

Q.1 Explain the following terms:

Ans Nozzle efficiency: It is defined as the ratio of the Actual enthalpy drop to the isentropic enthalpy drop b/w the same pre.

$$\text{Nozzle efficiency} = \eta = \frac{\text{Actual enthalpy drop} = h_1 - h_f}{\text{Isentropic enthalpy drop} = h_1 - h_s}$$

When steam at entry to nozzle is dry saturated =

$$= \frac{h_0 - h_r}{h_0 - h_s}$$

Q.2 Explain the essential diff. in the fun. of moving blades in impulse and reaction turbine.

Ans Impulse turbine

1. The steam completely expands in the nozzle and its pre. remains const. while passing through the blade passage.
2. The relative velocity of steam remain const. while passing over moving blades.
3. The shape of blade is of Profile type.
4. The blade passage is of const. cross-sectional area as there is no expansion.
5. The blade speed & steam speed are large due to large pre. drop.
6. Less space is needed per unit power.
7. They are suitable for small power.

Reaction turbine

1. The steam expands partially in the fixed blades & further expansion takes place in the moving blades.
2. The relative velocity of steam increase as it expands while passing over the moving blades.
3. The shape of blades is of airfoil type.
4. The blade passage is of variable cross sectional area to allow expansion.
5. The blade speed & steam speed are small due to small pre. drop.
6. more space is needed per unit power.
7. They are suitable for medium & high power.

Q.3 Define vacuum efficiency & condenser efficiency. Discuss the factor on which these are depends.

Ans vacuum efficiency \Rightarrow This is the ratio of the actual vacuum at perfect condensing plant. It means there should be no air present in the condenser & the pre. in it should be that due to exhaust steam alone at inlet to the condenser corresponding to the saturation temp. of steam.

$$\text{vacuum efficiency} = \frac{\text{Actual vacuum}}{\text{max. obtainable vacuum}}$$

Vacuum efficiency would be 100% if there is no air present in condenser.

* Condenser efficiency \Rightarrow It states that as the ratio of the diff. b/w the outlet & inlet temp. of the cooling water.

$$\text{Condenser efficiency} = \frac{\text{Rise in temp. of cooling water}}{\text{Temp. corres. to vacuum} - \text{inlet temp. of cooling water}}$$

in the condenser.

Q.4 Velocity compounding: There are a no. of moving blades separated by ring of fixed blades keyed in slots on a common shaft. The steam from the boiler is passed through

nozzle where it expands to condense pressure, it acquires very high velocity. This high velocity steam then passes through a no. of moving & fixed blades rings. Since there is no fall in pressure, the steam flows over the moving blades.



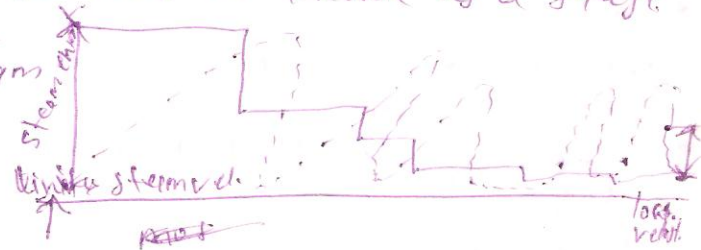
* Advantages:- Relatively few no. of stages & hence less initial cost
 - requires less space.

- The system is reliable & easy to start.

* Disadvantages:- This friction loss is high due to high velocity.
 - The η is also low due to the fact that the ratio of blade velocity to steam velocity is not optimum for all wheels.

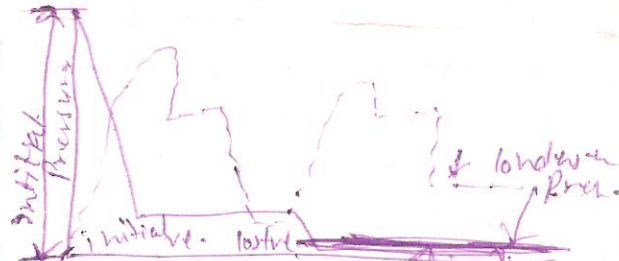
* Pressure compounding:- In this case rings of fixed nozzles are interspersed between the rings of moving blades which are keyed to the shaft in series. The steam from boiler is passed through the first ring of nozzle where it expands partially. The velocity is absorbed. Each pressure drop as already discussed is known as a stage.

This is most efficient type of turbine because the ratio of blade velocity to steam velocity remains constant, but has the disadvantages of large no. of stages and hence it is most expensive.



Pressure velocity compounding:- It is a combination of two methods. The total drop in steam pressure is carried out in two stages & the velocity obtained in each stage is also compounded.

Turbine method of compounding may be said to combine many of the advantages of both pressure and velocity staging. By allowing a bigger pressure drop in each stage, less no. of stages are necessary and hence a shorter turbine will be obtained for a given pressure drop. This method of pressure velocity compounding is used in the more & the Curtis turbine.



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Q.7 The principle advantages of jet condensers are its simplicity of design & lower manufacturing cost, lower upkeep, small floor space required, require less air is required, quantity of circulating water to effect.

The steam condensation

The principle advantages of surface condensers are - The maximum vacuum attained in a surface condenser is 73.5 cm of Hg, therefore it gives the highest thermal efficiency of the plant.

- Less air is carried out to the boiler & auxiliary power required is less than that of jet condensers.

* Limitations of surface condenser:-

- The surface condenser is quite bulky & requires more space.

- Its capital, running & maintenance cost are considerably high.