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COMPARISON BETWEEN TWO STROKE AND FOUR STROKE ENGINES

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ABSTRACT

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. Here, the working medium, the steam, is generated in a boiler, located outside the engine and allowed in to the cylinder to operate the piston to do mechanical work. In internal combustion engine, the combustion of fuel takes place inside the engine cylinder and heat is generated within the cylinder. This heat is added to the air inside the cylinder and thus the pressure of the air is increased tremendously. This high pressure air moves the piston which rotates the crank shaft and thus mechanical work is done.

1. INTRODUCTION

1.1 Based on fuel used

1.1.1 Diesel engine – Diesel is used as fuel
1.1.2 Petrol engine – Petrol is used as fuel
1.1.3 Gas engines – propane, butane or methane gases are used

1.2 Based ignition of fuel

1.2.1 Spark ignition engine – a mixture of air and fuel is drawn in to the engine cylinder. Ignition of fuel is done by using a spark plug. The spark plug produces a spark and ignites the air- fuel mixture. Such combustion is called constant volume combustion (C.V.C.).

1.2.2 Compression ignition engine – In compression ignition engines air is compressed in to the engine cylinder,. Due to this the temperature of the compressed air rises to 700-900 C. At this stage diesel is sprayed in to the cylinder in fine particles. Due to a very high temperature, the fuel gets ignited. This type of combustion is called constant pressure combustion (CP.C.) because the pressure inside the cylinder is almost constant when combustion is taking place.

1.3 Based on working cycle

1.3.1 Four stroke cycle engine - When the cycle is completed in two revolutions of the crankshaft, it is called four stroke cycle engines.

1.3.2 Two stroke cycle engine. - When the cycle is completed in one revolution of the crankshaft, it is called two stroke cycle engines

2. CONSTRUCTION OF AN IC ENGINE

I.C. engine converts the reciprocating motion of piston into rotary motion of the crankshaft by means of a connecting rod. 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. Usually a cylinder is bored in a cylinder block and a gasket, made of copper sheet or asbestos is inserted between the cylinder and the cylinder head to avoid ant leakage. The combustion space is provided at the top of the cylinder head where combustion takes place. 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. 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. A flywheel is provided at one end of the crankshaft for smoothing the uneven torque produced by the engine. There is an oil sump at the bottom of the engine which contains lubricating oil for lubricating different parts of the engine.

3. WORKING PRINCIPLE OF I.C. ENGINE/ FOUR STROKE CYCLE ENGINE / TWO STROKE CYCLE ENGINE

A mixture of fuel with correct amount of air is exploded in an engine cylinder which is closed at one end. As a result of this explosion, heat is released and this heat causes the pressure of the burning gases to increase. This pressure forces a close fitting piston to move down the cylinder. The movement of piston is transmitted to a crankshaft by a connecting rod so that the crankshaft rotates and turns a flywheel connected to it. Power is taken from the rotating crank shaft to do mechanical work. To obtain continuous rotation of the crankshaft the explosion has to be repeated continuously.

Before the explosion to take place, the used gases are expelled from the cylinder, fresh charge of fuel and air are admitted in to the cylinder and the piston moved back to its starting position. The sequences of events taking place in an engine is called the working cycle of the engine. The sequence of events taking place inside the engine are as follows

1. Admission of air or air-fuel mixture inside the engine cylinder (suction)
2. Compression of the air or air fuel mixture inside the engine (compression)
3. Injection of fuel in compressed air for ignition of the fuel or ignition of air-fuel mixture by an electric spark using a spark plug to produce thermal power inside the cylinder (power)
4. Removal of all the burnt gases from the cylinder to receive fresh charge (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.

4. FOUR STROKE CYCLE ENGINE (DIESEL/ PETROL ENGINE)

In four stroke cycle engines the four events namely suction, compression, power and exhaust take place inside the engine cylinder. The four events are completed in four strokes of the piston (two revolutions of the crank shaft). This engine has got valves for controlling the inlet of charge and outlet of exhaust gases. The opening and closing of the valve is controlled by cams, fitted on camshaft. The camshaft is driven by crankshaft with the help of suitable gears or chains. The camshaft runs at half the speed of the crankshaft. The events taking place in I.C. engine are as follows:

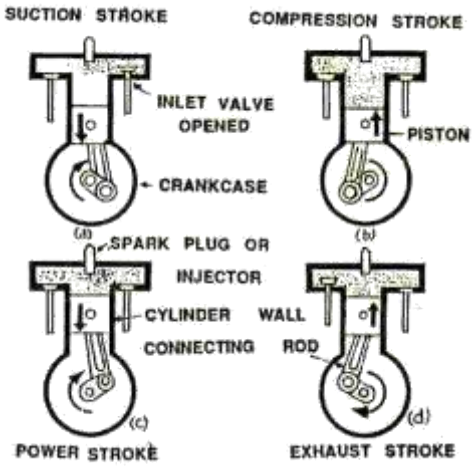


Fig 1. Four stroke cycle engine

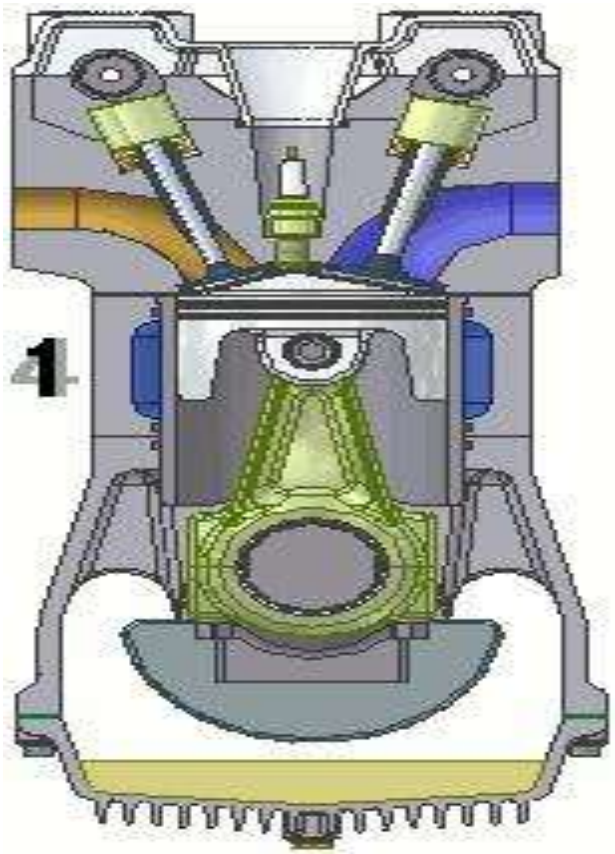


Fig 2. Four stroke cycle engine

4.1 Suction stroke

During suction stroke inlet valve opens and the piston moves downward. Only air or a mixture of air and fuel are drawn inside the cylinder. The exhaust valve remains in closed position during this stroke. The pressure in the engine cylinder is less than atmospheric pressure during this stroke (Fig. 1a)

4.2 Compression stroke

During this stroke the piston moves upward. Both valves are in closed position. The charge taken in the cylinder is compressed by the upward movement of piston. If only air is compressed, as in case of diesel engine, diesel is injected at the end of the compression stroke and ignition of fuel takes place due to high pressure and temperature of the compressed air. If a mixture of air and fuel is compressed in the cylinder, as in case of petrol engine, the mixture is ignited by a spark plug.

4.3 Power stroke

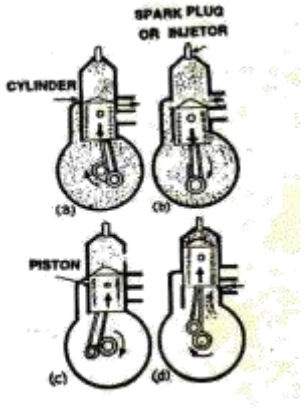
After ignition of fuel, tremendous amount of heat is generated, causing very high pressure in the cylinder which pushes the piston downward (Fig.1b). The downward movement of the piston at this instant is called power stroke. The connecting rod transmits the power from piston to the crank shaft and crank shaft rotates. Mechanical work can be taped at the rotating crank shaft. Both valves remain closed during power stroke.

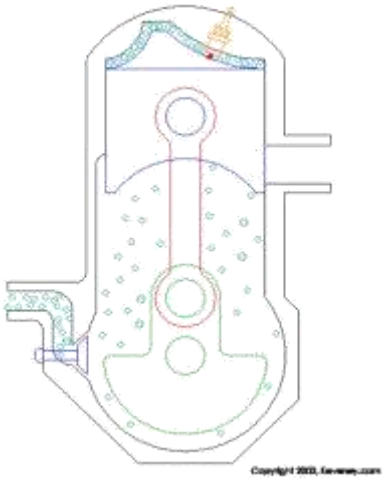
4.4 Exhaust stroke

During this stroke piston moves upward. Exhaust valve opens and exhaust gases go out through exhaust valves opening. All the burnt gases go out of the engine and the cylinder becomes ready to receive the fresh charge. During this stroke inlet valve remains closed .

Thus it is found that out of four strokes, there is only one power stroke and three idle strokes in four stroke cycle engines. The power stroke supplies necessary momentum for useful work.

5. TWO STROKE CYCLE ENGINE (PETROL ENGINE)





In two stroke cycle engines, the whole sequence of events i.e., suction, compression, power and exhaust are completed in two strokes of the piston i.e. one revolution of the crankshaft. There is no valve in this type of engine. Gas movement takes place through holes called ports in the cylinder. The crankcase of the engine is air tight in which the crankshaft rotates.

5.1 Two stroke cycle

5.1.1 Upward stroke of the piston (Suction + Compression)

When the piston moves upward it covers two of the ports, the exhaust port and transfer port, which are normally almost opposite to each other. This traps the charge of air- fuel mixture drawn already in to the cylinder. Further upward movement of the piston compresses the charge and also uncovers the suction port. Now fresh mixture is drawn through this port into the crankcase. Just before the end of this stroke, the mixture in the cylinder is ignited by a spark plug (Fig 2 c &d). Thus, during this stroke both suction and compression events are completed.

Burning of the fuel rises the temperature and pressure of the gases which forces the piston to move down the cylinder. When the piston moves down, it closes the suction port, trapping the fresh charge drawn into the crankcase during the previous upward stroke. Further downward movement of the piston uncovers first the exhaust port and then the transfer port. Now fresh charge in the crankcase moves in to the cylinder through the transfer port driving out the burnt gases through the exhaust port. Special shaped piston crown deflect the incoming mixture up around the cylinder so that it can help in driving out the exhaust gases . During the downward stroke of the piston power and exhaust events are completed.

6. COMPARISON BETWEEN TWO STROKE AND FOUR STROKE ENGINES

	Four stroke engine	Two stroke engine
1.	One power stroke for every two revolutions of the crankshaft.	One power stroke for each revolution of the crankshaft.
2.	There are inlet and exhaust valves in the engine.	There are inlet and exhaust ports instead of valves.
3.	Crankcase is not fully closed and air tight.	Crankcase is fully closed and air tight.
4.	Top of the piston compresses the charge.	Both sides of the piston compress the charge.
5.	Size of the flywheel is comparatively larger.	Size of the flywheel is comparatively smaller.
6.	Fuel is fully consumed.	Fuel is not fully consumed.
7.	Weight of engine per hp is high.	Weight of engine per hp is comparatively low
8.	Thermal efficiency is high.	Thermal efficiency is comparatively low.
9.	Removal or exhaust gases easy.	Removal of exhaust gases comparatively difficult.
10.	Torque produced is even.	Torque produced is less even.
11.	For a given weight, engine would give only half the power of two stroke engine.	For same weight, two stroke engine gives twice the power that of four stroke engine.
12.	All types of speed are possible (high and low).	Mostly high speed engines are there.
13.	It can be operated in one direction only.	It can be operated in both direction (clockwise and counter clockwise).

7. WORKING PRINCIPLE OF DIESEL ENGINE

The basic components of diesel engine are cylinder, piston, injector, valves, connecting rod and crankshaft. In diesel engines only air is drawn into the cylinder. The engine has high compression ratio hence the air in the cylinder attains very high temperature and pressure at the end of the compression stroke. At the end of the compression stroke, the fuel is sprayed into the cylinder in atomized form using injectors. Due to high temperature, the fuel gets ignited, begins to burn and produce lot of heat. Due to the heat the gases expand, move the piston downward and rotate the crank shaft. The torque available at the rotating crank shaft is used to do any mechanical work

7.1 Special features of diesel engine

1) Engine has high compression ratio ranging from 14:1 to 22:1.
2) During compression stroke, the engine attains high pressure ranging from 30 to 45 kg/cm^2 and high temperature of about 500°C.

3) At the end of the compression stroke, fuel is injected into the cylinder through injectors (atomizers) at a very high pressure ranging from 120 to 200 kg/cm^2.
4) Ignition takes place due to heat of compression only.
5) There is no external spark in diesel engine.
6) Diesel engine has better slogging or lugging ability i.e. it maintains higher torque for a longer duration of time at a lower speed.

8. CONCLUSION

- **Power take-off horse power (PTO HP)** - It is the power delivered by a tractor through its PTO shaft. In general, the belt and PTO horse power of a tractor will approximately be the same. The PTO hp is around 80-85% 0f tractor engine power
- **Drawbar horse power (DBHP)** - It is the power of a tractor measured at the drawbar of a tractor. It is that power which is available for pulling loads. It is around 50-55 % of engine power
- **Frictional horse power (FHP)** - It is the power required to run the engine at a given speed without producing any useful work. It represents the friction and pumping losses of an engine.

  IHP = BHP + FHP

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