

Air Compressor

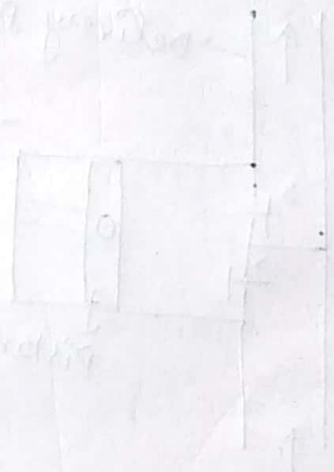
An air compressor is a machine to compress the air and to raise its pressure. The air compressor sucks air from atmosphere, compresses it and then delivers the same under high pressure to a storage vessel.

Main Components of Compressed air systems →

- Intake air filters
- Inter-stage coolers
- After coolers
- Air dryers
- Moisture drain traps
- Receivers

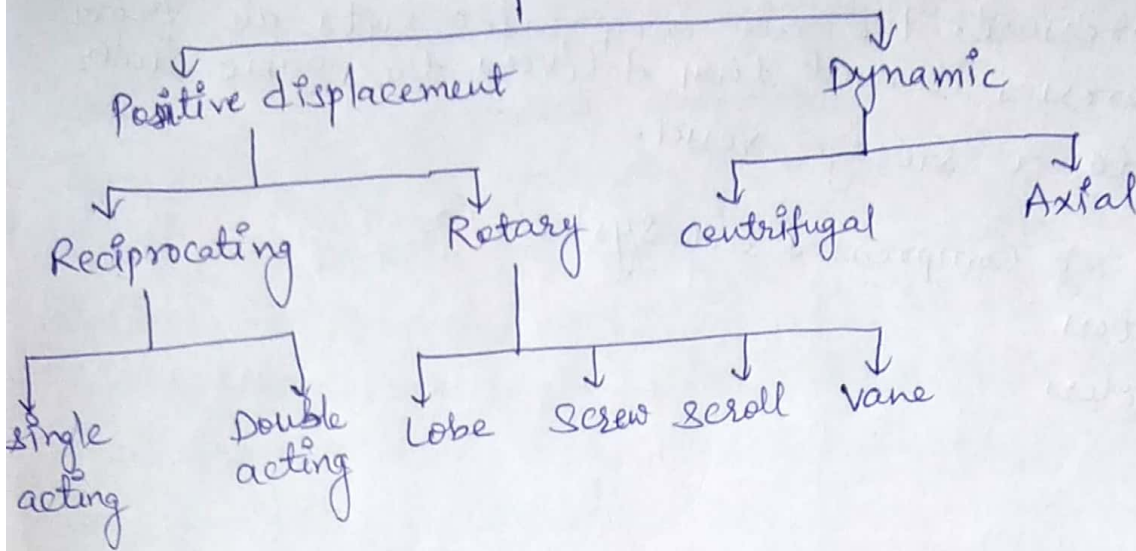
Classification of Compressor →

- 1) Method of Compression:-
 - a) Reciprocating compressor
 - b) Rotary compressor
 - c) Centrifugal compressor
- 2) Principle of operation:-
 - a) Positive displacement
 - b) Rotodynamic or steady flow compressors
- 3) Number of stages
 - a) Single stage
 - b) Multi stage
- 4) Number of cylinder
 - a) Single cylinder
 - b) Multi cylinder

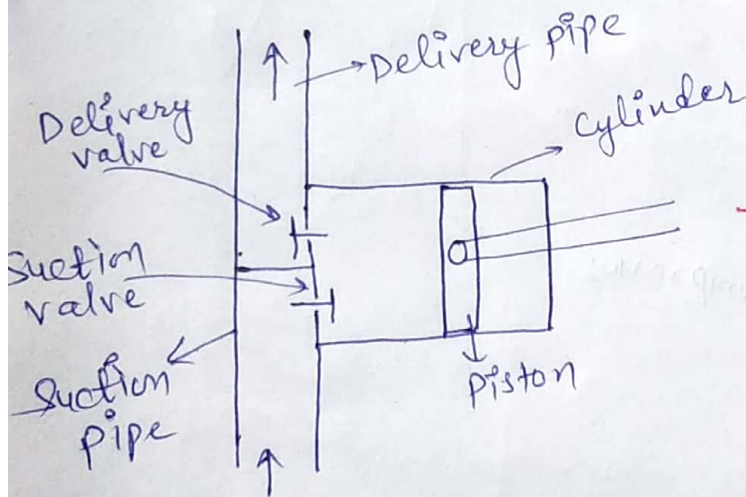


Types of Compressors →

Two Basic Types of Compressors



Positive Displacement Compressor → These compressors causes movement by trapping a fixed amount of air then forcing (displacing) that trapped volume into discharge pipe, that's why called Positive displacement



→ Reciprocating Compressor

Dynamic Compressor → It is continuous flow compressor characterised by rotating impeller to add velocity and thus pressure to fluid.

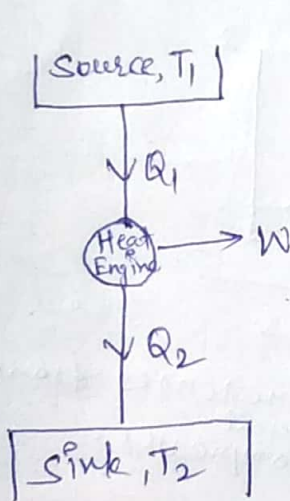
Refrigerator & Heat Pump

Refrigerator →

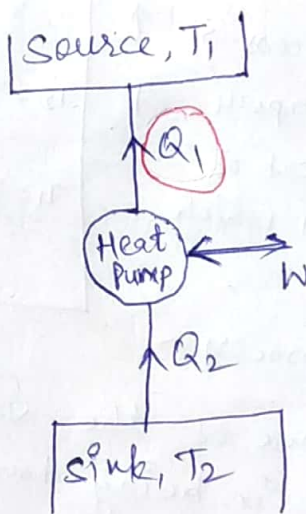
- The term refrigeration is used for the process of removing heat. (i.e. cooling) from a substance.
- Theoretically, the refrigeration is a reversed heat engine, or a heat pump which pumps heat from a cold body and delivers it to hot body.
- The substance which works in a heat pump to extract heat from a cold body and to deliver it to a hot body is called refrigerant.

Coefficient of Performance of a refrigerator →

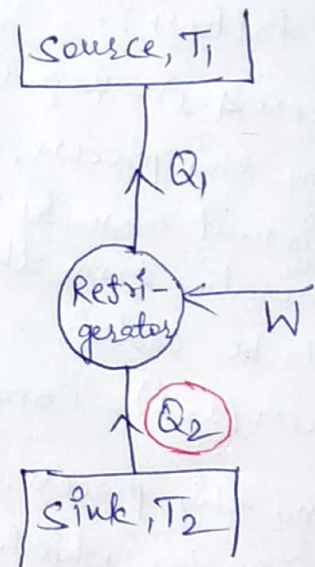
$$\text{COP} = \frac{\text{Amount of heat extracted}}{\text{Work Input}} = \frac{Q}{W}$$



$$\eta_{\text{H.E.}} = \frac{W}{Q_1}$$



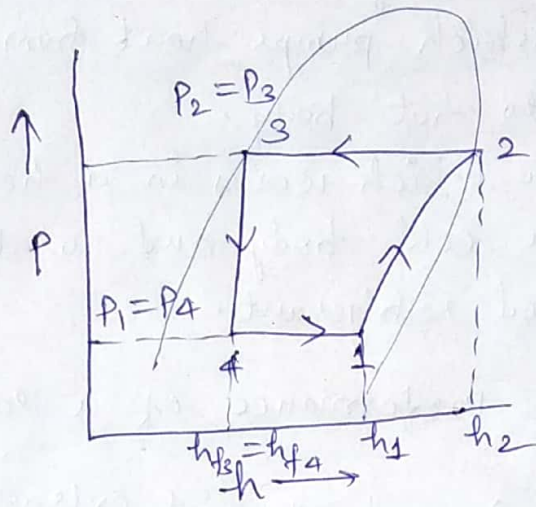
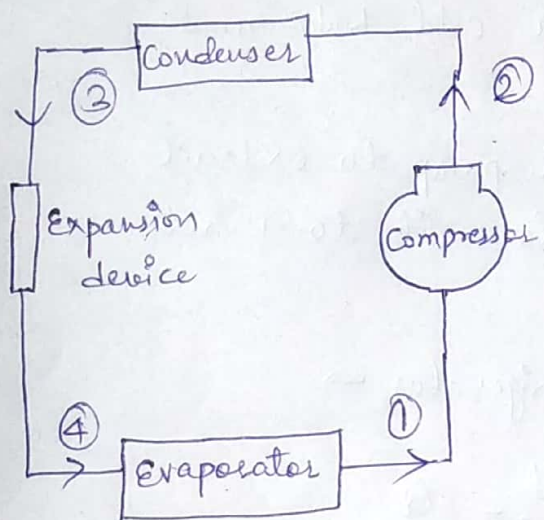
$$\text{COP}_{\text{HP}} = \frac{Q_1}{W}$$



$$\text{COP}_R = \frac{Q_2}{W}$$

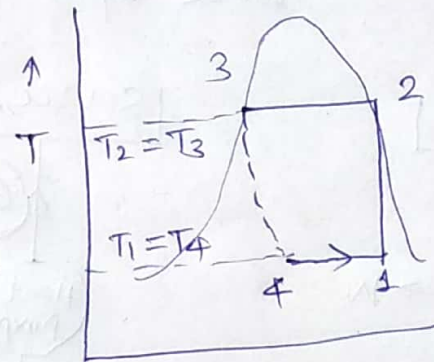
Vapour Compression Refrigeration System →

This system uses a suitable working substance, termed as refrigerant which condenses & evaporates at temperature and pressure close to atmospheric conditions.



The four process of cycle are as follows:-

1) Process (4-1) - Vaporising process →
During this process, liquid-vapour refrigerant absorbs latent heat of vaporisation from the medium which is to be cooled.



2) Process (1-2) - Compression process →

During this process, the pressure of the vapour increases from P_1 to P_2 for which W work is being done on compresses.

3) Process (2-3) - Condensation process →

During this process, the vapour refrigerant is changed into liquid refrigerant while exchanging heat with the surrounding.

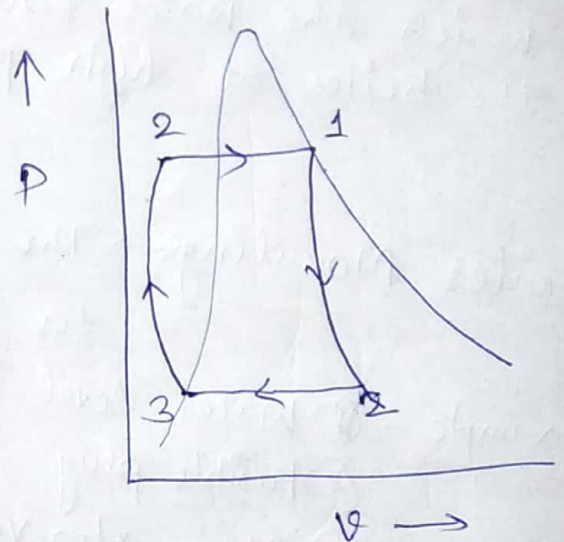
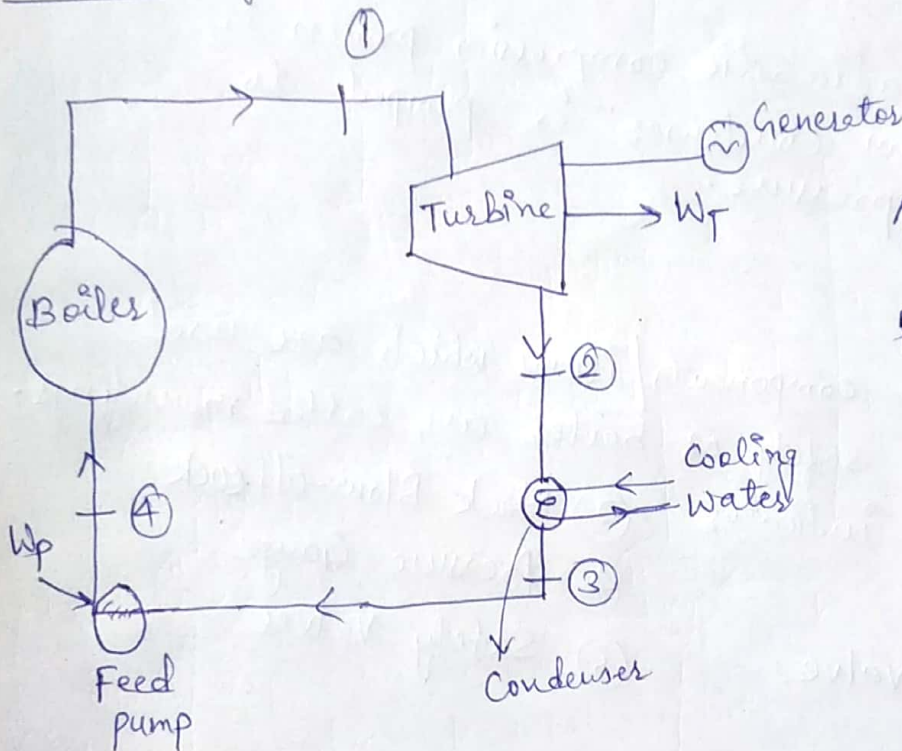
4) Process (3-4) - Expansion process →

The liquid refrigerant is expanded by throttling process and pressure of liquid refrigerant changes from P_3 to P_4 .

Steam Power Plant

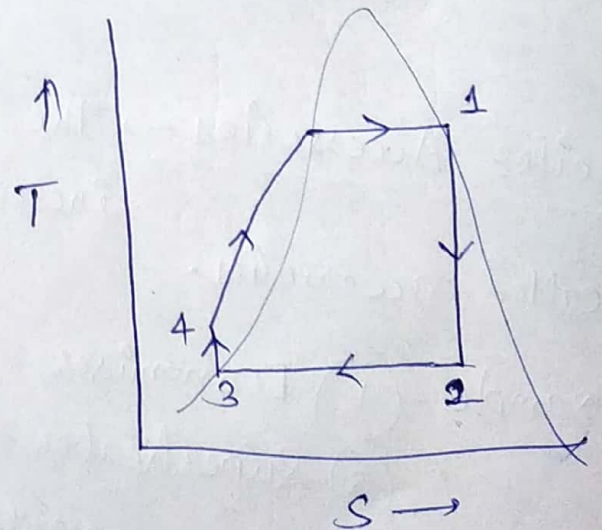
- Steam Power Plant is used to produce mechanical or Electrical (in generator) power by the thermal energy of the steam.
- The steam is produced in a boiler by burning coal at a suitable temperature.
- Steam power plant is also known as thermal power plant.
- Steam power plant uses Rankine cycle for power generation.

Rankine Cycle →



Process (4-1) - Boilers →

- Here liquid converts into vapour after gaining the heat from the combustion of coal.
- It is a constant pressure heat addition process.



Process (1-2) - Turbine →

- It is a reversible adiabatic expansion process.
- Mechanical work is produced in it at the expense of thermal energy of steam.

Process (2-3) - Condenser →

- During this process, heat is lost at constant pressure to the outside.
- It is known as constant pressure heat rejection process.

Process (3-4) - Feed Pump →

- It is a reversible adiabatic compression process in which the water from condenser is pumped to the boiler at high pressure.

Boiler Mountings → The components/items which are used for safety of boiler are called mountings.

- Example -
- | | |
|-------------------------|----------------------------------|
| ① Water level indicator | ② Block Blow-off cock |
| ③ Fusible plug | ④ Pressure Gauge |
| ⑤ Steam stop valve | ⑥ Safety valves |

Boiler Accessories → The items which are used for increasing the boiler efficiency are called accessories.

- Example -
- | | |
|-------------------|-------------|
| ① Economiser | ② Preheater |
| ③ Superheater | ④ Injector |
| ⑤ Steam separator | ⑥ Feed Pump |