

Kapil Gupta
D.1 Batch
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LECTURE – 2

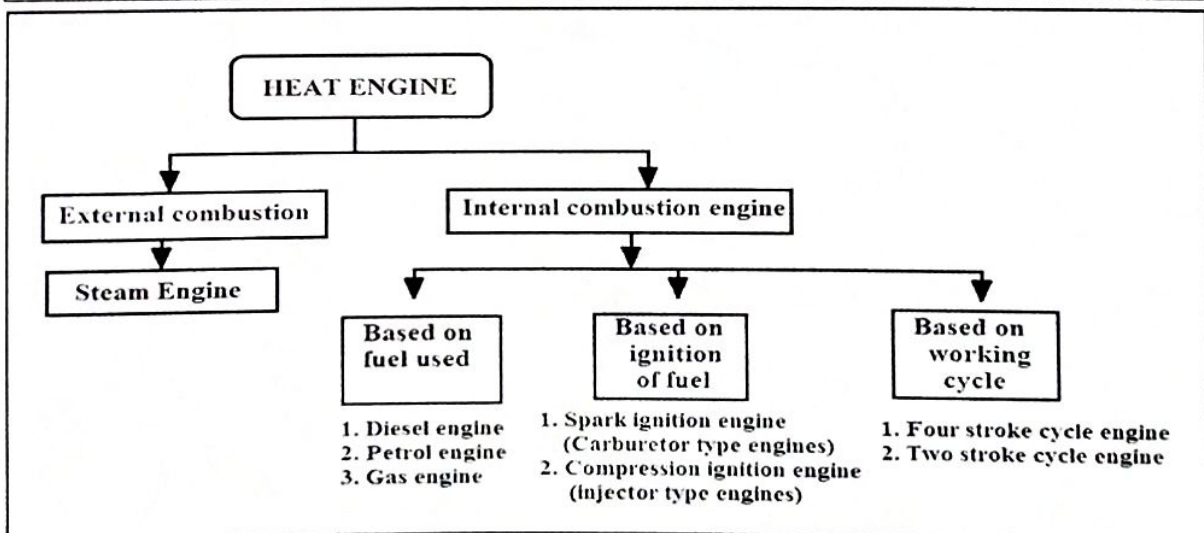
- I. C. Engines
- Working Principles of I.C. Engines
- Study of Different Components of I.C. Engines

Dr. SUSHILKUMAR N. BANSUDE

❖ HEAT ENGINE

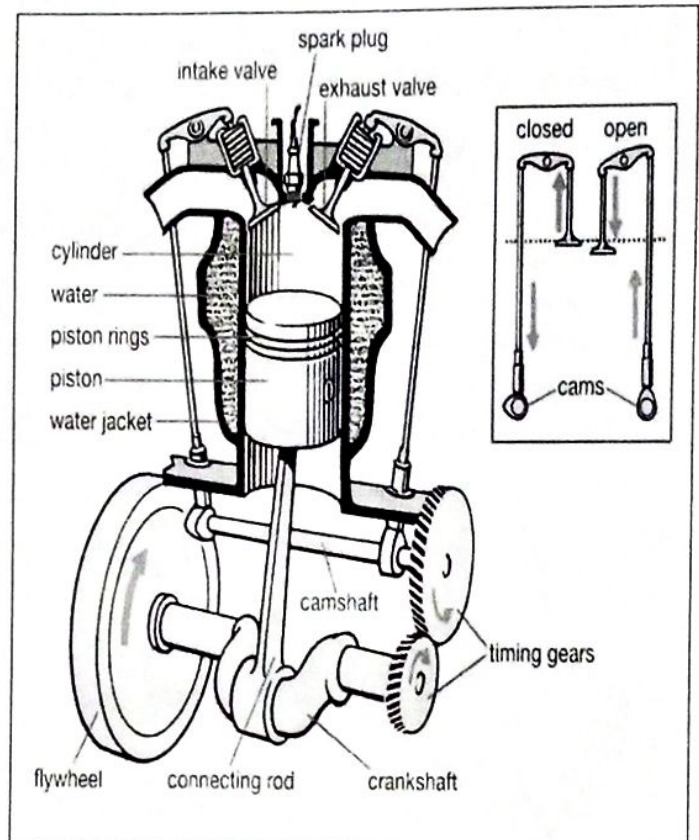
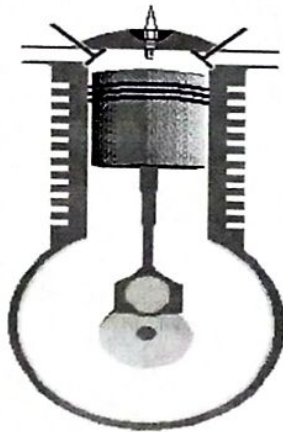
- Heat engine is a machine for converting heat (developed by burning fuel) into useful work.
- It can be said that heat engine is equipment which generates thermal energy and transforms it into mechanical energy.

❖ CLASSIFICATION OF HEAT ENGINES:



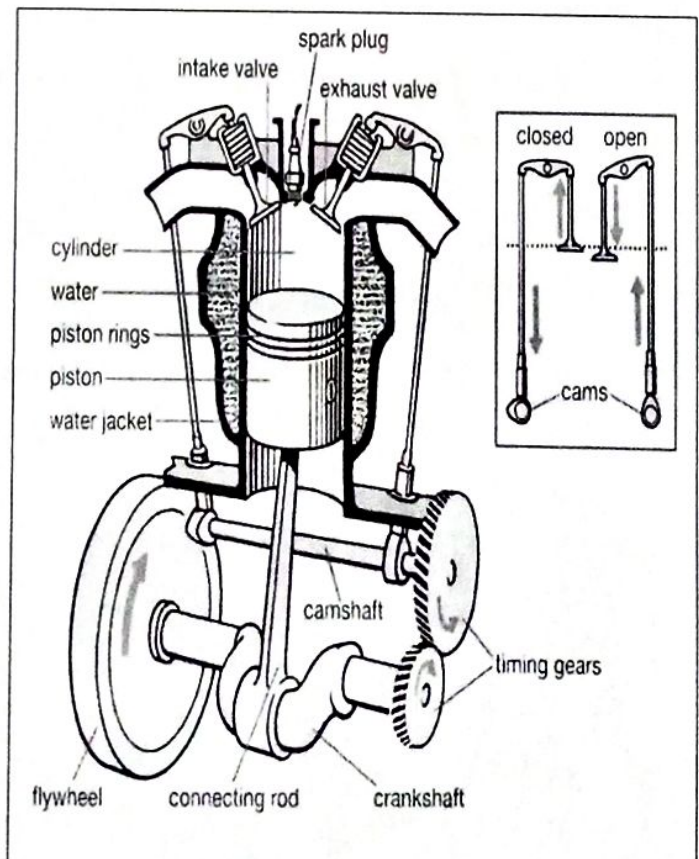
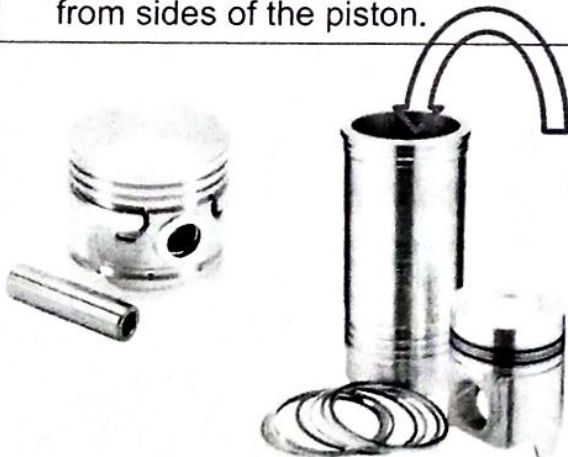
❖ CONSTRUCTION OF AN I.C. ENGINE:

- I.C. engine converts the reciprocating motion of piston into rotary motion of the crankshaft by means of a connecting rod.



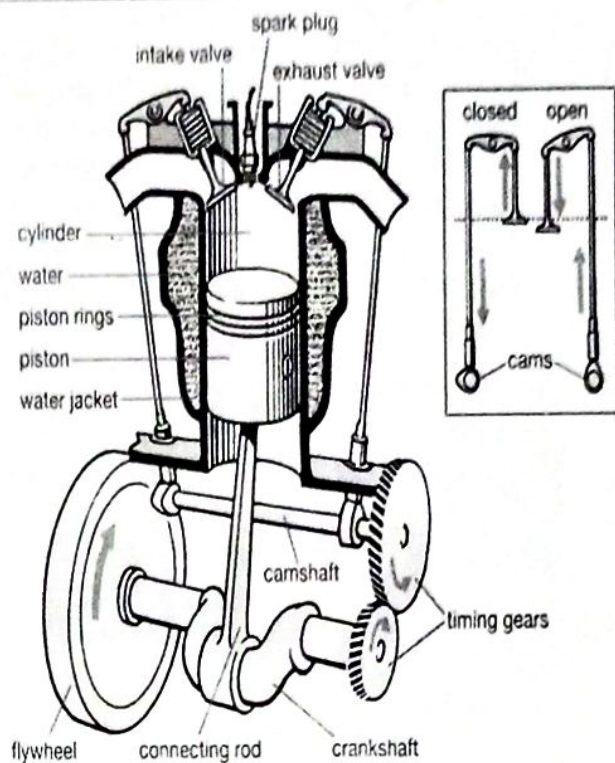
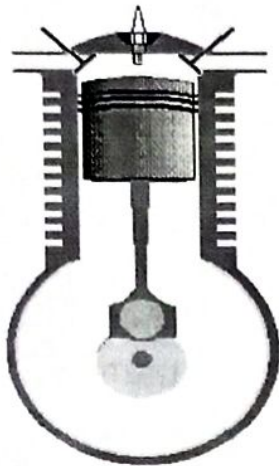
❖ CONSTRUCTION OF AN I.C. ENGINE:

- The piston which reciprocating in the cylinder is very close fit in the cylinder.
- Rings are inserted in the circumferential grooves of the piston to prevent leakage of gases from sides of the piston.



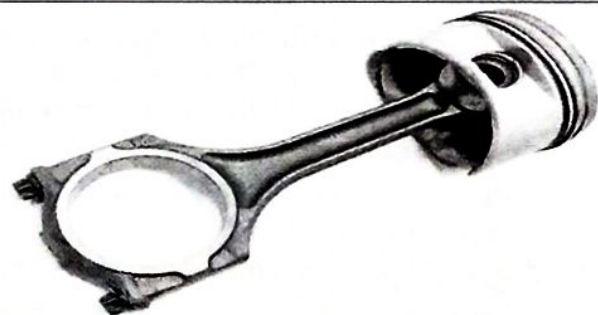
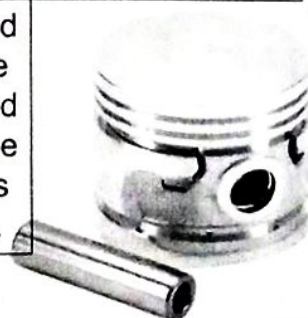
❖ CONSTRUCTION OF AN I.C. ENGINE:

- The combustion space is provided at the top of the cylinder head where combustion takes place.



❖ CONSTRUCTION OF AN I.C. ENGINE:

- The connecting rod connects the piston and the crankshaft.
- The end of the connecting rod connecting the piston is called small end.
- A pin called gudgeon pin or wrist pin is provided for connecting the piston and the connecting rod at the small end.
- The other end of the connecting rod connecting the crank shaft is called big end.



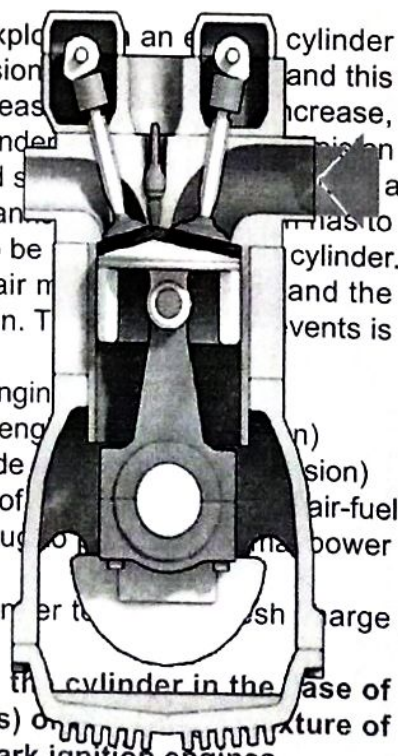
❖ CONSTRUCTION OF AN I.C. ENGINE:

- When piston is moved up and down, the motion is transmitted to the crank shaft by the connecting rod and the crank shaft makes rotary motion.
- The crankshaft rotates in main bearings which are fitted the crankcase.



❖ WORKING PRINCIPLE OF INTERNAL COMBUSTION ENGINE (I. C. ENGINE):

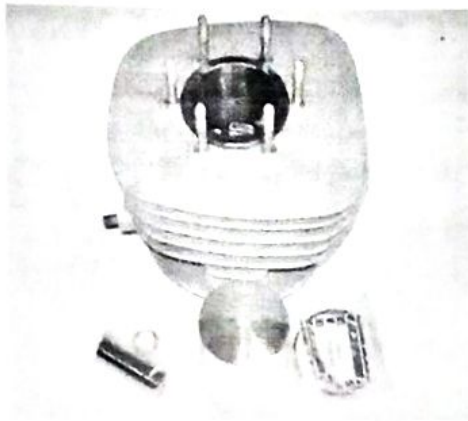
- A mixture of fuel with correct amount of air is exploded in a cylinder which is closed at one end. As a result of explosion, the pressure of the burning gases increases and this increase forces a close fitting piston to move down the cylinder. This motion is transmitted to a crankshaft by a connecting rod and a flywheel. To obtain continuous rotation of the crankshaft, the cycle must be repeated. Before this, the burnt gases have to be removed from the cylinder. At the same time the fresh charge of fuel and air must be returned back to its starting position. This cycle is known as working cycle.
- The sequence of events taking place inside the engine is as follows:
 1. Admission of air or air-fuel mixture inside the engine.
 2. Compression of the air or air fuel mixture inside the cylinder.
 3. Injection of fuel in compressed air for ignition of the mixture by an electric spark using a spark plug (power).
 4. Removal of all the burnt gases from the cylinder (exhaust).
- **Note:** Charge means admitting fresh air in to the cylinder in the case of compression ignition engines (diesel engines) or admitting a mixture of air and fuel in to the cylinder in the case of spark ignition engines.



❖ I.C. ENGINE COMPONENTS

1. Cylinder:

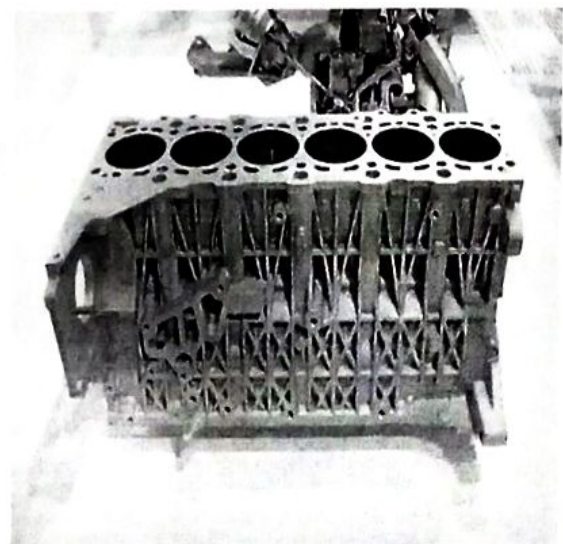
- It is a part of the engine which confines the expanding gases and forms the combustion space.
- It is the basic part of the engine.
- It provides space in which piston operates to suck the air or air-fuel mixture.
- The piston compresses the charge and the gas is allowed to expand in the cylinder, transmitting power for useful work.
- **Cylinders are usually made of high grade cast iron.**



❖ I.C. ENGINE COMPONENTS

2. Cylinder Block:

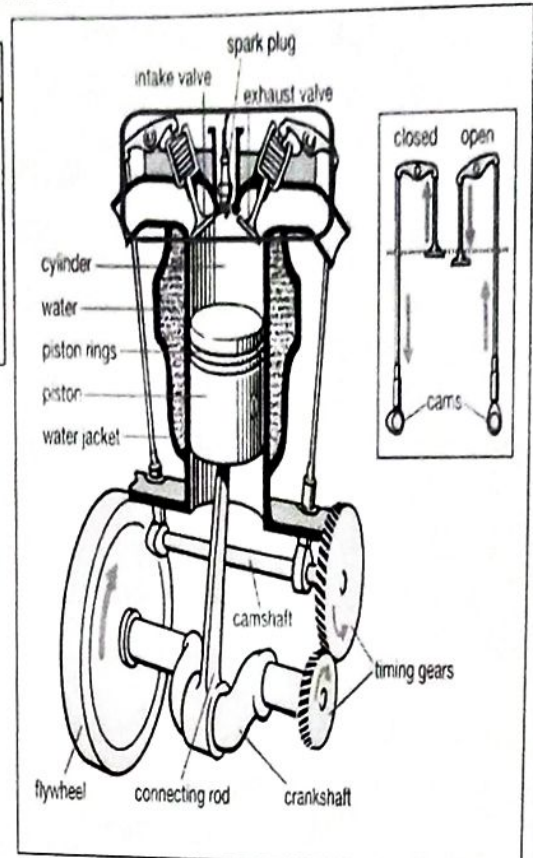
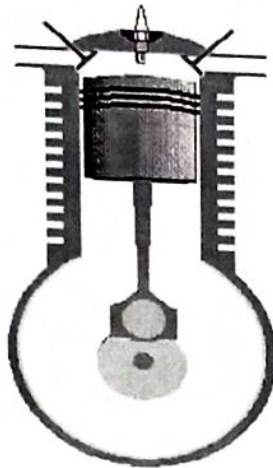
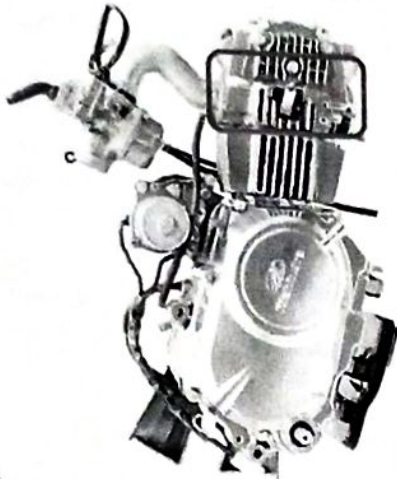
- It is the solid casting body which includes the cylinder and water jackets (cooling fins in the air cooled engines).



❖ I.C. ENGINE COMPONENTS

3. Cylinder Head:

- It is a detachable portion of an engine which covers the cylinder and includes the combustion chamber, spark plugs or injector and valves.



❖ I.C. ENGINE COMPONENTS

4. Cylinder liner or sleeve:

- It is a cylindrical lining either wet or dry type which is inserted in the cylinder block in which the piston slides.
- Liners are classified as: (1) Dry liner and (2) Wet liner.
- Dry liner makes metal to metal contact with the cylinder block casing. Wet liners come in contact with the cooling water, whereas dry liners do not come in contact with the cooling water.



❖ I.C. ENGINE COMPONENTS

5. Piston:

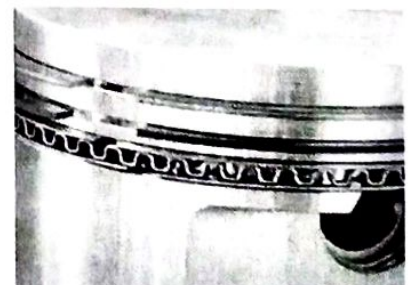
- It is a cylindrical part closed at one end which maintains a close sliding fit in the engine cylinder.
- It is connected to the connecting rod by a piston pin.
- The force of the expanding gases against the closed end of the piston, forces the piston down in the cylinder, this causes the connecting rod to rotate the crankshaft (Fig 3).
- **Pistons are usually made of Cast iron.** Cast iron is chosen due to its high compressive strength, low coefficient of expansion, resistance to high temperature, ease of casting and low cost.
- **Head (Crown) of piston:** It is the top of the piston.
- **Skirt:** It is that portion of the piston below the piston pin which is designed to absorb the side movements of the piston.



❖ I.C. ENGINE COMPONENTS

6. Piston Rings:

- It is a split expansion ring, placed in the groove of the piston.
- **They are usually made of cast iron or pressed steel alloy.**
- The functions of the piston rings are as follows:
 1. It forms a gas tight combustion chamber for all positions of piston.
 2. It reduces contact area between cylinder wall and piston wall for preventing friction losses and excessive wear.
 3. It controls the cylinder lubrication.
 4. It transmits the heat away from the piston to the cylinder walls.
- Piston rings are of two types:
 - a) **Compression ring and**
 - b) **Oil ring.**



❖ I.C. ENGINE COMPONENTS

7. Piston Pin:

- It is also called wrist pin or gudgeon pin.
- Piston pin is used to join the connecting rod to the piston.
- It provides a flexible or hinge like connection between the piston and the connecting rod.
- It is usually made of case hardened alloy steel.

8. Connecting rod:

- It is a special type of rod, one end of which is attached to the piston and the other end to the crankshaft.
- It transmits the power of combustion to the crankshaft and makes it rotate continuously.
- It is usually made of drop forged steel.



❖ I.C. ENGINE COMPONENTS

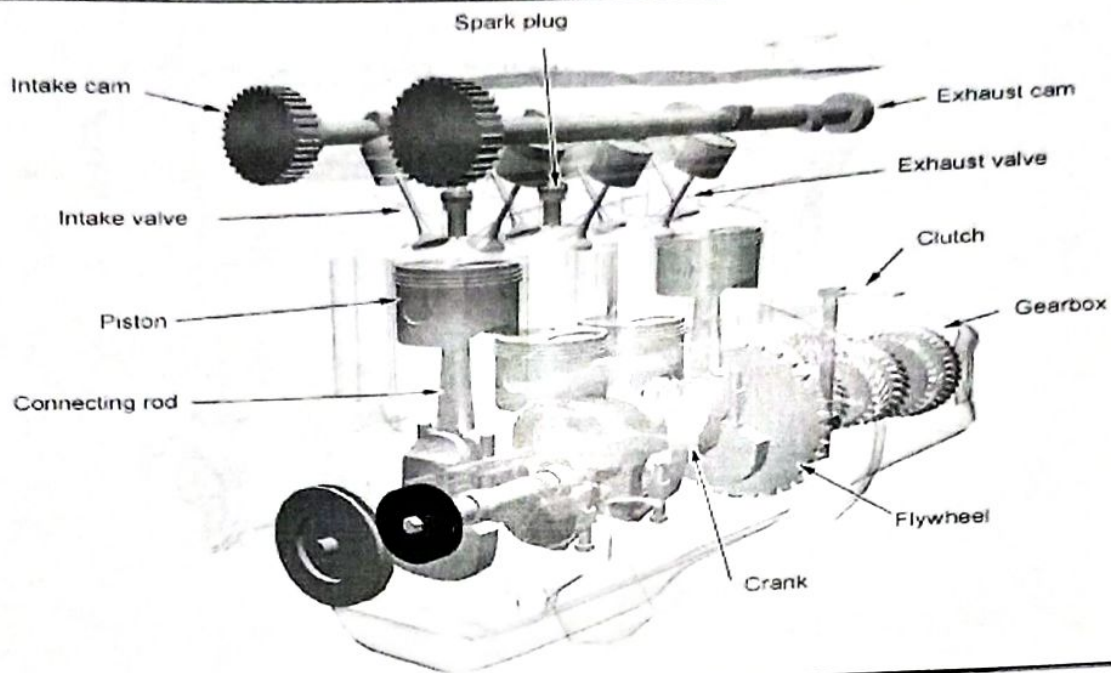
9. Crankshaft:

- It is the main shaft of an engine which converts the reciprocating motion of the piston into rotary motion of the flywheel.
- Usually the crankshaft is made of drop forged steel or cast steel.
- The space that supports the crankshaft in the cylinder block is called *main journal*, whereas the part to which connecting rod is attached is known as *crank journal*.



❖ I.C. ENGINE COMPONENTS

10. Fly Wheel:



❖ I.C. ENGINE COMPONENTS

11. Crankcase:

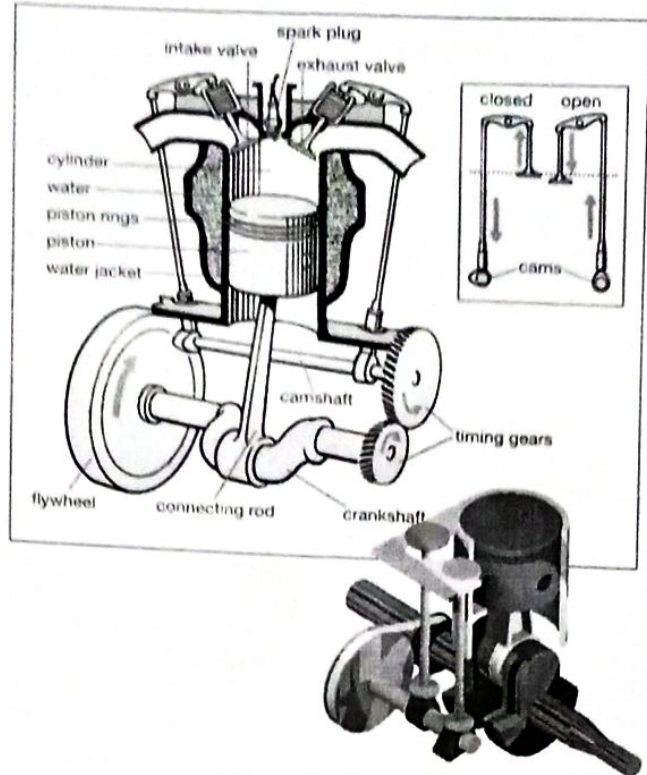
- The crankcase is that part of the engine which supports and encloses the crankshaft and camshaft.
- It provides a reservoir for the lubricating oil.
- It also serves as a mounting unit for such accessories as the oil pump, oil filter, starting motor and ignition components.
- The upper portion of the crankcase is usually integral with cylinder block.
- The lower part of the crankcase is commonly called oil pan and is usually made of cast iron or cast aluminum.



❖ I.C. ENGINE COMPONENTS

12. Camshaft:

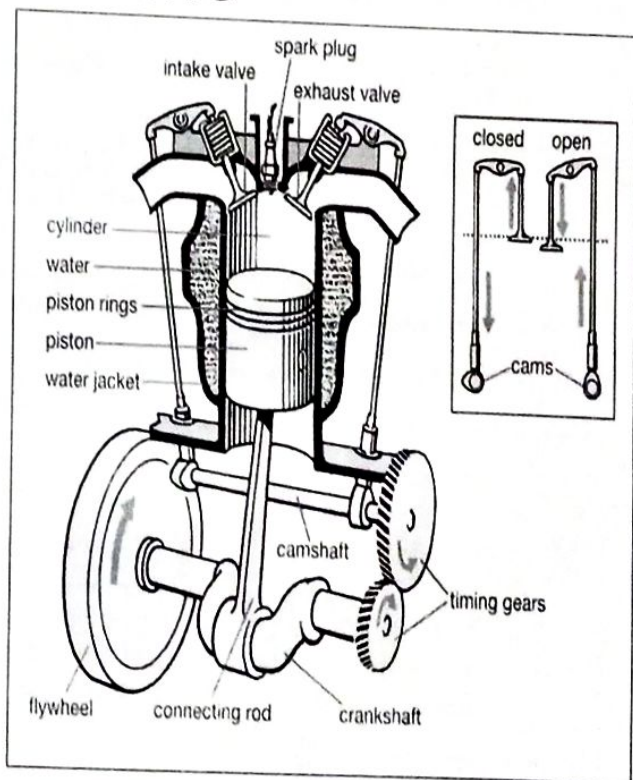
- It is a shaft which raises and lowers the inlet and exhaust valves at proper times.
- Camshaft is driven by crankshaft by means of gears, chains or sprockets.
- The speed of the camshaft is exactly half the speed of the crankshaft in four stroke engine.
- Camshaft operates the ignition timing mechanism, lubricating oil pump and fuel pump.
- It is mounted in the crankcase, parallel to the crankshaft.



❖ I.C. ENGINE COMPONENTS

13. Timing Gears:

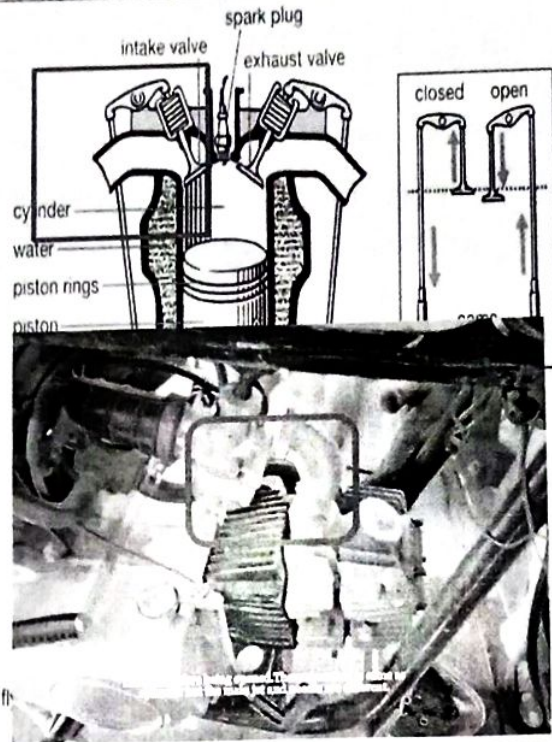
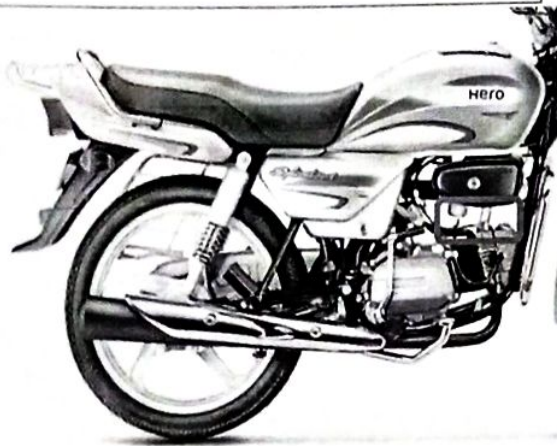
- Timing gear is a combination of gears, one gear of which is mounted at one end of the camshaft and the other gear at the crankshaft.
- Camshaft gear is bigger in size than that of the crankshaft gear and it has twice as many teeth as that of the crankshaft gear.
- For this reason, this gear is commonly called **half time gear**.
- Timing gear controls the timing of ignition, timing of opening and closing of valve as well as fuel injection timing.



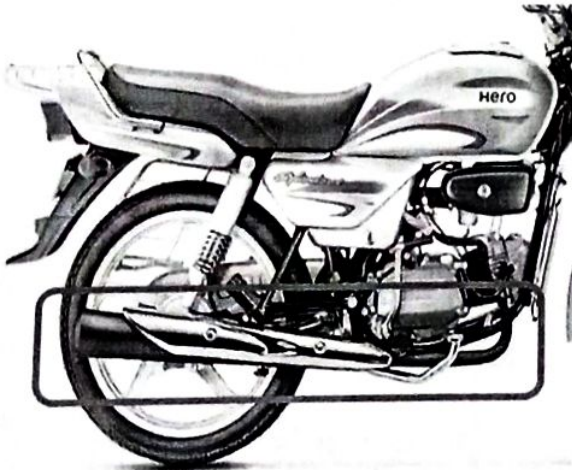
❖ I.C. ENGINE COMPONENTS

14. Inlet Manifold :

- It is that part of the engine through which air or air-fuel mixture enters into the engine cylinder. It is fitted by the side of the cylinder head.

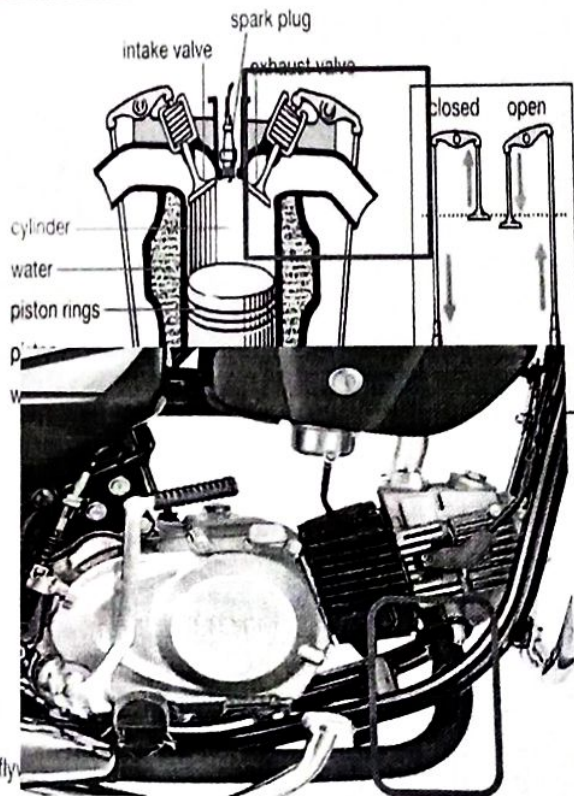


❖ I.C. ENGINE COMPONENTS



15. Exhaust Manifold

- It is that part of the engine through which exhaust gases go out of the engine cylinder. It is capable of withstanding high temperature of burnt gases. It is fitted by the side of the cylinder head.



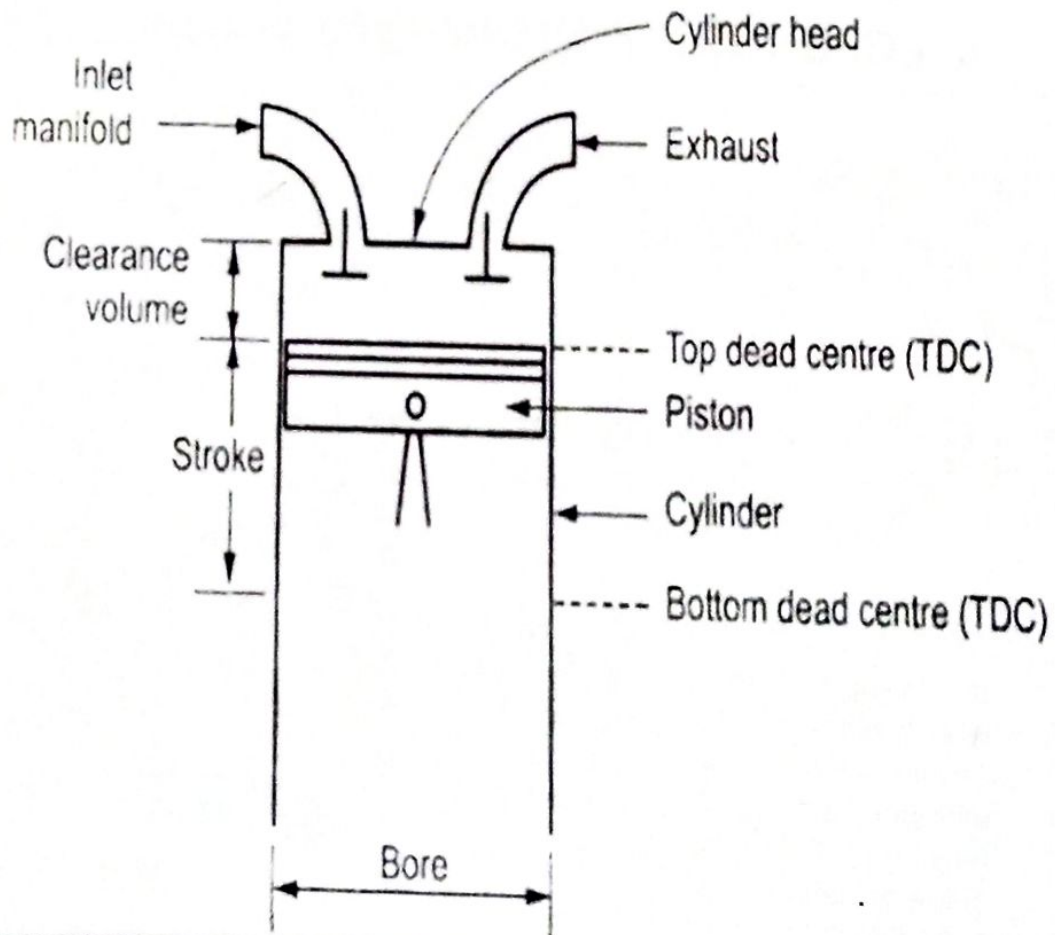
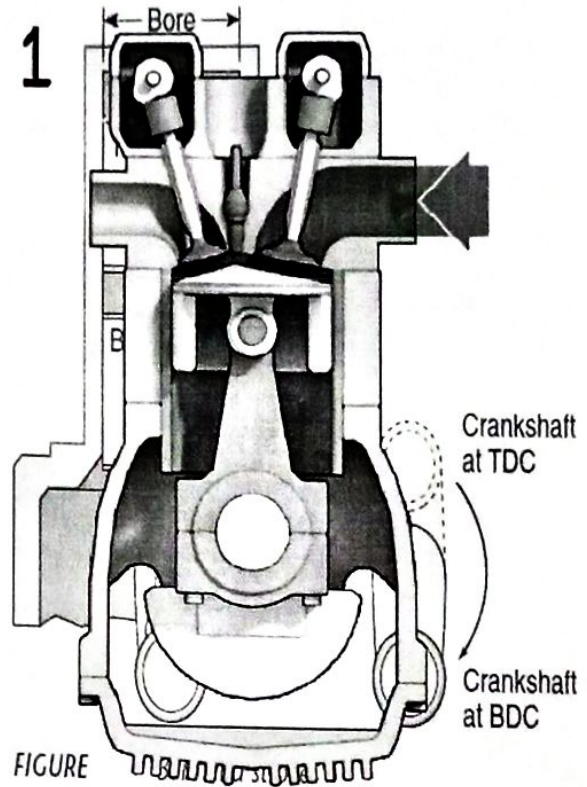
❖ I.C. ENGINE COMPONENTS

Top dead centre

- When the piston is at the top of its stroke, it is said to be at the top dead centre (TDC)

Bottom dead centre

- When the piston is at the bottom of its stroke, it is said to be at its bottom dead centre (BDC).
- In two stroke cycle engines both the sides of the piston are effective which not the case in four strokes cycle engine.



❖ I.C. ENGINE COMPONENTS

Scavenging

- The process of removal of burnt or exhaust gases from the engine cylinder is known as scavenging.
- Entire burnt gases do not go out in normal stroke, hence some type of blower or compressor is used to remove the exhaust gases in two stroke cycle engine.

