

PRACTICAL: 1
INTRODUCTION TO IC ENGINES

AIM: - Introduction to IC Engines

Apparatus: - Models of 2-Stroke / 4-Stroke Petrol and Diesel Engines.

Theory: - The working Principle of Engines.

- **Four Stroke (S.I) Engine.**

In a four stroke engine, the cycles of operations is completed in 4 strokes of piston or 2 revolution of crank shaft. Each stroke consists of 180° & hence the fuel cycle consists of 720° of crank rotation. The 4-Stroke are: -

- **Suction or Intake Stroke:** - In starts at, when the piston is at top dead centre & about to move downwards. The inlet valve is open at that time and exhaust valve is closed due to suction created by the motion of the piston towards the bottom dead centre, the charge containing air fuel mixture is drawn into the cylinder. When the piston reaches BDC the suction stroke ends and inlet valve is closed.
- **Compression Stroke:** - The charge taken into the cylinder during suction stroke is compressed by return stroke of piston. During this stroke both the valves are closed. The mixture which fills the entire cylinder volume is now compressed into the clearance volume. At the end, the mixture is ignited with the help of electrode of spark plug. During the burning process the chemical energy of fuel is converted to heat energy. The pressure is increased in the end due to heat release.
- **Expansion Stroke:** - The burnt gases escape out and the exhaust valve opens but inlet valve remaining closed the piston moves from BDC to TDC and sweeps the burnt gases out at almost atmospheric pressure. The exhaust valve gets closed at the end of this stroke. Thus, for one complete cycle of engine, there is only one power stroke while crank shaft makes 2 revolutions.
- **Exhaust Stroke:** - During the upward motion of the piston, the exhaust valve is open and inlet valve is closed. The piston moves up in cylinder pushing out the burnt gases through the exhaust valve. As the piston reaches the TDC, again the inlet valve opens and fresh charge is taken in during next downward movement of the piston and the cycle is repeated.

2-Stroke (S.I) Engines.

In a 2-Stroke engine, the filling process is accompanied by the charge compressed in a crank case or by a blower. The induction of compressed charge moves out the product of combustion through exhaust ports. Therefore, no piston stroke is required. For these 2-strokes one for compression of fresh charge and second for power stroke.

The charge conducted into the crank case through the spring loaded valve when the pressure in the crank case is reduced due to upward motion of piston during the compression stroke. After the compression & ignition expansion takes place in usual way.

During the expansion stroke the charge in crankcase is compressed. Near the end of the expansion stroke, the piston uncovers the exhaust ports and the cylinder pressure drops to atmosphere pressure as combustion produced leave the cylinder.

Construction Details

- **Cylinder:** - It is a cylindrical vessel or space in which the piston makes a reciprocating produces.

- **Piston**: - It is a cylindrical component fitted into the cylinder forming the moving boundary of combustion system. It fits in cylinder perfectly.
- **Combustion Chamber**: - It is the space enclosed in the upper part of cylinder, by the cylinder head & the piston top during combustion process.
- **Inlet Manifold**: - The pipe which connects the intake system to the inlet valve of engine.
- **Exhaust Manifold**: - The pipe which connects the exhaust system to the exhaust valve of engine.
- **Inlet / Exhaust Valves**: - They are provided on the cylinder head to head to regulate the charge coming into or going out of the chamber.
- **Spark Plug**: - It is used to initiate the combustion process in S.I engines.
- **Connected Rod**: - It connects piston & the crank shaft.
- **Crank shaft**: - It converts the reciprocating motion of the piston into useful rotary motion of output shaft.
- **Gudgeon pins**: - It forms a link between connection rod and the piston.
- **Cam shaft**: - It controls the opening & closing of the valves.
- **Cam**: - They open the valves at the correct times.
- **Carburetor**: - Used in S.I engine for atomizing & vaporizing and mixture it with air in varying proportion.

Four Stroke (C.I.) Engine.

In four strokes C.I. Engine compression ratio is from 16 to 20. During suction stroke air is inducted. In C.I. engines high pressure. Fuel pump and injectors are provided to inject the fuel into combustion chamber and ignition chamber system is not necessary.

Construction Details

1. **Suction**: - During suction stroke, air is inducted through inlet valve.
2. **Compression**: - The air inducted is compressed into the clearance volume.
3. **Expansion**: - Fuel injection starts nearly at the end of the compression stroke. The rate of injection is such that the combustion maintains the pressure constant inspired of piston movement on its expansion stroke increasing the volume. After injection of fuel, the products of combustion chamber expand.
4. **Exhaust**: - The piston traveling from BQC to TDC pushes out the products of combustion out of cylinder.

Two Stroke (C.I.) Engine.

In two stroke engines, the cycle is completed in one revolution of the crankshaft. In 2-stroke engine, the filling process is accomplished by the charge compressed in crankcase or by a blower. The induction of compressed charge moves out of the exhaust ports. Therefore, no piston strokes are required for these 2 operations. Two strokes are sufficient to complete the cycle one for compressing the fresh charge and other for expansion or power stroke.

1. **Compression**: - The air or charge is inducted into the crankcase through the spring loaded inlet valve when the pressure in crankcase is reduced due to upward motion of piston.

2. **Expansion**: - During this, the charge in the crankcase is compressed. At the end the piston uncovers the exhaust ports and cylinder pressure drops to the atmospheric

pressure. Further movement of piston opens the transfer ports, permitting the slightest compressed charge in the crankcase to enter the engine cylinder.

Construction Details

1. **Cylinder**: - In it the piston makes a reciprocating process motion.
2. **Piston**: - It is a cylindrical component fitted into the cylinder forming the moving boundary of the combustion system. It fits into cylinder.
3. **Combustion Chamber**: - The space enclosed in the upper part of the cylinder, by the head and the piston top during the combustion process.
4. **Inlet/ Outlet ports**: - They are provided on the side of cylinder to regulate the charge coming in and out of cylinder.
5. **Fuel Injector**: - It injects the fuel in combustion chamber to initiate combustion process for power stroke.
6. **Connecting Rod**: - It interconnects crank shaft and the piston.

Fly Wheel: - The net torque imparted to the crankshaft during one complete cycle of operation of the engine fluctuates causing change in angular velocity of shaft. In order to achieve uniform torque an internal mass is attached to the output shaft & this is called as fly wheel.

EXERCISE

1. Explain the Classification of IC Engines.
2. Describe the working principle of 2-Stroke petrol Engine?
3. Describe the working principle of 4-Stroke petrol Engine?
4. What is the main difference between 2-Stroke Petrol Engine and 4-Stroke Petrol Engine?
5. Describe the working principle of 2-Stroke Diesel Engine?
6. Describe the working principle of 4-Stroke Diesel Engine?
7. Explain the thermodynamic Analysis of IC engine.
8. State the comparison between SI and CI engines on the basis of thermodynamic and operating variables.