Instrumental Tech

TURBOMOLECULAR PUMP (TMP)

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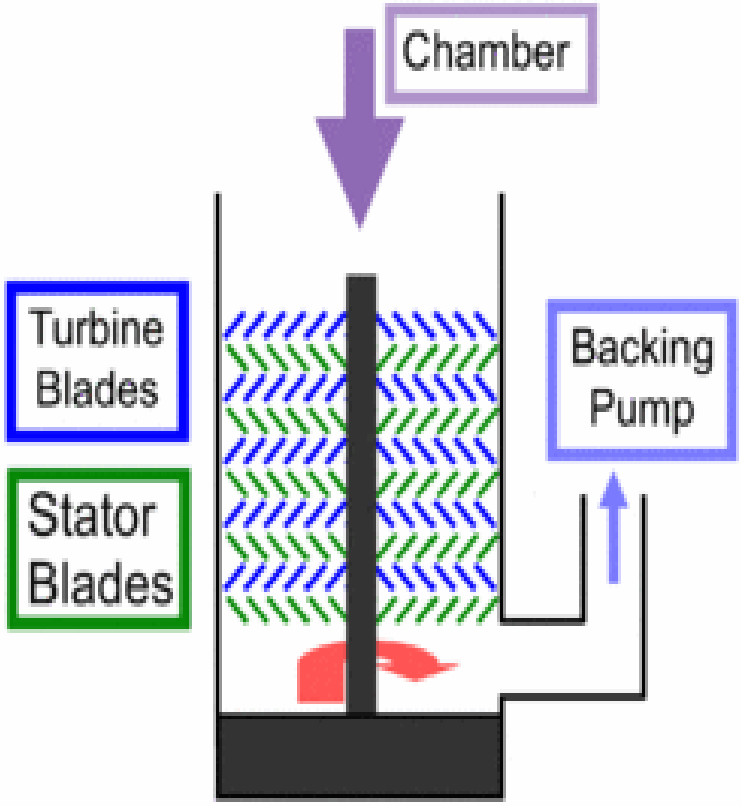
INTRODUCTION

- Turbomolecular pump is a vacuum pump.
- It is used to obtain or maintain high vacuum.
- The design is based on axial flow compressor mechanism.
- Prof. A. Shapiro of MIT first provided the theoretical model.
- In 1958 it was first appeared in the high vacuum industry.
- Hybrid and compound pumps appeared around 1985.

OPERATING PRINCIPLE

Interior view of a turbomolecular pump

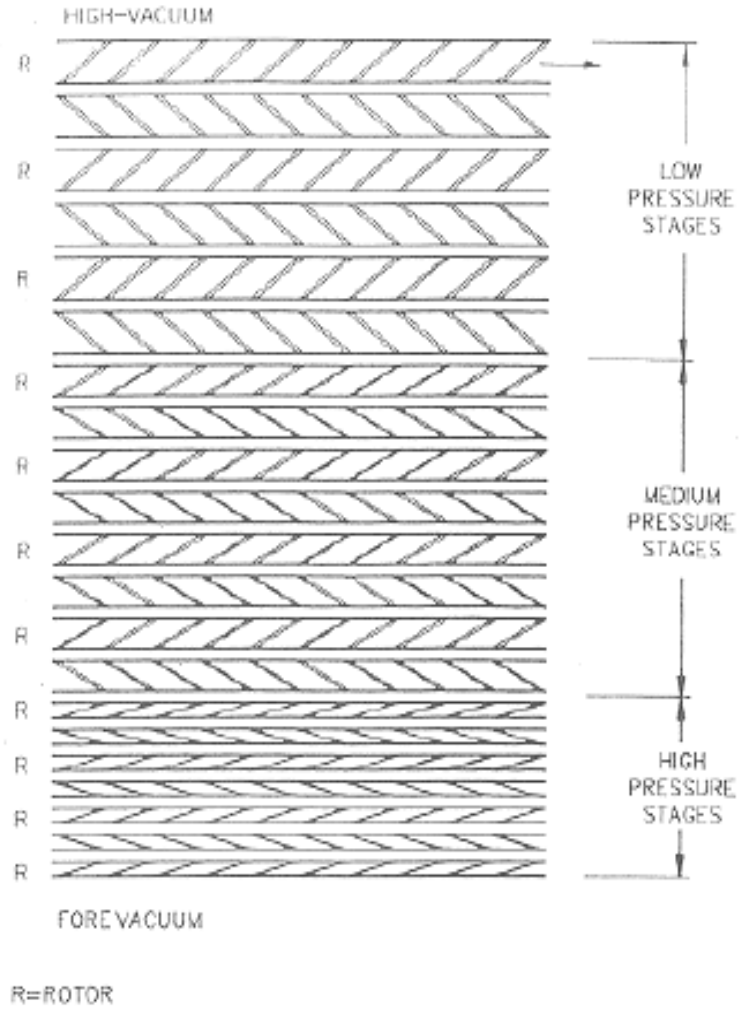
It is considered as a momentum transfer dev
accelerate gas molecules in downstream dire
For this the rotor speed should be comparabl
thermal velocity of gas molecules.



Schematic of a turbomolecular pu

ttp://en.wikipedia.org/wiki/Turbomolecular_pump

CHOICE OF ROTOR AND STATOR FOR IMPROVED PE



To obtain a maximum pumping speed, th blades should have less inclination.

But to produce the highest possible comp ratio, the blade inclination should be high

At the entrance to the pump, the blade a should be small, and they should increas later stages.

The most efficient design would require c in all blade design parameters for each ro and stator.

But for practical reasons, blade heights a angles are usually changed only once or

Typical assembly of rotors and stators for conventional pumps

Ref. Hablanian, M. H. *High-vacuum Technology : A Practical Guide Mechanical Engineering*, 2nd ed; CRC Press, 1997

ADVANTAGES

Creates ultra high vacuum (up to 10^{-10} torr depending on size)

Pumps with magnetic bearings and pumps with grease-lubricated, ceramic ba
be mounted on the vacuum chamber at any angle.

Small and medium-sized turbo pumps can attain operating speed (1000 Hz) i
When properly vented they can also be stopped in a few minutes.

Turbo pumps operate at rather low voltages. The high rotational speed is obt
high-frequency motors. Currents are also low because motor power requirem
comparatively low.

The lower power requirement for unit mass flow rate produce a lower operati

Corrosive gases can be handled with special design and care.

DISADVANTAGES

Requires backing vacuum to work properly. Average mean free path of air in a pressure is 70 nm. Turbomolecular blades cannot be built with anything close small clearance.

Compression ratios for lighter gas like hydrogen and helium is very small. The pumped out easily.

Bearing has to be greased in every 6 months and changed in every 2-3 years

Rotor balance has to be maintained perfectly.

It has to be vented properly to avoid damage.

Considering the precision machining and balancing requirements, high-precis high-speed bearings, and relatively high stresses developed in the rotor; turb requires high initial cost.

THANK YOU