

Sept. 16, 1930.

W. S. ELLIOTT

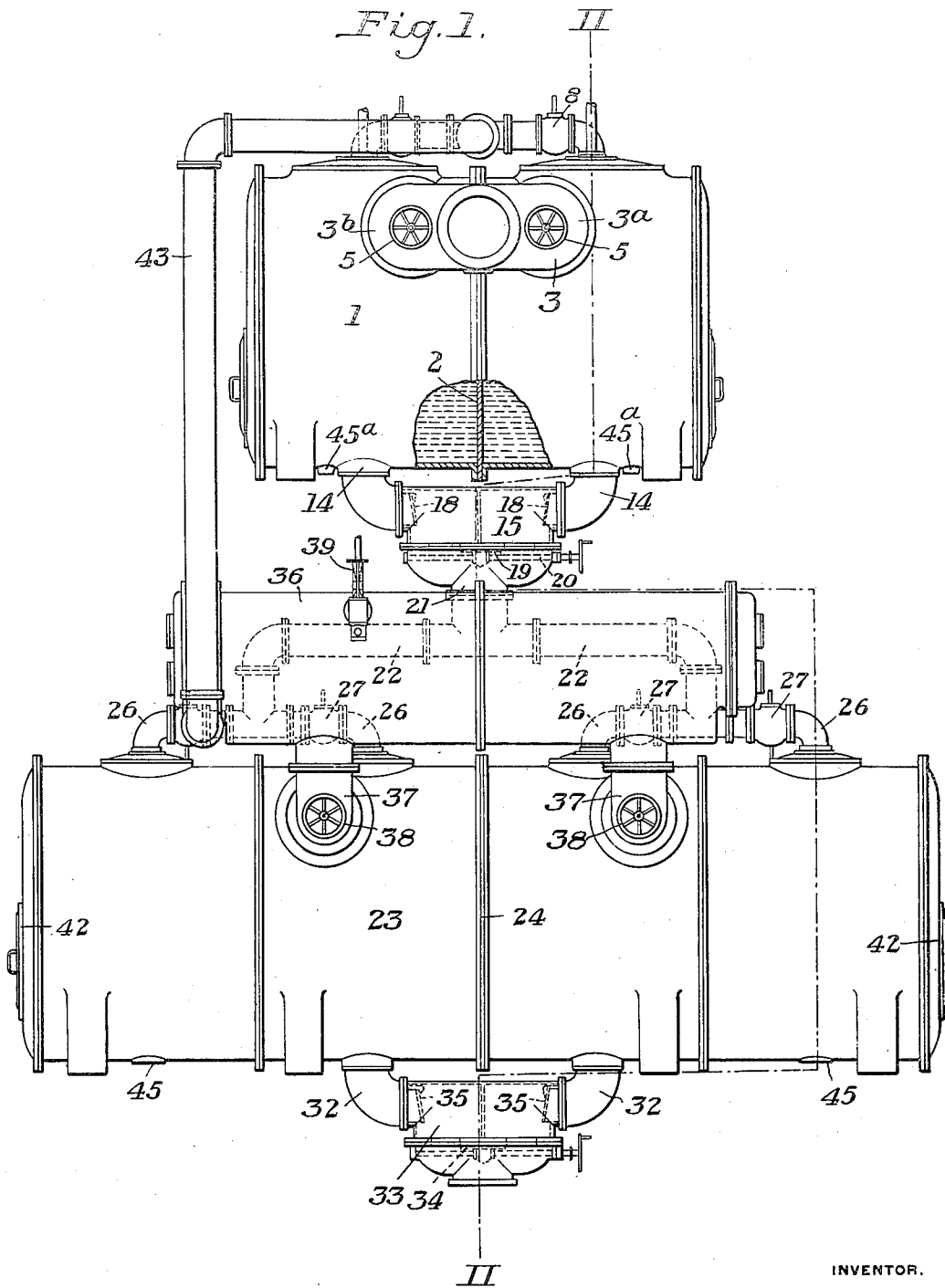
1,776,019

TREATMENT OF LIQUIDS

Filed Jan. 14, 1921

4 Sheets-Sheet 1

Fig. 1.



INVENTOR.

Wm S. Elliott
by Baker, Byrnes & Connelley
his atty

Sept. 16, 1930.

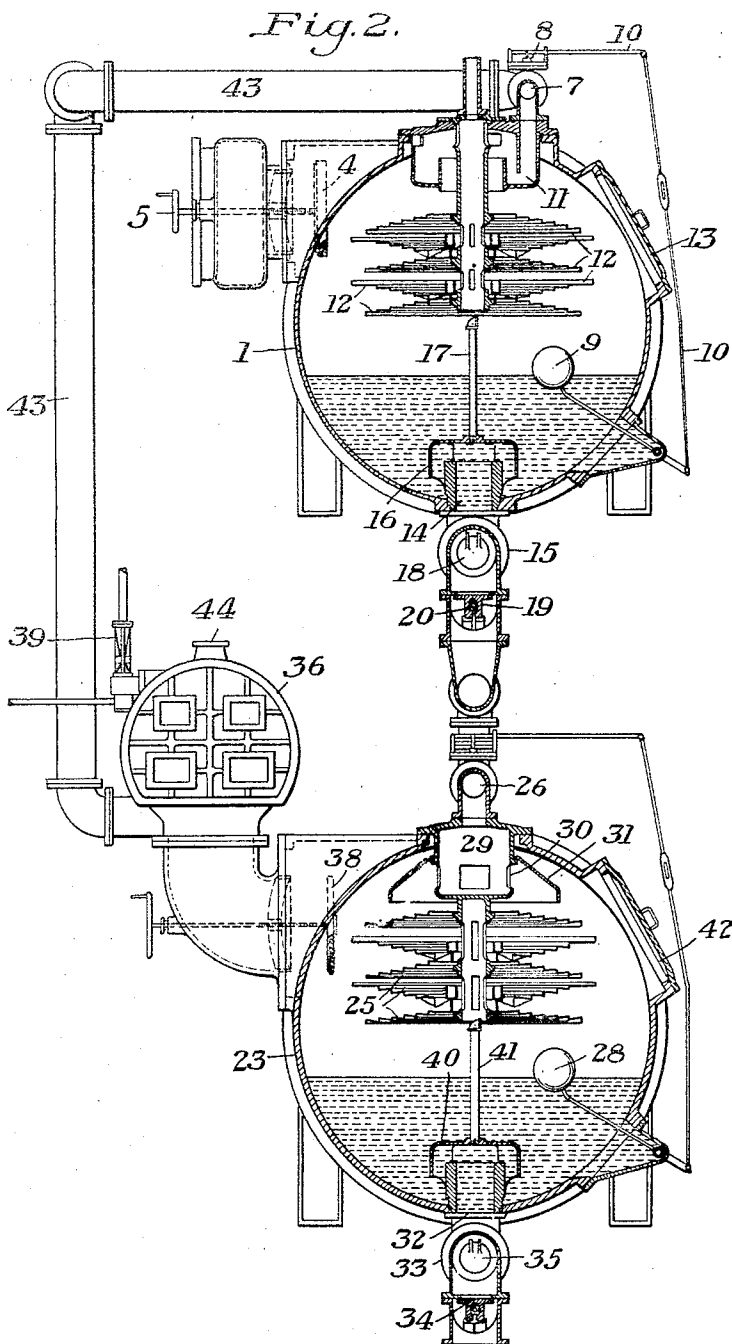
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TREATMENT OF LIQUIDS

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4 Sheets-Sheet 2



INVENTOR.

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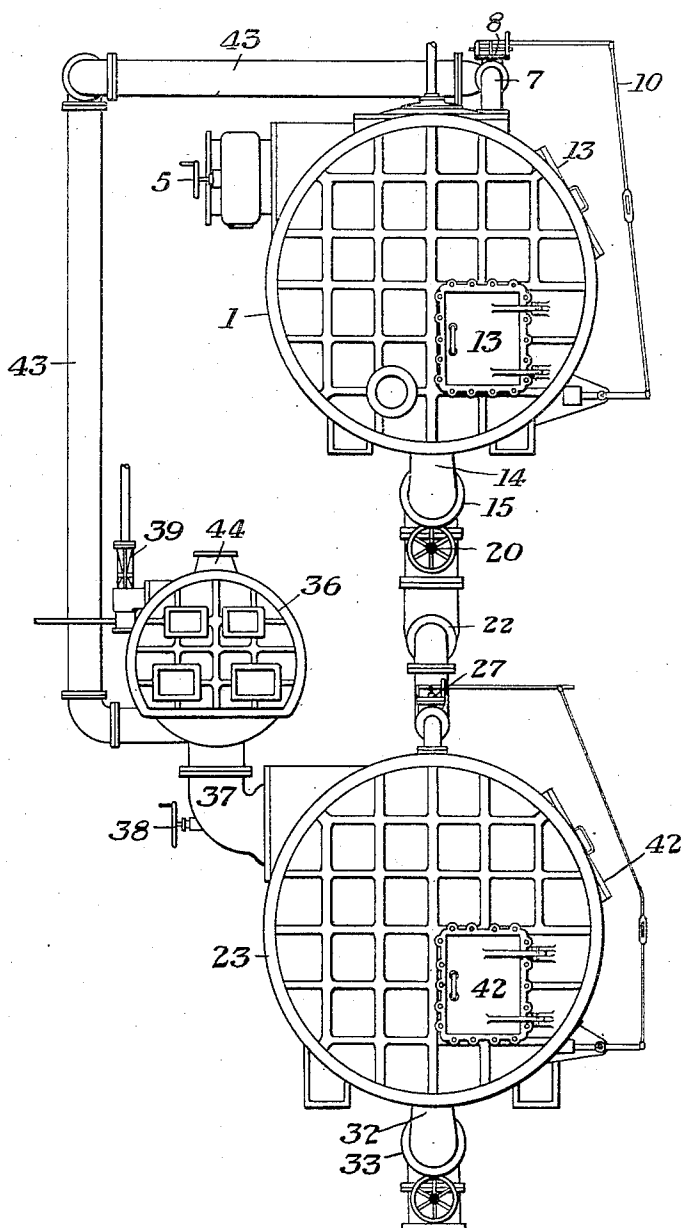
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TREATMENT OF LIQUIDS

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4 Sheets-Sheet 3

Fig. 3.



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TREATMENT OF LIQUIDS

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4 Sheets-Sheet 4

Fig. 4.

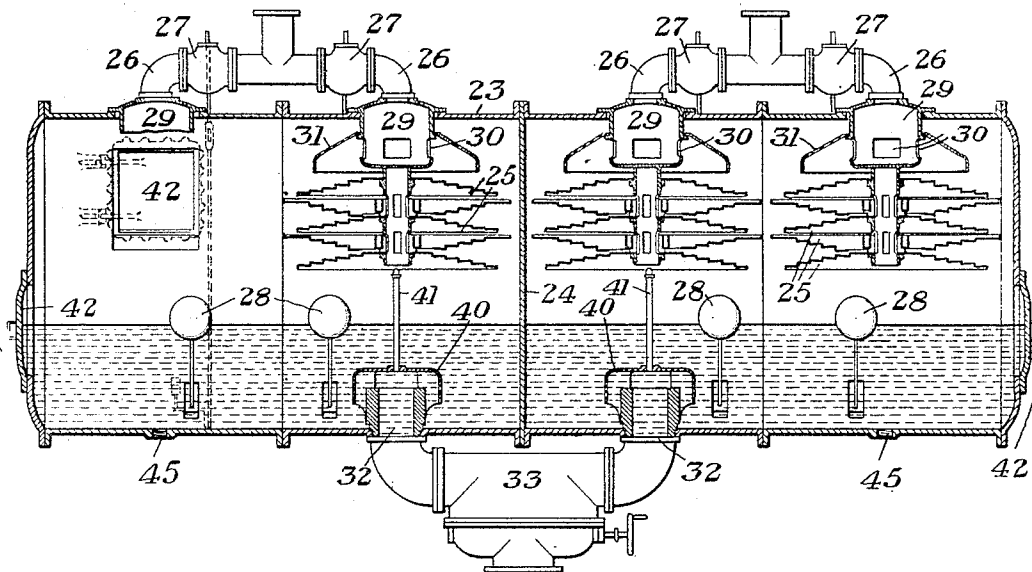
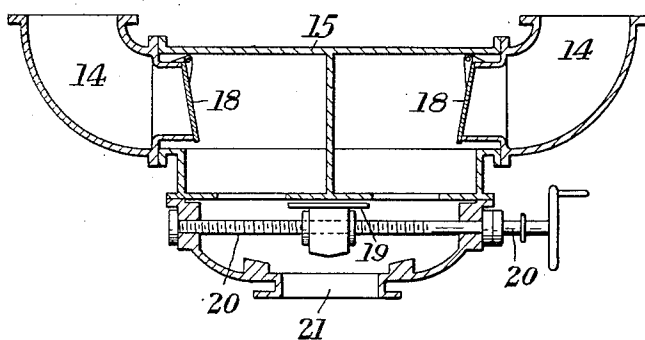


Fig. 5.



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UNITED STATES PATENT OFFICE

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TREATMENT OF LIQUIDS

Application filed January 14, 1921. Serial No. 437,239.

Figure 1 is a front elevation of one form of apparatus embodying my invention with a portion of the casing of the heater broken away;

Figure 2 is a section on the irregular line II—II of Figure 1;

Figure 3 is an end view;

Figure 4 is a longitudinal section of the separator with one set of distributing pans broken away; and

Figure 5 is a detail sectional view showing a portion of the connections between the heater and the separator.

My invention has relation to apparatus for separating air and other dissolved gases from water and other liquids; and more particularly to apparatus for carrying out the method of separation described and claimed in my Patent No. 1,321,999, dated November 18, 1919.

In carrying out the method of said patent, a large amount of carbonates are released in the separator, and thereby cause an accumulation of scale and mud which is necessary to be removed at frequent intervals. The heating of the water in the heater also produces more or less precipitation, necessitating frequent cleaning. Repairs to both the heater and separator are sometimes necessary. In carrying out the method, it is essential that it should be as continuous in its operation as possible.

The present invention is designed to provide apparatus of the character described, in which the method may be continuously carried out, notwithstanding cleaning and repairing operations; and to this end, the invention consists in providing the heater and separator with a plurality of compartments, together with connections for the several compartments so constructed and arranged that any desired compartment can be isolated or cut out of operation without effecting the operation of the remaining compartments.

The invention also comprises various other features of construction and arrangement of parts, which are of advantage in the proper use of the system, as will be hereinafter more particularly pointed out.

In the accompanying drawings, in which

I have shown a preferred embodiment of my invention and which will now be described, the numeral 1 designates a heater which is divided into two compartments by a partition plate 2. 3 is an inlet chamber for admitting steam to the heater, this inlet having the two branches 3^a and 3^b, communicating, respectively, with the heater compartments. Each of these branches is provided with a control valve 4, actuated by any suitable means, such as the hand wheel 5, these valves providing means whereby steam may be admitted to both compartments or may be shut off from either compartment at will. 7 designates a water supply connection having two branches, one of which enters the upper portion of each of the heater compartments. Each of the branches is controlled by a valve 8, and these valves are, in turn, controlled by floats 9, through the connections 10, said parts providing means whereby a substantially constant water level may be maintained in each of the compartments, and also means whereby the supply of water may be cut off at will from either compartment. Each of the water supply connections enters a suitable distributor 11 in the upper portion of its compartment, this distributor distributing the water to a series of corrugated pans 12. 13 designates clean-out doors for gaining access to the interior of the heater compartments for removing and cleaning the pans, there being one or more sets of pans at each side of the partition plate 2.

Each heater compartment is provided with a bottom outlet 14, the two outlets leading into a common junction box 15. Each outlet is preferably covered by a hood 16, open at its bottom to permit the liquid to enter thereunder to the upper end of the outlet 14, and provided with a venting pipe 17, extending upwardly into the heater to a point above the liquid level therein. The junction box 15 is provided with the two check valves 18, placed one at the discharge end of each of the connections 14. 19 designates a gate valve, actuated by a screw 20. When this valve is in its intermediate position, as shown in Figure 5, the outlet openings from both compartments of the junction box 15 are

open; but the valve can be moved in either direction from this position to close off either compartment of said box, and thereby isolate the corresponding compartment of the heater.

The outlet 21 from the junction box below the valve 19 is connected to a branched pipe 22, which supplies the separator 23. This separator is divided into two compartments by means of a partition plate 24, and each compartment preferably has in its upper portion a plurality of sets of distributing pans 25 (see Figure 4). In order to give each set of these pans its own independent supply, each branch of the pipe 22 is again branched, with one arm 26 arranged to supply each set of pans. Each of the branches 26 is provided with a water-sealed control valve 27, controlled by a float 28. The discharge from each branch 26 is into an inlet box 29, having lateral discharge openings 30, and surrounded by a hood 31, which confines the water as it enters the separator for the purpose hereinafter described.

Each compartment of the separator has an outlet 32, these two outlets leading into opposite compartments of a junction box 33, having a gate valve 34, similar to the gate valve 19, above described, this valve providing means whereby either compartment of the separator may be isolated. The junction box 33 is also provided with check valves 35, similar to the check valves 18 in the junction box 15.

36 is a condenser having a separate connection 37 with each compartment of the separator, each of these connections being controlled by an independent valve 38. 39 is an ejector for carrying off the non-condensable gases from the condenser.

Each outlet branch 32 from the separator has its open inner end surrounded by a hood 40, similar to the hood 16 in the heater, this hood having a venting pipe 41, extending upwardly into the separator chamber to a point above the liquid level therein. 42 designates clean-out doors for the separator. As many of these doors may be provided as desired. The water supply connection for the heater is connected by a pipe 43 with the condenser, the water supply connection of the latter being shown at 44.

The operation is as follows: The water or other liquid which is heated in the compartment of the heater flows into the separator under the control of the float valves 28. A partial vacuum is maintained in the condenser. The temperature and pressure maintained in the separator compartments are definitely lower than the temperature and pressure in the heater. The hot water enters the separator at a region of lower pressure and temperature, giving up instantaneously a portion of the amount of its con-

tained heat, thereby causing violent boiling. This boiling action is so violent as to scatter the water through a considerable range, and it is for the purpose of preventing too wide scattering that the hoods 31, before described, are provided, these hoods insuring the passage of the water over the pans 25. As a result of the sudden or instantaneous boiling of the water as it enters the separator, the vapors or gases contained therein are released and pass into the condenser where the vapors are condensed. The non-condensable gases are exhausted by the action of the ejector 39. The water used for condensing purposes enters the condenser from some source having a temperature below the temperature of the separator and passes out of the condenser at a higher temperature through the pipe 43, by which it is conveyed to the heater compartment and distributed therein. If the amount of water passing through the separator, heater and condenser is the same, the temperature rise in the condenser will correspond to the temperature drop in the separator, provided, however, that the temperature of the water entering the separator is substantially equal to the temperature of the water in the heater, minus the temperature of the water in the separator. For practical operation, it is recommended that water having a temperature of from five to ten degrees below those above mentioned should be employed, in order to reduce the cost of the condenser. For example, if the temperature of the heater is at 200° F., and the temperature in the separator at 180° F., (the drop being 20° F.), the rise in temperature of the water passing through the condenser will be substantially 20° F.; and the water entering the condenser will be at a temperature of about 160° F., with some addition to provide for radiation losses, etc. If, however, the varying conditions are such that a smaller quantity of water passes through the condenser than passes through the separator and heater, then the rise in temperature in the condenser will be greater than the drop in temperature of the separator and the initial temperature of the water, but the amount given up by the separator is substantially absorbed by the condenser.

It is necessary in the carrying out of the invention that a definite fixed temperature difference be maintained between the heater and the separator, and this is accomplished by the water-sealed valves 27, which emit water to the separator compartments proportionately, as required. There is thus maintained a definite difference in temperature in the separator as compared to the temperature of the heater and the water therein immediately before the water enters the separator.

By the provision of the separate compart-

ments in both the heater and the separator, either compartment of the heater or either compartment of the separator may be isolated, so that one compartment can be thoroughly cleaned without interfering with the operation of the remaining compartments. The shutting off of one side of the heater requires merely the closing of the control valve 4 at that side, the disconnecting of the float-actuating connections for the valve 8 at the same side, and the movement of the gate valve 19 over the outlet port communicating with the side of the heater to be isolated. The isolation of either compartment of the separator requires merely the disconnection of the float-actuating connections for the valves 27 at that side of the separator, the closing of the valve 38 between the condenser and that compartment and the closing of the valve 34 to close the outlet from that compartment.

Each separator compartment is preferably provided with a blow-off 45, which can be opened for the compartment which is being isolated, thereby destroying the vacuum at that side and permitting the water to flow out. The heater may be provided with similar blow-off connections 45^a.

It will be understood that the construction and arrangement which I have herein shown and described is illustrative only, and that it may be widely varied in practice. The essential feature of my invention is the provision of means whereby any desired portion of the heater or of the separator or of both may be isolated to permit cleaning or repairs thereto, without interfering with the operation of the remaining compartments. Obviously this can be accomplished in various ways.

I claim:

1. In an apparatus for separating gases from liquids, a heater divided into compartments, means for heating any one or all of said compartments at will either individually or simultaneously, a separator having a vapor space and a liquid space, connections between each of the heater compartments and the separator permitting the flow of heated liquid from the heater compartments to the separator through the vapor space therein, means for controlling said connections to permit either compartment of the heater to be isolated, and means cooperating with the separator for withdrawing released vapors therefrom, substantially as described.

2. In an apparatus for the treatment of liquids, a heater, means for heating the same, a separator divided into compartments, each having a vapor space and a liquid space, connections between the heater and each compartment of the separator permitting the flow of heated liquid from the heater to the compartments of the separator, said connections having controlling means whereby any

compartment of the separator may be isolated, and means cooperating with the vapor space in any one or all of said compartments for withdrawing released vapors therefrom, substantially as described.

3. Apparatus for the treatment of liquids, comprising a heater having separate compartments, a separator also having separate compartments, each having a vapor space and a liquid space, and valved connections whereby either compartment of the heater may be connected with all the compartments of the separator or with any separator compartment for feeding liquid through the vapor space therein, substantially as described.

4. Apparatus for separating gases from liquids, comprising a heating chamber having a plurality of compartments, a separating chamber having a vapor space and a liquid space, a condenser connected with the vapor space of the separating chamber, and means for cutting out of service any compartment of the heater, substantially as described.

5. Apparatus for separating gases from liquids, comprising a heating chamber having a plurality of compartments, a separating chamber having a plurality of compartments, a condenser connected with each compartment of the separator, and means for isolating any desired compartment of the separator, substantially as described.

6. Apparatus for separating gases from liquids, comprising a heater having a plurality of compartments, a separator having a plurality of compartments, a condenser having an independent connection with each compartment of the separator, and means for isolating any desired compartment of either the heater or the separator and for isolating the condenser from the compartment of the separator so isolated, substantially as described.

7. Apparatus for separating gases from liquids, comprising a heater having a plurality of separate compartments, a separate steam and liquid supply for each of said compartments, a separate outlet for each compartment, a separator having a liquid space and a vapor space, and a common connection between the said outlets and the vapor space of the separator, substantially as described.

8. Apparatus for separating gases from liquids, comprising a heater having a plurality of separate compartments, a separate steam and liquid supply for each of said compartments, a separate outlet for each compartment, a separator, and a common connection between the said outlets and the separator, the separator also having a plurality of compartments with a separate supply leading from the common connection to each of the compartments, substantially as described.

9. Apparatus for separating gases from

liquids, comprising a heater having a plurality of separate compartments, a separate steam and liquid supply for each of said compartments, a separate outlet for each compartment, a separator, and a connection between the said outlets and the separator, the separator also having a plurality of compartments with separate supplies leading from the heater to each of the compartments, each of the compartments of the separator having a separately controlled inlet valve in its supply connection, substantially as described.

10. Apparatus for separating gases and liquids comprising a heater, a separator and a condenser, the separator having a plurality of compartments, each of said compartments having a separate valved connection with the condenser and each of said compartments also having a separate valved supply connection leading to the outlet of the heater, substantially as described.

11. Apparatus for separating gases from liquids, comprising a heater having a plurality of compartments, a separator also having a plurality of compartments, and valved connections for said compartments, whereby either compartment of either the heater or the separator may be isolated, said separator and heater having means for permitting access to their respective compartments, substantially as described.

12. In an apparatus for the treatment of liquids, a heater, means for heating the same, a separator divided into compartments, each having a vapor space and a liquid space, connections between the heater and each compartment of the separator permitting the flow of heated liquid from the heater to the compartments of the separator, said connections having a controlling means whereby any compartment of the separator may be isolated, and means cooperating with the vapor space in any one or all of said compartments for withdrawing released vapors therefrom and recovering the heat of such vapors, substantially as described.

13. An apparatus for deaerating water comprising a chamber having a liquid space and a vapor space, a condenser provided with a cooling water supply connection and operating to maintain substantially constant conditions of pressure within said vapor space, a connection for conveying condenser cooling water from the condenser to said chamber and including means for supplying additional heat to heated water, means in said last-mentioned connection operative in accordance with demands for treated water on said chamber for delivering condenser cooling water to said chamber in a substantially continuous manner, and means for separately conveying condensed vapors from said condenser to said chamber at condenser pressure and in a substantially

continuous manner, substantially as described.

14. Apparatus for producing substantially air free water, comprising a temperature stage, a pressure stage, means for passing the water from the temperature stage to the pressure stage, a surface type vent condenser cooperating with and freely open to one of said stages and effective for continuously returning its condensate to such stage at the pressure of the condenser, and delivering it thereto at substantially said pressure, and means for passing the cooling water from the condenser to said temperature stage.

15. In an apparatus for producing substantially air free water, a temperature stage, a pressure stage, means for supplying to said temperature stage, heat in accordance with demands, means for passing the liquid first to the temperature stage and then to the pressure stage, in accordance with demands for deaerated water, and a surface type vent condenser continuously cooperating with one of said stages and operative for returning its condensate thereto in a substantially continuous manner at condenser pressure, and delivering it thereto at substantially said pressure.

16. In an apparatus for producing air free water, a temperature stage of water treatment, a pressure stage of water treatment, a vent condenser cooperating with the pressure stage and effective for returning its condensate thereto at condenser pressure, and delivering it thereto at substantially said pressure, and means for supplying the water to be deaerated successively to said condenser, temperature stage and pressure stage in accordance with demands for deaerated water.

17. In an apparatus for producing substantially air free water, a heater constituting a temperature stage of water treatment constructed to supply heat to the liquid in accordance with the work being done therein, a receiver constituting a pressure stage and effective for receiving liquid from the temperature stage, and a vent condenser cooperating with one of said stages and effective in a substantially continuous manner for returning its condensate thereto at condenser pressure, and delivering it thereto at substantially said pressure.

18. In an apparatus for producing substantially air free water, a heater constituting a temperature stage of water treatment constructed to supply heat to the liquid in accordance with the work being done therein, a receiver constituting a pressure stage and effective for receiving liquid from the temperature stage, and a vent condenser cooperating with one of said stages and effective in a substantially continuous manner for returning its condensate thereto at condenser pressure, and maintaining it during its return at substantially said such pressure, there

being means for feeding the water to be deaerated successively to said vent condenser, temperature stage and pressure stage, in accordance with demands for deaerated liquid.

19. In an apparatus for producing substantially air free water, an induction heater constituting a temperature stage of water treatment, a receiver adapted to receive heated liquid from said temperature stage and constituting a stage of pressure treatment for the heated liquid, a vent condenser continuously cooperating with one of said stages for maintaining substantially constant conditions therein, said condenser being effective for returning its condensate to one of said stages at condenser pressure, and maintaining it during its return at substantially such pressure, and means for successively supplying the water to be deaerated to said condenser, induction heater and receiver in accordance with demands on the apparatus for deaerated water.

20. In an apparatus for producing substantially air free water, a temperature stage, a pressure stage, a water supply communication between said stages, means for delivering the water to be deaerated first to the temperature stage and then through said communication to the pressure stage, means for supplying heating steam to the apparatus, the temperature stage comprising an open induction heater for bringing the steam and water into intimate contact and for controlling the amount of steam and heating the water in the temperature stage to bring it to a temperature as high as possible in the presence of the air therein, said pressure stage comprising a contact heater performing no substantial heating duty, and a surface type vent condenser cooperating with and freely open to one of said stages and effective for continuously returning its condensate to said stage at the pressure of the condenser, the return connection being of such construction as to maintain the condensate at substantially condenser pressure during its return.

21. An apparatus for producing substantially air free water, comprising a temperature stage, a pressure stage, means for passing the water from the temperature stage to the pressure stage, a surface type vent condenser having a continuously open vent, said condenser cooperating with and freely open to one of said stages and effective for continuously returning its condensate to said stage at the pressure of the condenser, the return connection being of such construction as to maintain the condensate at substantially condenser pressure during its return, and means for passing the cooling water for the condenser to said temperature stage.

22. An apparatus for producing substantially air free water, comprising a temperature stage, a pressure stage, means for passing the water from the temperature stage to

the pressure stage, a surface type vent condenser cooperating with and freely open to one of said stages and effective for continuously delivering its condensate to such stage at substantially the pressure of the condenser, means for continuously withdrawing non-condensed vapors from the vent condenser, and means for passing the cooling water for the condenser to said temperature stage.

23. In an apparatus for producing substantially air free water, a temperature stage of water treatment, a pressure stage of water treatment, means for supplying to said temperature stage heat in accordance with demands and for raising the temperature of the water in the temperature stage substantially as high as it can be raised by such heat in the presence of the air content of the water and steam, to thereby eliminate as much of the air content as it is possible to eliminate at that temperature, means for passing the water first to the temperature stage for preliminary air removal and then to the pressure stage in accordance with demands for deaerated water, said pressure stage being effective for removing substantially all of the air remaining in the water after treatment in the temperature stage, and a surface type vent condenser continuously co-operating with one of said stages through a freely open connection and operative for returning condensate formed therein to the stage with which it cooperates in a substantially continuous manner at substantially condenser temperature, and delivering it to such stage at substantially said temperature.

24. Apparatus for producing substantially air free water, comprising a temperature stage of water treatment, a pressure stage of water treatment, means for passing the water from the temperature stage to the pressure stage, a surface type vent condenser cooperating with and freely open to one of said stages and effective for continuously returning its condensate to such stage at substantially the temperature of the condenser, and delivering it thereto at substantially said temperature, and means for passing the cooling water from the condenser to said temperature stage.

In testimony whereof, I have hereunto set my hand.

WILLIAM S. ELLIOTT.