

AUTOMOTIVE MATERIALS



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Syllabus

1. Engines
2. The cylinder
3. The piston & piston ring
4. The camshaft & crankshaft
5. The connecting rod
6. The catalyst



UNIT 1 ENGINE



Contents

- The reciprocating engine
- Advantages and disadvantages of reciprocating engines
- Engine components and typical materials
- Recent trends in engine technology



The reciprocating engine

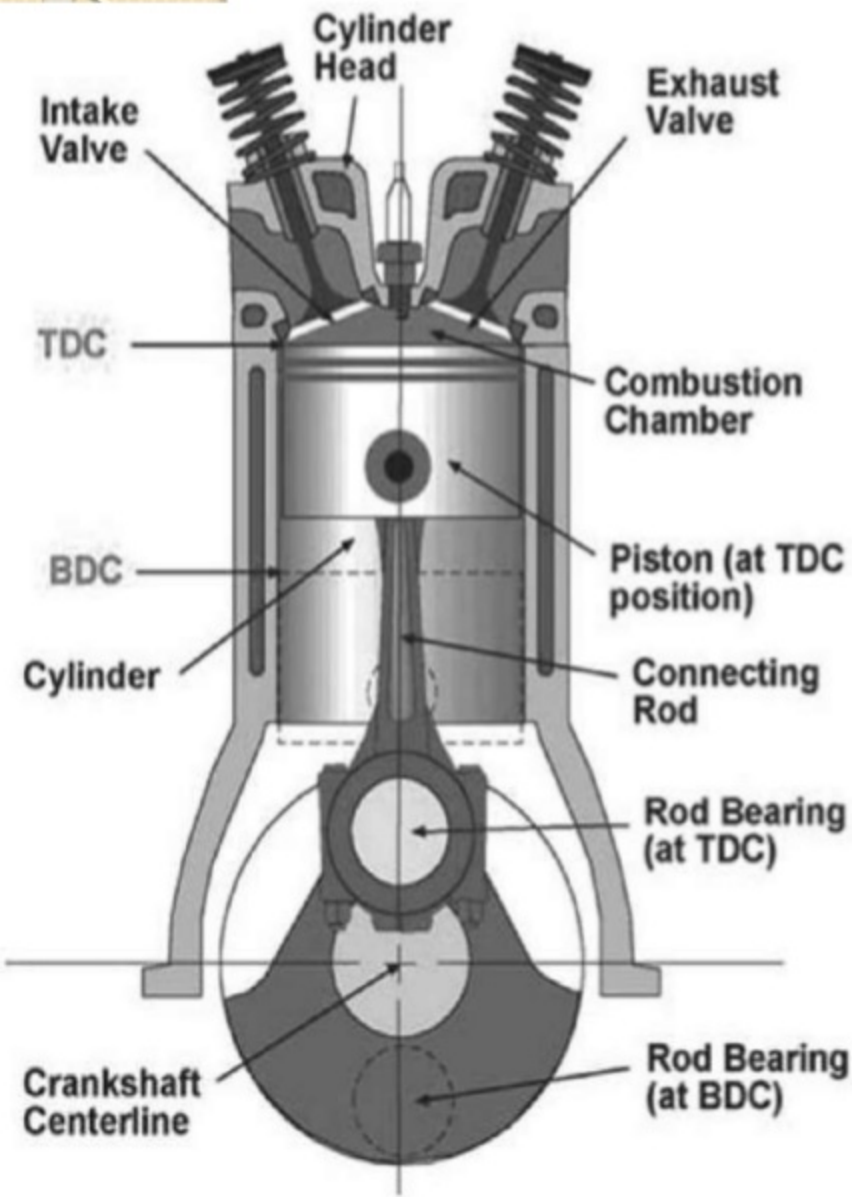
- The reciprocating engine is an engine in which one or more pistons move up and down in cylinders which gives power to crankshaft to rotate.
- The engine is the heart of a car although it is normally hidden under the bonnet.
- Another type is rotary engine.



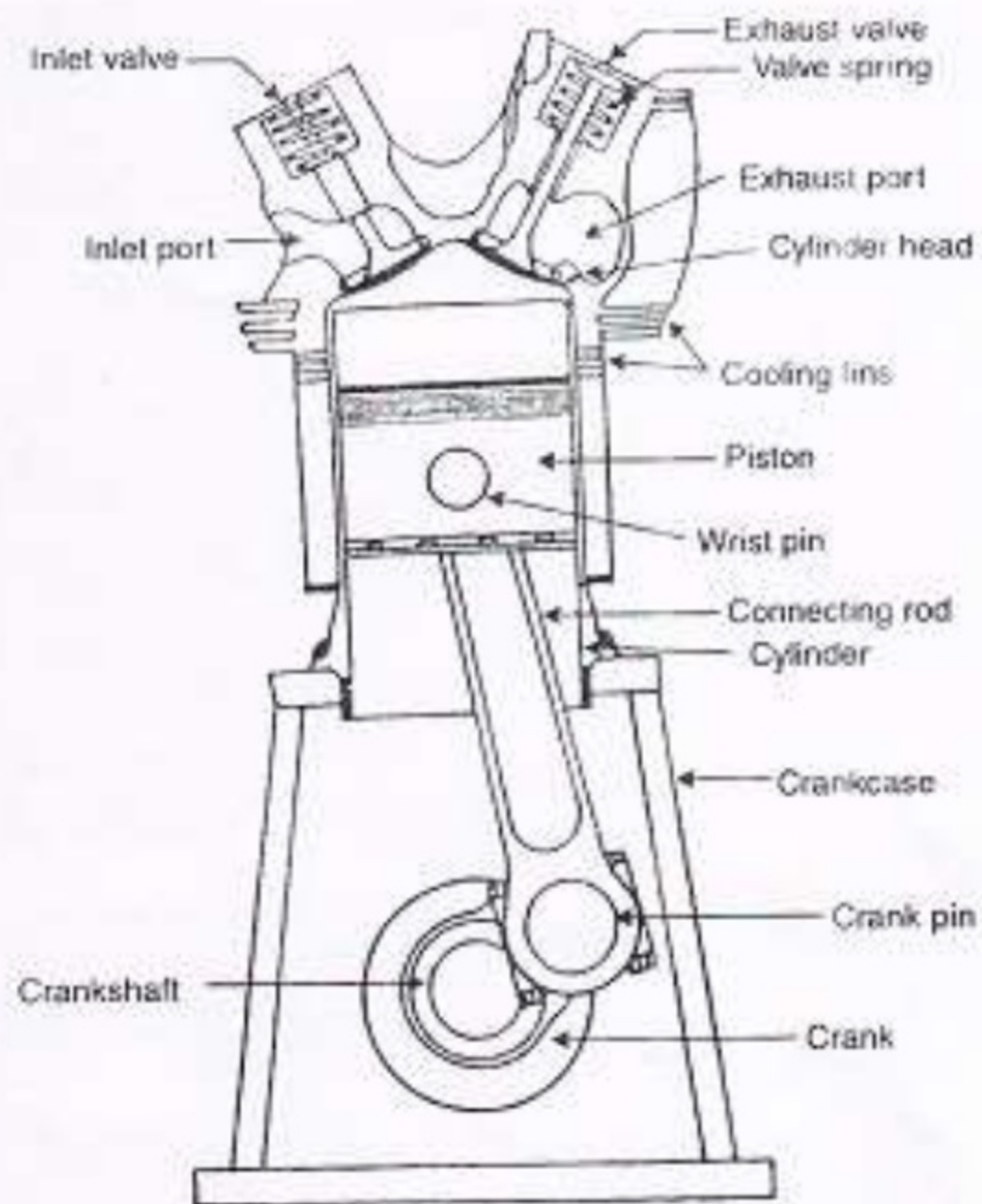
Principal of Reciprocating Engine

If you put a tiny amount of high energy fuel like gasoline in a small enclosed space and ignite it so, we can see incredible amount of energy is released in the form of expanding gas.

Basics of Reciprocating Engines



- The cylinder which is closed at one end is filled with a mixture of fuel and air.
- As the crankshaft turns it pushes piston.
- The piston is forced up and compresses the mixture in the top of the cylinder.
- The mixture is set alight and, as it burns, it creates a gas pressure on the piston, forcing it down the cylinder.



Air-cooled Reciprocating engine

Constructional details of Reciprocating Engines

A cross-section of an air-cooled engine with principal parts is shown in next page.

A. Parts common to both Petrol and Diesel engine:

- | | | |
|---|-------------------|--------------------|
| 1. Cylinder, | 2. Cylinder head, | 3. Piston, |
| 4. Piston rings, | 5. Gudgeon pin, | 6. Connecting rod, |
| 7. Crankshaft, | 8. Crank, | 9. Engine bearing, |
| 10. Crank case. | 11. Flywheel, | 12. Governor, |
| 13. Valves and valve operating mechanism. | | |

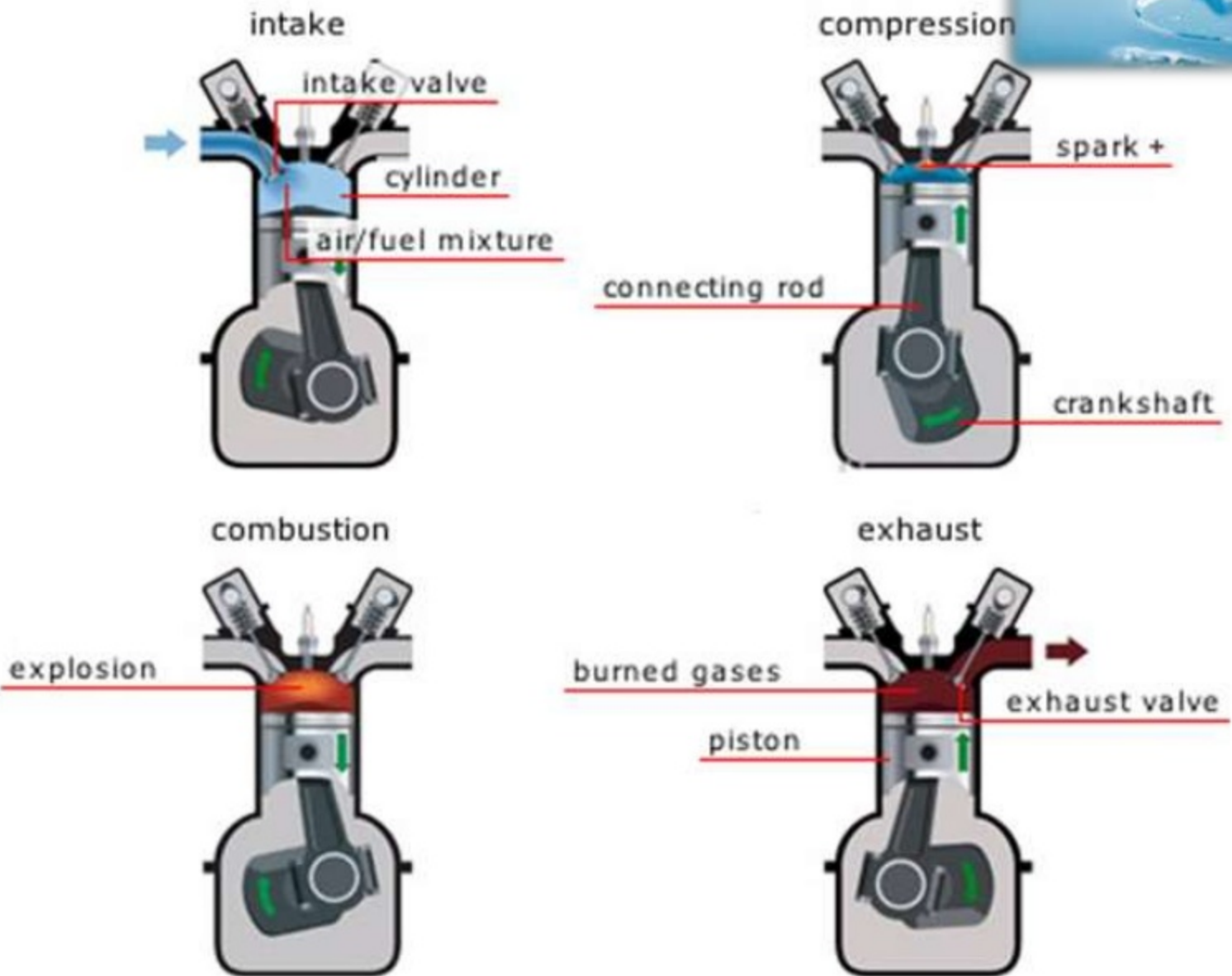
B. Parts for Petrol engines only:

- | | | |
|----------------|----------------|---------------|
| 1. Spark plug, | 2. Carburetor, | 3. Fuel pump. |
|----------------|----------------|---------------|

C. Parts for Diesel engine only :

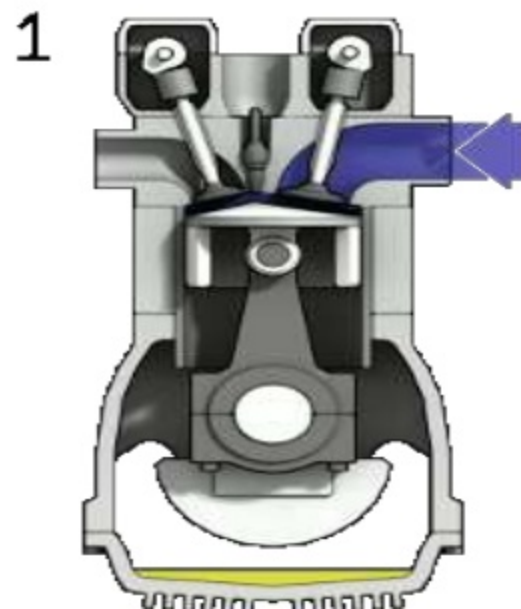
- | | |
|---------------|--------------|
| 1. Fuel pump, | 2. Injector. |
|---------------|--------------|

Four Stroke Engine



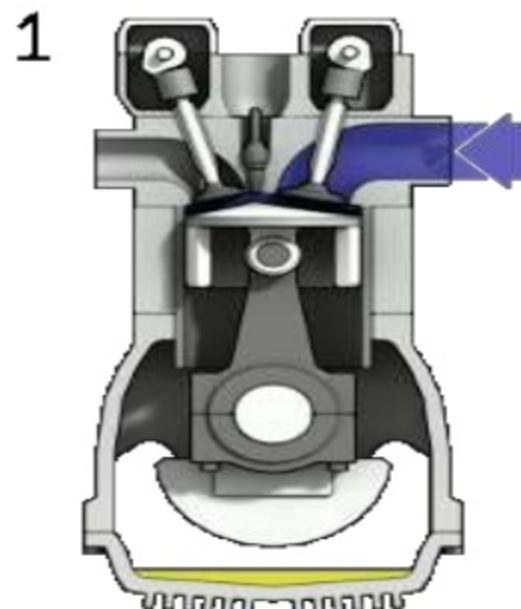
Working of Four Stroke Engines

1. **Intake stroke:** the intake stroke draws air and fuel into the combustion chamber. The piston descends in the cylinder bore to evacuate the combustion chamber. When the inlet valve opens, atmospheric pressure forces the air-fuel charge into the evacuated chamber. As a result, the combustible mixture of fuel and air fills the chamber.



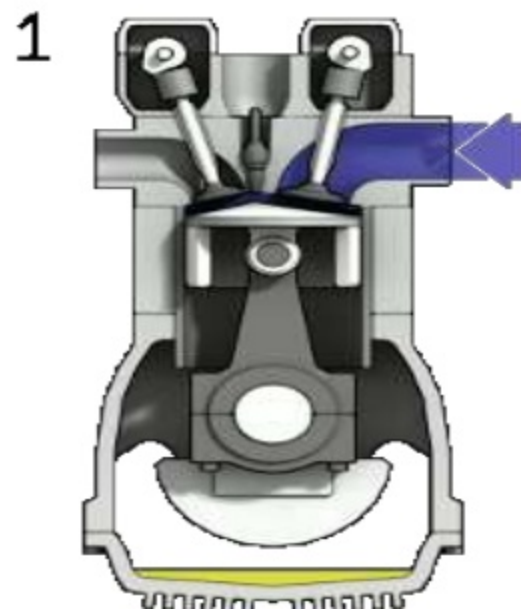
Working of Four Stroke Engines

2. **Compression stroke:** at the end of the intake stroke, both inlet and exhaust valves are closed. The inertial action of the crankshaft in turn lifts the piston which compresses the mixture. The ratio of the combustion chamber volume before and after compression is called the compression ratio. Typically the value is approximately 9:1 in spark ignition engines and 15:1 in diesel engines.



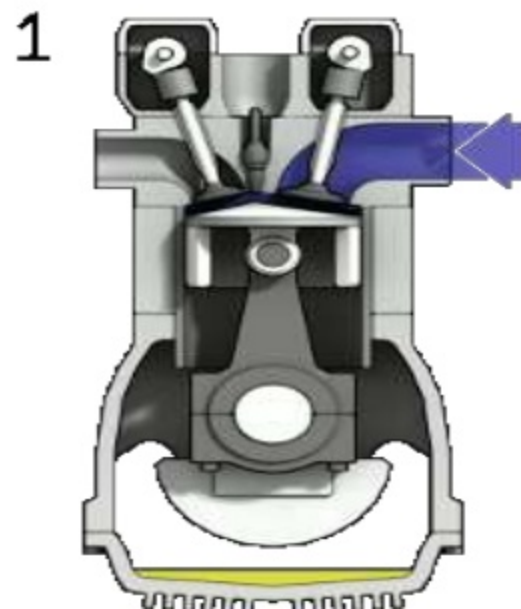
Working of Four Stroke Engines

3. **Power stroke:** when the piston ascends and reaches top dead center, an electric current ignites the spark plug and as the mixed gas burns, it expands and builds pressure in the combustion chamber. The resulting pressure pushes the piston down with several tons of force.



Working of Four Stroke Engines

4. **Exhaust stroke**: during the exhaust stroke, the inlet valve remains closed whilst the exhaust valve opens. The moving piston pushes the burned fumes through the now open exhaust port and another intake stroke starts again.

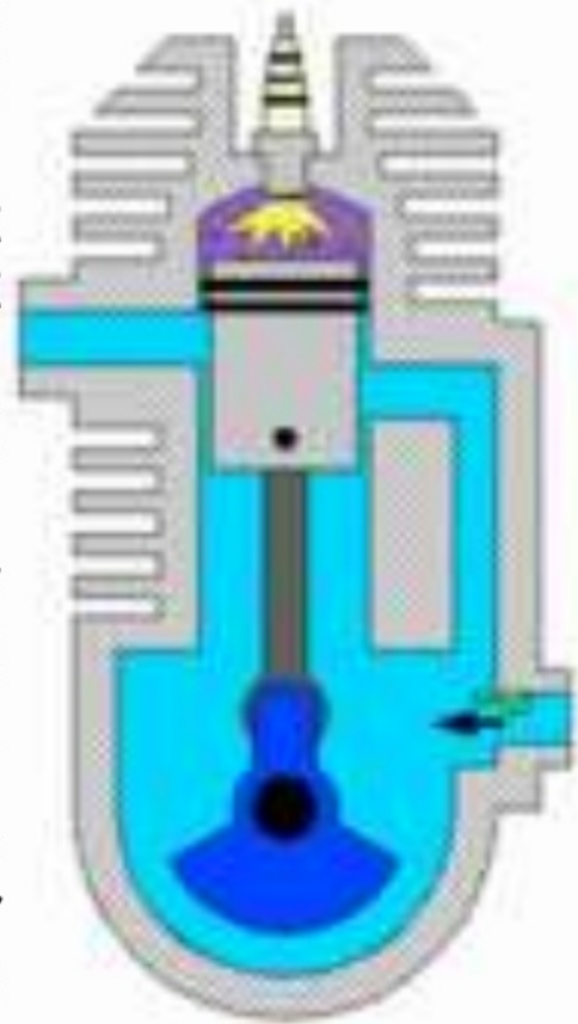


Salient Features About Engines

- During one cycle, the piston makes two round trips and the crankshaft revolves twice.
- The inlet and exhaust valves open and close only once.
- The ignition plug also sparks only once.
- A petrol engine, whether four- or two-stroke, is called a spark ignition (SI) engine because it fires with an ignition plug.
- The four-stroke-cycle engine contains the lubricating oil in the crankcase.
- The oil lubricates the crankshaft bearings and cools the hot piston

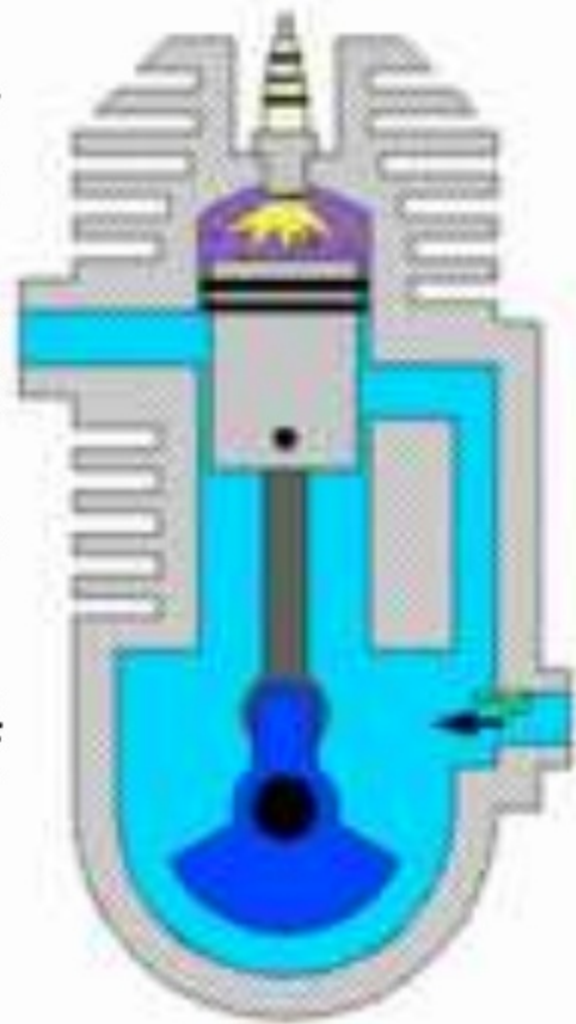
Two-stroke Engines

- The two-stroke engine is similar to that of the four-stroke-cycle engine in its reciprocating mechanism.
- It uses the piston-crankshaft mechanism, but requires only one revolution of the crankshaft for a complete power-producing cycle.
- The two-stroke engine does not use inlet and exhaust valves.
- The gas exchange is implemented by scavenging and exhaust porthole openings in the bore wall. The upward and downward motion of the piston simultaneously opens and closes these portholes. The air-fuel mixture then goes in or out of the combustion chamber through the portholes. Combustion takes place at every rotation of the crankshaft.



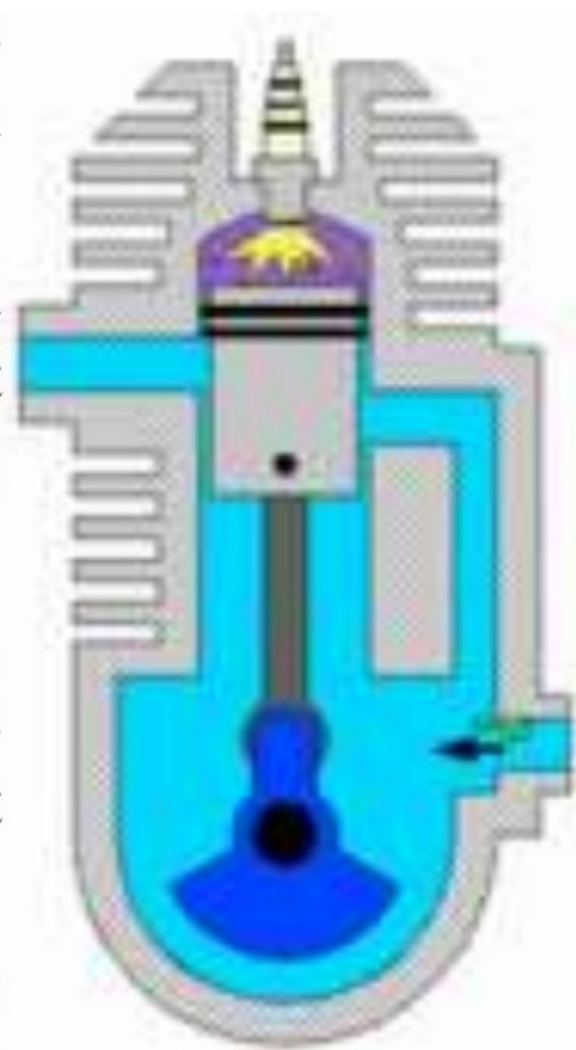
Working of Two-stroke Engines

- The gas exchange is implemented by scavenging and exhaust port opening in the bore wall.
- The upward and downward motion of the piston simultaneously opens and closes these port holes.
- The air-fuel mixture then goes in or out of the combustion chamber through the port holes.
- After spark ignition inside chamber, Combustion takes place at every rotation of the crankshaft.



Features of Two-stroke Engines

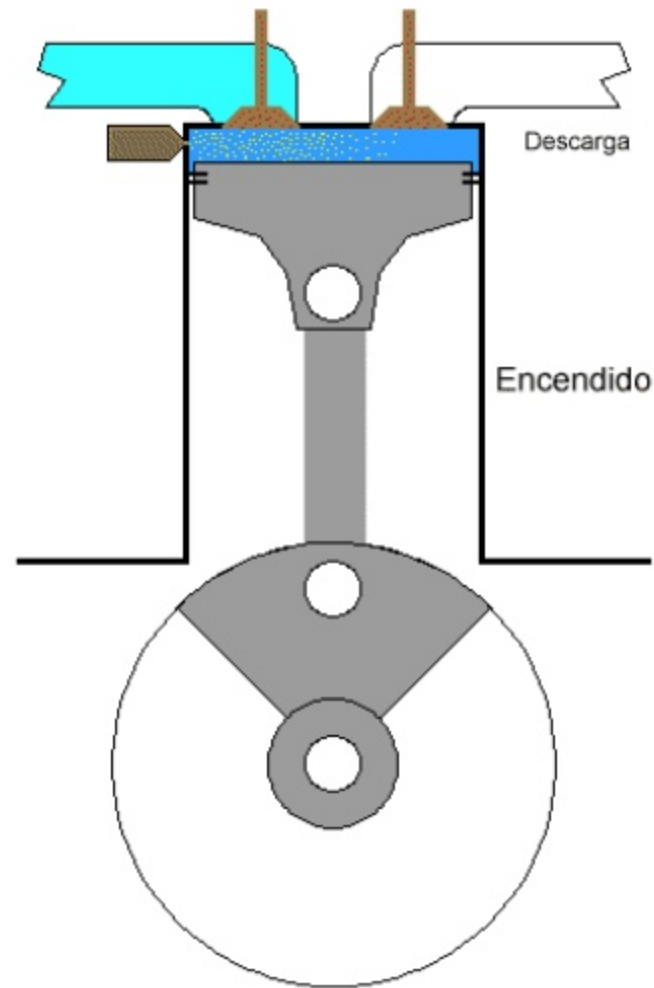
- In the two-stroke engine, the space in the crankcase works as a pre-compression chamber for each successive fuel charge.
- The fuel and lubricating oil are premixed and introduced into the crankcase, so that the crankcase cannot be used for storing the lubricating oil.
- When combustion occurs in the cylinder, the combustion pressure compresses the new gas in the crankcase for the next combustion.
- The burnt gas then exhausts while drawing in new gas. The lubricating oil mixed into the air-fuel mixture also burns



Diesel Engine

The only difference between diesel engine and a four-stroke gasoline engine is:

- No sparkplug on Diesel engine.
- Has a higher compression ratio.
(14:1 to 25:1)
- Better fuel mileage.



Diesel Engine

Intake Stroke:

- Piston moves from TDC to BDC
- creating vacuum in the cylinder Intake valve opens allowing *only air* to enter the cylinder and exhaust valve remains closed

