Petrol Engines

The device is popularly known as Spark Ignition engine. It is invented by Otto and the engine is working on the principle of Otto cycle. The chemical energy is stored in the fuel is converted into heat energy to perform useful work. The expanding gases convert the heat energy into mechanical energy by moving the piston up and down inside the cylinder.

TWO STROKE PETROL ENGINE

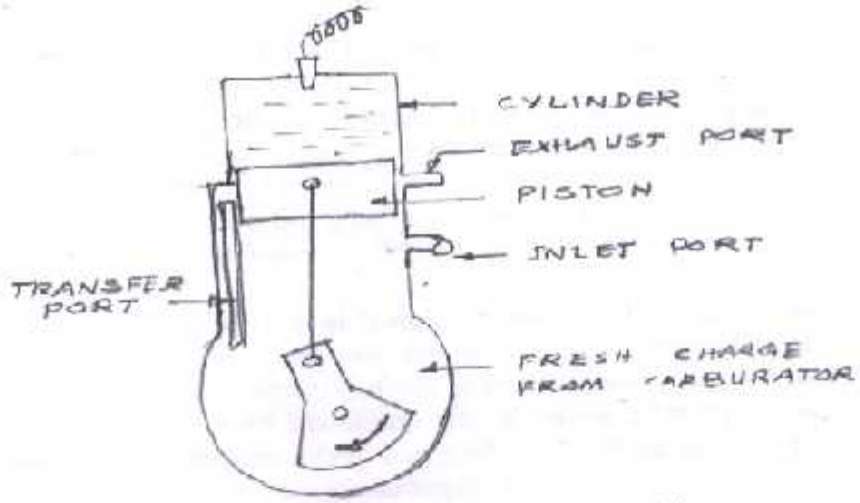
For two stroke engine, all the events (i.e. suction, compression, expansion and exhaust) are completed in two stroke of the piston or one revolution (360^0) of the crank shaft. In one revolution of the crank shaft there will be one power stroke.

Construction:

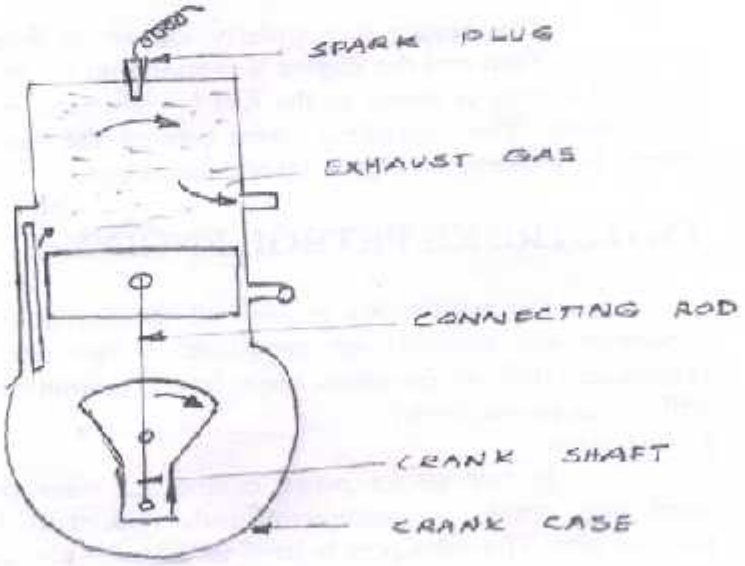
In two stroke petrol engine, the main parts are cylinder, piston, spark plug, crank case, connecting rod, crank shaft, inlet port, outlet port and transfer port. The inlet port is used to push the air-fuel mixture into the crank case. Transfer port is used to transfer the air-fuel mixture from the crank case to the combustion chamber. After combustion the exhaust port sends the burnt gases to the atmosphere. Valves and valve operating mechanism is not used in this engine.

A piston carrying rings reciprocates inside the cylinder. The piston is connected to the crankshaft through a connecting rod and crank. The piston is made to crown or deflector on top side which deflects the fresh charge upwards and forces out the burnt gases through exhaust port. These engines are air cooling fins arranged around the outer surface of the cylinder. A spark plug is provided on the top side of the cylinder head to ignite the air fuel mixture.

Thus the crank shaft and connecting rod converts the reciprocating motion of the piston into rotary motion. In one side of the crank shaft, flywheel is mounted with the ring gear. The ring gear is used to start the engine initially with the help of self starter.



SUCTION AND COMPRESSION DURING UPWARD STROKE OF THE PISTON



EXPANSION AND EXHAUST DURING DOWNWARD STROKE OF THE PISTON

Working principle:

Upward Stroke (Suction and Compression)

During the upward stroke, the piston moves from bottom dead center to top dead center. The previously sucked air fuel mixture enters the cylinder through transfer port. Now the piston moves up further and closes the transfer port first and also exhaust port. Due to upward movement of piston, the charged air fuel mixture is compressed. The radio of compression ranges from 7:1 to 15:1 at the end of the stroke. Thus the pressure and temperature of the charges increases at the end of the compression.

When the piston is nearly at top dead center, the charge (air fuel mixture) is ignited by a spark plug and combustion takes place. At the same time, the lower edge of the piston has opened the inlet port. A partial vacuum is created in crank case (i.e. pressure in crank case is less than the atmospheric pressure), so that the air fuel mixture from the carburetor is sucked into the crank case.

Downward stroke (Expansion and Exhaust):

Due to the combustion of charge, the hot high pressure gas expands and the piston moves from top dead center to bottom dead center. So the power is produced. In this stroke, power is given to the crank shaft and stored in flywheel. During its downward movement the piston first open both exhaust and transfer ports and then closes inlet port. Due to downward movement of the piston the charge already in crank case is compressed and enters cylinder soon after transfer port opens. This type of compressing charge in crank case is known as crank case compression.

The freshly entered charge from crank case to the engine cylinder (top of the piston) pushes hot burnt gases outside through exhaust port. This is known as scavenging. In two stroke engine the piston is given some specific shape (as shown in figure) known as crowning.

When the piston reaches bottom dead center, the piston moves upward again. During this movement, piston first closes the transfer port and then the exhausts port. The compression of the charge takes place till it reaches top dead center. When the piston is nearly at top dead center, the inlet port opens and fresh charge enters into the crank case. After the compression, combustion of charge takes place and the cycle is repeated.

Since the engine requires only two strokes to complete one cycle, it is called two stroke engine. The crank shaft makes only one revolution to complete the cycle. The power is developed during each revolution of the crank shaft. Hence the engine is widely used in two wheelers.

FOUR STROKE PETROL ENGINE:

In four stroke engine, one working cycle is completed in four strokes of the piston or two revolutions (720^0) of the crank shaft. Hence it is called as four stroke engine. In four stroke engine, two valves are placed instead of port as that of two stroke engines. It is called as inlet and exhaust valves. The engine is also called as Otto cycle engine.

Construction:

Four stroke petrol engines mainly consists of cylinder head, cylinder, spark plug, piston, crank case, connecting rod, crank shaft, inlet valve, and exhaust valve. The piston is connected to the crank shaft through a connecting rod and crank. Thus the crank shaft and connecting rod converts the reciprocating motion of the piston into rotary motion. In one side of the crank shaft the flywheel is mounted with the ring gear. The ring gear starts the engine initially with the help of self starter. The inlet and exhaust valves are mounted on the top of the cylinder head.

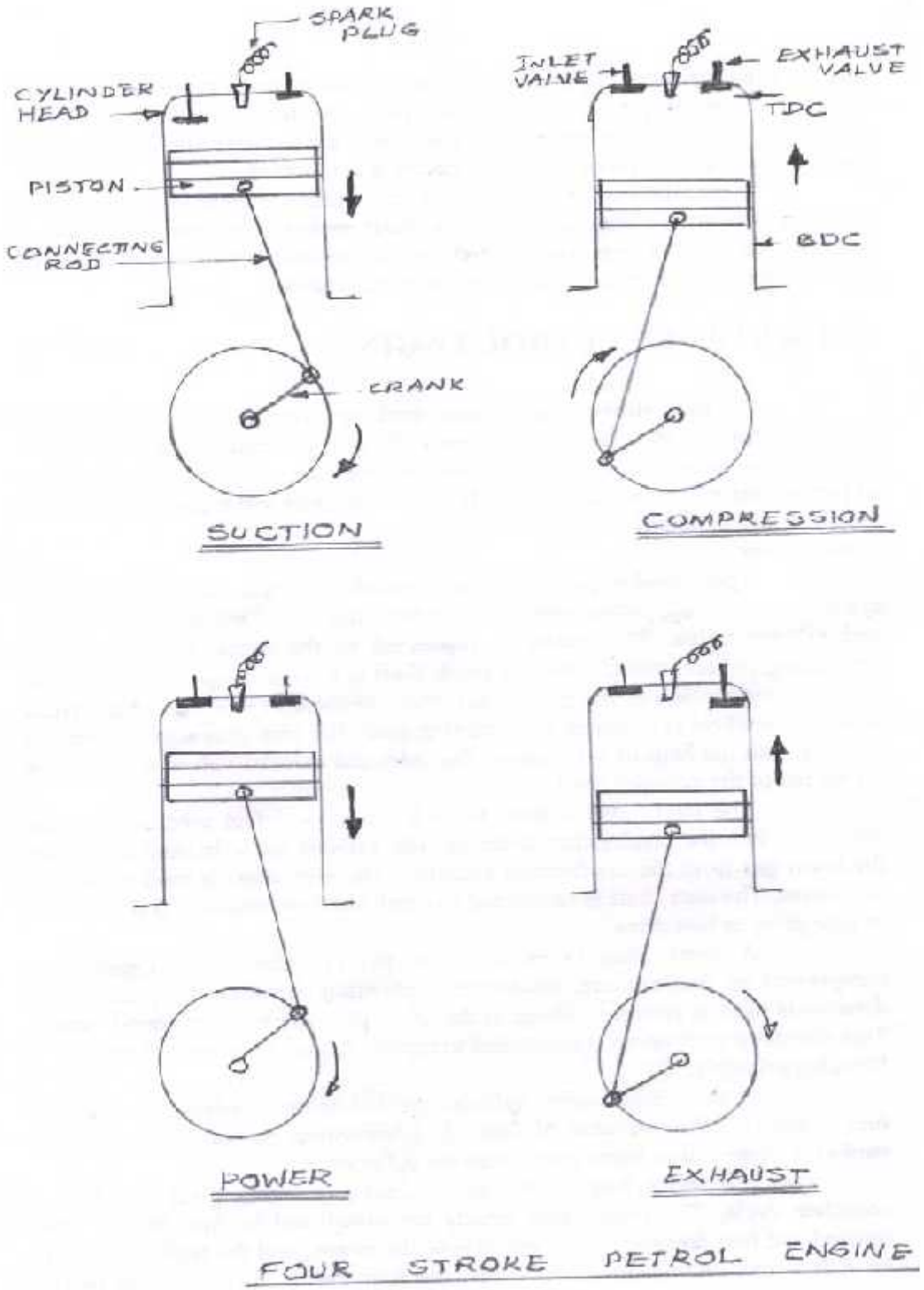
The inlet valve is used to suck the air and fuel mixture from the carburetor into the combustion chamber. The exhaust valve is used to exhaust the burnt gas from the combustion chamber. The cam shaft is used to operate the valves. The cam shaft is connected to crank shaft by means of a chain drive or gear drive or belt drive.

A spark plug is provided on the cylinder head to ignite the compressed air fuel mixture, inside the combustion chamber. An alternator or dynamo is used to provide voltage to the spark plug to create an electric spark. This alternator or dynamo is connected to the crank shaft by means of belt.

Working principle:

In the petrol engine cylinder the following 1.Suction of fuel (air fuel mixture) 2.Compression of fuel 3. Combustion of burnt gases (power stroke). 4. Removal of burnt gases from the cylinder.

The above four events are continuously taking place and form a complete cycle. The above four events are completed in four strokes (two upward and two downward movements) of the piston, and the engine is said to be four stroke engine. In other words, the four events are completed in two revolution of crank shaft (720^0). In addition to above four, another event “ignition” takes place instantaneously just before the end of compression.


SPARK PLUG
CYLINDER HEAD
PISTON
CONNECTING ROD
CRANK
SUCTION
INLET VAINE
EXHAUST VALVE
TDC
BDC
COMPRESSION
POWER
EXHAUST
FOUR STROKE PETROL ENGINE

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Suction stroke: At the beginning of this stroke the piston is at TDC, both the inlet and the exhaust valves are closed condition. When the piston moves from TDC to BDC, the pressure inside the cylinder becomes lower than the atmospheric pressure. Due to this pressure difference the inlet valve is opened and the air fuel mixture is drawn into the cylinder till the piston reaches BDC. During this period the temperature of atmospheric air at 28^0C to 32^0C is increased to 250^0C inside the cylinder.

When the crankshaft rotates 180^0 the piston completes one stroke. At the end of suction stroke the inlet valve is closed and the exhaust valve is already in the closed position.

Compression stroke: At the beginning of this stroke the piston is at BDC and then moves to TDC. During this stroke, both inlet and exhaust valves are closed. At this position the air fuel mixture is compressed inside the cylinder (compression ranges from 7:1 to 15:1). Due to this compression the air fuel mixture attains very high pressure (12 to 18 bars) and temperature (400^0C). At the end of the stroke, the piston is at TDC and charge gets compressed in the clearance volume. Now the total crank angle turned is 360 deg., ie one revolution of crank.

Ignition: At the end of the compression stroke the air fuel mixture is ignited with the help of spark plug and combustion takes place (within a period of2 milli seconds). Hence there is a sudden rise is pressure (60 to 65 bar) and temperature (1400 deg) of combustion gases.

Power stroke (or) Expansion stroke:

The high pressure combustion gases exert very high pressure on the piston and push the piston from TDC to BDC at a speed of 15-22 m/sec. During the stroke, both the inlet and the exhaust valves remain closed. The combustion gases expand and work is done during this stroke by this burnt gases. So this stroke is called working stroke or power stroke.

Due to this stroke the crank shaft and the fly wheel are rotated. As the piston moves to BDC, the pressure of the hot gases gradually decrease. By the end of this stroke the total crank angle turned is (180 + 180 + 180 = 540 deg) i.e. one and half revolution of crank.

Exhaust stroke: At the end of the power stroke the piston will be at the bottom dead center. At the same time, the inlet valve is closed and exhaust valve is opened. At this position a pressure of 12 bar and a temperature of 500 deg are obtained in the cylinder. The energy stored in the flywheel causes the crank shaft to continue the rotation. Due to the upward movement of the piston, the burnt gases are forced out to the atmosphere through the exhaust valve. By the end of this stroke the total crank angle is turned (180 + 180 + 180 + 180 = 720 deg) i.e.

two revolution of crank. By the end of this stroke the cylinder is ready to receive the fresh charge.

Since this engine requires four strokes to complete one working cycle, it is called four stroke engine. The crank shaft makes two revolutions to complete one cycle.

ADVANTAGAES OF TWO STROKE OVER FOUR STROKE CYCLE ENGINES:

Advantages:

1.Two stroke cycle engine gives one working stroke for each revolution of the crankshaft. So the power developed by two stroke engine is twice that developed by four stroke cycle engine for the same engine speed and cylinder volume.

2.The turning moment on the crankshaft is more even in two stroke engine and so a lighter flywheel is required in it.

3.It is light and require less space than a four stroke cycle engine for the same power, hence it is more suitable for auto, motor cycle and scooters.

3.Weight of the engine is less due to absence of valves.

4.It has high mechanical efficiency due to absence of cam shaft and rockers.

5It requires few spare parts due to its simple design.

Disadvantages:

1.Air standard efficiency of the two stroke cycle engine is less than four stroke cycle engine because the compression ratio of the two stroke cycle engine is less than that of the four stroke cycle engine.

2.Overall efficiency is less.

3.In two stroke cycle engines, the piston gets over heated due to firing in each revolution and oil cooling of the piston is necessary.

4.The consumption of lubricating oil is large in a two stroke cycle engine because of high operating temperature.

5.The fresh charge is mixed by the burnt gases due to incomplete scavenging.

6.There is greater wear and tear of moving parts.