"WORKING MODEL OF STEAM TURBINE"

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ABSTRACT

The superheat degree of the regenerative extraction steam in double reheat systems it is very high, leading to large temperature difference in the heat transfer process and worse thermal performancet. This paper presents two typical systems to make the superheat of the extraction steam be used reasonably, which are a double reheat system with outer steam coolers and a double reheat system with a regenerative steam turbine. Thermodynamic analyses and techno-economic analyses are conducted to reveal the energy-saving effects of different systems. The results show that: the power generation efficiency of the system with outer steam coolers is increased by 0.16%-points than the conventional double reheat system, and the power generation efficiency of the system with a regenerative steam turbine can be further increased by 0.51%-point.

***Keyword**: - Thermal, Regenerative Steam Turbine, Thermodynamic, Economic Performance*

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1. INTRODUCTION:

A station thermal power is a power plant in which the prime mover is steam driven, Water is heated, convert into steam and spins a steam turbine which drives an electrical generator. After it passes through the turbine, then steam is condensed in a condenser and recycled to where it was heated; this is known as a Rankin cycle. The greatest variation in the design of thermal power stations is due to the different fossil fuel resources generally used to heating the water. Some prefer to use the term energy center because such facilities convert forms of heat energy into the electrical energy. Certain thermal power plants are also designed to produce heat energy for industrial purposes of district heating, in addition to generating electrical power. Globally, fossil fueled thermal power plants produce a large part of man-made CO_2 emissions to the atmosphere, and reduce the efforts these are varied and widespread.

Almost all coal, nuclear, geothermal, solar thermal electric, and many natural gas power plants are thermal. Natural gas it is frequently combusted in gas turbines as well as boilers. The waste heat from a turbine can be used to raise the steam, in a combined cycle plant that improves overall efficiency. The Power plants burning coal, fuel oil, natural gas are often called fossil-fuel power plants. Non-nuclear thermal power plants, particularly fossil-fueled plants, which does not use co-generation, are sometimes referred to as conventional power plants.

2. LITERATURE SURVEY:-

Steam turbine is an good prime Mover to convert heat energy of steam to mechanical energy. Of all heat engines and prime movers the steam turbine is nearest to the ideal and it is widely accepted in power plants and in all industries where power is required for process. In power generation widely steam turbine is used because of its greater efficiency and higher power-to-weight ratio. Because the turbine generates 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 steam turbines.

3. COMPONENT

3.1 STEAM TURBINES

A Steam turbines extract heat from steam and transform it into rotational energy by expanding the steam from high to low pressure, resulting in mechanical work. Small and intermediate-size steam turbines are used for wide range of applications, including power generation, drivers for mechanical services. When coupled with gears they can be used to drive fans, reciprocating compressors and classes of low-speed machinery. The largest turbine applications are generator drives in utility and central power stations.

Fig. Steam turbine

3.2 BOILER

A boiler is a closed vessel in which water and fluid is heated. The fluid does not necessarily boil. The vaporized fluid exits the boiler for use in various processes or heating applications including water heating, central heating, boiler-based power generation, cooking, and sanitation. . .

Fig. Boiler

3.3 DC GENERATOR

DC Motors provide a means for precise positioning and speed control without the use of feedback sensors. The basic operation of a DC motor allows the shaft to move a precise number of degrees each time a pulse of electricity is sent to the motor. The shaft of the motor moves only the number of degrees that it was designed for when each pulse is delivered, you can control the pulses that are sent and control the speed. The rotor of the motor produces torque from the interaction between the magnetic field into the stator and rotor. The strength of the magnetic fields is proportional to the amount of current sent to the stator and the number of turns in the windings.[8]

Fig. DC Generator

3.4 PRESSURE GAUGE

Lots of techniques have been developed for the measurement of pressure and vacuum. Instruments used to measure pressure is called as pressure gauges or vacuum gauges. A manometer is an instrument to use measure pressure, although the term is often used nowadays to mean any pressure measuring instrument. A vacuum gauge is used to measure the pressure in a vacuum which is further divided into two categories, high and low vacuum and sometimes ultra-high vacuum. The applicable pressure range of many of the techniques used to measure vacuums has an overlap. Hence, by combining several different types of gauge, it is possible to measure system pressure continuously from 10 mbar down to 10−11 mbar. [11]

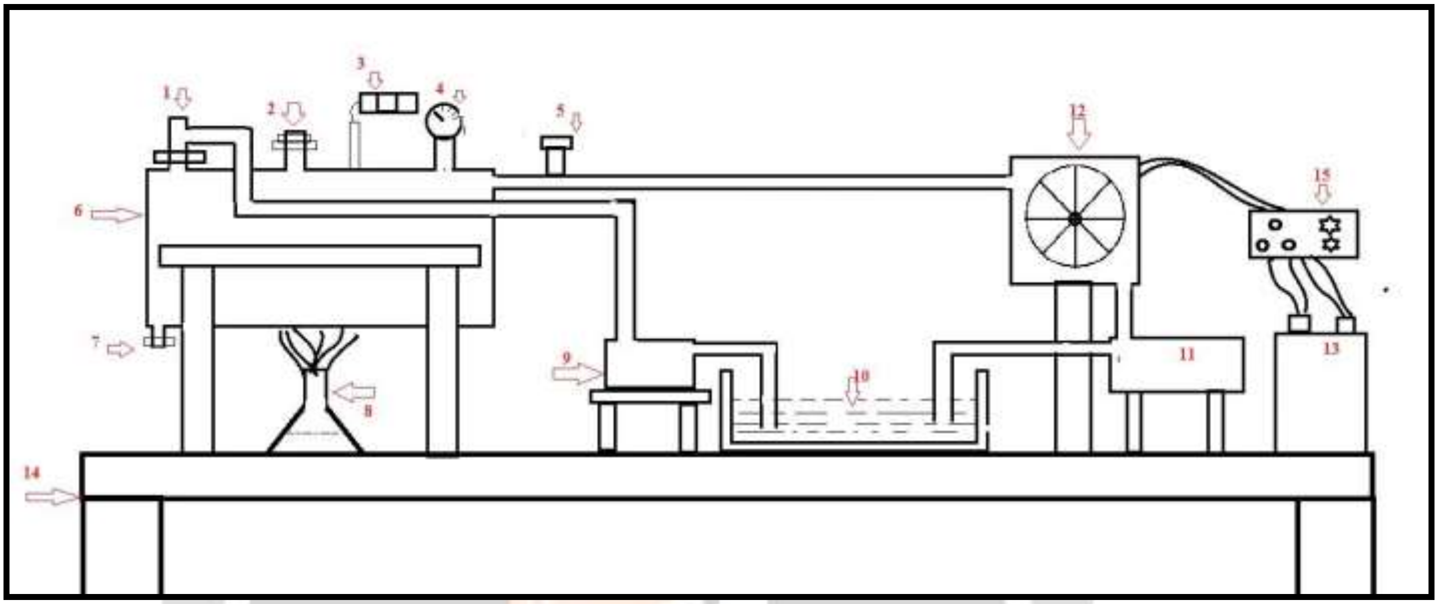
Fig. Pressure Gauge

3.5 SAFETY VALVE

A safety valve is a valve mechanism which automatically releases a substance from a boiler, pressure vessel, or other system, when the pressure or temperature exceeds preset limits. It is one of a set of pressure safety valves or pressure relief valves , which also includes relief valves, safety relief valves, low pressure safety valves, and vacuum pressure safety valves. Safety valves first used on steam boilers during the Industrial Revolution. Early boilers operating without them were cause to accidental explosion. A gate valve also known as a sluice valve is a valve that opens by the rectangular gate wedge out of the path of the fluid. The distinct feature of a gate valve is the sealing surfaces between the gate and seats are planar, so the gate valves are often used when a straight-line flow of fluid and minimum restriction is desired. The gate faces can form a wedge shape or they can be parallel.[13]

Fig. Safety Valve

4. SOFTWARE DIAGRAM



1. Water inlet 2.Pressure relief valve 3. Digital thermocouple 4.Pressure gauge 5. Pressure control valve 6.Boiler 7. Drain water outlet 8.Burner 9.Pump 10.Reservoir 11.Condenser 12.Turbine 13. Battery14. Frame 15.Switch board

5. PROCEDURE

A steam turbine is a device that convert thermal energy of steam into mechanical energy by turning the blade of rotor.

Because the turbine generates rotary motion, it is particularly suited to be used to drive an electrical generator – about 90% of all electricity generation in the United States (1996) is by using steam turbines.The steam turbine is one type of heat engine that derives much of its improvement in thermodynamic efficiency from the use of multiple stages in the expansion of the steam in turbine, which conclude in a closer approach to the ideal reversible expansion process.

6. CALCULATION

Pressure P1 = 2 bar

Expansion of steam pressure = 0.07bar

Turbine efficiency = $\frac{h1-h2'}{h1-h2}$

The efficiency of turbine range from 85 to 88% $\eta t = \frac{ActuL\ work\ in\ turbine}{isentropic\ work\ in\ turbine}$

ηp efficiency of pump

ηp = $\frac{isentropic\ work\ supplied}{actual\ work\ supplied}$

= $\frac{hf4-hf3}{hf4'-hf3}$

Range from 80 to 90%

η= 1- $\frac{heat\ rejected}{heat\ added}$

= 1- $\frac{Qr}{Qa}$

Critical temperature of water = 150º

Critical pressure = 221.2

From h-s diag

h1 = 278kj/kg (at 11 bar)

hf3 = 163kj/kg (at 0.07bar)

Pump work = Vf2 (P1-P2)

= 0.001 (3-0.07)*102
= 0.293 kJ/kg
Heat supplied Qa= (h1-hf3)- pump work
= (2181-163)-1.093
= 2616.9 kJ/kgk
Total change in entropy = S2-S3 .

= - (6.554-0.54)
= -5.994kJ/kg
Heat rejected = h2-hf3
= 2035-163
= 1872 kJ/kg
Theoretical thermal efficiency = $turbine\ work - pump\ work heat\ sipplied$
= $(h1-h2)-wp2616.9$
= (2781−2035)−1.0932616.9
= 28.46%
Actual output = Wtisen*ηt*ηm - $wp\eta p$
= (2781-2035)*0.8*0.95 – 1.0930.8
= 565.59 kJ/kg
Overall actual thermal efficiency = Wtisen∗ηt∗ηm∗ηgen − $wp\eta pQa$
= (2781−2035)∗0.8∗0.95∗0.96 – 1.0930.82616.9
= 20.75%
Work done by turbine = h1-h2
= 2781-2035
= 746 kJ/kg
Net work done = turbine work – pump work
= (h1-h2)-1.093
= 746-1.093
= 744.907
Theoretical steam consumption
= 3600$net\ work\ done$
= 3600744.907
= [4.832]

Fig. model of steam turbine

ADVANTAGES

- High efficiency at full load
- Mechanical simplicity and hence potential reliability.
- Conventional steam locomotives have substantial reciprocating masses such as connecting rods and valve gear.

APPLICATION

- Electric power station.
- Turbine steam ship
- turbo electric drive

CONCLUSION

- A miniature steam power plant was presented.
- Construction and operation details were explained.
- The voltage generated by the power plant is enough to lighten two LEDS.

REFERRENCE

[1] Maury Klein, The Power Makers: Steam, Electricity, and the Men Who Invented Modern America Bloomsbury Publishing USA, 2009 ISBN 1-59691-677-X

[2] Climate TechBook Hydropower, Pew Center on Global Climate Change, October 2009

[3] British Electricity International (1991). Modern Power Station Practice: incorporating modern power system practice (3rd Edition (12 volume set) ed.). Pergamon. ISBN 0-08-040510-X.

[4] Babcock & Wilcox Co. (2005). Steam: Its Generation and Use (41st edition ed.). ISBN 0-9634570-0-4.

[5] Thomas C. Elliott, Kao Chen, Robert Swanekamp (coauthors) (1997). Standard Handbook of Powerplant Engineering (2nd edition ed.). McGraw-Hill Professional. ISBN 0-07-019435-1.

[6] Zhiqiang Kang, et al., 2014 in this paper In order to achieve high utilization efficiency of residual heat by reducing the energy conversion process.