Jan. 7, 1969 K. KNIZIA 3,420,212

CIRCUIT FOR A REGENERATIVE PREHEATING

Filed March 27, 1967 Sheet 1 of 2

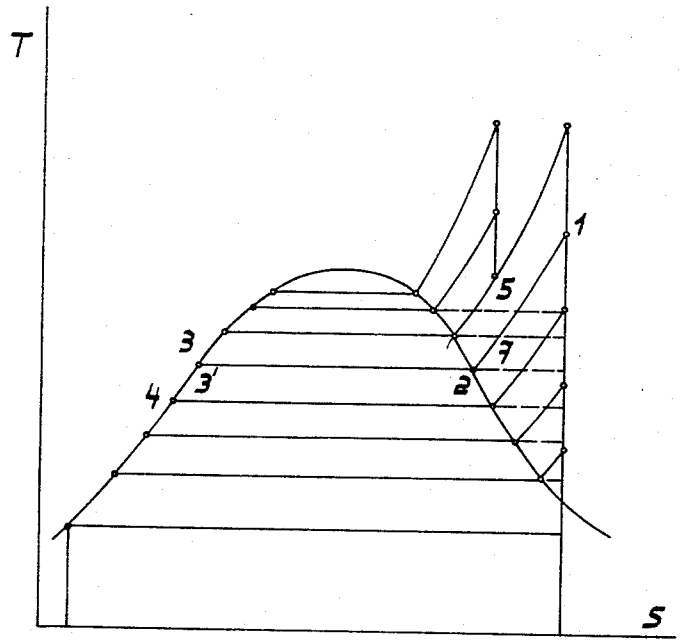


Fig. 1.

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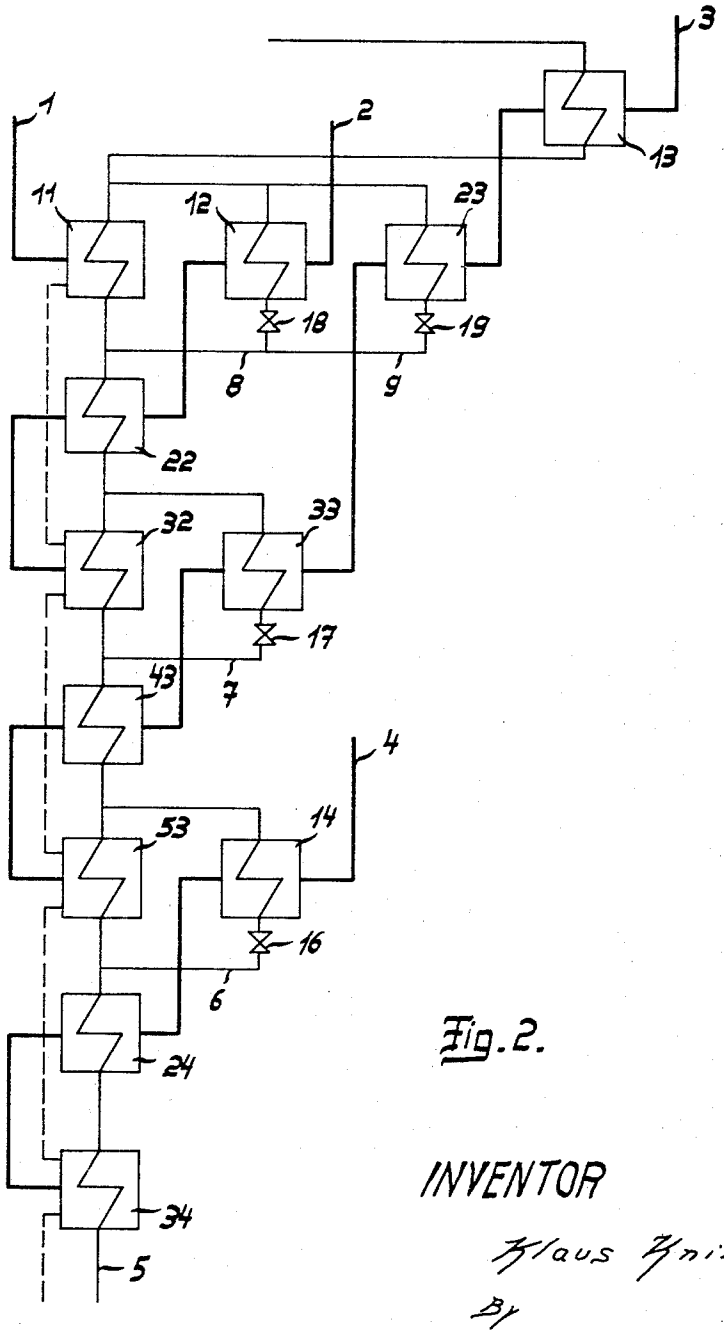


Fig. 2.

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CIRCUIT FOR A REGENERATIVE PREHEATING

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ABSTRACT OF THE DISCLOSURE

The present invention relates to a circuit for use in connection with steam plants for regeneratively preheating feed water which includes primarily feed water conveying conduit means with a plurality of first deheater means serially interposed therein while a plurality of bleeder steam lines respectively lead into said first deheater means for conveying thereto bleeder steam to be deheated in said first deheater means. The said circuit also comprises feed water preheater means likewise interposed in said primary conduit means from which latter secondary feed water conduit means are branched off and arranged in parallel thereto while bypassing said feed water preheater means, said secondary conduit means having interposed therein second deheater means.

The present invention relates to a circuit for the regenerative preheating of feed water. The basic process in steam power plants, the Clausius-Rankine process, is "carnotized" by the regenerative preheating of the feed water. In this connection, bleeder steam is at various pressures withdrawn from the turbine and employed for preheating the feed water in various stages.

With increasing steam temperatures and the employment of one or more intermediate superheating stages, the expansion lines of the steam in the turbine will have such high entropy values (FIG. 1) that the bleeder steam flows are considerably superheated. These bleeder steam flows will then first in an isobaric manner convey their superheating heat for instance from 1 to 2, and subsequently in an isobaric-isothermic manner from 2 to 3 in order to heat up the feed water in the respective preheating stage from 4 to 3'. Inasmuch as the heat deduction from 1 to 2 is effected at the high temperature level with regard to the feed water exit temperature from the respective preheater pertaining thereto, the temperature differences undergo corresponding losses in energy. These losses can be reduced by the application of deheating circuits in which the superheating heat of the bleeder steam of the upper stages is partly conveyed to the feed water after leaving the highest preheater, i.e. at the highest available temperature level.

There have furthermore become known deheating circuits in which the feed water flow, after leaving the regenerative preheater at the highest feed water temperature, is divided into a plurality of feed water flows which are further heated up in deheaters to which bleeder steam is conveyed from various stages.

It is an object of the present invention to improve the economy of circuits of the above mentioned type.

It is a further object of this invention to obtain a maximum heating up of the feed water at a minimum of temperature differences between heat-deducting and heat-absorbing means while the superheating heat inherent to the bleeder steam is taken advantage of to a maximum extent.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

FIG. 1 represents an S-T diagram.

FIG. 2 shows a circuit according to the present invention.

In conformity with the present invention, in a plant with a regenerative preheating, in which feed water partial flows are heated up by bleeder steam branched off from the main flow and deheated, the deheaters are so arranged that the bleeder steam will give off its superheating heat in at least two stages which are serially arranged with regard to the steam side before the bleeder steam in the form of saturated steam enters the feed water preheater intended for receiving the evaporation heat.

This method brings about that the process-internal heat exchange will take place at low energy losses whereby the total degree of efficiency of the steam power process will be improved.

Referring now to the drawings, in FIG. 2, for purposes of simplicity, four different bleeder stages of a turbine have been assumed. The feed water main line is designated with the reference numeral 5 whereas the reference numerals 6, 7 and 8 indicate feed water branch lines. The steam discharged from the bleeder stage 1 passes into the feed water preheater 11 in which it will be condensed. The bleeder steam withdrawn from stage 2 gives off a portion of its superheating heat in a deheater 12, then passes into a further deheater 22 and finally is condensed in the feed water preheater 32. The steam coming from stage 3 successively passes through four deheaters, namely 13, 23, 33, 43, in which the said steam gives off a portion of its superheating heat and is condensed in a heat exchanger 53. The deheaters 13, 23, 33 are passed through by branched off feed water flows, whereas the deheater 43 is interposed in the main feed water flow line. The steam withdrawn from the bleeder stage 4 gives off its superheating heat in the deheater 14 and subsequently gives off additional superheating heat in the deheater 24 and is finally condensed in the feed water preheater 34. Thus, with the bleeder stage 2 on the steam side there are two deheaters 12 and 22 arranged in series, while with the bleeder stage 3 four deheaters 13, 23, 33, 43 and with the bleeder stage 4 again two deheaters 14, 24 are provided. While the deheaters 24, 43 and 22 are passed through by the feed water main flow, in other words are interposed in the main line, the deheater 14 will, when seen from the feed water side, be located in a shunt with regard to the feed water deheater 53, and the deheater 33 will be located in the shunt with regard to the feed water preheater 32. The deheaters 12 and 23 are on the feed water side parallel to the lines 8, 18 and both are located in shunt with regard to the feed water preheater 11. The feed water withdrawn from the deheater 22 thus splits itself up into three partial flows of which the first one representing the main feed water flow, passes through the feed water preheater 11. The partial flow 8 is passed through the deheater 12, and the partial flow 9 is passed through the deheater 23. The partial flows 8 and 9 which flow to the deheaters 12 and 23 are by preceding control valves 18, 19 so controlled that, while considering the steam quantities of different temperatures bled at 2 and 3, as far as possible equal end temperatures of the feed water quantities are obtained which flow through the deheaters. For the same reason, a control valve 17 is arranged ahead of the deheater 33 and in the line 6 ahead of the deheater 14.

It is, of course, to be understood that the present invention is, by no means, limited to the particular arrangements shown in the drawings but also comprises any modifications within the scope of the appended claims.

What I claim is:

1. A circuit for regeneratively preheating boiler feedwater by a plurality of sources of steam tapped from a

turbine supplied by the boiler, each said source having a different degree of superheat, said circuit comprising: a primary feedwater conduit along which the feedwater to be preheated flows, first and second groups of heat exchangers, each heat exchanger having a first passage for feedwater and a second passage for steam, all of said second group of heat exchangers and some of said first group consisting of deheaters in which superheat only is extracted from the steam supplied thereto, the others of the heat exchangers of said first group consisting of preheaters in which the steam supplied thereto is condensed; and the said first passages of the heat exchangers of said first group being serially arranged in said primary conduit, the said first passages of the heat exchangers of said second group being connected in parallel with selected distributed ones of the first passages of the heat exchangers of said first group, valve means connected in series with said first passages of the heat exchangers of said second group to control the rate of feedwater flow therethrough, and at least the second passages of at least one deheater from said second group and one deheater from said first group being connected in series with a respective said source of steam.

2. A circuit according to claim 1 in which said first group of heat exchangers consist of preheaters and deheaters alternately arranged in said primary conduit with the feedwater first passing through a preheater and finally passing through a deheater.

3. A circuit according to claim 2 which includes a further source of steam connected to the said second passage of a preheater of said first group of heat exchangers.

4. A circuit according to claim 2 in which a pair of the said first passages of the heat exchangers of said second group are connected in parallel with the same said first passage of a heat exchanger of said first group.

5. A circuit according to claim 1 in which the said heat exchangers pertaining to a respective source of steam are distributed along the length of said primary conduit so the steam encounters progressively lower feedwater temperatures in passing from the first deheater which it encounters to the preheater in which it is condensed.

6. A circuit according to claim 5 in which each heat exchanger of said second group has its said first passage connected in parallel with the said first passage of a preheater of said first group.

7. A circuit according to claim 6 in which the steam supplied to the said second passage of each deheater of the said first group except the final one thereof is conveyed thereto from the said second passage of the deheater of said second group which has its said first passage in parallel with the first passage of the preheater following the respective deheater of the first group.

8. A circuit according to claim 7 in which the steam leaving the second passage of each deheater of the first group is conveyed to the second passage of the preceding preheater of the first group.

9. A circuit according to claim 8 in which the final preheater of said first group has the said first passage thereof connected in parallel with a pair of the said first passages of deheaters of said second group.

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