



SNS COLLEGE OF TECHNOLOGY

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Department of Mechanical Engineering Diesel Engines

The diesel engine operates on a very similar way that of petrol engine. The major difference is that the ignition occurs spontaneously due to the high temperature of the compressed air and spark plug of petrol engine is replaced with fuel injector.

The essential feature of this engine is the compression of air through a volume ratio of not less than 12 to 1 or 13 to 1 and having a maximum value of as much as 20 to 1. The compression ratio of this engine is higher than the petrol engine and hence, the thermal efficiency is also high. Diesel engines are normally used in heavy duty vehicles like bus, trucks, tractors and cars.

TWO STROKE DIESEL ENGINE

The working of two stroke diesel engine is similar to that of the two stroke petrol engine except that the fuel injection at TDC and spark plug is replaced with fuel injector. 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 of the crank shaft.

Constructional details:

A two stroke diesel engine consists of a cylinder with one end fitted with a cover and the other end fitted with a hermetically sealed crank case. Instead of valves as in four stroke system, there are three ports namely inlet, exhaust and transfer ports cut in the walls of the cylinder.

The lower one known as the admission port or inlet port admits the air into the crank case. The upper one known as the exhaust port through which the spent gases are expelled out of the cylinder. A transfer port provided diametrically opposite to the exhaust port, but slightly at a lower level serves as the passage for the transfer of air from the crank case in to the cylinder.

A piston carrying rings reciprocates inside the cylinder. Periodically covers and uncovers these ports. The piston is made to crown on top side which deflects the fresh charge upwards and forces out the burnt gases through exhaust port. A fuel injector is provided on the cylinder head to atomize the fuel (diesel). The piston is connected to the crankshaft through a connecting rod and crank. It converts the reciprocating motion of the piston into rotary motion. On one side of

the crank shaft, flywheel is mounted with the ring gear. The ring gear starts the engine initially with the help of the self starter.

WORKING PRINCIPLE OF TWO STROKE DIESEL ENGINE:

Upward stroke (Suction and Compression)

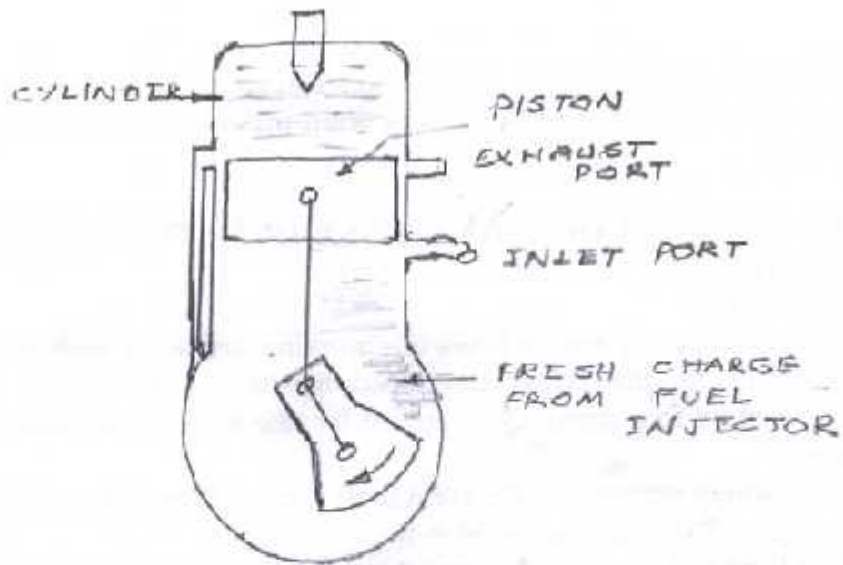
During the upward stroke, the piston moves from bottom dead center to top dead center. During this movement, the piston closes the transfer port first and then exhausts port closes and fresh air already in the cylinder is compressed by the piston. When the piston is nearly at the top dead center, the compressed air will attain a temperature greater than the ignition temperature of the diesel oil. As soon as the fuel is injected into the cylinder by injector, the fuel is ignited and combustion takes place. The ratio of compression ranges from 16:1 to 20:1. At the same time, the lower edge of the piston has opened the inlet port and fresh air enters into the crank case. The pressure differential set up between the atmosphere and the crank case will draw the air through the inlet port.

Downward Stroke (Expansion and Exhaust)

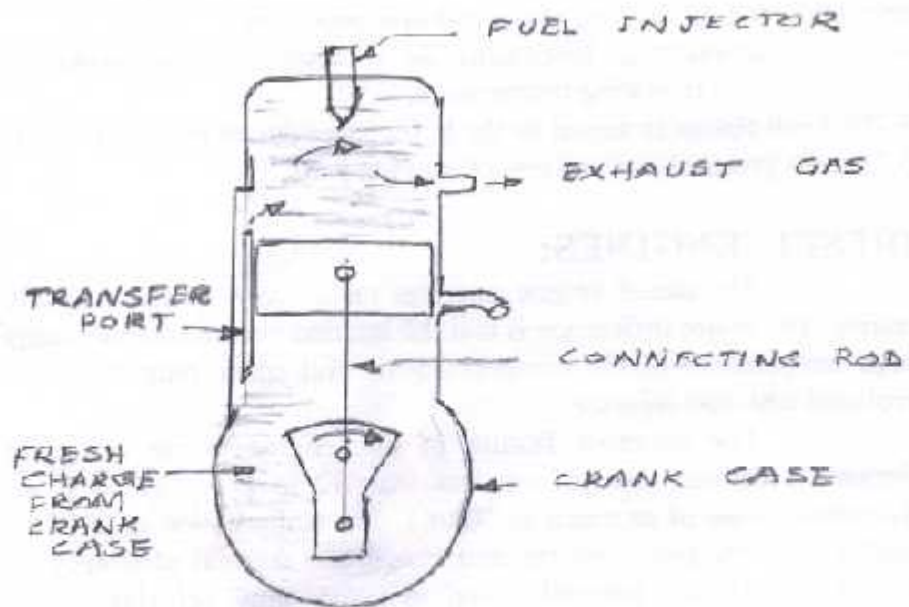
Due to combustion, the fuel expands which increase the pressure of the hot gases in the cylinder. The high pressure burning gases force the piston downwards (expansion takes place). The piston performs the power stroke. During this movement, the exhaust port opens first. Hence the burnt gases which are still at a pressure slightly higher than the atmosphere pressure escape through the exhaust port.. After some times transfer port opens which admits the fresh air from crank case to the engine cylinder (top of the piston) and finally the piston closes the inlet port. Due to the crowning of the piston, the fresh air goes to the top of the cylinder. Hence it forces out the remaining burnt gases through the exhaust port. This action is known as scavenging.

When the piston reaches bottom dead center, the piston moves upwards again. During the movement, piston first closes the transfer port and then the exhaust port. The compression of fresh air takes place till it reaches top dead center. When the piston is nearly at the top dead center, the inlet port opens and fresh air enters into the crankcase. After the compression of fuel takes place and the cycle is repeated. Thus in a two stroke engine, the cycle of events are completed in two strokes of the piston or in one revolution of the crank shaft.

Since the engine requires only two strokes to complete one cycle, it is called two stroke engine. The crankshaft makes only one revolution to complete the cycle. The power is developed during every revolution of the crankshaft.



SUCTION AND COMPRESSION DURING UPWARD STROKE OF PISTON



EXPANSION AND EXHAUST DURING DOWNWARD STROKE OF PISTON

FOUR STROKE DIESEL ENGINE

In four stroke cycle engine, one working cycle is completed in four strokes of the piston or two revolution 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. These are called as inlet and exhaust valves.

CONSTRUCTIONAL DETAILS:

A four stroke diesel engine consists of a cylinder with its one end fitted with a cover and the other end left open. The cover is provided with the inlet and exhaust valves. These inlet and exhaust valves are opened and closed by mechanically operated cams. The fuel injector is fitted at the top of the cover to atomize the fuel. A piston carrying rings reciprocates inside the cylinder. The piston is connected to the crankshaft through a connecting rod and crank. It converts the reciprocating motion of the piston into the rotary motion.

WORKING PRINCIPLE:

SUCTION STROKE:

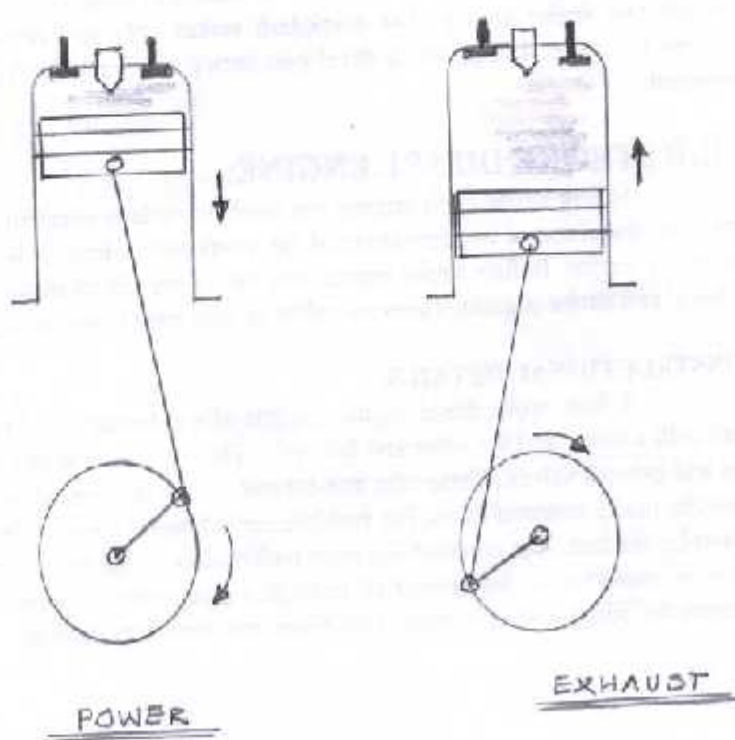
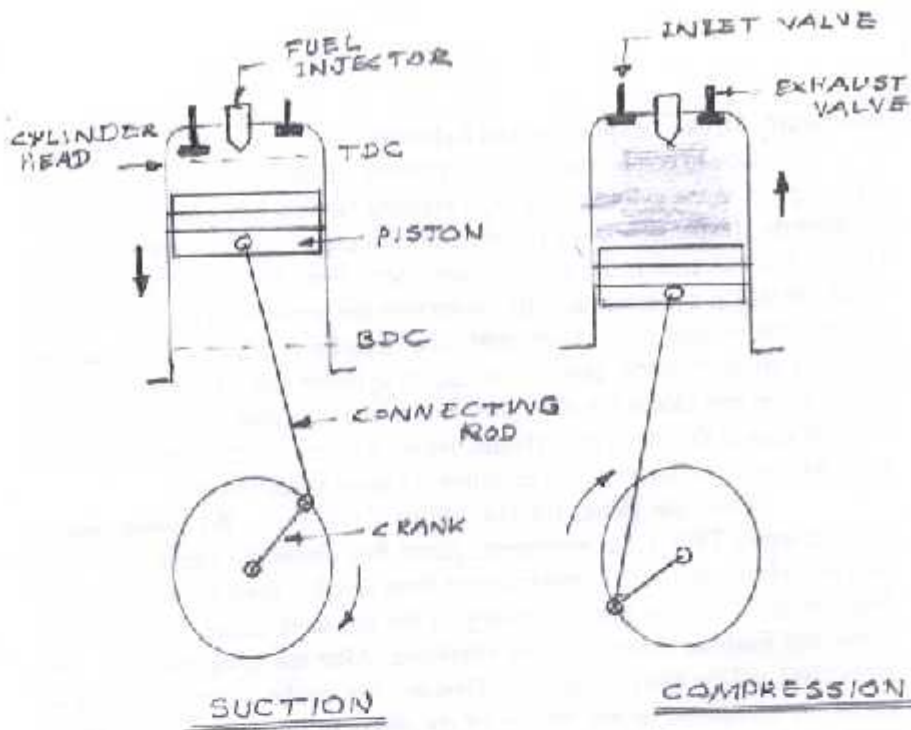
Suction stroke starts when the piston is at the top dead center and about to move downwards. At that time, the inlet valve is opened and exhaust valve is closed. Due to the downward movement of the piston, partial vacuum is created inside the cylinder. Due to the pressure difference between the atmosphere (1.01325 bar) and the inside of the cylinder (0.7 to 0.8 bar), only the atmospheric air is allowed into the cylinder.

Atmospheric air at 28 deg cen to 32 deg cen is increased to 250 deg cen inside the cylinder. When the piston reaches the bottom dead center, the suction stroke ends and inlet valve closes.

COMPRESSION STROKE:

The air taken into the cylinder during the suction stroke is compressed by the upward movement of the piston (bottom to top dead center). During this stroke, both the inlet and exhaust valves are closed. In compression ignition (CI) engine, compression ratio varies from 16:1 to 22:1. The compression ratio in this engine is higher than the four stroke petrol engine. The air it is being compressed gets heated up and therefore its temperature will be increased. At the end of this stroke the air attains ignition temperature of 850 deg cen to 900 deg cen at a pressure of 28 to 35 bar.

Ignition: Just before the end of the compression stroke the fuel is injected into combustion chamber by means of fuel injection system. Due to high temperature (900 deg cen) and a pressure (65 to 70 bar) in the cylinder, the fuel is ignited and combustion takes place.



FOUR STROKE DIESEL ENGINE

POWER STROKE (or) EXPANSION STROKE:

The high pressure of the burnt gases force the piston towards bottom dead center. During this stroke, both the inlet and exhaust valves remains closed. Due to the downward movement of the piston, the rotary motion is obtained in the crankshaft through connecting rod. Thus, power of useful work is obtained during this stroke. Both pressure and temperature decrease during expansion.

EXHAUST STROKE:

At the end of the expansion stroke, the exhaust valve opens and inlet valve remains closed. Due to the upward movement of the piston, the burnt gases are forced out to the atmosphere through the exhaust valve. The exhaust valve closes shortly after the piston reaches top dead center. The pressure and temperature decreases to 1.5 – 2 bar and 400 to 500 deg cen respectively. 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. The engine is widely used in trucks, tractors, cars.

ADVANTAGES AND DISADVANTAGES OF SI ENGINES OVER CI ENGINES

Advantages: Initial cost is less.

It is lighter in weight and occupies less space.

Due to low compression easy to start.

Disadvantages: Requires costly fuels.

Suitable for light duty vehicles.