April 15, 1930. C. E. LUCKE 1,754,722

EVAPORATING OR DEGASIFYING APPARATUS

Filed Aug. 3, 1925

Fig. 1.

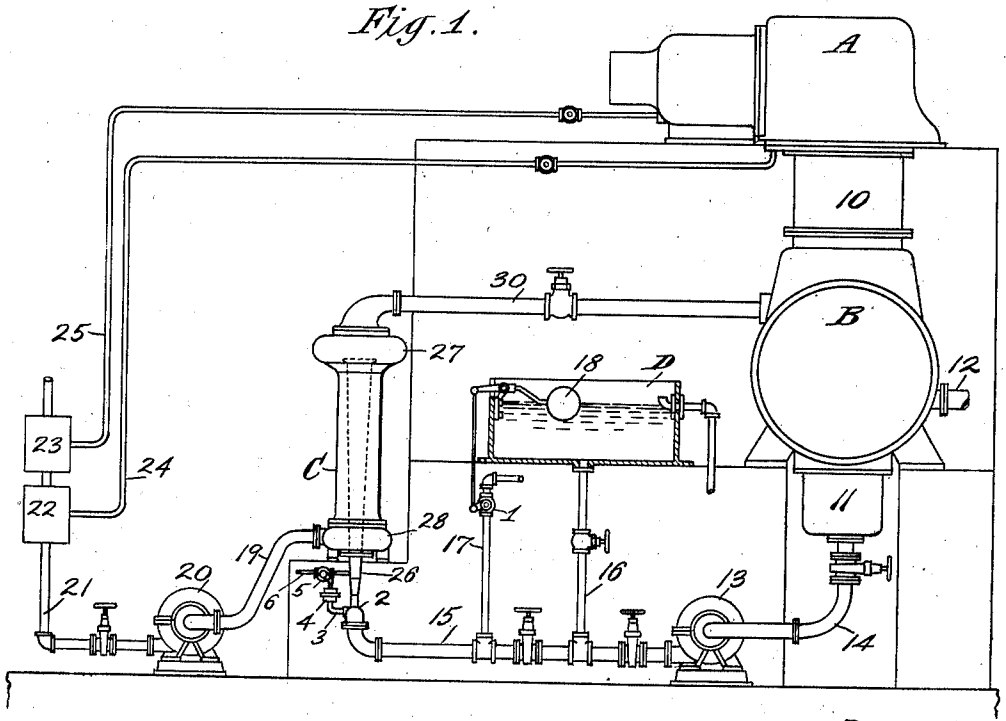


Fig. 2.

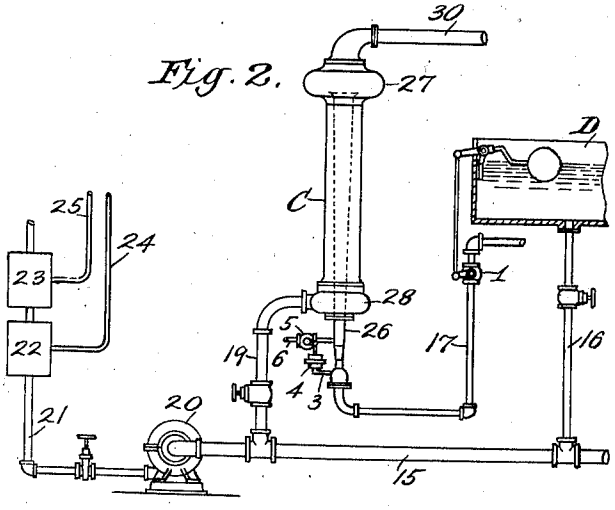
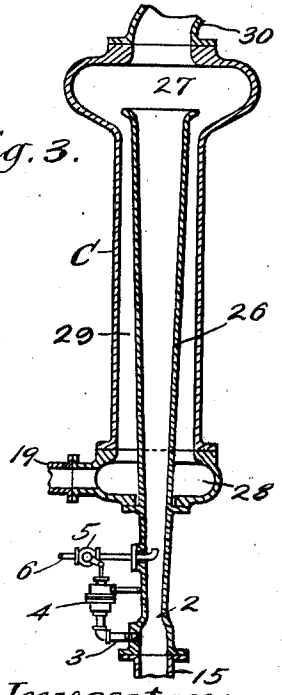


Fig. 3.



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UNITED STATES PATENT OFFICE

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EVAPORATING OR DEGASIFYING APPARATUS

Application filed August 3, 1925. Serial No. 47,671.

This invention relates to improvements in degasifying apparatus adapted especially for removing entrained air and gases from water for boiler or other use by evaporating a portion of the water, the especial object of the invention being to provide a simple, cheap and efficient degasifying system which may be readily applied to condensers now in use, as well as included in new installations. The apparatus may be used also with other liquids and as an evaporating apparatus for other purposes.

In accordance with my invention, as applied in degasifying water, the water is degasified in a single chamber and at a single operation by raising the water in a column so as to reduce the pressure towards the top of the water column sufficiently to evaporate gradually the small quantity of water necessary to remove the air and gases contained in the water. The water preferably is heated before or during its passage through the degasifier, and the chamber at the top of the column preferably is a vacuum chamber. The degasified water preferably returns vertically downward to the feed pump by which it is delivered to the boiler or other apparatus for use, so that the static head of the water column is not lost. In condenser applications of my degasifying apparatus, a closed system is used to prevent regasifying of the degasified water, and all the condensate may be treated in the degasifying apparatus, or only the make-up water. In either case a surge tank is used arranged to take care of the variations in the amount of water in the system and keep the pumps fully charged with water.

For a full understanding of the invention, I have shown for purpose of illustration a complete condenser and boiler feed system employing my degasifying apparatus and embodying all the features of the invention in a preferred form, and this apparatus will now be described in detail and the features forming the invention then particularly pointed out in the claims.

In the drawings—

Figure 1 is a diagrammatic elevation of a turbine and condenser with a closed system for degasifying and heating the condensate for boiler feed, with all the condensate treated in the degasifier;

Figure 2 is a partial view showing a modification in which only the make-up water is treated in the degasifier;

Figure 3 is a detail vertical section of the degasifier shown in Figs. 1 and 2.

Referring now to the drawings, A is a steam turbine, B a surface condenser receiving the exhaust from the steam turbine through exhaust connection 10, and from which condenser the condensate passes to hot-well 11, the air and gases being taken off from the condenser as usual through connection 12. The condensate is shown as delivered from the hot-well 11 by centrifugal pump 13 connected to hot-well 11 by pipe 14. It will be understood that all these parts may be of any suitable construction, and the particular arrangement shown is only for purpose of illustration.

Referring now to the boiler feed system and degasifying apparatus applied to the steam turbine and condenser shown and above referred to, the condensate is forced by pump 13 through pipe 15 to the bottom or inlet end of the degasifier C, and the upper chamber of the degasifier is connected by pipe 30 to carry off all vapors and gases from the degasifier to the condenser and maintain the degasifier under the condenser vacuum. A surge tank D is placed at a suitable elevation and connected with pipe 15 by pipe 16 so as to permit the free flow of water upward and downward between the surge tank D and condensate pipe 15. The location and capacity of the surge tank D is such as to take care of all variations in system liquid, and to form a water column so long that the flow up or down through the pipe 16 does not exceed the volume of that pipe and thus introduce air into the system. A small quantity of air may get into the system through the surge tank, but this will be taken care of by the degasification of the entire boiler feed water as shown in Fig. 1. The make-up water is supplied to the condensate pipe 15 from the pipe 17, the amount of make-up water being varied by the level of water in the surge tank and the

float 18 connected to valve 1 on make-up water pipe 17. The degasified condensate and make-up water passes from the degasifier C through pipe 19 to boiler feed pump 20, and is forced by the latter through discharge pipe 21, closed feed water heaters 22, 23, to the boiler. The feed water heaters 22, 23 are supplied with heating steam from the turbine A, the first heater 22 preferably being supplied with low pressure steam through pipe 24 and the second heater 23 being supplied with high pressure steam through pipe 25, as shown.

The construction shown in Fig. 2 is the same as that shown in Fig. 1 and similarly lettered, except that the condensate does not pass through the degasifier, but only the make-up water, the condensate pipe 15 passing directly to the boiler feed pump 20, and the make-up water pipe 17 being connected to the inlet of the degasifier in the same manner as is the pipe 15 in Fig. 1.

Referring now to the construction of the degasifier as shown in section in Figure 3 in its preferred form, the degasifier consists of an inner tube 26, which preferably, and as shown, expands upwardly forming in effect a hollow cone which extends upward to the top vacuum chamber which is connected by pipe 30 to the condenser, and this expanding tube 26 is open at the top and separated from the outer wall of the degasifier C to form an annular chamber 27 which is enlarged to such horizontal dimension as to provide the desired extended water surface for the escape of air and vapor. Below the chamber 27, an annular chamber 29 extending downward about the tube 26 is formed through which the degasified water overflows from the top of the tube 26 to the chamber 28 at the bottom of the degasifier casing with which discharge pipe 19 connects.

The lower end of the tube 26 above its connection with condensate pipe 15 or make-up pipe 17, is formed with a contracted portion or throat 2, and below and above this throat connection is made by pipes 3 to a pressure-controlled valve 4 operating to control a throttle valve 5 on steam pipe 6, which steam pipe 6 enters tube 26 near the lower end and bent upward to deliver heating steam in line with the water flow so as to heat the water passing upward through tube 26 to the temperature desired for degasifying evaporation, the amount of steam supplied being dependent upon the amount of water flowing to the degasifier and controlled by the pressure of the water flow, through throat 2.

It will be seen that my degasifier or evaporator is of very simple and cheap construction, and it will be most efficient in use, the whole system involving but small expense and requiring no complicated apparatus or parts outside of the degasifier except such as are standard equipment in condenser installations, and the whole degasifier system may be readily added to old engine and condenser installations as well as cheaply included in new installations.

In the operation of the apparatus, the water preferably is heated to a temperature near the boiling point for the pressure at the point where the steam is admitted. The hot water then rises vertically and the absolute pressure thereby decreases until at the top of the column the pressure is reduced to that of the chamber 27. Evaporation takes place in the hot water by the gradual reduction of pressure in the vertical column, and the bubbles of air and other gases are given the maximum travel through the water, increasing in volume toward the top. The height of the tube 26 will be such as to secure the water column necessary for the evaporation required, the evaporation depending upon the height of the water column, the temperature of the water, and the pressure in chamber 27. All of the water returns vertically downward so that the static head of the column is not lost, but passes on to the suction of the feed pump 20. While the water is preferably heated by steam admitted under control of the water flow, the degasifier may be used with water having the required temperature before admission to the degasifier, irrespective of how such temperature is obtained.

The top of the degasifier is preferably connected to the main condenser in condenser installations, as shown, for condensing the vapors from the degasifier and maintaining the desired pressure in chamber 27, but it will be understood that any other suitable arrangement may be used for handling the vapors and maintaining the desired pressure and that these will be varied in accordance with the installations in which the degasifier is used, and that other modifications in the degasifier and system may be made by those skilled in the art within the invention defined by the claims.

What is claimed is:

1. A degasifier having a vertical tube with a receiving water inlet at the lower end, a vapor and gas chamber at the upper end and into which the tube opens, means for carrying off the vapor and gas from said chamber and maintaining a predetermined pressure therein, a steam inlet for supplying heating steam to the water column, and means for controlling the amount of steam supplied to the water column in accordance with the water flow to the tube.

2. A degasifier having an upwardly expanding tube with a water inlet at the lower end, a vapor and gas chamber at the upper end into which the tube opens, means for carrying off the vapor and gas from said chamber and maintaining a predetermined pressure therein, a steam inlet for supplying

heating steam to the water column, and means for controlling the amount of steam supplied to the water column in accordance with the water flow to the tube.

3. An evaporating apparatus having a vertical tube with a liquid inlet at the lower end and a chamber at the upper end of the tube having a vapor and gas outlet, a steam inlet for supplying heating steam to the water column, and means for controlling the amount of steam supplied to the water column in accordance with the water flow to the tube.

4. The combination with a condenser, of a degasifying apparatus receiving the condensate from the condenser, comprising a vertical tube having its condensate inlet at the lower end and a chamber at the upper end of the tube having a vapour and gas outlet, a steam inlet for supplying heating steam to the condensate column, means for controlling the amount of steam supplied to the condensate column in accordance with the condensate flow to the tube.

5. The combination with a condenser, of a degasifying apparatus receiving the condensate from the condenser, comprising a vertical tube having its condensate inlet at the lower end and a chamber at the upper end of the tube having a vapour and gas outlet, and a steam inlet for supplying heating steam to the condensate column, means for controlling the amount of steam supplied to the condensate column in accordance with the condensate flow to the tube, and a downward discharge for the degasified condensate from the chamber for recovering the head of the condensate column in the tube.

6. A degasifier including an outer wall, an inner tube extending upwardly within the chamber formed by said outer wall and gradually increasing in cross-sectional area as it extends upwardly in the chamber formed by the outer wall, said outer wall forming an annular chamber about the inner tube through which the degasified water overflows and having an enlargement formed at its lower end, means for heating the water in the column within said inner tube, and means for controlling the heating of the water in accordance with the water flow to the tube.

7. A degasifier including an outer wall, an inner tube extending upwardly within the chamber formed by said outer wall and gradually increasing in cross-sectional area as it extends upwardly in the chamber formed by the outer wall, said outer wall forming an annular chamber about the inner tube through which the degasified water overflows and having an enlargement formed at its lower end, said inner tube being formed with a contracted throat near its lower inlet end, means for supplying a heating agent to the water in the tube above said throat, a pipe communicating with the tube and extending around said throat and means in said pipe for controlling the supplying of the heating agent in accordance with the water flow through said throat.

In testimony whereof, I have hereunto set my hand.

CHARLES E. LUCKE.