Aug. 14, 1951 J. F. SEBALD 2,564,583

DEAERATING FEEDWATER HEATER

Filed Sept. 30, 1948 2 Sheets-Sheet 1

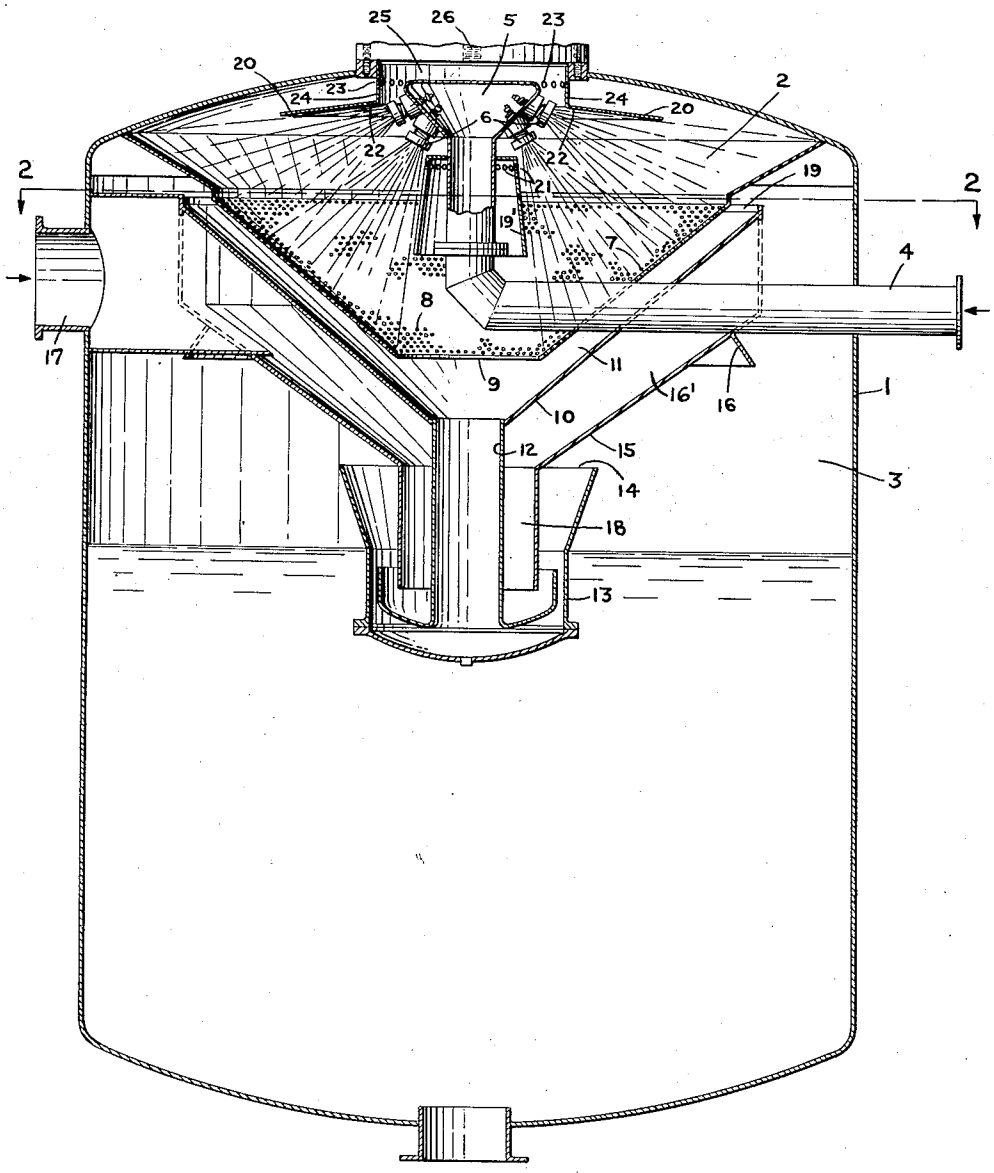


FIG. 1

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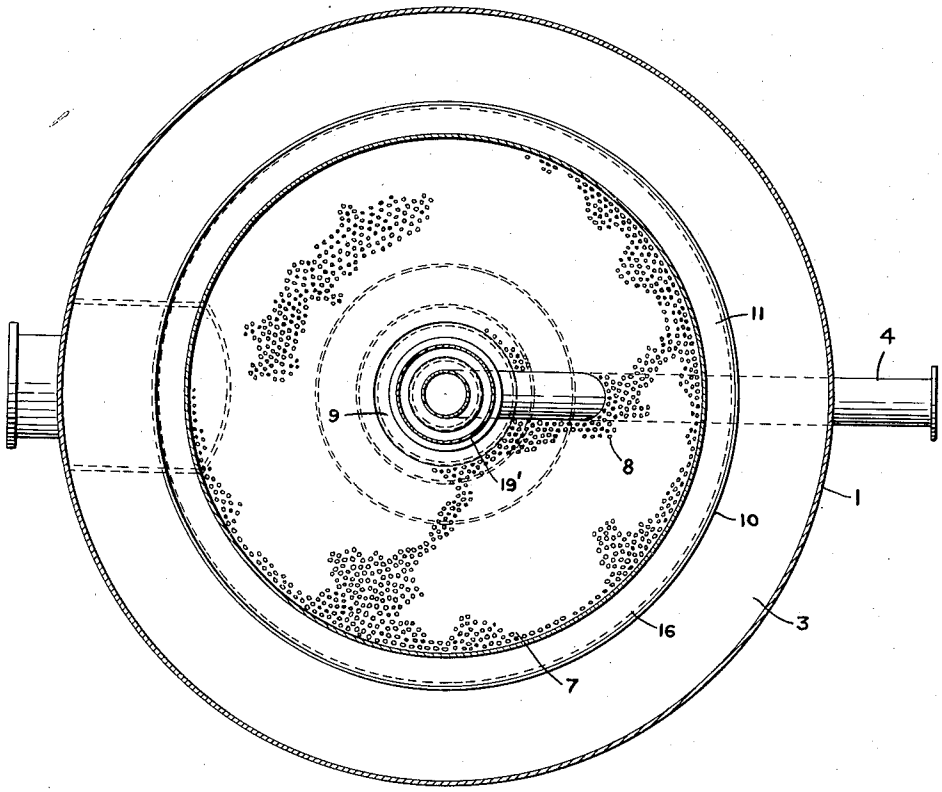


FIG. 2

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DEAERATING FEED-WATER HEATER

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9 Claims. (Cl. 261—115)

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This invention relates to apparatus for heating and degasifying liquids, particularly such apparatus known in the art as "jet type" heaters wherein the water to be heated and degasified is sprayed into or mixed in direct contact with the heating steam and is projected into a low pressure area for "flashing" or reboiling for heating the water and separating the non-condensible gases, particularly oxygen, from the heated water. Such heaters, while all of the common general type, are known in the trade as the atomizing type heater, shown for example in prior Patents 2,315,227 of March 30, 1943, and 2,321,839 of June 15, 1943, and the intimate mixing type shown for example, in Patents 2,308,719 and 2,308,721 of January 19, 1943.

In water heaters of these direct contact types all of the heating steam is not condensed in the heating and degasifying operation of the apparatus and vent condensers are employed such as shown at U in Patent 2,315,227; at 31' in Patent 2,321,839; at 30 in Figure 1 of Patent 2,308,719, and at 5 in Patent 2,308,721 in the apparatus for condensing the residual steam and cooling the non-condensible gases which later are released to atmosphere, while the condensed steam is returned as liquid condensate to the apparatus. Such vent condensers which are universally employed with water heaters and deaerators of the type above referred to, as well as with those of the earlier tray type of heater are surface type condensers and are relatively expensive to manufacture, are heavy and materially increase the space required for installation of the apparatus. These qualities are undesirable in modern power plant construction and particularly in marine power plants, wherein space on shipboard is at a premium and in which it is desired to keep the weight of such equipment or apparatus at a minimum.

On object of the present invention is to provide in water heating and degasifying apparatus as above referred to, direct contact means contained within the shell of the heater and degasifier for condensing the residual steam, i. e., the steam which is not condensed during the heating and degasifying operation of the apparatus.

More specifically, the present invention comprises a feed-water heater and degasifier of the type above referred to wherein the spray pattern of the incoming cold water is so arranged and so baffled that the flow path of the residual steam is counter-current to the flow of the incoming cold water and the spray nozzles which spray the incoming cold water into the heater are so located and their spray pattern is so baffled as to provide a restriction for the steam flowing towards the spray valves with the baffling arranged so as to force a major portion of the residual steam through the coldest section of the spray pattern of cold water prior to the discharge of any non-condensed residual steam and released non-condensible gases to atmosphere.

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With these and other objects in view, as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, showing a deaerating feed water heater of a preferred form embodying the invention, and the features forming the invention will be specifically pointed out in the claims.

In the drawings

Figure 1 is a vertical section through a fragment of a feedwater heater and degasifier constructed in accordance with the present invention.

Figure 2 is a cross section taken on line 2—2 of Figure 1.

Referring more particularly to the drawings, the improved feedwater heater comprises a shell 1 including a first or initial heating chamber 2 and a second or low pressure heating and degasifying chamber 3.

The feedwater to be heated enters the heater and degasifier through the water inlet pipe 4 and passes to a spray head 5 located preferably near the top or uppermost portion of the shell 1. A plurality of spray valves 6 of any approved construction which may be purchased upon the open market are connected to the spray head 5 and spray the cold water to be heated and degasified into the first or initial heating chamber 2. The water, passing through the initial or first chamber 2 strikes against the conical baffle 7. The conical baffle 7 is perforated as shown at 8 and is provided with a relatively large opening 9 at its center and lowermost portion. The water passing through the perforations 8 and through the central opening 9 falls upon a conical baffle 10 which extends parallel to the conical baffle 7, as clearly shown in Fig. 1 of the drawings. From the space 11 between the baffles 7 and 10 the water flows through a down pipe 12 into the mixer structure 13 where it is thoroughly mixed with steam in intimate direct contact and projected from the outlet 14 of the mixing structure 13 against the bottom of the baffle 15 and the deflecting baffle 16. The baffles 15 and 16 tend to break up the flow of steam and water and direct it into the

second chamber 3 wherein the pressure is reduced, resulting in a release of the non-condensible gases.

The steam enters the feedwater heater and degasifier through a steam inlet 17 into the enclosed conical space 16' formed between the baffles 10 and 15 and thus the steam and water are introduced into the mixing apparatus 13 in substantially parallel extending relationship and in a separated but thermal-heat-exchange relationship. The steam passes into the mixing apparatus 13 through the annular space 18 which surrounds the water inlet 12 and from the outlet of the annular space 18 enters the mixing passage where it is thoroughly mixed with the water and discharged into the second or degasifying chamber 3.

As clearly shown in Fig. 1 of the drawing, the uppermost portion of the space 11 formed between the perforated baffle 7 and the imperforate baffle 10 opens, as shown at 19, into the uppermost portion of the second chamber 3 and thus the residual steam and released non-condensible gases flow from the chamber 3 into the annular space 11 from whence some of the steam passes through the perforations 8 into the first chamber 2 while the major portion of the steam is directed to the central opening 9 in the perforated baffle 7. By directing the major portion of the steam to the central opening 9 the steam will serve to "scrub" the water flowing through the perforations 8 into the space 11. From the opening 9 the residual steam and released non-condensible gases flow upwardly through the first chamber 2 towards the coldest part of the water being sprayed into the first chamber 2, that is, towards the spray valves 6 in a direction counter-current to the flow of the water sprayed into and through the first chamber 2. The spray valves 6 are so located and their spray pattern is so baffled by means of the centrally disposed annular baffle 19' and the upper baffle 20 as to provide a restriction of the steam flowing toward the spray valves and to force the residual steam through the spray pattern of the incoming cold water. The centrally disposed annular baffle 19' encircles the cold water inlet pipe 4 for a portion of its length, as clearly shown in Figure 1 of the drawings, and it serves to assist in maintaining the desired water flow pattern and to prevent steam from short-circuiting across the chamber 2. The baffle 19' provides an enclosed downwardly opening space and it is provided with a plurality of perforations 21 near its closed top to permit the escape of any non-condensible gases which might enter the confined space within the baffle.

The upper substantially horizontal baffle 20 which is placed above the spray valves 6 so as to prevent upward flow of the water is provided with a plurality of perforations 22 to permit the passage of released non-condensible gases and any small quantity of residual steam which is not condensed in the first chamber 2 to pass into the space in the top of the shell or housing 1 and from this space the released non-condensible gases and the non-condensed residual steam passes through openings 23 in the annular baffle 24 into the space 25. This prevents any pocketing of non-condensible gases in the space between the baffle 20 and the top of the shell 1. Released non-condensibles and remaining non-condensed vapor also pass through the sprays of water and into and through the space 25 around the spray head 5. The space 25 is formed at the top of the shell 1 and is opened to atmosphere through an atmospheric vent 26 which permits the escape of the released non-condensible gases together with any residual steam which is non-condensed in the first space 2, to atmosphere.

By the arrangement of the spray nozzles and the various baffles to provide the above described flow paths of the incoming cold water and the residual steam practically all of the residual steam will be condensed within the shell 1 of the heater and the use of vent condensers as above referred to in connection with the various patents itemized will be eliminated, thereby materially reducing the weight of the feedwater heating and degasifying apparatus, as well as reducing its cost without sacrificing any of the advantages.

In the claims, as in the foregoing specification the term "residual steam" is used to designate the steam which is not condensed by its direct heat exchange and degasifying contact with the water in the second or low pressure chamber 3 of the apparatus.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown, but that they may be widely modified within the invention defined by the claims.

What is claimed is:

1. In a water heating and degasifying apparatus, a housing, a pair of operably connected first stage and second stage treatment chambers in said housing, means for introducing water to be heated and degasified into said first stage chamber including a spray head and a plurality of spray nozzles carried thereby, said spray nozzles arranged to spray the incoming water into said first stage treatment chamber in downwardly diverging substantially conical flow patterns composed of broken up diverging fine streams, second means for introducing steam into said second stage chamber, means for introducing water from said first stage chamber into said second stage chamber including an inverted substantially frustroconical baffle, means operably associated with both of said second means and said water introducing means for directing water and steam being introduced into said second chamber into direct heat exchange and degasifying relationship with respect to each other, an inclined inverted frustroconical baffle carried within said housing and extending across the upper end of said second stage chamber in spaced relation to the inverted baffle of said water introducing means to provide a transverse passage for non-condensible gases and residual steam from said second stage chamber into said first stage chamber, said inclined baffle having an opening in its lowermost portion opening upwardly into said first stage chamber to direct steam into the first stage chamber in countercurrent direction to the sprayed water and a substantially frustroconical baffle in said first stage chamber and located substantially centrally of the downwardly diverging conical flow pattern of the incoming water.

2. A water heating and degasifying apparatus as claimed in claim 1 wherein said shell has an accumulation space for non-condensible gases and non-condensed vapor therein said space being located about and above said spray head, and a vent in said accumulation space to vent the non-condensible gases and residual steam to atmosphere.

3. A water heating and degasifying apparatus as claimed in claim 1 wherein said shell has an accumulation space for non-condensible gases and non-condensed vapor therein said space being located about and above said spray head, a vent in said accumulation space to vent the non-condensible gases and residual steam to atmosphere, an inclined baffle in said housing extending into said first stage chamber in spaced relation to said second water introducing means to provide a prolonged inlet passage for incoming residual steam and non-condensible gases.

4. A water heating and degasifying apparatus as claimed in claim 1 wherein said shell has an accumulation space for non-condensible gases and non-condensed vapor therein said space being located about and above said spray head, and a vent in said accumulation space to vent the non-condensible gases and residual steam to atmosphere, a baffle about the inlet to said accumulation space to prevent by-passing of residual steam and non-condensible gases to said accumulation space, said baffle provided with perforations to prevent pocketing of non-condensibles in the space between the baffle and shell.

5. In a water heating and degasifying apparatus, a housing, a pair of operably connected stage treatment chambers in said housing, means for introducing water to be heated and degasified into the first of said chambers, means for introducing steam into the second of said chambers, means for introducing water from said first chamber into said second chamber, means for directing water and steam being introduced into said second chamber into a direct heat exchange and degasifying relationship with respect to each other, said means for introducing water from said first chamber into said second chamber comprising upper and lower parallel baffles forming an annular space between them which is open at its perimeter to said second chamber to permit residual steam and released gases to pass from the second chamber into the first chamber, said baffles being provided with openings at their centers to allow water to pass from the first chamber to the second chamber, said uppermost of said parallel baffles being provided with a plurality of perforations to permit water and some residual steam to pass therethrough in countercurrent directions.

6. Water heating and degasifying apparatus as claimed in claim 5 wherein the central opening in said upper baffle is relatively large to permit the major portion of the steam to pass into the first chamber through said large central opening and effect a scrubbing action on such matter as passes through said perforations.

7. In a water heating and degasifying apparatus, a housing, a pair of operably connected stage treatment chambers in said housing, a plurality of spray valves for spray water into the first of said chambers, means for introducing steam into the second of said chambers, means for introducing water from said first chamber into said second chamber, both of said means being arranged to maintain the water and steam in a separated but thermal heat exchange relationship, means operably associated with said steam and water introducing means for directing water and steam being introduced into said second chamber into a direct heat exchange and degasifying relationship with respect to each other, means for delivering residual steam from said second chamber to said first chamber, said water introducing means and said residual steam delivering means so constructed and arranged that the residual steam entering the first chamber will flow towards the cold water in a countercurrent direction with respect to the flow path of the water in said chamber, baffles in said first chamber, said spray valves and said baffles being arranged so as to provide a restriction to the flow of residual steam flowing through said first chamber, said means for introducing water from said first chamber into said second chamber comprising upper and lower parallel baffles forming an annular space between them which is open at its perimeter to said second chamber to permit residual steam and released gases to pass from the second chamber into the first chamber, said upper baffle being provided with a plurality of perforations to permit water and some steam to pass therethrough in countercurrent direction.

8. In a water heating and degasifying apparatus, a housing, a pair of operably connected stage treatment chambers in said housing, a plurality of spray valves for spraying water into the first of said chambers, means for introducing steam into the second of said chambers, means for introducing water from said first chamber into said second chamber, both of said means being arranged to maintain the water and steam in a separated but thermal heat exchange relationship, means operably associated with said steam and water introducing means for directing water and steam being introduced into said second chamber into a direct heat exchange and degasifying relationship with respect to each other, means for delivering residual steam from said second chamber to said first chamber, said water introducing means and said residual steam delivering means so constructed and arranged that the residual steam entering the first chamber will flow towards the cold water in a countercurrent direction with respect to the flow path of water in said chamber, baffles in said first chamber, said spray valves and said baffles being arranged so as to provide a restriction to the flow of residual steam flowing through said first chamber, said means for introducing water from said first chamber into said second chamber comprising upper and lower parallel baffles forming an annular space between them which is open at its perimeter to said second chamber to permit residual steam and released gases to pass from the second chamber into the first chamber, said upper baffle provided with a relatively large opening at its center for the passage of residual steam therethrough into the first chamber.

9. In a water heating and degasifying apparatus, a housing, a pair of operably connected first stage and second stage treatment chambers in said housing, means for introducing water to be heated and degasified into said first stage chamber including a spray head and a plurality of spray valves carried thereby, said spray valves arranged to spray the incoming water into said first stage treatment chamber in downwardly diverging substantially conical flow patterns composed of broken-up diverging fine streams, means for introducing steam into said second stage chamber, means for introducing steam from said second stage chamber into said first stage chamber including a baffle having a centrally disposed opening for directing steam into the first stage chamber in countercurrent flow direction to the flow direction of the incoming sprayed water, and a centrally disposed annular baffle in said first stage chamber substantially in line with said

opening to provide a restriction for steam flowing towards said spray valves and to force the major part of such steam through the sprays of water, a substantially horizontal baffle in said housing above said spray valves to prevent upward flow of incoming water, said substantially horizontal baffle having an annular extension baffle connected thereto and forming a confined non-condensible collection space above said spray head, said annular baffle provided with openings to permit passage of non-condensibles into said collection space, and said housing provided with a vent opening into said collection space.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
695,320	Matthews	Mar. 11, 1902
899,063	Mueller	Sept. 22, 1908
1,792,164	Holland	Feb. 10, 1931
2,308,721	Sebald	Jan. 19, 1943
2,344,554	McDermet	Mar. 21, 1944
2,345,217	Rohlin	Mar. 28, 1944