CHAPTER 3

# FUEL SYSTEM




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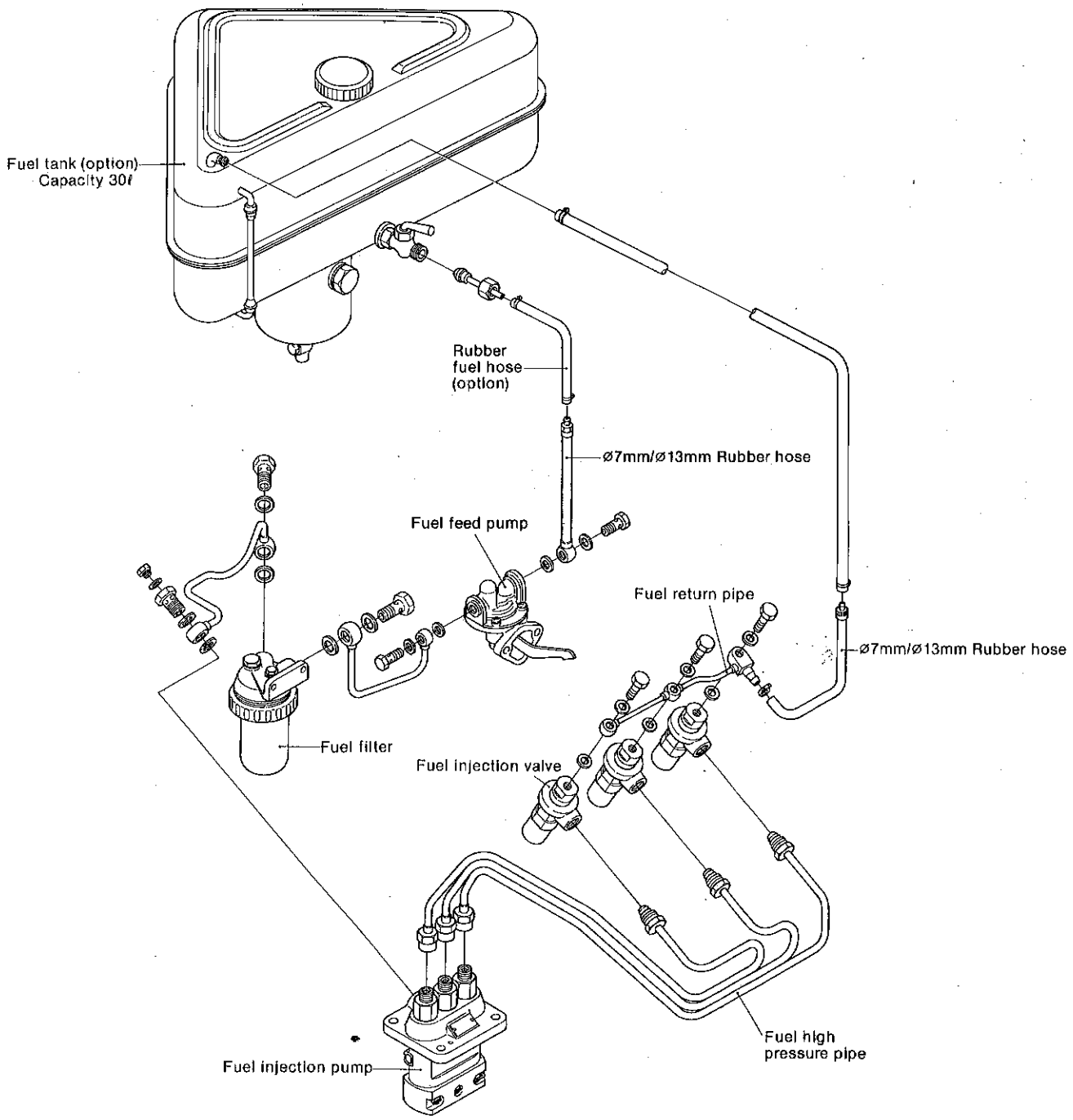
# 1. Fuel Injection System



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## 1-1 Construction

The fuel system consists mainly of an injection pump, injection pipe, and an injection nozzle, plus a fuel tank, feed pump, fuel filter and other associated parts. The injection pump is driven by a fuel cam mounted on the camshaft and is controlled by a governor. Fuel stored in the fuel tank is fed to the fuel filter through the feed pump. (The feed pump is indispensable when the fuel tank is installed lower than the injection pump.)
Dirt and other impurities in the fuel are removed by the filter and the clean fuel is sent to the injection pump, which applies the necessary pressure for injection to the fuel and atomizes the fuel by passing it through the injection nozzle. The injection pump also controls the amount of fuel injected and the injection timing according to the engine load and speed by means of a governor.
The injection pump feeds the fuel to the injection nozzle through a high pressure pipe. The pressurized fuel is atomized and injected by the injection nozzle into the precombustion chamber.
Fuel that overflows the injection nozzle is returned to the fuel tank through the fuel return pipe. The quality of the equipment and parts comprising the fuel injection system directly affects combustion performance and has a considerable effect on engine performance. Therefore, this system must be inspected and serviced regularly to ensure top performance.
The pipework diagram of the fuel system is for the model 3GM30(F)(C) engine. Models 1GM10(C) and 2GM20(F)(C) are the same except for the shape of the fuel injection pump and fuel feed pump, and the number of fuel injection valves. It is also the same for models 3GM30(F)(C) and 3HM35(F)(C) except for the fuel injection pump and fuel injection valve.

## 1-2 Fuel injection system specifications

| | 1GM10(C) | 2GM20(F)(C) | 3GM30(F)(C) | 3HM35(F)(C) |
|---|---|---|---|---|
| Type of injection pump | YPFR-0707-1 | YPFR-0707-2 | YPFR-0707 | YPFR-0707 |
| Type of injection nozzle | YDN-OSDYD1 (Throttle) | | | YDN-OSDYD1 (Throttle) |
| Injection pressure | 170 kg/cm² (2418 lb/in.²) | | | 160 kg/cm² (2276 lb/in.²) |
| Plunger diameter × stroke | ø6mm (0.2362in.) × 7mm (0.2756in.) | | | ø6.5mm (0.2559in.) × 7mm (0.2756in.) |
| Delivery valve suction capacity | 23.5mm³/st (0.0014in.³/st) | | | 23.5mm³/st (0.0014 in³/st) |
| Fuel feed pressure | 0.1 kg/cm² (1.4224 lb/in.²) | | | 0.1 kg/cm² (1.4224 lb/in²) |



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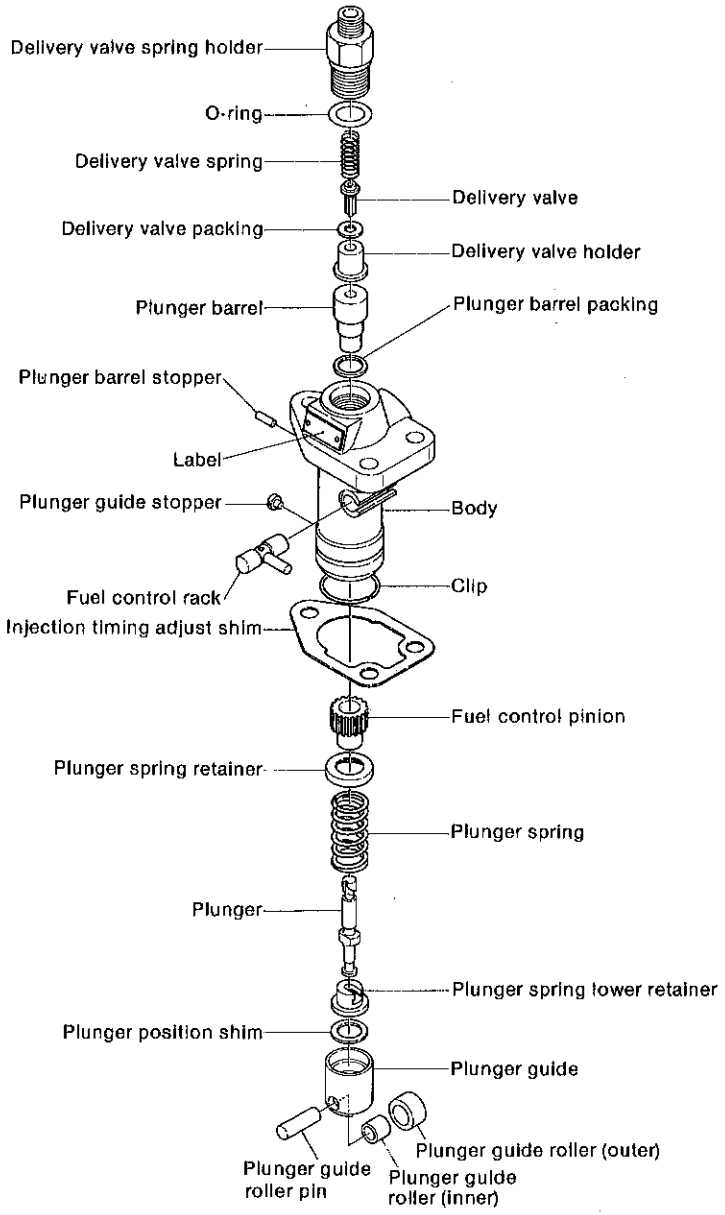
# 2. Injection Pump

The injection pump is the most important part of the fuel system. This pump feeds the proper amount of fuel to the engine at the proper time in accordance with the engine load.
This engine uses a Bosch integral type injection pump for two/three cylinders. It is designed and manufactured by Yanmar, and is ideal for the fuel system of this engine.
Since the injection pump is subjected to extremely high pressures and must be accurate as well as deformation and wear-free, stringently selected materials are used and precision finished after undergoing heat treatment.
The injection pump must be handled carefully. Since the delivery valve and delivery valve holder and the plunger and plunger barrel are lapped, they must be changed as pairs.

The fuel injection pump is constructed from the following main parts.
(1) Pump parts which compress and deliver the fuel: plunger, plunger barrel.
(2) Parts which move the plunger: camshaft, tappet, plunger spring, plunger spring retainer.
(3) Parts which control the injection amount: control rack, control pinion, control sleeve.
(4) Parts which prevent back flow and dripping during injection: delivery valve.

## 2-1 Construction

### 2-1.1 1GM10(C)



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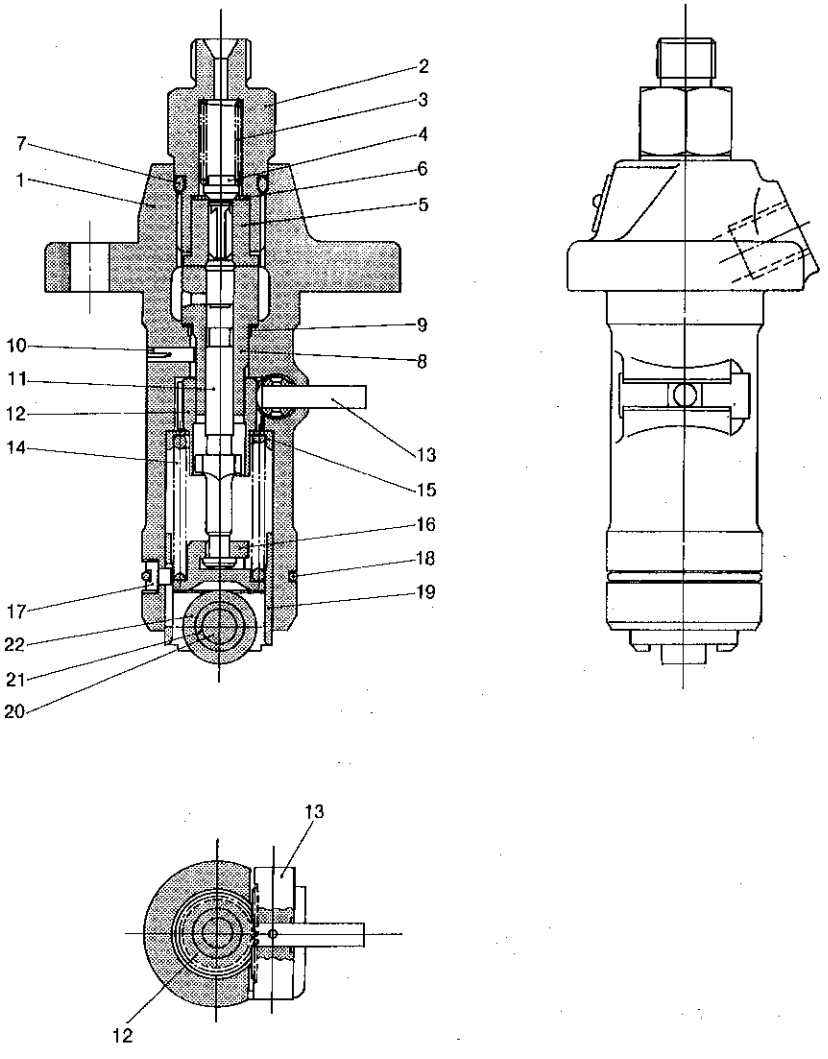


1 Body
2 Delivery valve spring holder
3 Delivery valve spring
4 Delivery valve
5 Delivery valve holder
6 Delivery valve packing
7 O-ring
8 Plunger barrel
9 Plunger barrel packing
10 Plunger barrel stopper
11 Plunger
12 Fuel control pinion
13 Fuel control rack
14 Plunger spring
15 Plunger spring retainer
16 Plunger spring lower retainer
17 Plunger guide stopper
18 Clip
19 Plunger guide
20 Plunger guide roller pin
21 Plunger guide roller (inner)
22 Plunger guide roller (outer)



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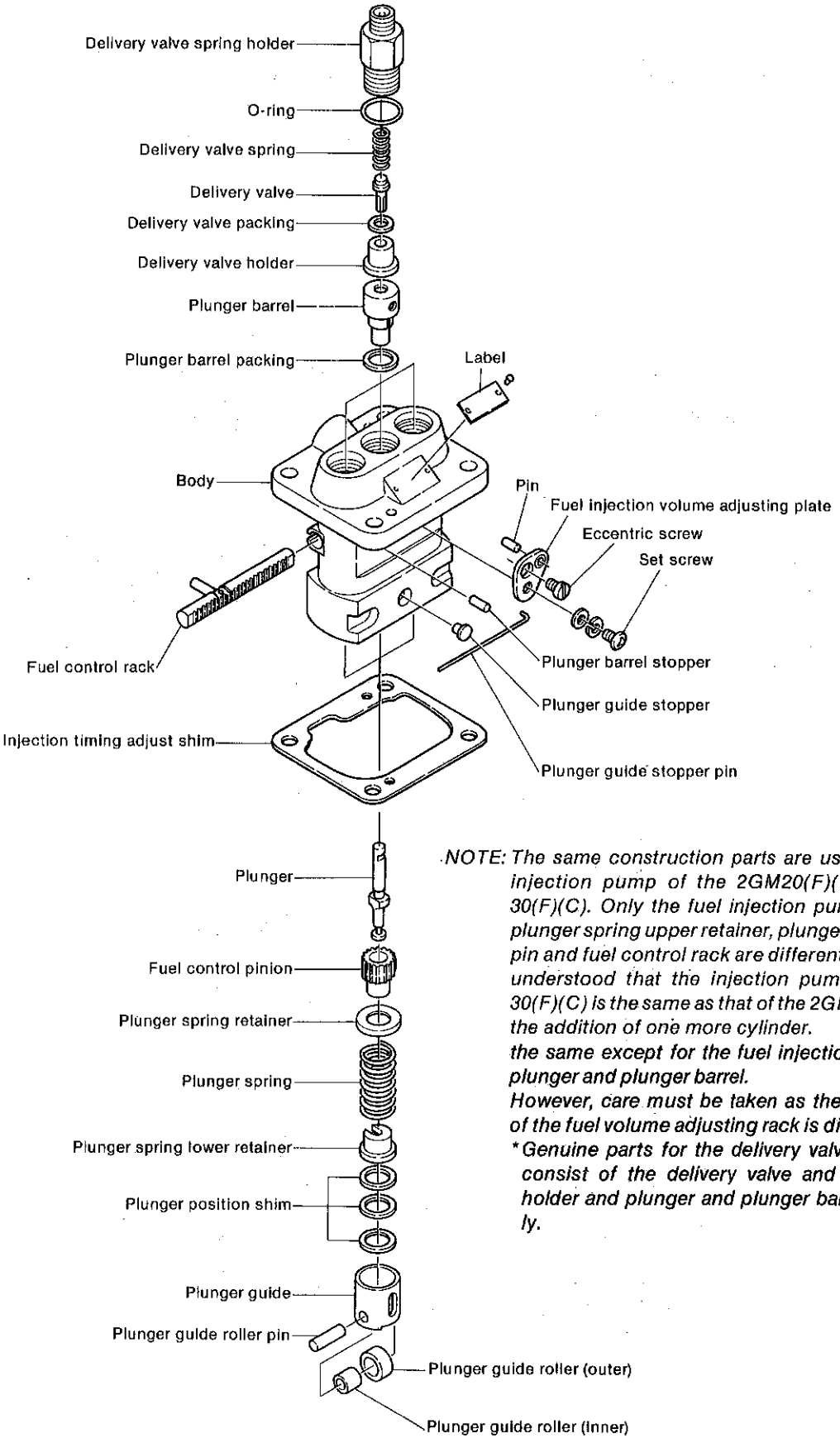
### 2-1.2 2GM20(F)(C), 3GM30(F)(C), 3HM35(F)(C)




*NOTE: The same construction parts are used for the fuel injection pump of the 2GM20(F)(C) and 30GM 30(F)(C). Only the fuel injection pump body itself, plunger spring upper retainer, plunger guide stopper pin and fuel control rack are different, and it may be understood that the injection pump of the 3GM 30(F)(C) is the same as that of the 2GM20(F)(C) with the addition of one more cylinder.*

*the same except for the fuel injection pump body, plunger and plunger barrel.*

*However, care must be taken as the basic surface of the fuel volume adjusting rack is different.*

**Genuine parts for the delivery valve and plunger consist of the delivery valve and delivery valve holder and plunger and plunger barrel respectively.*



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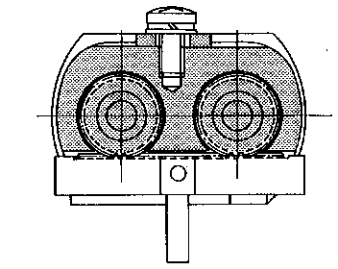
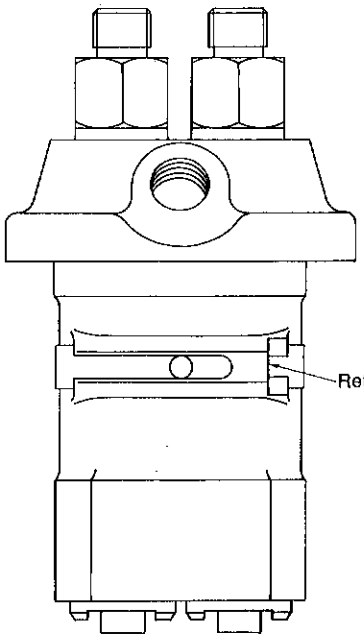
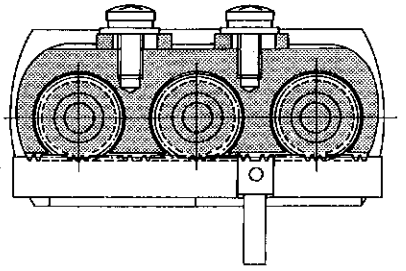
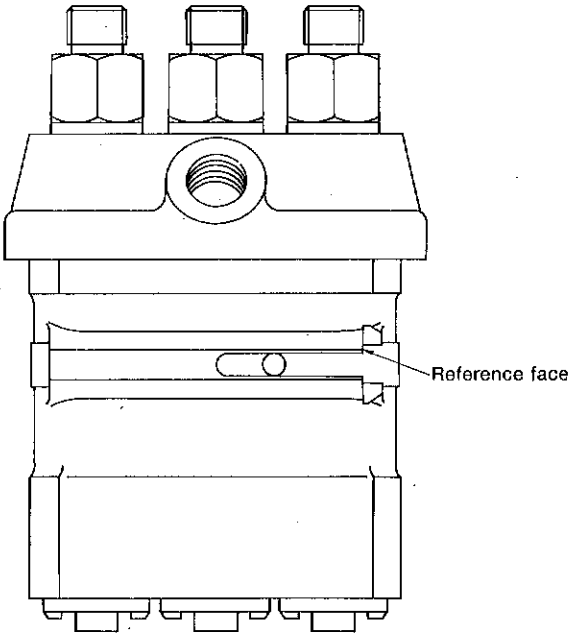
2GM20(F)(C)

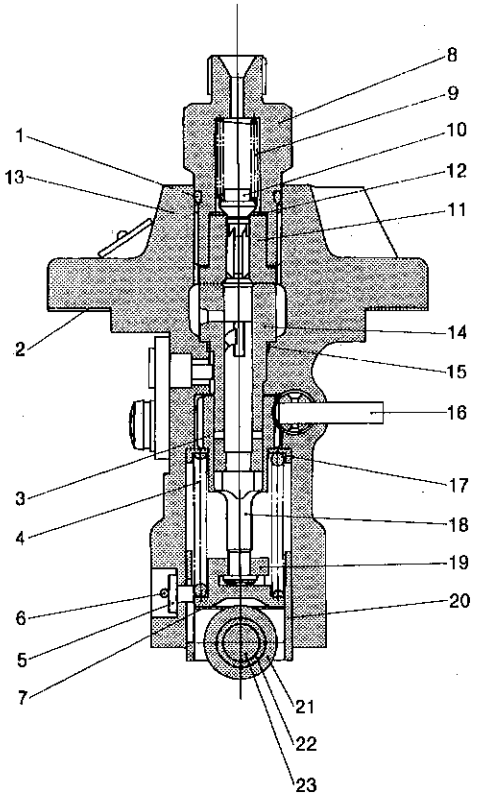





3GM30(F)(C)






1 O-ring
2 Injection timing shim
3 Fuel control pinion
4 Plunger spring
5 Plunger guide stopper
6 Plunger guide stopper pin
7 Plunger position shim
8 Delivery valve spring holder
9 Delivery valve spring
10 Delivery valve
11 Delivery valve holder
12 Delivery valve packing
13 Body
14 Plunger barrel
15 Plunger barrel packing
16 Fuel control rack
17 Plunger spring retainer
18 Plunger
19 Plunger spring lower retainer
20 Plunger guide
21 Plunger guide roller (outer)
22 Plunger guide roller (inner)
23 Plunger guide roller pin



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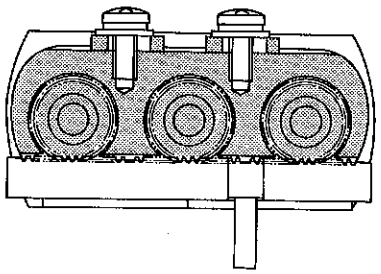
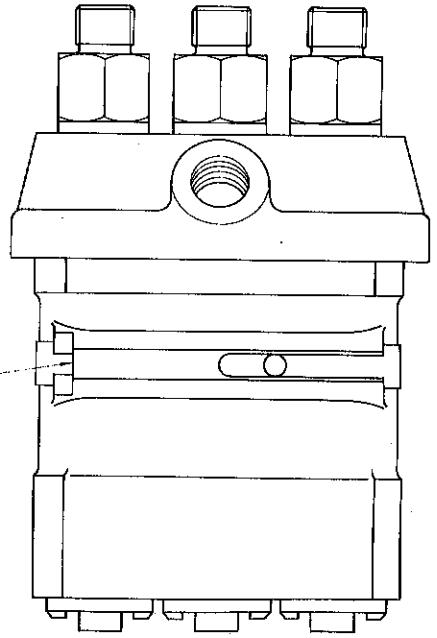
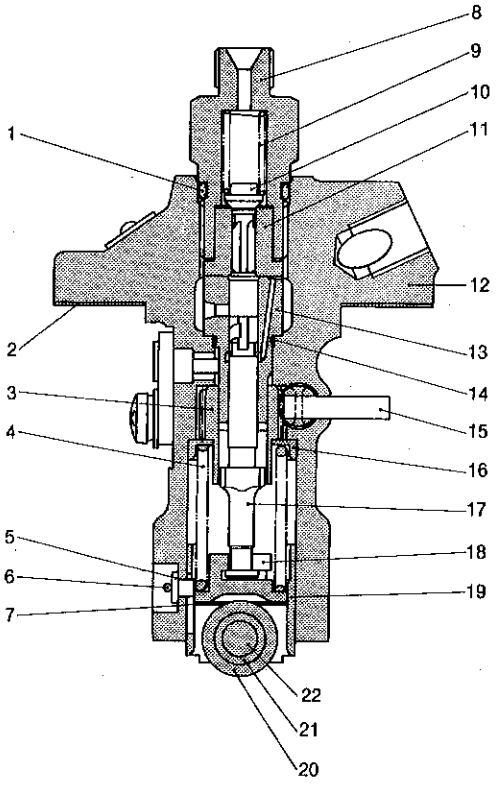
### 3HM35(F)(C)

The construction is the same as the fuel injection pump on model 2GM20(F)(C) or 3GM30(F)(C) engines except for the differences of the plunger diameters, shape of plungers and plunger barrels. Take care as the position of the basic surface for adjusting the injection volume is different.






1 O-ring
2 Injection timing shim
3 Fuel control pinion
4 Plunger spring
5 Plunger guide stopper
6 Plunger guide stopper pin
7 Plunger position shim
8 Delivery valve spring holder
9 Delivery valve spring
10 Delivery valve
11 Delivery valve holder
12 Body
13 Plunger barrel
14 Plunger barrel packing
15 Fuel control rack
16 Plunger spring retainer
17 Plunger
18 Plunger spring lower retainer
19 Plunger guide
20 Plunger guide roller (outer)
21 Plunger guide roller (inner)
22 Plunger guide roller pin



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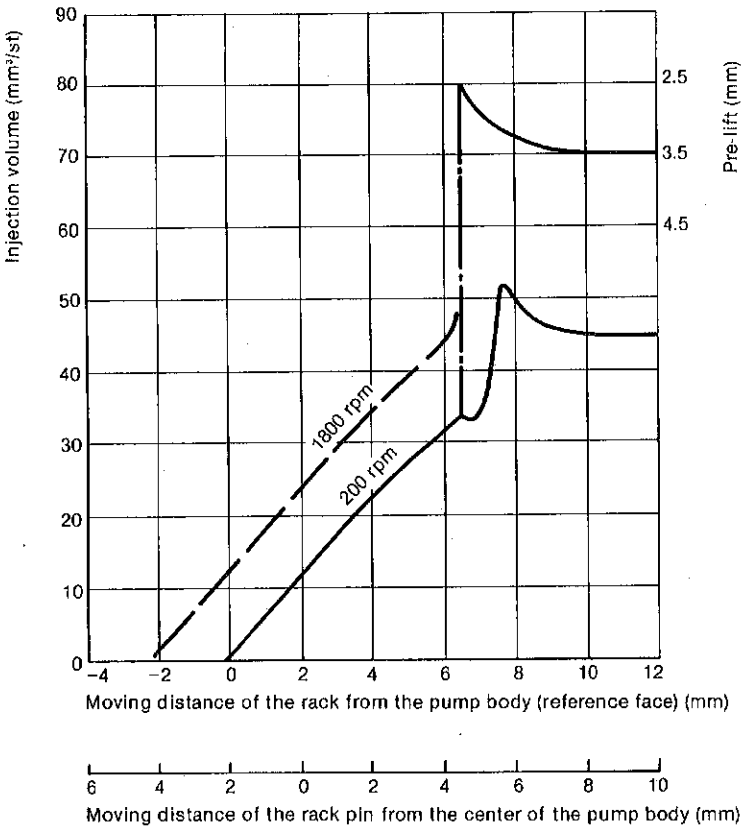
## 2-2 Specifications and performance of fuel injection pump

### 2-2.1 Specifications of fuel injection pump

| | | | 1GM10(C) | 2GM20(F)(C) | 3GM30(F)(C) | 3HM35(F)(C) |
|---|---|---|---|---|---|---|
| Plunger diameter | | | 6mm (0.2362in.) | | | 6.5mm (0.2559in.) |
| Standard plunger stroke | | | 7mm (0.2756in.) | | | |
| Static mechanical lift at injection | | | 2.5mm (0.0984in.) [at starting 3.2mm (0.1260in.)] | | | |
| Sliding resistance of fuel volume adjusting rack (when pump stops) | | | 60g (0.002 lb) or less | | | |
| Top clearance of plunger (at the set dimension of 76 ±0.05mm) | | | 1.0mm (0.0394in.) | | | |
| Thickness of plunger position adjusting shim | | | 0.1mm (0.0039in.), 0.2mm (0.0079in.), 0.3mm (0.0118in.) | | | |
| Plunger spring (124950-51190 commonly used) | Free length | | 35.5mm (1.3976in.) | | | |
| | Spring constant | | 1.93 kg/cm (10.8 lb/in.) | | | |
| | Load | At upper limit | 25.1 kg (55.3 lb) | | | |
| | | At lower limit | 11.6 kg (25.6 lb) | | | |
| | | At static injection | 16.4 kg (36.2 lb) | | | |
| Suction volume of delivery valve | | | 23.5mm³ (0.0014in.³) (24.5 according to 1GM10(C) drawing) | | | |
| Opening pressure of delivery valve | | | Approx. 16.3 kg/cm² (231.8 lb/in²) | | | |
| Delivery valve spring (124550-51320 commonly used) | Free length | | 21.0mm (0.8268in.) | | | |
| | Spring constant | | 0.64 kg/cm (9.1 lb/in.) | | | |
| Rack stroke | | | Approx. 15mm (0.5906in.) | | | |

### 2-2.2 Injection volume characteristics of fuel injection pump

(1) Model 1GM10(C)



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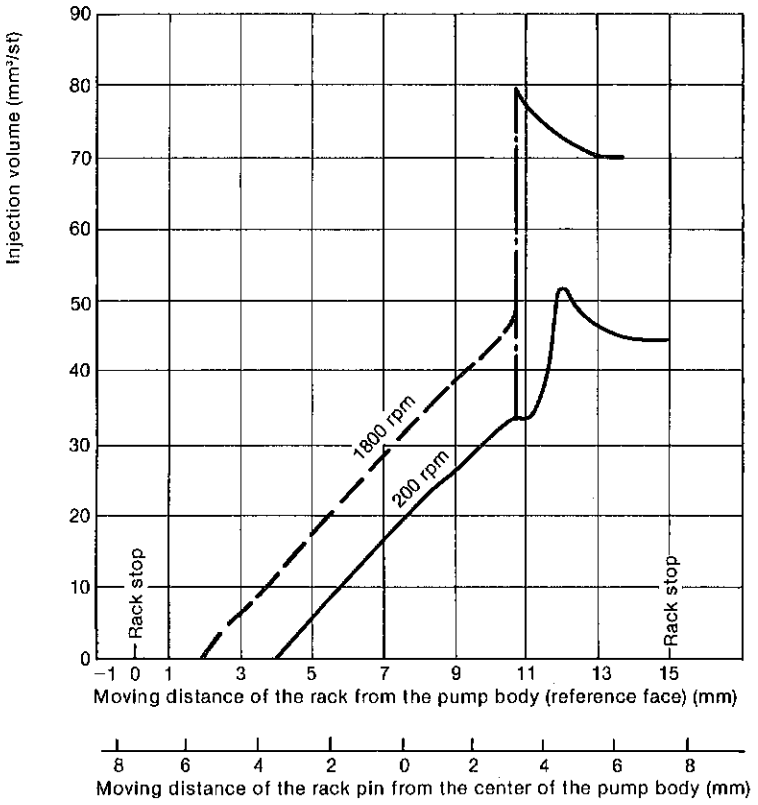
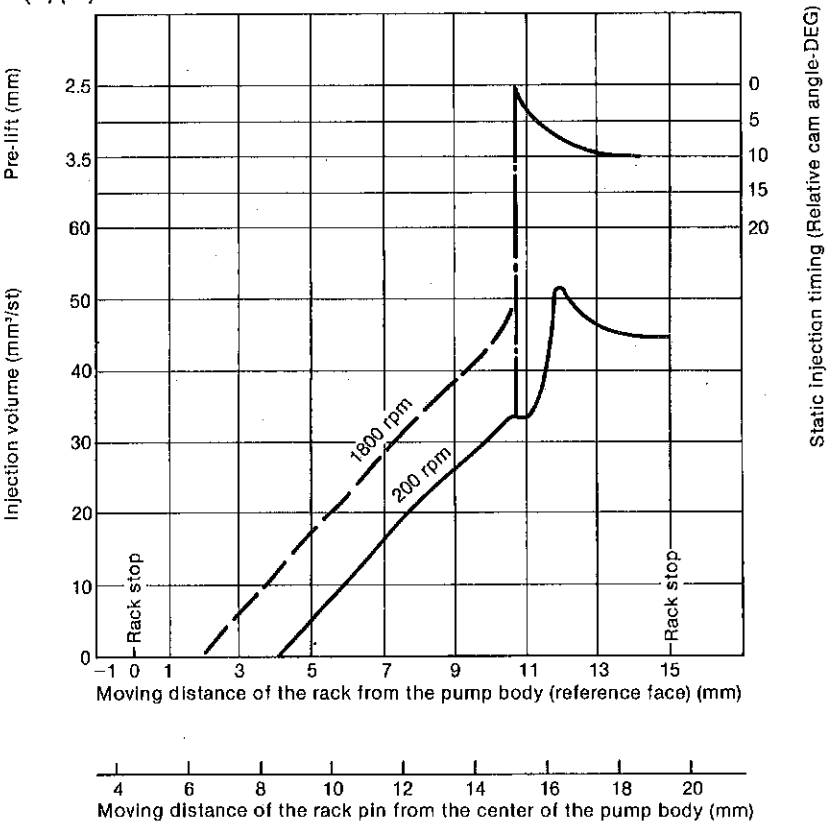
(2) Model 2GM20(F)(C)




(3) Model 3GM30(F)(C)



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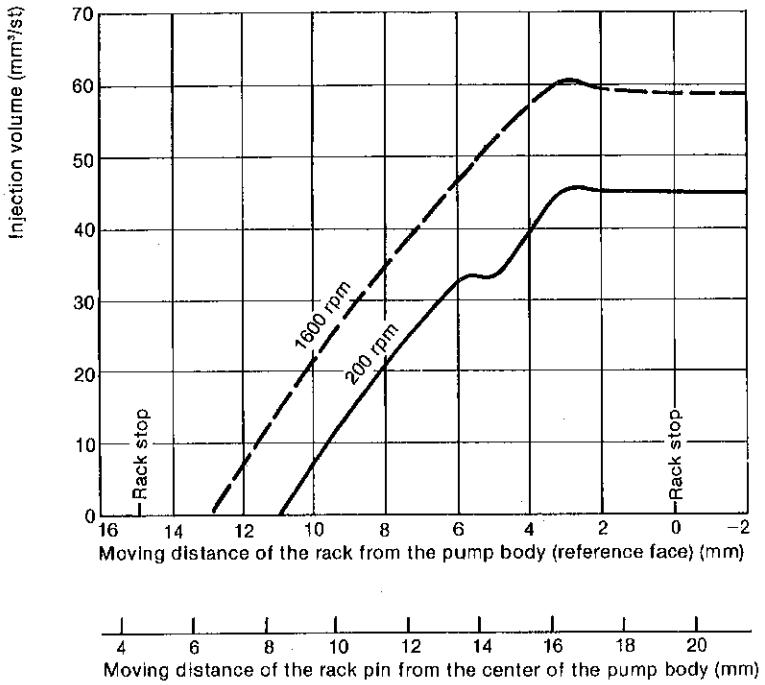
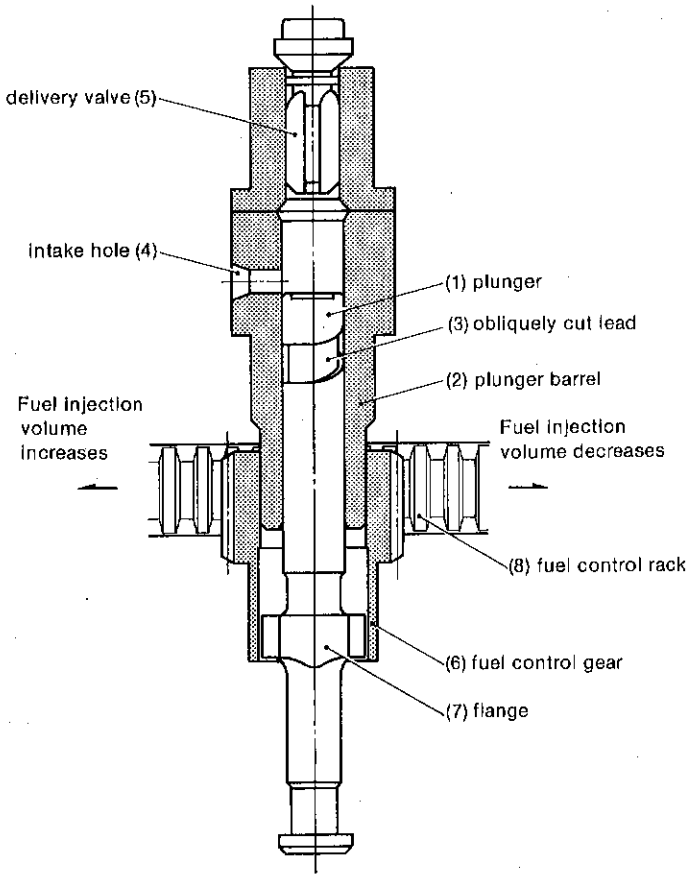
(4) Model 3HM35(F)(C)




## 2-3 Operation of fuel injection pump

The fuel injection pump force-feeds the fuel by means of the plunger (1) which operates at a constant stroke. Since the plunger is lap fitted into the plunger barrel (2) for super precison, it can be replaced only as a set. The cylindrical surface of the plunger has an obliquely cut lead (3) and a groove which connects the lead to the plunger head. The plunger has an intake hole (4) through which the fuel passes and is force-fed by the plunger. Then the fuel opens the delivery valve (5), goes through the fuel injection tube, and is injected into the spiral-vortex type pre-combustion chamber from the injection valve. The plunger is fitted with the fuel control gear (6), and its flange (7) fits into the longitudinal groove which is cut in the inner surface of the lower end of the control gear. The fuel control gear is in mesh with the fuel control rack, the motion of which rotates the plunger to constantly vary the amount of fuel injected from zero to maximum.



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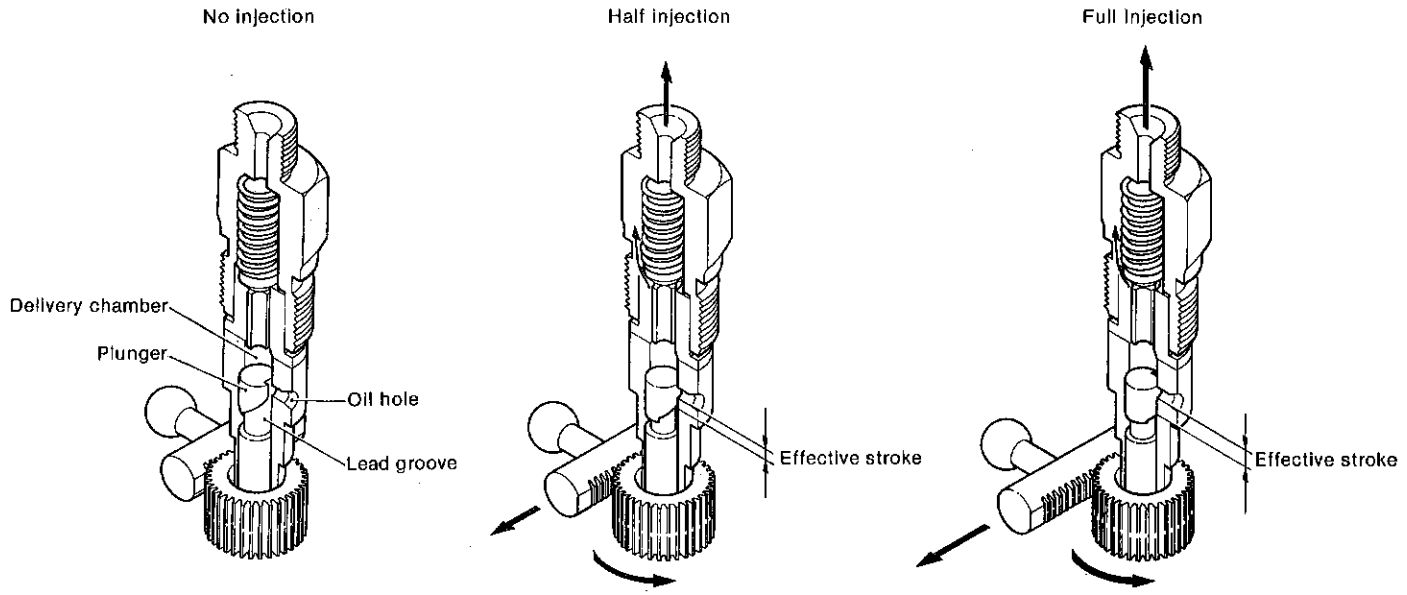
### 2-3.1 Fuel control

When the plunger (1) is at bottom dead center, the oil, which comes in through the oil hole, fills the delivery chamber (3) to above the plunger. The oil pressure then builds up as the plunger rises and closes the oil hole, and by opening the delivery valve, the oil is force-fed toward the fuel injection tube. As the plunger, pushed by the plunger guide, rises further, the pressure of the oil between the delivery chamber and the nozzle also increases. when this oil pressure builds up to 155 to 165 kg/cm$^2$, the nozzle opens, and the fuel oil is injected into the spiral vortex type combustion chamber. However, if the plunger keeps rising and the lead groove (4) lines up with the oil hope (2), the oil under high pressure in the delivery chamber passes up the lead from the longitudinal groove and is driven back into the suction chamber from the oil hole. At the same time, force feeding of the fuel is suspended.

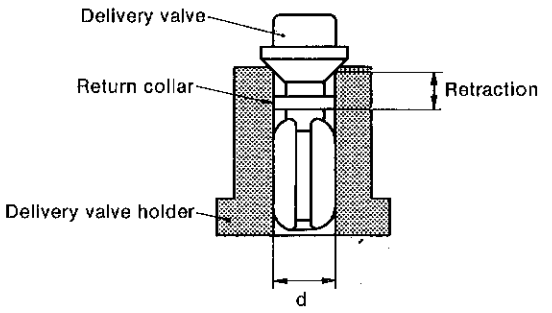



As a result of the above action, the plunger is rotated by the fuel control rack and the angle of this rotation changes the effective stroke of the plunger and controls the discharge of the pump. Also, when the fuel control rack lines up the longitudinal groove on the plunger with the oil hole, the oil hole does not close, despite the rise of the plunger, but rather the fuel is driven back to the suction chamber. As a result the fuel is not force-fed but the amount of injection is reduced to zero. At this time the fuel control rack is at the cylinder side end; when it reaches the opposite side end the maximum amount of fuel is injected. Before the maximum injection level is reached, the fuel injection control shaft regulates the amount of fuel injected to the normal operation level.

*NOTE: The plunger is an integral part of the plunger barrel and takes in and compresses fuel by reciprocating inside the plunger barrel. The plunger and plunger barrel are precisely machined, and because the plunger is driven in an extremely small space, the two should be used together and should not be changed with other cylinders.*

### 2-3.2 Action of the delivery valve and the sucking-back of fuel

The delivery valve on top of the plunger prevents the fuel inside the injection tube from flowing backward toward the plunger side and also serves to suck back the fuel to prevent the backward dripping of the nozzle valve. When the notch (lead) of the plunger comes up to the oil hole of the plunger barrel, the feeding pressure acting on the fuel oil drops, and the delivery valve falls due to the force of the spring. After the sucking-back collar has first shut off the fuel injection tube and the delivery chamber, the delivery valve drops further until comes in contact with the seat surface, in correspondence with the amount of fall (i.e., increase in volume), the fuel oil pressure within the injection tube drops, speeding up the closure of the nozzle valve, and sucking up the fuel before it drips back. This enhances the durability of the nozzle and improves fuel oil combustion.




| | |
|---|---|
| Amount of fuel retraction | $\pi/4\ d^2\ell$ = 23.5mm$^3$/stroke (0.0014in$^3$./st.) |



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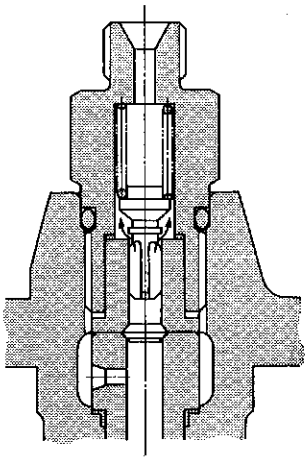

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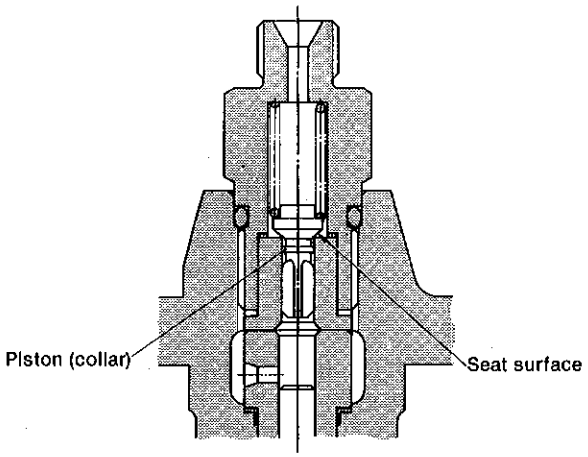
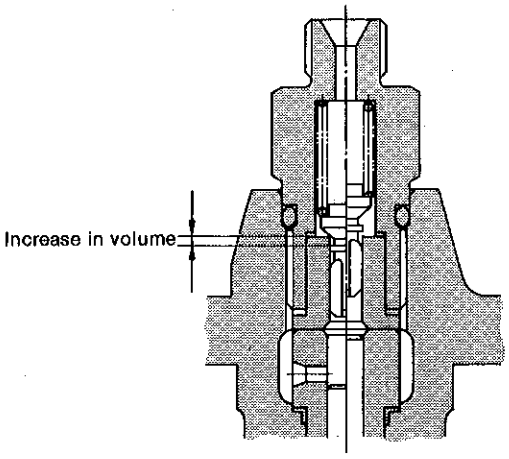



Close




Retraction of fuel

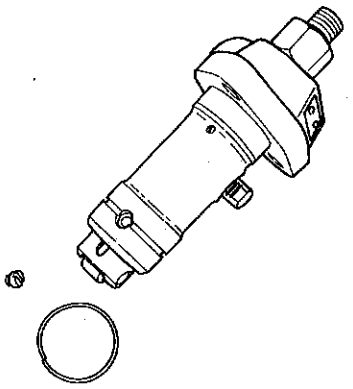
## 2-4 Disassembly of fuel injection pump

As a rule, the injection pump should not be disassembled, but when disassembly is unavoidable, proceed as described below.

### 2-4.1 Dismantling of fuel injection pump of model 1GM10(C) engine.

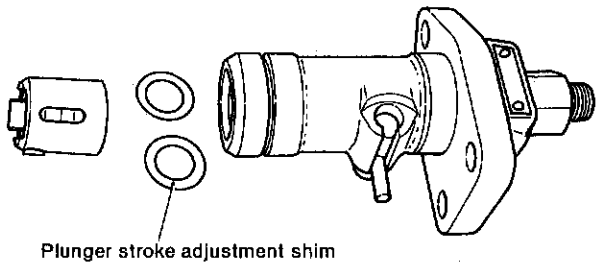
*NOTES: 1) Before disassembly wash the pump in clean oil, and after assembly arrange all parts carefully.*
*2) Make sure the work area is exceptionally clean.*

(1) Remove the plunger guide stopper pin with needle nose pliers.



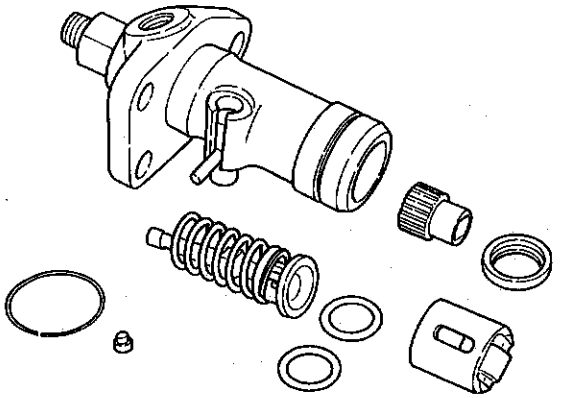
(2) Remove the plunger guide stopper.
The stopper can be removed by pushing the plunger guide down with the palm of your hand.
(3) Remove the plunger guide.

*NOTE: Be careful not to lose the plunger stroke adjusting shim which is located inside the plunger guide.*



Plunger stroke adjustment shim

(4) Remove the plunger and plunger spring lower retainer.
Be careful not to damage the plunger.
(5) Remove the plunger spring, fuel control pinion and plunger spring upper retainer, using your fingers or tweezers.





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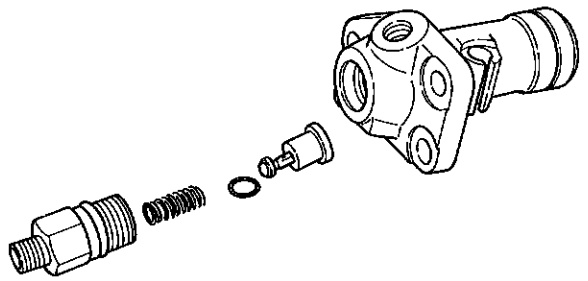
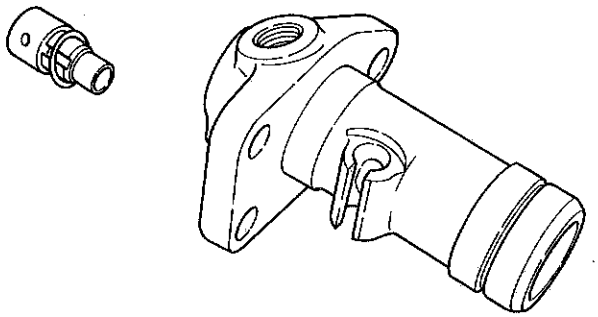
(6) Remove the fuel control rack.
(7) Remove the delivery valve holder; be careful not to damage the O-ring.
(8) Remove the delivery valve spring.
(9) Remove the delivery valve.



(10) Remove the plunger barrel by pushing it toward the delivery valve side.
(11) Remove the plunger barrel packing.

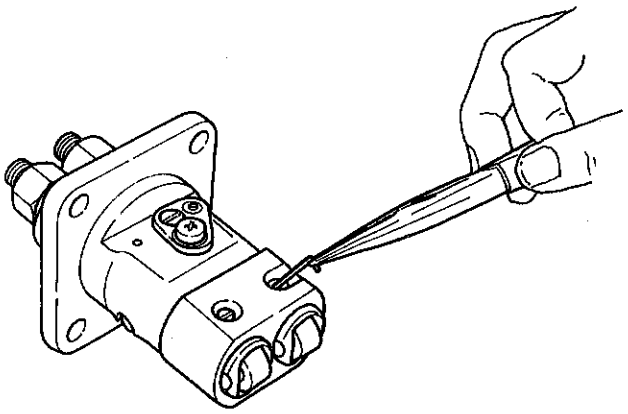


*NOTES: 1) Line up the plunger barrel and the plunger, and put them in order.*
*2) Immerse the delivery valve, plunger, etc. in clean oil.*
*3) Do not loosen or remove the plunger barrel stopper, etc.*

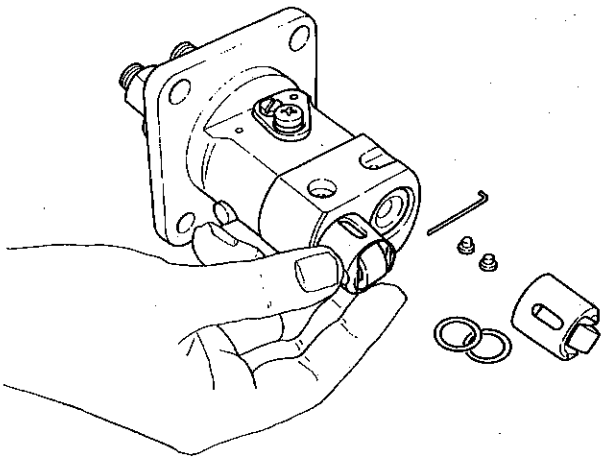
**2-4.2 Dismantling of fuel pump of model 2GM20(F)(C), 3GM30(F)(C) and 3HM35(F)(C)**

The cylinders are classified as No. 1, No. 2 and No. 3 from the left, when facing the name plate fitted on the upper part of the fuel injection pump. When dismantling, it is necessary to prepare pans or vessels in which to keep the dismantled parts from each cylinder; each part must be placed in the corresponding pan or vessel for each cylinder, namely, No. 1, No. 2 and No. 3 cylinder. If a part is placed in the wrong pan or vessel, reassembly becomes impossible without a pump tester. The following explanation is for to the pump of the 2 cylinder type engine [model 2GM20(F)(C)], but it applies equally to that of the 3 cylinder type engine [model 3GM30(F)(C)] which merely has an additional set. The construction of the fuel pump of model 3HM35(F)(C) engine is the same as that of model 3GM30(F)(C) engine except for the differences of plunger, plunger barrel, and the position of the injection volume adjusting rack.

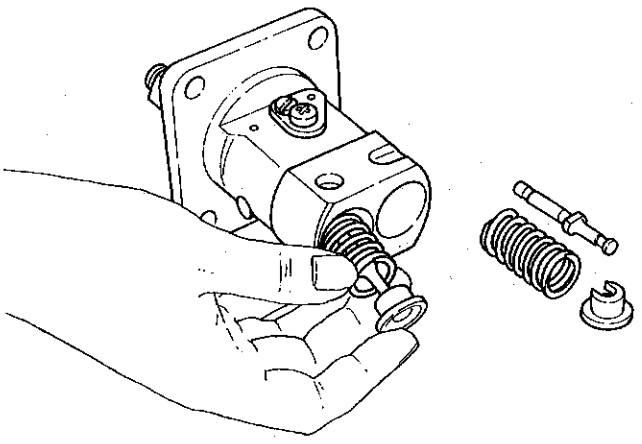
(1) Remove the plunger guide stopper pin with needle nose pliers.



(2) Remove the No.1 plunger guide stopper.
The stopper can be removed by pushing the plunger guide down with the palm of your hand.
(3) Remove the No.1 plunger guide.



(4) Remove the No.1 plunger, plunger spring lower retainer and plunger shim; be careful not to damage the plunger.
(5) Remove the No.1 plunger spring.





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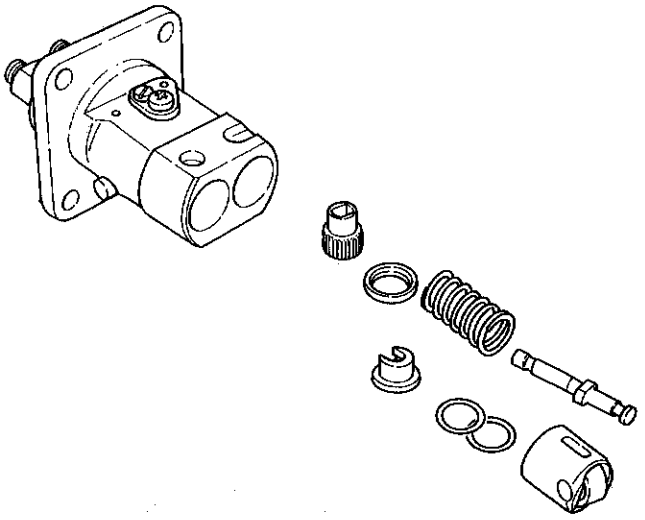
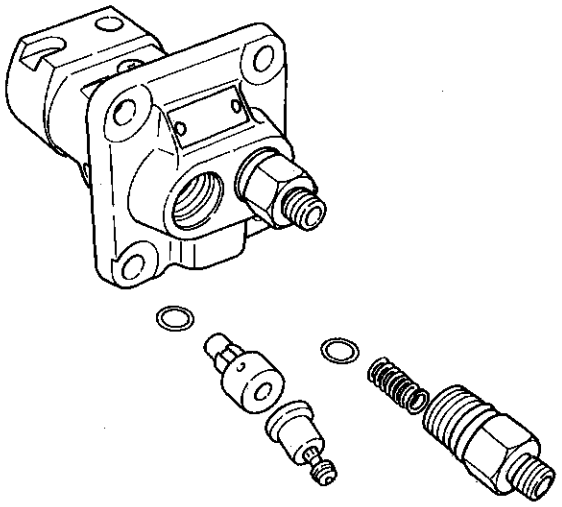
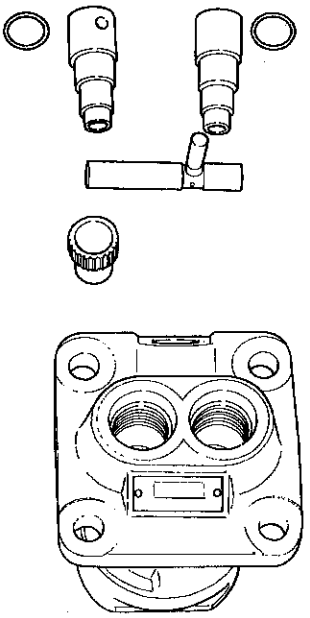
(6) Remove the No.1 plunger spring upper retainer, using your fingers or tweezers.
(7) Remove the No.1 control sleeve



(8) Remove the No.1 delivery valve holder; be careful not to damage the O-ring.
(9) Remove the No.1 delivery valve spring.
(10) Remove the No.1 delivery valve, delivery valve seat and packing.



(11) Remove the No.1 plunger barrel; be careful not to damage the face that matches the delivery valve seat.
(12) Remove the No.1 plunger barrel packing.
(13) For No.2 cylinder, repeat the above steps (2) through (11).
(14) The above item also applies to No.3 cylinder for the 3 cylinder type engine.
(15) Remove the control rack.



*NOTES: 1) Line up the plunger valve and the plunger, and put them in order.*
*2) Immerse the delivery valve, plunger, etc. in clean oil.*
*3) Do not loosen or remove the injection control plate, etc.*

## 2-5 Inspecting injection pump parts

### 2-5.1 Rinse each component part in clean light oil before inspecting it.

*NOTE: Do not touch the sliding surface of the plunger and the delivery valve with your fingers during handling.*

### 2-5.2 Tappet

Inspect the cam sliding surface of the tappet roller for wear, scoring and peeling; replace the tappet and roller assembly when the total tappet and roller play exceeds 0.3mm.

### 2-5.3 Control rack and pinion

(1) Check the control rack teeth and sliding surface for damage and abnormalities. If found, replace.

*NOTE: When replacing the control rack, adjust fuel discharge with a fuel injection pump tester and stamp a rack mark.*



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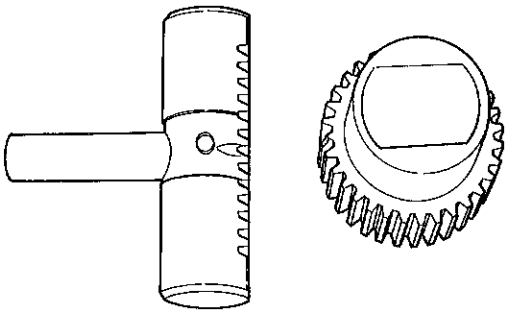
(2) Replace pinion if teeth are damaged or worn unevenly.

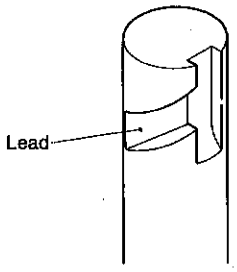


(3) If the control rack does not move smoothly when a force of within 60g is applied, replace the rack and pinion assembly.

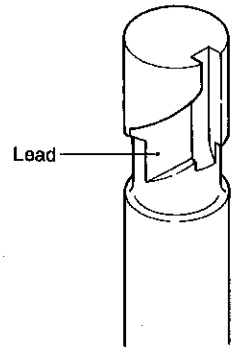
**2-5.4 Plunger**

(1) Inspect the plunger for wear, scoring and discoloration around the lead. If any problems are found, conduct a pressure test and replace the plunger and plunger barrel assembly.

*For models 1GM10(C), 2GM20(F)(C) and 3GM30(F)(C)*



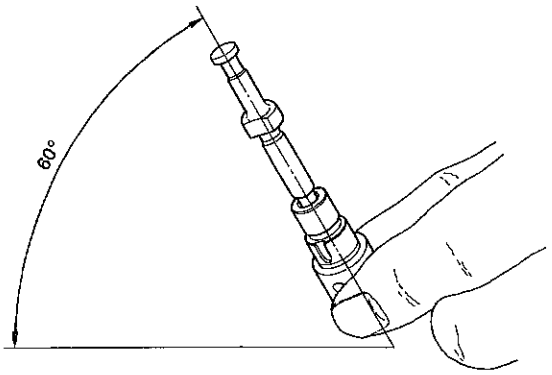

*For model 3HM35(F)(C)*




(2) Inspect the outside sliding surface of the plunger with a magnifying glass. Lap or replace the plunger and plunger barrel assembly when corrosion, hairline cracks, staining and/or scoring are detected.

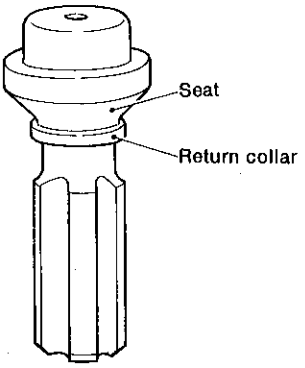
(3) Check the clearance between the plunger collar and control sleeve groove. Replace these parts when wear exceeds the specified limit.

(4) After cleaning the plunger, tilt it approximately 60°, as shown in the figure, and slowly slide it down. Repeat this several times while rotating the plunger. The plunger should slide slowly and smoothly. If it slides too quickly, or binds along the way, repair or replace it.

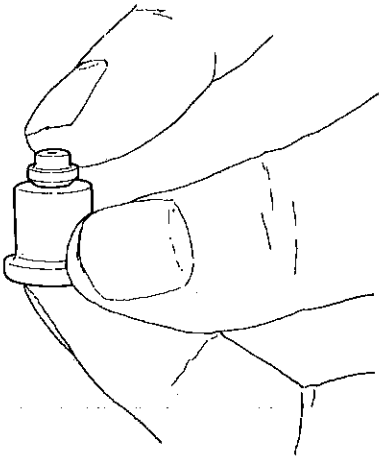



**2-5.5 Delivery valve**

(1) Replace the delivery valve if the return collar and seat are scored, dented or worn.




(2) Raise the delivery valve and put a finger over the hole on the valve seat bottom. Let go of the delivery valve. If it sinks quickly and stops at the position where the suck-back collar closes the valve seat hole, the delivery valve may be considered normal. If this is not the case, replace the delivery valve as a set.





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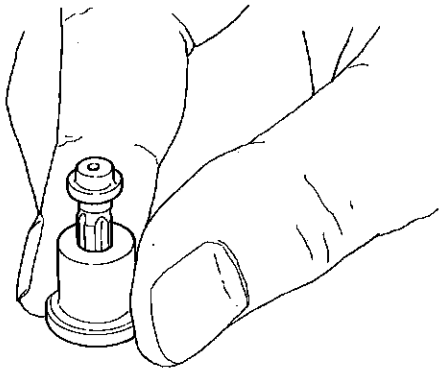
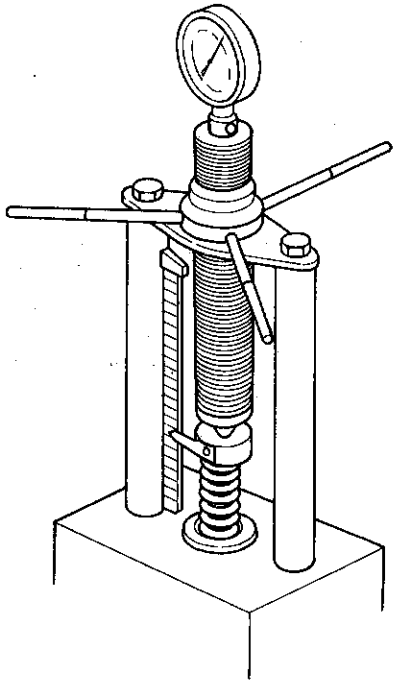
(3) Place your finger over the hole in the bottom of the valve seat and insert the valve into the valve body. If the valve returns to its original position when you remove your finger, the valve is okay. If some defect is found, replace with a new valve.
(4) If the valve closes completely by its own weight when you remove your finger from the hole on the bottom of the valve seat, the valve is okay. If it doesn't close perfectly replace with a new valve.



*NOTE: When using a brand-new set, wash off the rustproof oil with clean oil or gasoline. Then, wash once more with clean oil, and follow the steps outlined above.*

**2-5.6 Plunger spring and delivery valve spring**

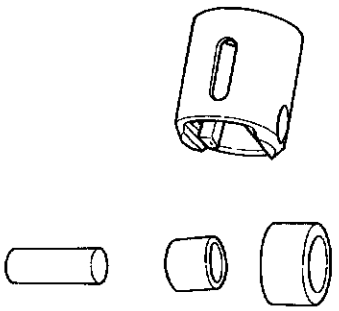
Inspect the plunger spring and delivery valve spring for fractured coils, rust, inclination and permanent strain. Replace the spring when faulty.



| | Free length | Set length | Set load |
|---|---|---|---|
| Plunger spring | 35.5mm (1.3976in.) | 29.5mm (1.1614in.) | 11.59 ±1.1 kg (23.13 ~ 27.98 lb) |
| Delivery valve spring | 21mm (0.8268in.) | 17.25mm (0.6791in.) | 2.4 ±0.24 kg (4.76 ~ 5.82 lb) |

**2-5.7 Plunger guide**

Check the tappet roller (Inside and outside) and roller pin for damage and uneven wear, and replace if required.
Measure the clearance between the plunger and plunger guide. If the clearance exceeds the limit, replace.



mm (in.)

| | |
|---|---|
| Clearance limit | 0.3 (0.0118) |

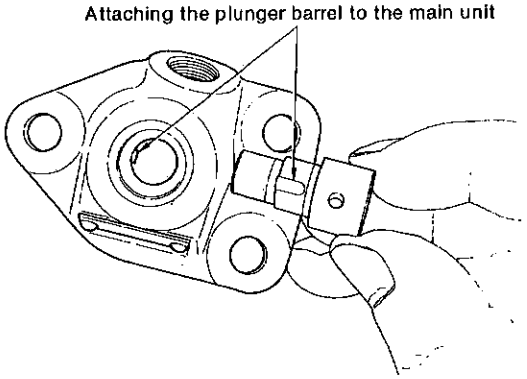
**2-6 Assembling the fuel injection pump**

*NOTES: 1) After inspection, divide the components into two groups, i.e. the components to be replaced, and those that are reusable. Rinse the components and store the two groups separately.*
*2) Replace the packing with a new one.*

**1GM10(C)**

(1) While lining up the plunger barrel positioning groove with the dowel of the main unit, attach the plunger barrel to the main unit.

Attaching the plunger barrel to the main unit





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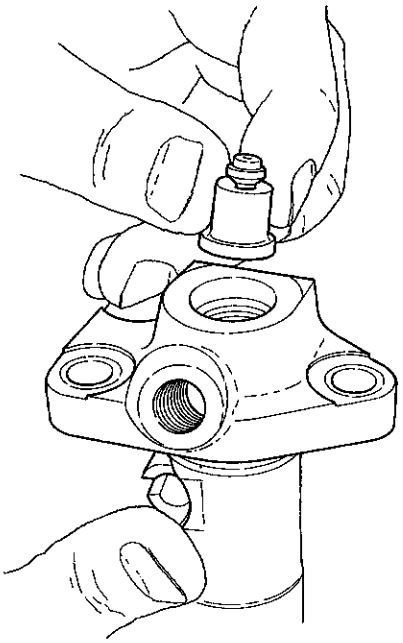
(2) Attach the delivery valve seat and the delivery valve to the main unit.



Attaching the delivery valve to the main unit

*NOTE: If the delivery valve tip projects noticeably above the top of the main unit of the pump, the plunger barrel has been installed incorrectly, and must be re-attached.*

(3) Attach the delivery valve packing and the delivery valve spring to the main unit and carefully tighten the delivery valve holder.

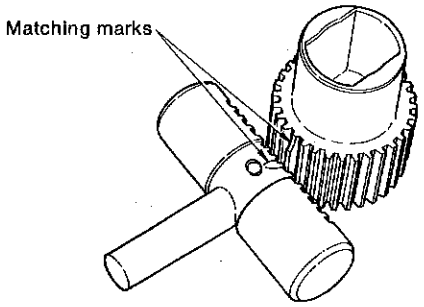
*NOTE: Tighten the delivery valve holder with a torque wrench after attaching the plunger and while checking the fuel control rack for sliding motion.*

| 1GM(10(C) | kg-m (ft-lb) |
|---|---|
| Tightening torque | 4.0 ~ 4.5 (28.92 ~ 32.54) |

(4) With the matching mark of the fuel control rack directed towards the lower part of the main unit of the pump, attach the fuel control rack to the main unit.

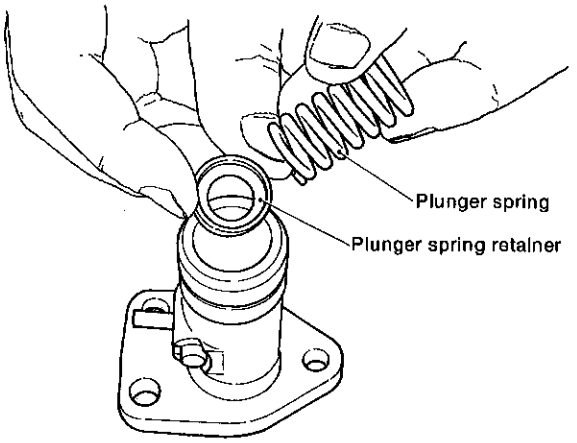
*NOTE: Make sure the fuel control rack moves smoothly along its entire stroke.*

(5) By aligning the matching mark on the fuel control pinion with that on the fuel control rack, attach the fuel control pinion to the main unit.



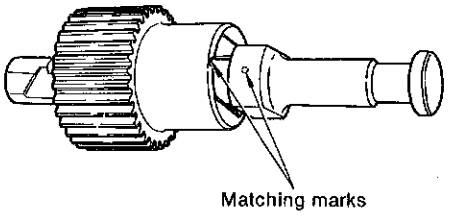

*NOTE: After attaching the fuel control pinion to the main unit, check its meshing by moving the fuel control rack.*

(6) Insert the plunger spring retainer and attach the plunger spring to the main unit.



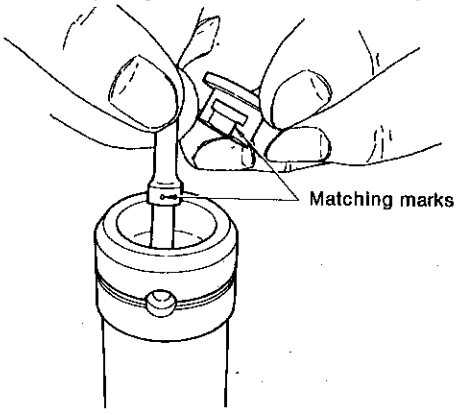

*NOTE: The plunger spring retainer should face the underside of the pump.*

(7) After aligning the matching mark on the plunger flange with that on the fuel control pinion, attach the plunger to the main unit.




*NOTE: Invert and stand the main unit of the pump upright and attach the plunger to it carefully.*

(8) Mount the plunger lower retainer on the plunger.




(9) Insert the plunger adjusting shims.

*NOTE: Insert the same number of shims with the same thickness as those inserted before disassembling the pump. After re-assembling the pump, measure and adjust the top clearance of the plunger.*



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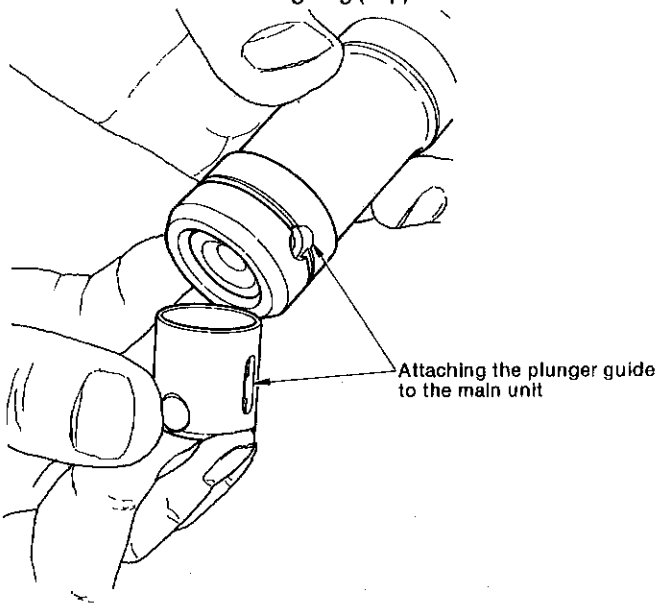
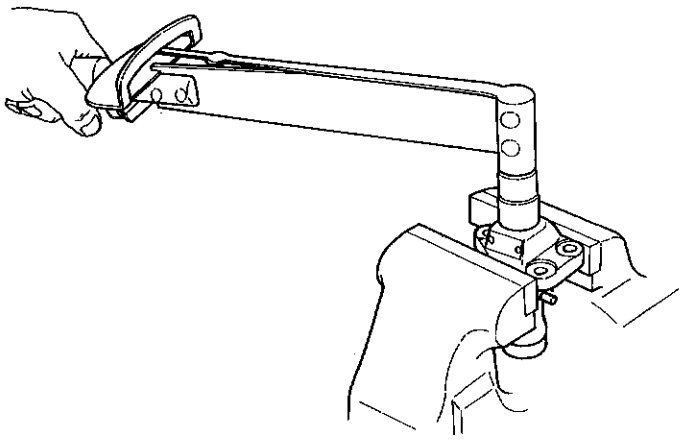
(10) While adjusting the direction of the plunger guide stopper hole for the plunger guide, insert the plunger guide carefully.
When the plunger guide stopper hole is lined up with the plunger guide, insert the plunger guide stopper. Then mount the retaining ring (clip).




(11) After attaching tighten the delivery valve holder with a torque wrench.



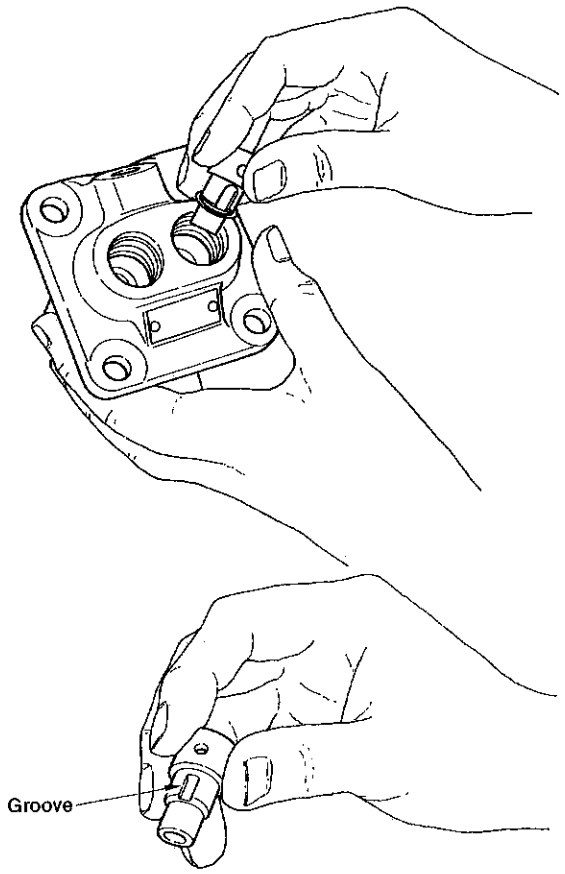
1GM10(C) kg-m (ft-lb)

| | |
|---|---|
| Tightening torque | 4.0 ~ 4.5 (28.92 ~ 32.54) |

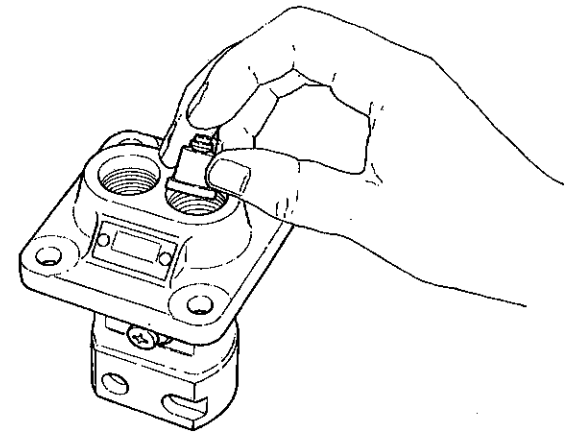
**2GM20(F)(C), 3GM30(F)(C) and 3HM35(F)(C)**

To ensure that the injection pump is correctly reassembled, the following points must be kept in mind:
- The parts for each cylinder must not be mixed together.
- When parts are replaced, the parts for each cylinder must always be replaced at the same time.
- When assembling, parts must be washed in fuel oil and matching marks and scribe lines lined up.

(1) Install the No.1 plunger barrel packing.
(2) Insert the No.1 plunger barrel by aligning the groove of the barrel lock pin.




(3) Install the No.1 delivery valve, delivery valve seat and packing.



*NOTE: If the delivery valve tip projects noticeably above the top of the main unit of the pump, the plunger barrel has been installed incorrectly, and must be re-attached.*

(4) Insert the No.1 delivery valve spring.



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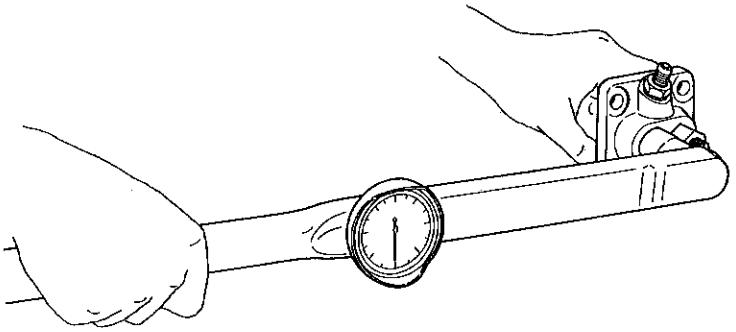
(5) Tighten the No.1 delivery valve holder.



**2GM20(F)(C), 3GM30(F)(C), 3HM35(F)(C)** kg-m (ft-lb)

| | |
|---|---|
| Tightening torque | 4.0 ~ 4.5 (28.92 ~ 32.54) |

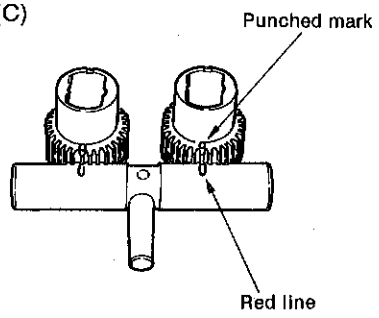
*NOTE: Tighten the delivery valve holder with a torque wrench after attaching the plunger and while checking the fuel control rack for sliding motion.*

(6) With the matching mark of the fuel control rack directed towards the lower part of the main unit of the pump, attach the fuel control rack to the main unit.

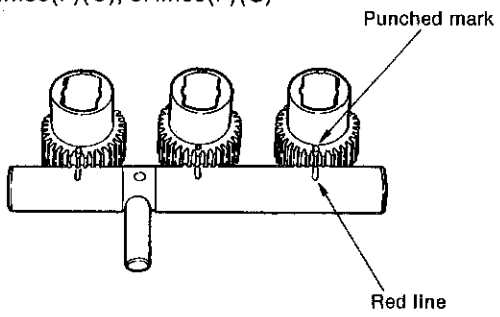
*NOTE: Make sure the fuel control rack moves smoothly along its entire stroke.*

(7) By aligning the matching mark on the fuel control pinion with that on the fuel control rack, attach the fuel control pinion to the main unit.

2GM20(F)(C)

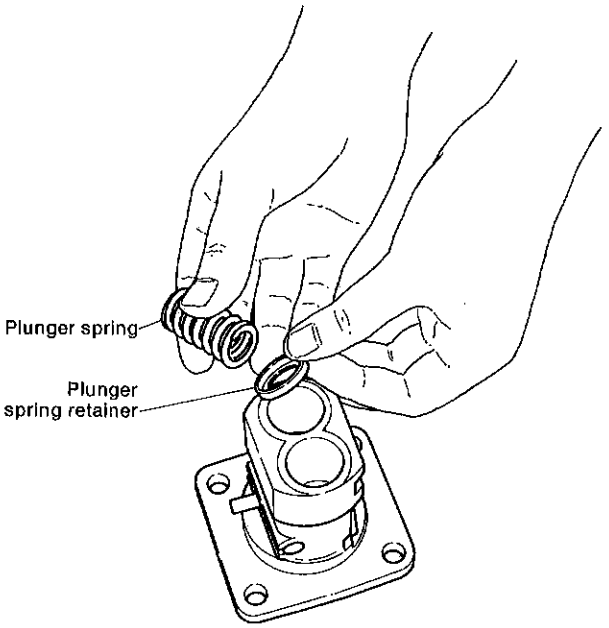



3GM30(F)(C), 3HM35(F)(C)



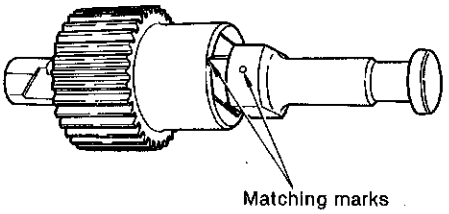

*NOTE: After attaching the fuel control pinion to the main unit, check its meshing by moving the fuel control rack.*

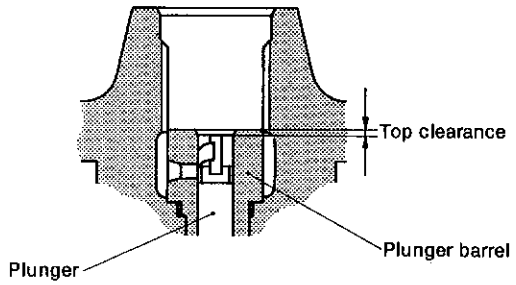
(8) Insert the No.1 plunger spring retainer and attach the plunger spring to the main unit.




*NOTE: The plunger spring retainer should face the underside the pump.*

(9) After aligning the matching mark on the plunger flange with that on the fuel control pinion, attach the plunger to the main unit.




*NOTE: By inverting and standing the main unit of the pump upright attach the plunger to it carefully.*

(10) Install the No.1 plunger spring lower retainer. Make sure that it is not installed backwards.



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(11) Insert the plunger shim.
*NOTE: Insert the same number of shims with the same thickness as those inserted before disassembling the pump. After re-assembling the pump, measure and adjust the top clearance of the plunger.*
(12) Insert the No.1 plunger guide.
(13) Insert the No.1 plunger guide stopper.
(14) For the pump of the 2 cylinder type engine, repeat the above steps for No.2 cylinder.
(15) For the pump of the 3 cylinder type engine, repeat the above steps for No.3 cylinder.
(16) Install the plunger guide stopper pin.
(17) After attachment tighten the delivery valve holder with a torque wrench.

| 2GM20(F)(C), 3GM30(F)(C), 3HM35(F)(C) | kg-m (ft-lb) |
|---|---|
| Tightening torque | 4.0 ~ 4.5 (28.92 ~ 32.54) |

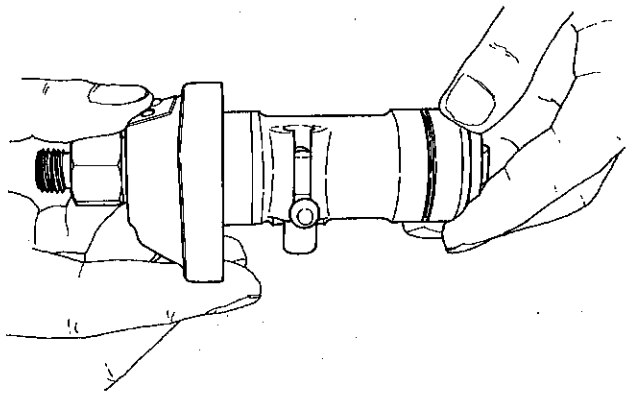
*NOTE: When the tightening torque of the delivery valve holder exceeds the prescribed torque, the plunger will be distorted, the sliding resistance of the control rack will increase, and proper performance will not be obtained. Moreover, excessive tightening will damage the pump body and delivery valve gasket, and cause a variety of other problems.*

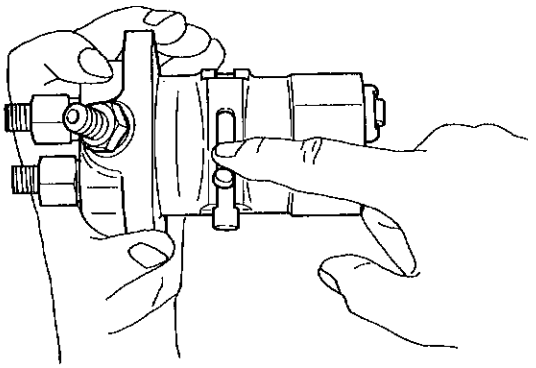
## 2-7 Inspection after reassembly

When the engine doesn't run smoothly and the injection pump is suspected as being the cause, or when the pump has been disassembled and parts replaced, always conduct the following tests.

### 2-7.1 Control rack resistance test

After reassembling the pump, wash it in clean fuel, move the rack and check resistance as follows:
(1) This test is performed to determine the resistance of the control rack. When the resistance is large, the engine will run irregularly or race suddenly.
(2) Place the pump on its side, hold up the control rack and allow it to slide down by its own weight. The rack should slide smoothly over its entire stroke. Place the pump on end and perform the above test again; check for any abnormalities. [Resistance below 60g (0.132 lb)]
(3) Since a high sliding resistance is probably a result of the following, disassemble the pump and wash or repair it.

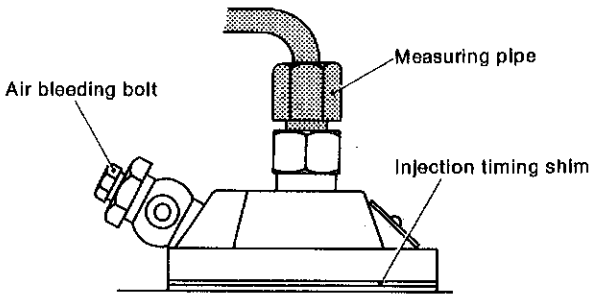




(a) Resistance of the rotating and sliding parts of the plunger assembly is too high.
(b) Delivery valve holder is too tight (plunger barrel distorted).
(c) Control rack or control pinion teeth and control rack outside circumference are dirty or damaged.
(d) Injection pump body control rack hole is damaged.
(e) Plunger barrel packing is not installed correctly and the barrel is distorted. (Since in this case fuel will leak into the crankcase and dilute the lubricating oil, special care must be taken).

### 2-7.2 Fuel injection timing

Fuel injection timing is adjusted by timing shims inserted between the pump body and gear case pump mounting seat.
The injection pump must be mounted on the engine, and each cylinder injection timing adjusted.
Adjusting the injection timing
(1) Remove the high pressure pipe from the pump.
(2) Install a measuring pipe if the injection pump does not have a nipple on the delivery side.
(3) Bleed the air from the injection pump.




(4) Set the control rack to the middle fuel injection position (Pull the lever when setting the accelerator lever.)
(5) Turn the crankshaft slowly by hand, and read the timing mark (TD) on the flywheel the instant fuel appears at the measuring pipe or pipe joint nipple.
(FID+ Fuel injection from delivery valve.)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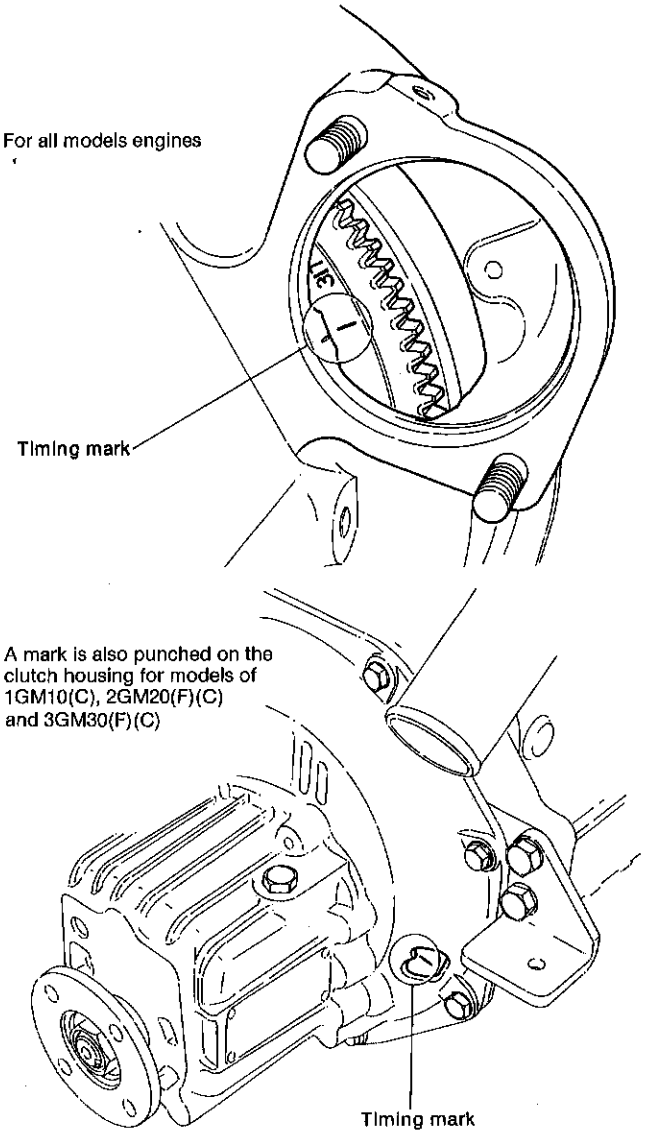
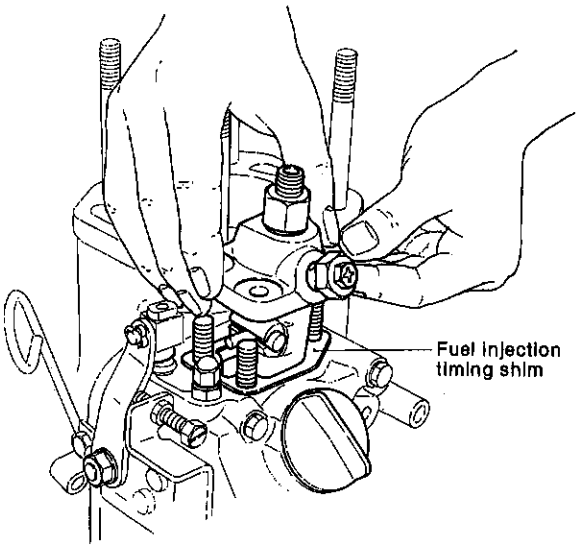


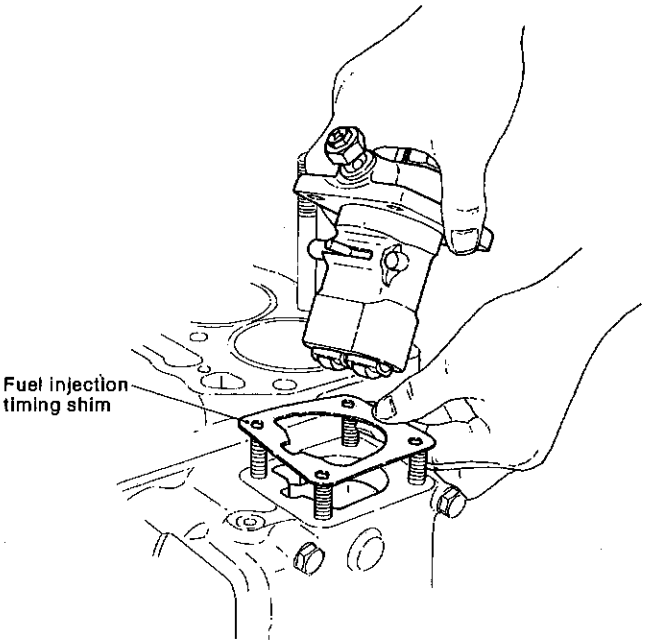

(6) If the injection timing is off, add plunger shims when the timing is slow, and remove shims when the timing is fast. Adjust the timing of every pump in the same manner. (Refer to item, "Plunger head gap adjustment".)

(7) After the injection timing of every pump has been matched, recheck the injection timing as described in item (5) above. If the injection timing is not properly set, adjust it with the timing shims.

| | | 1GM10(C) | 2GM20 (F)(C) | 3GM30 (F)(C) | 3HM35 (F)(C) |
|---|---|---|---|---|---|
| Fuel injection timing | | bTDC15° (FID) | bTDC15° (FID) | bTDC18° (FID) | bTDC21° (F(D) |
| Fuel inection timing shim | 0.2mm (0.008in.) | 1 shim 104271-01930 | 2 shims 124950-01931 | 2 shims 121450-01931 | |
| | 0.3mm (0.012in.) | 1 shim 104271-01940 | 2 shims 124950-01941 | 2 shims 121450-01941 | |
| | 0.5mm (0.020) | — | 1 shim 124950-01961 | 1 shim 124950-01961 | |
| | Set No. | 104271-01950 | 124950-01951 | 121450-01951 | |

The thickness of the plunger location adjusting shim and the injection timing adjusting plate is 0.1 mm. With this the injection timing can be changed by approximately 1° on the crankshaft.




(8) Finally, turn the crankshaft slowly and confirm that it turns easily. If it is stiff or does not rotate, the plunger head gap is too small.



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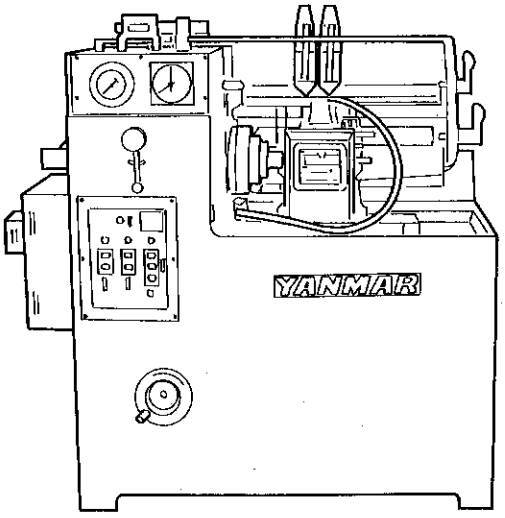
## 2-8 Injection pump adjustment

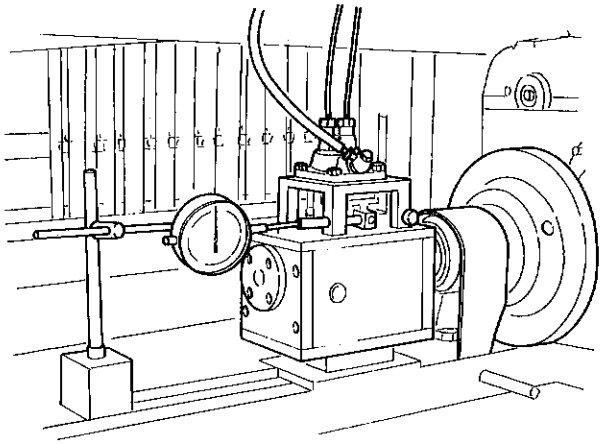
The injection pump is adjusted with an injection pump tester after reassembly.




### 2-8.1 Setting pump on tester

(1) After the injection pump has been disassembled and reassembled, install it on a pump tester
...cam lift: 7mm (0.276in.).

(2) Confirm that the control rack slides smoothly. If it does not, inspect the injection pump and repair it so that the rack slides smoothly
...control rack full stroke: 15mm (0.5905in.).

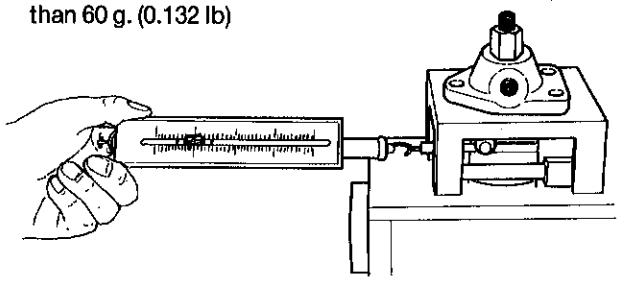


(3) Run the pump tester at low speed, loosen the air bleeder screw, and bleed the air from the injection pump.

### 2-8.2 Measuring the sliding resistance of the fuel control rack

Measure the sliding resistance of the fuel control rack with a spring scale (balance).

(1) Number of pump rotations/sliding resistance: 0rpm/less than 60 g. (0.132 lb)



*NOTE: If the sliding resistance is unsatisfactory, disassemble, inspect and repair the fuel control rack.*

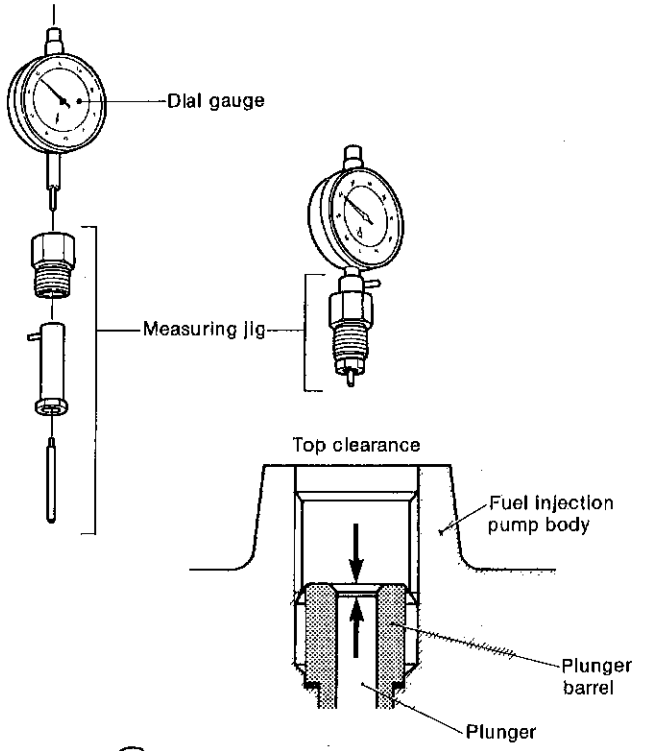
### 2-8.3 Adjusting the plunger top clearance

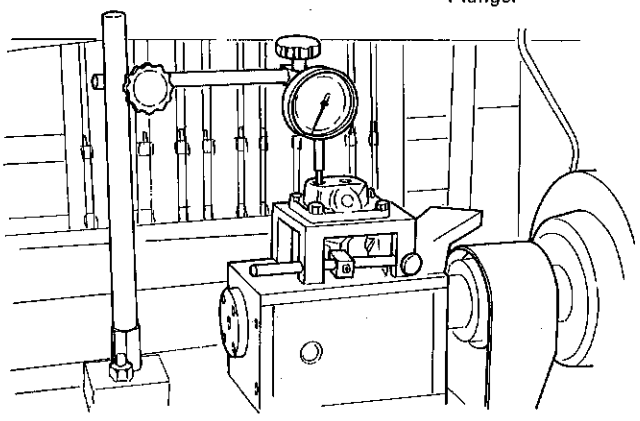
(1) Set the pump installation dimension (end of plunger barrel when the roller is on the cam base cycle) at 76 ±0.05mm (2.9902 ~ 2.9941in.), remove the delivery valve holder and delivery valve, and set the plunger to top dead center by turning the camshaft. Measure the difference in height (head gap) between the end of the plunger and the end of the plunger barrel using a dial gauge.

mm (in.)

| | |
|---|---|
| Plunger top clearance | 1.0 ±0.05 (0.0374 ~ 0.0398) |

(2) Using the plunger top clearance measuring jig
1) Install a dial gauge on the measuring jig.
2) Stand the measuring jig on a stool and set the dial gauge pointer to O.
3) Remove the pump delivery valve and install the measuring jig.
4) Turn the camshaft to set the plunger to top dead center and read the dial gauge. The value given is the plunger top clearance.





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(3) When the plunger top clearance is larger than the prescribed value, remove the plunger guide and insert plunger shims between the plunger spring lower retainer and the plunger guide. Adjust each pump in the same manner.

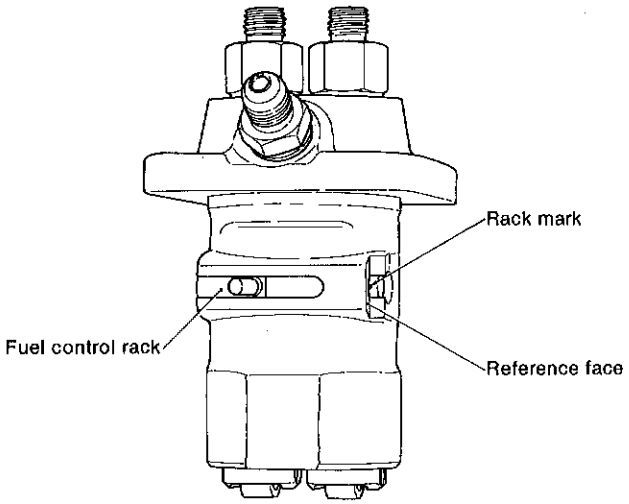
| | | |
|---|---|---|
| Plunger shim thickness | 0.1mm (0.004in.) | 174307-51710 |
| | 0.2mm (0.008in.) | 174307-51720 |
| | 0.3mm (0.012in.) | 174307-51730 |

(4) After rechecking adjustment, install the delivery valve.

| | |
|---|---|
| Delivery valve holder tightening torque | 4.0 ~ 4.5 kg-m (29 ~ 32.6 lb-ft) |

### 2-8.4 Checking the cylinder injection interval

(1) Align the control rack punch mark with the pump reference face.




(2) Turn the pump by hand to check the No.1 cylinder injection timing.
(3) Turn the pump in the prescribed direction and check the No.2/3 cylinder injection timing.
(4) Using the plunger shims, adjust each cylinder injection timing interval.

| | For crankshaft angle | For camshaft angle |
|---|---|---|
| 2GM20(F)(C) | 180° 540°<br>1 ~ 2 ~ 1 | 90° 270°<br>1 ~ 2 ~ 1 |
| 3GM30(F)(C),<br>3HM35(F)(C) | 240° 240° 240°<br>1 ~ 3 ~ 2 ~ 1 | 120° 120° 120°<br>1 ~ 3 ~ 2 ~ 1 |

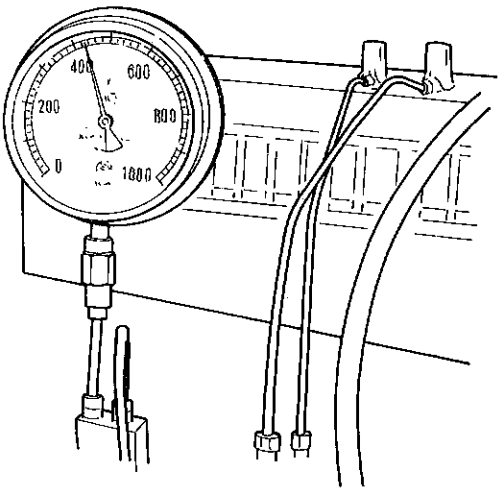
### 2-8.5 Delivery valve oil-tight test

(1) Install a 1,000 kg/cm² (14,223 lb/in.²) pressure gauge on the delivery valve holder.
(2) Drive the fuel pump to apply a pressure of approximately 120 kg/cm² (1,707 lb/in.²) and measure the time required for the pressure to drop from 100 kg/cm² (1,422 lb/in²) to 90 kg/cm² (1280 lb/in.²)

| | |
|---|---|
| Pump speed | 200 rpm |
| Pressure drop standard | 20 sec. or more |
| Pressure drop limit | 5 sec. or less |

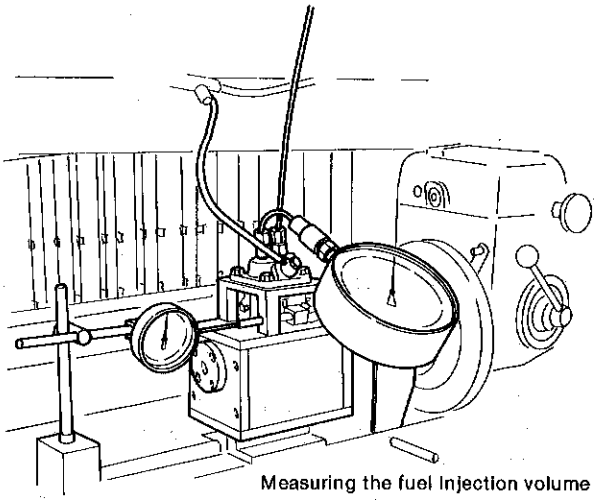
(3) If both the plunger and the delivery valve fail the test, replace them.

### 2-8.6 Plunger pressure test

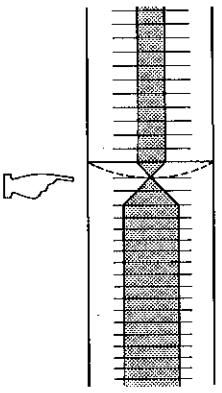



(1) Install a 1,000 kg/cm² (14,223 lb/in.²) pressure gauge on the delivery valve holder.
(2) Check that there is no oil leaking from the delivery valve holder and high pressure pipe mountings, and that the pressure does not drop suddenly when raised to 500 kg/cm² (7,112 lb/in.²) or higher.
Pressure gauge AVT 1/2 × 150 × 1,000 kg/cm²

### 2-8.7 Measuring the fuel injection volume



Measuring the fuel injection volume





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(1) Set the fuel pump camshaft speed.
(2) Check the injection nozzle.

| | 1GM10(C) | 2GM20(F)(C), 3GM30(F)(C) | 3HM35(F)(C) |
|---|---|---|---|
| Pump speed | 1800 rpm | | 1700 rpm |
| Plunger diameter x stroke | $\phi$6 x 7mm (0.2362 x 0.2756in.) | | $\phi$6.5 x 7mm (0.2559 x 0.2756in.) |
| Injection nozzle type | YDN-OSDYD1 | | YDN-OSDY1 |
| Pressure for fuel injeciton | 170 kg/cm$^2$ (2418 lb/in$^2$) | | 160 kg/cm$^2$ (2276 lb/in$^2$) |
| Amount of injection at rack mark position | 22.5~23.5cc (1.37~1.43in.$^3$) | 21.5cc~22.5cc (1.31~1.37in.$^3$) | 27.5~28.5cc (1.68~1.74in.$^3$) |
| Allowable error between cylinder | — | 1cc (0.06in.$^3$) or less | 1cc (0.06in.$^3$) or less |
| Stroke | 1000 | | 1000 |

*NOTE: Mainting the pressure for feeding oil to the injection pump at 0.5 kg/cm$^2$. (7.1 lb/in.$^2$)*

**2-8.8 Adjustment of injection volume for each cylinder**

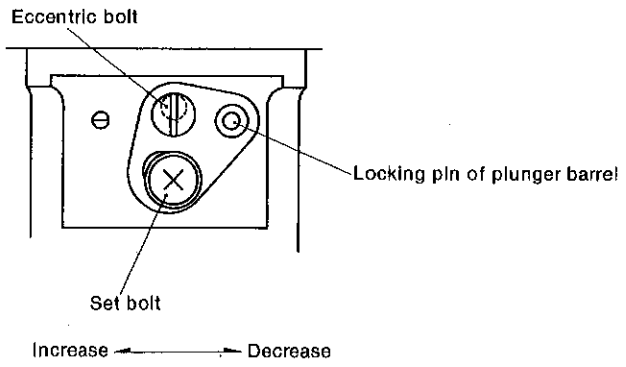
(1) Fluctuation of injection volume
The injection volumes of each cylinder must be adjusted to within 3% of each other.

$$\text{Average injection volume} = \frac{\text{total volume of all cylinder injection}}{\text{number of cylinders}}$$

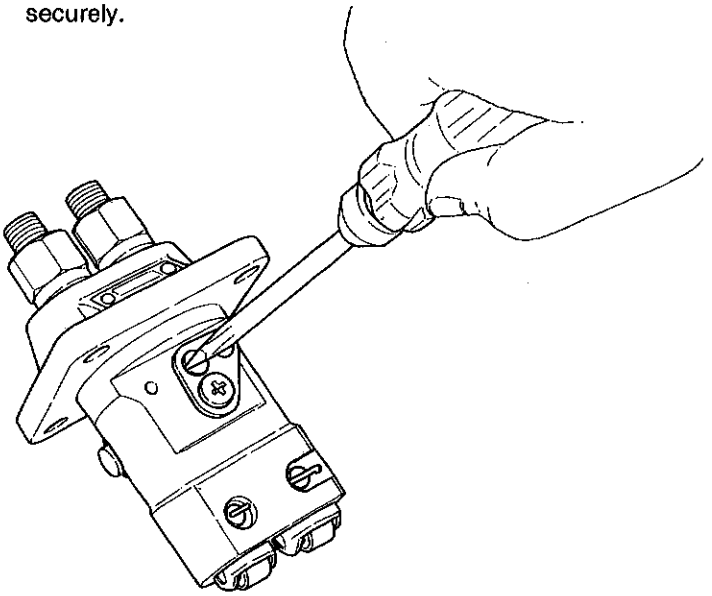
$$\text{Difference} = \frac{\text{Maximum injection volume} - \text{average injection volume}}{\text{Average injection volume}} \times 100$$

When the difference exceeds 3%, adjust the injection volume by sliding the control sleeve and pinion, when the difference exceeds 3%, the engine output will drop and/or one cylinder will overheat.

(2) Adjustment of injection volume
In order to adjust the fluctuation of injection volume for each cylinder, alter the position of the injection volume adjusting plate at the side of the fuel injection of pump body.
The injection volume adjusting plate is operated by the eccentric bolt which is integrated with the locking pin of the plunger barrel and changes the position of the plunger barrel. When the plunger barrel is turned, the relative position of the suction hole with respect to the lower lead of the plunger changes the injection volume.




By loosening the set bolt and turning the eccentric bolt clockwise, the position of the pin moves to the left to increase the injection volume, and by turning the eccentric bolt counterclockwise, the pin moves to the right to decrease the injection volume.
After adjusting the injection volume, tighten the set bolt securely.





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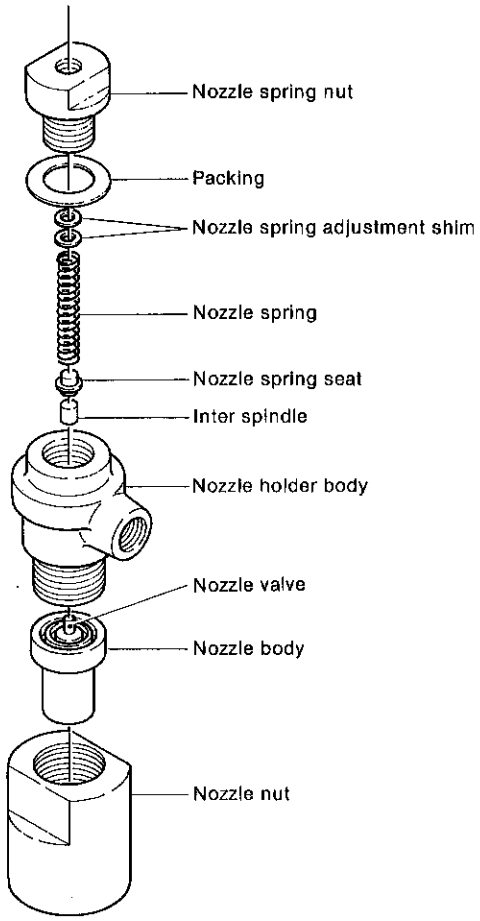
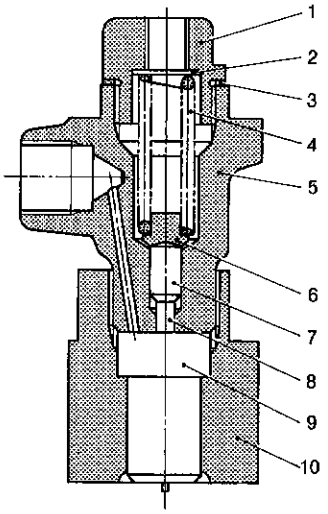
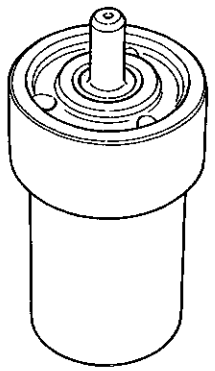
# 3. Injection Nozzle

## 3-1 Construction

The injection nozzle atomizes the fuel sent from the injection pump and injects it into the precombustion chamber in the prescribed injection pattern to obtain good combustion through optimum fuel/air mixing.
The main parts of the injection nozzle are the nozzle holder and nozzle body. Since both these parts are exposed to hot combustion gas, they must be extremely durable.
Moreover, since their operation is extremely sensitive to the pressure of the fuel, high precision is required. Both are made of quality alloy steel that has been specially heat treated and lapped, so they must always be handled as a pair.
Common parts are used for the fuel valve of models 1GM10(C), 2GM20(F)(C) and 3GM30(F)(C). The only difference between the GM model series and model 3HM35(F)(C) is the nozzle case nut.



1. Nozzle spring nut
2. Nozzle spring adjustment shim
3. Packing
4. Nozzle spring
5. Nozzle holder body
6. Nozzle spring seat
7. Inter spindle
8. Nozzle valve
9. Nozzle body
10. Nozzle nut

## 3-2 Specifications for nozzle valve

| Engine model | | 1GM10(C), 2GM20(F)(C), 3GM30(F)(C) | 3HM35(F)(C) |
|---|---|---|---|
| Nozzle | Type of nozzle valve | YDN-OSDYD1 (Throttle) | |
| | Valve opening pressure | 170 ±5 kg/cm² (2347 ~ 2489 lb/in.²) | 160 ±5 kg/cm² (2205 ~ 2347 lb/in.²) |
| | Diameter of injection nozzle | ø1mm (0.0394in.) | |
| | Angle of injection | 5° ~ 10° | |
| Nozzle spring | Free length | 30.0mm (1.1811in.) | |
| | Mounted length | 28.7mm (1.1299in.) | |
| | Mounted load | 14.14 kg (31.17 lb) | |
| Nozzle spring adjusting plate (for adjusting nozzle opening pressure) | | 0.1mm (0.0039in.) 0.15mm (0.0059in.) 0.2mm (0.0079in.) 0.3mm (0.0118in.) 0.5mm (0.0197in.) | |



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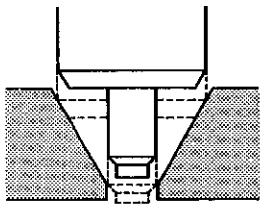
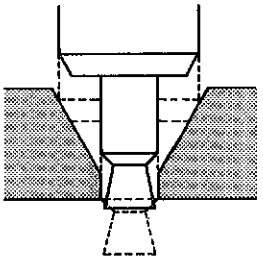
### 3-3 Yanmar throttle nozzle

The semi-throttle nozzles used in this engine are designed and manufactured by Yanmar. A semi-throttle nozzle resembles a pintle nozzle, except that with the former the nozzle hole at the end of nozzle and nozzle body are longer and the end of the nozzle is tapered. This nozzle features a "throttling effect": relatively less fuel is injected into the precombustion chamber at the initial stage of injection, and the volume is increased as the nozzle rises. This type of throttle nozzle ideal for small, high-speed engines.



Pintle nozzle



YANMAR semi-throttle nozzle

### 3-4 Nozzle operation

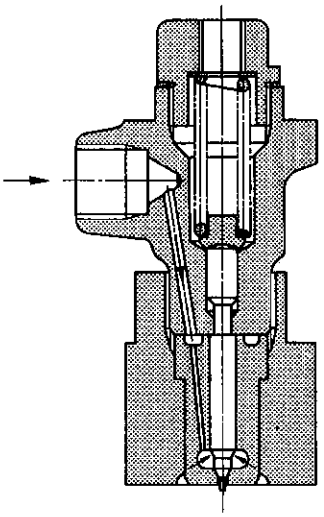
The nozzle is pushed down to its lowest position by the pressure-adjusting nozzle spring and contacts the valve seat of the nozzle body.

Under high pressure, fuel from the fuel pump passes through the hole drilled in the nozzle holder, enters the circular groove at the end of the nozzle body and then enters the pressure chamber at the bottom of the nozzle body.

When the force acting in the axial direction on the differential area of the nozzle on the pressure chamber overcomes the force of the spring, the nozzle is pushed up and the fuel is injected into the precombustion chamber through the throttle hole.

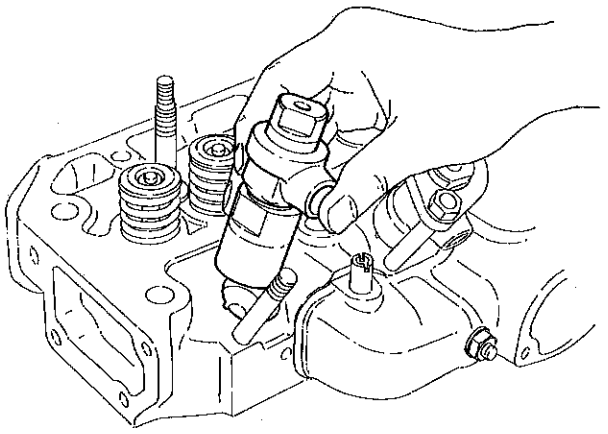
The nozzle is closed again when the pressure in the nozzle body's pressure chamber drops below the force of the spring.

This cycle is repeated at each opening and closing of the injection pump delivery valve.

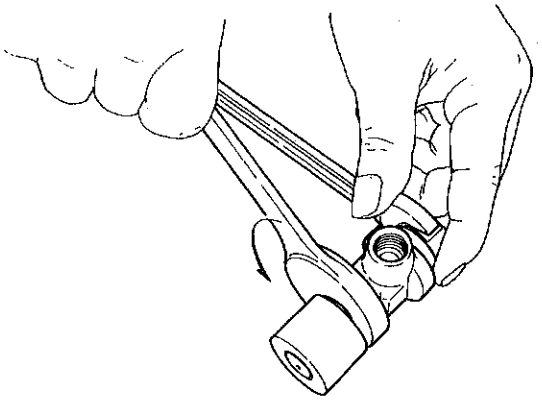


### 3-5 Disassembly and reassembly

#### 3-5.1 Disassembly sequence



(1) Remove the carbon from the nozzle end.
(2) Loosen the nozzle spring holder.
(3) Remove the nozzle holder body from the nozzle mounting nut.

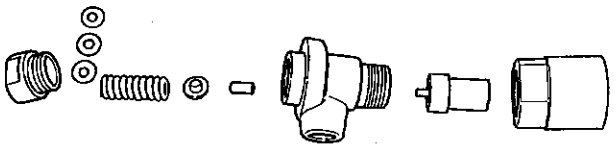


(4) Remove the nozzle body and nozzle ass'y from the nozzle mounting nut.
(5) Remove the nozzle spring retainer from the nozzle holder body, and remove the nozzle spring retainer, inter-spindle etc.

Reassemble in the reverse order of disassembly, paying special attention to the following items.

#### 3-5.2 Disassembly and reassembly precautions

(1) The disassembled parts must be washed in fuel oil, and carbon must be completely removed from the end of the nozzle body, the nozzle body and the nozzle mounting nut fitting section.
If reassembled while any carbon remains, the nozzle will not tighten evenly, causing faulty injection.





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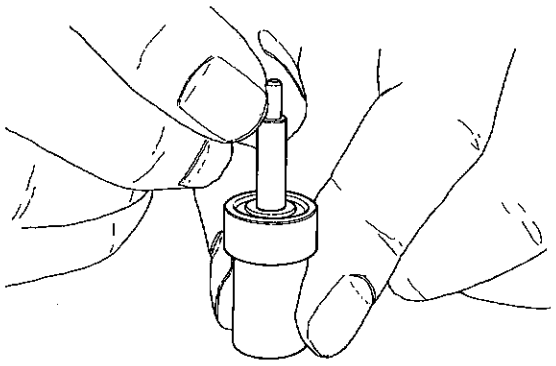
(2) Parts for No.1 cylinder and No.2 cylinder must be kept separate. The nozzle body and nozzle must always be handled as a pair.

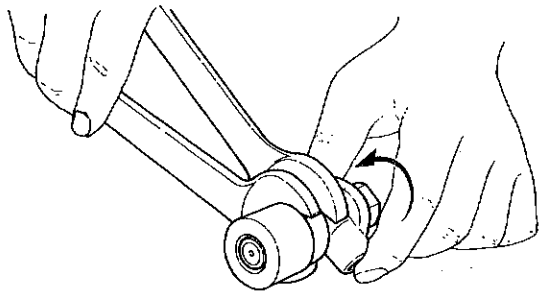
(3) Precautions when using a new nozzle.
First immerse the new nozzle in rust-preventive oil, and then seal it on the outside with seal peel. After removing the seal peel, immerse the nozzle in diesel oil and remove the rust-preventive oil from both inside and outside the nozzle.
Stand the nozzle holder upright, lift the nozzle about 1/3 of its length: it should drop smoothly by it own weight when released.



(4) The nozzle must be fitted on the nozzle holder with the nozzle spring retainer loosened.
If the nozzle is installed with the nozzle spring tightened, the nozzle mounting nut will be tightened unevenly and oil will leak from between the end of the nozzle holder body and the end of the nozzle mounting nut, causing faulty injection.

kg-m (ft-lb)

| | | |
|---|---|---|
| Nozzle tightening torque | Nozzle nut | 10 (72.36) |
| | Nozzle spring nut | 7.0 ~ 8.0 (50.65 ~ 57.89) |

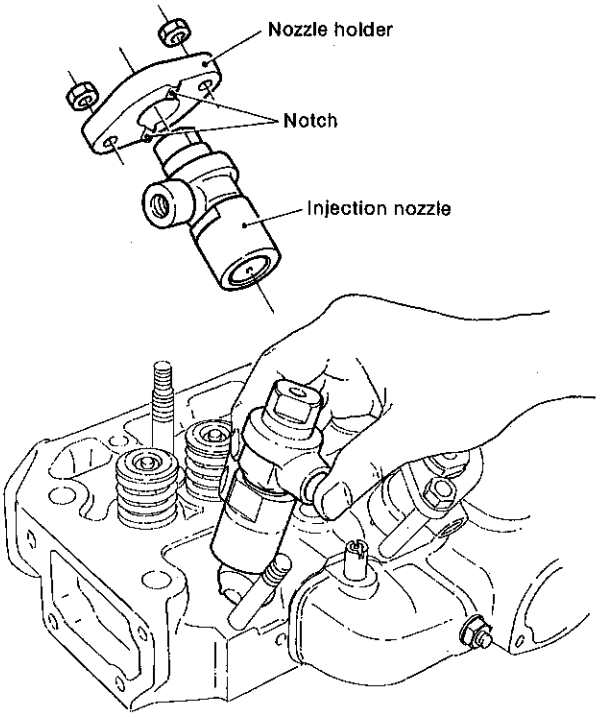


(5) When installing the injection nozzle on the cylinder head, tighten the nozzle holder nuts alternately, being careful to tighten them evenly.

kg-m (ft-lb)

| | |
|---|---|
| Tightening torque | 2 (14.5) |

The nozzle holder must be installed with the notch side on the nozzle side.



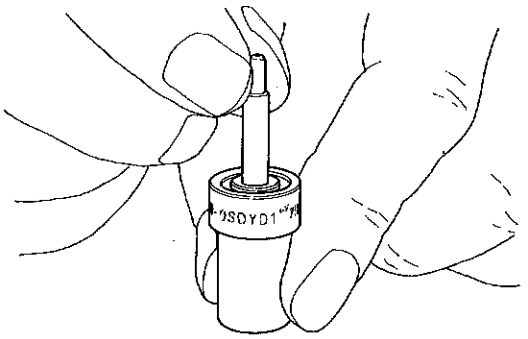

## 3-6 Injection nozzle inspection and adjustment

### 3-6.1 Carbon and corrosion on the nozzle body

Inspect the end and sides of the nozzle body for carbon build-up and corrosion. If there is considerable carbon build-up, check the properties of the fuel used, etc.
Replace the body if heavily corroded.

### 3-6.2 Checking nozzle action

Wash the nozzle in clean fuel oil and hold the nozzle body upright, then lift the nozzle about 1/3 of its length with one hand. The nozzle is in good condition if it drops smoothly by its own weight when released. If the nozzle slides stiffly, repair or replace it.





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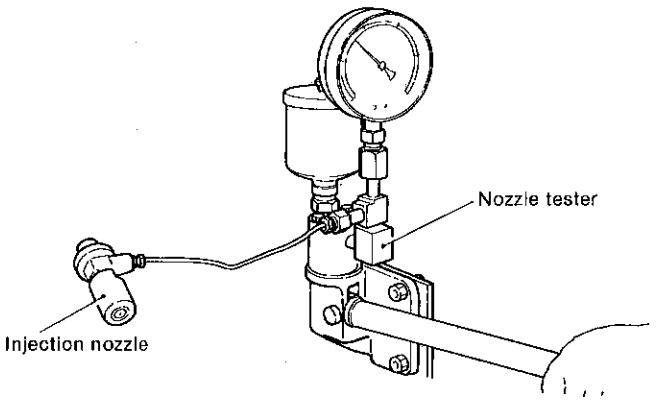
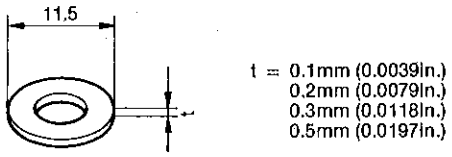
### 3-6.3 Adjusting the nozzle injection pressure

Fit the injection nozzle to the high pressure pipe of a nozzle tester and slowly operate the lever of the tester. Read the pressure when instant injection from the nozzle begins.
If the injection pressure is lower than the prescribed pressure, remove the nozzle spring holder and adjust the pressure by adding nozzle spring shims.
The injection pressure increases about 10 kg/cm² (142.2 lb/in.²) when a 0.1mm (0.004in.) shim is added.




| | 1GM10(C), 2GM20(F) 3GM30(F)(C) | 3HM35(F)(C) |
|---|---|---|
| Injection pressure | 170±5 kg/cm² (2347~2489 lb/in.²) | 160±5 kg/cm² (2205~2347 lb/in.²) |

### 3-6.4 Nozzle seat oil tightness check

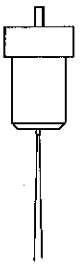
After injecting the fuel several times by operating the lever of the nozzle tester, wipe the oil off the injection port. Then raise the pressure to 20 kg/cm² (284.5 lb/in.²) 140kg/cm² (1991 lb/in.²) lower than the prescribed injection pressure. The nozzle is faulty if oil drips from the nozzle. In this case, clean, repair or replace the nozzle.

### 3-6.5 Checking the spray condition

Adjust the nozzle injection pressure to the prescribed value and check the condition of the spray while operating the tester at 4—6 times/sec. Judge the condition of the spray by referring to the below figure.

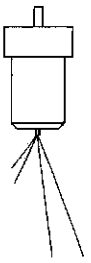
Normal

Stream



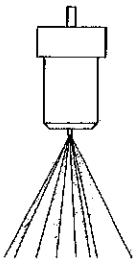
- Injection pressure low
- Nozzle seized
- Nozzle spring broken
- Dirt on valve seat

Spike



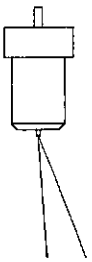
- Injection port damaged or dirty
- Carbon build-up
- Nozzle end abnormally worn

Spray



- Injection port worn
- Carbon build-up

Slanted



- Uneven seat contact
- Injection port damaged or worn
- Carbon build-up

### 3-6.6 Inspecting the nozzle spring

Inspect the nozzle spring for fractured coils, corrosion, and permanent strain, and replace the spring when faulty.

### 3-6.7 Inspecting the nozzle spring retainer and inter-spindle

Inspect the nozzle spring retainer and inter-spindle for wear and peeling of the contact face, and repair or replace the spring if faulty.



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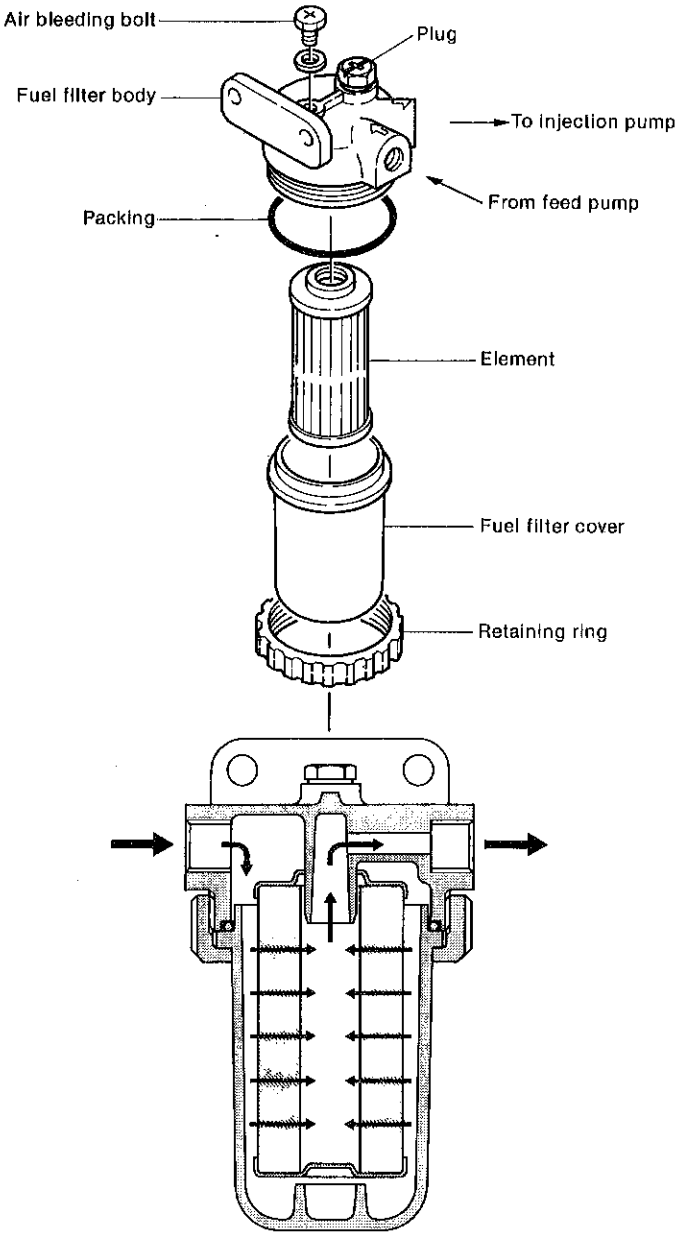
# 4. Fuel Filter

## 4-1 Construction

The fuel filter is installed between the feed pump and injection pump, and serves to remove dirt and impurities from the oil fed from the fuel tank through the feed pump.
The fuel filter incorporates a replaceable filter paper element. Fuel from the fuel tank enters the outside of the element and passes through the element under its own pressure. As it passes through, the dirt and impurities in the fuel are filtered out, allowing only clean fuel to enter the interior of the element. The fuel exits from the outlet at the top center of the filter and is sent to the injection pump.
A cross-headed hexagonal bolt is fitted to the fuel filter body. Loosen the bolt with a cross-headed screw driver before starting or after dismantling and reassembly to bleed the air in the fuel system to the fuel oil filter.

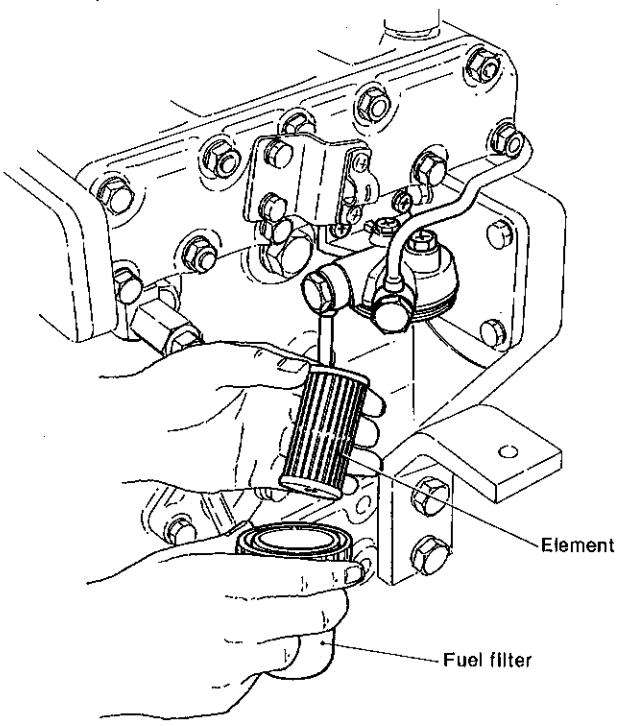



## 4.2 Specification (Common to all models)

| | |
|---|---|
| Filtering Area | 333cm² (20.3in.²) |
| Material of element | Cotton fiber |
| Filter mesh | 10 ~ 15μ |

## 4-3 Inspection

The fuel filter must be periodically inspected. If there is water and sediment in the filter, remove all dirt, rust, etc. by washing the filter with clean fuel.
The normal replacement interval for the element is 250 hours, but the element should be replaced whenever it is dirty or damaged, even if the 250 hour replacement period has not elapsed.




| | |
|---|---|
| Filter cleaning | First time 50 hours |
| Filter element replacement | Every 250 hours |



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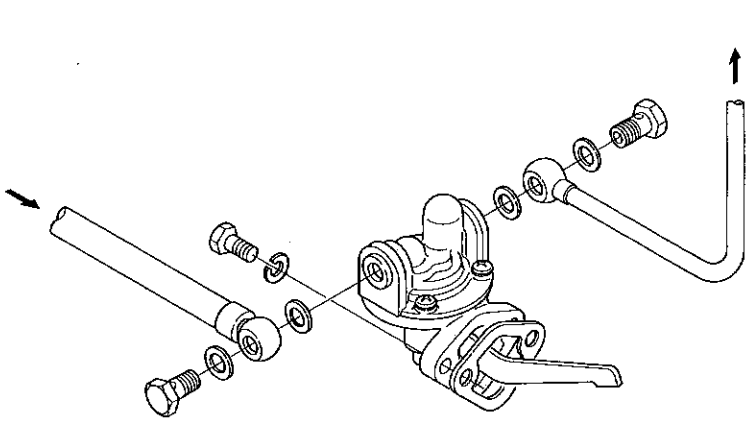
# 5. Fuel Feed Pump

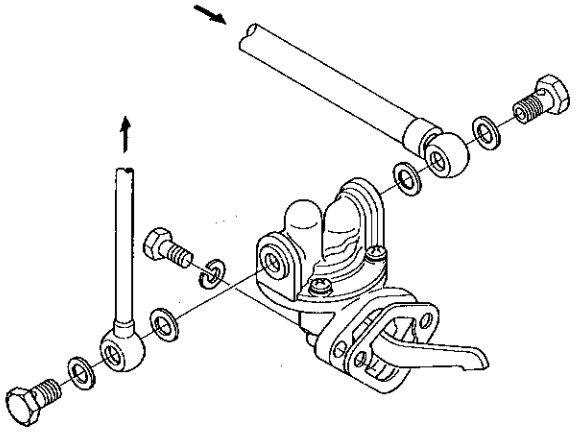
### 5-1 Construction

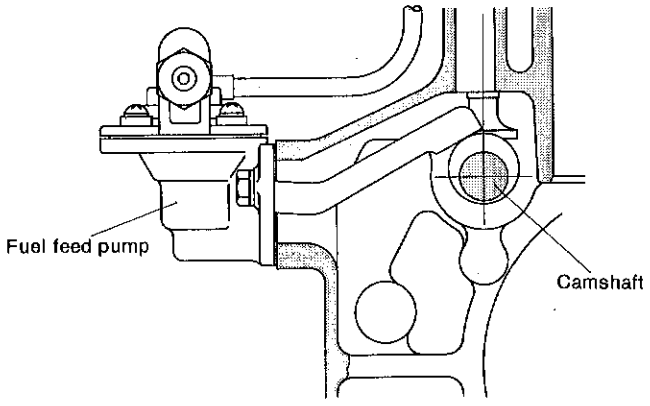
The fuel pump feeds the fuel from the fuel tank to the injection pump through the fuel filter. When the fuel tank is installed at a higher position than the fuel filter and injection pump, the fuel will be fed by its head pressure, but if the, fuel tank is lower than the filter and injection pump, a fuel pump is required.
The fuel pump of this engine is a diaphragm type and is installed on the exhaust side of the cylinder body. The diaphragm is operated by the movement of a lever by the fuel feed pump cam at the cam shaft.

### Specifications

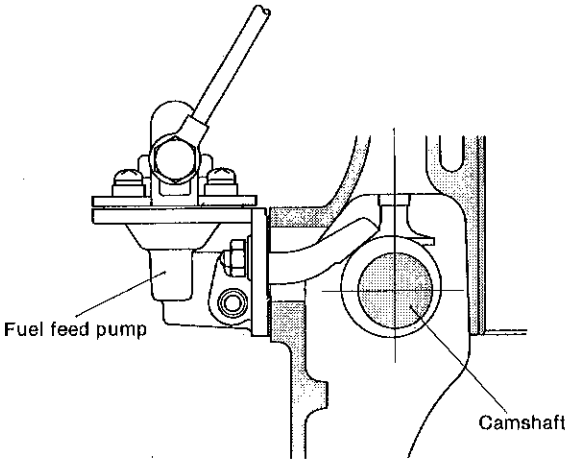
| | 1GM10(C) | 2GM20(F)(C), 3GM30(F)(C), 3HM35(F)(C) |
|---|---|---|
| Part No. | 105582-52010 | 129301-52020 |
| Suction head | Max. 0.8m (3.15in.) | |
| Capacity | 0.3ℓ/min. at 1000 rpm | |
| Feed Pressure | 0.1 kg/cm² (1422 lb/in.²) at 600~1800 rpm | |
| Suction pressure | −60 mmHG at 600 rpm | |








1GM10(C)




2GM20(F)(C), 3GM30(F)(C), 3HM35(F)(C)



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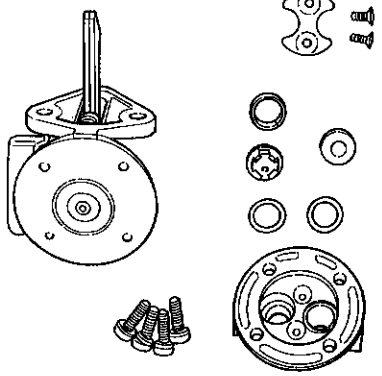
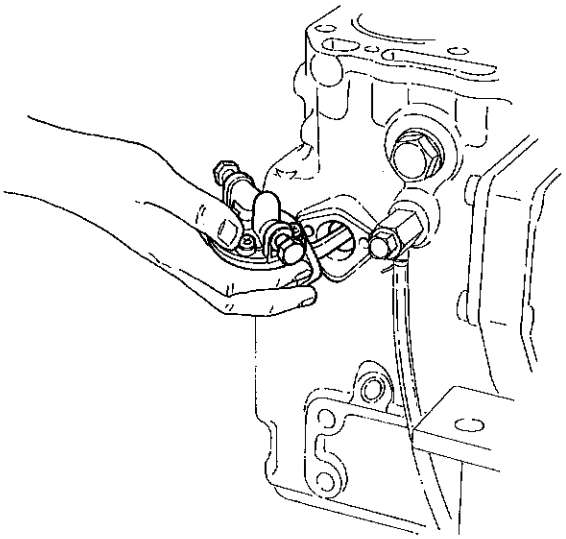
## 5-2 Disassembly and reassembly

### 5-2.1 Disassembly

Clean the outside of the pump, inscribe a matching mark on the upper body and lower body of the pump, disassemble and put the components in order.

Component parts of fuel feed pump

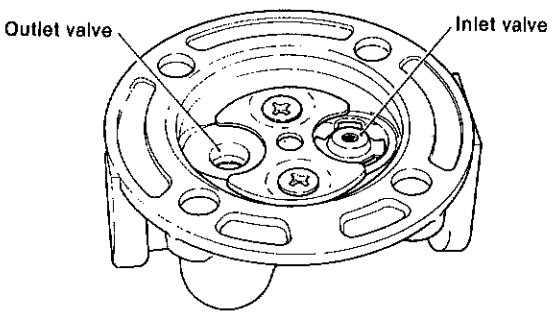




### 5-2.2 Reassembly

Assemble the pump by reversing the disassembling procedures. Pay close attention to the following:

(1) Clean the components, blow compressed air against them, and inspect. Replace any defective components.
(2) Replace the packings, etc. with new ones.
(3) When mounting the valves, be careful not to mix up the inlet and outlet valves. Also, don't forget the valve packing.



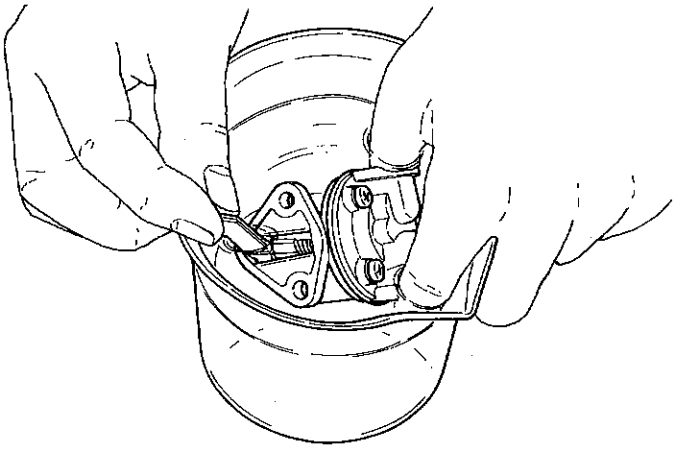

(4) Make sure the diaphragm mounting hole is in the correct position and gently attach the diaphragm to the pump body.
(5) Line up the matching marks on the pump body, and clamp on the pump body evenly.

| | |
|---|---|
| Tightening torque of screw | 30 ±10 kg-cm<br>(1.45 ~ 2.89 ft-lb) |

## 5-3 Inspecting and adjusting the fuel feed pump

### 5-3.1 Checking the pump for fuel oil leaks

After removal, immerse the pump in kerosene, stop its outlet port with a finger and, by operating the rocker arm, check for bubbles.
If any bubbles are present, this indicates a defective point which should be replaced.



### 5-3.2 Checking the pump for engine oil leaks

Check pump mounting bolts for looseness and the pump packing for breaks. Retighten any loose bolts and replace defective packing.

### 5-3.3 Measuring the sucking power

Attach a piece of vinyl hose to the inlet port, keep the pump at a specified height (head) above the fuel oil level, and operate the rocker arm by hand. If the fuel oil spurts out from the outlet port, the pump is all right. A simpler method of testing pump power is as follows: cover the inlet port with a finger and, by operating the rocker arm by hand, estimate the pump's sucking power by judging the suction on the finger, Although this is not an exact method, it can at least confirm that the diaphragm, valves, etc. are operating.



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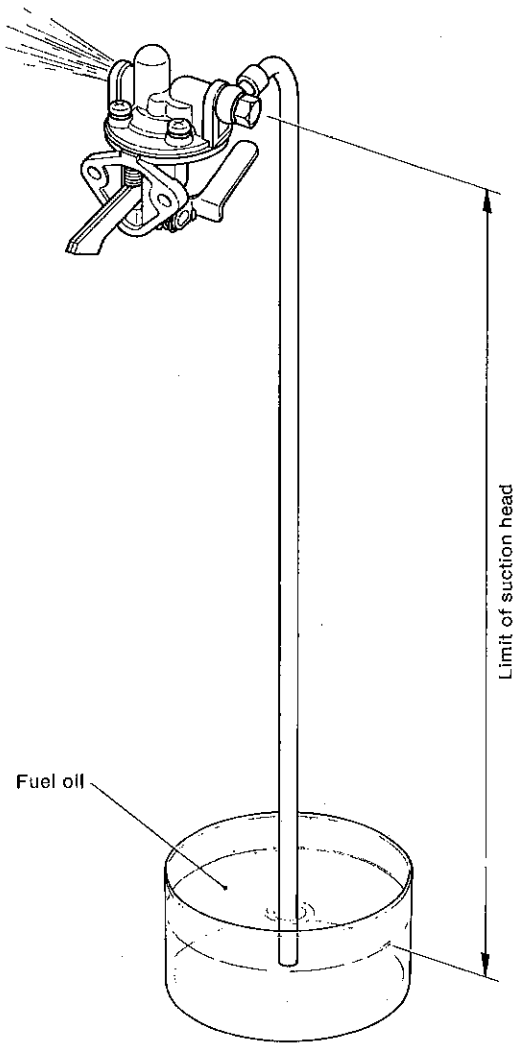
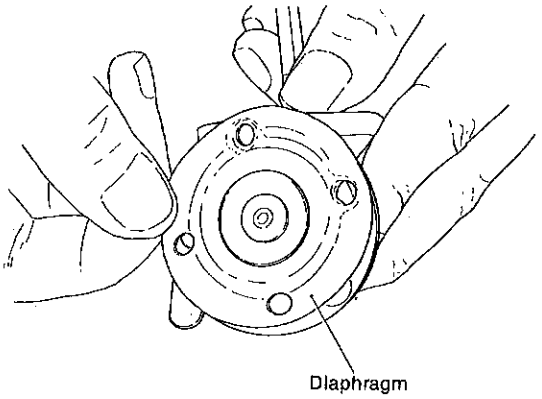


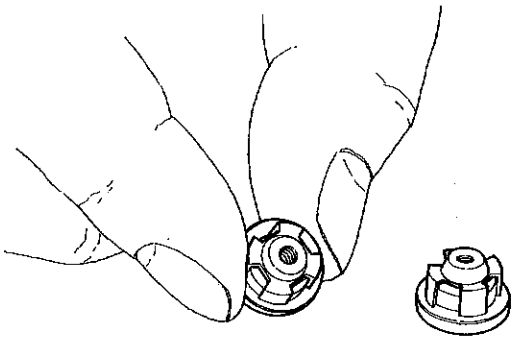

**5-3.4 Aging, breakdown and cracking of the diaphragm**

Since the diaphragm is constantly in motion, the cloth on its flexible parts becomes thin, cracked, and sometimes breaks down after long periods of use. A broken diaphragm causes fuel oil leakage and fragments of the diaphragm often contaminate the engine oil, seriously hampering fuel oil discharge or blocking it altogther.




**5-3.5 The contact area and mounting condition of valve**

Test the valve seat as follows: Remove the valve and blow into the valve seat from the direction in which the valve spring is mounted. If air leaks, replace-the seat with a new one. If fuel oil leaks as a result of dust, foreign objects, etc. caught in the valve seat, rinse it and clean it by blowing it with air.



**5-3.6 Diaphragm spring and rocker arm spring**

Check the diaphragm spring and rocker arm spring for permanent deformation, and the rocker arm and rocker pin for wear. If any of these components are defective, replace them with new ones.

*NOTE: When it becomes necessary to replace any of these parts, the entire fuel feed pump assembly should be replaced.*



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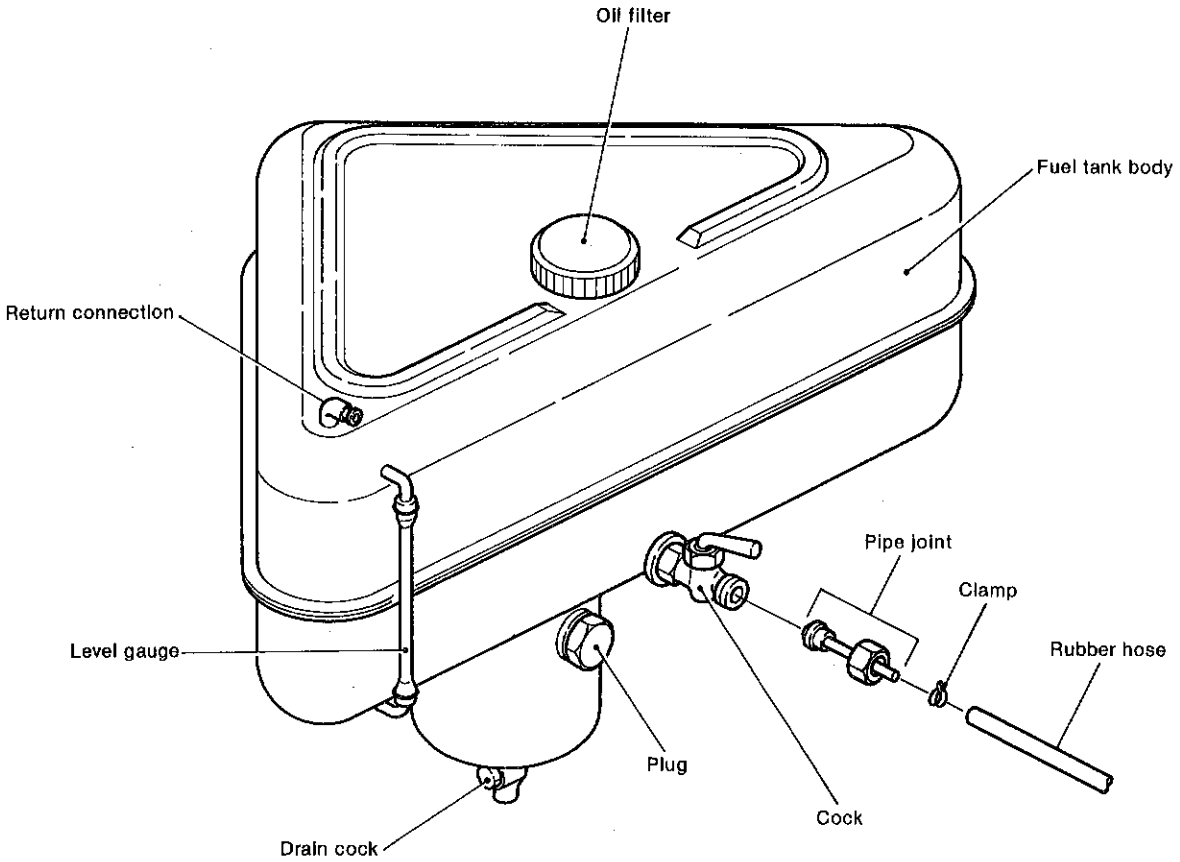
# 6. Fuel Tank (Option)

The fuel tank is optionally available. Its capacity is 30 litres for all engine models and is triangular to fit compactly into the engine room. As an accessory, a rubber hose of 2m length is attached to feed fuel oil from the fuel tank to the fuel pump. A connection to return fuel oil is provided at the top of the fuel tank, and by connecting a rubber hose from the fuel valve, the overflow oil can be returned to the tank.




| | |
|---|---|
| Material | Steel plate |
| Capacity | 30ℓ |
| Thread of outlet cock | PF 1/2 |
| Size of rubber hose | ø7/ø13 × 2000mm<br>(0.2756/0.5118 × 78.74in.) |



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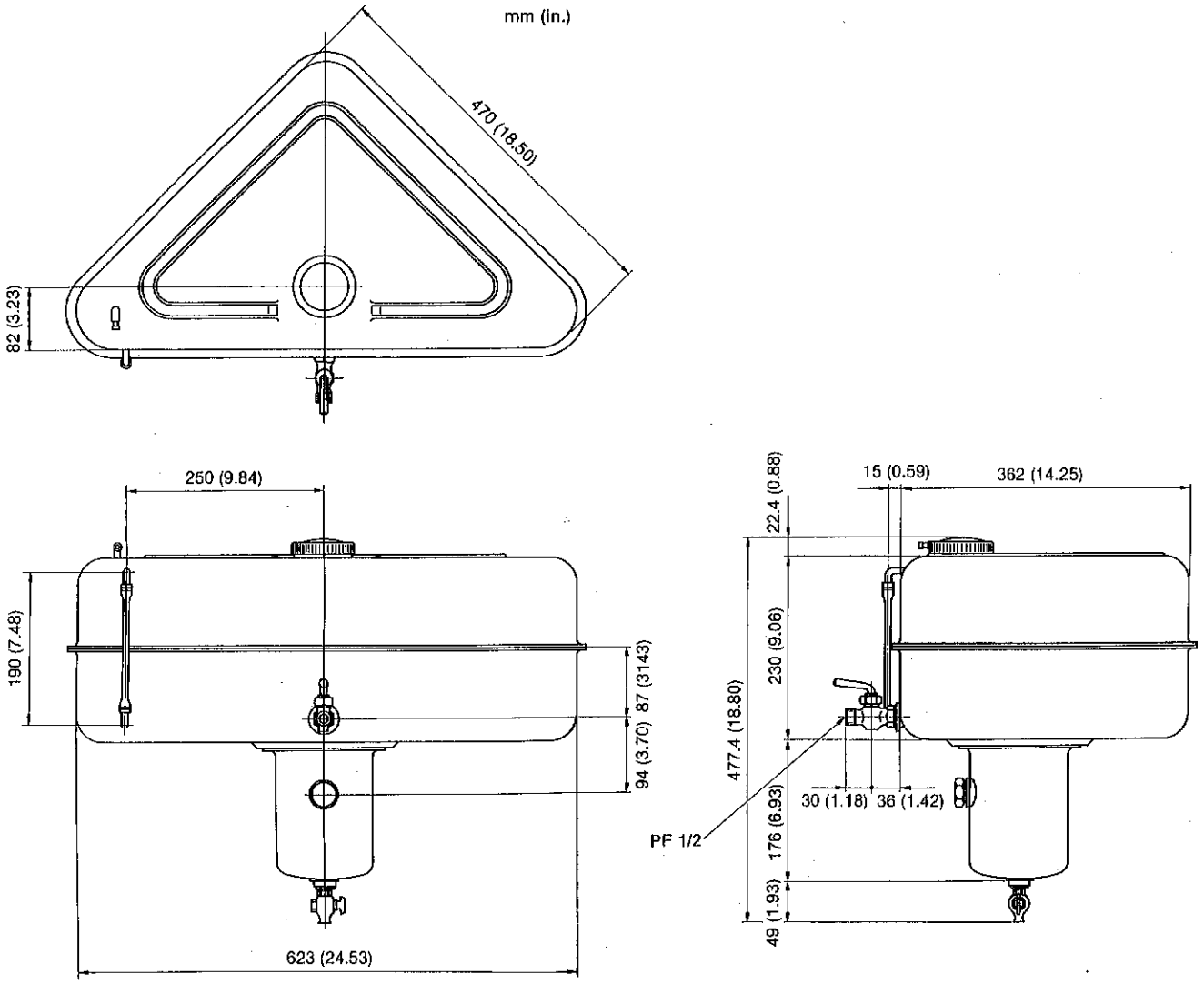
**Dimension**



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