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H. TREDE ET AL

1,883,124

INDIRECTLY HEATED STEAM GENERATOR

Filed Dec. 15, 1931

2 Sheets-Sheet 1

Fig. 1.

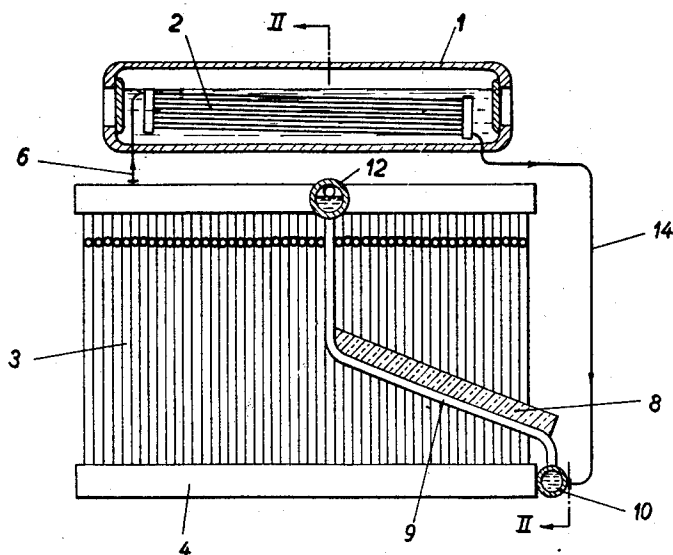
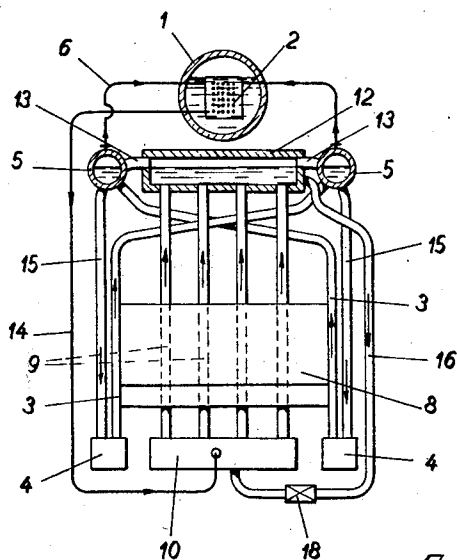


Fig. 2.



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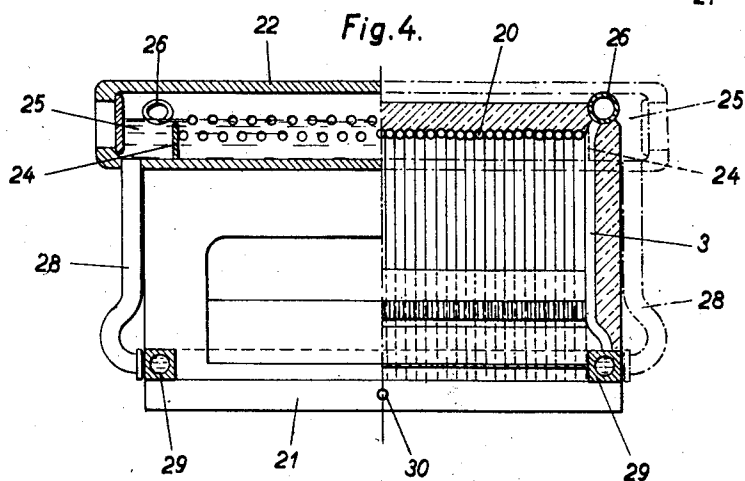
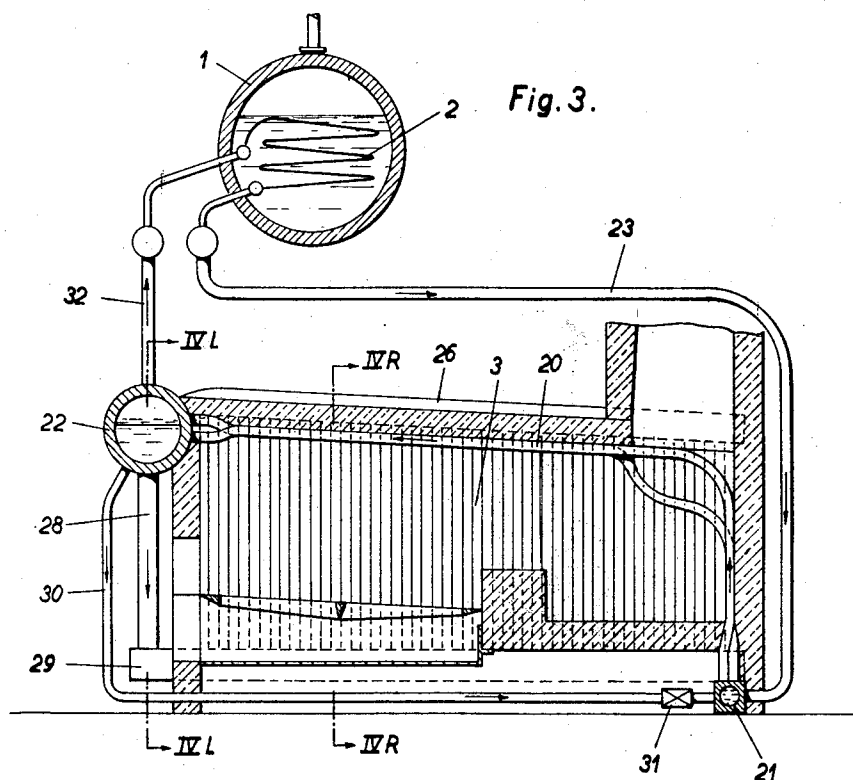
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UNITED STATES PATENT OFFICE

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INDIRECTLY HEATED STEAM GENERATOR

Application filed December 15, 1931, Serial No. 581,252, and in Germany January 10, 1931.

The invention relates to indirectly heated steam generators having a closed circuit in which the heating medium is evaporated in heat receiving tubes outside the boiler drum and condensed in heating elements within the boiler drum. In such steam generators it is usual to connect into the circuit of the heating medium an intermediate header serving as a fluid separator and to return the separated fluid to the circuit by downcomers at suitable points. In such a way, increased circulation of the fluid through the heated tubes of the circuit is secured so that the tubes are well cooled and protected against burning. If heating fluid is lost, by leakage, for instance, at the connections in the circuit, it may happen that the fluid level in the circuit is lowered to such an extent that an insufficient amount of fluid, or even no fluid at all, will flow through the highly heated parts of the heat receiving tubes and these parts will therefore not be cooled sufficiently. In order to secure even under such unfavorable conditions an effective cooling of the exposed or otherwise highly heated parts of the circuit, according to the invention those boiler parts, such as the tubes forming the roof of the combustion chamber, fire bridge tubes, grate cooling tubes and the like, which are exposed to the greatest heat, are connected in the return path of the condensate of the heating medium as it flows from the heating elements of the boiler drum to the heating elements of the furnace. Therefore, the condensate of the heating medium, or a part of it only if the arrangement is applied only to a part of the heat receiving tubes, must flow through the highly heated parts entirely independently of the level of the fluid in the system, because the condensate formed can reach the less highly heated tubes only through the above mentioned intermediate header after it has passed through the highly heated tubes.

The connection according to the invention may be such that the tubes which are first traversed by the condensate are connected to a special intermediate header which in turn is connected with the intermediate headers of the remaining heat receiving tubes. On the other hand, a joint intermediate header

may be provided for all the heat receiving tubes in which a chamber is formed by walls serving as overflow elements to which the heat receiving tubes which are first traversed by the condensate and their downcomers are connected. This arrangement has the advantage that in regular operation, that is, with the usual high fluid level in the system, in addition to the passage of the condensate through these heat receiving tubes, a fluid circulation independent of the flow of the condensate occurs in a shorter path through the intermediate header. If the fluid level in the system sinks below the upper edge of the overflow walls of the separated chamber, cooling is still effected by the condensate from the heating elements because this condensate then moves in what is, in effect, a closed circuit through the most exposed heat receiving surfaces or tubes.

In the drawings, two forms of the invention are shown by way of example.

Fig. 1 is a longitudinal section through one modification.

Fig. 2 is a cross section upon line II—II of Fig. 1.

Fig. 3 is a longitudinal section through another modification.

Fig. 4 is at the left a cross section on line IV L—IV L and at the right a cross section on line IV R—IV R of Fig. 3.

In Figs. 1 and 2, 1 is the indirectly heated boiler drum, 2 the heating elements in the boiler drum, and 3 the heat receiving tubes outside the drum, which are connected at their lower ends to headers 4 and at their upper ends to intermediate headers 5. From these intermediate headers 5 pipes 6 lead to the heating elements 2. It is assumed that the tubes 3 form the side walls of the furnace chamber. In this furnace chamber a fire bridge wall 8 is arranged, which rests on bent tubes 9. These tubes 9 are connected at their lower ends to a header 10 and at their upper ends to an intermediate header 12. The header 10 is separated from the headers 4. The intermediate header 12 is connected to the intermediate headers 5 by couplings 13 so that any steam generated in the fire bridge tubes 9 is led through the pipes 6 to the heat-

ing elements 2 in the drum 1. The heating elements 2 are connected by a condensate discharge pipe 14 to the header 10. The condensate from the heating elements therefore
 5 flows first through the fire bridge tubes 9 and thereafter through the intermediate header 12 into the intermediate headers 5 and from these further into the water tubes 3. In such a way an effective cooling of the especially
 10 highly heated bridge wall supporting tubes is secured by the condensate as it flows from the heating elements.

The intermediate headers 5 are connected by the downcomers 15 to the headers 4 and
 15 the intermediate header 12 is connected by a downcomer 16 to the header 10. In this way, in addition to the main circuit of the heating medium which leads from the water tubes, that is, the tubes 3 and the bridge wall
 20 supporting tubes 9, through the intermediate headers 12 and 5 and the pipes 6 to the heating elements 2, fluid circuits having shorter paths are formed as well by the water tubes 3 and by the fire bridge tubes 9.
 25 Into the downcomer 16 a non-return valve or other device 18 is connected which permits the circulation in the shorter circuit 10, 9, 12, 16 in one direction only.

In Figs. 3 and 4, 1 is the indirectly heated
 30 boiler drum, 2 the heating elements in this drum, and 3 the water tubes arranged as side wall tubes. In the return path of the condensate from the heating elements the tubes 20 forming the roof of the combustion chamber are connected. These tubes 20 are connected
 35 at their lower ends to a header 21 and at their upper ends to an intermediate header 22. The condensate return pipe 23 connects the heating elements 2 with the header 21.
 40 The inlets of the roof tubes 20 into the intermediate header 22 lie in a middle chamber of the header which is separated by intermediate walls 24 from the side chambers 25 of the header. The intermediate walls 24 do not
 45 extend completely across the header 22 but only a little above a central horizontal plane, and serve therefore as overflows over which the heating medium can flow from the middle part of the header to the side chambers
 50 when it is at its normal level. Headers 26 enter the side chambers 25 and water tubes 3 are connected at their upper ends to these headers. Downcomers 28 also start from these side chambers 25 and lead to headers
 55 29 to which the water tubes 3 are connected at their lower ends. Downcomer 30 leads to the header 21 from the middle chamber of the intermediate header 22. A device 31 is connected in the downcomer 30 which permits the fluid to circulate only in one direction. The main circuit of the heating medium is completed by a pipe 32 connecting
 60 the intermediate header 22 with the heating elements 2. This circuit leads from the heat receiving tubes, that is, from the side wall

tubes 3 and the roof tubes 20, through the intermediate header 22, the pipe 32, the heating elements 2 and the condensate return 23 to the header 21. In addition to the main circuit of the heating medium, fluid circuits having
 70 shorter paths are provided through the intermediate header 22 for the side wall tubes 3 and for the roof tubes 20, that for the side wall tubes 3 through the downcomers 28 and the headers 29, 26 and that for the roof tubes
 75 20 through the downcomer 30 and the header 21. Since the condensate from the heating elements 2 must flow first through the roof tubes 20 before it can get to the intermediate header 22 and from this header to the water
 80 tubes 3, a sufficient cooling action on these especially highly heated roof tubes is secured. It is also obvious that, even if the fluid level becomes so low that the quantity in the middle chamber of the header 22 is
 85 insufficient to overflow the walls 24, there will still be a circulation through the shorter circuit including the roof tubes 20 and the downcomer 30 which will cool the roof tubes enough to prevent them from burning out.
 90 At the same time, any steam generated in these tubes will pass to the heating elements, and the condensate will be returned to the roof tubes.

In the described examples it has been assumed that all the condensate of the heating
 95 elements in the drum 1 is led first to the tubes which are most highly heated. If the highly heated heating surface which is to be cooled forms only a very small part of the complete heating surface it is of course
 100 also permissible to lead only a part of the condensate through the especially highly heated surface and then to the remaining heating surface, and to lead the other part of the condensate directly to the less highly
 105 heated heating surface.

Having now described our invention, what we now claim as new and desire to secure by Letters Patent of the United States is as follows:

1. In a steam generator in which steam is generated by the indirect system by means of a heating medium flowing in a closed circuit, said circuit including heat receiving tubes
 115 some of which are more highly heated than others and heating elements, a substantially horizontal header, an overflow wall in said header dividing the same into a plurality of chambers, the highly heated tubes being connected to one of said chambers, the less highly heated tubes being connected to the other of said chambers, and means to conduct the condensate from said heating elements first to
 120 said highly heated tubes and through said tubes to said first chamber.

2. In a steam generator in which steam is generated by the indirect system by means of a heating medium flowing in a closed circuit

cuit, said circuit including heat receiving tubes some of which are more highly heated than others and heating elements, lower and intermediate headers to which said highly	
5 heated tubes are connected, means to conduct the condensate from said heating elements first to said lower header and through said highly heated tubes to said intermediate header, connections from said intermediate	
10 header to the less highly heated tubes, a downcomer connecting said headers, and means in said downcomer to permit flow of fluid therethrough from said intermediate header to said lower header only.	70
15 3. In a steam generator in which steam is generated by the indirect system by means of a heating medium flowing in a closed circuit, said circuit including heat receiving tubes some of which are more highly heated than	75
20 others and heating elements, lower and intermediate headers to which said highly heated tubes are connected, other lower and intermediate headers to which said less highly heated tubes are connected, means connecting said	
25 first intermediate header to said second intermediate header, means to conduct the condensate from said heating elements first to said first lower header and through the highly heated tubes to said first intermediate header.	80
30 4. In a steam generator in which steam is generated by the indirect system by means of a heating medium flowing in a closed circuit, said circuit including heat receiving tubes some of which are more highly heated than	85
35 others and heating elements, lower and intermediate headers to which said highly heated tubes are connected, other lower and intermediate headers to which said less highly heated tubes are connected, means connecting said	
40 first intermediate header to said second intermediate header, means to conduct the condensate from said heating elements first to said first lower header and through the highly heated tubes to said first intermediate header,	90
45 and downcomers connecting each intermediate header to the corresponding lower header.	95
5. In a steam generator in which steam is generated by the indirect system by means of a heating medium flowing in a closed circuit, said circuit including heat receiving tubes some of which are more highly heated than	
50 others and heating elements, a substantially horizontal header, an overflow wall in said header dividing the same into a plurality of chambers, the highly heated tubes being connected to one of said chambers, the less highly heated tubes being connected to the other of said chambers, a lower header to which the	100
55 highly heated tubes are connected, a second lower header to which the less highly heated tubes are connected, means to conduct the condensate from said heating elements to said first lower header, and downcomers connecting said first chamber to said first lower head-	105
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er and said second chamber to said second lower header.

In testimony whereof, we have hereunto set our signatures.

HANS TREDE.

OTTO H. HARTMANN.