Oct. 25, 1932. D. W. RUDORFF 1,884,263

SUPERHEATER

Filed March 5, 1931

Fig. 1

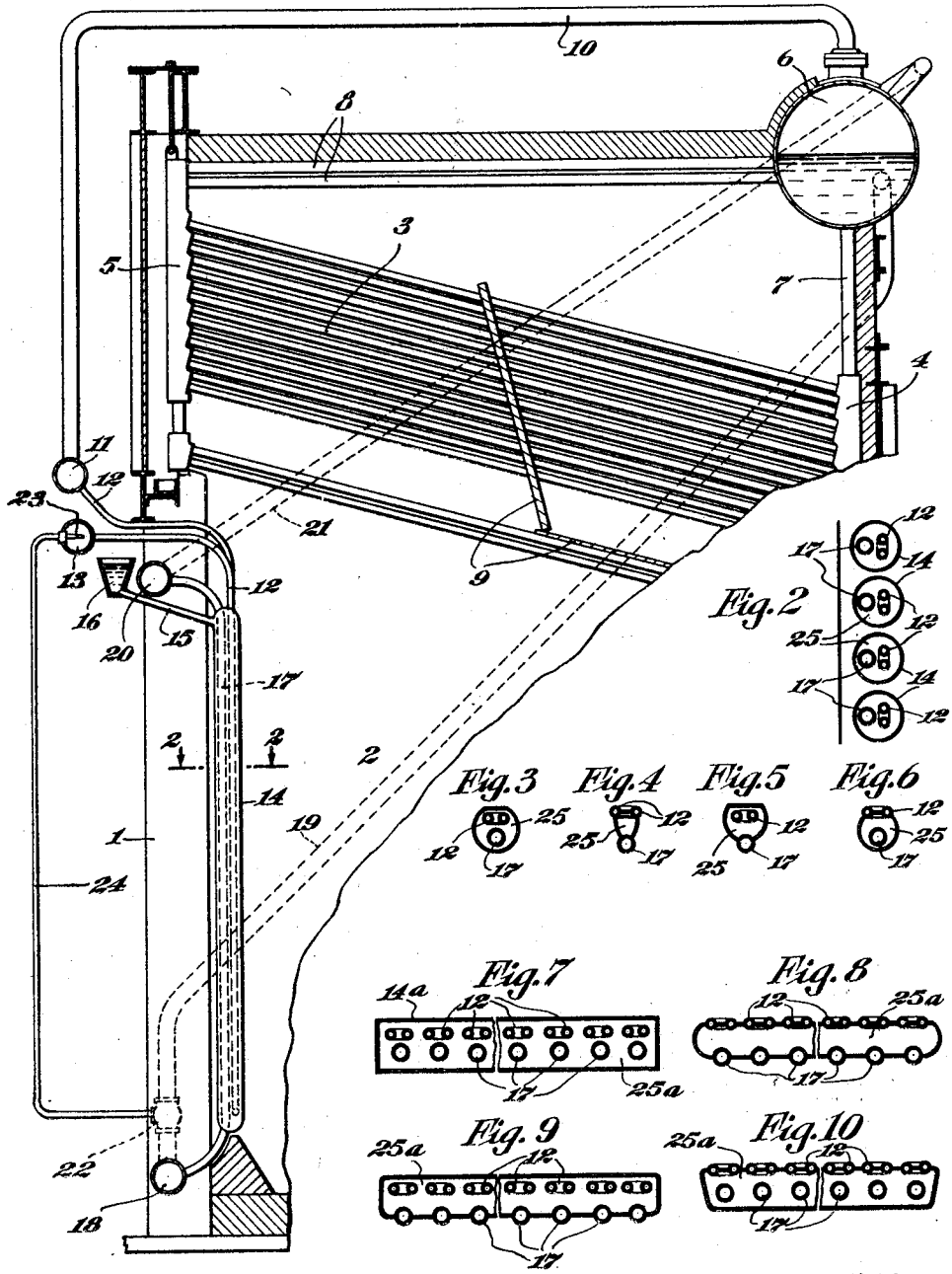

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 10

INVENTOR
Dagobert W. Rudorff
BY O. V. Thiele
ATTORNEY

Patented Oct. 25, 1932 1,884,263

UNITED STATES PATENT OFFICE

DAGOBERT W. RUDORFF, OF NEW YORK, N. Y., ASSIGNOR TO THE SUPERHEATER COMPANY, OF NEW YORK, N. Y.

SUPERHEATER

Application filed March 5, 1931. Serial No. 520,205.

This invention relates to devices for regulating the temperature of superheated steam and has for its object the provision of an improved apparatus and method for this purpose. The invention is illustrated in the drawing accompanying the present specification in which drawing

Fig. 1 shows a fragmentary vertical longitudinal section through a water-tube boiler equipped with my invention;

Fig. 2 is a cross-section on line 2—2 of Fig. 1;

Figs. 3 to 6 are transverse sectional views of different forms of the elements of the structure used to carry out my invention;

Figs. 7 to 10 are four further views showing different forms of groups of elements which may be used to carry out the invention.

The invention, as briefly pointed out above, relates to the regulation of the temperature of superheated steam and for the purpose of illustrating a source of superheated steam I show a horizontal water-tube cross drum type of boiler. The setting 1 incloses the furnace 2 below the water tube 3, the latter being connected to lower headers 4 and upper headers 5. Water from the steam and water drum 6 is carried to the headers 4 through the pipes on nipples 7 and a steam and water mixture is carried through the pipes 8 back to the steam and water drum 6. Baffling 9 directs the products of combustion from the furnace 2 on their way to the stack connection (not shown). The steam that is liberated in the steam and water drum 6 is carried by means of the pipe 10 to the superheater inlet header 11. This header delivers the steam to a series of superheater elements 12 which are arranged inside of the furnace in a manner presently to be described to absorb heat from the furnace and thereby to superheat the steam. The other ends of the tubular superheater elements 12 are connected to the outlet header 13 whence the steam is taken to the point of consumption.

In the form shown in the illustration, the superheater is placed against one of the furnace walls, so that it receives a large share of its heat by direct radiation from the fire. Instead, however, of arranging the bare superheater elements 12 in a row against the furance wall as has been done heretofore, I arrange them inside of a casing or casings, which may take a variety of forms. In the form of the invention illustrated in Figs. 1 and 2, the superheater elements 12 are each placed in a casing 14. This casing is a closed chamber having a connection 15 to a container 16 arranged at a somewhat higher level. Each superheater element 12 is, in the form shown, made up of two branches connected at their lower ends by a return bend. Both of the branches pass through the wall of the casing 14 at its top.

Also arranged within each casing 14 is a water tube 17. As shown in the form of the invention according to Fig. 1, the water tubes enter the casing 14 at the top and leave at the bottom. They are hermetically sealed at these points into the casing. The lower ends of the tubes 17 are connected to a common header or manifold 18 which communicates with the water space of the steam and water drum by means of the pipe 19, whereas the upper ends of the pipe 17 are connected to a common manifold or header 20 which is in communication by means of the pipe 21 with the steam space of the drum 6. In the pipe 19 there is preferably placed a valve 22 shown in Fig. 1 as of a thermostatic type acting in response to the temperature of the steam in header 13. For this purpose a thermostatic element is shown at 23 within the header 13 connected to the valve operating mechanism of the valve 22 by means of the pipe 24.

The inside of each casing 14 is filled with a metal which will remain fluid at the temperatures involved, preferably such a metal as Wood's metal. The metal is filled in through the chamber 16 and its level is maintained somewhere within this chamber 16.

The operation of the device is as follows: The walls of the casings 14 which lie on the side toward the furnace absorb heat principally by radiation and to a slighter degree by convection and transmit the heat to the melted metal within. This metal gives up heat to the steam flowing through the units 12 as well as to the water within the tubes 17.

The presence of the tubes 17 with their volume of water inside prevents the temperature of the melted metal rising to such a degree that either the superheater tubes or the casings 14 would be injured. During periods of firing up and at other times when the superheater and the casings 14 require protection, the valve 22 will be wide open so that the maximum amount of heat abstraction by means of water in the tubes 17 can be obtained. The superheater is thereby protected even with no steam flowing through it,—a condition which exists particularly during firing up periods.

After steam has begun to be liberated in drum 6 and to be drawn off from header 13, this steam will itself in part protect the superheater tubes and the casings 14. Under some conditions it may be unnecessary to retain any water in the tubes 17. The valve 22 can therefore under such conditions be closed entirely, the water in the tubes 17 being allowed to evaporate without being replenished. The maximum degree of superheat will then be obtained. If it is desired to lower the degree of superheat somewhat, the valve 22 is opened partly, thereby admitting some water into the tubes 17. If it is admitted at the right rate, the tubes 17 will not be filled entirely with water and the cooling effect will be confined particularly to the lower part of the arrangement. In this way, the steam will not have as high a temperature upon delivery to the header 13 as it would were there no water present in the tubes 17. By opening the valve 22 to a further or lesser degree, the temperature of the steam can be anything desired within limits. Preferably, the valve 22 is given its position automatically in response to the steam temperature in header 13 by the thermostatic arrangement described above, including the thermostatic element 23, the valve 22, and the connecting pipe 24. This is a perfectly well-known arrangement and it is therefore believed unnecessary to describe it in any detail.

It will be clear that a number of variations are possible in the general arrangement without losing the real inventive thought. Whereas in the form just described and illustrated in Fig. 2, the superheater tubes and the water tubes lie within the casings 14 (this arrangement being repeated in Fig. 3). A structure like that in Fig. 4 may be used. Here the superheater tubes 12 are arranged in the same general relation to the water tube 17 as in the form first described but instead of lying inside of the casing they are connected by means of plates to form an interior triangular space 25 and this space is filled with the melted metal. It will be seen that the action of the apparatus is in a general way similar to that of the form first described although the superheater elements are here exposed to a little more severe conditions and the cooling effect of the tube 17 is not as great.

In Fig. 5 is shown a form which may be regarded as a combination of the first two. The superheater pipes 12 here lie within the casing but the pipe 17 lies in the same relative position as in Fig. 4, that is, it has the two longitudinal edges of the casing welded to it in such a manner that the tube lies partly within and partly without the casing. The melted metal is of course in the space 25.

In Fig. 6 the superheater tubes are in the relative position they are in Fig. 4 and the water tube is placed entirely within the space 25.

Instead of having a separate casing for each superheater element and its associated water tube, a number of these elements and tubes may be placed in a single casing. This is illustrated in Fig. 7 where the casing 14*a* incloses a plurality of superheater elements 12 and water tubes 17. The space 25*a* is here filled with melted metal. In Fig. 8 the space 25*a* is defined by a plurality of superheater elements 12 and water tubes 17 connected together by a series of plates to form a closed chamber as will be clear from an inspection of the figure.

In Fig. 9 the superheater elements 12 lie entirely inside and the water tubes 17 partly inside and partly outside of the chamber 25*a*, whereas in Fig. 10 the arrangement is reversed, the water tubes 17 lying completely within and the superheater tubes 12 partly within and partly without the space 25*a*.

I claim:

1. In apparatus of the class described, the combination of a structure comprising a receptacle, liquid metal in said receptacle, and two conduits in heat transferring relation to said liquid metal, means to heat the structure; means to circulate through one of said conduits a fluid to be heated, and means to circulate a cooling fluid through the other of said conduits.

2. In apparatus of the class described, the combination of a structure comprising a receptacle, liquid metal in said receptacle, and two conduits in heat transferring relation to said liquid metal; means to heat the structure; means to circulate a fluid to be heated through one of the conduits; and means to circulate a cooling fluid at a controlled rate through the other conduit.

3. In apparatus of the class described, the combination of a boiler, a furnace therefor, a steam superheater comprising a structure exposed to heat from the furnace and comprising a receptacle, a liquid metal in said receptacle, and two conduits in heat transferring relation to said liquid metal; means to convey steam from the boiler to one end of one of said conduits; means to take steam away from the other end of said conduit; and means to circulate a cooling fluid at a controlled rate through the other conduit.

4. Apparatus in accordance with claim 3,

and further including means to control the rate of the introduction of the cooling fluid into the second conduit automatically in response to temperature changes of the steam leaving the first conduit.

5. In apparatus of the class described, the combination of a boiler, a furnace therefor, a steam superheater exposed to radiant heat from the furnace and comprising a casing, a liquid metal filling the casing, a conduit to convey a fluid through the liquid metal out of communication with it but in heat transferring relation to it, means to convey steam from the boiler to one end of said conduit, means to convey it away from the other end of the conduit, a second conduit extending through but not opening into the liquid metal in the casing, means to introduce water from the boiler into one end of said second conduit, and means to convey back to the boiler from the other end of the second conduit any steam forming in it.

6. Apparatus in accordance with claim 5 and further comprising a thermostatically controlled valve in the means supplying water to the second conduit and regulating the quantity in response to temperature conditions in the steam leaving the first conduit.

7. In a radiant type superheater, means to protect the superheater at times when no steam or an insufficient quantity of steam is flowing through it, comprising water cooled pipes, liquid metal contacting with the superheater and wtih the water cooled pipes, and means to contain said liquid metal.

8. In a radiant type superheater comprising a tubular superheater element through which the steam flows, means to protect the element at times when no steam or insufficient steam is flowing through it comprising a water cooled pipe, a casing surrounding the element and the pipe, and a liquid metal filling the space in the casing outside of the element and the pipe.

9. In a radiant type superheater comprising a tubular superheater element through which the steam flows, means to regulate the temperature of the steam at the outlet of the element comprising a pipe, a casing surrounding the element and the pipe, a liquid metal filling the space in the casing outside of the element and the pipe, and means to introduce a cooling medium into the pipe at a rate responsive to the temperature of the steam at the outlet from the element.

10. In apparatus of the class described, the combination of a boiler, a furnace therefor, an alined series of elongated metallic casings arranged in upright position adjacent to one wall of the furnace, a receptacle above and in communication with the casings, a superheater element extending into each casing but not opening into it, means to deliver steam from the boiler to and take it away from the elements, a pipe extending lengthwise through each casing without opening into it, means to deliver water from the boiler to the lower ends of the pipes and to deliver steam from the upper ends to the boiler drum, a thermostatically controlled valve in the means supplying water to the pipes operative in response to the temperature of the steam at the outlet from the elements, and liquid metal filling the receptacle and the space in the casing outside of the elements and the pipes.

DAGOBERT W. RUDORFF.