

- [54] STEAM GAS TURBINE INCLUDING A
GAS TURBINE AND A STEAM TURBINE
WITH A STEAM GENERATOR AT THE
DOWNSTREAM END**

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60/107, 92, 39.18 R, 39.18 B

- [56]
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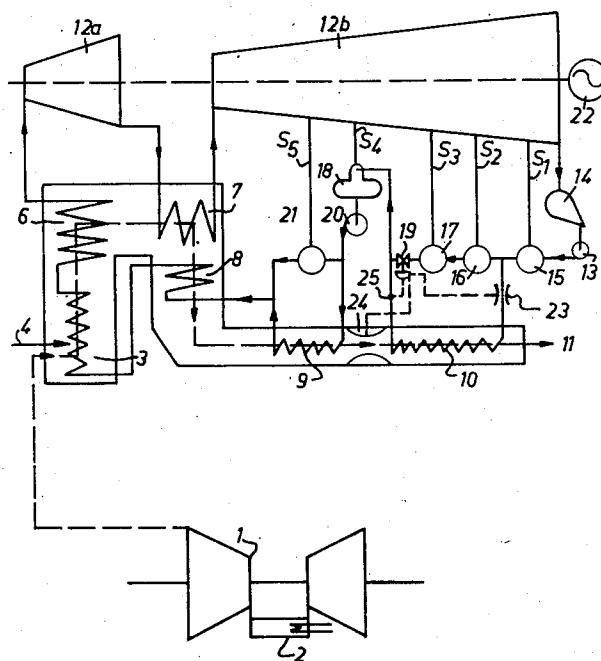
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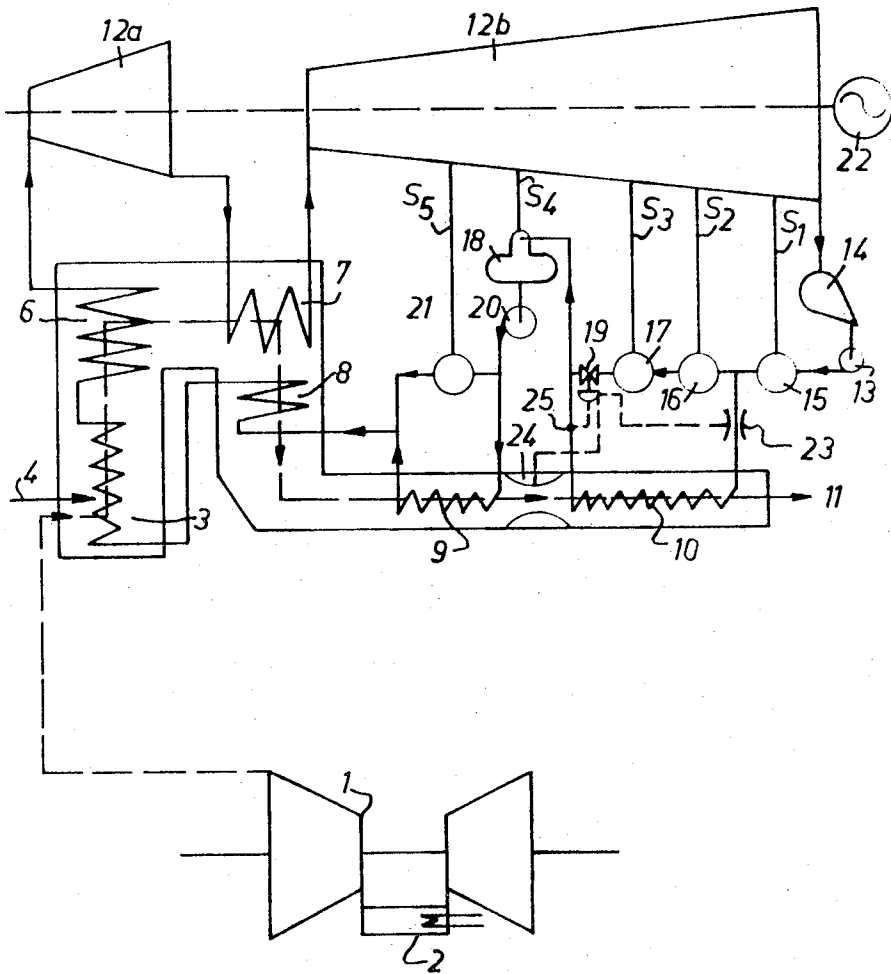
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ABSTRACT

A steam gas plant including a gas turbine the exhaust gases of the gas turbine feed the burners of the steam generator which in turn feeds the steam turbine, a steam generator, and a steam turbine, in which the operation of the gas turbine continues under full load even for reduced loads on the steam turbine. The invention maintains under varying steam turbine loads the temperature at the input of a deaerator constant, the deaerator being fed in parallel by an economizer subjected to the heat of the flue gases of the steam generator and by water heaters fed with steam extracted from the turbine. To ensure constant temperature, one of the streams feeding the deaerator is controlled by a gate the extent of opening of which is defined by the ratio of the throughput of flue gases acting on the economizer and the flow of water in the economizer and possibly also by the modifications in the temperature at the output of the economizer.

4 Claims, 1 Drawing Figure





STEAM GAS TURBINE INCLUDING A GAS TURBINE AND A STEAM TURBINE WITH A STEAM GENERATOR AT THE DOWNSTREAM END

Our invention has for its object improvements in a steam gas plant of the type including a gas turbine, a steam turbine provided with a steam generator at the downstream end, wherein the outputs of one or more gas turbines feed the burners of one or more steam generators and one or more steam turbines are associated with heat exchangers for heating the feed water of the steam generator or generators.

Our invention has in particular for its object a method for operating a plant of such a type so as to ensure the proper utilization of the entire plant under different load conditions.

According to our invention, the temperature of the water at the input of the deaerator, which is fed with water from one or more water heaters and from an economizer inserted in parallel with the heater or heaters, is maintained by adjusting the throughput of the water passing through the heater or heaters under the control of the ratio of the throughput of water passing through the economizer and the throughput of flue gases passing out of the steam generator.

Our invention has also for its object a plant for the execution of our method. Our method includes in the usual manner one or more water heaters and an economizer inserted in parallel with the heater or heaters and a deaerator connected both with the heaters and with the economizer and, according to our invention, a gate inserted in the channel of the heater or heaters or in that of the economizer is controlled by the ratio of the throughput of water passing through the economizer and the throughput of flue gases passing out of the steam generator.

There is described hereinafter, by way of example and in a non-limiting sense, an embodiment of our improved plant, reference being made to the single FIGURE of the accompanying drawing which illustrates diagrammatically such an improved plant.

Our improved plant includes a turbine 1 fed with fuel at 2 and feeding with its exhaust gases the burners of a steam generator 3. The exhaust gases, containing large amounts of oxygen allow the fuel introduced at 4 to burn in the steam generator.

The steam generator 3 is provided with a superheater 6, a water heater 7 and three economizers 8, 9 and 10. The flue gases pass in succession through these various components before they are exhausted through the chimney 11. The plant includes furthermore a steam turbine constituted by two stages or groups of stages 12a and 12b. The input of the first stage or group of stages is connected with the output of the superheater 6 and its output opens into the reheater 7. The input of the second stage or group of stages 12b is connected with the output of said reheater 7 whereas its output is connected with the input of a pump 13 through the agency of a condenser 14. At the output of the pump 13, the condensed water is sent into a water heater 15 fed with steam tapped off the extraction port S1 of the turbine. At its outlet, the stream of water is divided into two streams of which one is heated in the economizer 10 while the other passes through two water heaters 16 and 17 fed with steam passing out of the extraction ports S2 and S3 of the turbine respectively.

As it passes out of the water heater 17, the water is mixed with that passing out of the economizer 10 and the mixture is directed towards a deaerator 18 fed with steam from an extraction port S4 of the turbine.

The division into two streams of the water passing through the economizer 10 and through the water heaters 16 and 17 is controlled by a throttling of the stream of water passing out of the water heater 17, the throttling being obtained by operation of the gate 19.

At the output end of the deaerator 18 the entire stream of water is sucked in by a feed pump 20. The pump is connected with the input of the steam generator 3 through the water-heater 21, fed with steam by an extraction port S5 in the turbine, and the economizer 8, the economizer 9 being inserted

in parallel with the water heater 21. An alternator 22 is carried by the shaft of the turbine 12a, 12b.

It is a well-known fact that in such a plant the deaerator operates effectively only if the water feeding it reaches it at a temperature lower than the saturation temperature corresponding to the pressure of the extracted water feeding it.

On the other hand, the plant is sufficiently efficient for intermediate loads only if the gas turbine 1 operates under full load conditions and sends into the steam generator the same throughput of exhaust gases as under full load conditions.

Consequently, the throughput of flue gases passing through the economizer 10 remains the same under partial loads as under full load and, since the throughput of feed water decreases with the load, the temperature of the water at the output end of the economizer 10 increases when the load is reduced.

In order to maintain proper operation of the deaerator 18, it is necessary to limit the rise in temperature of the water at the output of the economizer 10, and this is obtained by closing the gate 19 whereby the throughput of water passing through the economizer 10 increases.

Of course the operation of the gate 19 should follow the changes in the load of the plant very slowly and it should be controlled therefore by a regulating loop. The execution of such a regulating loop is difficult since the economizer 10 is very large and time is required for the water to pass through it.

A mere regulation controlled by the measurement of the water temperature at the output of the economizer 10 could not operate alone since the delay between the control of the gate 19 and the tapping off of a temperature-controlled pulse at the output of the economizer 10 would be too long.

The results are far better if the gate 19 is controlled by the actual cause of the variation in temperature at the output of the economizer 10, that is by the changes in the throughput of water and of flue gases.

In our improved plant, the gate 19 is controlled by the difference between the ratio of the throughput of water in the economizer 10 as measured at 23 and the output of flue gases as measured at 24 and a reference value.

In order to improve the operation of the regulating loop, it is possible to additionally send a correcting signal which is proportional to the ratio between the temperature at the output of the economizer 10 as measured at 25 and a reference temperature.

This arrangement adapted to keep the temperature of the water at the input of the deaerator 18 at a suitable value provides excellent efficiency of the plant under partial loads while continuously feeding the steam generator with the full output of the exhaust gases passing out of the gas turbine 1. This leads to an improved efficiency of the plant under partial loads.

The invention provides thus an improvement in the general efficiency of the plant under partial loads through the presence of the regulating loop which adjusts continuously the throughput of water within the economizer 10 to the value required for maintaining a predetermined water temperature at the input of the deaerator.

Obviously our invention is not limited to the embodiment described and illustrated and it covers all modifications thereof falling within the scope of the accompanying claims.

What we claim is:

1. A method for operating a plant including a gas turbine, a steam generator fed by the exhaust gases from said gas turbine, a deaerator for the water feeding said steam generator, an economizer associated with said steam generator and at least one water heater inserted in parallel with said economizer and feeding water into said deaerator, a steam turbine fed by said steam generator and out of which steam is exhausted to heat said water heaters, the steps consisting in producing signals defining the ratio of the throughputs of water in said economizer and of flue gases in said steam generator and adjusting the throughput of water in said water heaters in conformity with said signals to maintain constancy of temperature at the input of said deaerator.

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2. A method as claimed in claim 1 including the further step of applying additional correcting signals defining the actual ratio of the temperature at the output of said economizer and a reference temperature

3. In a plant including a gas turbine, a steam generator fed by the exhaust gases from said gas turbine, a deaerator for the water feeding said steam generator, an economizer associated with said steam generator and at least one water heater inserted in parallel with said economizer and feeding water into said deaerator, a steam turbine fed by said steam generator and out of which steam is exhausted to heat said water heaters,

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the provision of a gate controlling the throughput of water in at least one of said economizer or said water heater, and means defining the ratio of the throughput of water in said economizer and the throughput of flue gases in said steam generator and controlling the operation of said gate in conformity with said ratio.

4. A plant as claimed in claim 3 including further means defining the ratio of the temperature at the output of said economizer and a reference temperature and producing a corresponding correcting signal for the operation of the gate.

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