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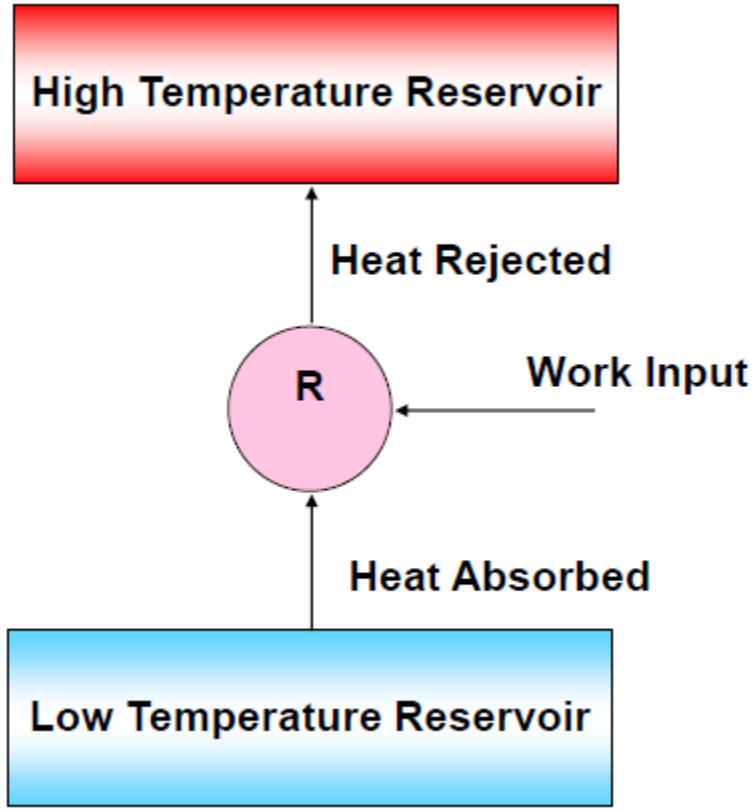
THE SCIENCE OF WOW

Learn about Refrigeration and Air Conditioning

Harinder Singh, Sr. Technical Assistant (HVAC)

Harminderpal Singh, MMS

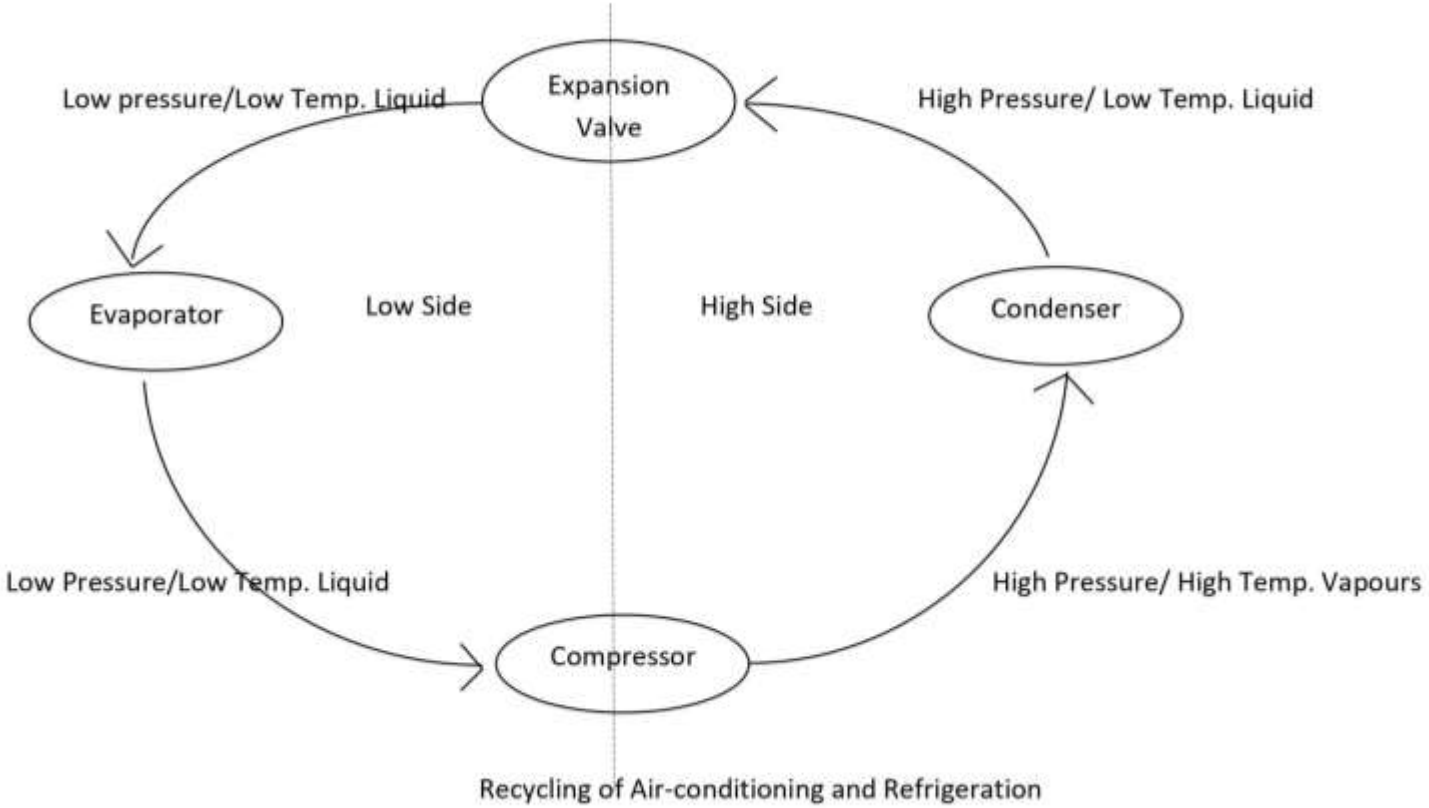
- HVAC is short form – Heat, Ventilation & Air – conditioning
- Modern HVAC System was discovered by Mr. Willis Haviland Carrier in 1902.
- Refrigeration and air conditioning is used to cool products or a building environment.
- As per Science, two type of heat are:
  - Sensible Heat – It is the amount of heat required to raise the temperature of substance without changing its state.
  - Latent Heat – It is the amount of heat required to change the state of body without changing its temperature.



- Refrigeration is based on latent heat.
- It is a evaporation process because “evaporation is cause of cooling”.
- Capacity of Refrigeration is described in “Ton Refrigeration” or “Kilo Calories” as the standard unit
  - Ton refrigeration or simply ton (denoted by TR) is equivalent to the ‘Rate of heat transfer needed to produce 1 ton (2000 lbs) of ice at 32^0F (from water at 32^0F) in 24 hours.
  - An international kilocalorie (IT) per hour (kcal/h) is the metric unit of power
  - 1 Ton refrigeration equals 3023.9491333333 kcal/h

- HVAC is electromechanical System because it comprises of electrical as well as mechanical parts.
- Four major parts of Refrigeration are :
  - Compressor
  - Condenser
  - Expansion Valve
  - Evaporator

Simple Diagram of Refrigeration Cycle:



Compressor

- It is the heart of the air-conditioning and refrigeration system. Compressor recycle the refrigerant in system.
- Compressor suck the refrigerant vapours at low temperature and low pressure from suction line and compresses into high temperature and high pressure vapours towards condition through discharge line.

Condenser

- It receives vapours above their critical pressure and above critical temperature from compressor and bring down the temperature below their critical temperature by transforming heat to air or water.
- In this way, it condenses the gas.

Expansion Valve

- It is also called refrigerant control device.
- It is fixed in liquid line in between condenser and evaporator.
- Its function is to reduce the high pressure liquid refrigerant into low pressure liquid refrigerant and to supply liquid refrigerant to evaporator in the desired quantity because under reduce pressure refrigerant can evaporate quickly.

Evaporator

- It is the part of refrigeration in which liquid refrigerant evaporates in an enclosed space by absorbing heat of warm material place around it.

How Do HVACs work?

- Air Conditioners use a refrigerant to operate.
- A Refrigerant is a compound which is a fluid or a Gas which can readily absorb heat from the environment and can provide refrigeration (or air conditioning) when combined with other components such as compressors and evaporators
- Refrigerant is kept inside copper coils. It operates as below:
  - Refrigerant absorbs heat from indoor air and changes from a low-pressure gas to a high-pressure liquid.
  - Air conditioning components send the refrigerant outside where a fan blows hot air over the coils and exhausts it to the exterior.
  - The refrigerant then cools down and turns back into a low-pressure gas
  - Another fan located inside the home blows air over the cool coils to distribute the resulting cold air in the room/building.
  - Then the cycle repeats.

Types of Refrigerants

The most common refrigerants used for air conditioning are:

- **Chlorofluorocarbons (CFCs), including R12.** These were used earlier but were found to contribute to the greenhouse gas effect. Production of new stocks was stopped in 1994.
- **Hydrochlorofluorocarbons (HCFCs), including R22.** Slightly less damaging to the ozone layer than R12, but is being phased to prevent Climate Change.
- **Hydrofluorocarbons (HFCs), including R410A and R134.** With no chlorine in the mix, this is safer for the environment and is now being used in place of R22. Air conditioners that run on R410A are more efficient, offer better air quality, increase comfort and improve reliability.

AC Star Rating

- The star rating is provided by Bureau of Energy Efficiency on the product for the customer awareness.
- The cooling efficiency of 5 star AC is more than that of less star rated AC's and also energy consumption is less of 5 star AC, if compared to less star rated AC.
- AC's are available in 1 Star, 2 Star, 3 Star, 4 Star and 5 Star and the cost of AC depends upon its star rating.

Inverter AC

- The latest and most efficient technology available in market today is Inverter AC.
- It can save 30-50% of electricity of a regular air-conditioner.
- It is observed that compressor of regular AC's is either off or on. When it get on, it works at its full capacity and when thermostat sense the set temperature, the compressor stops whereas fan continues to work and compressor start again and again at full load as per temperature set value.
- Inverter technology works like an accelerator in a car. When compressor needs more power or less power, it gives accordingly. So compressor is always ON but draws less power or more power depending on the temperature of the incoming air and set level of thermostat.
- The speed and power is adjusted appropriately depending upon heat load of room.

Some Interesting Facts about Refrigeration

- Artificial refrigeration began with a Scottish professor William Cullen, who designed a small refrigerating machine in 1755.
- The first U.S. refrigeration patent was filed by a Doctor (Dr. John Gorrie) from Florida, USA. He wanted to keep his fever-stricken patients cool and tried to cool the air with cold water. He created a compression system in the 1840's, but it ended up freezing the water instead of just cooling it.
- He became a pioneer in the invention of artificial manufacture of ice, refrigeration, and air conditioning. He was granted the Patent for mechanical refrigeration in 1851.
- The world's largest refrigerator is a 27-kilometer long cryogenic distribution line on the border between France and Switzerland and is part of the large Hadron Collider.
- A refrigerator is actually more efficient when it is fully loaded

Interesting Facts about Air conditioning

- HVAC systems are a luxury that many of us take for granted.
- Willis Carrier invented the modern air conditioner to help the Sackett-Wilhelms Lithographing and Publishing Company in 1902 to fix their printing problems. Later he founded the Carrier Engineering Corporation.
- The first air-conditioning unit installed in a car was by Packard Motor Company in 1939.
- Air conditioning not only improves comfort and productivity; it also saves lives! Heat-related deaths fell around 80% in the 20th century.
- However, most homes did not have air conditioning until the 1970s. In India and developing countries many homes still do not have ACs.

THANKS