March 28, 1944. V. A. ROHLIN 2,345,217

ATOMIZING DEAERATOR

Filed June 11, 1942

Fig. 1.

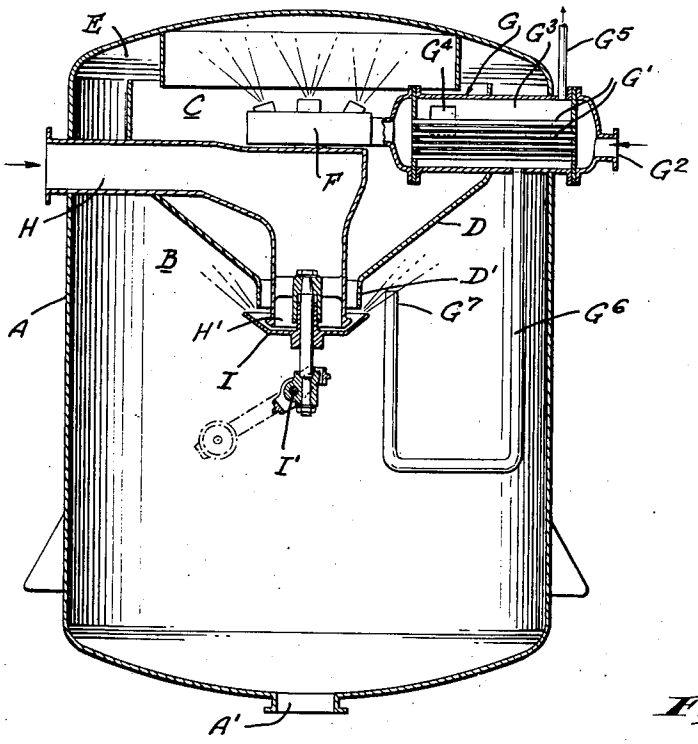



Fig. 2.

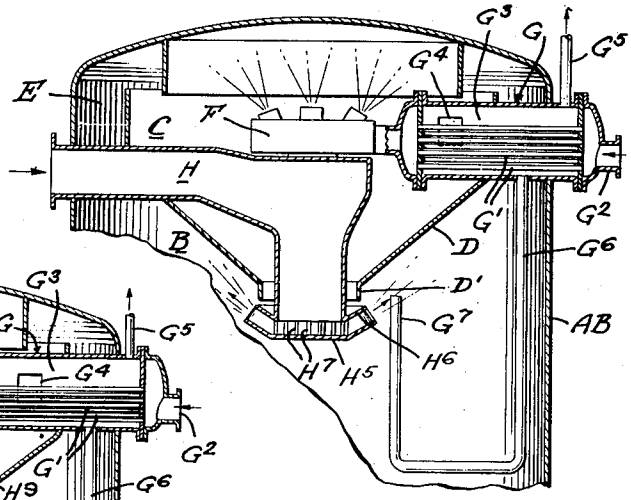
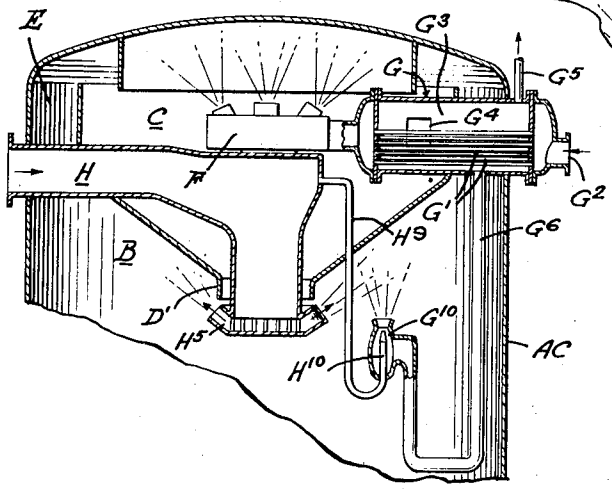



Fig. 3.




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2,345,217

## ATOMIZING DEAERATOR

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3 Claims. (Cl. 183—2.5)

The general object of the present invention is to provide a water heating and deaerating device with improved means for moving condensate into the device from its associated vent condenser. More specifically, the object of the present invention is to provide a two stage atomizing deaerator of any of the types now in use, with means for utilizing available energy in the steam to move condensate into the deaerator from its vent condenser when the water level in the condensing space of the vent condenser is not high enough for the gravitational passage of the condensate into the atomizing zone of the deaerator.

The need for the present invention is primarily due to the pressure conditions existing in two stage atomizing deaerators, and to the characteristic compactness of design of such deaerators. Those deaerators have found their principal field of use in marine service, wherein the avoidance of unnecessary bulk and head room is highly desirable. This has led to the extension of the vent condenser through the side wall of the deaerator tank into the upper initial water heating section of the deaerator, into which the condenser drains so that the condensate may pass from the said section into the atomizing zone along with the water sprayed into and initially heated in said upper section of the deaerator. With such an arrangement under heavy load conditions the water may accumulate in the upper water heating section, to the level of the bottom of the condenser, with the result that the available water head is then insufficient to move condensate out of the condensing space of the condenser at the proper rate.

To provide the energy needed to atomize the water the steam used must have its pressure reduced one pound or so at full load, as the steam passes from the supply pipe into the deaerating space. To move the steam from the deaerating section into the primary heating section of the deaerator, and from the last mentioned section into the condensing space of the vent condenser, requires a reduction in the pressure of the steam which in operation at rated capacity, may amount to a water head of six or eight inches. The last mentioned pressure loss increases in proportion to the square of the load, and an atomizing deaerator may be operated from time to time with a load which is 100 per cent greater than the rated capacity or nominal full load of the deaerator.

Some water head is also needed to overcome the frictional resistance to the rapid movement of the condensate through the condensate discharge pipe of the condenser, required under heavy load conditions.

In accordance with the present invention, proper movement of the condensate into the deaerator from the vent condenser is insured by utilizing some of the energy of the steam supplied to the deaerator in producing the desired condensate movement.

In a simple form of the present invention I provide the vent condenser with a drainage discharge pipe terminating in an outlet so disposed relative to the path of the atomizing jet of steam discharged into the deaerating section of the deaerator, that the steam will subject the drainage outlet to an aspirating or suction effect. In some cases, however, I may provide a steam lift or ejector device at the drainage end of the drainage pipe, and pass a small portion of the steam supplied to the deaerator directly into said device for impelling fluid use therein.

The present invention is well adapted for use in atomizing deaerators of the so called fixed orifice type, as well as in atomizing deaerators of the type in which the steam is discharged into the deaerating space by an atomizing valve loaded to maintain a definite difference between the pressure in the steam supply pipe and in the deaerating space.

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 and descriptive matter in which I have illustrated and described preferred embodiments of the invention.

Of the drawing:

Fig. 1 is a somewhat diagrammatic elevation of an atomizing deaerator including a loaded atomizing valve;

Fig. 2 is an elevation taken similarly to Fig. 1, and showing an atomizing deaerator of the fixed orifice type; and

Fig. 3 illustrates the use of a drainage discharge device of the steam lift of the ejector type.

The deaerator A shown somewhat diagrammatically in Fig. 1, is of a type which is now in extensive use on steamships, and which is also

used in some land installations. The interior of the space within the enclosing tank or shell of the deaerator is divided by a baffle D into a lower deaerating space B, and an upper, initial water heating space C. The partition D is shown as funnel shaped, having a central depending spout portion D'. Adjacent the top of the partition D one or more ports E are provided for the passage of steam from the deaerating space B into the initial water heating space C. The water treated in the apparatus is sprayed into the upper portion of the space C by spraying means F, to which water is supplied under suitable pressure through the tubes G' of a vent condenser G having a water inlet $G^2$ and having a condensing space $G^3$.

The air and gases separated from the water in the spaces B and C pass from the latter along with some steam into the condensing space $G^3$ through a port $G^4$. Much of the steam in the mixture entering the condensing space $G^3$ is condensed therein, and the uncondensed residue of said mixture is discharged through an outlet $G^5$. The outlet $G^5$ may open directly into the atmosphere when the normal pressure in the condenser is not less than the pressure of the atmosphere, and may be connected to a vacuum pump when the pressure in the space C is subatmospheric. A drainage pipe $G^6$ serves to pass condensate forming in the condensing space $G^3$ into the deaerating space B.

The steam used in heating and deaerating the water treated is supplied by a pipe H, which customarily extends, as shown, horizontally through the shell of the deaerator into the central portion of the space C, and comprises a depending discharge end portion H'. The latter is smaller in diameter than, and extends coaxially down through the spout D', thereby providing an annular passage for the downflow of the water from the space C into the space B.

The atomizer shown in Fig. 1 is of the loaded valve type, and the lower end edge of the pipe portion $H^1$ forms a horizontal valve seat, towards which a subjacent vertically movable valve member I is biased by means shown as comprising a horizontal rock shaft I' extending through the wall of the tank and having its inner end link connected to the valve member I and having its outer end connected to a suitable spring or weight loading means which need not be illustrated and described, as they are well known, one form being illustrated, for example, in Patent 1,943,890, granted January 16, 1934, on an application filed by George H. Gibson and me, as joint inventors.

With the atomizing valve I and its seat H' formed and disposed in the general manner illustrated in Fig. 1, steam is discharged in the form of a hollow conical jet moving upwardly and outwardly from the valve axis, and in accordance with the present invention the discharge end $G^7$ of the condenser drainage pipe $G^6$ is disposed adjacent the discharge edge of the valve, so that the jet of steam discharged will impress a substantial suction or aspirating effect on the drainage pipe. With the steam pressure drop of a pound or so which the valve I customarily maintains to insure the desired water atomizing effect, the aspirating action of the steam jet on the drainage pipe $G^6$ may amount to a water head of a foot or more.

In Fig. 2 I have illustrated the use of the present invention in a deaerator AB of the so-called fixed orifice type, which differs from the deaerator of Fig. 1, essentially, and as shown, only in that the valve I of Fig. 1 is replaced in Fig. 2 by a similarly shaped member $H^5$, which is spaced a fixed distance away from the lower edge of the steam pipe portion H'. As shown in Fig. 2 the pipe portion H' is provided at its lower end with an uprising conical flange or baffle portion $H^6$, spaced away from the uprising conical outer portion of the part $H^5$, and curved vanes $H^7$ are placed between the parts $H^5$ and $H^6$, to provide channels leading from the bore of the pipe H' to the periphery of the part $H^6$ and curved to effect tangential discharge of the water.

In operation under normal load conditions, the pressure drop between the steam pipe H and the deaerating space B of the deaerator AB is about the same in the fixed orifice deaerator AB in the deaerator A of Fig. 1. When the load is high enough to make its condensate moving effect desirable the drainage pipe outlet $G^7$ will be subjected to substantially the same drainage moving effect in apparatus of the type shown in Fig. 2, as in apparatus of the type shown in Fig. 1.

In Fig. 3 I have illustrated a form of the invention differing from those shown in Figs. 1 and 2, in that the condensate drainage pipe $G^6$ is provided at its discharge end with an ejector $G^{10}$ including an axial nozzle $H^{10}$ receiving steam from the pipe H through a branch $H^9$, and discharging the steam in a jet coaxial with and directed toward the discharge outlet G of the ejector $G^{10}$.

As those skilled in the art will understand, the ejector $G^{10}$ may be so shaped to act as a steam jet ejector or exhauster, or to act as a steam lift pumping device. In either case, effective use is made of the steam diverted from the atomizing jet through the pipe $H^9$, and in Fig. 3 the device $G^{10}$ takes full advantage of the difference between the pressure in the pipe H and the pressure in the deaerating space B.

The deaerator AC shown in Fig. 3 is like the deaerator AB shown in Fig. 2, in having a fixed orifice, but the device $G^{10}$ shown in Fig. 3 may be used equally well in a deaerator of the loaded valve type shown in Fig. 1.

While the use of the present invention theoretically reduces the amount of atomizing energy available from a given amount of steam supplied to a deaerator operating under given pressure conditions, the amount of energy thus made unavailable for atomization purposes, is relatively small and inconsequential. Moreover, the heat units per pound of steam which are available for use in heating the water passing through the apparatus, will be the same for the steam discharged into the space B of Fig. 3 through the condensate discharger $G^{10}$, as for the steam discharged through the fixed orifice between the parts A and $A^6$.

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. An atomizing deaerator comprising a water heating section, a deaerating section in communication with said heating section to receive water therefrom and to discharge steam thereinto, a vent condenser having a condensing space in communication with said heating space to receive a steam and gaseous mixture therefrom and having an outlet for the discharge of uncondensed residue, means for supplying water to be heated and deaerated to said heating section, conduit means for passing water from said heating section into said deaerating section, a water of condensate discharge connection to said vent condenser having its discharge end in a portion of said deaerating section displaced from said conduit means, means for discharging heated and deaerated water from said deaerating section, means supplying steam to said deaerator at a pressure above the steam pressure in said deaerating section and means for utilizing a portion of the energy of the steam supplied in atomizing the water passing into the deaerating section from the heating section and for utilizing another portion of the energy of the steam supplied in moving a jet of steam past the discharge edge of said discharge connection and thereby impressing a suction on said discharge connection and atomizing the condensate discharged.

2. An atomizing deaerator comprising a water heating section, a deaerating section in communication with said heating section to receive water therefrom and to discharge steam thereinto, a vent condenser having a condensing space in communication with said heating space to receive a steam and gaseous mixture therefrom and having an outlet for the discharge of uncondensed residue, means for supplying water to be heated and deaerated to said heating section, conduit means for passing water from said heating section into said deaerating section, a water of condensate discharge connection to said vent condenser having its discharge end in a portion of said deaerating section displaced from said conduit means, means for discharging heated and deaerated water from said deaerating section, and means supplying steam to said deaerating section in the form of a jet atomizing the water received in said section and impressing a suction on the discharge end of said condensate discharge connection and atomizing the condensate discharged.

3. An atomizing deaerator comprising a water heating section, a deaerating section in communication with said heating section to receive water therefrom and to discharge steam thereinto, a vent condenser having a condensing space in communication with said heating space to receive a steam and gaseous mixture from the latter and having an outlet for the discharge of uncondensed residue and having a water of condensate discharge connection with its discharge end in said deaerating section, means for supplying water to be heated and deaerated to said heating section, means for discharging heated and deaerated water from said deaerating section, means supplying steam to said deaerator comprising a supply conduit, an orifice through which an atomizing jet of steam is discharged into said deaerating section from said conduit and means connected to said conduit and actuated by steam received from said conduit to impress a suction on the discharge end of said condensate discharge connection and to atomize the condensate discharged.

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