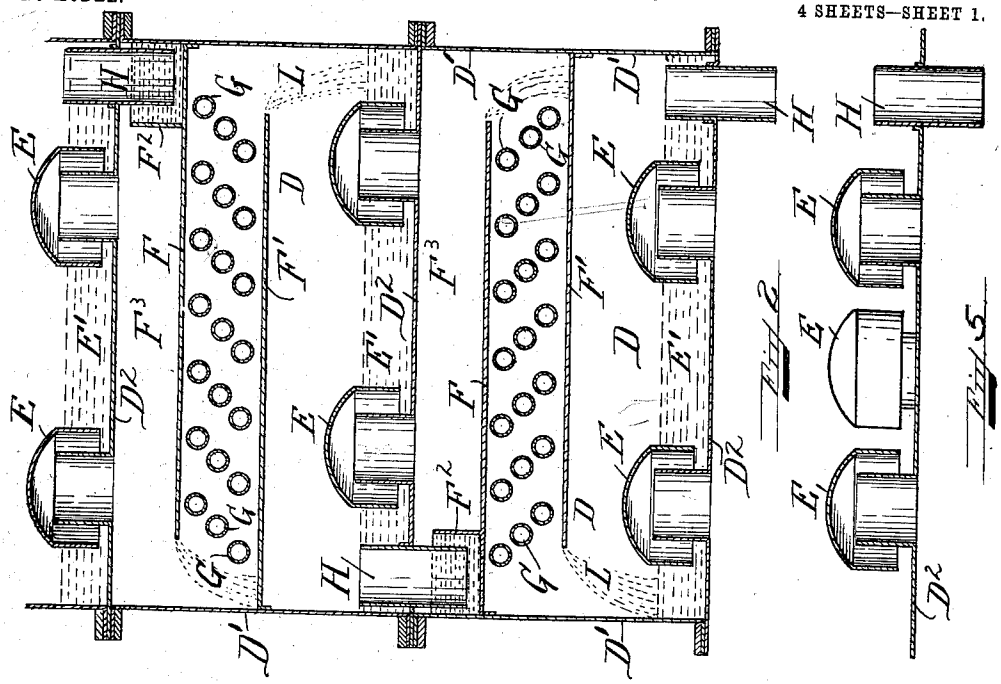
No. 731,799. PATENTED JUNE 23, 1903.

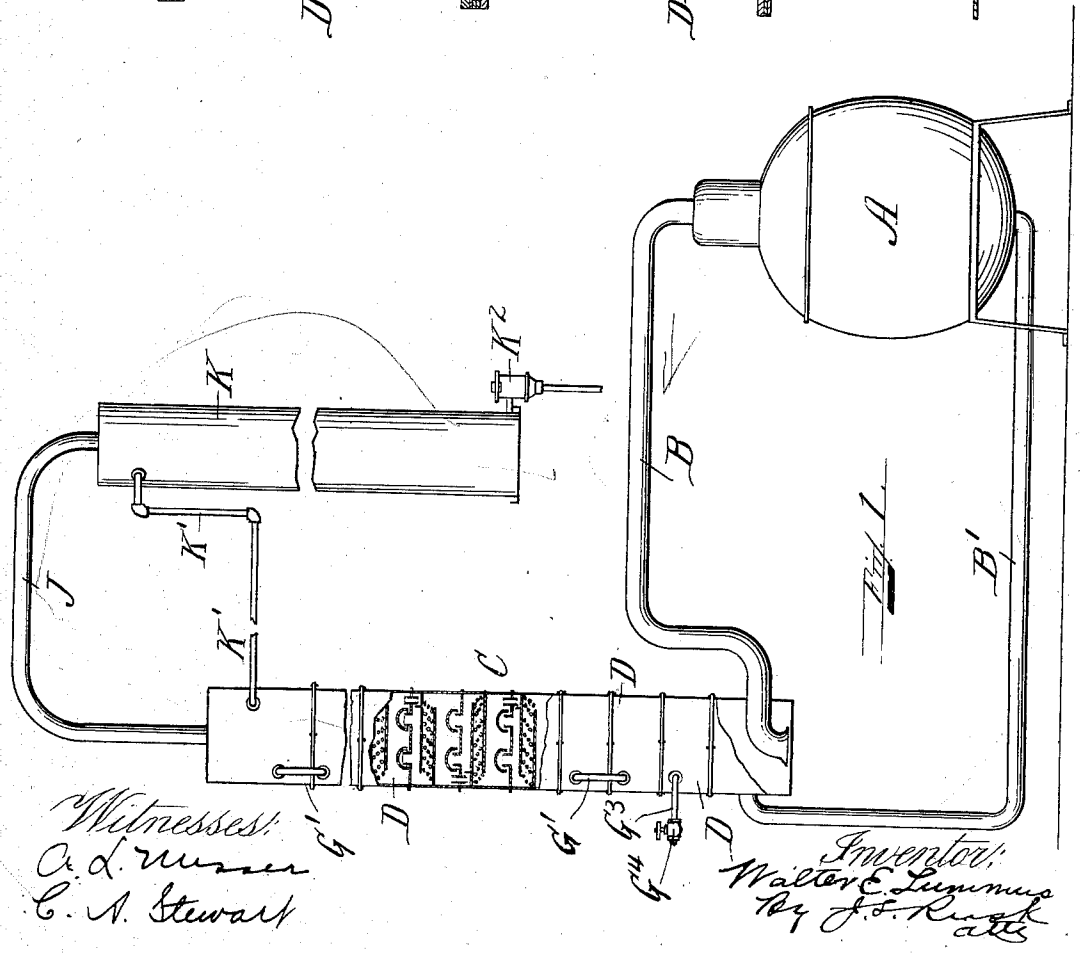
W. E. LUMMUS.

DISTILLING APPARATUS.

APPLICATION FILED AUG. 1, 1901.

NO MODEL. 4 SHEETS—SHEET 1.





Witnesses:
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C. A. Stewart

Inventor:
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By J. L. Rugh
Atty

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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NO MODEL. 4 SHEETS—SHEET 2.

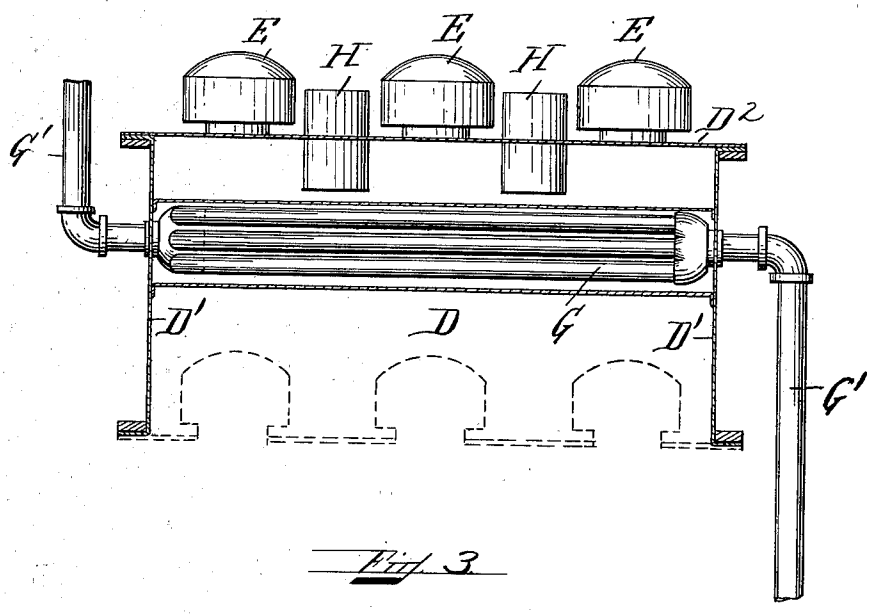


Fig 3

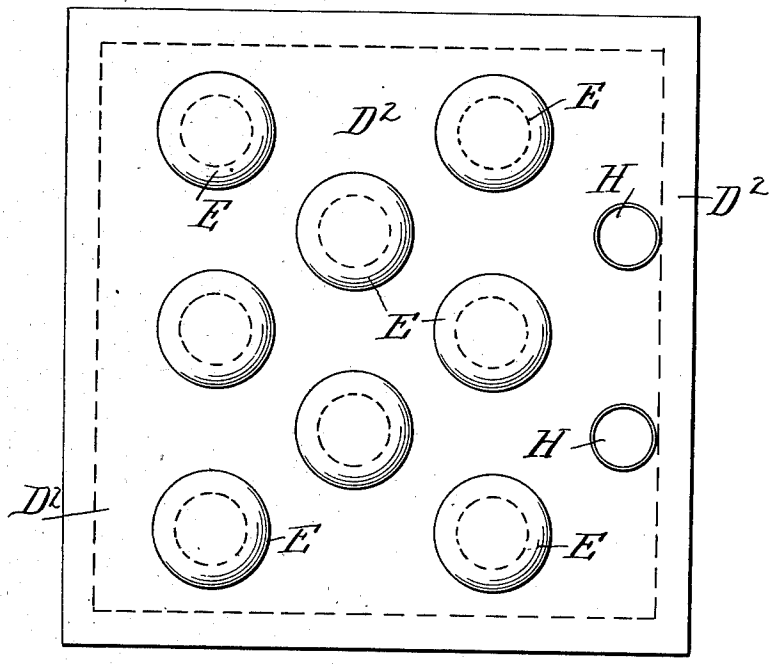


Fig 4

Witnesses:
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NO MODEL. 4 SHEETS—SHEET 3.

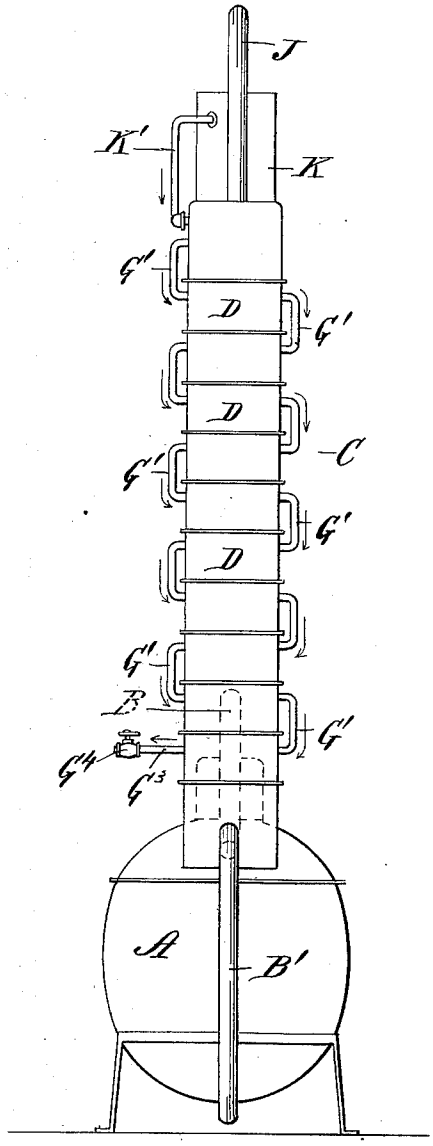


Fig. 6.

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No. 731,799. PATENTED JUNE 23, 1903.

W. E. LUMMUS.

DISTILLING APPARATUS.

APPLICATION FILED AUG. 1, 1901.

NO MODEL. 4 SHEETS—SHEET 4.

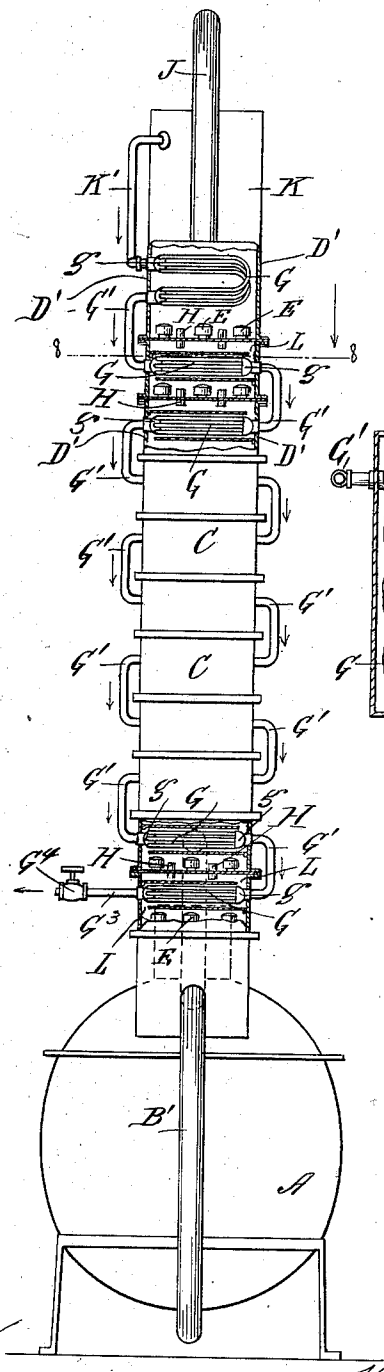


Fig. 7.

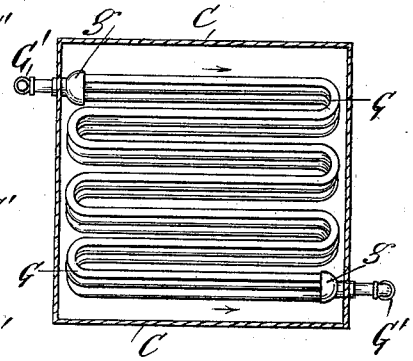


Fig. 8.

Witnesses:
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No. 731,799. Patented June 23, 1903.

UNITED STATES PATENT OFFICE.

WALTER E. LUMMUS, OF LYNN, MASSACHUSETTS.

DISTILLING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 731,799, dated June 23, 1903.

Application filed August 1, 1901. Serial No. 70,494. (No model.)

To all whom it may concern:

Be it known that I, WALTER E. LUMMUS, of Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Distilling Apparatus, of which the following is a specification.

My invention relates to new and useful improvements in distilling apparatus, and its object is to separate mixtures of unequally-volatile liquids into sharply distinct liquid distillates consisting, first, of the most volatile ingredient, followed by the remaining ingredients in the order of their boiling-points or volatility.

My invention consists of certain novel features hereinafter described, and particularly pointed out in the claims.

In the accompanying drawings, which illustrate a construction embodying my invention, Figure 1 is a general view of a still and a condenser with my improved rectifying-column partly in section. Fig. 2 is an enlarged transverse longitdiunal sectional view of two chambers of a rectifying-column. Fig. 3 is an elevation of one chamber, taken at right angles to the construction shown in Fig. 2 and with the shell removed. Fig. 4 is a plan view of the floor of one of the chambers. Fig. 5 is a detail view of the diaphragm forming the floor of each chamber. Fig. 6 is a side elevation taken at right angles to the end elevation shown in Fig. 1. Fig. 7 is a side elevation similar to Fig. 6, partly in section, indicating the course of the condensing medium. Fig. 8 is a sectional view taken on the line 8 8, Fig. 7, to show the arrangement of the condensing-coils.

Like letters of reference refer to like parts throughout the several views.

The liquor to be separated is vaporized in the still A, from which the vapors pass by the pipe B to the bottom of the square column C, consisting of a number of chambers D, having four side walls D′ and similar in construction and located one over the other. The mixed vapors enter the column C under the surface of the liquid E′, standing on the floor formed by the diaphragm D^2 of each chamber D and cause it to boil and distil off vapor, which passes around the diaphragm F′, then around the pipes G, and thence around the diaphragm F into the chamber F^3, then up through the staggered boiling-caps E of the diaphragm D^2 and below the surface of the liquid E′ in the next chamber D, where it boils the liquid in that chamber. This process is repeated in each chamber D as the vapors ascend the column. The alternate distillation and condensation combined with the diminishing heat permits only the most volatile portions to survive the ascent, the vapor from the top chamber passing through the pipe J to the condenser K, whence it passes through the usual tail-box K^2 and is collected in suitable receivers. In each chamber D, the least-volatile vapors condense and overflow the down-pipes H, carried on the diaphragm D^2, and flow across the diaphragms F F′ and fall into the liquid of the next lower chamber at the point of infall L for redistillation. The boiling-caps E, as shown in Fig. 4, are staggered, so as to produce uniform boiling of these liquids or "discards," which travel across the boiling area to the down-pipes H. The down-pipes H are located on the opposite side of each chamber from the infall L, so as to cause the discards to traverse the boiling area before they are permitted to overflow to the next lower chamber. The overflow or discard from the bottom chamber returns to the still by the pipe B′. The cooling liquid from the condenser K or other suitable source passing through the pipe K′ enters the header *g* and traverses the pipes G in the top chamber of the column C and then passes through another header *g* into the pipe G′, connected to a header *g*, and then through the pipes G of the next lower chamber, and so on, descending through all the headers and pipes in the column to the outlet G^3, where the flow is controlled by the valve G^4. This liquid descending the column through the pipes G always moves in a general direction opposite to that of the ascending vapor, and, as the temperature is highest in the bottom chamber, the liquid which leaves each chamber at its hottest point enters the next lower and warmer chamber at its coolest point, and is therefore constantly encountering hotter vapor and absorbing more heat from the vapors in contact with the outside of the pipes G, which are the conductors for the condensing medium and are arranged in inclined rows, as shown, and act as deflectors to the ascend-

ing vapors. This absorption of heat effects a fractional condensation of the least-volatile vapors, which fall in a spray on the diaphragms F F′ and joining the discard from the down-pipes H are swept down into the next lower chamber to be redistilled. The pipes G are arranged in staggered rows, as shown, in order to secure increased and uniform effect, and by dividing the liquid along a number of parallel pipes, as shown, greater surface is offered to passing vapors for condensation. The pipes G′, leading from one chamber to another, are arranged so that the inlet and outlet are on opposite sides of the chambers D, (see Figs. 3 and 6,) so as to introduce the cooling liquid flowing from the hottest end of the higher chamber to the coolest end of the next lower chamber, the sections to this end being arranged so that the unlike ends come one over the other. The extension F^2 of the diaphragm F when charged with liquid prevents the vapors from passing up through the down-pipes H, as the liquid forms a seal against the vapors which collect in the chamber F^3 and which are thus compelled to pass up through the boiling-caps E and into the liquid E′ on the floor of the chamber above. The diaphragms F F′ serve as conductors to deliver the discards from the higher chamber and condensed vapors from the pipes G to the boiling liquid in the bottom of each chamber, and they also form diaphragms on which the discards and condensed vapors are spread out in thin layers exposed to the action of the ascending hot vapors, which by the arrangement of the diaphragms F F′ are made to take a zigzag course from the bottom of each chamber up and around the pipes G and then up into the chamber F^3. This construction of a column composed of a series of chambers suitably bolted together permits of the extension of the apparatus by the addition of more chambers and also permits of easy transportation and erection, and the rectangular form of the said chambers secures uniform action of the liquids and vapors upon one another. The diaphragm D^2 is made separate from each chamber and is inserted in place, as shown in Fig. 2, and this arrangement provides simplicity of construction and also permits easy access to the interior for inspection and repairs. The diaphragm D^2 is made separate from the wall or shell of each chamber and assembled between contiguous sections and fastened to flanges of the adjacent sections by bolts or clamps, and the removal of these bolts or clamps permits of opening or sliding out any section for cleansing or repairs, and these diaphragms are not integral parts of the separate sections. In each chamber D fractional distillation takes place in the bottom of each chamber, where the liquid E^2 is boiling, and fractional condensation takes place between the diaphragms F F^2, where the vapors come in contact with the pipes G. The space above the diaphragm F forms a chamber F^3, in which the vapors collect and pass up through the staggered boiling-caps E.

The apparatus above described is especially applicable to the distillation of grain or ethyl alcohol, which has a boiling-point when absolutely pure of 169° Fahrenheit. This apparatus is designed to produce alcohol of high purity from a liquid containing about fifty per cent. alcohol and fifty per cent. water at the start, which liquid is placed in the still to which the column is connected. This mixture boils at about 190° Fahrenheit. The vapor of this liquid when boiled in the still contains a mixture of water and alcohol in which the alcohol more largely predominates, and is led to the bottom chamber of the rectifying-column, where it partly condenses, filling that chamber to the level of the overflow-pipes. From the construction as shown it is obvious that when the boiling-caps E are submerged no vapor can pass through this column without bubbling up through the liquid E′, surrounding said caps. As this liquid is slightly stronger of alcohol than the vapor, the latent heat of the vapor causes the liquid to boil gently and distil off a vapor composed of a mixture of alcohol and water in which the alcohol predominates to a still greater extent. The same vapor entering the next higher chamber at first condenses against the cold walls and coils until the boiling-caps in the second chamber are submerged, and the same cycle of operations takes place until all the chambers are filled or "charged." Thenceforward until the distillation is complete or until no more alcohol remains in the still the operation is continuous. The vapors arising from the still are constantly growing weaker as the solution becomes attenuated. The discarded or condensed liquids are led back from the lower chamber of the column to the bottom of the still to be further distilled. The progress of the operation depends upon the fact that each distillation produces a vapor in which the more volatile compound is stronger than in the preceding operation, or, in other words, each distillation produces a stronger vapor until the desired concentration is achieved.

Among the substances which may be distilled in this apparatus are methyl alcohol, ethyl alcohol, coal-tar naphthas, creosote, essential oils of all kinds, turpentine, petroleum, coal-tar, wood-tar, gas liquid, and ammonia.

I do not limit myself to the arrangement and construction shown, as the same may be varied without departing from the spirit of my invention.

Having thus described the nature of my invention and set forth a construction embodying the same, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting of a series of communicating chambers, dia-

phragms in said chambers for directing the flow of the ascending vapors and on which the descending condensed vapors and discards flow exposed to said ascending vapors, means in said chambers for causing distillation of the ascending vapors by admitting the ascending vapors below the surface of the liquid in said chambers, conductors in said chambers for the condensing medium and against which the said ascending vapors impinge as they travel in a direction opposite to the flow of the condensing medium thereby causing fractional condensation, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, means for connecting the conductors in the adjacent chambers to allow the condensing medium to flow from one chamber to another, and a condenser into which the ascending vapors pass from said rectifying-column.

2. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting of a series of communicating chambers, diaphragms in said chambers for directing the flow of the ascending vapors and on which the descending condensed vapors and discards flow exposed to said ascending vapors, means in said chambers for causing distillation of the ascending vapors by admitting the ascending vapors below the surface of the liquid in said chambers, conductors located between said diaphragms for the condensing medium and against which the ascending vapors impinge as they travel in a direction opposite to the flow of the condensing medium thereby causing fractional condensation, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, means for connecting the conductors in the adjacent chambers to allow the condensing medium to flow from one chamber to another, and a condenser into which the ascending vapors pass from said rectifying-column.

3. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting of a series of communicating chambers, diaphragms in said chambers for directing the flow of the ascending vapors and on which the descending condensed vapors and discards flow exposed to said ascending vapors, means in said chambers for causing distillation of the ascending vapors by admitting the ascending vapors below the surface of the liquid in said chambers, conductors in said chambers for the condensing medium and against which the said ascending vapors impinge as they travel in a horizontal direction opposite to the flow of the condensing medium thereby causing fractional condensation, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, means for connecting the conductors in the adjacent chambers to allow the condensing medium to flow from one chamber to another, and a condenser into which the ascending vapors pass from said rectifying-column.

4. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting of a series of communicating chambers, diaphragms in said chambers for directing the flow of the ascending vapors and on which the descending condensed vapors and discards flow exposed to said ascending vapors, means in said chambers for causing distillation of the ascending vapors by admitting the ascending vapors below the surface of the liquid in said chambers, conductors located between said diaphragms for the condensing medium and against which the said ascending vapors impinge as they travel in a horizontal direction opposite to the flow of the condensing medium thereby causing fractional condensation, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, means for connecting the conductors in the adjacent chambers to allow the condensing medium to flow from one chamber to another, and a condenser into which the ascending vapors pass from said rectifying-column.

5. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting of a series of communicating chambers, diaphragms in said chambers for directing the flow of the ascending vapors and on which the descending condensed vapors and discards flow exposed to said ascending vapors, means in said chambers for causing distillation of the ascending vapors by admitting the ascending vapors below the surface of the liquid in said chambers, conductors in said chambers for the condensing medium and against which said ascending vapors impinge as they travel in a direction opposite to the flow of the condensing medium thereby causing fractional condensation, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, means for connecting the conductors at the hottest portion of one chamber with the conductors at the coolest portion of the next lower chamber to allow the condensing medium to pass from one chamber to another, and a condenser into which the ascending vapors pass from said rectifying-column.

6. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting of a series of communicating chambers, diaphragms in said chambers for directing the flow of the ascending vapors and on which the descending condensed vapors and discards flow exposed to said ascending vapors, means in said chambers for causing distillation of the ascending vapors by admitting the ascending vapors below the surface of the liquid in said chambers, conductors located between said

diaphragms for the condensing medium and against which the said ascending vapors impinge as they travel in a direction opposite to the flow of the condensing medium thereby causing fractional condensation, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, means for connecting the conductors at the hottest portion of one chamber with the conductors at the coolest portion of the next lower chamber to allow the condensing medium to pass from one chamber to another, and a condenser into which the ascending vapors pass from said rectifying-column.

7. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting of a series of communicating chambers, diaphragms in said chambers for directing the flow of the ascending vapors and on which the descending condensed vapors and discards flow exposed to said ascending vapors, means in said chambers for causing distillation of the ascending vapors by admitting the ascending vapors below the surface of the liquid in said chambers, conductors in said chambers arranged in inclined rows for the condensing medium and against which the said ascending vapors impinge as they travel in a direction opposite to the flow of the condensing medium thereby causing fractional condensation, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, means for connecting the conductors in the adjacent chambers to allow the condensing medium to flow from one chamber to another, and a condenser into which the ascending vapors pass from said rectifying-column.

8. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting of a series of communicating chambers, diaphragms in said chambers for directing the flow of the ascending vapors and on which the descending condensed vapors and discards flow exposed to said ascending vapors, means in said chambers for causing distillation of the ascending vapors by admitting the ascending vapors below the surface of the liquid in said chambers, conductors arranged in inclined rows for the condensing medium and located between said diaphragms and against which conductors the said ascending vapors impinge as they travel in a direction opposite to the flow of the condensing medium thereby causing fractional condensation, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, means for connecting the conductors at the hottest portion of one chamber to the conductors at the coolest portion of the next lower chamber, and a condenser into which the ascending vapors pass from said rectifying-column.

9. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting of a series of communicating chambers, boiling-caps in the bottom of said chambers through which the ascending vapors pass below the surface of the liquid, down-pipes communicating with said chambers and through which the condensed vapors and discards pass downwardly and adapted to maintain the level of the liquids on the bottom of each chamber above the outlet of the boiling-caps whereby the ascending vapors pass through said liquid and distillation takes place, means for preventing the ascending vapors from passing through said down-pipes, diaphragms in said chambers for directing the flow of the ascending vapors and on which the descending condensed vapors and discards flow exposed to said ascending vapors, conductors in said chambers through which the condensing medium flows and against which said vapors impinge as they travel in a direction opposite to the flow of the condensing medium thereby causing fractional condensation, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, means for supplying cooling liquid to said conductors to cause fractional condensation of the ascending vapors, means for connecting the conductors at the hottest portion of one chamber with the conductors at the coolest portion of the next lower chamber, and a condenser into which the ascending vapors pass from said rectifying-column.

10. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting of a series of communicating chambers, boiling-caps in the bottom of said chambers through which the ascending vapors pass below the surface of the liquid, down-pipes communicating with said chambers and through which the condensed vapors and discards pass downwardly and located on opposite side from the discard-inlet and adapted to maintain the level of the liquids on the bottom of said chambers above the outlet of the boiling-caps whereby the ascending vapors pass through said liquid and distillation takes place, means for preventing the ascending vapors from passing through said down-pipes, diaphragms in said chambers for directing the flow of the ascending vapors and on which the descending condensed vapors and discards flow exposed to said ascending vapors, conductors through which the condensing medium flows and located between said diaphragms and against which conductors the said ascending vapors impinge as they travel in a direction opposite to the flow of the condensing medium whereby fractional condensation takes place, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, an inlet and an outlet to and from said conductors on opposite sides of said chambers, means for

supplying cooling liquid to said condenser to cause fractional condensation of the ascending vapors, means for connecting the conductors at the hottest portion of one chamber with the conductors at the coolest portion of the next lower chamber, and a condenser into which the ascending vapors pass from said rectifying-column.

11. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting of a series of communicating chambers, boiling-caps in the bottom of said chambers through which the ascending vapors pass below the surface of the liquid, down-pipes communicating with said chambers and through which the condensed vapors and discards pass downwardly and located on the opposite side from the discard-inlet and adapted to maintain the level of the liquids on the bottom of said chambers above the outlet of the boiling-caps whereby the ascending vapors pass through said liquid and distillation takes place, means for preventing the ascending vapors from passing through said down-pipes, diaphragms in said chambers for directing the flow of the ascending vapors in a zigzag course and on which the descending condensed vapors and discards flow in a zigzag course exposed to said ascending vapors, conductors through which the condensing medium flows and located between said diaphragms and against which conductors the said ascending vapors impinge as they travel in a direction opposite to the flow of the condensing medium thereby causing fractional condensation, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, an inlet and an outlet to and from said conductors on opposite sides of said chambers, means for supplying cooling liquid to said condenser to cause fractional condensation of the ascending vapors, means for connecting the conductors at the hottest portion of one chamber with the conductors at the coolest portion of the next lower chamber, and a condenser into which the ascending vapors pass from said rectifying-column.

12. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting of a series of communicating chambers, means in said chambers for causing distillation of the ascending vapors by admitting the ascending vapors below the surface of the liquid in said chambers, conductors in said chambers for the condensing medium and against which the ascending vapors impinge as they travel in a direction opposite to the flow of the condensing medium thereby causing fractional condensation, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, means for connecting the conductors in the adjacent chambers to allow the condensing medium to flow from one chamber to another, and a condenser into which the ascending vapors pass from said rectifying-column.

13. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting of a series of communicating chambers, means in said chambers for causing distillation of the ascending vapors by admitting the ascending vapors below the surface of the liquid in said chambers, conductors in said chambers for the condensing medium and against which the ascending vapors impinge as they travel in a direction opposite to the flow of the condensing medium thereby causing fractional condensation, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, and a condenser into which the ascending vapors pass from said rectifying-column.

14. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting of a series of communicating chambers, diaphragms in said chambers for directing the flow of the ascending vapors and on which the descending condensed vapors and discards flow exposed to said ascending vapors, means in said chambers for causing distillation of the ascending vapors by admitting the ascending vapors below the surface of the liquid in said chambers, conductors in said chambers for the condensing medium and against which the said ascending vapors impinge as they travel in a direction opposite to the flow of the condensing medium thereby causing fractional condensation, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, and a condenser into which the ascending vapors pass from said rectifying-column.

15. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting of a series of communicating chambers, means in said chambers for directing the flow of the ascending vapors and on which the descending condensed vapors and discards flow exposed to the said ascending vapors, means in said chambers for causing distillation of the ascending vapors by admitting the ascending vapors below the surface of the liquid in said chambers, means in said chambers through which the condensing medium flows in a direction opposite to the travel of the said ascending vapors for producing fractional condensation of the ascending vapors, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, and a condenser into which the ascending vapors pass from said rectifying-column.

16. In an apparatus of the character described, a still, a rectifying-column for receiving the vapors from said still and consisting

of a series of communicating chambers, means in said chambers for directing the flow of the ascending vapors and on which the descending condensed vapors and discards flow exposed to the said ascending vapors, means in said chambers for causing distillation of the ascending vapors by admitting the ascending vapors below the surface of the liquid in said chambers, means in said chambers through which the condensing medium flows in a horizontal direction opposite to the horizontal travel of the said ascending vapors for producing fractional condensation of the ascending vapors, means for causing the condensing medium to flow through said chambers in a direction opposite to the travel of the ascending vapors, and a condenser into which the ascending vapors pass from said rectifying-column.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 23d day of July, A. D. 1901.

WALTER E. LUMMUS.

Witnesses:
A. L. MESSER,
C. A. STEWART.