

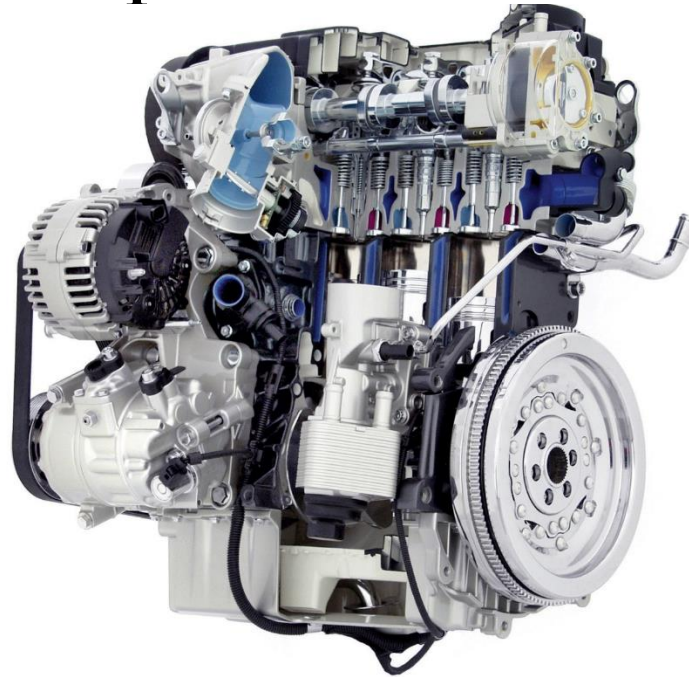
Internal Combustion Engines

ENME 535

Department of Mechanical and Mechatronics Engineering

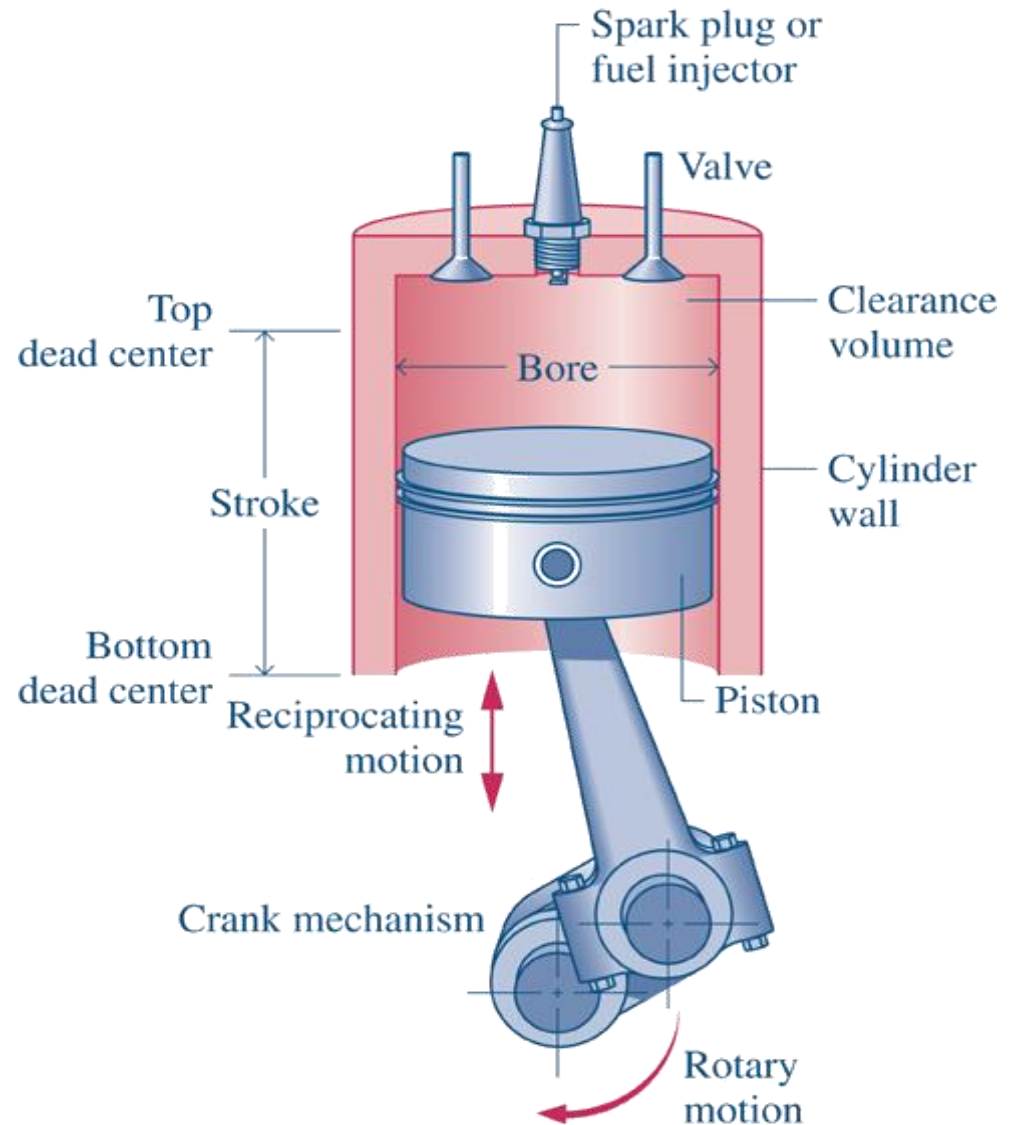
Dr. Mohammad Karaeen

Chapter 1: Introduction



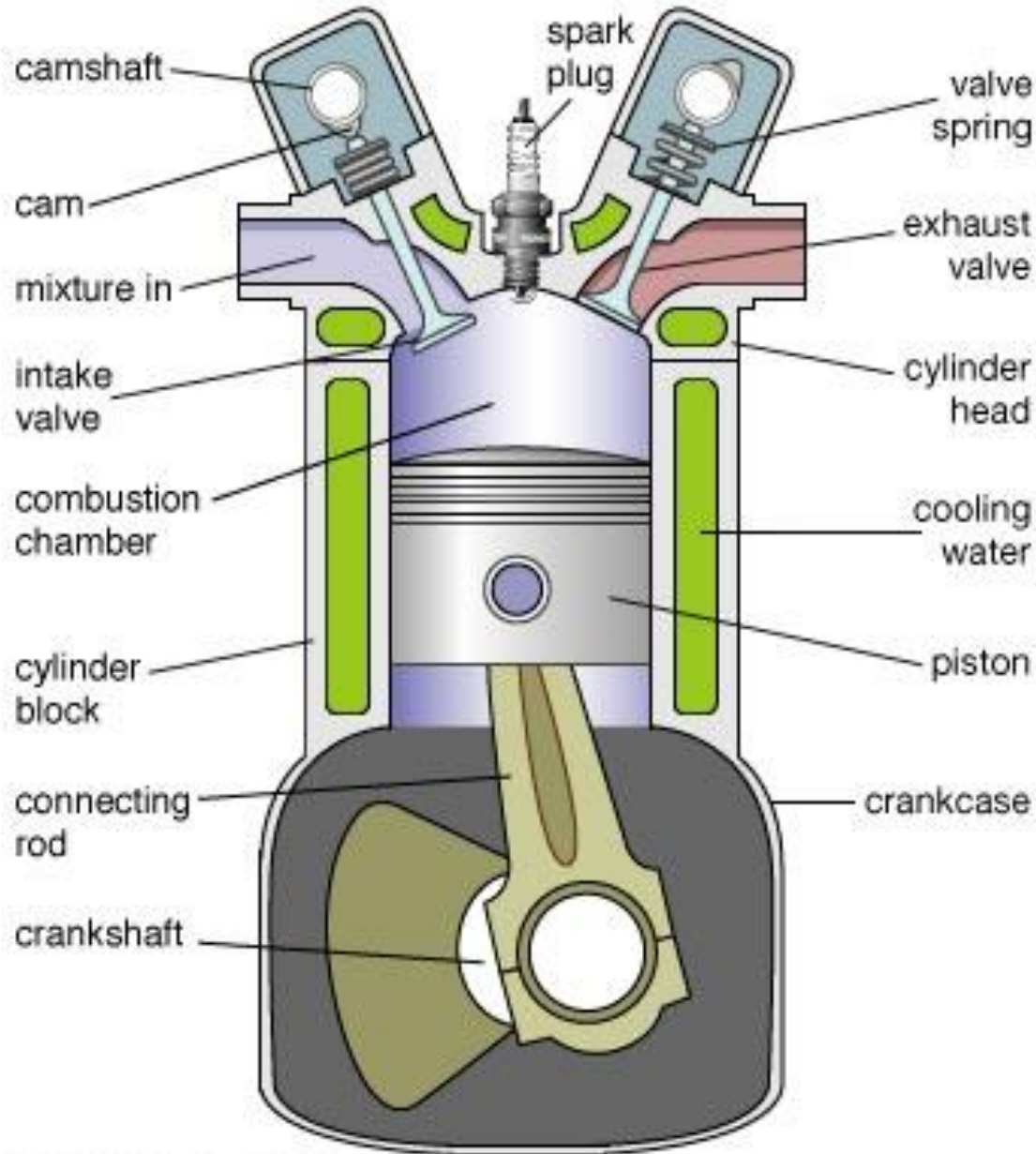
What is an Internal Combustion engine

Internal Combustion Engine
Is an open circuit
non cyclic
quazi steady flow
work producing device.

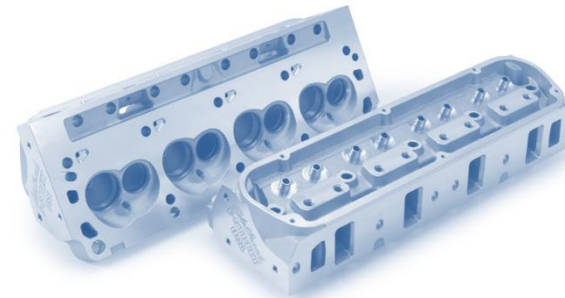


Engine Terminology

Internal Combustion Engine Terminology

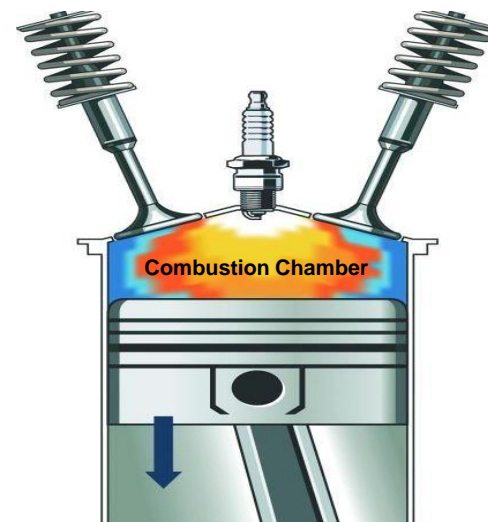


- **Block** : Body of the engine containing cylinders, made of cast iron or aluminum.
- **Cylinder** : The circular cylinders in the engine block in which the pistons reciprocate back and forth.
- **Head** : The piece which closes the end of the cylinders, usually containing part of the clearance volume of the combustion chamber.



Internal Combustion Engine Parts

- **Piston:** the piston is simply a solid cylinder of metal, which moves up and down in the hollow cylinder of the engine block.
- **Combustion chamber:**
The end of the cylinder between the head and the piston face where combustion occurs.
The size of combustion chamber continuously changes from minimum volume when the piston is at TDC to a maximum volume when the piston at BDC.



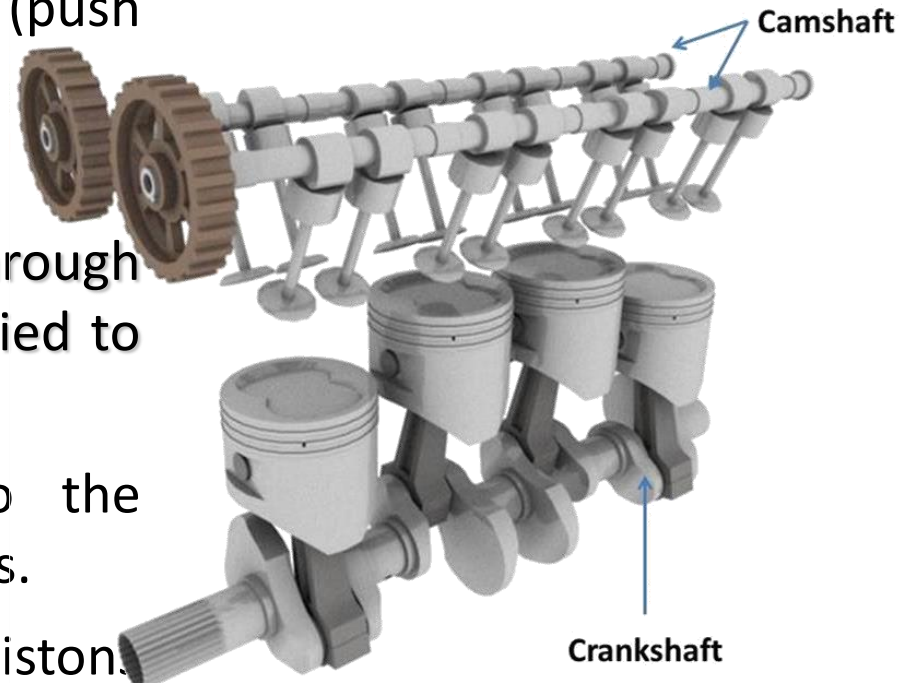
Internal Combustion Engine Parts

Camshaft : Rotating shaft used to push open valves at the proper time in the engine cycle, either directly or through mechanical or hydraulic linkage (push rods, rocker arms, tappets).

Crankshaft : Rotating shaft through which engine work output is supplied to external systems.

The crankshaft is connected to the engine block with the main bearings.

It is rotated by the reciprocating pistons through the connecting rods connected to the crankshaft.



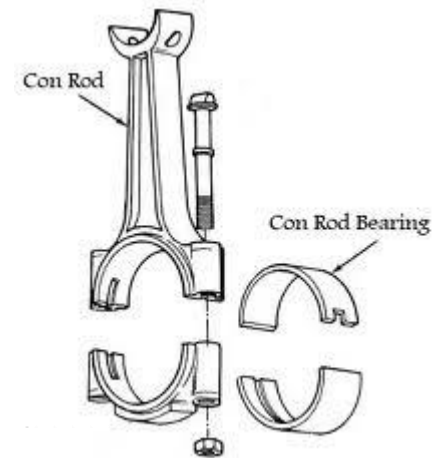
Connecting rod:

Connecting rod connects the piston to crankshaft and transmits the motion and thrust of piston to crankshaft.

It converts the reciprocating motion of the piston into rotary motion of crankshaft.

There are two end of connecting rod one is known as big end and other as small end.

The connecting rods are made of nickel, chrome, and chrome vanadium steels. For small engines the material may be aluminum.



Internal Combustion Engine Parts

- Piston rings:** Metal rings that fit into circumferential grooves around the piston and form a sliding surface against the cylinder walls.
- Crankcase :** Part of the engine block surrounding the crankshaft.
 In many engines the oil pan makes up part of the crankcase housing.
- Exhaust manifold :** Piping system which carries exhaust gases away from the engine cylinders, usually made of cast iron .



Internal Combustion Engine Parts

Intake manifold :Piping system which delivers incoming air to the cylinders, usually made of cast metal, plastic, or composite material.

In most SI engines, fuel is added to the air in the intake manifold system by fuel

The individual pipe to a single cylinder is called runner.



Spark plug : Electrical device used to initiate combustion in an SI engine by creating high voltage discharge across an electrode gap.



Internal Combustion Engine Parts

- **Fuel injector** : A pressurized nozzle that sprays fuel into the incoming air (SI engines)or into the cylinder (CI engines).
- **Fuel pump** : Electrically or mechanically driven pump to supply fuel from the fuel tank (reservoir) to the engine.
- **Glow plug** : Small electrical resistance heater mounted inside the combustion chamber of many CI engines, used to preheat the chamber enough so that combustion will occur when first starting a cold engine.
The glow plug is turn off after the engine is started.



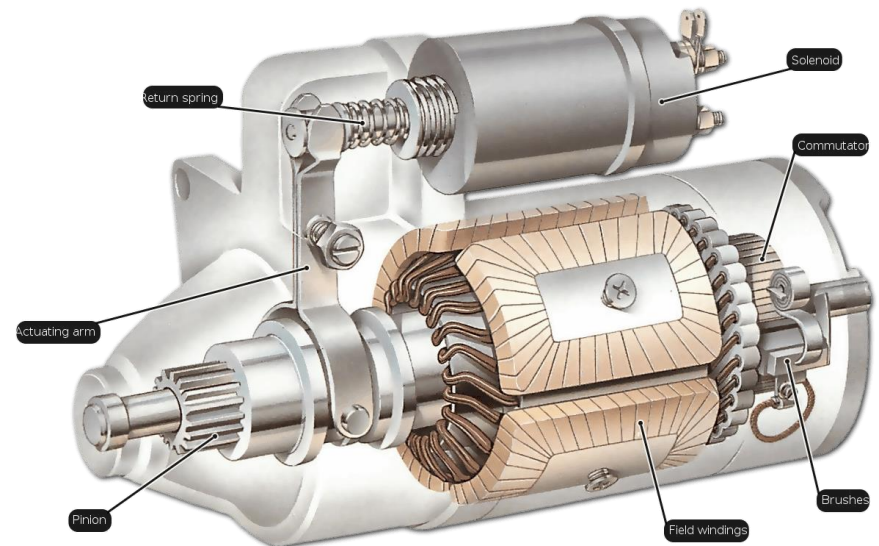
Internal Combustion Engine Parts

- **Flywheel** : Rotating mass with a large moment of inertia connected to the crank shaft of the engine.

The purpose of the flywheel is to store energy and furnish large angular momentum that keeps the engine rotating between power strokes and smooths out engine operation.



Starter : Several methods are used to start IC engines. Most are started by use of an electric motor (starter) geared to the engine flywheel. Energy is supplied from an electric battery.



Internal Combustion Engine Shapes

MULTI CYLINDERS

In-line

All cylinders are arranged linearly



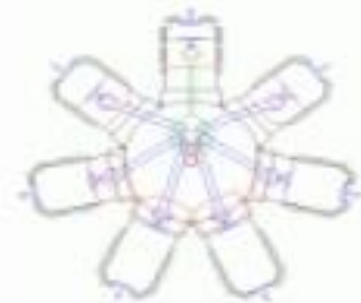
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Cylinders are in two banks inclined at an angle to each other and with one crank-shaft



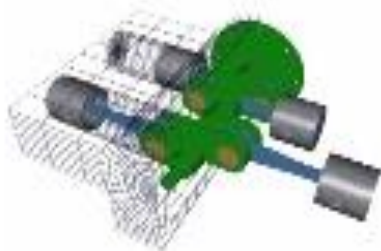
Radial/Rotary

the radial engine is an engine with more than two cylinders in each row equally spaced around the crank shaft



Opposed Cylinder

Banks located in the same plane on opposite sides of the crank-shaft



Opposed Piston

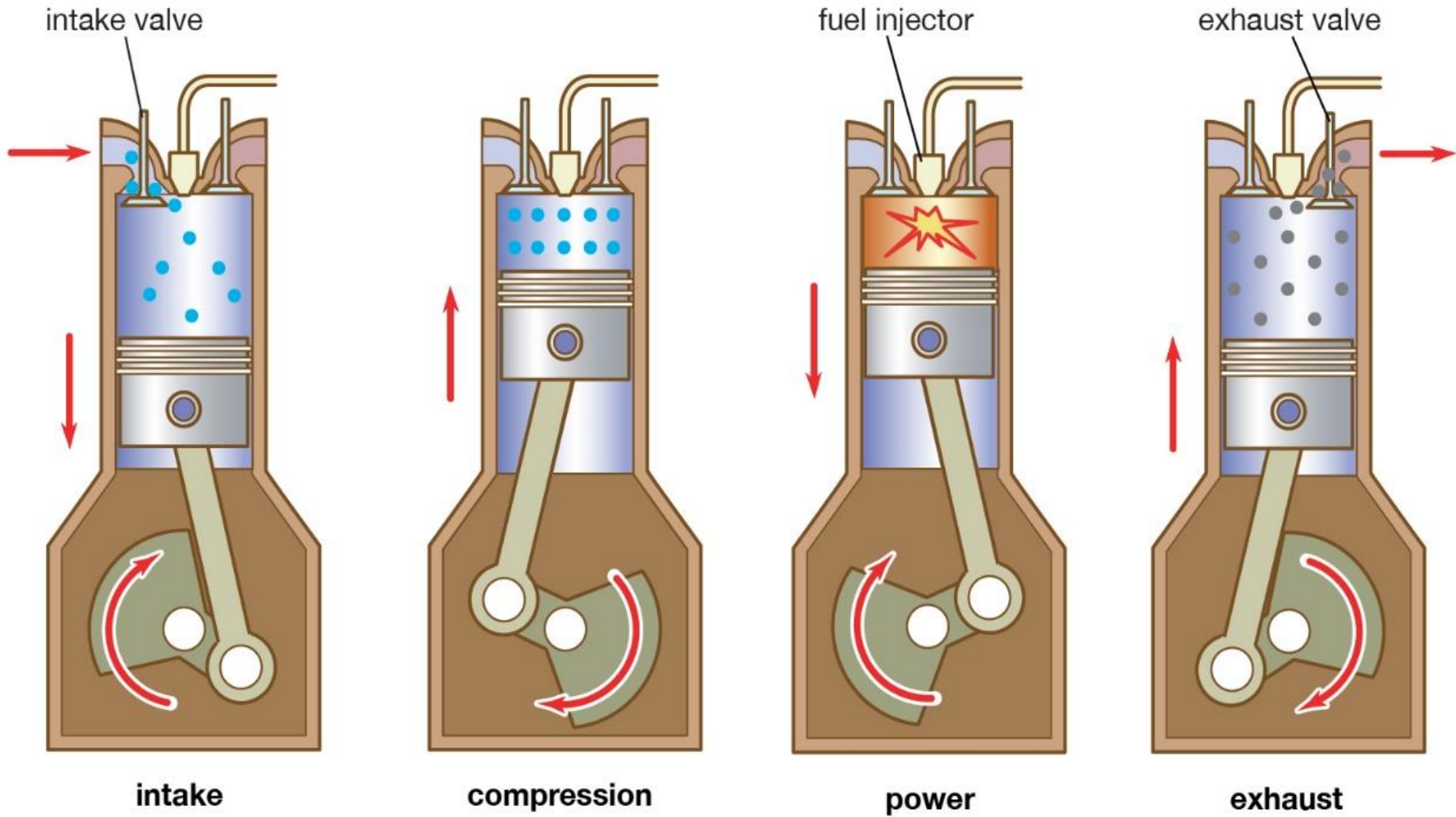
When a single cylinder houses two pistons, each of which drives a separate crank shaft



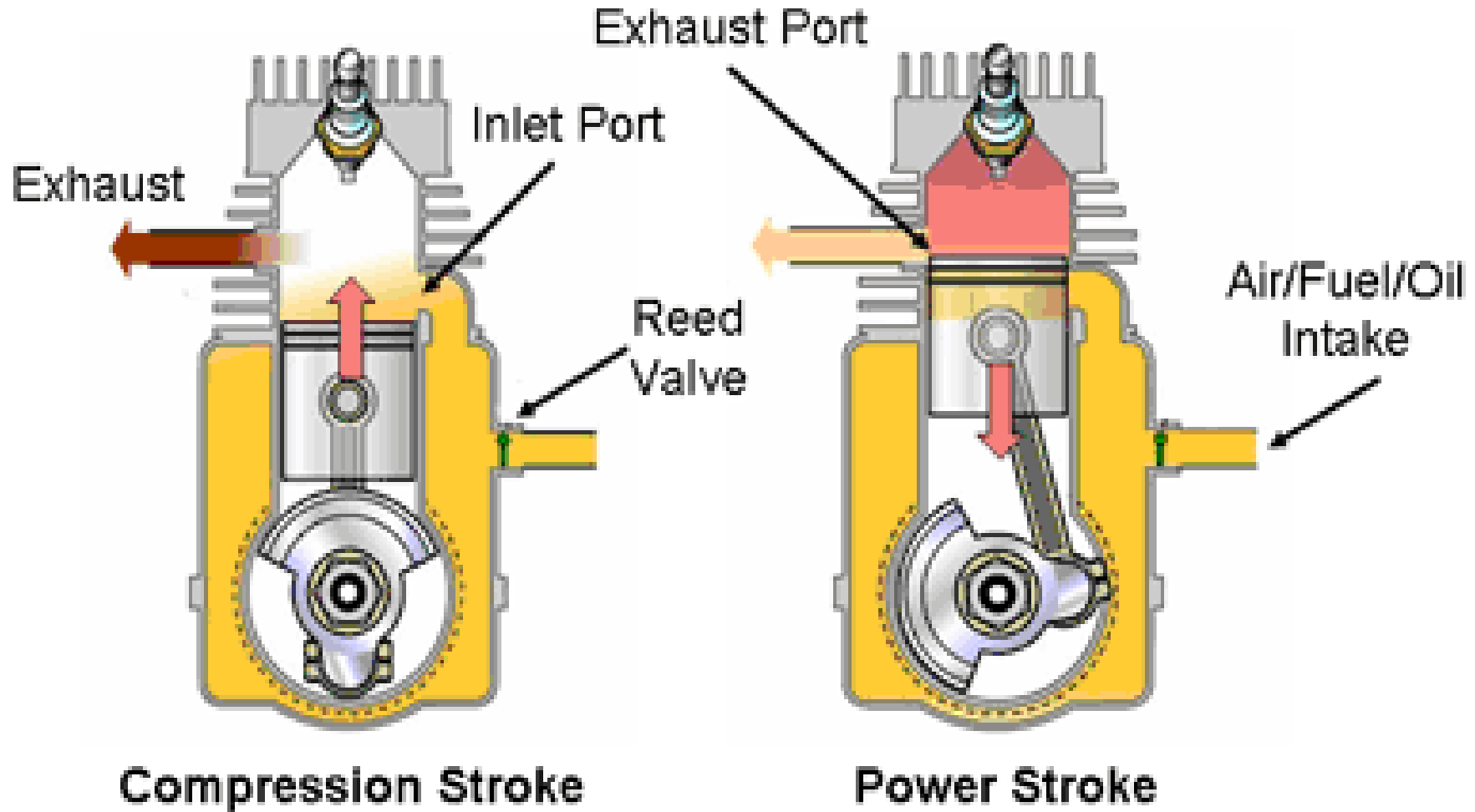
- Cylinders may be vertical or horizontal
- Vertical engines needs smaller area
- When area is available horizontal engines may be used

Introduction to Engines - Dr. Rohit Singh Lather

4- Stroke Engines



Two-Stroke Engine Cycle



Comparison of Four-stroke and two-stroke engine:

| Four-stroke engine | Two-stroke engine |
|---|--|
| 1. Four stroke of the piston and two revolution of | crankshaft Two stroke of the piston and one revolution of crankshaft |
| 2. One power stroke in every two revolution of crankshaft | One power stroke in each revolution of crankshaft |
| 3. Heavier flywheel due to non-uniform turning movement | Lighter flywheel due to more uniform turning movement |
| 4. Power produce is less Theoretically | power produce is twice than the four stroke engine for same size |
| 5. Heavy and bulky | Light and compact |
| 6. Lesser cooling and lubrication requirements | Greater cooling and lubrication requirements |

Comparison of Four-stroke and two-stroke engine:

| Four-stroke engine | Two-stroke engine |
|--|---|
| 7. Lesser rate of wear and tear | Higher rate of wear and tear |
| 8. Contains valve and valve mechanism | Contains ports arrangement |
| 9. Higher initial cost | Cheaper initial cost |
| 10. Volumetric efficiency is more due to greater time of induction | Volumetric efficiency less due to lesser time of induction |
| 11. Thermal efficiency is high and also part load efficiency better | Thermal efficiency is low, part load efficiency lesser |
| 12. It is used where efficiency is important. Ex-cars, buses, trucks, tractors, industrial engines, aero planes, power generation etc. | It is used where low cost, compactness and light weight are important. scooters, motor cycles, propulsion ship etc. |