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DESIGN AND FABRICATION OF STEAM TURBINE

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ABSTRACT

Steam turbine is an excellent prime mover to convert heat energy of steam to mechanical energy of all heat engines and prime mover the steam turbine is nearest to the ideal and it is widely used in power plants and in all industries where power is needed for process. In power generation mostly steam turbine is used to drive an electrical generator rotary motion, it is particularly suited to be used to drive an electrical generator about 80% of all electricity generation in the world is by use of an steam turbine. Rotar is an heart of an steam turbine and it affects the efficiency of the steam turbine. In this project we have mainly discussed about the working process of a steam turbine is much higher than that of a steam engine.

Keywords: Steam turbine, Energy, Efficiency, Power

INTRODUCTION

Turbine rotor is an important part of the unit, which carries the energy and torque of the unit. The safety of steam turbine unit mainly depends on the quality of rotor. The start- up model of steam turbine unit is the key factor to optimize the start-up of steam turbine. To ensure that the stress value of steam turbine rotor is less than the yield limit value of rotor material is the decisive factor to shorten the start-up time of steam turbine unit. From a few years ago to now, people's quality of life has been significantly improved, the power grid capacity has also been significantly improved, so the peak value of the power grid is also increasing. Frequent peak shaving operation refers to frequent startup and shutdown of steam turbine units. The change of turbine working condition will cause the damage of rotor material and reduce the life of the rotor. Change the parameters of turbine greatly during the start-up process. Among them, the change of temperature parameter is the most important. Temperature changes will make the rotor produce a force, called thermal stress. At the same time, the metal material will deform, which is mainly manifested as expansion deformation. Once the thermal stress exceeds the yield limit of the rotor material, the high temperature parts of the rotor will be damaged to some extent, which will eventually bring some potential safety hazards. The needs of today's society need to be met, so it is very necessary and important to study the quick start process. The start and stop of steam turbine depends on how long it can be used, which directly affects the service life of the unit. The start-up and shut-down of steam turbine unit are studied in detail, and the start-up and shut-down curve of the unit is given, which is used to guide the start-up and shut-down of the unit and improve the safety and economy of the unit.

In a word, the start-up optimization of steam turbine is a function optimization problem. At the same time, the function has constraints. Generally speaking, the starting time is the shortest and the stress is in a reasonable range. This paper analyses the start-up mathematical model of steam turbine through the start-up and stop process of steam turbine. In the actual power plant, it is unrealistic to measure and test the input data, so using complex simulation software is the most commonly used evaluation method. There should be a certain degree of superheat when the. main steam of steam turbine enters.The superheat degree should be at least 50 ◦C and generally not more than 426 ◦C. The temperature difference between two pipes is generally less than or equal to 17 C. The temperature difference between main hot steam and reheat steam is generally 28 C, and the maximum temperature difference should be less than 80 ◦C. After the impulse start parameters are selected, before the impulse start of the steam turbine, it is necessary to conduct a comprehensive inspection on the main equipment and various auxiliary equipment, and all the equipment should have the start-up conditions. When the main equipment and other auxiliary equipment meet the start-up conditions, start the impulse start of the steam turbine. The impulse starting of steam turbine is mainly divided into four links. The first link is the impulse starting of steam turbine to 600r/min. cut off the inlet steam quickly and conduct five minutes of friction inspection. Professional technicians listen to the internal sound of steam turbine carefully and continue to increase the speed under the condition that there is no friction in the flow passage and the oil return of bearing is normal. The standard of speed increase is generally 100 r/min. The second link of steam turbine impulse starting is warm-up. The warm-up time and speed standard should be in accordance with the start-up curve provided by the steam turbine factory. The third link of steam turbine impulse starting is that before the speed rises to the critical speed of rotor, it is necessary to check and warm up the turbine at medium speed. The fourth link of steam turbine impulse starting is that when the steam turbine is warming up at medium speed, the time and temperature of warming up should meet the requirements provided by the manufacturer when the steam turbine leaves the factory.

PROPOSED SYSTEM

Chemical energy in the fuel is released in the form of heat during combustion. The products of combustion (ie) the flue gases, transfer this heat to the coil carrying water by radiation and convection

Residual heat in the flue gases is absorbed in the economiser, where feed water is heated to expel dissolved gases. Air required for the combustion supplied by the blower which imparts velocity and pressure to the air by centrifugal action of its rotting blades. For maximum efficiency correct amount of excess air has to be supplied. More air than necessary results in wastage of heat because of a large quantity of hot gases escaping form the chimney Lesser air results in incomplete combustion and soot formation. Soot's gets deposited on heat transfer surfaces and hampers heat transfer.

To use minimum possible excess air requires vigorous mixing of air and fuel, so that air is available to each fuel particle and to have a better combustion. Before the fuel can burn, it has to evaporate into gaseous form. The achieve this: Firstly, the fuel is atomised into a fine mist by passing it through a swirler in the nozzle under pressure. Atomisation produces very large surface area from which fuel can evaporate.

Fuel cannot be properly atomised if it is too viscous. Light Diesel Oil (LDO) has a low viscosity so that it can be easily atomised except in very cold weather. Furnace oil (FO) or Low Sulphur Heavy Stock (L.SHS) are too viscous at room temperature an have to be heated to reduce their viscosity.

The STEAMBEST has a reversible flame type furnace. The flame produced by the burner travels down in the furnace and the flue gases are in reverse direction. Thus two passes of flue gases are completed in the furnace itself. The fuel particles have a longer sustenance in the furnace Incombustible fuel particles on the outer zone of the flame are burnt by the hot reversing gases, resulting in better combustion and higher heat transfer compared to single pass furnaces.

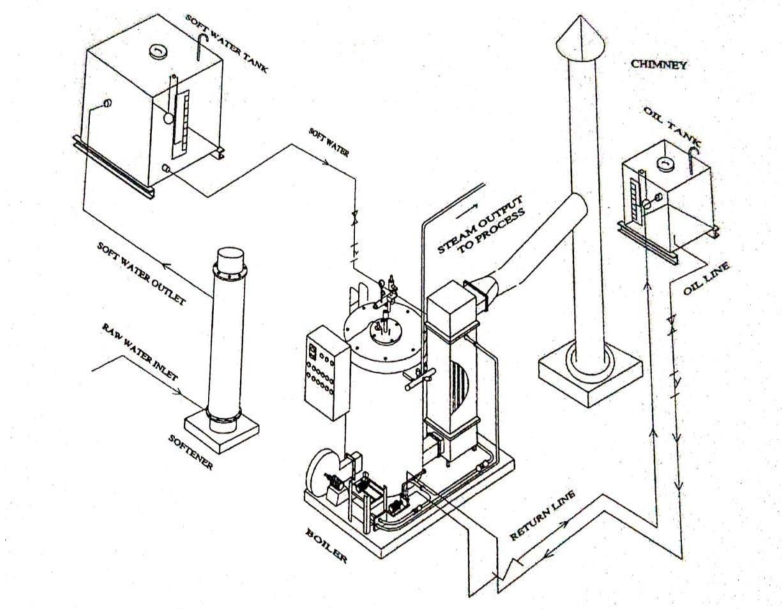


Fig 1: P&I DIAGRAM

Steam Turbine

A steam turbine is a prime mover in which rotary motion is obtained by the gradual change of momentum of the steam: N the steam turbine the force is exerted on the blades and it rotates the vanes or buckets or blades. The action of steam in this case is known as "dynamic".

In general a steam turbine essentially consists of the following two parts:

1. Nozzle
2. Blades

The Flow of Steam through nozzle: The steam nozzle is a passage of varying cross section by means of which the heat energy of steam is converted into kinetic energy. The nozzle is so shaped that it will perform this conversion of energy with minimum loss. These nozzles can be classified into three categories viz convergent Nozzle, Divergent Nozzle and Convergent - Divergent nozzle.

The flow of steam through a nozzle may be regarded in its simplest form, as being an adiabatic expansion. The steam enters the nozzle with a relatively negligible velocity and a high initial pressure. As the steam expands the velocity will increase. The heat energy of the steam being converted to kinetic energy. It will be interesting to know that the steam enters with high pressure and negligible velocity but leaves the nozzle with a very high velocity and low pressure.

During the expansion of steam through nozzle no heat is supplied (or rejected and also no external work is done. The work is done by increasing kinetic energy of the steam. The expansion is therefore an adiabatic flow. It should be noticed that the expansion of steam is not a free expansion of steam is not a free expansion and the steam is not throttled. Because it has a large velocity at the end of expansion.

Experimental Procedure

- Connect the steam turbine Panel to a single phase 230 V power source with neutral connection.
- Switch on the turbine panel board main switch. When the sufficient pressure (10 kg/cm^2 to 12kg/cm^2) is built in the boiler allow water to circulate through the condenser by switching on the condenser water supply pump. Slowly open the boiler main value for a minute and simultaneously open the mainline value's bypass valve in the steam line and the ball valve provided under the turbine.
- When all the condensed water in the steam line and turbine is driven out close the main line bypass valve and the valve under the turbine.
- Now the turbine starts picking up speed around 2000 rpm load the turbine by switching on individual rotary switch to the bulbs (No.1Position is off and no.2 position is on

Operating Medium	: Steam Power
Output	: 500 Wts
Inlet Pressure	: 10 kg/cm^2
Inlet Temperature	: 120 to 160 deg.c.

Procedure

For loading the turbine to ¼,1/2 ,3/4 &full load:Take one set of reading at 10 kg/cm^2 boiler pressure i.e. Volt , Ampere, Mass of steam flow (condensate collecting time for 4 cm rise.) Turbine speed, turbine inlet Pressure kg/cm^2 Turbine outlet pressure in meter of water column and temperature scanner reading at five position.

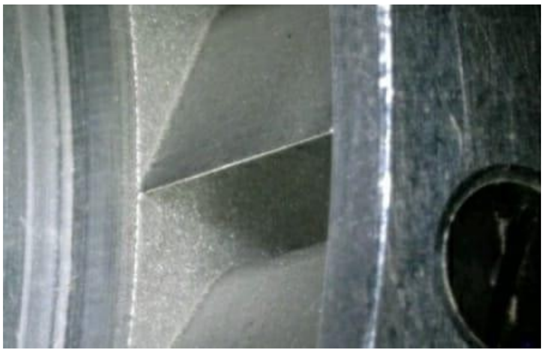
1. t_1 ^{0}C -Steam inlet temperature
2. t_2 ^{0}C -Steam outlet temperature
3. t_3 ^{0}C -Condensate water temperature
4. t_4 ^{0}C -Condensate water inlet temperature
5. t_5 ^{0}C -Condensate water outlet temperature

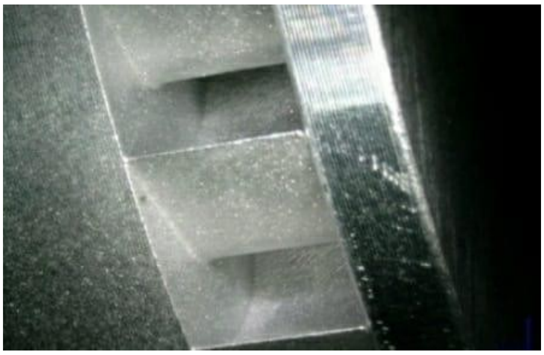
Calorimeter by the valve provided on the calorimeter and note down the following:

1. Water separated in the separating calorimeter
2. Pressure on separating calorimeter in kg/cm^2
3. Pressure after throttling in kg/cm^2
4. Temperature after throttling in deg ^{0}C
5. Condensate water collected after throttling ml/min.

RESULTS

S.NO	PARAMETER	SYMBOL	FORMULAE	UNIT	RESULTS
1	Heat generated b burnt fuel oil pe hour	Qf	100	%	100.0
2	Heat gained by steam per hour	Qs	100*Qs/Qf	%	68.9
3	Heat loss to flue gass	Qg	101*Qg/Qf	%	21.4
4	Unaccounted hea loss	Qua	102*Qua/Qf	%	9.7
5	Heat released b burnt fuel oil pe hour	y Qf	M*C.V(C.V=4450 kj/kg)	MJ/hour	647.617
6	Heat loss to flue gas	Qg	Ma*cpg*(tg-tr)	MJ/hour	138.5
7	Unaccounted hea loss	Qu_a	Q^f-(Q_s+Qg)	MJ/hour	62.891
8	Heat gained by steam per hour	Qs	m_s*(h-hfw)/100	Kj/kg	446.276





CONCLUSION

An overview for improving steam power turbine energy generation efficiency has been carried out in this work. The conclusion following from the study includes, Sustainability for the purpose of lower cost, leading to economical generation of electric power, and environmental effects via reduced emission per unit of energy generation, by using the steam power generation plant will require improving the system efficiency. It could be possible to improve efficiency of the steam turbine power plant system through optimization of the design parameters of the last stage LP turbine blade in nozzle. It will also be necessary to conduct further research into the materials properties of the LP turbine blade for steam power generation system for the improvement of efficiency improvement that could be accrued from improve turbine materials properties.

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