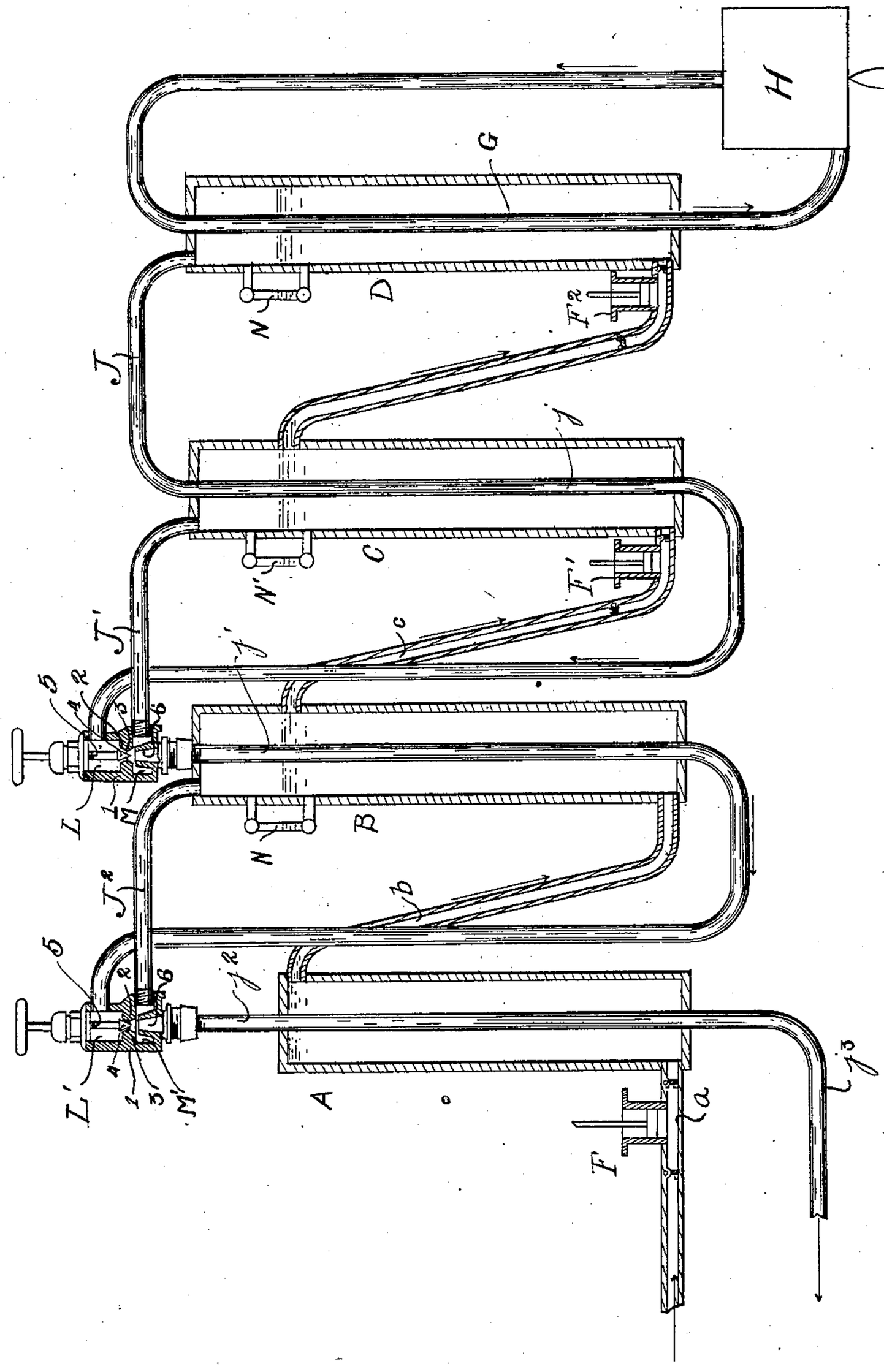
No. 713,297. Patented Nov. 11, 1902.

W. F. M. GOSS.

DISTILLING APPARATUS.

(Application filed Mar. 12, 1900.)

(No Model.)



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DISTILLING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 713,297, dated November 11, 1902.

Application filed March 12, 1900. Serial No. 8,320. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM F. M. GOSS, a citizen of the United States, residing at Lafayette, in the county of Tippecanoe and State of Indiana, have invented a certain new and useful Improvement in Distilling Apparatus, (Case No. 1,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to distilling apparatus for distilling liquids by first evaporating them and then condensing the vapors. It may also be used as an efficient means for concentrating solutions, such as those of salts and sugars, by the process of evaporation.

Prominent objects of the invention are to provide a simple and inexpensive apparatus of this kind and to secure the highest possible degree of efficiency in operation.

In the drawing the figure is an illustration, partly in section and partly in elevation, of an apparatus embodying my invention.

The apparatus shown in the drawing is a very simple form, intended primarily to show the principle of operation of the system and is shown more or less diagrammatically.

The apparatus shown consists of a set or series of chambers A, B, C, and D, which can be simply cylinders adapted to contain the liquid to be distilled. The chamber A is provided with an inlet-pipe *a*, connected to the lower end of the cylinder, and this inlet-pipe is provided with a pump F. A circulation-pipe *b* is extended between the upper end of the cylinder A and the lower end of the cylinder B. In a somewhat-similar way circulation-pipes *c* and *d* are extended, respectively, between the chamber B from a point near the upper end thereof and the lower end of chamber C and between the chamber C from a point near to its upper end and the lower end of chamber D.

The circulation-pipes *c* and *d* are provided with pumps F′ and F², respectively. The pump F′ is adapted to deliver an amount of water less than that delivered by the pump F, and the pump F² is adapted to deliver less than pump F′. This difference in delivery can be secured in various ways—as, for example, by making the pumps of different size—in which case F will be the largest, F′ the next largest, and F² the smallest. Since the purpose of the pumps is to secure a circulation of the water to be distilled through the successive chambers A B C and into the chamber D, it is obvious that devices or arrangements other than pumps can be employed.

The chambers B, C, and D are provided, respectively, with gages N N′ N², respectively, adapted to indicate the height of liquid in the respective chambers.

The endmost chamber D is provided with means whereby its contents can be heated, the arrangement shown consisting of a steam-pipe G, extending from a boiler H into and through the chamber and returning outside of the chamber to the boiler, so as to form a complete circuit for the boiler-steam. This boiler is shown as being provided with a suitable heating device.

A pipe J extends from the top of the endmost chamber D into the top of the chamber C and through the same and thence upwardly to a point above the chamber B, where it is connected with a pressure-reducing valve L. A pipe J′ extends from the top of the chamber C across to a point above the next preceding chamber B, where it is connected with a mixing-chamber M, this mixing-chamber M being conveniently made in a single fitting with the pressure-reducing valve L. A pipe *j*′ is connected with the lower end of the mixing-chamber M and extends downwardly through the chamber B and thence upwardly to a point above the first chamber A, where it is connected with a pressure-reducing valve L′. A pipe J² extends from the top of the second chamber B across to a point above the first chamber A, where it is connected with a mixing-chamber M′, which, as in the former instance, is conveniently made integral with the pressure-reducing valve L′. A pipe *j*² is connected with the lower end of the mixing-chamber M′ and extends downwardly into and through the first chamber A, the lower end *j*³ of this pipe forming an outlet or discharge pipe.

The pressure-reducing valves L L′ and mix-

ing-chambers M M′ can be of any suitable or desired construction. They can of course be made as separate fittings; but as a preferred arrangement they are made a pressure-reducing and mixing chamber in a single fitting, as shown and previously set forth. In such case this fitting comprises a casting 1, having a transverse partition 2, provided with a port 3. The port 3 is controlled by a valve 4 on a valve-stem 5, which extends upwardly out of the upper end of the fitting. The fitting is also provided with an upwardly-extending nozzle 6, having its upper end close to the partition 2.

In the case of the fitting forming the combined valve L and chamber M the pipe J is connected with the upper end of the fitting and the pipe J′ with the lower end thereof. The wire-drawing occasioned by the passage of matter from the pipe J through the partially-closed port 3 reduces the pressure of such material, as result of which the upper part of the fitting acts as a pressure-reducing valve. The matter coming from the pipe J′ passes into the nozzle 6 and there becomes mixed with the matter coming through the port 3, the lower part of the fitting acting as a mixing-chamber.

The apparatus thus constructed will operate as follows: The water to be evaporated is delivered into the bottom of the chamber A through the supply-pipe *a*. From this chamber it passes to the chamber B by way of the pipe *b*, and thence a portion of that received by B passes into the chamber C by way of the pipe *c*, and a portion of that received by C passes onto chamber D by way of pipe *d*. The endmost chamber D is continually heated to a high temperature, depending, of course, upon the pressure of the steam issuing from the boiler H, and this chamber is the only one to which heat is applied from an external source. The liquid within this chamber D will become evaporated, and the vapor will issue into the pipe J, through which it will circulate. In passing downwardly through the portion *j* of the pipe J—that is, the portion contained within the chamber C—the vapors will become condensed, and the condensate will pass upwardly through the remaining portion of the pipe J and into the pressure-reducing valve L. From the valve L the condensate will pass into the pipe *j′* and in so doing will have its pressure reduced an extent dependent, of course, upon the construction or arrangement of the valve L. It will circulate through the pipe *j′* and into the pressure-reducing valve L′, where its pressure will again be reduced, after which it will again pass into the pipe j^2 and discharge through the discharge end j^3 thereof. The condensation in the pipe portion *j* of the vapors from the chamber D heats the liquid in the chamber C and causes the same to evaporate to a greater or less extent. These vapors issue into the pipe J′, through which they pass to the mixing-chamber M, where they mix with the condensate coming from the pressure-reducing valve L. The vapors thus mixed with the condensate pass with the same into the pipe *j′*, and in passing downwardly through this pipe these vapors become condensed. The condensate thus formed circulates through the remaining portion of the pipe *j′* with the other condensate and has its pressure reduced by the pressure-reducing valve L′, as described in connection with said other condensate, and thence passes into the pipe j^2 and out the discharge end j^3 thereof. The condensation in the pipe *j′* of the vapors from the pipe J′ heats the liquid in the chamber B, and this heating effect is increased by the passage in said pipe *j′* of the condensate from the pipe J. A portion of the liquid thus heated evaporates, and the vapors thus formed issue into the pipe J^2 and thence into the mixing-chamber M′, where they mix with the combined condensate coming from the pressure-reducing valve L′. These vapors are condensed in the pipe j^2, and this condensate issues with the combined condensate from the pipes J and *j′* through the discharge-pipe j^3.

It will be understood, of course, that the process is continuous and uniform. The liquid to be distilled is fed continuously to the first chamber A and circulates continuously through it and to and through the other chambers B, C, and D. The evaporation of the liquid occurs simultaneously in all of these chambers except the first, and the vapors issue in steady streams into the respective vapor-pipes and are continuously condensed by the contents of the preceding chambers, and the condensate from the various chambers collects in the return-duct formed by the pipes and is discharged in a steady stream through the outlet j^3. Thus there is brought about a continuous forward flow of the liquid to be distilled, a continuous evaporation and condensation, and a continuous return flow of the condensate.

It will at once appear that since the pressure-reducing valve L causes the pressure in the pipe *j′* to be lower than that of the pipe *j* the temperature of the former is lower than that of the latter, and consequently the pipe *j′* will not heat the liquid in the chamber B to as high a temperature as that to which the liquid in the chamber C is heated. The temperature of the liquid in the chamber B will therefore be lower than that of the liquid in the chamber C and its pressure less. For the same reason the temperature and pressure of the liquid in the chamber A will be lower than that of B. As a result the ingoing stream of liquid to be distilled has its pressure raised repeatedly in passing from chamber to chamber and the outcoming or return stream of distillate has its pressure and temperature reduced as it returns from chamber to chamber. The temperature of the discharge is desirably made to approach as near as possible to the temperature of the liquid supplied the first chamber through the supply-pipe.

It will be seen that by my invention I utilize both the vapors resulting from evaporation and also the condensate resulting from condensing such vapors in heating the liquid to be distilled. In this way, neither the vapors nor the condensate from the different chambers being discharged from the apparatus, there is no loss, except such as occurs from radiation and from the discharge by reason of the temperature of the same exceeding that of the supply. It is therefore apparent that the apparatus is capable of giving the highest economy, it being possible by reducing the radiation to the lowest possible extent and causing the temperature of the discharge to approach as nearly as possible to the temperature of the supply to cause the efficiency to approach one hundred per cent.

It is obvious that the construction of the apparatus can be greatly varied. The number of chambers can be increased and decreased. The arrangement of the vapor-pipes in connection with the same can be changed, and other alterations can be made within the knowledge of those skilled in the art. It will be understood that the apparatus shown is merely illustrative for the purpose of showing my invention.

In the apparatus as constructed with the number of chambers shown there will be delivered from the outlet j^3 a mixture of water and uncondensed steam. When the number of chambers is increased to seven, this mixture will be substantially all water, and it will be the same when the number of chambers is more than seven. By increasing the number of chambers better results are obtained, the efficiency of the apparatus is generally increased, and the temperature of the discharge is lowered.

What I claim as my invention is—

1. The combination with a series of connected chambers, of means whereby both the vapors from one of such chambers and the liquid resulting from the condensation of vapor given off by another of such chambers can be employed in evaporating the contents of one or more of the other chambers, and means for inducing flows of the liquid to be evaporated and of the condensate in opposite directions.

2. The combination with a series of connected chambers, of means whereby both the vapors from all of said chambers and the liquid resulting from the condensation of such vapors can be employed in evaporating the liquid to be distilled, and means for inducing flows of the liquid to be distilled and the condensate in opposite directions.

3. The combination with a series of connected chambers, of means for heating the endmost chamber, means for delivering the vapors from such chamber to the next preceding chamber so that they act to heat the contents thereof and become condensed thereby, means for similarly delivering the vapors from each of the other chambers to the chambers respectively preceding, means whereby the condensate resulting from the condensation of vapors from each chamber can be employed in heating the contents of the chambers preceding the one at which condensation occurs, means for inducing the flow of the liquid to be distilled from chamber to chamber toward the endmost chamber, and means for inducing a return flow of the condensate from chamber to chamber away from said endmost chamber, substantially as set forth.

4. The combination with a series of connected chambers, of means for inducing a forward circulation of the contents of the chambers through the series, and means for causing a return circulation or flow of the vapors and liquid resulting from the condensation of the vapors in such a way that both the vapors from each chamber and the liquid resulting from the condensation of these vapors act to evaporate the liquid to be distilled.

5. The combination with a series of connected chambers, of means whereby the vapors from each chamber can be employed in heating the contents of the next preceding chamber and also whereby the liquid resulting from the condensation of such vapors can be employed in heating the contents of the chamber preceding the one heated by the vapors, and means for inducing flows of the liquid to be distilled and the condensate from chamber to chamber in opposite directions.

6. The combination with a series of connected chambers, of pipes forming a single continuous return-duct for the vapors from said chambers and also for the condensate of such vapors, said duct being associated with the chambers so that the contents thereof serve to evaporate the contents of the chambers, means for conveying the vapors from all of said chambers into said duct, means for inducing a forward flow of the liquid to be distilled from chamber to chamber, and means for inducing a flow of the condensate in said duct in a direction opposite to the flow of the liquid to be distilled.

7. The combination with a series of connected chambers, of means for inducing a forward flow of the liquid to be distilled from chamber to chamber toward the endmost chamber, means for heating said endmost chamber, pipes forming a single continuous return-duct for vapors and liquid of condensation, so arranged that the contents of said duct serve to evaporate the contents of the chambers of the series, means for conveying the vapors from each of said chambers into said duct, and means for inducing a flow of the vapors and condensate in said duct in a direction away from said endmost or hottest chamber, substantially as set forth.

8. The combination with a series of connected chambers, of means for inducing a forward circulation through the chambers in succession, means for heating the endmost chamber, pipes forming a single continuous return-duct for vapors and products of con-

densation, said duct being associated with the chambers so that the contents thereof serve to heat the contents of the chambers, and arranged to convey the contents thereof in a backwardly direction from chamber to chamber, pipes adapted to convey the vapors from all the chambers into said duct, means for mixing the vapors from the chambers properly with the liquid of condensation in the duct, and means for reducing the pressure as required by the difference in temperature of the different chambers.

9. The combination with a series of connected chambers, of means for causing a forward circulation through the chambers in succession, means for heating the endmost chamber, pipes forming a single continuous return-duct for vapors and products of condensation, said duct being associated with the chambers so that the contents thereof serve to heat the contents of the chambers and arranged to convey such contents backwardly from chamber to chamber, pipes adapted to convey the vapors from all the chambers into said duct, means for mixing the vapors from the chambers properly with the liquid of condensation in the duct, and means for reducing the pressure as required by the difference in temperature of the different chambers.

10. An apparatus of the class specified, comprising a series of connected chambers, means for causing a forward circulation of their contents through all of the chambers in the series in succession, means for heating the endmost chamber, pipes extending through the chambers so as to form a single continuous return-duct for the vapors and liquid of condensation, said pipes being provided with reducing-valves between each chamber, and being arranged to convey the contents thereof backwardly through the series of chambers, vapor-pipes extending from each chamber to said duct, and mixers at the connections of said vapor-pipes with said duct.

11. An apparatus of the class specified, comprising a series of chambers connected so as to permit a forward circulation of their contents through all of the chambers in the series in succession, means for heating the endmost chamber, pipes extending through the chambers so as to form a single continuous return-duct for returning the vapors and liquid of condensation backwardly throughout the series of chambers, said pipes being provided with reducing-valves between each chamber, vapor-pipes extending from each chamber to said duct, mixers at the connections of said vapor-pipes with said duct, and pumps for inducing a circulation of the contents of the chambers through all of the same in succession.

12. In an apparatus of the class specified, the combination of means for holding the liquid to be distilled, means for evaporating a portion of the same, means for inducing a flow of the liquid toward such portion, means whereby the vapors produced by such evaporation can be employed in evaporating an incoming portion of the liquid, means whereby the condensate from such vapors can be employed in heating and evaporating another incoming portion of the liquid, and means for inducing a return flow of the condensate in a direction opposite to the incoming flow of the liquid to be distilled.

13. In an apparatus of the class specified, the combination of means for holding the liquid to be distilled in separate portions, means for causing the evaporation from one of such portions, means for inducing a flow of the liquid from portion to portion to such first-mentioned portion, means for maintaining the temperature and pressure of the various portions successively lower than in said portion where the evaporation is caused, whereby such portion becomes the hottest one and the others successively cooler, means for employing the products of evaporation from the hottest portion in heating and evaporating the preceding portions, means for employing the products of evaporation from the other portions in heating and evaporating the respectively preceding portions, and means for inducing a flow of the products of evaporation in the form of both vapor and condensate from chamber to chamber in a direction from the hottest to the coolest portion, substantially as set forth.

14. In an apparatus of the class specified, the combination with means for holding the liquid to be distilled, of means for inducing a forward circulation or movement thereof, means for evaporating a portion of the liquid, and means for inducing a circulation of such vapors and the condensate therefrom in a direction opposite the direction of flow of the liquid to be distilled, whereby both the vapors produced by such evaporation and the condensate therefrom can be employed in evaporating the remaining portion of the liquid.

In witness whereof I hereunto subscribe my name this 7th day of March, A. D. 1900.

WM. F. M. GOSS.

Witnesses:

W. G. GLASBOWER, Jr.,

W. D. PENCE.