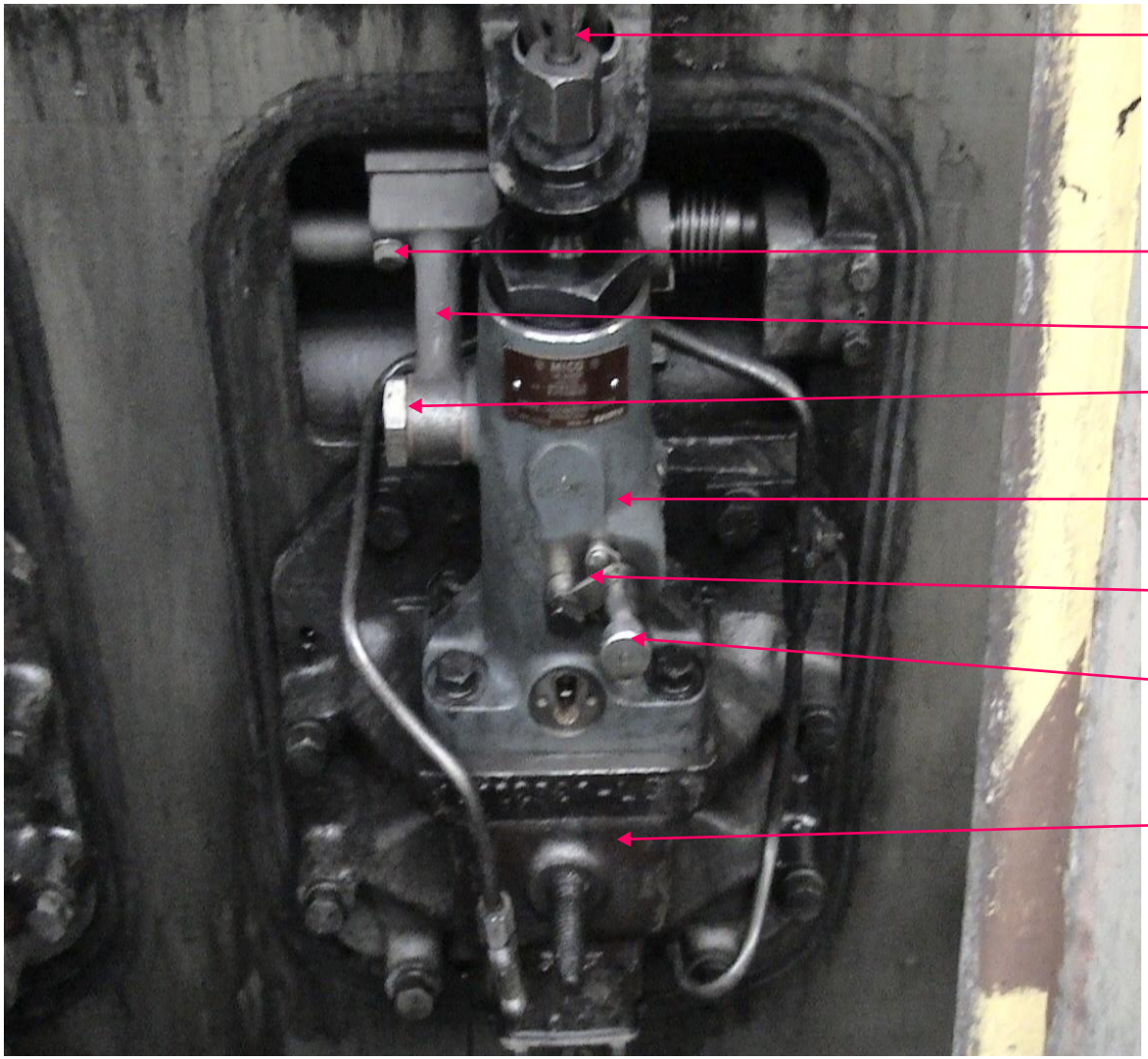
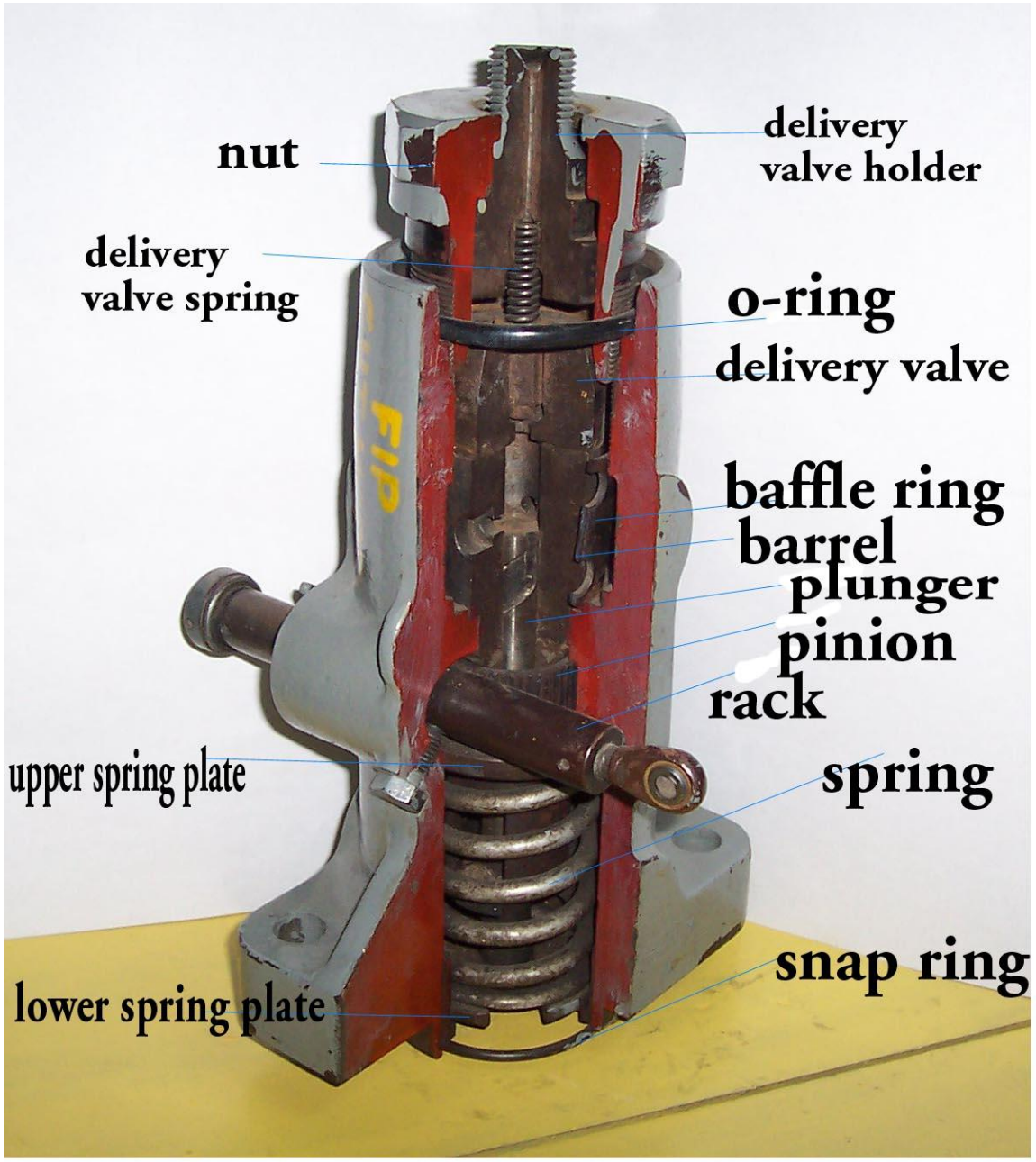
FUEL INJECTION SYSTEM

- FUEL INJECTION PUMP



Above picture showing different parts of fuel injection pump (FIP), H.P. inlet, banzo bolt, rack bar, H.P. tube..

FIP CUT SECTION



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

- The fuel injection pump used is a constant stroke plunger type pump with variable quantity of fuel delivery to suit the demand of the engine. This type of pumps are commonly known as BOSCH type pumps patented by Dr. Bosch of Germany.
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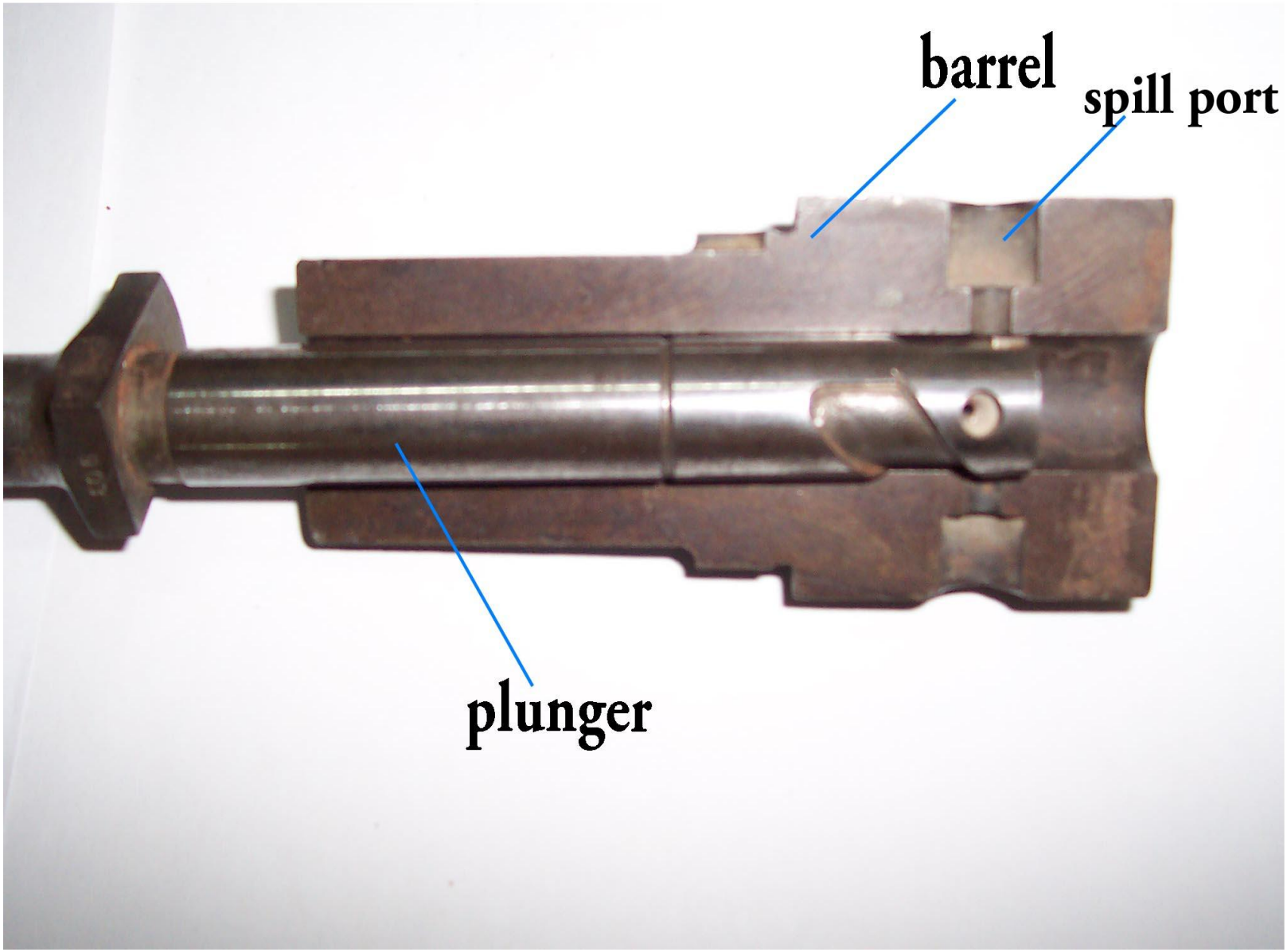
Functions of Fuel Injection Pump

- 1. To raise the fuel oil pressure to a valve which will efficiently atomize the fuel.
- 2. To supply the correct quantity of fuel to the injection nozzle in response to Governor demand.
- 3. To time the delivery of the fuel at a definite point in the engine cycle, and within a limited number of degrees of engine crankshaft rotation.

Main Parts of FIP

- Housing
- Delivery valve and spring
- Delivery valve holding nut
- Control Rack
- Control sleeve
- Guide cup
- Lower spring seat
- Snubber valve assembly.
- Pumping element- Barrel , plunger & Plunger spring.

The pumping stroke of the plunger is controlled by the fuel cam. The length of stroke of the plunger and the time of stroke is dependent on cam profile and cam angle. The return stroke of the plunger is due to the plunger spring.


barrel
spill port
plunger

The plunger moves inside the barrel, which has very close tolerances with the plunger. When the plunger reaches to BDC the spill ports in the barrel which are open to the fuel feed system having oil at 3kg/cm2 pressure available there are open. Oil then rushes to fill up the empty space inside the barrel.

- At the correct time in the diesel cycle the fuel cam pushes the plunger forward and the spill ports are then covered up by the moving plunger. The oil thus trapped into the barrel is forced out through the delivery valve to be injected into the combustion chamber through the injection nozzle.

- The plunger has two identical helical groves or helix cut at the top edge with a relief slot. At the bottom of the plunger there is a lug to fit into the slots of the control sleeve. When the rotation of the engine moves the camshaft and the fuel cam moves the plunger to make the upward stroke. it may also rotate slightly, if necessary, through the engine governor , control shaft, control rack and control sleeve.

- This rotary movement of the plunger along with reciprocating strokes changes the position of the helical relief in respect to the spill port and oil instead of being delivered through the pump outlet escapes back to the low pressure feed system. The governor for engine speed control, sensing the requirement of the fuel controls the rotary motion of the plunger, while it is also having reciprocating pumping strokes.

PLUNGER & SLEEVE

NO FUEL POSITION

- Thus alignment of helix relief with the spill ports sooner or later will make the stroke more or less effective.
- The helix constantly remaining in alignment with the spill ports by-passes the entire amount of oil and nothing is being delivered by the pump. The engine stops because of no fuel injection and this is known as NO FUEL POSITION.

FULL FUEL POSITION

- When alignment of helix relief with spill port is delayed, that would mean partly effective stroke and engine runs at low speed and power output is partial. When helix is not in alignment with the spill port throughout the stroke, that is FULL FUEL POSITION, because the entire length of the stroke is effective and engine out put and speed is at the peak.

- The position of the plunger and its relation between spill port and helix is determined by the position of the control rack graduated in mm. Linear movement of the fuel rack by the governor and the movement of the control shaft has relative rotary movement of the plunger, thereby aligning the helix and the spill port sooner or later making the stroke fully effective, partly effective or fully ineffective.

- The oil then pass through the delivery valve. The delivery valve is a spring loaded valve which opens at the oil pressure developed by the pump plunger. This helps increase the delivery pressure of oil, function as a non-return valve, retaining oil in the high pressure line. This also helps in snap termination of fuel injection to arrest the tendency of dribbling during fuel injection.

Eliminates the possibility of secondary injection

- As the Plunger helix uncovers the barrel ports, there is a sudden pressure drop below the delivery valve and the valve closes.
- As the valve snaps into its seat, the volume available for the fuel is increased and the pressure is reduced in the injection tubing below the closing pressure of the nozzle.
- This action of the valve eliminates the possibility of secondary injection at the nozzle.

The delivery valve also acts as a check valve to prevent cylinder gas from blowing back into the pump if a nozzle valve is stuck open.

- A snubber valve, located in the high pressure line pump nut, is used to dampen pulsations in the high pressure injection line.

Phasing of FIP

- PHASING: Setting of Pump according to Injection Timing.

SETTING OF FIP

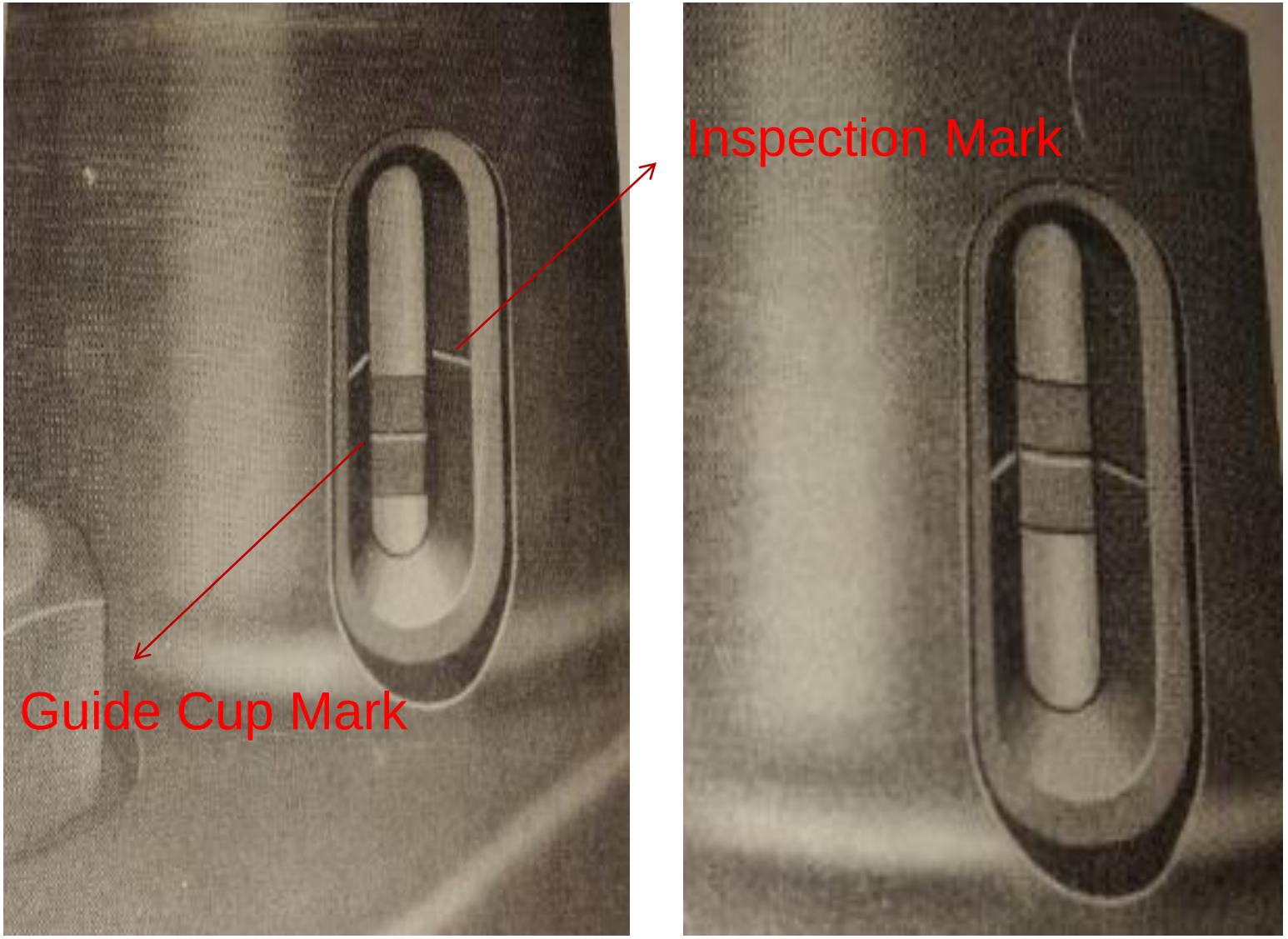
- PHASING: Setting of Pump according to Injection Timing

- CALIBRATION: Calibrating delivery of the pump according to Rack Position

calibrating machine at 300 rpm and 300 stroke

9mm = 45 ml

28 mm= 401 ml


Inspection Mark
Guide Cup Mark

TIMING SETTING