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# Enhance Performance of Steam Turbine by Alternation in Its Design

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A B S T R A C T

Steam turbine has different section to reduce the losses occurred in the steam expansion. High pressure section is used to absorb maximum amount of steam. While medium and low pressure section are made in various 3 types section division for absorbing steam power.The casing has the key and it is directed in the axial way , this way is directly connected with low pressure side and absorbs maximum amount of thermal energy.

In the theory of water turbine one can concern with pressure of water, but in the steam turbine developer has to consider the thermal energy of steam. The steam with high pressure with low temperature cannot perform best in the section, but high temperature steam gives the maximum efficiency and output so overall consumption of the coal is reduced and the plant can run with better efficiency.

So one should take in mind to maintain the sufficient temperature of the steam to absorb maximum amount of thermal energy from the steam. Also steam turbine has its own advantages compare to the other prime movers. With concern with thermodynamic and Mechanical scope of advantages the steam turbine saves extra consumption of fuel and gives best performance in the concern parameter.

Keywords: Steam turbine, Requirement of quantity of steam, flow of super heated steam, Moisture content ; Super heater, Condensation of steam.

## 1. Introduction.

There is advantage of the steam turbine is that There is no internal lubrication inside the components of the turbine therefore there is no issue of leakage inside the turbine and therefore exhaust system can be condensed directly and it can be used by proper way after converting to water directly to the boiler.

Another advantage of steam turbine is that it can produce large amount of power compared to the reciprocating steam engine. In reciprocating steam engine there is issue of of lubrication therefore it is possibility of leakage of lubricating oil inside the piston rings and other components in the engine Also there is issue of friction between the reciprocating parts of the reciprocating engine so overall efficiency of steam turbine is higher compared to the steam engine

In steam turbine, the aerofoil shapes of blades are used to create the lift force, So turbine blades can rotate the rotor at high speed without wasting the energy of steam. The aerofoil shape will provide the lift force as per its design consideration and also weight of the turbine blades are considered at the time of operation. This shape is very identical to convert Flow energy of steam into mechanical energy of turbine. In the casing of turbine rotor is arranged in such a way that pressure and temperature of the fluid decreases but kinetic energy is increased. So after each and every rotor arrangement there is stator arrangement to convert the pressure and temperature into proper output of work.

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Degree of reaction is important phenomena to convert the kinetic energy of turbine into mechanical power. So developer should arrange number of sets of stator and rotor in such a way that the proper decrement in pressure and temperature would take place for conversion of energy from flow energy to kinetic energy.

Nomenclature

| | |
|---|---|
| SGT | Steam and Gas turbie |
| Sup | Superheated steam |
| AC | Alternative current |
| Wout | Output work |
| H | Height of blades) |
| Q | Heat transfer rate) |
| G | Gravitational force |
| Ein | Input hear transfer . |
| A = | Blades area [$m^2$] |

(%)

## 2. Mechanism of Electricity generation inside Turbine section

Steam turbine should be facilitated with the proper gland mechanism to avoid the leakage of the steam. At the time of starting the pressure and temperature of the steam is analysed for the proper working and conversion of energy.

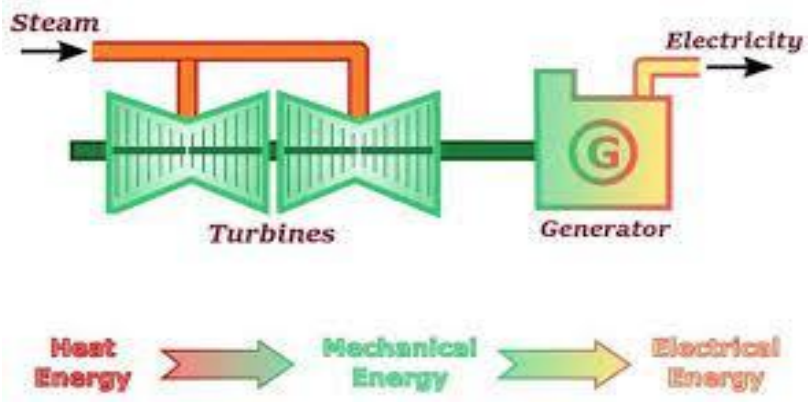


**Figure 1 Steam turbine and Generator**

Developer should keep in mind that whenever conversion of energy takes place there will be always losses of energy .In steam turbine there is availability of thermal energy and this energy is converted into kinetic energy so there is always loss and as per the laws of thermodynamics 100 % energy conversion is not possible. 2nd law also indicates the entropy standard and there is also degradation of energy after each stage of turbine.

### 2.1 Modification of blades to increase efficiency

Normally blades are designed in such a way that it will reduce the pressure of steam at the extent level and converts that pressure into kinetic energy. But sometime there is possibility of steam to escape from the side corners and this steam will not crate sufficient impact to the bucket of turbine. So in latent trends blades are designed with the follow up of stator and rotor side by side arrangement to abstracts maximum amount of thermal energy. Aero foil shape with optimise degree of reaction is preferred for the conversion of flow of energy. One should have take in mind that the flow of steam must not occur in the opposite direction after striking to the next rotor. So Fluent and CFD software's are available for the proper design and flow occurrence inside the turbine.

### 2.2 Oil Lubrication for turbine

There is a oil pump which is in central position and controlling the lubrication requirement throughout the system. The lubrication system must work and seal oil system should be in reliable position during operation of the turbo set at rated speed. The pump is located in the front bearing pedestal and is directly driven by the turbine shaft through the coupling. Auxiliary oil pump: Auxiliary oil pumps supply the oil during start-up and shut down of the turbo set the pumps can either be switched on manually or automatically through pressure switches.

Jacking oil pump: When the set is stationary the shafts come into metallic contact with the bottom bearing lining. The same issue is here, at the time of starting of turbine, the shaft is at rest positing. Due to low speed of shaft there will be a contact between the shaft and the lower surface. Due to this friction there is possibility of breaking of the lower surface therefore pressurized pump is used for the flow of lubricating oil. This oil will reduce the friction between the lower surface and the shaft and will provide a thick film of oil between the shaft and surface. So there will be initial rotation of the shaft will be started and after a period of time the oil film will be thicker and it will give better lubrication to the system.

## 3. Diagram of steam turbine

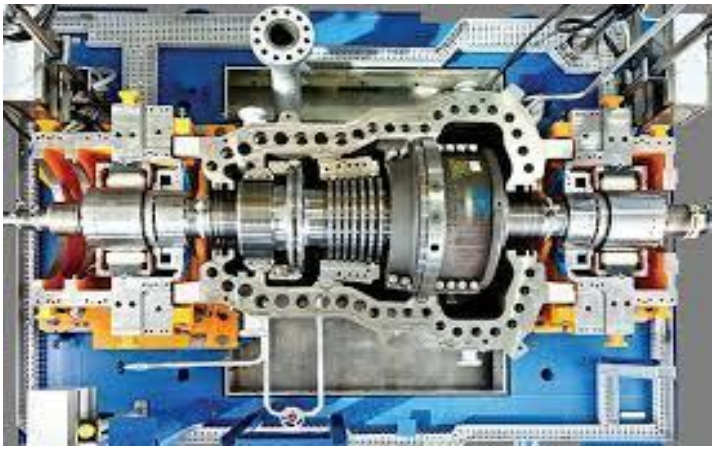

**Figure 2 Components of a turbine shows oil free operation**

As in the steam turbine there is no requirement for the lubricating oil between the components so it is very easy for service turbine after a period of time. But at the lower side of the turbine at the initial stage to reduce the friction and to give the initial motion to the turbine there is thick oil field is required only at the point of starting.

### 3.1 Design steam turbine

1. It is be noted that thermodynamic analysis should be proper so output is not affected by losses.
2. For the rotor performance the dynamic calculation must be clear.
3. For design blades the diameter and the length should be proper.
4. For best output of the steam conversion material should be proper that does not restrict the flow of steam..
5. Proper governing system must be used to prevent losses of energy flow.

6. Proper documentation is required to design and modification of each component.

### 3.2 Impulse Turbine

Impulse turbine can work when velocity of input flow is high. This turbine can work over the low head. Due to low head the flow of water is low and there may be chance of less efficiency. But developer can make a water flow design such a way that at the input section there should be high pressure and it will give its best performance. It is also noted that the efficiency of the turbine is measured: Total outflow of the turbine to the input given to the turbine.

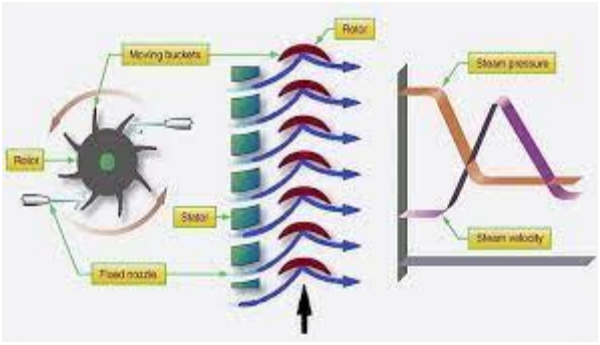


**Figure 3 Impulse turbine Technology**

### 3.3 Reaction turbine

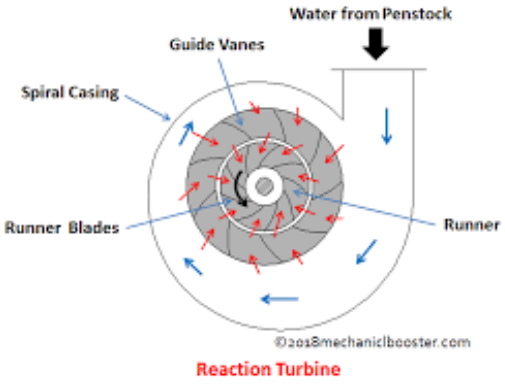


**Figure 4 Working of Reaction turbine**

This turbine is submerged under the water and it creates pressure to rotate the wheel. It is working on the principle of 3$^{rd}$ law of Newton – as every action contains the reaction and it is completely equal to its reaction. As per this law the water strikes and creates the force on the wheel and the same way wheel gives the reactive force and due to that force it starts to rotate. There is gradual decrement in the pressure of steam as it enters from the inlet.

## 4. Conclusion

Steam turbine efficiency is concern with the outflow of steam and friction concern with the inflow of steam. Material of the blades is also responsible for the steam velocity. Low weight material is really a great opportunity to the steam turbine for better efficiency. Also it will increase the rotation of the shaft and helps the alternator for more generation of the power.

At the other hand, low weight tends to less strength and reliability to the shaft and there may be chances for the wear and teat of the component at the time of peak load. If this happens then there may be long time for its maintenance and affect on the overall cost of the plant. SO developer has to optimise the material that can withstand the excess pressure and temperature of steam. In India itb should be also noted that overall cost of the turbine component must be within the cost calculation.

As the other part of the temperature consideration, the overall drop of the temperature should be available in the each stage of the turbine. There is also provision in the new era turbine that HP and MP turbine starts as per their sequence and reduce the pressure of steam and also creates the reasonable temperature drop in each stage. At the end of last stage almost energy conversion takes place and net gain is achieved by the pressure of the steam.

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## REFERENCES

1] H. Takenaga and K. Katayama, "Performance improvement of mechanical drive steam turbines," Proceedings of 11th Symposium.

2] The Royal Academy of Engineering, "Forces on large steam turbine blades".

3] Sir C. A Parsons "The steam turbine" (1911).

4] Dr. R. K. Bansal, "Fluid mechanics and hydraulic machines (revised ninth edition)," (2010), pg. 833 and 834

5] Prof. Q. H. Nagpurwala, "Design of steam turbines," M.S.Ramaiah School of Advanced Studies, Bengaluru, pg. 55,56

6] R. Singh, A. Arya and S. Pandey, "Effect of steam inlet temperature on performance of partial admission steam turbine," IJERST vol. 3 No. 4, (2014), pg. 304

7] Theodosios Korakianitis and Paschalis Papagiannidis. Surface-curvature-distribution effects on turbine-cascade performance. In ASMEInternational Gas Turbine and Aeroengine Congress and Exposition, American Society of Mechanical Engineers.

8] O Zweifel. The spacing of turbo-machine blading, especially with large angular deflection. Brown Boveri Rev

9] Teik Lin Chu. Effects of mach number and flow incidence on aerodynamic losses of steam turbine blades.

10] David Japikse, Nicholas Baines, et al. Introduction to turbo machinery.