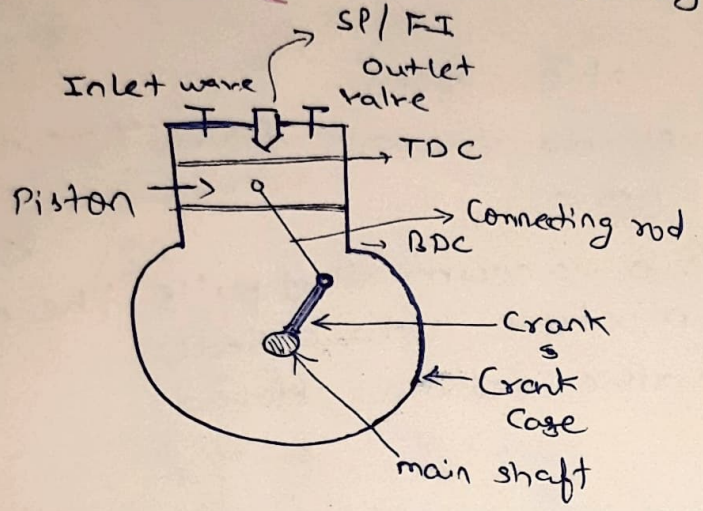
Unit 2 I.C Engine & Pump

* IC Engine

SP ⇒ spark plug
FI → Fuel ingine

TDC → Top dead center
BDC → Bottom dead center.



IC Engines are heat engines where combustion of fuel occurs inside the engine cylinder.
They convert chemical energy into mechanical energy

classification -

- Based on fuel
  - Petrol (spark ignition)
  - Diesal (Compression ignition)
- Base on Cooling method
  - Air cooled
  - Water-cooled
- Based on Number of strokes
  - Two-stroke engine
  - Four-stroke engine
- Based on number of cylinder
  - Single cylinder
  - Multi cylinder.

Main Components

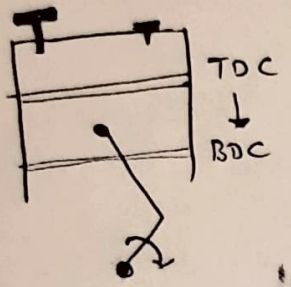
* cylinder → Chamber where fuel combustion takes place
* piston → moves up and down inside the cylinder.
* Connecting Rod → Connect piston to crankshaft.
* Crank Shaft → Converts reciprocating motion to rotary motion.
* Valves → Control intake & exhaust of gases
* Spark plug → (in petrol) : ignites the air-fuel mixture
* fuel injector (in diesel) Inject fuel into combustion
* Cooling System → Maintain temp
* Lubrication system → Reduce friction.

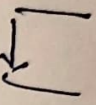
* Four-Stroke IC Engines

① Intake (Suction) Stroke –

To draw the air-fuel mixture or air into cylinder.

Process – • The intake valve opens
• piston moves downward from TDC to BDC



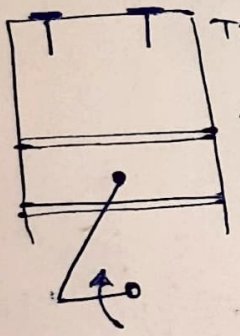


• This creates a vaccum that pulls the air or fuel mixture into cylinder.
• exhaust valve remains closed.

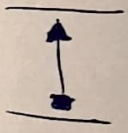
② Compression stroke –

To compress the air-fuel mixture to increase ⓟ temp.

Process – • Both intake & exhaust valve are closed.
• The piston moves upward from BDC to TDC



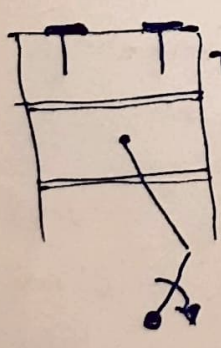
mixture is compressed in the combustion chamber.
• At the end of this stroke.
↳ A spark plug ignites the mixture
↳ Fuel is injected into hot compressed air.



③ Power Stroke –

To generate power from the combustion of fuel.

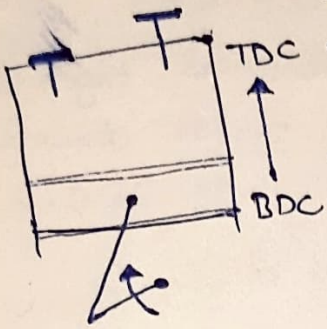
Process – • Combustion occurs, rapidly increasing pressure
• Forces the piston down from TDC to BDC
• This stroke produces useful work & rotates the crankshaft.
• Both valve remain closed.



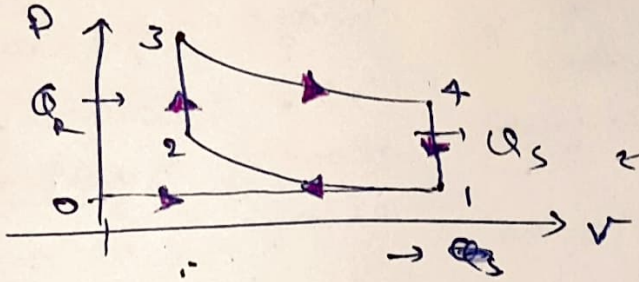
(4) Exhaust stroke - con

To expel burnt gases from the combustion chamber.

Process -
- exhaust valve opens.
- piston moves up from BDC to TDC
- Burnt gases are pushed out through the exhaust valve
- intake valve remains closed.



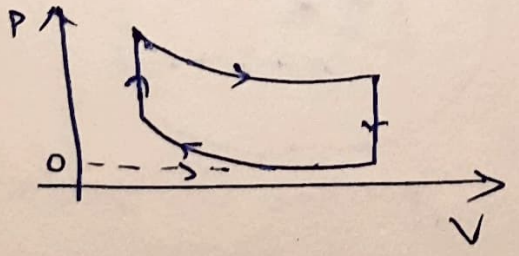
Note in 2 Rotation crank → 1 power stroke.



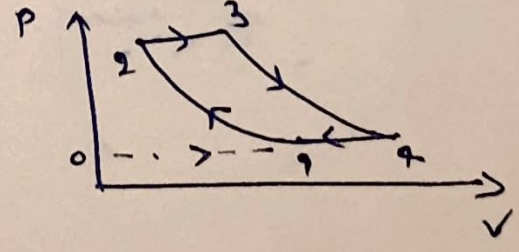
~~Constant volum~~ (Constant volume process)

- Difference between 4 stroke petrol engine & diesel engine

* SI engine 4 Stroke Petrol engine	* CI engine 4 Stroke diesel engine
→ Ignition - Sparic (SI)	Compression (CI)
Fuel - Petrol	diesel
Efficiency - lower	Higher
weight lighter	Heavier
maintance → Easier & cheaper	Costly & complex.
Constant Volume ⇒ 10 bar Pressure	Constant Pressure ⇒ 33 bar
Application → Cars / bikes / Scooter	Trucks, buses, tractors, heavy machinery.



8 to 12 (Combustion ratio)



14 to 25 (Combustion ratio)

* 2 Stroke IC engine - → Petrol engine
→ Diesel engine

(Working)

Stroke 1

(Compression + Suction)

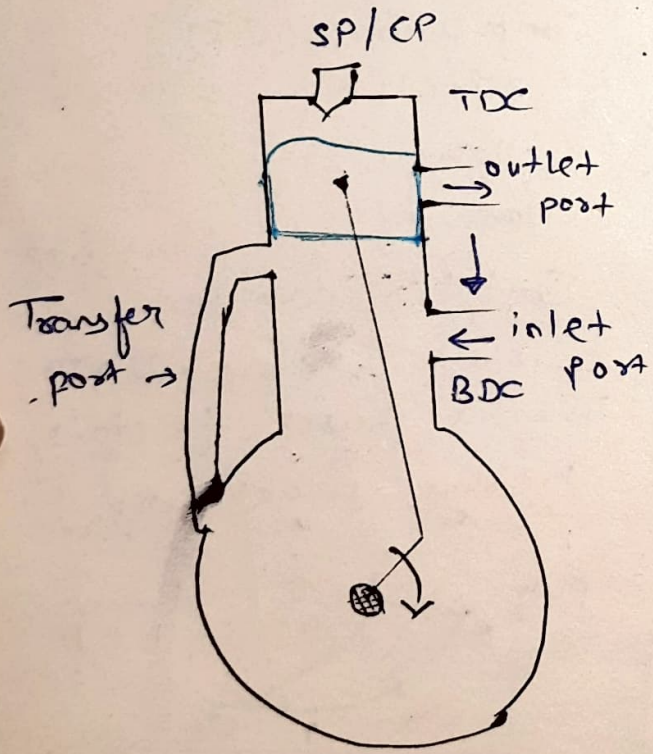
Piston moves upward from Bottom (BDC) to TDC

→ It compress feul mixture inside the combustion engine.

- At the same time, partial vaccume is created in the crankcase, drawing in a fresh ~~air~~ feul the inlet port.

→ Just before the piston reaches TDC

Spark plug or fuel injected into the compressed mixture.



Stroke 2

(Power + Exhaust)

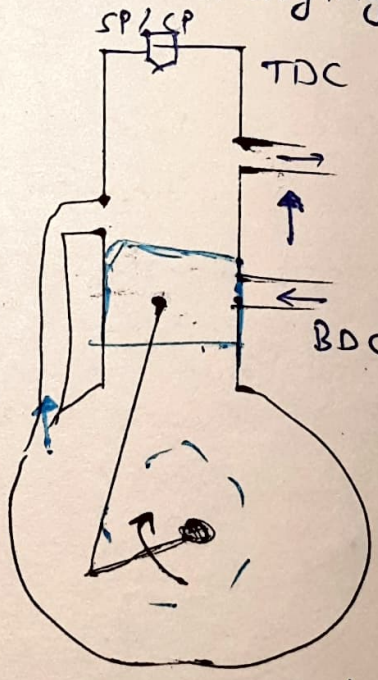
Due to combustion, high pressr forces the piston downward from BTDC to BDC.

→ As piston moves down compressed the fresh charge in the crankcase.

→ Firstly exhaust port opens, allowing burnt gases to escape.

→ transfer port opens & the fresh charge enter the cylinder, pushing out remaining exhaust gases.

(Scavenging).



partial compression process.

main Components

Cylinder, Piston, Spark plug / Combustion plug, port → inlet, outlet, transfer, Crankcase

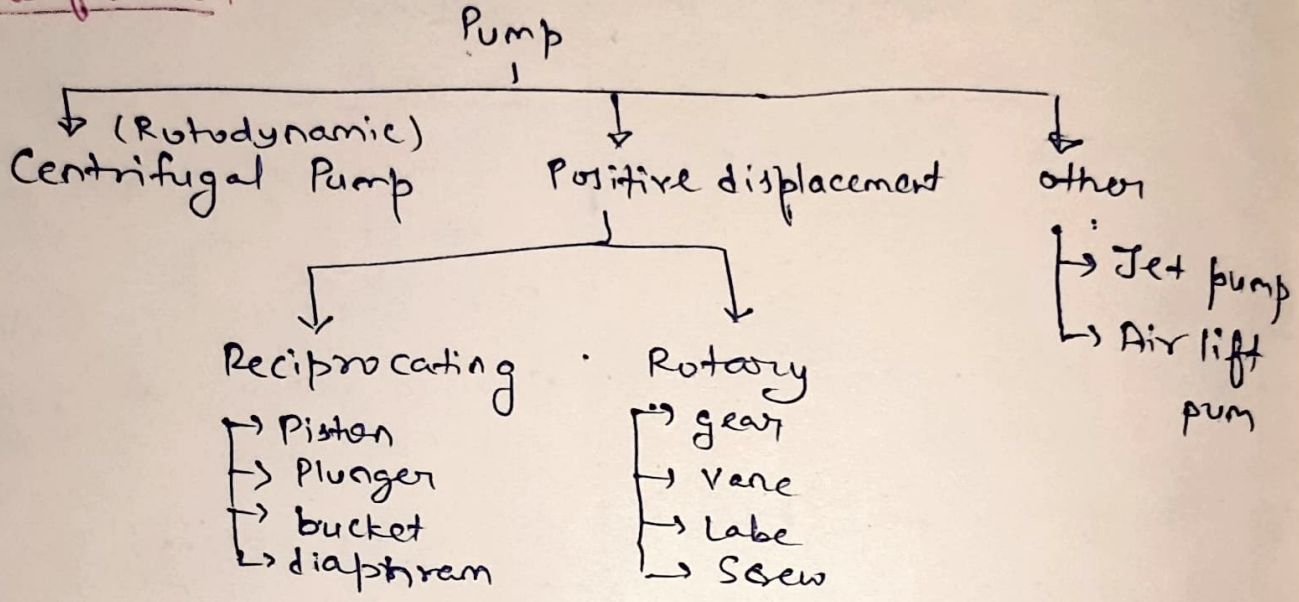
Difference between 2 stroke & 4 stroke

2 Stroke	4 Stroke
1) 2 rotation of crank, 1 power stroke	1 rotation of crank, 1 power stroke.
2) Valves are used	Ports are used.
3) Cam & follower mechanism is used	Cam & follower mechanism is not used.
4) Size of fly wheel is more	Size of fly wheel is less
5) Size of engine is more (weight)	Size of engine is less (weight)
6) Flat face head of piston is used.	Aerofoil head of piston is used.
7) Thermal efficiency is more	Thermal efficiency is less.
8) Cost is more	Cost is less
9) maintanence is more	maintanance is less.

* IP → Indicated power
BP → Brake power

* **Pump** :- Pump is a device which is used to transfer the liquid from one place to another by increasing the head (Pre.) of liquid.

classification -

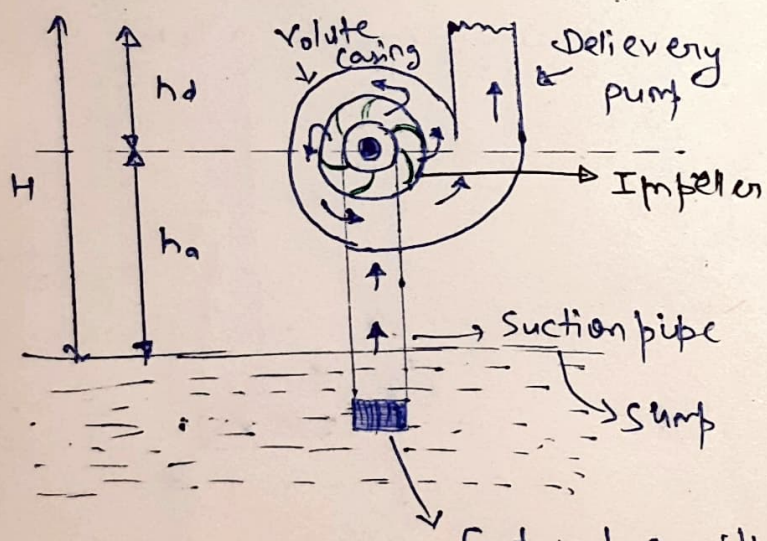


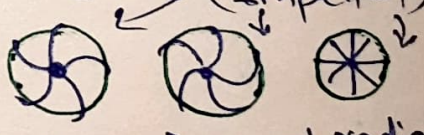
In Syllabus → Centrifugal pump.
Reciprocating

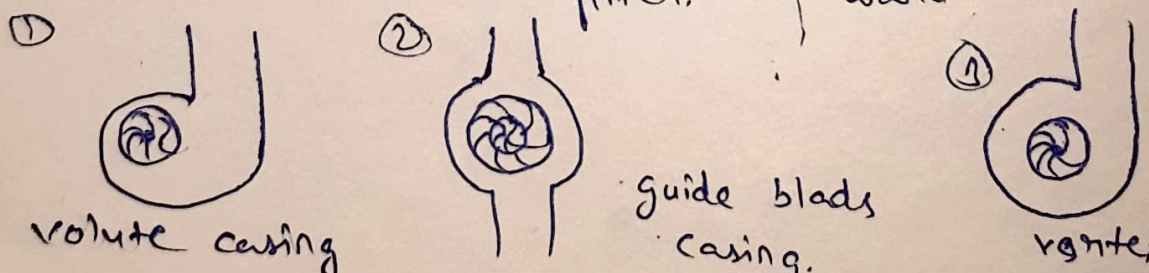
(1) Centrifugal Pump -

* These pumps use centrifugal force generated by a rotating impeller to move fluid.

It convert mechanical energy into kinetic energy.







Parts

Delievery pipe - Used to transfer liquid.

Impeller - Rotating part used to increase Pressure of liquid.

Suction pipe - One end inside the liquid & another is connected with ~~pipe~~ pump.

foot valve → One way valve. Allow water in upward direction.

priming cup => work as coolent, To remove air bubble from casing.

Casing - Provide protection cover to the pump.

Filter or strainer → screen liquid.

working Fluid enters the pump impeller along or near to the rotating axis & is accelerated by the impeller.

Kinetic energy of the fluid is converted to pressure energy in the volute casing & the fluid is discharged at high pressure.

Application

- Domestic water supply
- Irrigation system.
- Chemical processing plants
- Cooling water system.

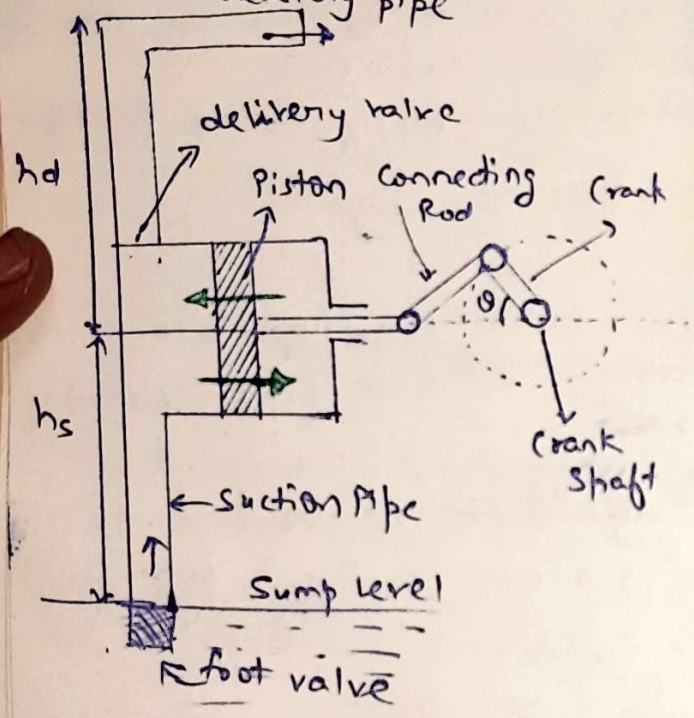
Static head, $H = h_s + h_d$ → delievery head

h_s → Suction head

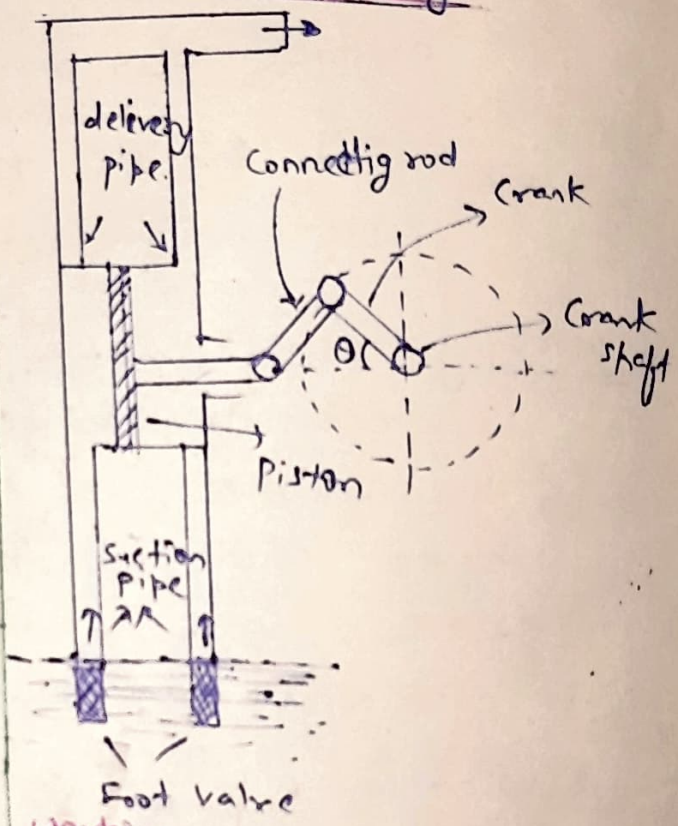
(2) Reciprocating Pump :-

Reciprocating Pump operates on the principle of a piston moving back & forth within a cylinder to draw & discharge fluid.

Single Acting



Double Acting



Working	
• Only one suction pipe	– Two suction pipes.
• Only one delivery pipe	– Two delivery pipes.
• Water acts on one side of piston	– Water acts both side of piston.
• During one rotation of shaft there is only one delivery stroke	– Two delivery stroke
• Water pumped will be less	– Double amount of water will be pumped.
• Less power required	– High power required
• Cost is less	– Cost is more

* working (for both)

- Suction Stroke :- The piston moves away from the cylinder head, creating a vacuum that draws fluid into the cylinder through a Suction valve.
- Delivery stroke :- The piston moves towards the cylinder head, increasing pressure & pushing the fluid out through a delivery valve.

- Application . Used in hydraulic system
  - Oil drilling rigs
  - High - pressure cleaning systems.
  - Water supply to boilers.

Note Cavitation - Formation & rapid collapse of vapor bubbles in a liquid, due to pressure drop.

⇒ it can be removed by increasing the pressure at the pump inlet, reducing fluid temp & optimizing pump & system design.