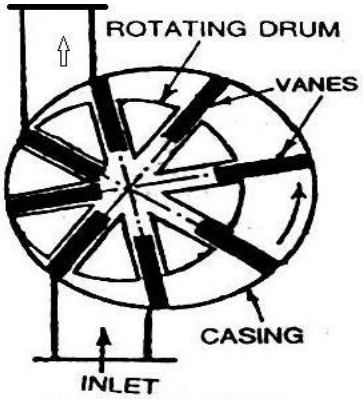
delivery area.

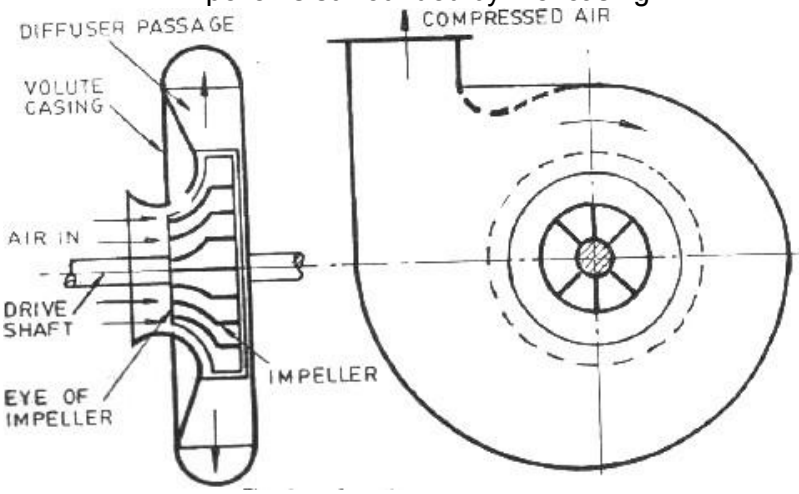


Working: When the rotor is rotated by the prime mover, air is entrapped between two consecutive vanes. This air is gradually compressed due to decreasing volume between the rotor and the outer casing. This air is delivered to the receiver. This partly compressed air is further increased in pressure due to the back flow of high pressure air from the receiver.
Advantages: 1. Very simple and compact, 2. High efficiency 3. Higher speeds are possible

Fig: 2.12 Vane blower

2.18.3 Centrifugal compressor

Construction: It consists of an impeller, a casing and a diffuser. The impeller consists of a number of blades or vanes, is mounted on the compressor shaft inside the casing. The impeller is surrounded by the casing.



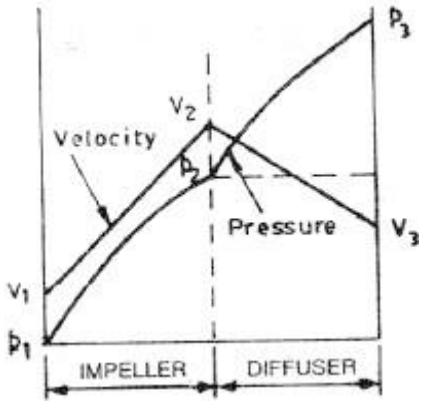


Fig: 2.13 Centrifugal compressor **Fig: 2.14 Pressure – velocity Plot**

Working: In this compressor air enters axially and leaves radially. When the impeller rotates, air enters axially through the eye of the impeller with a low velocity. This air moves over the impeller vanes. Then, it flows radially outwards from the impeller. The velocity and pressure increases in the impeller. The air then enters the diverging passage known as diffuser. In the diffuser, kinetic energy is converted into pressure energy and the pressure of the air further increases. It is shown in fig:4.14. Finally, high pressure air is delivered to the receiver. Generally half of the total pressure rise takes place in the impeller and the other half in the diffuser.
Applications: Centrifugal compressors are used for low pressure units such as for refrigeration, supercharging of internal combustion engines, etc.

2.18.4 Axial flow compressor

In this air compressor, air enters and leaves axially.
Construction: It consists of two sets of blades: Rotor blades and stator blades. The blades are so arranged that the unit consists of adjacent rows of rotor blades and stator blades as shown in fig:4.15. The stator blades are fixed to the casing. The rotor blades are fixed on the rotating drum. The drum is rotated by a prime mover through a driving shaft. Single stage compressor consists of a row of rotor blades followed by a row of stator blades. Compression of air takes place in each pair of blades (one rotor blade and one stator blade). Hence there are many stages of compression in this type of compressor.
Working: When the switch is switched on, the prime mover rotates the drum. Air enters through the compressor inlet and passes through the rotor and stator blades. While passing through the blades, the air is compressed between the blades. The air is also compressed between the casing and the blades. The air

flow passage area is gradually reduced from the inlet to the outlet of the compressor. This increases the pressure of the air considerably. Finally, high pressure air is delivered to the receiver.

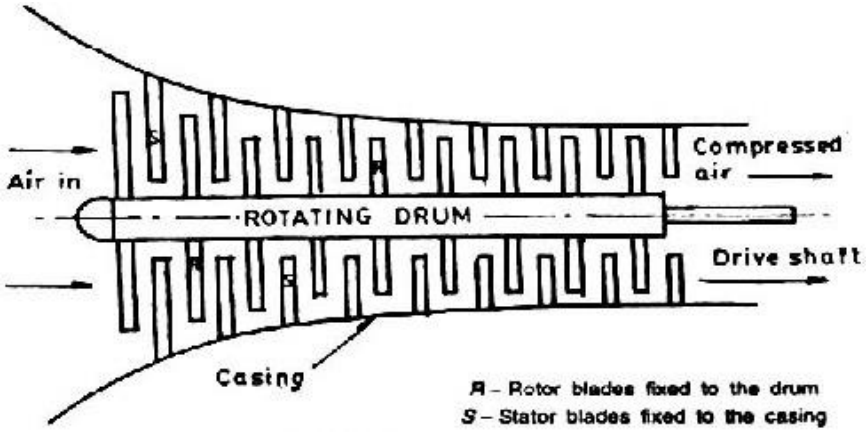


Fig:2.15 Axial flow compressor

Applications:
1. They are widely used in high pressure units such as industrial and marine gas turbine plants,
2. They are most suitable for aircraft work (Jet propulsion) since they require less frontal area.

2.19 Comparison of Reciprocating and Rotary compressors

Reciprocating compressors	Rotary compressors
1. It is suitable for low rates of flow. Flow rate is limited to m³/s	It is suitable for large rates of flow. Flow rate can be as large as 50 m³/s.
2. It is used for high pressure rise. It can compress fluids up to 1000 bar.	It is used for medium pressure rise. The pressure rise is limited to 10 bar.
3. It cannot be coupled to turbines or I.C. engines.	It can be directly coupled to turbines or high speed internal combustion engines due to their higher speeds.
4. The flow of air is intermittent.	It gives uniform delivery of air.
5. The criterion of thermodynamic efficiency is isentropic.	The criterion of thermodynamic efficiency is isothermal.
6. Due to sliding parts it requires more lubrication.	No sliding parts. Hence needs lesser lubrication. It gives clean supply of air.
7. Maintenance cost is high because of large number of reciprocating parts.	Maintenance cost is less.
8. Complicated construction. It has more number of parts.	Simple in construction. It has less number of parts.
9. Torque is not uniform.	Uniform torque.

2.20 Free Air Delivery(FAD): It is the volume of air drawn into a compressor from the atmosphere. After compression and cooling the air is returned to the original temperature but it is at a higher pressure. Suppose atmospheric conditions are p_a ,T_a and V_a (the FAD) and the compressed conditions are p, V and T.

Applying the gas law we have

$$\frac{pV}{T} = \frac{p_a V_a}{T_a}$$

$$V_a = \frac{pVT_a}{Tp_a} = F.A.D.$$