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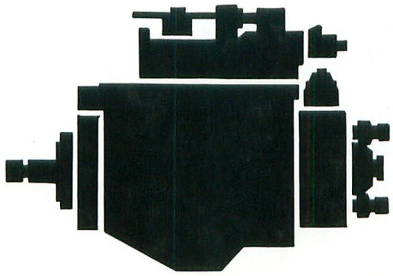
SERVICE MANUAL

REPAIR SERVICE & MAINTENANCE

FUEL INJECTION PUMP MODEL VE



ZEXEL

FOREWORD

This service manual has been prepared for the purpose of assisting service personnel in providing efficient and correct service and maintenance on the VE model Injection Pump installed in passenger vehicles, light trucks, vans and off-road vehicles.
This manual includes procedures for adjustment, disassembly and reassembly of components.

The contents of this manual, including illustrations, drawings and specifications are the latest available at the time of printing.
The right is reserved to make changes in specifications and procedures at any time without notice.

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SPECIAL TOOLS FOR PUMP DISASSEMBLY AND REASSEMBLY

To service the VE type injection pumps, the following special tools and general tools should be prepared.

No.	Part No.	Part Name	Q'ty	Remarks
1	157829-0420	Measuring device	1	Measurement of dimensions "KF" and "K"
2	157829-1100	Block gauge	1	Dimension "MS" adjustment
3	157829-0720	Inserter	1	For installing control shaft
4	157914-2500	Socket wrench	1	For removing and installing head plug
5	157914-2600	Socket wrench	1	For removing and installing regulating valve
6	157914-2700	Socket wrench	1	For removing and installing pivot bolt
7	157829-5420	Feed pump holder	1	For removing and installing feed pump
8	157915-2620	Adjusting device	1	For adjusting and tightening governor shaft
9	157914-1100	Socket wrench	1	For removing and installing delivery valve holder (SW 14 mm)
10	157922-0900	Oil seal guide	1	For 17mm dia. drive shaft
11	157922-1000	Oil seal guide	1	For 20mm dia. drive shaft (short)
12	157922-1100	Oil seal guide	1	For 20mm dia. drive shaft (long)
13	157925-2420	Oil seal extractor	1	For 17mm dia. drive shaft
14	157925-2720	Oil seal extractor	1	For 20mm dia. drive shaft
15	157829-8620	Measuring device	1	For measuring dimension "MS" (used together with measuring device 157829-3520, left-hand thread M10×1)
16	157829-7520	Block gauge	1	For adjusting boost compensator lever position during dimension "MS" measurement
17	157829-7620	Block gauge	1	For adjusting boost compensator lever position
18	157841-9200	Measuring device	1	For measuring dimension "MS" (used together with measuring device 157829-3520, and pin 157829-8300, right hand thread M10×1)
19	157944-8520	Universal vise	1	Used with brackets (157944-7920 and 157944-8720)
20	157944-7920	Bracket	1	For fixing VE pump
21	157944-7200	Bracket	1	For fixing bracket (157944-7920)
22	010010-2200	Bolt	1	For fixing bracket (157944-7200)
23	105794-0050	Universal vise	1	Previous type
24	157944-2600	Bracket	1	Used with universal vise (105794-0050)
25	157954-3600	Dial gauge	1	For measuring dimensions "KF" and "K"

Note: The special tool KIT (105790-1080) for the VE pump includes tools with key numbers 1 to 17.

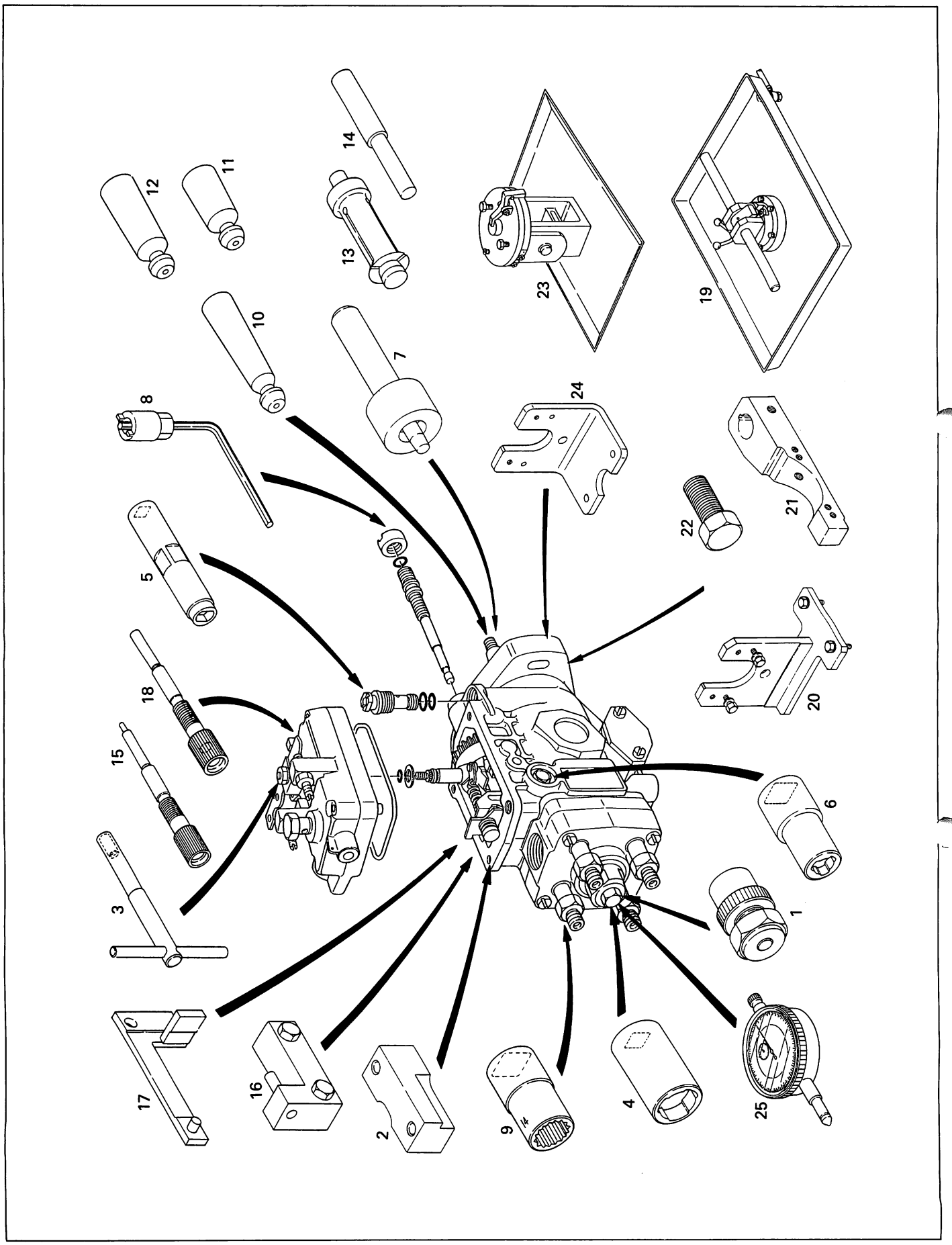


Fig. 1 Special tools for disassembly and reassembly

INJECTION PUMP DISASSEMBLY

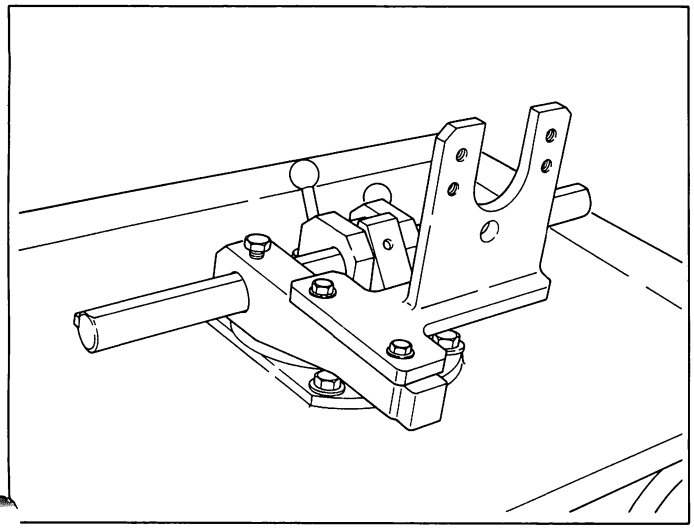


Fig. 2 Fixing the bracket

Preparation

1. Keep the bench and workshop clean and before disassembly clean completely the outside of the injection pump assembly.
2. Before disassembly record the positions of adjustable parts to facilitate reassembly, and record injection pump performance so that a comparison may be made after adjustment.
3. The numbers in parentheses following part names refer to the key numbers in Fig. 133, and those following tool names refer to tool part numbers.

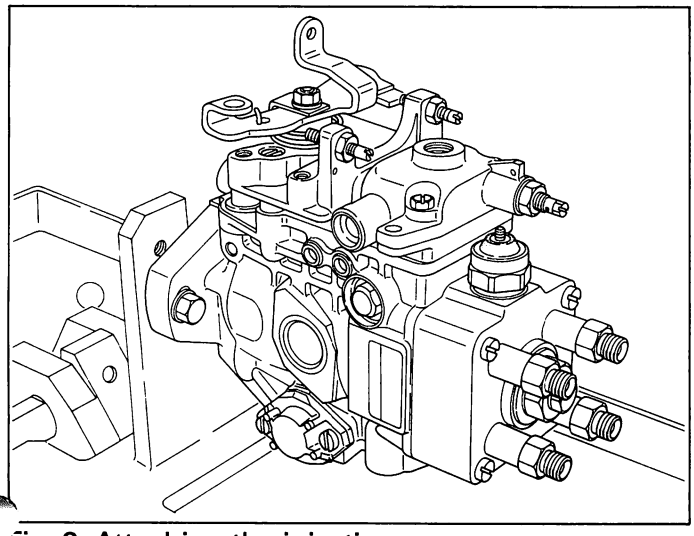


Fig. 3 Attaching the injection pump

Disassembly

1. Before attaching the injection pump to the universal vise, remove the overflow valve (136) and drain the fuel oil from the pump.
2. Fix the bracket (157944-7200) to the universal vise (157944-8520) using the bolt (010010-2200).
3. Securely fix the bracket (157944-7920) to the bracket (157944-7200) using the two bolts. (Fig. 2)
4. Attach the injection pump to the bracket (157944-7920) using the two bolts. (Fig. 3)

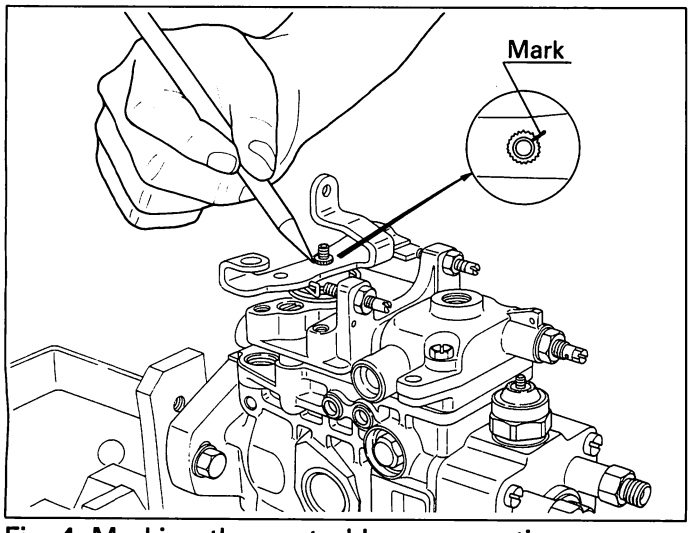


Fig. 4 Marking the control lever mounting position

5. Remove the nut (67/7), spring washer (67/6) and bracket (67/19), and then mark the mounting position on the control lever (67/5) and control shaft (67/2) for easier reassembly and readjustment. (Fig. 4)

Note: **As there are aligning marks on the control lever and control shaft in the case of 2-piece separate type control levers, note their positions before disassembly.**

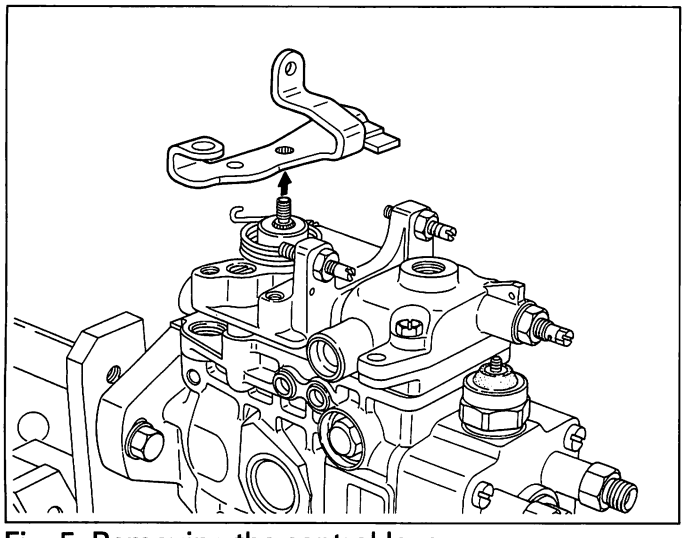


Fig. 5 Removing the control lever

6. Remove the control lever and then remove the cylindrical, helical, coiled spring (67/18). (Fig. 5)

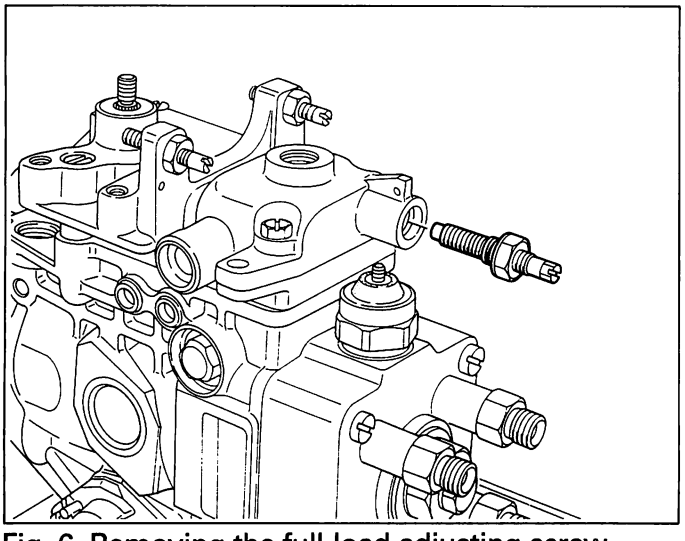


Fig. 6 Removing the full-load adjusting screw

7. Loosen the nut (90) and remove the full-load adjusting screw (88) together with the washer (87) and O-ring (91). (Fig. 6)

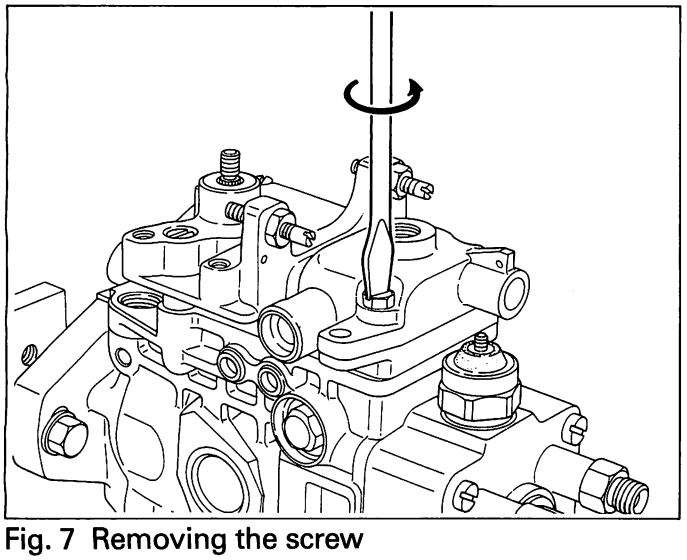


Fig. 7 Removing the screw

8. Remove the four screws (123) fixing the governor cover (67/1). (Fig. 7)

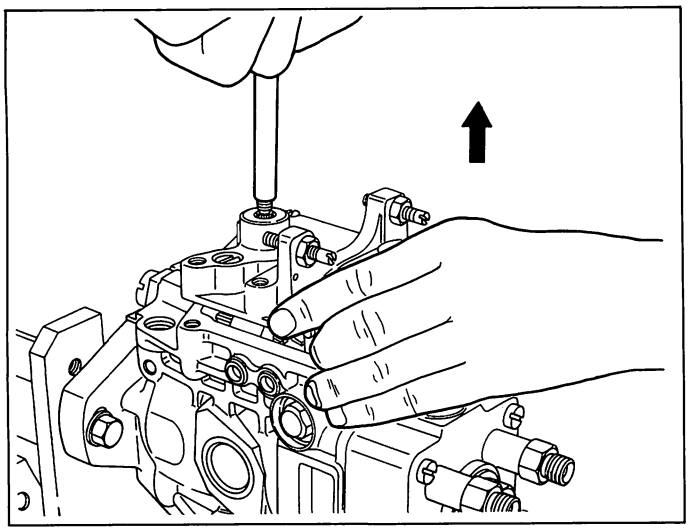


Fig. 8 Removing the governor cover

9. Screw the inserter (157829-0720) onto the control shaft (67/2). Next, lift and separate the governor cover from the control shaft, while holding the control shaft with the inserter. (Fig. 8)

Note: Do not tap the control shaft using a hammer.

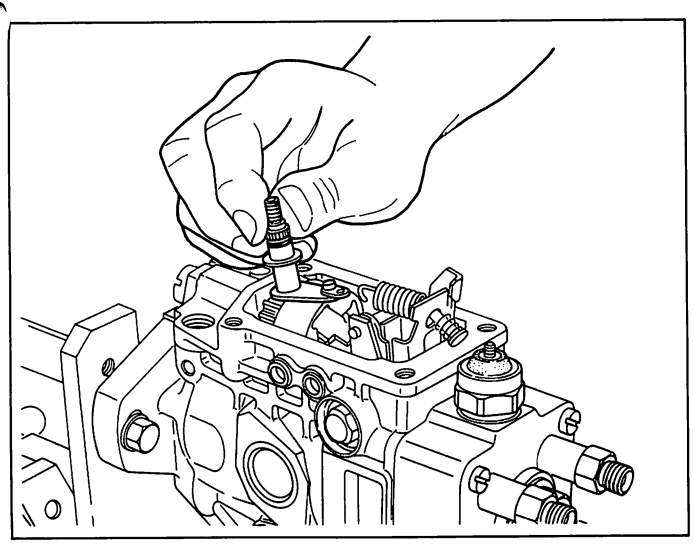


Fig. 9 Removing the control shaft

10. Remove the control shaft (67/2) from the governor spring (122) together with the O-ring (67/3) and washer (67/4). (Fig. 9)

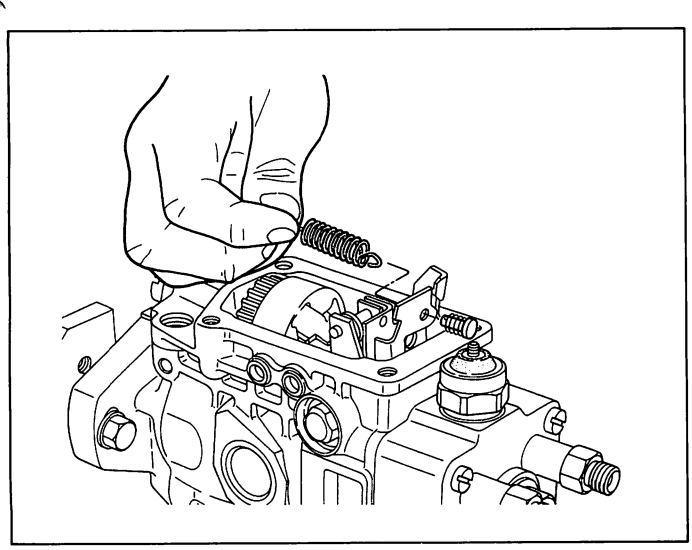


Fig. 10 Removing the governor spring

11. Disconnect the governor spring (122) from the retaining pin (120) and remove the pin and two springs. (Fig. 10)

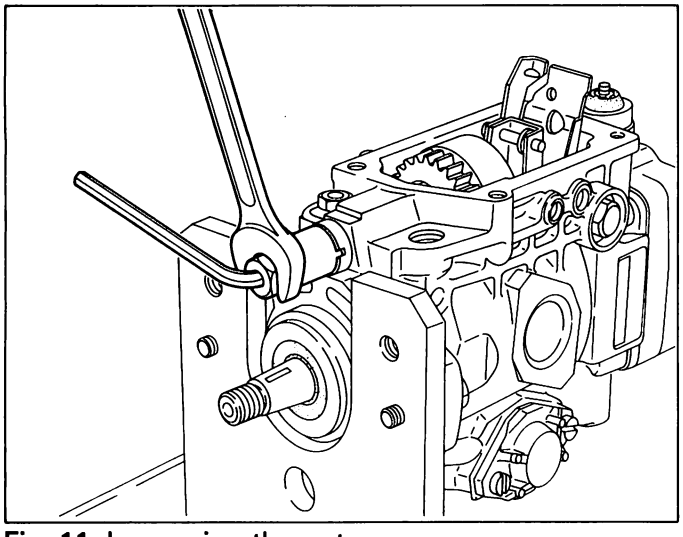


Fig. 11 Loosening the nut

12. Using the adjusting device (157915-2620) loosen the nut (107) and remove it. (Fig. 11)

Govenor shaft threads are as follows.

Direction of pump rotation	Current spec.	New spec.
Clockwise	Left-handed	Right-handed
Counterclock-wise	Right-handed	Right-handed

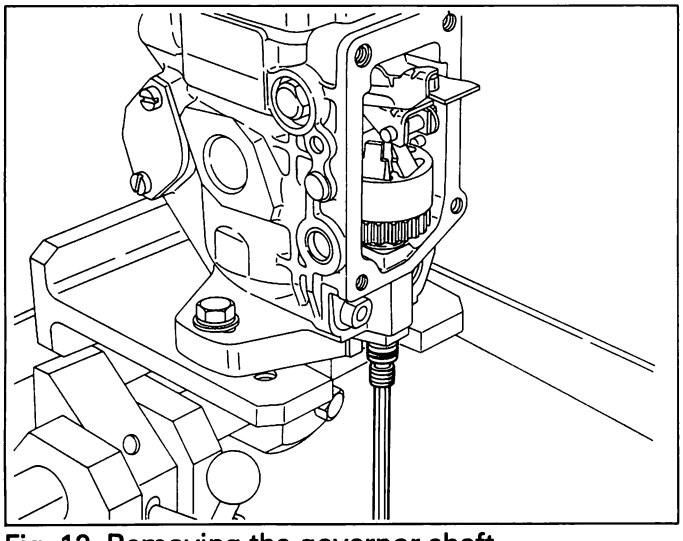


Fig. 12 Removing the governor shaft

13. Secure the injection pump upright in the universal vise, loosen the governor shaft (108) using a hexagon wrench and then remove it. (Fig. 12)

Govenor shaft threads are as follows.

Direction of pump rotation	Current spec.	New spec.
Clockwise	Left-handed	Right-handed
Counterclock-wise	Right-handed	Right-handed

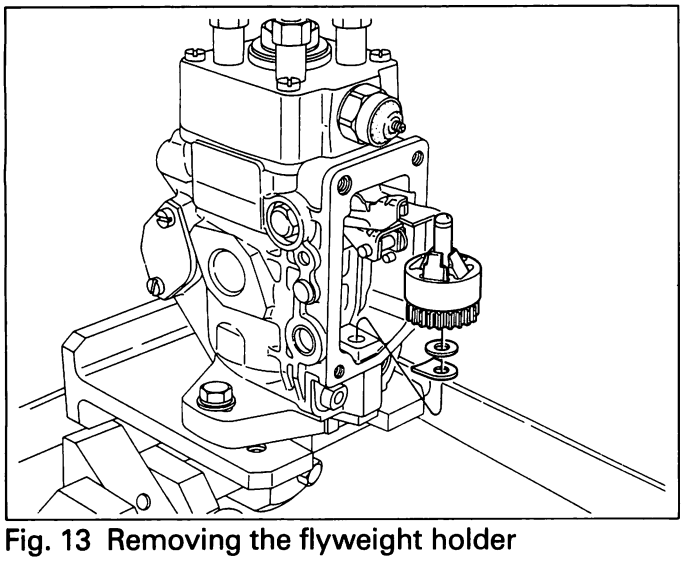


Fig. 13 Removing the flyweight holder

14. Remove the flyweight holder (112) together with the flyweights (113), washer (114) and governor sleeve (115). (Fig. 13)

Note: Take care not to lose the shim (110) and washer (111) at the base of the flyweight holder.

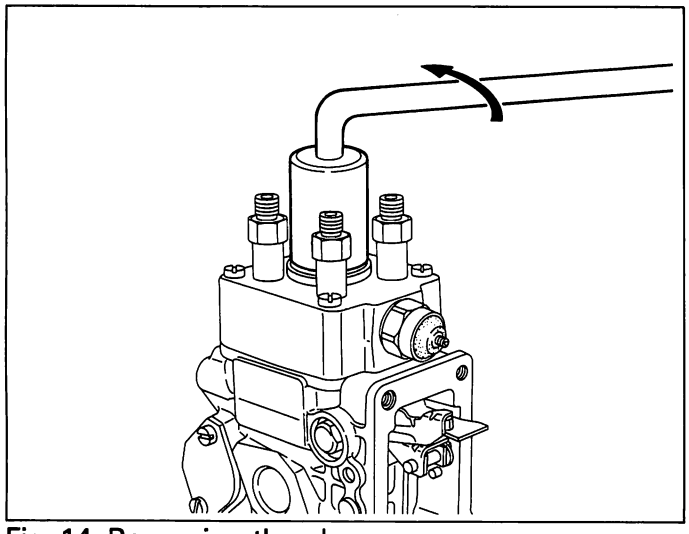


Fig. 14 Removing the plug

15. Loosen the plug (130) using the socket wrench (157914-2500), and then remove it together with the O-ring (129). (Fig. 14)

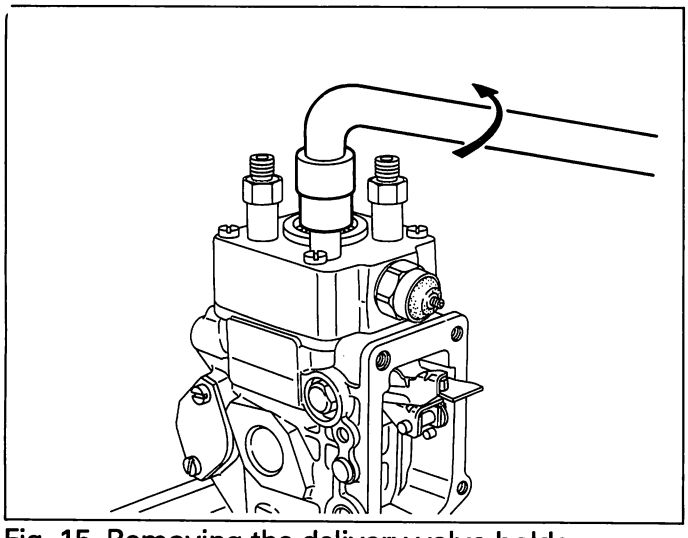


Fig. 15 Removing the delivery valve holder

16. Loosen the delivery valve holder (58) using the socket wrench (157914-1100), and then remove it together with the delivery valve spring (56) and washer (57). (Fig. 15)

Note: 1 The letters A, B... etc. are engraved on each cylinder of the distributor head (50) for identification. Remove each delivery valve holder and delivery valve, etc. in alphabetical sequence and label them to ensure that they are remounted in the same cylinders.

2 Washers (57) are not mounted on delivery valve holders fitted with damping valves.

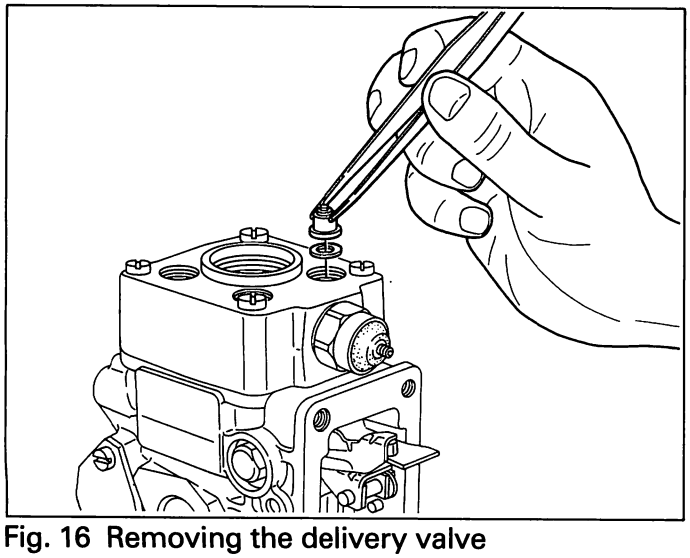


Fig. 16 Removing the delivery valve

17. Remove the delivery valve (55). (Fig. 16)
18. Remove the delivery valve gasket (54).

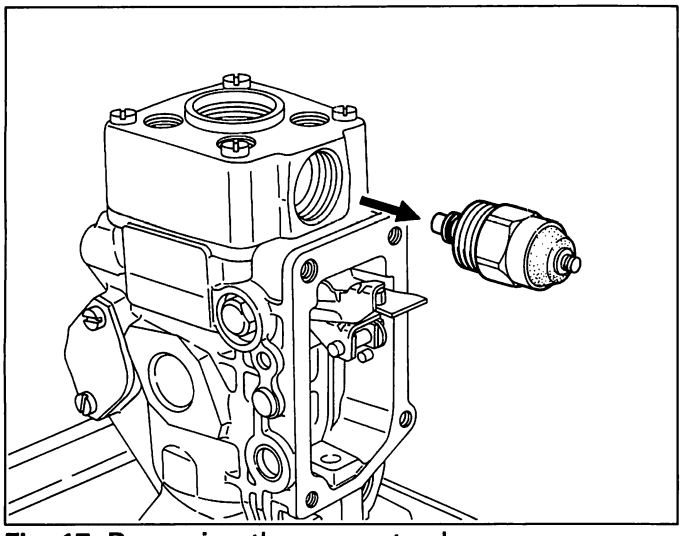


Fig. 17 Removing the magnet valve

19. Remove the magnet valve (240) together with the O-ring (Fig. 17)

Note: Take care not to lose the spring (240/2) and armature (240/3).

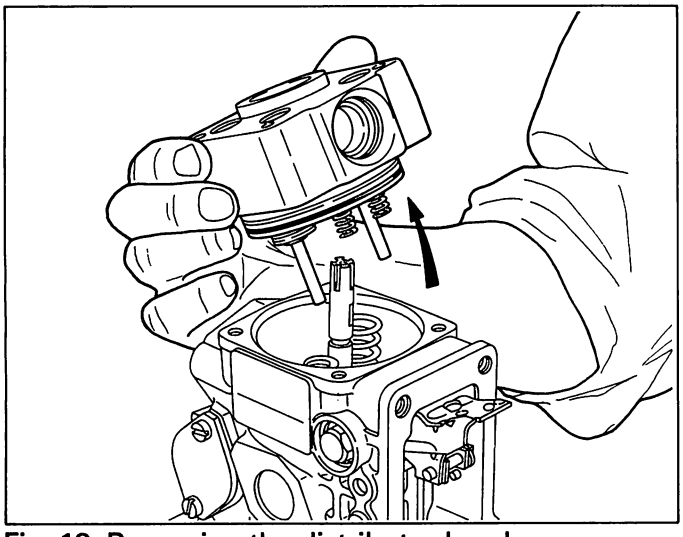


Fig. 18 Removing the distributor head

20. Loosen the four screws (60) and remove the distributor head (50) from the pump housing together with the O-ring (51). (Fig. 18)

Note: Take care not to lose the two springs (106), guide pins (49), shims (48) and spring seats (47).

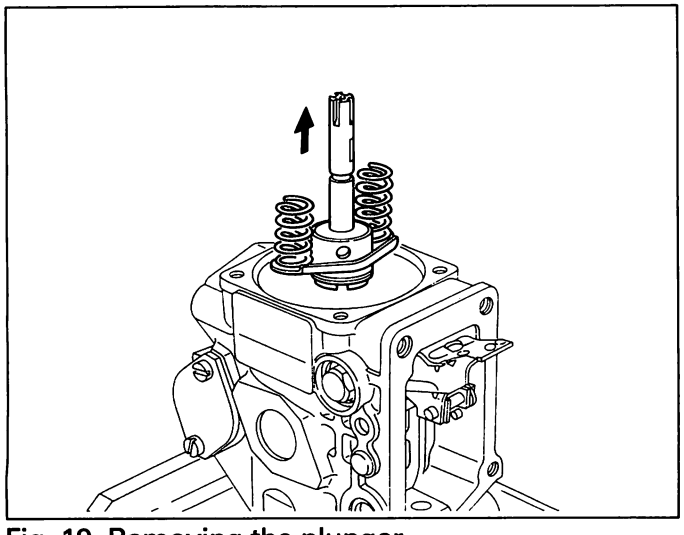


Fig. 19 Removing the plunger

21. Remove the plunger (50/2) from the pump housing together with the control sleeve (50/3), plunger springs (46), spring seat (45), shim (43) and washer (44). (Fig. 19)

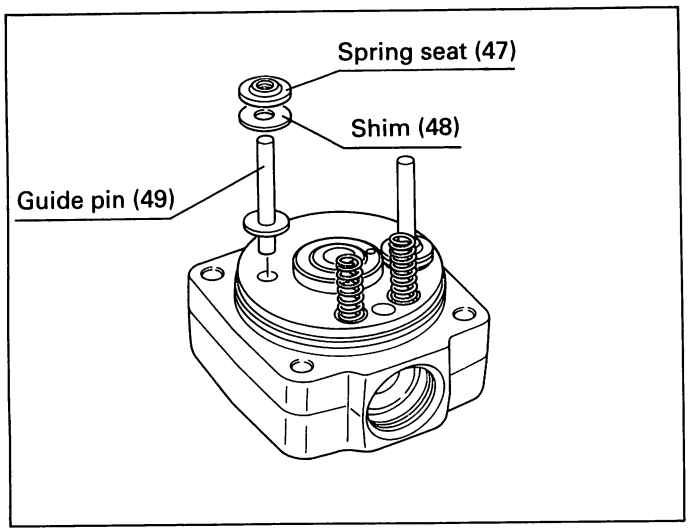


Fig. 20 Removing the guide pin

22. Remove the guide pins (49) from the distributor head together with the shims (48) and spring seats (47). (Fig. 20)

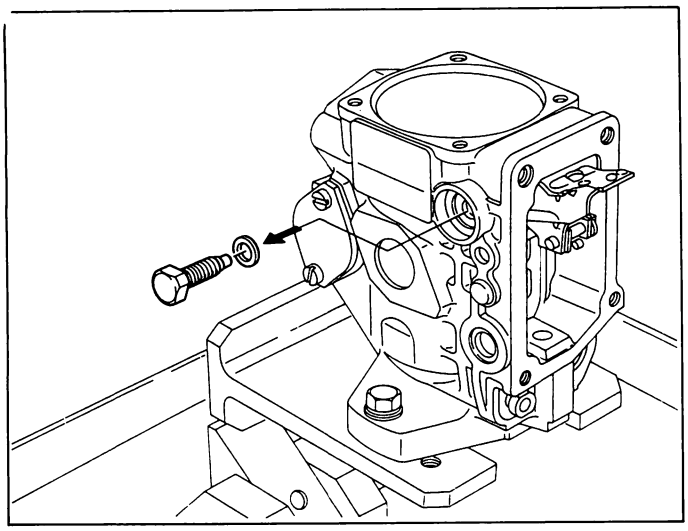


Fig. 21 Removing the pivot bolt

23. Loosen the two pivot bolts (104) on the sides of the pump housing using the socket wrench (157914-2700), and remove them together with the gaskets (105). (Fig. 21)

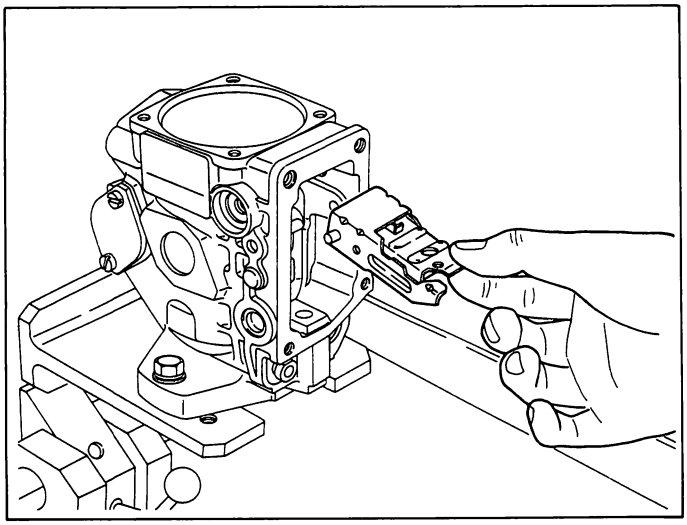


Fig. 22 Removing the governor lever assembly

24. Remove the governor lever assembly (95) i.e. the starting lever, tension lever and corrector lever by loosening each pivot bolt. (Fig. 22)

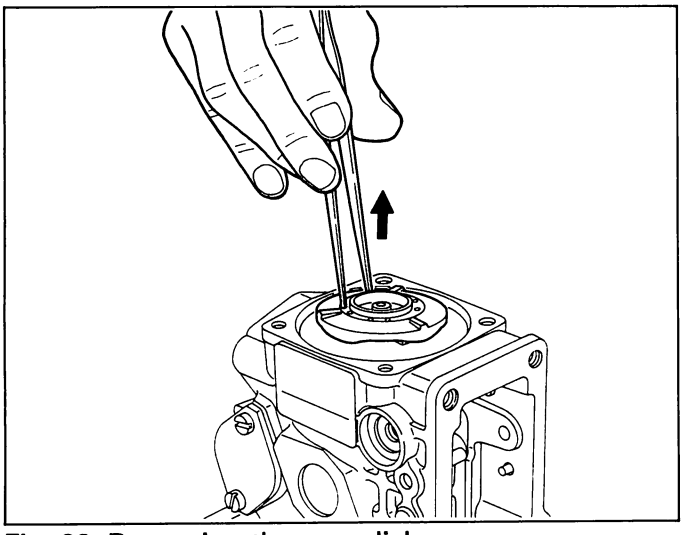


Fig. 23 Removing the cam disk

25. Remove the cam disk (29) together with the shim (52). (Fig. 23)

Note: Take care not to lose the shim on the cam disk.

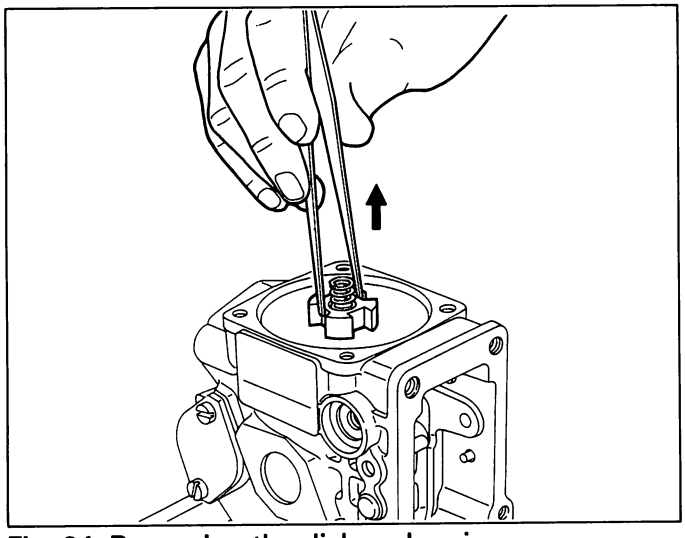


Fig. 24 Removing the disk and spring

26. Remove the disk (27) together with the spring (200). (Fig. 24)

Note: Take care not to lose the spring.

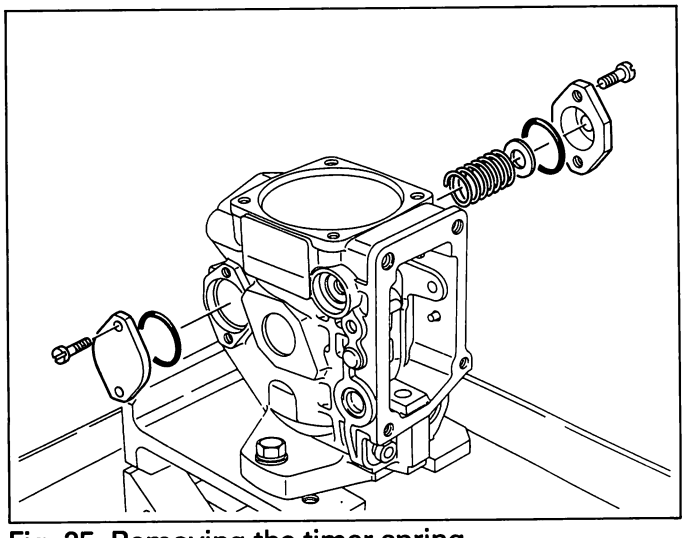


Fig. 25 Removing the timer spring

27. Loosen the 4 screws (38 and 40) and remove the timer covers (37 and 39) together with the timer spring (34) and O-rings (30 and 36). (Fig. 25)

Note: Take care not to lose the shim(s) (35) inside the cover.

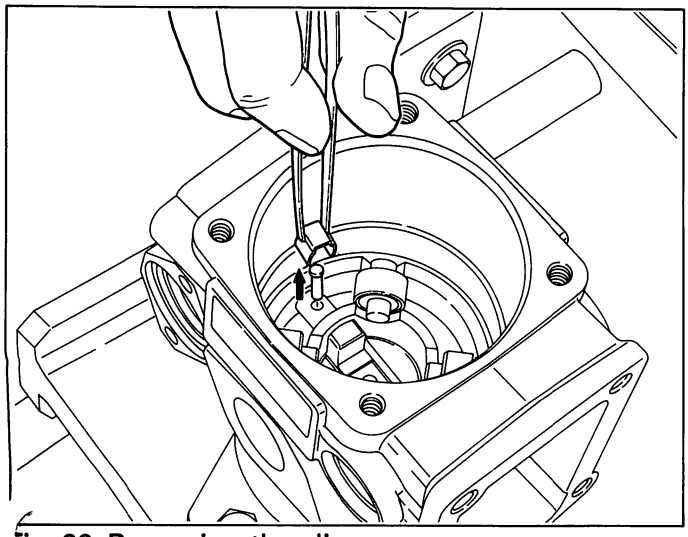


Fig. 26 Removing the clip

28. Using tweezers, remove the clip (26) and pin (25) from the roller holder pin (24) connecting the timer piston (31) to the roller holder assembly (20). (Fig. 26)

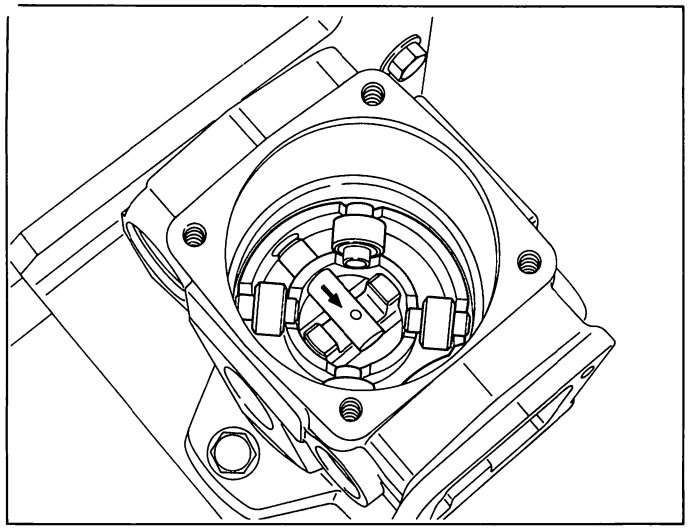


Fig. 27 Disconnecting the roller holder pin

29. Slide the roller holder pin (24) towards the center of the roller assembly (20), as shown in Fig. 27, to enable the roller assembly to be disconnected from the timer piston (31).

Note: During this operation rotate the drive shaft to a position permitting easy movement of the roller holder pin.

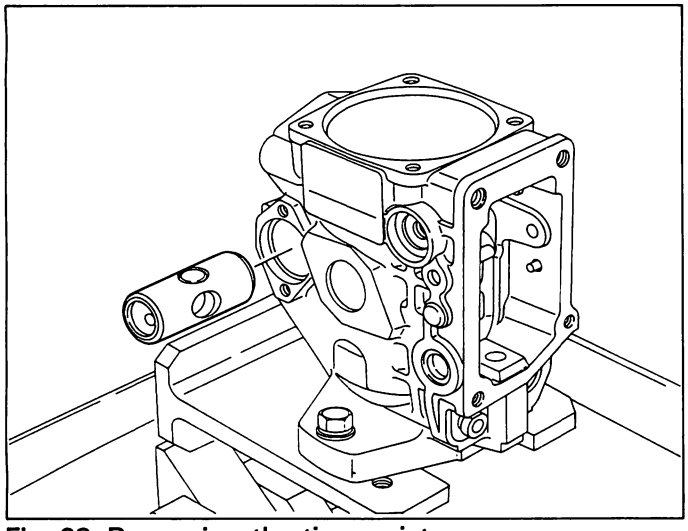


Fig. 28 Removing the timer piston

30. Extract the timer piston (31) together with the slider (32) and shim (33). (Fig. 28)

Note: Take care not to lose the slider and shim in the timer piston.

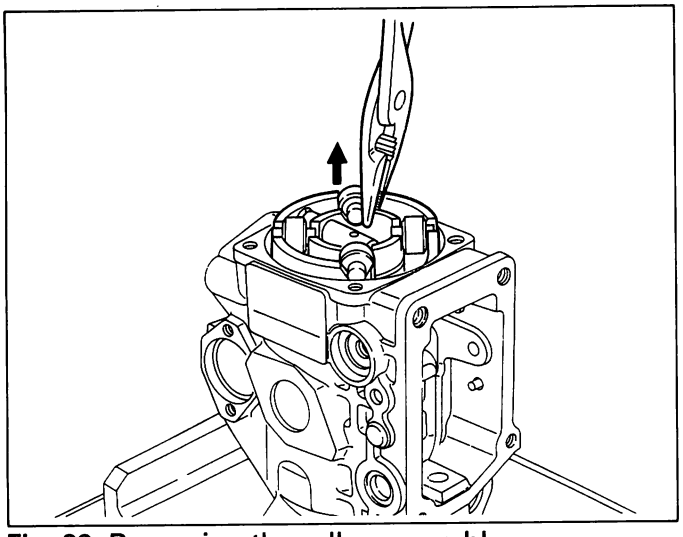


Fig. 29 Removing the roller assembly

31. Extract the roller assembly (20) by grasping the inside of the roller holder with long-nosed pliers and lightly pulling. (Fig. 29)

Note: Take care not to disturb the position of each roller, roller bush and roller pin already fitted in the roller holder.

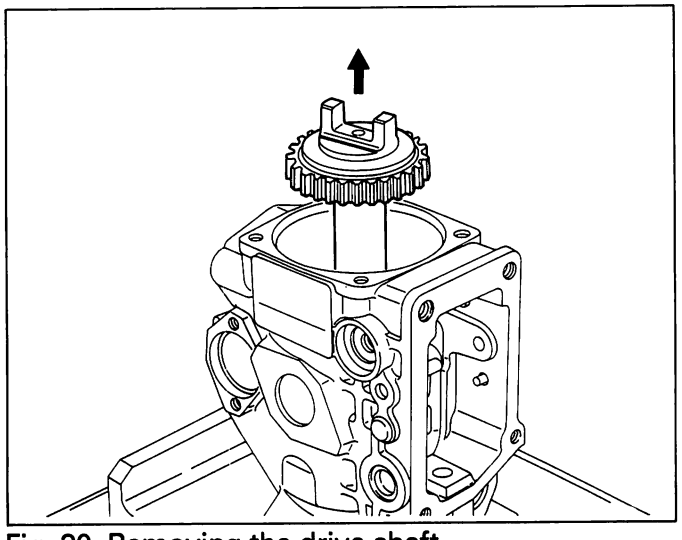


Fig. 30 Removing the drive shaft

32. Rotate the drive shaft (12/1) until its keyway faces the top of the injection pump and then attach the oil seal guide (157922-0900: for 17ϕ shaft, 157922-1000: for 20ϕ short shaft, 157922-1100: for 20ϕ long shaft) onto the drive shaft to prevent the keyway from damaging the oil seal.

33. Extract the drive shaft together with the gear (12/4), rubber dampers (12/3), washer (17) and woodruff key (12/2). (Fig. 30)

Note: Take care not to lose the feed pump woodruff key on the drive shaft.

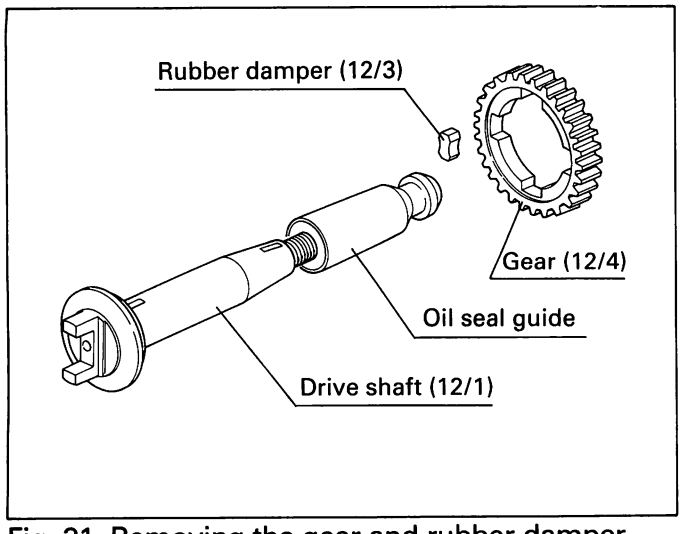


Fig. 31 Removing the gear and rubber damper

34. Remove the gear, rubber dampers and oil seal guide from the drive shaft. (Fig. 31)

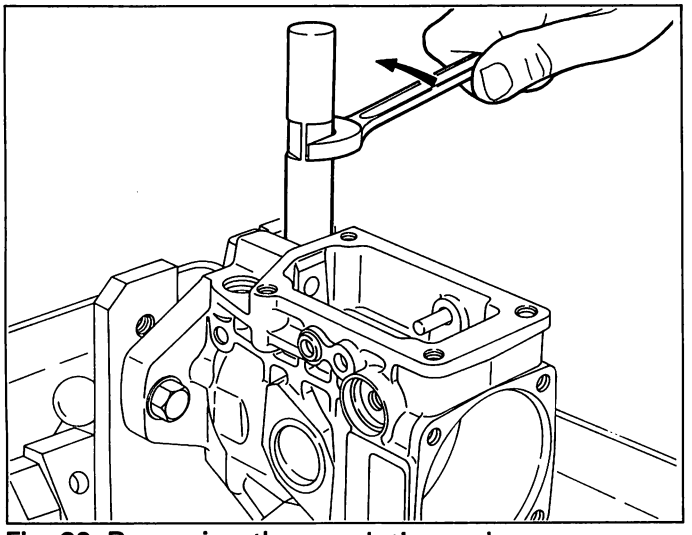


Fig. 32 Removing the regulating valve

35. Loosen the regulating valve (135) using a socket wrench (157914-2600), and remove it together with the O-rings (133 and 134). (Fig. 32)

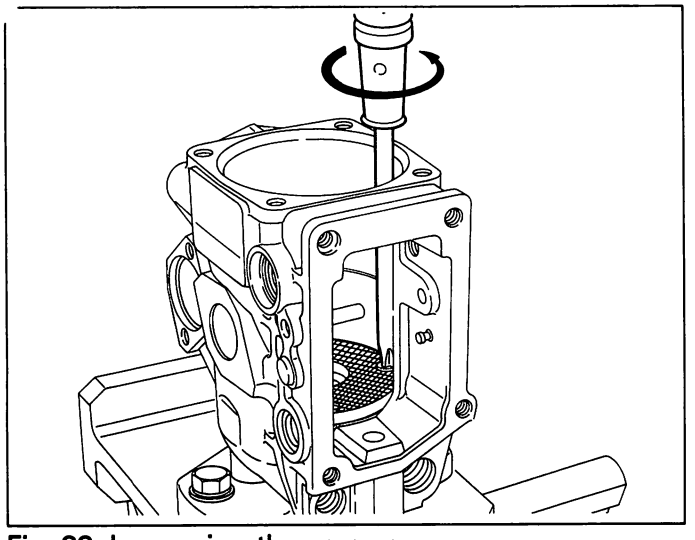


Fig. 33 Loosening the screws

36. Loosen the two screws (10) fixing the feed pump cover (9) and then remove them. (Fig. 33)

37. After removing the pump housing from the bracket (157944-7920) insert the feed pump holder (157829-5420) into the pump housing, and then reverse the position of the injection pump.

38. While lightly tapping the pump housing with a plastic hammer, remove the feed pump assembly (6) together with the cover (9) by extracting the feed pump holder downwards. (Fig. 34)

Note: 1 Do not tilt the liner while extracting the feed pump holder.
2 After removing the feed pump assembly, take care not to alter the position of each blade installed in the rotor.

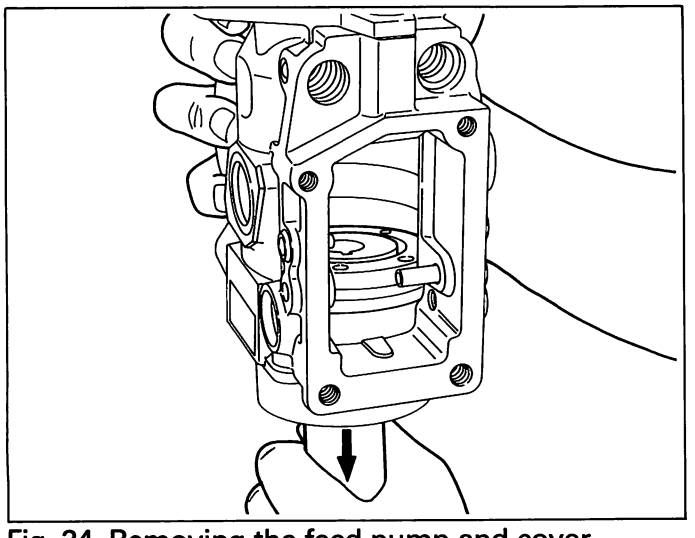


Fig. 34 Removing the feed pump and cover

This completes the disassembly of the injection pump. Thoroughly wash all disassembled parts in light oil.
After washing, inspect all pump parts and replace those which are worn or damaged. Immerse all sliding parts in clean light oil. Do not disassemble the plunger and control sleeve from the distributor head, and the delivery valves from the valve seats.
Replace all O-rings, gaskets, oil seals and seal rings.

INJECTION PUMP REASSEMBLY

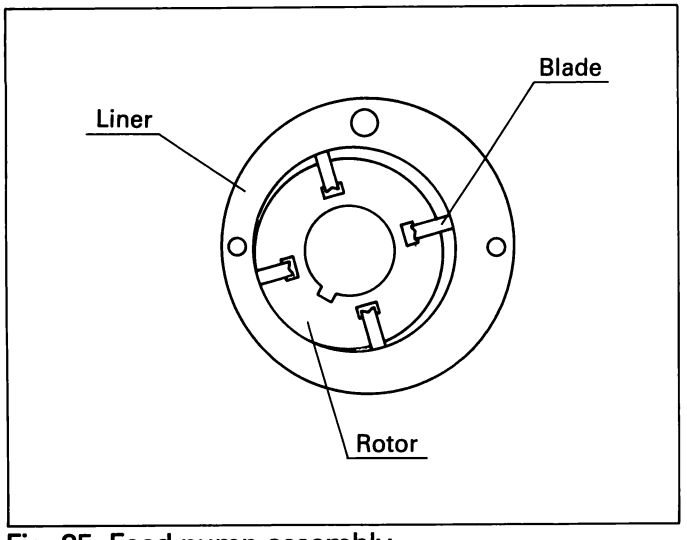


Fig. 35 Feed pump assembly

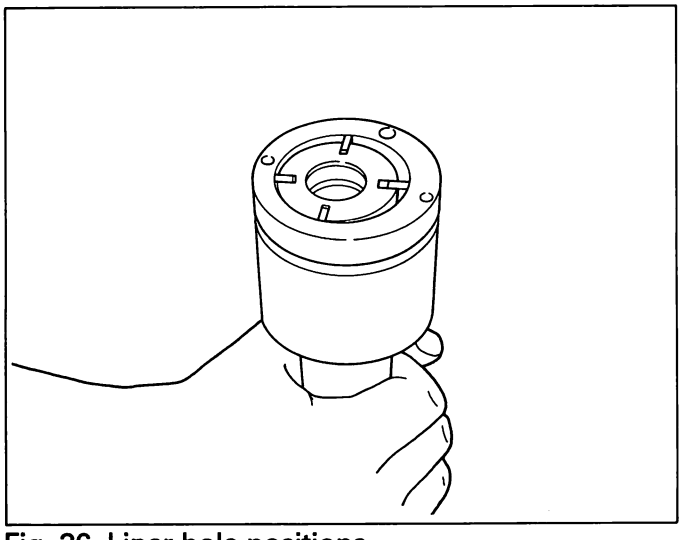


Fig. 36 Liner hole positions

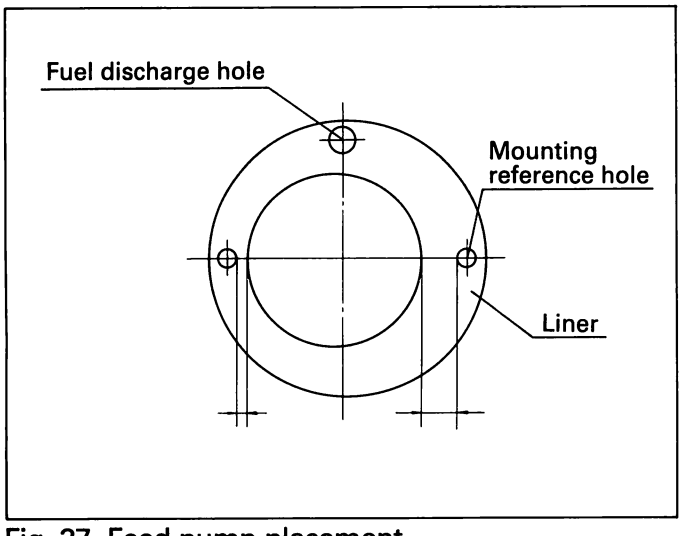


Fig. 37 Feed pump placement

Feed Pump Reassembly

Reassembly of the injection pump is the reverse of the disassembly procedure. However, points which require special attention are explained below.
The direction of rotation indicated in the text is always that viewed from the drive side.
Refer to Fig. 130 for the tightening torque for tightened nuts and bolts etc.

1. The feed pump assembly (6) consists of a rotor with four blades, and a liner. Assemble the blades with the grooved ends facing the inside of the rotor and in the position where each blade was previously installed. Then, ensure that they slide smoothly with the rotor. Never alter the installation position of each blade. (Fig. 35)
2. Place the feed pump cover (9) and then the pump assembly on the feed pump holder (157829-5420).

Note: The liner mounting holes (two diametrically opposed holes) are positioned at unequal distances from the inside wall of the liner. The mounting hole furthest from the liner's inside wall is the reference hole when installing the feed pump assembly. (Figs 36 and 37)

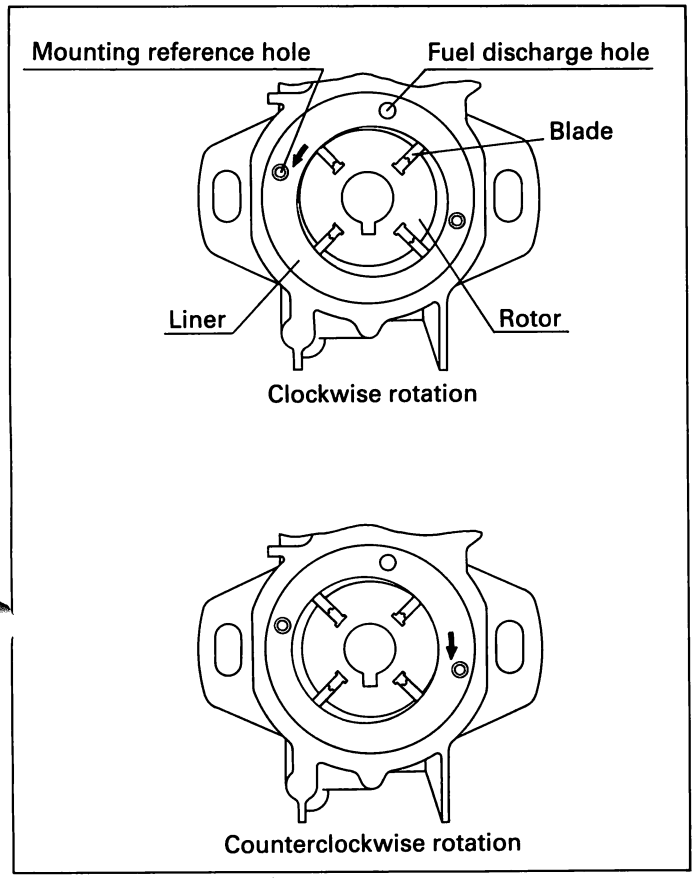


Fig. 38 Liner mounting position

3. If the injection pump rotates in a clockwise direction (R), the feed pump is installed in the pump housing so that the reference hole is on the right-hand side when the feed pump is viewed from the drive side. Conversely, if the injection pump rotates in a counterclockwise direction (L), the feed pump is installed so that the reference hole is on the left-hand side. (Figs. 37 and 38)

Note: Be sure to install the liner correctly. If left and right-hand sides are reversed, fuel will not be discharged from the feed pump.

In Fig. 38, the pump is viewed from the distributor head side.

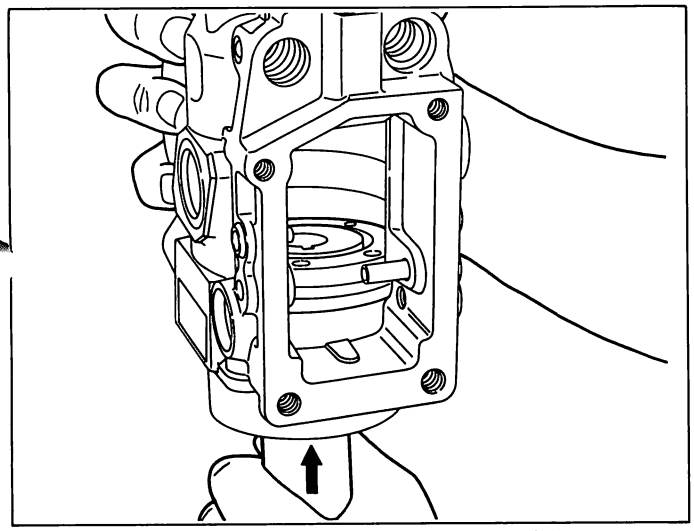


Fig. 39 Installing the feed pump assembly

4. Slide the injection pump housing over the feed pump assembly and cover positioned on the feed pump holder. (Fig. 39)

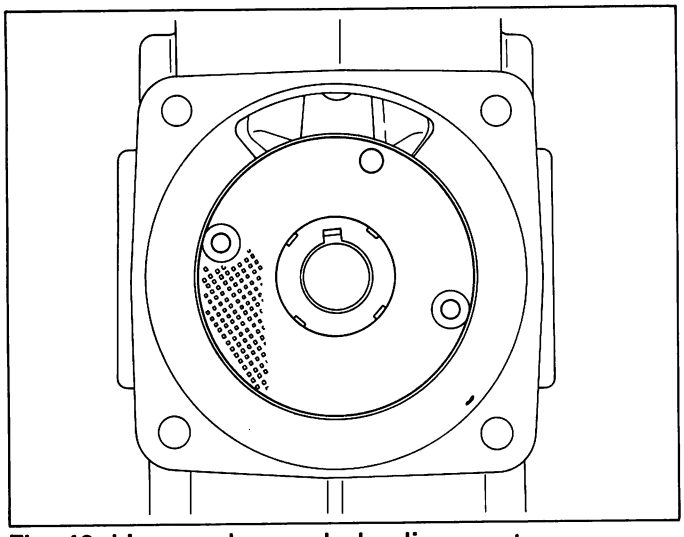


Fig. 40 Liner and cover hole alignment

5. Before tightening the feed pump cover (9), ensure that all three holes align with the liner holes, and that the discharge hole faces the top of the injection pump i.e. the governor side. (Fig. 40)

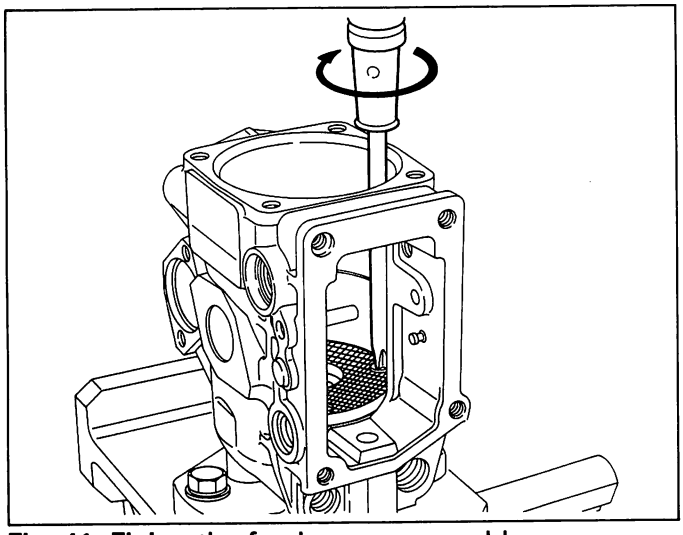


Fig. 41 Fixing the feed pump assembly

6. Secure the feed pump assembly (6) using the two screws (10). (Fig. 41) After assembly, move the rotor up and down and left and right using the fingertips to check that it moves smoothly.

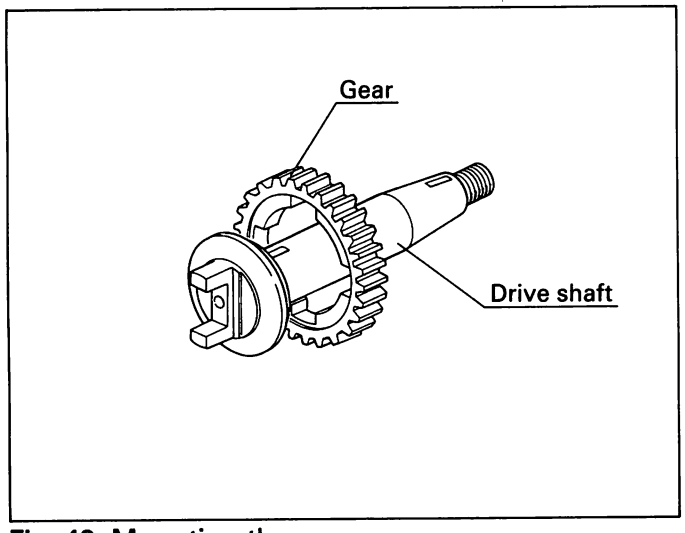


Fig. 42 Mounting the gear

Drive Shaft Reassembly

1. Mount the gear on the drive shaft (12/1), ensuring that the stepped side of the gear faces the drive shaft teeth. (Fig. 42)
2. Install new rubber dampers in the gear.

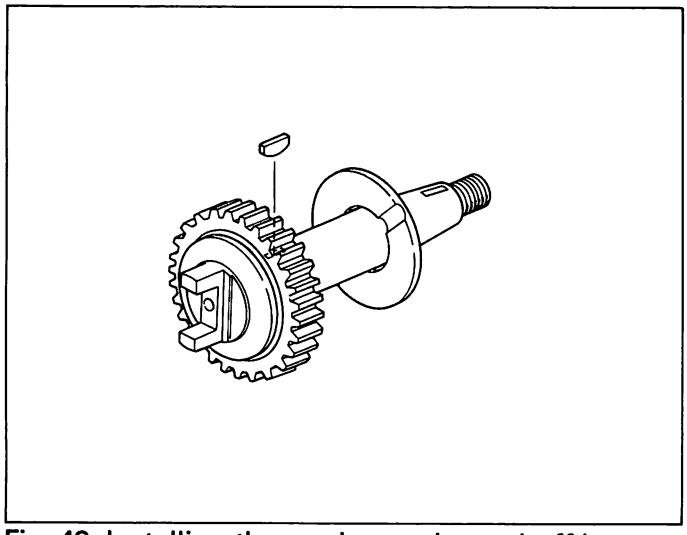


Fig. 43 Installing the washer and woodruff key

3. Fit the washer (17) and feed pump woodruff key (12/2) onto the drive shaft. (Fig. 43)

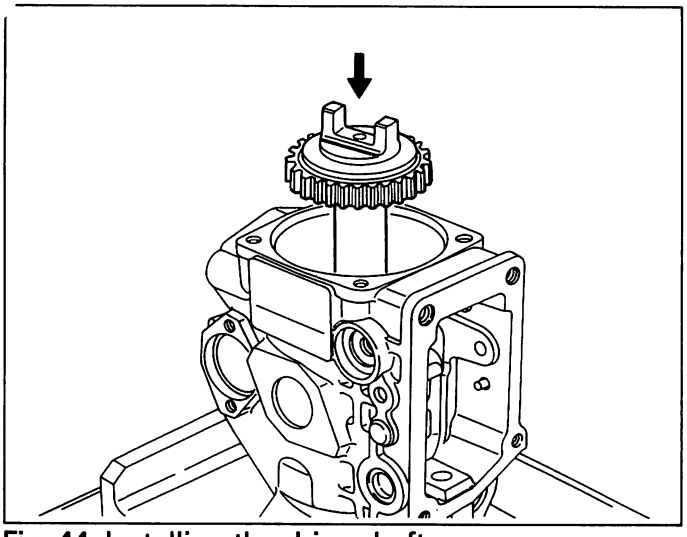


Fig. 44 Installing the drive shaft

4. Before installing the drive shaft in the pump housing, fit the oil seal guide (refer to disassembly procedure; 157922-0900: for 17ϕ shaft, 157922-1000: for 20ϕ short shaft, 157922-1100: for 20ϕ long shaft) onto the drive shaft.
   Next, rotate the feed pump and turn the drive shaft to align the keyway and the woodruff key. After aligning them, install the drive shaft in the pump housing. (Fig. 44)

Note: If the key rises, hold it down lightly with tweezers so that the shaft can be installed smoothly. Take care that the key does not damage the feed pump cover. After installing the drive shaft, rotate it by hand to check that it rotates smoothly.

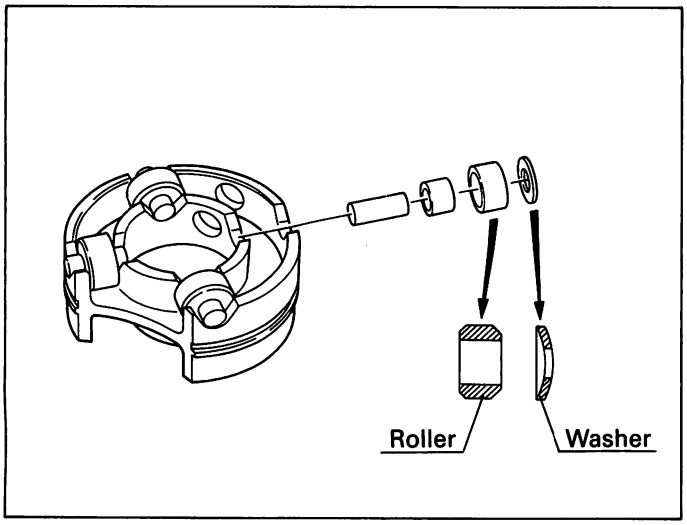


Fig. 45 Roller assembly component parts

Roller Holder Reassembly

1. During reassembly ensure that the convex surfaces of the washers and the more chamfered sides of the rollers are facing the outer side of the roller holder. (Fig. 45)

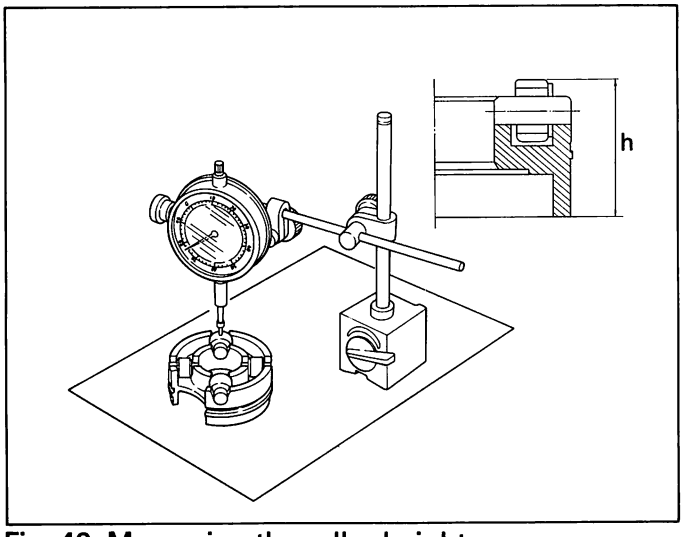


Fig. 46 Measuring the roller height

2. Using a dial gauge, measure the height(h) of each roller in the roller holder assembly and check that the difference in height of each the roller does not exceed 0.02mm. (Fig. 46)

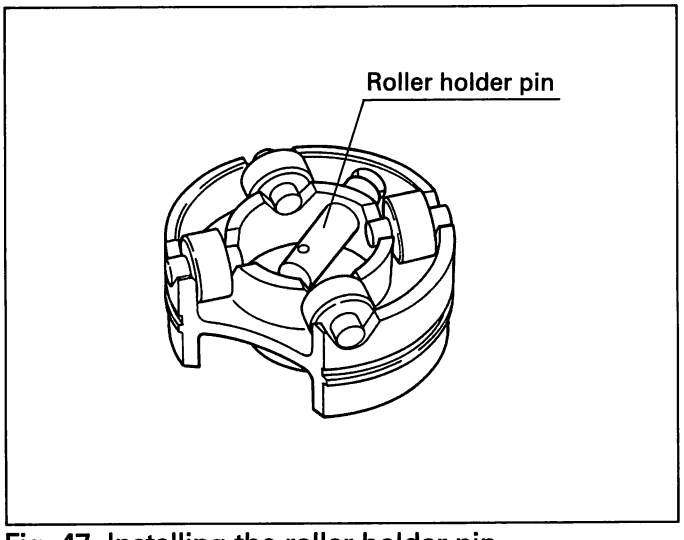


Fig. 47 Installing the roller holder pin

3. Fit the roller holder pin (24) into the roller holder assembly so that the pin hole is placed inside the roller holder. (Fig. 47)

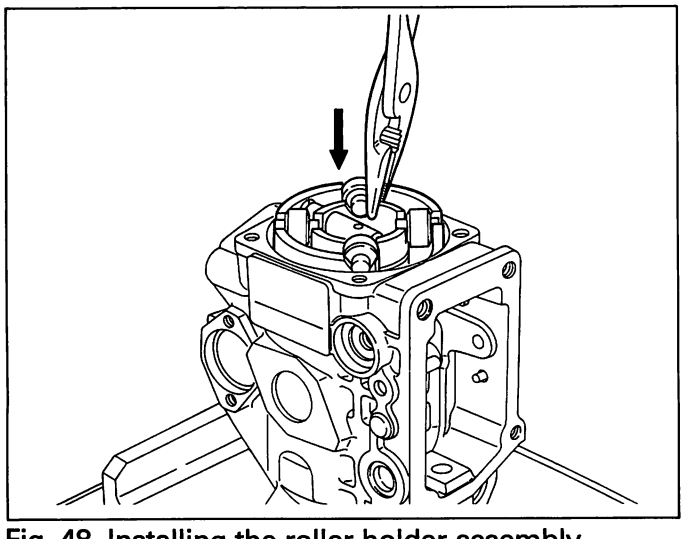


Fig. 48 Installing the roller holder assembly

4. Install the roller holder assembly in the pump housing so that the roller holder pin (24) is positioned on the timer side. (Fig. 48)

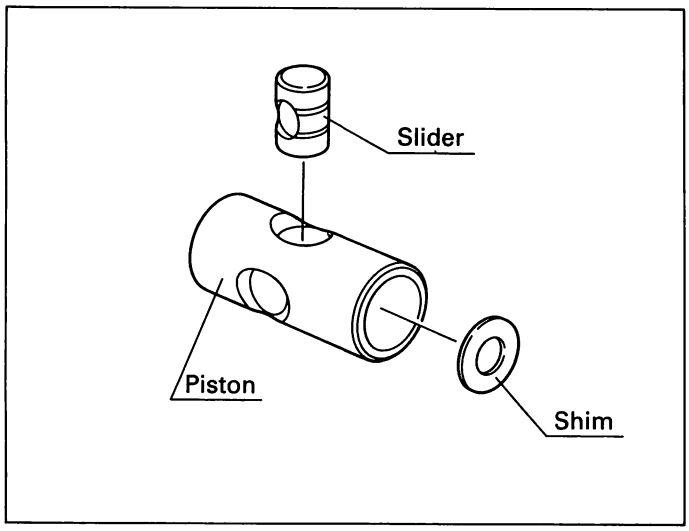


Fig. 49 Timer piston reassembly

Timer Reassembly

1. Apply grease to the slider (32) and insert it together with the shim (33) into the timer piston (31). (Fig. 49)

Note: **After inserting, position the slider so as to align the slider hole with the timer piston hole into which the roller holder pin will be inserted.**

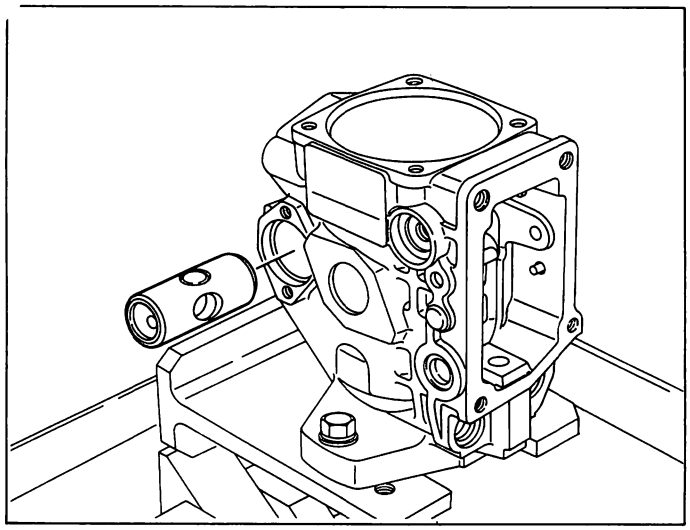


Fig. 50 Installing the timer piston

2. Install the timer piston (31) in the pump housing so that the low-pressure side (timer spring side) is on the right-hand side (viewed from the drive side) for clockwise injection pump rotation (R), or the left-hand side for counterclockwise injection pump rotation (L). (Fig. 50)
   Then, position the timer piston so that the slider hole (i.e. the timer piston hole) faces in the direction of the roller holder pin.

Note: **Check that the low pressure side is on the side where the hole leads the low-pressure side to the fuel inlet port i.e. applies low pressure to the timer.**

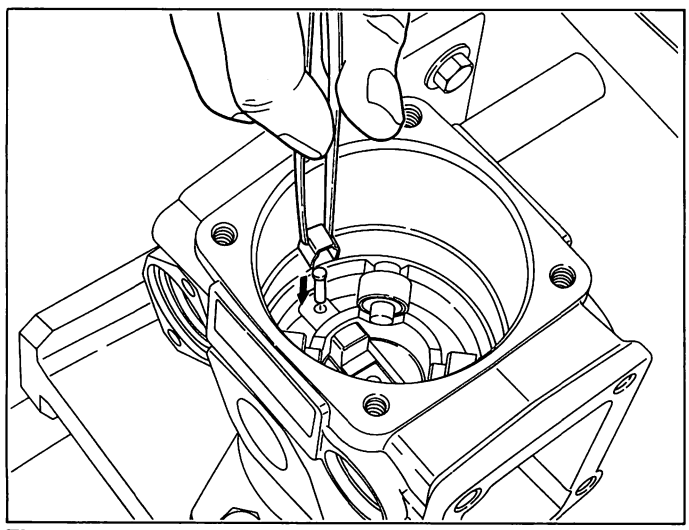


Fig. 51 Connecting the timer

3. To connect the timer, push the previously inserted roller holder pin (24) into the slider (32) in the timer piston and fix it with the pin (25). Then, fit the clip (26) onto the pin (25). Check that the timer piston slides smoothly. (Figs. 51 and 52). Always use a new clip.

Note: **The timer stroke is determined by the length of the timer piston, and therefore there is no need to measure it.**

4. Install the cover (39) together with the O-ring (36).

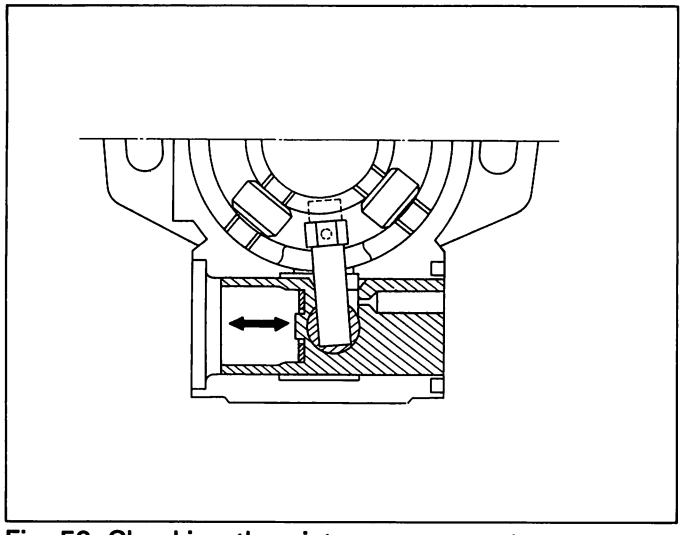


Fig. 52 Checking the piston movement

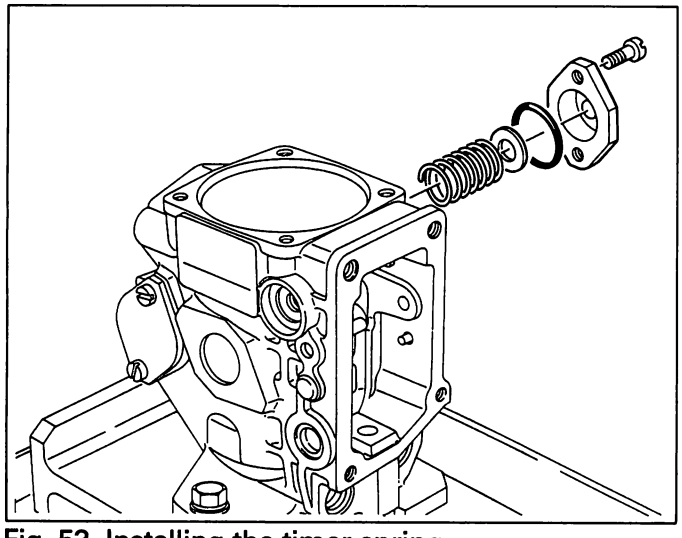


Fig. 53 Installing the timer spring

5. Install the timer spring to the low-pressure side (that is the right-hand side for clockwise pump rotation or, the left-hand side for counterclockwise pump rotation when viewed from the drive side.)
6. Install the cover (37) together with the shim (35) and O-ring. (30). (Fig. 53)

Note: Be sure to insert a shim at each end of the spring.

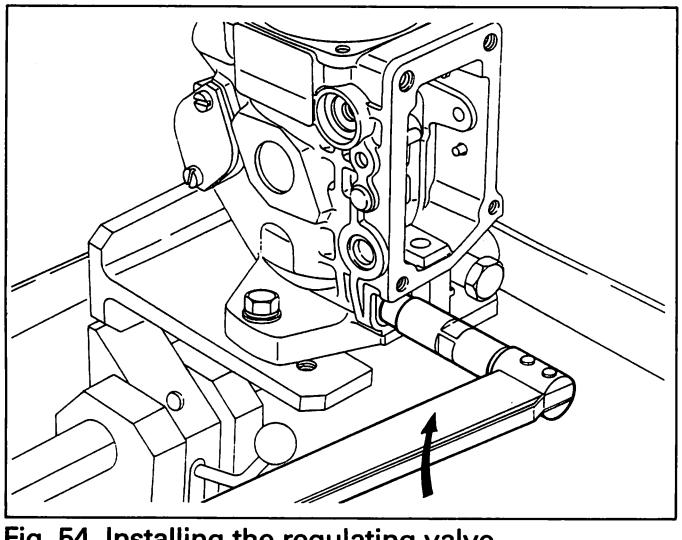


Fig. 54 Installing the regulating valve

Regulating Valve Installation

Using a socket wrench (157914-2600), install the regulating valve together with the O-rings (133 and 134). Then, tighten it at the specified torque. (Fig. 54)

Tightening torque: 1.0 to 1.3 Kg-m

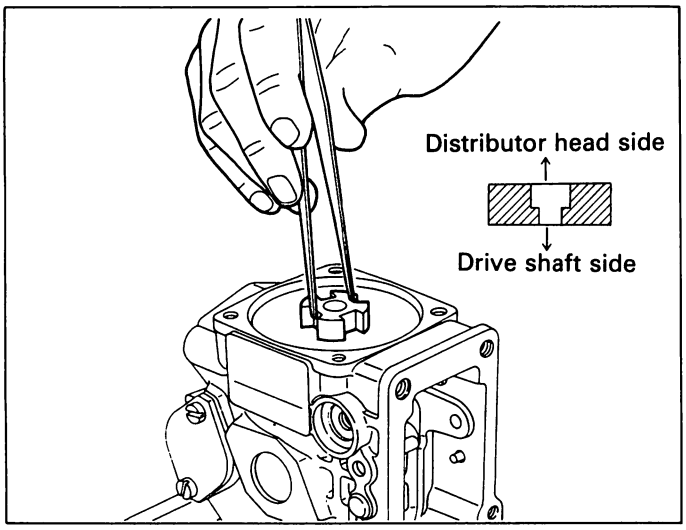


Fig. 55 Installing the disk

Disk Installation

Mount the disk (27) on the drive shaft (12/1) so that the larger diameter disk center hole faces the distributor head side. (Fig. 55)

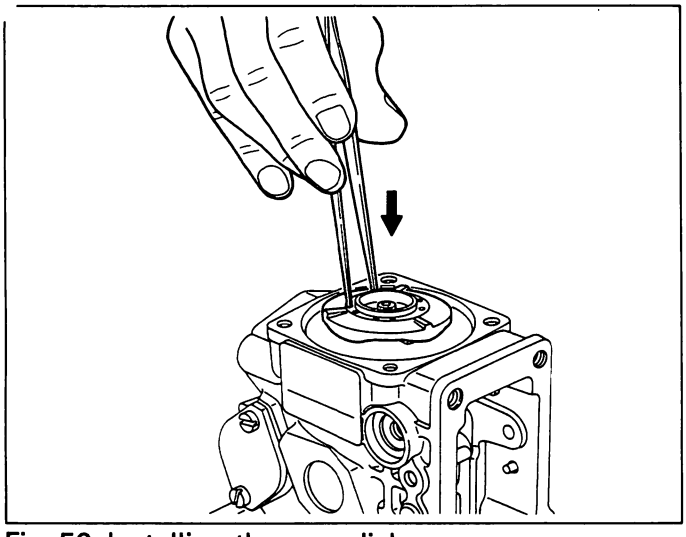


Fig. 56 Installing the cam disk

Cam Disk Installation

Before installing the cam disk (29), turn the drive shaft so that its keyway faces the top of the pump. Next, position the knock pin fitted on the cam disk/plunger contact face so that it is facing in the same direction as the keyway i.e. towards the top of the pump. Install the cam disk. (Fig. 56)

Note: The cam disk knock pin must align with the drive shaft keyway. If it does not align, injection will be out of sequence.

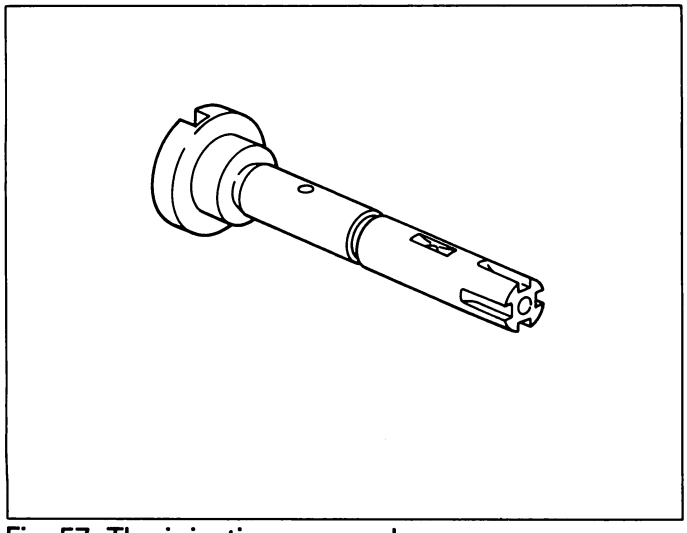


Fig. 57 The injection pump plunger

Distributor Head Assembly Reassembly and Installation

Caution: The plunger slides inside the distributor barrel pressed into the distributor head (50), and the control sleeve. As it is lapped to an extremely small tolerance, it must be handled with great care. (Fig. 57)

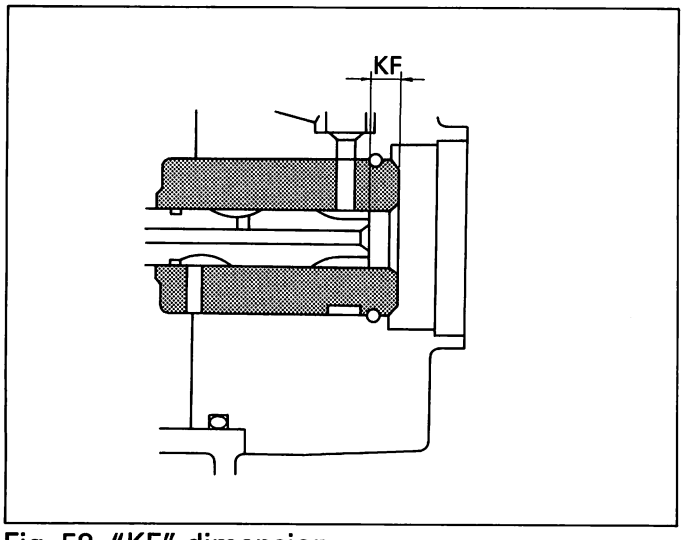


Fig. 58 "KF" dimension

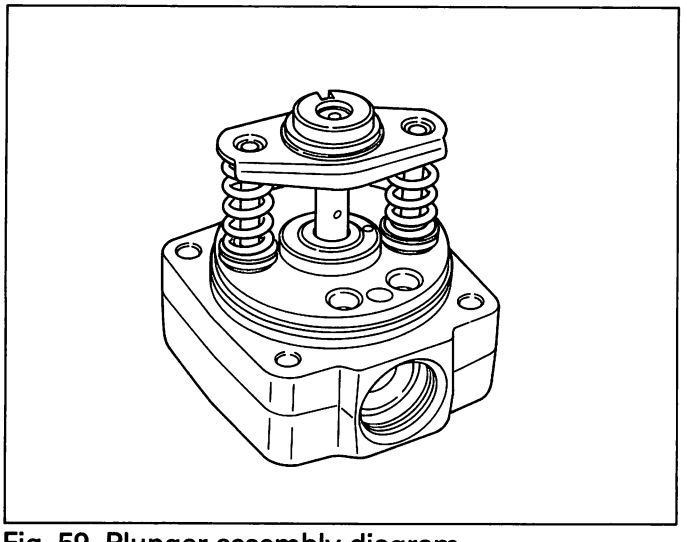


Fig. 59 Plunger assembly diagram

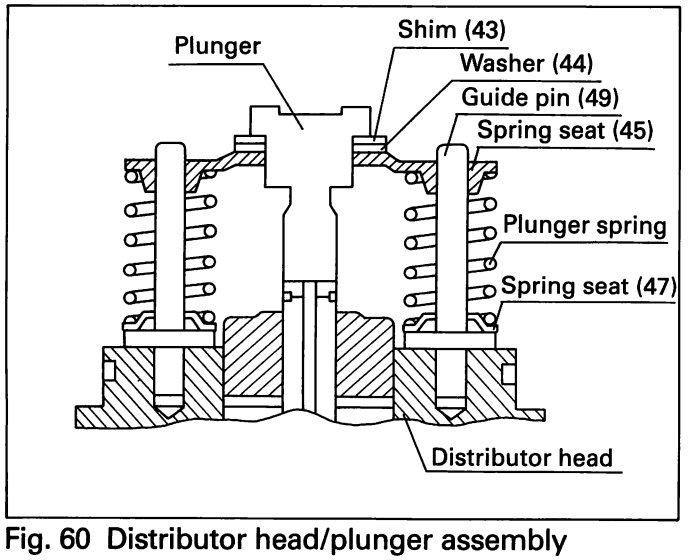


Fig. 60 Distributor head/plunger assembly

Measurement of plunger spring set length ("KF" dimension)

1. The "KF" dimension is the distance between the end face of the distributor barrel and the end face of the plunger. (Fig. 58)

2. Fit the guide pin (49) into the distributor head (50), and then install the spring seat (47) and plunger spring (46) on the guide pin. Do not install the shim (48).

3. Next, fit the shim (43), washer (44) and spring seat (45) on the plunger in that order and install the plunger on the distributor head. (Figs. 59 and 60)

Note: Do not install the control sleeve.

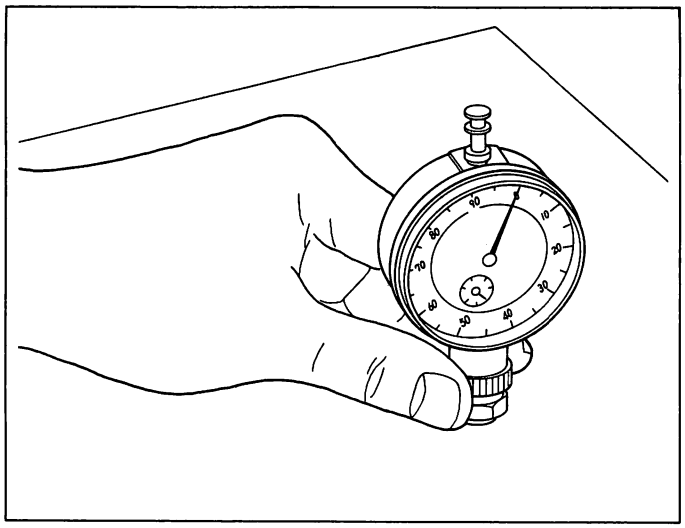


Fig. 61 Dial gauge "0" (zero) position

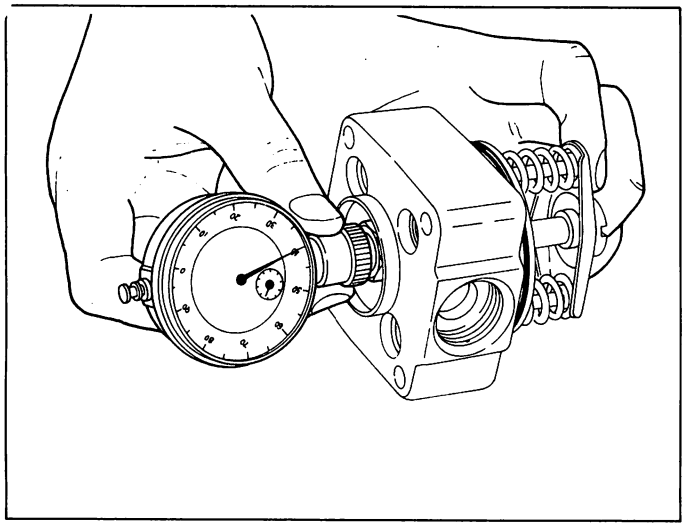


Fig. 62 Measuring the "KF" dimension

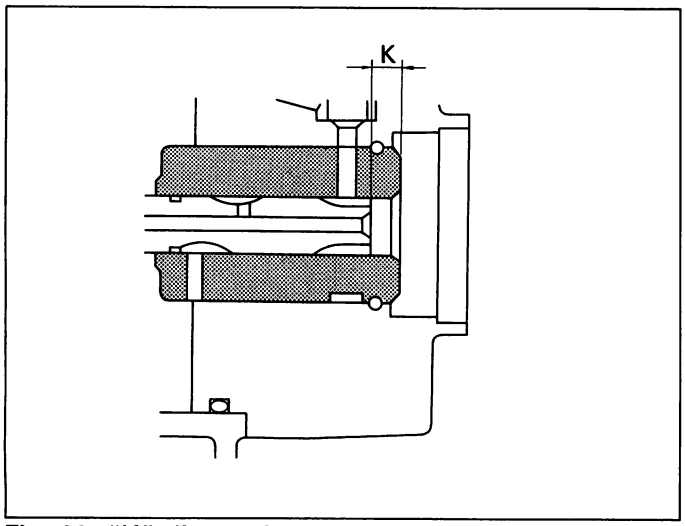


Fig. 63 "K" dimension

4. Fit a dial gauge on the measuring device (157829-0420) and set it to the "0" (zero) position. (Fig. 61)
5. Keeping the distributor head horizontal, lightly press the bottom of the plunger in an axial direction. Insert the measuring device (157829-0420) into the distributor head plug hole and measure the "KF" dimension.
6. Adjust the thickness of the shims (48) until the "KF" dimension is as specified. (Fig. 62) Fit shims (48) of identical thickness to both the left and right plunger springs.

Note: 1. When shims of the exact thickness are not available, use slightly thicker shims.
2. When replacing plunger springs, always replace both plunger springs at the same time.

Shims

Part No.	Thick-ness	Part No.	Thick-ness
146603-0000	0.5	146690-1400	0.9
146603-0100	0.8	146690-1500	1.1
146603-0200	1.0	146690-1600	1.3
146603-0300	1.2	146690-1700	1.4
146603-0400	1.5	146690-1800	1.6
146603-0500	1.8	146690-1900	1.7
146603-0600	2.0		

Adjustment of plunger assembly dimension ("K" dimension)

1. The "K" dimension is the distance from the end face of the distributor barrel to the end face of the top of the plunger when the plunger is in the B.D.C. position. (Fig. 63)
2. Install the plunger, fitted with the shim (43), washer (44), spring seat (45) and shim (52), on the cam disk (29).

Note: Ensure the cam disk knock pin enters the groove at the bottom of the plunger.

3. Fit the plunger springs (46) onto the spring seats (45).

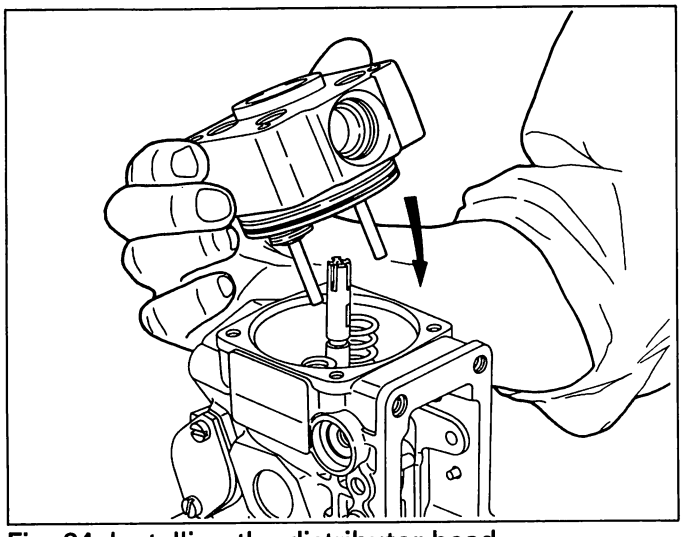


Fig. 64 Installing the distributor head

4. As shown in Fig. 64, carefully insert the distributor head fitted with the guide pins (49), shims (48) and spring seats (47) into the pump housing (taking care that it is correctly aligned with the plunger)
5. Fix the distributor head with the screws (60).
6. Rotate the drive shaft and check the plunger rotation to ensure that the knock pin is properly seated in the groove.

Note: Do not coat the shim (52) with grease.

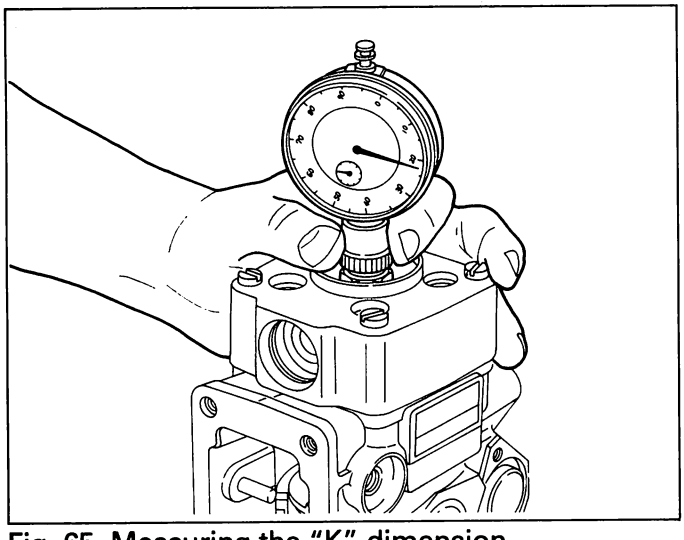


Fig. 65 Measuring the "K" dimension

Measurement of "K" dimension

1. Rotate the drive shaft until the plunger reaches the B.D.C. position.
2. After confirming the dial gauge "0" (zero) position, measure the "K" dimension using the measuring device (157829-0420).
3. Adjust the thickness of the shim (52) until the "K" dimension is as specified. (Fig. 65)
4. Remove the distributor head and plunger.

Note: There are 59 different shim thicknesses ranging from part No. 146420-0000 to part No. 146420-5800, increasing in increments of 0.02 mm as follows.

Shims

Part No.	Thickness (mm)	Remarks
146420-0000	1.90	
≀	≀	51 types
146420-5000	2.90	
146420-5100	1.74	
≀	≀	8 types
146420-5800	1.88	

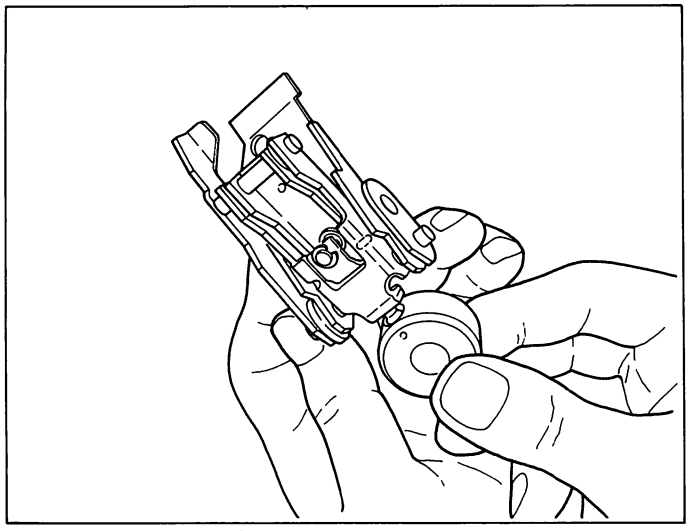


Fig. 66 Checking ball-pin movement

Distributor assembly installation

1. After adjustment of "K" dimension (selection of the shims), remove once again the cam disk and then be sure to fit the spring (200) onto the disk (27). Install the cam disk (29) so that the cam disk knock pin aligns with the drive shaft keyway.
2. Fit the governor lever assembly (95) ball pin into the control sleeve hole to check that it moves smoothly but firmly. (Fig. 66)

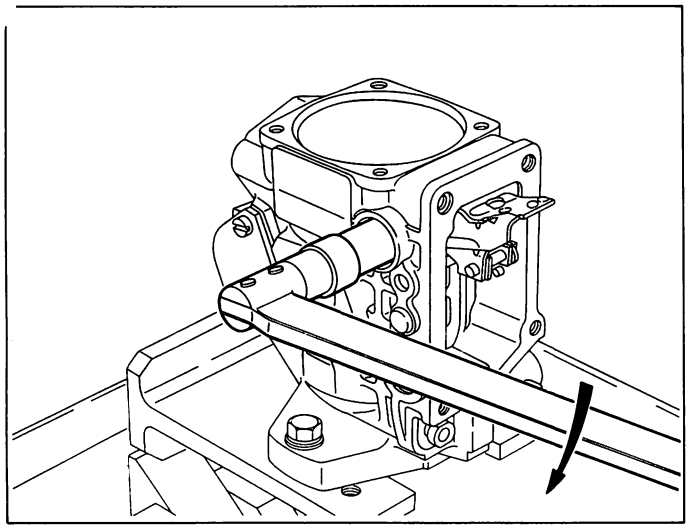


Fig. 67 Installing the governor lever assembly

3. Using a socket wrench (157914-2700), install the governor lever assembly (95) in the pump housing using the pivot bolts (104) and gaskets (105). (Fig. 67)

Note: Check that the governor lever assembly slides smoothly.

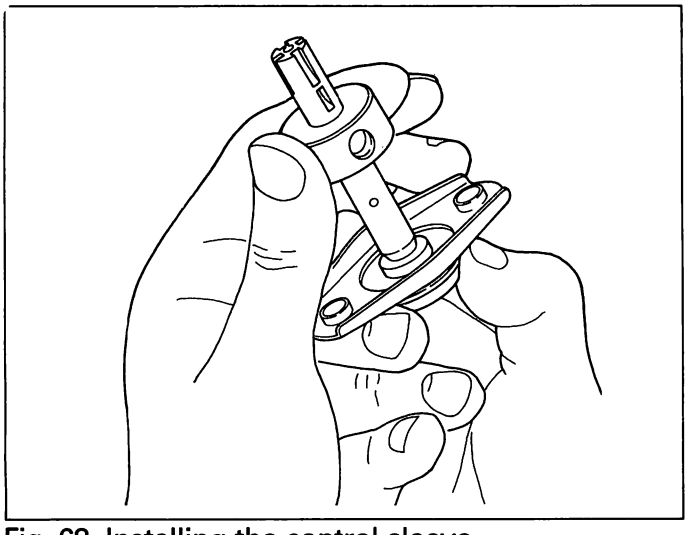


Fig. 68 Installing the control sleeve

4. Fit the shim (43), the washer (44) (with oil groove) and the spring seat (45) on the plunger in the above sequence, and then install the control sleeve on the plunger. (Fig. 68)

Note: During reassembly ensure that the spring seat's spring guide is installed on the distributor head side. Install the control sleeve so that the small hole faces the cam disk. (Fig. 69)

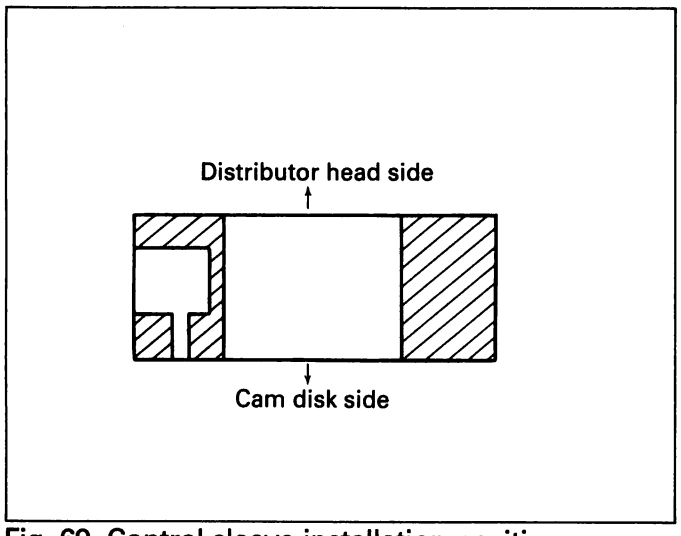


Fig. 69 Control sleeve installation position

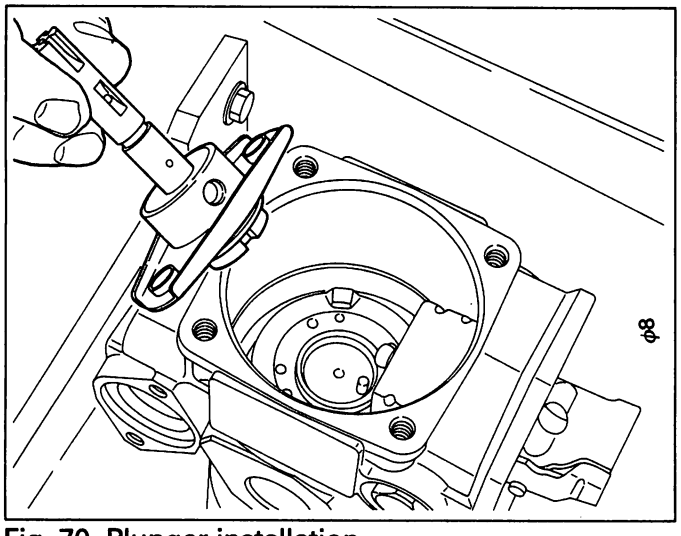


Fig. 70 Plunger installation

5. Install the assembled plunger, together with the previously selected shim (52), in the pump housing. (Fig. 70) This is done by inserting the lever assembly (95) ball pin into the control sleeve hole, and then, as previously described, inserting the cam disk knock pin into the groove at the bottom of the plunger.

Note: Apply grease to the shim(52).

6. Place the plunger springs (46) on the spring seat (45).

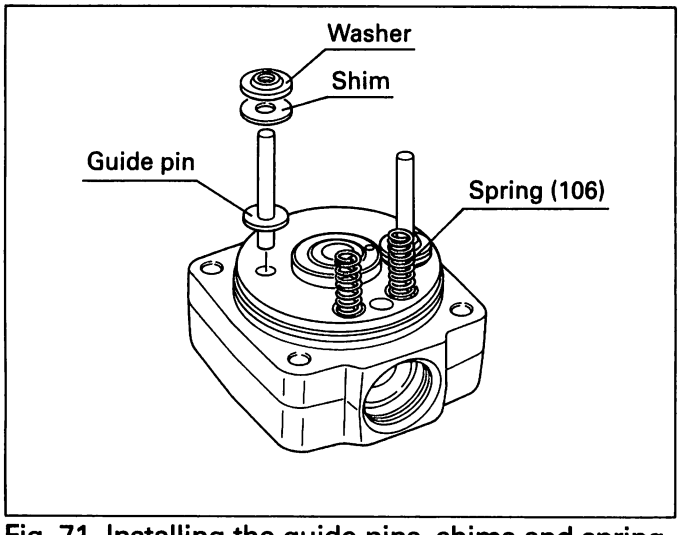


Fig. 71 Installing the guide pins, shims and spring seats

7. Fit the O-ring (51) on the distributor head, and then apply grease to and install the guide pins (49), shims (48) and spring seats (47) in the distributor head. Next, apply grease to the springs (106) and fit them on the distributor head. (Fig. 71)

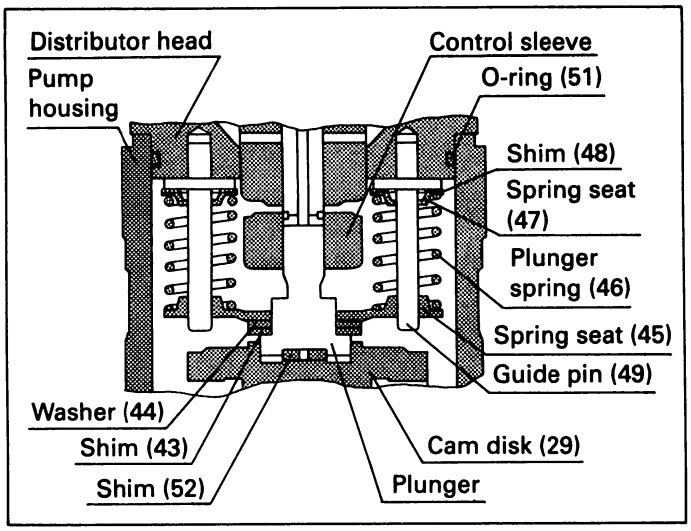


Fig. 72 Distributor head/plunger assembly diagram

8. Carefully fit the reassembled distributor head onto the pump housing after positioning the springs (106) so that they face the governor lever assembly. (Figs. 72 and 73)
9. Take care not to damage the O-ring (51).

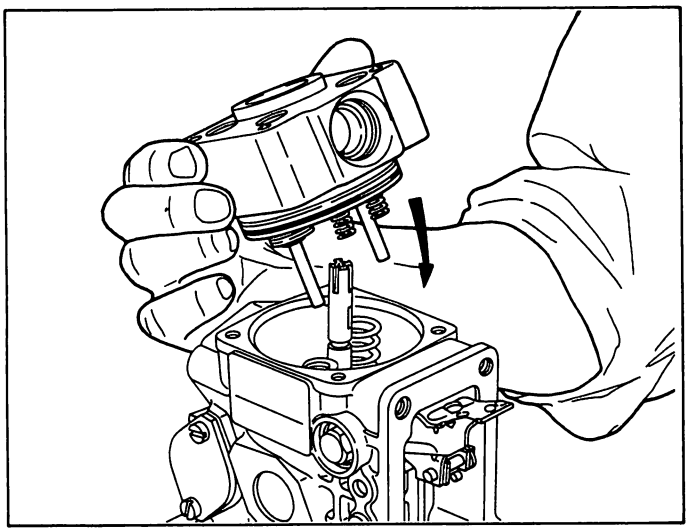


Fig. 73 Reinstalling the distributor head

10. Check that the ends of the guide pins (49) are properly seated in the spring seat (45) guide holes, the governor lever assembly ball pin (95) is inserted in the control sleeve hole and that the shim (52) is properly seated between the cam disk and the bottom of the plunger.

Note: Push down on the distributor head, and check that it reaches the O-ring.

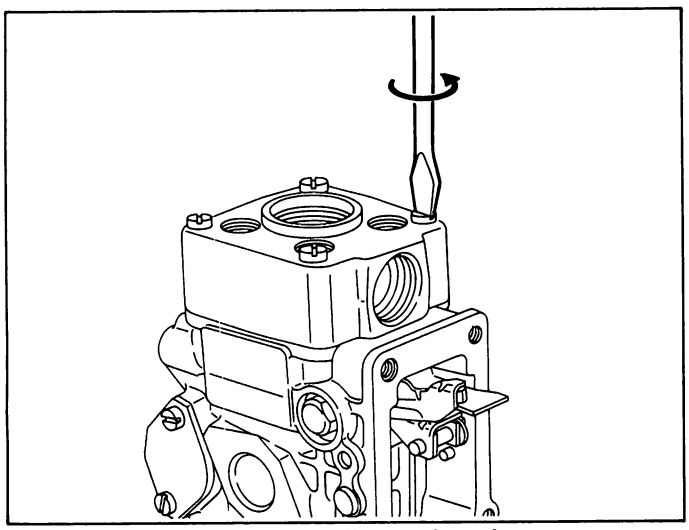


Fig. 74 Securing the distributor head

11. Fix the distributor head assembly (50) to the pump housing with the four screws (60). Tighten all four screws gradually and uniformly. (Fig. 74)
    After tightening the screws, operate the governor lever assembly and check that the control sleeve smoothly follows the lever movement.

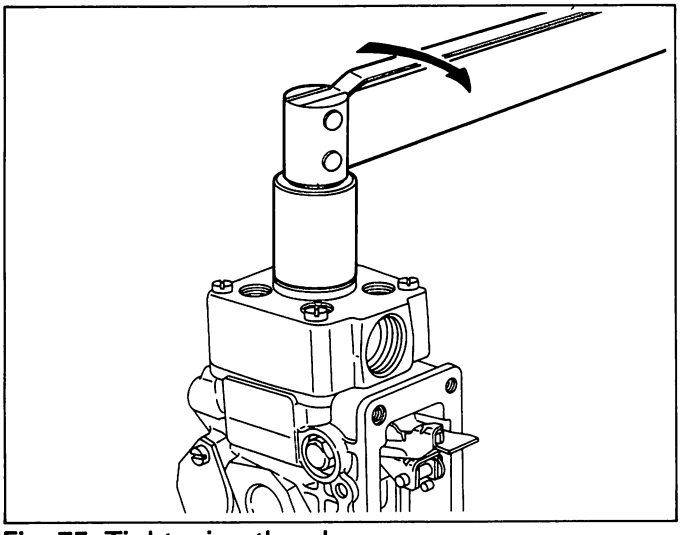


Fig. 75 Tightening the plug

12. Fit the O-ring on the new plug (130) and screw the plug into the distributor head assembly. Tighten it to the specified torque using a socket wrench (157914-2500). (Fig. 75)

    Tightening torque: 6.0 to 8.0 Kg-m

Note: Be sure to use a new plug (130).

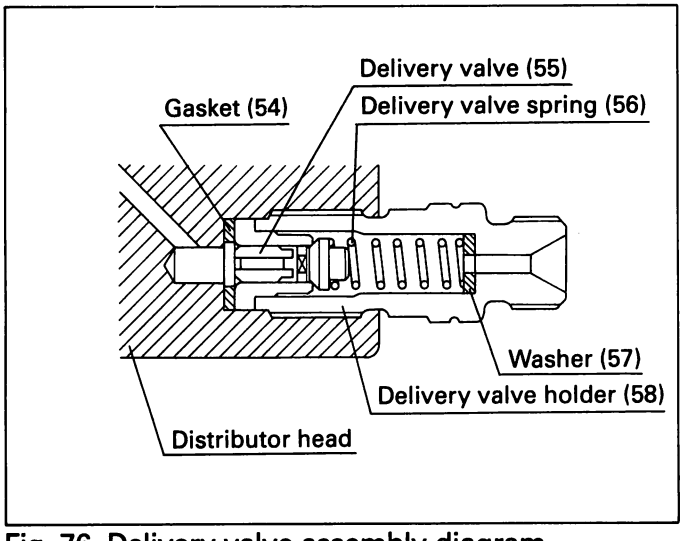


Fig. 76 Delivery valve assembly diagram

Delivery Valve Installation

Install the delivery valve gasket (54), delivery valve assembly (55), delivery valve spring (56), washer (57) and delivery valve holder (58) in the distributor head assembly and tighten to the specified torque using the socket wrench (157914-1100). (Figs. 76 and 77)

Tightening torque: 4.5 to 5.5 Kg-m

Note: 1 In the delivery valve assembly, the delivery valve and valve seat are a matched set and must be replaced together.

2 Washers (57) are not mounted on delivery valve holders fitted with damping valves.

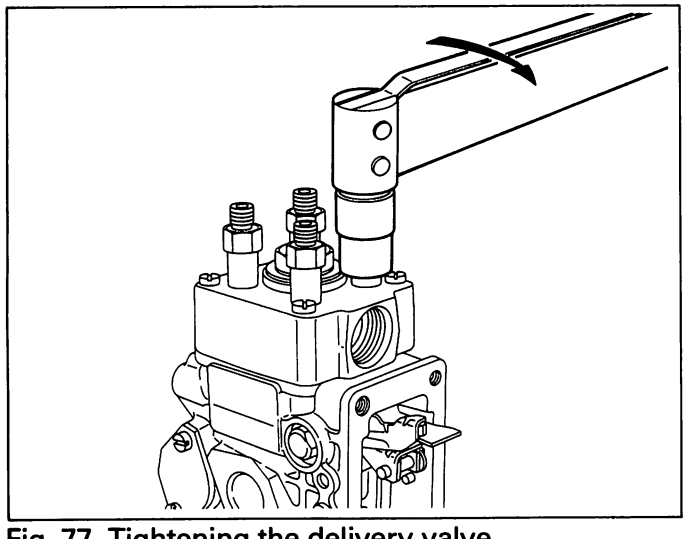


Fig. 77 Tightening the delivery valve

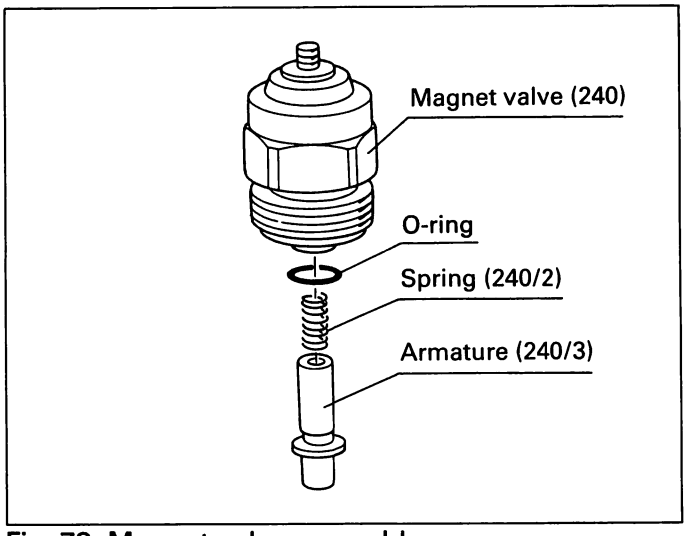


Fig. 78 Magnet valve assembly

Magnet Valve Installation

Insert the spring (240/2) and armature (240/3) into the magnet valve and screw the magnet valve (240), together with the O-ring (241), into the distributor head assembly. Tighten to the specified torque. (Fig. 78)

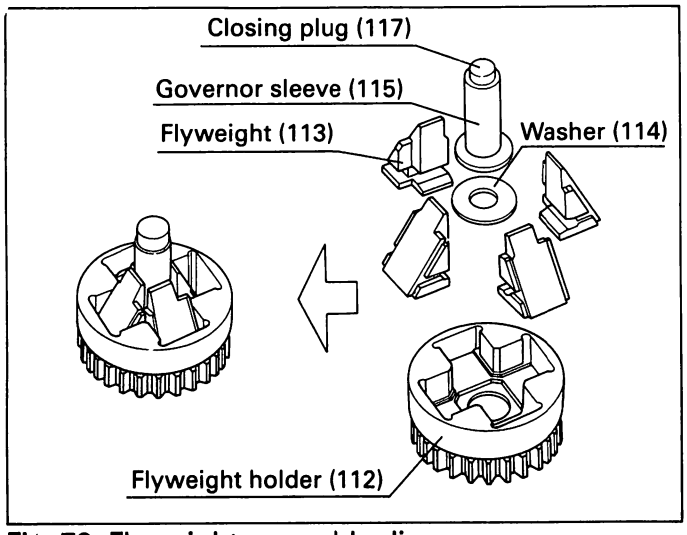


Fig. 79 Flyweight assembly diagram

Governor Installation

1. Flyweight assembly installation
   The flyweight holder (112) is driven by the drive shaft via the flyweight drive gear. Firstly, install the four flyweights (113) in the flyweight holder.

Note: When replacing the flyweights, all four must be replaced together.

2. Install the washer (114) and governor sleeve (115), fitted with the closing plug (117), in the flyweight holder. (Fig. 79)

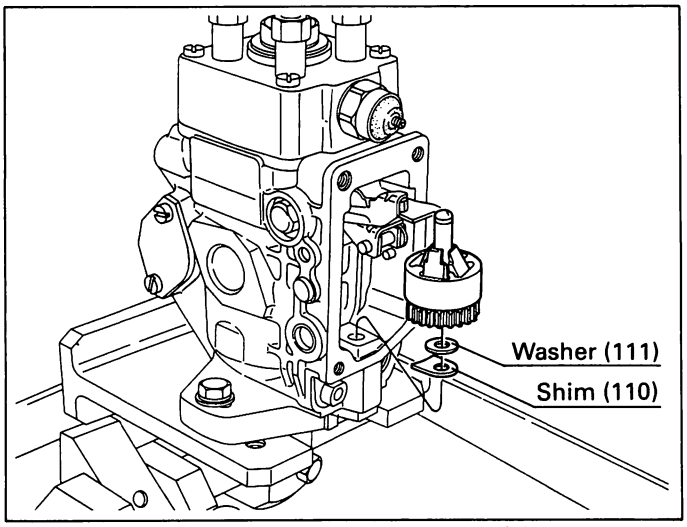


Fig. 80 Installing the flyweight assembly

3. Install the flyweight assembly, shim (110) and washer (111) in the housing. (Fig. 80)

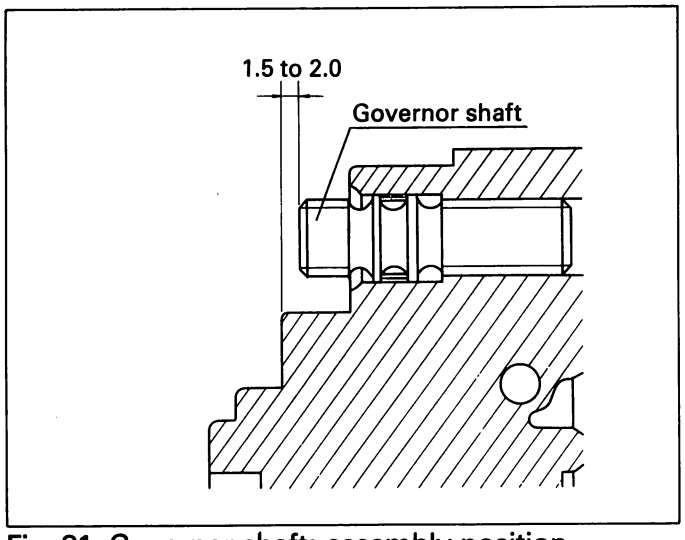


Fig. 81 Governor shaft: assembly position

4. Install the governor shaft (108) and O-ring (109) in the pump housing. Screw in the governor shaft so that the distance from the end face of the pump housing flange to the end face of the governor shaft is 1.5 to 2.0 mm (approx. 3 mm for an injection pump equipped with a load timer). (Figs. 81 and 82)

Govenor shaft threads are as follows.

Direction of pump rotation	Current spec.	New spec.
Clockwise	Left-handed	Right-handed
Counterclockwise	Right-handed	Right-handed

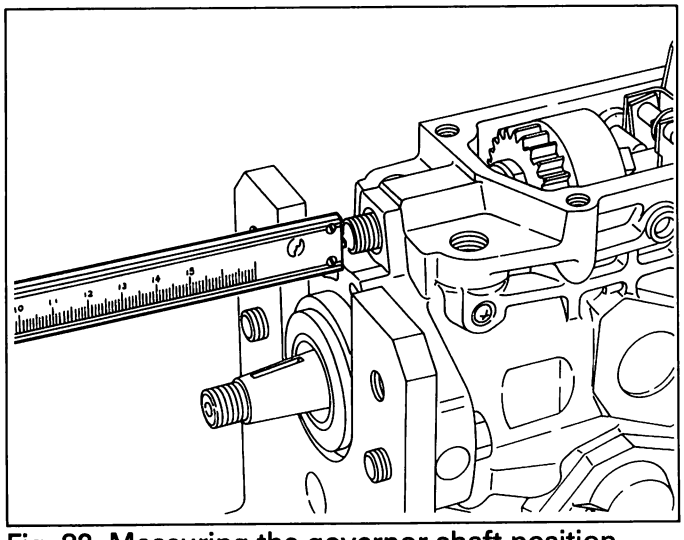


Fig. 82 Measuring the governor shaft position

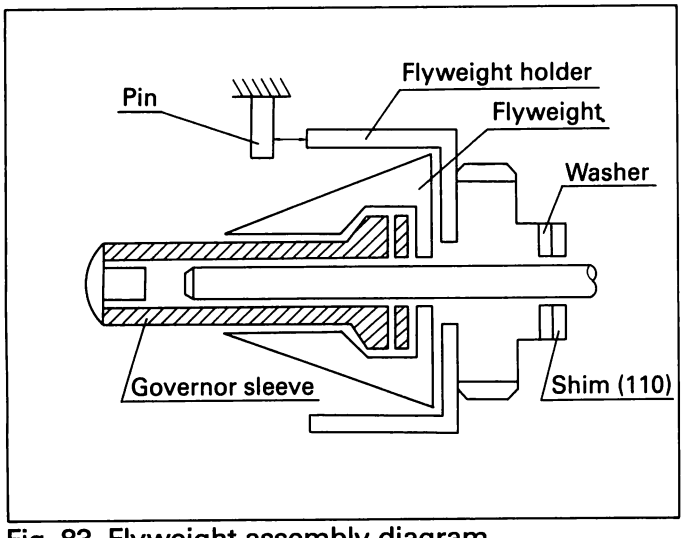


Fig. 83 Flyweight assembly diagram

5. Using a thickness gauge, measure the clearance between the end face of the flyweight holder (112) and the pin pressed into the pump housing. Adjust the clearance to 0.15–0.35 mm using the shim (110) at the back of the flyweight holder. (Figs. 83 and 84)

Note: Where a stepped pin is installed, the clearance is 0.35–0.55 mm.

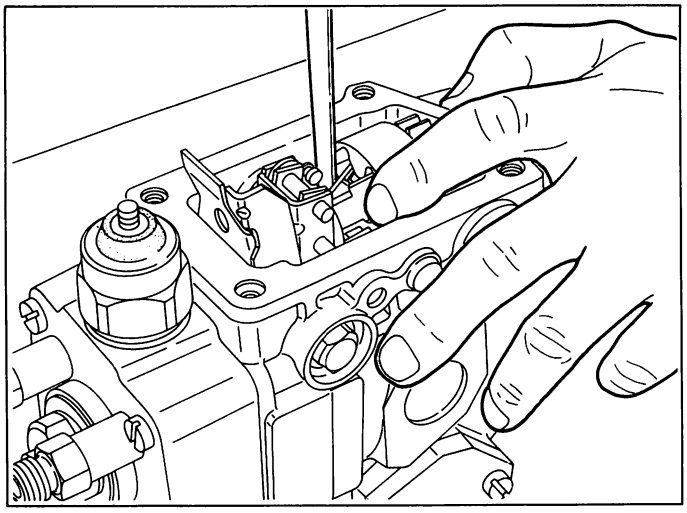
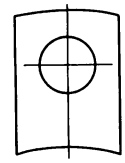


Fig. 84 Measuring the flyweight holder/pin clearance

Shims

Part No.	Thickness (mm)	Shape
146571-0000	1.05	
146571-0100	1.25	
146571-0200	1.45	
146571-0300	1.65	
146571-0400	1.85	
146571-0500	1.15	
146571-0600	1.35	
146571-0700	1.55	
146571-0800	1.75	

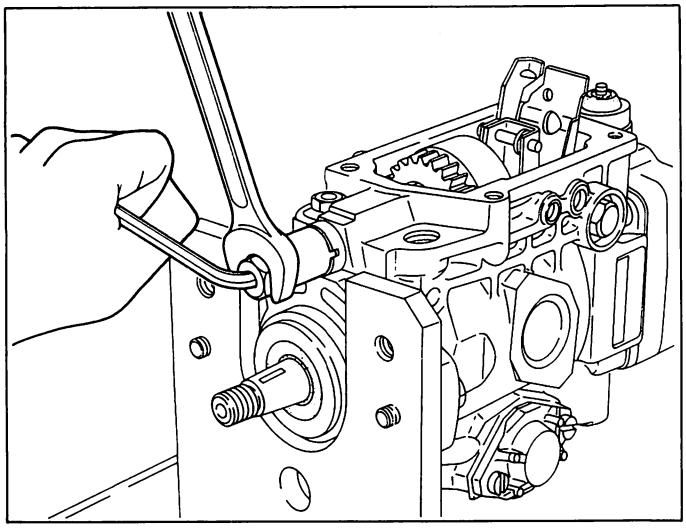


Fig. 85 Securing the governor shaft

6. Fix the governor shaft (108) by tightening the nut (107) using the adjusting device (157915-2620). (Fig. 85)

Note: Check that the distance between the end face of the pump housing flange and the end face of the governor shaft is 1.5 to 2.0 mm (approx. 3 mm for an injection pump equipped with a load timer).

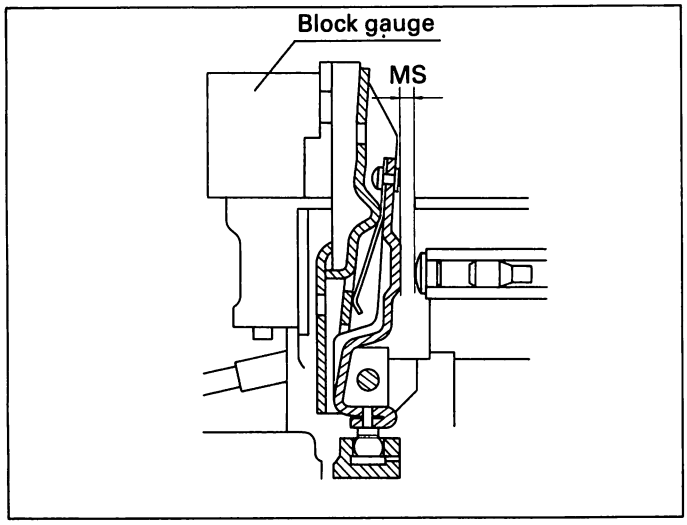


Fig. 86 "MS" dimension

Starting stroke ("MS" dimension) adjustment

1. The starting stroke, which determines the quantity of fuel required for starting, is the distance between the closing plug (117) in the governor sleeve (115) and the end face of the starting lever. (Fig. 86)

There are differences in the "MS" dimension measurement method depending on the type of governor lever assembly.

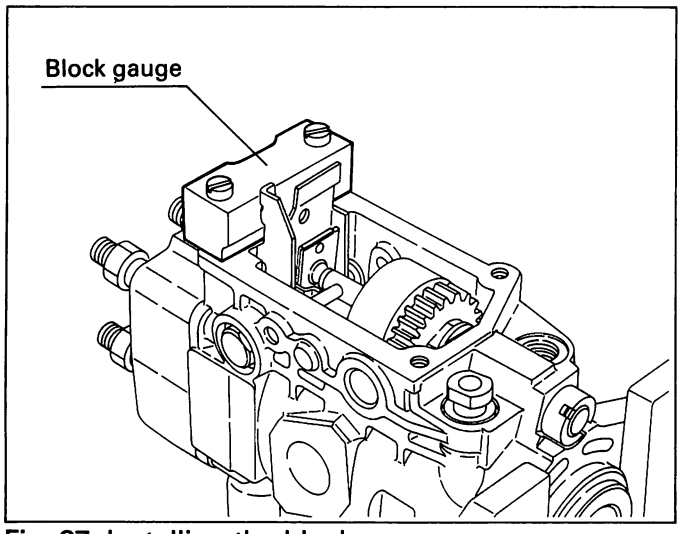


Fig. 87 Installing the block gauge

(a) Standard type

–1 Fit a block gauge (157829-1100) to the pump housing using two screws (123) and ensure that the block gauge groove faces the governor lever assembly. (Fig. 87)

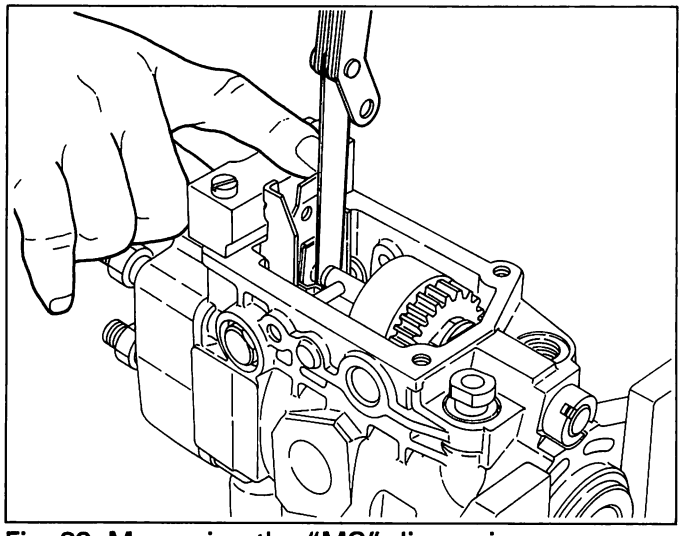


Fig. 88 Measuring the "MS" dimension

–2 Push the corrector lever against the block gauge and the tension lever against the stopper pin pressed into the pump housing. Next, push the starting lever against the tension lever (the starting spring is compressed). Measure the "MS" dimension using a thickness gauge. (Fig. 88)

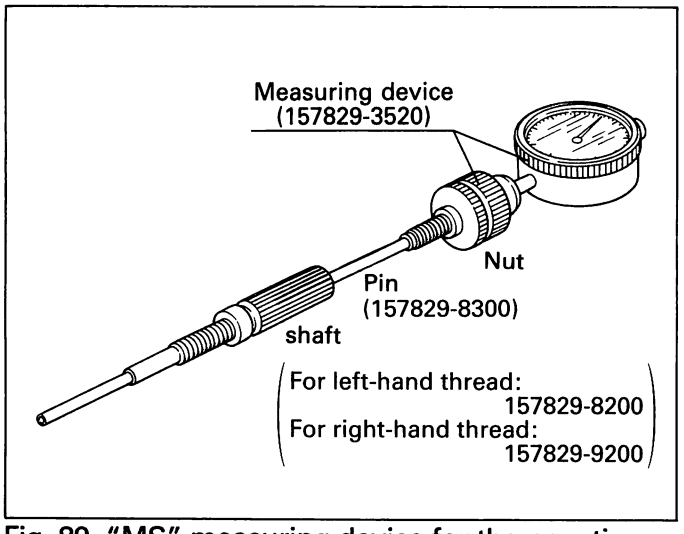


Fig. 89 "MS" measuring device for the negative torque control spring

(b) With the negative torque control spring

–1 Use the "MS" measuring device (157829-8620) and plunger lift stroke measuring device (157829-3520) for measuring the "MS" dimension of the control lever assembly equipped with the negative torque control spring.
Before the measurement of the "MS" dimension, replace the pin of the plunger lift stroke measuring device with the pin (157829-8300) of the "MS" measuring device (Fig. 89).

Note: The "MS" measuring device (15829-8620; for left handthread) includes a shaft (157829-8200) and a pin (157829-8300).

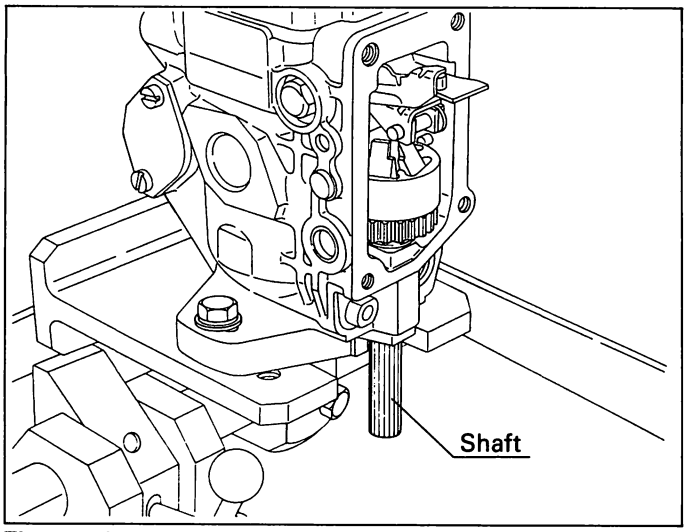


Fig. 90 Installing the measuring device

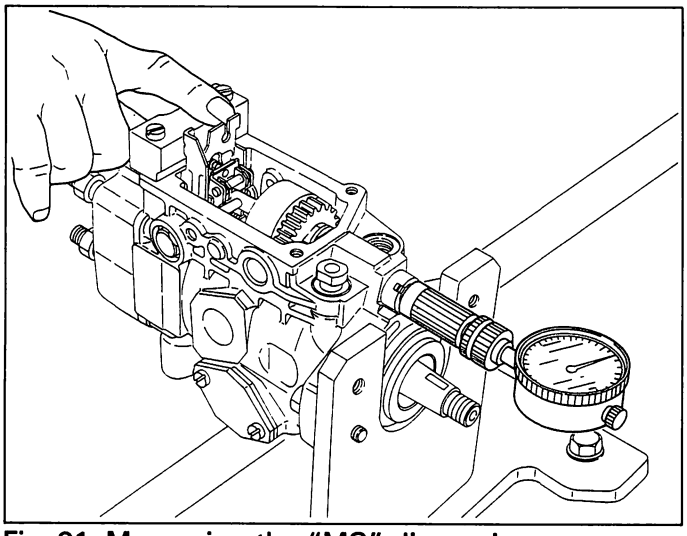


Fig. 91 Measuring the "MS" dimension

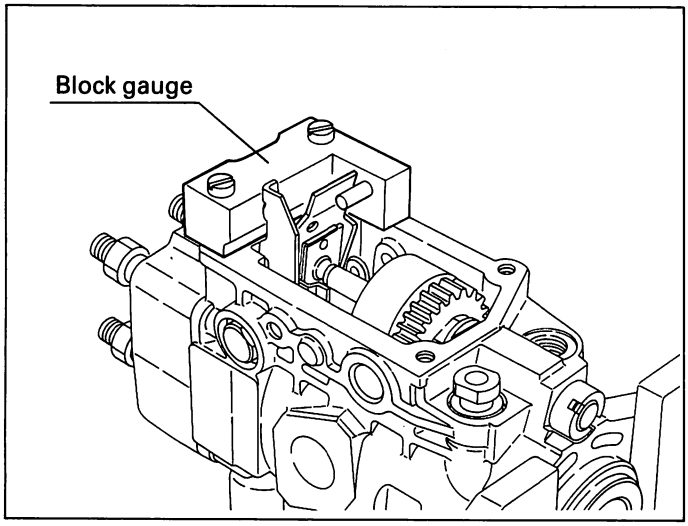


Fig. 92 Installing the block gauge (for the boost or aneroid compensator)

–2 Position the pump upright and then remove the nut (107) and governor shaft (108).
Install the shaft of the "MS" measuring device in place of the governor shaft.
Take care not to drop the washer (111) and shim (110). (Fig. 90)

–3 Install the block gauge and insert the pin with the plunger lift stroke measuring device into the measuring device shaft (already installed to the pump housing).
Ensure that the governor sleeve is firmly pushed toward the flyweight side.
Then, fix the dial gauge using the measuring device nut so that the dial gauge indication is between 2 to 3 mm (i.e. the tip of the pin touches the near side of the closing plug), depending on the specified "MS" dimension, and then align the dial gauge "0" point with the dial gauge pointer while pushing the tip of the dial gauge.

–4 Push the corrector lever against the block gauge and the tension lever against the stopper pin pressfitted into the pump housing.
Push the governor sleeve until the starting lever contacts the tension lever (the governor sleeve will not move any further) and then measure the "MS" dimension from the dial gauge. (Fig. 91).

(c) With the boost compensator and aneroid compensator.
Use the block gauge (157829-7520) to measure the "MS" dimension for a pump equipped with the boost compensator or aneroid compensator, as the stopper pin can not be pressfitted into the pump housing in these cases.
These "MS" measurement procedures are the same as those of the standard type or the negative torque control spring type. (Fig. 92)

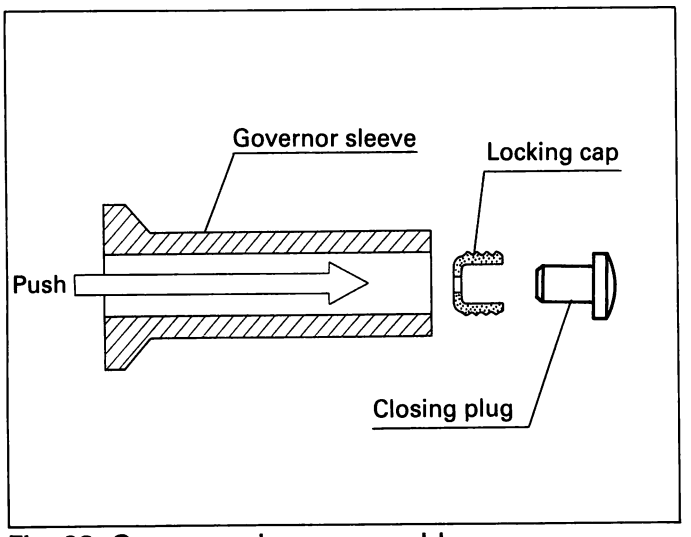
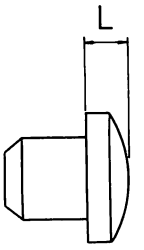


Fig. 93 Governor sleeve assembly

2. If not within the specified range, according to the result of the above measurement, select a suitable closing plug (117) so that the "MS" dimension is as specified.
   Then, remove the closing plug from the governor sleeve and replace it with the selected closing plug. (Fig. 93)

Note: 1 During this procedure it is necessary to remove the flyweight holder assembly (governor sleeve) previously installed in the pump housing.
2 Take care not to lose the locking cap (116).

Closing plugs

Part No.	Length (mm)	Shape
146577-0000	1.7	
146577-0100	1.9	
146577-0200	2.1	
146577-0300	2.3	
146577-0400	2.5	
146577-0500	2.7	
146577-0600	2.9	
146577-0700	3.1	
146577-0800	3.3	
146577-0900	3.5	
146577-1000	3.7	
146577-1100	3.9	
146577-1200	4.1	
146577-1300	4.3	
146577-1400	4.5	
146577-1500	4.7	
146577-1600	4.9	
146577-1700	5.1	

3. Reinstall the flyweight assembly, governor sleeve and governor shaft (108), and then recheck the various dimensions of the assembled components.

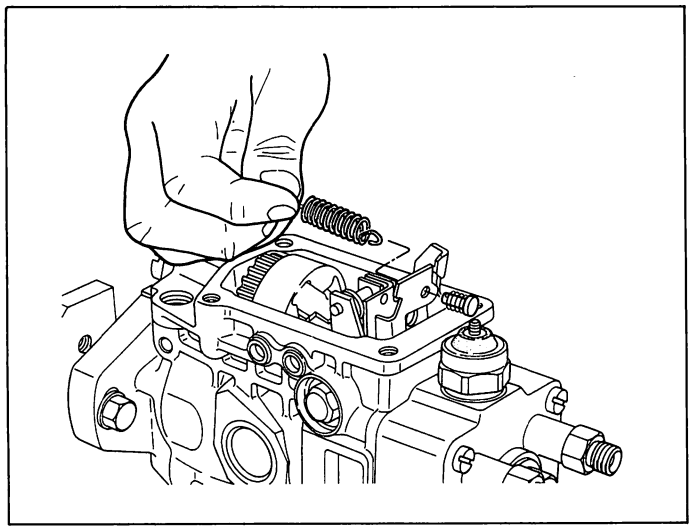


Fig. 94 Governor spring/retaining pin reassembly

Governor Cover Reassembly and Installation

1. Fit the retaining pin (120), together with the springs, onto the tension lever and then connect the retaining pin to the governor spring (122). (Fig. 94)

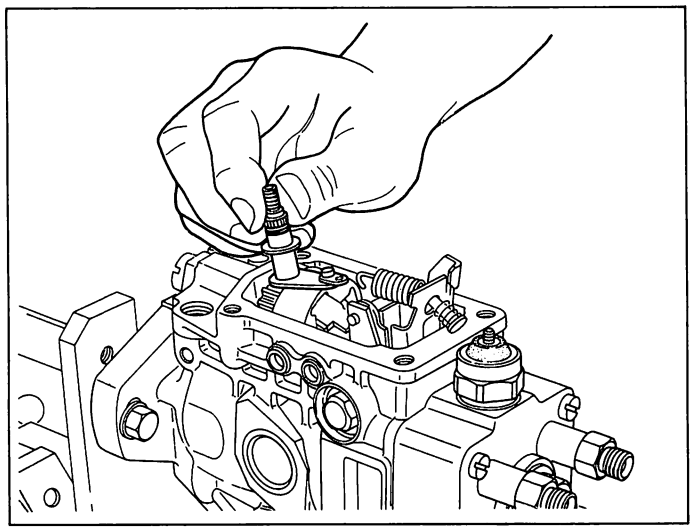


Fig. 95 Governor spring/control shaft reassembly

2. Fit the shim (67/4) and O-ring (67/3) on the control shaft (67/2) and connect the governor spring (122) to the control shaft link. (Fig. 95)

Note: Ensure the open part of the spring hook faces downwards.
Before fitting the control shaft into the governor cover, apply grease to the control shaft O-ring (67/3).

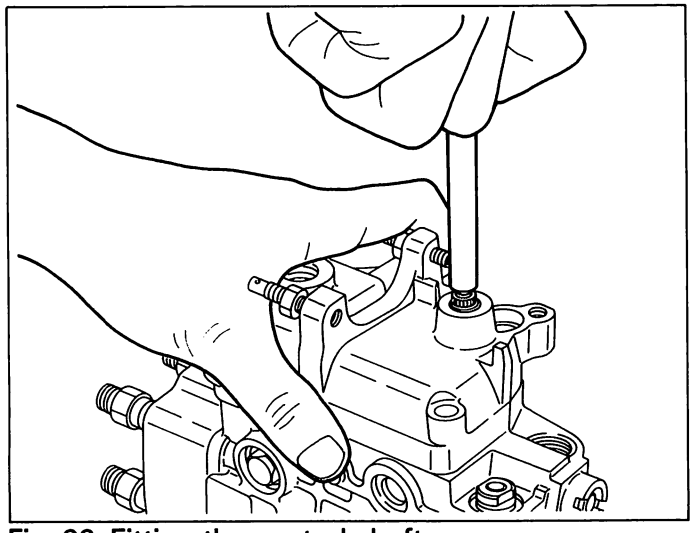


Fig. 96 Fitting the control shaft

3. Fit the seal ring (92) to the governor cover (67/1)
4. Insert the inserter (157829-0720) through the control shaft mounting hole on the governor cover (67/1) and screw it onto the threaded part of the control shaft (67/2). Next, fit the control shaft into the governor cover while pulling the inserter and pushing the governor cover into place. (Fig. 96)
5. Fix the governor cover (67/1) with the screws (123).
6. Fit the control lever (67/5) to the control shaft together with the spring (67/18), bracket (67/19) and washer (67/6) and fix the assembly using the nut (67/7).

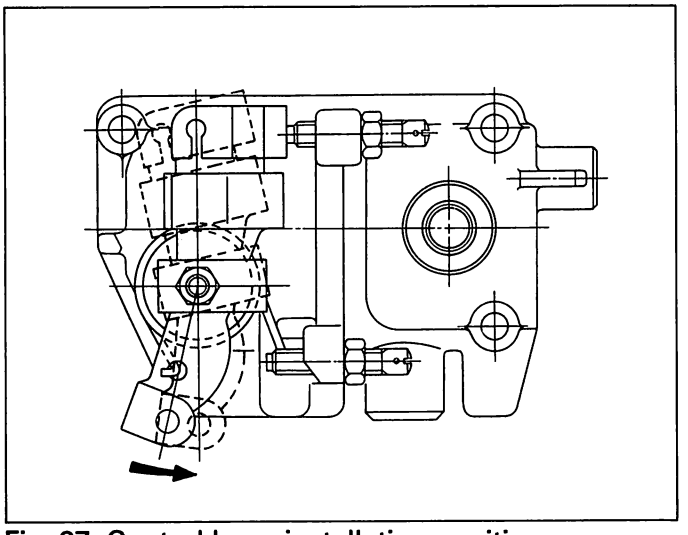


Fig. 97 Control lever installation position

Note: The control lever should be installed in a vertical position or positioned toward the maximum speed position when tension is first felt in the governor spring. (Fig. 97)

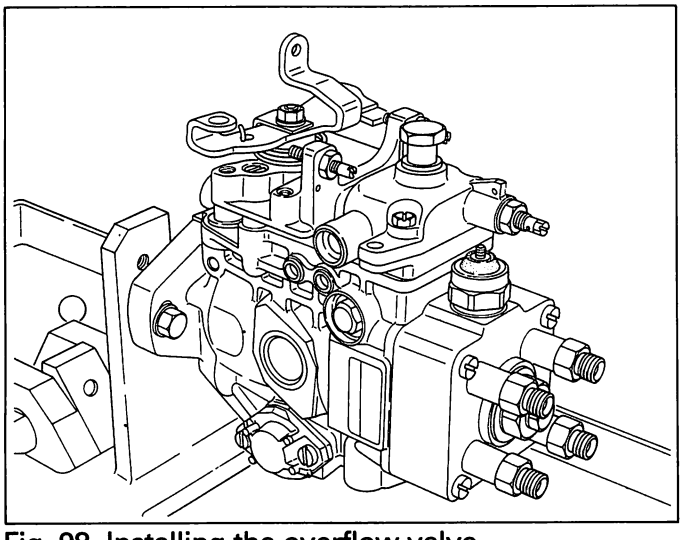


Fig. 98 Installing the overflow valve

Full-load Adjusting Screw Installation

Fit the O-ring (91) to the full-load adjusting screw (88) and install the screw in the governor cover.

Overflow Valve Installation

Install the overflow valve (136). (Fig. 98)
This completes the reassembly procedure.

INJECTION PUMP ADJUSTMENT

After reassembling the injection pump, adjust it in the following manner using the injection pump test stand.

Prepare the special service tools described in "Service Tools for Adjustment"

SERVICE TOOLS FOR ADJUSTMENT

No.	Part No.	Part Name	Q'ty	Remarks
1	105781-0160	Fixing Stand	1	For mounting pumps on the test stand (center height: 110 mm; for 5 NP and 10 NP model pump test stands)
1	105781-0180	Fixing Stand	1	For mounting pumps on the test stand (center height: 125 mm; for 7 NP and 15 NP model pump test stands)
2	157811-0520	Flange	1	Adapter for installing pumps (50 mm diameter)
3	157842-4420	Coupling	1	Used for pump adjustment (17 mm diameter driveshaft; 3 mm key groove)
3	157842-4520	Coupling	1	Used for pump adjustment (20 mm diameter driveshaft; 2.5 mm key groove; 10 mm tooth width)
3	157842-4620	Coupling	1	Used for pump adjustment (20 mm diameter driveshaft; 4 mm key groove)
4	105784-1100	Accumulator Unit	1	For 5 NP model pump test stand
4	105784-1110	Accumulator Unit	1	For 10 NP model pump test stand
5	105784-1080	Heater	1	For heating test oil (for 5 NP model pump test stand)
5	105784-1090	Heater	1	For heating test oil (for 10 NP model pump test stand)
6	105780-0000	Test Nozzle	6	For adjusting pump (Bosch type No: NP-DN112SD12T)
7	105780-2080	Nozzle Holder	6	
8	157805-0320	Pipe	6	For adjusting pump (2 mm×6 mm× 840 mm; M12×1.5–M14×1.5)
9	105782-8150	Measuring Device	1	For measuring pump timer stroke (mounted on high pressure side)
9	105782-8190	Measuring Device	1	For measuring pump timer stroke (mounted on low pressure side)
10	105782-8160	Measuring Device	1	For measuring pump pre-stroke (without dial gauge)
11	157829-0820	Adjusting Device	1	For adjusting regulating valve

No.	Part No.	Part Name	Q'ty	Remarks
12	157829-4620	Extractor	1	For regulating valve disassembly
13	157829-5220	Inserter	1	For inserting regulating valve spring ring
14	105784-0140	Digital Tachometer	1	For pump speed indication
15	157970-0500	Measuring Cylinder	1	For measuring feed pump supply rate (500 cc.)
16	157829-3520	Measuring Device	1	For measuring pump plunger lift (used when mounting pump on engine) Dial gauge Part No.: 157954-4100 (0–5 mm, ×0.01 mm)
17	105765-1290	Pipe Assembly	1	For pressure gauge (for 7 NP and 10 NP model pump test stands)
18	157844-0320	Holder Assembly	1	For calking 2-piece separate type control lever

Note: 1. The quantities shown in the "Quantity" column are those for a 6-cylinder engine.
2. Key numbers 4, 5 and 14 are not necessary when using the 7 NP or 15 NP model pump test stands.

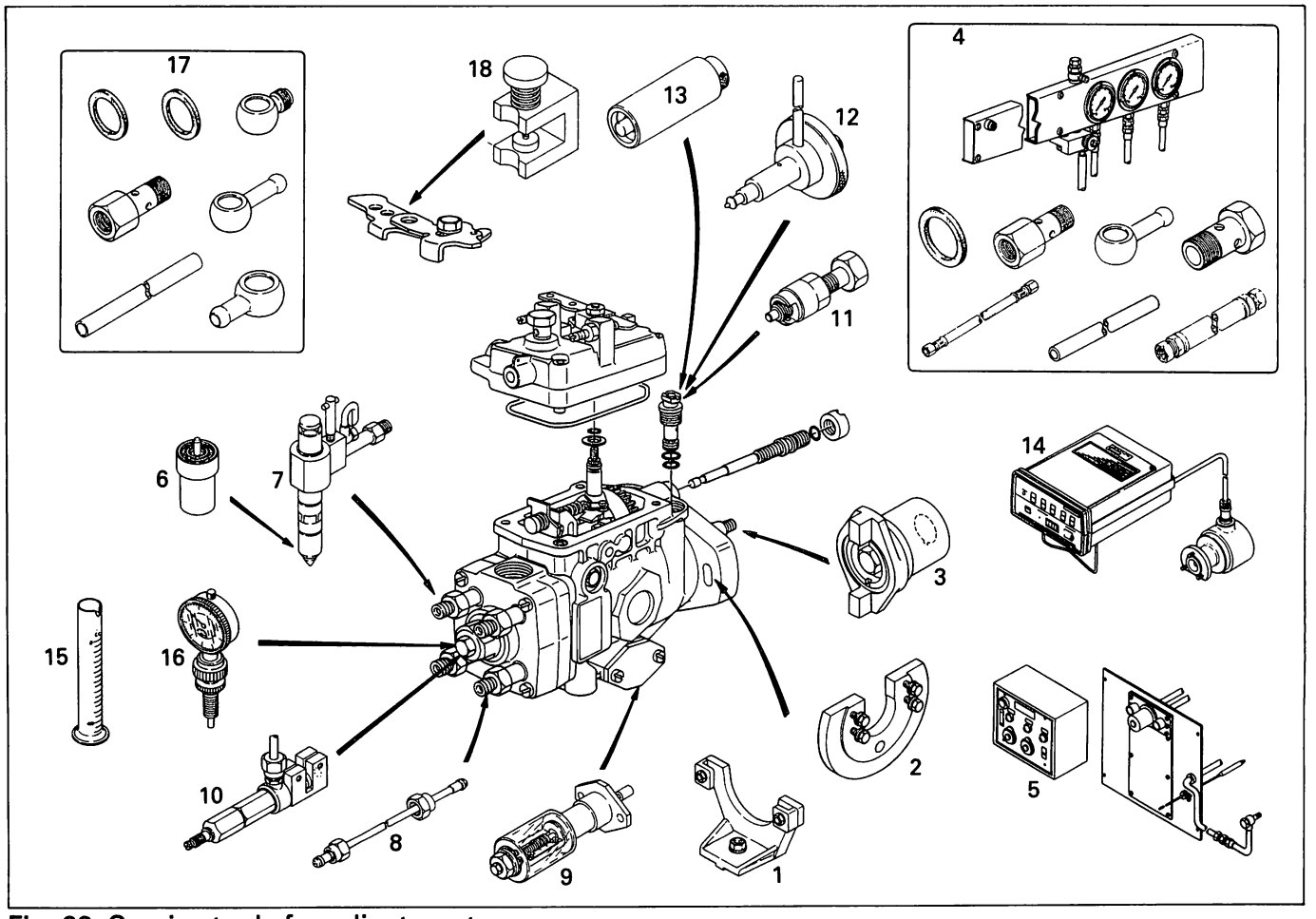


Fig. 99 Service tools for adjustment

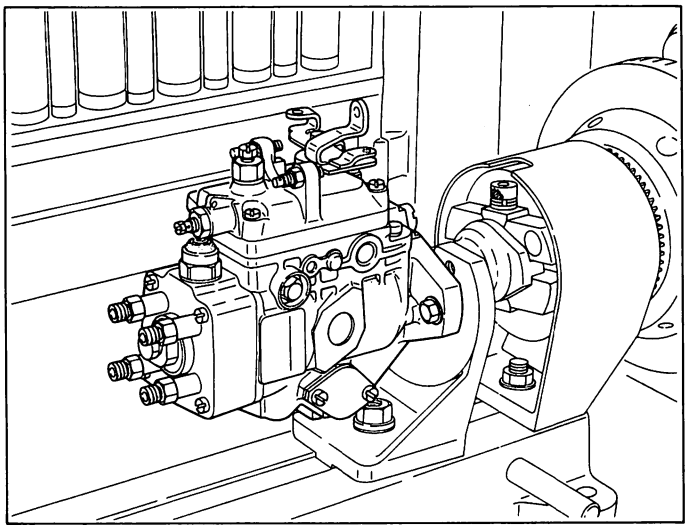


Fig. 100 Mounting the injection pump

Injection Pump Installation

1. Fit the key in the drive shaft and attach the coupling.
2. Mount the injection pump on the fixing stand (105781-0360) and connect it to the injection pump test stand. (Fig. 100)

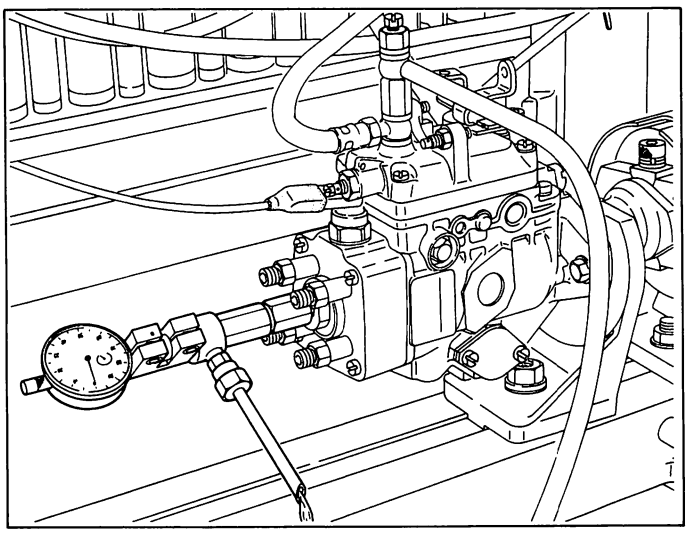


Fig. 101 Connecting the pipes

Pre-stroke Adjustment (for applicable plungers)

1. After removing the bolt (130/3) screwed into the plug (130), fit the measuring device (105782-8160) with the dial gauge (157954-3600).
2. Connect the supply and overflow fuel pipes to the injection pump. (Fig. 101)
3. Apply the specified voltage to the magnet valve and feed pressure of 0.2 kg/cm^2.
4. Set the "0" (zero) position of the dial gauge to align with the plunger's bottom dead center position and, at this time, confirm that the test oil flows from the measuring device. (Fig. 101)
5. Rotate the injection pump manually in the specified direction and measure the plunger pre-stroke from the indication of the dial gauge when the test oil ceases flowing. (Fig. 102)

Note: If not within the specified range, adjust it by exchanging the shim (52) with a suitable one until it is as specified .

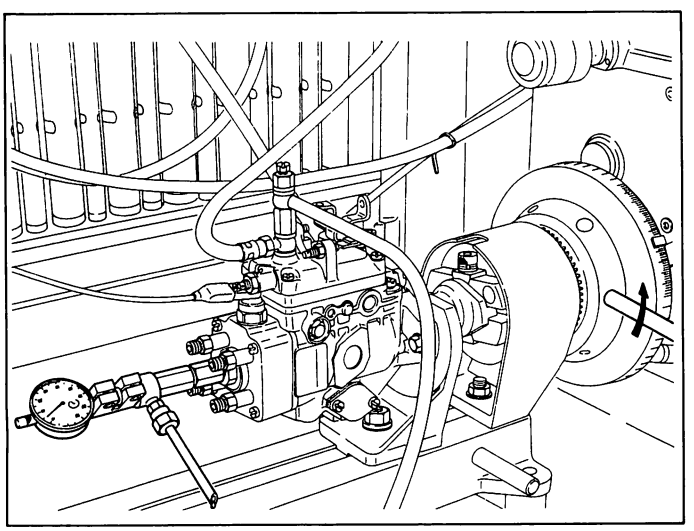


Fig. 102 Measuring the pre-stroke

Piping components for the 5 NP and 10 NP model test stands

Key No.	Part Name	Part No.	Q'ty	Remarks
	Injection pump tester	105760-0010 105760-0500 105760-0020 105760-0510		50 Hz 60 Hz
1	Pipe joint bolt	029731-4080	1	
2	Gasket	026514-2040	2	
3	Pipe joint	029711-4190	1	
4	Accumulator assembly	157841-0020 157841-2420	1	
5	Flexible hose	157984-7400	1	
6	Pipe joint bolt	027412-2440	1	
7	Gasket	026512-1640	2	
8	Pipe joint	029711-2240	1	
9	Gasket	026512-1640	2	
10	Pipe joint	029711-2160	1	
11	Pipe joint bolt	157975-8800	1	
12	Pipe joint	029711-2180	1	
13	Flexible hose	157984-8100	2	
14	Vinyl hose	157986-0500	2	
p_1	Pressure gauge	157955-2300 157955-0800	1	2 kg/cm^2
p_2	Pressure gauge	157955-2300 157955-0800	1	2 kg/cm^2
p_3	Pressure gauge	157955-2200 157955-0700	1	15 kg/cm^2

Note: 1. Key Nos. 1 to 3 are pump test stand accessories.
2. Key Nos. 4 to 14 are included with the accumulator unit (105784-1100, -1110).
3. Key Nos. p_1 to p_3 are included with the accumulator assembly (157841-0020, -2420).

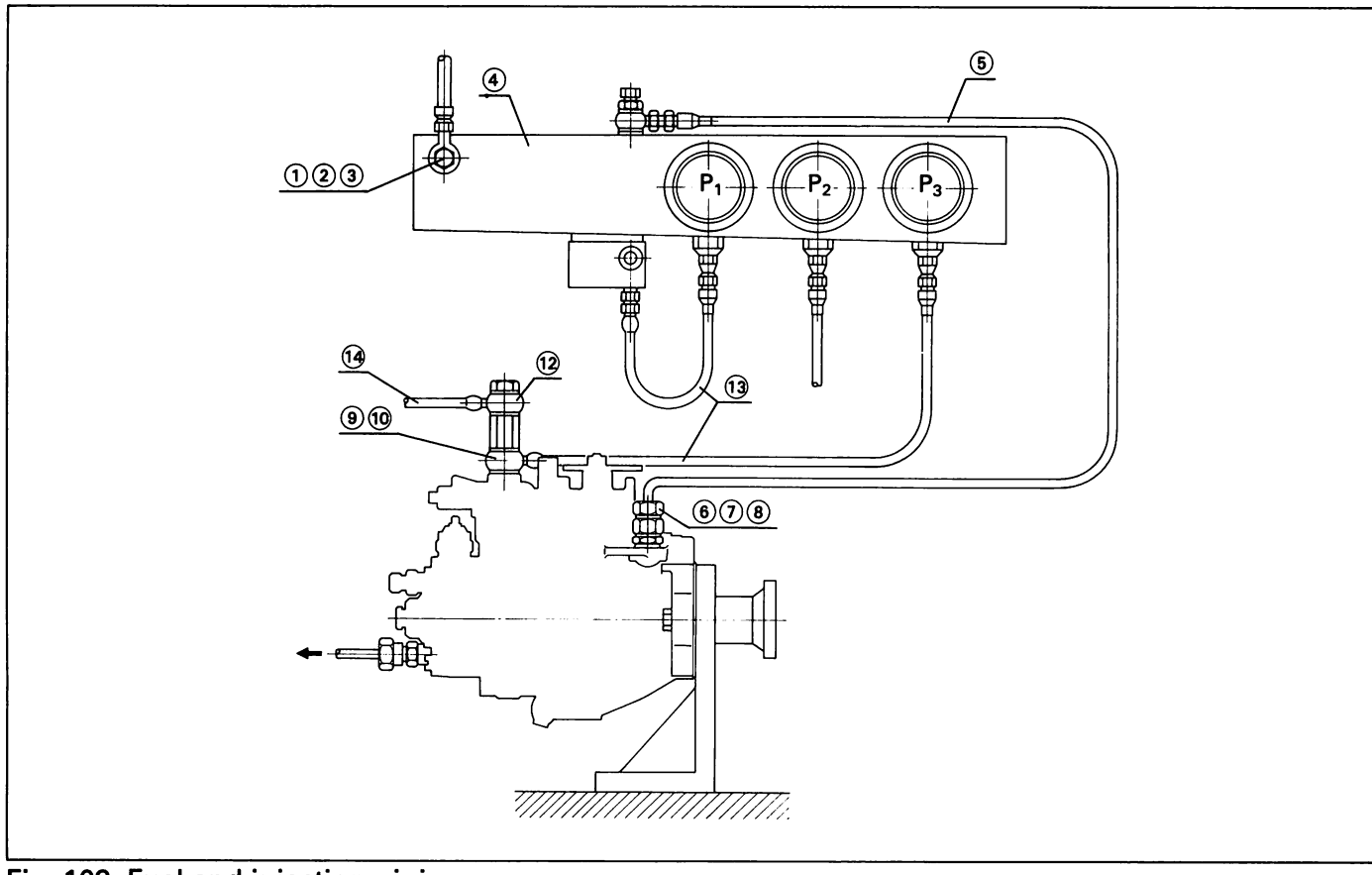


Fig. 103 Fuel and injection piping

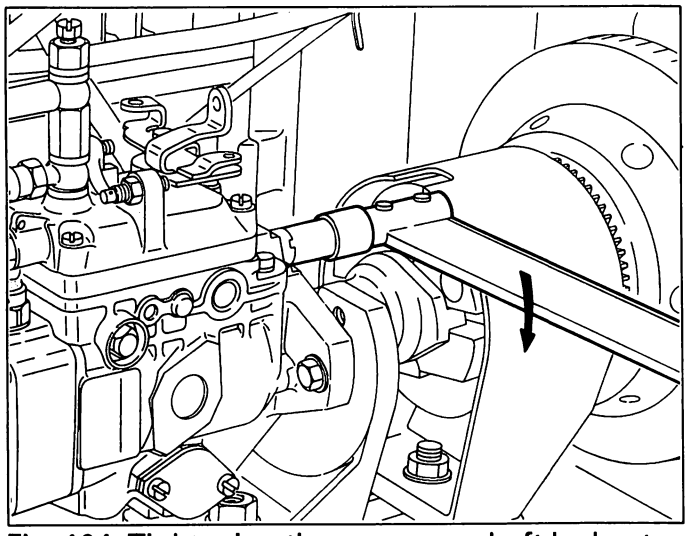


Fig. 104 Tightening the governor shaft locknut

Piping

Connect the fuel and injection pipes as shown in Fig. 103.

Checking governor shaft assembled dimensions

Check that the distance from the end face of the pump housing flange to the end face of the governor shaft is 1.5 to 2.0 mm (approx. 3 mm for an injection pump equipped with a load timer). If not within this range, make adjustment using the adjusting device (157915-2620). After adjustment, tighten the nut to the specified torque. (Fig. 104)

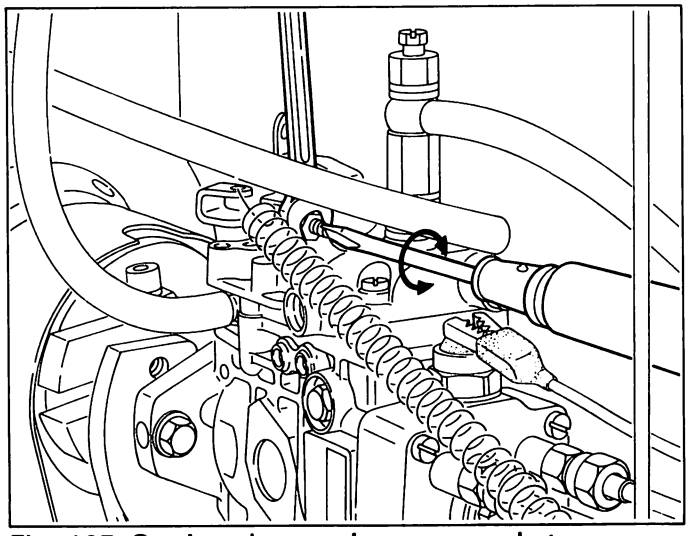


Fig. 105 Setting the maximum speed stopper bolt

Running-in Operation

1. Maintain the test oil temperature at 45^{+5}°C.
2. Operate the magnet valve by applying the specified voltage.
3. Rotate the injection pump by hand and check that it operates smoothly.
4. Rotate the pump at low speed (approx. 300 rpm) and check that air in the pump chamber flows from the overflow valve (136).
5. Adjust the test oil pressure to the specified value.
6. Gradually raise the pump speed and, while pulling the control lever with a spring toward the maximum speed position, set the control lever position using the maximum speed stopper bolt so that the flyweights do not start opening at speeds below 1500 rpm. Then, fix it in position. (Fig. 105)

   Perform subsequent adjustments with the control lever in this position. Confirm that injection occurs, and then thoroughly wipe the surface of the pump so that any oil leakage may be clearly seen.
7. Operate the pump at 1000 rpm and, if operation is normal, continue to warm up the pump for 10 minutes. If any oil leakage, injection failure or unusual noise etc. is detected, immediately stop the pump and determine the cause.

ADJUSTMENTS

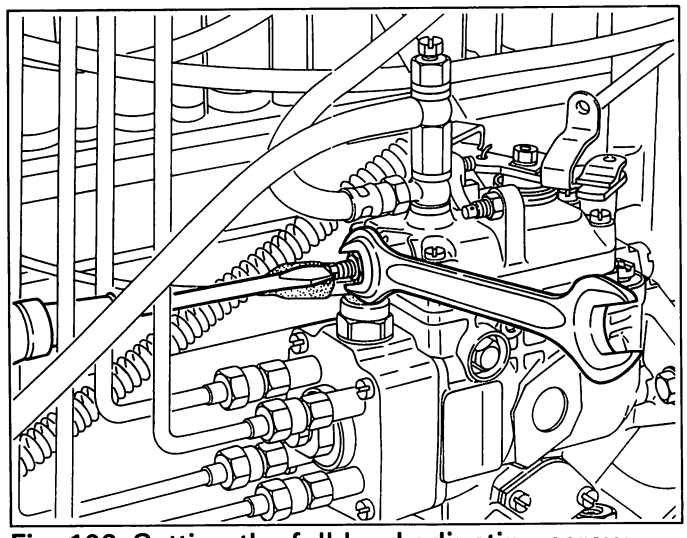


Fig. 106 Setting the full-load adjusting screw

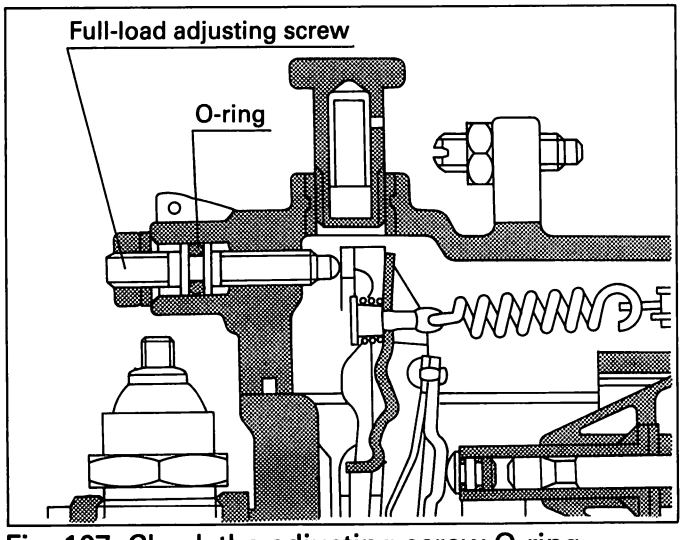


Fig. 107 Check the adjusting screw O-ring

Full-load Injection Quantity Adjustment

1. Fix the control lever in the maximum speed position and check that the governor does not operate at the speed specified in the calibration data.
2. Measure the injection quantity at the speed specified in the calibration data. If the injection quantity is not as specified , adjust the injection quantity using the full-load adjusting screw (88). Be sure to tighten the nut (90) before measuring the injection quantity. (Fig. 106)
3. Check that the full-load adjusting screw O-ring is not projecting from the cover mounting hole. If projecting from the hole, use a shorter adjusting screw. Conversely, if the full-load adjusting screw is too short, it will not be possible to adjust the full-load injection quantity and the nut will not sufficiently engage the screw. In this case, use a longer adjusting screw. (Fig. 107)

Adjusting screws

Part No.	Length (L) (mm)	Shape
146545-0300 146545-0400 146545-0500	53 55 57	L

4. Check that the differences in the injection quantities between the cylinders are within the specified range.

   If not within the specified range, adjust by replacing the delivery valve(s).

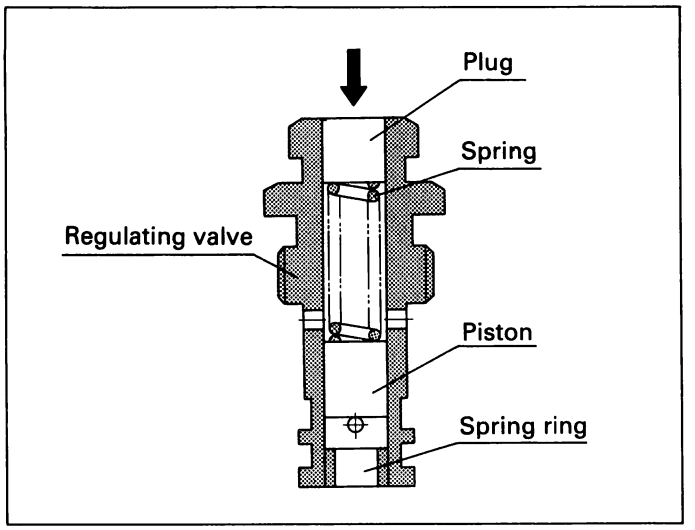


Fig. 108 Regulating valve construction

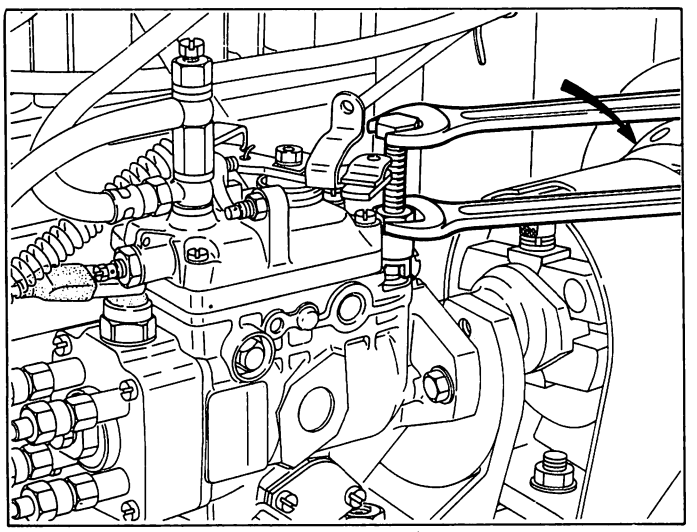


Fig. 109 Adjusting the pump chamber pressure

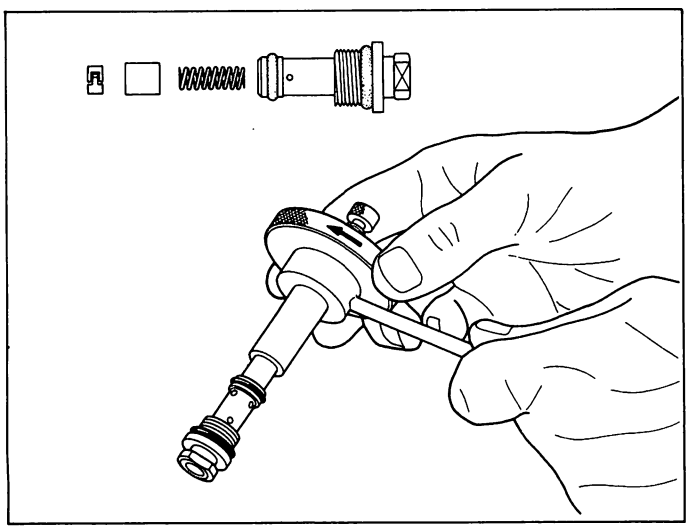


Fig. 110 Disassembling the regulating valve

Supply Pressure Adjustment

1. Using a pressure gauge compatible with the specified piping, measure the pump chamber pressure at the speed indicated in the calibration data, and check that it is within the specified range. If the pressure is outside the specified range, adjust it as follows while carefully observing the pressure gauge reading.
2. If the pressure is lower than the specified value, push in the regulating valve's plug using the adjusting device (157829-0820) to adjust the pressure to the specified value. (Figs. 108 and 109)

Note: Do not push the plug in too far.

3. If the pressure is higher than the specified value, disassemble the regulating valve and push the plug out from the inside to reduce the pressure to the specified value.

Note: Disassemble the regulating valve only when absolutely necessary.

1) Using a socket wrench (157914-2600), remove the regulating valve.
2) Using the extractor (157829-4620), remove the spring ring, and then remove the piston and spring. Next, push the plug outwards. (Figs. 110 and 111)

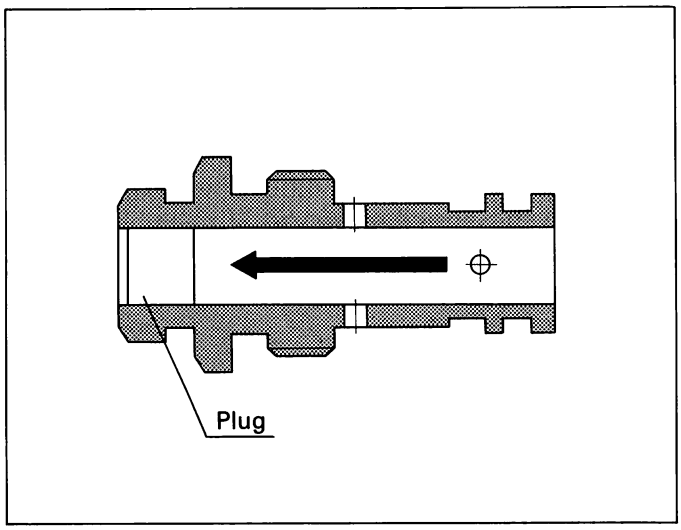


Fig. 111 Adjusting the plug position

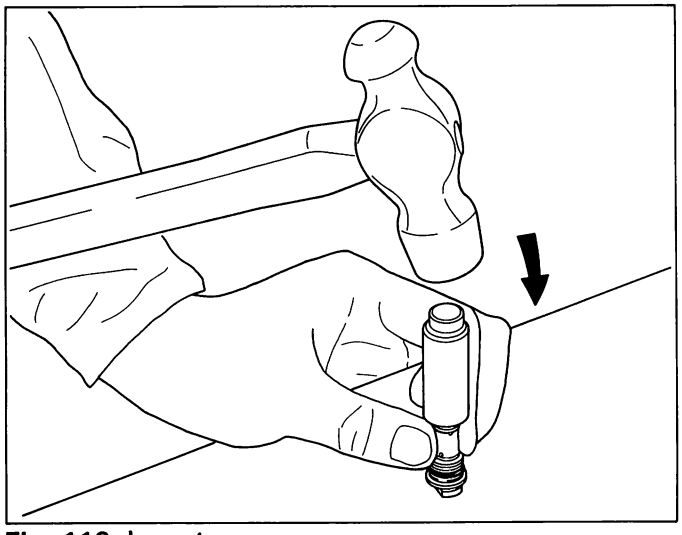


Fig. 112 Inserter

3) Reinstall the spring and piston. Then, insert a new spring ring using the inserter (157829-5220). Ensure the spring ring is flush with the end of the regulating valve. (Figs. 112 and 113)
4) Install the regulating valve in the pump housing and tighten to the specified torque.
5) Confirm the pump chamber pressure by referring to the calibration data.

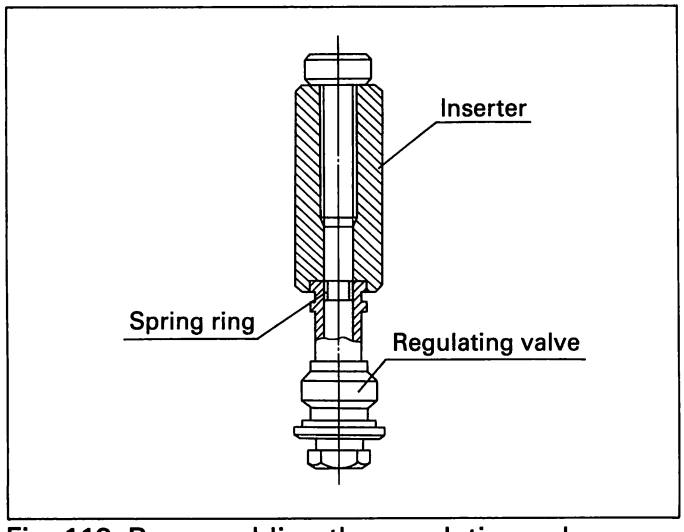


Fig. 113 Reassembling the regulating valve

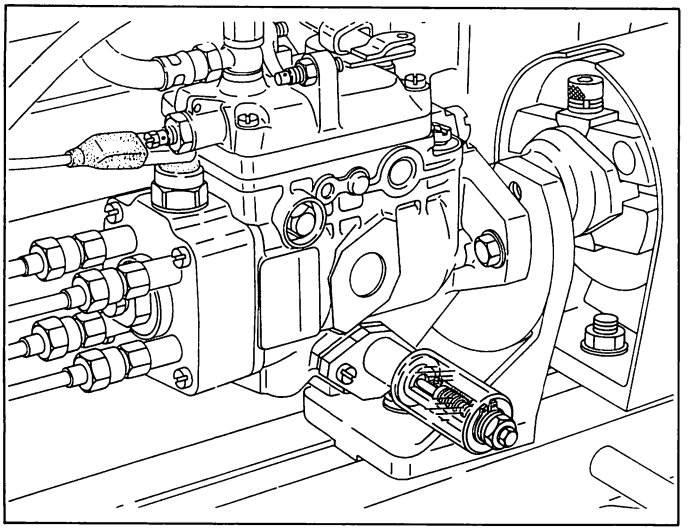


Fig. 114 Attaching the measuring device

Timer Adjustment

1. Remove the cover from the timer's high-pressure side (the side without the timer spring) by loosening the two screws and then attach the measuring device (105782-8150) (Fig. 114)

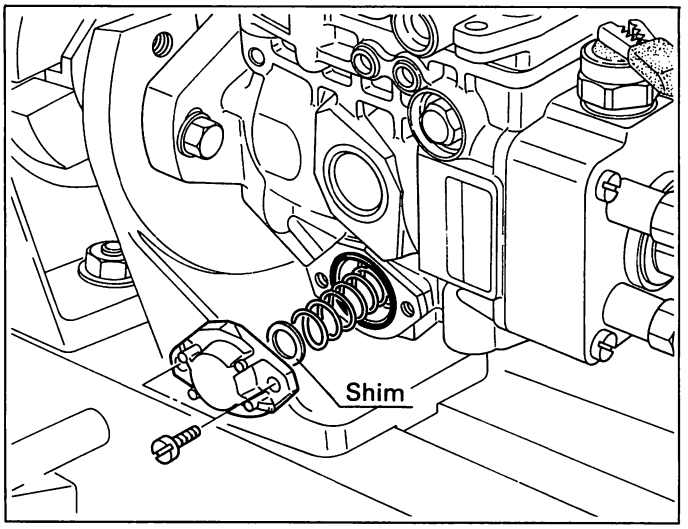


Fig. 115 Replacing the shim(s)

2. Rotate the injection pump at the speed specified in the calibration data, check the timer stroke (i.e. the indication on the measuring device), and if it is not within the specified range adjust it by replacing the shim(s) between the end of the timer spring and the low pressure side timer cover. (Fig. 115)

Shims

Part No.	Thick-ness (mm)	Part No.	Thick-ness (mm)
146603-0700	0.6	146603-1000	1.0
146603-0800	0.7	146603-1100	1.2
146603-0900	0.9	146603-3600	2.4

Checking Full-load Injection Quantity

1. Check the full-load injection quantity.
   If not as specified, adjust it using the full-load adjusting screw. (Refer to Fig. 106)
2. Check the position of the full-load adjusting screw O-ring.
   If not correctly positioned, adjust it by replacing the full-load adjusting screw. (Refer to Fig. 107)
3. Check that the differences in the injection quantities between the cylinders are within the specified range.
   If not, adjust by replacing the delivery valve assemblies.

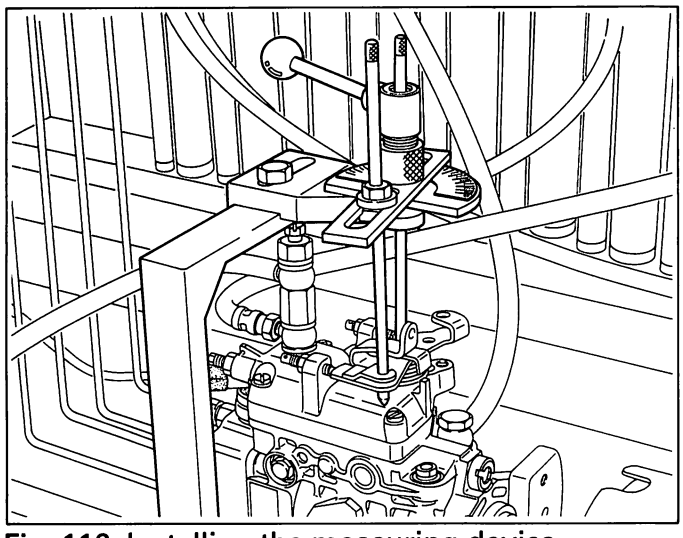


Fig. 116 Installing the measuring device

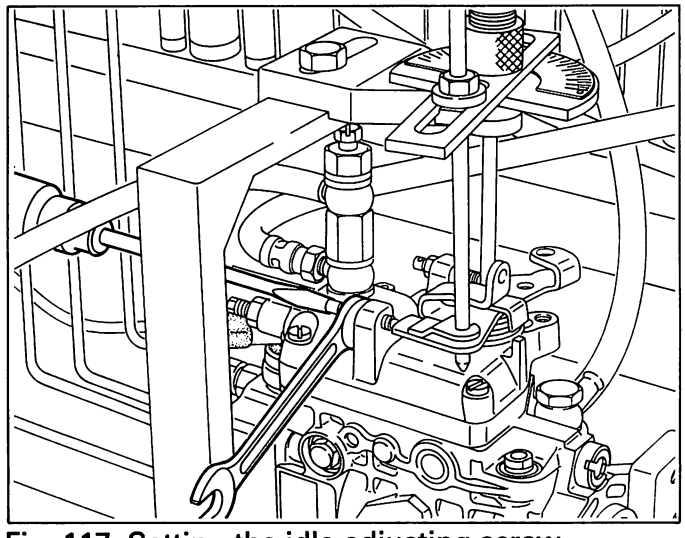


Fig. 117 Setting the idle adjusting screw

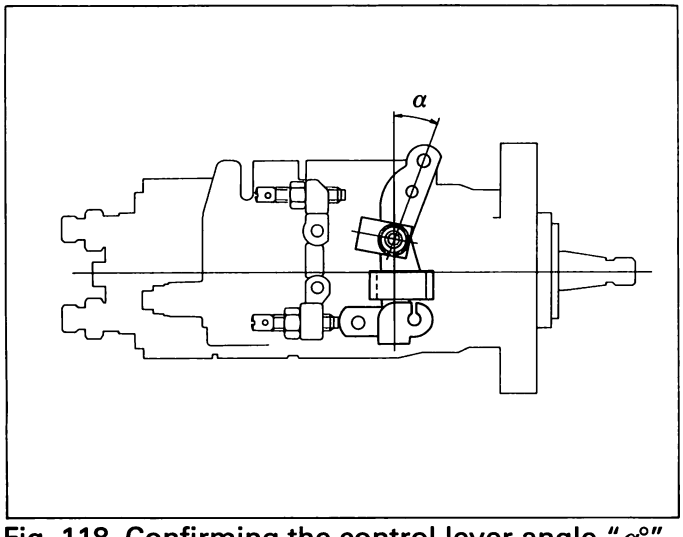


Fig. 118 Confirming the control lever angle "α°"

Idling Adjustment

1. Release the control lever (previously fixed during the above procedures) from the spring.
2. Install the injection pump measuring device (105782-6230) to measure the control lever angle. (Fig. 116)

Note: The control lever is always pushed against the idle adjusting screw by the return spring (67/18), so it is not necessary to pull the control lever towards the idling position using a spring.

3. Operate the injection pump at the specified speed and turn the idle adjusting screw until the specified injection quantity is obtained. (Fig. 117)
4. Confirm that the control lever angle (α) is as specified by referring to the measuring device indication. (Fig. 118)
5. If not as specified, adjust it by altering the fitting position of the serrations between the control lever and the control shaft. Then, readjust the idle adjusting screw.

Note: Each serration is equal to a 15° difference in the control lever angle. If adjustment can not be performed, adjust it according to the following. There are differences in the control lever angle adjustment methods depending on the control lever type, as shown below.

a) Standard type
One type of the standard control lever is different from the above in that the phase of the serrations differs by 7.5°. Use this lever to adjust the control lever angle if the above lever is not suitable.

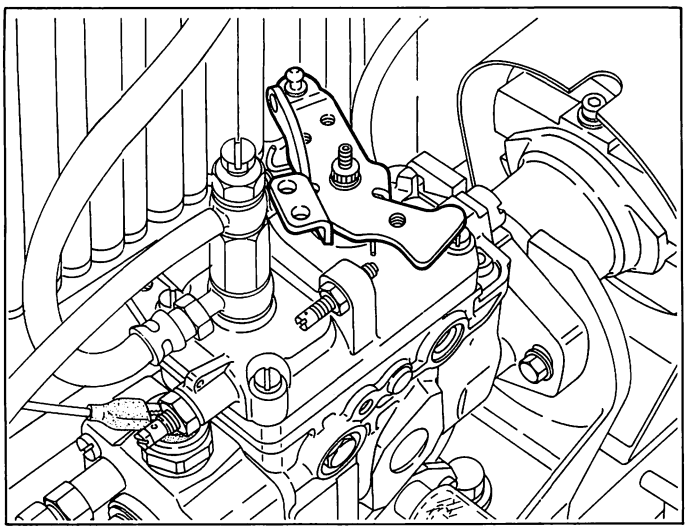


Fig. 119 Fitting the control lever base

b) 2-piece separate type
Replace this control lever base with a new one if angle adjustment cannot be performed. The adjustment and calking method to integrate the 2-piece separate type levers are explained below.

–1 Fit the control lever base to the control shaft. (Fig. 119)

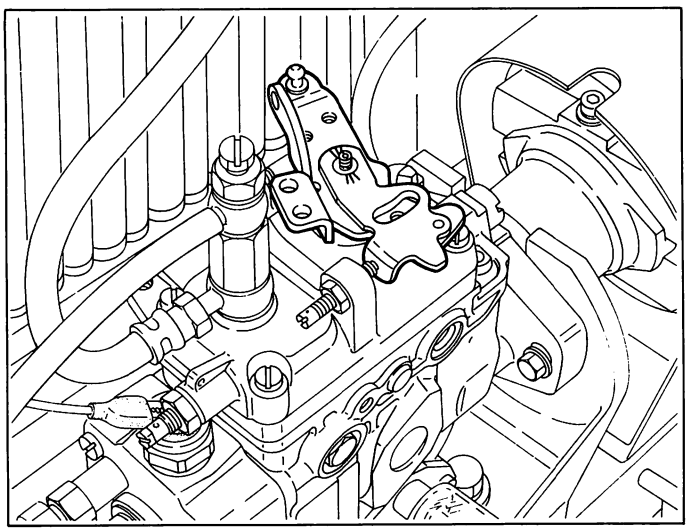


Fig. 120 Fitting the control lever top

–2 Fit the control lever top on the control lever base so that the control lever top's and the control shaft's stamped aligning marks are aligned.

Note: Although the control lever top has 3 aligning marks, the control shaft's aligning mark is usually aligned with the centre aligning mark. (Fig.120)

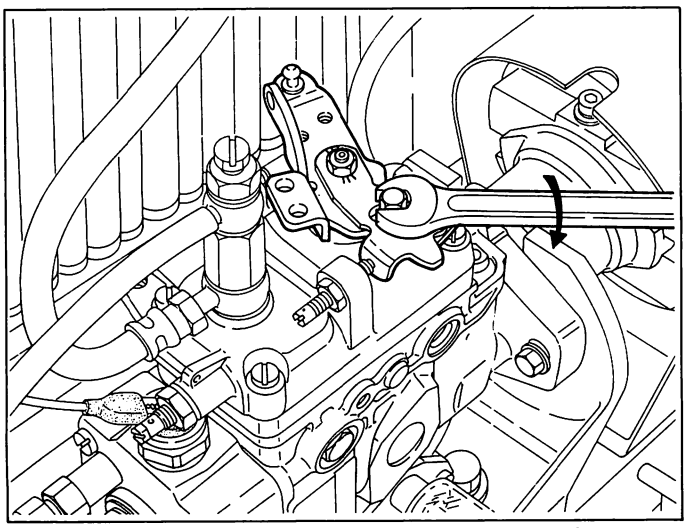


Fig. 121 Fixing the control lever base and top

–3 Then, fix the control lever top to the control shaft using a nut and spring washer.

–4 Screw the fixing bolt in the control lever base through the control lever top's slot to fit the control lever base to the control lever top. Then, tighten the fixing bolt lightly. (Fig.121)

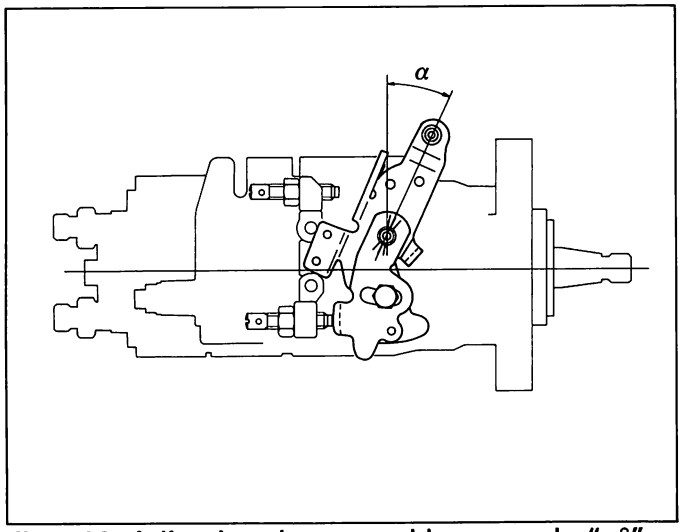


Fig. 122 Adjusting the control lever angle "α°"

–5 After the idling injection quantity adjustment, set the control lever base by loosening the fixing bolt so that the control lever angle is as specified (α) when measured using the measuring device. (Fig.122)
Then, fix the control lever base to the control lever top using the fixing bolt while taking care not to alter the position of the control lever base.

6. If performing the control lever angle adjustment, reset the idling adjusting screw to readjust the idling injection quantity.

Confirming Excess Fuel Injection Quantity for Engine Starting

1. Fix the control lever in the maximum speed position.
2. Operate the pump at the specified low speed and confirm that the excess fuel injection quantity for starting is within the specified range. If not as specified, check the governor lever starting stroke ("MS" dimension).

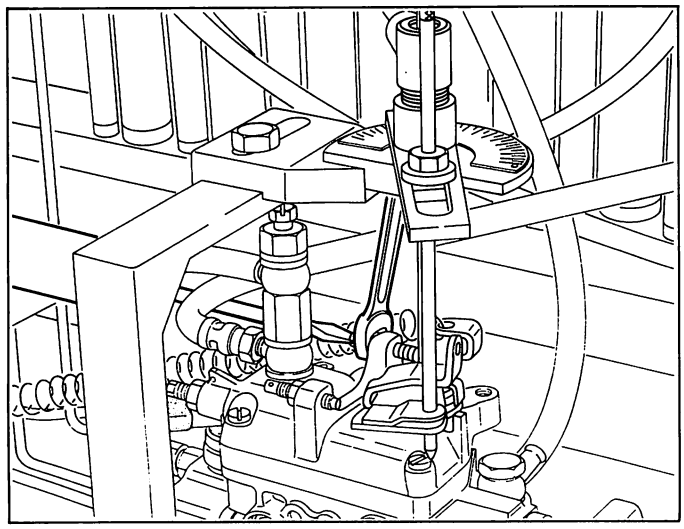


Fig. 123 Setting the maximum-speed stopper bolt

Maximum Speed Injection Quantity Adjustment

1. Fix the control lever in the maximum speed position.
2. Operate the pump at the no-load maximum speed specified in the calibration data and set the maximum speed stopper bolt so that the specified injection quantity is obtained. (Fig. 123)

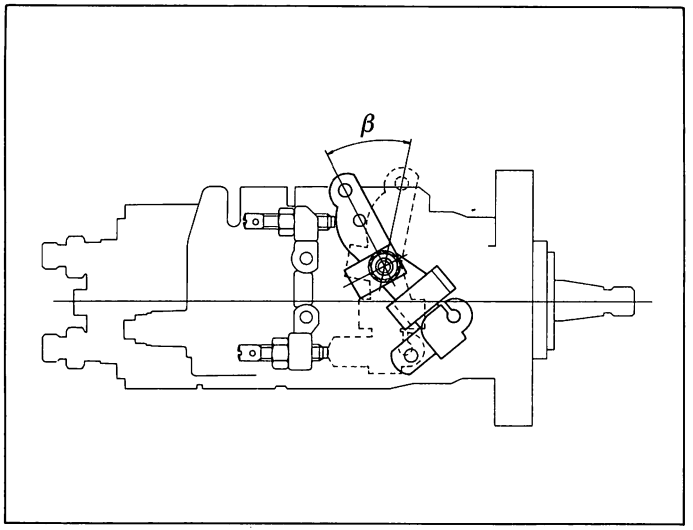


Fig. 124 Confirming the control lever angle "β°"

3. Confirm that the control lever angle (β) is as specified by referring to the measuring device indication. (Fig. 124)
4. If not as specified, adjust it by altering the fitting position of the serrations between the control lever and the control shaft. Then, readjust the maximum speed stopper bolt.

Note: After this procedure, the idling adjustment procedures must be repeated.

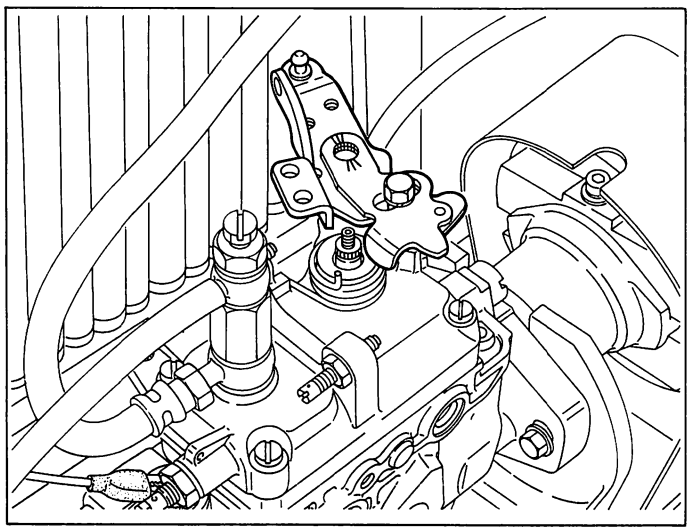


Fig. 125 Removing the control lever assembly

5. After performing the above procedures for the new 2-piece separate type control lever, the control lever assembly must be calked using the holder assembly (157844-0320) so that the position of the control lever base in relation to the control lever top can not be changed. This procedure is as follows.

–1 Remove the control lever assembly from the control shaft and note the relative positions of the aligning marks on the control lever top and the control shaft. (Fig.125)

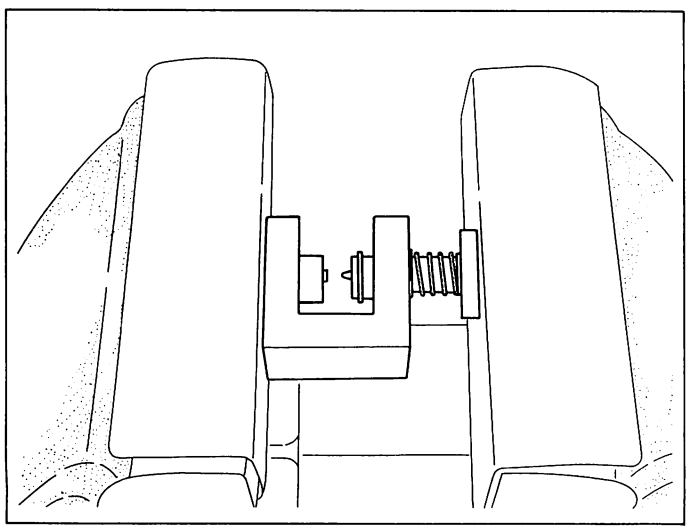


Fig. 126 Holder assembly preparation

–2 Place the holder assembly (157844-0320) in a vise. (Fig.126)

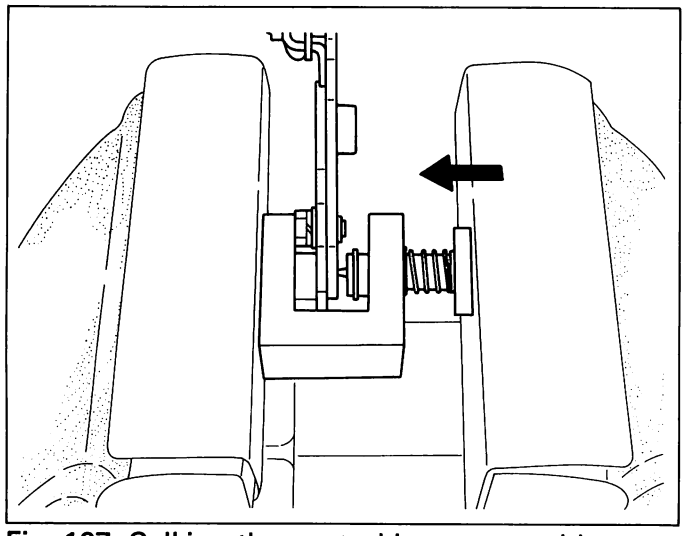


Fig. 127 Calking the control lever assembly

–3 After positioning the holder assembly's guide pin (ϕ3 mm) in the control lever top's hole (ϕ3.6 mm), tighten the vise to calk the control lever assembly and to therefore hold the control lever base and top together as a unit. (Fig. 127)

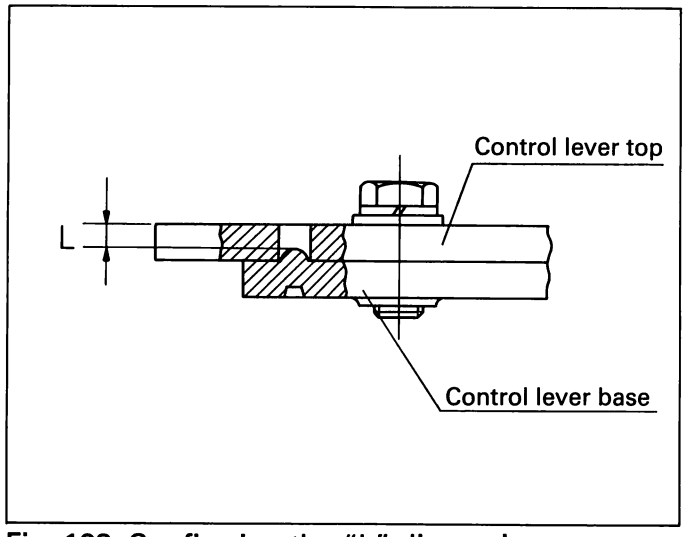


Fig. 128 Confirming the "L" dimension

–4 Remove the control lever assembly and holder assembly from the vise.
Then, confirm that the "L" dimension is less than 2.2 mm. (Fig.128) If greater than 2.2 mm, re-calk the control lever assembly using the holder assembly.

–5 Attach the control lever assembly to the control shaft after the spring (67/18) installation so as to align the control shaft's and the control lever top's aligning marks in the same position as that previous to removal for calking.
Then, fix it using the nut and spring washer.

–6 Confirm the idling and no-load maximum speed injection quantities at the specified pump speeds by fixing the control lever in the specified positions (refer to the calibration data).

Supply Pressure Confirmation

Confirm that the pump chamber pressures at each specified pump speed are as specified in the calibration data with the control lever fixed in the maximum position.

Timer Stroke Confirmation

Confirm that the timer strokes at each specified pump speed are as specified in the calibration data with the control lever fixed in the maximum position.

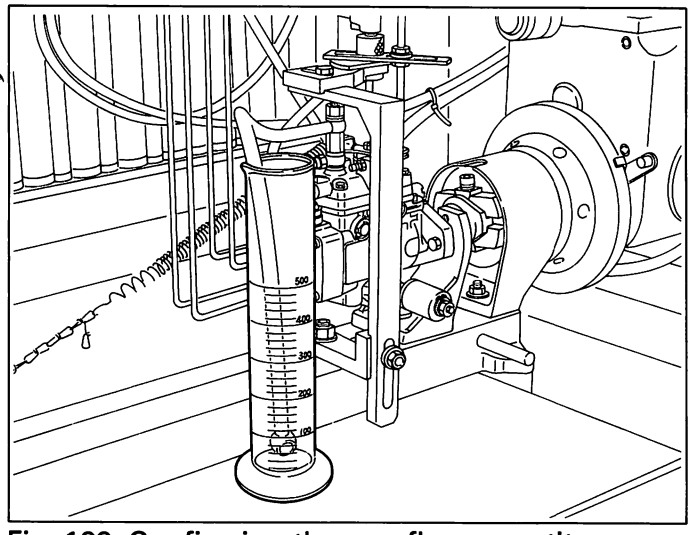


Fig. 129 Confirming the overflow quantity

Overflow Quantity Measurement

Measure the overflow quantity from the overflow valve, at the specified pump speed, with the control lever fixed in the maximum position using the measuring cylinder (157970-0500) and confirm that it is as specified in the calibration data. (Fig129)

Injection Quantity (Governing) Confirmation

Confirm each injection quantity under the conditions (pump speed, control lever position, etc.) indicated in the calibration data.

Confirming Magnet Valve Operation

Confirm that the magnet valve operates to end injection immediately the specified voltage is removed (at the specified pump speed and with the control lever in the position specified in the calibration data).

TIGHTENING TORQUES

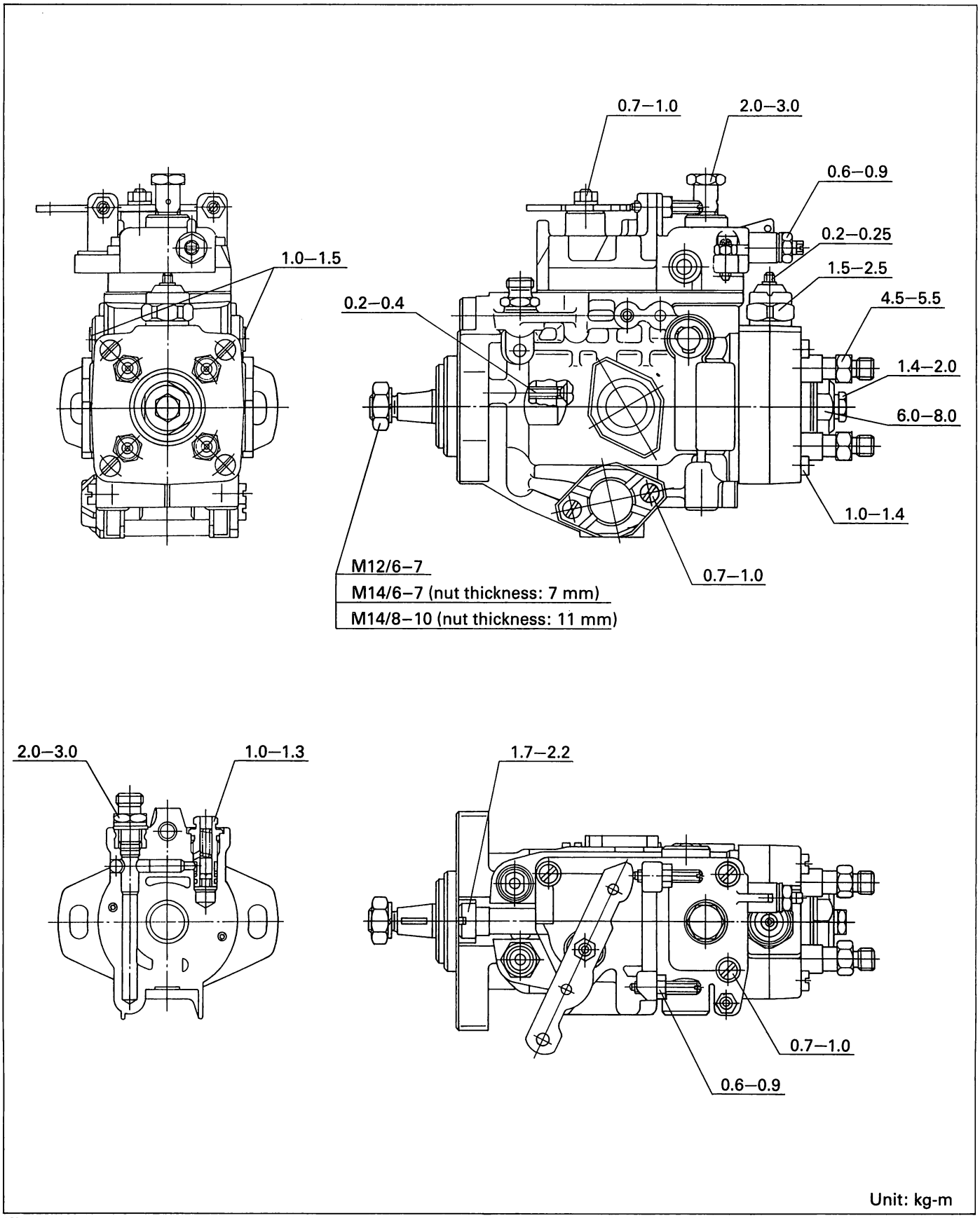
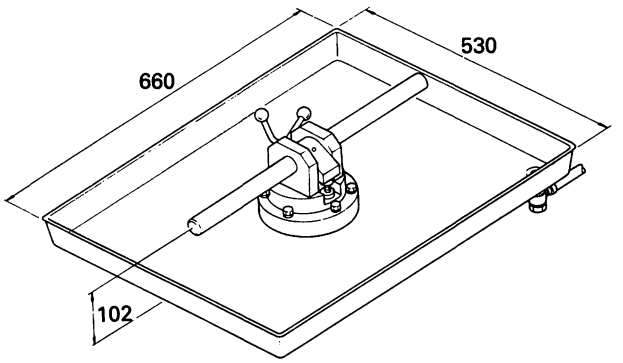


Fig. 130 Tightening torques

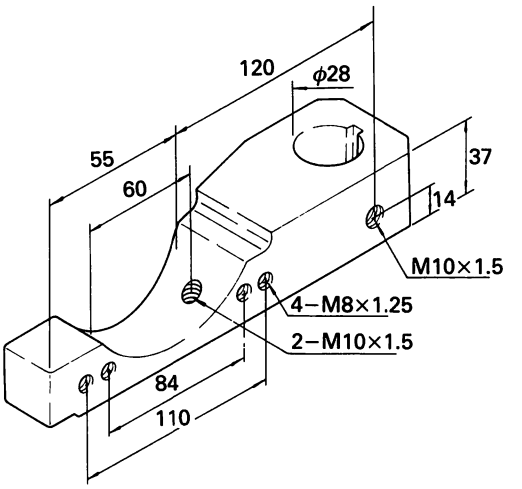
SPECIAL TOOLS

DISASSEMBLY STAND

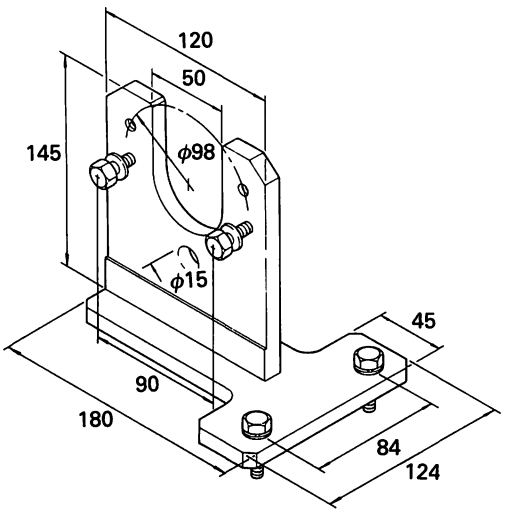
(1) 157944-8520 Universal vise
(Used together with key Nos. (2) to (4))



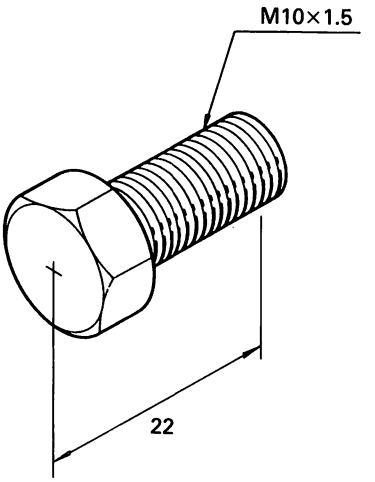
(2) 157944-7200 Bracket



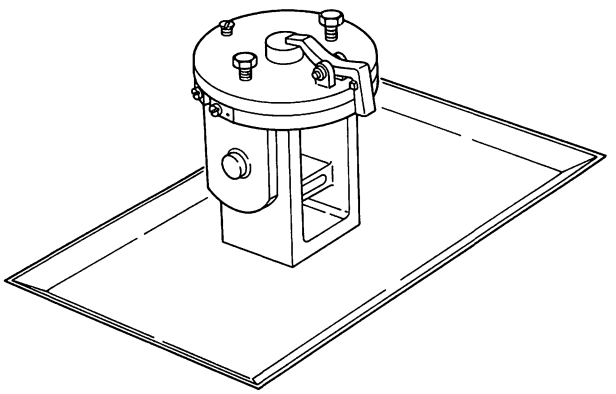
(3) 157944-7920 Bracket



(4) 010010-2200 Bolt



(5) 105794-0050 Universal vise
(Including key No. (6))



(6) 157944-2600 Plate

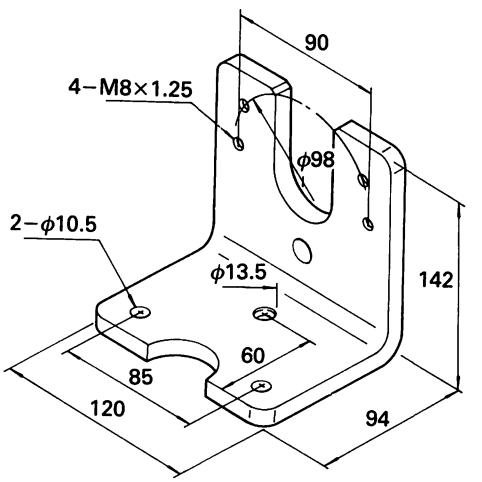
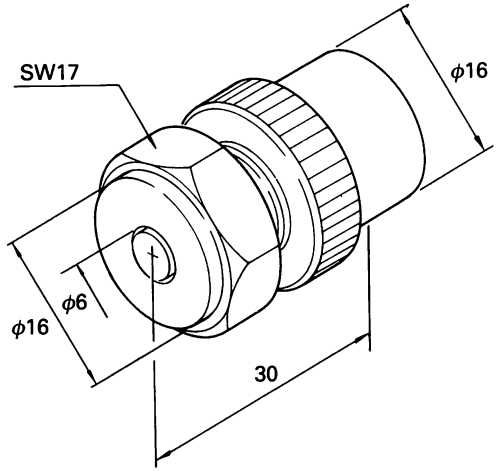


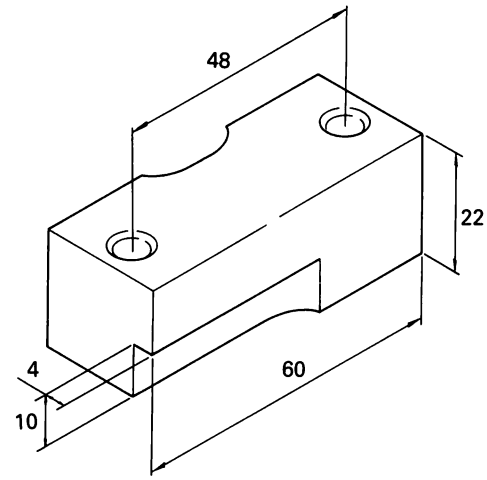
Fig. 131-1 Special tools

SPECIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY (KIT NO. 105790-1080)

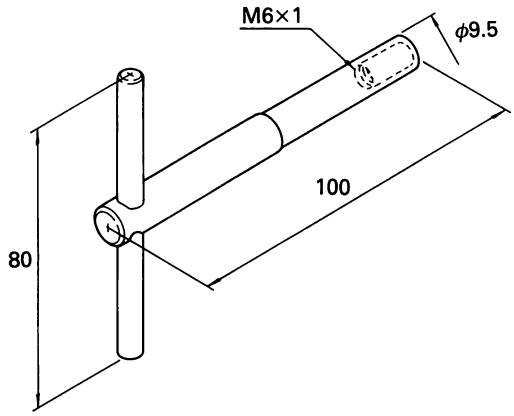
(1) 157829-0420 Measuring device



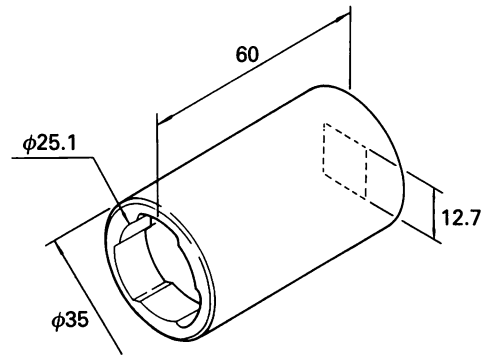
(2) 157829-1100 Block gauge



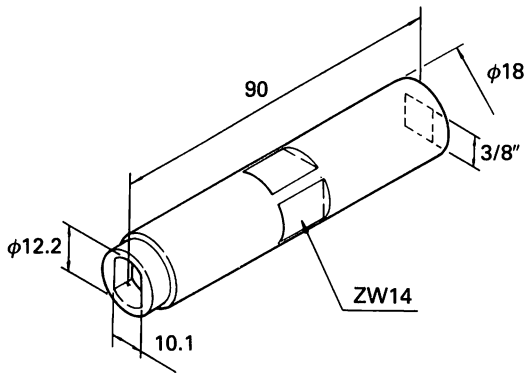
(3) 157829-0720 Inserter



(4) 157914-2500 Socket wrench



(5) 157914-2600 Socket wrench



(6) 157914-2700 Socket wrench

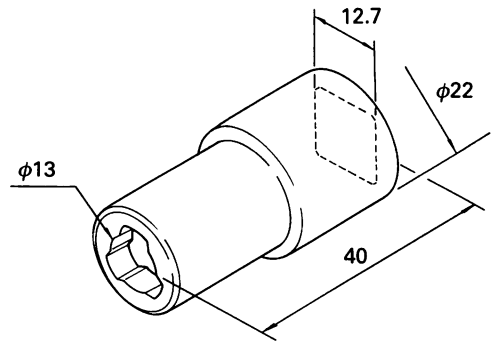
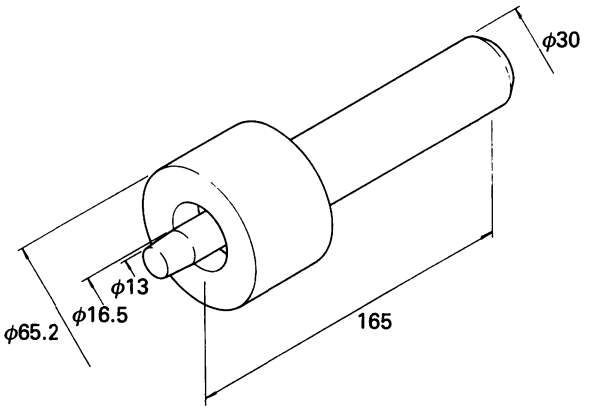
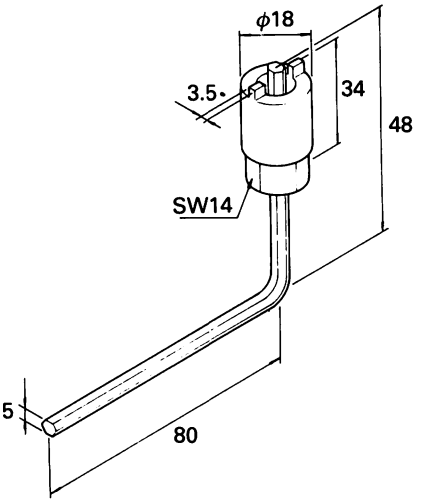


Fig. 131-2 Special tools

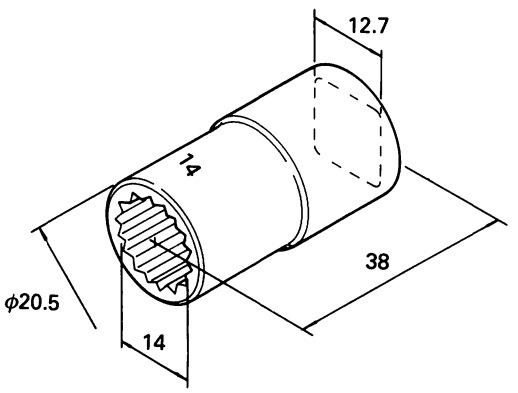
(7) 157829-5420 Feed pump holder



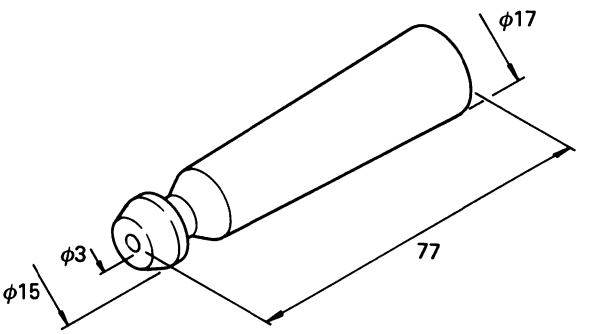
(8) 157915-2620 Adjusting device



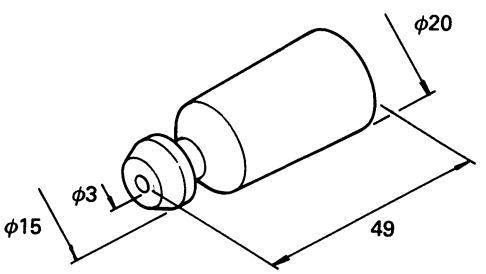
(9) 157914-1100 Socket wrench



(10) 157922-0900 Oil seal guide



(11) 157922-1000 Oil seal guide



(12) 157922-1100 Oil seal guide

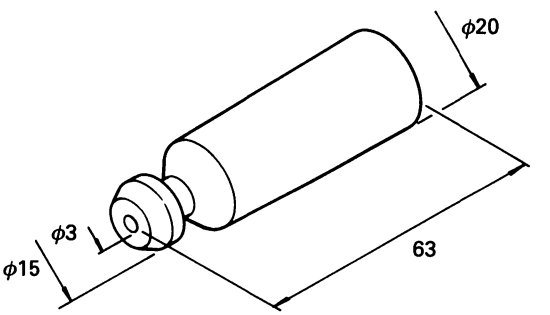
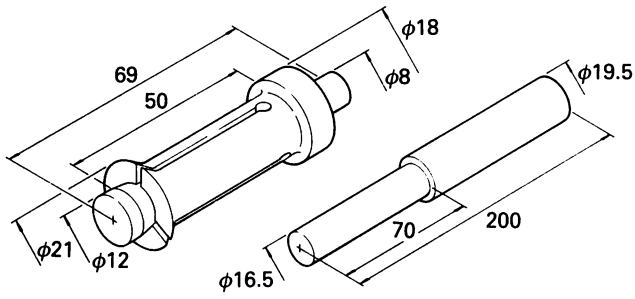
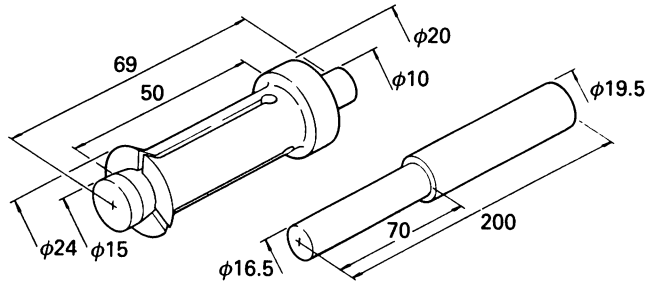


Fig. 131-3 Special tools

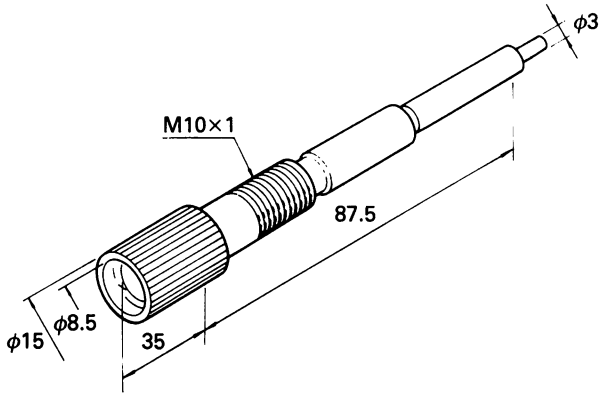
(13) 157925-2420 Oil seal extractor



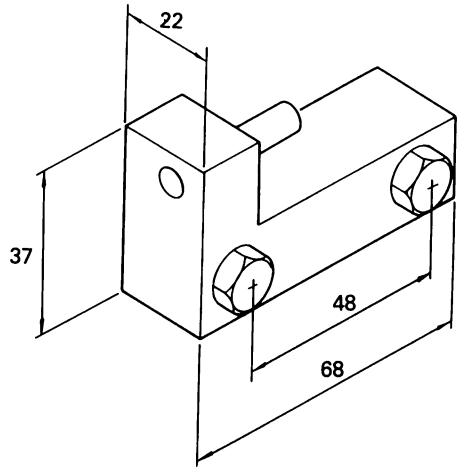
(14) 157925-2720 Oil seal extractor



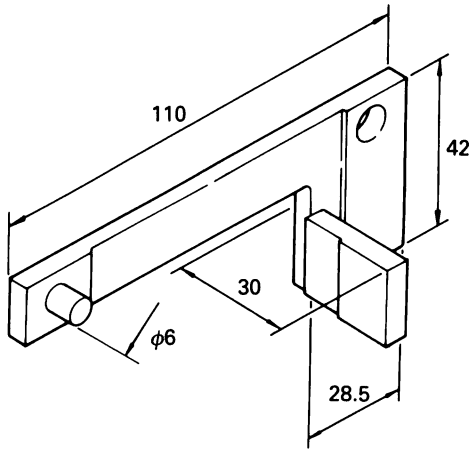
(15) 157829-8620 Measuring device



(16) 157829-7520 Block gauge



(17) 157829-7620 Block gauge



(18) 157841-9200 Measuring device

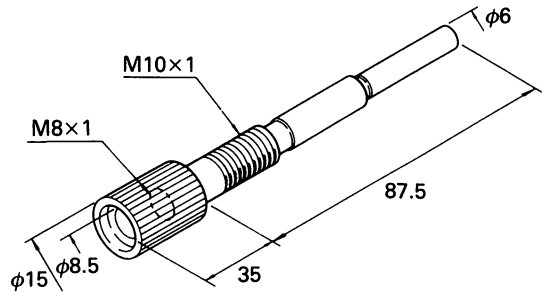
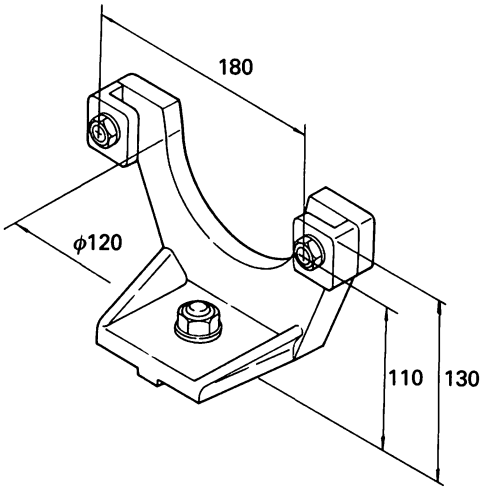


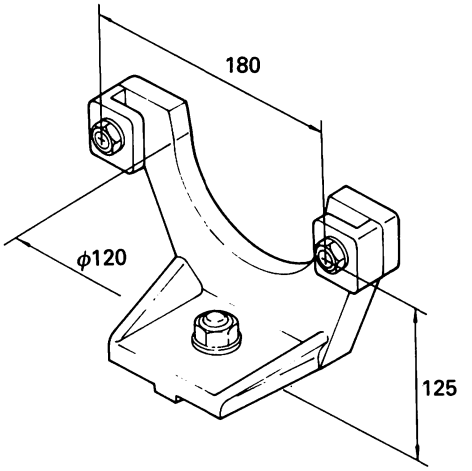
Fig. 131-4 Special tools

SERVICE TOOLS FOR ADJUSTMENT

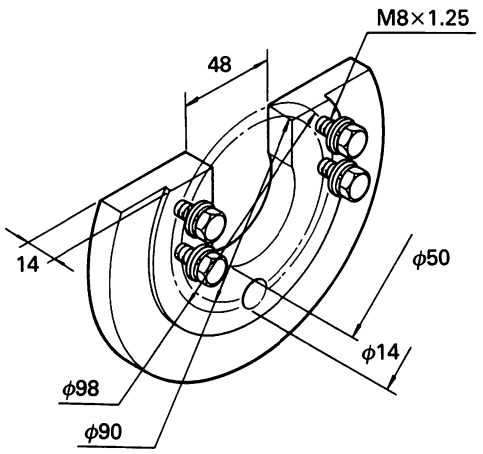
(1) 105781-0160 Fixing stand



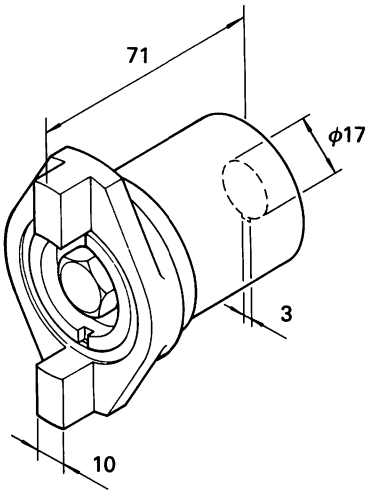
(2) 105781-0180 Fixing stand



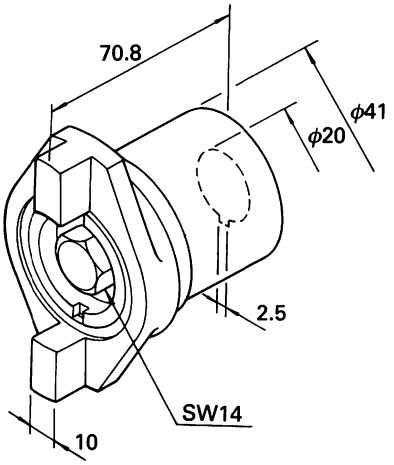
(3) 157811-0520 Flange



(4) 157842-4420 Coupling



(5) 157842-4520 Coupling



(6) 157842-4620 Coupling

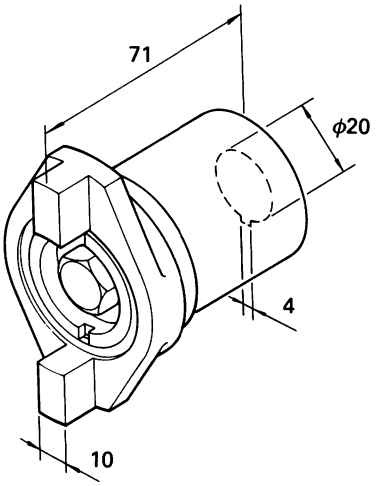
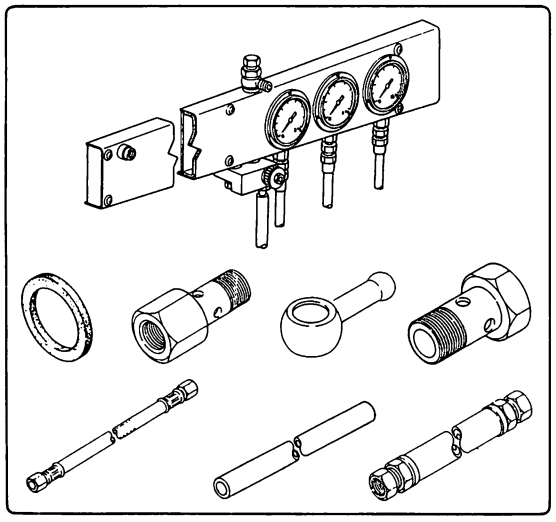
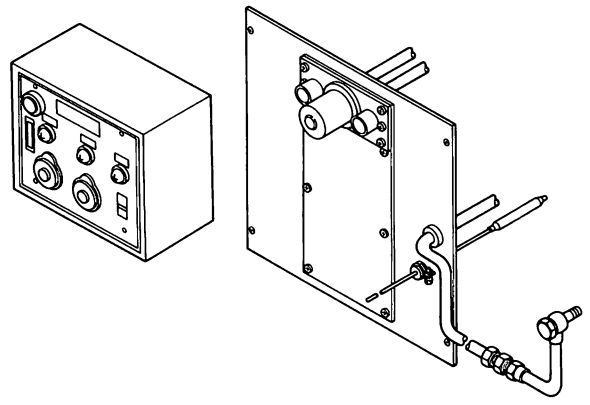


Fig. 132-1 Adjusting tools

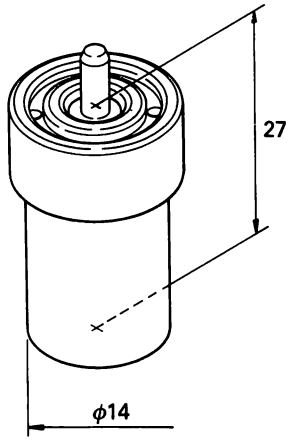
(7) 105784-1100 Accumulator unit
105784-1110 Accumulator unit



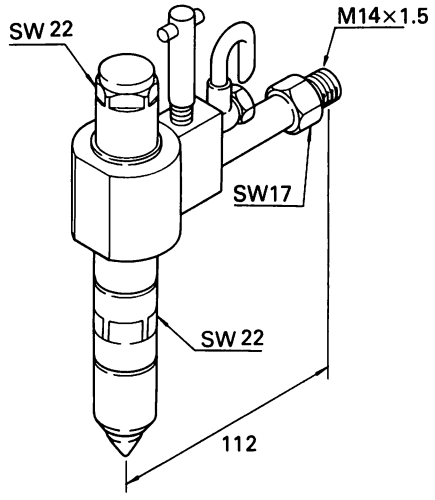
(8) 105784-1080 Heater
105784-1090 Heater



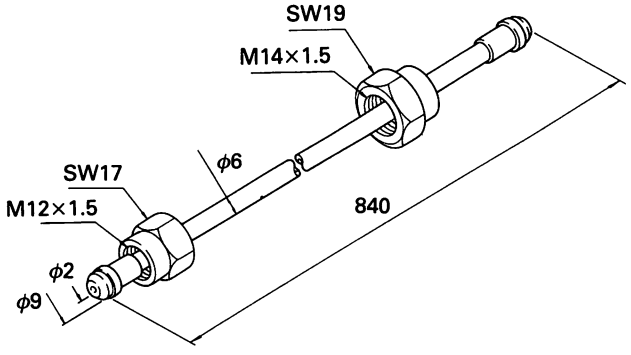
(9) 105780-0000 Test nozzle



(10) 105780-2080 Nozzle holder



(11) 157805-0320 Pipe



(12) 105782-8150 Measuring device

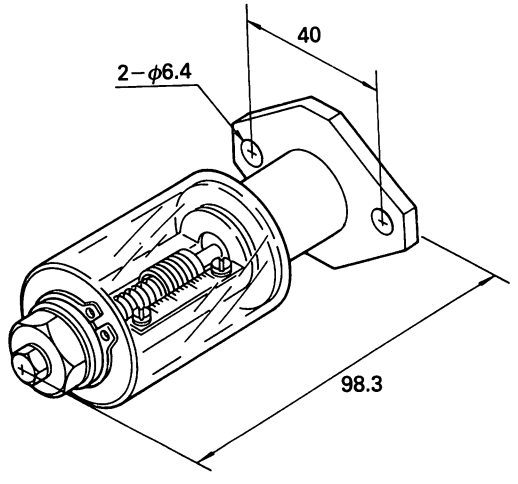
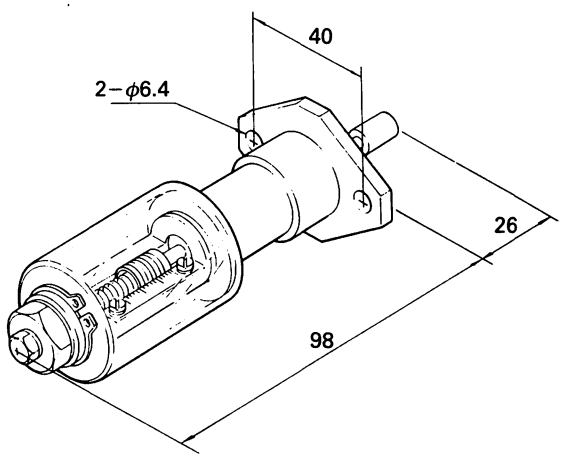
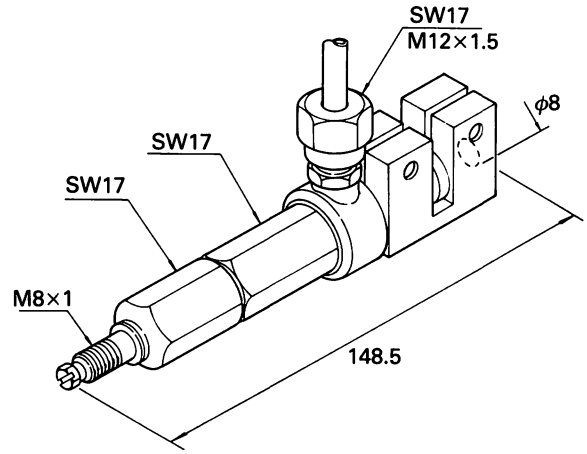


Fig. 132-2 Adjusting tools

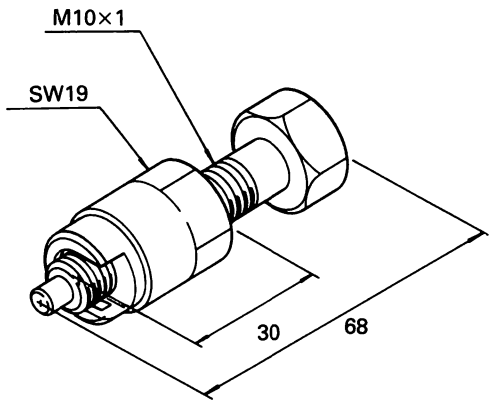
(13) 105782-8190 Measuring device



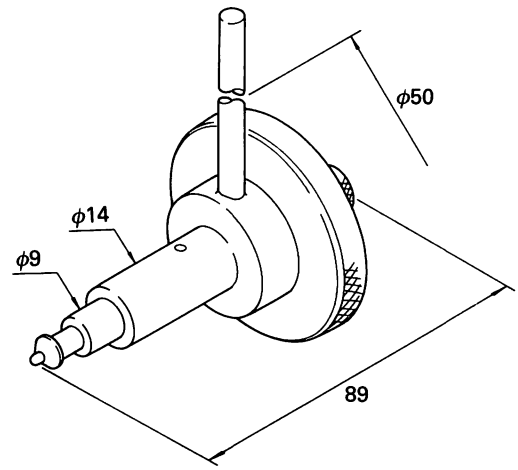
(14) 105782-8160 Measuring device



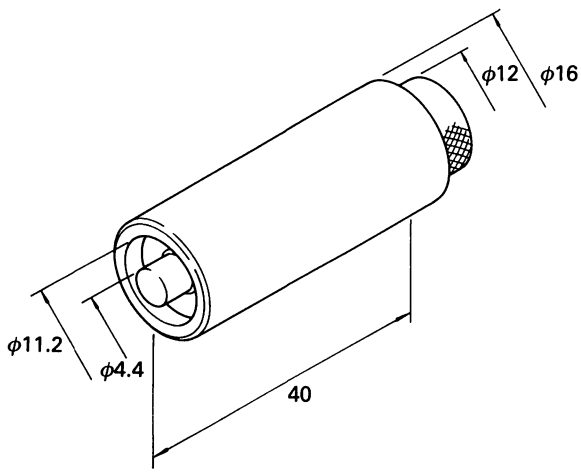
(15) 157829-0820 Adjusting device



(16) 157829-4620 Extractor



(17) 157829-5220 Inserter



(18) 105784-0140 Digital tachometer

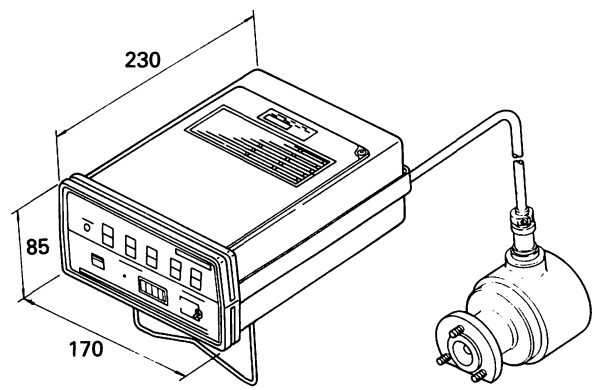
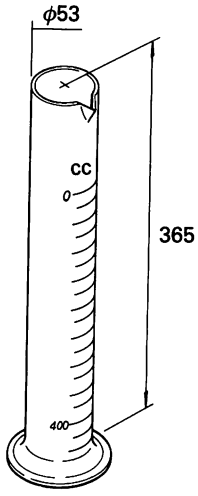
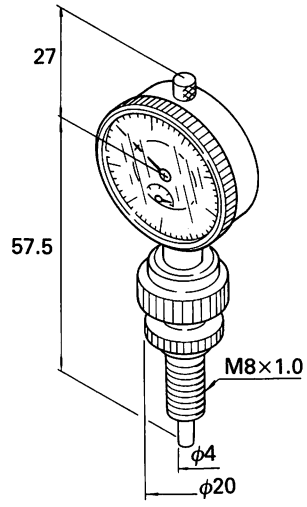


Fig. 132-3 Adjusting tools

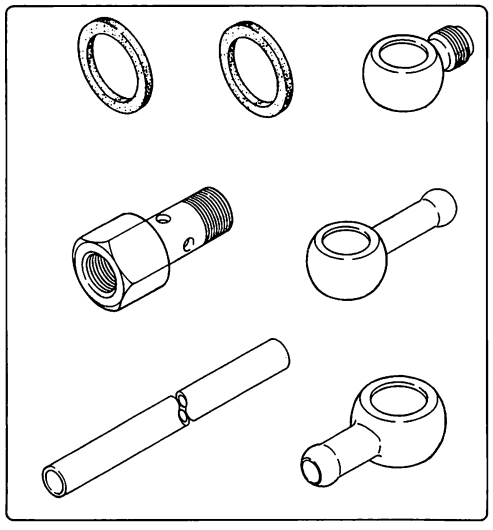
(19) 157970-0500 Measuring cylinder



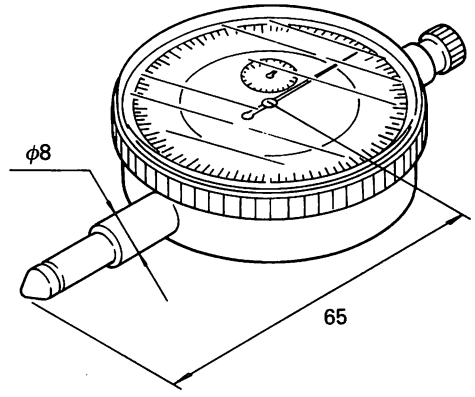
(20) 157829-3520 Measuring device



(21) 105765-1290 Pipe assembly



(22) 157954-3600 Dial gauge



(23) 157844-0320 Holder assembly

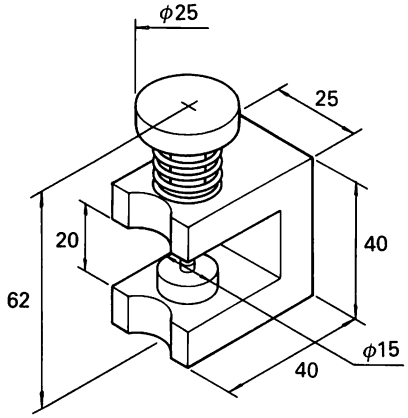


Fig. 132-4 Adjusting tools

EXPLODED VIEW OF THE VE INJECTION PUMP

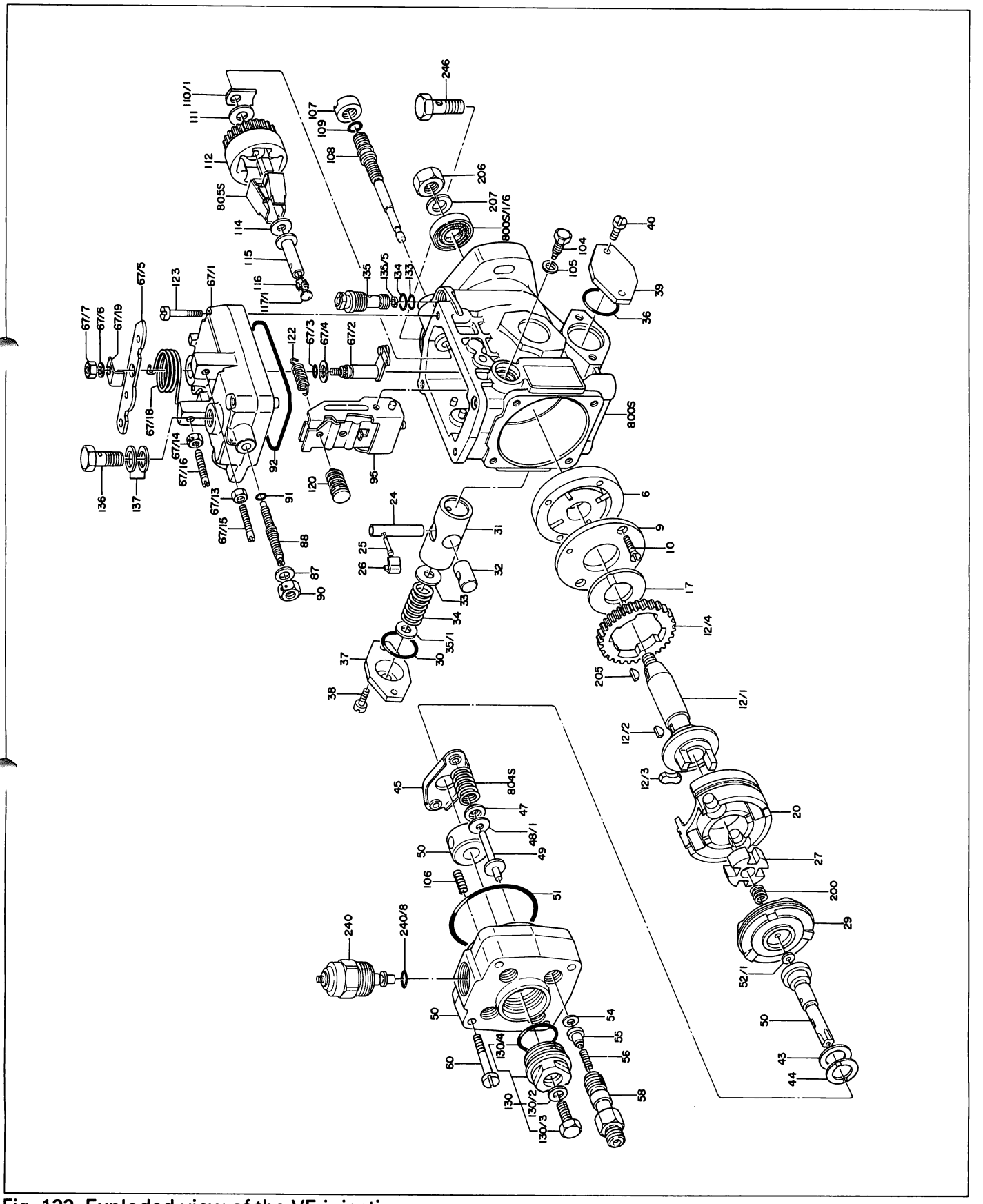


Fig. 133 Exploded view of the VE injection pump

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