

Working of a Four (4) Stroke Engine

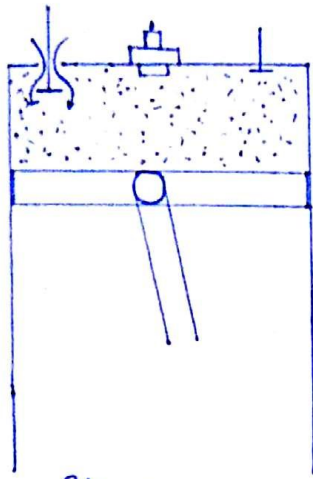


Fig. 1
Suction stroke

Fig 1) Piston is at TDC. The inlet valve is open (the opening and closing of the valves takes place due to the operation of a cam profile). For the rotation of shaft from Top to bottom the piston moves down TDC to BDC. Vacuum is created inside the cylinder. Fresh air fuel mixture (AFM) is sucked into the engine cylinder. Hence the piston motion from TDC to BDC is known as the suction stroke. The ~~outlet~~ outlet valve remains close throughout.

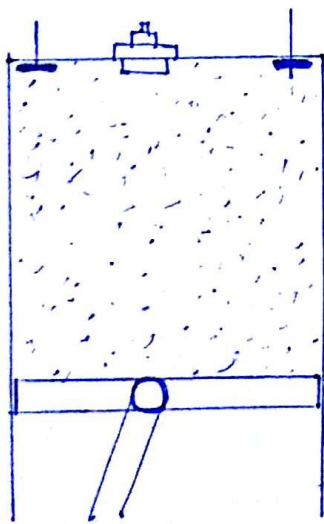


Fig 2.
Comp. stroke

Fig 2). For further rotation of shaft from Bottom to Top the piston moves from BDC to TDC. At the start of the motion, the inlet valve gets closed. Hence no mass can flow out of the cylinder. During upward motion of cylinder the volume decreases and compression takes place. The motion of piston from BDC to

→ TDC is known as the compression stroke. When the piston is at TDC (end of the comp. stroke), ~~there~~ There is flow of current to spark plug.

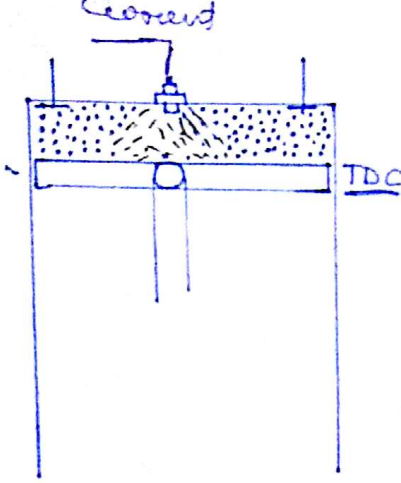


Fig 3

Fig 3) As the current flows to the spark plug the voltage available is about 10,000 V and is known as the break down voltage. At this voltage, spark is generated at the other end of spark plug that is inside the cylinder. This spark ignites the fuel in the AFM and heat flows from this fuel to the air

HA at Const. Vol particles to the AFM. Heat addition takes place at constant volume. In practice the piston undergoes change in direction at TDC during heat addition. And at the end of HA the air is strong enough to push the piston down for further motion.

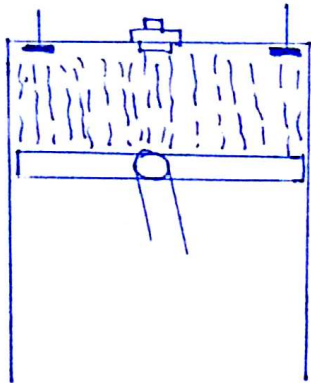


Fig 4.

Fig 4) The strong and hot gas pushes the piston down from TDC to BDC at the end of HA. The air expands and useful power is available from the piston. Hence this downward motion of piston is known as the expansion or power stroke.

Expansion or power stroke ~

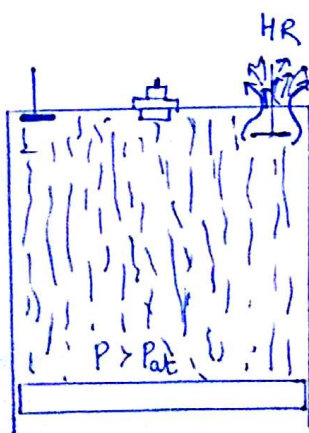


Fig 5.

Fig 5) At the end of expansion stroke i.e. when the piston is at BDC the pressure inside the cylinder is much above the P_{atm} and the outlet valve open. The expanded gases flow out the cylinder due to difference in pressure. This flow takes place through the outlet valve.

HR at Const. Vol Heat rejection takes place at constant volume. In practice, the piston undergoes change in direction at BDC during heat rejection. About 90-95% of the gases leave the cylinder during heat rejection.

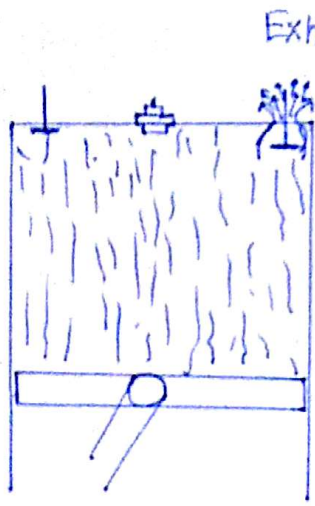


Fig 6.

Exhaust stroke

Fig 6) After heat rejection, the piston moves up from BDC to TDC and the left over gases after heat rejection is pushed out of the exhaust valve by this ~~excess~~ upward motion of piston. This process is known as exhaust. Hence the upward motion of piston is called the exhaust stroke.

No Entry

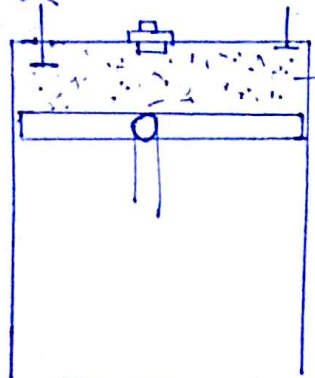


Fig 7.

Fig 7) At the end of exhaust stroke (piston is at TDC). The outlet valve closes and inlet valve closes. Small quantity of the exhaust gas remains in the clearance Vol. The pressure of this gas is approx $P \approx 1.2 \text{ bar}$.

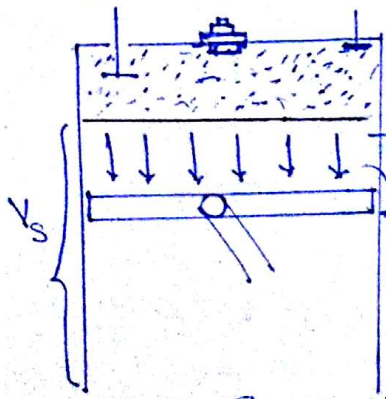
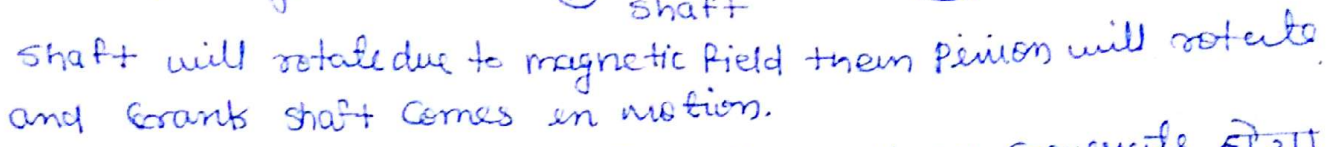
Entry
 $P = 1 \text{ bar}$ 

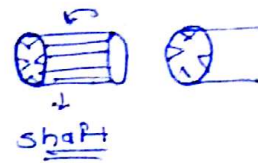
Fig 8.

stroke

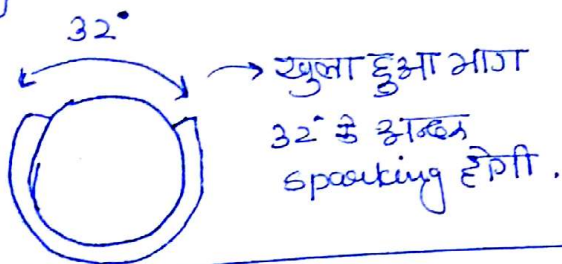
Fig 8) As the piston moves down for the suction stroke of next cycle the fresh AFM does not enter in at the start of suction stroke. Instead, the exhaust gas in clearance volume expands to fill the space created by the downward motion of piston. When the pressure inside the cylinder becomes equal to the outside pressure, fresh AFM from the carburetor will then rush in to fill the cylinder until the end of the stroke.



→ shaft flux को भी काट रहे हैं इसलिए voltage generate होता है by ~~Faraday~~ law.



{ Voltage $\rightarrow$ electric
Pressure



→ Thus, The Volume the actual air (V_a), entering the cylinder is less than that of stroke volume. The ratio of this volume of Air to the stroke volume is defined as the Volumetric efficiency of the engine and Given by

$$\eta_a = \frac{V_a}{V_s}$$

Working of Two Stroke Engine:-

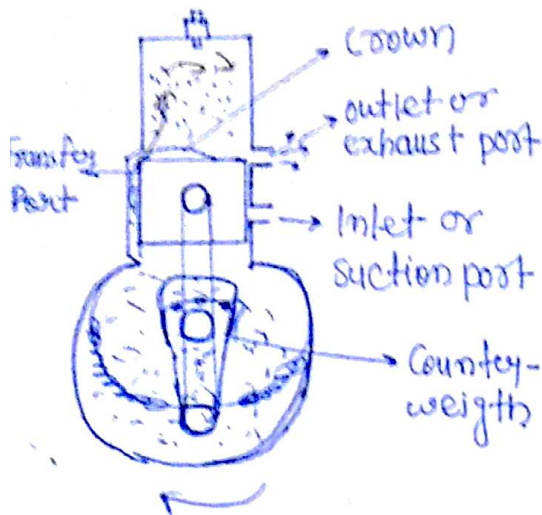


Fig ①

Fig ① Piston is at BDC and the transfer port is open on both sides of the piston. Fresh AFM below the piston flows through the transfer port to occupy the space above the piston. It may be seen from Fig ① that both the transfer port & outlet port are open at same

time hence some fresh AFM will escape out of the exhaust port. To prevent this escape, a projection is introduced on top of the piston is known as the crown. The fresh AFM flowing in the direction of exhaust port will collide with the crown and rise to the top. In the mean time, the left over exhaust gases of the previous cycle are pushed out of the exhaust port by the rising up of fresh AFM. This process is known as scavenging. As the piston is at point of moving up the space above the piston will be filled with fresh AFM.

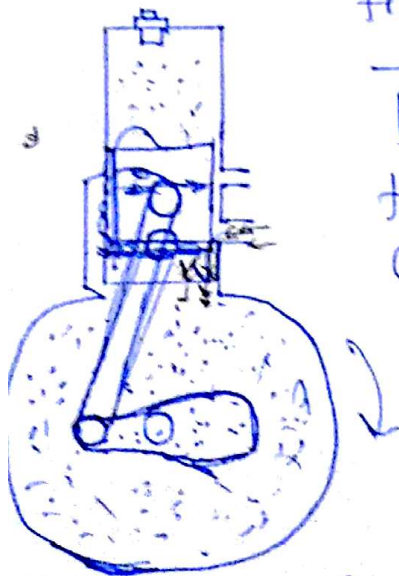


Fig ②

Fig ② During upward motion of the piston, the fresh AFM above the piston gets compressed. As the piston completes about 30% of upward motion, the inlet port is opened to the carburetor. For further upward motion of piston, fresh AFM ~~enters~~ of the next cycle enters from the carburetor into the engine cylinder in the space below the piston. This suction continues until the piston reaches the TDC.

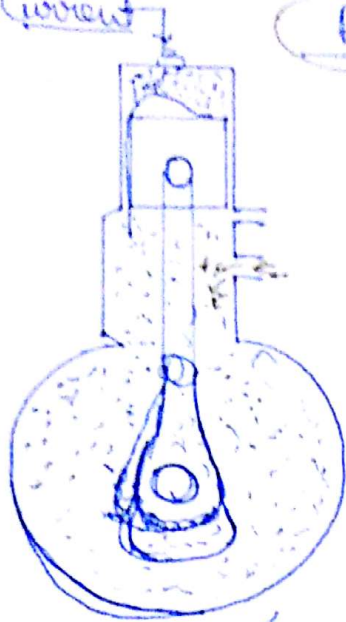


fig 3

(Fig 3) When the piston reaches the TDC the compression of AFM above the piston gets over and current is supplied to the spark plug. Heat addition takes place at const. vol. The voltage available across spark plug is about 10,000 Volt.

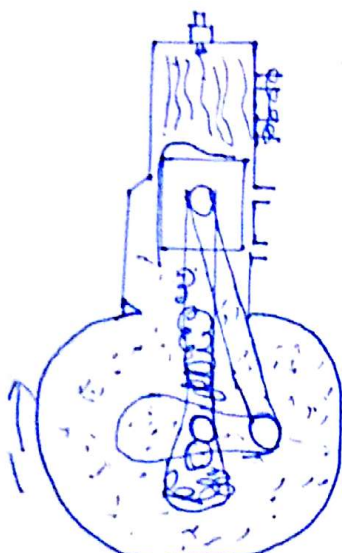


Fig 4.

(Fig 4) At the end of heat addition the hot & strong gases push the piston down. The gases expand and useful power is obtained. When the piston has completed about 70% of downward power stroke, the inlet port gets closed. The fresh AFM of the next cycle below the piston gets partly compressed for further downward motion of piston.

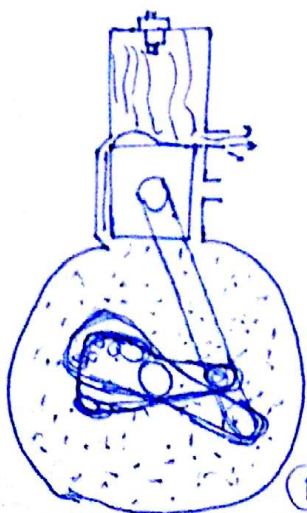


Fig 5.

(Part compression)

(Fig 5) As the piston completes about 90% of downward motion the outlet port is open and a major portion of exhaust gases leaves the cylinder out of the exhaust port during the remaining downward motion of piston. When the piston reaches BDC the operation is repeated in the same manner as explained.