

Diesel Power Plants:

* A generating station in which diesel engine is used as the prime mover for the generation of electrical energy is known as diesel power station.

* These plants are generally used as backup power plants.

* Capacity 2 to 50 MW.

* These plants are also installed at place where fuel cost is low, water supply is limited where loads are relatively small and electric supply is not available.

Advantages:

* It can be located at any place.

* The design and layout of the plant are quite simple.

* Occupies less space.

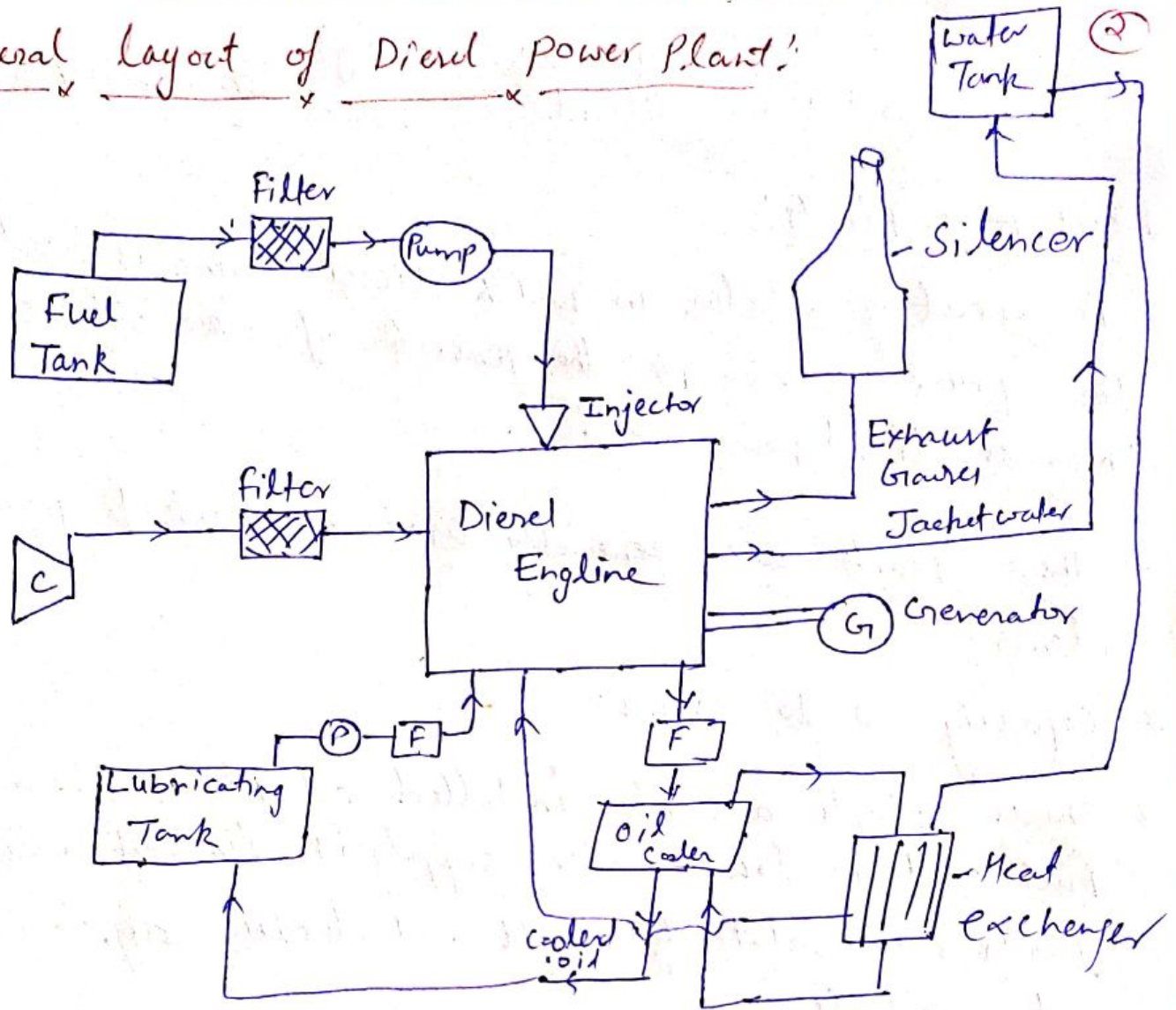
* There are no standby losses.

* Cooling water requirements are low.

* Overall capital cost per unit of installed capacity is less.

* ~~It~~ ~~can~~ The thermal efficiency of the plant is higher than that of steam power plants.

General layout of Diesel power plant:

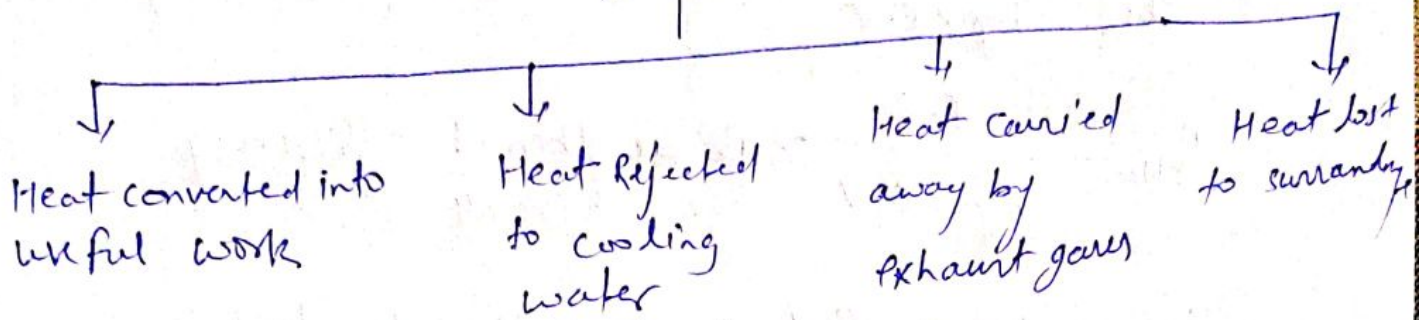


Mainly it consists of following system:

- * Diesel Engine and generator.
- * Engine Air Intake system
- * Exhaust system
- * cooling system
- * Engine fuel system
- * Lubrication system
- * Starting system.

Performance of Diesel Engine:-

Heat supplied to the engine



Brake power:-

* The power available at the ~~engine~~ engine output shaft.

$$B.P = \frac{2\pi NT}{60} \text{ Watt}$$

N - speed
T - Torque

Indicated power:-

Power produced within the engine cylinder.

$$I.P = \frac{P_m \cdot A \cdot L \cdot n}{60} \text{ Watt}$$

$P_m \rightarrow$ mean effective pressure
 $A \rightarrow$ piston cross-sectional Area
 $L \rightarrow$ stroke
 $n = N$ for two stroke engine
 $n = N/2$ for four stroke engine.

Volumetric efficiency:-

- * It is breathing ability of engine.
- * It is the ratio of mass of actual charge inducted to the mass of charge corresponding to the swept volume.
- * Volumetric efficiency of an engine varies from 70% to 80%, but in case of supercharged engines it may be more than 100%.

Thermal Efficiency:

$$\eta_{bth} = \frac{B.P.}{m_f \times C.V.} \rightarrow \text{Brake thermal efficiency}$$

$$\eta_{ith} = \frac{I.P.}{m_f \times C.V.} \rightarrow \text{Brake thermal efficiency or overall}$$

m_f = fuel consumption in kg/sec
 $C.V.$ = calorific value of fuel, KJ/kg

Relative Efficiency:

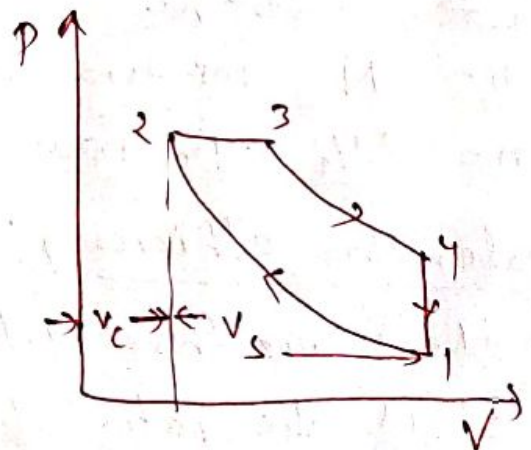
$$\eta_r = \frac{\eta_{ith}}{\text{Air standard efficiency } (\eta_a)}$$

Air standard efficiency:

$$\eta_a = 1 - \frac{1}{r^{(\gamma-1)}} \left[\frac{(p^\gamma - 1)}{\gamma(p-1)} \right]$$

$$\text{Cut off Ratio } \rho = \frac{V_3}{V_2}$$

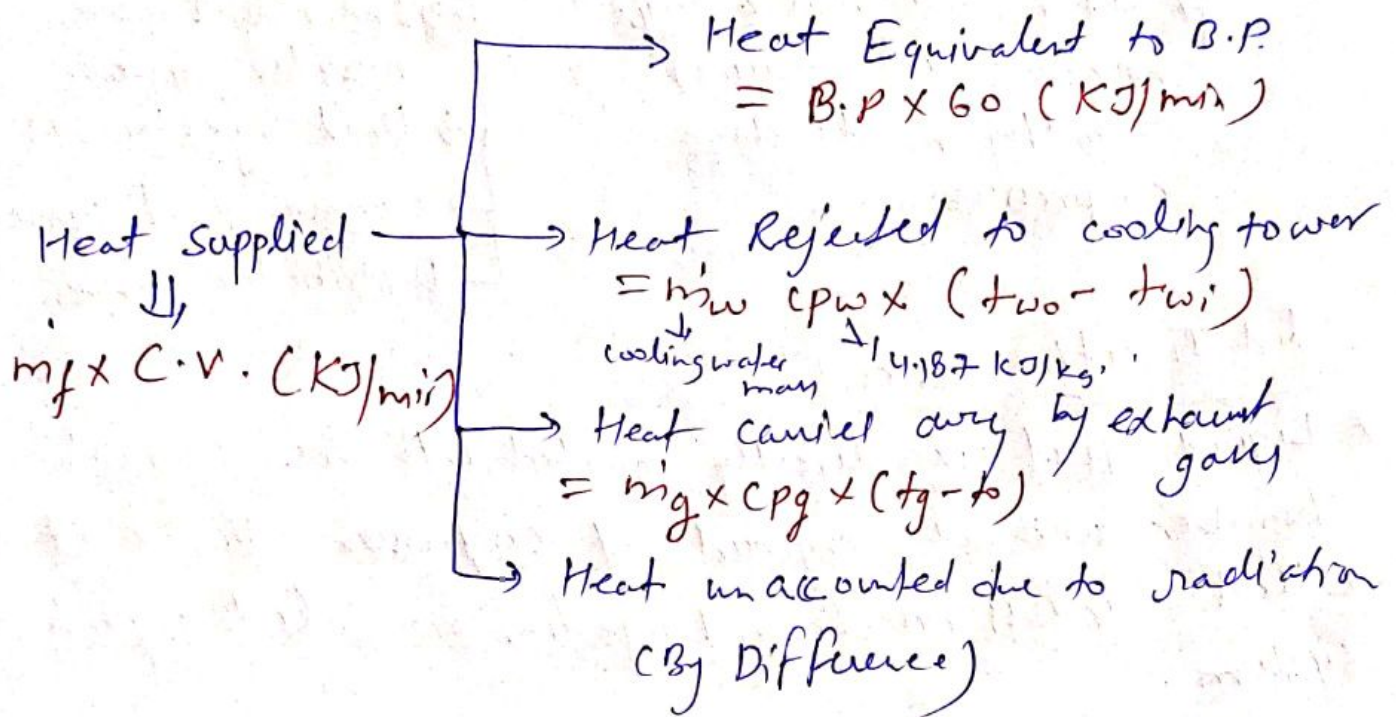
$$\text{Compression Ratio } r = \frac{V_1}{V_2}$$



Heat Balance sheet or Energy Balance:

(5)

- * It represents the account of the heat supplied in fuel and released in combustion and it's utilization in the engine.



Fuel Injection System:

- * Metering of fuel injected per cycle.
- * Timing the injection of the fuel correctly in the cycle so that maximum power is obtained ensuring fuel economy and clean burning.
- * Proper atomization of fuel into very fine droplets.
- * To supply equal quantities of metered fuel to all cylinders in case of multi cylinder engines.

Injection System

⑥

Air Injection system

- * fuel is forced by compressed air
- * Not in use now a days because it requires a bulky multi stage compressor.

Solid or Mechanical Injection system

- Individual pump and nozzle system
- Unit injector system
- Common Rail system
- Distributor system

Solid Injection System!

- * Liquid fuel is directly injected into the combustion chamber without any aid of compressor Hence it is called air less mechanical injection or solid injection system.

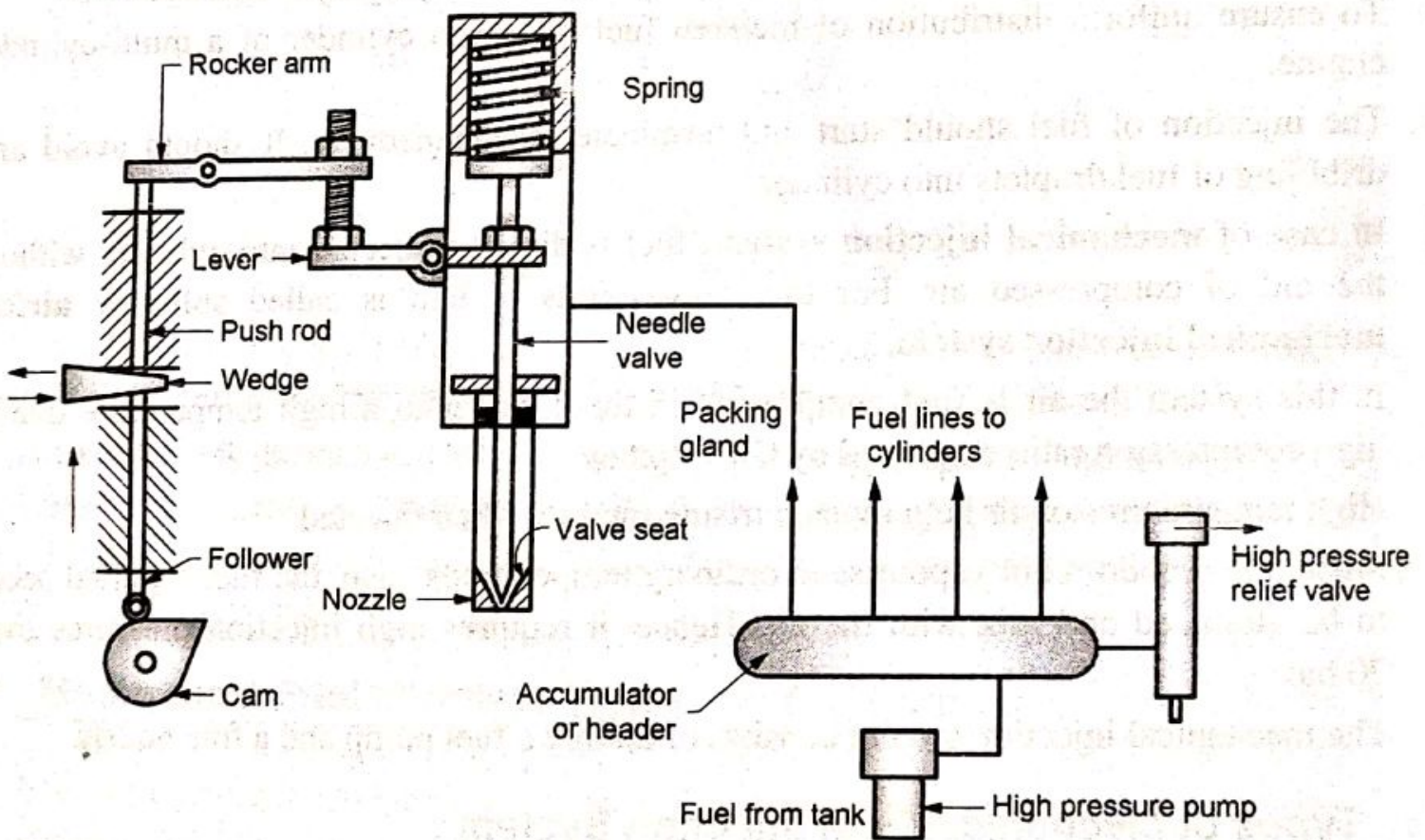
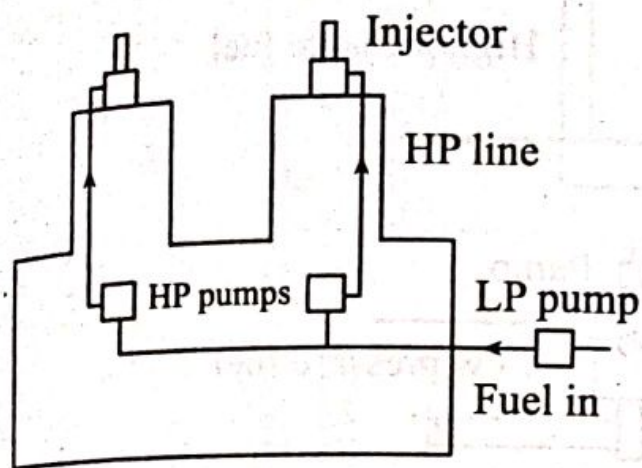
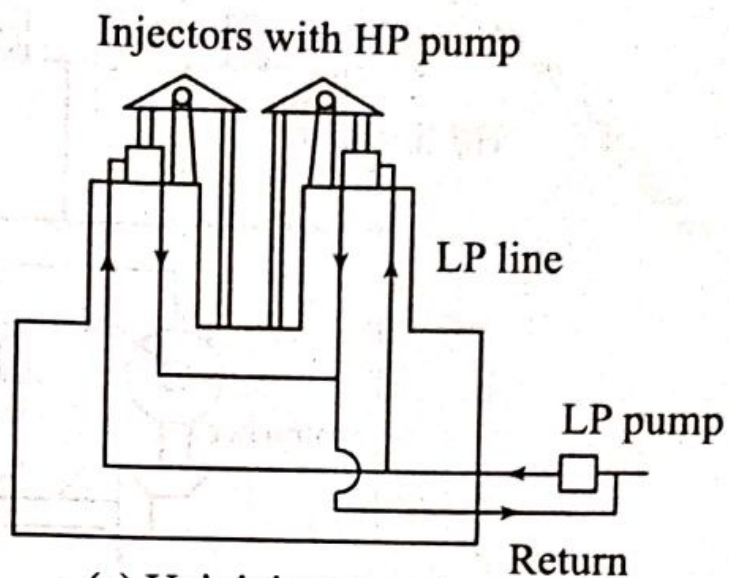


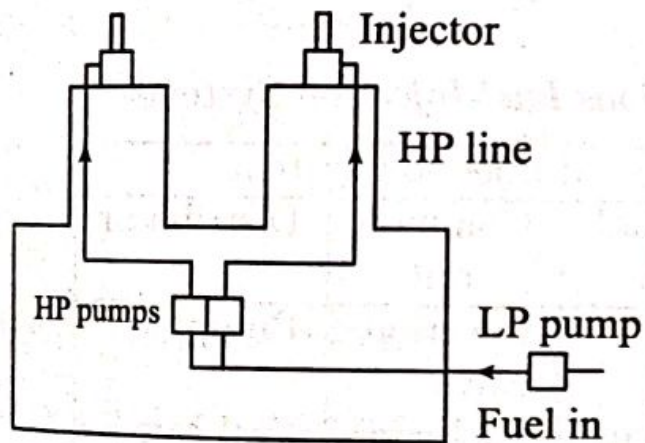
Fig. 8.13.1 : Common rail system



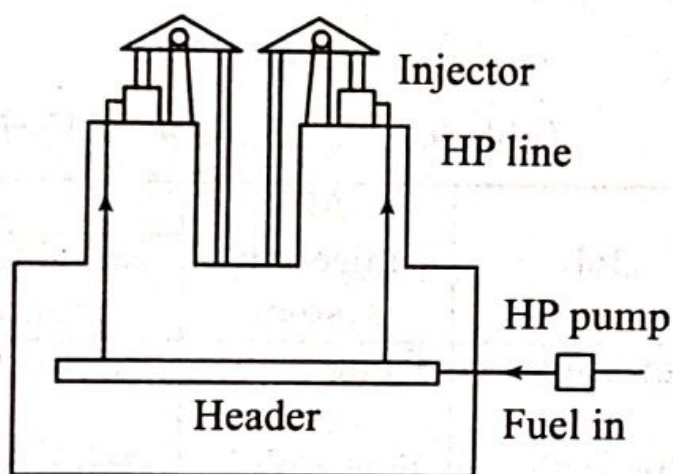
(a) Individual pump and nozzle with separated pumps



(c) Unit injector system



(b) Individual pump and nozzle with pumps in cluster



(d) Common rail system

Fig. 9.2 Injection Systems with Pump and Nozzle Arrangements used in CI Engines

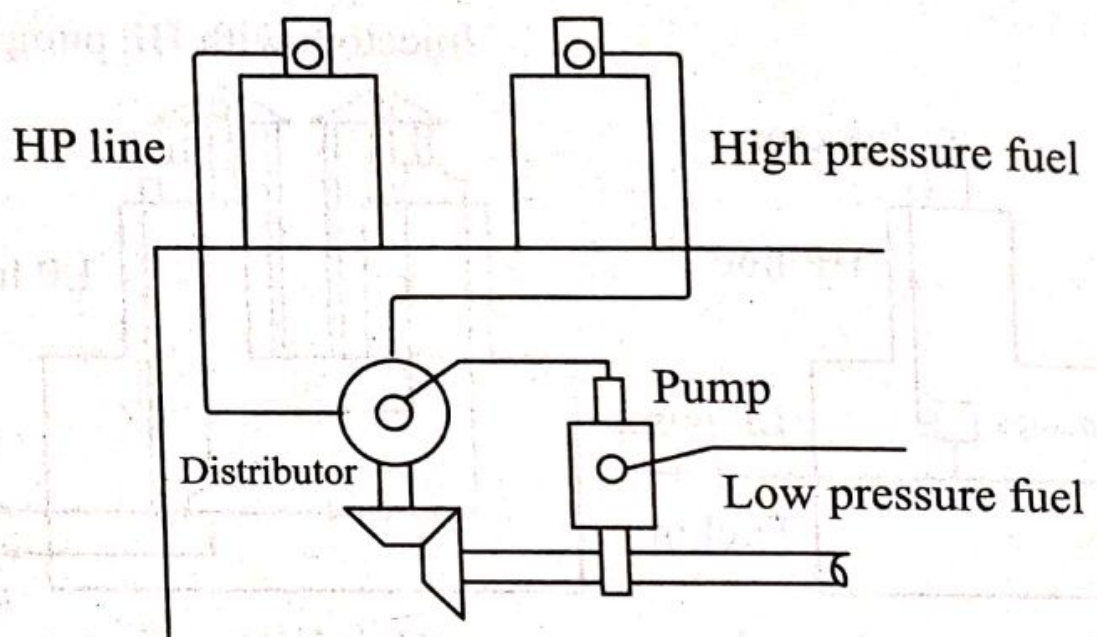


Fig. 9.3 Schematic Diagram of Distributor System