Steam Turbine

ME 267

Fundamentals of Mechanical Engineering

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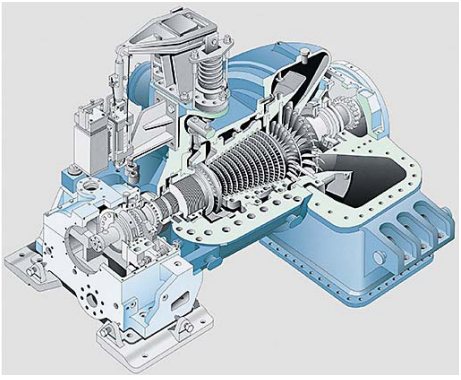
STEAM TURBINE

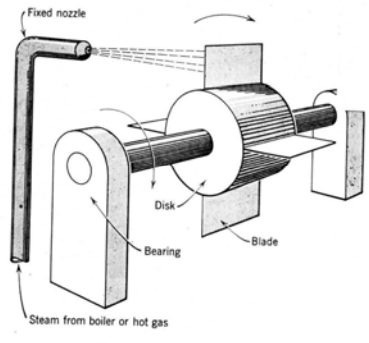


Steam Turbine

- A steam turbine is prime mover which uses steam as its working fluid
- It operates by performing two functions :
  - a part or whole of the pressure energy of steam is transformed into kinetic energy by means of expansion through suitable passages such as nozzles
  - the kinetic energy and the remaining portion of the pressure energy of steam, if any, are converted into mechanical work with the help of moving blades fitted on the wheel

Steam Turbine

- Steam turbines are steady flow devices where steam enters through nozzles, expands to lower pressure and in doing so develops high velocity i.e. high kinetic energy. Part of this kinetic energy of the jet can be used in the same manner as water jet is used in water wheel. This kind of turbine is called impulse turbine.



A simple impulse turbine.

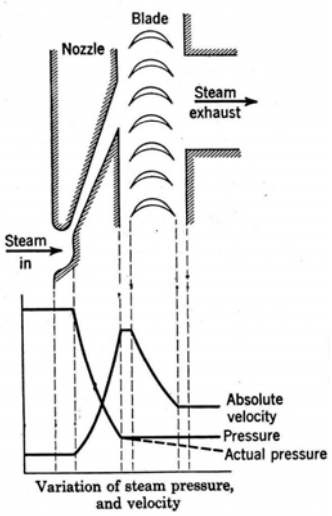
Nozzle

- A nozzle is a steady flow device and is nothing but a passage of varying cross section for the flow of steam in order to increase its velocity by expansion with decrease of pressure.
- Its main function is to convert the available enthalpy into kinetic energy by producing a jet of steam at a high velocity.
- The section of a nozzle may be round, square, or rectangular. They are used in impulse turbines and fitted with the casing or with diaphragms.
- From Continuity Equation

$$\rho A v = Const$$

Impulse Turbine

- In an impulse turbine, the steam taken from the boiler first comes to the steam chest and then it passes through nozzles and impacts on the moving blades.
- Due to the impulse of steam over the moving blades, the wheel rotates and so the power is available from the shaft**.**
- As the steam expands through the nozzle, the velocity and the volume of steam are increased with decrease in pressure

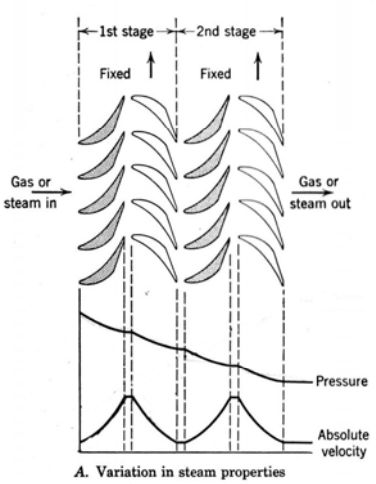


Variation of steam pressure, and velocity

Steam Turbine

Reaction Turbine

- Constructed of rows of fixed and moving blades
- Moving blades move as a result of change of momentum of steam and also as a result of expansion.
- In the reaction turbine, fixed rotor blades themselves are arranged to form convergent nozzles. This type of turbine makes use of the reaction force produced as the steam accelerates through the nozzles formed by the rotor.



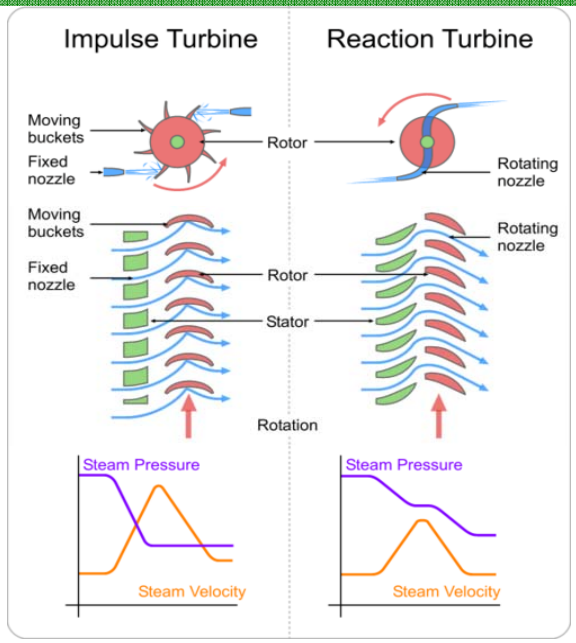
A. Variation in steam properties

Steam Turbine

Reaction Turbine

- Steam is directed onto the rotor by the fixed vanes of the stator. It leaves the stator as a jet that fills the entire circumference of the rotor.
- The steam then changes direction and increases its speed relative to the speed of the blades. A pressure drop occurs across both the stator and the rotor, with steam accelerating through the stator and decelerating through the rotor, with no net change in steam velocity across the stage but with a decrease in both pressure and temperature, reflecting the work performed in the driving of the rotor.

Steam Turbine



Steam Turbine

Difference between Impulse Turbine and Reaction of turbine

Steam Turbine

That's all about today