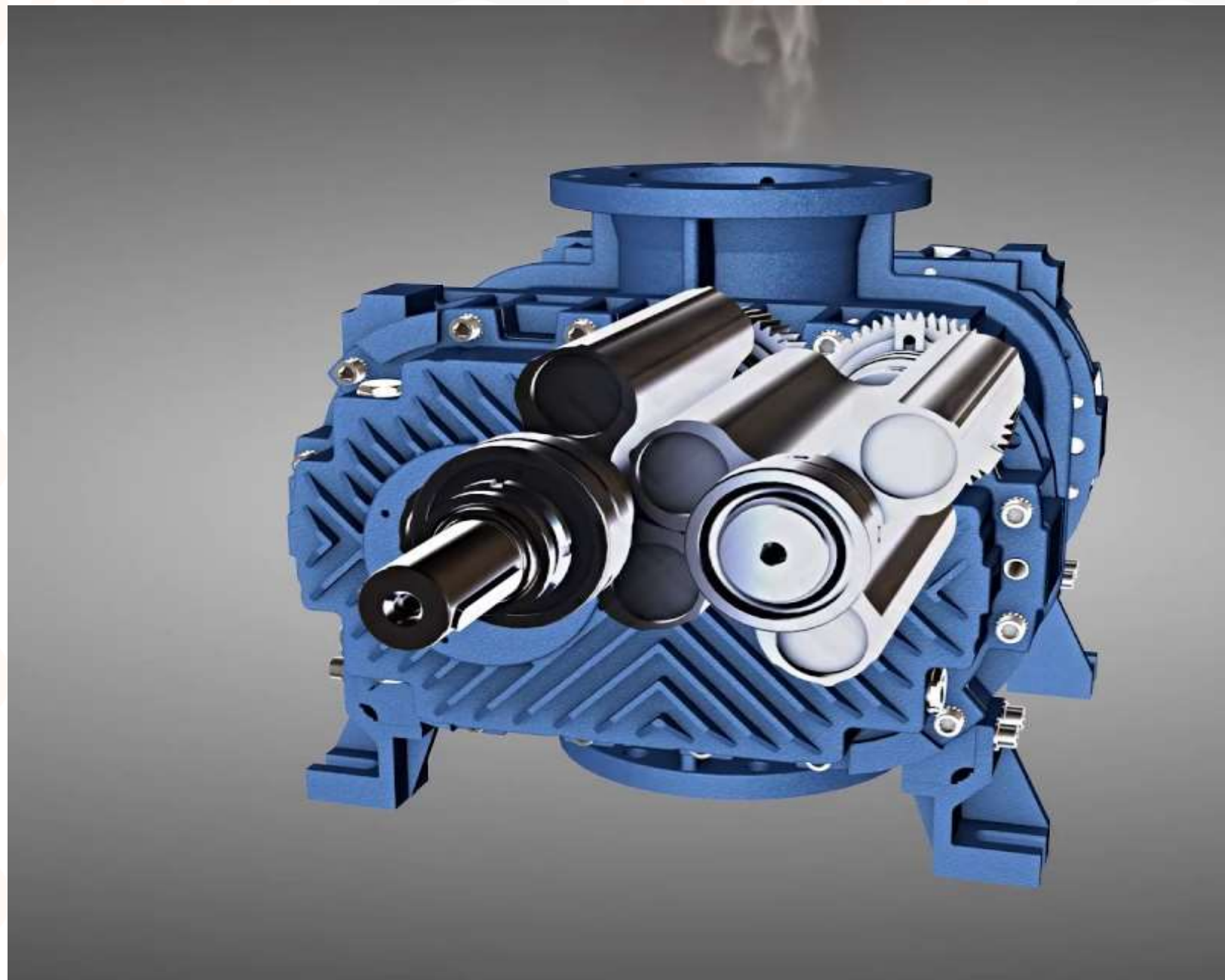


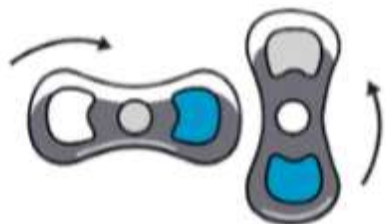
Root blower: Performance & Efficiency



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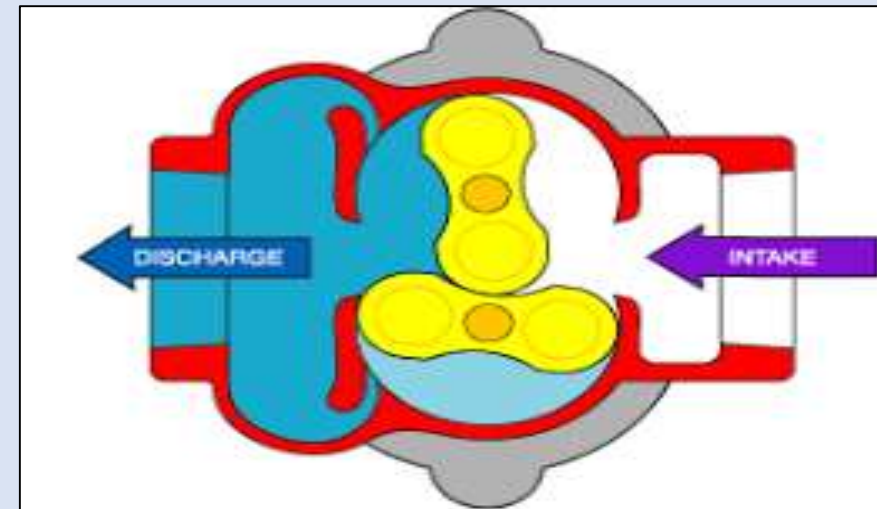
1. INTRODUCTION

1. The “Roots,” lobe-style blower is a type of positive displacement (PD) blower, the latter of which was invented in the late 1850s by the Roots brothers.
2. The Roots-type blower is a positive displacement lobe pump that operates by pumping a fluid with a pair of meshing lobes resembling a set of stretched gears.
3. Fluid is trapped in pockets surrounding the lobes and carried from the intake side to the exhaust.
4. Roots blowers are used to generate constant airflows that are independent of discharge pressure conditions. Root blower applications are limited to low and medium pressure and vacuum processes and can be used to provide small to large airflow rates.

A Roots blower with two-lobed rotors is quite common. Most real Roots blowers' rotors have three or four lobes.

Key terms:

1. Rotary vane
2. Pump body
3. Rotary vane
4. Intake
5. Pumping
6. Forced air or air-fuel mixture into the intake manifold



Root blower has the following advantages:

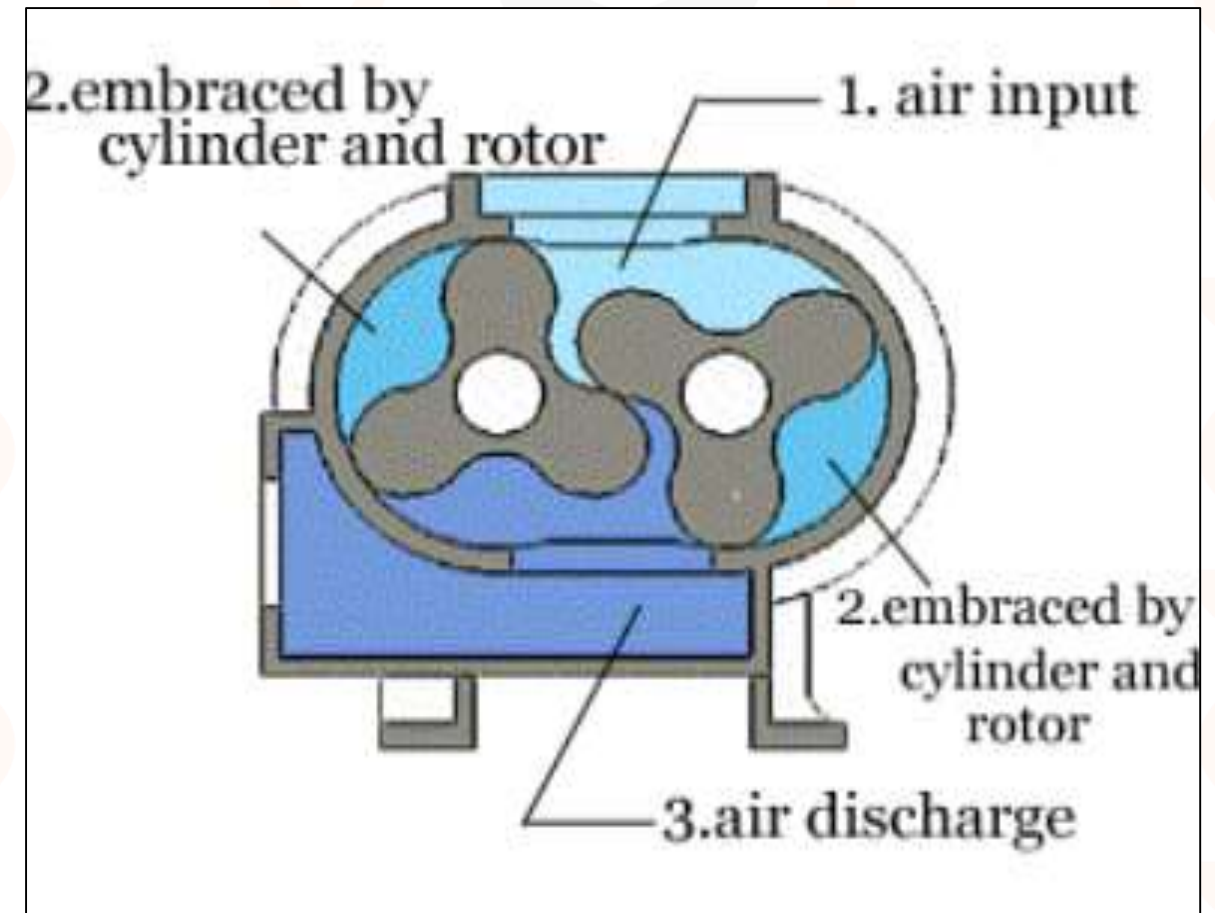
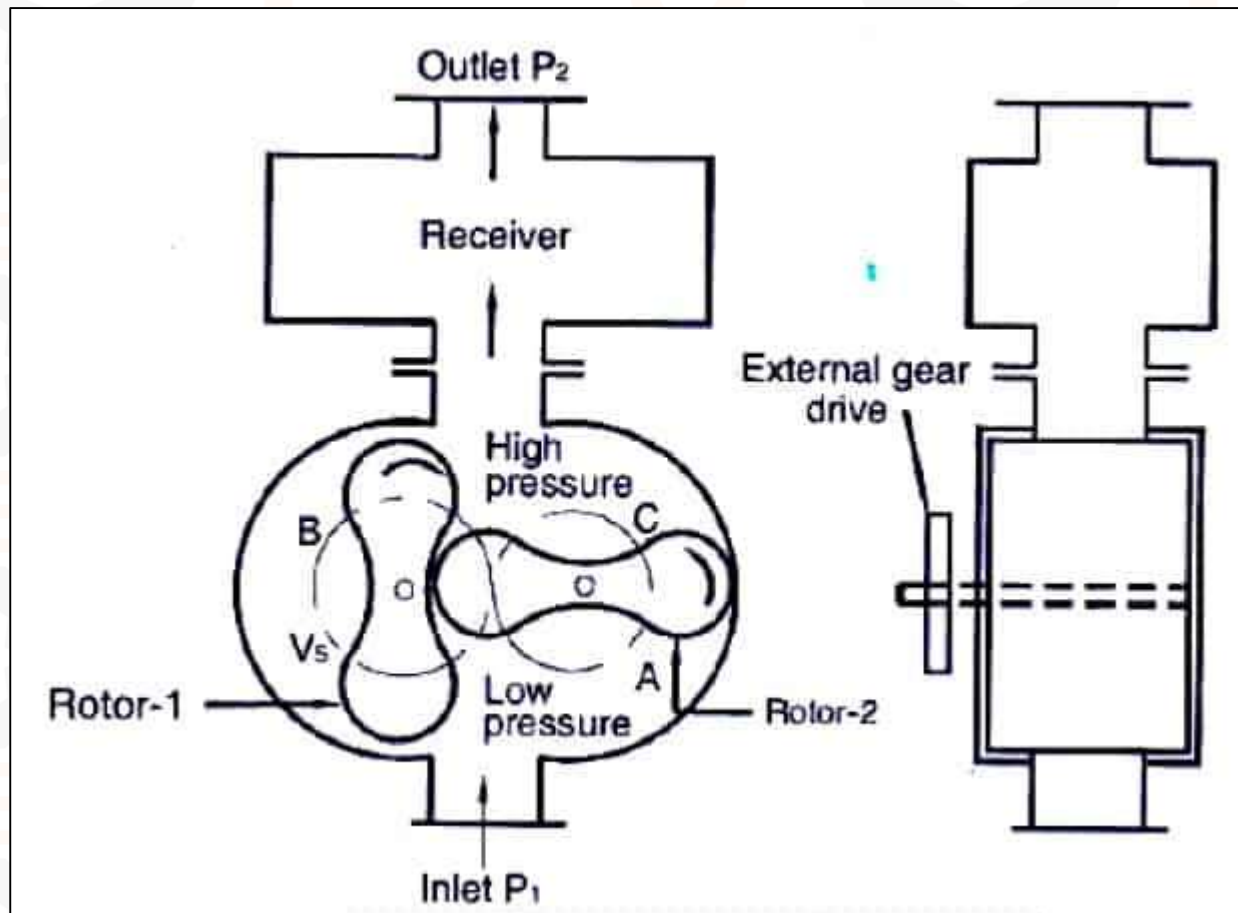
- 1) It has only two moving parts (i.e two rotors) which are identical in shape and size.
- 2) Its operation is entirely rotary.
- 3) As the rotors are symmetric about their center of rotation, the operation is dynamically balanced.
- 4) Discharge of the compressed gas is complete and there is no clearance volume.

2. Working principle of root blower

- The three-lobe rotor consist of a pair of involute-shaped lobes/rotors rotating inside an oval-shaped casing, closed at ends by side plates. One end is a driving lobe which is driven by the external power source. These two rotors rotate one opposite to the other, their movement is synchronized by a set of timing gears.
- The geometric configuration of the lobes allows them to have, at any moment, a generatrix in common; due to very low machine tolerance, this common generatrix acts also as a sealing device for both rotors.

2. Working principle of root blower

- During the operation, One or two lobes of each rotor encounter with the internal surface of the casing, this creates a chamber in which the gas is trapped. As the rotation continues, the trapped gas moves along until it reaches the position of discharging port.
- The two rotors make six intake and exhaust cycles per revolution, therefore the capacity of the roots blower is determined by its operating speed and increases proportionally with the speed, but it is independent of the pressure differential between the inlet and outlet ports



Schematic representation of Root blower with two-lobe rotor

3. The efficiency of Roots blower

Roots efficiency is defined as the ratio of isentropic work done to actual work done and it is given by,

$$\eta_{Root} = \frac{\frac{C_p}{R} \left[(r_p)^{\frac{\gamma-1}{\gamma}} - 1 \right]}{r_p - 1}$$

This equation shows that the efficiency of the root decreases with the increase in pressure ratio.

Consideration when selecting a Root Blower

1) Usage and Use Conditions

Specify usage, location, and running conditions such as continuous or intermittent.

2) Air-Capacity

Specify the required air-capacity based on the standard conditions (1 Atm., 20° C, relative humidity 65%) or on the referential conditions.

3) Pressure

Always specify whether the pressure is constant or variant. In the variant case, please specify the corresponding relationship between the air capacity and pressure, such as air-capacity increases when the pressure decreases, and vice versa.

One should check the range of variation and specify whether the pressure specified is the static pressure at the outlet or the differential pressure between the inlet and outlet.

4) Type and Specific Weight of the Gas Transported

- Gas type and its ingredients
- Portion and size of other ingredients
- The Specific weight
- Chemical characteristics
- Suggested materials
- Whether the gas is explosive or toxic

Ordinary air shall be used if none of the above items is provided.

5) Temperature of the Gas

The standard Trun-Dean Blower is for transporting a gas of normal inlet temperature. If the inlet temperature is high, the rotor of the blower may seize due to thermal expansion.

6) Electric Motor

For a motor-driven unit, One should know the voltage, frequency, phase, etc. of your electricity

Application

- Roots blowers are used to aeration to intake raw water, sewage and industrial organic waste. The aeration drives the digestion of the waste by microorganisms. Roots blowers are also used for grit tank cleaning, filter flushing, backwashing and the recovery of gases. Oil-free roots blowers are used for deep cell aeration.

They are commonly used in :

- Wastewater treatment plants
- Electroplating tanks
- Activated sludge systems.
- Drying systems.

Conclusion

1. A Roots blower is a mechanical device for moving air or other gases. As the flow process is highly complex in roots blower operation, it is necessary to analyse efficiency of lobes and develop the geometry of roots and casing to reduce the flow loss significantly
2. A roots blower performance depends on quality of air intake and geometry used. The quality of air has a major impact on the lobe arrangement and effect on temperature increase, reduced thickness of lobes and impact on performance of roots blower.
3. Roots blower is used to control the room conditions like temperature, moisture control, mist and transfer low volume intake into the system, increase the power efficiency of the engine. It is reliable, economical and having low maintenance cost.

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