

[54] **METHOD AND MEANS CUTTING OUT LOW TEMPERATURE CORROSION BY SULPHUR CONTAINING FUEL IN THE TERMINAL PARTS OF A STEAM GENERATOR IN THE ABSENCE OF AIR-HEATING MEANS**

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[58] Field of Search **122/412, 421, 441; 60/107, 60/106**

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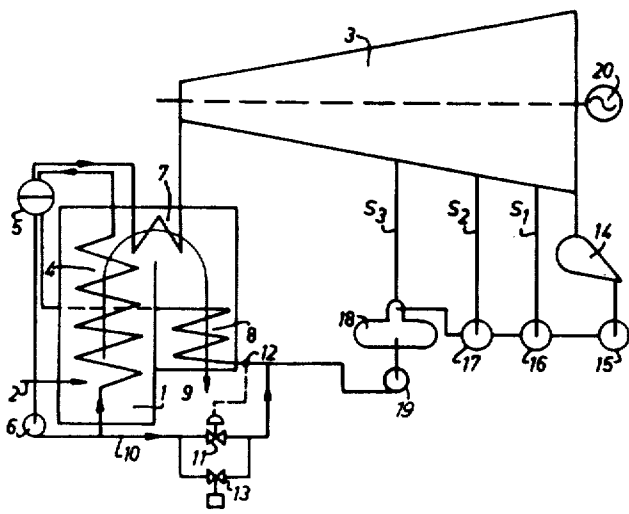
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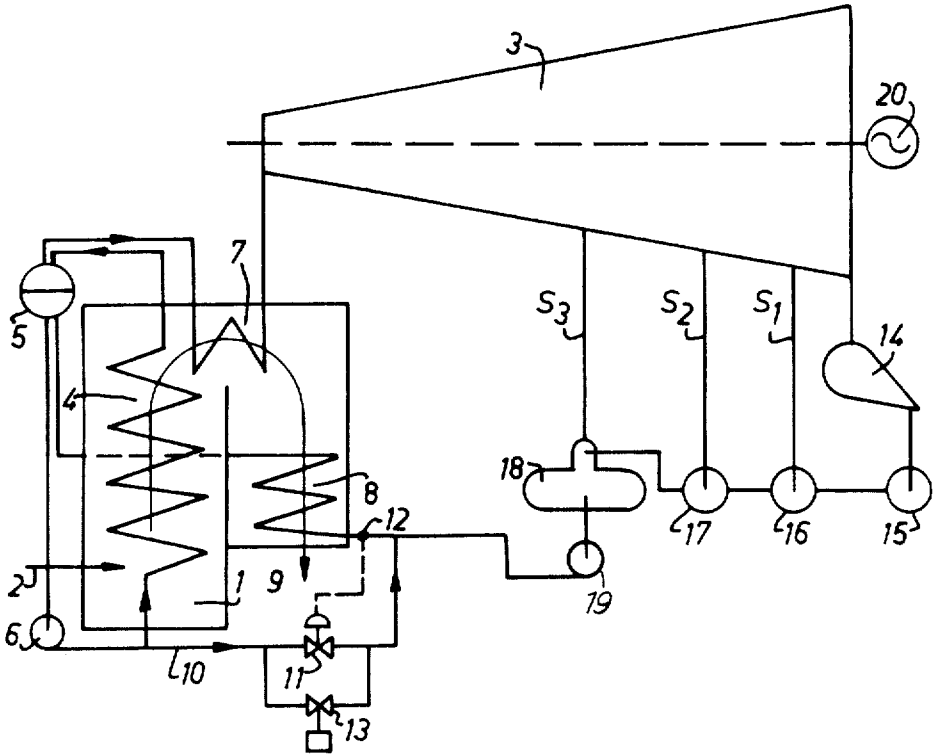
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[57] **ABSTRACT**

To prevent corrosion in the economizers and the like structures at the output end of a steam generator burning sulphur-containing fuel and feeding a steam turbine, there is provided a channel connecting the input of the steam generator boiler with the input of the economizer so as to raise the temperature in the latter above corrosion temperature. A gate in said channel allows an adjustment of the flow of water through the latter and a by-pass for said gate allows a low basic permanent flow of water to pass through said channel, which flow can be stopped by a further gate.

3 Claims, 1 Drawing Figure





**METHOD AND MEANS CUTTING OUT LOW
TEMPERATURE CORROSION BY SULPHUR
CONTAINING FUEL IN THE TERMINAL PARTS OF A
STEAM GENERATOR IN THE ABSENCE OF AIR-
HEATING MEANS**

Our invention has for its object conventional plants including a steam generator, a steam turbine and heat exchangers fed by tapping off steam through extraction ports so as to heat the water feeding the steam generator, assuming said steam generator operates with sulphur-containing fuel.

Our invention has more particularly for its object a method for operating such a plant, said method providing the advantage of eliminating the corrosion in the terminal heat exchangers associated with the steam generator while the conditions of operation of the plant are improved for certain particular cases.

According to our invention, a fraction of the feed water passing out of the boiler in the steam generator is sent into the input of the terminal economizer or economizers.

Our invention has also for its object a plant for executing said method. Said plant is characterized by a channel connecting the input of the boiler in the steam generator with the input of one or more terminal economizers, in which channel a gate is inserted.

In an advantageous embodiment, the plant includes means controlling said gate, which means are sensitive to the temperature of the water at the input of the economizer and open said gate when the temperature has a tendency to sink and conversely, said temperature being held thus at a substantially constant value.

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

As illustrated our improved plant includes a steam generator 1 fed with fuel at 2 and producing superheated steam expanding in a turbine 3. The steam generator encloses a boiler 4 while an expansion vessel 5 is provided for separating the water and steam passing out of the boiler bundle 4. One or more circulating pumps 6 provide for the circulation of water in the boiler 4 while a superheater 7 and an economizer 8 are also provided in the steam generator. The flue gases pass in succession through these different heat exchangers before they are exhausted into the chimney 9.

At the output end of the circulation pump 6, a pipe 10 branches off shuntwise so as to send a fraction of the water throughput directly into the input of the economizer 8. Said pipe is provided with a regulating gate 11 adapted to adjust the throughput of water reaching the input of the economizer 8, under control of the temperature of the water at the input of said economizer 8, said temperature being measured by an instrument 12. Said regulating gate 11 is associated with a by-pass controlled by a cutting off gate 13 controlled from a distance.

At the output of the turbine 3, the steam is condensed in a condenser 14 at the output end of which the water is sucked in by an extraction pump 15 beyond which it is heated in the water heaters 16 and 17 fed by steam passing out of two extracting ports S1 and S2 in the steam turbine. The water passing out of the water heater 17 enters a deaerator 18 which latter is fed with steam tapped off the extraction port S3 of the turbine, after which the pressure of the water is raised by a feed pump 19 which delivers it then directly into the economizer 8 in the steam generator 1.

An alternator 20 is connected with the shaft of the turbine 3.

It is a well-known fact that, in steam generators burning sulphur-containing fuel, external corrosion phenomena appear on the outside of the terminal heat exchangers when the temperature of the metal forming the latter is lower than the temperature of the acid dew point of the fuel gases.

Another well-known fact is that the temperature and pressure of the steam extracted from the turbine and feeding the

deaerator and the water heaters depend on the load on the turbine 3 and in particular, under low loads, the temperature at the input of the economizer 8 is much lower than under full load conditions.

The same is the case for the temperature of the metal of the tubes forming the heat exchanger 8 and this may lead to their corrosion if the temperature sinks underneath the acid dew point of the flue gases.

It is not possible to increase inconsiderately the temperature and pressure of the extracted steam heating the feed water for the steam generator, since this would lead under full load conditions to an exaggeratedly high temperature of the water feeding the steam generator and the flue gases would pass out of the steam generator at a very high temperature which would considerably reduce the general efficiency of the cycle.

It is therefore of considerable interest to heat the water feeding the economizer 8 under partial load conditions so as to protect said economizer 8 against corrosion phenomena while retaining an excellent efficiency for the plant under full load conditions.

This result is reached in accordance with our invention by sending into the input of the economizer 8 a fraction of the feed water for the boiler 4 as provided by opening the gate 11. Said gate is opened automatically by the regulating chain controlled by the temperature measuring apparatus 12 and which has for its object to maintain a suitable value for the temperature of the water at the input of the economizer 8.

The water passing out of the circulation pump 6 is very hot and, when mixed with the feed water delivered by the pump 16, it causes the temperature of the water at the input of the economizer 8 to assume the desired value.

There is no difficulty in diverting under low loads a small fraction of the water feeding the boiler 4, since in such a case the heat fluxes in the steam generator are not very considerable and the rate of vaporization in the different tubes is very low.

On the other hand, since for such loads the temperature of the water at the output of the circulation pump 6 is far above the temperature of the acid dew point of the flue gases, the throughput of hot water to be diverted from the boiler for heating the feed water of the economizer 8 is very small.

During certain operative stages of the plant and chiefly when starting the steam generator and steam turbine, during operation of the latter under a low load and also when stopping or disconnecting the steam generator, the economizer 8 receives a comparatively large amount of heat produced by the normal combustion of the fuel introduced at 2 or ascribable to the thermic inertia of the considerable mass of the apparatus carried in the steam generator 1, while said economizer is fed only by an extremely reduced stream of water which sinks even down to zero when the steam generator stops or is disconnected.

Such conditions lead to a boiling of the water in the terminal sections of the economizers 8 and this results in a circulation of water and a local superheating of certain tubes, which two latter phenomena may damage the economizer and cause a hammering to arise while the tubes may be broken by extrusion.

It is therefore of interest to prevent such phenomena by producing a forced circulation of water through said economizer 8 during such special operative conditions.

This is obtained by opening the by-pass gate 13. A certain amount of water flows then out of the expansion vessel 5 by reason of the high manometric head of the circulating pumps 6 and said amount of water may thus be sent into the economizer 8 and return thence into the vessel 5. Such a circulation of water homogenizes the temperatures in the economizer 8 and prevents any boiling in the latter whereby all risks of damage are eliminated.

Our improved method may also be used in a steam generator in which the water flows naturally and its circulation is not assisted by a pump. Obviously in such a case the overpressure of the water at the input of the vaporizing boiler with

reference to the pressure in the economizer is small and the water throughput which may be sent into the input of the economizer is always small.

The preceding description shows that our invention eliminates all risks of damage to the economizer 8 during the following operative steps: starting, stopping and disconnecting by producing a circulation of water through the economizer as provided by opening the gate 13. This eliminates under partial load conditions any external corrosion of the low temperature section of the economizer 8, this being ensured by heating the water feeding the steam generator through admixture with hot water passing out of the vessel 5 upon opening the regulating valve 11. Said protection against corrosion is obtained without reducing the efficiency of the plant when operating at full load.

What we claim is:

1. In the operation of a plant including a steam generator enclosing a boiler and burning sulphur-containing fuel, a steam turbine fed by steam from said generator, heat exchangers for heating the water fed to said boiler and an economizer in the output section of said generator fed with the water heated by said exchangers and returned to the boiler, the steps

consisting in diverting a fraction of the water flowing to the boiler to the input of said economizer, and mixing said fraction with said water from said exchangers at the input to said economizer, and controlling the rate of flow of said water diverted from said boiler according to the temperature of the water at the input of said economizer to maintain said temperature at a substantially constant value above corrosion value.

2. In a plant burning sulphur-containing fuel consisting of a steam generator enclosing a boiler, a steam turbine connected to the output of said generator, heat exchangers connected to said steam turbine and an economizer in the output section of said generator connected to said exchangers and said boiler, the improvement comprising a channel connecting the input of said boiler with the input of said economizer, a gate in said channel and means sensitive to the temperature of the input of said economizer for controlling said gate to provide substantial constancy of said temperature at a value above corrosion temperature.

3. The plant of claim 2 comprising a by-pass across said gate in said channel and means for closing said by-pass.

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