FUEL OIL SYSTEM

Fuel feed system

Fuel Injection System

FUEL OIL SYSTEM

- The fuel oil system is designed to introduce fuel oil into the engine cylinders at the correct time, at correct high pressure, at correct quantity and correctly atomised.

- The system injects into the cylinder correctly metered amount of fuel in highly atomised form at a stipulated time in the four stroke cycle operation of the engine.

- High pressure of fuel is required for lifting the nozzle valve and penetration of fuel into the pressurised combustion chamber.

- High pressure also helps in proper atomization so that the small droplets come in better contact with the fresh air in combustion chamber and thus have better combustion.

- Metering the fuel to correct required quantity is important because the locomotive engine is a variable speed and variable load engine with variable requirement of fuel within a particular range.

- Timing the injection of fuel is also important to enable fuel to burn completely for maximum benefit out of it.

- The fuel oil system may be discussed in two portions separately, although both are a part of an integrated system: -

- (i) Fuel feed system

- (ii) Fuel injection system

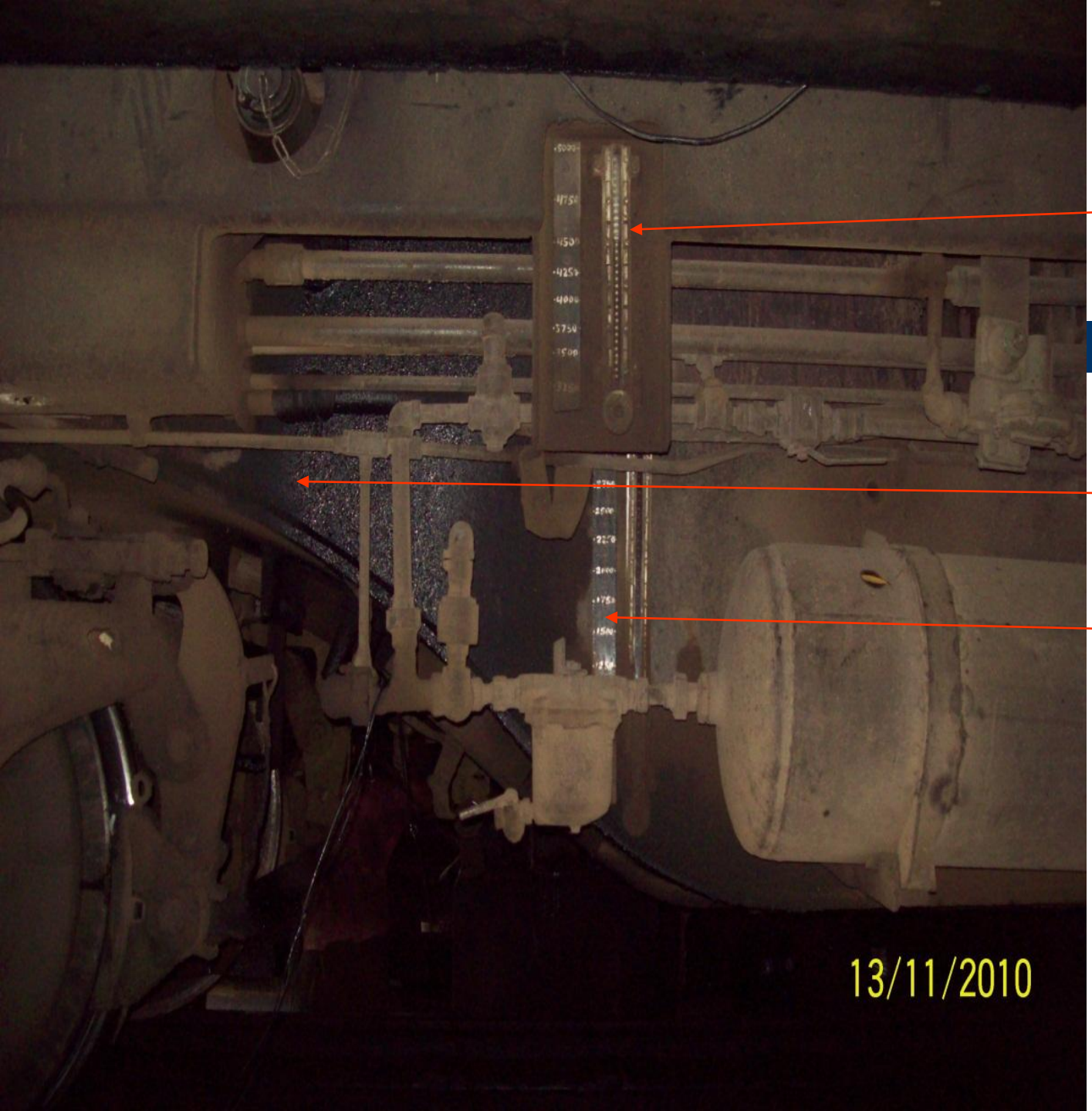
FUEL FEED SYSTEM

- The fuel feed system includes the following: -
- (1) Fuel oil tank
- (2) Fuel primary filter
- (3) Fuel transfer pump / fuel booster pump

- (4) Fuel relief valve
- (5) Secondary filter
- (6) Fuel regulating valve
- (7) Fuel oil header

FUEL OIL TANK

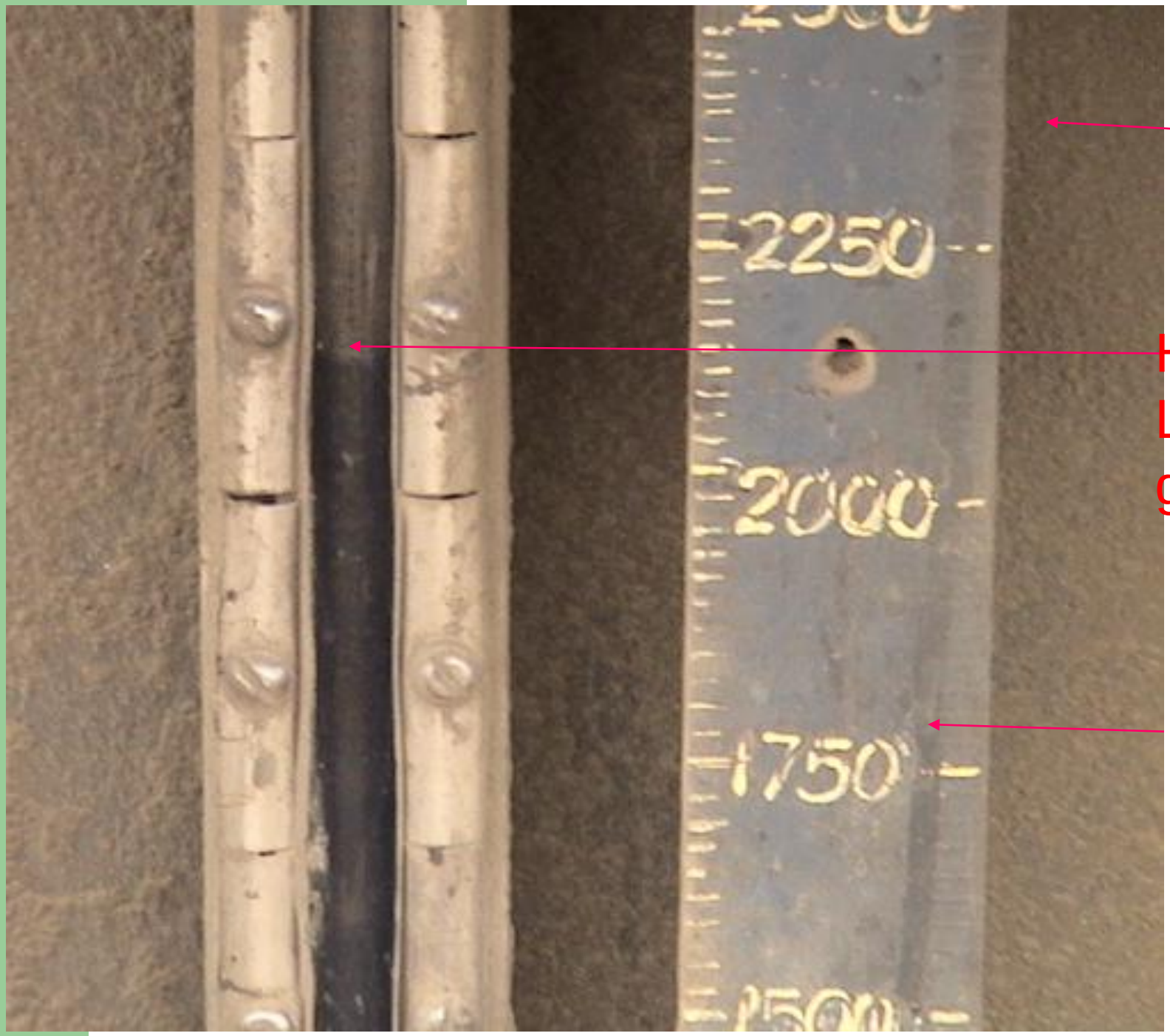
- The fuel oil tank of 5000 ltrs capacity is fabricated under the superstructure of the locomotive and located in between two bogies.



Small glow rod

Fuel oil tank

Large glow rod

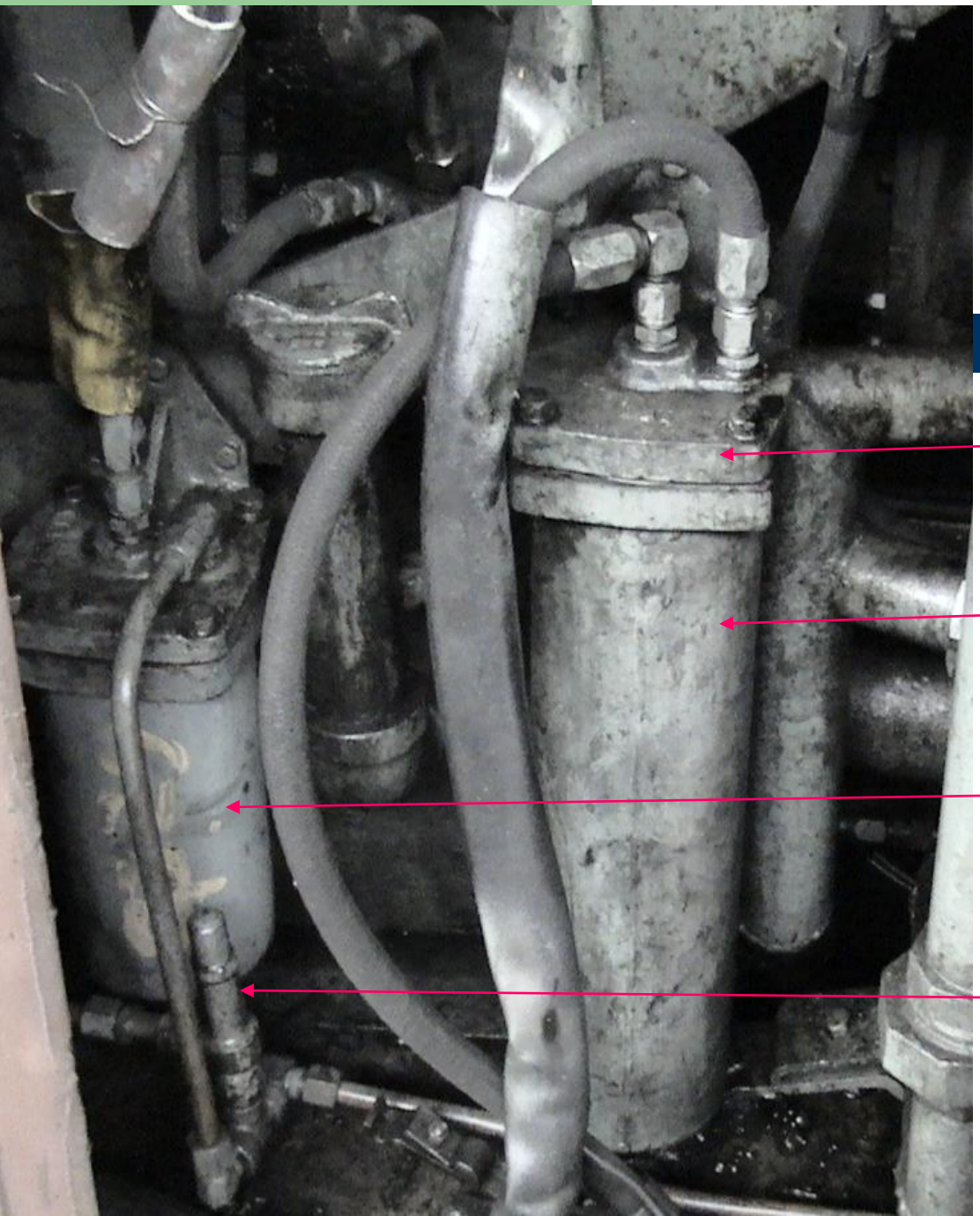

2250
2000
1750
HSD Tank
HSD Level in glow rod
Number Plate

Baffle walls are there inside it to arrest surge of oil when the locomotive is moving.

- A strainer filter at the filling plug, an indirect vent, drain plug and glo-rod type level indicators are also provided.

PRIMARY FILTER

- A filter is provided on the suction side of the fuel transfer pump to allow only filtered oil getting into the pump. This is intended to enhance the life of the Fuel transfer pump.

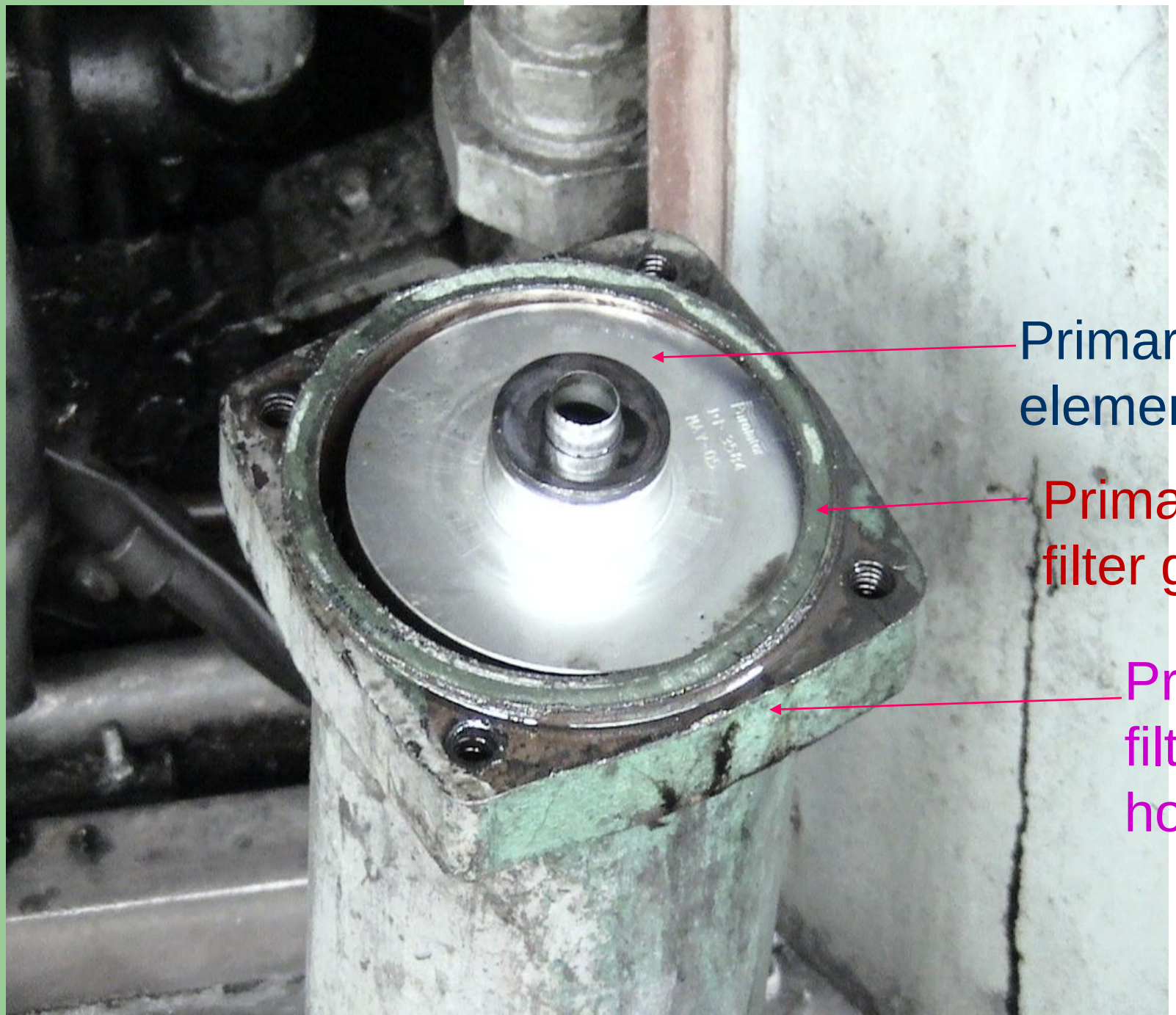


Primary filter Bracket

Primary Filter Housing

Secondary filter housing

Fuel oil relief valve


Primary filter element
Primary filter gasket
Primary filter housing

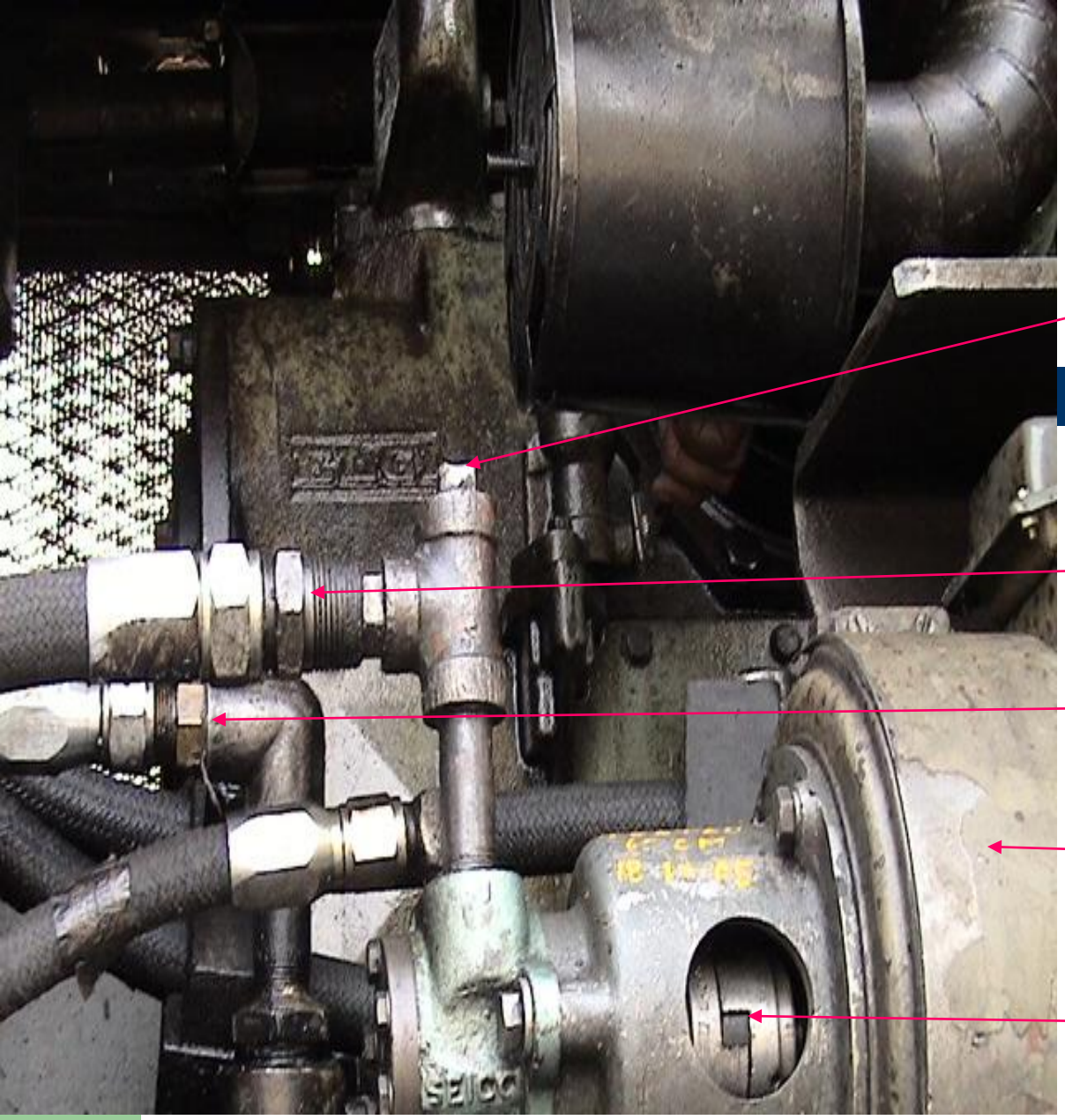

Gasket
Top face
Primary filter housing

primary filter element

- filter is paper type filter and have greater ability to absorb moisture and longer service life.

FUEL TRANSFER PUMP / BOOSTER PUMP

- The fuel oil feed system has a transfer pump or booster pump to lift the fuel from the tank below to the system. The gear type pump used is driven by a D.C. motor with current available from the storage batteries through a suitable circuit. The pump capacity is 14 ltrs. per minute at 1725 rpm at pressure 4 to 4.8 kg/cm. sq.



Dummy for vac. checking

Suction Pipe

Delivery Pipe

Fuel oil Booster Motor

Coupler

FUEL RELIEF VALVE

- The spring loaded relief valve is meant for by-passing excess oil back to the fuel tank, thus releasing excess load on the pump and the motor to ensure their safety. It is adjusted to a pressure of 6.0-kg/cm. sq. and by-passes the excess fuel back to the tank. It also ensures the safety of the secondary filter and the pipe lines.

FUEL SECONDARY FILTER

- The fuel secondary filter is located after the booster pump in the fuel feed system. The filter used is a paper type filter cartridge of finer quality, renewable at regular intervals. This filter arrests the finer dirt particles left over by the primary filter and ensure longer life of the fuel injection equipments.

FUEL REGULATING VALVE

- The fuel-regulating valve is a spring-loaded valve of similar design like the fuel relief valve but located after the secondary filter in the fuel feed system.

- This valve is adjusted to 4.0-kg/cm. sq. pressure and always maintains the same pressure in the fuel feed system by releasing the excess pressure, if any, back to the fuel oil tank. There is no by-passing of oil if the pressure is less than the adjusted level.

FUNCTIONING OF FUEL FEED SYSTEM

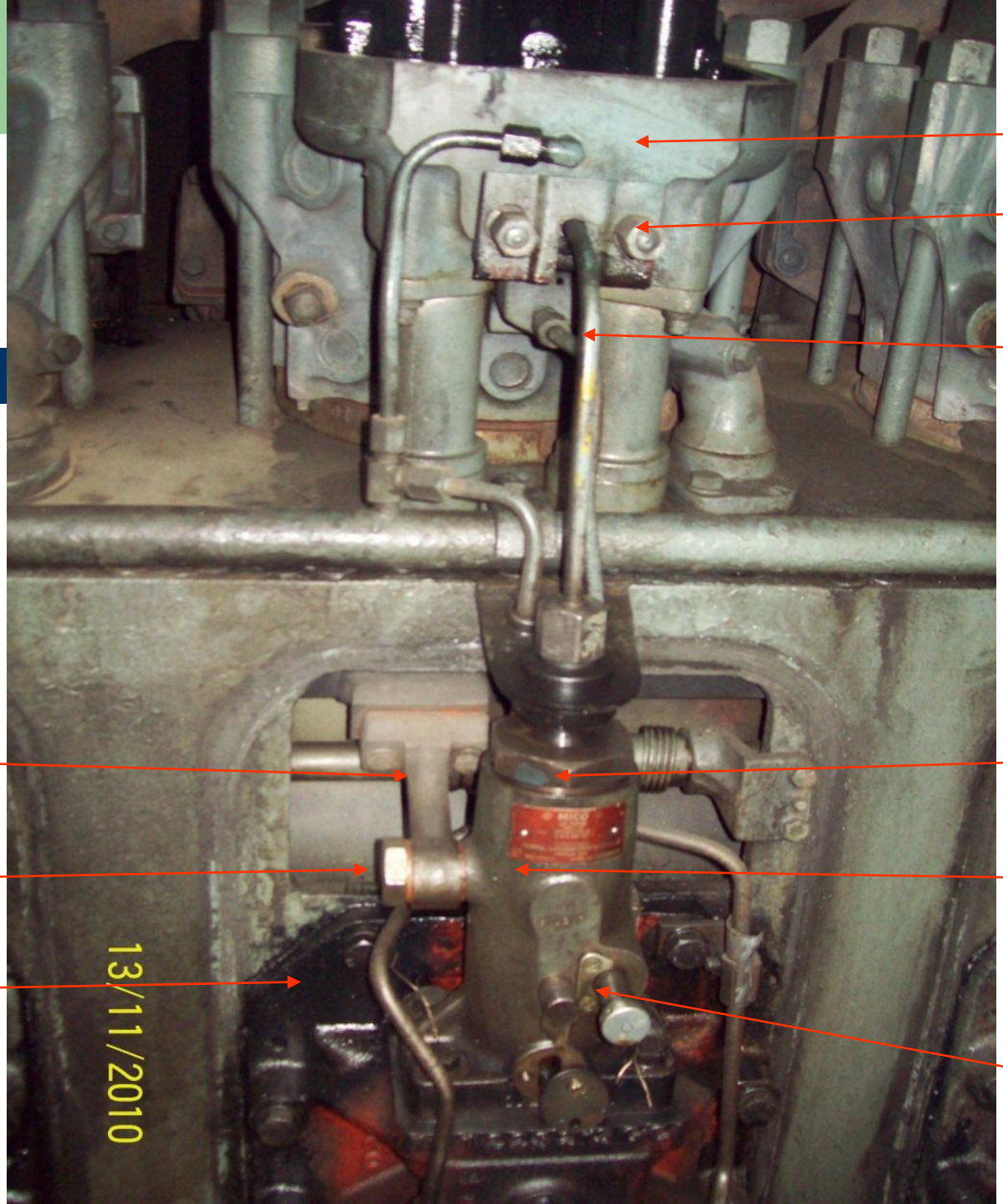
- The fuel booster pump or transfer pump is switched on and the pump starts sucking oil from the fuel oil tank, filtered through the primary filter. Because of variable consumption by the engine, the delivery pressure of the pump may rise increasing load on the pump and its drive motor.

- When the rate of consumption of fuel by the engine is low,

- the relief valve ensures the safety of the components by releasing load, by-passing the excess pressure back to the tank. Then oil passes through the paper type secondary filter and proceeds to the left side fuel header.

- The fuel header is connected to eight numbers of fuel injection pumps on the right bank of the engine,

- and a steady oil supply is maintained to the pumps at a pressure of 4.0-kg/cm. Sq. Then the fuel oil passes on to the left side header and reaches the eight fuel injection pumps on the left bank through fuel jumper pipes.



Cylinder head

H.P. tube holding stud

High pressure tube

H.P. tube holding nut

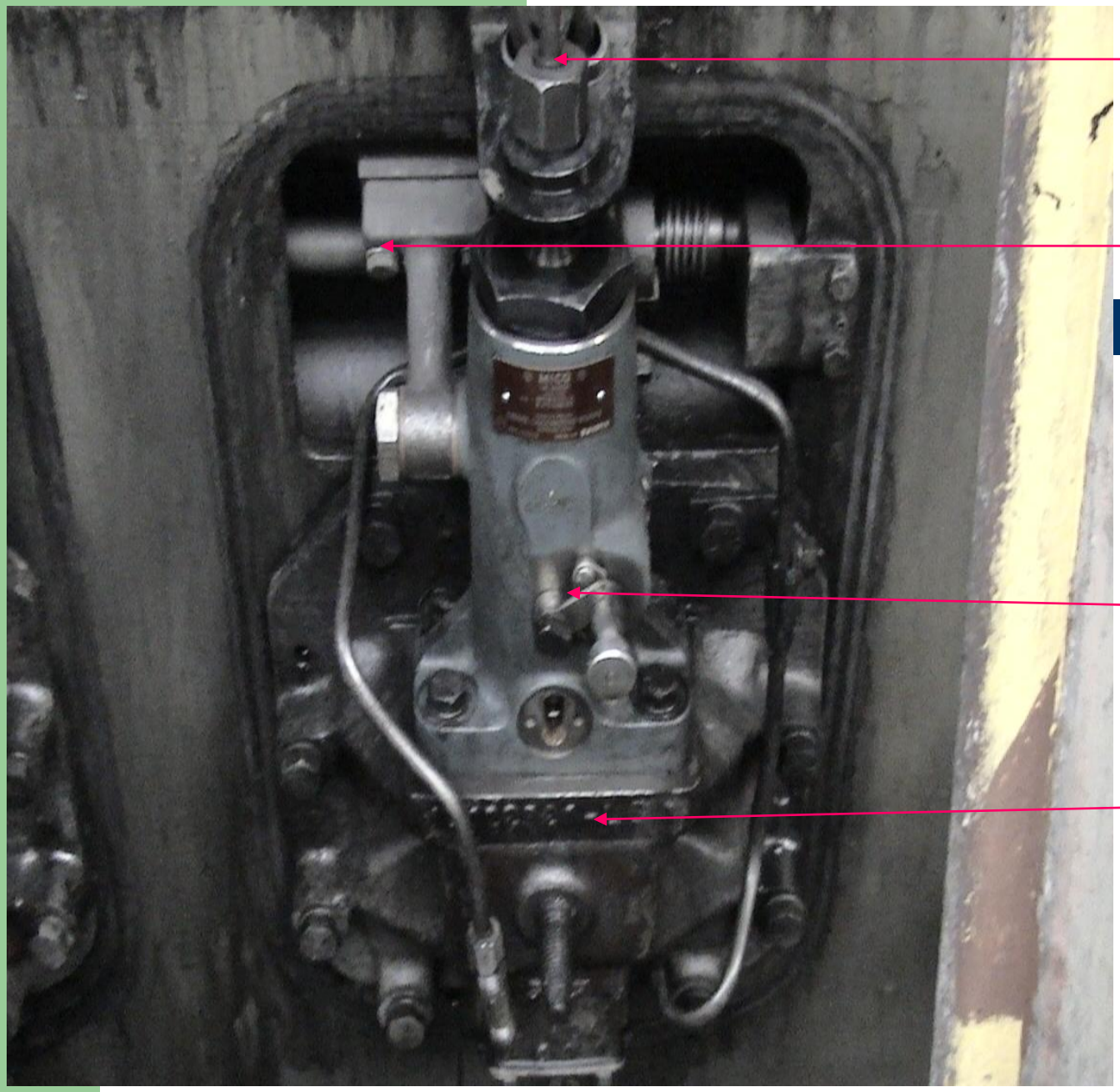
Fuel injection pump

Fuel rack

Fuel jumper

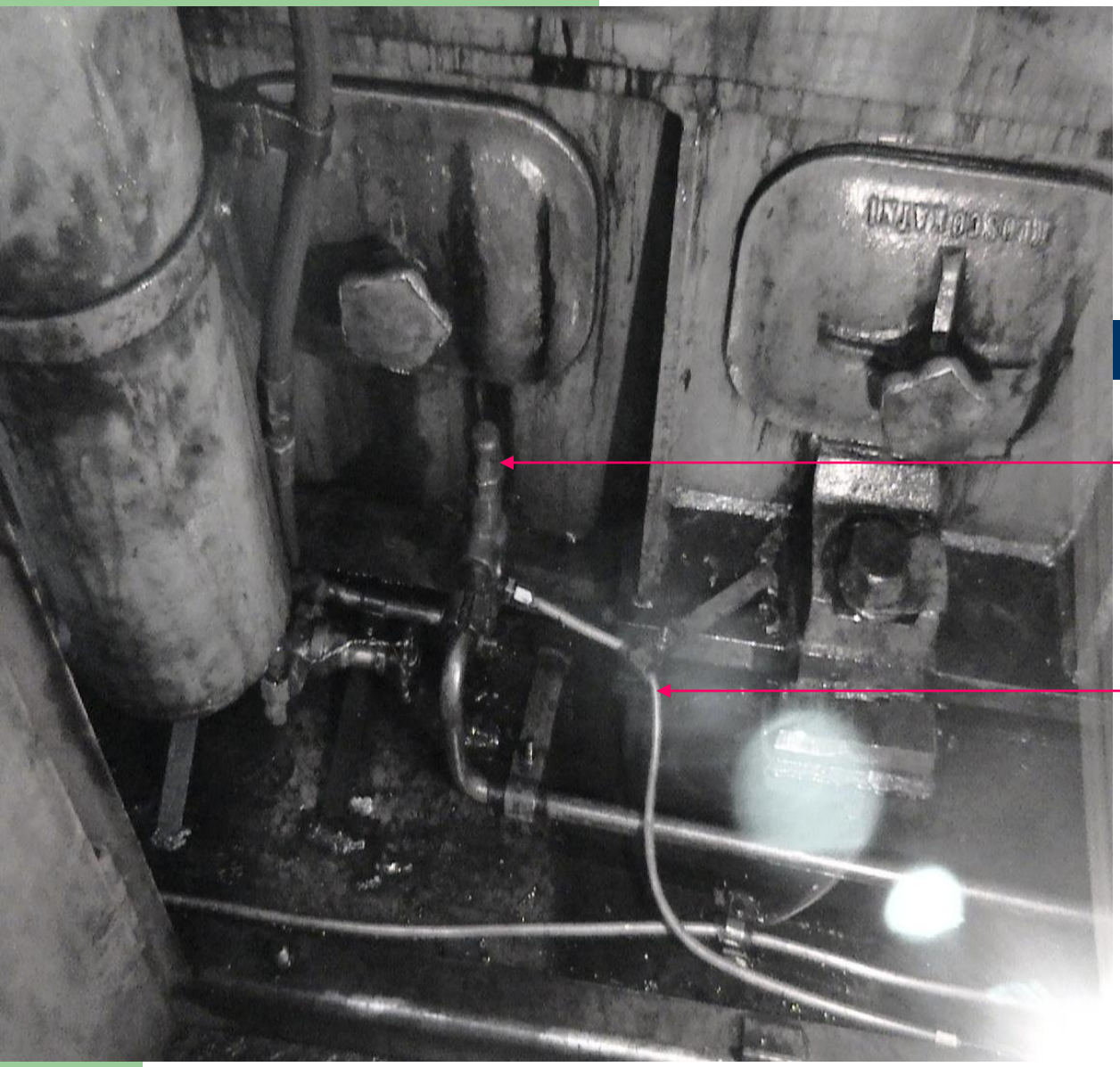
Benzo bolt

Fuel injection pump support


High pressure line nut
Fuel jumper bolt
Locked rack bar
FIP support

FUEL
HEADER
PIPE

- The regulating valve remaining after the left side fuel header, takes care of excess pressure over 4.0 kg/cm. sq
- by-passing the extra oil back to the tank. A gauge connection is taken from here leading to the driver's cabin for indicating the fuel oil feed pressure. Thus the fuel feed system keeps fuel continuously available to the fuel injection pumps, which the pumps may use or refuse depending on the demand of the engine.



Fuel regulating valve

Fuel return pipe

BAP gauge

Lube oil pr. gauge

Fuel oil pr. gauge

FUEL OIL SYSTEM

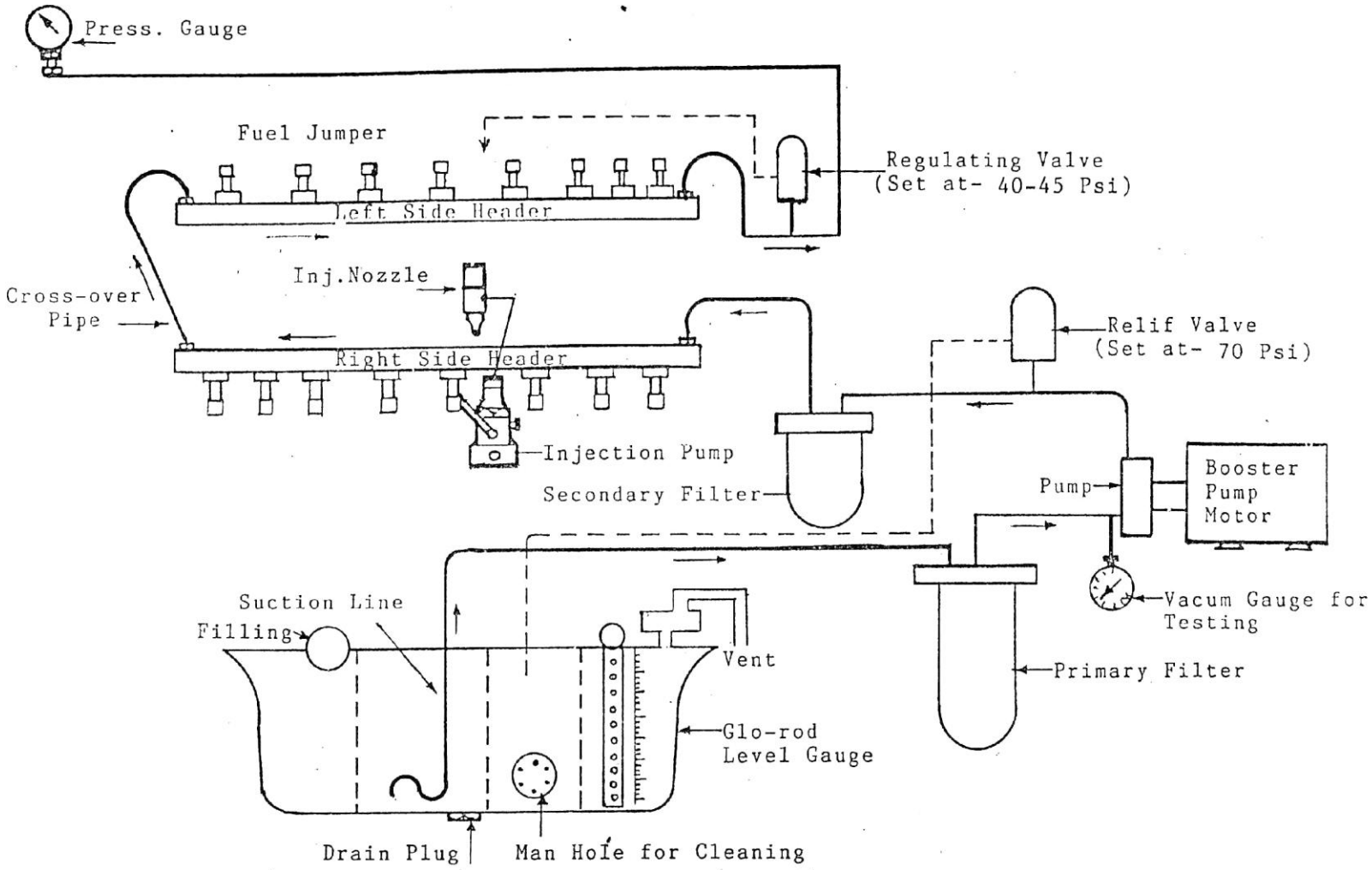


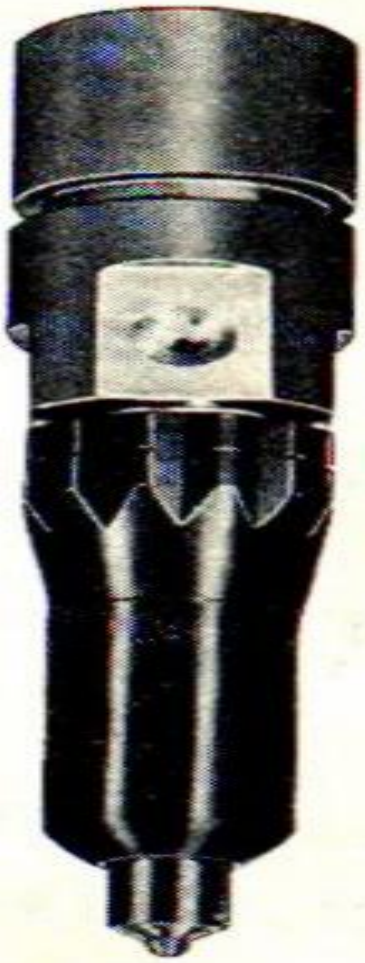
FIG. FOS-1

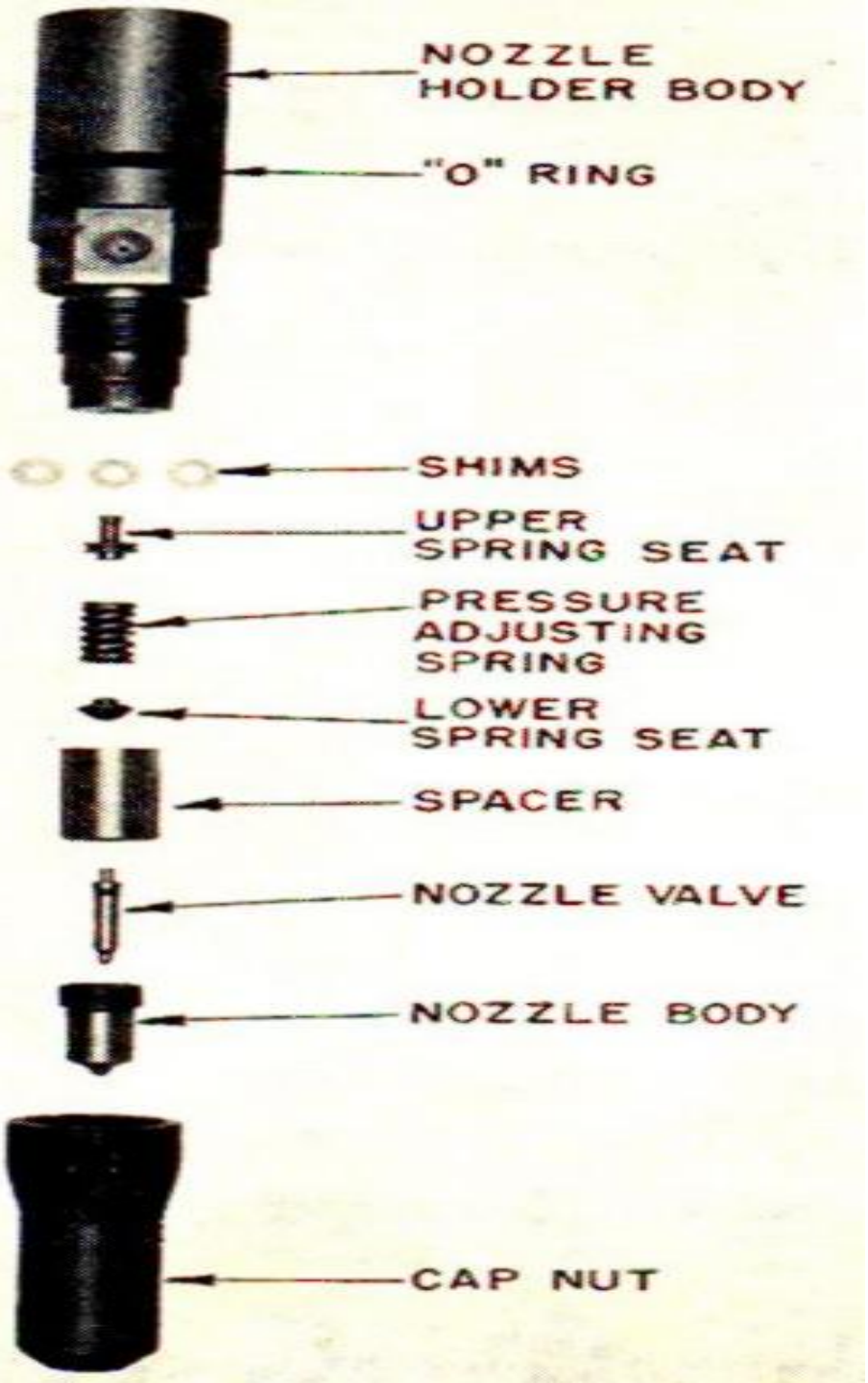
Fuel Injection

- To inject fuel at a sufficiently high pressure so that the fuel enters the cylinder with a high velocity.
- Fuel injection nozzle injects fuel oil to combustion chamber at 3600-4050psi

F/INJECTOR-Major Parts

- Nozzle body
- Nozzle Valve
- Spacer
- Pressure adjusting spring
- Nozzle holder body.
- Cap nut




NOZZLE HOLDER BODY
"O" RING
SHIMS
UPPER SPRING SEAT
PRESSURE ADJUSTING SPRING
LOWER SPRING SEAT
SPACER
NOZZLE VALVE
NOZZLE BODY
CAP NUT

Testing of F/INJECTOR

- The following tests are conducted on a specially designed machine-
  - Spray pressure (3900-4050 PSI for new & 3600-3800 PSI for reconditioned nozzle)
  - Spray pattern(9,by taking impression on blotting paper)
  - Dribbling (at 3500PSI for 10 sec)
  - Nozzle chatter
  - Nozzle leak off rate(3500PSI to 1000PSI in 9 to 19sec)

FUEL INJECTION NOZZLE INSPECTION AND MAINTENANCE

The criteria for good nozzle is good atomization, correct spray pattern and no

leakage or dribbling. Before a nozzle is put to test the assembly must be rinsed in fuel oil, nozzle holes cleaned with wire brush and spray holes cleaned with steel wire of correct thickness.

SPRAY PATTERN

Spray of fuel should take place through all the holes uniformly and properly atomised. While the atomization can be seen through the glass jar, an impression taken on a sheet of blotting paper at a distance of 1 to 1 ½ inch also gives a clear impression of the spray pattern.

SPRAY PRESSURE

The stipulated correct pressure at which the spray should take place 3900-4050 psi for new and 3600-3800 psi for reconditioned nozzles. If the pressure is down to 3600 psi the nozzle needs replacement. The spray pressure is indicated in the gauge provided in the test machine. Shims are being used to increase or decrease the tension of nozzle spring which increases or decreases the spray pressure

DRIBBLING

There should be no loose drops of fuel coming out of the nozzle before or after the injections. In fact the nozzle tip of a good nozzle should always remain dry. The process of checking dribbling during testing is by having injections manually done couple of times quickly and check the nozzle tip whether leaky.

Raising the pressure within 100 psi of set injection pressure and holding it for about 10 seconds may also give a clear idea of the nozzle dribbling, if any.

The reasons of nozzle dribbling are 1) Improper pressure setting 2) Dirt stuck up between the valve and the valve seat 3) Improper contact between the valve and valve seat 4) Valve sticking inside the valve body.

NOZZLE CHATTER

The chattering sound is a sort of cracking noise created due to free movement of the nozzle valve inside the valve body. If the chatter is not proper then chances are that the valve is not moving freely inside the nozzle.

NOZZLE LEAK OFF RATE

A very minute portion of the oil inside the nozzle passes through the clearance between the valve and the valve body for the purpose of lubrication. Excess clearance between them may cause excess leak off, thus reducing the amount of fuel actually injected.

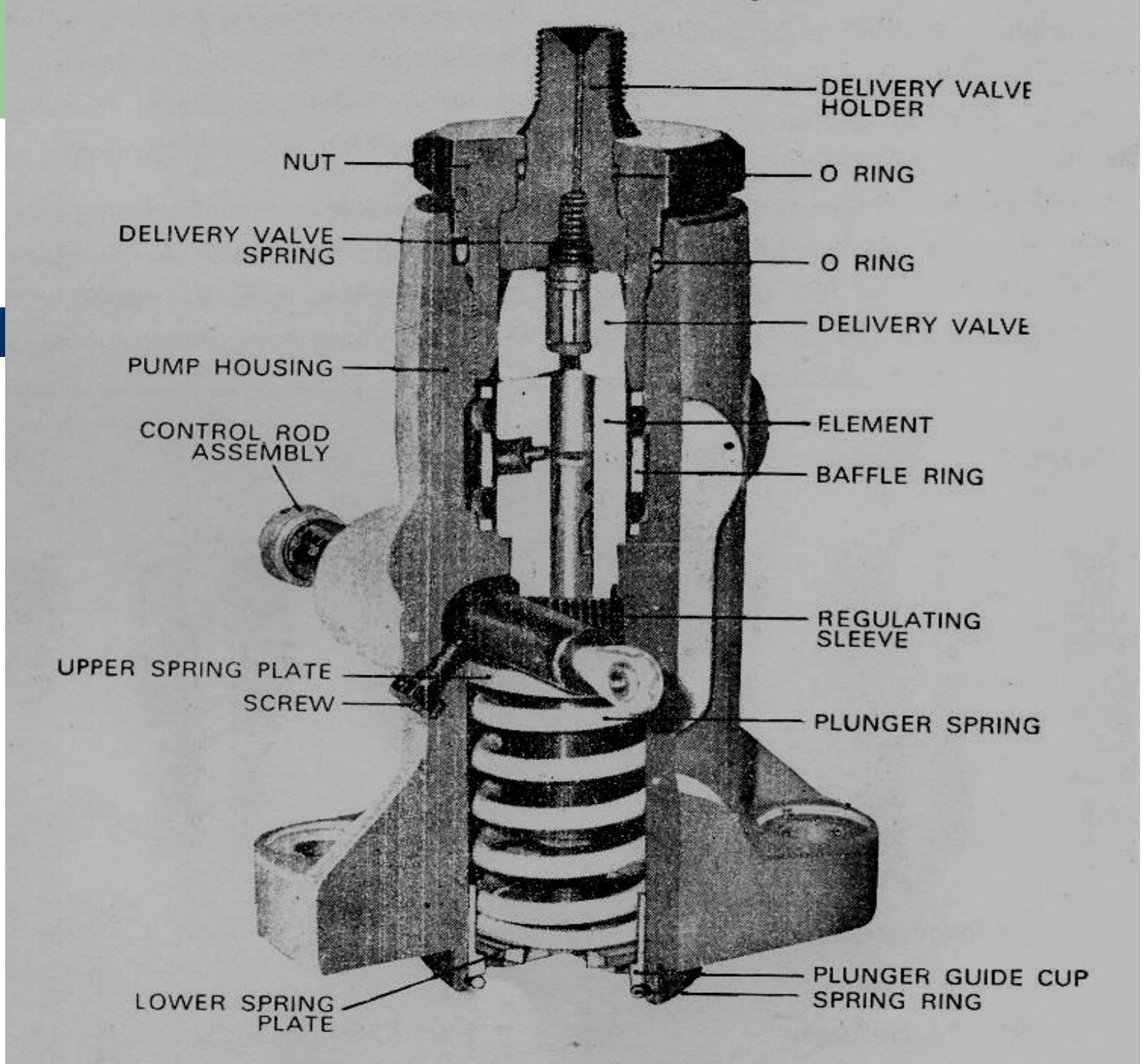
The process of checking the leak off rate is by creating pressure in the nozzle up to 3500 psi and hold the pressure till it drops to 1000 psi. The drop of pressures is due to the leak off and higher the leak off rate the pressure drop is quicker. In the event of the leak off time recorded below stipulation the nozzle valve and the valve body have to be changed for excessive wear and clearance between them.

Fuel Injection Pump

- It is single acting constant stroke plunger type pump.
- Function-
  - Raise the fuel oil pressure to nozzle to atomize the fuel.
  - Supply the correct quantity of fuel to nozzle.
  - Deliver the fuel at accurate time.

FIP-Major Parts

- Control Rack
- Barrel & plunger
- Control sleeve
- Plunger spring
- Guide cup
- Lower spring seat.
- Snubber valve assembly.


DELIVERY VALVE HOLDER
NUT
O RING
DELIVERY VALVE SPRING
O RING
DELIVERY VALVE
PUMP HOUSING
ELEMENT
CONTROL ROD ASSEMBLY
BAFFLE RING
REGULATING SLEEVE
UPPER SPRING PLATE
SCREW
PLUNGER SPRING
PLUNGER GUIDE CUP
SPRING RING
LOWER SPRING PLATE

Calibration of FIP

- Purpose
  - It is done after overhauling to ensure that it delivers the same and stipulated amount of fuel at a particular rack position.
- Process of FIP calibration & testing
  - The oil discharged for 300 stroke of the pump is measured at idle and full load. For WDM2,it is as –
    - 9mm rack position(idle) -34 CC +1/-5
    - 30 mm rack position (Full load) - 351 CC +4/-11

FIP Delievery on 300 stroke

- For 17 mm pump
- 9mm rack- 66 to 84cc
- 30 mm rack- 390 to 420 cc

- For 18 mm pump
- 9mm rack-86 to 104 cc
- 28 mm rack- 462 to 492 cc

Phasing of FIP

- PHASING: Setting of Pump according to Injection Timing.


BOSCH
FIP TESTING MACHINE
(BOSCH)
MACHINE № 050268016
COMMISSIONING. 1.1.86
WORKING.

ORIFICE TEST

- Purpose:
  - This test is conducted to check the efficiency of the fuel feed system under full load condition.
- Process:
  - Fit a orifice plate of 1/8 inch in the system before the regulating V/V.
  - Place a container to collect the leak off oil.
  - Switch on the Fuel booster P/P for 60 sec.
  - The rate of leak should be about 9 ltrs per minute.

1. An orifice plate of 1/8 inch is fitted in the system before the regulating valve.

2. A container to be placed under the orifice to collect the oil that would leak through it during the test.

3. The fuel booster pump to be switched on for 60 seconds.

4. The rate of leakage should be about 9 Lts. of fuel per minute through the orifice (with the engine in stopped condition). The system should be able to maintain 3 KG/cm pressure with this rate of leakage which simulates approx. the full load consumption by the engine. In the event of drop in pressure the rate of leakage would also be less indicating some defect in the system reducing its efficiency to meet the full requirement of fuel during peak load.

FUEL EFFICIENT KIT

- PURPOSE
  - To improve specific fuel consumption by 6%, Reduction in existing exhaust gas temp by 100ºand reduction in lube oil consumption.
  1. Modified water connection to after cooler
  2. 17 mm fuel injection pump
  3. Modified cam shaft with 140 degree over lap
  4. Larger after
  5. Steel cap pistons
  6. High efficiency turbo charger