

March 20, 1956

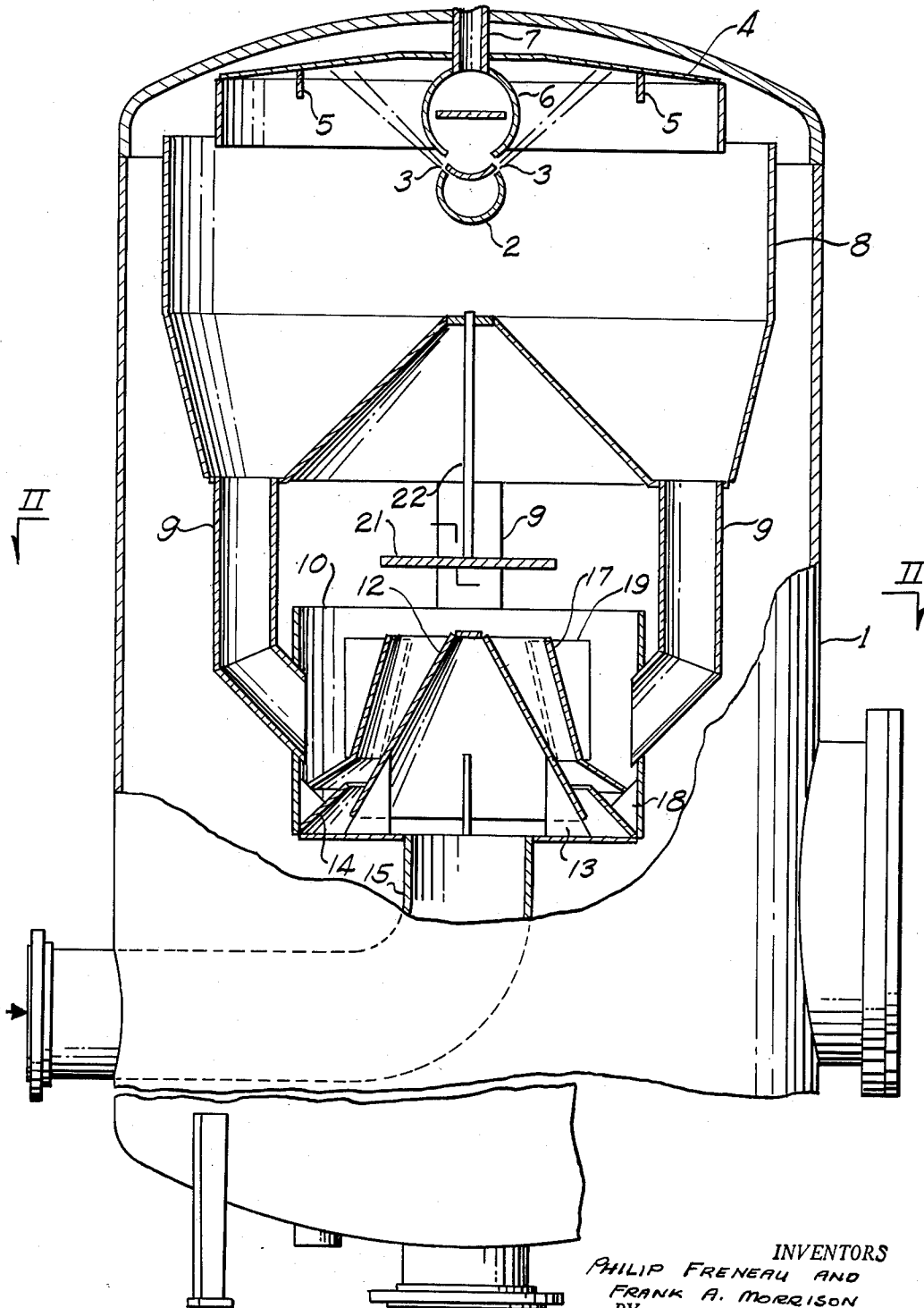
P. FRENEAU ET AL

2,738,852

DEAERATING HEATER

Filed Feb. 9, 1954

4 Sheets-Sheet 1



INVENTORS
PHILIP FRENEAU AND
FRANK A. MORRISON
BY

Brown, Cutchlow, Hick & Leckham
THEIR ATTORNEYS

March 20, 1956

P. FRENEAU ET AL

2,738,852

DEAERATING HEATER

Filed Feb. 9, 1954

4 Sheets-Sheet 2

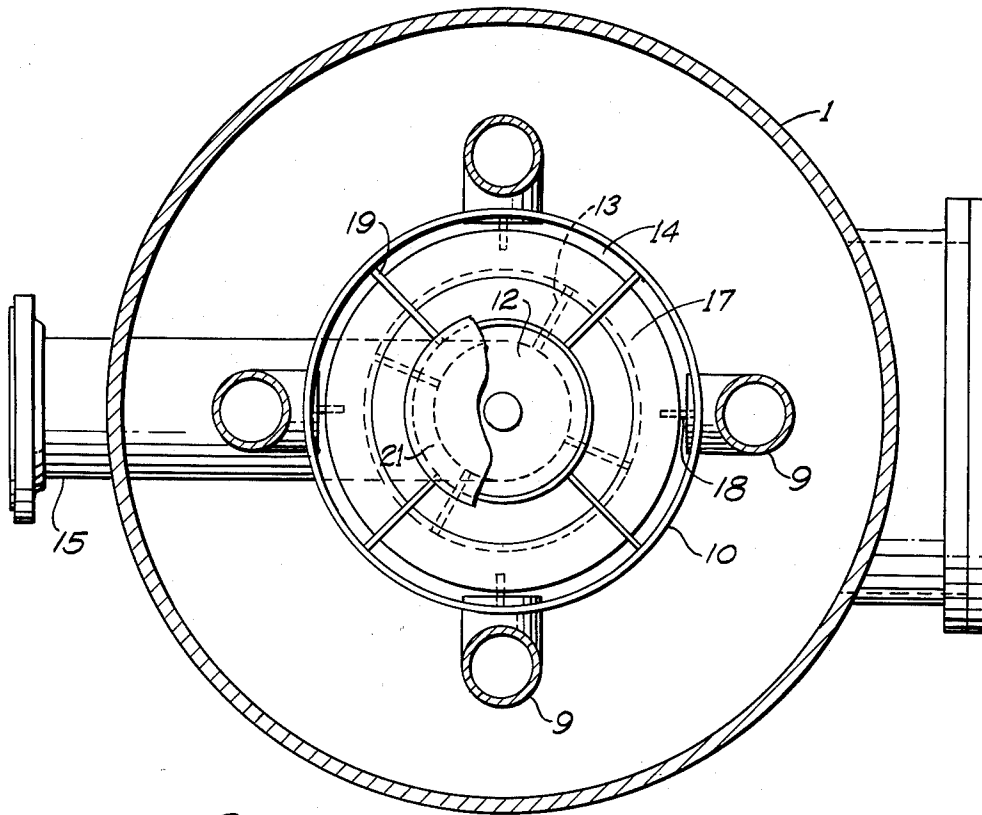


Fig. 2

INVENTORS

PHILIP FRENEAU AND
FRANK A. MORRISON
BY

Brown, Citchlow, Flick & Lockman

THEIR ATTORNEYS

March 20, 1956

P. FRENEAU ET AL

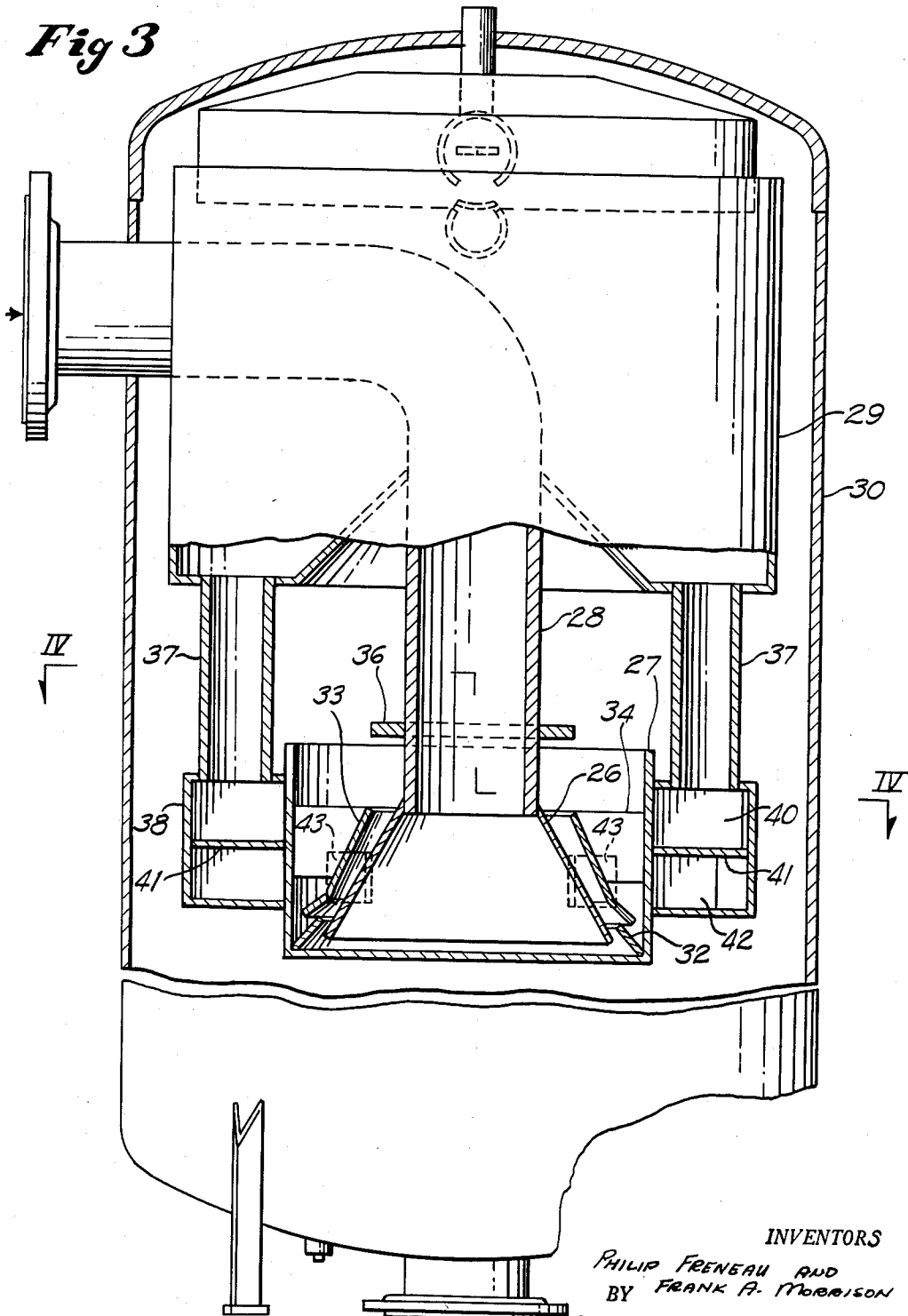
2,738,852

DEAERATING HEATER

Filed Feb. 9, 1954

4 Sheets-Sheet 3

Fig 3



INVENTORS

PHILIP FRENEAU AND
BY FRANK A. MORRISON

Brown, Citchlaw, Flick & Leckham

THEIR ATTORNEYS

March 20, 1956

P. FRENEAU ET AL

2,738,852

DEAERATING HEATER

Filed Feb. 9, 1954

4 Sheets-Sheet 4

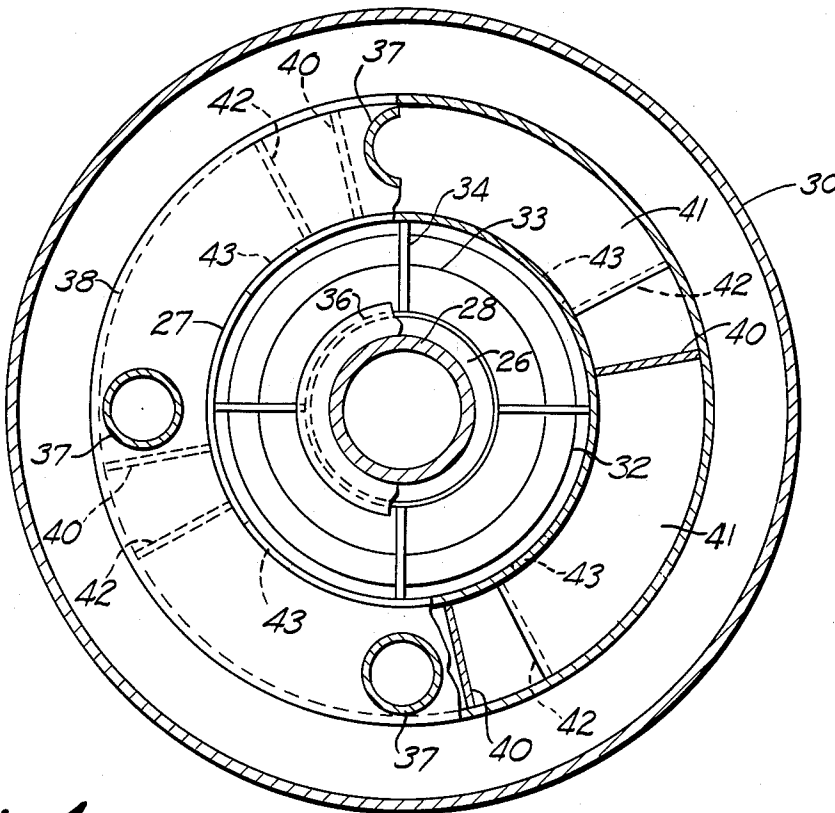


Fig. 4

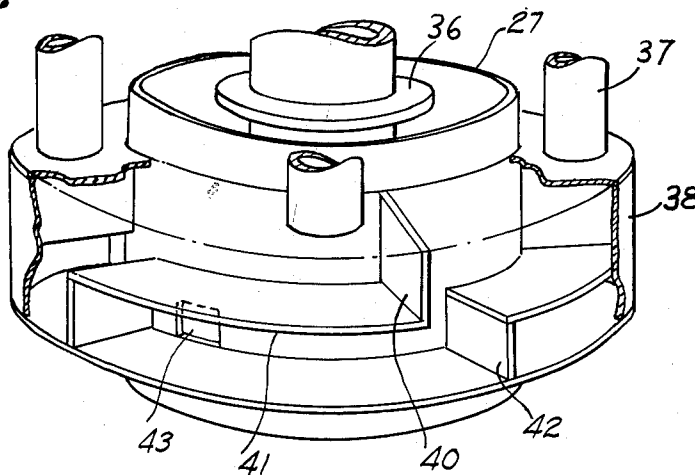


Fig. 5

INVENTORS
PHILIP FRENEAU AND
FRANK A. MORRISON
BY

Brown, Critchlow, Hicks & Leckham
THEIR ATTORNEYS

1

2,738,852

DEAERATING HEATER

Philip Freneau and Frank A. Morrison, Jeannette, Pa.,
assignors to Elliott Company, Jeannette, Pa., a corporation of Pennsylvania

Application February 9, 1954; Serial No. 409,119

9 Claims. (Cl. 183—2.5)

This invention relates to deaerating heaters, in which water is heated by steam to liberate the non-condensable gases.

Deaerating heaters of this general type are well known. After water has been sprayed into the tank, it is collected and directed into a lower chamber where it is picked up by steam and thrown upward against a baffle. The water falls from the baffle into the lower part of the tank and the steam continues to rise to heat the water spray. It sometimes happens, however, especially at low loads, that the steam and water do not mix properly and the water is not heated to as high a temperature as it should be.

It is among the objects of this invention to provide a deaerating heater in which water that is not properly mixed with the steam is recirculated until it is properly mixed, and in which the operation of the heater is not affected adversely if it is mounted in a ship where it is tilted back and forth.

In accordance with this invention a deaerating tank contains means for spraying water inside its upper part. Below the sprayer there is a water collector, and below that an open top recirculation chamber is located. Water is conducted from the collector down into the chamber, which is spaced from the collector and from the side of the tank. In the bottom of the chamber there is an upwardly directed annular steam nozzle. An upwardly directed annular mixing nozzle also is located in the chamber and has at its lower end an inlet that communicates with the outlet of the steam nozzle and with the lower part of the recirculation chamber around the steam nozzle. Steam is conducted into the tank and chamber and to the steam nozzle in order to entrain water and carry it up through the mixing nozzle and out of its upper end. In the path of the mixture of steam and water issuing from the mixing nozzle there is an impact member which deflects the water and steam striking it. The diameter of the recirculation chamber is such that only if there has been thorough mixing of the steam and water in the mixing nozzle will the water which strikes the impact member have sufficient velocity to bounce out beyond the chamber or to be carried out beyond it by the residual steam velocity and fall into the tank below. Consequently, inadequately mixed water, moving at a lower velocity, falls back into the recirculation chamber where it again is entrained by the steam and thrown up against the impact member. In one form of the invention provision is made for conducting water from the low side of a tilted recirculation chamber to its high side to insure proper water distribution in the recirculation chamber.

The invention is illustrated in the accompanying drawings, in which:

Fig. 1 is a fragmentary side view of our deaerating heater, showing the upper portion in central vertical section;

Fig. 2 is a horizontal section taken on the line II—II of Fig. 1;

2

Figs. 3 and 4 are views similar to Figs. 1 and 2, respectively, of a modification; and

Fig. 5 is a fragmentary perspective view, partly in section, of the recirculation chamber assembly of the second embodiment.

Referring to Figs. 1 and 2 of the drawings, relatively cold boiler feedwater enters one side of the upper end of a cylindrical deaerating tank 1 and is conducted diametrically across it through a horizontal spray pipe 2. This pipe may be provided with two parallel rows of closely spaced jets 3 extending along it for spraying the water in sheets upwardly and outwardly in opposite directions against the top of a circular dome 4. The side wall of the dome extends downwardly a short distance around a spaced pair of parallel straight baffles 5 that are secured to the top of the dome. Non-condensable gases liberated in the tank pass into an open-bottom receiver 6 extending across the tank and escape through vent 7 which has a restricted orifice at its upper end (not shown). The sprayed water, which is heated to a high temperature by the steam in the tank, falls into a cylindrical collector 8 that encircles the lower end of the dome and that is spaced from the dome and the side of the tank. The central portion of the bottom wall of the collector extends upward so that the water must flow into the encircling narrow area which has several, preferably four, drain pipes 9 extending downward from it. The lower ends of the pipes extend through the side of a cylindrical recirculation chamber 10, which has an open top spaced from the bottom of the collector.

Disposed in the center of the recirculation chamber is a hollow cone 12, which is spaced from the bottom of the chamber by means of vertical triangular plates 13. This cone also is spaced a considerable distance from the side wall of the chamber. The lower end of the cone is encircled by an upwardly tapered ring 14, which has its lower edge engaging the bottom of the chamber, preferably where it joins the side wall. The upper end of the ring is spaced from the cone, but the ring is tapered less sharply than the cone so that an upwardly tapered annular passage is formed between them. This passage is a nozzle, decreasing in area in the direction of steam flow, for steam that enters the recirculation chamber through a central opening in its bottom connected by a steam pipe 15 with a source of steam outside of the tank.

The cone 12 is encircled above the tapered ring by an annular member 17 that is tapered upwardly more sharply than the cone, except for its lower end which is flared out and is supported by triangular plates 18 secured to the side of the chamber. The annular member also is positioned in the chamber by other radial plates 19 secured to the side of the chamber. Where the two tapers of the annular member meet a short distance above the tapered ring 14, a constriction is formed. The flared lower end of the annular member encircles the upper end of the ring and is spaced from it, but preferably it is tapered less sharply. The passage between the annular member and cone forms an upwardly directed annular mixing nozzle, because steam issuing from the upper end of the steam nozzle will flow up through the mixing nozzle and in doing so will draw water into the lower end of the mixing nozzle and carry it up through it and out of its upper end.

Above the recirculation chamber there is an impact member coaxial with the chamber. This member may be a flat circular plate 21 mounted on the lower end of a rod 22 that extends downward from the raised bottom of the water collector. This plate is in the path of the steam and water mixture issuing from the mixing nozzle. The water droplets striking the plate will bounce outward. Since the water is entrained by the steam in the mixing nozzle, there is a velocity interchange between them. If the exchange is complete, which means

proper mixing of steam and water, the velocity with which the water will hit the impact plate will be high enough to carry the water outward beyond the side wall of the recirculation chamber with the assistance of the residual steam velocity. On the other hand, if the velocity interchange is incomplete due to inadequate mixing of steam and water, or if because of operation at low loads the steam velocity is insufficient to properly mix and accelerate the water particles, the water striking the impact plate will not bounce clear of the recirculation chamber but will fall back into it for recirculation. Consequently, any inadequately heated water will recirculate until it is brought up to temperature. The steam separating from the water at the impact plate flows outward and upward around collector 8 to heat the water spray entering the tank.

In the embodiment shown in Figs. 3, 4 and 5, recirculation is produced in the same way as in the first embodiment, but steam is admitted to the cone 26 from the top instead of from the bottom. Thus, the cone in the center of cylindrical recirculation chamber 27 has a large diameter top that is provided with an axial opening in which the lower end of a steam pipe 28 is mounted. The cone is supported above the bottom of the chamber by the pipe which extends upward through the convex bottom of the water collector 29 and then out through the side of the collector and the tank 30. Encircling the lower end of the cone in spaced relation therewith is an upwardly tapered ring 32 that is secured to the chamber bottom at its junction with the side wall. This ring forms with the cone an upwardly tapered annular steam nozzle which decreases in area in the direction of steam flow. The rest of the cone is encircled by an annular member 33 that is spaced from it and tapered more sharply, except for its flaring lower end, so that a constriction is formed between the cone and the upper end of the flared portion of the annular member. The passage between the annular member and cone forms a mixing nozzle. The annular member is supported by radial plates 34 fastened to the side of the recirculation chamber.

Steam issuing from the steam nozzle flows upward through the mixing nozzle and entrains water from the recirculation chamber, which it blows out of the top of the mixing nozzle. This water is blown up against the side of the steam pipe and an impact member in the form of a plate 36 encircling the steam pipe above the recirculation chamber. As in the first embodiment of the invention, water that has been properly entrained with the steam will strike the impact plate with sufficient velocity to be thrown clear of the recirculation chamber. Improperly mixed water will have a lower velocity and therefore will fall back into the chamber and be recirculated.

Another feature of this second embodiment of the invention, which also could be applied to the first embodiment, is that provision is made for insuring operation of the recirculator even though the tank is installed in a ship where the pitch and roll ordinarily would cause the water from the collector to be delivered only to the low side of the tilted recirculation chamber. Adequate distribution of the water around the inside of the chamber is accomplished by having the lower ends of the drain pipes 37 from the collector enter the top of a housing 38 which encircles the recirculation chamber and is secured to it. With four drain pipes, for example, the inlets into the top of the housing are spaced 90° apart, as shown in Fig. 4. Beside each inlet inside of the housing there is an upper vertical wall 40 extending from the top of the housing down about half way. From the bottom of each of these walls a partition 41 extends substantially horizontally below the adjacent inlet to a point near the next upper vertical wall. Each of these horizontal partitions therefore extends a little less than 90° around the housing. At the end of each horizontal partition opposite to the end that is joined to an upper

vertical wall there is a lower vertical wall 42 that extends from the partition down to the bottom of the housing.

To connect the inside of the housing with the recirculation chamber, the side wall of the latter has a port 43 opening into the space beside each lower vertical wall below the adjoining horizontal partition. When these ports are located 90° apart, each port is 180° or less from the inlet that supplies the water that will flow through that port. With this arrangement, water entering housing 38 from the drainpipe 37 at the low side of collector 29 when the tank is tilted will flow along the underlying horizontal partition 41 and off its open end into the space beneath the next horizontal partition. Although the port 43 that connects this latter space with the inside of the recirculation chamber will be near the high side of the tilted housing, it will be at a lower level than the upper end of drainpipe 37 serving this port unless the tank has been tilted to an extreme degree by an unusually rough sea. Consequently, much of the water from the low side of the housing will flow around it and into the high side of the recirculation chamber where it will be picked up by the steam and blown up against the impact member. The recirculator therefore will continue to operate quite effectively.

According to the provisions of the patent statutes, we have explained the principle of our invention and have illustrated and described what we now consider to represent its best embodiment. However, we desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

We claim:

1. A deaerating heater comprising a deaerating tank having a vent for escape of non-condensable gases, means for spraying water inside the upper part of the tank, a water collector below said means, an open top recirculation chamber below said collector and spaced therefrom and from the side of the tank, means for conducting water from the collector to said chamber, an upwardly directed annular steam nozzle in the bottom of the chamber, an upwardly directed annular mixing nozzle in the chamber having at its lower end an inlet communicating with the upper end of the steam nozzle and with the lower part of the chamber around the steam nozzle, the upper end of the mixing nozzle being spaced from the side of said chamber, means for conducting steam into the tank and said chamber and to the steam nozzle to carry water up through the mixing nozzle and out of its upper end, and an impact member having a lower surface in the path of the steam and water mixture issuing from the mixing nozzle, the diameter of the recirculation chamber being greater than the impact member and enough greater than the upper end of the mixing nozzle that only if there has been thorough mixing of the steam and water in the mixing nozzle will the water striking the impact member have sufficient energy to be carried out beyond said chamber with the assistance of the residual steam velocity and fall into the tank below, whereby inadequately mixed water having insufficient energy will fall back into said chamber and be entrained by the steam again.

2. A deaerating heater according to claim 1, in which the bottom of said recirculation chamber is provided with a central opening receiving the inner end of said steam-conducting means, and said impact member is a circular plate.

3. A deaerating heater according to claim 1, in which said steam-conducting means enters the tank above said recirculation chamber and has its inner end portion directed downward and surrounded by the upper end of said mixing nozzle, and said impact member is a ring encircling said inner portion of the steam conducting means.

4. A deaerating heater according to claim 1, in which the inner wall of said mixing nozzle tapers upward.

5

5. A deaerating heater according to claim 4, in which the outer wall of said mixing nozzle tapers upward but to a less extent than said inner wall, whereby to form a constriction above said steam nozzle.

6. A deaerating heater comprising a deaerating tank having a vent for escape of non-condensable gases, means for spraying water inside the upper part of the tank, a water collector below said means, an open top recirculation chamber below said collector and spaced therefrom and from the side of the tank, means for conducting water from the collector to said chamber, an upwardly tapered conical member in the center of the chamber spaced from its bottom and side walls, an annular member encircling the conical member to form a mixing nozzle and having a flaring lower end portion spaced from the side wall of said chamber, an upwardly tapered ring encircling the lower end of said conical member between it and said flaring portion and spaced from both, the lower end of the ring being secured to the adjoining wall of said chamber, means for conducting steam into said conical member axially thereof so that it can escape between the bottoms of the member and chamber, whereby steam will flow up between the ring and conical member and carry water up through the mixing nozzle and out of its upper end in an upwardly converging stream, and an impact member above the conical member having a lower surface in the path and below the apex of said stream issuing from the mixing nozzle, the diameter of the recirculation chamber being greater than the impact member and enough greater than the upper end of said annular member that only if there has been thorough mixing of the steam and water in the mixing nozzle will the water striking the impact member have sufficient energy to be carried out beyond said chamber with the assistance of the residual steam velocity and fall into the tank below, whereby inadequately mixed water having insufficient energy will fall back into said chamber and be entrained by the steam again.

6

7. A deaerating heater according to claim 6, in which the top of said conical member is provided with an opening, said steam-conducting means enters the tank above said recirculation chamber and has its inner end extending down to said conical member opening, and said impact member encircles said steam conducting means.

8. A deaerating heater according to claim 1, including a housing encircling said chamber and joined thereto, the top of the housing being provided with circumferentially spaced water-receiving inlets connected with said water conducting means, an upper vertical partition in the housing beside each inlet and extending from the top of the housing part way down, a substantially horizontal partition below each inlet extending from the bottom of the adjacent vertical partition to a point near the next upper vertical partition, a lower vertical partition extending from adjacent said point down to the bottom of said housing, the wall of said chamber having a port connecting the space beside each lower vertical partition below the adjoining horizontal partition with the chamber, whereby water entering the housing through any inlet will flow along the top of the underlying horizontal partition and down beneath the adjacent horizontal partition to the communicating port.

9. A deaerating heater in accordance with claim 8, in which said inlets are 90° apart and said ports also are 90° apart.

References Cited in the file of this patent

UNITED STATES PATENTS

1,808,424	Manifold	June 2, 1931
2,308,720	Sebald	Jan. 19, 1943
2,315,227	Rohlin et al.	Mar. 30, 1943
2,564,584	Sebald	Aug. 14, 1951
2,580,791	Kahn	Jan. 1, 1952