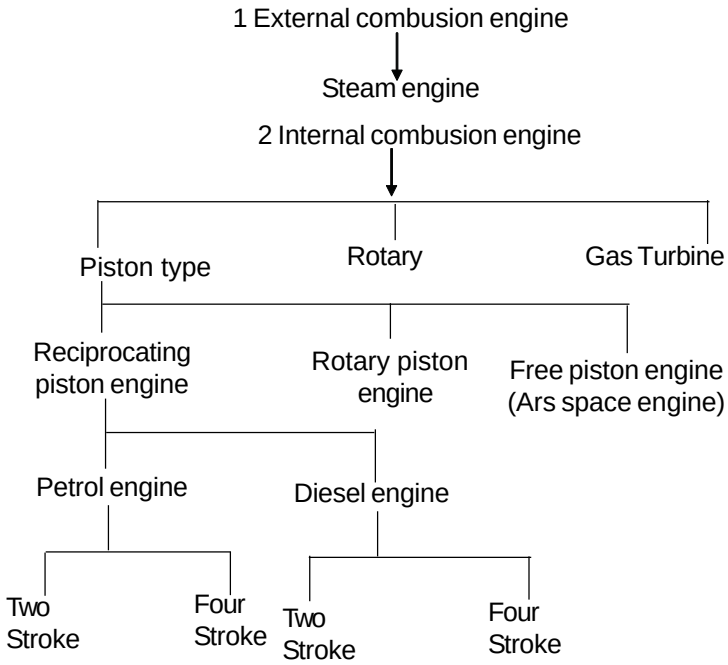
Internal and external combustion engine

Objectives: At the end of this lesson you shall be able to
- **type of heat engine**
- **state the internal and external combustion engine**
- **difference between an internal and external combustion engine.**

Types of heat engines



Internal combustion engine

Internal combustion engines are those heat engine, that burns their fuel and takes combustion inside the cylinder, this definition including the two stroke and four stroke engine, spark ignition and compression ignition engine, austine and jet engines are also internal combustion engine. Ex: Wankel.

External combustion engine

The external combustion engines are those heat engine that burn their fuel outside the engine cylinder. The energy developed during the combustion of fuel is transmitted to steam. This steam acts on the piston inside cylinder example - railway steam engine.

Difference between internal and external combustion engine

Sl.No.	Internal combustion engine	External combustion engine
1	Occupies less space.	Occupies more space.
2	Lighter in weight.	Heavier in weight.
3	High speed engine.	Slow speed engine.
4	Combustion of fuel takes palce inside the engine.	Combustion of fuel takes palce outside the engine.
5	No fuels used in when engine is not running.	Soild or liquid fuels used to form steam.
6	No loss of fuel when engine is not running.	Fuel has to burn even when the engine is not running for small halts.
7	Could be started or stopped at will.	Cannot be started unless steam is prepared which takes much time.
8	Temperature produced inside the cylinder is too high.	Works at comparatively low temperature.
9	Cooling arrangement necessary.	No cooling of the cylinders required. Rather it is steam jacketed.
10	Single acting.	Mostly double acting.
11	Exhause gas temperature as high as 300°C.	The temperature of exhaust steam is quite low.
12	Thermal efficiency of diesel engine up to 40%.	Thermal efficiency up to 24% as that of petrol engine.
13	No needs boiler, furnace or condenser.	Boiler, furnace and condenser are must.

Classification of I.C engines

Objective: At the end of this lesson you shall be able to
- **state the classification of engines.**

Engines are classified according to the following factors.

Number of cylinders

Single cylinder

Multi cylinder

Arrangements of cylinders

In-line engine (Fig 1)

`V' shape engine (Fig 2)

Opposed engine (Fig 3)

Horizontal engine

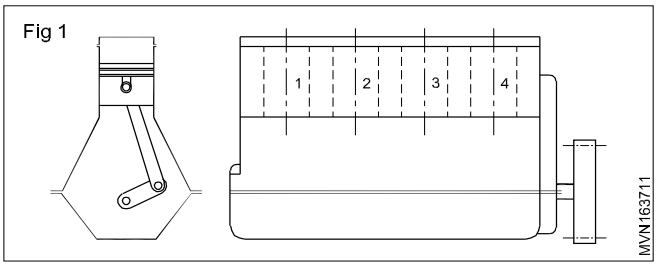
Radial engine (Fig 4)

Vertical engine

Types of engines as per cylinder arrangement

In-line engines

Fig 1

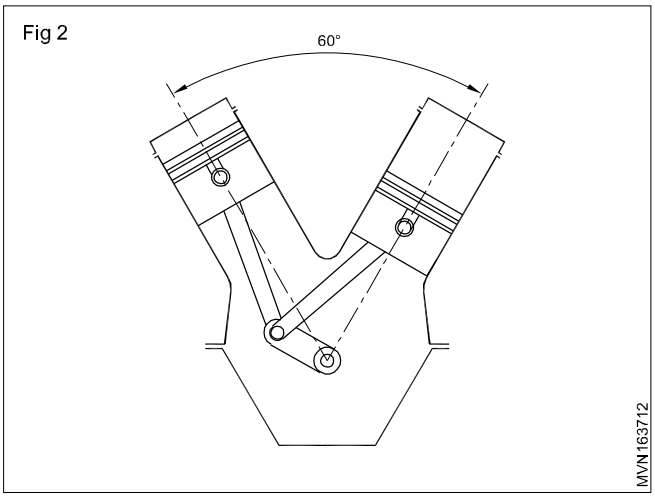


In this type, the cylinders are arranged in one line. The length of the crankshaft is longer than that of the other types of engines, and hence a limited number of cylinders are used. Better balancing and more uniform torque is obtained in this type.

'V' shape engines

In this type, the cylinders are arranged in V shape at an angle, of usually 60°. This engine is more economical and compact. For multi-cylinder engines, the length of the crankshaft is much shorter than that of the in- line engine. In this type, the engine height is also lower than it is in the in-line engine.

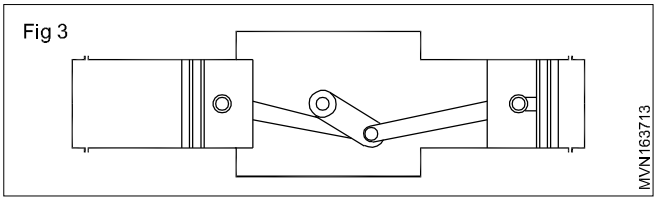
Fig 2



Opposed engines

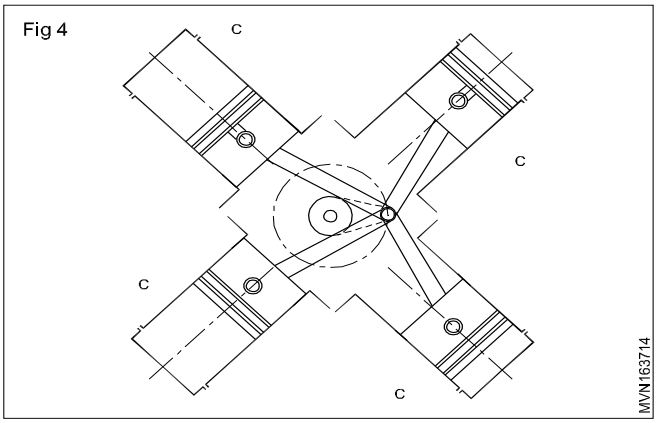
In this type the cylinders are arranged horizontally opposite to each other. This provides better mechanical balance. This type of engine can run smoothly even at a much higher speed. It also gives higher output. The length of the engine is too much, and therefore engine has to be placed in the transverse direction in the vehicle.

Fig 3



Radial engines

Fig 4



In this type, the cylinders are arranged radially. This type of engine is shorter, lighter and more rigid. Since it is rigid, a higher engine speed is possible and a higher combustion pressure can be obtained. This leads to high fuel efficiency. The radial type engines are used mostly in aeroplanes.

Types of engine as per number of cylinders

Single cylinder engines

An engine which has only one cylinder is called a single cylinder engine. Since it is a single cylinder engine it cannot develop more power. It is normally used only in two wheelers like scooters and motor cycles.

Multi cylinder engines

These engines have more than one cylinder. Two-cylinder engines are usually used in tractors. Three or four cylinder engines are used in cars, jeeps and other vehicles. In heavy vehicles six-cylinder engines are used. A greater number of cylinders gives smoother engine operation.

Types of fuel used

Petrol

Diesel

Gas

Types of valve arrangements

`I' head engine

`F' head engine

`L' head engine

`H' head engine

`T' head engine

Application of engine

Constant speed engine

Variable speed engine

Engine Cooling system

Air cooled engine

Water cooled engine

Strokes of engine

Four-stroke engine

Two-stroke engine

Function of diesel engine

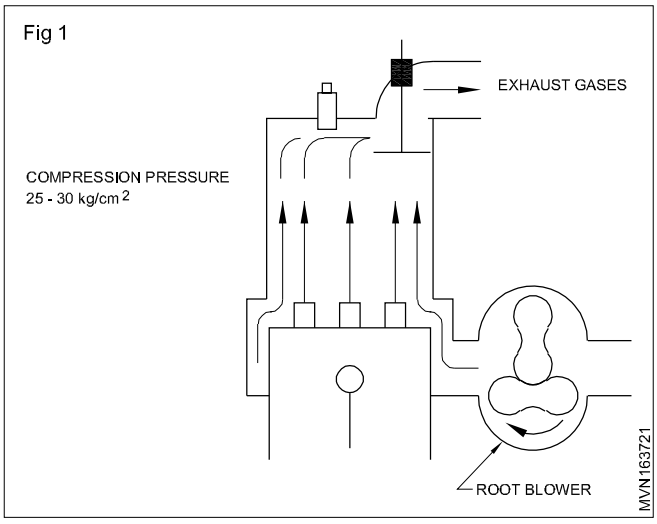
Objectives: At the end of this lesson you shall be able to
- **describe the function of a two-stroke diesel engine**
- **describe the function of a four-stroke diesel engine.**

Two stroke diesel engine

To produce power in a two stroke engine the following operation take place in the sequence given.

First stroke: Piston at BDC to TDC, the scavenging port and outlet valve open (Fig 1). A root blower sucks in pure air and presses it through the scavenging port into the cylinder. The tangential layout of the scavenging port brings the air into a turbulent motion. The cylinder is completely flushed out in the direct current and filled with fresh air. The exhaust gases flow out towards the outlet valve.

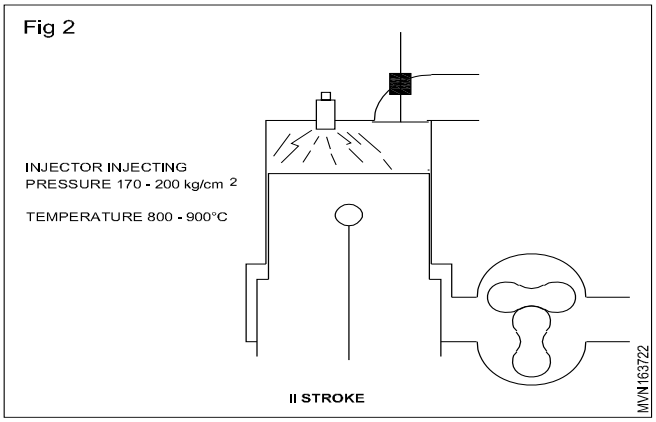
Fig 1



As the piston moves up from BDC to TDC the scavenging port and outlet valve closed. The piston compresses the fresh air to the compression chamber. The air temperature increases intensively.

Second stroke: Piston at TDC (Fig 2) scavenging port and outlet valve closed. The fuel is directly injected into the cylinder with the help of a fuel injection pump and an injector fitted in the cylinder head. The fuel gets vaporised into an ignitable fuel air mixture by the hot air. After attaining the ignition temperature the mixture gets automatically ignited and burns. The heat increases the pressure in the combustion chamber. The gases get expanded and push the piston towards the bottom dead centre.

Fig 2



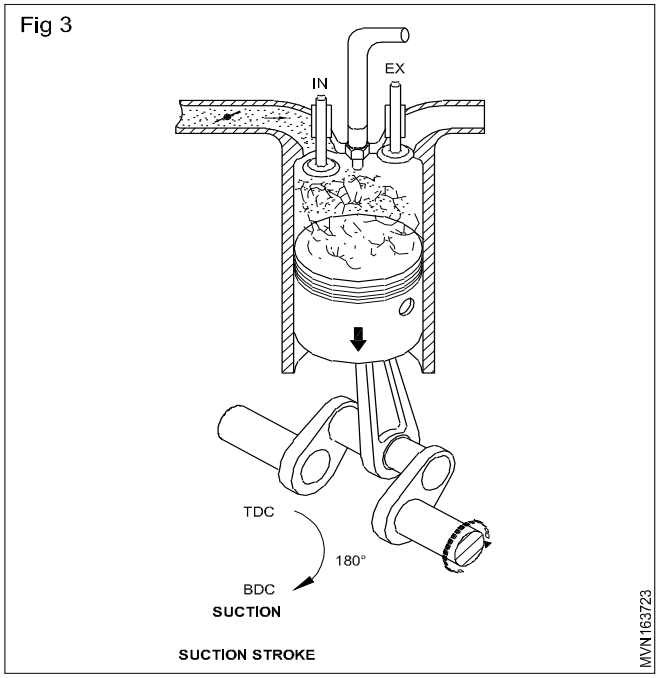
Four-stroke engine

To produce power in a four-stroke engine the following operations take place in the sequence given.

Suction stroke

The piston moves from TDC to BDC (Fig 3). A vacuum is

Fig 3

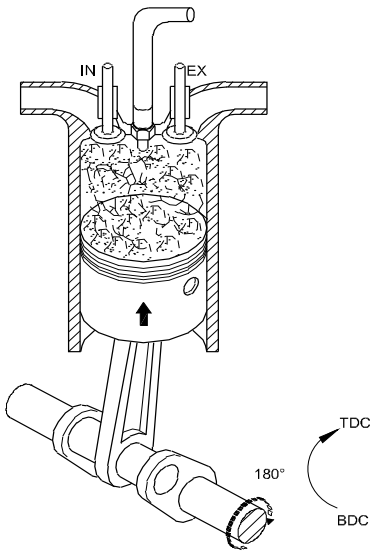


created inside the cylinder. The inlet valve opens while the exhaust valve remains closed. The charge air enters into the cylinder.

Compression stroke (Fig 4)

The inlet and exhaust valves are closed. The piston moves from BDC to TDC (Fig.4). The charged air is compressed in the cylinder. The compressed air pressure and temperatur is increased upto 800°C.

Fig 4



COMPRESSION STROKE

Power stroke

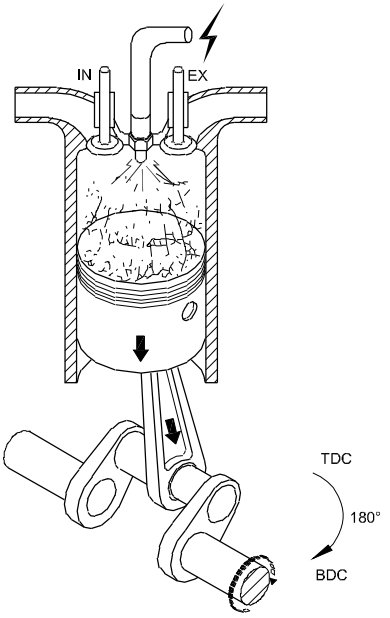
At the end of the compression stroke diesel fuel is injected into the hot compressed air in the combustion chamber; result burning of diesel with an explosion the gas expand and pressure develops inside the cylinder. The piston moves from TDC to BDC (Fig 5). Both the valves remain closed. Power is supplied to the fly wheel.

Exhaust stroke

The inlet valve remains in closed position. The exhaust valve opens, the piston moves from BDC to TDC (Fig 6) due to the energy stored in the flywheel. The burnt gases inside the cylinder go out through the exhaust valves.

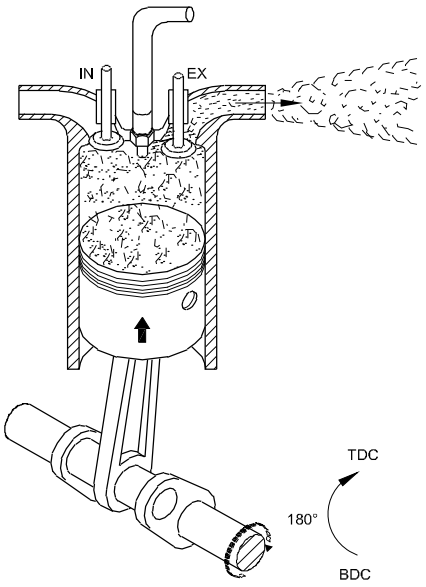
The cycle of suction, compression power and exhaust are repeated. In this type of engines one power stroke is obtained in two revolutions of the crankshaft.

Fig 5



POWER STROKE

Fig 6



EXHAUST STROKE

Function of spark ignition engine

Objectives: At the end of this lesson you shall be able to

- **describe the function of a two-stroke engine**
- **describe the function of a four-stroke engine**
- **differentiate between a four-stroke and a two-stroke engine**
- **explain an OTTO cycle**
- **explain a diesel cycle.**

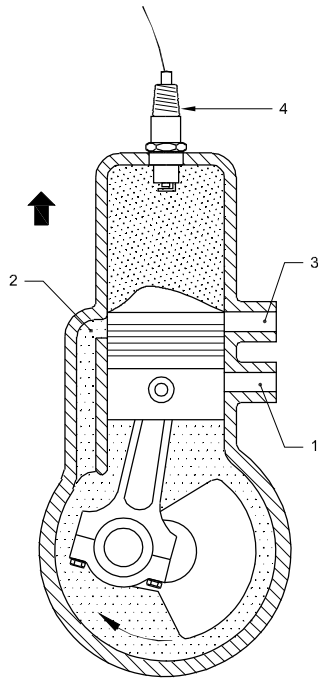
Two-Stroke spark ignition engine

To produce power in two stroke engine the following operations take place in the sequence given below.

First stroke (Suction and compression) (Fig.1)

As the piston moves up from BDC,(Fig 1) it closes the inlet port (1), the exhaust port (3) and the transfer port (2). Further upward movement of the piston results in compressing the mixture in the cylinder and opening of the inlet port (1). The upward motion of the piston creates a

Fig 1



FIRST STROKE

MVN163731

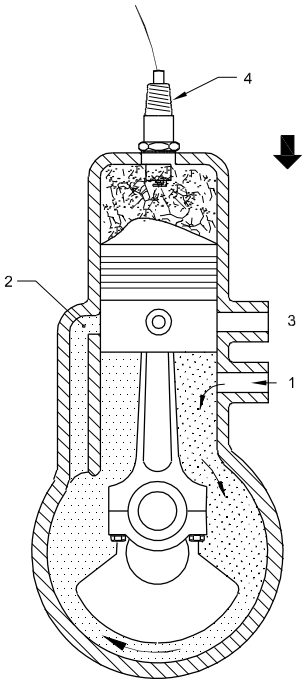
partial vacuum inside the crank-case below the piston, and the air/fuel mixture is drawn into the crank-case through the inlet port (I). The exhaust and transfer ports remain closed during the operation of the upward stroke and the charge which reached above the piston during the previous stroke is compressed.

At the end of this stroke the mixture is ignited by an electric spark (4). This causes the pressure to rise.

Second stroke (power and exhaust)

The piston is forced downward from the TDC (Fig 2). During this stroke the exhaust port opens and burnt gases escape into the atmosphere.

Fig 2



FIRST STROKE

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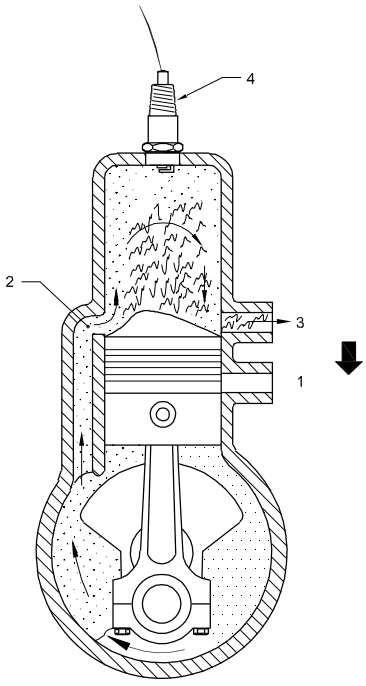
Further downward movement of the piston opens the transfer port and allows the partially compressed mixture, received during the previous stroke, to reach the combustion chamber from the crankcase.

The piston head has a special shape. It deflects a fresh change of fuel mixture up into the cylinder. The mixture flows down and pushes the burnt gas out. Through the exhaust port. This process is called scavenging. Once the flywheel has completed one revolution, the cycle is repeated. In this engine one power stroke is obtained in each revolution of the crankshaft.

Spark ignition (Fig 3)

In a spark ignition (SI) engine, petrol is used as fuel. During the suction stroke the air and fuel mixture is sucked into the cylinder. The quantity of the mixture is metered by the carburettor according to the load and speed. The ratio of air/fuel mixture is also metered by the carburettor. During the compression stroke, this air/fuel mixture is ignited by the spark and the mixture is burnt. It raises the pressure of the gas above the piston. The piston is forced down and this power is supplied to the flywheel. During the exhaust stroke burnt gases escape through the exhaust port/valve.

Fig 3



SECOND STROKE

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In this type of engine the compression ratio is low.

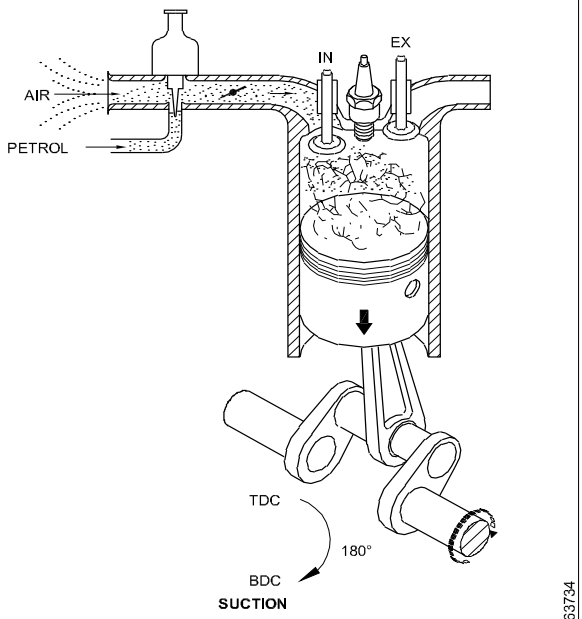
Four-stroke spark ignition engine

To produce power in a four-stroke engine the following operations take place in the sequence given below.

Suction stroke

The piston moves from TDC to BDC (Fig 4). A vacuum is created inside the cylinder. The inlet valve opens while the exhaust valve remains closed. The charge (air/air-fuel mixture) enters the cylinder.

Fig 4

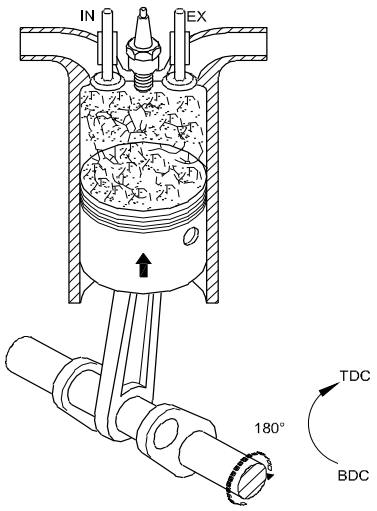


SUCTION STROKE

Compression stroke

The inlet valve closes. The exhaust valve remains closed. The piston moves from BDC to TDC (Fig. 5). The charge (air/air-fuel mixture) is compressed. The pressure and temperature rise.

Fig 5

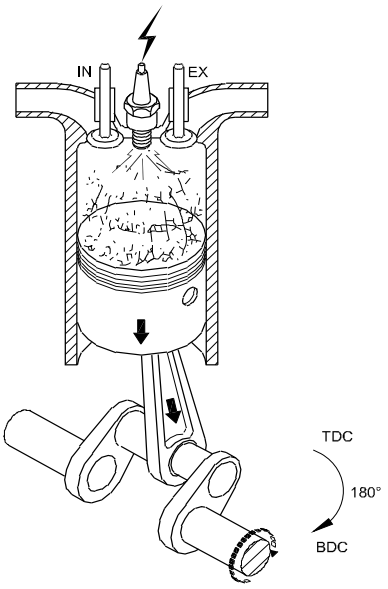


COMPRESSION STROKE

Power stroke

The compressed is ignited air fuel mixture and pressure develops inside the cylinder. The gas expands and the piston is forced down from TDC to BDC (Fig 6). Both the valves remain closed. Power is supplied to the flywheel.

Fig 6



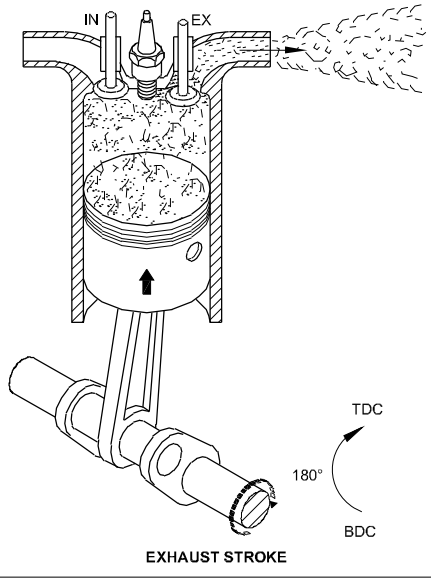
POWER STROKE

Exhaust stroke

The inlet valve remains in the closed position. The exhaust valve opens, the piston moves from BDC to TDC (Fig 7) due to the energy stored in the flywheel. The burnt gases inside the cylinder go out through the exhaust valves. At the end of the stroke the exhaust valve closes.

The cycle of suction, compression power and exhaust are repeated. In this type of engines one power stroke is obtained in two revolutions of the crankshaft.

Fig 7



EXHAUST STROKE