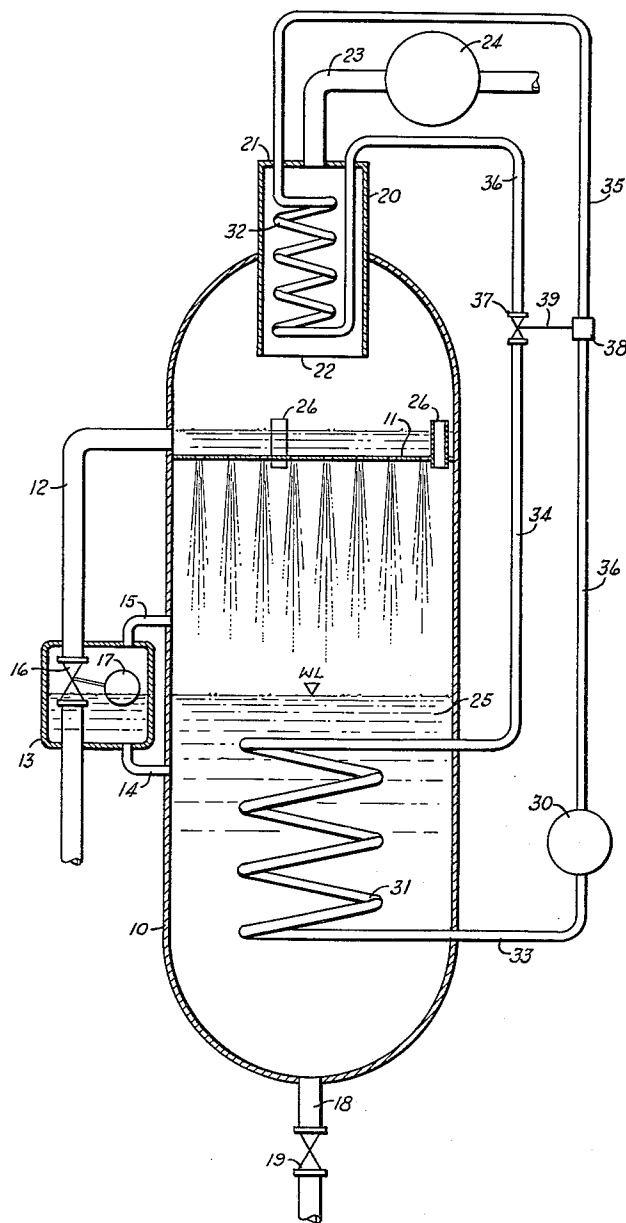


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H. L. BOWERS
VACUUM DEAERATOR
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HERBERT L. BOWERS

INVENTOR.

BY

Erin D. Bowers
ATTORNEY

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3,091,098 VACUUM DEAERATOR

Herbert L. Bowers, Fair Lawn, N.J., assignor to Pfaudler Permutit, Inc., New York, N.Y., a corporation of New York

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This invention relates to vacuum deaeration, and it comprises, in combination, a deaeration tank, a vacuum pump having an inlet connection in communication with said tank, a heat exchanger in said inlet connection, and means for circulating refrigerant through said heat exchanger, all as more fully described and as claimed hereinafter.

Vacuum deaerators have come into fairly extensive use for removing dissolved air and other gases from water in order to reduce the corrosive effect of the water upon pipe lines and other metal objects with which the water comes into contact. They are also used sometimes in the treatment of boiler feed water. Vacuum deaerators are based upon the fact that the solubility of gases in water is zero at the boiling point. They operate by passing the water to be deaerated through a closed vessel in which the pressure is lowered by means of a vacuum pump to or close to the value at which the water boils, such pressure depending, of course, on the temperature of the water. The vacuum pump has the task of not only reducing the pressure in the vessel to the required low value, but also of removing from the low pressure condition in the vessel and discharging into the atmosphere the gases released from the water, together with substantial quantities of water vapor formed by evaporation of a portion of the water passing through the vessel. This requires a relatively large vacuum pump with relatively large power requirements. Both the high first cost of such large vacuum pumps, and especially the high cost of power to operate them have prevented the installation of vacuum deaerators in many cases in which their use would otherwise have been desirable.

It is an object of this invention to provide a vacuum deaerator which operates effectively with a substantially smaller vacuum pump than has heretofore been required.

Another object is to provide a vacuum deaerator with substantially lower power requirements for maintaining it in operation.

The manner in which these and other objects are achieved is set forth in the following description and illustrated in the drawing which shows an elevational diagrammatic view, partly in cross section, of an apparatus in accordance with my invention.

My novel vacuum deaerator comprises a tank 10 having in its upper portion a perforated plate 11 to distribute the water to be deaerated which is admitted to the tank 10 through an inlet pipe 12. A chamber 13 is in communication with the inside of tank 10 through connections 14 and 15. The pipe 12 passes through chamber 13 and is provided with a valve 16 operated by a float 17 so as to maintain in tank 10 a water level as indicated by the symbol "WL." An outlet pipe 18 provided with a valve 19 is connected with the bottom of tank 10 and leads, usually through a pump, to a point of use for deaerated water. Mounted on the top of tank 10 is a compartment 20 which has a closed top 21 and an open bottom 22. A pipe 23 connects the upper portion of compartment 20 with a vacuum pump 24 discharging into the atmosphere. One or several ducts 26 are mounted on the plate 11 to establish inter-communication between the vapor spaces below and above the plate 11.

The compartment 20 may be partly within and partly without the tank 10 as shown, or it may be arranged en-

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tirely inside or entirely outside of the tank 10, if desired. The vacuum pump 24 may be a mechanical pump operated by an electric motor or a steam engine, or it may be a multi-stage ejector using steam as the operating fluid.

As ancillary equipment for my deaerator, there are provided a compressor 30, a condenser 31 located in the body of water 25 below the water level WL, and a heat exchanger or evaporator 32 located in the compartment 20. Conduit 33 connects the compressor 30 with the condenser 31, conduit 34 interconnects the condenser 31 and the evaporator 32, and a conduit 35 connects the evaporator 32 with the compressor 30. The system comprising compressor 30, condenser 31, evaporator 32 and conduits 33, 34, and 35 is filled with a refrigerant 36, such as Freon, which is circulated in the system by the compressor 30 to produce a cooling effect in the evaporator 32 and in chamber 20. A valve 37 is provided in conduit 34. A thermostatic element 38 in conduit 35 has an actuating connection 39 with the valve 37 which is thereby adapted to throttle the flow of the refrigerant 36 so as to prevent the formation of any ice or frost on the evaporator 32.

The body of water 25 is a good place for the location of the condenser 31 because then the heat extracted from the refrigerant 36 is transferred to the water being deaerated which is advantageous in many installations. However, the condenser 31 may be placed in any other desired and suitable location.

In operation, the refrigeration mechanism is adjusted to maintain in the compartment 20 a temperature of about 35° F., just enough above 32° F., the freezing temperature of water, to insure that no ice formation will occur. Let it be assumed that the water to be deaerated has a temperature of 60° F. At that temperature the water will boil under an absolute pressure of 0.2563 pound per square inch. A vacuum pump 24 is selected to maintain in tank 10 an absolute pressure of about 0.26 to 0.27 pound per square inch. As the entering water is distributed by the perforated plate 11 and drops through the vapor space below the plate 11 practically all the dissolved gases are released, and together with a substantial amount of vapor generated from the water by evaporation, rise through the ducts 26 and flow into the compartment 20. There the non-condensable gases are cooled from about 60° F. to about 35° F. whereby their volume is reduced somewhat. At the same time the major portion of the water vapor is condensed, the water droplets falling through the open bottom 22 back into the tank 10. The reduced volume of non-condensable gases mixed with the remaining reduced volume of vapor is then withdrawn by the vacuum pump 24 and discharged to the atmosphere.

Under these conditions the total volume of gases and vapor that must be withdrawn by the vacuum pump 24 is only about one-half of what it would be if no refrigeration were provided in the compartment 20. Accordingly, the size of the vacuum pump and the amount of power needed to operate it are reduced by about 50 percent. The cost of the refrigeration system as well as its power requirements are substantially less than the aforesaid savings effected in the vacuum pump so that the vacuum deaerating apparatus, according to my invention, is less expensive, both in first cost as well as in cost of operation, compared with a conventional vacuum deaerator of the prior art.

Other incidental advantages of the new vacuum deaerator are that the heat from the water vapor condensed in compartment 20 is recovered, and that the vacuum pump operates under more favorable conditions. When oil is used as sealing liquid the reduced volume of steam condensed in the vacuum pump has less tendency to emulsify and flood out the sealing oil and the problem due to the pump casing heating up is reduced because less steam is

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condensed and, therefore, less heat is generated in the pump.

While I have shown and described what I consider the best embodiment of my invention, modifications may be made without departing from its spirit, and reference is, therefore, made to the following claims for a definition of the scope of my invention.

What I claim is:

1. A vacuum deaerator comprising a tank, means for maintaining a water level in said tank, an inlet for water to be deaerated connected with said tank, an outlet for deaerated water connected with said tank below said water level, a compartment located above said water level and having its lower portion in communication with said tank, a pipe connected with the upper portion of said compartment, a vacuum pump in said pipe, a condenser, an evaporator in said compartment, a compressor, a first conduit interconnecting said compressor and said condenser, a

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second conduit interconnecting said condenser and said evaporator, and a third conduit interconnecting said evaporator and said compressor.

2. The vacuum deaerator of claim 1, said condenser being located in the lower portion of said tank.

3. In the vacuum deaerator of claim 1, a valve in said second conduit, and a temperature responsive element in said third conduit for actuating said valve.

References Cited in the file of this patent

UNITED STATES PATENTS

1,466,670	Monti	Sept. 4, 1923
2,613,513	Shields	Oct. 14, 1952
2,671,524	Gilwood	Mar. 9, 1954

FOREIGN PATENTS

427,302	Great Britain	1935
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