



INTERNAL COMBUSTION ENGINES

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INTERNAL COMBUSTION ENGINE

- Function - Converts chemical energy in fuel into heat energy then to mechanical energy to perform useful work.



Chemical



Heat



Mechanical



CLASSIFICATION

- According to type of fuel used
 - Petrol engine.
 - Diesel engine.
 - Gas engine.
 - Bi-fuel engine.
- According to number of strokes per cycle
 - 4 – stroke engines.
 - 2 – stroke engines.



CLASSIFICATION

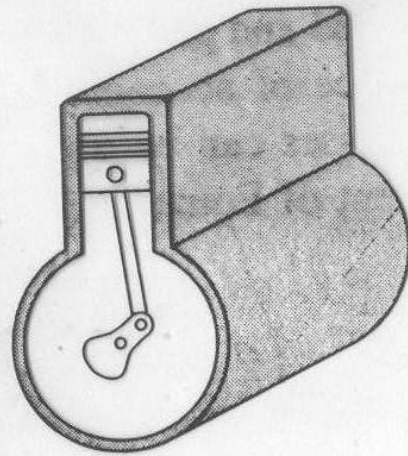
- According to method of ignition
 - Spark ignition.
 - Compression ignition.
- According to the cycle of combustion
 - Otto cycle.
 - Diesel cycle.
 - Dual combustion.
- According to the number of cylinders
 - Single cylinder.
 - Multi cylinder.



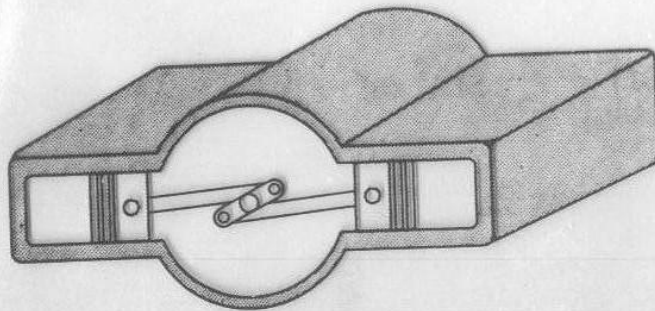
CLASSIFICATION

- According to the arrangement of cylinders
 - Vertical engine.
 - Horizontal.
 - Inline engine.
 - Radial engine.
 - V- engine.
- According to method of cooling
 - Air cooled engine.
 - Water cooled engine.

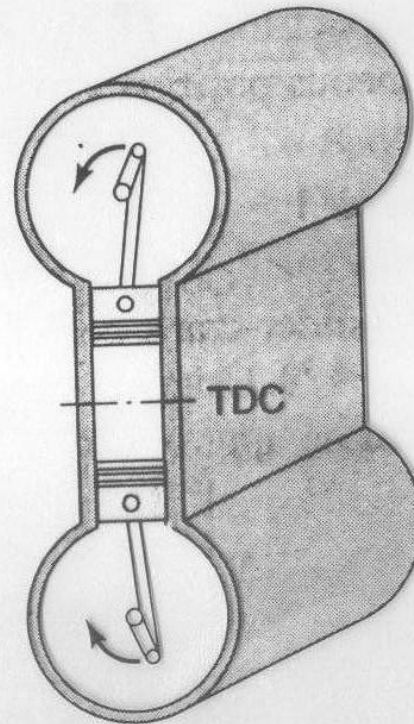




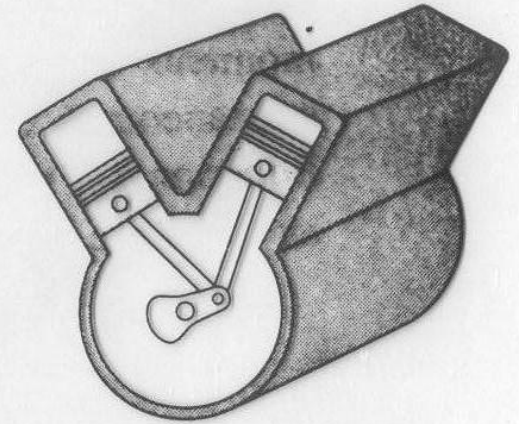
(a) In line



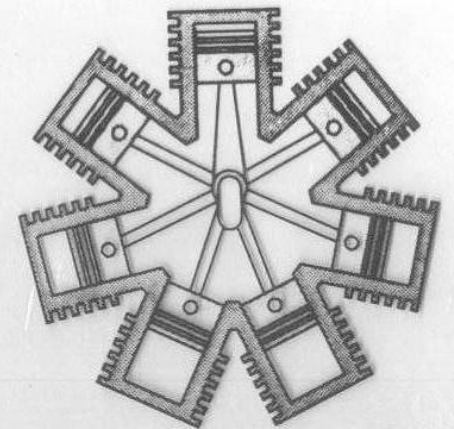
(b) Horizontally opposed



(c) Opposed piston
(crankshafts geared together)



(d) V

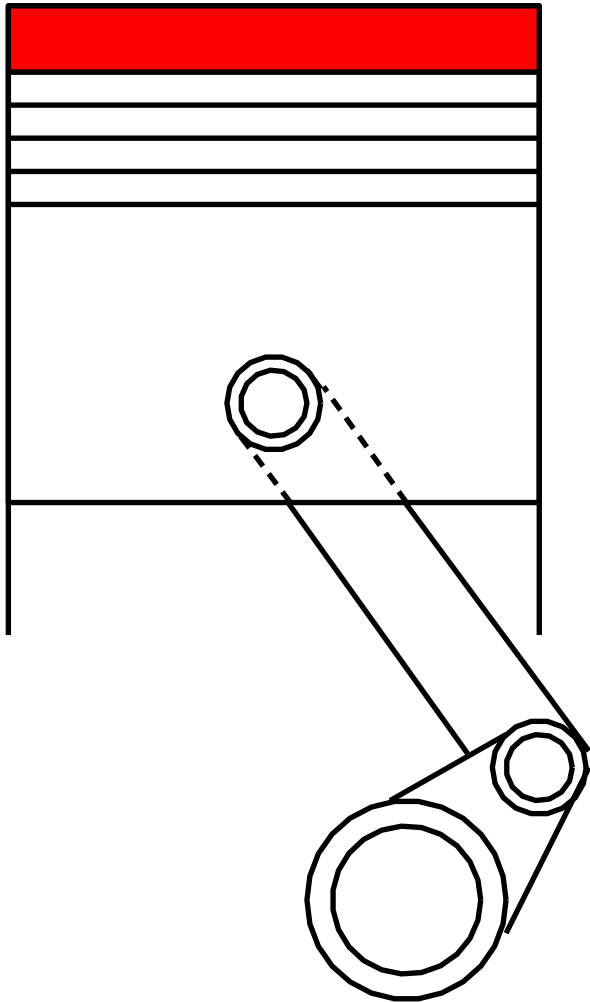


(e) Radial

- **The internal combustion of an engine, **heart** of the automobile.**
- **The difference between the two cycle and four cycle engine is the **number of strokes** it uses to start the fuel reaction of internal combustion.**

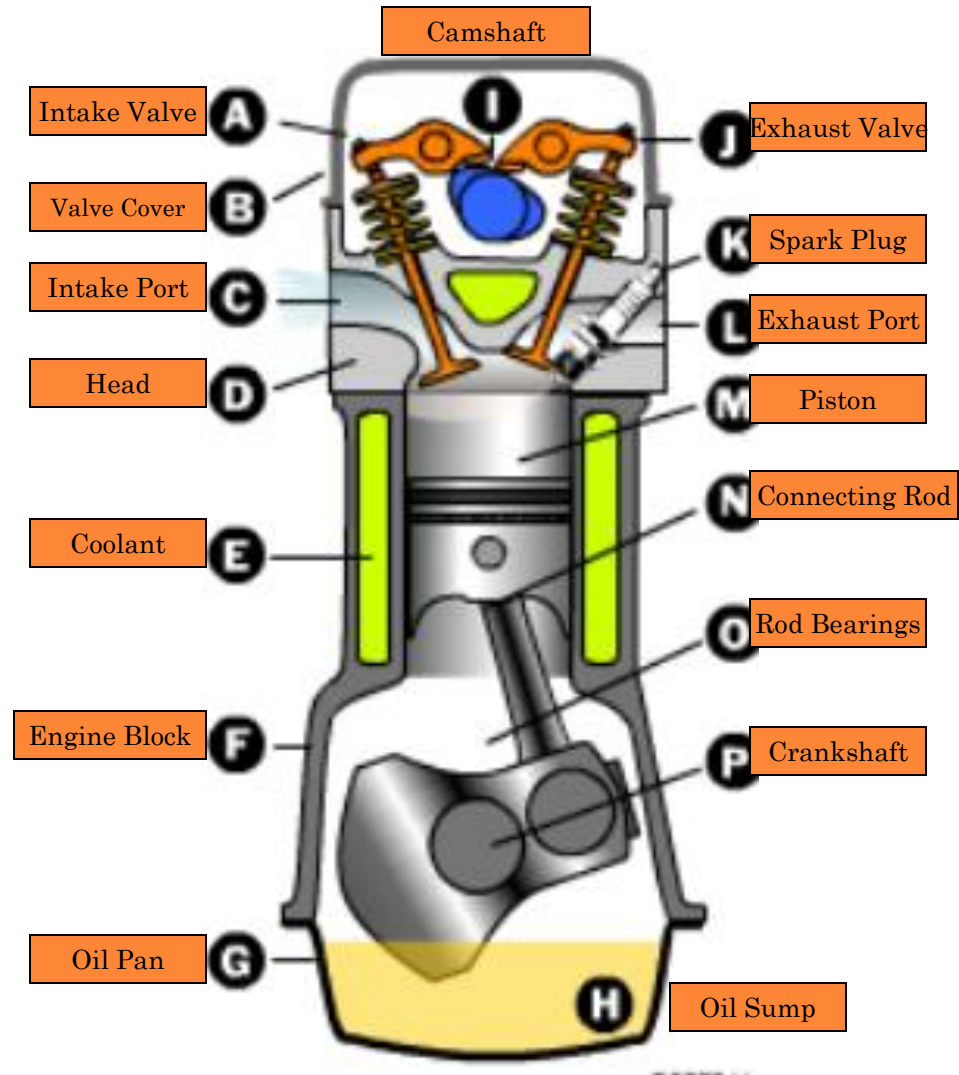


REQUIREMENTS FOR I.C. ENGINE OPERATION



- All Internal combustion engines must carry out five events:
 - Air-fuel mixture must be brought into the combustion chamber.
 - Mixture must be compressed.
 - Mixture must be ignited.
 - Burning mixture must expand into increasing combustion chamber volume.
 - Exhaust gasses must be removed.

BASIC COMPONENTS OF FOUR-STROKE ENGINES



- Cylinder

- Piston

- Piston rings

- Intake valve

- Exhaust valve

- Crankshaft

- Connectiong rod

- Spark plug



SPARK PLUG

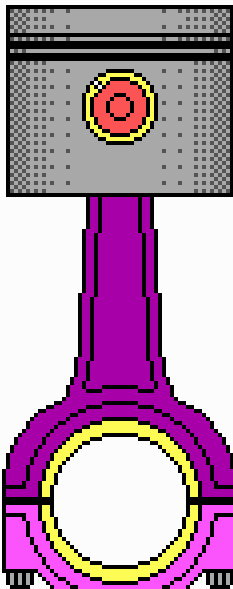


- A device, inserted into the combustion chamber for firing an electrical spark to ignite air-fuel mixture to create heat.
- It provides the means of ignition when the petrol engine's piston is at the end of compression stroke, close to Top Dead Center(TDC)



CONNECTING ROD

- Connects the piston and piston pin to the crankshaft.

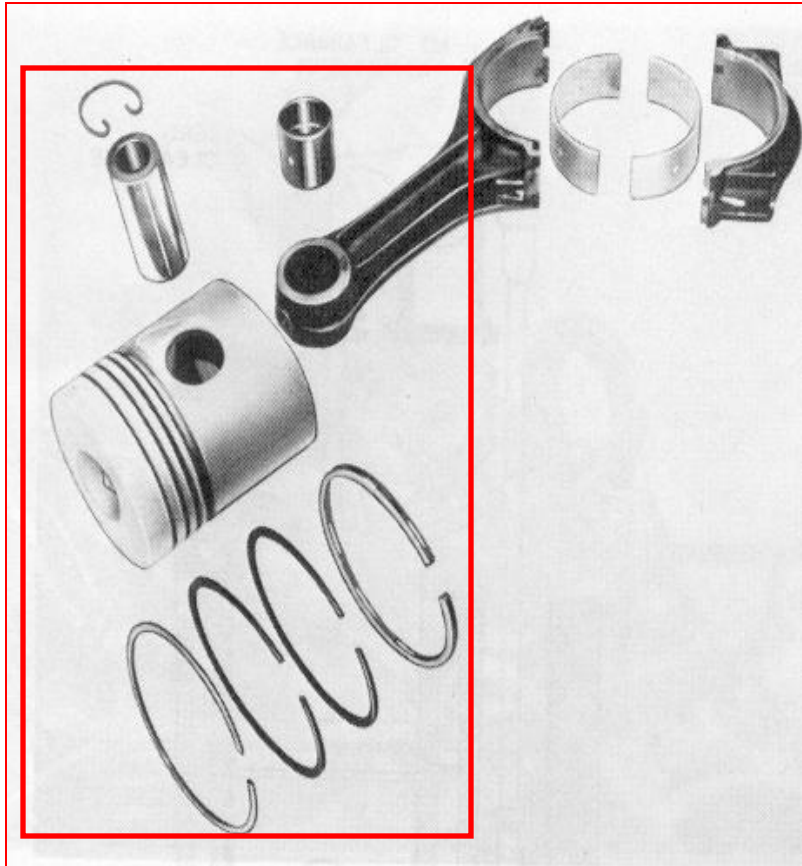


PISTON



- A sliding plug that harnesses the force of the burning gases in the cylinder.
- Close fitting hollow – cylinder plunger moving to and fro in the cylinder.
- *Function* – power developed by the combustion of fuel is transmitted by piston to the crankshaft through the connecting rod.

PISTON AND RINGS



○ Piston

- Metallic rings inserted into grooves provided at top end of the piston.
- Forms the “moveable bottom” of the combustion chamber.
 - Iron alloy or aluminum
- *Function* –Maintains a gas-tight joint between the piston and the cylinder.

○ Piston Rings

- Compression
- Oil-control
 - Cast iron

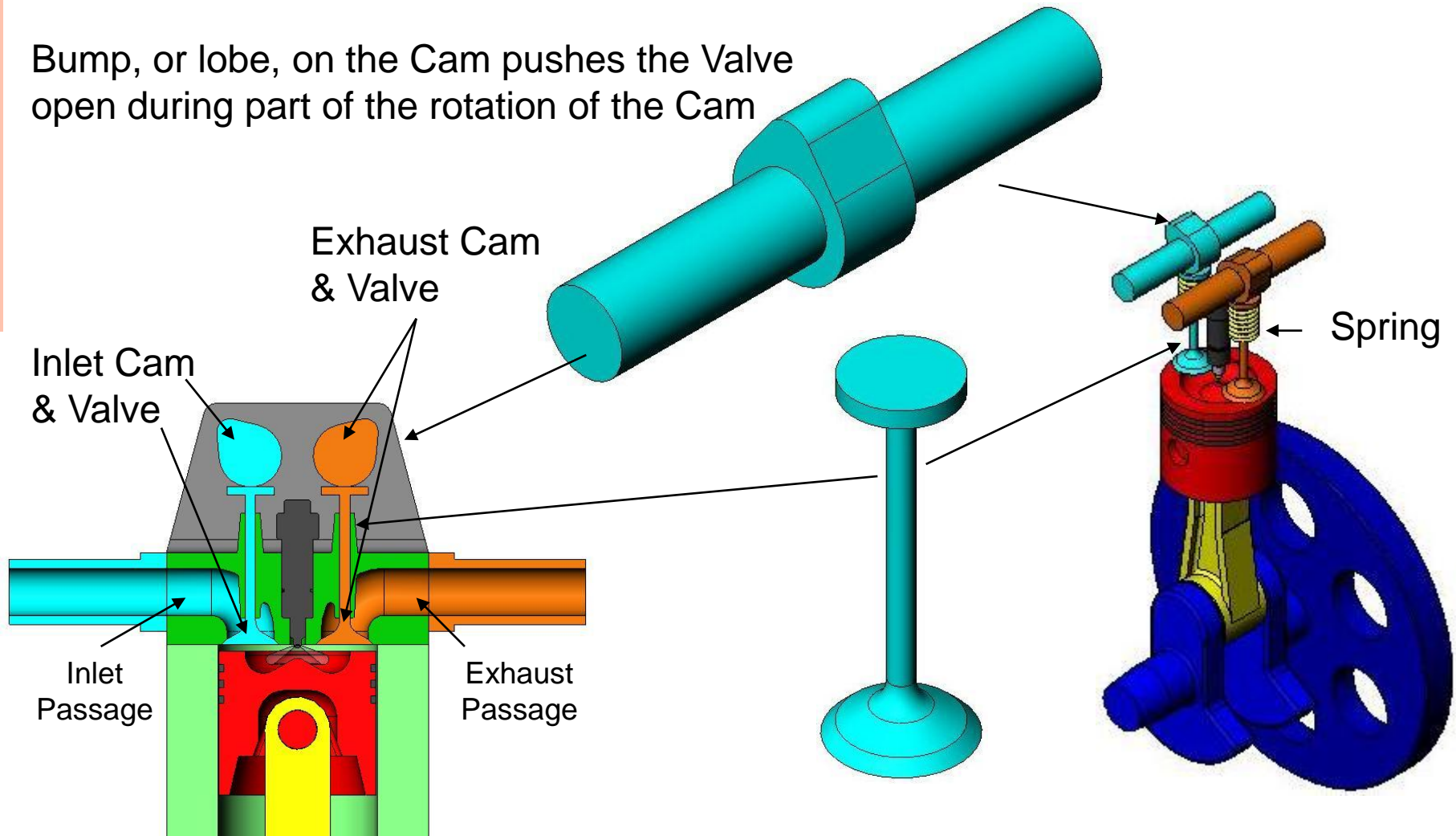
○ Piston pin



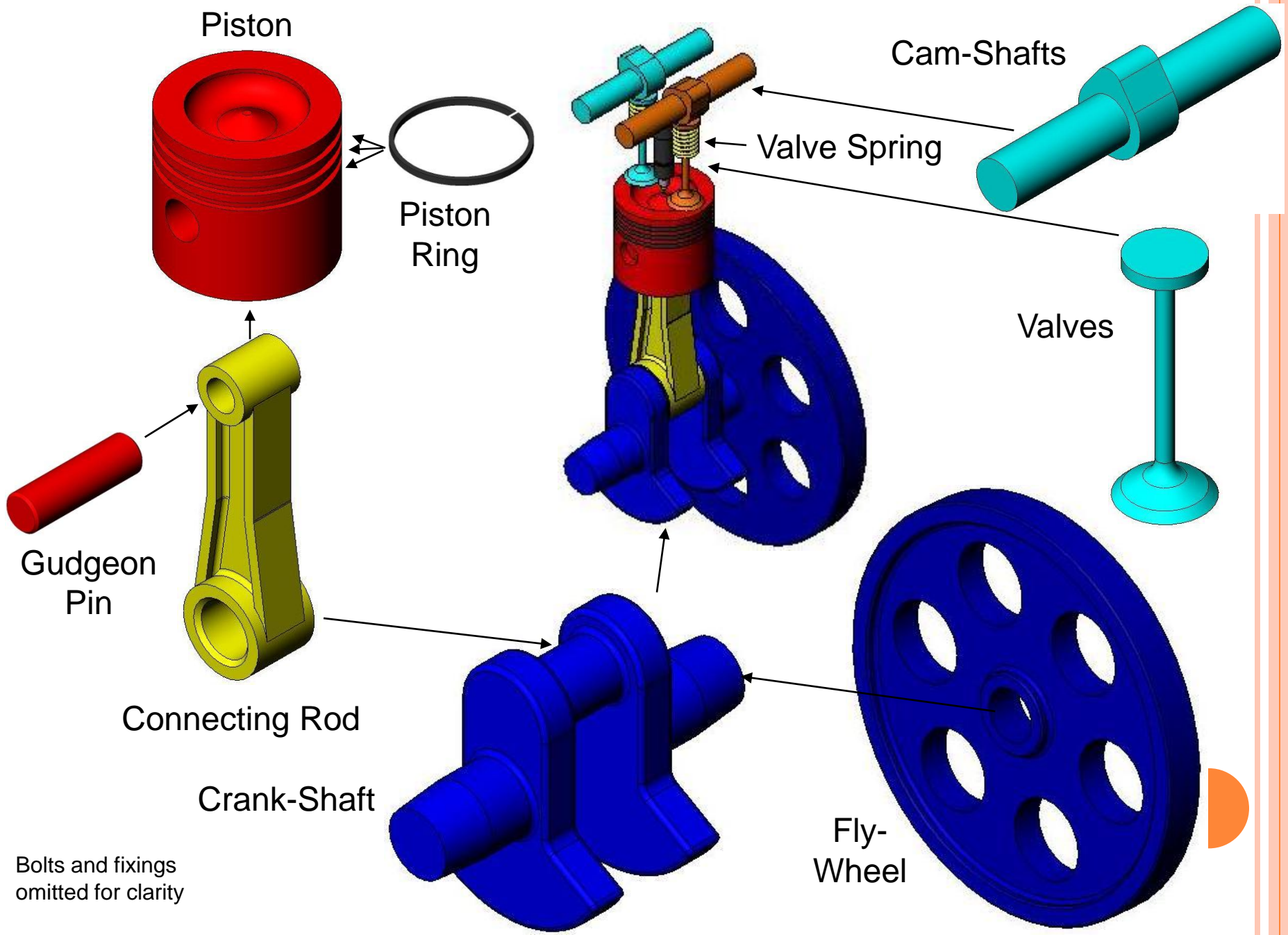
VALVES

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. They open into the Cylinder, so that they are held closed by the high pressures during the Compression and Power strokes.

Bump, or lobe, on the Cam pushes the Valve open during part of the rotation of the Cam



Main Moving parts



Some stationary parts

Cylinder
Head Cover

Fuel
Injector

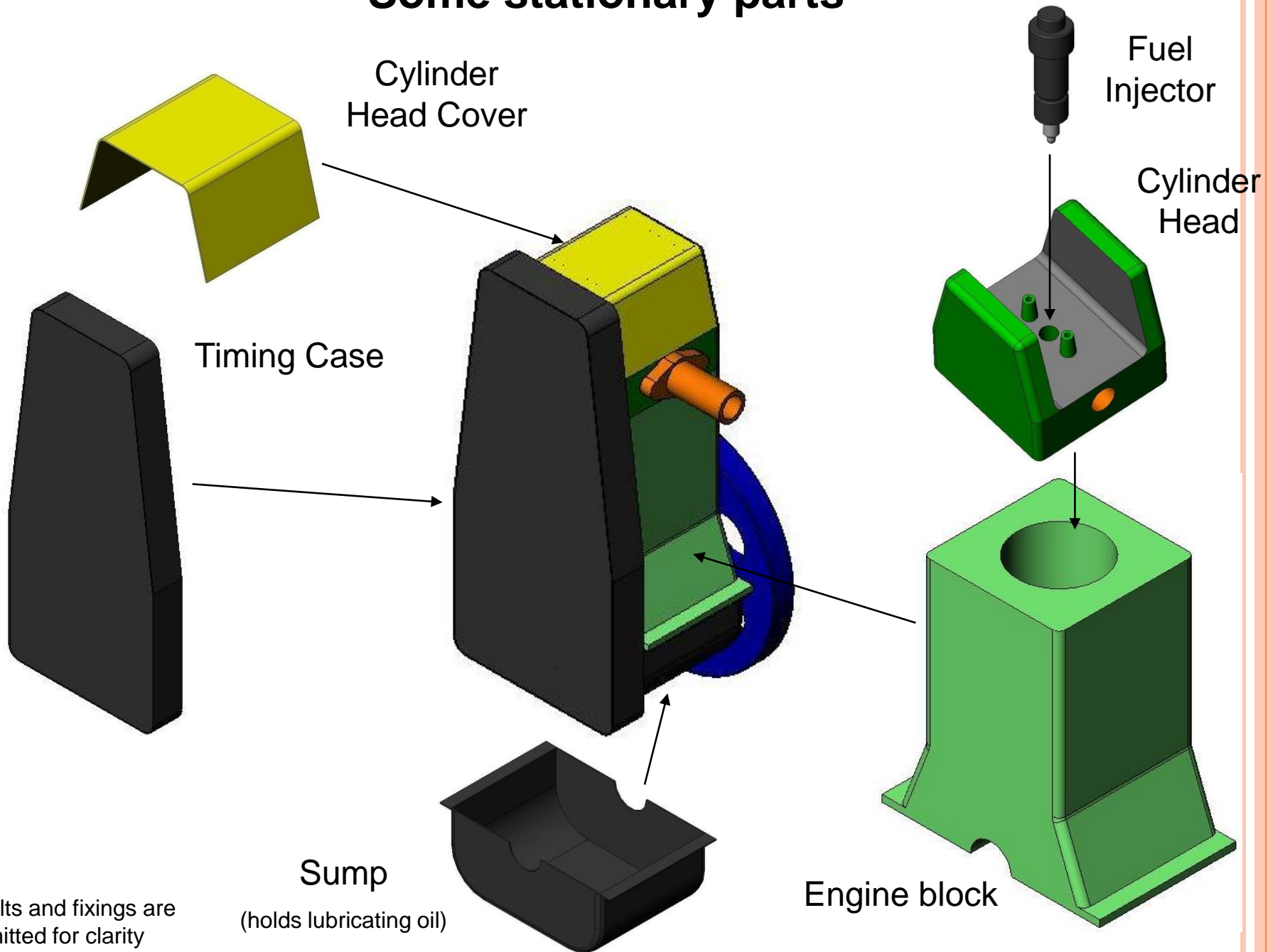
Cylinder
Head

Timing Case

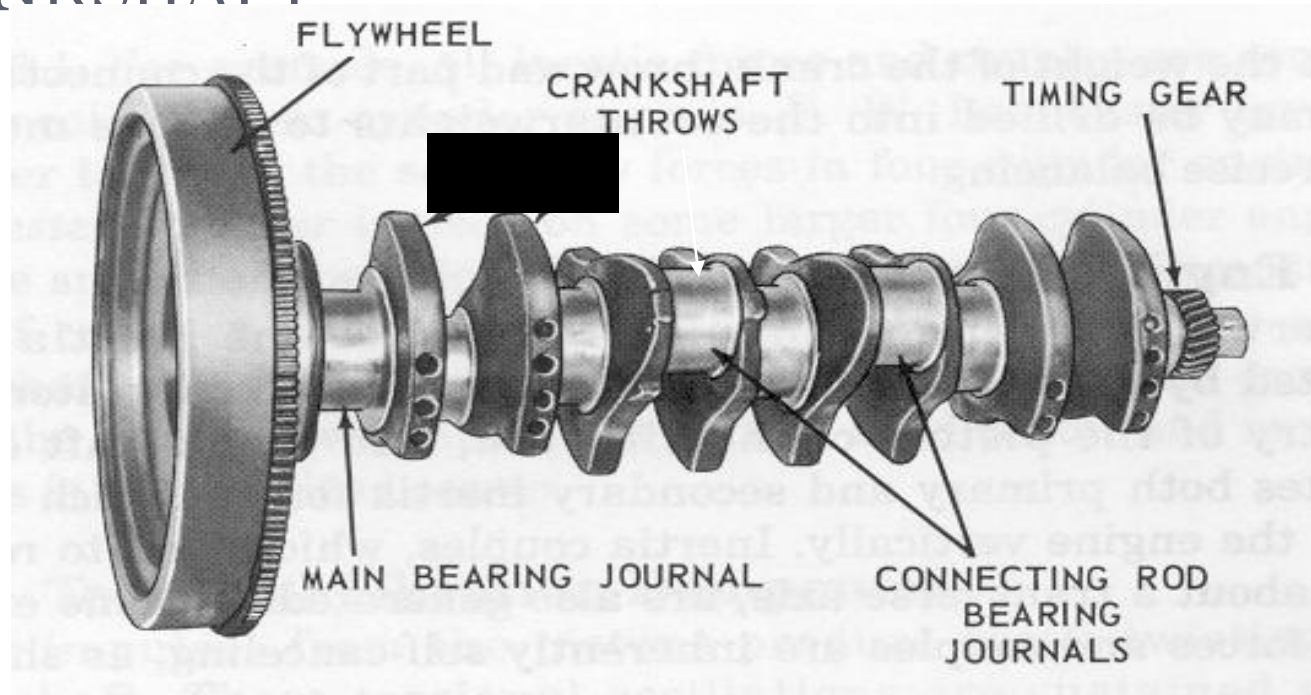
Sump
(holds lubricating oil)

Engine block

Bolts and fixings are
omitted for clarity



CRANKSHAFT



- ❑ Works with connecting rod to change reciprocating to rotary motion.
- ❑ Transmits mechanical energy from the engine.
- ❑ Made of heat-treated steel alloys.

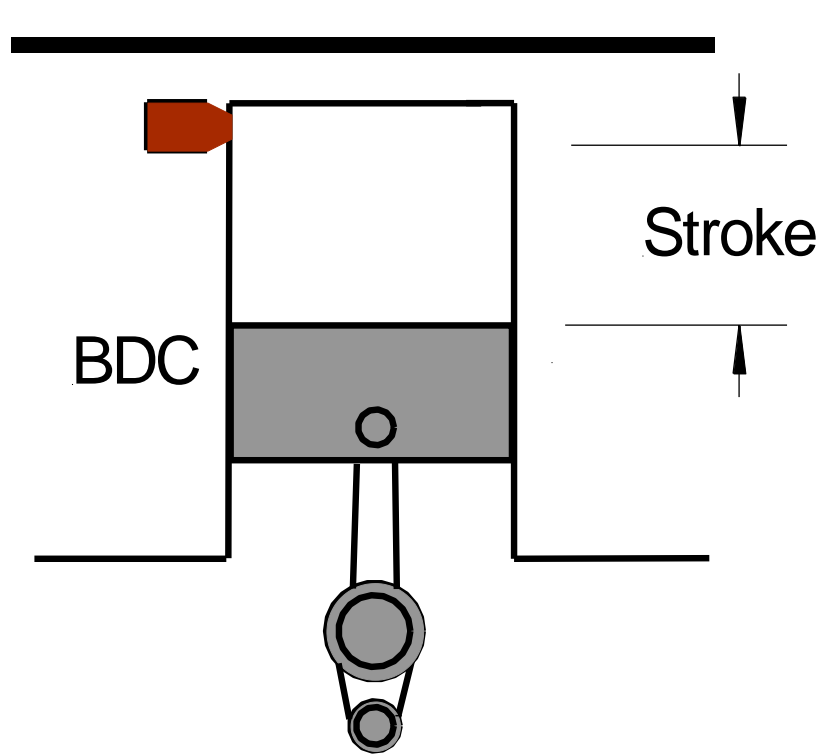


WHAT IS STROKE ?

- 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**.



MEANING OF STROKE



Linear distance piston travels from Top Dead Center (TDC) to Bottom Dead Center (BDC).

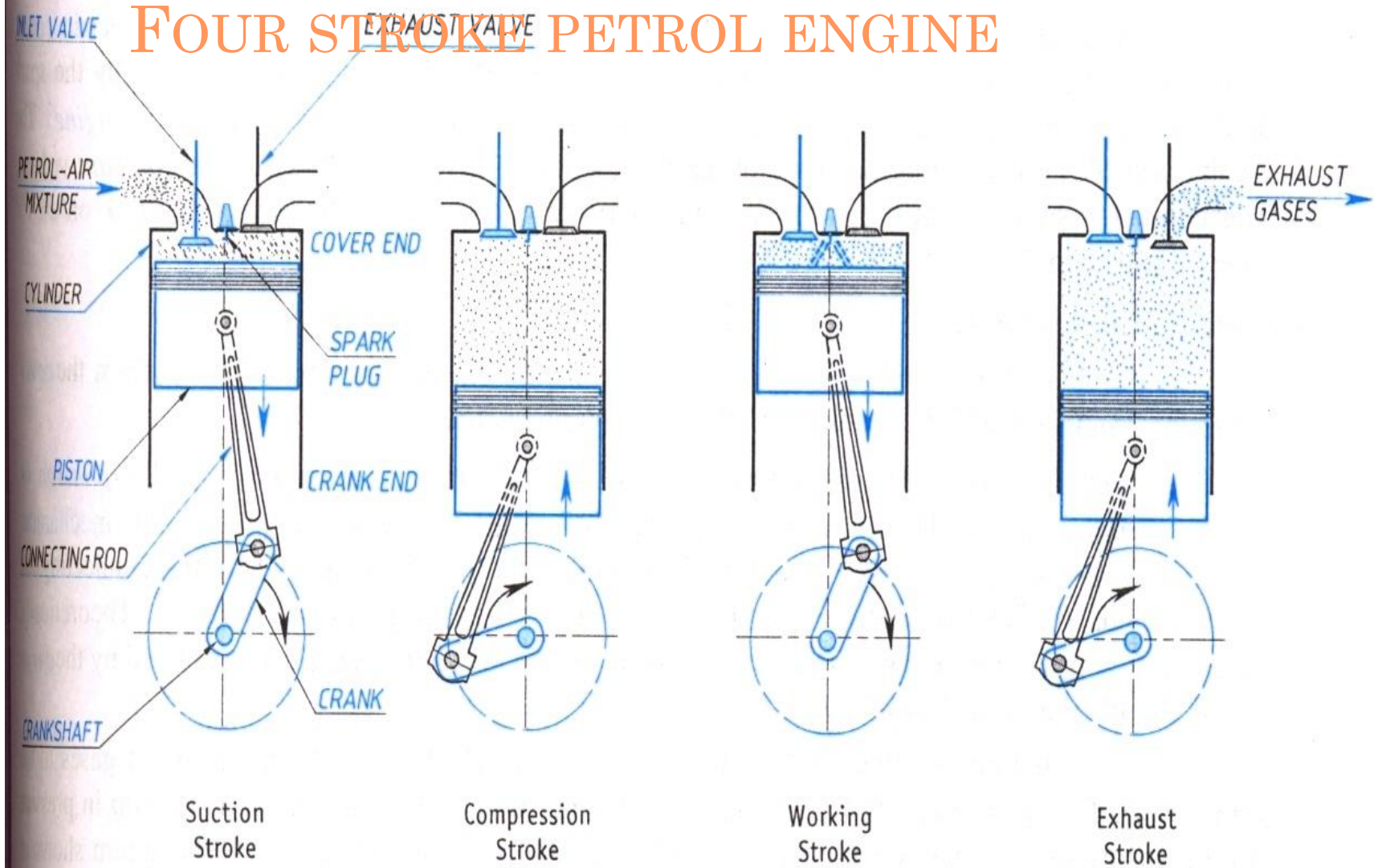


WHAT IS 2S & 4S ?

- **In a Four stroke (4S) IC Engine**, one working cycle is completed in 4 linear strokes of piston and two revolution of the crank shaft. Thus, one power stroke is obtained in each two revolutions of the crank shaft.
- **In a Two stroke (2S) IC Engine**, one working cycle is completed in 4 linear strokes of piston and two revolution of the crank shaft. Thus, one power stroke is obtained in each two revolutions of the crank shaft.



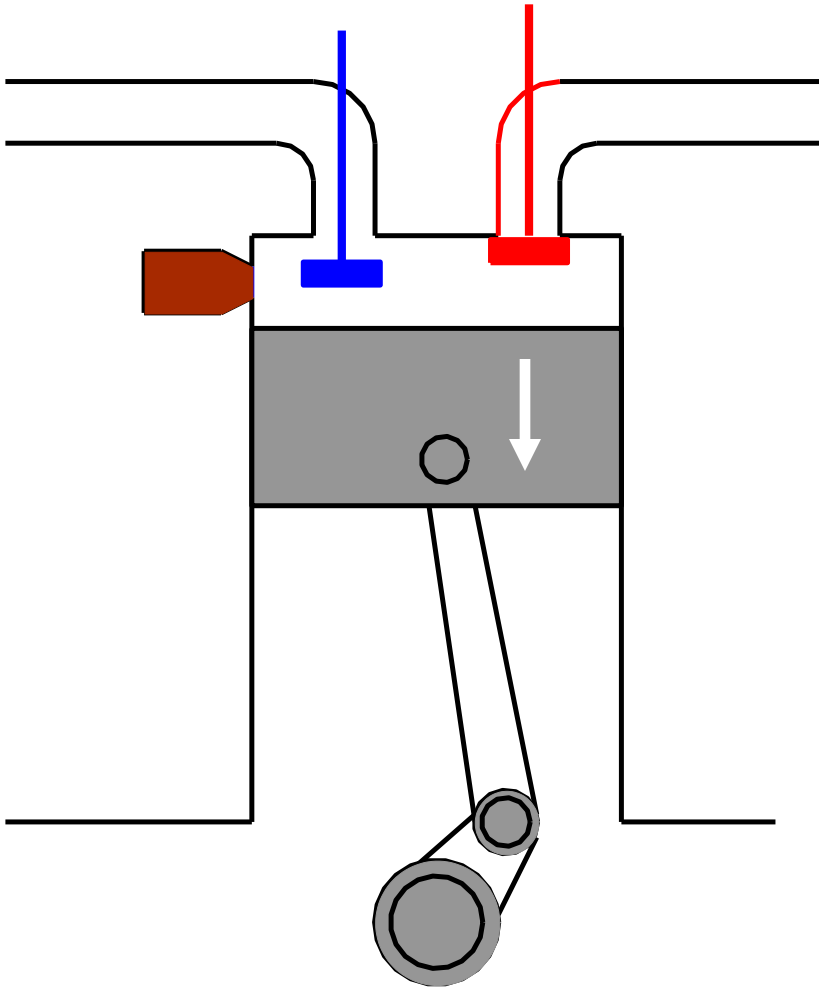
FOUR STROKE PETROL ENGINE



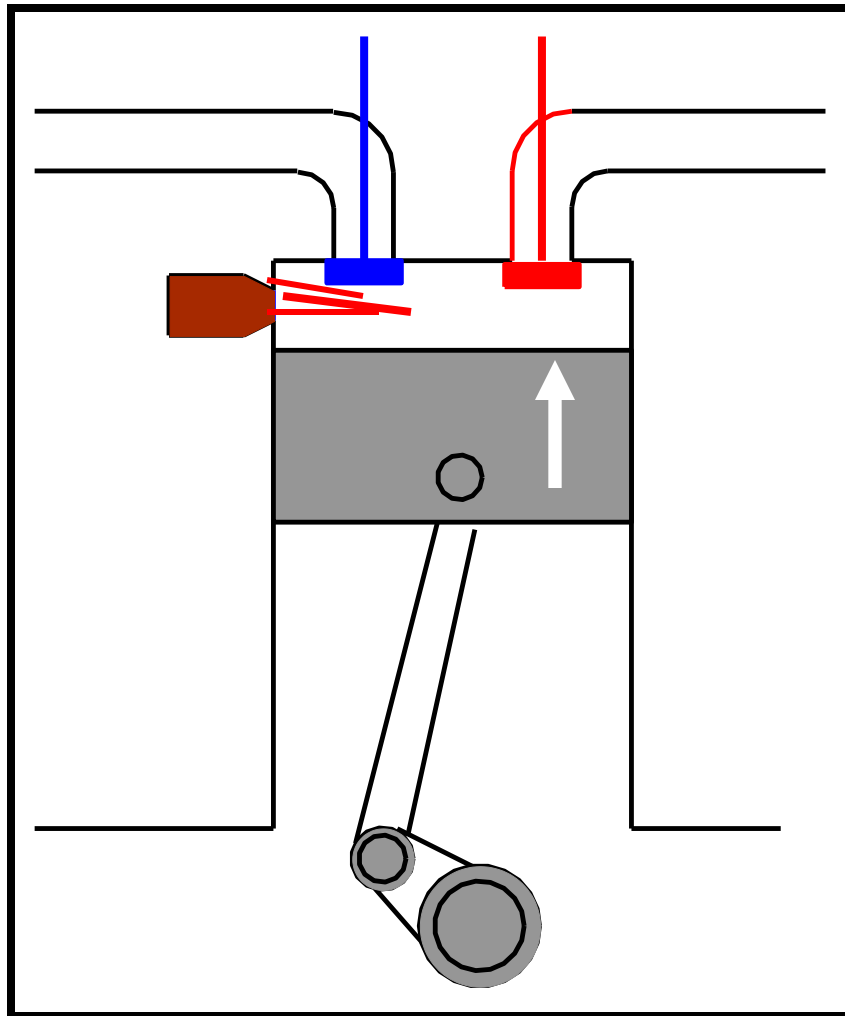
4-STROKE SI ENGINE OPERATION

○ Intake Stroke

- Intake valve open. Exhaust valve is closed.
- Piston moves down (TDC to BDC) in cylinder.
- Low pressure is created in cylinder.
- Petrol Air mixture is brought into the combustion chamber due to pressure differences.
- Crankshaft revolves half the rotation.



4-STROKE CYCLE ENGINE OPERATION



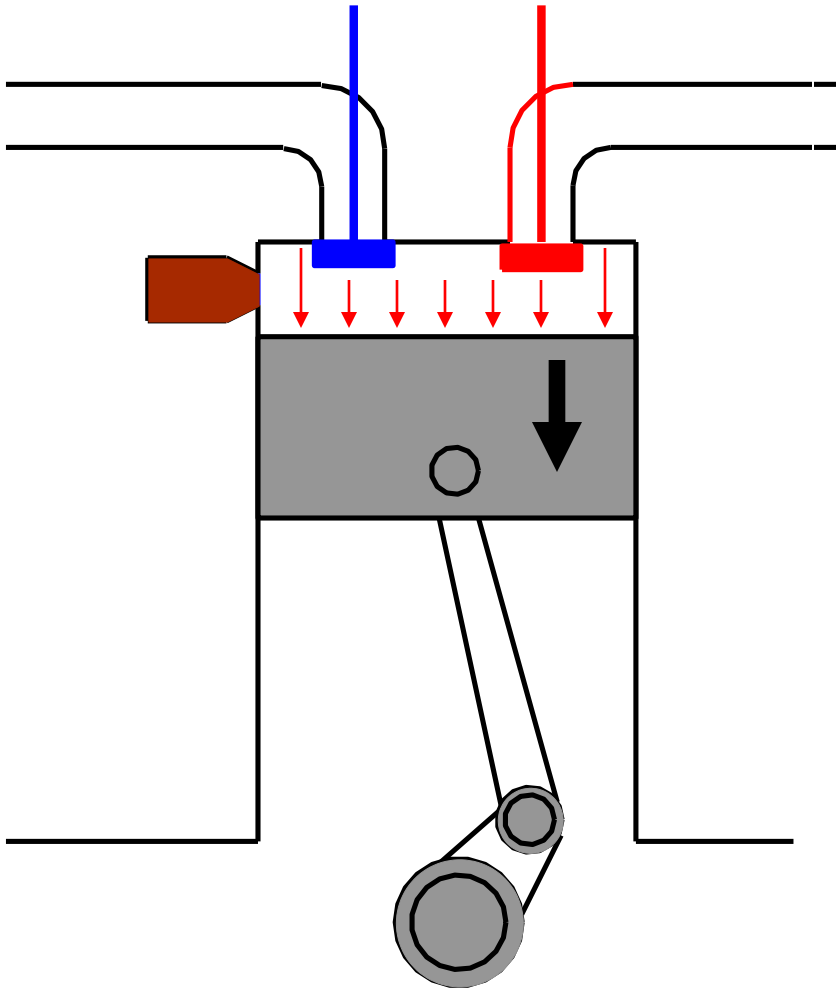
○ Compression Stroke

- Both valves closed.
- Piston moves from BDC to TDC
- Petrol-Air in combustion chamber is compressed, raising its temperature.
- Near TDC of Compression stroke, diesel fuel is injected into the combustion chamber.
- This mixture is ignited by the spark plug
- Crankshaft revolves half the rotation

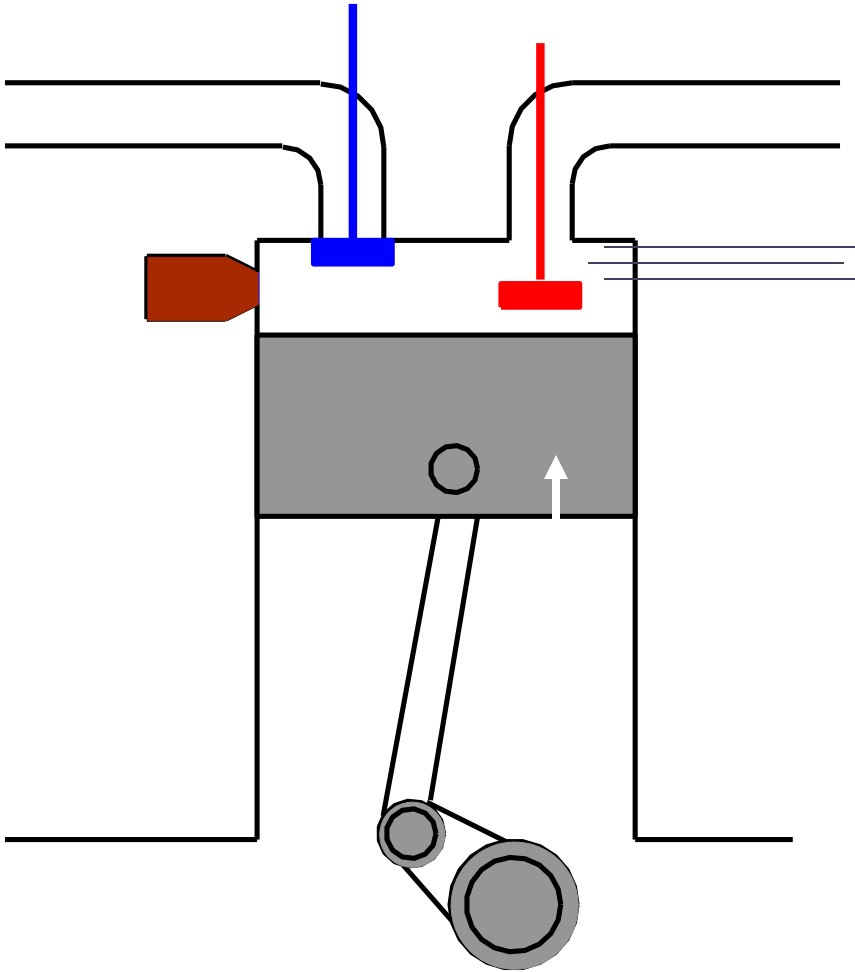
4-STROKE CYCLE ENGINE OPERATION

○ Power Stroke

- Both valves are closed
- Piston moves from TDC to BDC.
- Air-fuel mixture burns rapidly
- Expansion of the burning air-fuel mix applies force to the head of the piston
- Piston is driven down in the cylinder.
- Crankshaft revolves half the rotation.



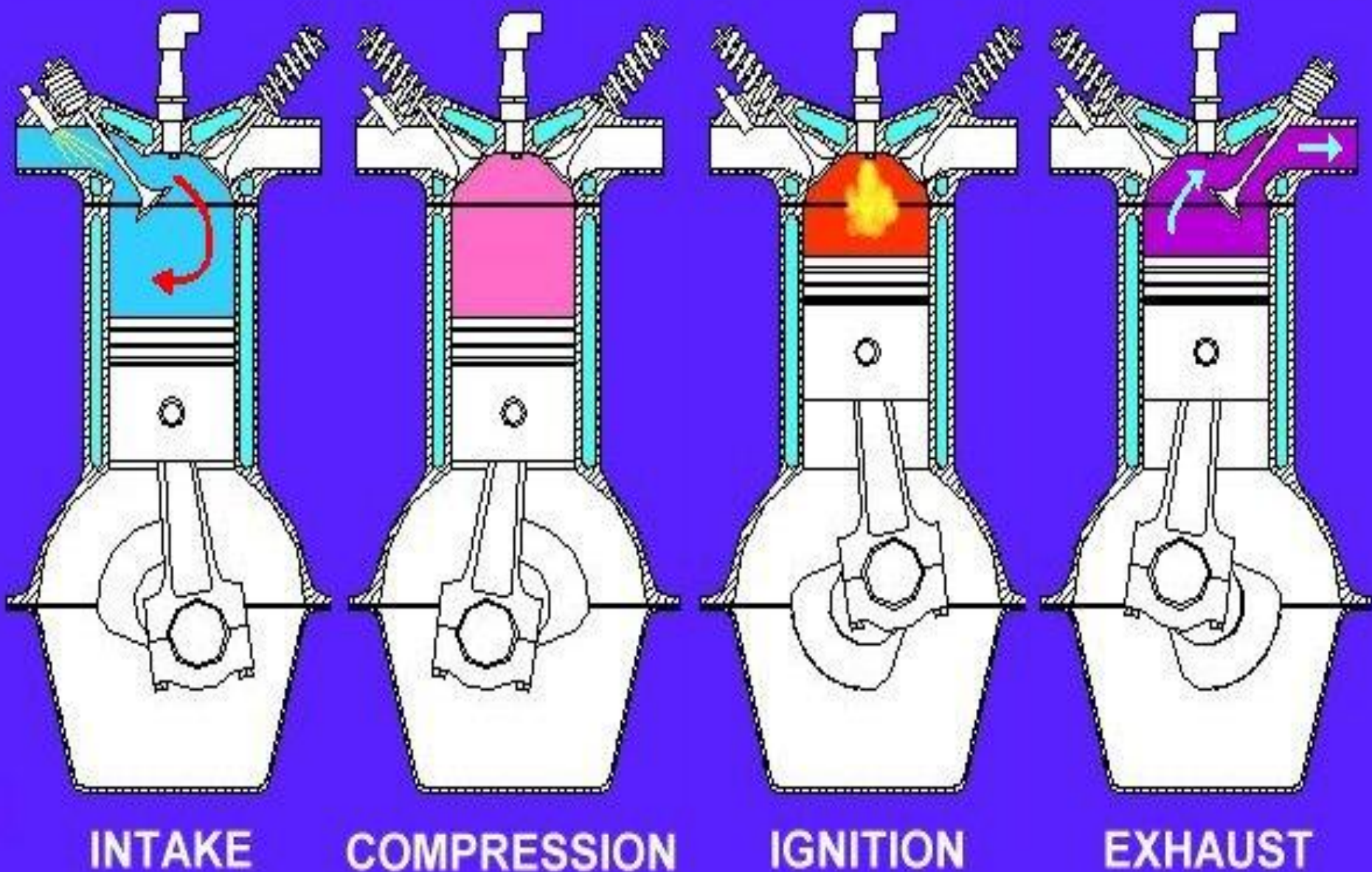
4-STROKE CYCLE ENGINE OPERATION



○ Exhaust Stroke

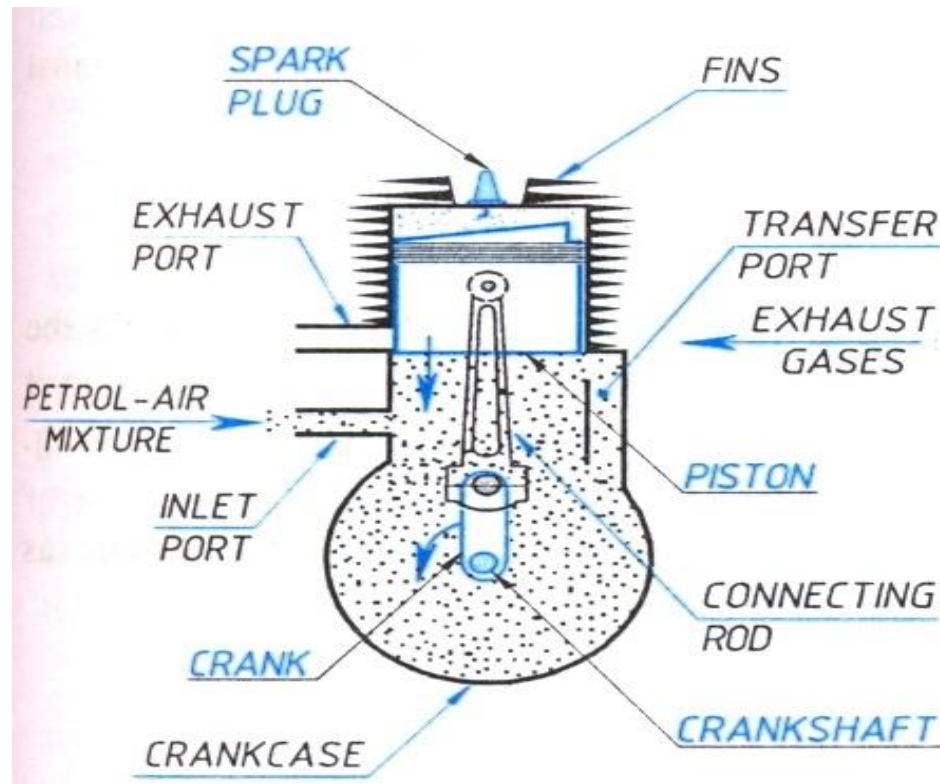
- exhaust is open and inlet is closed.
- Piston moves from BDC to TDC.
- crankshaft revolves half the rotation.
- energy for this stroke is supplied by flywheel.
- Burnt gases are expelled out through outlet port.

THE FOUR STROKE CYCLE



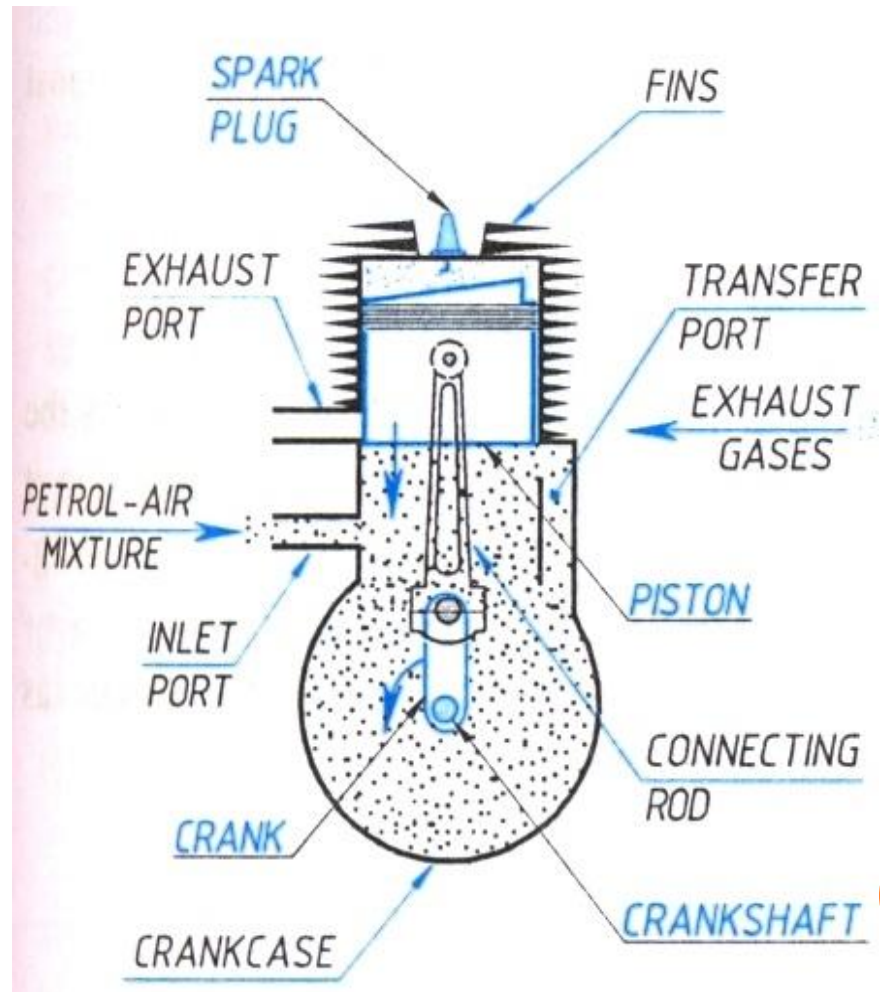
TWO STROKE PETROL ENGINE

- Performs two strokes to complete one working cycle.
- Works on *theoretical Otto cycle*.

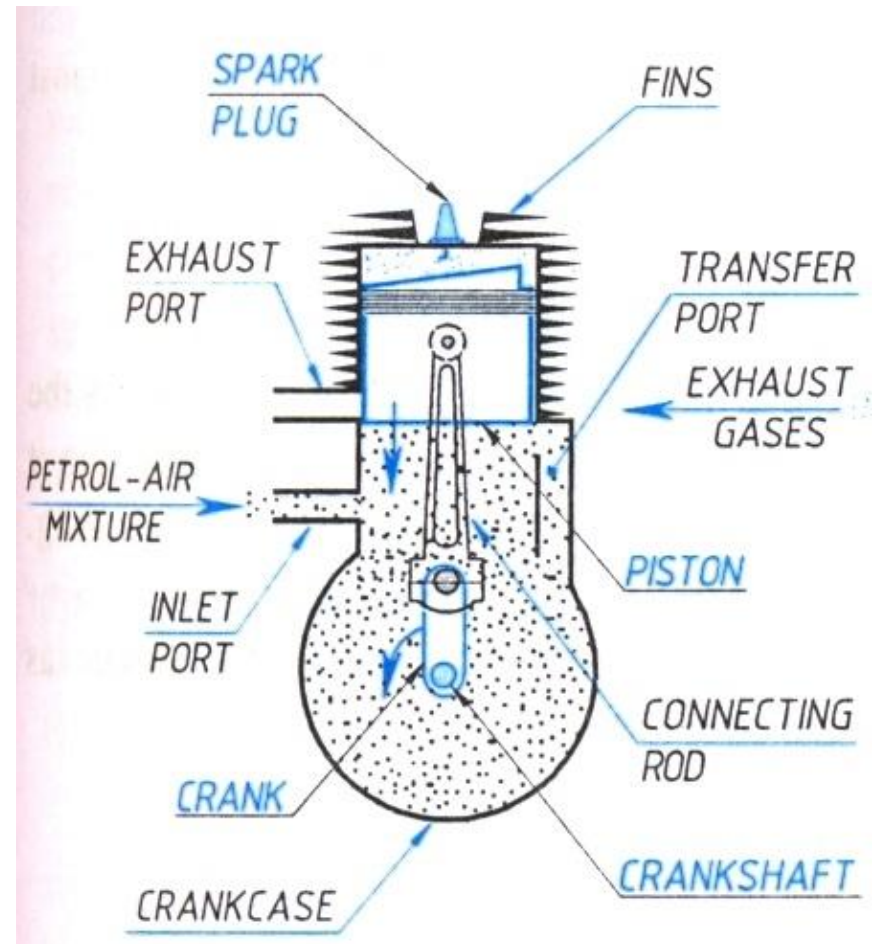


PARTS

- Cylinder with one end fitted with cover and other end with a **sealed crankcase**.
- **Ports** are provided one below other on circumference of the cylinder.
- Lower one is the **admission port** or **inlet port** and upper port is the exhaust port.
- Transfer port **diametrically opposite**.

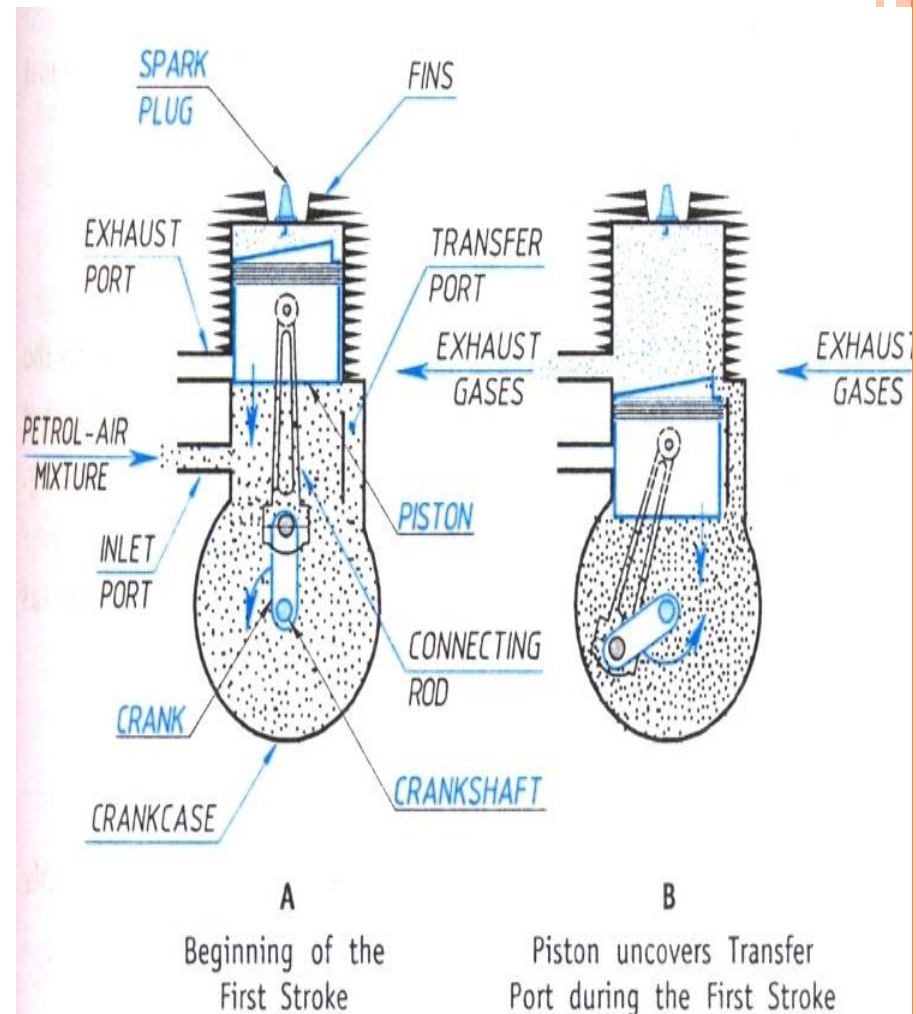


- Transfer port
 - *Function* – transfer of petrol air mixture from crankcase to cylinder.
- Spark plug, connecting rod, crank.

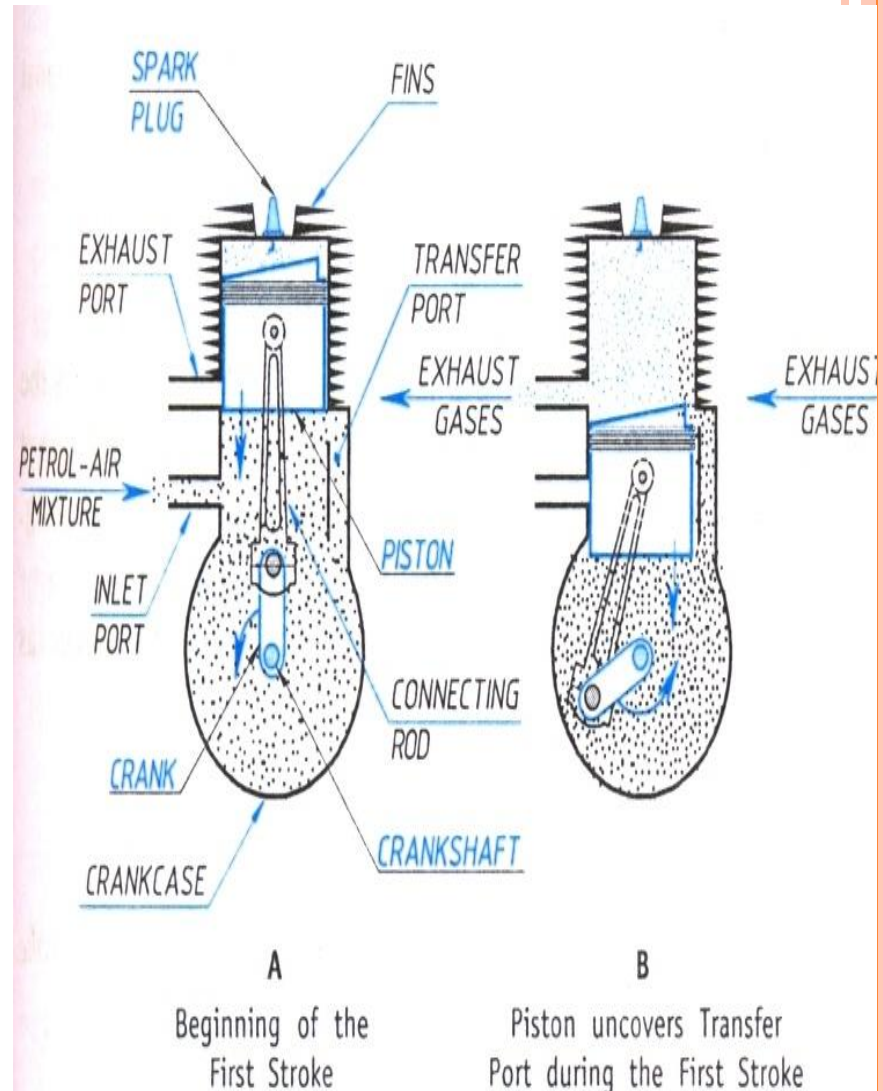


DOWNWARD STROKE

- Piston moves from TDC to BDC.
- Piston performs the power stroke.
- Transfer port opens letting the fresh charge into cylinder.

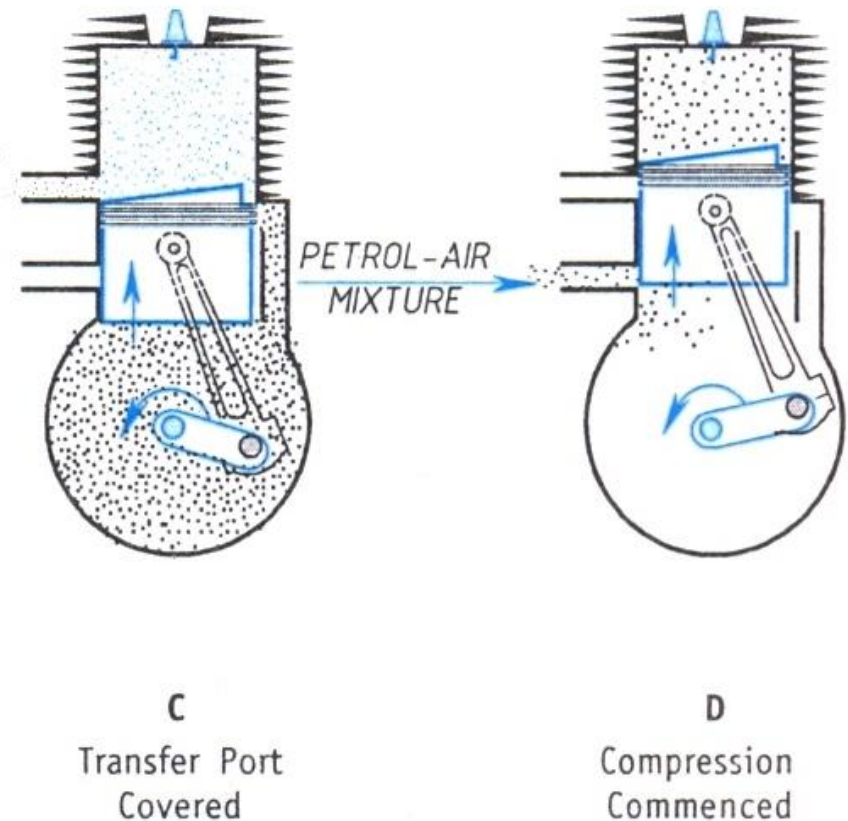


- Due to this the burnt gases are expelled out of the cylinder. This process is called as *scavenging*.
- Crankshaft rotates by half the revolution.

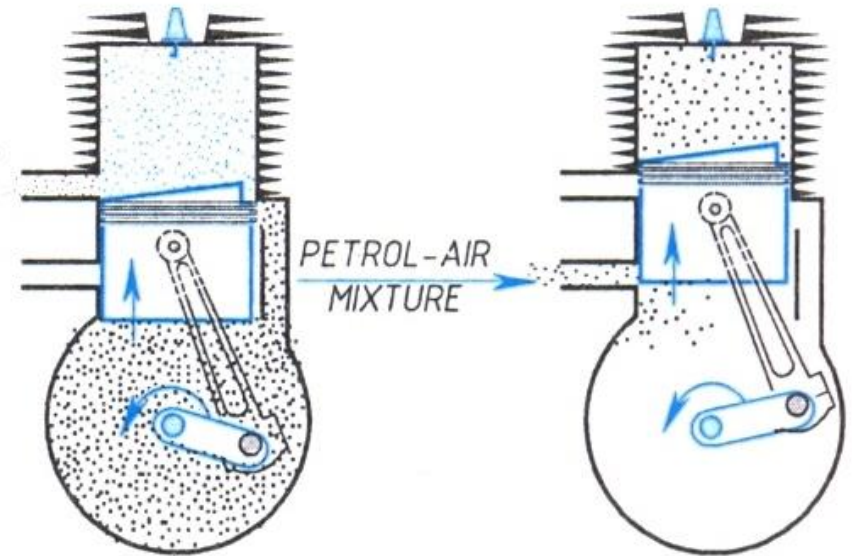


UPWARD STROKE

- Piston moves from BDC to TDC.
- Air fuel mixture is drawn in through inlet.
- Supply of petrol air mixture is cut off in upward motion of piston.
- Further piston will compress the petrol air mixture in cylinder.



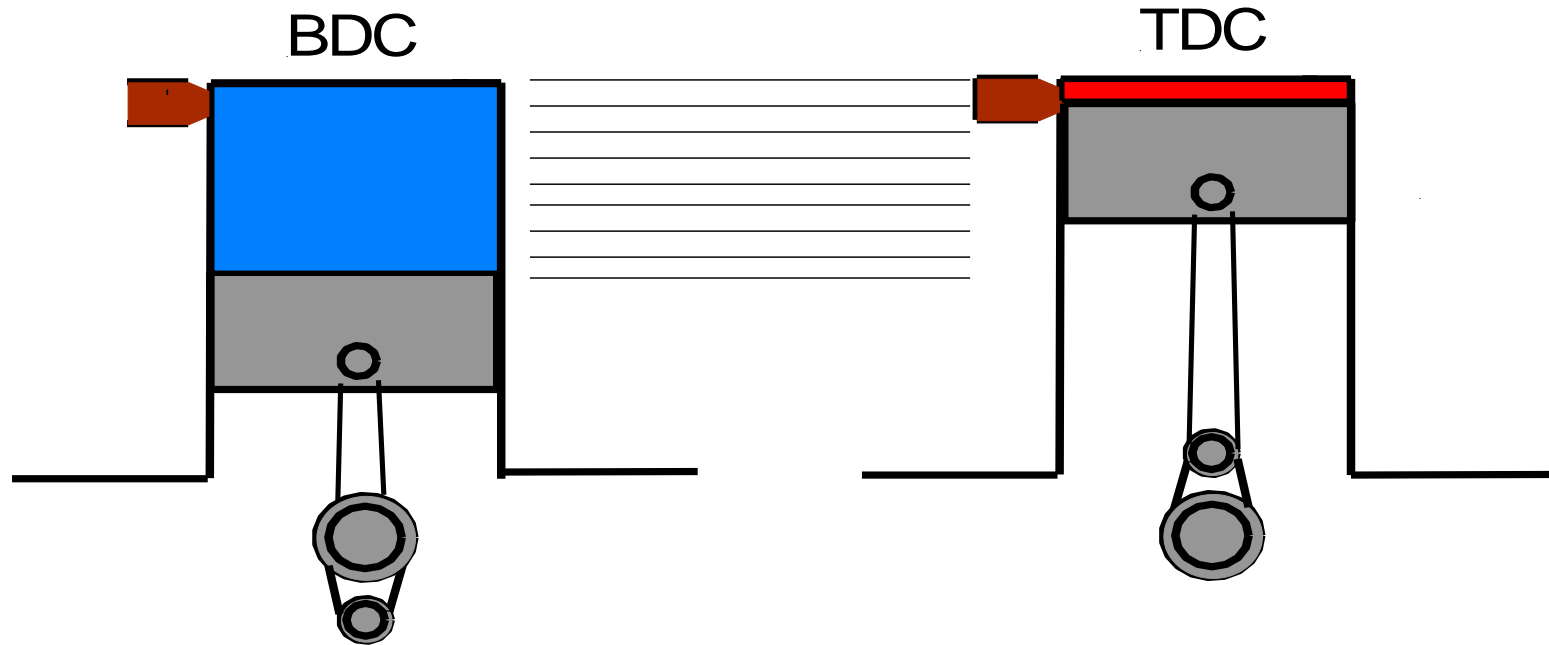
- At the end of the stroke spark plug ignites and combustion takes place.



C
Transfer Port
Covered

D
Compression
Commenced

COMPRESSION RATIO



Compression ratio -Ratio of the volume of the cylinder at the beginning of the compression stroke to that at the end of compression stroke, i.e. ratio of total cylinder volume to clearance volume.

The Compression ratio of diesel engine varies from 14:1 to 22:1 and that of spark ignition engine varies from 4:1 to 8:1.

-- Ratio of "Total Volume" in cylinder when piston at BDC to that when piston is at TDC.

