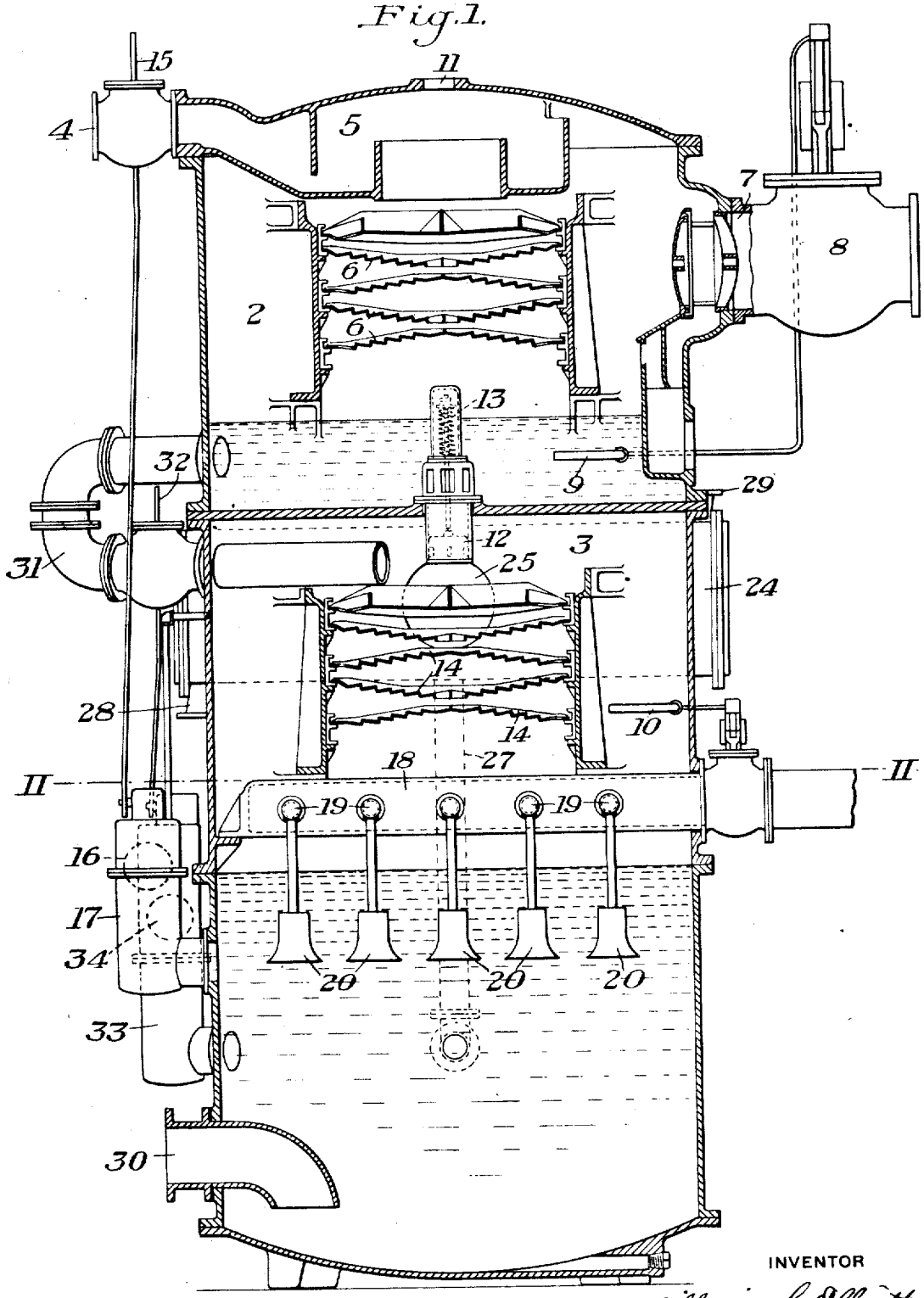
March 24, 1931. W. S. ELLIOTT 1,797,405

METHOD AND APPARATUS FOR SEPARATING AIR FROM LIQUIDS

Filed Feb. 17, 1923 2 Sheets-Sheet 1

Fig. 1.



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METHOD AND APPARATUS FOR SEPARATING AIR FROM LIQUIDS

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Fig. 2.

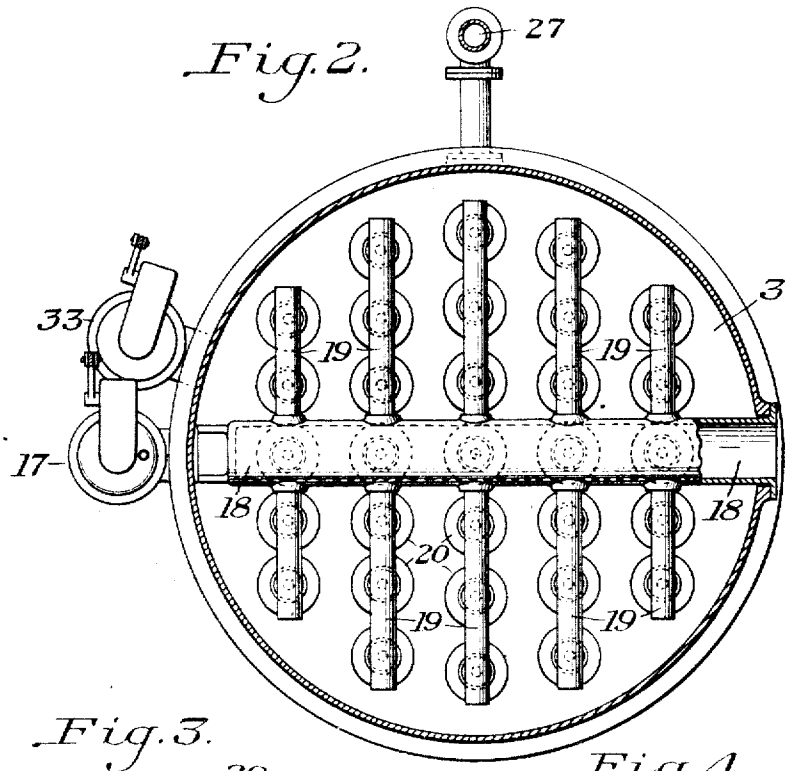


Fig. 3.

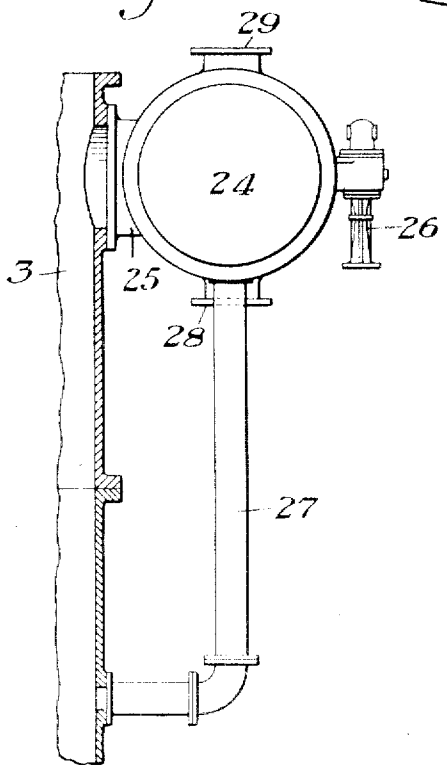


Fig. 4.

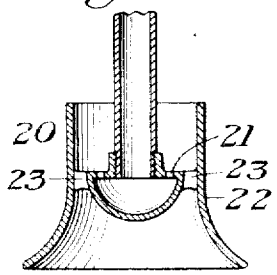
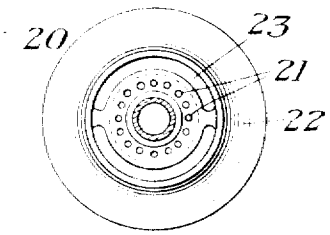


Fig. 5.



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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR SEPARATING AIR FROM LIQUIDS

Application filed February 17, 1923. Serial No. 619,565.

The present invention relates broadly to the treatment of liquids for the removal of air therefrom, together with the removal of other gases of a nature causing corrosion or other objectionable results.

At the present time, it is customary in the art to which this invention relates to attempt removal of air and other gases by boiling for predetermined periods, or, as shown in my prior Patent No. 1,321,999 of November 18, 1919, to effect the release of air and gases by an expansion of the water thereby causing the more or less instantaneous release due to evaporation of a definite amount of the water being treated of the air and gas. The first method has been found objectionable due to the long heating period required and the uncertainty of the results obtained. In some cases it is not desirable to maintain differences in temperature such as best suited for the instantaneous release of the air.

By the present invention there is provided a modified form of deaerating apparatus operating on a different principle whereby the advantageous results of both of the present methods are obtained without the accompanying disadvantages, permitting water having zero oxygen to be uniformly secured.

In the accompanying drawings, there is shown for purposes of illustration only one embodiment of the present invention, it being understood that the drawings do not define the limits of my invention and that changes may be made in the construction and operation without departing from the spirit of the invention or scope of my broader claims.

In the drawings,

Figure 1 is a vertical sectional view, somewhat diagrammatic, illustrating one embodiment of the present invention;

Figure 2 is a transverse sectional view on the line II—II of Figure 1;

Figure 3 is a detail view representing an end elevation of the condenser constituting part of the deaerating apparatus;

Figure 4 is a vertical sectional view on an enlarged scale of one of the steam supply nozles, and

Figure 5 is a top plan view of the construction illustrated in Figure 4.

In carrying out the present invention there may be provided apparatus of suitable construction preferably comprising a heating chamber 2 and a receiver 3. Communicating with the chamber 2 is a supply connection 4 through which the liquid to be treated is initially supplied to a distributing box 5. From this box the liquid overflows onto a series of agitating and distributing pans 6 over which it flows in cascade for effectively breaking up and agitating the liquid during its passage through the vapor space in the heating chamber.

The heating chamber may be heated in any desired manner, as by free steam supplied thereto through a connection 7. This connection may, if desired, be automatically controlled by a thermostatic valve 8 adapted to be operated by a thermostat 9 within the chamber 2. It will be apparent that in this chamber the steam is brought into intimate contact with the liquid in its divided condition whereby there is secured an efficient heat interchange.

This preliminary heating of the liquid causes the release of some of its contained air and gases, the amount of air and gases so released depending upon temperature conditions within the heating chamber. This chamber may be provided with a vent 11 preventing the same from becoming air-bound and permitting the escape of air, gases and vapor, whereby the desired vapor tension conditions within the heating chamber are constantly maintained.

From the heating chamber 2 the heated liquid is adapted to pass through a controlling valve 12 to the receiver. This valve is

so located as to always maintain a water seal between the heating chamber and the receiver, and may be adjustably controlled by means of a spring 13 permitting the pressure at which the valve opens to be varied as may be desired. The liquid passing the valve 12 flows in cascade over the agitating and distributing pans 14 positioned within the vapor space in the reservoir 3.

The desired levels may be maintained in the respective chambers 2 and 3 by a float-operated valve 15 in the inlet connection 4 and controlled by a suitable float 16 in the casing 17. By reason of its construction, it will be apparent that as the liquid level in the reservoir 3 lowers, additional liquid will be supplied to the heating chamber. This in turn will cause an increase of heat within the heating chamber for opening the valve 12.

Located at some suitable point within the receiver is a steam manifold 18 having a series of laterally extending branches 19. Each of these branches supplies steam nozzles 20 located below the level of the liquid within the receiving chamber. These nozzles may be of the construction illustrated in detail in Figures 4 and 5 comprising upwardly discharging steam openings 21 enclosed within a bell 22. This discharge of steam through the openings 21 causes liquid to be sucked upwardly through the passages 23 and into intimate contact with the escaping steam. This causes a violent ebullition to take place on the surface of the liquid in the receiver, which further breaks up the liquid and causes the release of any remaining air and gases therefrom. The temperature conditions within the receiver may be automatically controlled by providing the manifold with a valve, similar to the valve 8 and adapted to be controlled by the thermostat 10.

For withdrawing the vapor, air and gases from the vapor space within the receiver, and for maintaining the desired temperature and pressure conditions therein, there may be provided, in combination with the thermostatically controlled valves, a condenser 24 having a communication with the vapor space of the receiver and having a cooperating ejector 26. The connection 25 has an area sufficient to convey from the receiver an amount of vapor and gases at least substantially equal to the amount of steam supplied to the receiver through the manifold 18. Within the condenser, the condensible vapors are condensed and returned by suitable connection 27 to the receiver. The non-condensible content is then withdrawn through the ejector 26. It will be apparent that the vapor and gases withdrawn through the connection 25 contain a considerable amount of heat. This heat may be conveniently recovered by passing the cooling liquid through the condenser from the inlet 28 to the outlet 29 and then connecting the outlet by suitable piping to the inlet connection 4. In this manner, the heat released within the receiver will be effective for preheating the liquid supplied to the heating chamber.

For withdrawing the liquid as it may be required from the receiver 3, there may be provided a service connection 30. It will be apparent that the passage of liquid through the service connection will be in accordance with the demands on the apparatus and that such demands will, in turn, determine the amount of liquid and heat supplied to the apparatus. In some cases the demands through the service connection 30 may be so heavy that it is impossible to maintain the desired liquid level in the receiver by the volume of liquid passing the controlling valve 12. To compensate for this tendency, there is provided a supplementary connection 31 between the heating chamber and the receiver. Within this connection is a float-operated valve 32 controlled by a suitable float 34 within the casing 33 in communication with the receiver. In case the liquid level within the receiver should drop below a predetermined amount, the float operated valve 32 will be opened to permit the passage of supplementary liquid from the heating chamber to the receiver. It is desirable that the float 34 shall be effective for preventing the liquid level from ever falling below the outlets from the nozzles 20.

The use of deaerated water for industrial purposes requires that the deaerating apparatus be provided with means for delivering deaerated liquids at different temperatures. For example, in some cases it is desirable to supply deaerated water to economizers at temperatures as low as 135° F., while in other cases it is necessary that the water be supplied at temperatures as high as 210° F. In pipe systems handling hot water in buildings, the temperature has been found to be in the neighborhood of 165° F. For other manufacturing systems and purposes other definite temperatures are required.

With the apparatus disclosed herein, the control of the temperature of the delivered liquid is made quite easy. The temperature of this liquid may be controlled by varying the amount of heat supplied to the heating chamber and maintaining temperature and pressure conditions within the heating chamber and the receiver which are substantially equal, or by maintaining any desired temperature within the heating chamber and operating the condenser and ejector in such manner as to maintain different temperature and pressure conditions within the receiver. In still other cases, the condenser and ejector may be entirely omitted and the receiver permitted to discharge vapors and gases directly to the atmosphere.

In actual operation it has been found that where a definite temperature is maintained

within the heating chamber, the liquid passed at this temperature to the receiver, and a corresponding temperature maintained in the receiver, the heat released in the receiver will separate substantially all of the air from the liquid. It will be apparent that under these conditions the temperature of the steam supplied to the manifold 18 must be higher than the temperature within the receiver by an amount at least sufficient to overcome the static head of the liquid in the receiver above the nozzles 20.

For example, if a temperature of 175° F. is maintained in the heating chamber, a boiling temperature which will be equivalent to a vacuum of 16.33 inches of mercury, may be maintained within the receiver by the proper operation of the condenser and ejector or other form of withdrawing means. If a temperature of 210° F. is required within the receiver, the temperature in the heating chamber may still be maintained at 175° F. and the vacuum in the condenser reduced to zero or the vapors from the receiver permitted to discharge directly to the atmosphere. Under such conditions, the steam supplied by the manifold 18 combined with the exchange of heat between that steam and the liquid will provide a sufficient amount of vapor to raise the temperature of the liquid passing over the pans 14 to 210° F. These differences in pressure between the heating chamber and the receiver are made possible in the present case by the use of the adjustable spring on the controlling valve 12 and the proper operation of the condenser and ejector.

It is highly desirable that the amount of steam supplied through the manifold 18 be sufficient to change the phase of the liquids and vapors contained within the receiver to cause substantially complete separation of the liquid and air. The amount of heat in the steam so supplied should be not less than the amount equivalent to that required to evaporate not less than 1% of the total volume of the liquid as it passes through the receiver 3 at its boiling point. Also, the capacity of the air connection 25 should be sufficient to convey from the receiver all of the air, gases and vapors released within the receiver.

The advantages of the present invention arise from the provision of a liquid treating apparatus in which the liquid is successively heated in such manner that the control of the temperature of the delivered liquid is facilitated.

Further advantages arise from the provision of means for successively heating a given body of liquid under definite temperature and pressure conditions whereby all of the air may be effectively removed therefrom.

The foregoing results are accomplished in a highly satisfactory manner by an apparatus such as is disclosed in the drawings and described in the specification, but it will be obvious that many changes within the scope of the following claims may be made without destroying the usefulness of the invention.

I claim:

1. In an apparatus for separating air from liquids, a heating chamber, means for continuously supplying heat to said chamber in the amount required to maintain the desired temperature conditions therein irrespective of the volume of liquid being treated, a receiver, means for delivering liquid first to said heating chamber and then to said receiver, and means for supplying heat to said receiver to the amount required to maintain a deaerating atmosphere therein.

2. In an apparatus for separating air from liquids, a heating chamber, a source of heat therefor, means for automatically continuously controlling the amount of heat supplied to said heating chamber irrespective of the amount of liquid being treated, a receiver, means for delivering liquid first to said heating chamber and then to said receiver, and means for supplying heat to said receiver in the amount required to change the phase of the liquid supplied thereto from the heating chamber.

3. In an apparatus for separating air from liquids, a heating chamber, a source of heat therefor, a receiver, means for delivering liquid first to said heating chamber and then to said receiver, means automatically continuously controlling the amount of heat supplied to said heating chamber, and means for supplying heat to said receiver to uniformly change the phase of the liquid supplied thereto by the heating chamber.

4. In an apparatus for separating air from liquids, a heating chamber, means continuously controlling the amount of heat supplied to said chamber in accordance with the supply of liquid and irrespective of the volume, a receiver, means for delivering liquid first to said heating chamber and then to said receiver, and means for supplying heat to said receiver below the level of the liquid therein to violently agitate said liquid and maintain within the receiver a deaerating atmosphere.

5. In an apparatus for separating air from liquids, a heating chamber, a receiver, means for supplying liquid successively to said heating chamber and said receiver, means for continuously maintaining predetermined conditions within said heating chamber, means for separately supplying supplemental heat to said receiver, and means co-operating with said receiver for maintaining temperature conditions therein similar to or different from the temperature conditions within the heating chamber.

6. In an apparatus for separating air from liquids, a heating chamber, a receiver, a spring-controlled valve between said heating chamber and said receiver, means for supplying liquid to said heating chamber, said valve

permitting the passage of liquid under predetermined conditions from said heating chamber to said receiver, and means for separately heating both the heating chamber and the receiver.

7. In an apparatus for separating air from liquids, a heating chamber, a receiver, a spring-controlled valve between said heating chamber and said receiver, means for supplying liquid to said heating chamber, said valve permitting the passage of liquid under predetermined conditions from said heating chamber to said receiver, and means for separately heating both the heating chamber and the receiver, the heating means for said receiver supplying heat to the liquid therein below the liquid level.

8. In the method of separating air from liquids, the steps consisting in heating the liquid in one chamber, delivering the heated liquid to a second chamber, and supplying additional heat to the liquid in the second chamber below the level of the liquid therein and in accordance with the amount of liquid being treated to continuously change the phase of a definite percentage of said liquid.

9. In the method of separating air from liquids, the steps consisting in heating the liquid in one chamber, delivering the heated liquid to a second chamber, maintaining similar temperature conditions in both of said chambers, and supplying additional heat to the liquid in the second chamber below the level of the liquid therein.

10. In the method of separating air from liquids, the steps consisting in uniformly heating the liquid in one chamber by inducing a flow of heating steam thereinto in proportion to the work being done, delivering the heated liquid to a second chamber, supplying free steam to the liquid in the second chamber below the level of the liquid therein, and permitting the escape of vapors and gases from the second chamber in an amount sufficient to produce a constant evaporation of the liquid at its boiling point.

11. In the method of separating air from liquids, the steps consisting in heating all of the liquid in one chamber, maintaining predetermined temperature conditions in said chamber, delivering the heated liquid at said temperature to a second chamber, and supplying steam to the liquid in the second chamber below the liquid level therein, and at a temperature and pressure such as to overcome the static head of the liquid in the second chamber, and maintain therein a total vapor pressure with a partial air pressure low enough to insure deaeration of the liquid therein.

12. In the method of separating air from liquids, the steps consisting in supplying heated liquid to a receiver, maintaining definite temperature conditions within the receiver, and supplying free steam to the liquid in the receiver at a point below the level of the liquid therein, and at a temperature and pressure such as to overcome the static head of the liquid in the receiver, and maintain in the receiver a total vapor pressure with a partial air pressure low enough to insure deaeration of the liquid in the receiver.

13. Apparatus for deaerating water comprising in combination a closed chamber, having a water outlet and an air outlet, means for supplying water to be deaerated to said chamber to maintain a body of water therein partially filling the chamber, and means for scrubbing said body of water with steam, including provisions for injecting steam into the water and provisions whereby the steam injected into the water will set up a directed circulation of said body of water along a path of flow closed upon itself.

14. Apparatus for deaerating water comprising in combination a closed chamber provided with an air outlet and a water outlet, means automatically responsive to the amount of water in said chamber for supplying water to be deaerated to said chamber as required to maintain a body of water therein partially filling the chamber, and means for scrubbing and circulating said body of water comprising a steam jet pump.

15. In an apparatus for separating air from liquids, a heating chamber, a source of heat therefor, a receiver, means for delivering liquid first to said heating chamber and then to said receiver, means controlling the pressure at which the liquid passes to the receiver, and means for supplying heat to said receiver in the amount required to change the phase of the liquid supplied thereto from the heating chamber.

16. In an apparatus for separating air from liquids, a heating chamber, a source of heat therefor, a receiver, means for delivering liquid first to said heating chamber and then to said receiver, means for supplying heat to said receiver in the amount required to change the phase of the liquid supplied thereto from the heating chamber, and a supplemental means for passing liquid from the heating chamber to said receiver.

17. In apparatus for separating air from liquids, a heating chamber having a single source of heat, means for continuously supplying from said source to said chamber heat in the amount required to continuously maintain the desired temperature conditions therein, irrespective of the volume of liquid being treated, a receiver, means for delivering liquid first to said heating chamber and then to said receiver, and means for supplying heat to said receiver to the amount required to continuously maintain a deaerating atmosphere therein.

18. In apparatus for separating air from liquids, a heating chamber having the same

source of heat at all times, means for automatically continuously controlling the amount of heat supplied to said heating chamber from said source, a receiver, means for delivering liquid first to said heating chamber, and then to said receiver, and means for continuously supplying heat to said receiver in the amount required to maintain deaerating conditions therein.

In testimony whereof I have hereunto set my hand.

WILLIAM S. ELLIOTT.

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In testimony whereof I have hereunto set my hand.

WILLIAM S. ELLIOTT.

CERTIFICATE OF CORRECTION.

Patent No. 1,797,405. Granted March 24, 1931, to

WILLIAM S. ELLIOTT.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, claim 10, strike out lines 43 to 46, inclusive, and insert instead "in an amount sufficient to produce a constant evaporation of the liquid at its boiling point, and permitting the escape of vapors and gases from the second chamber."; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of April, A. D. 1931.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.

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