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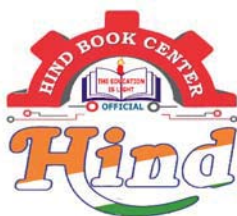
I.C.Engine

By-Praveen Kulkarni Sir

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Internal Combustion Engine (I.C. Engine)

Classroom Notes

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For GATE | ESE | PSU's

Mechanical Engineering

By: Mr. Praveen Kulkarni

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Ch-1 Basics of Engine

Engine:

it is a device which convert one form of energy into another useful form.

Based on combustion, engines are classified into

- (1) Internal combustion Engine
- (2) External combustion Engine

In internal combustion engine burning or combustion occurs in the cylinder and the power is developed in the same cylinder.

In external combustion engine heat is transferred from product of combustion to the working fluid.

Heat Engine:

heat engine is a device which converts chemical energy of fuel into heat (thermal) energy and subsequently heat energy is converted into mechanical power.

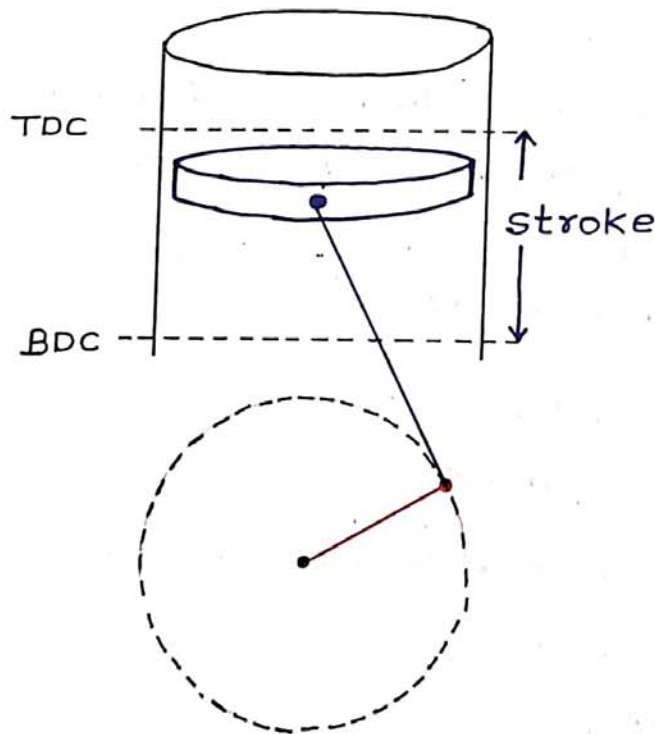
Advantages of IC Engine:

- (1) Mechanical Simplicity
- (2) Low initial cost due to the absense of boiler, turbine, condenser etc.
- (3) High efficiency
- (4) High power to weight ratio.

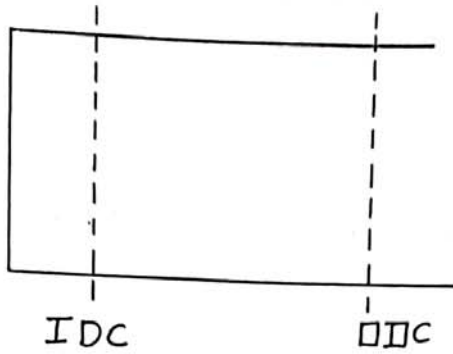
Engine Nomenclature:

- (1) Top dead centre (TDC): it is the dead centre when the piston is farthest from the crank shaft.
- In case of horizontal engine TDC is known as inner dead centre (IDC).

- (2) Bottom dead centre (BDC): it is the dead centre when the piston is nearest to the crank shaft.
- In case of horizontal engine it is known as outer dead centre (ODC).



Vertical Engine



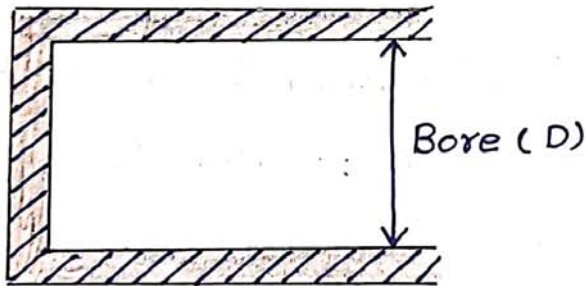
Horizontal engine

(3) Stroke or stroke length (L):

The distance between TDC and BDC is known as stroke or stroke length.

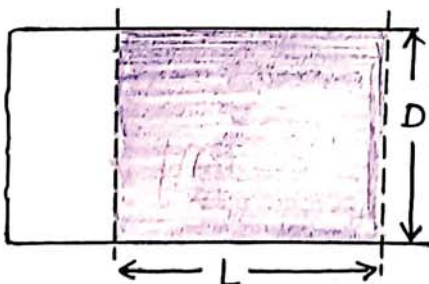
(4) Bore (D):

Inner diameter of cylinder is known as Bore.



(5) Stroke/swept/piston displacement volume (V_s):

it is the volume swept by the piston.



$$V_s = \frac{\pi}{4} D^2 L$$

Where D = Inner diameter (Bore) of cylinder
 L = stroke length

Note:

- If there are 'k' number of cylinders then the total swept volume.

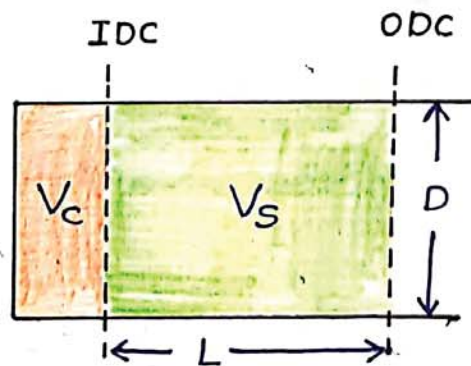
$$V_{\text{Total swept}} = k \times \frac{\pi}{4} D^2 L$$

- A 100 cc motorcycle means that the volume displaced by the piston inside the cylinder is 100 cubic centimeter.

(6) clearance volume (V_c):

it is the volume of the cylinder when the piston is at TDC or IDC.

- Clearance volume is provided to accommodate (or to provide space) valves and to prevent damaged to valves.



$$\text{Total volume } (V_T) = V_c + V_s$$

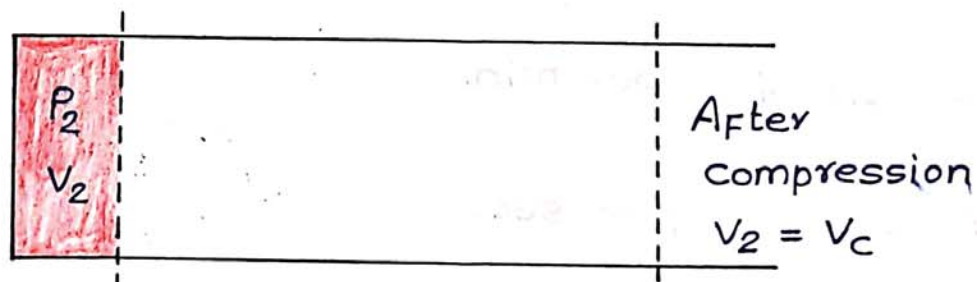
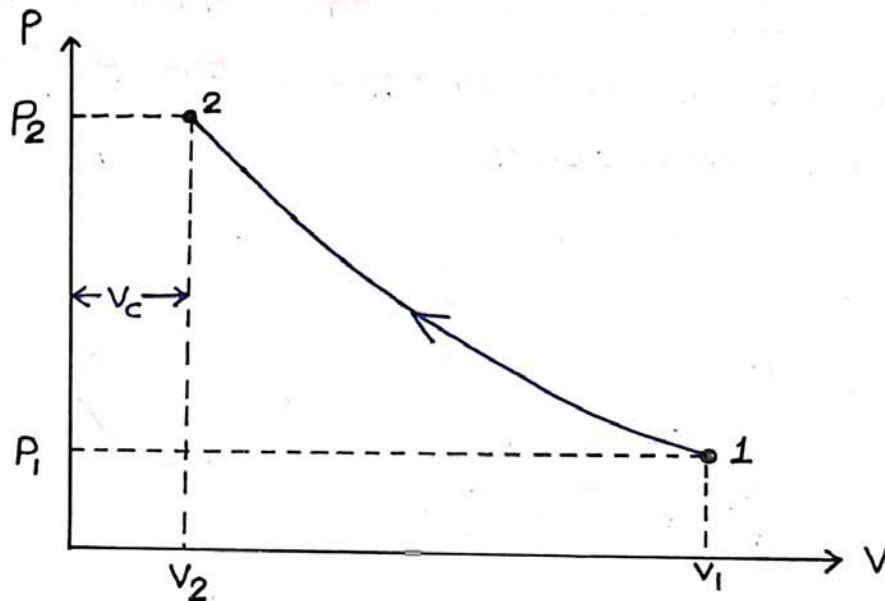
(7) clearance ratio (c):

it is the ratio of clearance volume to the swept volume.

$$c = \frac{V_c}{V_s}$$

(8) Compression ratio (r):

it is the ratio of volume before compression to the volume after compression.

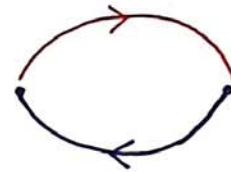
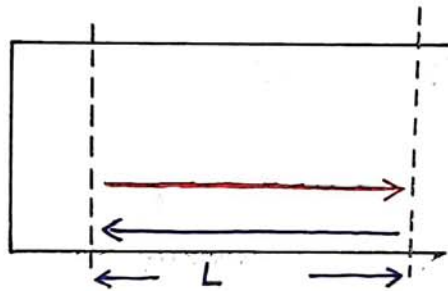


$$\gamma = \frac{\text{Volume before compression}}{\text{Volume after compression}}$$

$$\gamma = \frac{V_1}{V_2} = \frac{V_c + V_s}{V_c} = 1 + \frac{V_s}{V_c}$$

(9) Mean piston Speed:

In one stroke the shaft complete half revolution (180°) therefore the piston covers '2L' in one revolution.



In 1 rev. of shaft piston covers $\rightarrow 2L$

So, in N rev.

$$\Rightarrow \frac{2L}{\text{rev.}} \times N \frac{\text{rev.}}{\text{min}}$$

$$= 2LN \text{ per min.}$$

$$= \frac{2LN}{60} \text{ per sec.}$$

$$\text{Mean piston speed} = \frac{2LN}{60} \text{ (per sec.)}$$