

* I C ENGINE :-

- Bore (d) : Inner diameter of engine cylinder.
- Top dead centre (TDC) : Extreme position of piston at top of cylinder of vertical engine.
- Bottom dead centre (BDC) : Extreme position of piston at bottom of cylinder of vertical engine.
- Stroke (L) : Distance travelled by piston from TDC to BDC. It is maximum distance travelled by piston in cylinder in one direction.
- Clearance Volume (V_c) : Volume contained in the cylinder above top of piston, when piston is at TDC.
- Swept Volume : Volume swept by piston during one stroke is called swept volume / displacement of piston.

$$V_s = A \times L = \frac{\pi}{4} d^2 L$$

- Compression Ratio : It is ratio of volume in cylinder when piston is at bottom dead centre to volume when piston is at top dead centre.

$$(r_c) = \frac{V_s + V_c}{V_c}$$

* Advantage :-

- (i) Greater mechanical simplicity.
- (ii) Higher Power output per unit weight.
- (iii) Higher brake thermal efficiency.
- (iv) Easy starting from cold condition.

* Disadvantage :-

- (i) Can't use solid fuel which are cheaper.
- (ii) Expensive fuel.
- (iii) Balancing of reciprocating parts of engine is difficult.

* FOUR STROKE S.I (PETROL) ENGINE :-

WORKING :-

- (i) Four stroke SI engine works on principle getting one power stroke on two revolutions of crankshaft & considered as completion of one cycle.
- (ii) Working substance in this engine are petrol or gas.
- (iii) compression ratio used in these engines are varies from 6 to 10.

DRAW NEAT DIAGRAM :-

OPERATION :-

The process involved in cycle is suction stroke, compression stroke, Expansion & Exhaust stroke.

(I) SUCTION STROKE : (0-1)

- (i) During this stroke piston move away from cylinder head [T.D.C], which creates partial suction in combustion space. In case of petrol engine, mixture of air & petrol is admitted into cylinder through inlet valve.
- (ii) Exhaust valve is closed & inlet valve is opened & this is operated by cam & valve mechanism.
- (iii) Finally piston reaches bottom most position (B.D.C) & half rotation of crankshaft is completed. Piston makes one stroke & crankshaft 180° of rotation.

(II) COMPRESSION STROKE (1-2) :-

- (i) During this stroke inlet and exhaust valves both remain closed. Piston moves from B.D.C to T.D.C & charge is compressed upto its clearance volume.
- (ii) During this process pressure & temp of the mixture rises. Just before end of compression stroke, mixture is ignited with help of spark plug & due to release of chemical energy of fuel, the pressure & temp. of mixture further rises.

(III) EXPANSION (3-2)

- (i) During this stroke inlet & exhaust valves remain closed & piston moves from T.D.C to B.D.C. This stroke is also called working stroke.
- (ii) High pressure & temp. gases push down piston to create motive power. Piston makes one stroke & crankshaft moves 180° .

(IV) EXHAUST STROKE :

- (i) During this stroke inlet valve remains closed and exhaust valve opens. Piston moves from B.D.C to T.D.C & during this motion piston pushes out burnt gases from cylinder. Exhaust valve closes at end of stroke & part of burnt gases called residual gases remain in the clearance space.

* FOUR STROKE C.I (DIESEL) ENGINE :-

WORKING :-

- (i) Four stroke C.I engine works on principle getting of one stroke on two revolution of crankshaft completes one cycle.
- (ii) Working substance of these engines are diesel.
- (iii) Compression ratio is varied from 14 to 22.

OPERATION :-

(I) SUCTION STROKE :

- (i) During this stroke, inlet valve opens & exhaust valve remains closed. Only air is induced during suction. Piston moves from TDC to BDC during this stroke.
- (ii) Finally piston reaches bottom most position & half rotation of crankshaft is completed.

(II) COMPRESSION STROKE :

- (i) During this stroke piston moves from B.D.C to T.D.C & both valves are closed. Upward motion of piston compresses air. Just at end of compression stroke, fuel is sprayed on compressed air through fuel injector & combustion of fuel takes place.
- (ii) Temp. of air at end of compression stroke is sufficient to ignite fuel.

(III) EXPANSION :

- (i) Due to combustion of fuel heat is assumed to be added at constant pressure. After injection of fuel over product combustion expands over during piston movement from T.D.C to B.D.C

* TWO STROKE S.I ENGINE :-

WORKING:

- (i) It produces one power stroke & one idle stroke in each revolution, suction, compression, power & exhaust operation are completed in two strokes.
- (ii) Instead of exhaust & inlet valve, there are inlet, exhaust & transfer port which are opened or closed by movement of piston.

DIAGRAM:

(A) FIRST STROKE (SUCTION + COMPRESSION) :-

- (i) Upward motion of piston closes exhaust & transfer port & compresses charge. Charge is ignited by spark plug before piston reaches T.D.C. Position of piston opens inlet port simultaneously to allow air-fuel mixture to enter crank case.
- (ii) Air fuel mixture is already admitted into crank case during previous stroke. Mixture is allowed to enter on top of piston through transfer port. During this stroke both suction & compression events are completed.

(B) SECOND STROKE (POWER + EXHAUST) :-

- (i) Ignited air-fuel mixture at high pressure and temperature pushes piston from T.D.C to B.D.C position. This is power stroke. Downward motion of piston opens exhaust ports to release burnt gases to atmosphere.
- (2) Also piston compresses air-petrol mixture in crank case simultaneously & reaches B.D.C. Thus two strokes are completed in one revolution & same cycle is repeated continuously.

(ii) Both inlet & exhaust valve continue to remain closed & piston moves from T.D.C to B.D.C.

(iii) High temp & high pressure gases push down piston to create motive power.

(IV) EXHAUST STROKE:

(i) Exhaust valve opens & intake valve remains closed. Piston travelling from B.D.C to T.D.C pushes out combustion burnt gases. Since diesel engine uses very high compression ratio.

(ii) Temp. of air at end of compression stroke is very high & it is sufficient to self ignite fuel. Due to this in case of CI engine a spark plug is not needed. This method is called as auto ignition.

(iii) ~~Temp.~~

FOUR - STROKE

(1) It has four stroke of piston & two revolution of crankshaft.

(2) One power stroke in every two revolution of crankshaft.

(3) Heavy & bulky.

(4) Less cooling & lubrication required.

(5) Less wear & tear.

(6) Volumetric effi. is more.

(7) Thermal effi. is more.

(8) Contain valve & valve mechanism.

(9) Buses, cars, truck.

TWO - STROKE

(1) It has two stroke of piston & one revolution of crankshaft.

(2) One power stroke in each revolution of crankshaft.

(3) Light & Compact.

(4) Greater cooling & lubrication required.

(5) Higher wear & tear.

(6) Volumetric effi. is less.

(7) Thermal effi. is less.

(8) Do not contain valve & valve mechanism.

(9) Scooters, motor cycle, mopeds.

PETROL ENGINE

- (i) Works on otto cycle.
- (ii) During suction stroke itself petrol is admitted to cylinder with air.
- (iii) Air-petrol mixture.
- (iv) Compression ratio ranges from 6:1 to 12:1
- (v) Ignited by spark plug
- (vi) Engine speed of about 3000 rpm
- (vii) Thermal effi is low
- (viii) Low noise & vibration
- (ix) Weight is less
- (x) Pollution is more.
- (xi) Less maintenance

DIESEL ENGINE.

- (i) Works on diesel cycle.
- (ii) At end of compression stroke diesel is injected into cylinder.
- (iii) Air is drawn during suction.
- (iv) Compression ratio ranges from 16:1 to 20:1
- (v) Ignited by self-ignition.
- (vi) Speed ranging from 500 - 1500 rpm.
- (vii) Thermal effi. is high.
- (viii) High noise & vibration.
- (ix) weight is more.
- (x) Pollution is less.
- (xi) More maintenance.