Unit 3
Fuel supply system for petrol and diesel engine

AUTOMOBILE ENGINEERING

pics covered ;

Fuel Supply System

MPFI

Diesel Fuel System

CRDI

Presented By - **Arsalan Hassan**

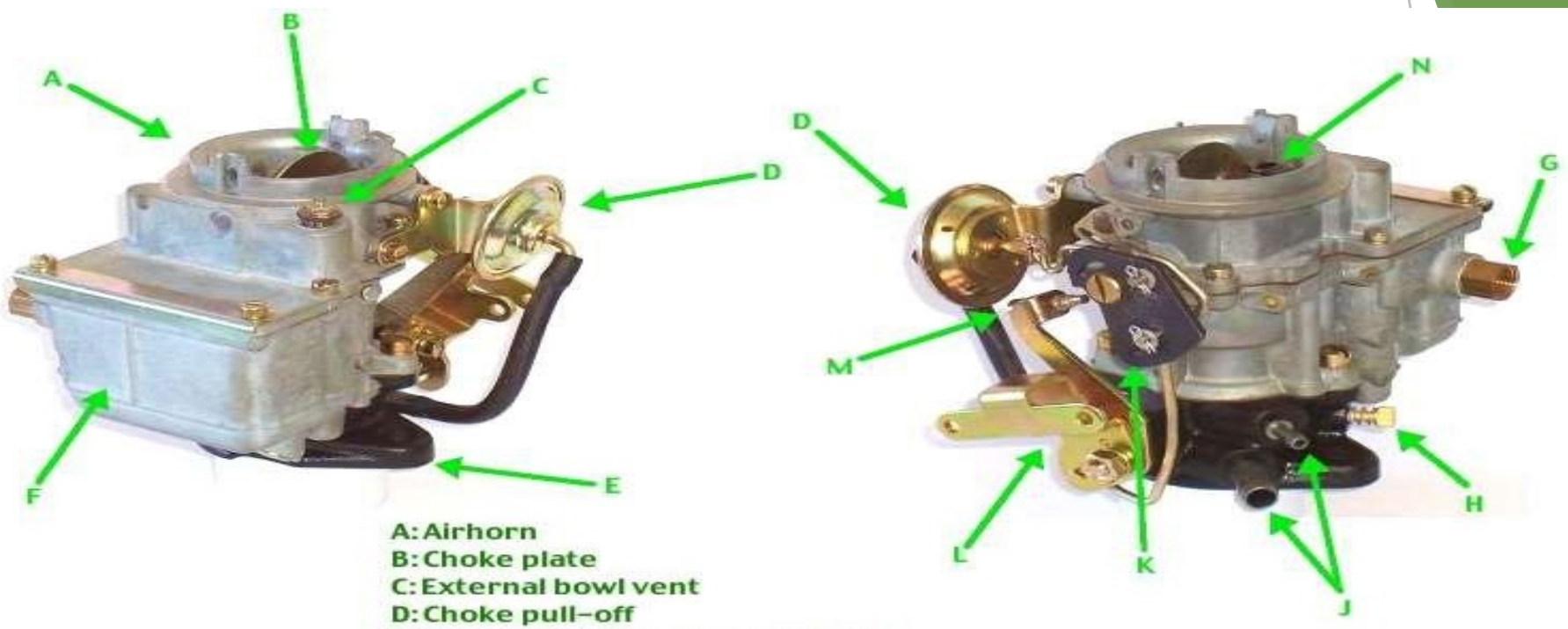
CARBURETION

The process of formation of combustible fuel-air mixture by mixing the proper amount of fuel with air before admission to the engine cylinder is called carburetion and the device which does this job is called carburetor.

Spark ignition engines normally use volatile liquid fuels. Preparation of fuel-air mixture is done outside the engine cylinder and formation of a homogenous mixture is normally not completed in the inlet manifold. Fuel droplets which remain in suspension continue to evaporate and mix with air even during suction and compression processes. The process of mixture preparation is extremely important for spark-ignition engines. The purpose of carburetion is to provide a combustible mixture of fuel and air in the required quantity and quality for efficient operation of the engines under all conditions.

Factors affecting carburetion

- Engine Speed
- Vaporization Characteristics of the Fuel
- Temperature of Incoming Air
- Design of the Carburetor
- Time available of the mixture preparation



A: Airhorn
B: Choke plate
C: External bowl vent
D: Choke pull-off
E: Throttle body & mounting base
F: Float bowl
G: Fuel inlet
H: Idle mixture adjusting screw
J: Vacuum nipples
K: Fast-idle cam
L: Throttle lever
M: Idle speed adjusting crackscrew
N: Internal bowl vent

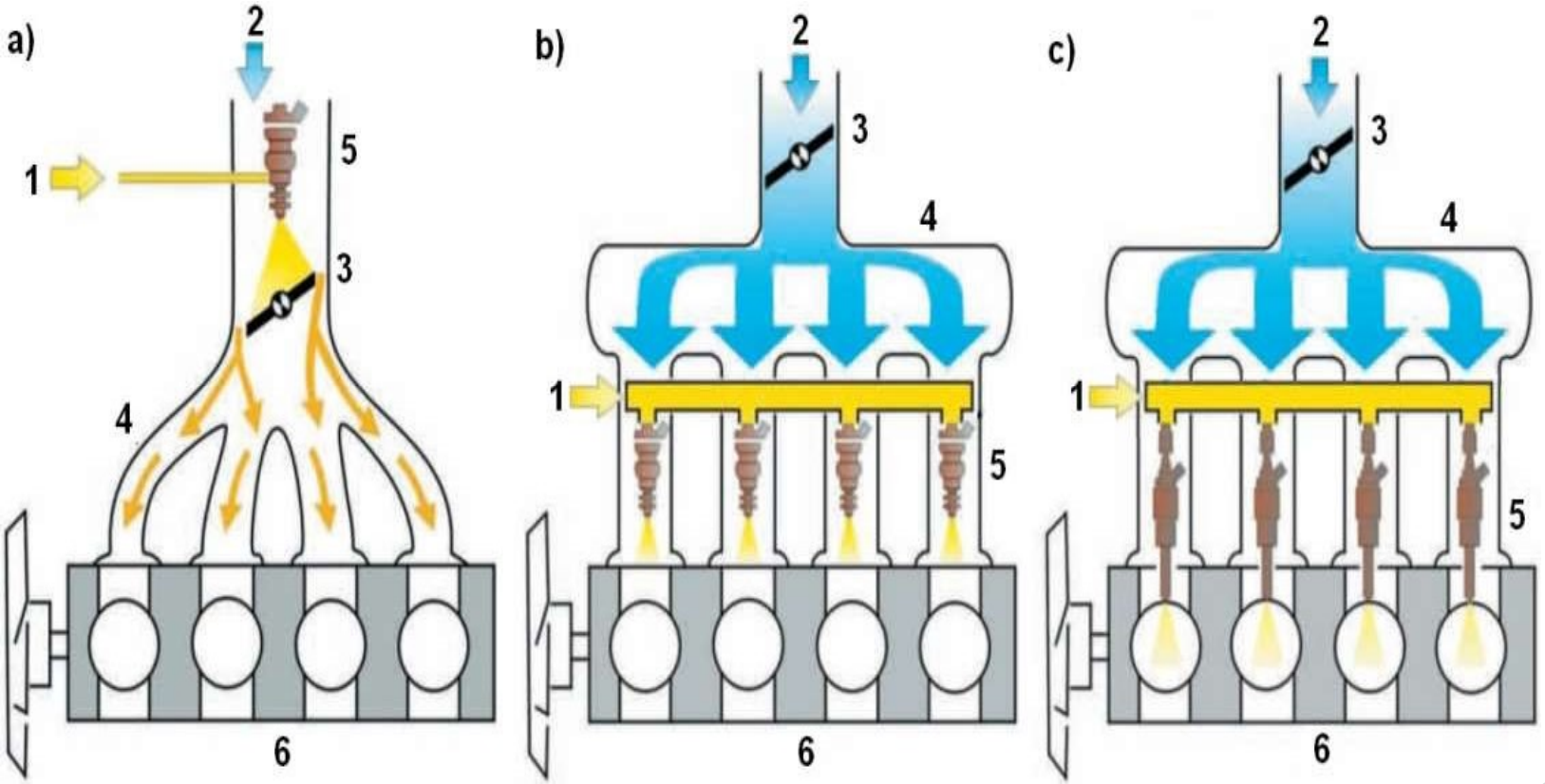
Multi Point Fuel Injection (MPFI)

MPFI System is a system which uses a small computer (yes, a small computer without keyboard or mouse, it's more like a microchip) to control the Car's Engine. A Petrol car's engine usually has three or more cylinders or fuel burning zones. So in case of an MPFI engine, there is one fuel –injector installed near each cylinder that is why they call it Multi-point (more than one points) Fuel Injection.

MPFI emerged an intelligent way to do what the Carburetor does. In MPFI system, each cylinder has one injector (which makes it multi-point). Each of these Injectors is controlled by one central car computer. This computer is a small micro-processor, which keeps telling each Injector about how much petrol and at what time it needs to inject near the cylinder so that only the required amount of petrol goes into the cylinder at the right moment.

The working of MPFI is similar to Carburetor, but in an improved way, because now each cylinder is treated independently unlike Carburetor. But one major Key difference is that MPFI is an intelligent system and Carburetor is not.

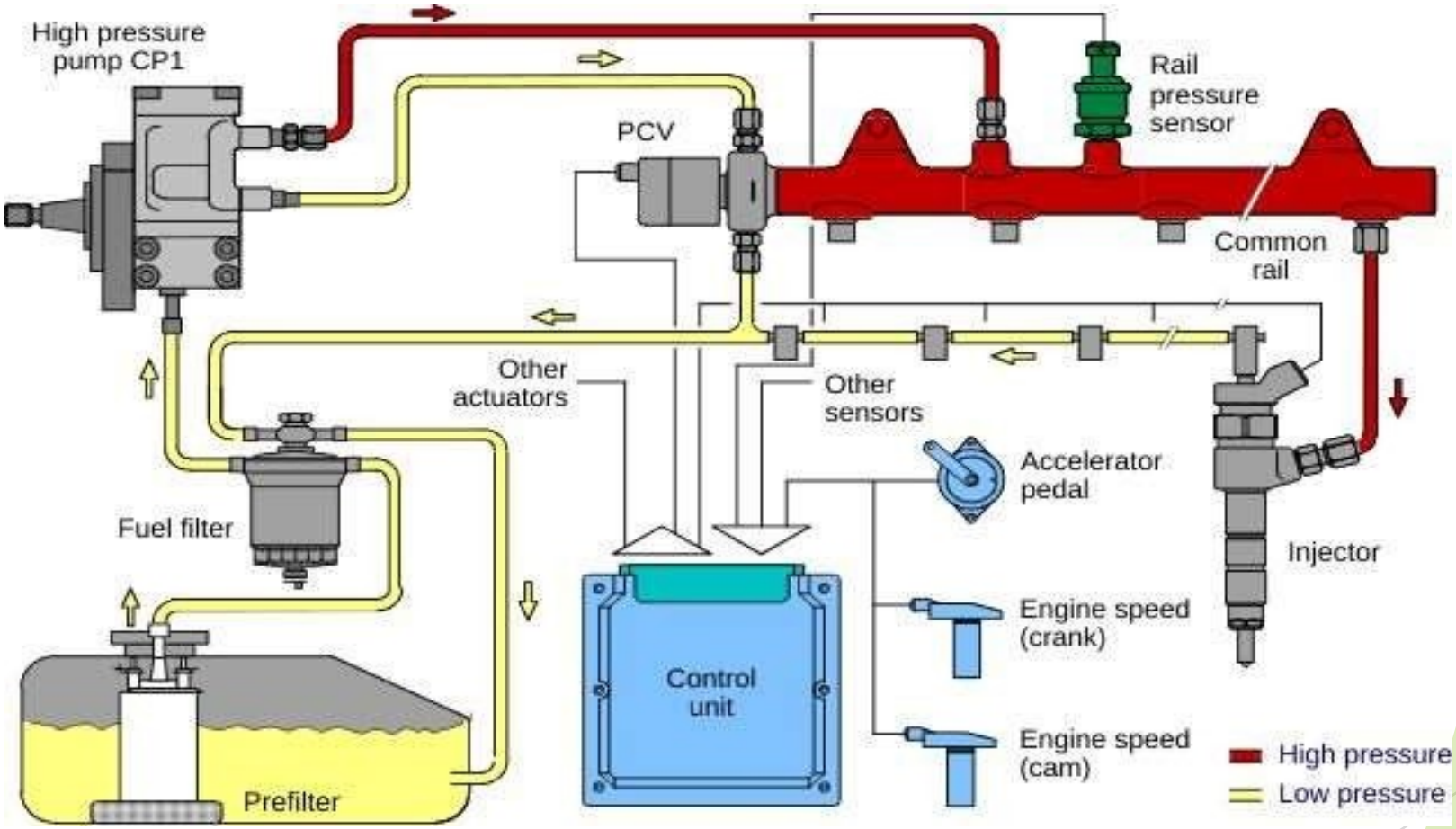
Based on all these inputs from the sensors, the computer in the MPFI system decides what amount of fuel to inject. Thus it makes it fuel efficient as it knows what amount of petrol should go in


a)
2
1
5
3
4
6
b)
2
3
4
1
5
6
c)
2
3
4
1
5
6

DIESEL FUEL SYSTEM

The function of the diesel fuel system is to inject a precise amount of atomized and pressurized fuel into each engine cylinder at the proper time. Combustion in a diesel engine occurs when this rush of fuel is mixed with hot compressed air. (No electrical spark is used as in a gasoline engine.)

A diesel fuel system is a critical component of any diesel engine and its optimum operation is essential for peak performance.

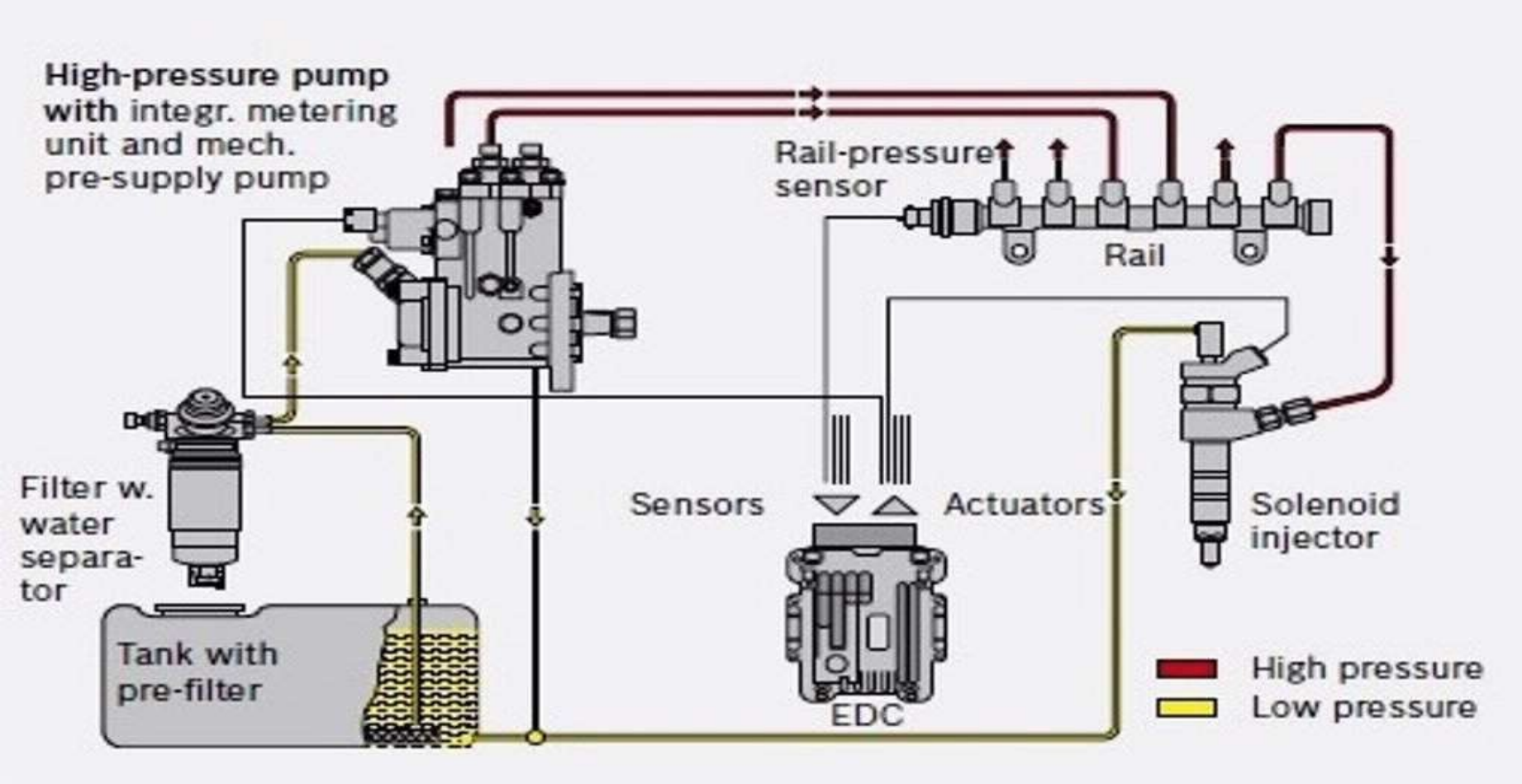

High pressure pump CP1
PCV
Rail pressure sensor
Common rail
Other actuators
Other sensors
Accelerator pedal
Fuel filter
Injector
Control unit
Engine speed (crank)
Engine speed (cam)
Prefilter
High pressure
Low pressure

Common Rail Direct Injection (CRDI)

Common rail direct fuel injection is a modern variant of direct fuel injection system for petrol and engines. On diesel engines, it features a high-pressure (over 1,000 bar or 15,000 psi) fuel rail feeding individual solenoid valves, as opposed to low-pressure fuel pump feeding unit injectors.

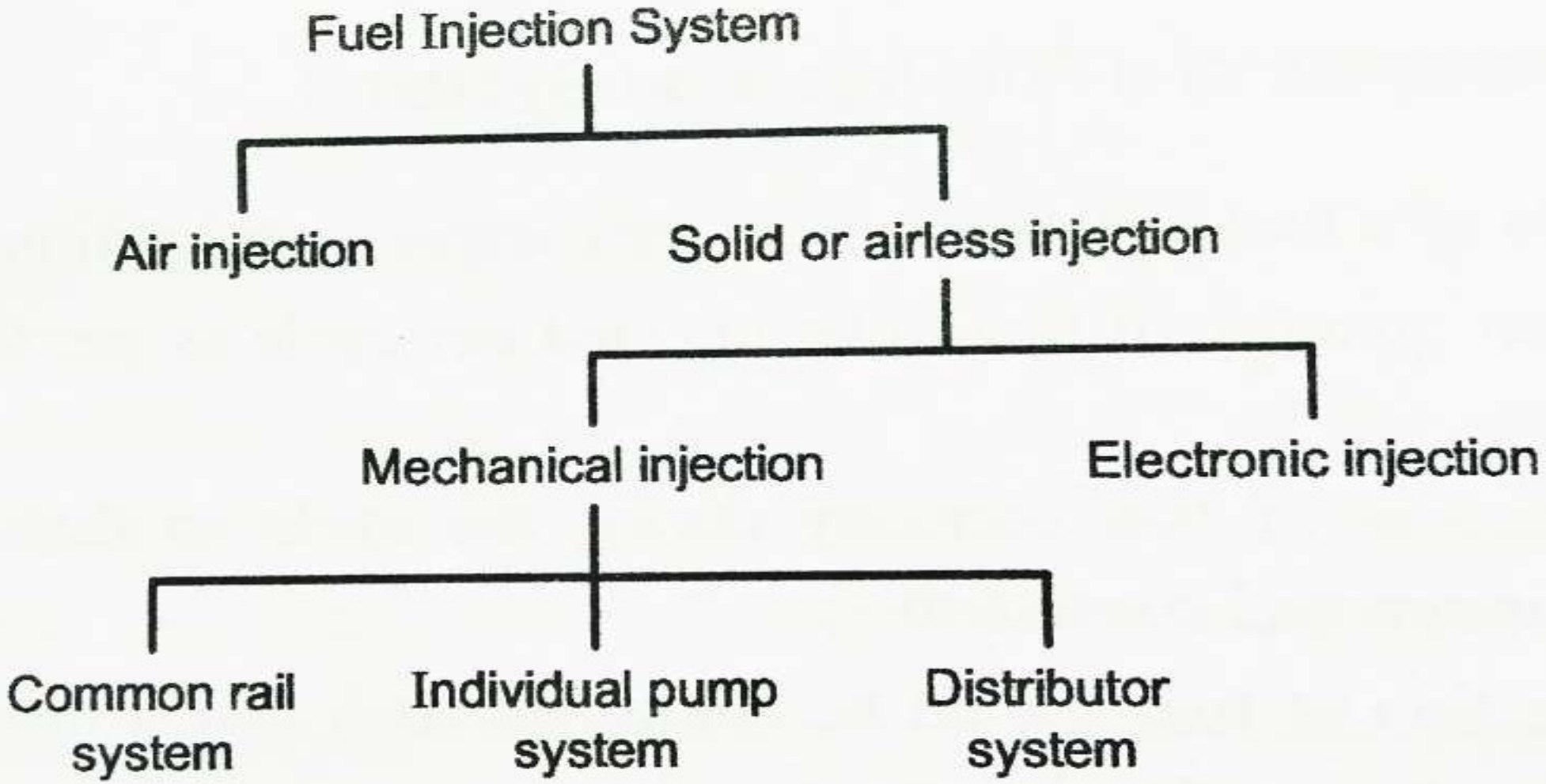
Third-generation common rail diesels now feature piezoelectric injectors for increased precision, with fuel pressures up to 2,000 bars or 29,000 psi. In gasoline engines, it is used in gasoline direct injection engine technology.

Solenoid or piezoelectric valves make possible fine electronic control over the fuel injection time and quantity, and the higher pressure that the common rail technology makes available provides better fuel atomisation. In order to lower engine noise, the engine's electronic control unit can inject a small amount of diesel just before the main injection event ("pilot" injection), thus reducing its explosiveness and vibration, as well as optimizing injection timing and quantity for variations in fuel quality, cold starting and so on. Some advanced common rail fuel systems perform as many as five injections per stroke.


High-pressure pump with integr. metering unit and mech. pre-supply pump
Rail-pressure sensor
Rail
Filter w. water separa-tor
Sensors
Actuators
Solenoid injector
Tank with pre-filter
EDC
High pressure
Low pressure

Fuel injection system for diesel engine

:



Air Injection System

e fuel is injected by means of high pressure air at about 70 bar into the combustion chamber.

compressor to supply compressed air & the fuel pump to draw the desired fuel from fuel tank both to be suppl

r.

ntages

des good atomization of fuel.

viscous fuel can be used .

vantages

ompressor needs extra maintenance.

m is bulky and expensive.

Solid or Airless Injection System

fuel is directly injected into the cylinder without the aid of compressed air.

uel does not vaporize at ordinary temperatures & also the fuel supplied needs to be & mix with air, it requires high injection pressure over 70 bar.

of solid Fuel Injection System

hanical Injection

tronic Injection

nical Injection is further classified as:

on rail direct injection (CRDI) system

dual pump system

outor system

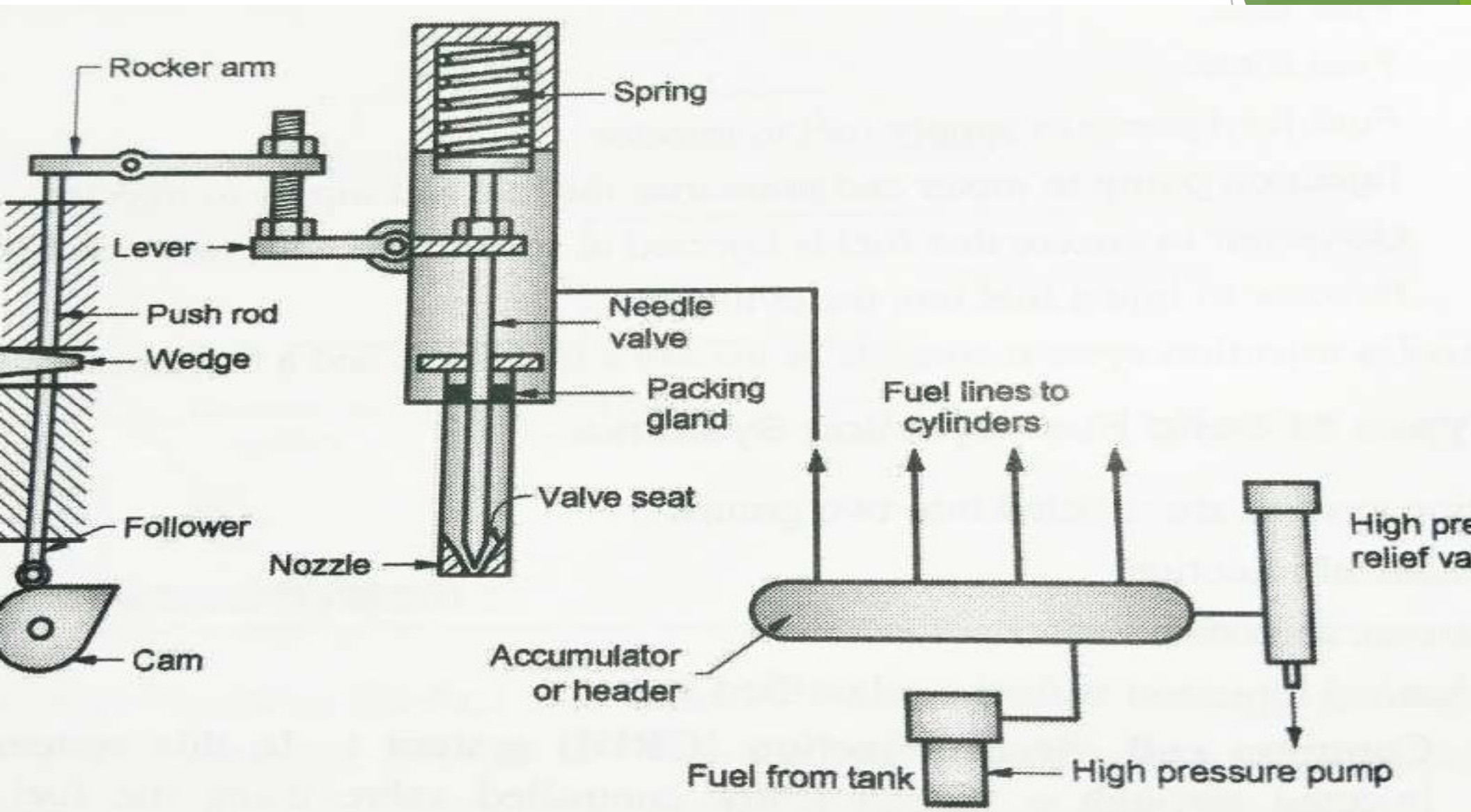


Fig. 4.31.1 : Common rail system

tages

system is simple & easy to maintenance.

n control fuel supply as per load & speed of engine.

s only one pump needed for a multi-cylinder engine.

vantages

m needs accurate design .

is a chance of developing leakage at the valve seat.

ion pressure used are in range of 200 – 300 bar pressure.

Individual Pump System

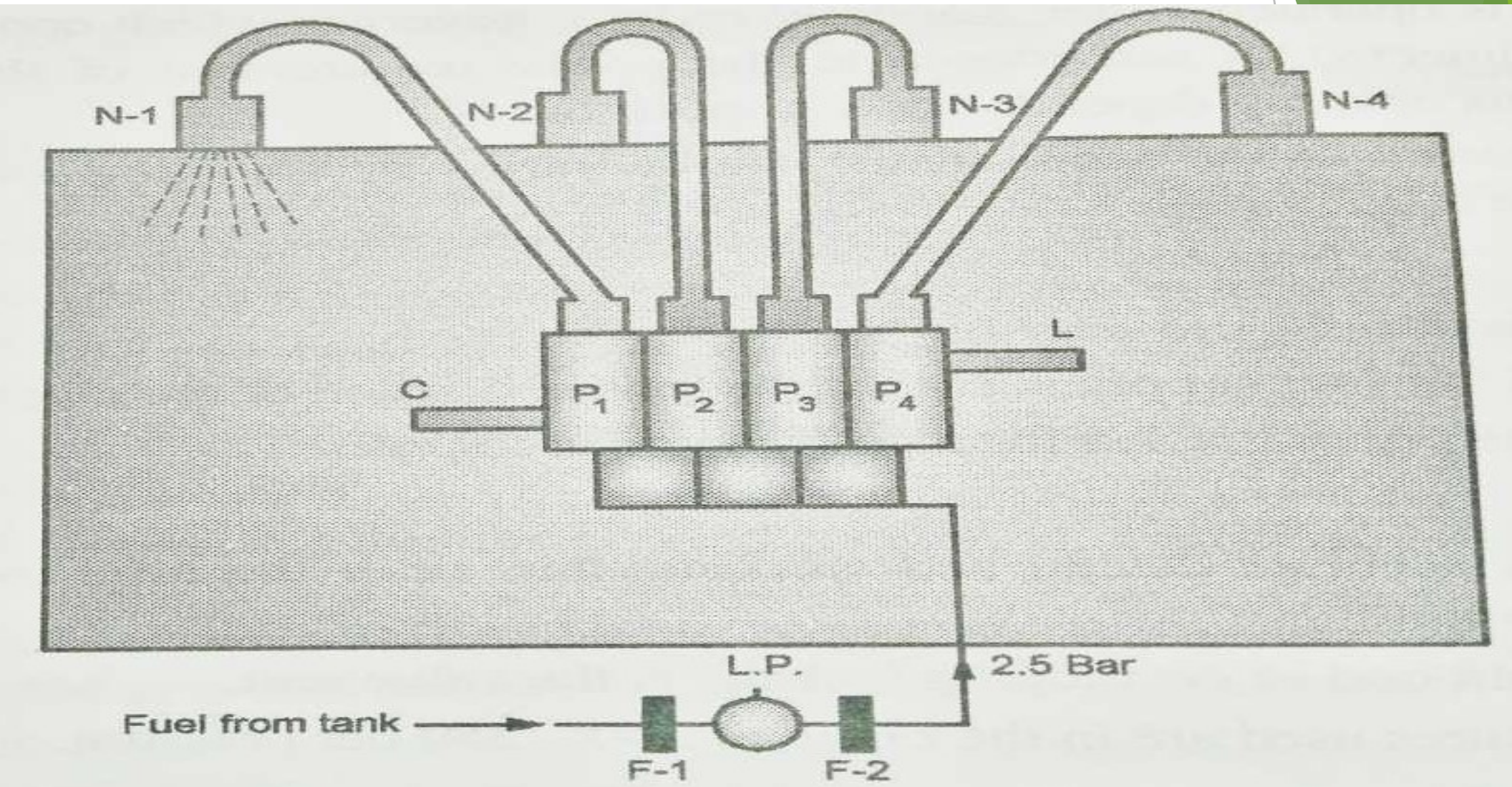


Fig. 4.31.2 : Individual pump system

Distributor System

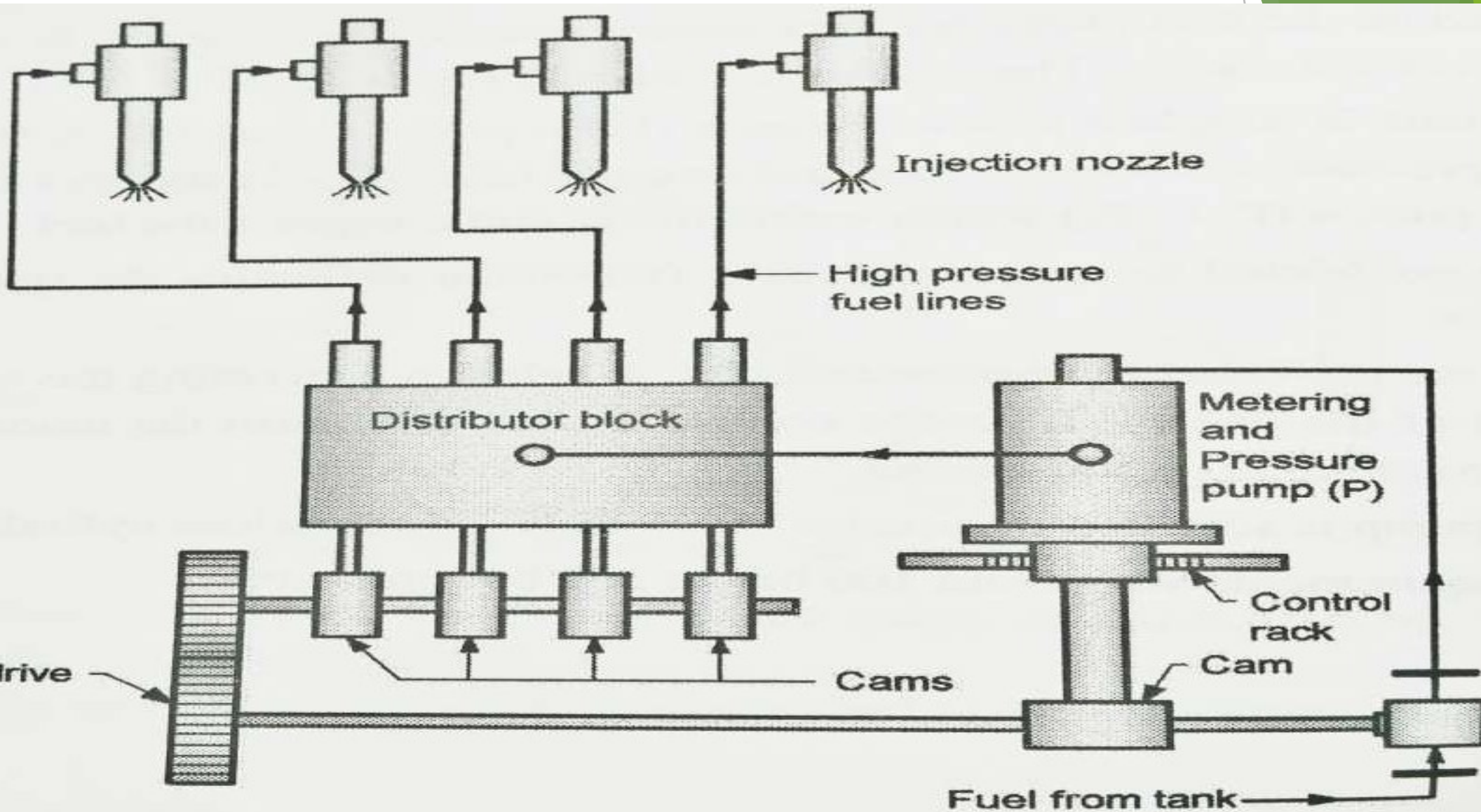


Fig. 4.31.3 : Distributor system

Electronic Injection

es the electronic sensors for precise metering of fuel.

ensors feed the data to an electronic control unit (ECU) which determines the amount of fuel to be injected
ing upon the engine speed & throttle position.

ntages

uces fuel consumption & gives better mileage.

uces exhaust emissions.

roves engine power.

vents overheating of engine during braking & idling conditions of the engine.

Fuel Injection Pumps

ives

eliver accurately metered quantity of fuel.

pressures in the range of 100 bar to 300 bar needed depending upon the compression ratio of

ne to achieve required atomization of fuel.

must be injected and terminated at the correct timing.

of Injection Pumps

type injection pump (Bosch fuel injection pump)

ributor type injection pump

Bosch Fuel Injection Pump

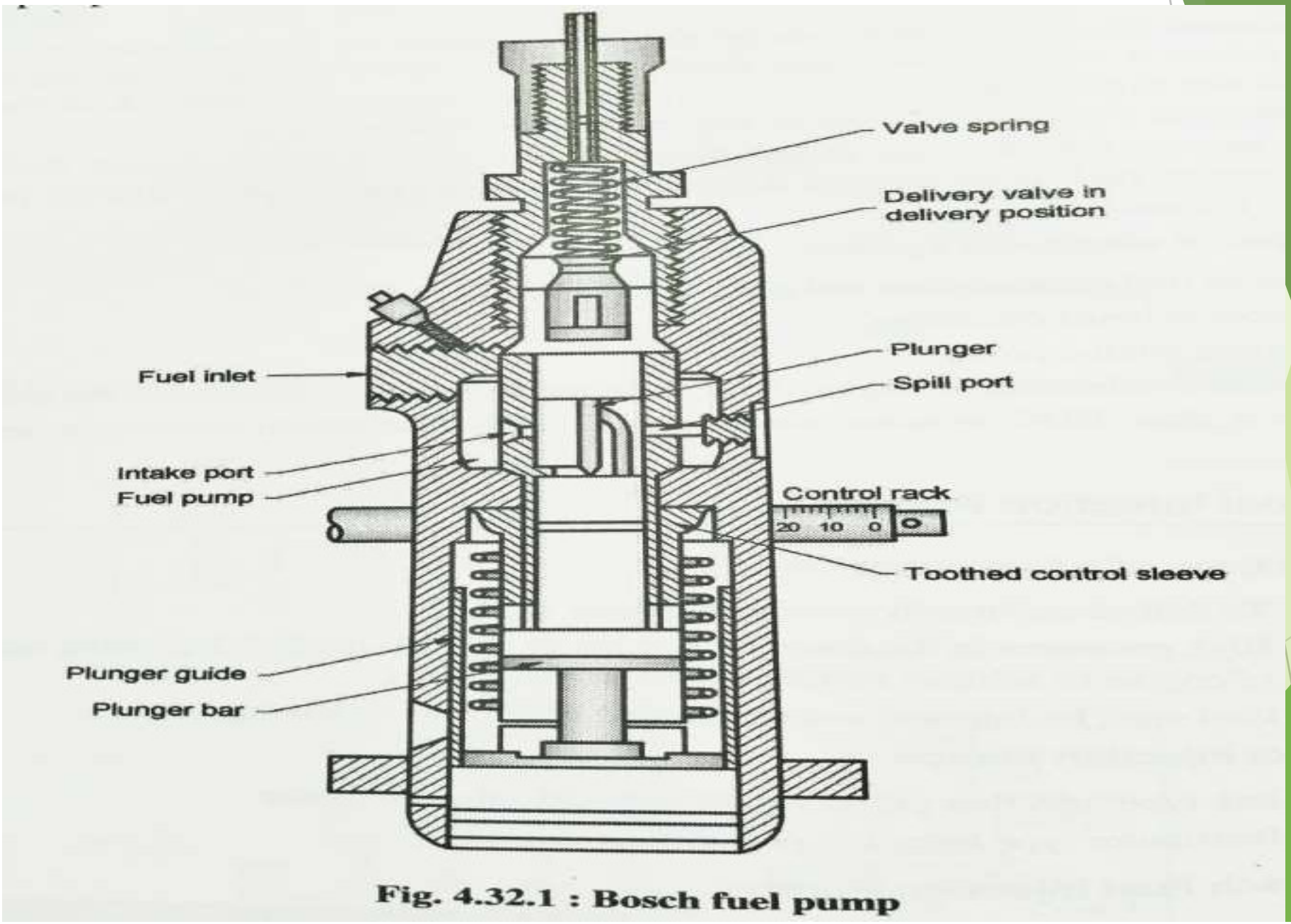
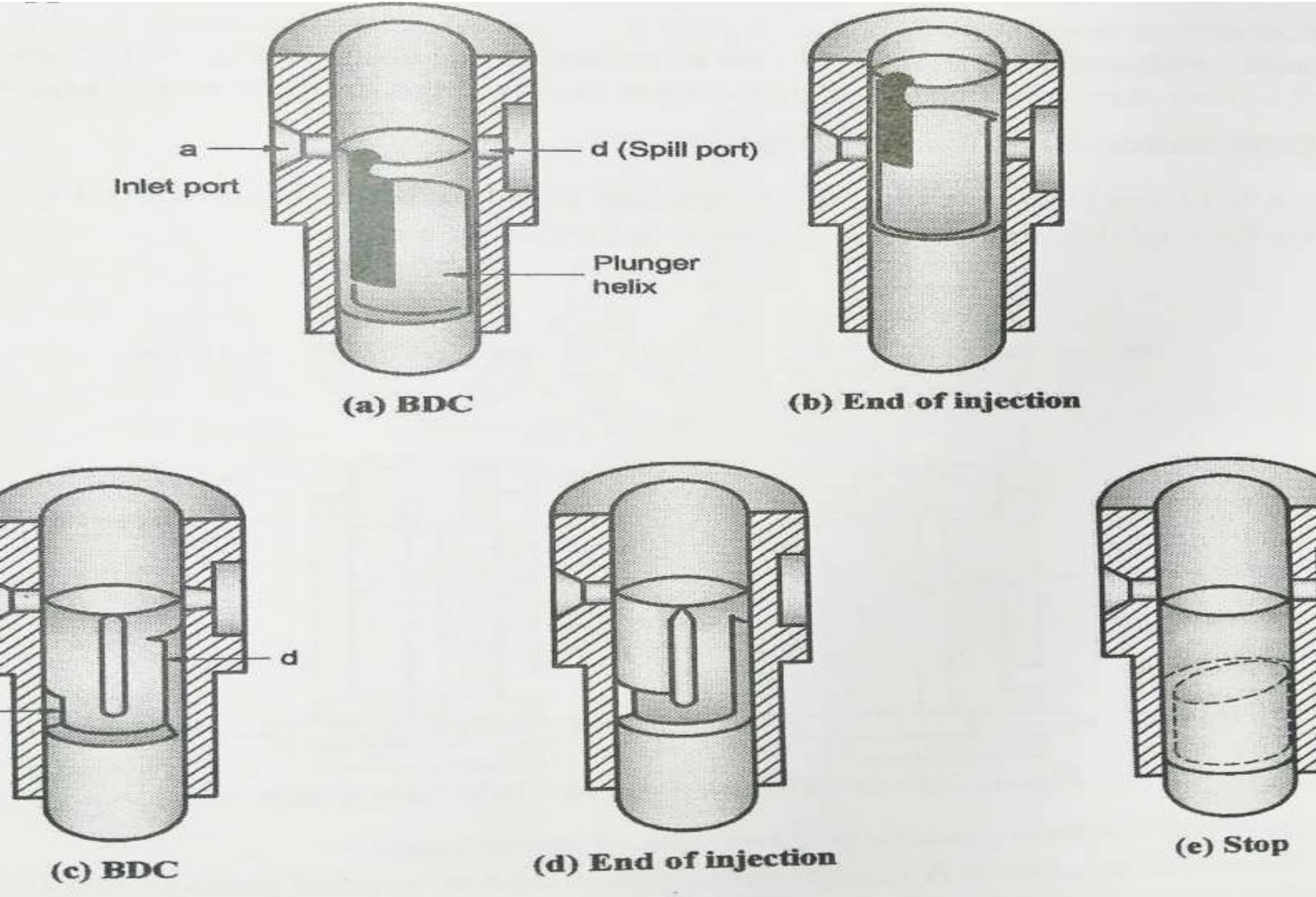


Fig. 4.32.1 : Bosch fuel pump


a
Inlet port
d (Spill port)
Plunger
helix
(a) BDC
(b) End of injection
d
(c) BDC
(d) End of injection
(e) Stop

Distributor Type Fuel Pump

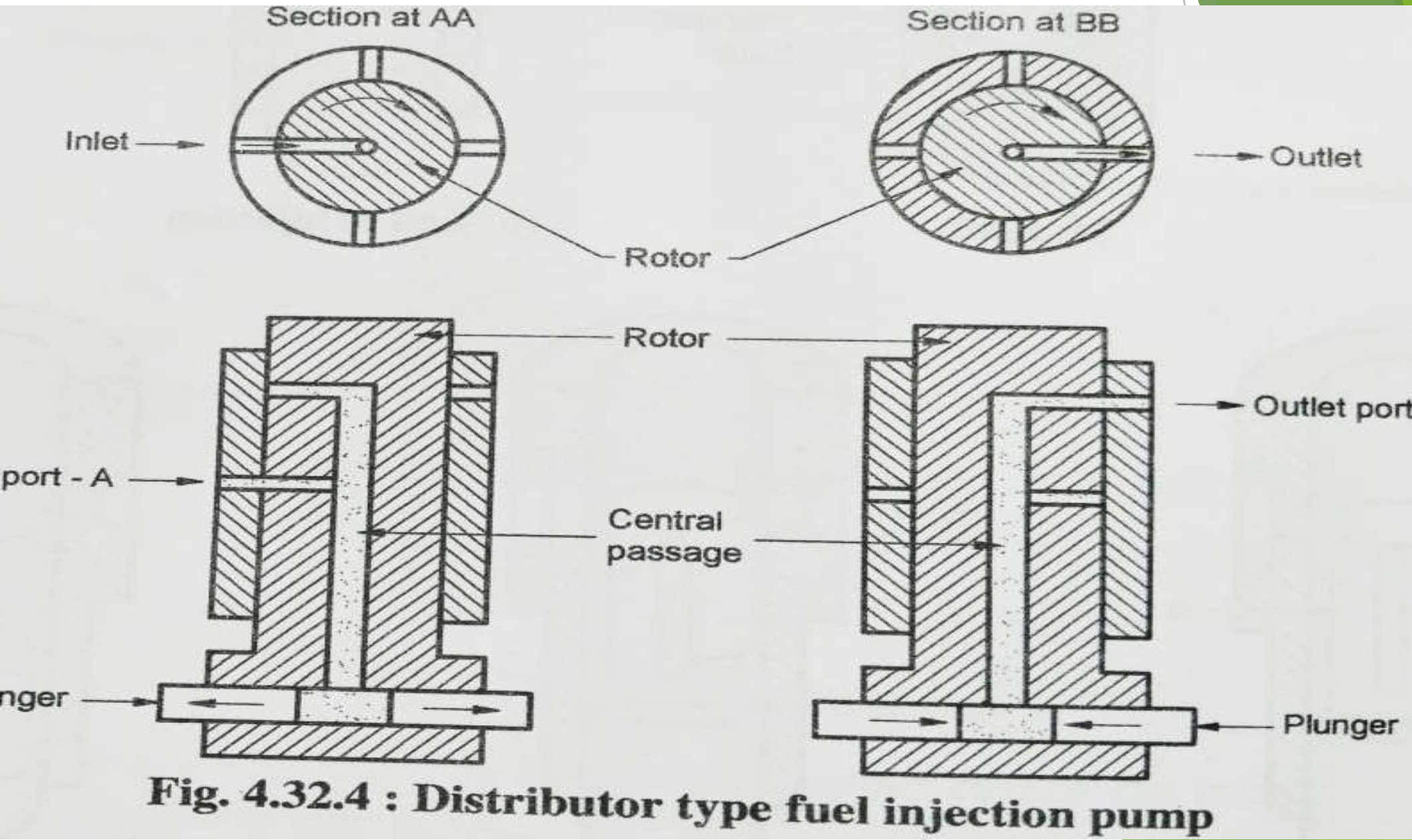


Fig. 4.32.4 : Distributor type fuel injection pump

Nozzles

le is the part of an injector through which the fuel is injected into the combustion chamber.

gn of nozzle should be such that the liquid fuel leaving the nozzle is atomized which helps in proper mixing & air.

of nozzle used in an injector depends on the type of combustion chamber used in an engine.

types of Nozzles:

- pintle nozzle
- single hole nozzle
- multi-hole nozzle
- pintaux nozzle

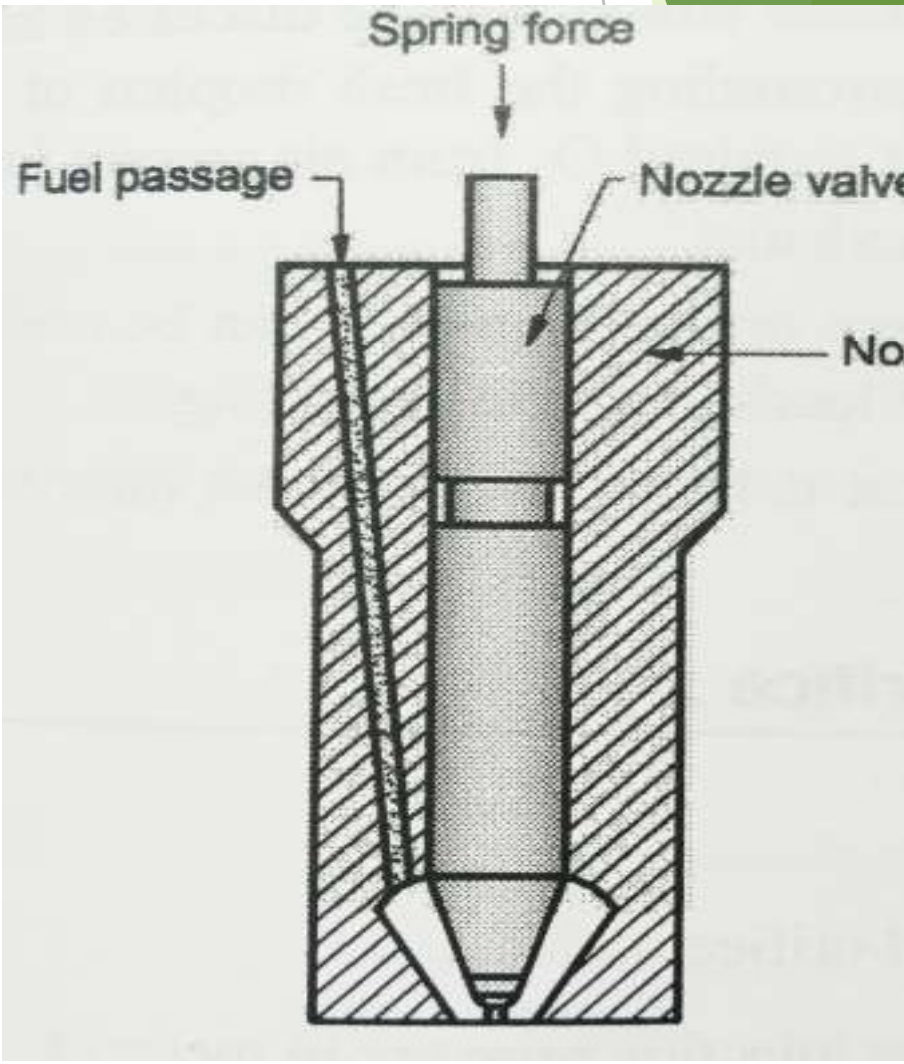
Pintle Nozzle

cations:

e thin ends in the form of pin.

be of the pin can be varied.

w cylindrical jet or a wide angle spray can be obtained.



tages

oids dribbling of fuel in the combustion
nber

Single hole nozzle

fications

ingle hole is bored at bottom tip of nozzle.

e diameter is of 0.2 mm.

ay cone angle obtained ranges from 5-20 degrees.

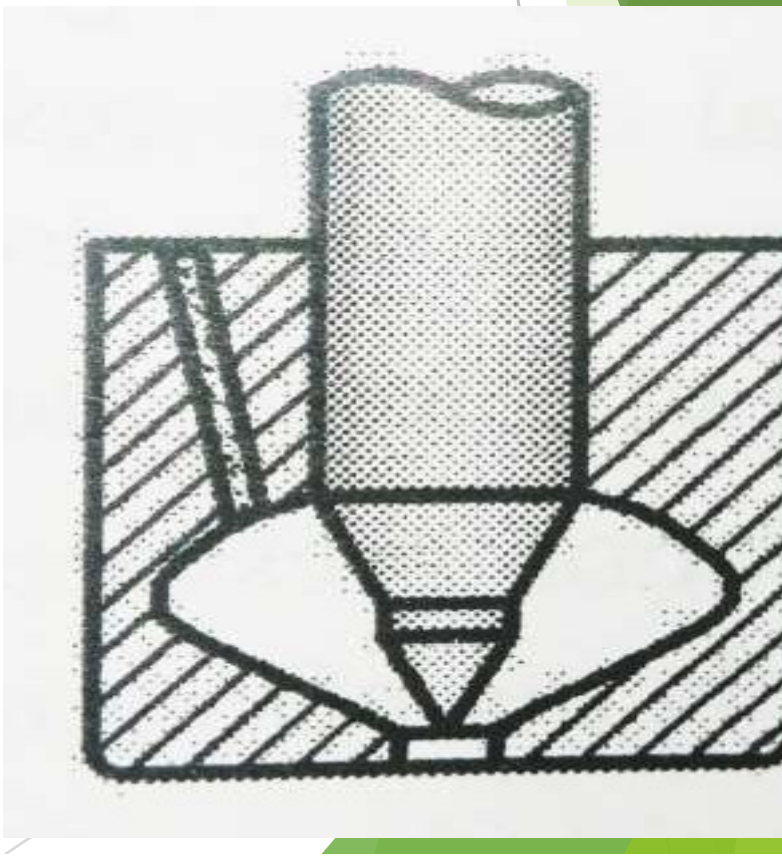
tages

able for open combustion chamber

vantages

s small spray cone angle.

e a tendency to dribble.



Multiple hole Nozzle

cations

multiple holes bored at the tip of the nozzle.

er of holes vary from 4 to 8.

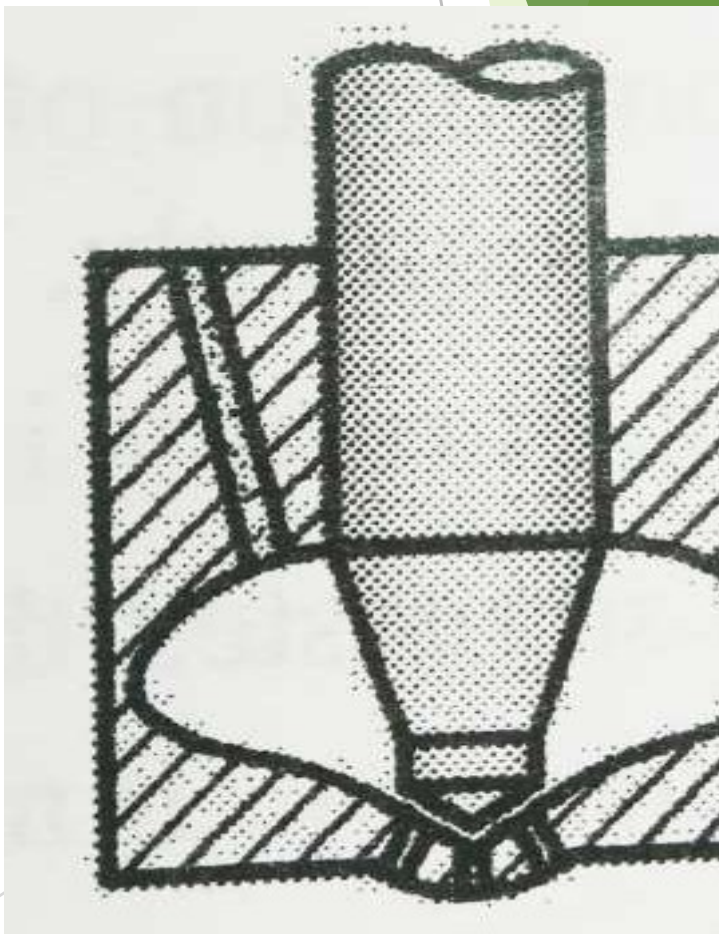
eter vary from 0.2 mm to 0.35 mm.

tages

ures proper mixing of fuel in the chamber.

antages

uires high injection pressures in the range of 180 to
ar.



Pintaux Nozzle

ications

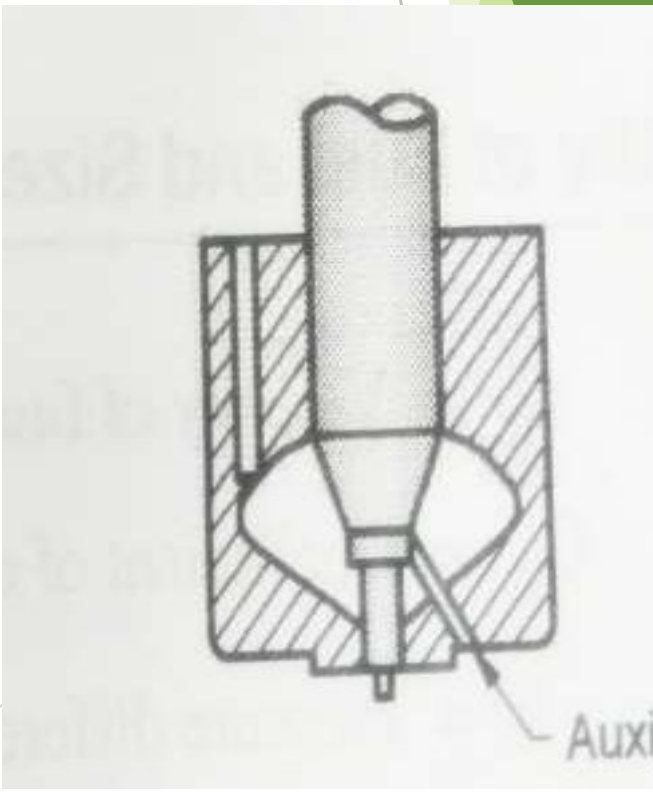
type of nozzle with an auxiliary hole drilled in it.

iary hole injects fuel in a direction upstream the direction of air before the main injection starts.

tages

duces the delay period due to better heat transfer between fuel &

sults into better cold starting performance.



Thank You