Introduction and Working of IC Engines

WHAT IS STROKE ?

- Reciprocating motion, used in reciprocating engines and other mechanisms, is back- and-forth motion. Each cycle of reciprocation consists of two opposite motions: there is a motion in one direction, and then a motion back in the opposite direction. Each of these is called a **stroke**.

WHAT IS 2S & 4S ?

- A **two-stroke petrol engine** is an internal combustion engine that completes the process cycle in one revolution of the crankshaft. Thus, one power stroke is obtained in each revolution of the crank shaft.
- A **four stroke diesel engine** is an internal combustion engine that completes the process cycle in two revolution of the crank shaft. Thus, one power stroke is obtained in each two revolutions of the crank shaft.

Basic Parts of the 2 stroke petrol engine

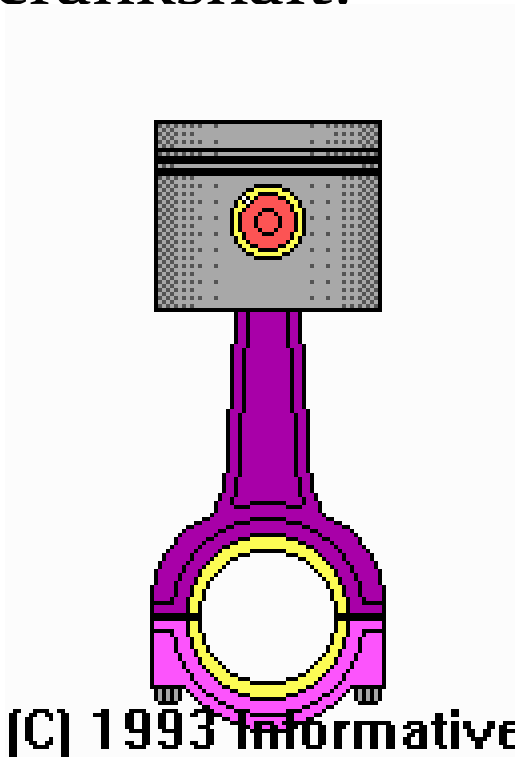
- Cylinder block
- Piston
- Piston rings
- Spark plug
- Connecting rod
- Crankshaft

Spark Plug

- Electric match used to begin the combustion process of burning air and petrol to create heat.
- It provides the means of ignition when the petrol engine's piston is at the end of compression stroke, close to Top Dead Center(TDC)

Connecting Rod

- Connects the piston and piston pin to the crankshaft.



Piston

A sliding plug that harnesses the force of the burning gases in the cylinder.

Crankshaft

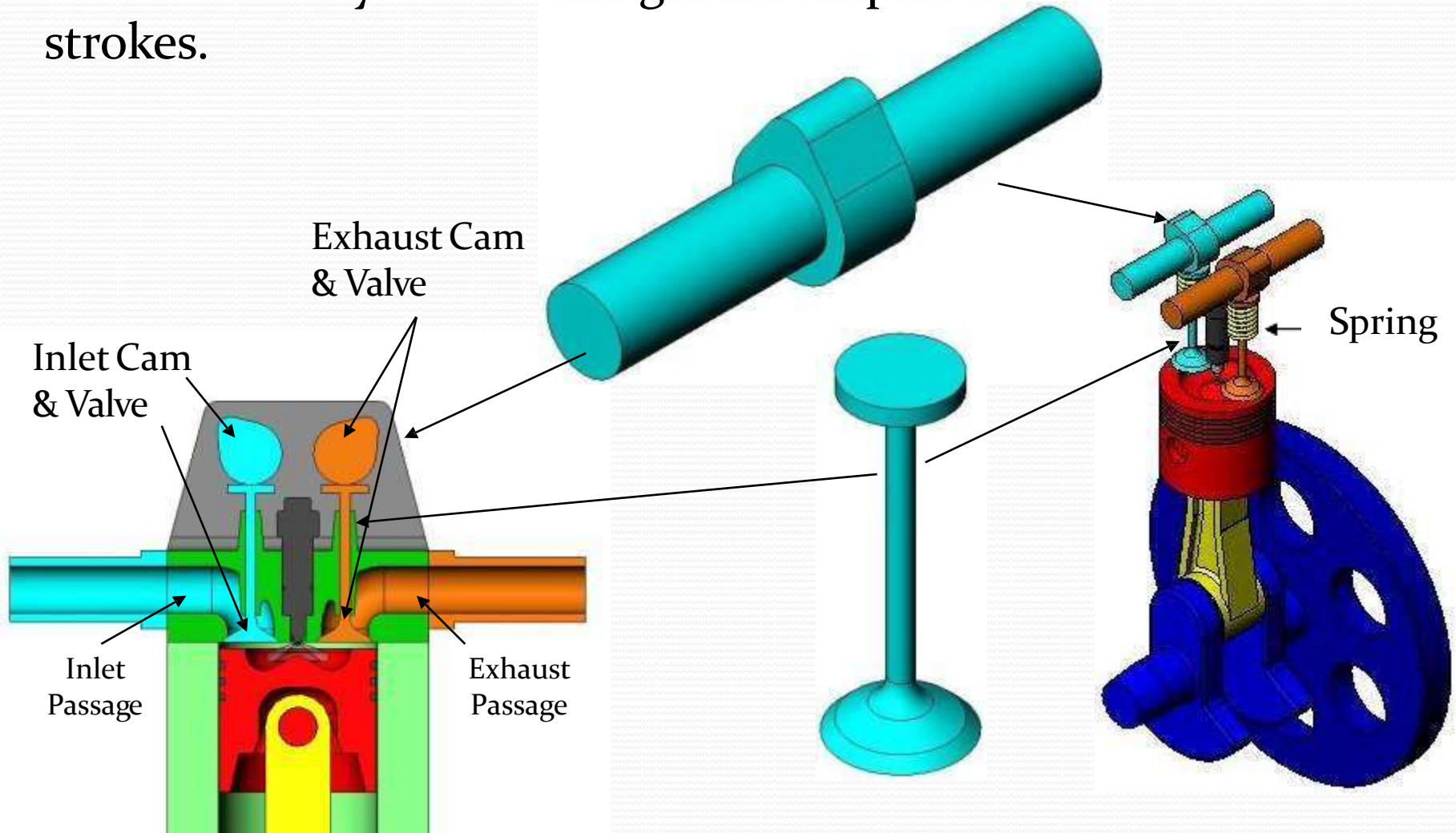
- Along the the piston pin and connecting rod it converts theup and down motion (reciprocating) of the engine to spinning (rotary) motion.

Basic Parts of the4S Diesel Engine

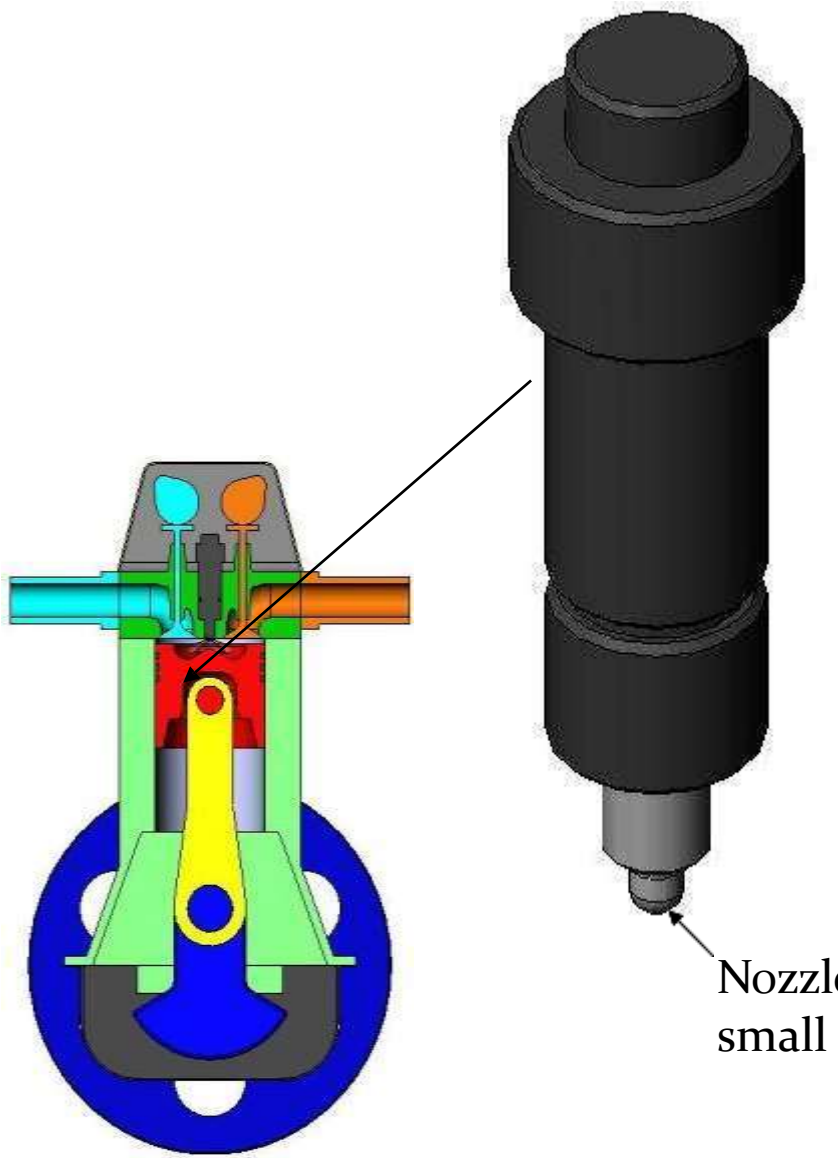
- Cylinder block
- Piston
- Piston pin
- Connecting rod
- Crankshaft
- Cylinder head
- Intake valve
- Exhaust valve
- Camshaft
- Timing gears
- Fuel injector

VALVES

One set of a Cam and a Valve controls the Inlet flow of fresh air into the Cylinder. The other set controls the burnt Exhaust Gases out of the Cylinder. Both these Valves are spring loaded to shut and seal the Cylinder during the Compression and Power strokes.



INJECTOR



Nozzle tip with several small holes for fuel spray

- The Fuel Injector is connected to a high pressure pump that is not illustrated.
- It sprays a small amount of diesel fuel into the Cylinder at the end of the Compression Stroke and beginning of the Power Stroke.
- The fuel is sprayed through several very small holes at very high pressure in order to form a fine mist of droplets of fuel that will ignite easily and burn quickly in the hot air.

Petrol - Engine

A petrol engine (known as a gasoline engine) is an internal combustion engine
with the spark ignition. So it is also known as spark ignition(S.I. Engine).

Fuel used In a petrol engine is a gasoline (Petrol) and similar volatile fuel.

Let's see about it's history.. . . .. It was invented in a 1876 in Germany by german inventor Nikolaus August Otto. The first petrol combustion engine was prototyped in 1882 in Italy by Enrico Bernardi.

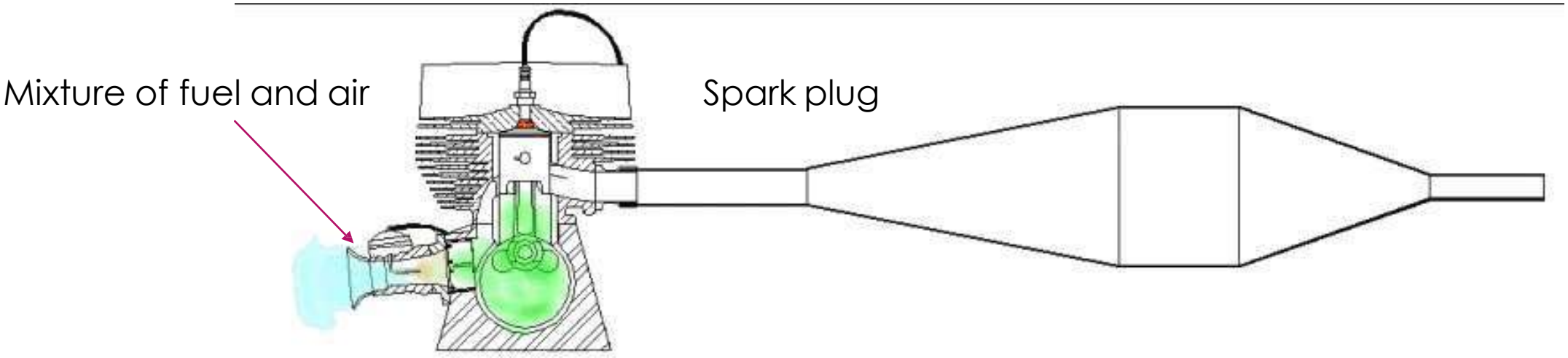
The petrol engine works on principle of theoretically otto cycle(constant volume cycle).

In most petrol engines, the fuel and air are usually pre-mixed before compression.

The pre-mixing was formerly done in a carburettor.

The process differs from a diesel engine in the method of mixing the fuel and air, and in using spark plugs to initiate the combustion process. In a diesel engine, only air is compressed , and the fuel is injected into very hot air at the end of the compression stroke, and self-ignites.

The spark plug fitted at the top of the cylinder head initiates the ignition of the air fuel mixture.



4 stroke
petrol - engine

A 4 stroke petrol engine shown in figure .

The valve operating the inlet is called inlet valve and the valve operating the exhaust is called exhaust valve. The spark plug fitted at the top of cylinder head initiates the ignition of the air fuel mixture.

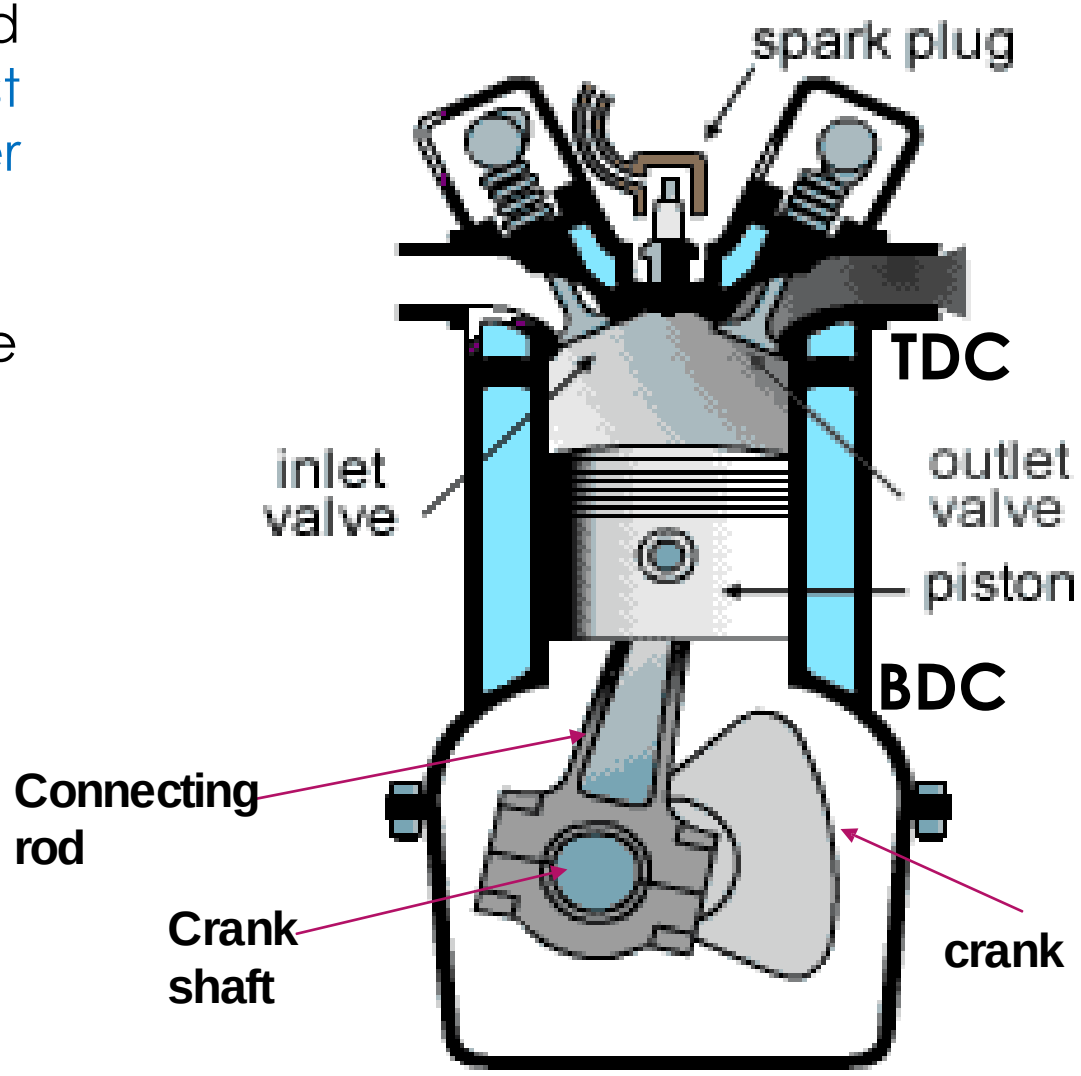
The piston performs four stroke to complete one working cycle. The four different strokes are;

1) Suction stroke

2) Compression stroke

3) Power stroke

4) Exhaust stroke



[4 STROKE PETROL ENGINE]

SUCTION STROKE

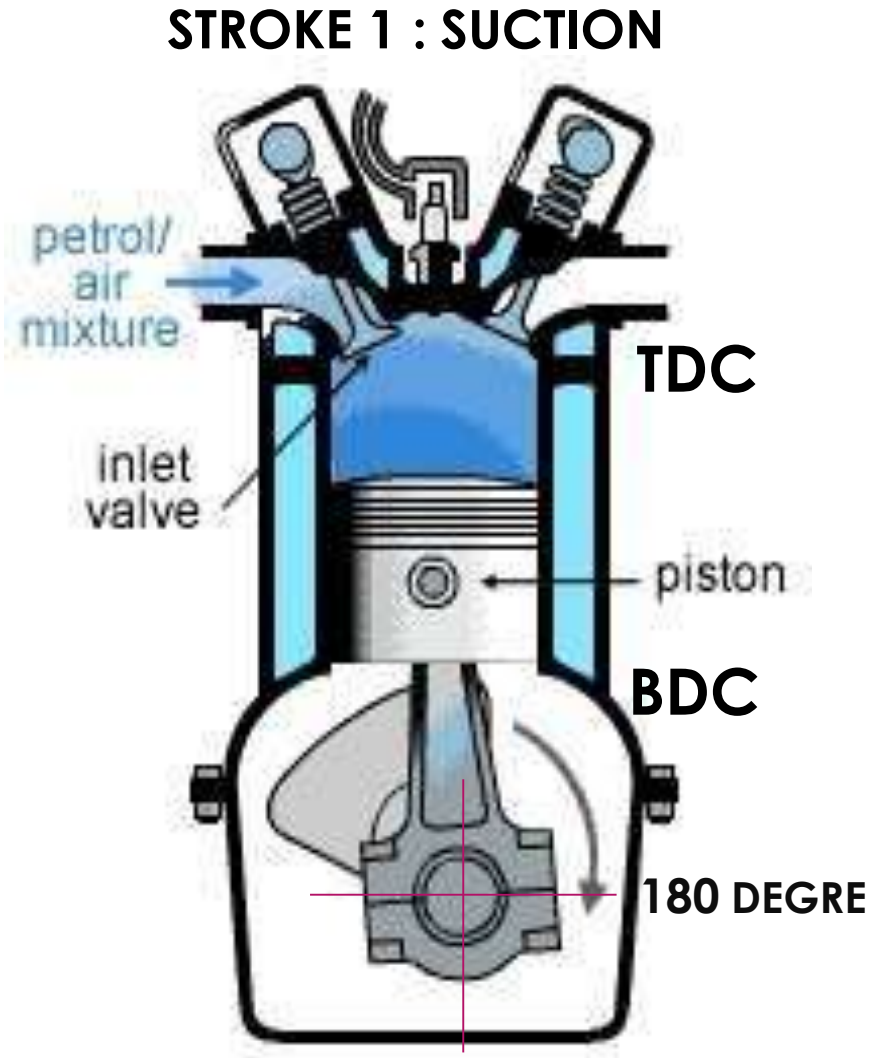
During this stroke, inlet valve opens and exhaust valve closed, the pressure in the cylinder will be atmosphere .

As the piston moves from the TDC To BDC , the volume in the cylinder increase , while simultaneously pressure decreases.

This create a pressure difference between the atmosphere and inside of the cylinder. Due to this pressure difference the petrol and air mixture will enter into the cylinder through carburettor.

The crankshaft has now made half rotation i.e. 180 degree of crank angle.

At the end of this stroke, the cylinder will filled completely with petrol and air mixture called charge and inlet valve is closed.



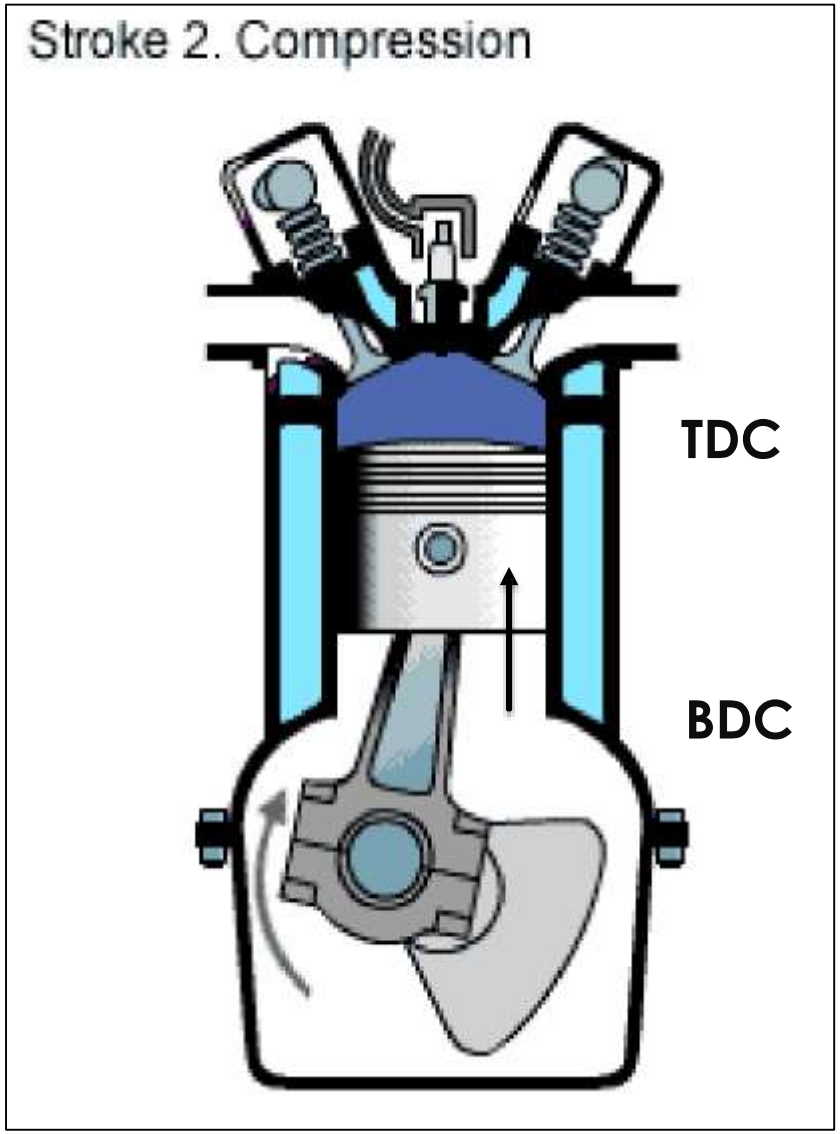
COMPRESSION STROKE

During this stroke both the inlet valve and exhaust valve are closed, the piston moves from BDC to TDC .

As this stroke being performed ,the petrol and air mixture contained in the cylinder will be compressed , so pressure and temperature of mixture increases. The process of compression is shown in fig.

Near the end of this stroke , the petrol and air mixture is ignited by the electric spark given out by the spark plug.

The combustion of petrol releases the hot gases which will increases the pressure at the constant volume.



POWER STROKE

During this stroke both the inlet valve and exhaust valve are closed, the piston moves from TDC to BDC.

The high pressure and high temperature burnt gases force the piston to perform this stroke, called power stroke. This stroke is also known as expansion or working stroke.

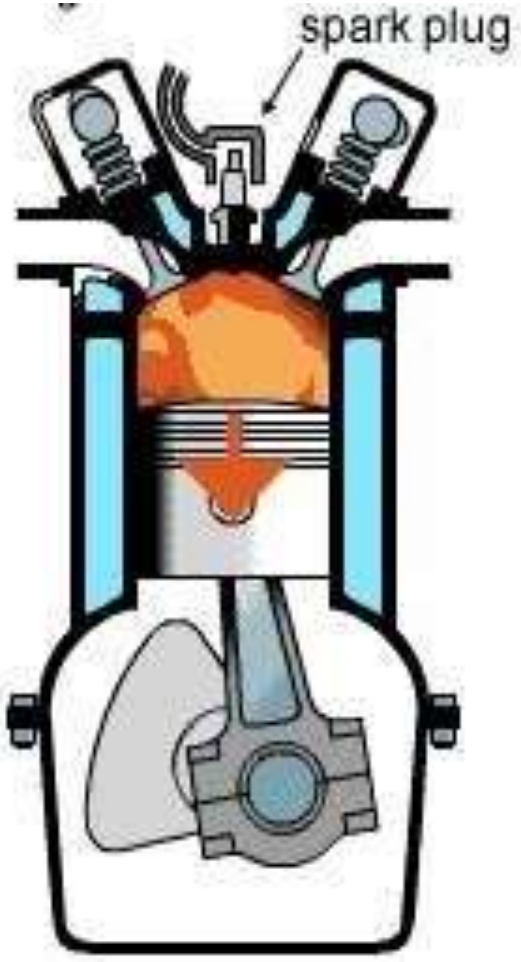
The engine produces mechanical work or power during this stroke.

As the piston moves from TDC to BDC , the pressure of hot gases gradually decreases and volume increases.

Near the end of this stroke, the exhaust valve opens which will release the burnt gases to the atmosphere.

This will suddenly bring the cylinder pressure to the atmospheric pressure.

STROKE 3 : POWER OR EXPANSION

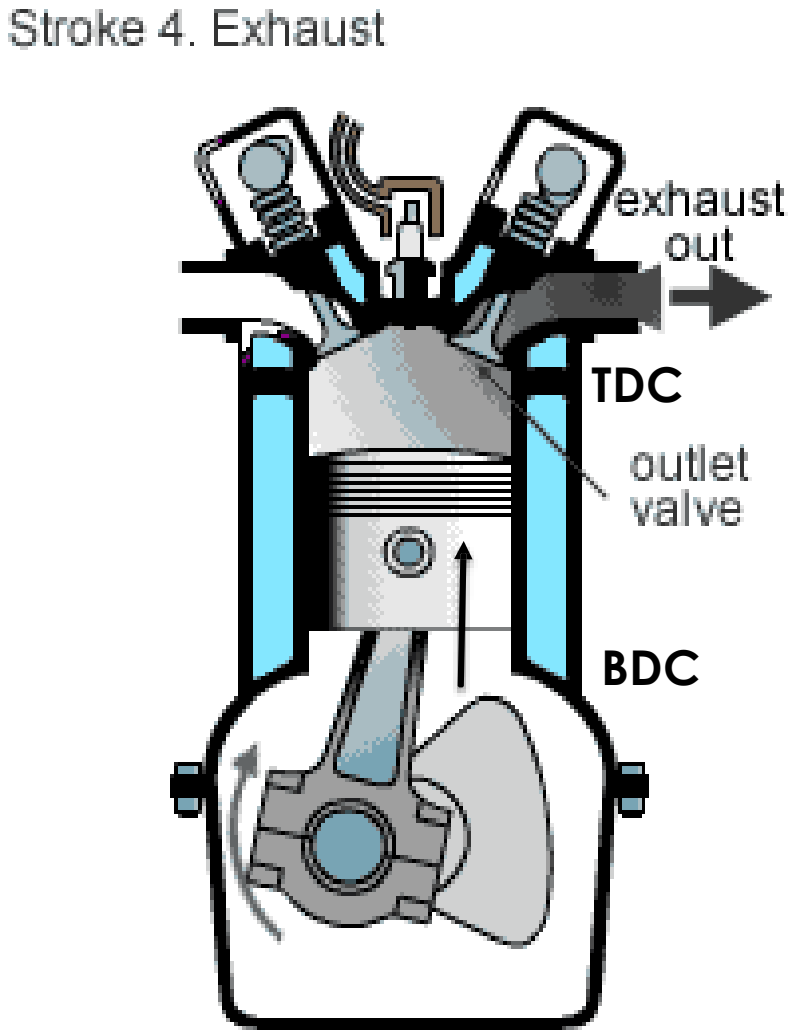


EXHAUST STROKE

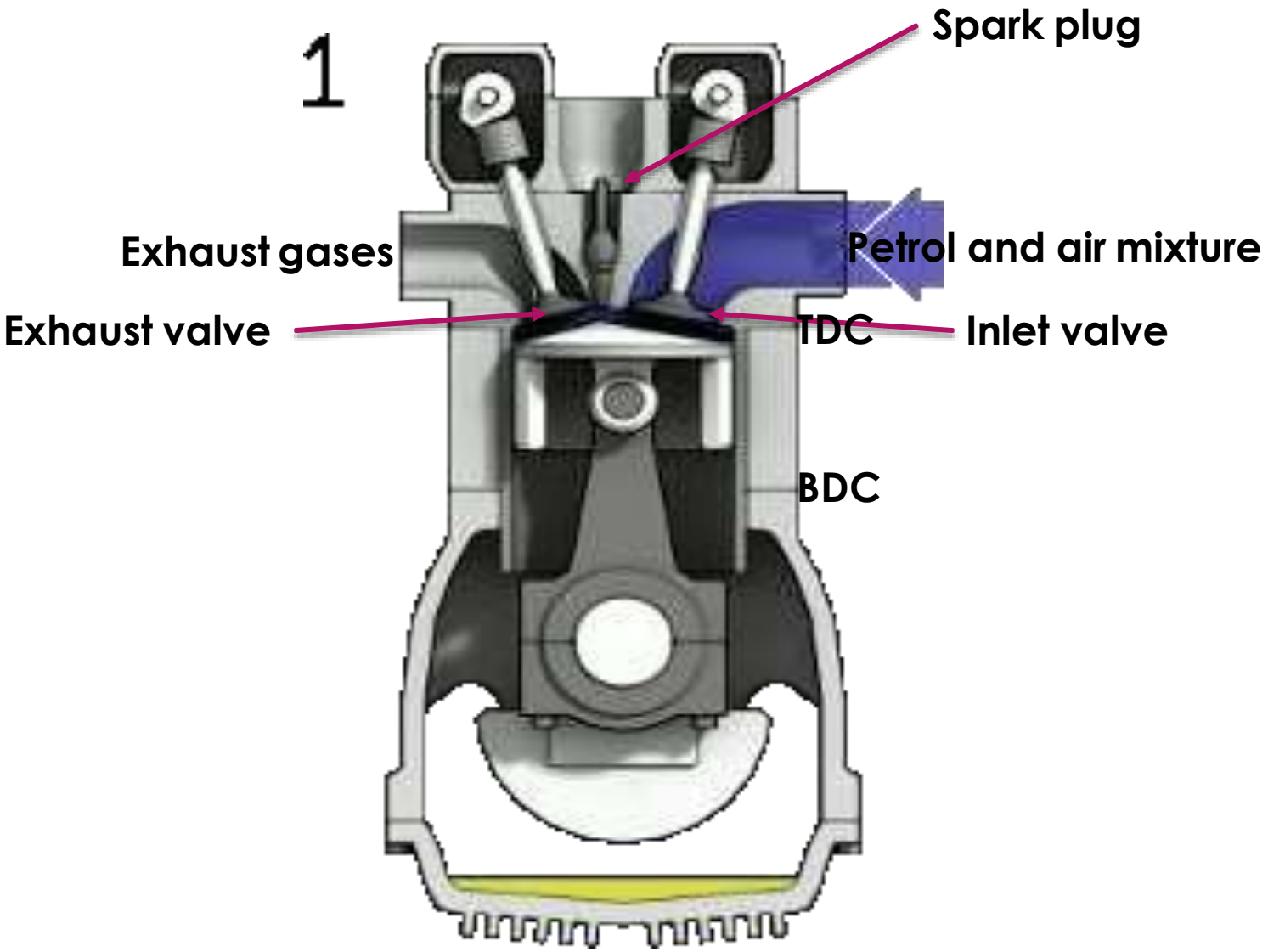
During this stroke, the exhaust valve opens and the inlet valve is closed .

The piston moves from BDC to TDC and during this motion piston pushes the exhaust gases (combustion product) out of the cylinder at constant pressure.

again the inlet valve open and the new cycle starts.



THE WORKING OF 4 - STROKE PETROL ENGINE.



2 stroke
petrol - engine

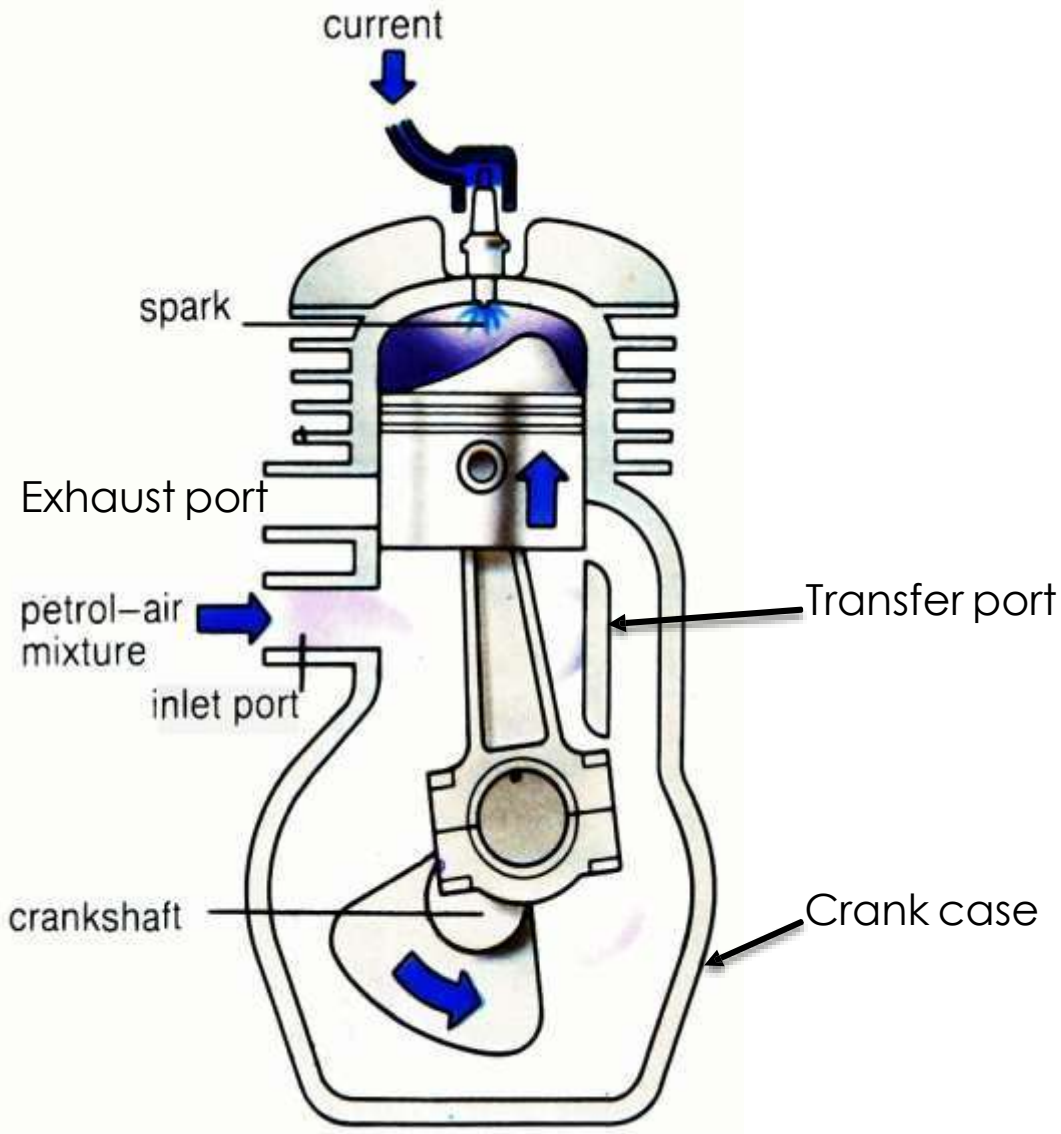
As the name itself implies, all the processes in the two stroke cycle engine are completed in two strokes. These engine have 1 power stroke per revolution of the crankshaft.

In the two stroke engine there is a two opening called ports are provided in place of valve of four stroke engines.

These ports are opened and closed by reciprocating motion of the piston in the cylinder.

One port known as a inlet port and another port is known as a exhaust port.

Two stroke engine consist of a cylinder with one end fitted with a cylinder head and other end fitted with a hermitically sealed crankcase which enables it to function as a pump in conjuction with the piston.



Working of the two stroke petrol engine

❖Intake of the petrol and air mixture

When the piston moves upward in the fig. D. A partial vacuum is created in the crankcase until is lower is edge uncovers the inlet port completely in fig. A.

The pressure difference set up between the atmosphere and the crankcase will suck the petrol and air mixture to inlet port, into crankcase in fig. A.

The suction will be continue till the inlet port is covered by piston during its next downward stroke after the inlet port is covered by piston in fig. B, its further downwards motion will compressed the charge in the crankcase upto top edge of the piston uncovers the transfer port in fig. B.

The compressed charge flows from the crankcase to cylinder through transfer port.

This will continue till the piston covers the transfer port during its next upward stroke in fig. C.

First stroke

At the beginning of the first stroke piston Is at the TDC as shown in fig. A. Piston moves from TDC to BDC.

The electric spark ignites the compressed charge . The combustion of the charge will release the hot gases which increase the temperature and pressure in cylinder. The high pressure combustion engine to force piston downward .

The piston perform power stroke till it uncovers the exhaust port As shown in fig. B. The combustion gases which are at the pressure slightly higher than atmosphere pressure escape through exhaust port.

The piston uncovers the transfer port the fresh charge flow from the crankcase into cylinder through transfer port as shown in fig. B.
Which enters the cylinder pushes the burnt gases , so more amount of exhaust gases come out through exhaust port as shown in fog. B.

This swiping out of exhaust gases by incoming fresh charge is called scavenging.

This will continue till the piston covers both the transfer and exhaust port during next upward stroke.

First stroke

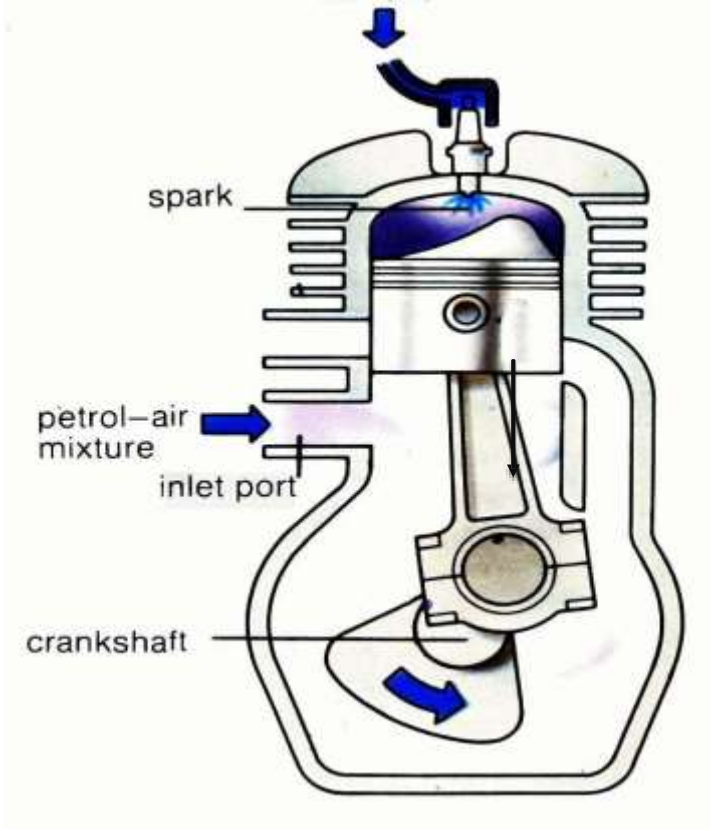


Fig. A

Beginning of the first stroke

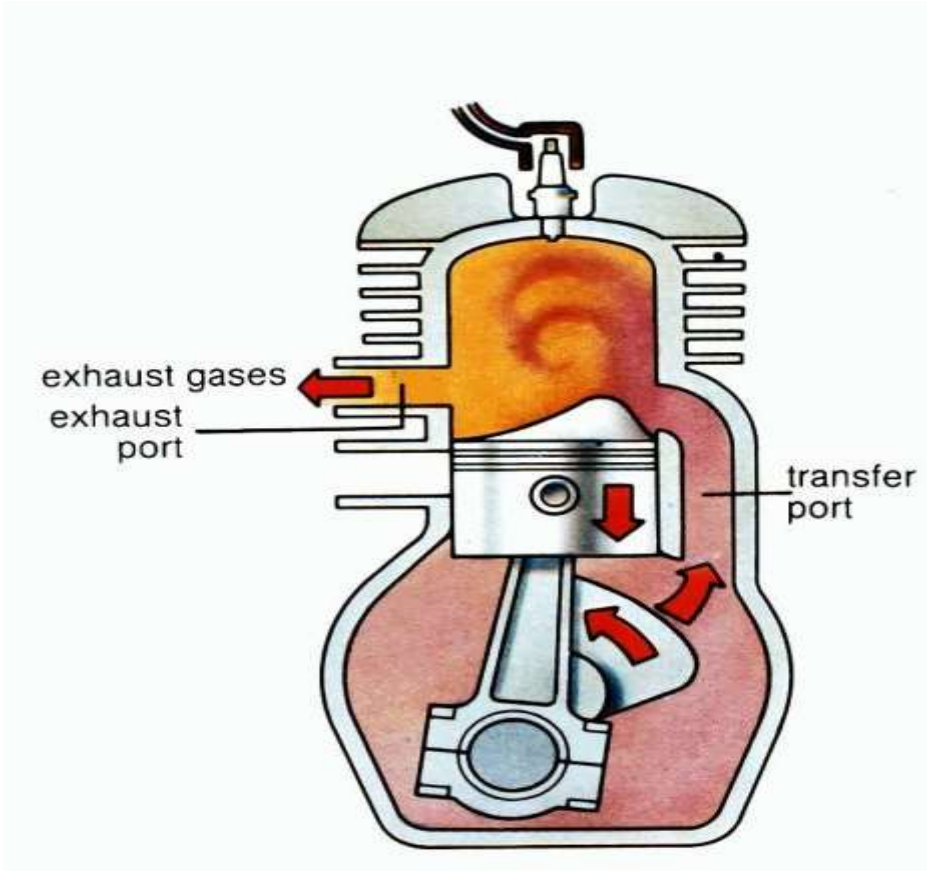


Fig. B

Piston uncovers transfer port During first stroke

Second Stroke

In this stroke piston moves from BDC to TDC.

When it covers the transfer port in fig. C. , the supply of charge is stopped and then when it moves further up it covers the exhaust port completely in fig. D stop the scavenging.

Further upward motion of the piston will compressed the charge in the cylinder.

After the piston reaches TDC the first stroke repeats again.

Second Stroke

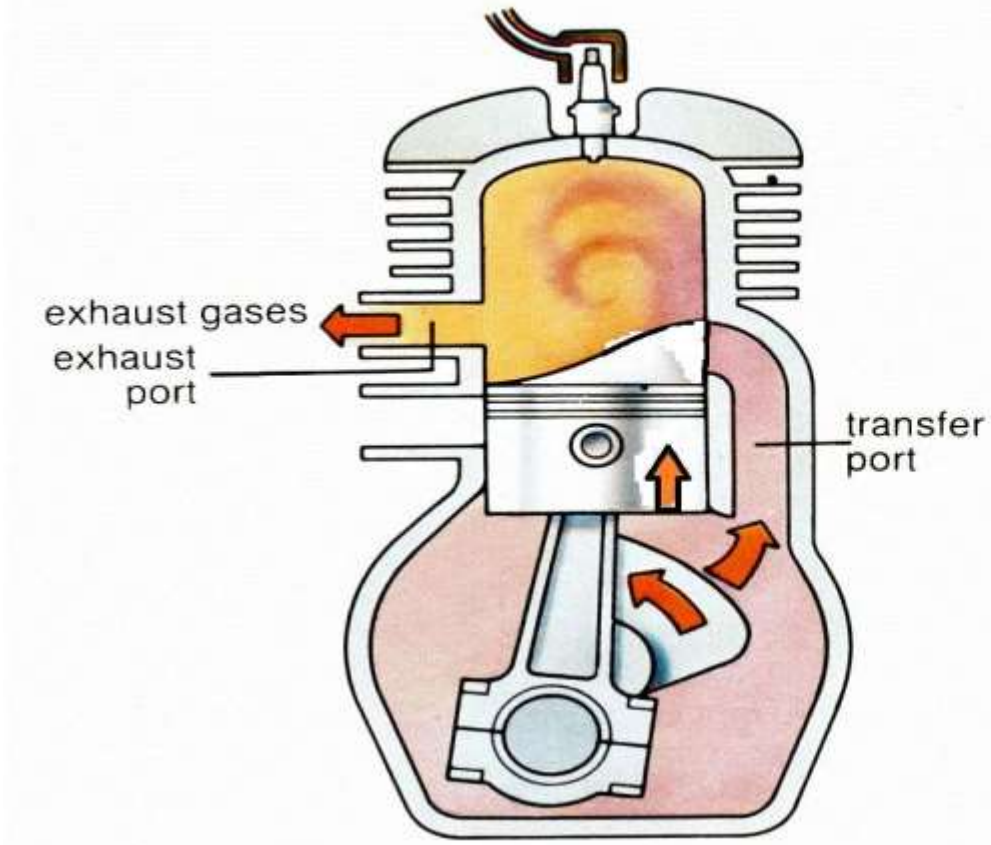


Fig. C.

Transfer port covered

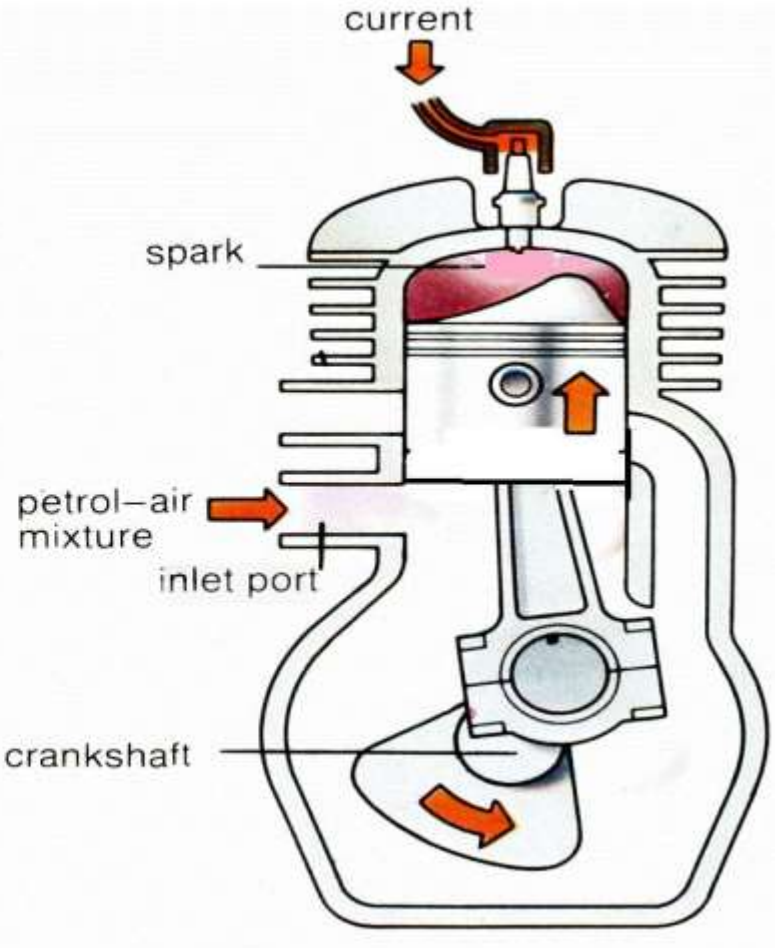


Fig. D.

Compression commenced

Advantages of 2S-petrol engine

- The power developed will be nearly twice that of four-stroke engine of same dimension and operating at the same speed.
- The work required to overcome the friction of the exhaust and suction strokes is saved.
- Low weight.
- Construction is simple.

Disadvantages of 2S-petrol engine

- As working on Otto-cycle, a part of the fresh mixture is lost through exhaust port.
- Part of the piston stroke is lost.
- Heavy consumption of lubricating oil.

Difference between 4 stroke & 2 stroke

Principle	4 stroke	2 stroke
1.Stroke per cycle	Four piston stroke	Only two piston stroke
2.Crank rotation per cycle	Two crank rotation	Only one crank rotation
3.Power stroke per cycle	Half of speed of crankshaft	Equal to speed of crankshaft
4.Power	In every alternate revolution	In every revolution
5.Fly wheel	Heavy flywheel	Lighter flywheel
6.Sizeof engine	Heavier , larger and more space	Lighter , more compact and less space
7.Admission of charge	Directly into cylinder	First admitted into crankcase, then transfer to engine
8.Valves	Inlet and exhaust valves	In place of valves, ports are there
9.Crankcase	It is not hermetically sealed	Hermetically sealed
10.Direction of rotation the crankshaft	In one direction	In both directions
11.Lubricant oil consumption	Less	More
12.Thermal efficiency	Higher	Less
13.Mechanical efficiency	Low	High
14.uses	Cars, tractors, buses	Mopeds, scooter, motor, cycle

Comparison of 4S-2S cycle engine

- Four stroke engine
  - Cycle is completed in four strokes of piston & in two revolution of crankshaft.
  - Heavier flywheel is needed.
  - Power produced for same size of engine is less.
  - Volumetric efficiency is more due to more time for induction.
- Two stroke engine
  - Cycle is completed in two strokes of piston & in one revolution of crankshaft.
  - Lighter flywheel can be used.
  - Power produced for same size of engine is twice.
  - Volumetric efficiency is low due to lesser time for induction.

Advantages of Petrol engine

High engine speeds of about 3000 rpm.

Lighter in a weight because maximum pressure and temperature is less.

Less initial cost.

Less maintenance cost.

Disadvantages of Petrol engine

low compression ratio ranging from 6 to 10.

The thermal efficiency is lower due to lower compression ratio.

Running cost higher because petrol is costlier.