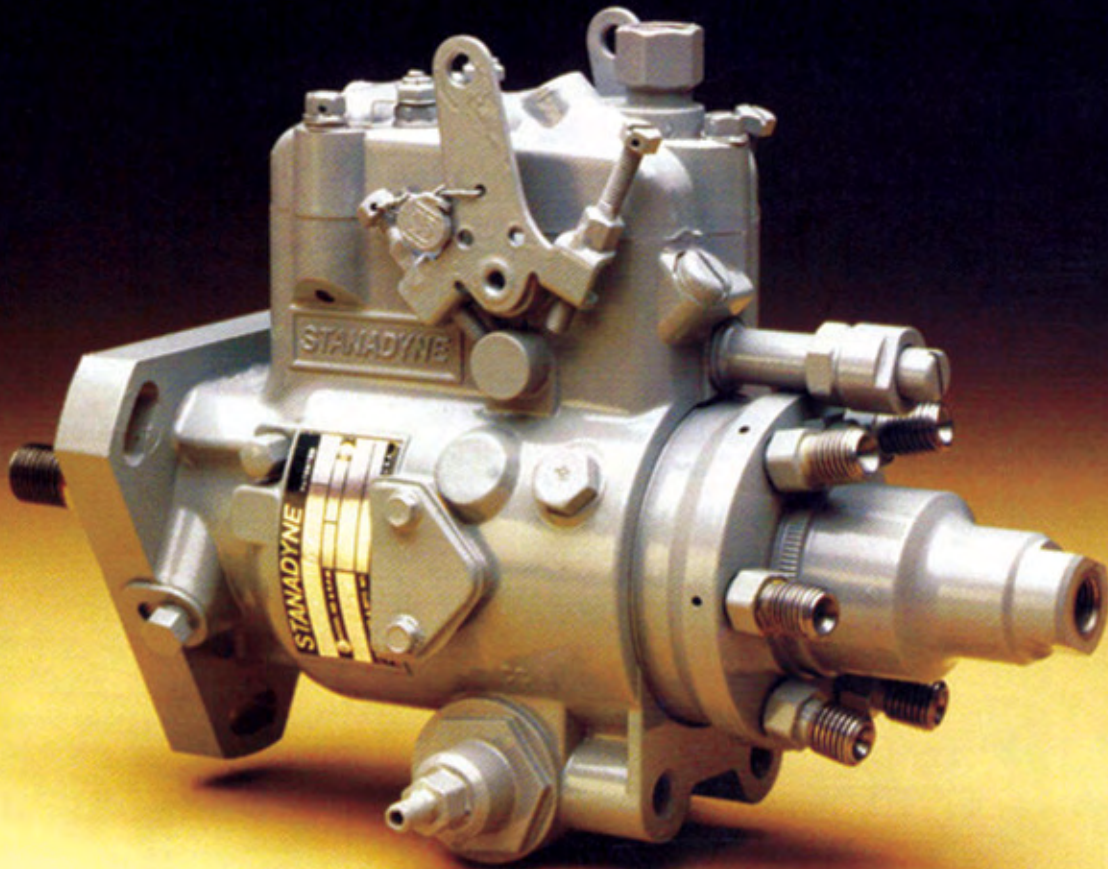


# Operation Manual Model DB4 Pump

**STANADYNE**





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## 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 understand the basic operating principles, disassemble, reassemble, and calibrate the Stanadyne DB4 type fuel injection pump and to make such adjustments and parts replacements as may be needed. It is recommended that inexperienced persons refrain from making adjustments and repairs, as such action may result in 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. Since several critical adjustments of the injection pump are required which cannot readily be made on the engine, it is also necessary that the service be performed in a facility equipped with the proper special tools and an approved, motorized test bench.

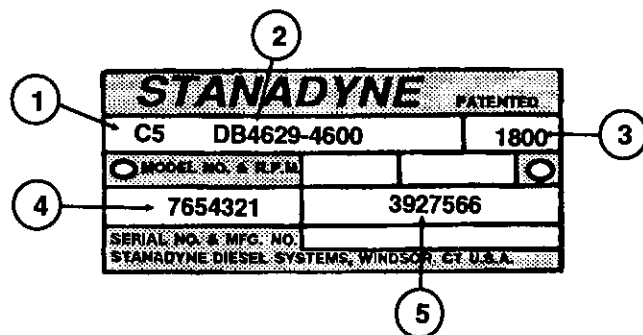
### B. Model Number System

The following information appears on the DB4 pump nameplate.

1. Date Code - Reference Service Bulletin 439.
2. Model Number - See description below  
(NOTE: Model Numbers may be abbreviated on nameplates [e.g. DB4-4600])
3. Rated or High Idle Engine RPM (See Individual Specification).
4. Serial Number.
5. Customer Part Number.

The model number describes the DB4 pump as follows:

<u>a</u>	<u>b</u>	<u>c</u>	<u>d</u>	<u>e</u>
DB	4	6	29	4600



- a. DB - "B" version of "D" series pump.
- b. 4 - Number of Pumping Plungers

c. 6 - Number of Engine Cylinders Served

d. 29 - Abbreviation of Plunger Diameter

25 - .250" (6.35mm)

27 - .270" (6.86mm)

29 - .290" (7.37mm)

31 - .310" (7.87mm)

e. 4600 - Specification Number - Determines selection of parts and adjustments for a given application. Must be included in any reference to the pump.

### C. General Information

The Stanadyne Model DB4 pump is described as an opposed plunger, inlet metered, distributor type pump.

Precise distribution between cylinders, inherent in the pump design, and the ability to preset fuel flow eliminates lengthy periods on the test stand. The pump is self lubricated (with the exception of the drive shaft bearing), contains essentially the same number of parts regardless of the number of cylinders served, and operates in any position.

## SECTION 1 - CONSTRUCTION AND OPERATION

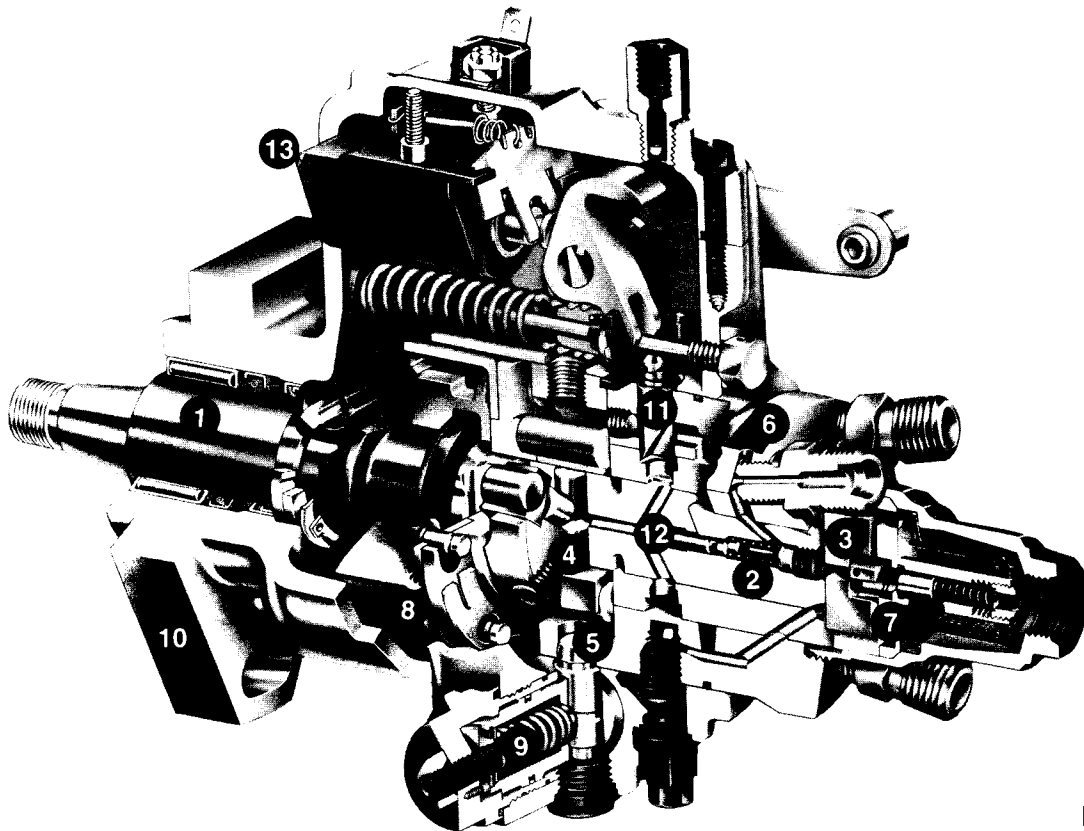


Fig. 1.1

### A. Components And Functions (Fig 1.1)

The main components of the Stanadyne DB4 pump are pictured above in Figure 1.1. They include:

1. Drive Shaft
2. Distributor Rotor
3. Transfer Pump Blades
4. Pumping Plungers (4)
5. Internal Cam Ring
6. Hydraulic Head
7. Pressure Regulator Assembly
8. Governor
9. Automatic Advance
10. Housing
11. Metering Valve
12. Delivery Valve
13. Electric Shutoff Solenoid

The main rotating components are the drive shaft (1), distributor rotor (2), transfer pump blades (3), and governor (8).

With reference to Fig. 1.1, the drive shaft engages the distributor rotor in the hydraulic head.

The four plungers are actuated toward each other simultaneously by an internal cam ring through rollers and shoes which are carried in slots at the drive end of the rotor. The number of cam lobes normally equals the number of engine cylinders.

The transfer pump at the rear of the rotor is of the positive displacement vane type and is enclosed in the end cap. The end cap also houses the fuel inlet filter screen and transfer pump pressure regulator. The face of the regulator assembly is compressed against the distributor rotor and forms an end seal for the transfer pump.

The distributor rotor incorporates two charging ports, a single axial bore and a discharge port to serve all head outlets to the injection lines.

The hydraulic head contains the bore in which the rotor revolves, the metering valve bore, the charging ports and the head discharge fittings. The high pressure injection lines which connect to the injectors are fastened to these discharge fittings.

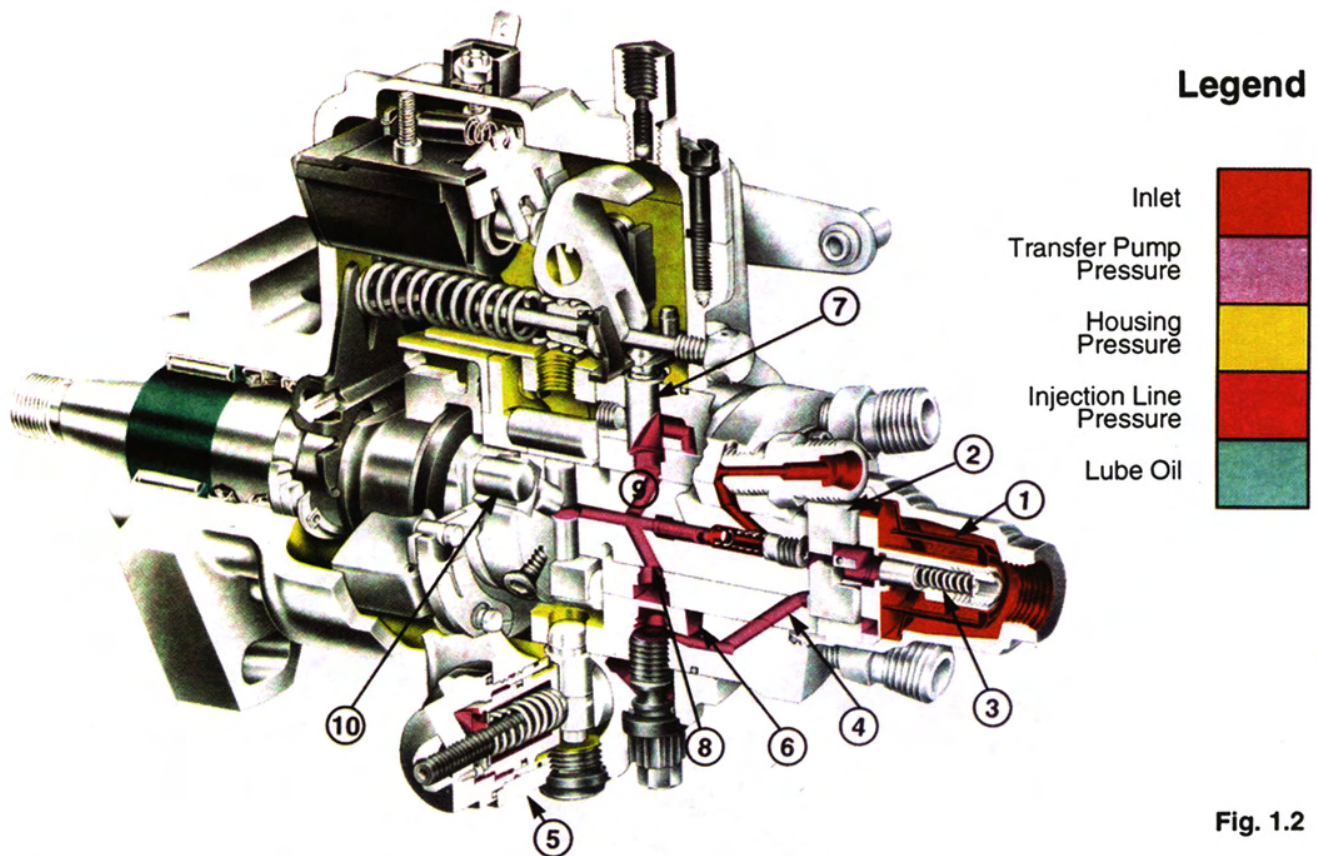


Fig. 1.2

The DB4 pump contains its own mechanical governor capable of close speed regulation. The centrifugal force of the weights in their retainer is transmitted through a sleeve to the governor arm and through a positive linkage to the metering valve. The metering valve can be closed to shut-off fuel through governor cover mounted electric shut-off solenoid or through an independently operated shut-off lever.

The automatic advance is a hydraulic mechanism which advances or retards the beginning of fuel delivery from the pump.

### B. Fuel Flow

The operating principles of the pump can be understood more readily by following the fuel circuit during a complete pump cycle (Fig. 1.2). Fuel is drawn from the supply tank by an electrical or mechanical supply pump and pressurized to approximately 1 - 8 psi through filters and enters the pump through the inlet filter screen (1) and the vane type fuel transfer pump (2). Some fuel is bypassed through the pressure regulator assembly (3) to the suction side.

Fuel under transfer pump pressure flows past the rotor retainers and then flows through a connecting

passage (4) in the head to the advance (5) and also to the transfer annulus (circular fuel passage) (6). The fuel flows around the transfer annulus and through a connecting passage to the metering valve (7). The radial position of the metering valve, controlled by the governor, regulates the flow of fuel into the charging annulus (8) which incorporates the charging ports.

As the rotor revolves, the two inlet passages (9) register with the charging ports in the hydraulic head, allowing fuel to flow into the pumping chamber. With further rotation, the inlet passages move out of registry and the 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 pressurized and delivered by the nozzle to the combustion chamber.

In addition, a vent wire arrangement (Ref. Section F) in the hydraulic head connects the outlet side of the transfer pump with the pump housing. This allows air and some fuel to be bled back to the fuel tank via the return line. The fuel thus bypassed fills the housing and lubricates the internal components.

### C. Transfer Pump

The positive displacement vane type fuel transfer pump consists of a stationary liner and spring loaded blades which are carried in slots in the rotor. Since the inside diameter of the liner is eccentric to the rotor axis, rotation causes the blades to move in the rotor slots. This blade movement changes the volume between the blade segments.

Since displacement of the transfer pump exceeds injection requirements, some of the fuel is recirculated by means of the transfer pump regulator to the inlet side of the transfer pump.

Figure 1.3 illustrates the pumping principle. Blade movement relative to the rotor causes a volume increase in the quadrant between blade 1 and 2 (Fig. 1.3a). At this time, the quadrant is in registry with a kidney shaped slot in the top portion of the regulator assembly. The increasing volume causes

fuel to be pulled through the inlet fitting and filter screen into the space formed by the transfer pump liner, blades and rotor. Volume between the two blades continues to increase until blade 2 passes out of registry with the regulator inlet slot. At this point the rotor has reached a position where the volume change between blades 1 and 2 is negligible (Fig. 1.3b) and fuel between the blades is carried to the bottom of the transfer pump liner.

As blade 1 passes the edge of the kidney shaped groove in the lower portion of the regulator assembly (Fig. 1.3c), the liner, whose inside diameter is eccentric to the rotor, pushes blades 1 and 2 in a direction opposite to their previous movement. The volume between the blades is reduced and pressurized fuel is delivered through the groove of the regulator assembly, past the rotor retainers and into an annulus on the rotor leading to the hydraulic head passage. Volume between the blades continues to decrease, pressurizing the fuel in the quadrant, until blade 2 passes the groove in the regulator assembly.

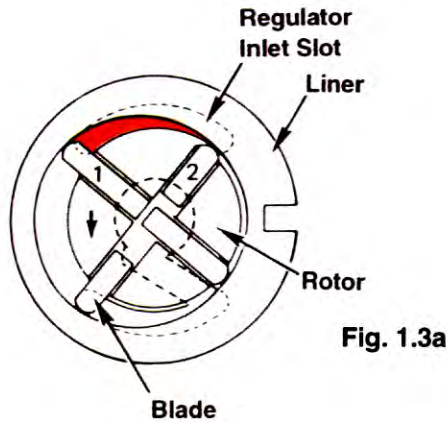


Fig. 1.3a

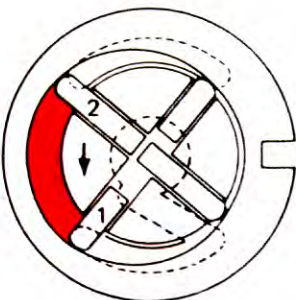


Fig. 1.3b

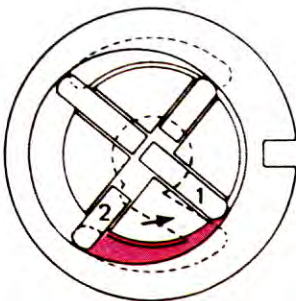


Fig. 1.3c

### Regulator Assembly Operation

Figure 1.4 shows the operation of the pressure regulating piston while the pump is running. Fuel pressure from the discharge side of the transfer

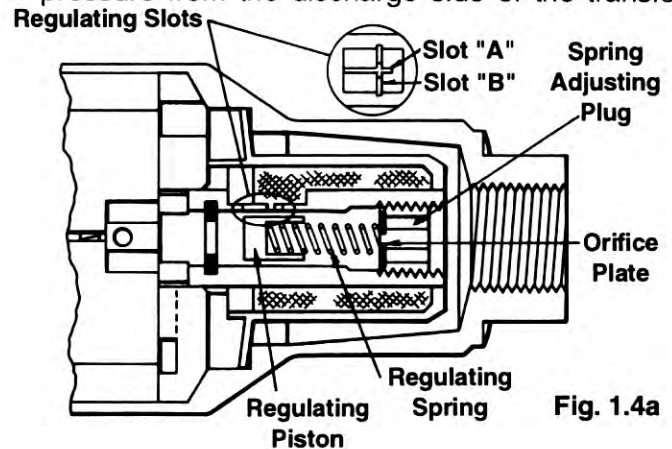


Fig. 1.4a

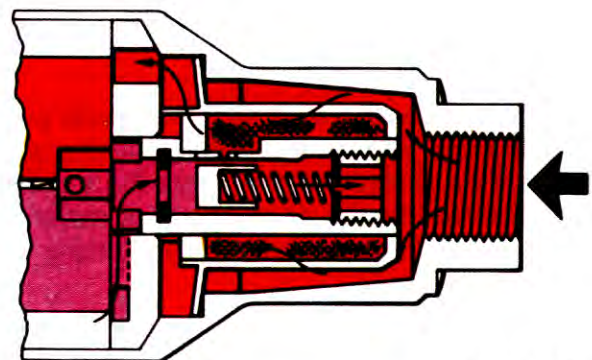


Fig. 1.4b

pump forces the piston in the regulator against the regulating spring. As pressure increases, the regulating spring is compressed until the edge of the regulating piston starts to uncover the longitudinal pressure regulating slot "A" (Fig. 1.4a). Since fuel 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 of the regulating slot "A". Therefore pressure increases with speed.

A pressure relief slot "B", which is perpendicular to slot "A", is incorporated in the regulator to limit the maximum transfer pressure at high speeds.

### Viscosity Compensation

The DB4 transfer pump works equally well with different grades of diesel fuel and varying temperatures, both of which affect fuel viscosity. A unique and simple feature of the regulating system offsets pressure changes which would normally result from variations in fuel viscosity. Located in the spring adjusting plug is a thin plate incorporating a sharp-edged orifice. Fuel leakage past the clearance between the regulating piston and its bore flows through the orifice back to the inlet side of the pump. While flow through a short orifice is virtually unaffected by viscosity changes, flow through the piston and bore clearance will vary with fuel viscosity. With hot and/or low viscosity fuels, leakage past the piston increases causing fuel pressure in the spring cavity to increase since flow through the orifice remains essentially the same regardless of fuel viscosity. This increased fuel pressure serves to assist the regulating spring and moves the piston, reducing the exposed regulating slot area. With cold or viscous fuels, very little leakage occurs past the piston causing little additional force to be exerted on the back side of the piston resulting in little or no pressure compensation.

## D. Charging And Discharging

### Charging Cycle

As the rotor revolves (Fig. 1.5) the two inlet passages in the rotor register with ports of the charging annulus. Fuel under pressure from the transfer pump, controlled by the opening of the metering valve, flows into the pumping chamber forcing the plungers apart.

The plungers are forced outward a distance proportionate to the amount of fuel metered past the metering valve while the charging ports are in registry. If only a small quantity of fuel is admitted

into the pumping chamber, as at idling, the plungers move out a short distance. Maximum plunger travel and, consequently, maximum fuel delivery is limited by a pair of 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 (Fig. 1.5) that while the angled inlet passages in the rotor are in registry with the ports in the charging annulus, the rotor discharge port is not in registry with a head outlet.

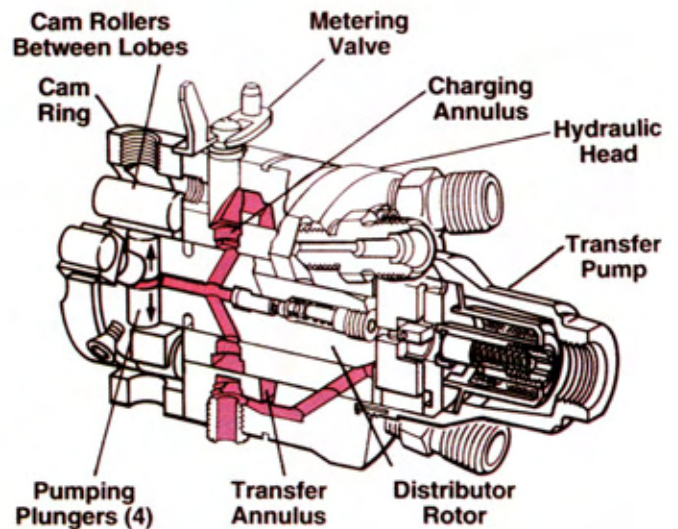


Fig. 1.5

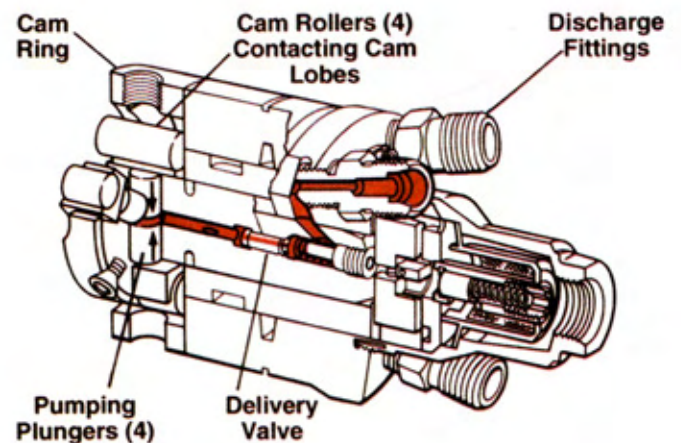


Fig. 1.6



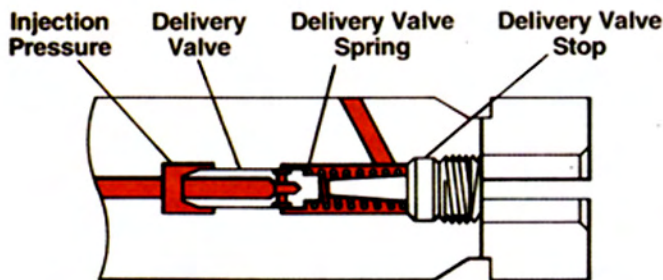
## Discharge Cycle

As the rotor continues to revolve (Fig. 1.6), the inlet passages move out of registry with the charging ports. The rotor discharge port opens to one of the head outlets. The rollers then contact the cam lobes and injection begins. Further rotation of the rotor moves the rollers up the cam lobe ramps pushing the plungers inward. During this stroke the fuel trapped between the plungers flows through the axial passage of the rotor and discharge port to the injection line. Delivery to the injection line continues until the rollers pass the innermost point on the cam lobe and begin to move outward. The pressure in the axial passage is then reduced, allowing the nozzle to close. This is the end of the injection.

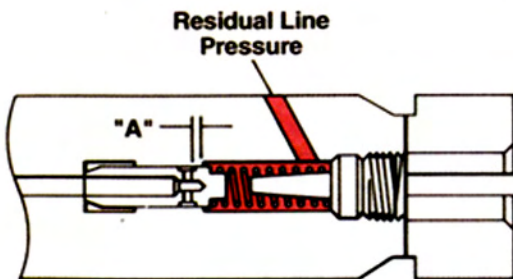
## E. Delivery Valve Function

The delivery valve (Figs. 1.7a and 1.7b) rapidly decreases 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 improperly atomized fuel from entering the combustion chamber.

The delivery valve operates in a bore in the center of the distributor rotor. Note that the valve requires



DELIVERY VALVE OPEN  
Fig. 1.7a



DELIVERY VALVE CLOSED  
Fig. 1.7b

no seat - only a stop to limit travel. Sealing is accomplished by the close clearance between valve and bore into which it fits. Since the same delivery valve performs the function of retraction for each injection line, the result is a 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 delivery valve spring chamber. Since the discharge port is already opened to a head outlet, the retraction volume and plunger displacement volume are delivered under high pressure to the nozzle. Delivery ends when the pressure on the plunger side of the delivery valve is quickly reduced, due to the cam rollers passing the highest point on the cam lobe which allows the plungers to move outward.

Following this, the rotor port closes completely and a residual injection line pressure is maintained. Note that the delivery valve is only required to seal while the discharge port is opened. Once the port is closed, residual line pressures are maintained by the seal of the close fitting head and rotor.

## F. Return Oil Circuit

Fuel under transfer pump pressure is discharged into a vent passage in the hydraulic head (Fig. 1.8). Flow through the passage is restricted by a vent

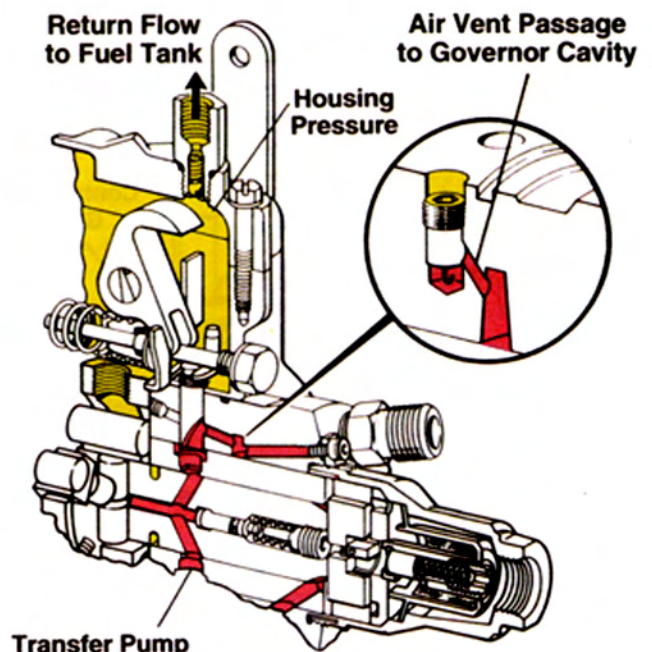


Fig 1.8

wire assembly designed to allow air and a small amount of fuel to flow into the housing cavity. The air and a small quantity of fuel then flow from the housing to the fuel tank via the return line.

The vent passage is located behind the metering valve bore and connects with a short vertical passage entering the governor compartment. Vent wire screw assemblies are available in 6 sizes in order to control return oil flow. Each screw assembly has a number etched on the bottom ranging from 0 to 5 with zero providing the largest flow and number 5 being the most restrictive. During calibration, return oil will be measured and if above or below specification, a vent wire with a different flow can be installed to bring the flow within specification. See individual specification for part numbers.

### G. Mechanical Governor

Stanadyne DB4 pumps utilize two popular types of mechanical governors - the all-speed type and the speed droop type. The governor serves the purpose of maintaining the desired engine speed under varying engine loads. All-speed governors are commonly used for industrial and agricultural applications where 6 to 10% governor regulation is adequate and load response rather than driveability is most desirable. The Stanadyne speed droop governor is a variation of the all-speed governor. It utilizes a low rate governor spring whose rate can be changed through an external adjustment. The speed droop governor is capable of governor regu-

lation within 3 to 5% and is popular for close regulation applications such as generator sets.

The mechanical governor (Fig. 1.9) utilizes energy from a set of weights carried in a weight retainer which is affixed to the distributor rotor and rotates with it. The force on the governor arm caused by the weights is balanced by the governor spring force which is controlled by the manually positioned throttle lever for the desired engine speed. As the pump operates, centrifugal force tips the weights outward which tends to move the governor thrust sleeve against the lower end of the governor arm. The governor arm, which pivots on the knife edge of the pivot shaft, in turn compresses the governor spring and moves the linkage hook which is connected to the metering valve arm and rotates the metering valve. This rotation varies how much of the metering valve's helical cut is exposed to the passage from the transfer pump, thereby controlling the quantity of fuel allowed to flow to the pumping plungers.

In the event of a speed increase due to a load reduction, the resultant increase in centrifugal force of the weights rotates the metering valve clockwise to reduce fuel. This limits the speed increase to a value determined by governor spring rate and throttle position.

When the load on the engine is increased, the speed tends to reduce. The lower speed reduces the force generated by the weights permitting the spring force to rotate the metering valve in a counter-clockwise direction to increase fuel. The speed of the engine at any point within the operating range is dependent upon the combination of load on the engine and the governor spring rate and setting as established by the throttle position.

In many all-speed governor equipped applications a light idle spring is provided for more sensitive regulation when weight energy is low in the low end of the speed range. The limits of throttle travel are set by adjusting screws for proper low idle and high idle positions.

A light tension linkage hook spring is used to connect the governor arm and the linkage hook and serves to take up any slack in the linkage joints. It also allows the shut-off mechanism to close the metering valve without having to overcome the governor spring force. Only a very light force is required to rotate the metering valve to the closed position.

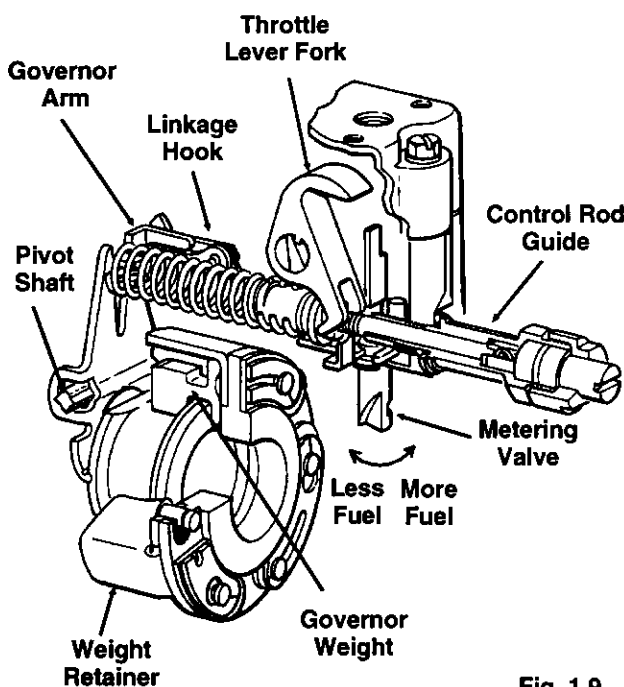


Fig. 1.9

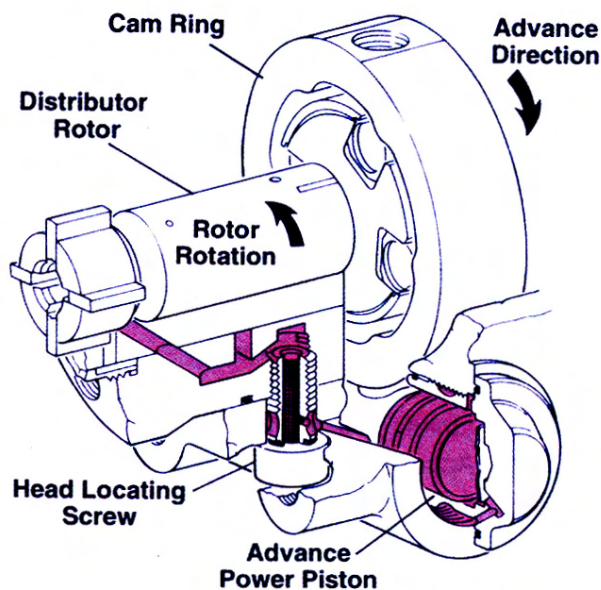


Fig. 1.10a

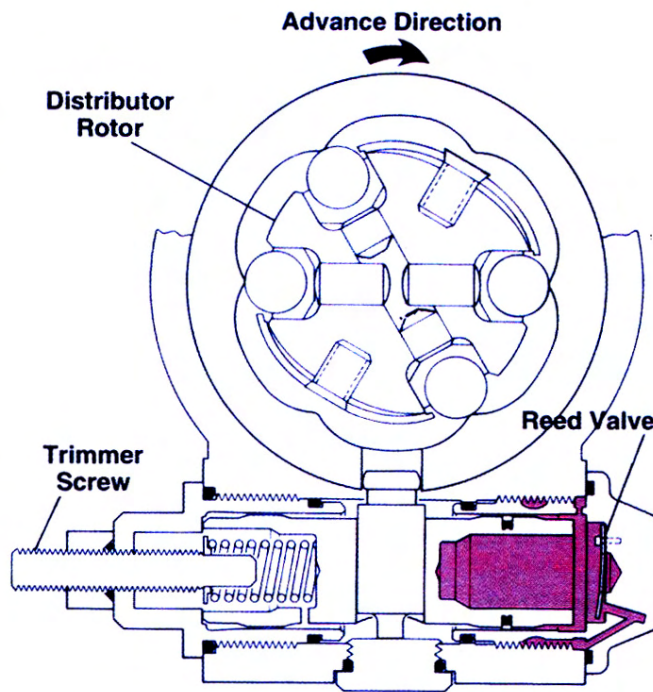


Fig. 1.10b

## H. Automatic Advance

The design permits the use of a simple, direct acting hydraulic mechanism, powered by fuel pressure from the transfer pump, to rotate the cam and vary delivery timing. The advance mechanism advances or retards start of fuel delivery in response to engine speed changes. In most injection systems, the actual beginning of delivery of fuel at the nozzle will start later (in engine degrees of rotation) as the speed increases.

Compensating this inherent "increasing injection lag" will often improve the high speed performance of the engine. 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 optimum power with minimum specific fuel consumption and minimum smoke.

The advance piston, located in a bore in the housing, engages the cam through the advance pin and rotates the cam (when fuel pressure moves the piston) opposite to the direction of rotor rotation. (Figures 1.10a and b). Fuel under transfer pump pressure is fed through a drilled passage in the hydraulic head which registers with the bore of the head locating screw. Fuel is then directed through a groove in the head locating screw to an annulus in the piston hole plug. It enters a port in the piston hole plug leading to the reed check valve. Increasing transfer pump pressure forces fuel past the valve to the advance piston. Fuel pressure against

the piston must overcome the opposing spring force plus the dynamic injection loading on the cam in order to change the cam position. The reed check valve prevents the normal tendency of the cam to return to the retard position during injection by trapping the fuel in the piston chamber. When engine speed decreases, the hydraulic pressure is reduced and the spring returns the cam to a retarded position in proportion to the reduction of speed. The fuel in the piston chamber is allowed to bleed off through a control orifice in the piston hole plug.

Most DB4 pumps use a speed advance mechanism meaning that the advance moves as a function of speed. As pump speed increases so does transfer pump pressure and therefore advance position. At low speeds, because transfer pump pressure is comparatively low, the cam remains in the retarded position. Total advance movement is limited by piston length.

A "trimmer screw" is provided to adjust advance spring preload which controls start of cam movement. It can be incorporated at either side of the advance mechanism.

Some DB4 pumps also use other types of advance mechanisms such as the servo light load advance which is both speed and load (fuel delivery level) responsive. These types are covered in separate Service Bulletins such as S.B.'s 359 and 373.

## SECTION 2 - DISASSEMBLY

Study the manual first. Before commencing disassembly of the pump, cover fuel inlet, fuel outlets, and return fuel connector and wash the unit with solvent and blow dry with filtered, compressed air. Keep in mind that dirt, dust and foreign matter are the greatest enemies of precision diesel fuel injection equipment; therefore it is essential that clean hands, work space and tools be used.

NOTE: All seals and gaskets and certain non-reusable parts as noted herein should be discarded during disassembly. After cleaning, parts should be lubricated with calibrating fluid and placed in a clean parts tray (Such as P/N 31216).

### Service Tools

Listed below are most of the common hand tools, special Stanadyne service tools and other equipment needed for servicing the DB4 pump. Other tools may be required for certain applications depending on the accessories. In general, the common hand tools must be obtained locally since Stanadyne only makes available the special service tools. In those cases where Stanadyne does offer a common hand tool, the part number is indicated.

### Common Hand Tools

1/4 inch nut driver  
5/16 inch nut driver  
11/32 inch nut driver  
Diagonal Cutting Pliers (P/N 31206)  
Needle Nose Pliers  
Small Brass or Plastic Headed Hammer  
Dental Pick Tool for Removing Seals  
3/8 inch Drive Ratchet  
1/4 inch Hex Bit Socket, 3/8 inch Drive  
T25 Torx Bit Socket, 1/4 inch Drive (P/N 31211)  
5/16 inch Socket, 3/8 inch Drive  
3/8 inch Socket, 3/8 inch Drive  
7/16 inch Socket, 3/8 inch Drive  
1/2 inch Socket, 3/8 inch Drive  
9/16 inch Socket, 3/8 inch Drive  
10mm Socket, 3/8 inch Drive  
17mm Socket, 3/8 inch Drive  
1/2 inch to 3/8 inch drive adapter  
1-1/8 inch Socket, 1/2 inch drive  
3/8 inch Open End Wrench  
7/16 inch Open End Wrench  
1/2 inch Open End Wrench

9/16 inch Open End Wrench  
5/8 inch Open End Wrench  
5/64 inch Hex Key Wrench (P/N 13310)  
3/16 inch Hex Key Wrench (P/N 13322)  
Small Screwdriver (P/N 16504)  
Medium Screwdriver  
Large Screwdriver

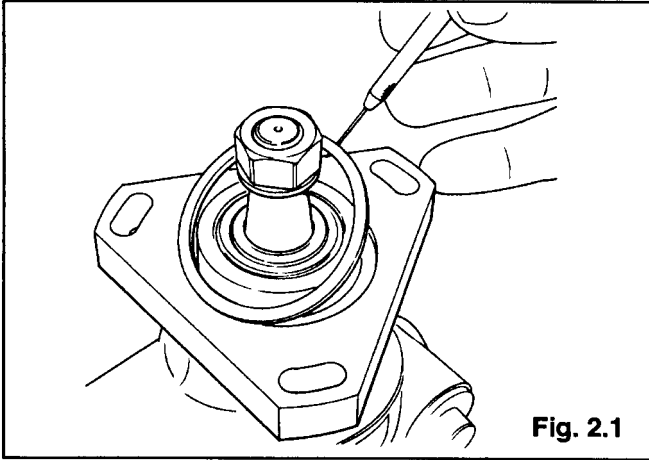
### Special Stanadyne Service Tools (Ref. Tool Manual 99929)

13301 Brass Hook  
13336 5/32 inch Hex Driver  
13337 Small Snap Ring Pliers  
13379 Linkage Hook Wrench  
14490 Advance Plug Wrench  
16199 Advance Piston Ring Compressor  
16313 Rotor Support Tool  
16336 1/8 inch Hex Driver  
16487 Eye Loupe  
18338 Throttle Shaft Seal Installation Tool  
19965 Pump Holding Fixture  
(85mm Pilot/105mm Bolt Circle)  
19969 Roller-to-Roller Setting Fixture  
20043 Snap Ring Pliers - Squeeze to Close  
20044 Snap Ring Pliers - Squeeze to Open  
20395 Timing Line Locator  
20548 Transfer Pump End Cap Socket  
20992 Shutoff Cam Remover  
22204 Assembly Lubricant  
22736 5/16 inch Hex Bit Socket, 3/8 inch Drive  
22939 T-27 Torx Bit Socket, 3/8 inch Drive  
23093 Linkage Gap Gage Kit  
23615 Pump Holding Fixture  
(50mm Pilot/98mm Bolt Circle)  
26081 Delivery Valve Extractor Tool  
26528 Electric Shutoff Solenoid Inst. Tool  
27760 Advance Plug Socket  
28311 Drive Shaft Bearing and Seal Puller  
28316 Drive Shaft Bearing and Seal Inst. Tool  
30465 Assembly Grease  
32129 Del. Valve Stop Seat Refinishing Tool

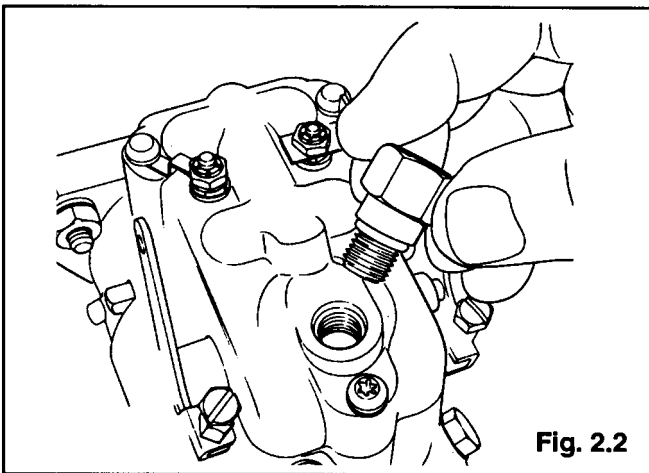
### Other Equipment

Medium Size Arbor Press  
1-2 inch Micrometer  
3/8 inch Drive Torque Wrench  
Tilt/Swivel Vise  
Parts Tray (P/N 31216)  
Clean Calibrating Fluid for Rinsing Parts

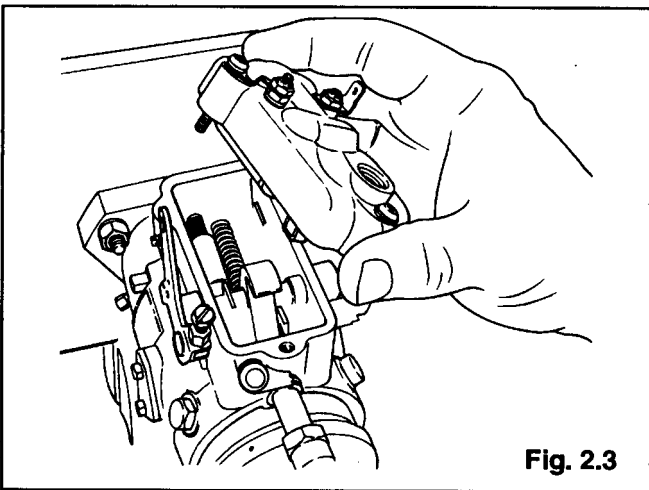
**STEP 1** Remove flange seal and discard.



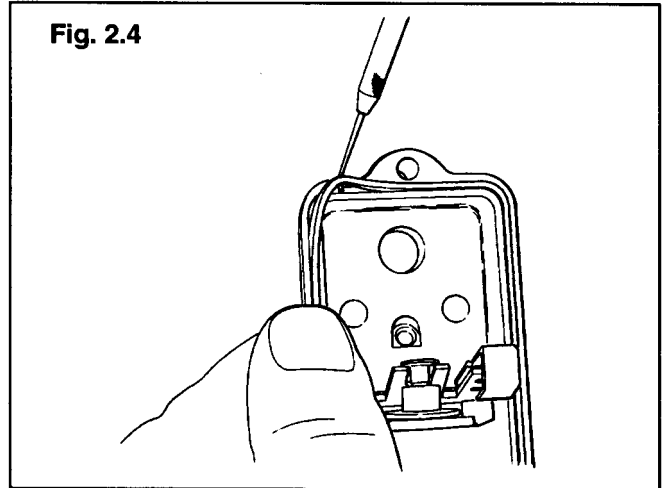
**STEP 2** Clamp pump holding fixture 23615 in vise and mount pump in fixture. Loosen and remove the return line connector/housing pressure regulator fitting from the governor cover. Remove the O-ring seal from the fitting and discard.



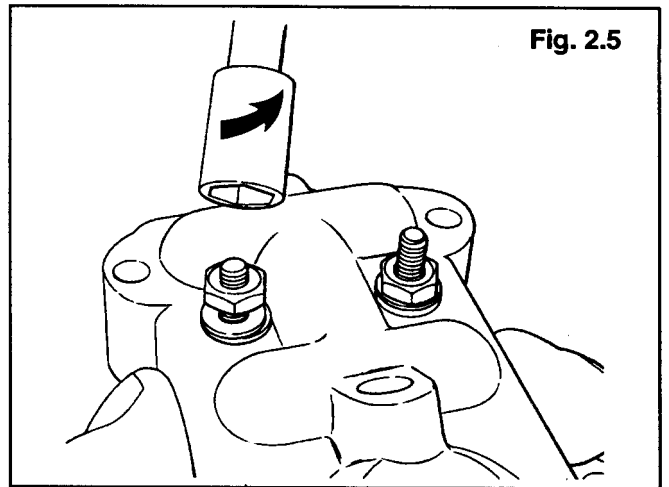
**STEP 3** Loosen and remove 3 governor cover screws and remove the governor cover assembly from the top of the pump.



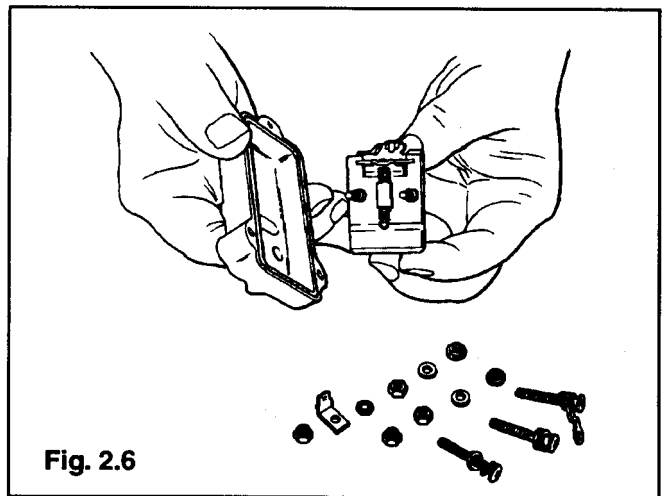
**STEP 4** Remove the governor cover seal and discard.



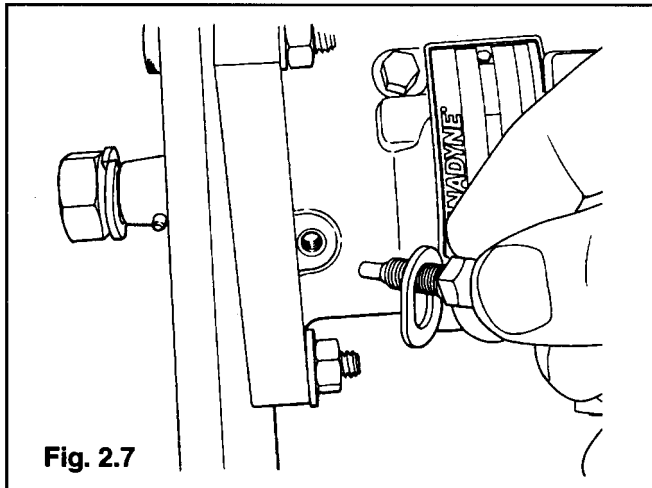
**STEP 5** Loosen and remove the electric shutoff solenoid locknuts, terminals, and washers from the solenoid terminal studs.



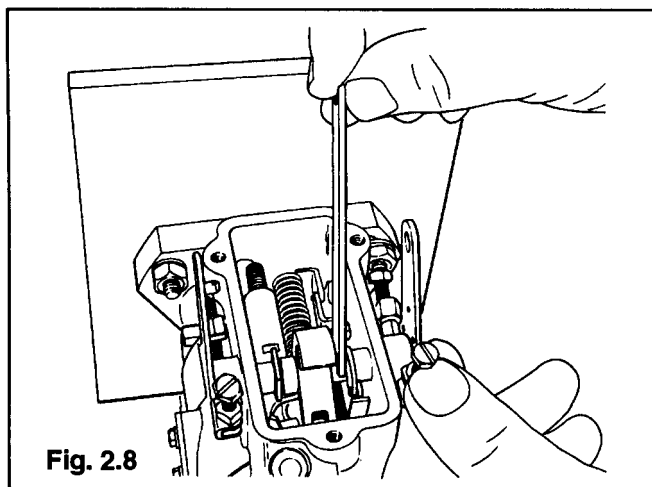
**STEP 6** Remove the electric shutoff solenoid from the cover. Remove the insulating tubes from the solenoid terminal studs and discard.



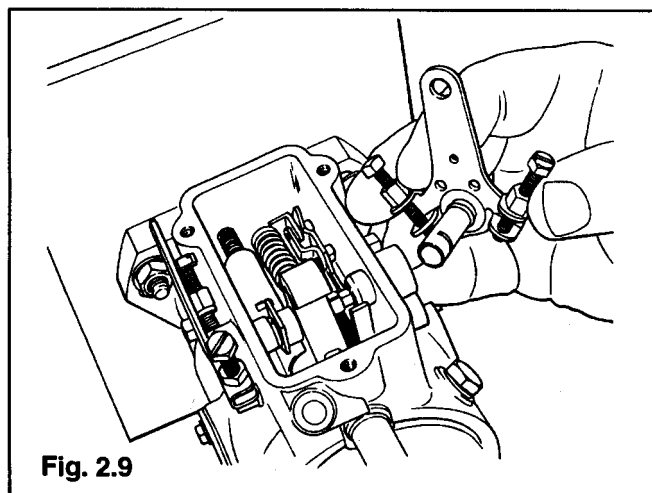
**STEP 7** Loosen and remove the drive shaft locking screw and key plate if so equipped.



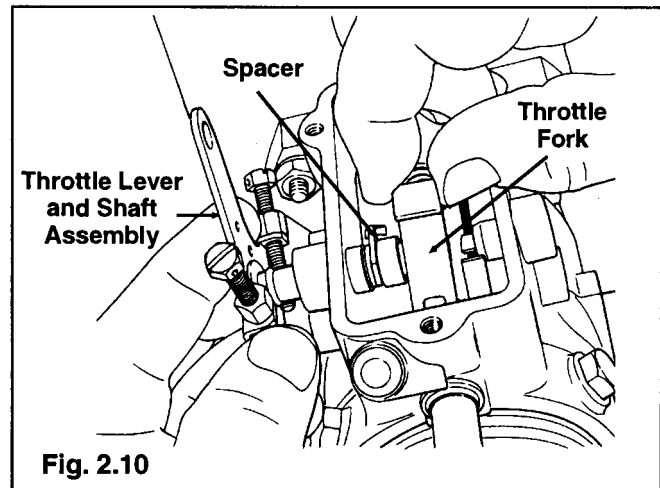
**STEP 8** Pry the shutoff cam and/or clip off of the throttle and shutoff shafts using tool 20992 and discard the cam or clip (Ref. Service Bulletin 157).



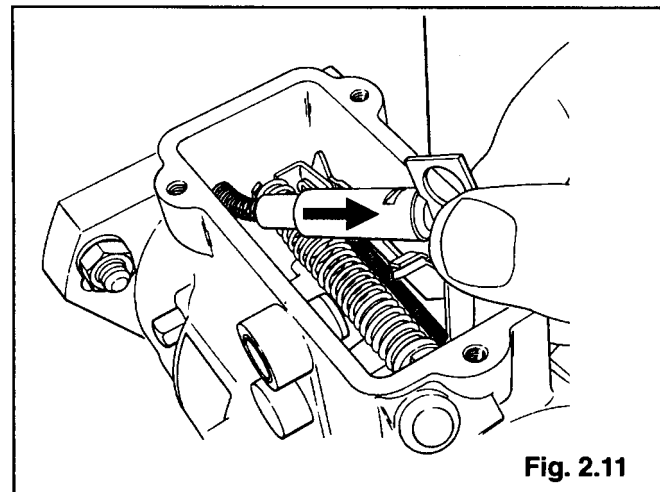
**STEP 9** Remove the shutoff shaft assembly. Remove the O-ring seal and spacer washer from the shaft and discard.



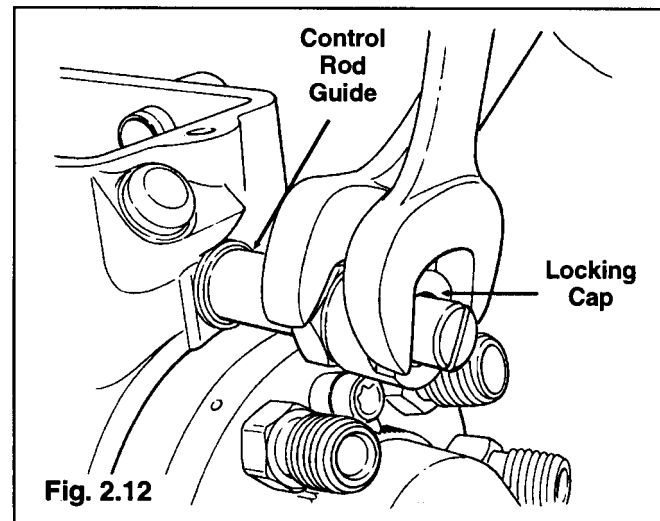
**STEP 10** Remove the throttle lever and shaft assembly and the throttle lever fork and spacer.



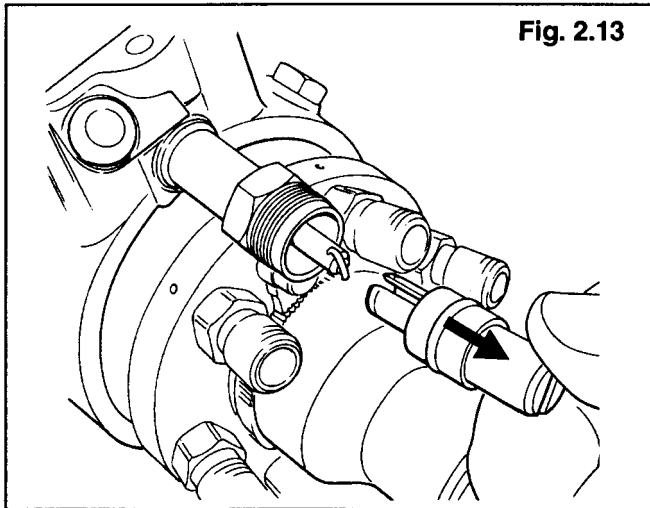
**STEP 11** If pump is equipped with a damper assembly, slide damper barrel off of damper piston.



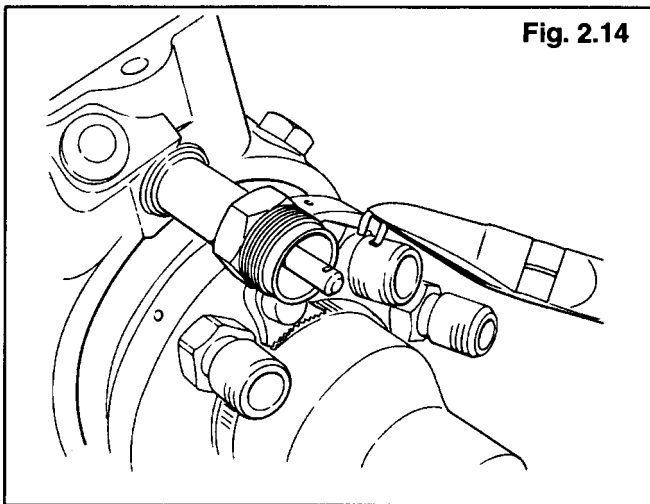
**STEP 12** While holding the control rod guide with a 5/8 inch wrench, use a 9/16 inch wrench to loosen and remove the droop control locking cap.



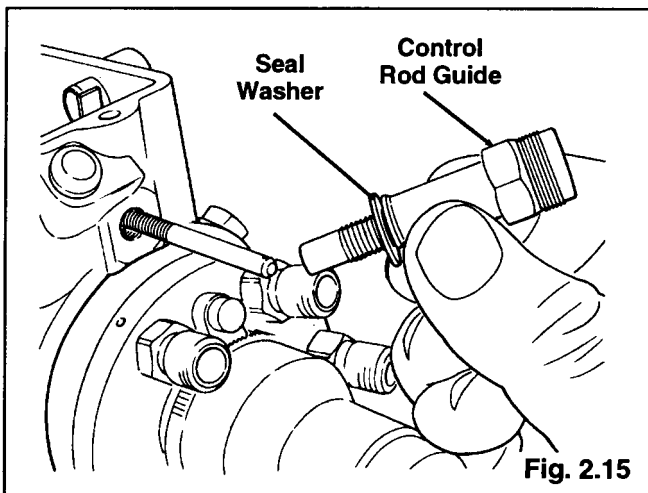
**STEP 13** Twist and pull to remove the slotted adjusting cap assembly. Remove the O-ring from the cap and discard.



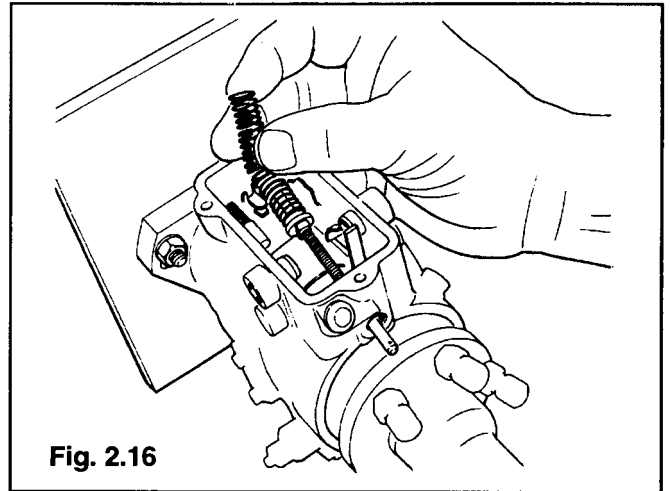
**STEP 14** Use diagonal cutting pliers to remove the control spring pin from the control rod.



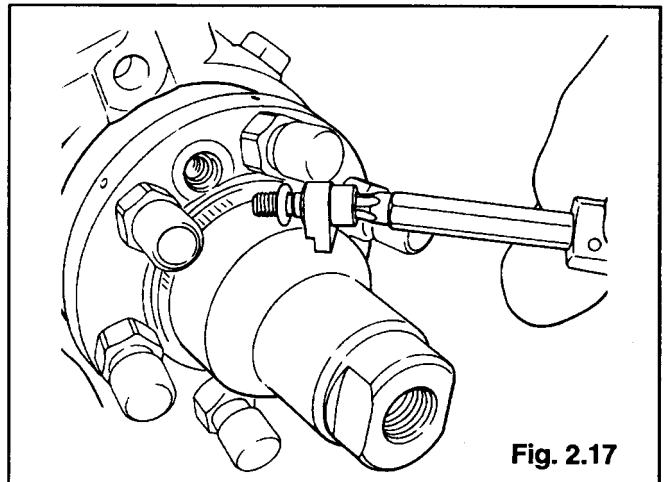
**STEP 15** Loosen and remove the control rod guide. Discard the seal washer.



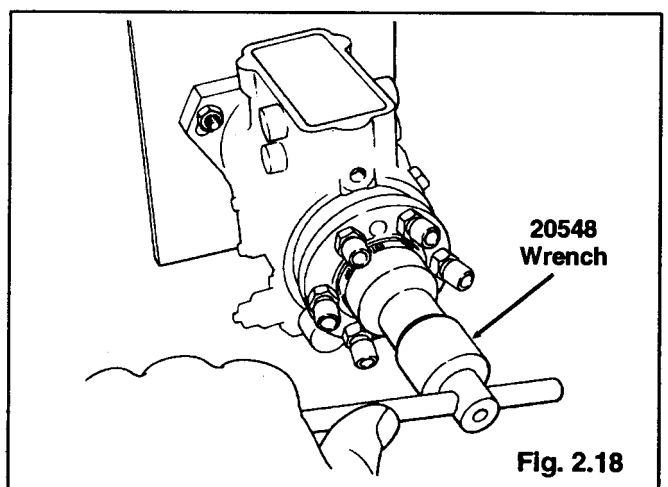
**STEP 16** Disengage governor spring from governor arm. Depress metering valve and remove control rod and spring assembly.



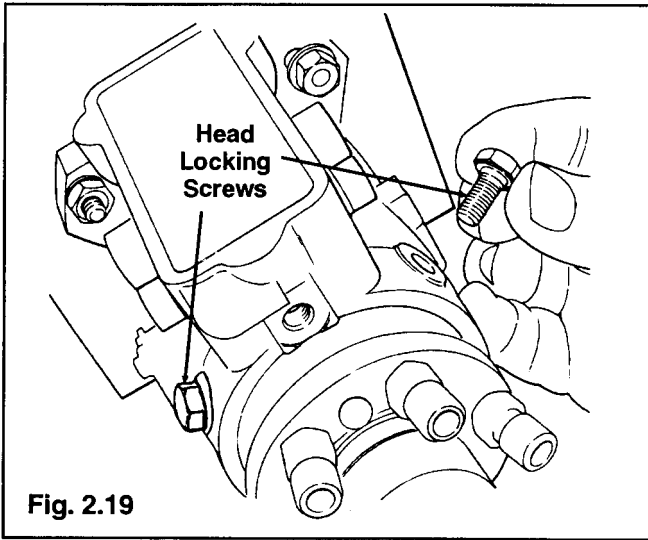
**STEP 17** Loosen and remove transfer pump end cap locking screw. Remove locking plate, screw and seal as an assembly. Discard seal.



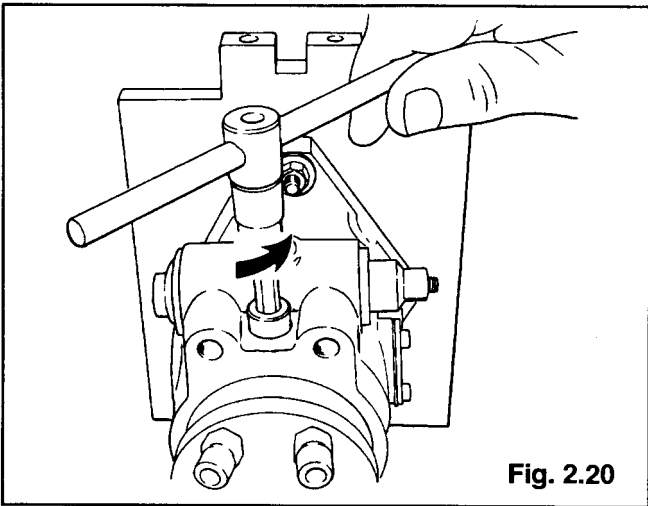
**STEP 18** Loosen but do not remove transfer pump end cap using 20548 tool.



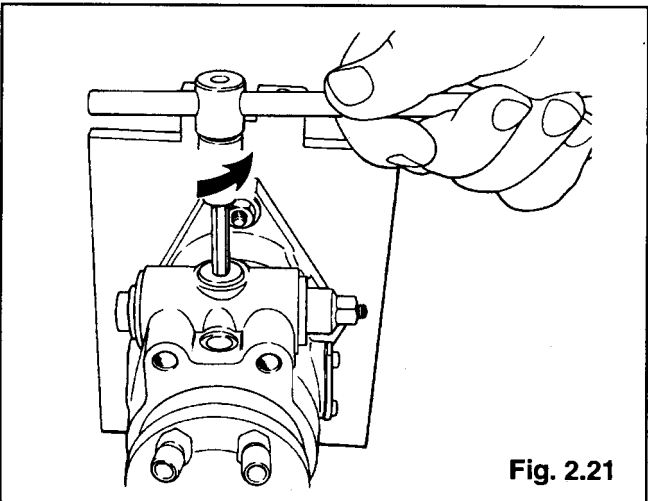
**STEP 19** Loosen and remove two head locking screws



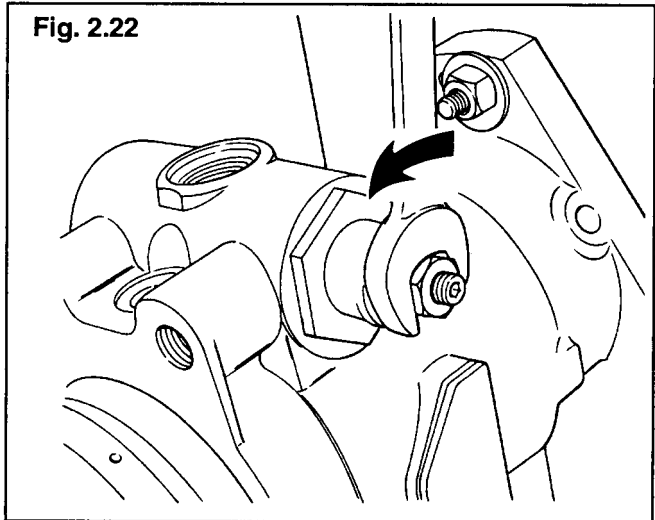
**STEP 20** Invert pump in vise and loosen and remove the head locating screw.



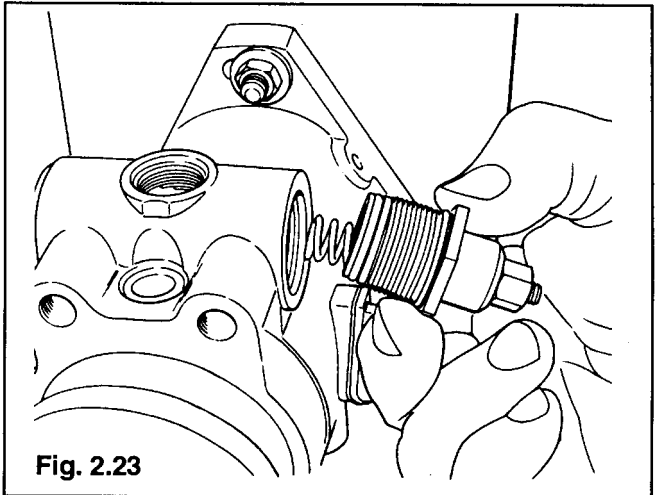
**STEP 21** Loosen and remove the cam pin hole plug. Remove and discard the seal.



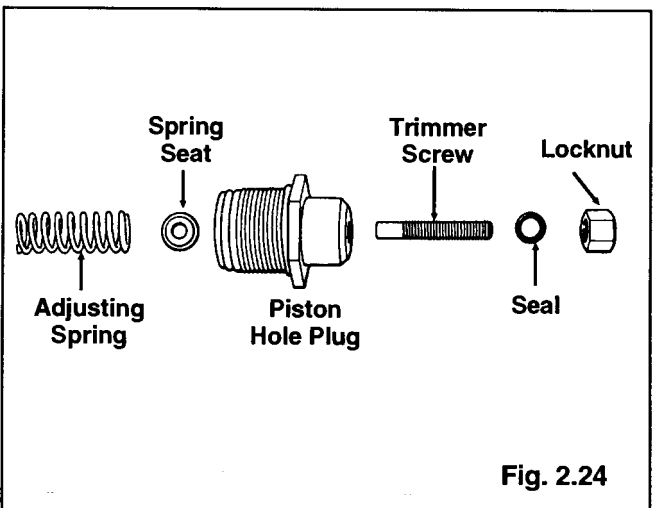
**STEP 22** Loosen trimmer screw locknut.



**STEP 23** Loosen and remove spring side advance plug assembly using wrench 14490.

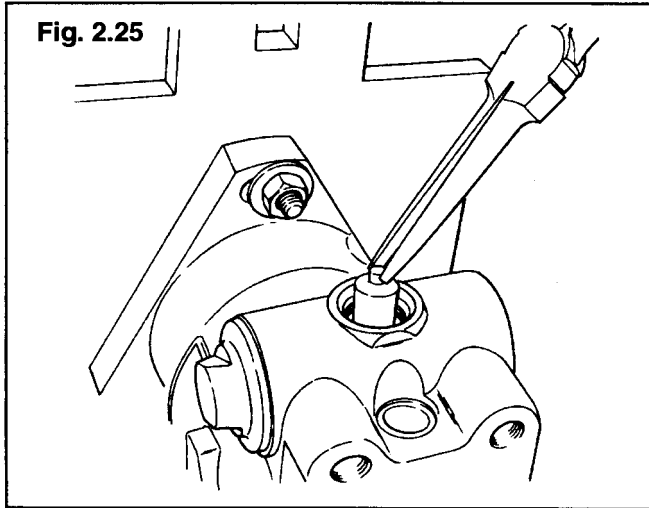


**STEP 24** Disassemble spring side advance plug assembly removing spring, spring seat, trimmer screw, seal and locknut. Discard seal.

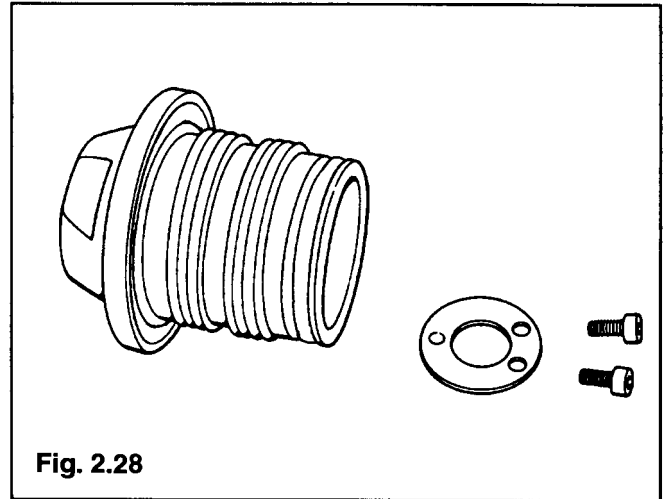




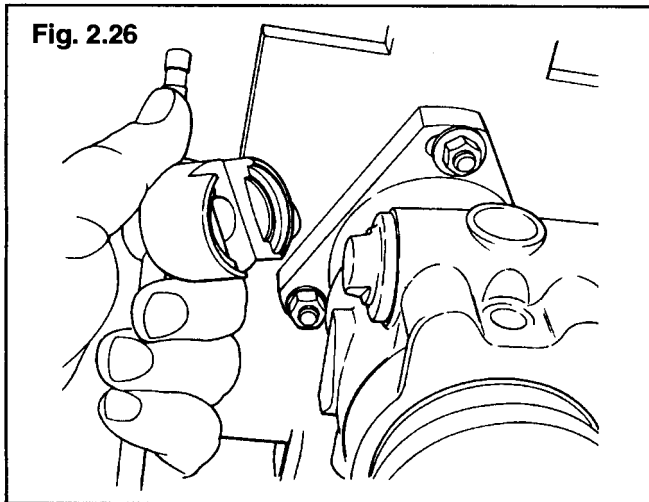
**STEP 25** Use needle nose pliers to remove the cam advance pin.



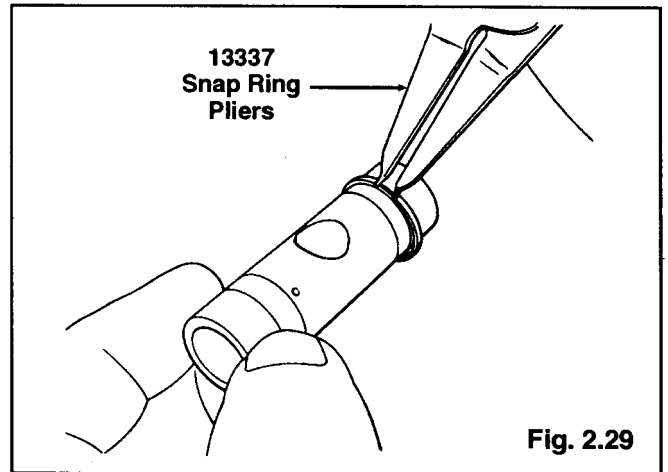
**STEP 28** Loosen and remove the 2 reed valve screws using a 5/64 inch hex wrench and remove the reed valve from the power side advance plug.



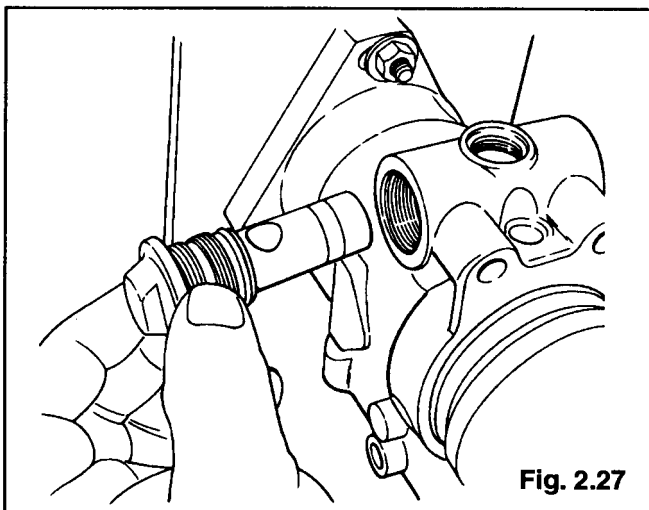
**STEP 26** Use advance socket 27760 to loosen the power side advance piston hole plug.



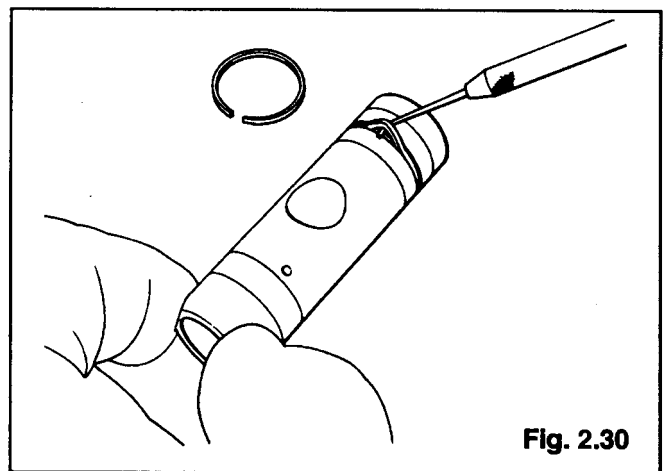
**STEP 29** Exercising care not to over-expand the ring, use 13337 snap ring pliers to remove the piston ring from the advance piston.



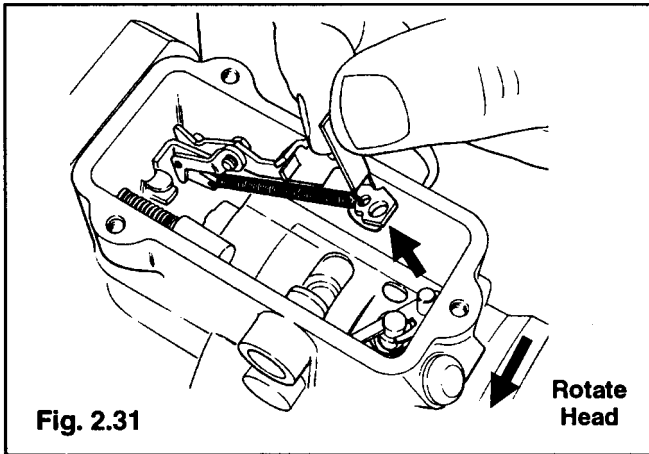
**STEP 27** Remove the power side advance piston hole plug and advance piston from the housing.



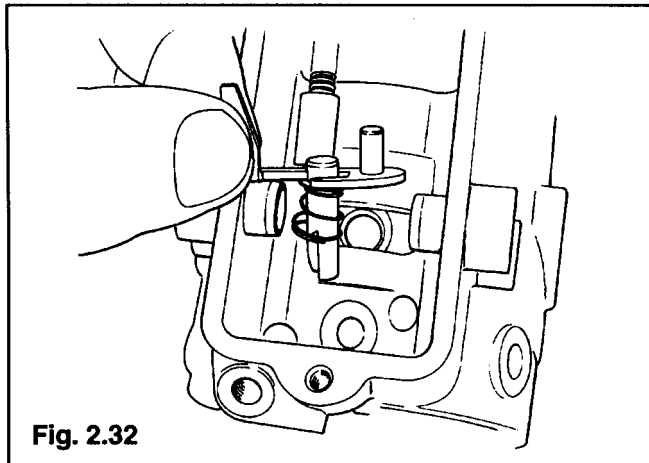
**STEP 30** Remove the square cross section seal from the groove in the advance piston using a dental pick or similar tool. Discard the seal.



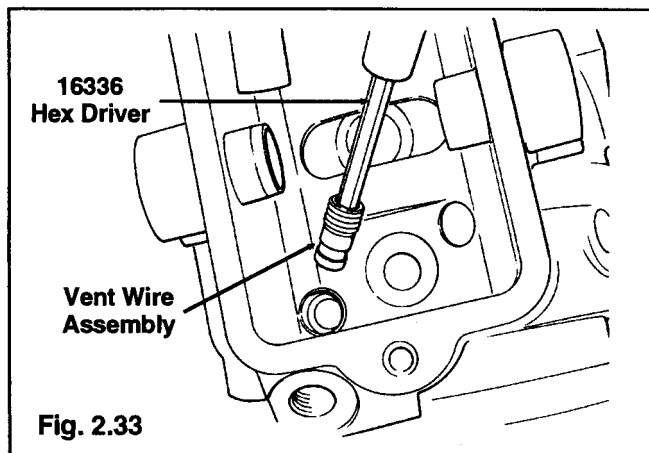
**STEP 31** Invert pump and holding fixture in vise. Rotate head and rotor counterclockwise in housing and lift linkage hook off metering valve arm. Disconnect linkage hook from governor arm and hang hook over side of housing.



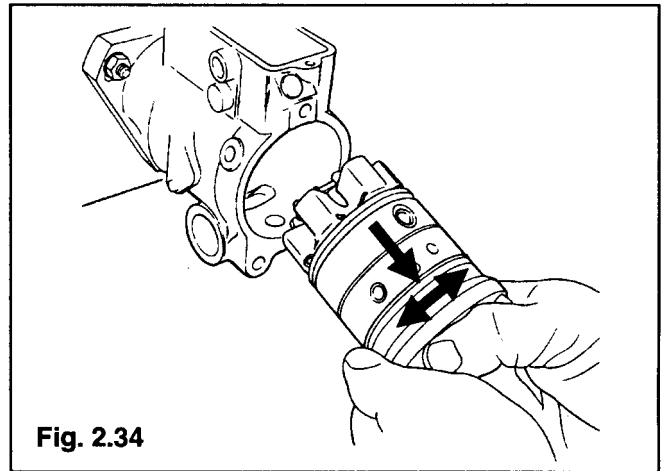
**STEP 32** Remove the metering valve and arm assembly, along with the metering valve spring and shim.



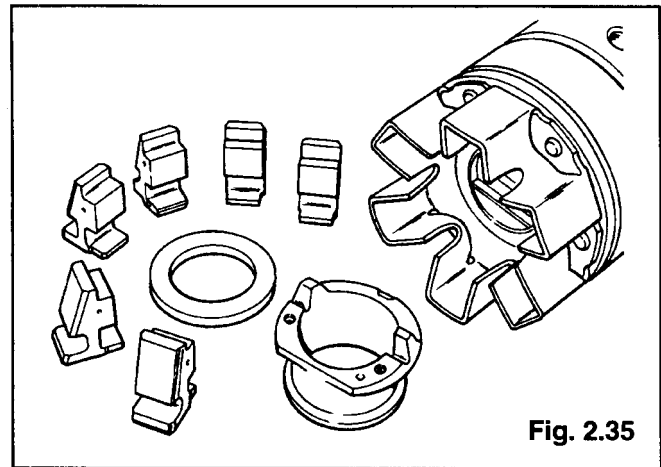
**STEP 33** Loosen and remove the vent wire assembly from the hydraulic head using 1/8 inch hex driver 16336.



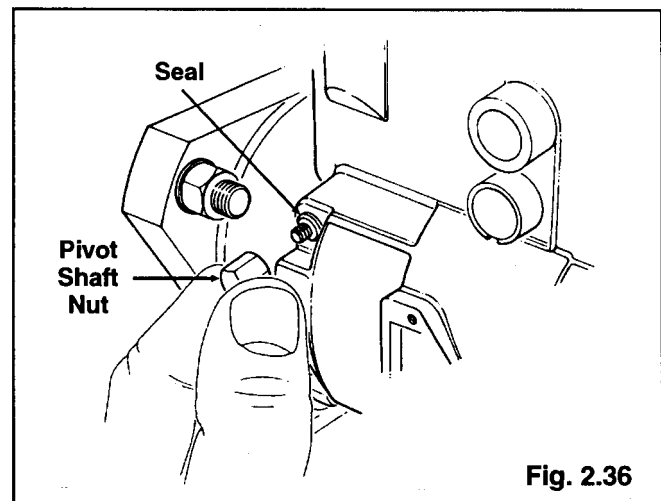
**STEP 34** Tilt the pump at an angle with the transfer pump end down and, using a twisting and pulling motion, remove the hydraulic head and rotor assembly.



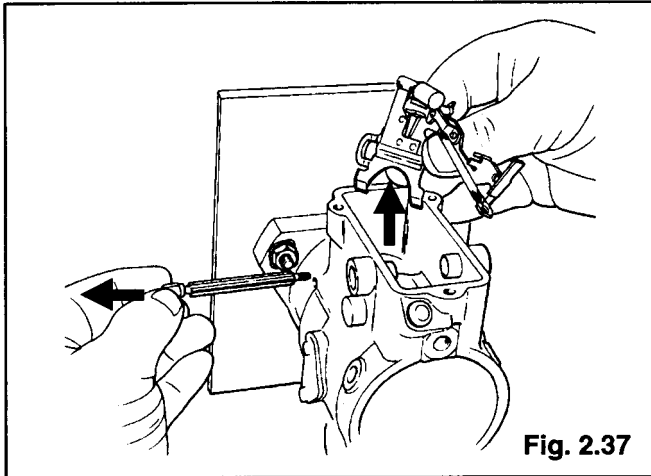
**STEP 35** Remove the governor thrust sleeve, thrust washer, and governor weights from the weight retainer assembly.



**STEP 36** Loosen and remove one pivot shaft nut and O-ring seal.

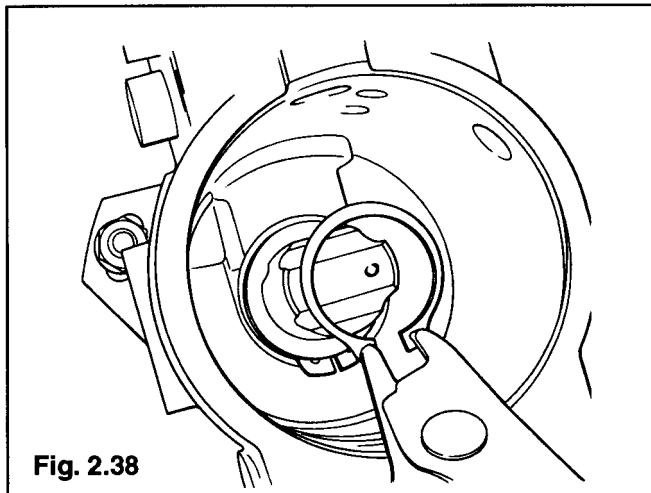


**STEP 37** Remove the pivot shaft, governor arm and linkage hook assembly.



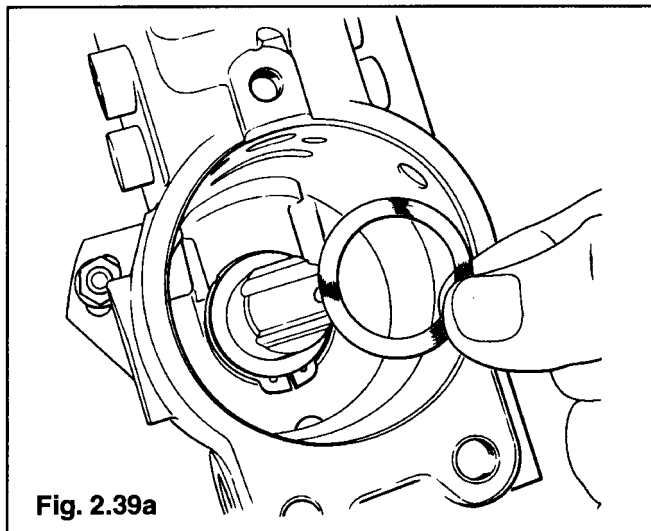
**Fig. 2.37**

**STEP 38** Remove drive shaft retaining ring using snap ring pliers 20044.

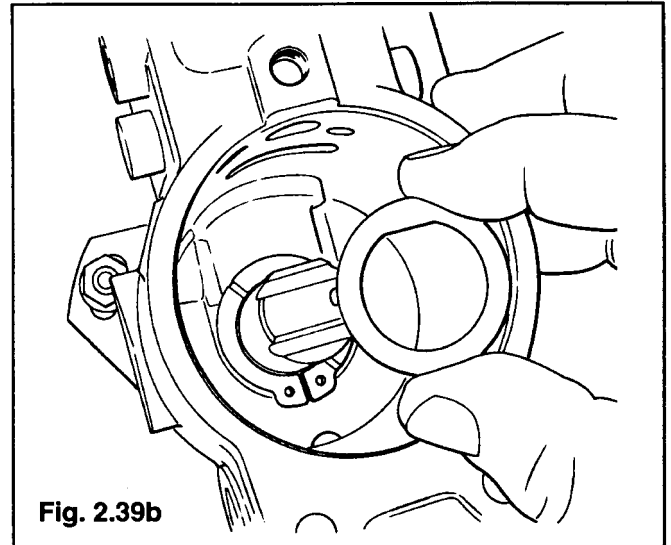


**Fig. 2.38**

**STEP 39** Remove drive shaft thrust spring and thrust washer as shown below in Figures 2.39a and 2.39b.

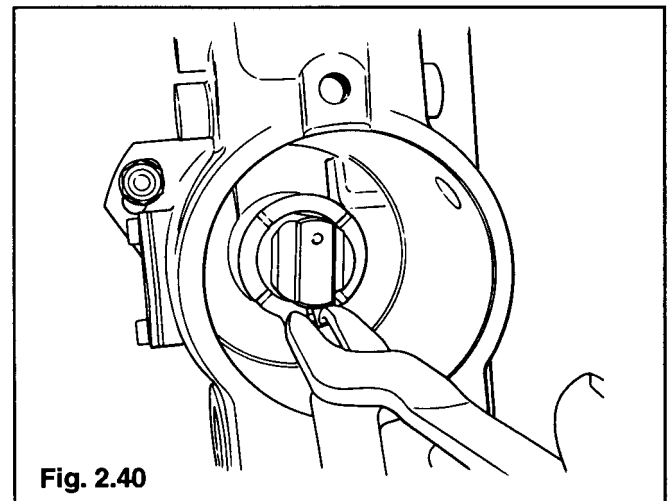


**Fig. 2.39a**



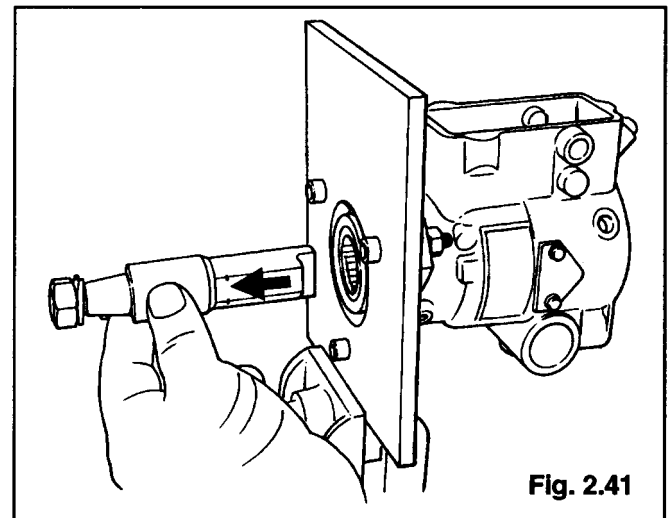
**Fig. 2.39b**

**STEP 40** Remove the thrust bearing from the housing using snap ring pliers 20043.



**Fig. 2.40**

**STEP 41** Remove the drive shaft from the housing by pulling it out from the drive end. Handle shaft with care so as not to damage area where seals ride.



**Fig. 2.41**

**STEP 42** Loosen and remove the two timing window retaining screws and remove the timing window cover and seal. Discard the seal.

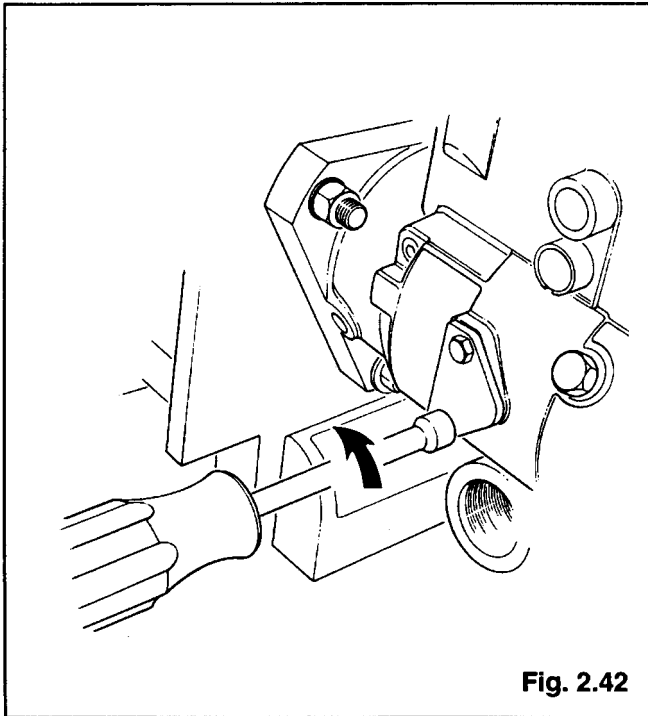


Fig. 2.42

**STEP 43** If not equipped with a torque screw, loosen and remove the torque screw hole plug. Discard the seal. If equipped with a torque screw, loosen the locknut and remove the torque screw, locknut and seal and discard the seal.

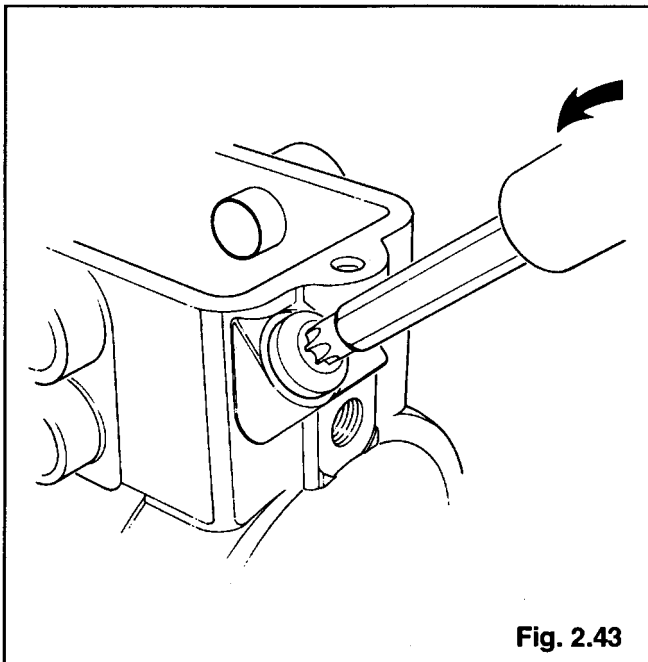


Fig. 2.43

**STEP 44** Position housing with flange facing upwards. Before removing drive shaft seals and bear-

ing be sure drive shaft locking screw has been removed if pump is so equipped. Prepare the 28311 bearing and seal puller as shown in Figure 2.44 by backing the outer nut off until flush with end of jacking screw. Also loosen inner nut until puller jaws are completely collapsed.

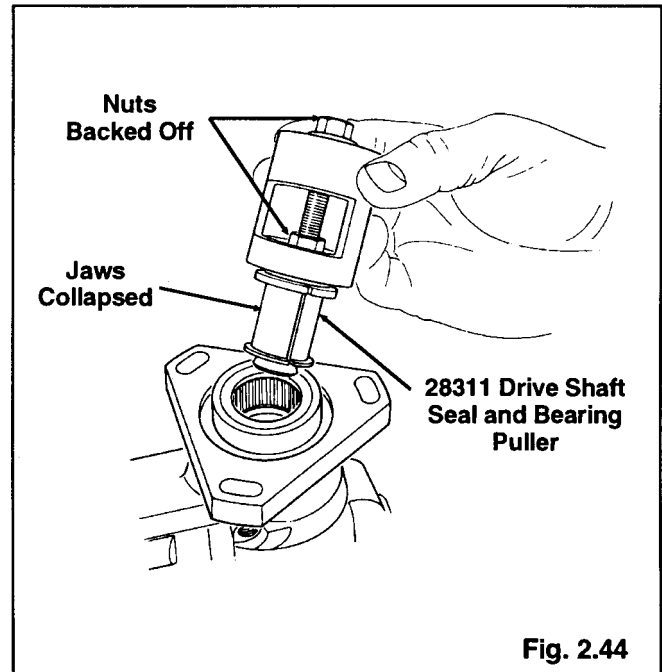


Fig. 2.44

**STEP 45** Lower puller jaws into drive shaft bore while positioning puller on housing centered over drive shaft bearing. Insert a 3/16 inch hex key into the jacking screw and place a 9/16 inch wrench on the inner nut to prevent it from turning. Back out the jacking screw to expand the jaws. Stop when the jaws contact the drive shaft seal casing - do not over tighten.

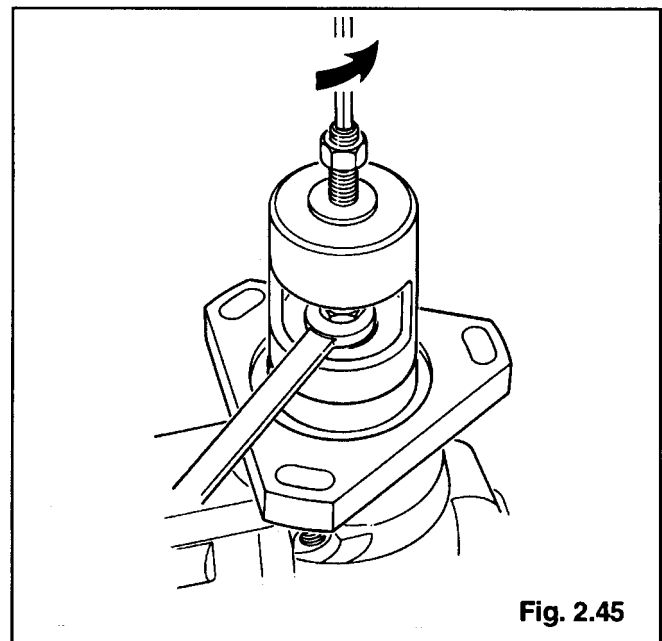


Fig. 2.45

**STEP 46** Remove the hex key and move the 9/16 inch wrench from the inner nut to the outer nut. Slowly tighten the outer nut to pull the two seals, the spacer (if used) and the drive shaft bearing from the housing.

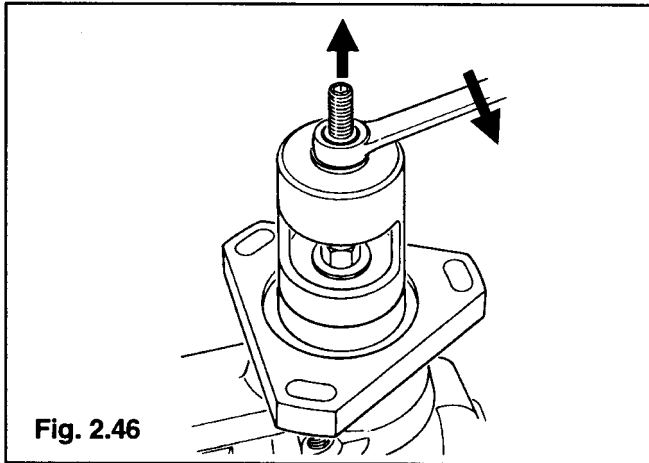


Fig. 2.46

**STEP 47** Loosen the outer and inner nuts to release the seals and bearing from the 28311 tool. Discard the seals and bearing. They should not be reused.

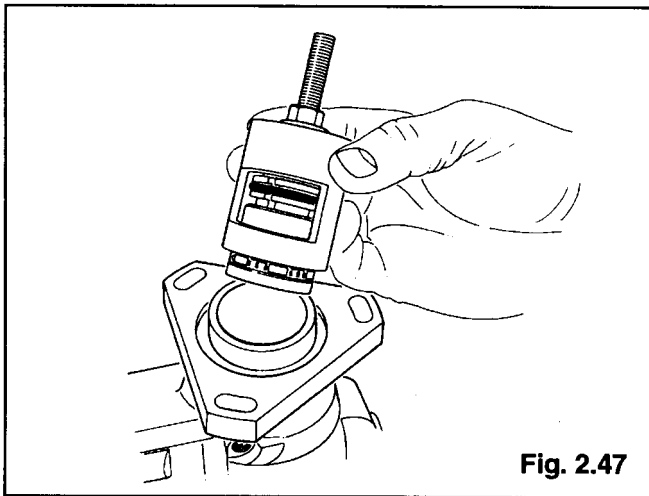


Fig. 2.47

**STEP 48** Remove the transfer pump end cap.

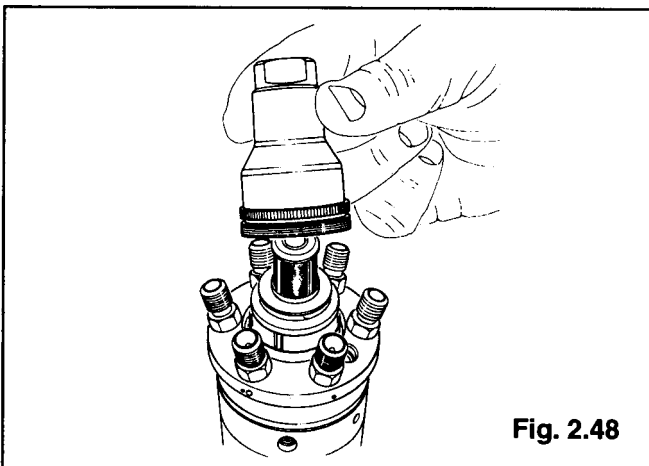


Fig. 2.48

**STEP 49** Lift the transfer pump regulator assembly off the hydraulic head assembly and remove the inlet filter screen from the regulator assembly (Reference Service Bulletin 444 for variations).

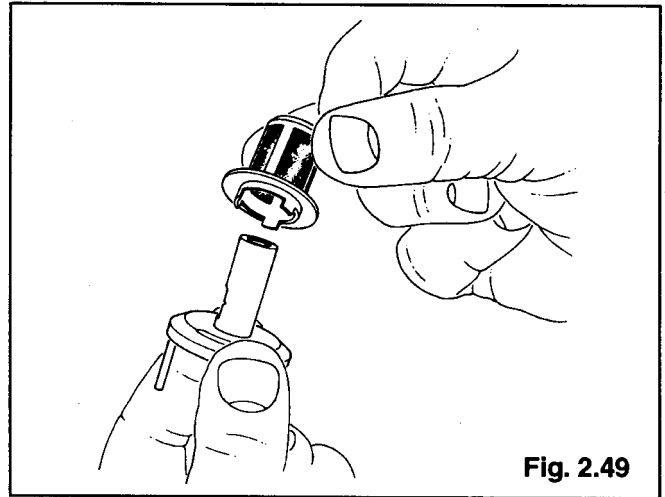


Fig. 2.49

**STEP 50** Loosen and remove the adjusting plug assembly using hex driver 13336.

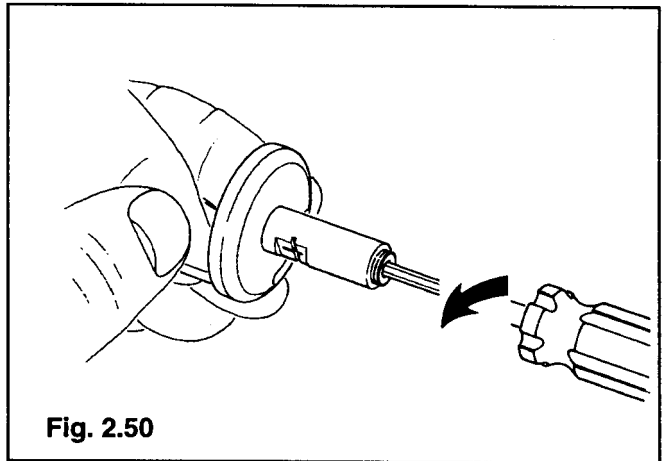


Fig. 2.50

**STEP 51** Remove the transfer pump regulating spring and piston.

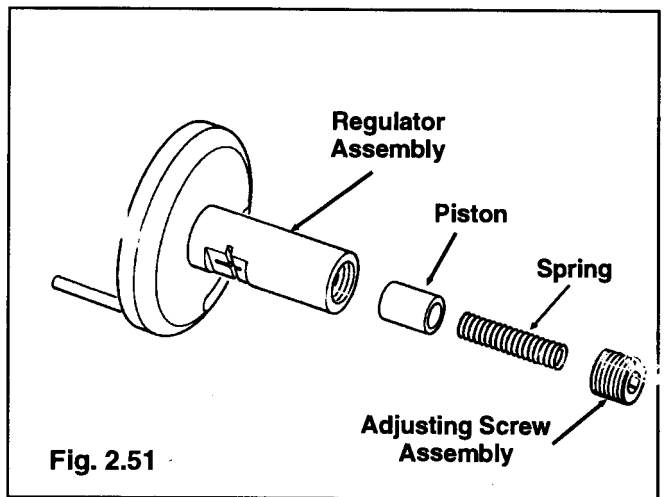


Fig. 2.51

**STEP 52** Use a dental tool or similar tool to remove the regulator sleeve seal. Discard the seal.

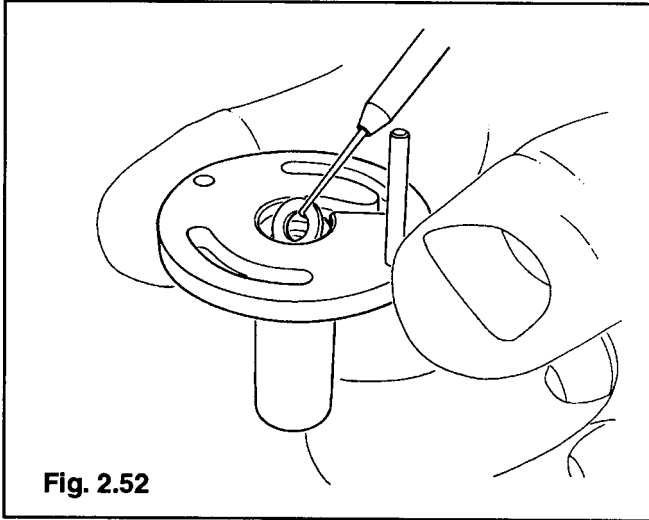


Fig. 2.52

**STEP 53** Remove the transfer pump liner and blades.

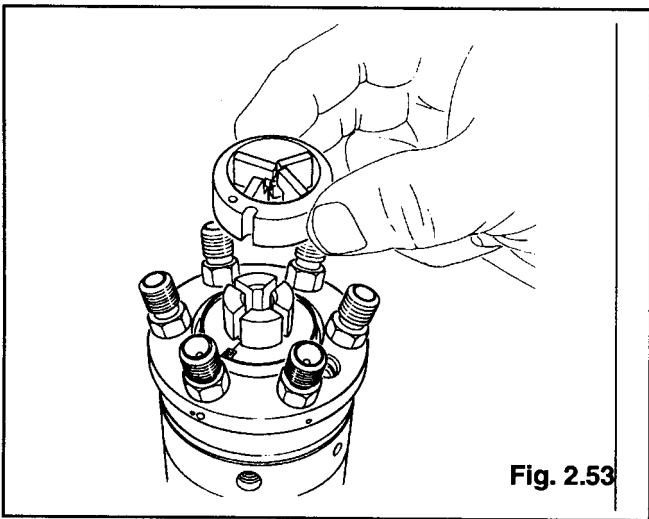


Fig. 2.53

**STEP 54** Lift off the liner locating ring.

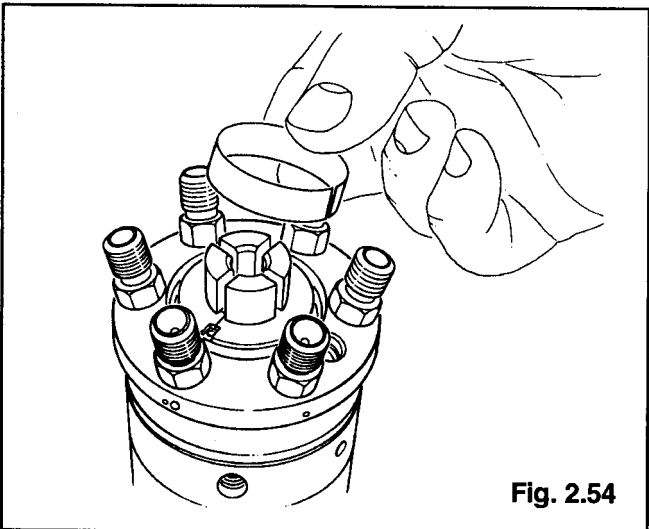


Fig. 2.54

**STEP 55** Remove the rotor retainers.

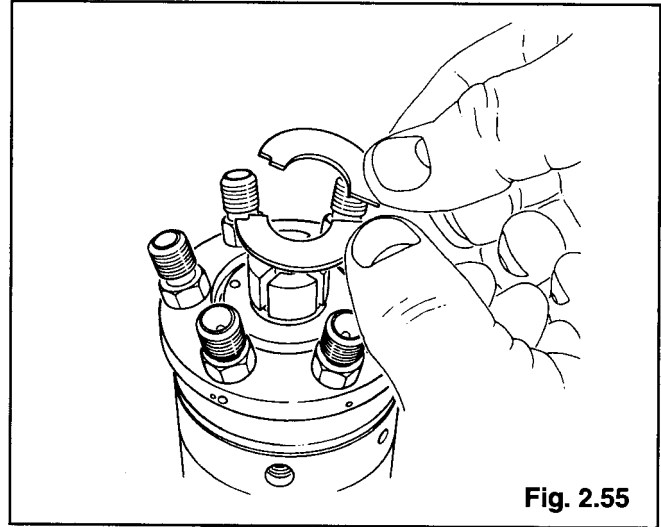


Fig. 2.55

**STEP 56** Remove the transfer pump end cap seal using a dental pick or similar tool.

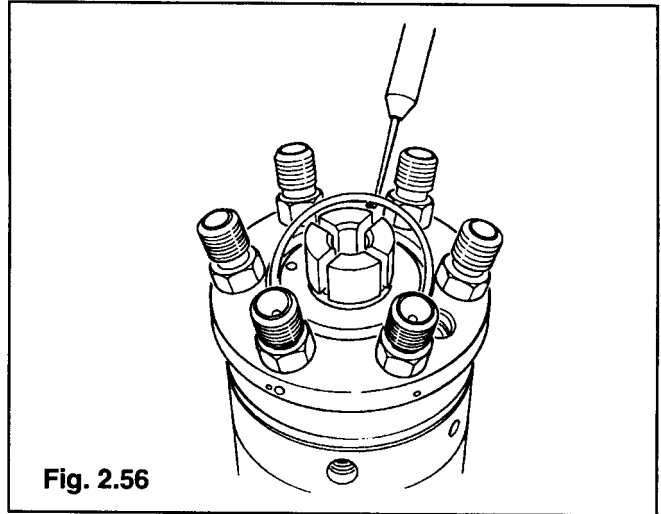


Fig. 2.56

**STEP 57** Carefully lift the hydraulic head assembly off the rotor.

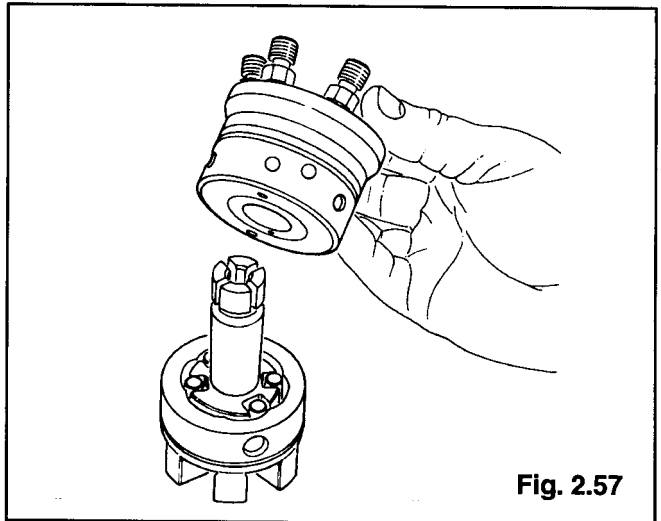
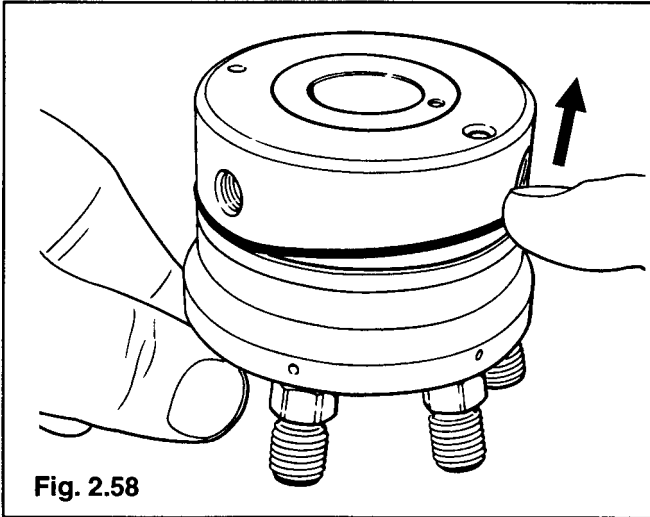
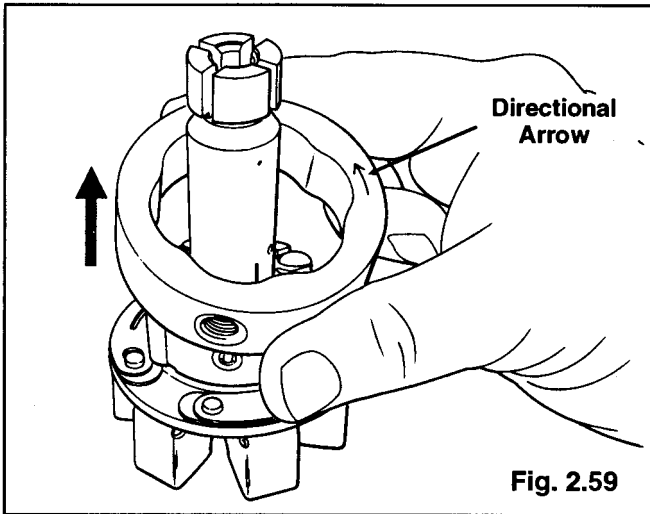


Fig. 2.57

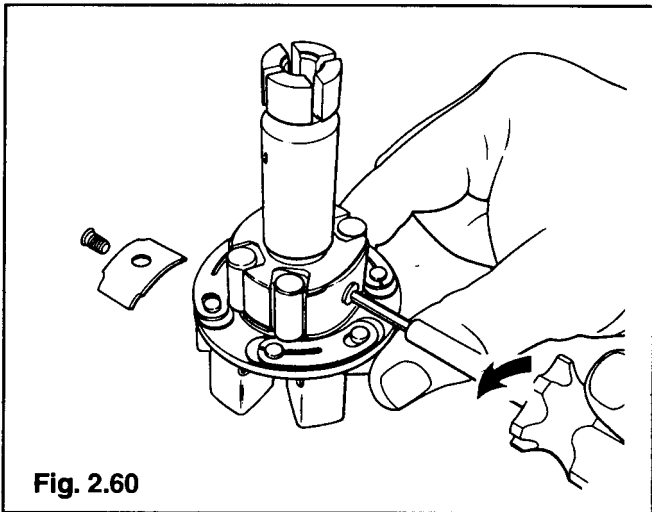
**STEP 58** Remove and discard the hydraulic head seal.



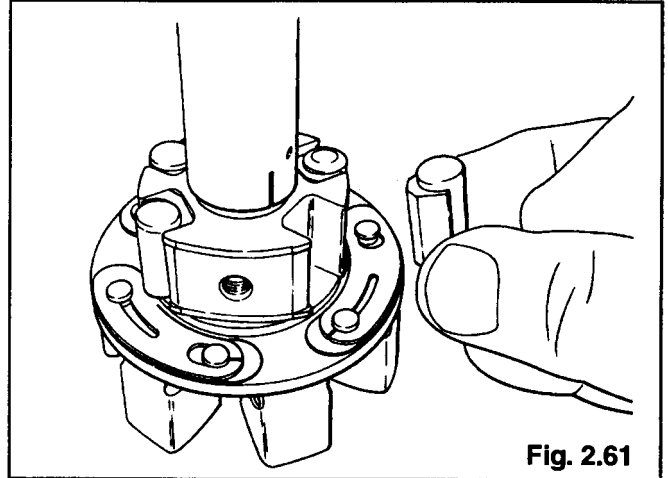
**STEP 59** Lift off the cam ring noting the directional arrow.



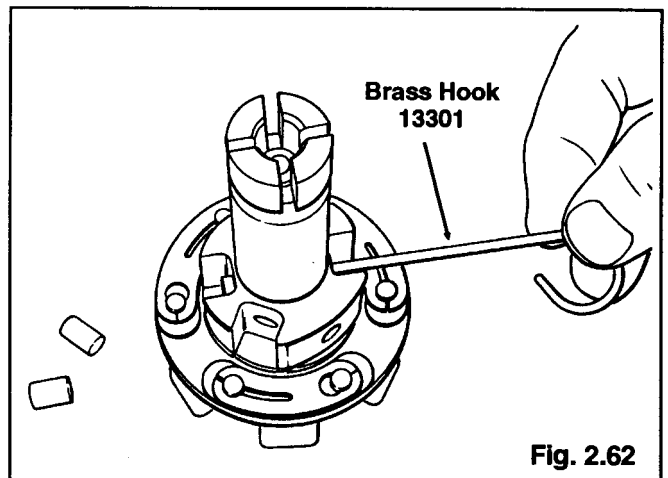
**STEP 60** Loosen and remove the leaf spring adjusting screws and remove the two leaf springs.



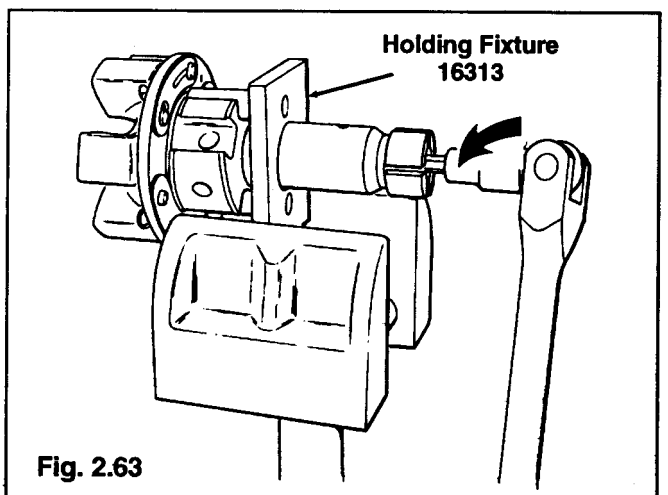
**STEP 61** Remove the four sets of shoes and rollers.



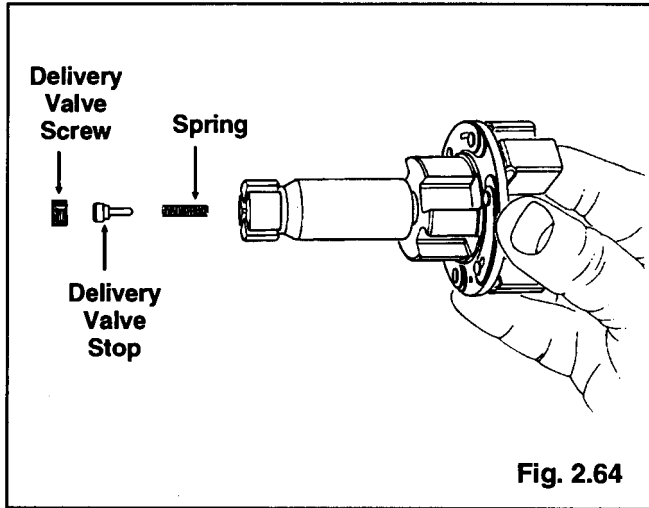
**STEP 62** Use brass hook 13301 (or equivalent) to push the four pumping plungers out of the rotor. Note the orientation of the short versus the long plungers.



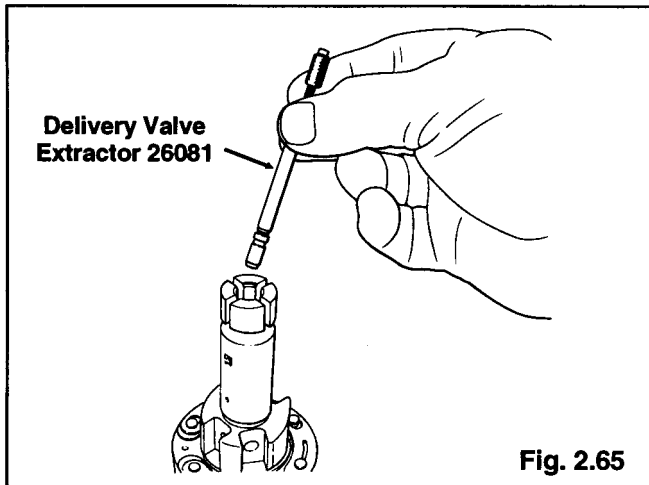
**STEP 63** Install rotor into 16313 fixture and clamp in vise. Loosen and remove delivery valve stop screw using a 3/16 inch hex key.



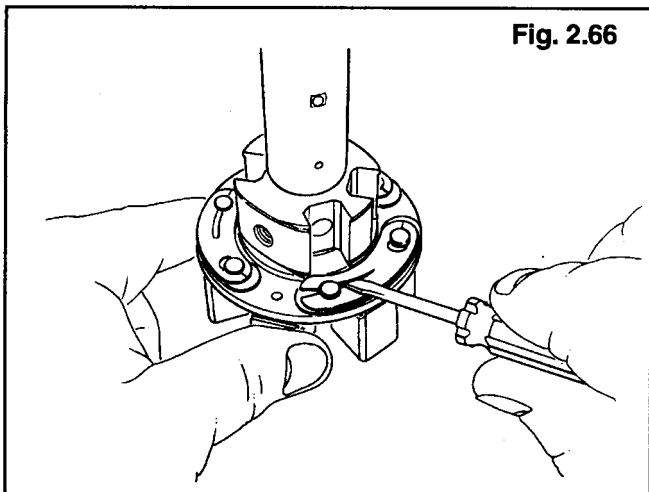
**STEP 64** Remove the delivery valve stop and discard and remove the delivery valve spring.



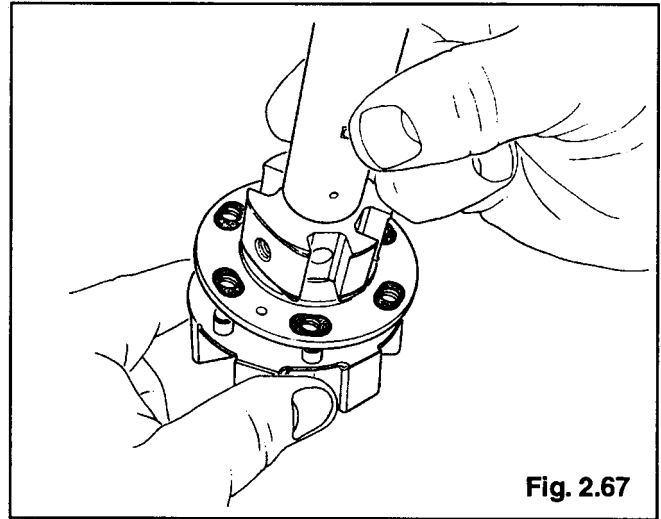
**STEP 65** Use delivery valve extractor 26081 to remove the delivery valve from its bore.



**STEP 66** Pry the weight retainer retaining clips off of the pins using a small screwdriver (Ref. Service Bulletin 370) and discard. Remove the three cushion retainers from the pins.



**STEP 67** Lift the rotor and hub assembly off the weight retainer pins. Remove the six rubber cushions from the hub and discard.





## SECTION 3 - CLEANING AND PARTS INSPECTION

### A. General

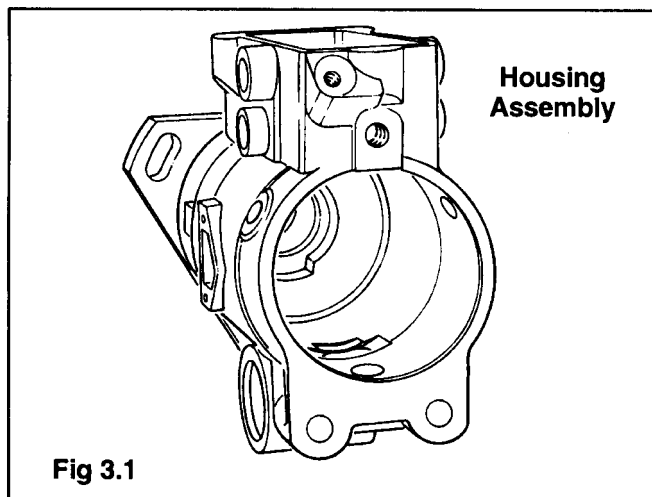
Once disassembled, the DB4 pump components must be cleaned and inspected prior to reassembly. All seals should now be discarded and most parts may be cleaned using standard cleaning processes and solvents, blown dry with clean, filtered compressed air, and dipped in clean calibrating fluid to prevent corrosion.

Electrical components such as the Electric Shutoff Solenoid should be wiped off with a clean cloth and put aside. Similarly, components containing non-serviceable rubber components such as an Aneroid (Ref. Service Bulletin 225) should also be wiped clean and put aside. Such components should never be submerged in harsh cleaning solvents.

### B. Component Inspection

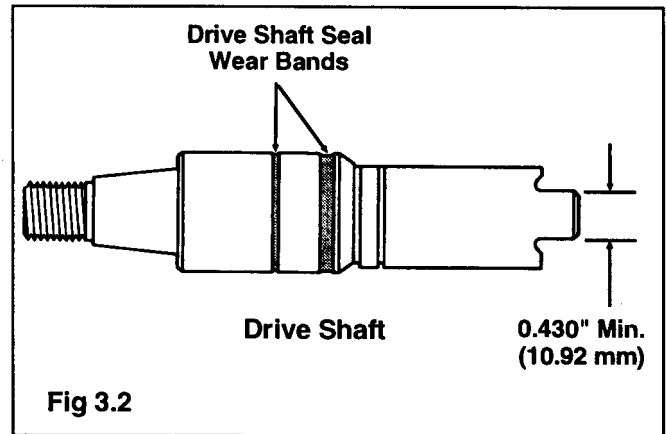
Each component should be examined for excessive wear, scoring, fretting, corrosion, distortion, cracks or breakage. Replace all damaged or excessively worn parts as necessary with genuine Stanadyne replacement parts. The illustrations included in this section depict typical locations where component wear might be observed in DB4 pumps. *NOTE: Damage and wear is not limited to these areas nor is the wear shown meant to indicate that these parts always require replacement. The appearance of a part is but one measure of whether the part needs to be replaced. Another, more important measure is whether the pump can be calibrated to specification on the test bench.*

**1. Housing** - Inspect the housing for cracks or signs of damage. Check threaded holes for damage. Inspect the inside of the housing where the hydraulic head seal contacts. Also examine the

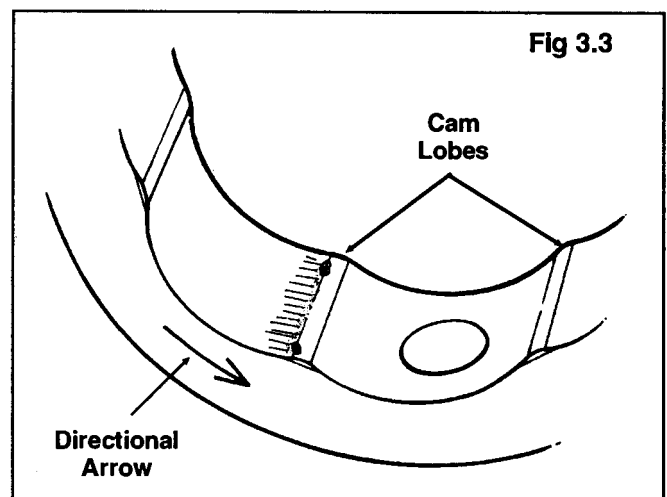


thrust bearing counterbore and the area where the cam ring rides. If the pump is equipped with a servo advance, examine the advance bore for excessive wear and see Service Bulletin 393 for advance bore salvage procedures and available piston sizes.

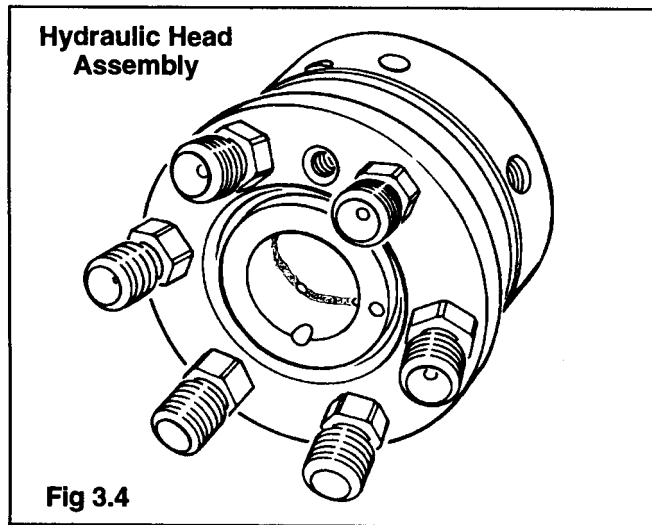
**2. Drive Shaft** - Handle the drive shaft as you would a distributor rotor to prevent damage or corrosion. Inspect the threads and taper for damage plus the drive tang for wear. Inspect the area where the drive shaft seals ride for nicks or scratches. Wear bands caused by the drive shaft seals are normal and should not be cause for drive shaft replacement (Ref. Service Bulletin 438A).



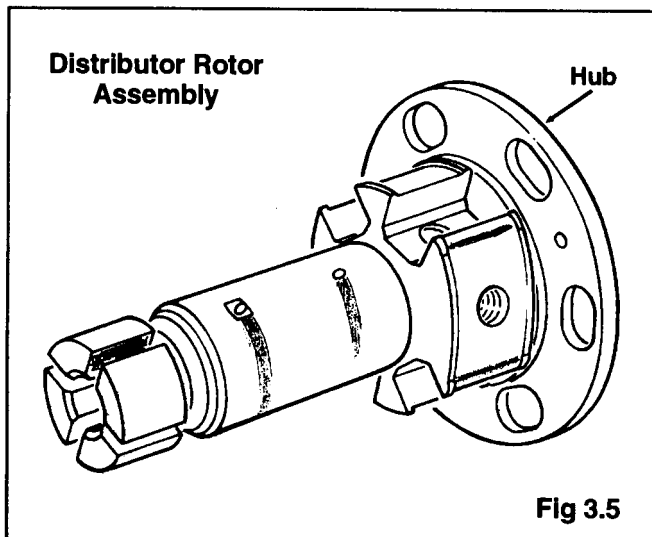
**3. Cam Ring** - The pumping portion of each lobe is the working portion of the cam ring. Observe the directional arrow to determine which side of the lobe is the pumping ramp. Service Bulletin 420 contains guidelines for acceptable or unacceptable types of lobe damage. Tool marks or unfinished areas on the inside diameter other than on the pumping ramps themselves are considered normal. Cam rings often have a mottled appearance from the heat treatment process, this is also considered normal.



**4. Hydraulic Head Assembly** - Examine the metering valve bore and the threaded holes for damage. Also examine the rotor bore for wear bands in line with the charging ports and/or the discharge ports which could indicate that dirty fuel was used. Inspect the discharge fittings for damage to the area where the injection lines seat or to the threads. If unserviceable, one fitting at a time can be replaced as outlined in Service Bulletin 294 but replacement should be avoided if possible so as not to risk rotor bore distortion which could render the head and rotor assembly unserviceable. Check the threaded hydraulic head plugs to ensure they are tight.

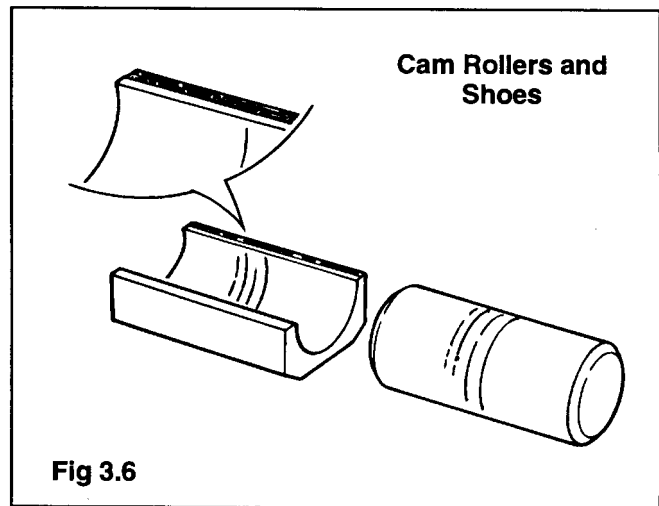


**5. Distributor Rotor Assembly** - The working areas of the distributor rotor include the transfer pump blade slots, the discharge and charging ports, the plunger bores, the leaf spring contact area and the drive slot. These areas should be examined for wear, erosion or damage. The flat delivery valve seat in the rotor bore should also be

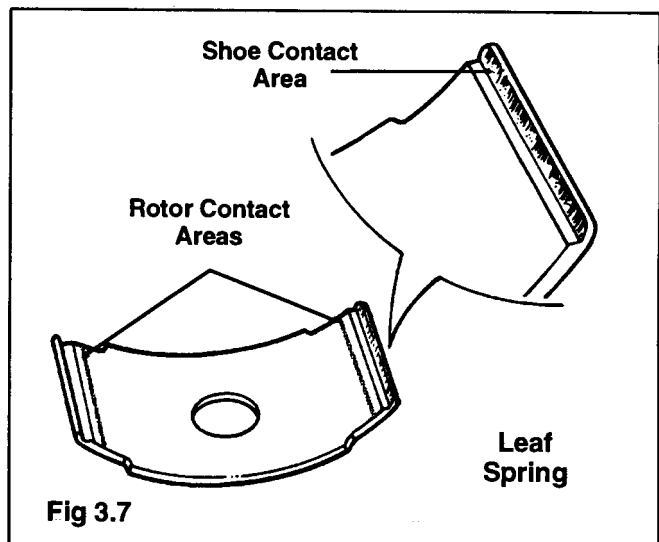


examined for chipping, erosion or damage. If necessary stop seat leakage may be checked as outlined in Service Bulletin 143B and the seat may be re-dressed using stop seat refinishing tool 32129. Also check to see that the governor weight retainer hub is secure on the rotor. If hub is loose, Head and Rotor Assembly must be replaced.

**6. Shoes and Rollers** - Inspect the edge of the shoe that has been in contact with the leaf spring for excessive wear or damage. Refer to Service Bulletin 332 for information on various shoe sizes and usage. Shoes with sides of equal height may be reversed in the shoe slot to expose the unused surface to the leaf spring. Inspect the inside of the shoe where the roller rides and the outside diameter of the roller for scoring. Be sure the rollers are a close fit in the shoes.

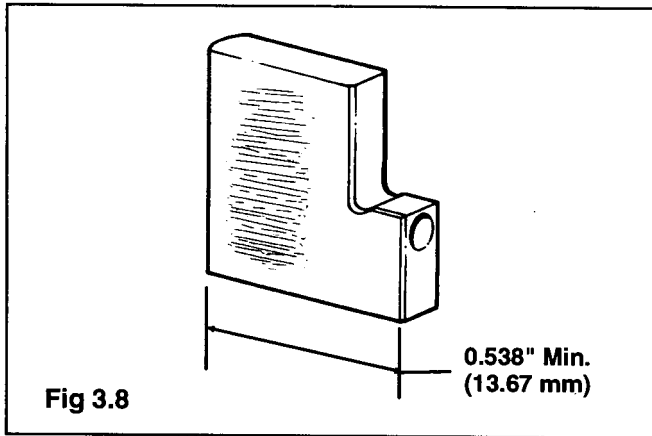


**7. Leaf Springs** - Examine the surface of the leaf spring which contact the cam roller shoes. Also inspect the area on the underside of the leaf spring which contacts the rotor. Pitting or excessive fret-

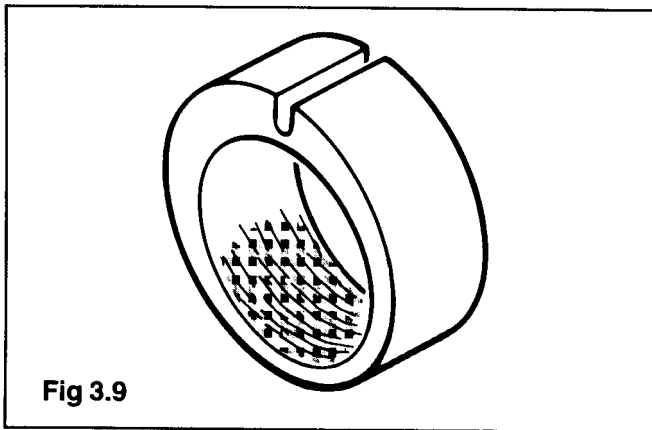


ting in this area would be cause for leaf spring replacement. Refer to Service Bulletins 332 and 464 for additional 4-plunger pump leaf spring information.

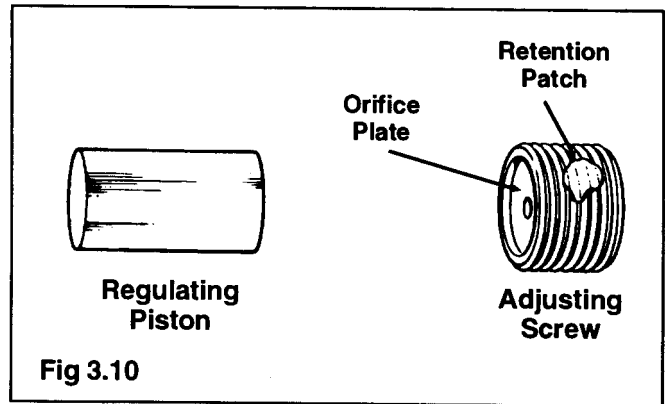
**8. Transfer Pump Blades** - Inspect the edge of the blade which rides on the inside of the transfer pump liner for excessive wear and scoring. A minimum allowable thickness is provided in Figure 3.8. Also examine the sides of the blades for wear from contact with the blade slots. Refer to Service Bulletins 304 and 125 for more information on transfer pump blades.



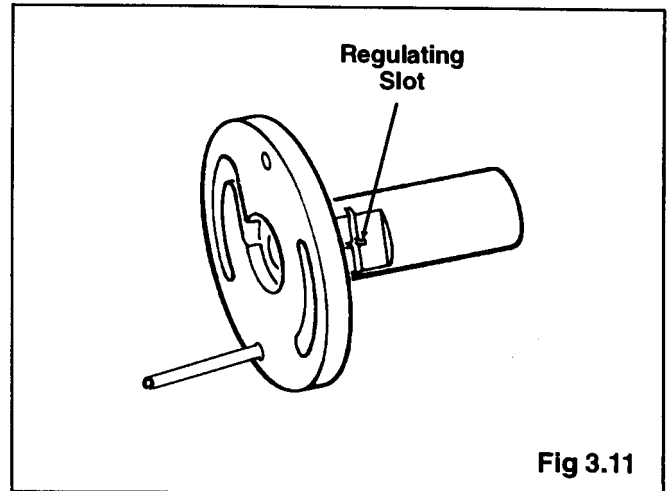
**9. Transfer Pump Liner** - Examine the inside diameter of the liner for scoring or excessive wear. Refer to Service Bulletin 125 for alternate liner part numbers for low viscosity or low lubricity fuel use.



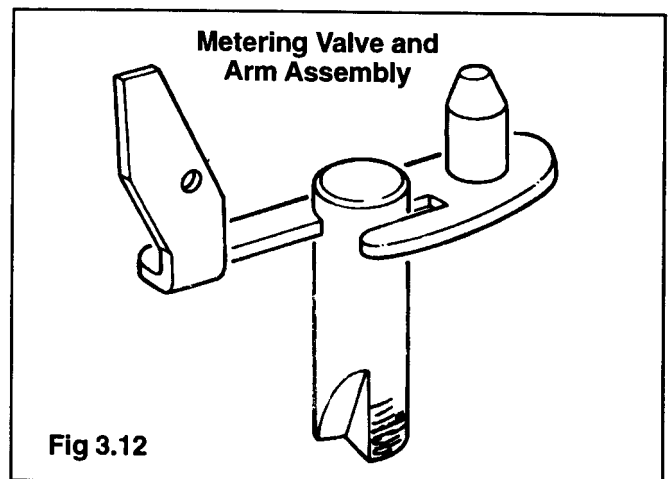
**10. Transfer Pump Regulating Piston and Adjusting Screw** - (Fig. 3.10) Inspect the adjusting screw to be sure the orifice is not plugged and the orifice plate is secure in the screw. If the retention patch does not offer enough resistance to turning when the screw is threaded in an out of the regulator, replace the screw. The regulating piston should be replaced if excessive scoring or wear are present on the outside diameter.



**11. Transfer Pump Regulator Assembly** - Examine the face of the regulator where the transfer pump blades ride. If light wear is present, the face may be lapped with fine grit lapping compound. Also examine the regulating piston bore and transfer pressure regulating slot for wear or damage. Replace the regulator locating pin if bent or broken.

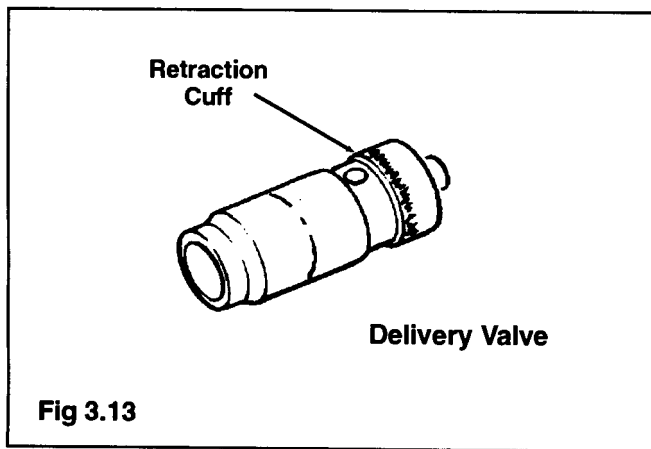


**12. Metering Valve and Arm Assembly** - Inspect the metering valve arm to be sure the pin on which the linkage hook rides is tightly mounted to the arm. Also check to see that the valve is securely attached to the arm. Examine the valve for excessive



scoring. The appearance of the valve is not, however, the best criteria to determine whether a particular valve requires replacement. Rather, it is the pump's ability to pass the test specifications - and in particular the shutoff requirements - that should be your guide as to whether a particular valve needs replacing. See Service Bulletin 336 for additional information on metering valves.

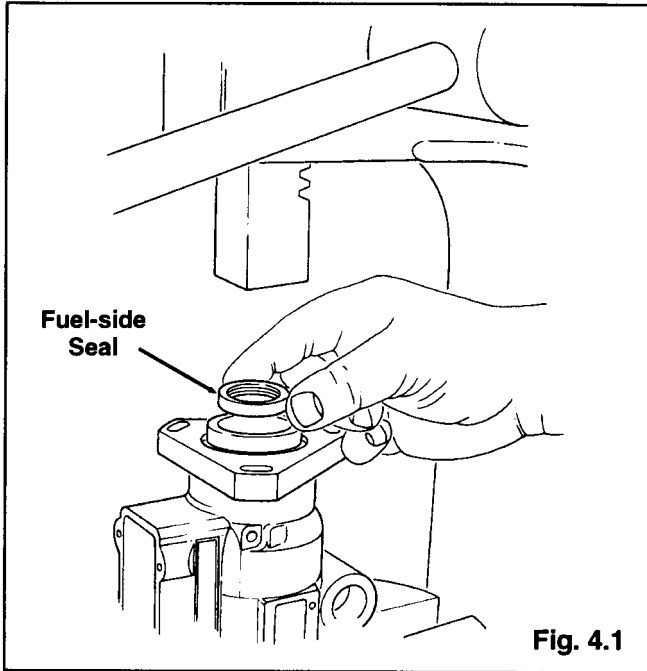
**13. Delivery Valve** - Inspect the cuff area of the delivery valve for excessive scratching or scoring. Also look for a wear band around the center of the valve which, if excessive, could be cause for replacement. Also check the valve for the correct retraction value. Service Bulletin 143B contains additional information on delivery valve identification.



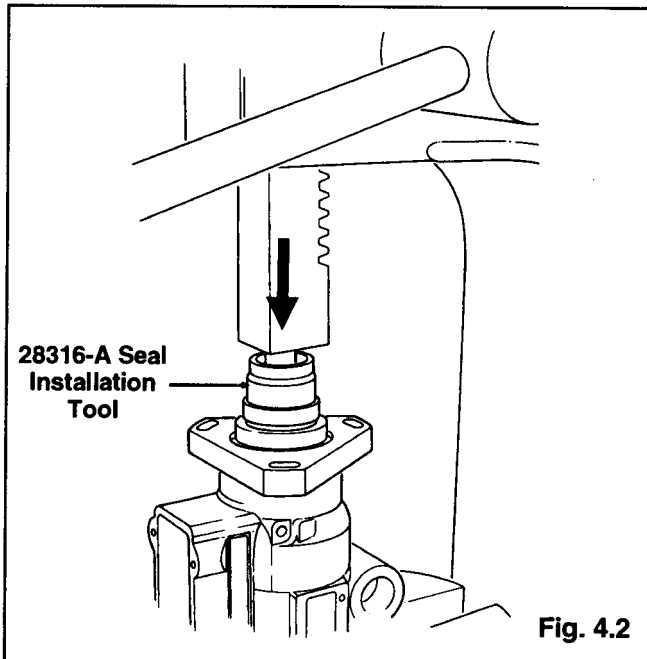
**Fig 3.13**

## SECTION 4 - REASSEMBLY

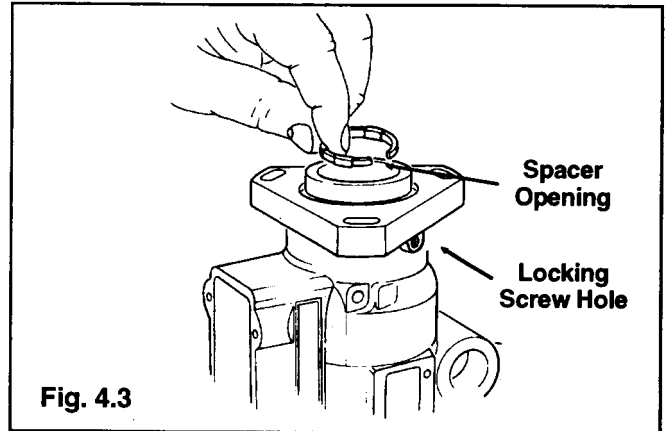
**STEP 1** Place housing, flange facing up on arbor press. Make sure housing is resting flatly. Drop fuel-side seal (blue) into the housing bore with seal lip facing downwards. **IMPORTANT: Do not use any lubricants on the fuel-side seal when pressing it in.**



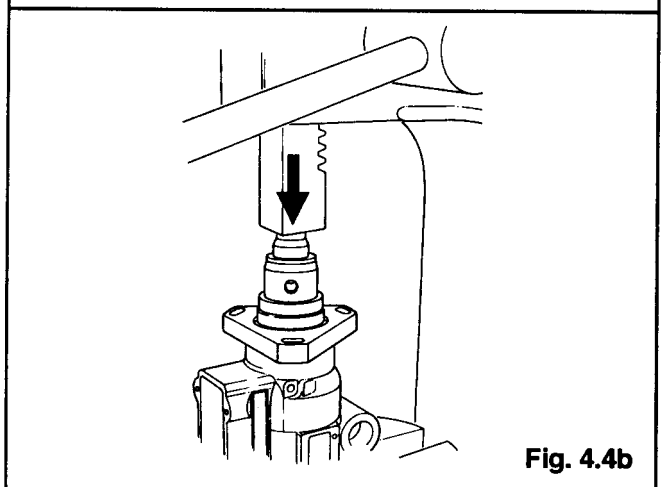
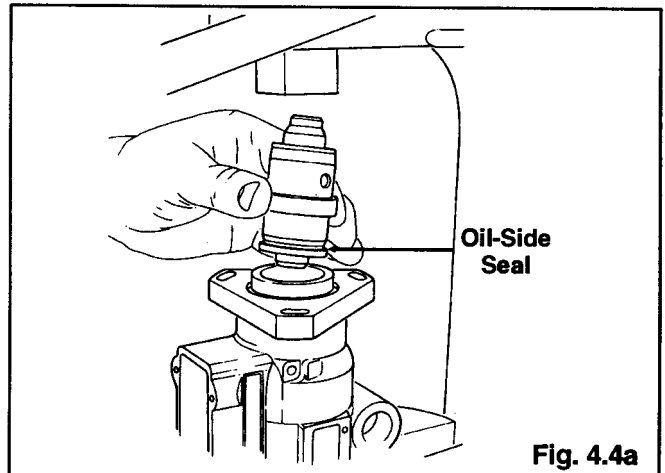
**STEP 2** Place seal installation tool 28316-A - end opposite removable collar - into housing bore (Reference Service Bulletin 438 for additional information regarding DB4 drive shaft seal and bearing installation. Press seal in until the tool bottoms.



**STEP 3** If specified, drop seal spacer into bore. On pumps equipped with drive shaft locking screws orient opening in spacer with locking screw hole.



**STEP 4** Apply a light coating of 30465 Lubriplate grease to the seal bore. Place the engine oil-side seal onto removable collar of the 28316-A tool with seal lip facing tool. Place tool in housing bore and press seal in until tool bottoms on housing. **NOTE: The engine oil-side seal will press in relatively easily until it contacts the spacer and fuel-side seal at which point considerable force will be needed to seat the tool against the housing face.**



**STEP 5** Remove the collar from the 28316 tool and place the drive shaft bearing onto the tool with the bearing part number facing the tool shoulder. Press the bearing into the pump until the tool bottoms. Check the bearing rollers for freedom of movement.

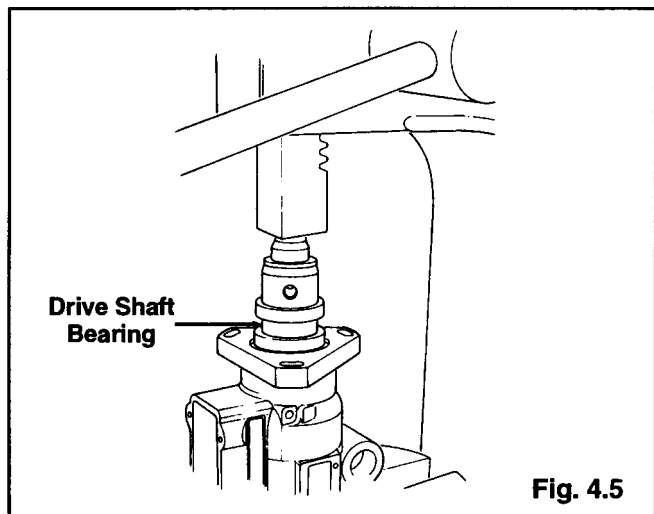


Fig. 4.5

**STEP 6** Install seal protection tube (included in seal and bearing kit) over drive shaft and lubricate tool and shaft with clean calibrating fluid. Insert drive shaft, tool end first, into housing from flange end until shoulder of shaft is flush with bearing. While holding shoulder of shaft flush with face of bearing, remove seal protection tube from inside of pump.

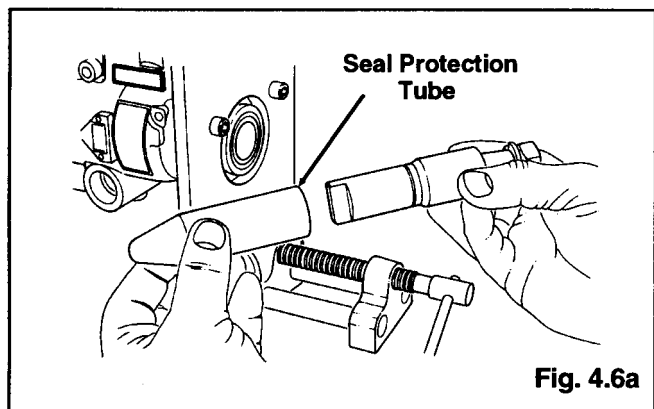


Fig. 4.6a

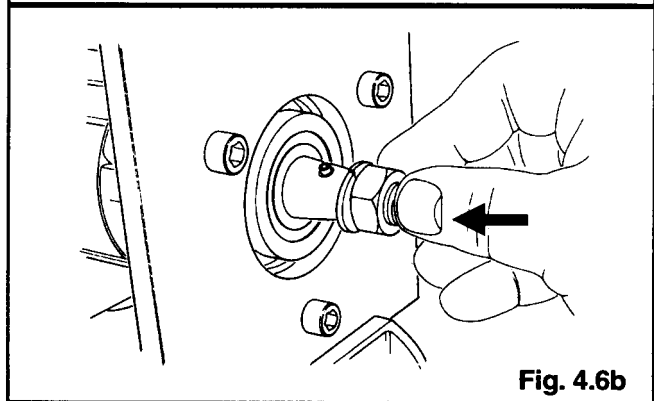


Fig. 4.6b

**STEP 7** Using snap ring pliers 20043, compress bronze thrust bearing and insert into counterbore in housing neck.

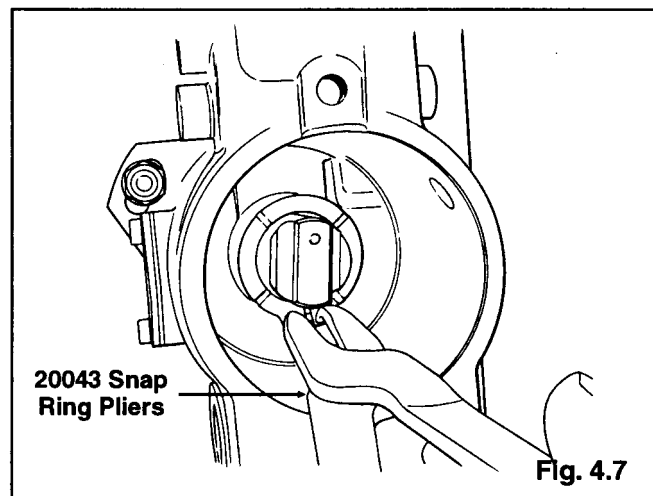


Fig. 4.7

**STEP 8** Slide thrust washer over shaft aligning flat on inside diameter of washer with flat on shaft until washer contacts thrust bearing.

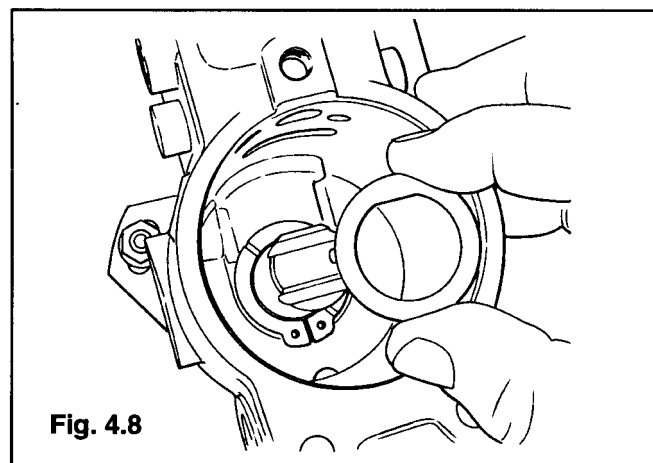


Fig. 4.8

**STEP 9** Slide spring washer onto shaft until it contacts thrust washer.

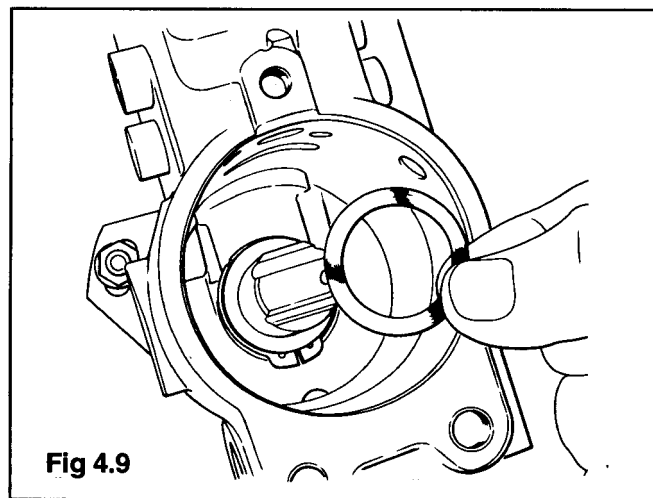
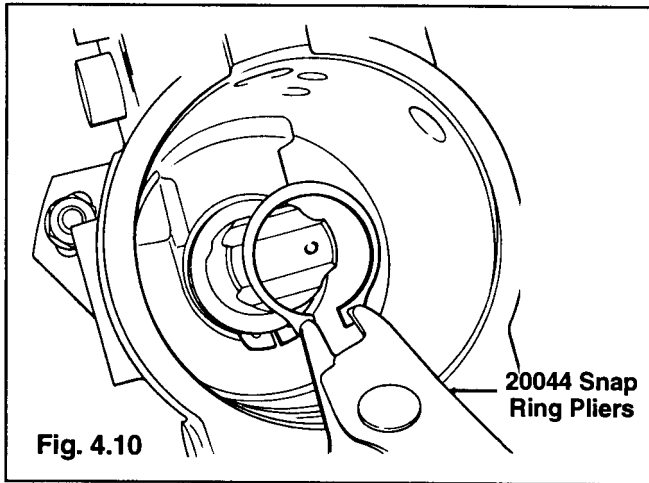
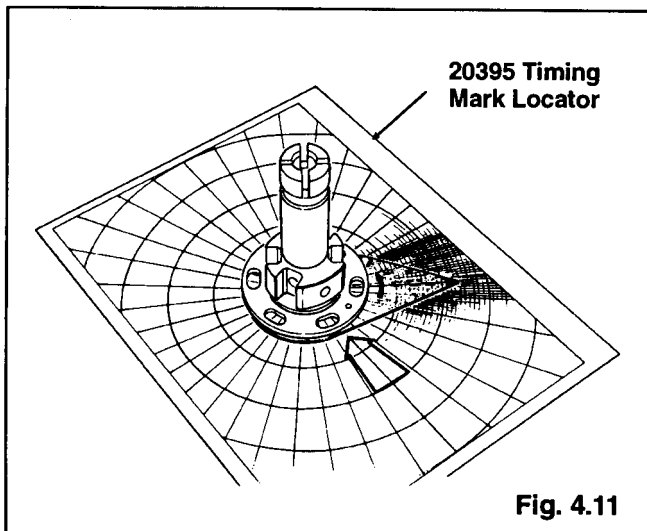


Fig 4.9

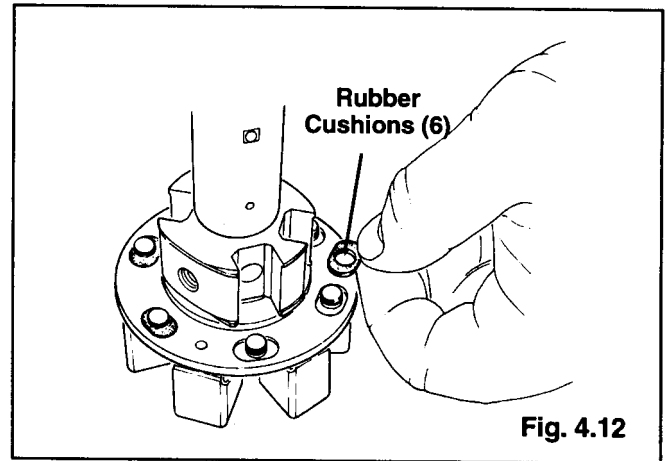
**STEP 10** Use snap ring pliers 20044 to expand the shaft retaining ring. Slide the ring over the shaft until it is seated completely into the groove on the shaft.



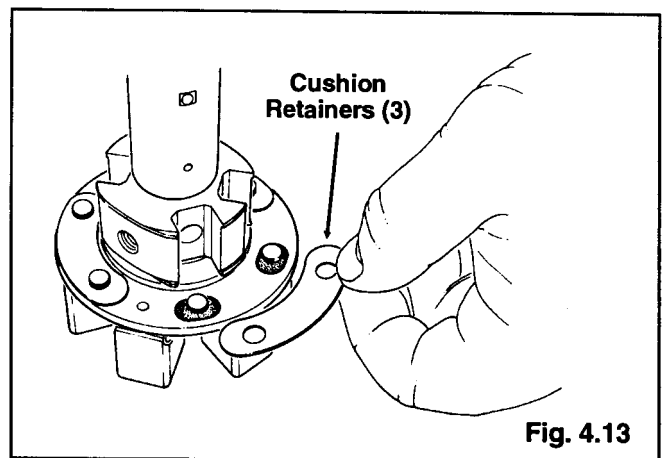
**STEP 11** Refer to individual specification to determine if pump calls for a timing mark on the weight retainer hub. The angle will be referenced in either the Pump Installation notes on the first page of the specification and/or in the Head and Rotor Group. If so, place the rotor assembly onto the 20395 timing mark locator with drill point in rotor drive tang aligned with tool pointer. Rotate the pointer and rotor in the direction of rotation indicated on the pointer (counterclockwise) until pointer is aligned with specified number of degrees on upper or outer scale. Mark on hub should line up with zero on locator (where "place timing line here" arrow point is). If not, use abrasive stone to remove incorrect mark from hub. Then place mark on hub at correct angle first with pencil and then overwrite with electric marking pencil. For pumps air timed to flange or weight retainer hub see individual specification and Service Bulletin 177 for additional information.



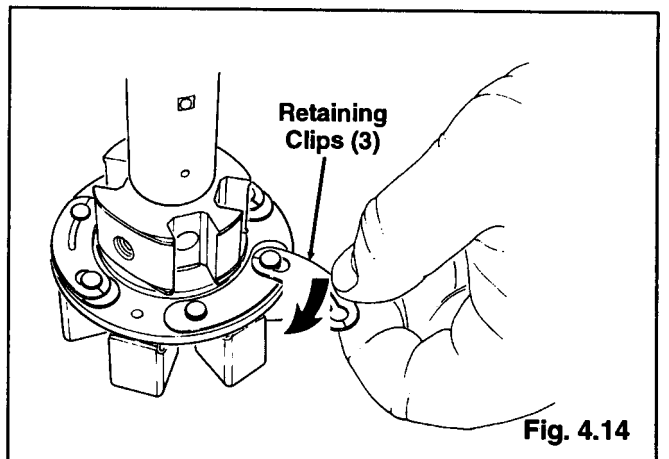
**STEP 12** Place rotor assembly onto weight retainer assembly. Install 6 kidney shaped rubber cushions into openings on hub with dimples facing up and towards rotor.



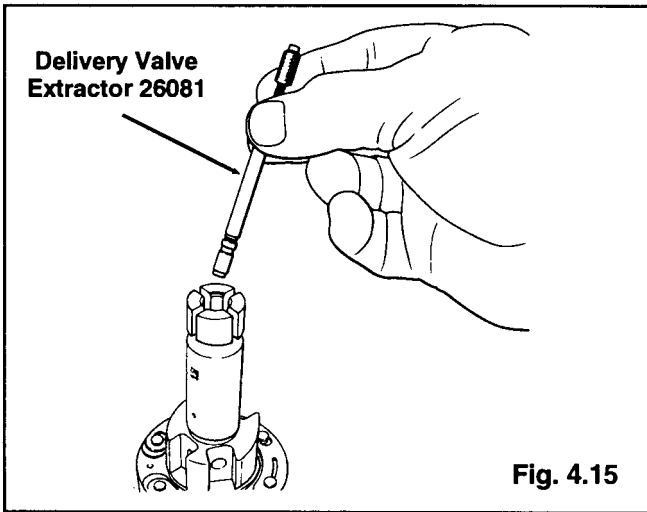
**STEP 13** Install 3 cushion retainers over weight retainer pins.



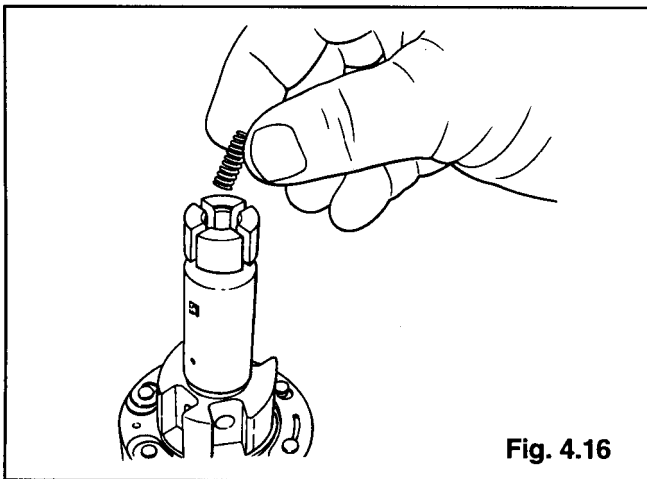
**STEP 14** Install 3 retaining clips over weight retainer pins as shown in Figure 4.14. Also see Service Bulletin 370 for more information on clip installation.



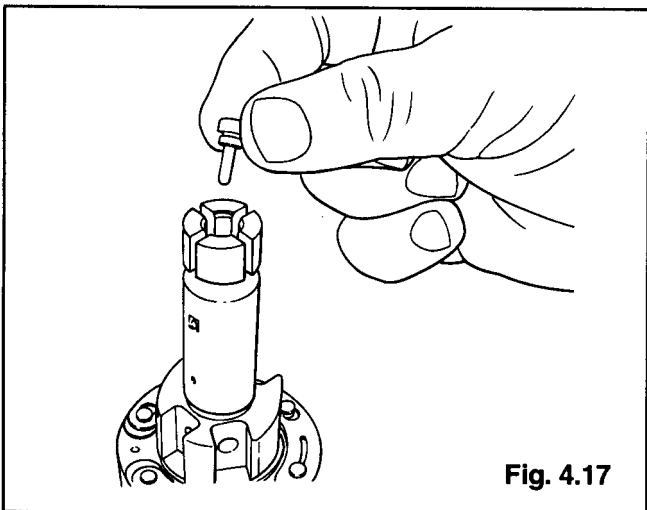
**STEP 15** Use delivery valve retractor 26081 to install delivery valve into its bore. Information regarding retraction values and oversize parts identification is contained in Service Bulletin 143B.



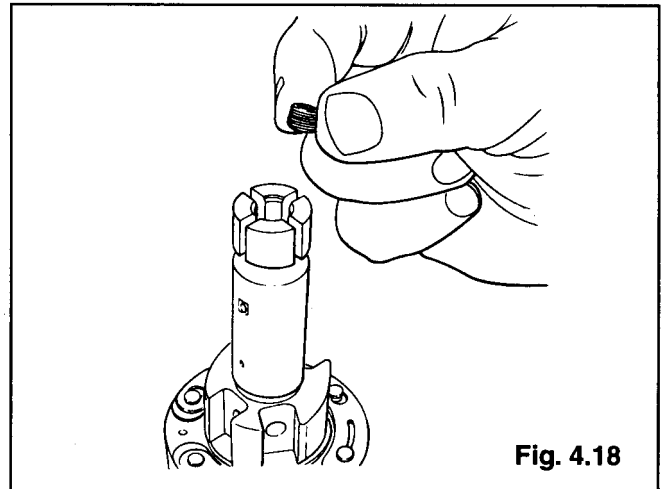
**STEP 16** Install delivery valve spring.



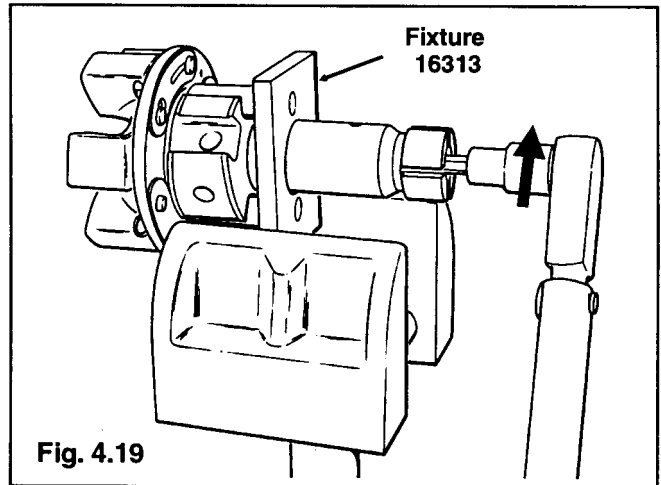
**STEP 17** Install new delivery valve stop (Ref. Service Bulletin 157).



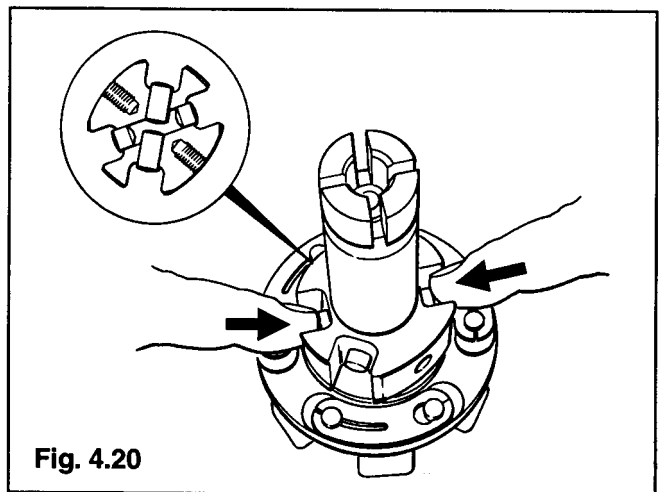
**STEP 18** Install the delivery valve stop screw.



**STEP 19** Install rotor into fixture 16313 and secure fixture in vise. Tighten delivery valve stop screw to 120-125 lbf-inches (13.6-14.1N•m).



**STEP 20** Install 4 pumping plungers. Reference Figure 4.20 for correct orientation and Service Bulletin 60 for additional information on plunger replacement.





**STEP 21** Install shoes and rollers. As outlined in Service Bulletin 332, there are a number of shoe options for four plunger pumps. Be sure to use the correct combination of shoes as outlined on the individual specification and orient them properly.

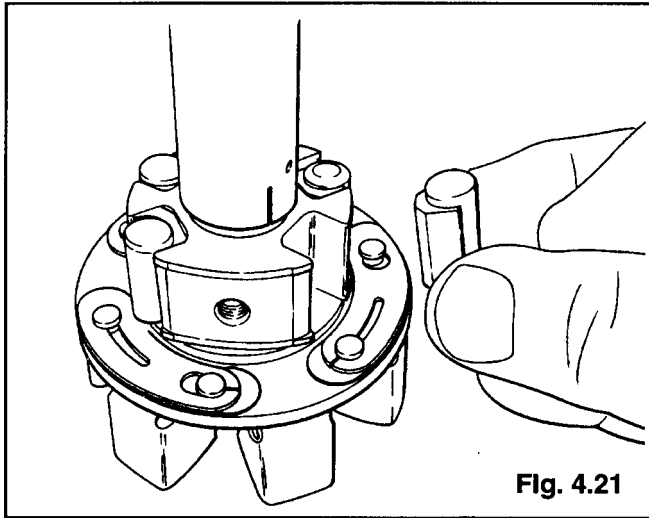


Fig. 4.21

**STEP 22** Install 2 leaf springs and leaf spring adjusting screws. Initially bottom screws, then back out 1 turn.

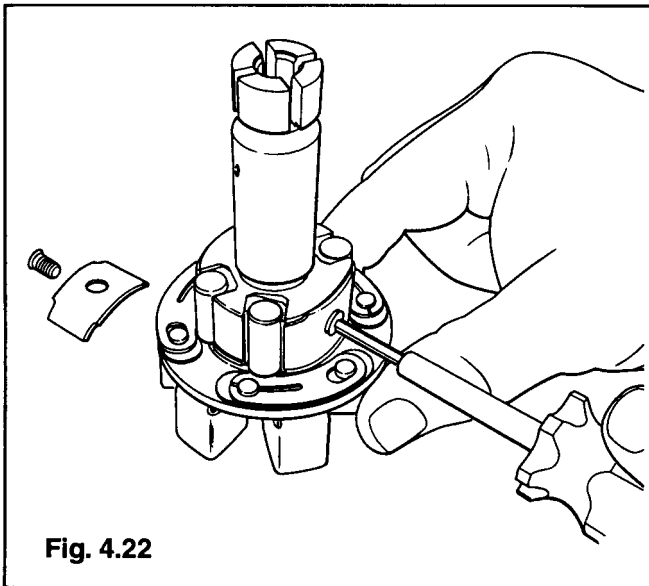


Fig. 4.22

**STEP 23** Secure roller-to-roller setting fixture 19969 in vise and insert rotor assembly. Connect dry, clean, filtered, compressed air source regulated to 40-100 p.s.i. (4.5-11.3 Kpa) to force plungers outward until shoes contact leaf spring. Using a 1-2 inch micrometer, measure the distance between the outer surfaces of each pair of opposed rollers. Compare the dimensions to the roller-to-roller dimension called for on the individual specification. Turn leaf spring adjusting screws clockwise to increase or counterclockwise to de-

crease the dimension. The 2 dimensions must be within 0.003 inches (0.076 mm) of each other and the average of both roller-to-roller dimensions must be within 0.0015 of the specified dimension. Example: Specified roller-to-roller dimension = 1.960 inches (49.78 mm). One pair of rollers measures 1.961 inches (49.81 mm) while the other measures 1.958 inches (49.73 mm). The 2 dimensions are within .003 inches of each other and the average of the 2 dimensions (1.9595 inches) is within 0.0015 inches of the specified roller-to-roller. Since each leaf spring controls one shoe and roller of each set it may be necessary to interchange shoes between slots or use optional size shoes (as indicated on the specification) in order to achieve the proper roller-to-roller dimension and concentricity.

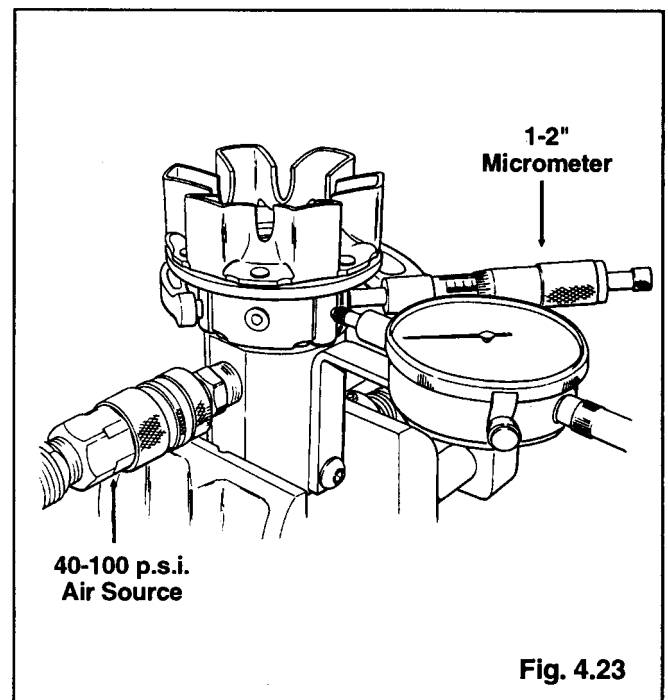
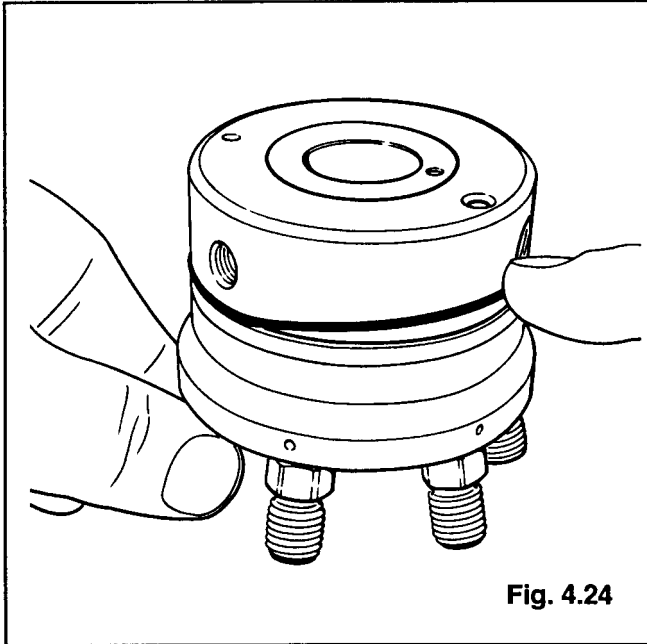


Fig. 4.23

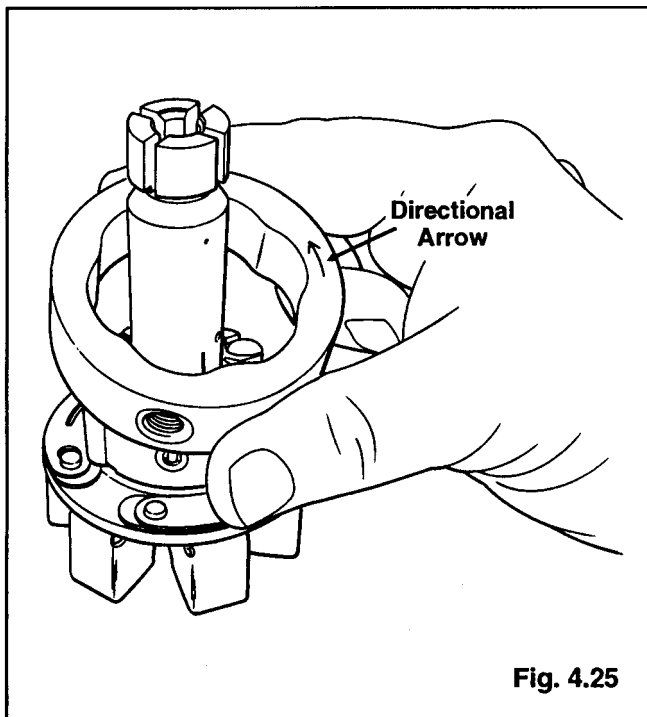
After the roller-to-roller dimensions are achieved the roller concentricity must be checked. Proper concentricity is needed to ensure that all rollers strike the cam lobes at the same time during pump operation. Rotate the rotor until one roller is aligned with the dial indicator plunger on fixture 19969. Slide the indicator inward until plunger depresses at least 0.010 inches (0.254 mm). "Zero" indicator by loosening thumbscrew and rotating dial. Re-check "zero" by rotating rotor to be sure indicator plunger is on high point of cam roller. Rotate rotor and observe dial indicator reading for each of the other 3 rollers. Roller concentricity must be within 0.004 inches (0.1 mm). If not within specification, concentricity can be achieved through interchanging of shoes or leaf spring positions.

**STEP 24** Install new hydraulic head seal into groove.



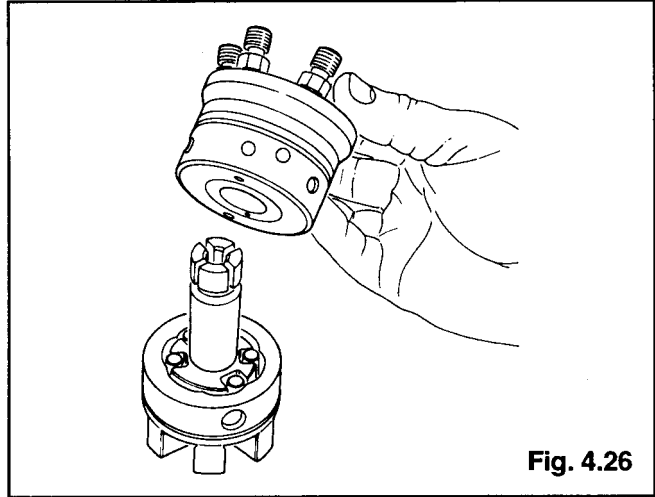
**Fig. 4.24**

**STEP 25** Check Installation Notes on individual specification to determine pump rotation ("C"=Clockwise, "CC"=Counterclockwise). Note that pump rotation is as viewed from pump drive end but since cam ring will be installed on rotor from transfer pump end, orient directional arrow on cam ring *opposite* specified direction of rotation. Place cam ring over rotor resting on weight retainer pins.



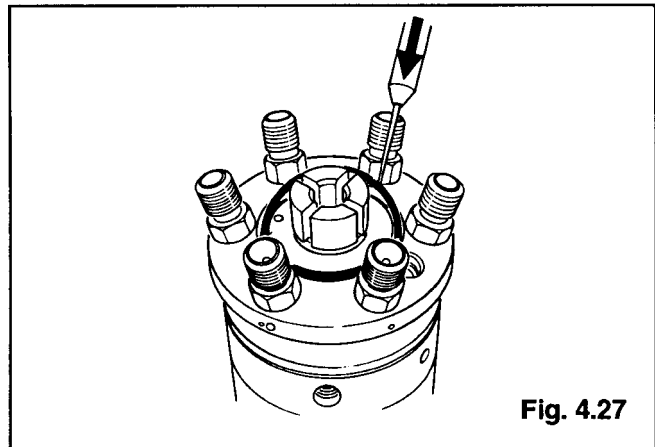
**Fig. 4.25**

**STEP 26** Carefully slide hydraulic head over rotor assembly.



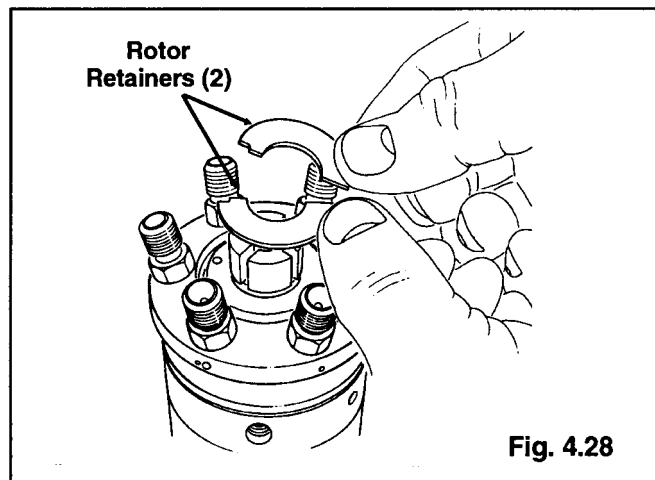
**Fig. 4.26**

**STEP 27** Install new transfer pump end cap seal into groove on hydraulic head. Be sure seal is pushed completely down into groove.



**Fig. 4.27**

**STEP 28** Install rotor retainers with cutouts aligned with hole in hydraulic head. Retainers showing wear pattern on one side may be turned over.



**Fig. 4.28**

**STEP 29** Install liner locating ring with opening in ring 90° from retainer ends.

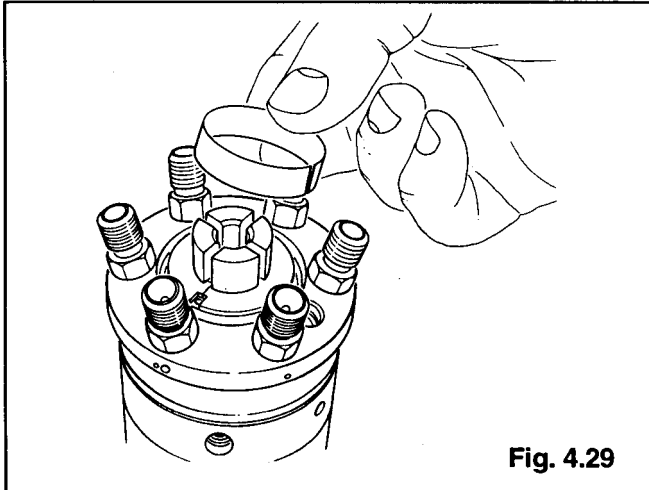


Fig. 4.29

**STEP 30** Install transfer pump liner also with notch aligned with hole in hydraulic head.

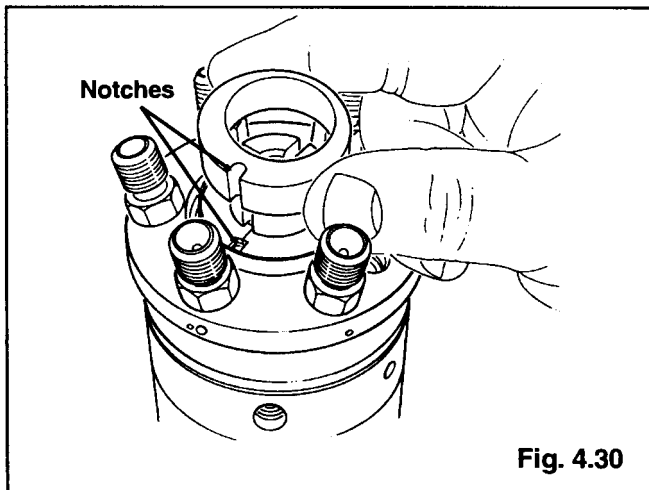


Fig. 4.30

**STEP 31** Install transfer pump blades and springs one pair at a time. Reference Service Bulletin 304 for information regarding blade options and oversize identification.

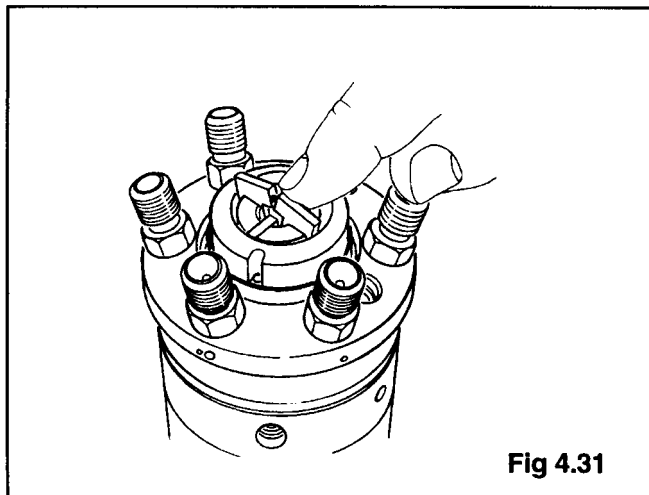


Fig 4.31

**STEP 32** Install new seal into groove in transfer pump regulator piston bore. Be sure seal is completely seated in groove. NOTE: Brass hook 13301 may be helpful for seating seal. Drop transfer pump regulating piston into bore with open end facing out to receive spring. Install regulating spring.

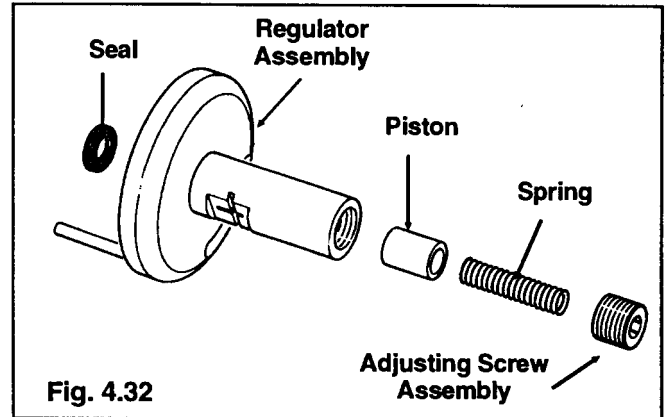


Fig. 4.32

**STEP 33** Install transfer pump pressure adjusting screw until 1-2 threads below flush with end of regulating sleeve. Exercise care not to exert excessive downward pressure on hex wrench while installing to prevent dislodging of the orifice plate.

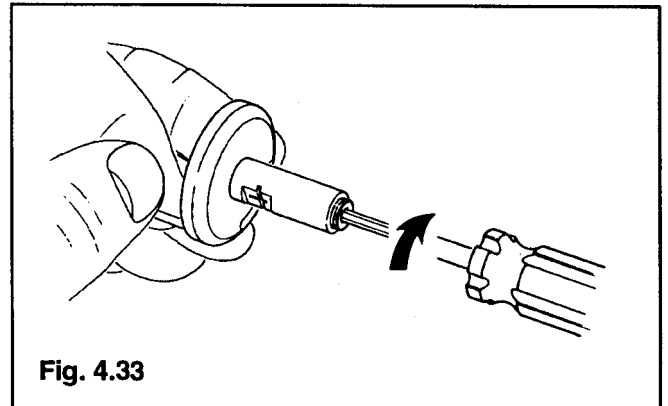


Fig. 4.33

**STEP 34** Install inlet filter screen. Reference Service Bulletin 444 for information regarding changes to transfer pump regulator components.

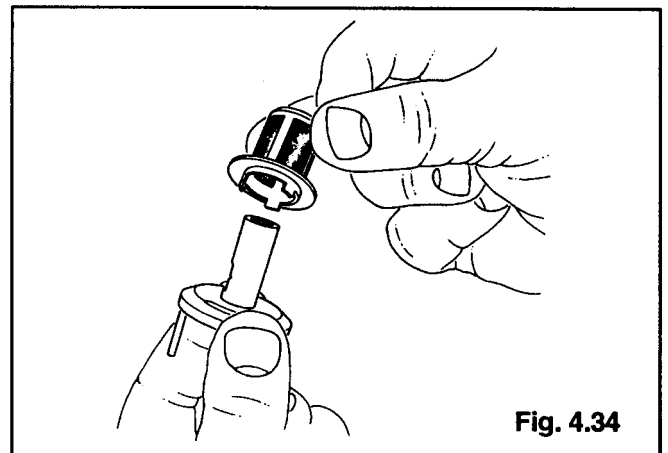
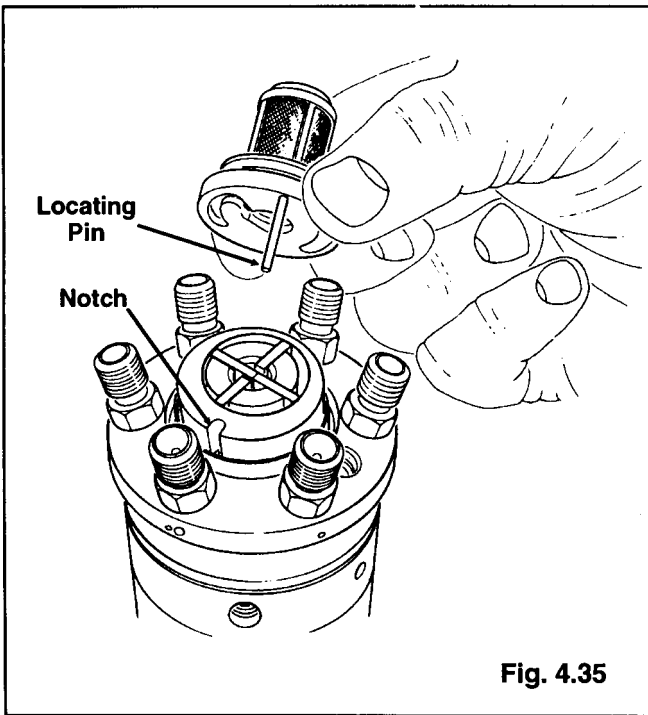
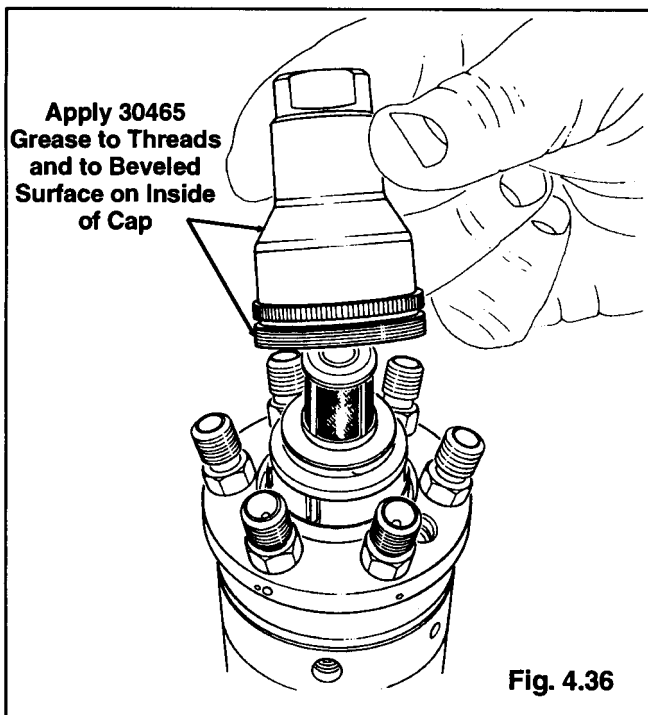


Fig. 4.34

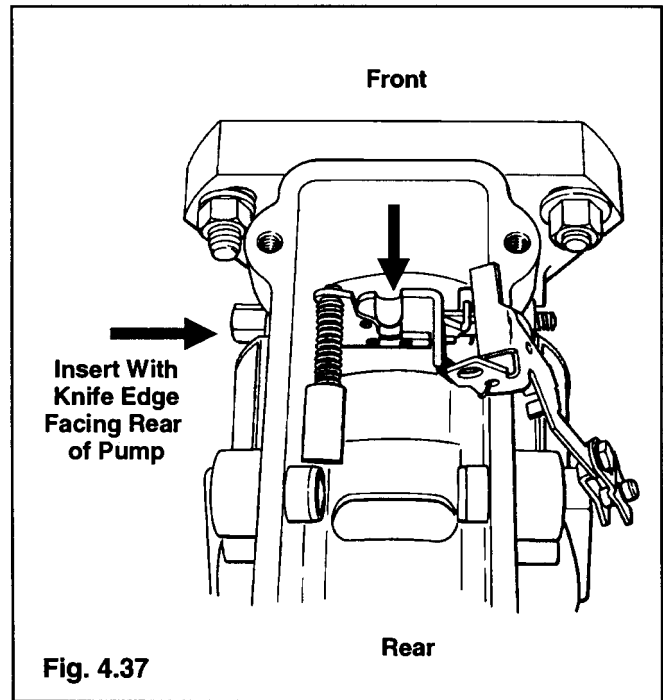
**STEP 35** Install regulator assembly by aligning locating pin with notches in transfer pump liner and rotor retainers and engaging pin with hole in hydraulic head.



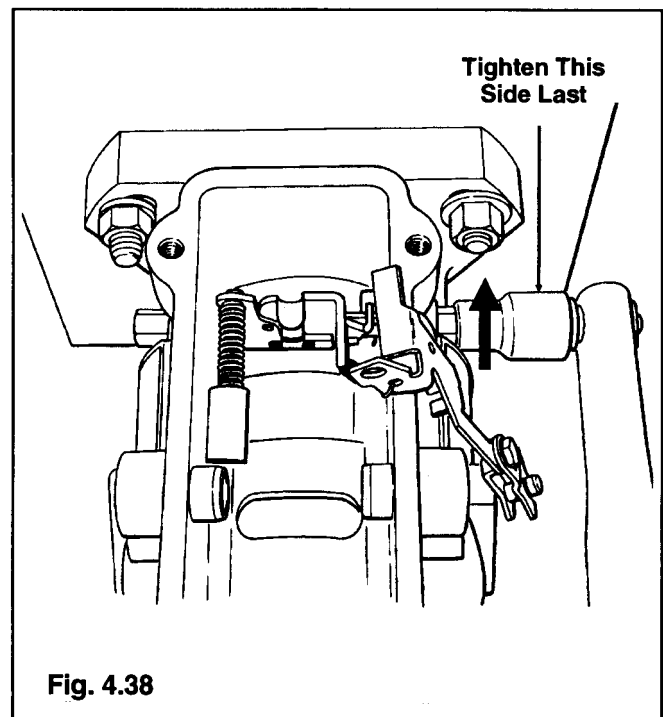
**STEP 36** Apply a thin coating of 30465 grease to beveled surface on inside of end cap and to end cap threads. Install end cap to hydraulic head assembly by rotating cap counterclockwise until "click" is heard, then rotating clockwise until hand tight.



**STEP 37** Insert governor arm into housing with linkage hook hanging over side of pump. Observe pivot shaft shape. Orient pivot shaft with knife edge facing rear (transfer pump end) of pump and insert into housing engaging openings in governor arm and hole on opposite side of housing.



**STEP 38** Assemble new seals to ends of pivot shaft. Install pivot shaft nuts and tighten each side alternately. Finish sequence with nut on linkage hook side of pump. Torque value is 20-25 lbf-inches (2.3-2.8 N•m).



**STEP 39** Invert head and rotor assembly and install governor weights into weight retainer with rounded "heels" in corners of sockets.

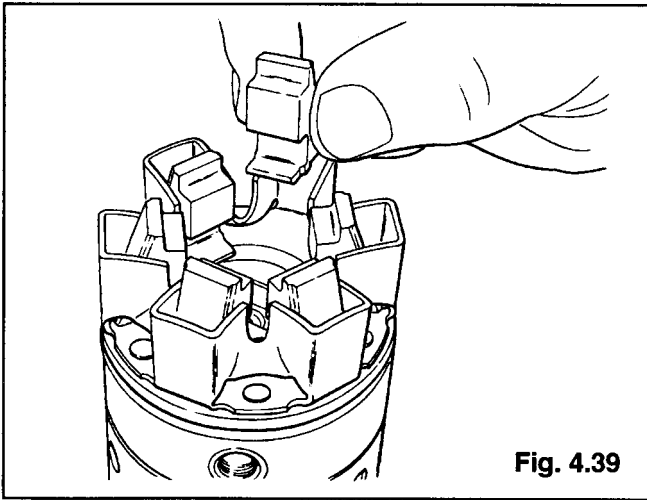


Fig. 4.39

**STEP 40** Assemble governor thrust washer making sure that washer is resting on top of weight "toes".

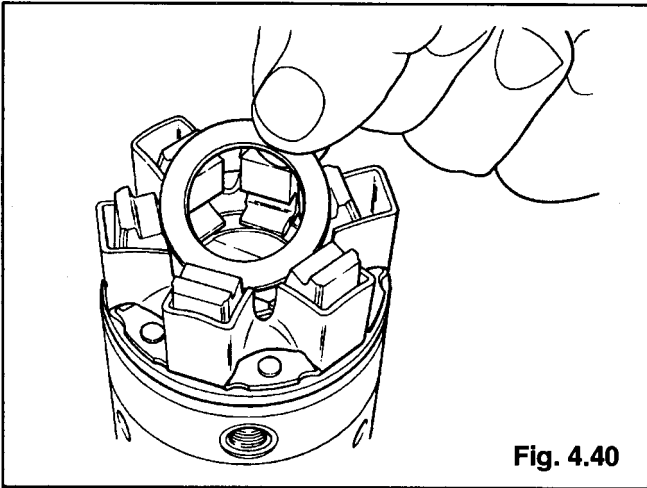


Fig. 4.40

**STEP 41** Install governor thrust sleeve.

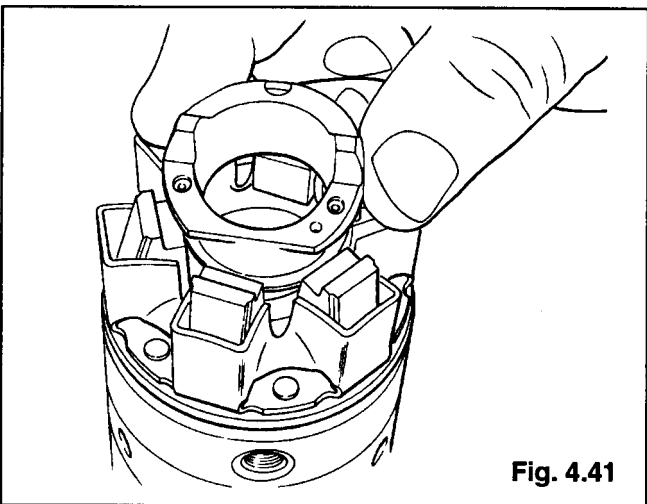


Fig. 4.41

**STEP 42** Secure housing, mounted on 23615 mounting plate, in vise with hydraulic head bore tilted downward at approximately a 30-45° angle. Rotate drive shaft until drill point on end is in 6 o'clock position. Apply a light coating of 22204 lubricant to hydraulic head seal and entrance to housing. Align drill point in rotor with head locating screw bore at bottom of head. Align cam pin hole in cam ring with head locating screw bore in hydraulic head. Orient thrust sleeve with governor arm groove in horizontal position so toes of arm will engage slots upon installation. Carefully slide head and rotor assembly into housing with metering valve bore at the 12 o'clock position. When head seal contacts housing push in with slight twisting motion until head locking screw bores align with holes in housing.

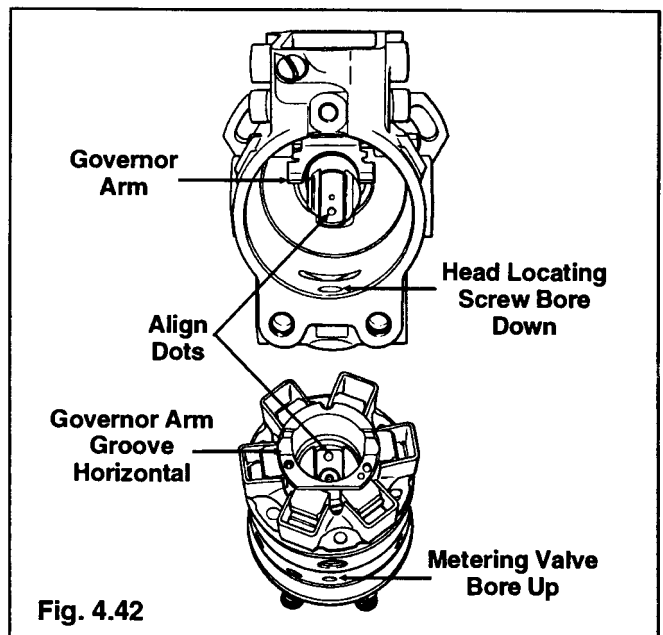


Fig. 4.42

**STEP 43** Install vent wire screw assembly into hydraulic head until it bottoms using 16336 hex driver. Be sure screw does not protrude above surface of head.

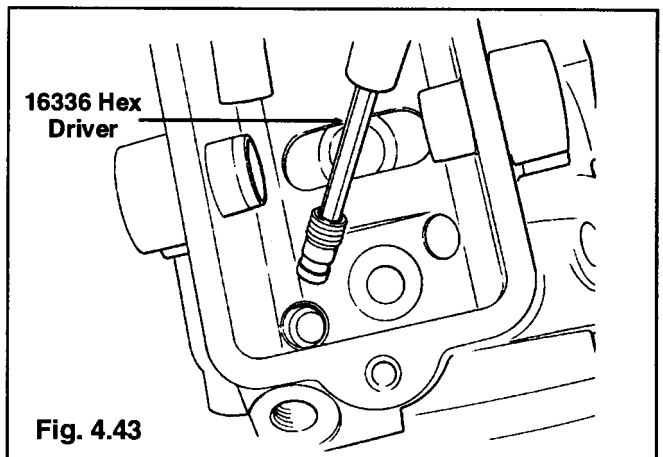


Fig. 4.43

**STEP 44** Install metering valve shim and tapered coil spring to metering valve and install assembly into metering valve bore in hydraulic head. *NOTE: Reference Service Bulletins 336 for information on metering valves and arm assemblies and Service Bulletin 237 for information on metering valves that utilize only shims and not a coil spring under the arm assembly.*

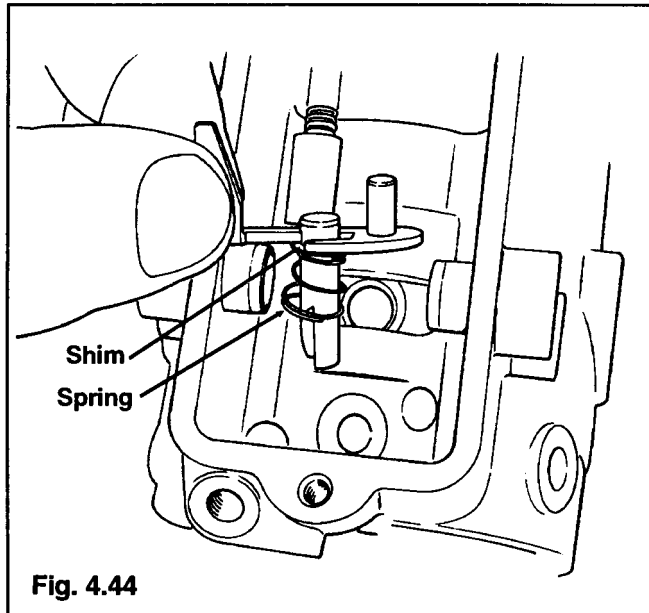


Fig. 4.44

**STEP 45** Engage the linkage hook to the cutout in the governor arm and fit the linkage hook onto the metering valve arm pin. DB4 pumps utilize long throttle shaft bushings for extra throttle shaft support. As a result, installing the linkage hook onto the metering valve arm may require rotating the hydraulic head slightly counterclockwise within the housing to provide adequate clearance for the linkage hook to clear the bushing and fit over the pin.

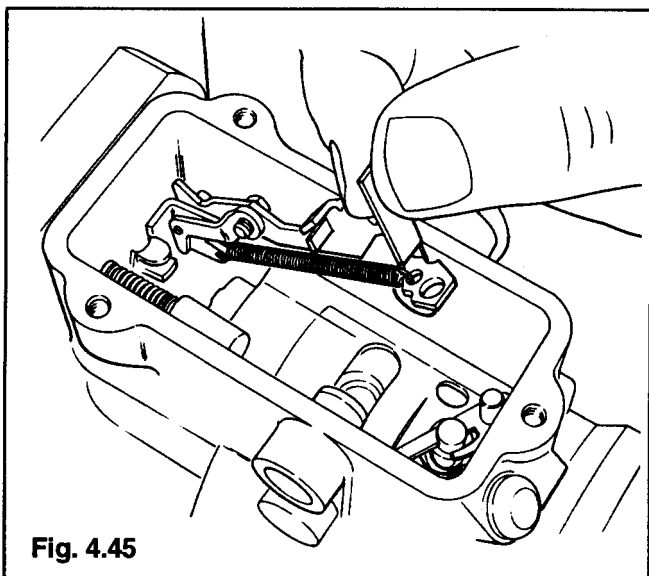


Fig. 4.45

**STEP 46** Align head locking screw holes with the holes in the housing. Install the head locking screws finger tight. Do not tighten at this time!

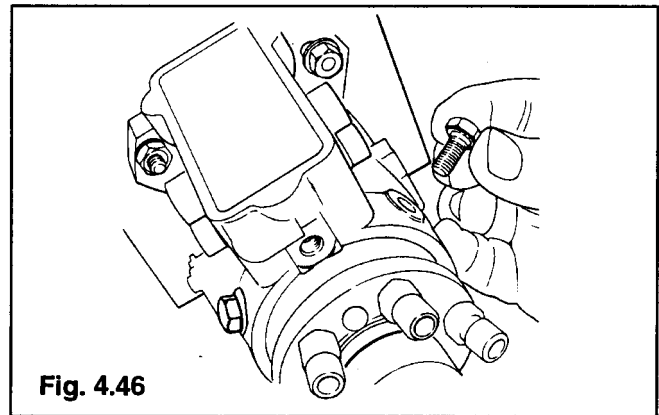


Fig. 4.46

**STEP 47** Reference Service Bulletin 97 for additional speed droop governor information. Thread control spring bushing onto control rod until it contacts control spring guide. Thread control spring 5 full turns onto spring guide (unless individual specification calls for a different number of turns).

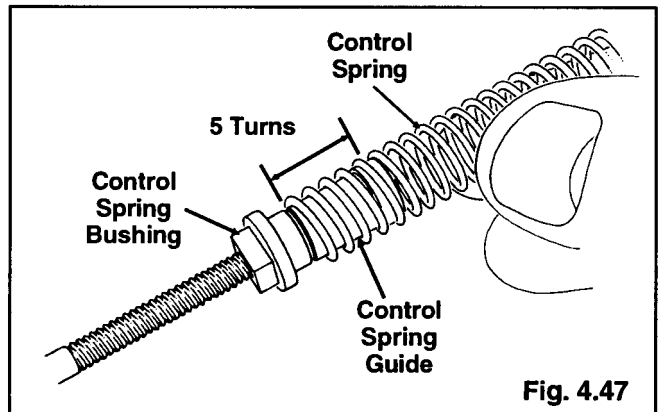


Fig. 4.47

**STEP 48** Depress metering valve and insert control rod through guide stud bore from inside of housing and install control spring over tabs on governor arm ensuring that the cross loop on end of spring is between tabs.

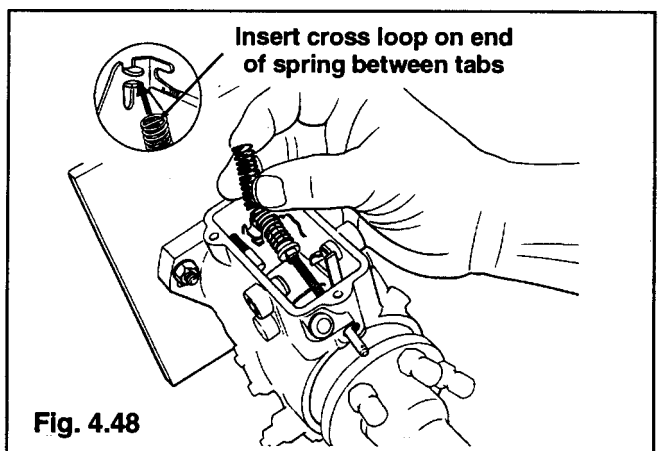
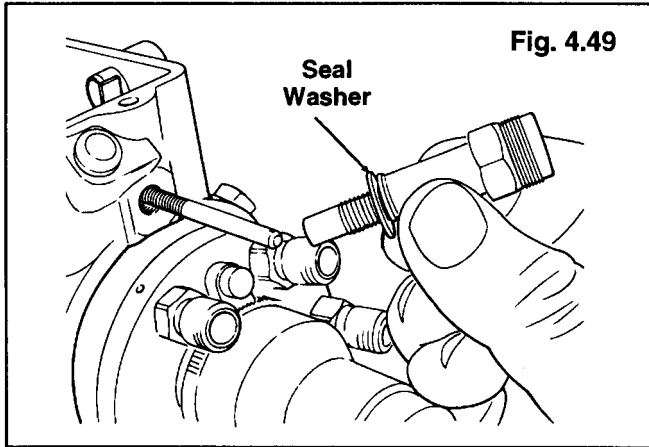
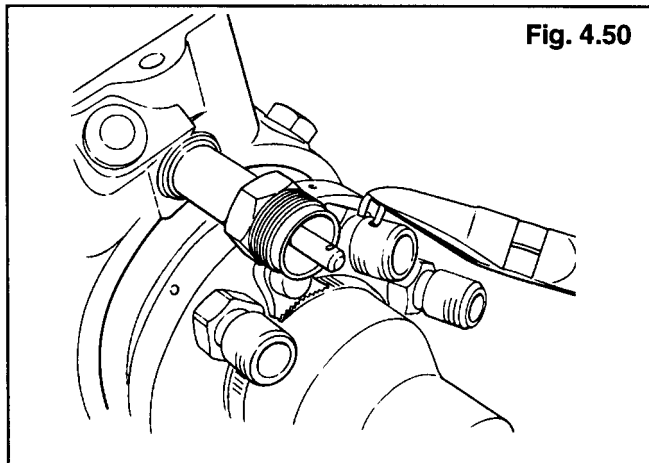


Fig. 4.48

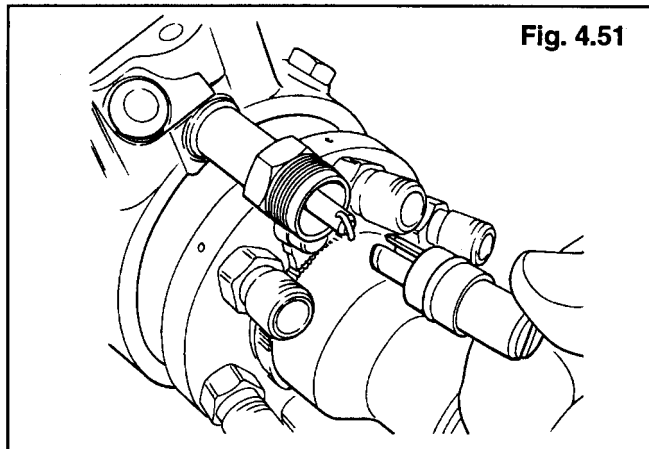
**STEP 49** Install new seal (combination steel and rubber washer) to control rod guide. Depress metering valve in bore and slide control rod guide over control rod and thread into housing. Use a 5/8" deep socket to tighten control rod guide to 70-80 lbf-inches (8-9 N•m).



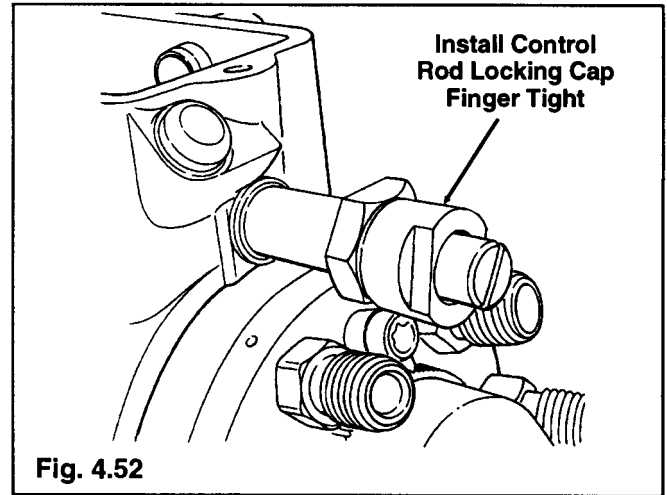
**STEP 50** Install control rod pin to control rod using diagonal cutting pliers.



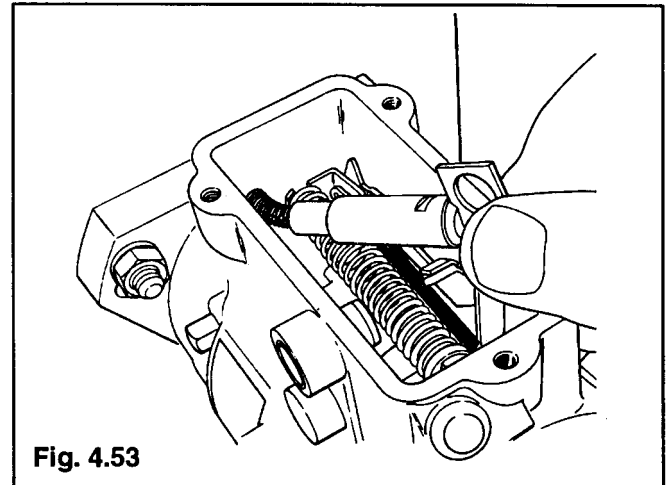
**STEP 51** Install new seal to adjusting cap assembly and slide cap onto control rod with slot in rod aligned with control rod pin.



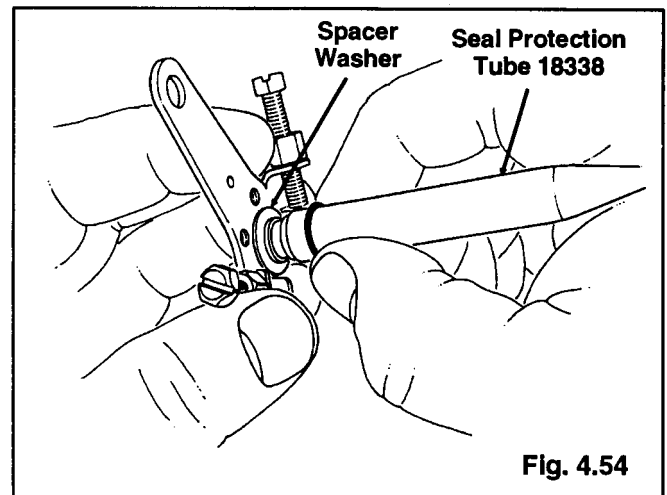
**STEP 52** Assemble droop control locking cap to control rod guide finger tight.



**STEP 53** Slide damper barrel onto piston assembly.



**STEP 54** Install new spacer washers to the throttle and shutoff shafts. Use protection tube 18338 to install new seals to the throttle and shutoff shafts.



**STEP 55** Refer to Installation Notes section of individual specification to determine whether throttle shaft is installed on left or right side of pump. Slide throttle shaft assembly into housing, lever pointing upwards, through hole in damper barrel bracket (if equipped) and spacer. Position throttle shaft lever in pump with fork straddling control rod and resting on flats of control spring bushing. Insert shaft through lever.

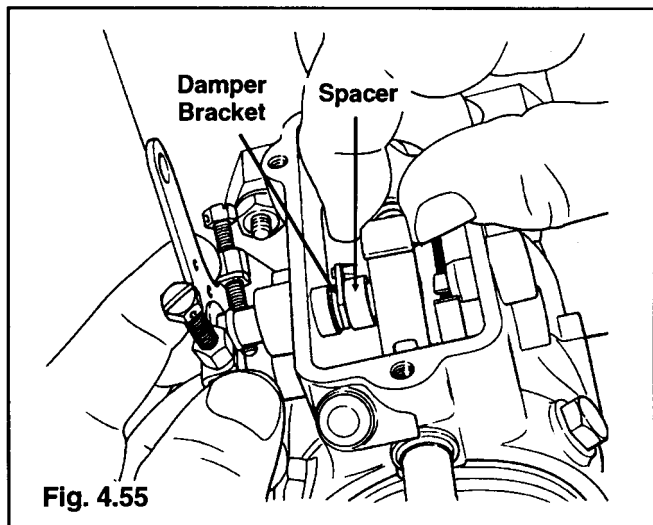


Fig. 4.55

**STEP 56** Install shutoff shaft assembly.

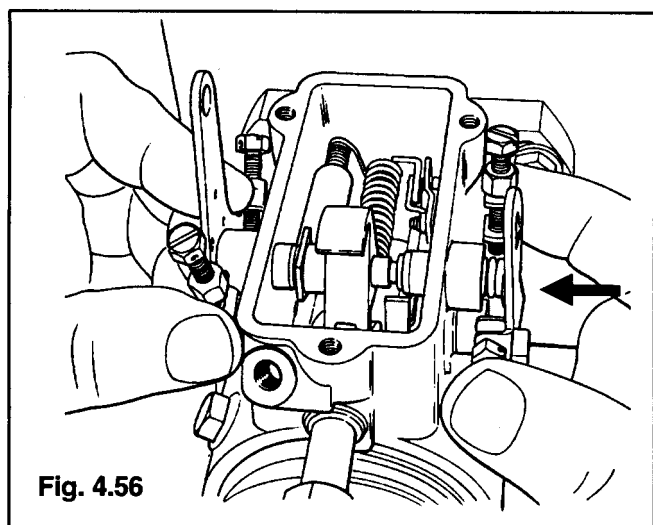


Fig. 4.56

**STEP 57** The governor linkage gap must be properly set prior to pump calibration in order to achieve complete shutoff, rated speed fuel delivery and proper pump performance. To set the gap, linkage hook wrench 13379 and gap setting kit 23093 will be needed. Additional linkage hook setting information may be found in Service Bulletin 95. Refer to the individual specification to determine the specified governor linkage gap, then partially loosen the adjusting screw with wrench 13379 until the parts can move in relationship to

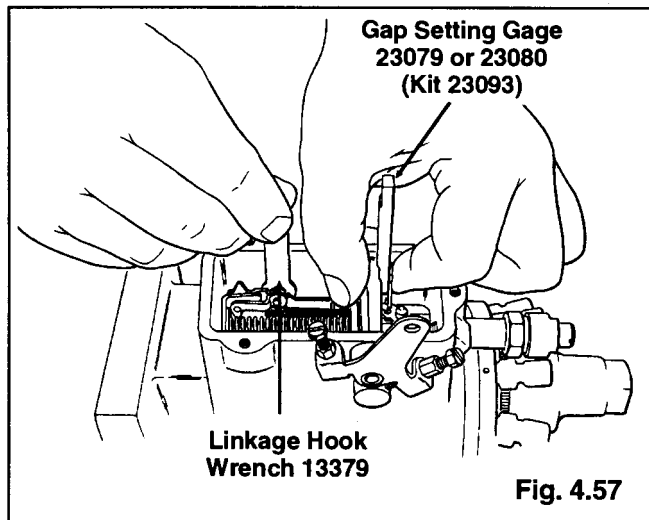


Fig. 4.57

one another but with some resistance. Expand the linkage to the maximum gap. Insert the appropriate thickness gap setting gage between the throttle shaft and the upright on the linkage hook. While holding the throttle lever in the wide open throttle position, close the gap to the thickness of the gage, press the linkage hook upright flush against the gage, and tighten the linkage hook locking screw. Rotate the drive shaft 1/2 turn and recheck the gap to be sure it is within the specified tolerance.

**STEP 58** Squeeze throttle and shutoff shafts together and install new shutoff cam (plain type for standard pumps and roller type for pumps used with external electronic governors - Ref. S.B. 462). A nut driver can be used to seat cam completely in notch. With the shutoff lever in the run position, adjust the rear adjusting screw until the shutoff cam is in the vertical position and not contacting the linkage hook. With the shutoff lever in the shutoff position adjust the front adjusting screw until the shutoff cam is positioned approximately 60° from vertical. Tighten the adjusting screw locknuts to 30-35 lbf-inches (3.4-4.0 N•m).

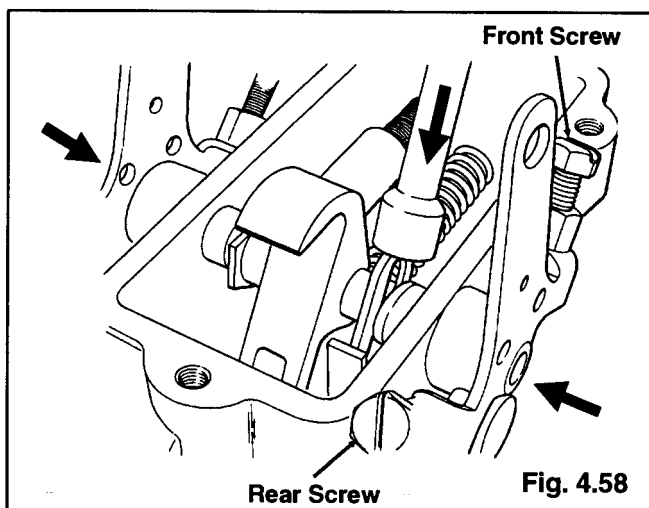


Fig. 4.58



**STEP 59** Invert pump in vise. Install new seal to head locating screw and install head locating screw to pump finger tight.

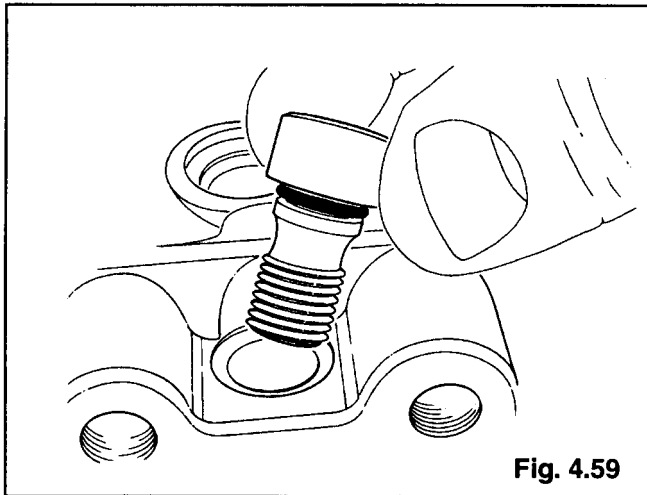


Fig. 4.59

**STEP 60** Assemble reed valve to power side piston hole plug with concave side (spot of yellow stain) facing up. Also see Service Bulletin 320 for additional information.

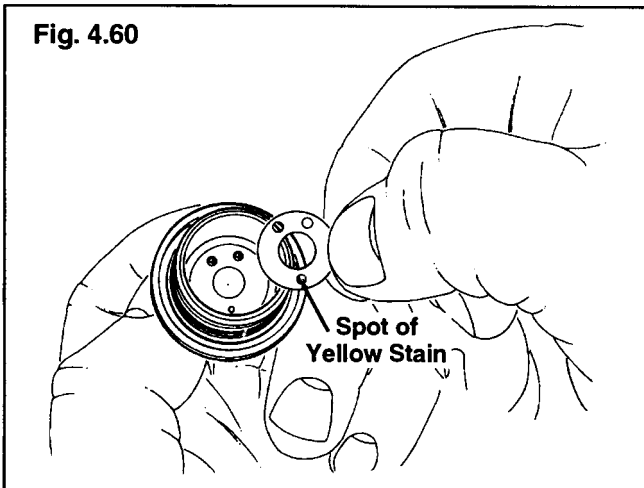


Fig. 4.60

**STEP 61** Install reed valve retaining screws.

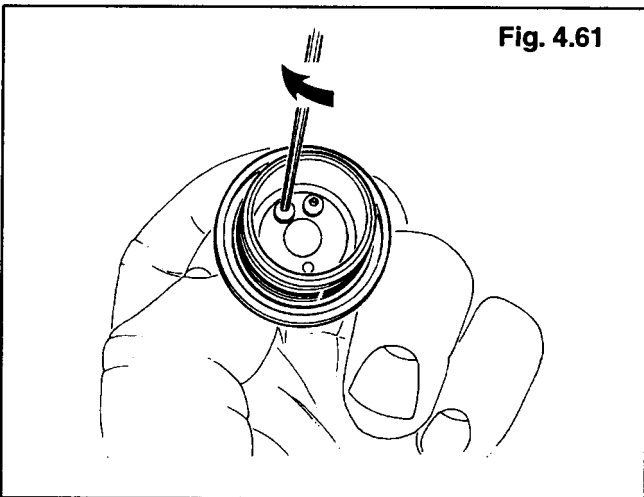


Fig. 4.61

**STEP 62** Install new advance piston ring seal (square cross section) to piston making sure that seal is not twisted in groove. NOTE: A dental pick or similar tool can be slipped under seal and rotated around circumference of piston to untwist this seal.

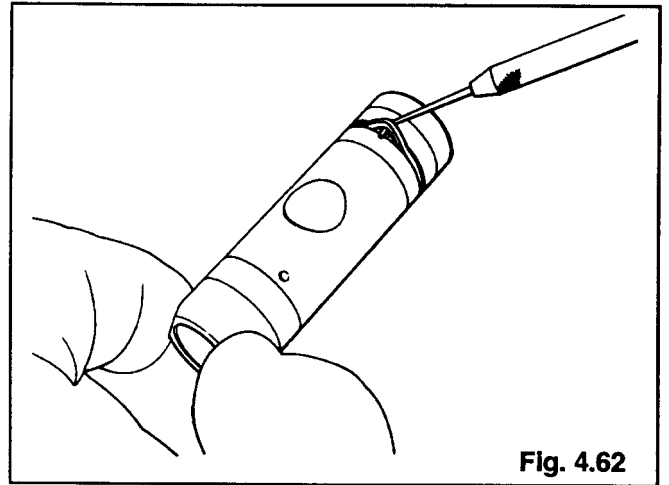


Fig. 4.62

**STEP 63** Slide piston ring into its groove on piston exercising caution not to over expand ring,

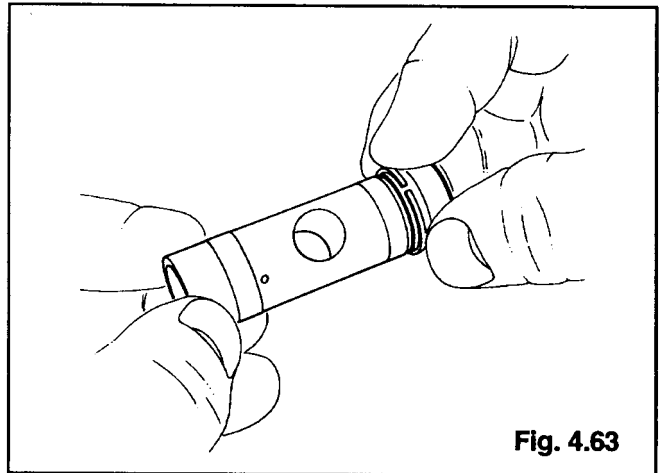


Fig. 4.63

**STEP 64** Slide piston ring compressor tool, P/N 16199, over end of piston, chamfered side facing piston ring.

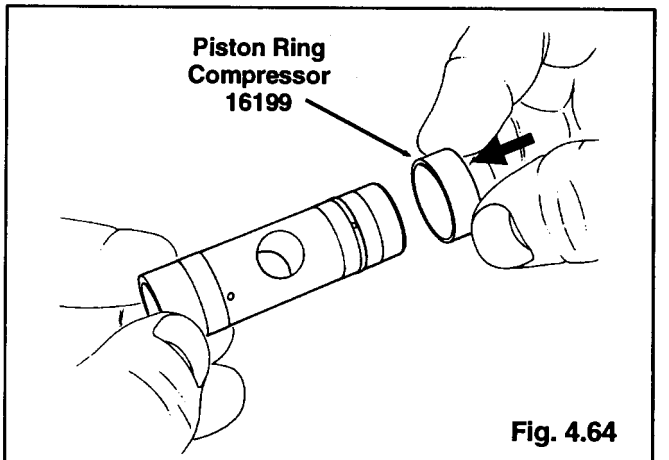
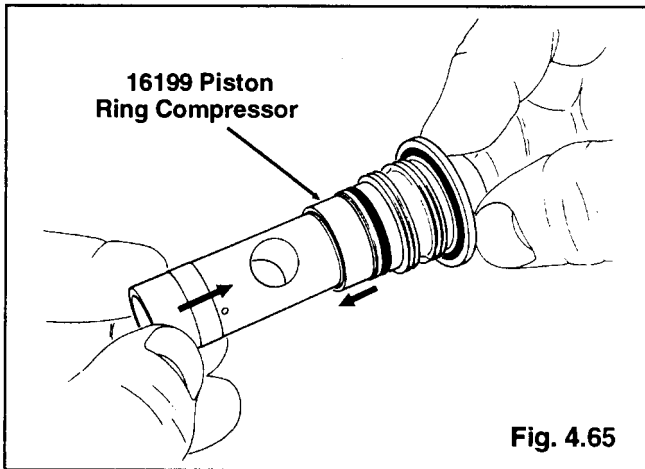
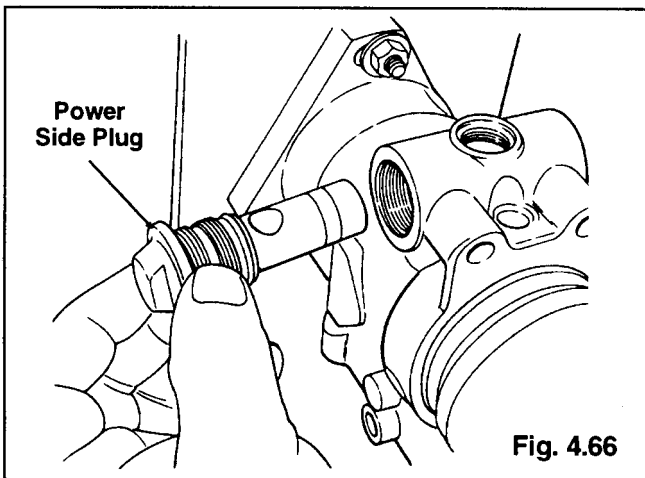


Fig. 4.64

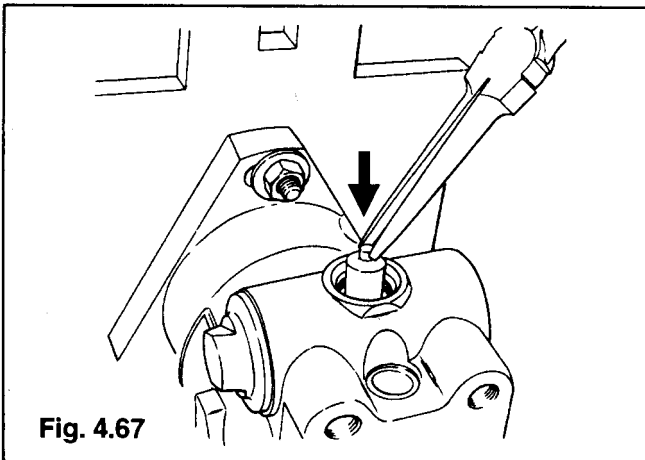
**STEP 65** Install piston into power side piston hole plug and remove tool.



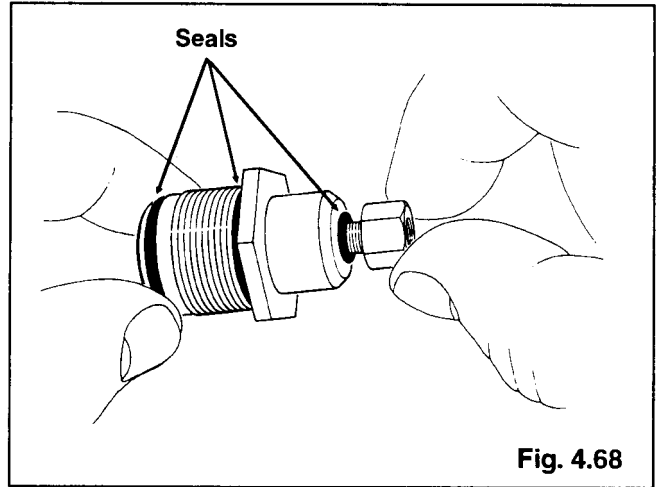
**STEP 66** Install 2 new O-ring seals to power side piston hole plug and install assembly to advance bore. **NOTE:** For clockwise rotation pumps power side plug will be on side of housing marked with "C". For counterclockwise pumps power side plug will be on side marked "CC".



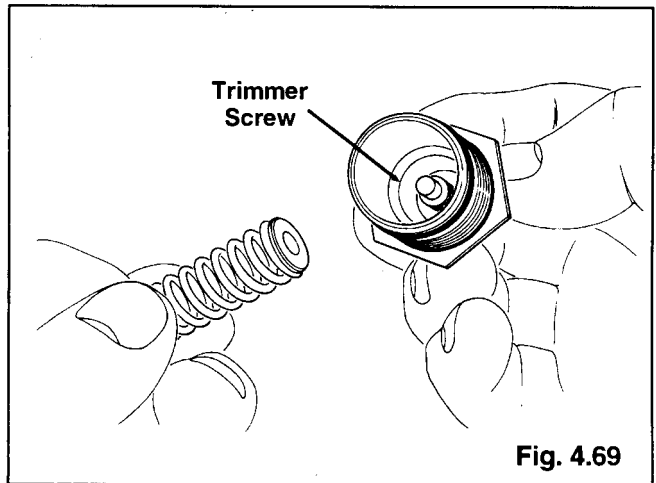
**STEP 67** Align pin hole in piston with hole in cam and install cam pin.



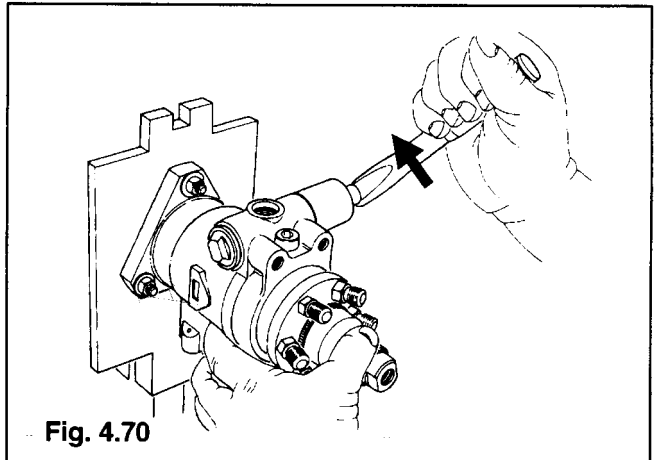
**STEP 68** Install 2 new O-ring seals to the spring side piston hole plug. Assemble the trimmer screw, a new O-ring seal and the locknut (chamfered side facing seal) to spring side plug.



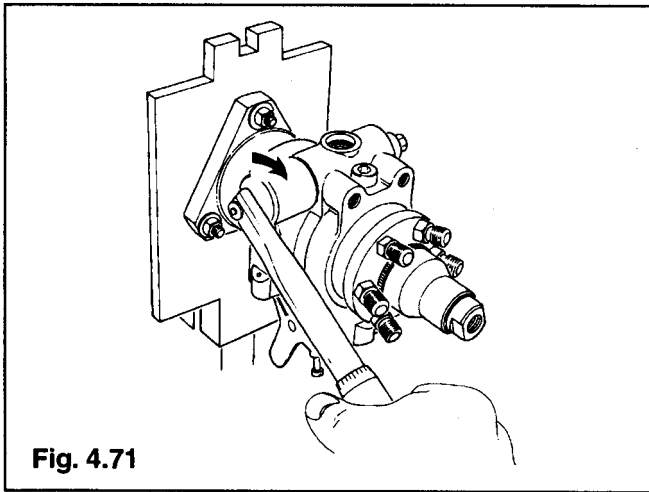
**STEP 69** Assemble the advance spring guide and the advance spring(s) to the trimmer screw.



**STEP 70** Install spring side plug assembly to housing and tighten to 455-505 lbf-inches (51.5-57.2 N•m) (Reference Service Bulletin 465.)

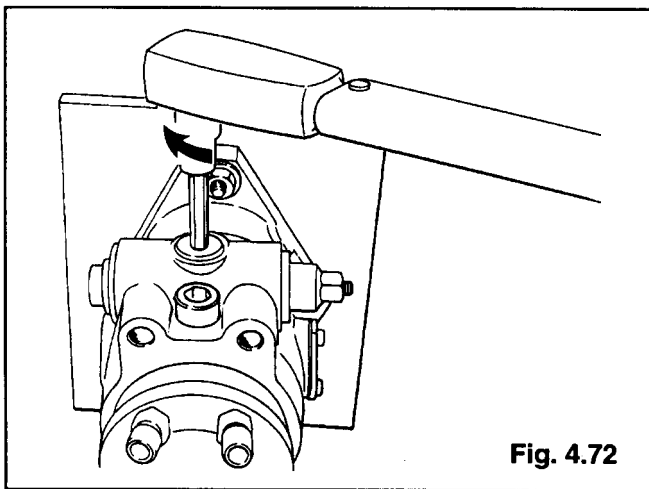


**STEP 71** Use wrench 27760 or 27761 to tighten the power side plug to 455-505 lbf-inches (51.5-57.2 N•m). (Reference Service Bulletin 465.)



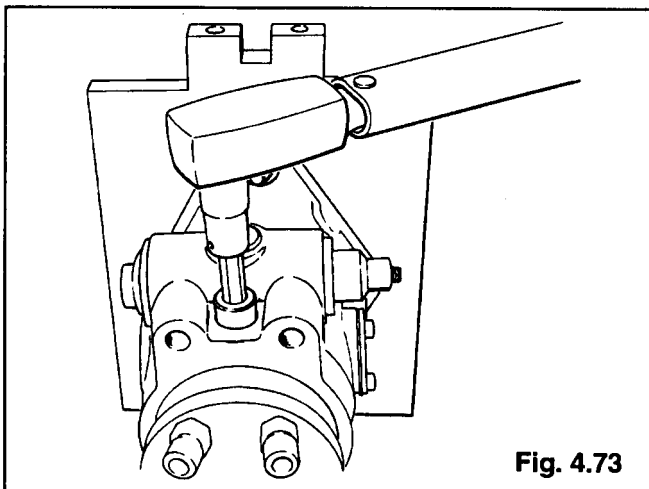
**Fig. 4.71**

**STEP 72** Install new seal to cam pin hole plug and install plug. Tighten to 75-100 lbf-inches (8.5-11.3 N•m).



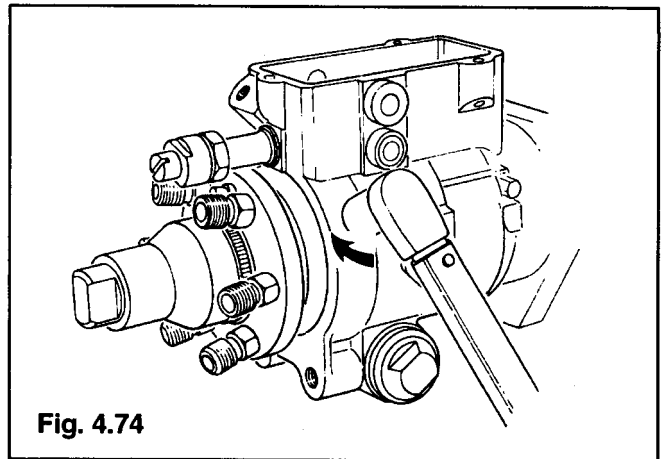
**Fig. 4.72**

**STEP 73** Tighten head locating screw to 180-220 lbf-inches (20.0-25.0 N•m).



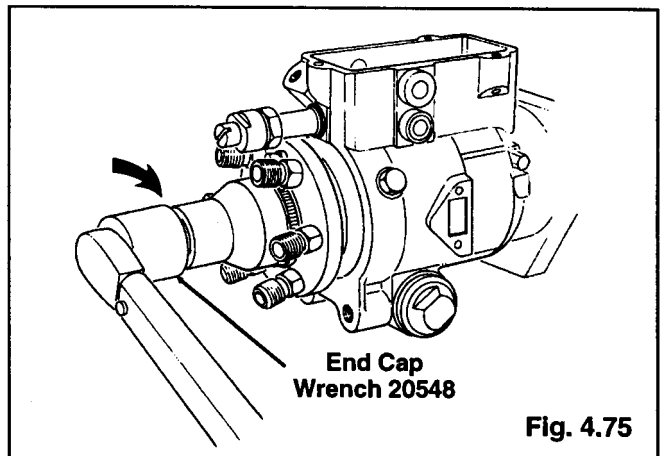
**Fig. 4.73**

**STEP 74** Invert pump and holding fixture in vise and tighten the two head locking screws to 180-220 lbf-inches (20.0-25.0 N•m).



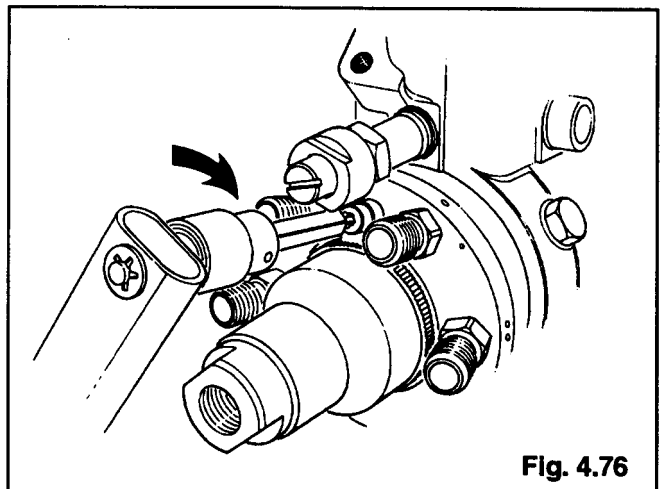
**Fig. 4.74**

**STEP 75** Using end cap wrench 20548 to tighten the transfer pump end cap to 360-440 lbf-inches (41.0-50.0 N•m).



**Fig. 4.75**

**STEP 76** Assemble transfer pump end cap locking plate and new seal to screw and install locking plate assembly to hydraulic head. Tighten screw to 70-80 lbf-inches (7.9-9.0 N•m).



**Fig. 4.76**

**STEP 77** If pump is not equipped with a torque screw, install torque screw hole plug and new seal and tighten to 75-100 lbf-inches (8.5-11.3 N•m). If equipped with a torque screw, install locknut and new seal to screw and install assembly to housing. Tighten to 50-60 lbf-inches (5.6-6.8 N•m).

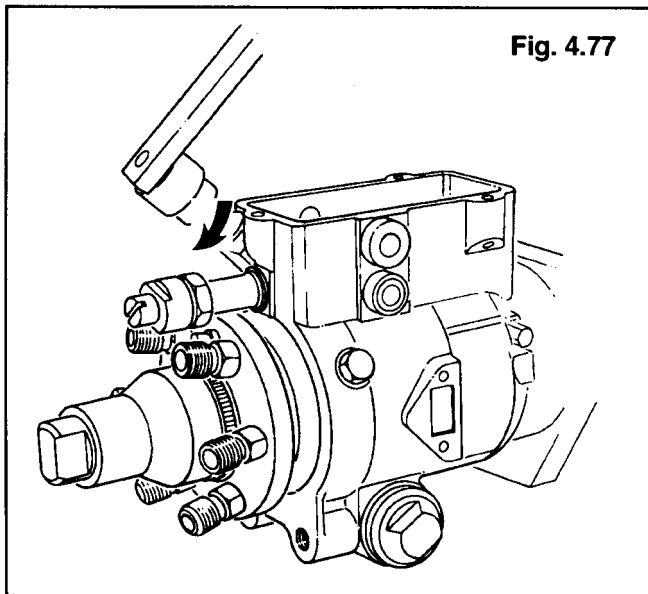


Fig. 4.77

**STEP 78** Assemble new terminal stud seals to electric shutoff solenoid and install solenoid to governor cover. Install insulating washers, flat washers, lock washers, and terminal contact nuts to studs and tighten nuts to 10-15 lbf-inches (1.1-1.7 N•m). Reference Service Bulletin 108 for additional information about electric shutoff solenoids.

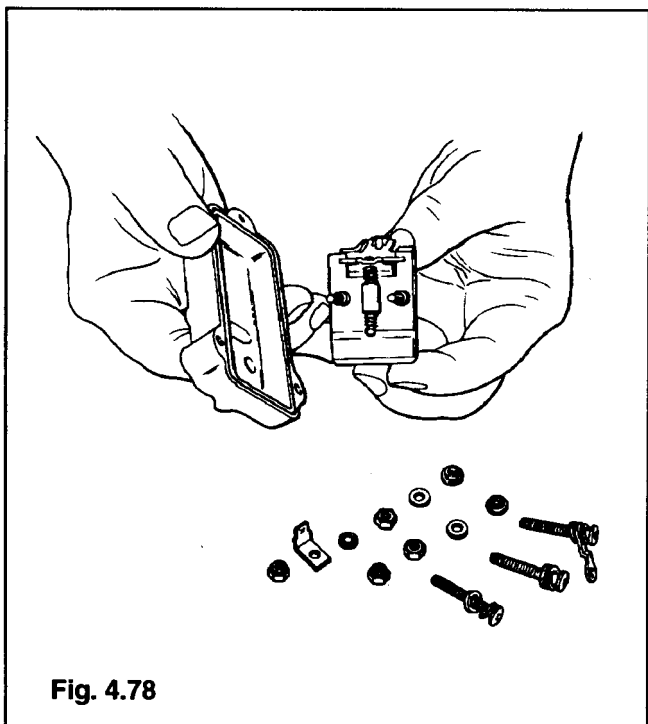


Fig. 4.78

**STEP 79** Install new governor cover seal.

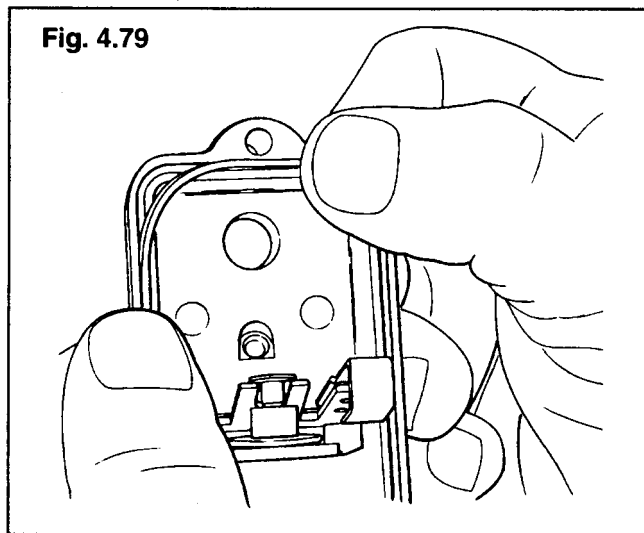


Fig. 4.79

**STEP 80** Install lockwasher and ground strap to appropriate electric shutoff terminal stud and install one governor cover screw with flat and lockwashers through ground strap and into cover. Install E.S.O. terminal locknuts and E.S.O. terminal (if equipped) to terminal studs and tighten to 10-15 lbf-inches (1.1-1.7 N•m). Install remaining two governor cover screws, washers and if equipped, tamper resistant cup to rear cover screw (Reference S.B. 134A).

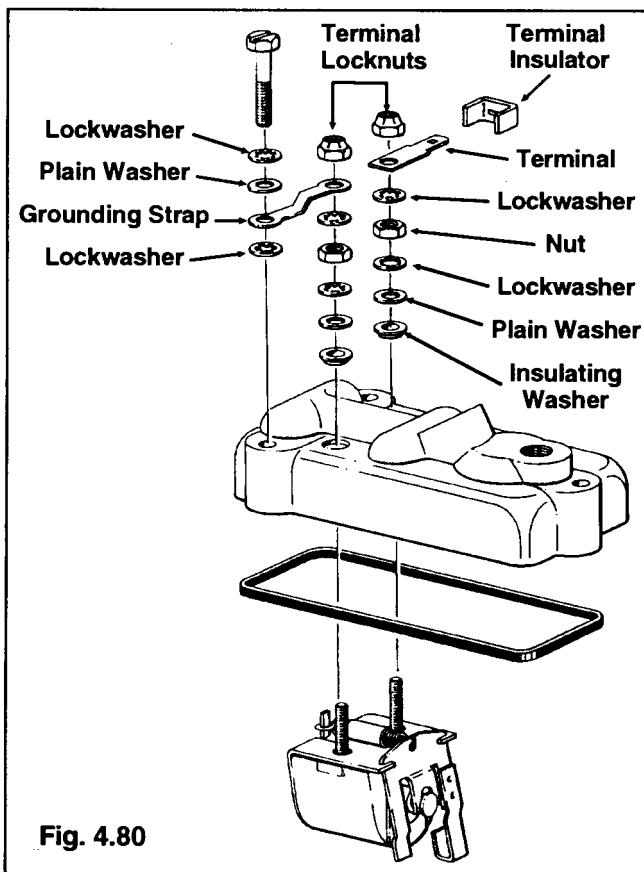
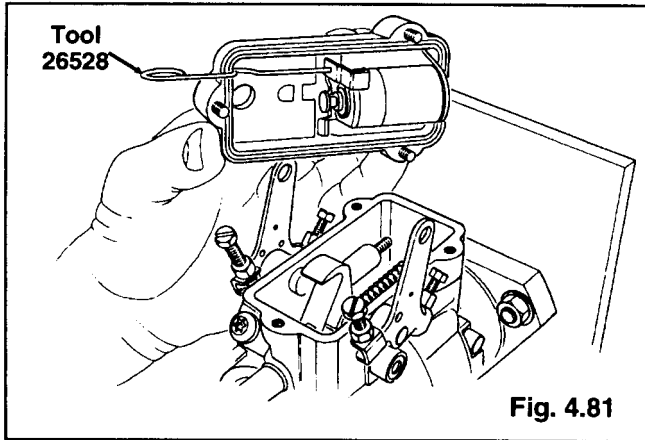
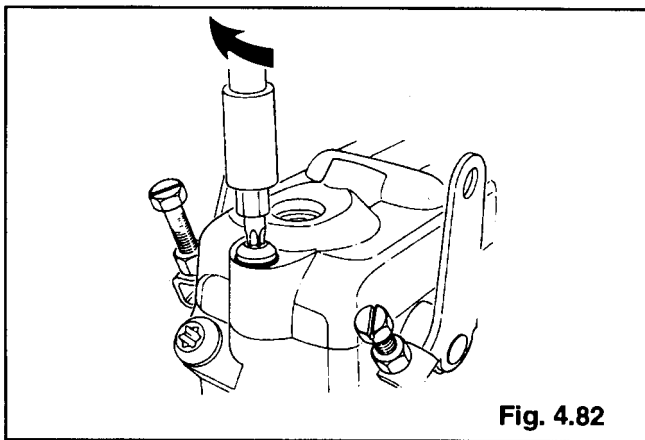


Fig. 4.80

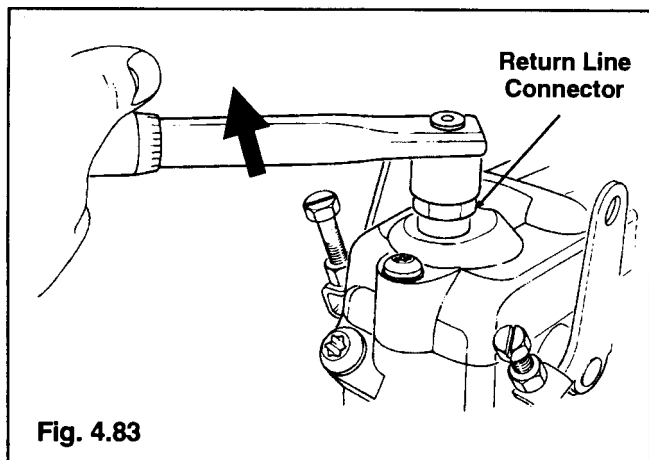
**STEP 81** If pump utilizes and energized to run (ETR) electric shutoff solenoid (ESO), use tool 26528 to retain shutoff arm in run position. Place governor cover on pump, rotate 26528 tool 90 degrees to release the arm and slide the tool out from between the cover and the housing.



**STEP 82** Tighten the governor cover screws to 35-45 lbf-inches (4.0-5.1 N•m).



**STEP 83** Assemble new seal to return line connector and assemble connector to governor cover. Tighten connector to 90-110 lbf-inches (10.2-12.4 N•m).



## SECTION 5 - BENCH TEST PROCEDURES

### A. Test Equipment Requirements

#### Test Bench

After reassembly, Stanadyne DB4 pumps must be calibrated to the individual specification requirements on a motorized test bench meeting ISO Standard 4008 which pertains to Fuel Injection Pump Test Bench Requirements.

At the present time, the minimum test bench horsepower requirements for DB4 pumps are as outlined in the Stanadyne Service Policies and Procedures Manual and are repeated here:

- Belt or Hydrostatic Drive - 7 Horsepower (5.2 kW)
- Direct Drive, DC Motor - 4 Horsepower (3 kW)

#### Test Bench Setup

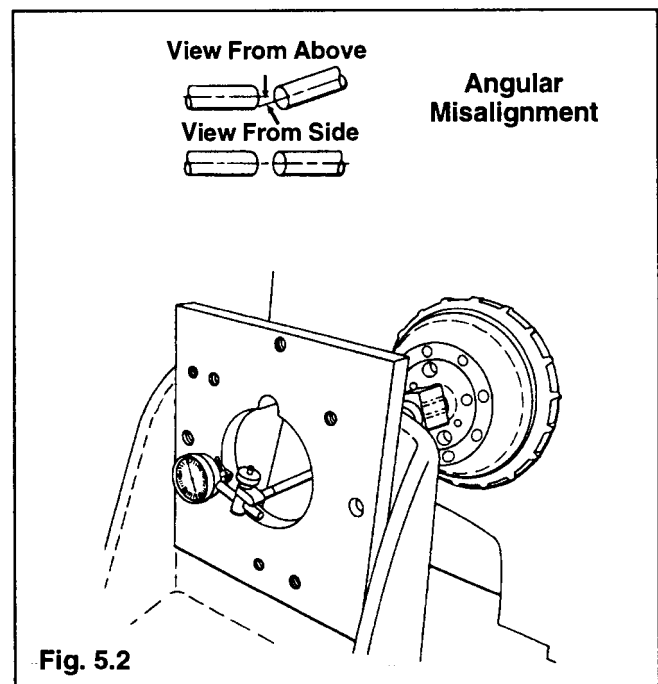
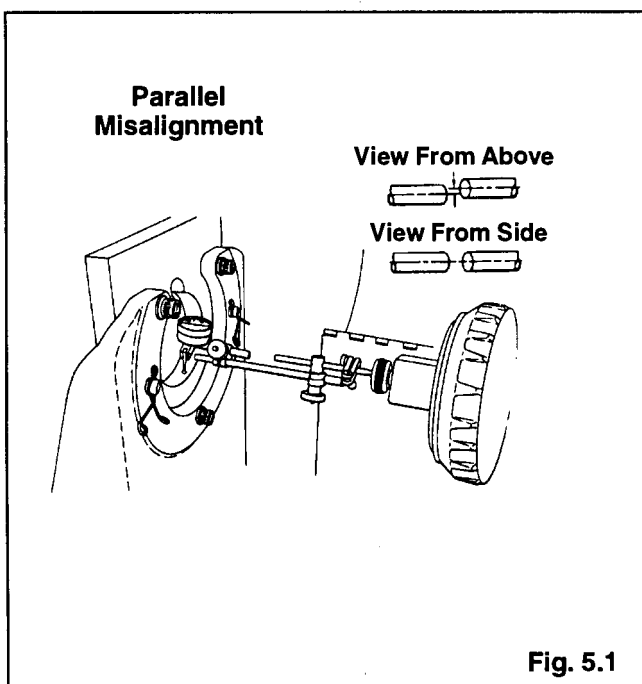
DB4 pumps are similar to DM pumps in that they are sensitive to test bench drive parallel or angular misalignment. Excessive misalignment could result in Head and Rotor seizure during testing, therefore test benches used for calibrating DB4 pumps should have their mounting and drive checked for proper alignment as follows:

**Parallel Alignment [Fig. 6.1]** - The pump mounting bracket pilot diameter *must* be held within .005" (0.127mm) Total Indicator Reading with the out-board end of the test stand drive shaft. The mount-

ing bracket should be in the immediate area of the test bench bed where the pump is normally mounted and connected for this measurement. Remove the test bench drive coupling and mount a dial indicator extending directly from the test stand drive shaft to the mounting bracket pilot. Depress indicator approximately .010" (0.254mm) and set to "zero". Rotate the test bench drive shaft 360° by hand while observing the indicator reading. Should the measurement exceed .005" (0.127mm), shim the bracket mounting supports as required to correct the alignment. If unable to correct the bracket mounting supports, consult the test bench manufacturer.

**Angular Alignment [Fig. 6.2]** - The pump mounting bracket front face *must* be held within .010" (0.254mm) Total Indicator Reading with the out-board end of the test bench drive shaft. With the same setup as parallel alignment, extend the dial indicator to the front face of the mounting bracket. Depress indicator approximately .010" (0.254mm) and set to "zero". Rotate the test bench drive shaft 360° by hand while watching the indicator. Should the measurement exceed .010" (0.254mm), shim the bracket mounting supports as required to correct the alignment. If unable to correct the bracket mounting supports, consult the test bench manufacturer.

The pump drive shaft must not be deflected by the test bench drive shaft. There should be .001 to .005" (0.0254 to 0.127mm) gap between the shaft coupling surfaces.



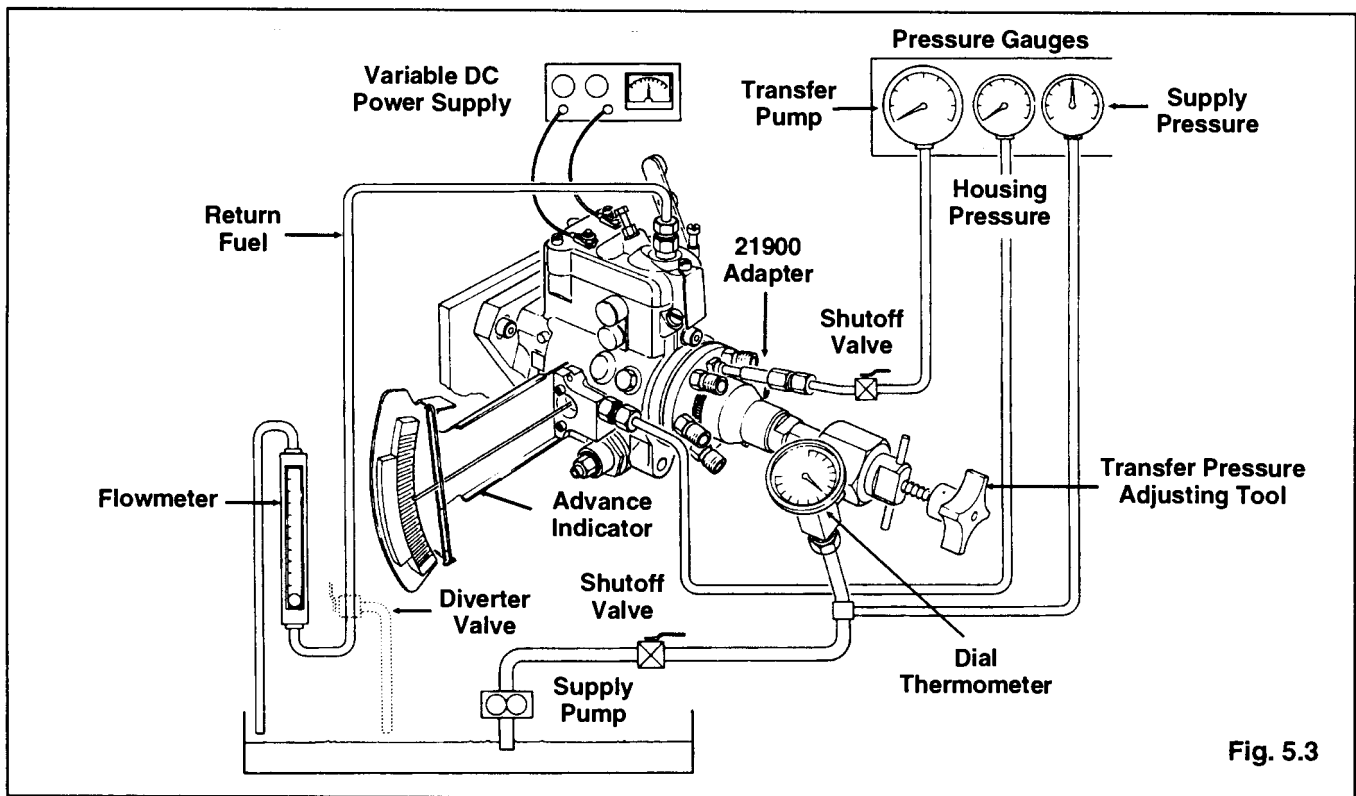


Fig. 5.3

As indicated in the ISO 4008 Standard, the test bench coupling should be of the self-aligning, no backlash type, such as a Thomas Coupling.

### Calibrating Injectors

At the present time, all DB4 pumps are tested with orifice plate calibrating injectors meeting ISO Standard 7440 or SAE Standard J968. Some models require 0.5mm orifice plates while others require 0.6mm orifice plates. Nozzle opening pressure is 3,000 p.s.i. (207 bar) using spring 781168 or equivalent. Parts Bulletin 184 and Service Bulletin 80 contain additional information on the availability of such test injectors. Service Dealers may possess one set of six such test injectors with 0.5mm orifice plates plus a set of six 0.6mm orifice plates to convert the injectors (or vice versa) in order to meet the DB4 calibrating injector requirements. Calibrating injector requirements are subject to change - always refer to the individual specification for the proper type.

### Injection Lines

Calibrating injection line requirements for DB4 pumps are also called out on the individual pump specification. It is recommended that test lines used for DB4 pumps meet ISO 4093 or J1418 standards. Currently there are two line sizes needed for calibrating DB4 pumps but the individual specification should always be consulted as line

requirements are subject to change. Also refer to Service Bulletin 80 and the "Distributor/Dealer Fuel Injection Test Line Evaluation Checklist", No. 99658, for line requirements. A set of six lines of each of the following sizes are currently required to calibrate DB4 pumps.

Inside Diameter	Length	Pump End Connection
0.063" (1.6mm)	25" (635mm)	12 x 1.5mm - 60° cone
0.063" (1.6mm)	25" (635mm)	14 x 1.5mm - 60° cone

### Special Tools

The following special Stanadyne service tools will be needed during calibration of DB4 pumps in addition to standard hand tools:

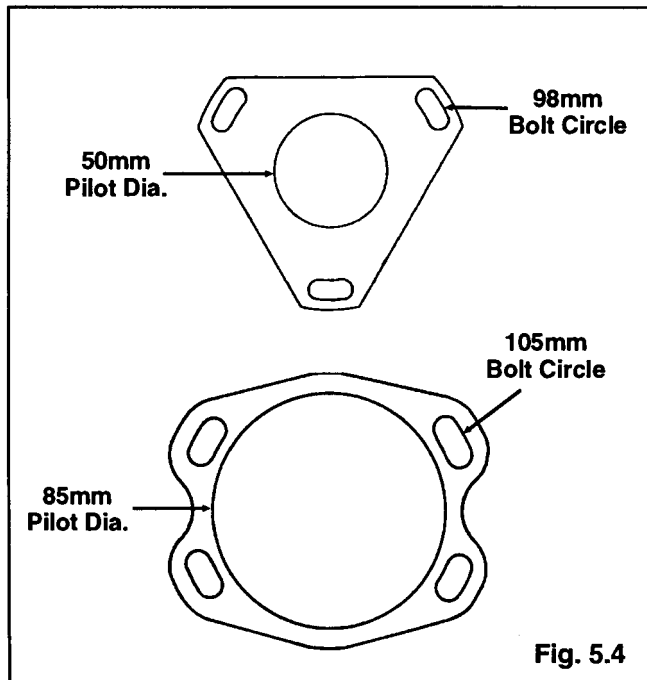
P/N	Description
21900	Transfer Pump Pressure Tap
23372*	Servo Light Load Advance Adjusting Tool
23745	Advance Indicator
26079**	Transfer Pump Pressure Adjuster

\*Needed for models equipped with this feature - Ref. S.B. 373.

\*\*Optional - allows adjustment of transfer pump pressure while pump is being operated.

## B. General Testing Procedures (Ref. Figure 5.3 and Service Bulletin 80)

Pump mounting adapters are provided by the various test equipment manufacturers, not by Stanadyne. At the present time DB4 pumps utilize the following mounting flange configurations.



Once the DB4 pump is mounted on the test bench, and the specified injection lines have been connected, attach the fuel supply line to the inlet of the pump. Service Bulletin 444 contains details regarding various inlet connection sizes. The 26079 transfer pressure adjusting tool kit contains all necessary adapters for the various inlet configurations. If the adjusting tool is not used, be sure to use an adapter fitting of the correct size and one that does not extend too far into the pump so as to block the transfer pressure regulator adjusting screw bore. If fuel flow out of this area is restricted, excessive transfer pump pressure could result which could damage the pump.

A thermometer must also be installed at the inlet of the pump as it is necessary to maintain the temperature of the calibrating fluid at 110 - 115°F (43 - 46°C) at the inlet during the entire calibration routine.

Similarly the test bench supply pressure must be maintained at the specified level (usually 2.0 ±0.5 p.s.i. [14 ±3kPa] throughout the test.

Next, attach the 23745 advance indicator to the timing window of the pump and engage the needle

into the groove on the cam ring and "zero" the indicator. Connect the housing pressure gauge to the fitting on the advance indicator. The return oil line can be routed to the test bench fuel tank, the test bench bed, or directed through a flow meter as shown in Figure 6.3.

If the pump is equipped with an electric shutoff solenoid, determine the voltage it is to be tested with by referring to the individual specification and set the variable voltage supply to this voltage. Voltage powering the solenoid should be measured at the E.S.O. terminal with a separate digital voltmeter. See Service bulletin 108 for additional information.

Install the 21900 transfer pump pressure tap along with the transfer pump end cap locking plate into the port provided on the hydraulic head. Connect the tap to the transfer pump pressure gauge. A shutoff valve must be installed at the tap so that the hose and gauge can be isolated from transfer pump pressure during calibration except when it is necessary to check or adjust the pressure. Failure to isolate the transfer pressure circuit from the gauge will cause calibration errors.

To test the pump, follow the steps on the individual specification. Please note that the specifications contain two test routines. The first one is for testing a pump as received (TAR) for service. This routine is frequently used for checking a pump's performance to determine if it has any warrantable defects. Please note that during the TAR routine that transfer pump pressure and return oil are not measured. Only those functions that have a direct affect on engine performance such as fuel delivery and advance movement are checked when testing a pump as received.

It should also be noted that during the test as received routine that the high and low idle settings should be checked first, and if necessary readjusted to specification prior to making other checks. This is done because these settings may have been altered on the engine and if they were, could result in erroneous fuel and/or advance readings at other checkpoints.

The test following service routine includes all adjustments and settings to properly calibrate the pump for the application. Follow the routine step by step and be sure the check for any special notes for additional information.



### C. Preparation of Pumps Following Calibration

After the pump has been calibrated, several final operations are necessary prior to returning it to the customer.

**Timing** - Refer to Service Bulletin 177 for a description of the common pump timing methods and check the specification to determine which method is used. Some DB4 pumps use a mark on the governor weight retainer which is placed at a specific angle using the 20395 timing line locating tool while other pump models are air timed with a mark being placed on the pump mounting flange. Some pumps utilize both of the above mentioned timing marks. Information on service tools and procedures for checking and placing air timing marks on the flange of DB4 pumps is contained in the special notes section of the individual specification and in Service Bulletin 480.

In addition, some DB4 pumps utilize locked drive shaft timing which is described in Service Bulletin 460. When this type of timing is used, align the timing mark on the governor weight retainer hub with the line on the cam ring as shown below in

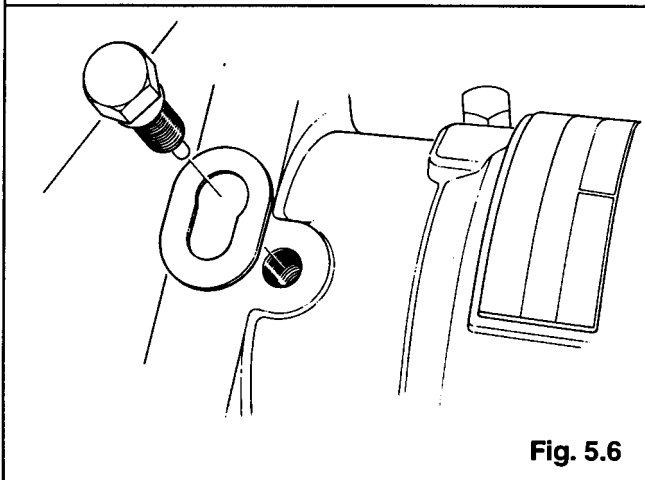
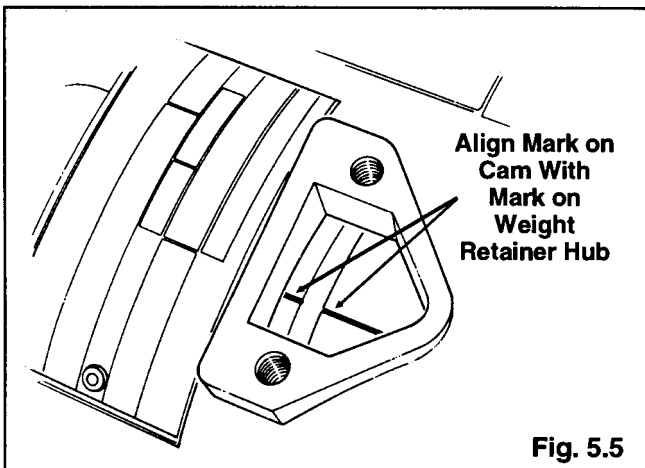


Figure 5.5. Then install the drive shaft locking screw into the housing aligning it with the large cutout on the key plate as shown in Figure 5.6. Tighten the screw to 105-110 lbf-inches (11.9-12.4 N•m) and then recheck the timing lines to make sure they are still aligned. If so, install the timing window cover, gasket and screws and tighten the screws to 15-20 lbf-inches (1.7-2.3 N•m).

**Tamper Resistance** - If specified, install the tamper resistant cap on the torque screw (Reference Service Bulletin 472). Also, if specified, install the tamper resistant cap and cup on the rear governor cover screw as outlined in Service Bulletin 134A. If the pump had sealing lacquer on any of the fasteners, replace it with red sealing lacquer (P/N 23042) as outlined in Service Bulletin 365. If any sealing wires (Ref. Service Bulletin 134) were used on any of the pump fasteners when the pump was received for service, these should also be replaced at this time using your 13364 seal press pliers. The part number for an individual wire is 10408 but they are sold in bundles of 50 pieces under part number 20288.

**Miscellaneous** - Reinstall the transfer pump pressure tap screw, transfer pump end cap locking plate and seal and tighten screw to 70-80 lbf-inches (7.9-9.0 N•m).

Install a new pilot seal to the face of the pump flange if the specification calls for one.

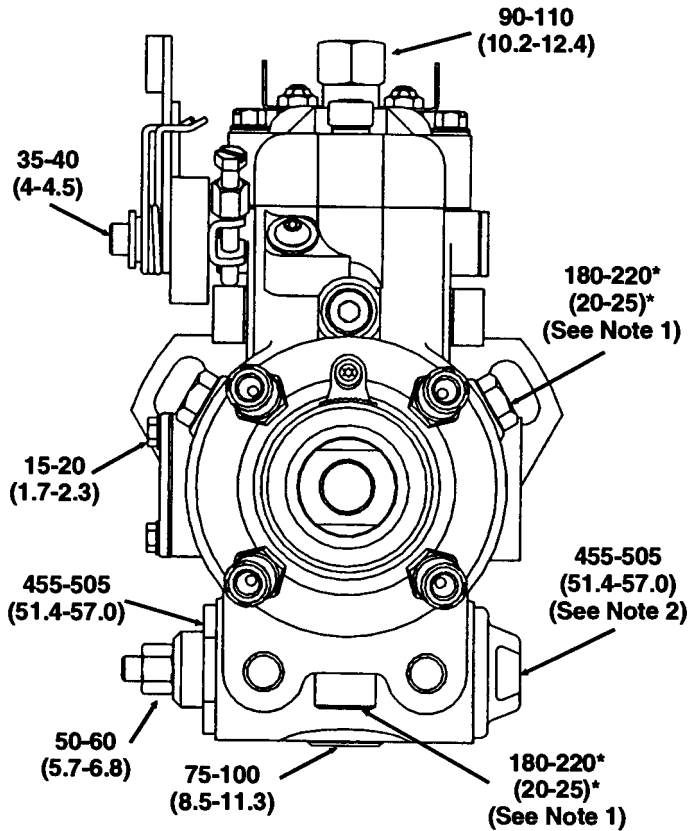
Install protective caps to prevent contaminants from entering the pump prior to and during installation on the engine. Caps should be fitted to the discharge fittings, the fuel inlet, and the return line connector.

## SECTION 6 - GENERAL DATA

### A. Torque Values

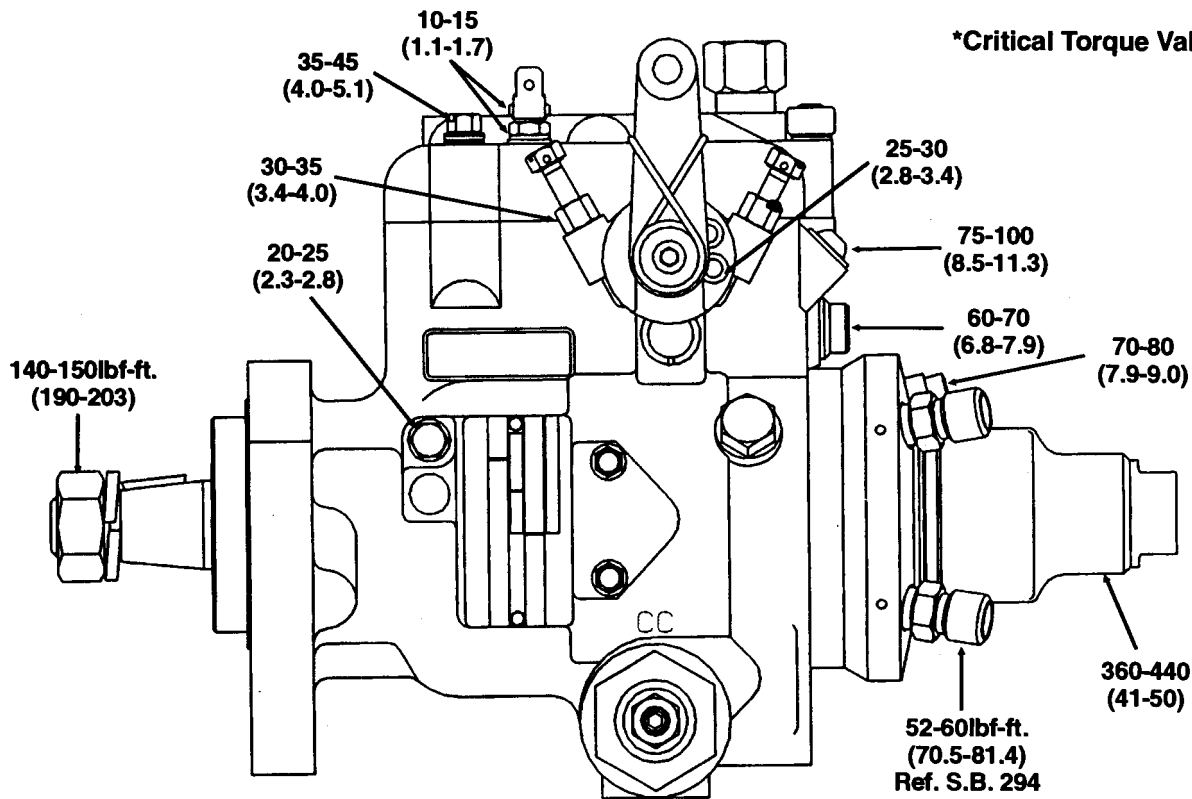
The following torque values apply to the threaded components of the DB4 pump. Please note that some torque values are designated as "critical" as indicated by an asterisk. This means that these fasteners must be hand tightened using extra care to ensure proper torque. *NOTE: Values are in lbf-inches and (Newton-meters) unless otherwise noted.*

<u>Description</u>	<u>Torque Value</u>
Delivery Valve Stop Screw	120-125* (13.6-14.1)*
Reed Valve Retaining Screws	3.0-5.0 (0.4-0.55)
Nut, Torque Screw	50-60 (5.6-6.8)
Nut, Manual Cold Start Advance Lever Retaining	215-265 (24.3-30.0)
Control Rod Guide (Speed Droop)	70-80 (8.0-9.0)
Cap, Droop Control Locking	60-70 (6.8-7.9)
Vent Wire Screw Assy.	32-38 (3.6-4.3)
Screw, Governor Linkage Hook	12-15 (1.36-1.70)
Screw, Drive Shaft Locking	105-110 (11.9-12.4)
Screw, Aneroid Bracket	35-45 (4.0-5.1)



**Note 1 - Tighten Head Locating Screw first, then Head Locking Screws.**

**Note 2 - Value is for Plugs with 1 inch - 20 threads. See Service Bulletin 465.**



**\*Critical Torque Values**

**Fig. 6.1**





**Stanadyne Corporation**  
92 Deerfield Road  
Windsor, CT 06095, U.S.A.  
[www.stanadyne.com](http://www.stanadyne.com)

**Stanadyne SpA**  
Via Matteotti 158  
25014 Castenedolo (Brescia), Italia

**Stanadyne Amalgamations Private Ltd.**  
96, Aranvayal Village  
Poonamalle-Thiruvallur High Road (Near Pratyusha Engg College)  
Thiruvallur District- 602025, India

**Stanadyne Changshu Corporation**  
155# Huangshan Road  
Southeast Economy Development Zone  
Changshu City, 215500, Jiangsu Province  
P.R.C. (People's Republic of China)