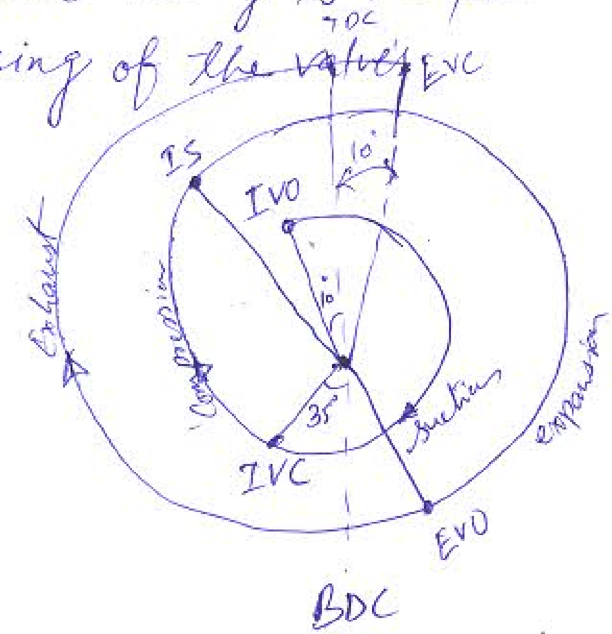
SECTION A NME 505, ST-2, Sol, Odd 17-18

Q.(1) Explain delay period in CI engine.

Ans: A definite period of inactivity between the time when the first droplet of fuel hits the hot air in the combustion chamber and the time it starts through the actual burning phase. This period is known as delay period.

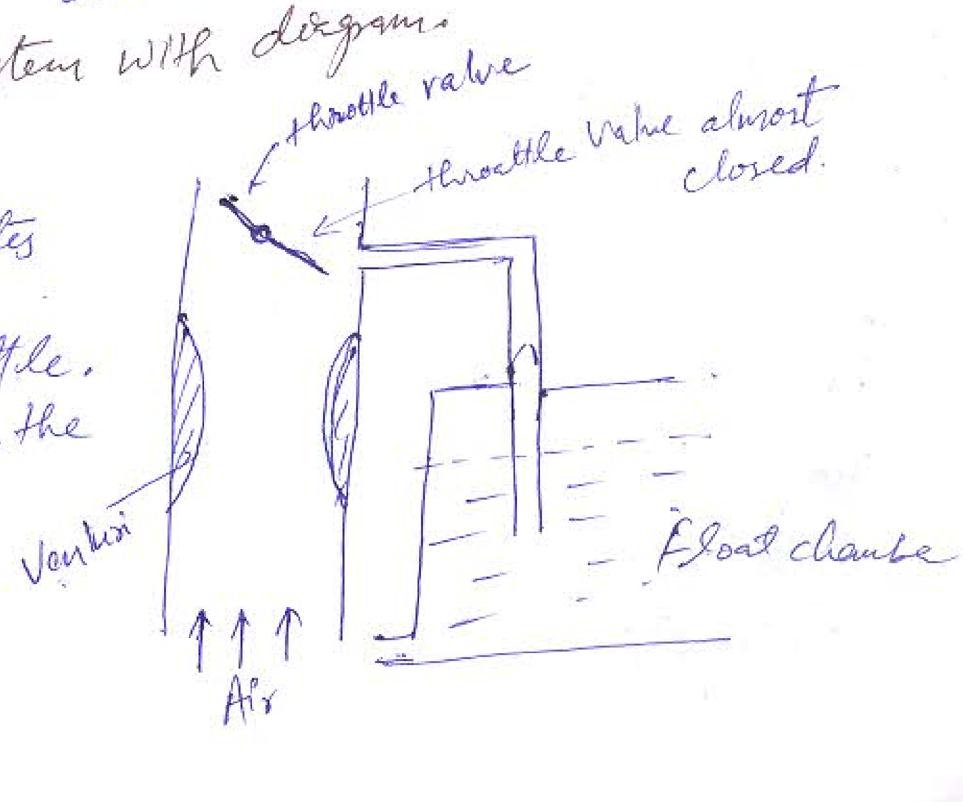
Q(2) Explain valve timing diagram of 4 stroke SI engine.

Ans: The valve timing is the precise timing of the opening and closing of the valves.



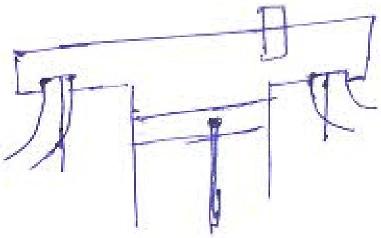
Q(3) Explain idling system with diagram.

Ans: An idling range is one which operates at no load with nearly closed throttle. Under this condition, the engine requires

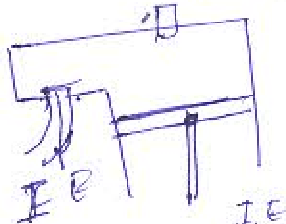


Q(4) Explain Combustion chamber design in SI engine.

Ans. The design of the combustion chamber for an SI engine has an important influence on the engine performance and its knocking tendencies.

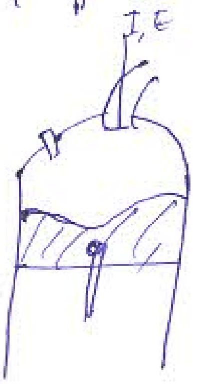


T-Head Type: Used in the early stage of engine development



L-Head Type

provides the two valves on the same side of the cylinder

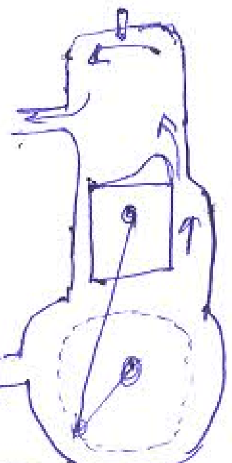


I-Head type

less surface to volume ratio therefore less heat loss.

Q(5) Write short notes on Scavenging in 2 stroke engine

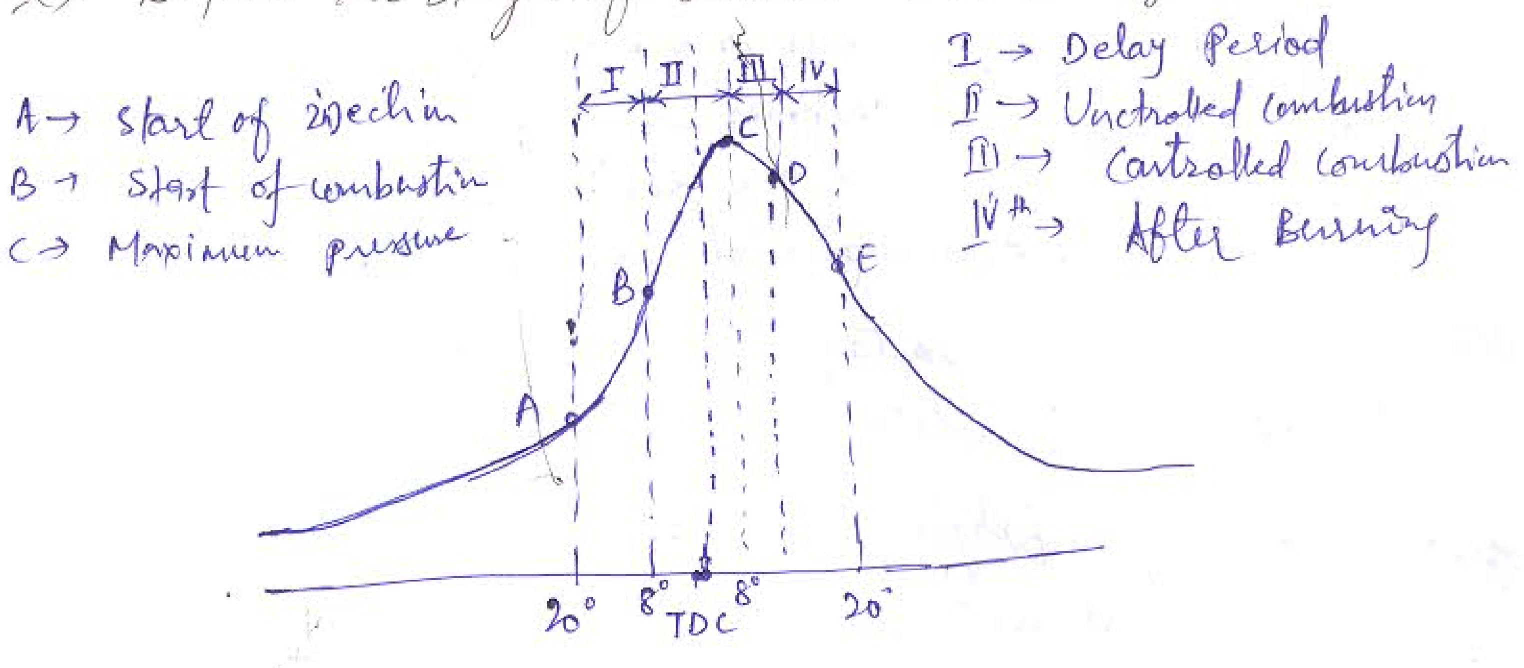
Ans. During scavenging



Both inlet & exhaust ports are open simultaneously for some time, there is a possibility that some of the fresh charge containing fuel escapes with the exhaust. This results in high fuel consumption and lower thermal efficiency

SECTION-B

Q(6) Explain the stages of combustion in CI engine.



Ignition-Delay period:-

* It is period during which some fuel has already been admitted but has not yet ignited. This period is counted from the start of injection to the point P-θ curve separates.

Rapid or uncontrolled Combustion:-

* In the second stage, the pressure rise is rapid because during the delay period the fuel droplet have had time to spread themselves over a wide area and they have fresh air all around them.
* The period of uncontrolled Combustion is counted from the end of delay period.

Controlled Combustion:-

* At the end of Second stage, the temperature and pressure are so high that the fuel droplet injected during the last stage burn almost as they enter and any further pressure rise can be controlled by mechanical means injection rate.

After burning

* The Combustion process shall end after the third stage. However, because of poor fuel distribution of the fuel particles, combustion continues during part of remainder of the expansion stroke. The duration of after burning continues to 70 - 80 degree of crank travel from TDC.

Q7. What are the advantages of supercharging. Explain the effect of altitude on power output.

Ans:- Method of supplying air or Air-Fuel mixture higher than the pressure at which the engine naturally aspirates, by means of a boosting device is called the supercharging.

Advantages: → Increase the power output.
→ Does not increase fuel consumption / brake kW hour.
→ Engine designed to withstand higher forces.
→ Used in Marine & automotive engines where weight and space are important.
→ Engines working at high altitudes. The power loss due to altitude can be compensated by supercharging.

Effect of Altitude on power output:

We know that $BP \propto \frac{P_{bm} \times A \times L \times n \times N \times k}{60,000}$ in kW

for same capacity power output is directly proportional to Mean effective Pressure. When Altitude increases pressure decreases. Due to this brake power or power output of the engine decreases. To compensate the power loss a supercharger is used to provide better power at high altitudes.

Q(8) Explain Normal & Abnormal combustion in SI engine. Also factors affecting knocking in SI engine.

Ans:

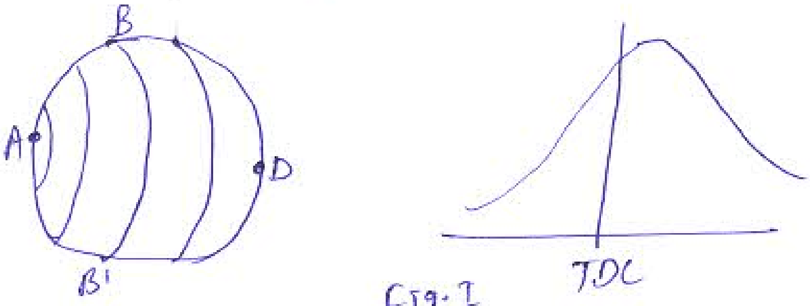


Fig. I

Normal combustion

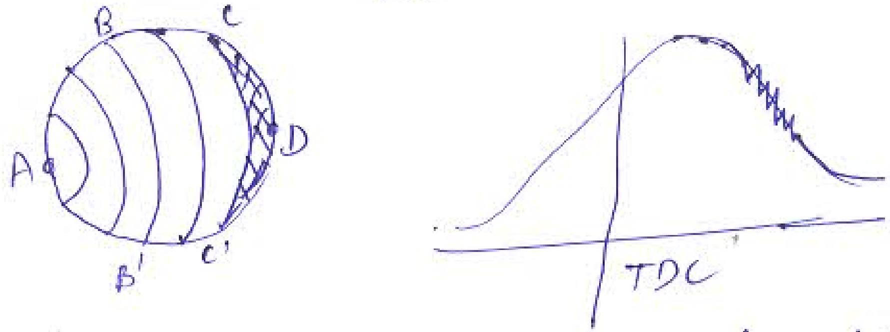


Fig II: Abnormal combustion

In fig. I shows a flame front travelling across combustion chamber from A to D, as the flame propagates the unburnt mixture called as end gas is compressed causes its temp to increase. The temp of the end gases increases further when it receive heat by radiation from burning charges.

In fig. II some of the end charges may undergo preflame reactions increasing its temp. further if the temp exceeds self ignition temp and if the unburnt gas remains at or above self ignition temp during the ignition delay period and advancing flame front does not reach the end gas spontaneous ignition or auto ignition will occur this is known as detonation or knocking.

Factors affecting Detonation :-

→ Compression ratio :→ Increase in compression ratio increases temp. reduces delay period and hence knocking tendency increases.

→ Supercharging :→ This increase in temp and hence the chances of detonation also increases.

→ Increasing load :→ Increase in load results in increase in temp of cylinder and end charge temp. hence knocking tendency increases.

→ Flame travel distance :→ It Also increases detonation.

→ Engine speed :→ Increases in engine speed increases turbulence hence knocking tendency decreases.

→ Engine size :- Flame require longer time to travel across the combustion chamber of a large engine size have greater tendency for knocking.

Q (9) A four cylinder petrol engine working on two stroke cycle develops 30KW at 2500 rpm. The Mean effective pressure on each piston is found to be 8 bar. The calorific value of fuel is 43900 KJ/kg and brake thermal efficiency is 29%. Calculate fuel consumption of the engine further determine the bore and stroke of each cylinder, if stroke to bore ratio is 1.5. Mechanical efficiency is 80.8%

Ans :→ Given $BP = 30\,KW$, $\eta_{m} = 80.8\%$, $N = 2500\,rpm$

$\eta_{bth} = 29\%$, $C_V = 43900\,KJ/kg$

$\dot{m}_f = ?$, $L = ?$, $D = ?$

∵ We know

$$\eta_{bth} = \frac{BP}{\dot{m}_f \times C_V}$$

$$0.29 = \frac{30\times10^3}{\dot{m}_f \times 43900\times10^3} \Rightarrow \boxed{\dot{m}_f = 2.3564 \text{ gm/sec}}$$ Ans

$$\Rightarrow \eta_m = \frac{BP}{ip} \Rightarrow ip = \frac{BP}{\eta_m} = \frac{30}{0.808} = 37.12 \text{ KW}$$

$$\because \; ip = \frac{P_m \times n \times \left(\frac{\pi}{4} D^2 \times L\right) \times N \times K}{60\times1000} \qquad \because L = 1.5D$$

$$\Rightarrow 37.12\times10^3\times60 = 8\times10^5 \times 4\times\frac{\pi}{4}D^3\times1.5\times2500\times1$$

$$\Rightarrow \boxed{\begin{aligned} D &= 61.8 \text{ mm} \\ L &= 92.7 \text{ mm}\end{aligned}}$$ Ans

Q(10) A single jet simple carburetor giving A/F = 15 : 1, has venturi throat = 3.5 cm dia. and creates 6.33 cm of Hg at venturi throat. Determine the size of fuel nozzle. Assume Cda = Cdf = 1. Patm at entrance = 1.013 bar, & Temp at carburetor entrance = 16°C. Take density of fuel = 750 kg/m^3. and fuel nozzle is at the same level as that of fuel in fuel chamber.

Ans. Given A/F = 15 : 1, $d_t = 3.5$ cm, $\Delta P = 6.33$ cm of Hg

$d_f = ?$, $\rho_f = 750$ kg/m^3

$C_{da} = C_{df} = 1$,

$$\rho_a = \frac{P_a}{RT} = 1.22 \text{ kg/m}^3$$

$$A/F = \frac{C_{da}\times A_t \times \sqrt{2\times\rho_a\times\Delta P}}{C_{df}\times A_f \times \sqrt{2\times\rho_f\times(\Delta P - \rho g h)}}$$

Here $h = 0$

$$\Rightarrow A/F = \frac{C_{da}\times\frac{\pi}{4}d_t^2}{C_{df}\times\frac{\pi}{4}d_f^2}\times\sqrt{\frac{\rho_a}{\rho_f}} \quad \Rightarrow \boxed{d_f = 1.81 \text{ mm}}$$

Ans.

SECTION C

Q (11) Classify fuel injection system. Why the air injection system is not used now a days. Also explain common rail fuel injection system with diagram.

Ans:- Fuel injection system can be classified as

→ Air injection system

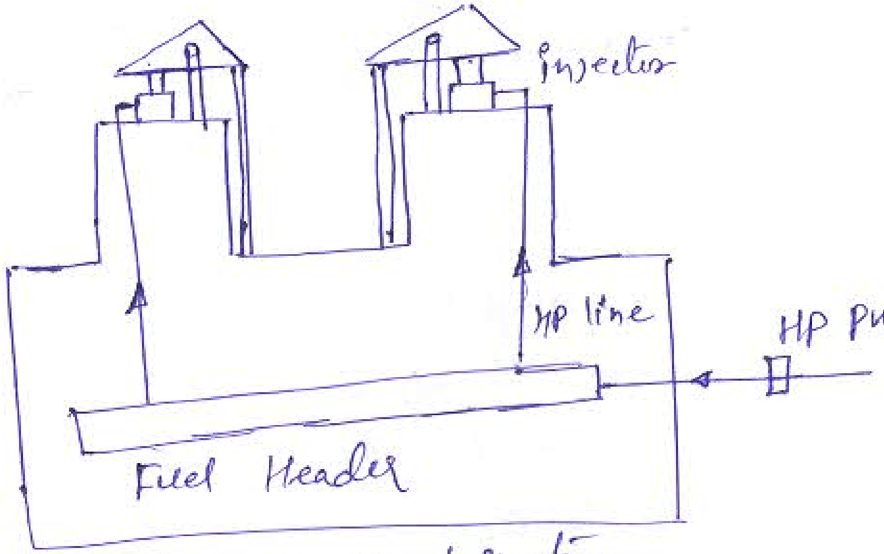
→ Solid injection system

- → Individual Pump & Nozzle System
- → Unit Injector System
- → Common rail system
- → Distributor System

Now a days air fuel injection system is not used because it requires a bulky multistage air compressor to force the fuel into cylinder. This causes an increase in engine weight and reduces the brake power output. One Advantages that is good mixing of fuel with air resultant higher mean effective pressure. Another is high viscous fuel which are less expensive can used. These advantages are off-set by requirement of a multistage compressor thereby the air injection system obsolete.

Common Rail fuel injection System :- A High Pressure (HP) pump supplies fuel, under high pressure, to a fuel header. High Pressure in the header forces the fuel to each of the nozzles located in the cylinder. At the

Proper time a mechanically operated valve allows the fuel to ~~each~~ enter the proper cylinder through the Nozzle.



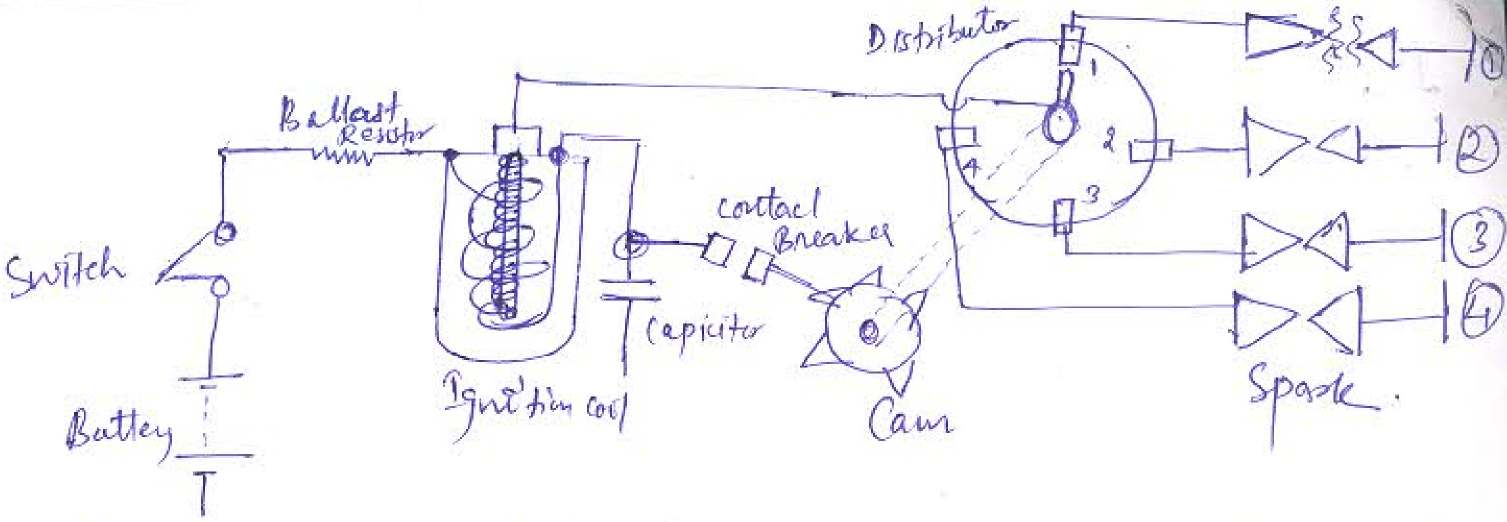
: Common Rail System

The pressure in the fuel header must be that, for which the injector was designed ie it must enable to penetrate and disperse the fuel in the combustion chamber. The amount of fuel entering the cylinder is regulated by varying the length of the push rod stroke. A high pressure pump is used for supplying fuel to a header, from where the fuel is metered by injectors.

Q(12) Compare battery and magneto ignition system & sketch the constructional layout of battery ignition system in details.

Ans.

Battery Ignition System	Magneto Ignition System
→ Battery is Neccessary	→ No battery is needed
→ More Maintenance problems	→ Less maintenance
→ occupies more space	→ less space
→ Used in car & light vehicles	→ Used in racing car & two wheeler
→ Good spark is available at low speed	→ quality of spark is poor due to low speed.
→ Primary current obtained from battery	→ Primary current generated by the magneto



⇒ When the switch is turned on the primary circuit gets closed and current start flowing through it. This primary current is set up a magnetic field around soft iron core of coil.

⇒ When the breaker points open by the action of the cam, the current which was flowing through the contact breaker start flowing through the condenser. As the condenser charges the primary current falls on the magnetic field collapse.

⇒ This changes in magnetic field induces a current in the primary winding which flows in the same direction as the primary current & charges the condensor to a voltage much higher than battery voltage. This stoping the current flow from the battery

⇒ Due to this, condensor then discharges into the battery thus reversing the direction of both primary current & magnetic field. This induces a high voltage in secondary winding of the coil. This high voltage is then carried high tension wire to the distributor rotor where it passes through one of the ignition harnesses into the spark plug and produces a spark.

THE END