

Steam :- Vapour of water and is invisible when pure

and dry.

→ Used as working substance in operation of steam engines and steam turbines.

→ Doesn't obey laws of perfect gases, until it is perfectly dry.

1. Wet steam :- When ^{the} steam contains moisture or particles of water in suspension.

2. Dry steam :- When the wet steam is further heated and it does not contain any suspended particles of water.

3. Superheated steam :- When dry steam is further heated at constant pressure.

* 4. Dryness fraction :- Ratio of the mass of actual dry

steam to the mass of same quantity of wet steam.

$$x = \frac{m_g}{m_g + m_f}$$

↗ mass of dry steam.
 ↗ mass of water in suspension

$$(Wet = dry + water) - \text{written}$$

Sensible heat of water— Amount of heat absorbed by 1 kg of water, when heated at a constant pressure, from the freezing point (0°C) to the temperature of formation steam. (Also known as liquid heat)

14th class (offline)
20-12-2023

Boiler → A closed vessel in which fluid (generally water) is heated to become hot water/steam.

Essential of a good steam boiler:-

- Rapidly meet the fluctuation of load
- Capable of quick starting.
- Light in weight
- Occupy a small space
- Sufficient to secure easy ignition.

Factors for selection of a steam boiler:-

- Required power and working pressure.
- Rate of steam generation. → The fuel and water available
- Type of fuel to be used.

Classification of steam boiler:-

1. According to the contents of tube:

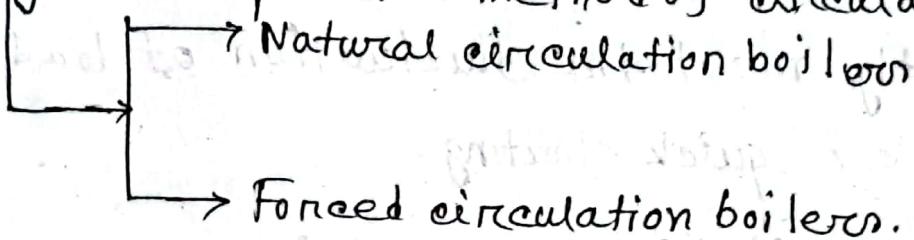
a) Fire tube/smoke tube boiler → The flames and hot gasses passes through the tube surrounded by water

Ex: Simple vertical boiler, cohran boiler.

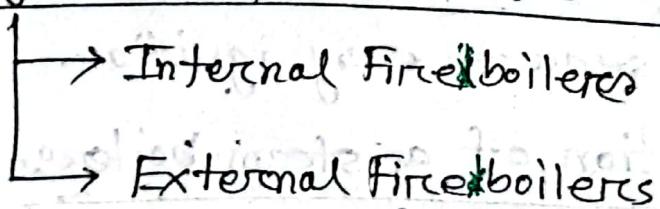
b) Water tube boiler \rightarrow Water is contained inside the tubes which are surrounded by flame and hot gasses from outside.

Ex:- La-Mont boiler, Benson boiler

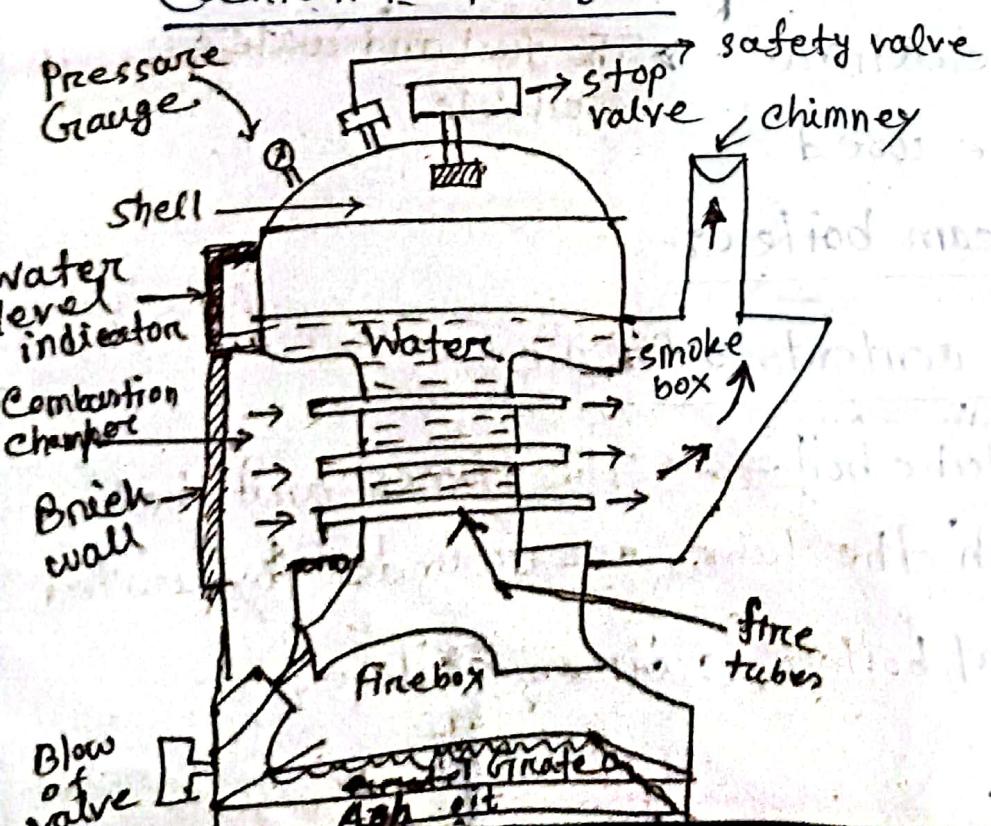
2. According to the position method of circulation:



3. According to the position of furnace:-

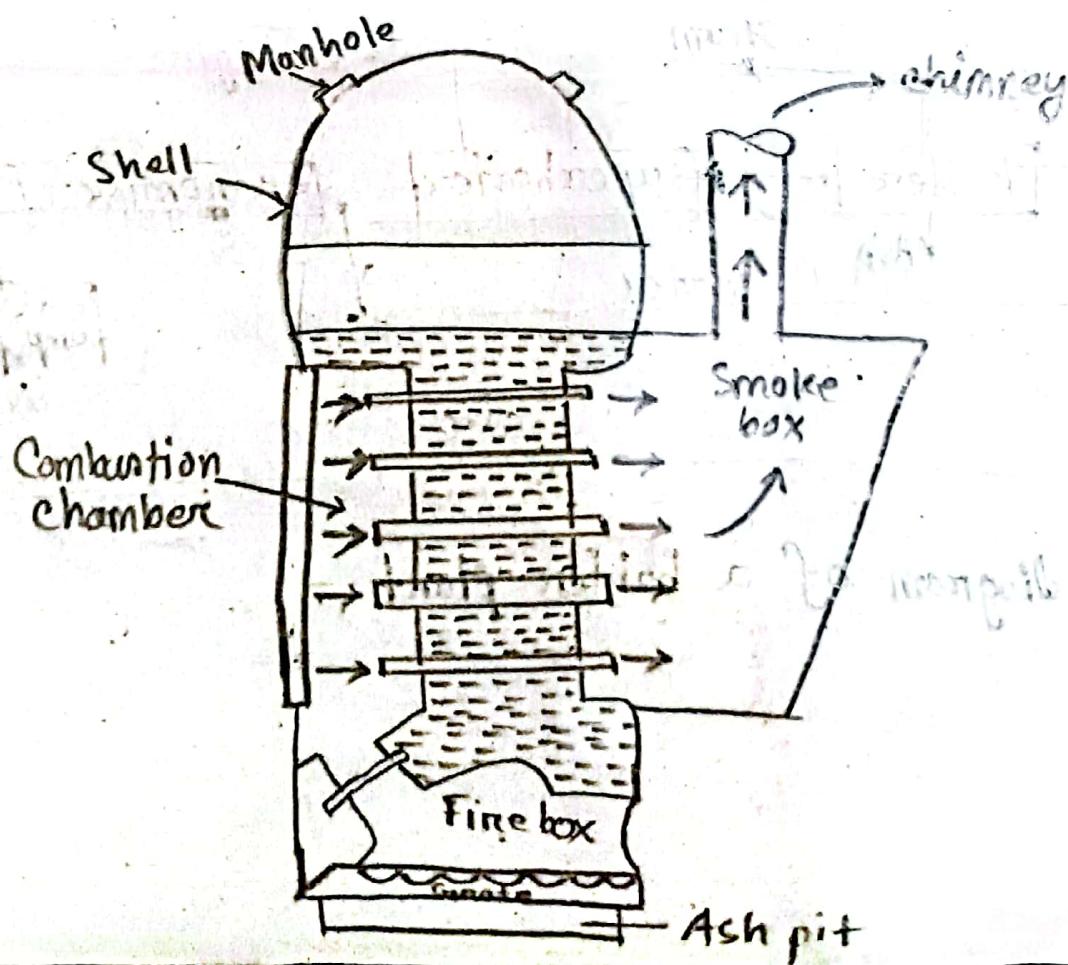


Cochran Boilers:-



- Vertically constructed which means height is more than width.
- Fire tubes are designed parallel to the surface.
- shell of whole Boiler and furnace is hemispherical in construction
- Furnace is connected to fire tubes and burnt gases pass into the tubes.
- Burnt gases enter smoke box and leave through chimney.

Coaching Boiler:



15th class (09-01-24)
offline (Not present)

Boiler Accessories:-

- Internal parts of a boiler and help in running efficiency
- There are many types of boiler accessories:
 1. Feed pump
 2. Super heater
 3. Economiser
 4. Air preheater

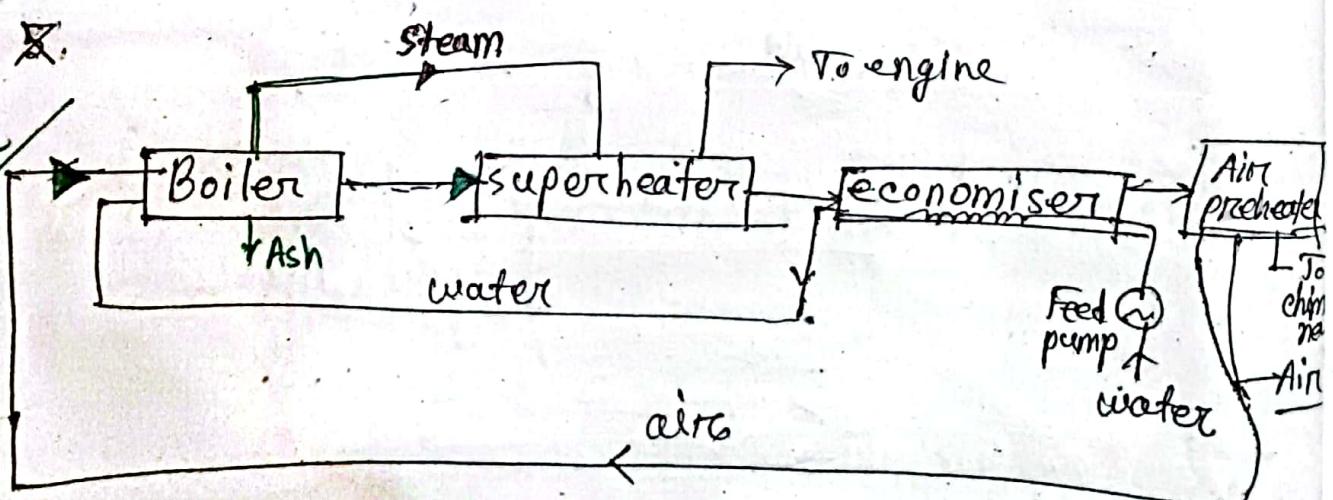


Fig: diagram of a boiler plant.

~~b.w~~ Advantages of using economiser and air preheater.

CT-02

pge-343

Sunday - (14-01-2024)

Topic:

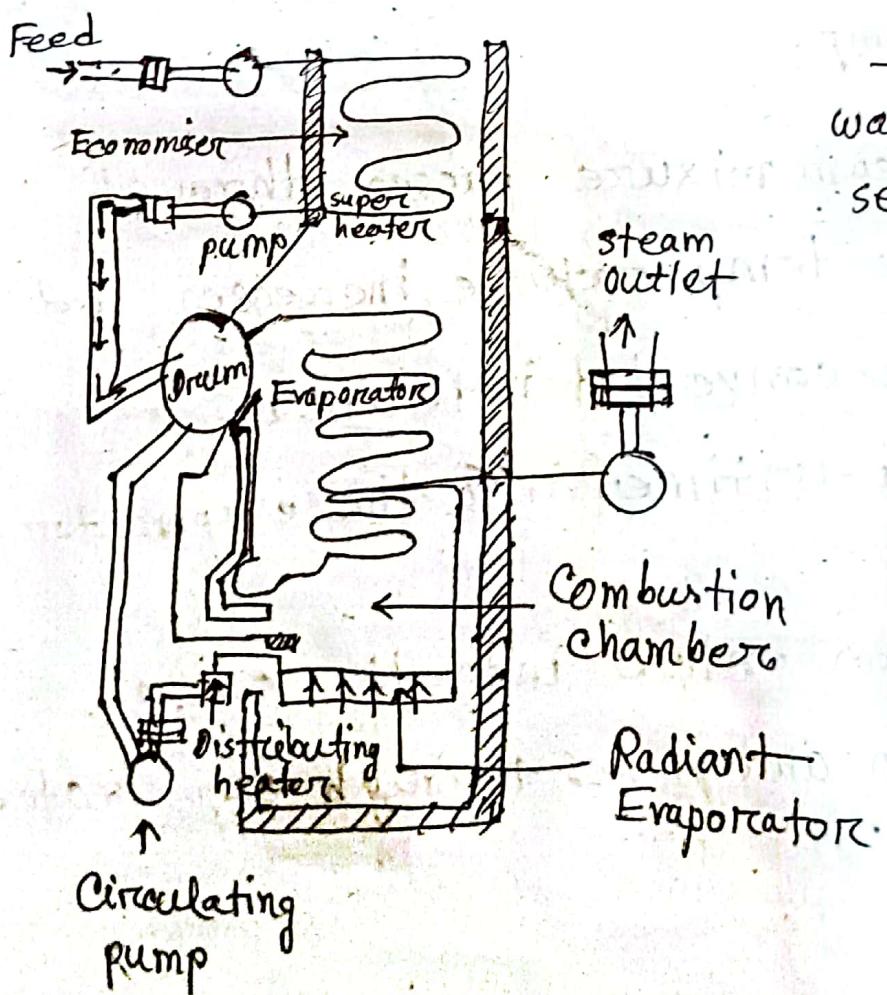
- 1) Cycle
- 2) IC engine
- 3) Boiler, शाय

Sheet (2+3)

16th class (offline)

10-01-2024

Working of a La-Mont Boiler:- (330 page) book



Drum वाले तरीके :

water and steam तरीके
separate - करा.

- Works on the principle of forced circulation of water with the help of centrifugal pump
- Feed pump circulates the water in the Economiser. Economiser heats the water.
- Then the water enters into steam separating drum.
- The mixture of water and steam is forced circulated through the radiant evaporator by external pump.
- Then water steam mixture passes through evaporator. Here temperature increases and most water gets converted into steam.
- Water passes (10-15) times into the evaporator tube.
- Saturated steam enters into the steam separator drum and passes through superheater.

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Equivalent Evaporation: (Performance test करार या नियंत्रित
बॉयलर Boiler या)

Amount of water evaporated from feed water at 100°C
and formed into dry and saturated steam at 100°C
at normal atmospheric pressure. It is written
as [from and at 100°C]

$$E = \frac{\text{Total heat required to evaporate feed water}}{2257}$$

$$= \frac{M_e(h - h_f)}{2257}$$

Where,

M_e = Actual mass of water evaporated/steam generated.

h = Total Enthalpy of steam generated

h_f = Enthalpy of feed water

$h - h_f$ = Heat required to evaporate 1 kg of water.

2257 kJ/kg = Latent heat of water at $[P = 1.031 \text{ bar}]$

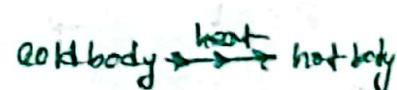
$\frac{h - h_f}{2257}$ = is known as factor of evaporation.

- 1) Different heat losses in Boiler: 351 page
*) ~~നിരവധി നിർമ്മാണ പദ്ധതികൾ, വിനിയോഗ ചെയ്യുന്നതോട്;~~
- 2) Boiler efficiency (Math -wise) 346 page

17th class (off)
(16-01-24)

New chapter:

Refrigeration: The process of Reducing and maintaining the temperature of a body below the general temperature of its surroundings.

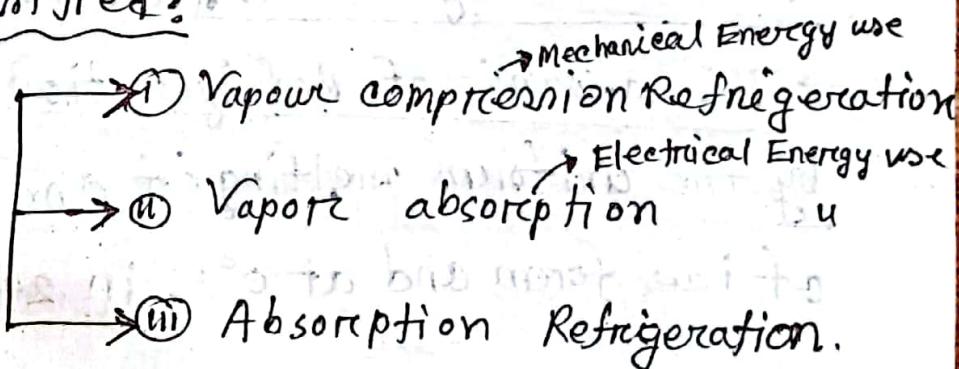
Refrigerator: Refrigerator is a reversed heat engine/a heat pump which pumps heat from cold body and delivers it to a hot body. 

Refrigerant: The substance which works in a heat pump to extract heat from a cold body and deliver to a hot body is called Refrigerant.

Method of refrigeration:

- ① Non cyclic Refrigeration → Cools area by melting ice.
- ② Cyclic Refrigeration → Consists of a refrigeration cycle
→ Satisfies second law of thermodynamics.
→ Can be classified:

i) Vapour cycle



ii) Gas cycle.

③ Thermodynamic Refrigerations:

→ Uses peltier effect to create a heat flux between the junction of two types of materials.

④ Magnetic Refrigeration:

→ A cooling technology based on the Magnetocaloric effect.

→ A strong magnetic field is applied to the refrigerant, force its various magnetic dipoles to align and putting these degree of freedom of the refrigerant into a state of lowered entropy.

Tonne of Refrigeration: (units of Refrigeration)

→ The amount of Refrigeration effect produced by the uniform melting of one tonne (1000 kg) of ice form and at 0°C in 24 hours.

$$1\text{TR} = 1000 \times 335 \text{ kJ in 24 hours.}$$

$$= \frac{1000 \times 335}{24 \times 60} = 232.6 \text{ kJ/min}$$

[Latent heat of ice = 335 kJ]

→ In actual practice, [210 kJ/min or 3.5 kW] is taken.

18th class (Offline)
17-01-2024

Coefficient of performance: (C.O.P)

→ Ratio of heat extracted in the refrigerators to the work done on the refrigerant.

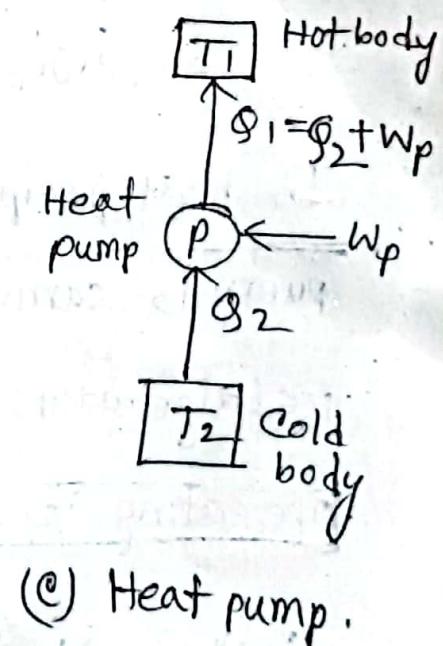
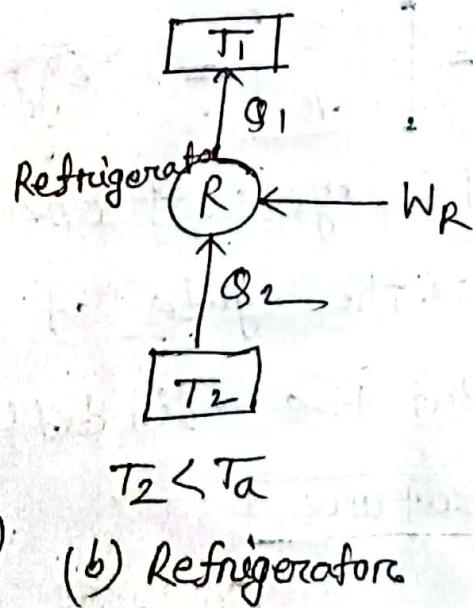
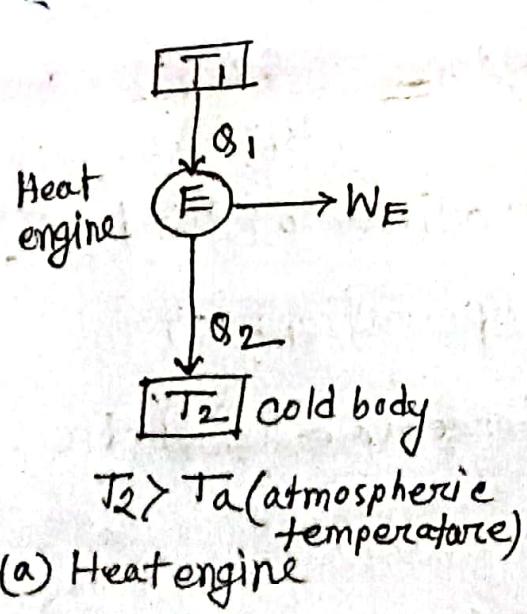
$$C.O.P = \frac{Q}{W}$$

Where,

Q = amount of heat extracted in the refrigerators.

W = amount of work done.

Difference between Heat engine, Refrigerators and Heat pump:



In the Heat engine, Heat supplied is converted into useful work.

$$\therefore \text{Workdone, } W_E = Q_1 - Q_2$$

$$\therefore (\text{C.O.P})_E = \frac{W_E}{Q_1} = \frac{Q_1 - Q_2}{Q_1}$$

In the Refrigerator, it extracts heat (Q_2) from cold body, and delivers it to a hot body. Work is required to be done.

$$\therefore W_R = Q_1 - Q_2$$

$$\therefore (\text{C.O.P})_R = \frac{Q_2}{W_R} = \frac{Q_2}{Q_1 - Q_2}$$

In heat pump, the cycle of operations of heat pump is same as the cycle of operations of refrigerators. But the main difference is their operating temperature.

$$\therefore W_p = Q_1 - Q_2$$

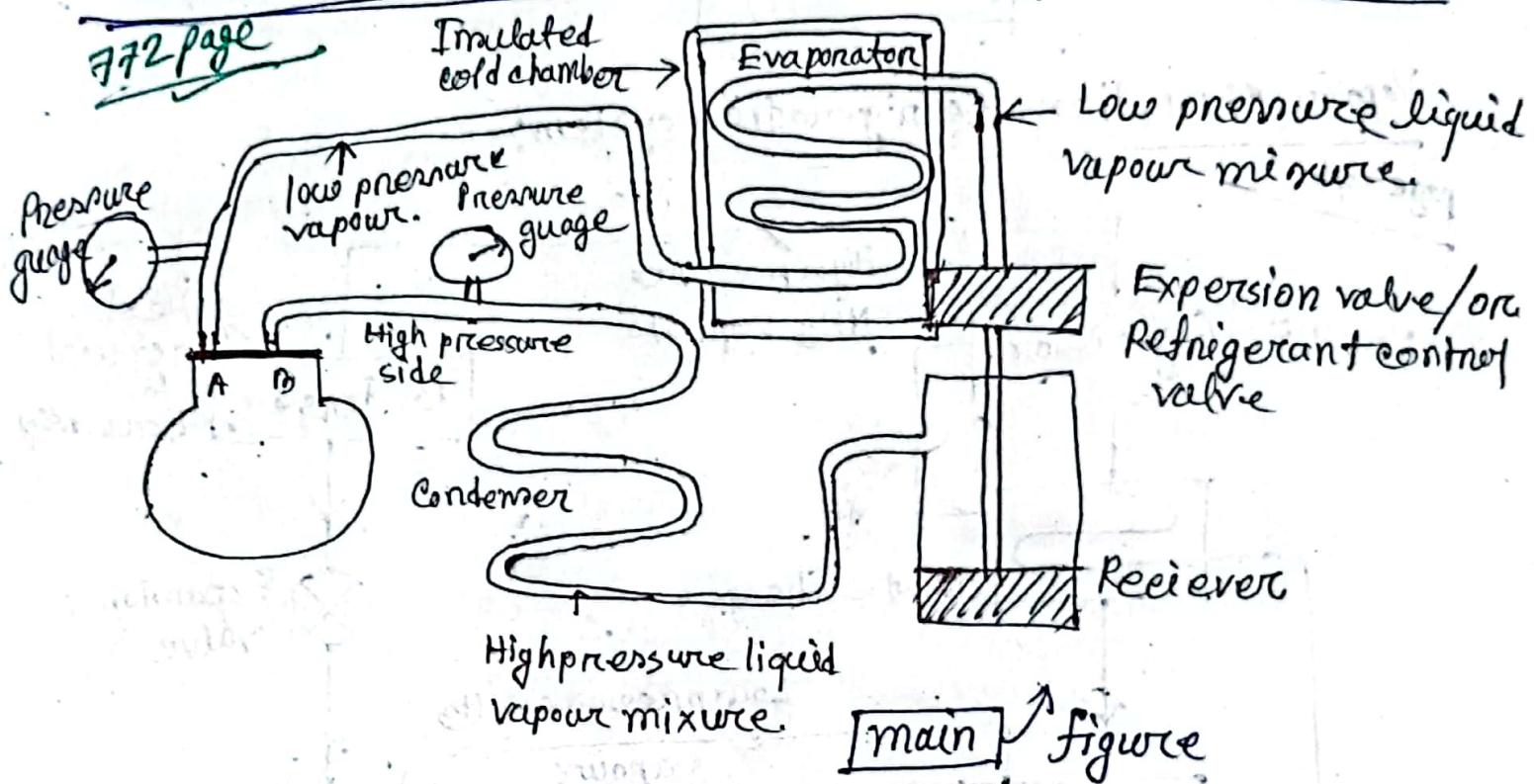
$$\therefore (\text{C.O.P})_P = \frac{Q_1}{W_p} = \frac{Q_1}{Q_1 - Q_2} = \frac{Q_2}{Q_1 - Q_2} + 1$$

[Heat pump operates between T_i and T_o] \rightarrow Hot body temp

$$W_p = W_R + 1$$

Mechanism of vapour compression Refrigeration system:-

772 page



1. Compressor.
2. Condenser
3. Receiver
4. Expansion valve
5. Evaporator

} Chapter (35 + 36)

Quiz → chapter reading
(3 + 26 + 35 + 36)

HW

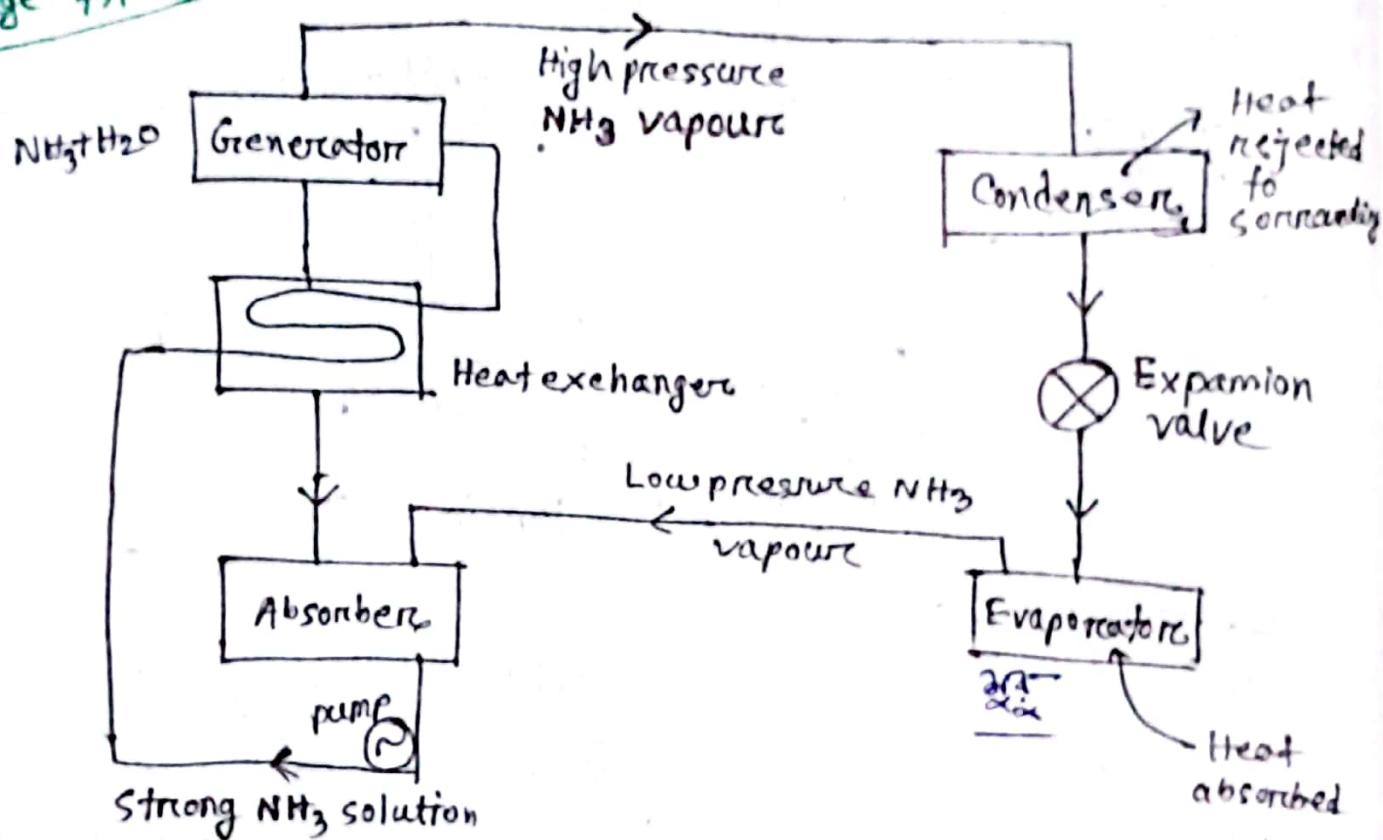
Ideal properties of Refrigerant

page - 793

19th class (offline)
(21-01-2024)

Vapour Absorption refrigeration system:-

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1. Absorption in an Absorber:-

The refrigerant NH_3 vapours from the evaporator enter the absorber and get absorbed in the weak solution of refrigerants ($\text{NH}_3 + \text{H}_2\text{O}$) and prepared strong solution.

→ The strong solution is pumped at high pressure by the pump.

2. Regeneration: In generator, the strong solution at high pressure is heated to evolve more than 80% of refrigerant vapours from the solution. Then vapours are sent to the condenser.

→ The weak solution in the generator is returned to the absorber.

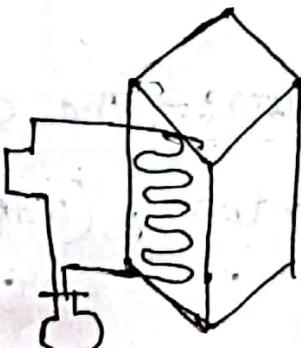
3. Condenser of refrigerant vapours:- The condenser removes the heat from the vapour (NH_3) with the help of a cooling medium.

→ The refrigerants changes its form from vapour to saturated liquid.

4. Expansion of the refrigerant by expansion valve and converted into low pressure.

*** 5. Evaporation of Refrigerants:-

- In the evaporators, the refrigerant absorbs the heat coming from the enclosed space (to be closed)
- The liquid Refrigerants gets completely converted into the Refrigerants vapours.
- The cycle continues and provide cooling



Ref.

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H.W: Vapour compression and vapour absorption ^(vs) Refrigeration system

Difference between ↗

Page - 794

Commonly used Refrigerants:

- NH_3
- CO_2
- SO_2
- Freon-12

CT-03 : Sunday (28-01-2024)
(Boiler + Refrigeration)

20th class (offline)
23-01-2024

Mathematical Problems :- CT(03) → For

Refrigeration: (35.1 ~ 35.10) → Page - (751-768)

→ 36.10

Boilers: (15.1 ~ 15.6) → Page (346-351)

CT=03
Part

→ (16.1 ~ 16.4) → Page (364-365)

Chapter (38)

CT=04