

UNIT - 2

I.C. ENGINES

2.0. Introduction:

In general heat Engines are defined as a device which transforms the chemical energy of a fuel into thermal energy and utilizes this thermal energy to perform useful work.

Types of Engines:

In general the Engines are two types, based on the location of combustion process taking place.

External combustion Engines:

If the process of combustion is taking place outside of the Engine, then it is External combustion Engines.

Eg : Steam Engines, Coal fired power plants , Stirling Engines etc.

Internal combustion Engines:

If the process of combustion is taking place inside of the Engine, then it is Internal combustion Engines.

Eg: Petrol Engines, Diesel Engines etc.

Classification of IC Engines:

Based on Various aspects the IC Engines are classified into different types.

1. Type of Ignition used :
 - A) Spark Ignition (SI) Engine,
 - B) Compression Ignition (CI) Engine,
 - C) Hot-Spot Ignition Engine.
2. Type of fuel used :
 - A) Petrol or Gasoline Engine.
 - B) Diesel Engine.
 - C) Gas Engine.
3. Number of Stroke per cycle :
 - A) Two Stroke Engine,
 - B) Four Stroke Engine.

4. Type of Cooling system :
 - A) Air Cooled Engine,
 - B) Water Cooled Engine,
 - C) Evaporative Cooling Engine.
5. Cycle of operation
 - A) Otto Cycle Engine,
 - B) Diesel Cycle Engine,
 - C) Dual Combustion Cycle or Semi Diesel Cycle Engine.
6. Method of Fuel Injection :
 - A) Carburetor Engine,
 - B) Air injection Engine,
 - C) Airless or Solid injection Engine.
7. Arrangement of cylinders :
 - A) Vertical Engine,
 - B) Horizontal Engine,
 - C) Radial Engine,
 - D) V- Engine,
 - E) Opposed Cylinder Engine.
 - F) Opposed Piston Engine.
8. Applications :
 - A) Stationary Engine,
 - B) Automotive Engine,
 - C) Marine Engine,
 - D) Aircraft Engine,
 - E) Locomotive Engine.
9. Valve location :
 - A) Overhead Valve Engine,
 - B) Side Valve Engine.
- 10.Speed :
 - A) Low Speed Engine,
 - B) High Speed Engine,
 - C) Medium Speed Engine.

11. Method of Governing :

- A) Hit and Miss Governed Engine,
- B) Qualitatively Governed Engine,
- C) Quantitatively Governed Engine.

2.3 Two-stroke Petrol Engine:

In two-stroke Petrol Engine, two strokes are present. One is upward stroke and other is downward stroke. In this Engine piston moving two times and crank shaft moving one time. It has inlet port, exhaust port and transfer port.

1. Upward Stroke:

Piston moving from bottom dead center to top dead center. The inlet port open. The air-fuel mixture enter into the crank case. The exhaust port and transfer port are closed. The air-fuel mixture in the cylinder is compressed when the piston moving upwards. When the piston coming to top dead center the compressed air-fuel mixture is ignited by using spark plug. Then the power is generated.

2. Downward Stroke:

When the air-fuel mixture is ignited the hot gases are produced in the cylinder. The hot gases makes pressure on the piston. Then the piston moving downward. The inlet port closed and the exhaust and transfer ports are open. The hot gases goes to the atmosphere through exhaust port. The air-fuel mixture present in the crank case goes to the cylinder through transfer port.

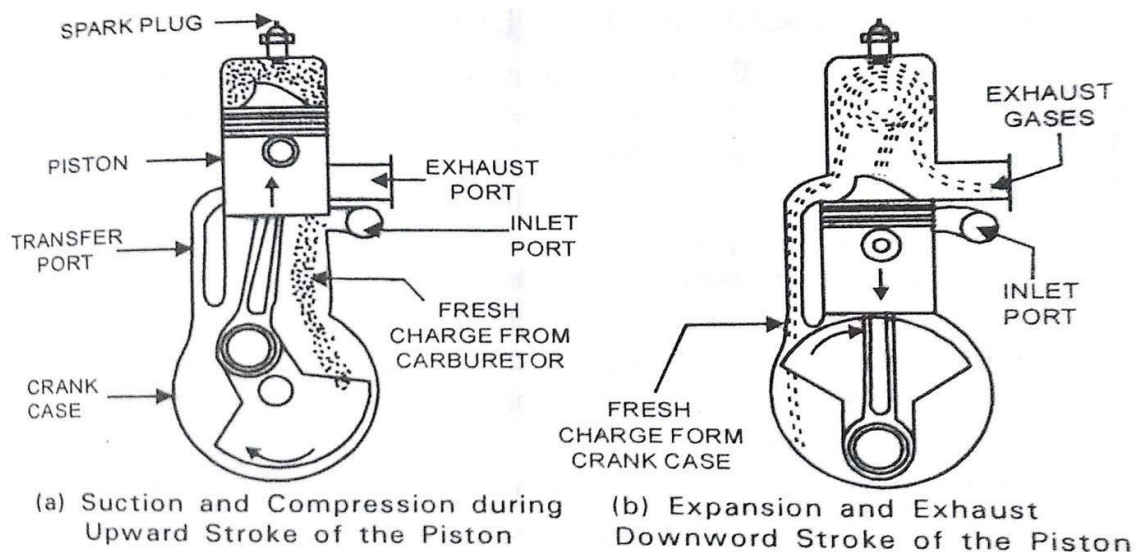


Fig 2.1 Working of 2 Stroke Engine

Four Stroke Petrol Engine:

Petrol Engine is also known as spark ignition Engine. The Engine cycle is completed in two revolutions of crank shaft and piston is moving four times.

The four strokes are

1. Suction Stroke
2. Compression Stroke
3. Power Stroke (or) Expansion Stroke
4. Exhaust Stroke.

1. Suction Stroke:

During the suction stroke inlet valve open and exhaust valve closed. The piston moving downwards and create partial vacuum in the cylinder. Due to pressure difference, The air-fuel mixture is sucked into the Engine cylinder. The crank shaft completes half of the revolution.

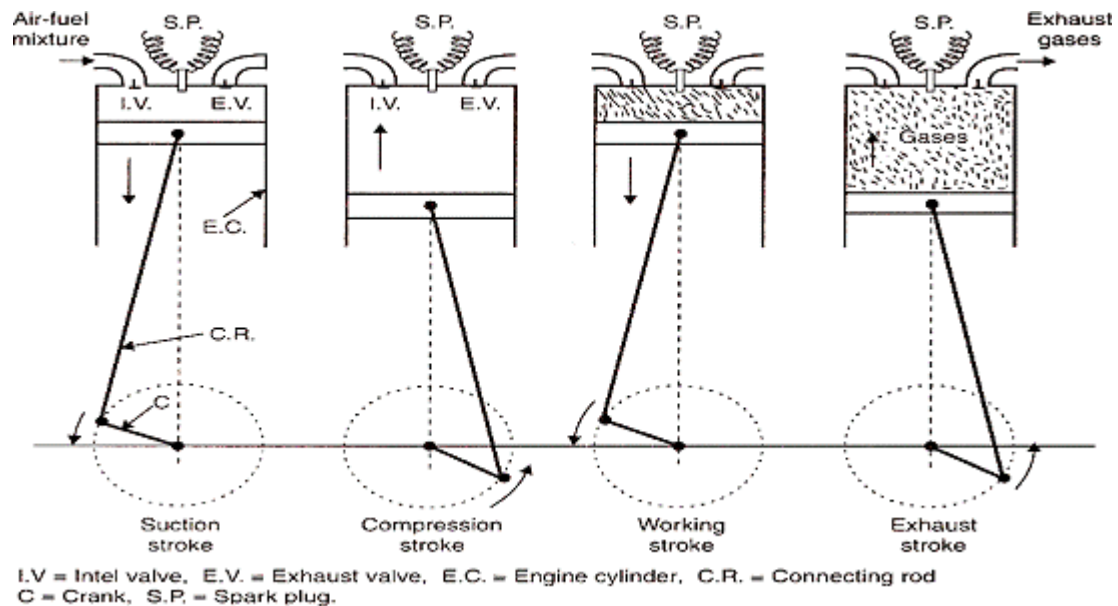


Fig 2.2 Working of 4 Stroke Petrol Engine

2. Compression Stroke:

During compression stroke, the inlet valve and exhaust valves are closed. The piston moving upwards and compress the charge to required pressure and temperature. At the end of the compression stroke, the charge is ignited by spark plug. The crank shaft completes half of the revolution.

3. Power Stroke (or) Expansion stroke:

During power stroke, the inlet valve and exhaust valves are closed. The piston moving downwards, in this stroke power is produced. The crank shaft completes half of the revolution.

4. Exhaust Stroke:

During exhaust stroke, exhaust valve is open and the inlet valve is closed. Piston moving upwards. The hot gases present in the cylinder are goes out through the exhaust valve. The crank shaft completes half of the revolution.

Four Stroke Diesel Engine:

The four stroke Diesel Engine works on Diesel cycle And the process of combustion is compression ignition.

The four strokes of Diesel Engine are

1. Suction stroke
2. Compression stroke
3. Power or Expansion stroke
4. Exhaust stroke

The piston moves four times and Crank shaft makes two revolutions.

Four-stroke cycle (Diesel)

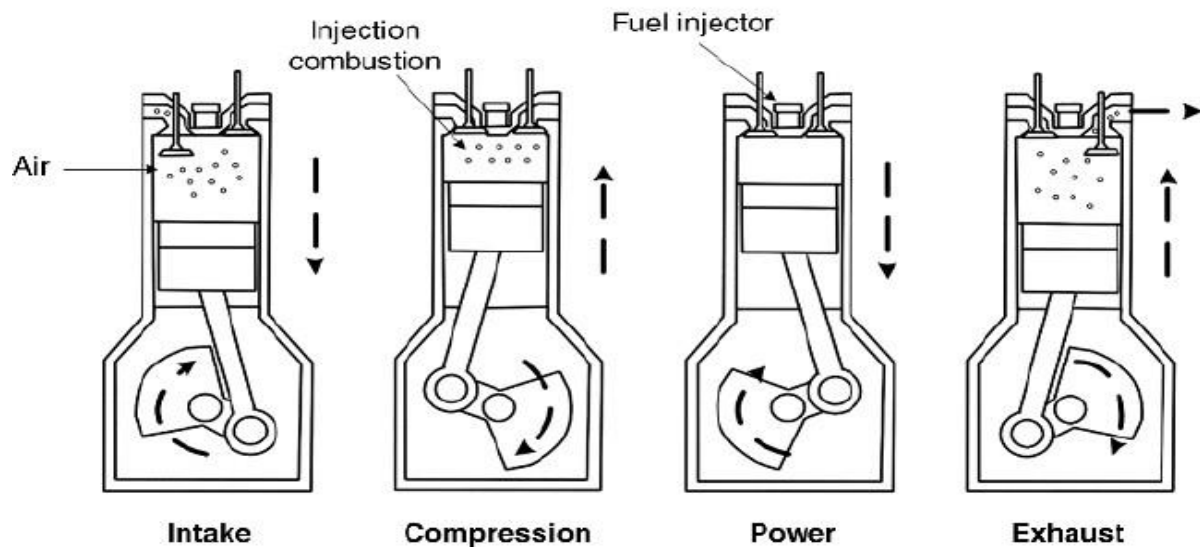


Fig 2.3 Working 4 S Diesel Engine

1. Suction Stroke:

In Suction stroke the piston moving from the top dead center to bottom dead center. The inlet valve open and outlet valve closed. The fresh air enter into the cylinder through inlet valve.

2. Compression Stroke:

In compression stroke, the piston moving from bottom dead center to top dead center. The inlet valve and outlet valves are closed. The air is compressed. At the end of the compression stroke, Fuel is injected into the cylinder by fuel injector. Ignition is taken place.

3. Power or Expansion Stroke:

In this stroke the piston moving from top dead center to bottom dead center. The inlet and outlet valves are closed. The power is generated.

4. Exhaust Stroke:

In Exhaust stroke the piston moving from bottom dead center to top dead center. The inlet valve closed and the outlet valve open. The hot gases go out through the outlet valve.

COMPARISION OF TWO-STROKE AND FOUR STROKE PETROL ENGINE:

S. No	TWO-STROKE PETROL ENGINE	FOUR-STROKE PETROL ENGINE
1.	In this ports are provided. The ports are opened and closed by piston.	In this valves are provided. The valves are operated by cam mechanism.
2.	The charge first enter into the crank case then goes to the cylinder through transfer port.	The charge is directly admitted into the Engine cylinder through inlet valve.
3.	All events are in two-strokes of the piston or one revolution of the crank shaft.	All events are completed in four-strokes of the piston or two revolutions of crank shaft.
4.	Torque is more uniform and requires lighter fly-wheel	Torque is not uniform and require heavy fly-wheel.
5.	Volumetric efficiency is low due to less time for suction.	Volumetric efficiency is mire due to more time for suction.
6.	Elimination of suction and exhaust strokes minimize the frictional loses.	More frictional loses.
7.	Thermal efficiency is lower	Thermal efficiency is higher.
8.	Consumes more lubricating oil.	Consumes less lubricating oil.
9.	More wear and tear and more noisy in operation.	Less wear and tear and les noisy in operation.
10	Generally employed in light duty vehicles such as scooters, motor cycles and hand sprayers.	Generally employed in heavy duty vehicles such as cars, buses, trucks, tractor and power generating units.
11	Engine cost is less.	Engine cost is more.

COMPARISION OF PETROL ENGINE AND DIESEL ENGINE:

S. No	PETROL ENGINE	DIESEL ENGINE
1.	Petrol Engine works on the principle of Otto cycle.	Diesel Engine works on the principle of Diesel cycle.
2.	Petrol and gases fuels are used.	Diesel And heavy oils are used.
3.	Mixture of air and fuel is drawn during suction stroke.	Only air is drawn during suction stroke.
4.	Requires Carburetor.	Requires fuel-injection pump.
5.	Spark plug is used to ignite the charge.	Fuel injector is used for ignition.
6.	Lighter due to low compression ratio.	Heavier due to high compression ratio.
7.	The initial cost is low.	The initial cost is high.
8.	Volumetric efficiency is less.	Volumetric efficiency is low.
9.	Wear and tear is more.	Wear and tear is less.
10	It makes less noise.	It makes more noise.
11.	Throttle is present	Governor is present.

Scavenging of I.C. Engine:

In an internal combustion Engine, scavenging is the process of replacing the exhaust gas in a cylinder with the fresh air/fuel mixture (or fresh air, in the case of direct-injection Engines) for the next cycle. If scavenging is incomplete, the remaining exhaust gases can cause improper combustion for the next cycle, leading to reduced power output.

The three main types of scavenging for two stroke Engines are cross flow, uniflow and loop flow.

Detonation in IC Engine:

Knocking (also knock, detonation, spark knock, pinging or pinking) in spark ignition internal combustion Engines occurs when combustion of some of the air/fuel mixture in the cylinder does not result from propagation of the flame front ignited by the spark plug, but one or more pockets of air/fuel mixture explode outside the envelope of the normal combustion front. The fuel-air charge is meant to be ignited by the spark plug only, and at a precise point in the piston's stroke. Knock occurs when the peak of the combustion process no longer occurs at the optimum moment for the four-stroke cycle. The shock wave

creates the characteristic metallic "pinging" sound, and cylinder pressure increases dramatically. Effects of Engine knocking range from inconsequential to completely destructive.

Definition for Bore and Stroke:

The inner diameter of the cylinder is called bore. Stroke is the distance of the piston travelled in the cylinder.

Short Answer Questions

1. Write the classification of IC engines according to the operation.
2. Write the classification of IC engines according to the method of fuel injection.
3. Write the classification of IC engines according to the method of governing.
4. Write the parts of 4-stroke engine.
5. Explain Bore & stroke.
6. Explain scavenging.

Long Answer Questions

1. Write the classification of IC engines.
2. Explain the working of 2-stroke petrol engine with neat sketch.
3. Explain the working of 4-stroke petrol engine with neat sketch.
4. Explain the working of 4-stroke diesel engine with neat sketch.
5. Write the comparison of 2-stroke & 4-stroke engine.
6. Write the comparison of petrol & diesel engine.