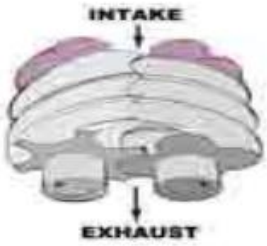
COMPRESSOR AND VACUUM PUMPS – CONTINUED

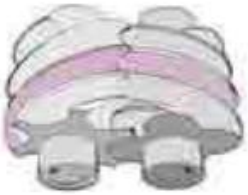
OTHER COMPRESSOR TYPES

- Screw compressor
  - Used in large commercial/industrial applications
  - Uses two matching, tapered gears, and open motor design
- Scroll compressor
  - Uses a matched set or scrolls to achieve compression
  - Becoming more popular for their ability to handle liquid refrigerant without compressor damage
- Centrifugal compressors
  - Used extensively for air conditioning in large structures
- Rotary compressor
  - Used in residential and light commercial applications – primarily in domestic refrigerators

Screw compressor

- Screw compressors use a pair of helical rotors.
- As the rotors rotate they intermesh, alternately exposing and closing off interlobe spaces at the ends of the rotors.
- When an interlobe space at the intake end opens up, refrigerant is sucked into it.
- As the rotors continue to rotate the refrigerant becomes trapped inside the interlobe space and is forced along the length of the rotors.
- The volume of the interlobe space decreases and the refrigerant is compressed.
- The compressed refrigerant exists when the inter lobe space reaches the other end inside a sealed chamber.





Rotary Screw Compressor

Advantages

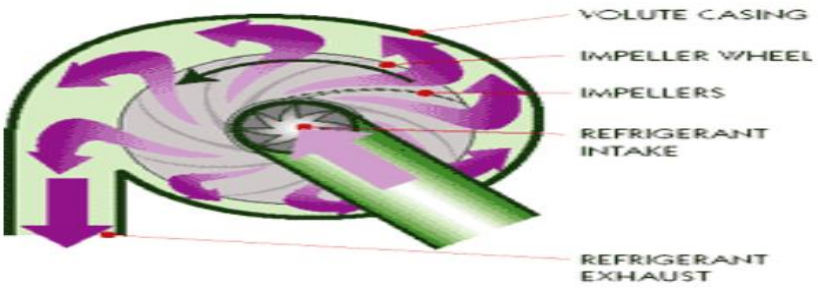
- Simple Design
- Low to Medium initial cost
- Low to Medium maintenance cost
- Two-stage designs provide good efficiency
- Easy to install
- Few moving parts
- Most popular compressor design in plants

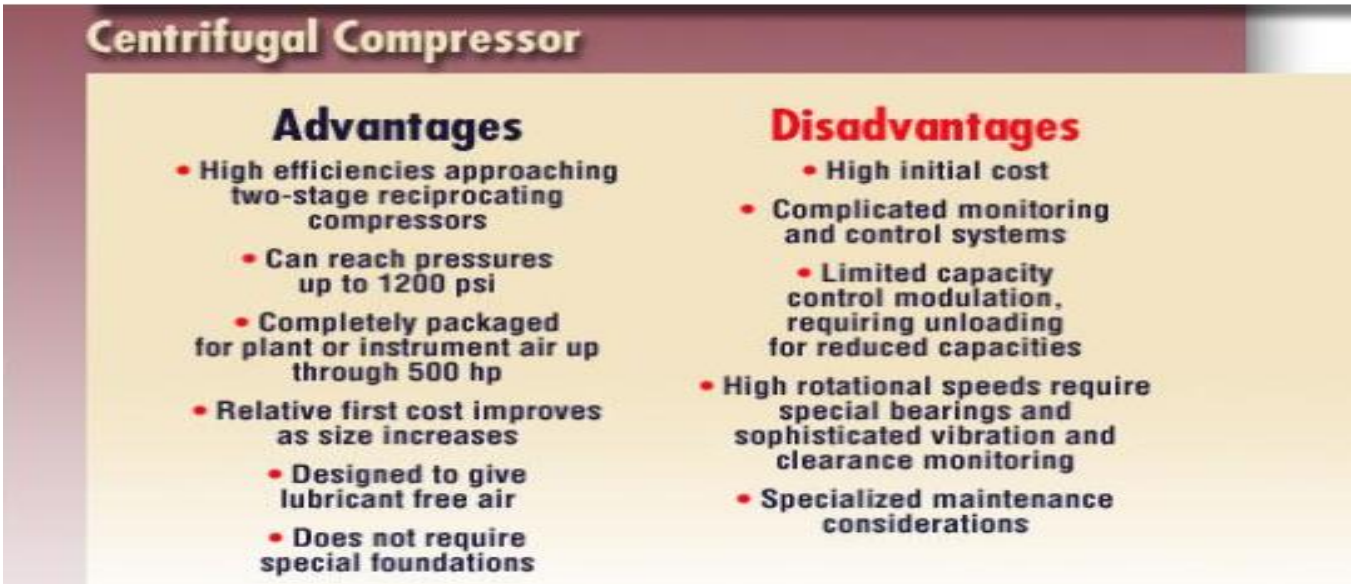
Disadvantages

- Limited airend life
- Airends are not field serviceable
- High rotational speeds
- Shorter life expectancy than other designs
- Oil injected designs have oil carryover
- Single-stage designs have lower efficiency
- Two-stage, oil-free designs have higher initial cost
- Difficulty with dirty environments

CENTRIFUGAL COMPRESSORS

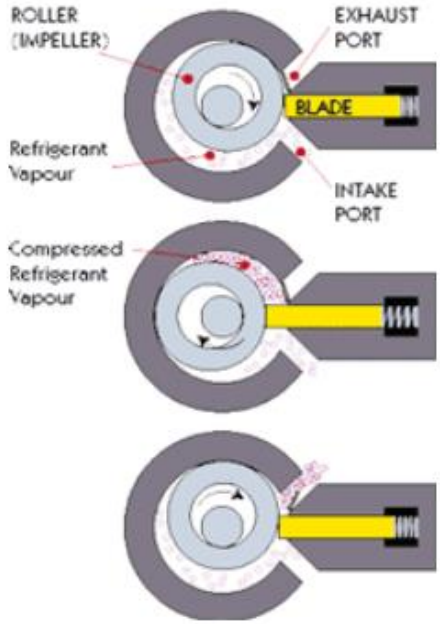
- Centrifugal compressors use the rotating action of an impeller wheel to exert centrifugal force on refrigerant inside a round chamber (volute).
- Refrigerant is sucked into the impeller wheel through a large circular intake and flows between the impellers.
- The impellers force the refrigerant outward, exerting centrifugal force on the refrigerant.
- The refrigerant is pressurized as it is forced against the sides of the volute.
- Centrifugal compressors are well suited to compressing large volumes of refrigerant to relatively low pressures.
- The compressive force generated by an impeller wheel is small, so chillers that use centrifugal compressors usually employ more than one impeller wheel, arranged in series.
- Centrifugal compressors are desirable for their simple design and few moving parts.





ROTARY COMPRESSORS

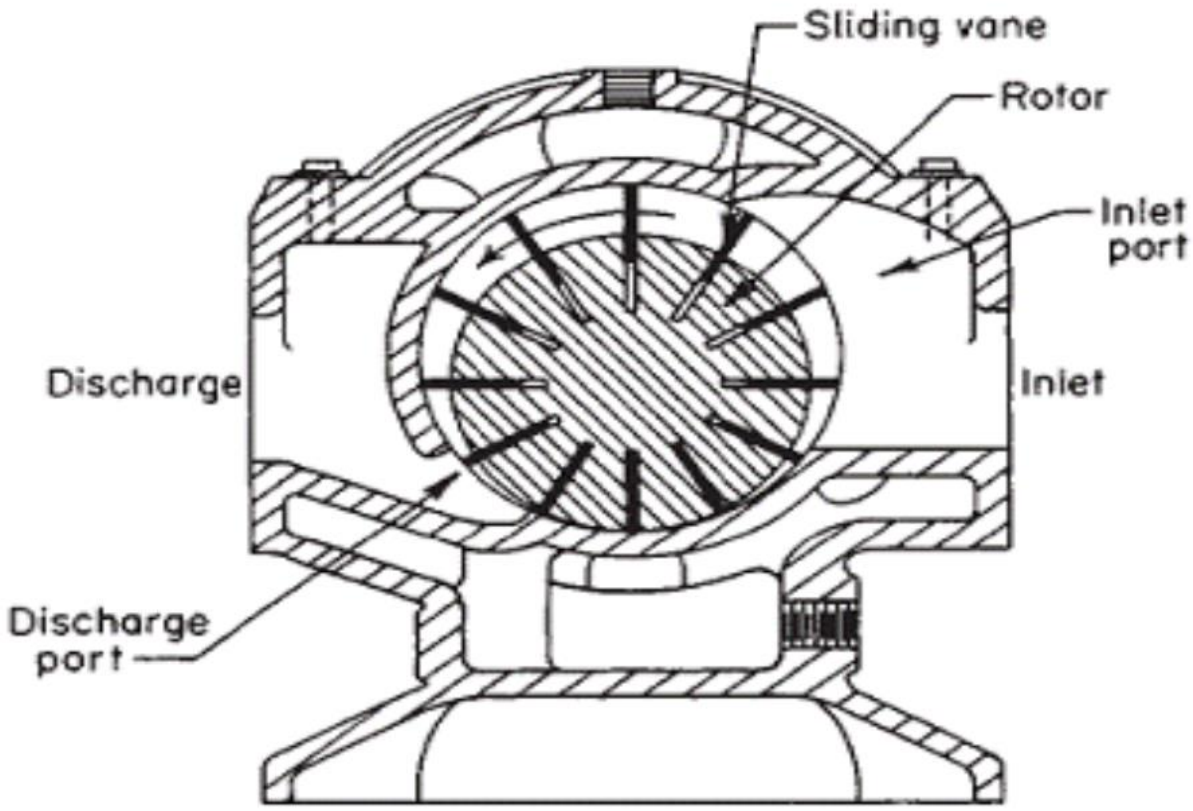
- In a rotary compressor the refrigerant is compressed by the rotating action of a roller inside a cylinder.
- The roller rotates eccentrically (off-centre) around a shaft so that part of the roller is always in contact with the inside wall of the cylinder.
- A spring-mounted blade is always rubbing against the roller.
- The two points of contact create two sealed areas of continuously variable volume inside the cylinder.
- At a certain point in the rotation of the roller, the intake port is exposed and a quantity of refrigerant is sucked into the cylinder, filling one of the sealed areas.
- As the roller continues to rotate the volume of the area the refrigerant occupies is reduced and the refrigerant is compressed.
- When the exhaust valve is exposed, the high-pressure refrigerant forces the exhaust valve to open and the refrigerant is released.
- Rotary compressors are very efficient because the actions of taking in refrigerant and compressing refrigerant occur simultaneously.



- There are three main types of rotary compressors: slide vane, lobe and liquid seal ring, all of which have their own variations and design facets to suit different purposes.

SLIDE VANE ROTARY COMPRESSOR

- The slide vane rotary compressor -- usually referred to as a rotary vane compressor -- is one of the more common rotary compressor designs in non-industrial sectors.
- It functions as air enters through a compartment of the vane housing at a pressurized rate, which drives the mechanism into a rotary movement.
- This causes the vane housing shaft to turn and its individual vanes to slide in or out, while ensuring they are in contact with the cylinder perimeter to create an air-tight seal.
- This tool requires compressed air as its function drive, and is favored more for home or smaller-scale use rather than for industrial needs.
    - As they are best suited to low- to moderate-pressure applications, they are generally long-lasting and durable models.



Rotary Vane Compressor

Advantages

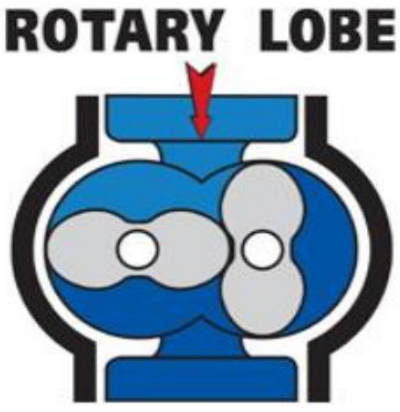
- Simple Design
- Easy to install
- Low to Medium cost
- Low maintenance cost
- Field serviceable airend
- Long life airend
- Low rotational speeds
- Very few moving parts
- Forgiving to dirty environments

Disadvantages

- Oil injected designs have oil carryover
- Single-stage designs have lower efficiency
- Difficulty with high pressures (over 200 psi)
- Oil-free designs are unavailable

ROTARY LOBE COMPRESSOR

- Rotary lobe compressors are suitable for industrial uses.
- The rotary lobe compressor combines two separate lobe design rotors within a single encasement.
- These are gear-driven, non-contact rotors that reduce the cavity size created by the lobes as they rotate.
- This affects the compression of the enclosed vapor, a process which continues until the pressurized vapor is dispersed through the exit portal.
- Rotary lobe compressors are typically used for industrial and municipal purposes, and are also utilized in the chemical and food processing industries.



LIQUID SEAL RING COMPRESSOR

- The liquid seal ring compressor is a vane compressor design that disperses fluid from an inclined and open impeller.
- While the impeller rotates, centrifugal force causes the liquid to gather at the outer edge of the cavity and form an air-tight seal.
- This compressor operates free of dust and oil, and is one of least cost-effective rotary compressors to operate and maintain.
- Liquid seal ring compressors can be single or multi-stage systems, depending on the application required.
- Typically, this type of compressor is utilized in specialized processes and for work involving corrosive and dangerous gases, and is a common feature in nuclear power plant operations.