

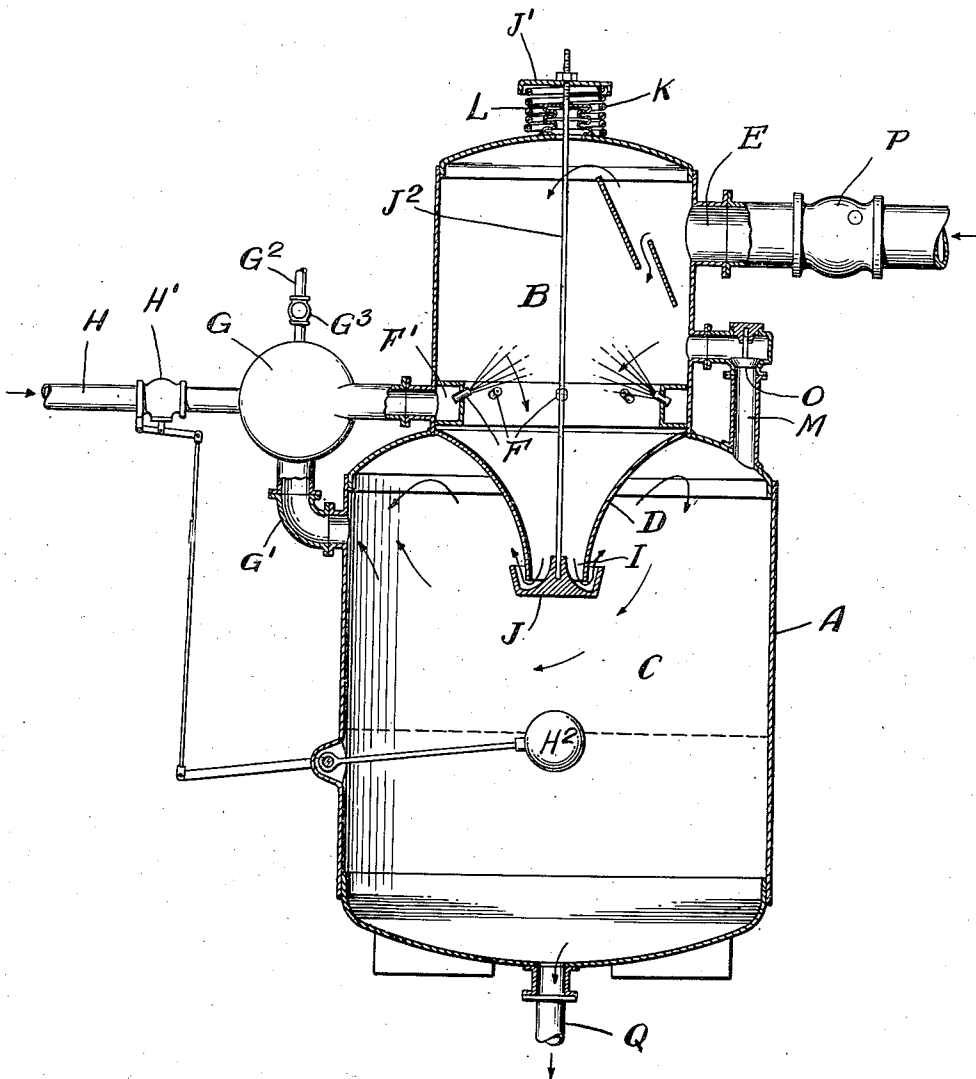
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DEAERATING APPARATUS

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## DEAERATING APPARATUS

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The general object of the present invention is to provide improved apparatus for heating and deaerating water. More specifically, the object of the invention is to provide improved apparatus of a two stage type, comprising two chambers through which the water is passed successively, and in each of which the water, while in a finely divided form, is brought into contact with steam employed to heat and deaerate the water.

In my improved apparatus, all of the steam used is passed initially into the first stage chamber, which may be called the heating chamber as the water treated is normally heated therein to a temperature but little below the temperature of the steam. The water thus sprayed into and heated in, and that formed by condensation in the heating chamber, pass out of that chamber and into the upper portion of the second chamber, which may be called the deaeration chamber, by gravitational flow through a heating chamber bottom outlet port or passage.

My improved apparatus comprises, and is characterized by means for so regulating communication between said chambers, that said port is variably throttled as required to keep the port open widely enough to permit the simultaneous discharge of steam and water and to avoid any accumulation of water above the port, while at the same time keeping the port sufficiently restricted to insure that the velocity at which the steam is discharged, is high enough to atomize the water simultaneously discharged through the port.

The means which I employ to thus regulate communication between the two chambers, comprises a valve which is biased, as by means of a spring or gravitational loading force, for movement into a position in which it closes said port, and which is given an opening movement by a predetermined excess of the pressure in the first stage chamber over that in the second stage chamber, and said means also includes a second port or passage controlled by a check valve, which is normally closed but which opens to equalize the pressures in the two chambers, whenever the pressure in the second stage chamber momentarily exceeds the steam pressure in the first stage chamber, as it may, from time to time.

My improved apparatus is simple in construction and efficient in operation, and is inherently compact and of relatively low weight, and is well adapted for use on ships but is not limited to such use.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages, and specific objects attained with its use, reference should be had to the accompanying

drawing in which I have illustrated in sectional elevation, an embodiment of the present invention.

The embodiment of the invention illustrated comprises a tank A, the interior of which is divided into an upper, first-stage, water heating chamber B, and a lower, second-stage, deaerating chamber C, by an interposed partition D. The steam used in heating and deaerating the water is supplied to the chamber B through a supply pipe E, from any suitable source, and usually, or at least frequently, is exhaust steam from a turbine or other steam motor. The water to be treated is sprayed into the steam atmosphere in the chamber B. The particular means shown for spraying the water into the chamber B comprises a plurality of spray nozzles F receiving water from an annular manifold F' coaxial with the tank, the nozzles F being arranged to discharge water jets inclined upwardly and toward the tank axis.

Water is supplied to the manifold F' through a vent condenser G from a supply pipe H at a rate regulated by a valve H' and float H<sup>2</sup>, as required to maintain an approximately constant water level in the chamber B. The vent condenser receives a steam and air mixture from the chamber C, and returns water condensation to the latter, through a conduit connection G' between the steam space in the chamber C and the condensing space of the vent condenser G. The latter is provided with a vent outlet G<sup>2</sup> including a throttling valve G<sup>3</sup> through which the undensified residue of the air and steam mixture may pass freely into the atmosphere, if atmospheric pressure is to be maintained in the chamber C.

The partition D is formed with a port I for the gravitational downflow therethrough into the chamber C of the water sprayed into the chamber B and formed in that chamber by the condensation of steam. As shown, the partition D with its port I is in the general form of a funnel coaxial with the tank A. Flow through the port I is regulated by a throttle valve J shown as of disc form and located below the port and biased for movement upward into the position in which it closes the port. In the somewhat diagrammatic form illustrated, the valve biasing means comprises a spring K external to the chamber B and acting between the top wall of the latter, and an adjustable abutment J' in the form of a nut threaded on the upper end of the stem J<sup>2</sup> of the valve J. As shown, the stem J<sup>2</sup> extends loosely through an opening in the rigid top wall of the tank. Flow through said opening is prevented by means of a bellows L attached at one end to the tank A at the margin of said opening and having its other end closed and rigidly connected to the stem J<sup>2</sup>.

A passage M controlled by a check, or non-

return, valve O, connects the steam space in the chamber C, to the chamber B at a level above the level of the port I. The valve O permits steam and air to flow from the chamber C into the chamber B, when the pressure in the chamber B falls below that in the chamber C, but the check valve O closes the passage M when the pressure in the chamber B exceeds the pressure in the chamber C, as is normally the case. To prevent objectionable backflow through the steam pipe E, as a result of some abnormal decrease in the steam source pressure, the pipe E advantageously includes a check valve P.

In the normal contemplated operation of the apparatus illustrated, water is supplied to the heating chamber B through the vent condenser G from the supply pipe H at a rate so regulated by the valve H' and float H<sup>2</sup> as to maintain an approximately constant water level in the deaerating chamber C, from which water is withdrawn for boiler feed or other purposes through an outlet Q. Steam supplied to the chamber B through the supply pipe E heats the water sprayed into the chamber C to approximately the temperature of the steam, and steam passing through the port I into the chamber C, completes the deaeration of the water and heats it to the full temperature of the steam in the chamber B.

Under normal conditions, the steam pressure in the chamber C will be less than the steam pressure in the chamber B by an amount which, in practice, will ordinarily vary from a pound or so down to a quarter of a pound. Said amount depends upon the compression of the loading spring K, and is predetermined to insure a velocity of steam discharge through the port I high enough to atomize the water simultaneously discharged through the port I, and thereby separate from the water the air and other non-condensable gases passing out of solution in the water as the temperature of the water is decreased.

The described procedure insures efficient heating and deaeration of the water. If, as a result of a temporary fluctuation or disturbance in operating conditions, the pressure in the heating chamber B tends to fall below the steam pressure in the deaerating chamber B, the normally closed check valve O opens and permits the pressures in the two chambers to equalize through the passage M. This substantially eliminates any tendency to an objectionable accumulation of water in the chamber B.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention as set forth in the appended claims and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Deaerating apparatus comprising a water deaerating chamber, a water heating chamber with a bottom outlet port for the discharge of water by gravitational downflow and for the simultaneous discharge of steam into the deaerating chamber, means for spraying the water to be heated and deaerated into the heating chamber, means for passing steam to heat and

deaerate the water into the first chamber, a valve biased for movement into position to close said port and actuated by the differential of the steam pressures in the two chambers to throttle the flow of steam through said port as required to maintain the heating chamber pressure in predetermined excess above the deaerating chamber pressure, a second port connecting said chambers, and a normally closed check valve controlling said second port and adapted to open upon an increase in the deaerating chamber pressure above the heating chamber pressure.

2. Deaerating apparatus comprising a water deaerating chamber, a water heating chamber with a bottom outlet port for the discharge of water by gravitational downflow into the deaerating chamber, means for spraying the water to be heated and deaerated into the heating chamber, means for passing steam to heat and deaerate the water into the first chamber, a vent condenser receiving air and steam from the deaerating chamber, a valve biased for movement into position to close said port and actuated by the differential of the steam pressures in the two chambers to maintain the heating chamber pressure in such excess above the pressure in the deaerating chamber that steam will normally pass into the deaerating chamber through said port with a velocity high enough to atomize the water simultaneously passing through said port, a second pressure port connecting said chambers and a normally closed check valve controlling said second port and adapted to open upon an increase in the pressure in the deaerating chamber above the pressure in the heating chamber.

3. Deaerating apparatus comprising a water deaerating chamber, a water heating chamber having a bottom wall formed with a horizontal outlet port for the discharge of water by gravitational downflow and for the simultaneous discharge of steam opening into the upper portion of the deaerating chamber, means for spraying water to be heated and deaerated into the heating chamber, means for passing steam to heat and deaerate the water into the first chamber, a vent condenser receiving air and steam from the deaerating chamber, and a horizontally disposed valve biased for movement into position to close said port and actuated by the differential of the steam pressures in the two chambers to open for the downflow through said port of water and sufficient steam to maintain the heating chamber pressure in predetermined excess above the pressure in the deaerating chamber.

4. Deaerating apparatus comprising a water deaerating chamber, a water heating chamber having a bottom wall comprising a lower portion of frusto conical form with its lower, smaller diameter end surrounding a steam and water outlet port opening into the upper portion of the deaerating chamber, means for spraying water to be heated and deaerated into the heating chamber, means for passing steam to heat and deaerate the water into the first chamber, and a horizontally disposed valve disc below said port and biased for movement into position to close said port and actuated by the differential of the steam pressures in the two chambers to open for the downflow through said port of water and sufficient steam to maintain the heating chamber pressure in predetermined excess above the pressure in the deaerating chamber.

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