

G. W. CHILDS.
EVAPORATING APPARATUS.

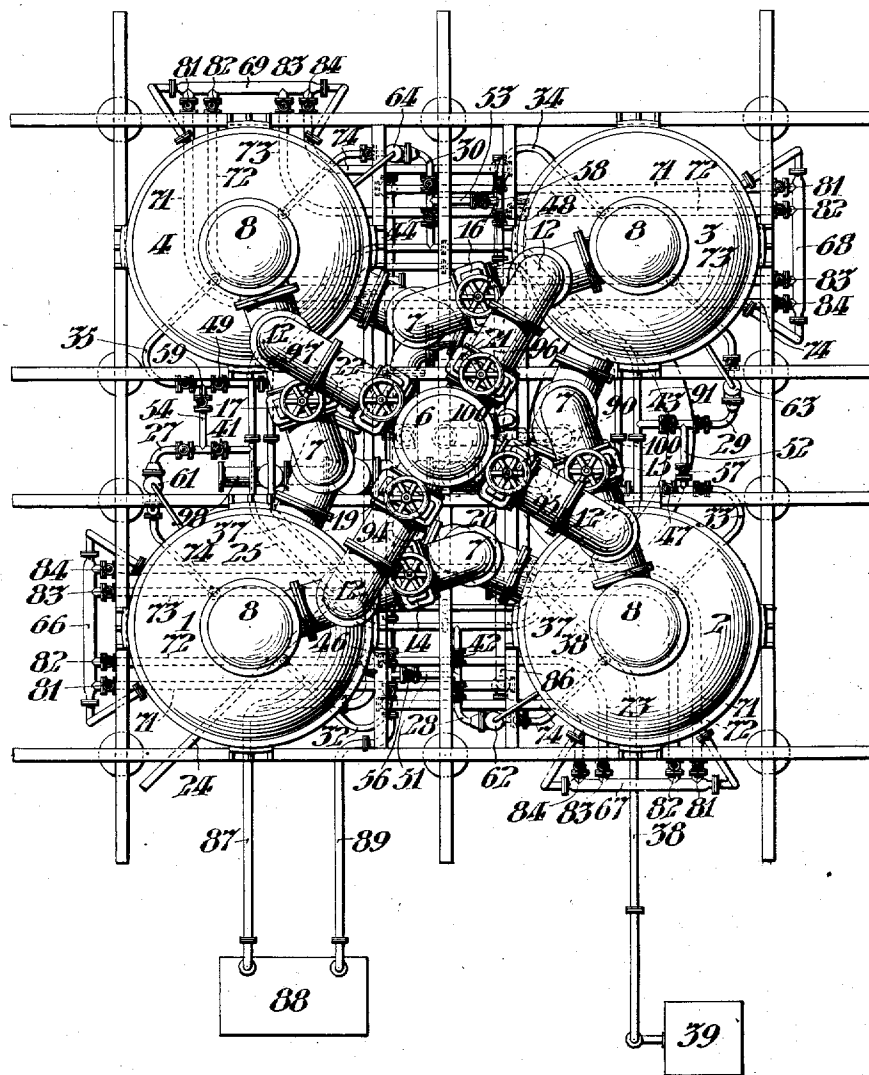
APPLICATION FILED DEC. 30, 1903. RENEWED AUG. 19, 1911.

1,005,600.

Patented Oct. 10, 1911.

2 SHEETS-SHEET 1.

FIG. 1.



WITNESSES:

Clifton C. Hollowell
John C. Berger

INVENTOR:

GEORGE WESLEY CHILDS,

By Vaige, Paul & Gentry
Attys.

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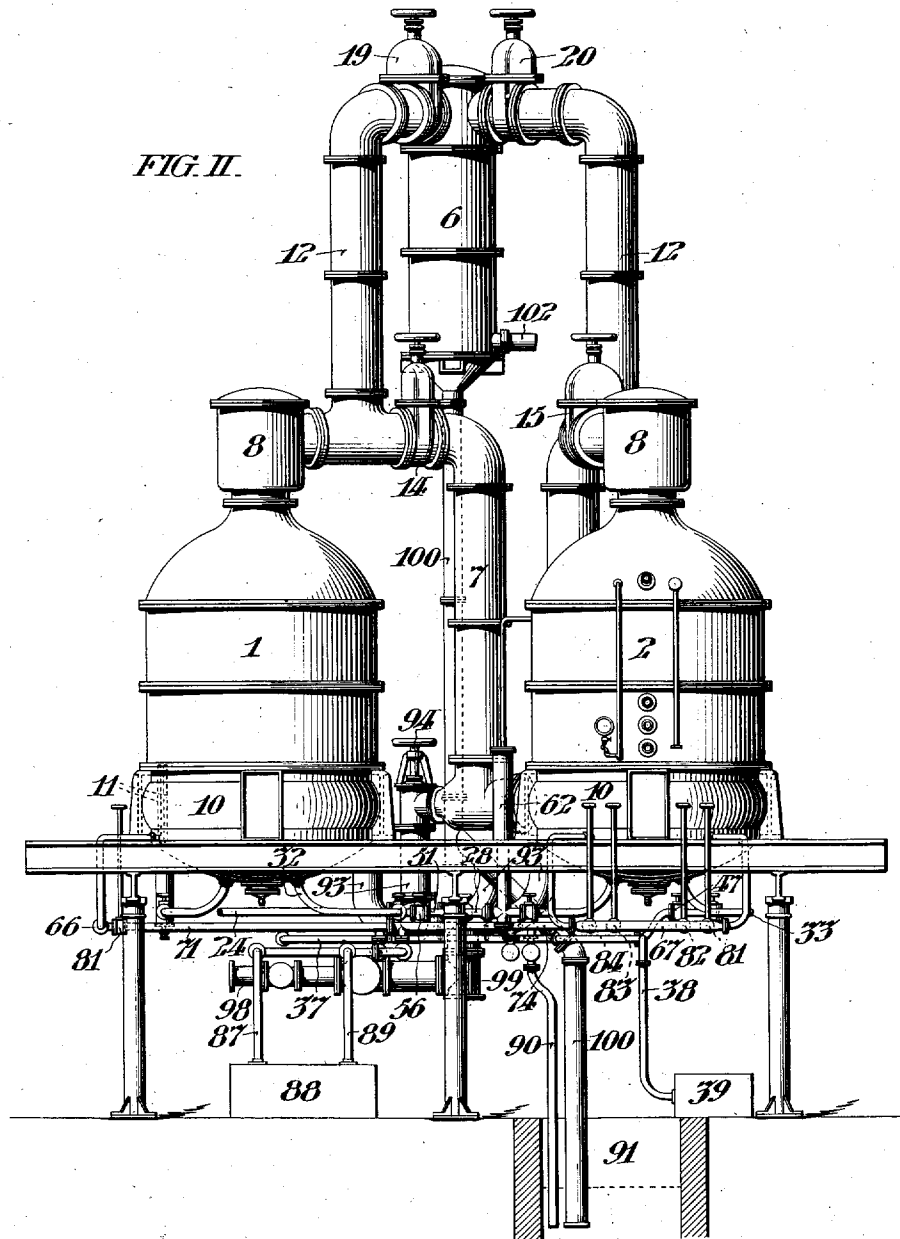
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2 SHEETS—SHEET 2.

FIG. II.



WITNESSES:

Clifton C. Halliwell
John C. Berger

INVENTOR:

GEORGE WESLEY CHILDS,

by Paige, Paul & Bailey,
Attys.

UNITED STATES PATENT OFFICE.

GEORGE WESLEY CHILDS, OF RIDGWAY, PENNSYLVANIA.

EVAPORATING APPARATUS.

1,005,600.

Specification of Letters Patent.

Patented Oct. 10, 1911.

Application filed December 30, 1903, Serial No. 187,093. Renewed August 19, 1911. Serial No. 645,011.

To all whom it may concern:

Be it known that I, GEORGE WESLEY CHILDS, of Ridgway, in the county of Elk and State of Pennsylvania, have invented certain new and useful Improvements in Evaporating Apparatus, whereof the following is a specification, reference being had to the accompanying drawings.

My improvements relate to apparatus of the class comprising a series of vessels wherein a partial vacuum is maintained and through which the liquid is progressed while vaporizing.

In apparatus of the class contemplated as heretofore constructed, the vessels are permanently connected with each other in an unchangeable sequence, so that a certain vessel of the series is constituted the initial one, to which the weak liquid is always introduced, and another vessel is constituted the terminal one, in which the liquid is always evaporated to greatest specific gravity and from which the liquid concentrate is finally discharged. Such an arrangement may be successfully employed for the concentration of some syrups, but I find that during the process of concentrating other solutions, such as extracts of bark, and similar vegetable matters, in such an apparatus, the tubes in contact with the liquid in the vessels succeeding the first one in the series become incrustated with deposits from the liquid, as the latter increases in specific gravity, and, as such deposits rapidly increase during the conduct of the process, the efficiency of the apparatus as a whole is not only materially reduced, by the presence of such deposits, but the liquid concentrate is deprived of the matter deposited. I have ascertained that the losses incident to the deposit of a portion of the matter from the solution, as above noted, may be obviated by utilizing each pan, in rotation, as the initial pan of the series, and consequently, utilizing in rotation, each pan as the terminal pan of the series; with the effect that the deposits made from the liquid of greater specific gravity are redissolved by the liquid of less specific gravity and all of the solid matter is discharged in solution in the concentrate. Therefore, my improved apparatus is of three-fold advantage, first, in that the maximum volume of production may be continuously maintained; second, that all of the concentrate may be discharged in liquid form, and, third, that the

cost of maintenance of the apparatus is materially reduced, for, the deposits aforesaid can only be eliminated from the ordinary apparatus by renewing the tubes or other parts upon which they lodge.

The herein described process of concentrating liquids forms the subject matter of Letters Patent of the United States #936,760 granted to me October 12th, 1909.

In the accompanying drawings, I have shown a multiple effect comprising four evaporating pans, so constructed and arranged with respect to a weak liquid inlet conduit and a concentrated liquid, discharge conduit, that any selected one of said pans may be constituted the initial pan of the series in connection with the weak liquid conduit, and any selected one of said pans may be constituted the terminal pan of the series in connection with the concentrated liquid discharge conduit. I also find it convenient to provide said apparatus with a vapor condenser and vapor pipes in such relation thereto that the vapors may be conducted to said condenser from which every one of the pans is, for the time being, the terminal pan. Said apparatus comprises other convenient adjunctive devices, but it is to be understood that I do not desire to limit myself to a series comprising any particular number, or to the employment of the particular adjunctive devices described.

My invention comprehends the various novel features of construction and arrangement hereinafter more definitely set forth.

In the drawings, Figure I, is a plan view of a quadruple effect, conveniently embodying my improvements, and, Fig. II, is a side elevation thereof.

In said figures,—1, 2, 3, and 4, are the evaporating pans of the series conveniently grouped around the vapor condenser 6. Said pans are connected with each other by counterpart vapor pipes 7, which extend from the upper vapor chamber 8, of one pan to the lower heating drum 10, of the next adjoining pan. Said pipes 7, have counterpart branches 12, extending to the condenser 6. Communication between the adjoining pans by way of the pipes 7, is respectively controlled by valves 14, 15, 16, and 17, the valve 14, controlling communication from the pan 1, to pan 2. Communication between said pans and the condenser by way of the branch pipes 12, is respectively controlled by the valves 19, 20, 21, 22, the valve

19, controlling communication from pan 1, to the condenser. The weak liquid which is to be concentrated is supplied through the inlet 24, to the conduit 25, which is connected with the pans 1, to 4 inclusive, by the respective branches 27, 28, 29, and 30, the pipe 27, connecting with pan 1. Similarly said pans 1 to 4 inclusive are respectively connected by branches 32, 33, 34, and 35, with the concentrated liquid discharge conduit 37, which latter is provided with the outlet 38, leading to the pump 39. The introduction of the weak liquid from the conduit 25, to any one of the pipes 27, 28, 29, and 30, selectively, in accordance with which pan is for the time being the initial one, is determined by the valves 41, 42, 43, and 44. Likewise the final discharge of concentrated liquid through either of the pipes 32, to 35, selectively, in accordance with which pan is for the time being the terminal one is determined by the valves 46, 47, 48 and 49, respectively. Moreover, the pipes 32, 33, 34, and 35, through which the liquid is discharged from the individual pans, are respectively provided with flanges 51, 52, 53, and 54, respectively extending to the inlet pipes 28, 29, 30, and 27, of the individual pans, and respectively controlled by valves 56, 57, 58, and 59, to determine whether the liquid shall be discharged to the next adjoining pan, or to the concentrated liquid conduit 37. The weak liquid inlet pipes 27, 28, 29, and 30, of the respective pans 1, to 4, inclusive, are conveniently provided with regulators 61, 62, 63, and 64, respectively, by which the liquid in the respective pans may be automatically maintained at a predetermined level.

The heating drums 10, of the pans 1, to 4, inclusive are respectively provided with condensation drain pipes 66, 67, 68, and 69, and, each of said condensation pipes is provided with four pipe connections respectively marked 71, 72, 73, and 74, and respectively controlled by valves 81, 82, 83, and 84. Said pipes 66, 67, 68, and 69, are differently connected, with the pipe 86, leading to the boilers; the pipe 87, leading to the left hand end of the water pump 88; the pipe 89, leading to the right hand end of said pump 88, and, the drip pipe 90, leading to the hot well 91, shown in Fig. II. It may be here noted that the different connections of the similarly arranged sets of valves 81, to 84, inclusive, which sets are respectively local to the condensation pipes 66, 67, 68, and 69, are found convenient with reference to the order in which they are opened, as hereinafter described, in accordance with which one of the pans 1 to 4, is for the time being the initial pan.

It is to be understood that the vapors arising from the liquid being concentrated

in what are for the time being the first, second and third pans of the series, are respectively utilized to heat the tubes 11, in the drums 10, of what are for the time being the second, third and fourth pans in the series, wherein they are condensed and discharged as water through the pipes 67, 68, and 69. In order that the drum 10, of whichever pan is the initial one may be heated, each of the vapor pipes 7, is provided with a steam inlet pipe 93. Said pipes 93, are respectively controlled by the valves 94, 95, 96, and 97; the valve 94, controlling the inlet of steam to the pipe 7, connecting the pan 1, with the pan 2. Said pipes 93, are conveniently brought together in common connection with a high pressure steam inlet 98, and low pressure exhaust steam inlet 99, controlled by suitable valves. The vapors from what is for the time being the fourth pan of the series are delivered through its respective branch pipe 12, to the condenser 6, which is provided with a drip outlet 100, extending to the hot well 91. Said condenser is also provided with the pipe 102, leading to a vacuum pump, so that the vaporization of the liquid in the last pan of the series may be facilitated.

When the pan 1, is to be used as the initial pan of the series and the pan 4, as the terminal pan, the valves are set as follows:—The valve 41, controlling communication between the weak liquid supply conduit 25, and the inlet pipe 27, leading through the regulator 61, to the pan 1, is opened; all of the other valves from said conduit 25, are closed; and, the valves 56, 57, and 58, controlling the connections between the adjoining pans are opened; so that the liquid flows successively from the pan 1, through pans 2, and 3, to pan 4, of course, increasing in specific gravity in its traverse. The concentrated liquid is discharged from pan 4, through the pipe 35, and, the valve 59, being closed and the valve 49, being opened, said concentrate is delivered to the conduit 37. The respective steam inlet valves 94, 95, and 96, leading to the pans 2, 3, and 4, are closed and the steam inlet valve 97, leading to the pan 1, opened. The vapor valves 14, 15, 16, are opened and the vapor valve 17, shut; the valves 19, 20, 21 are shut and the valve 22, opened. So that the liquid in the pan 1, is vaporized by the steam surrounding the tubes 11, containing it, and the vapors from pan 1, are delivered within the drum 10, of the pan 2, to again heat and vaporize the liquid. The vapor from pan 2, is delivered to the pan 3, wherein the liquid is again vaporized and the vapor delivered to the drum 10, of the pan 4. The liquid being again vaporized in pan 4, the vapors are delivered through the branch pipe 12, to the condenser 6, wherein they are condensed and flow through the pipe 100, to the hot well. All of the valves

81, are opened and the valves 82, 83 and 84, are shut, with the effect that the condensation pipes 66, 67, 68, and 69, of the respective pans 1, 2, 3, and 4, are respectively connected with the boiler, the hot well the right hand side of the pump 58, and the left hand side of said pump.

When the pan 4, is to be used as the initial pan of the series and the pan 3, as the terminal pan, the valves are set as follows:— The valve 44, controlling communication between the weak liquid supply conduit 25, and the inlet pipe 30, leading through the regulator 64, to the pan 4, is opened; all of the other valves from said conduit 25, are closed, and the valves 59, 56, and 57, controlling the connections between the adjoining pans are opened; so that the liquid flows successively from the pan 4, through the pans 1, and 2, to the pan 3. The concentrated liquid is discharged from the pan 3, through the pipe 34, and, the valve 58, being closed and the valve 48, being open said concentrate is delivered to the conduit 37. The respective steam inlets 97, 94, and 95, leading to the pans 1, 2, and 3, are closed, and the steam inlet 96, leading to the pan 4, opened. The vapor valves 17, 14, 15, are opened and the vapor valve 16, shut; the valves 22, 19, and 20, are shut and the valve 21, opened. So that the liquid in the pan 4, is vaporized, by the steam surrounding the tubes 11, containing it, and, the vapors from pan 4, are delivered within the drum 10, of the pan 1, and so on through the series; the vapors from the pan 3, being delivered through the branch pipe 12, to the condenser 6.

In the last named operation, with the pan 4, as the initial member of the series, all of the valves 84, are opened and the valves 81, 82, and 83, shut, to effect the proper connections of the respective condensation pipes 66, 67, 68, and 69. Similarly, when the pan 2, is the initial pan, all of the valves 82, are opened and the valves 81, 83, and 84, are shut; and, when the pan 3, is the initial pan, all of the valves 83, are opened and the valves 81, 82, and 84 shut.

It is to be understood that each of the pans of the series is thus in rotation constituted the initial member thereof, and the regions of introduction of the weak liquid and of discharge of the concentrate thus progressively shifted from one vessel to another in the series, at such intervals as to insure the solution and discharge of all of the involatile contents of the weak liquid in the concentrated liquid product.

Although I have described a form of evaporating pan wherein the liquid to be concentrated is disposed within tubes which are surrounded by the heating medium, to wit, the vapors from the preceding pans or steam from an external source, it is to be

understood that I do not desire to limit myself to that particular arrangement, as it is obvious that various modifications may be made without departing from the essential features of my invention.

I claim:—

1. In an evaporating apparatus, the combination with a condenser; of a plurality of pans grouped around the condenser; valved connections arranged to connect the vapor chamber of each pan with the heating drum of the next succeeding pan; valved connections arranged to connect each pan with the condenser; a liquid level regulator for each pan, having a liquid inlet and a connection with the corresponding pan; a liquid outlet from each pan; and, a valved by-pass connecting the liquid inlet in each pan with the liquid outlet of the next pan.

2. A double effect evaporator in combination with a condenser, each effect comprising an evaporating chamber, a heating chamber, a vapor pipe stationarily fixed, leading from the evaporating chamber to the condenser, and to the heating chamber of the adjoining effect, valves in said vapor pipe for closing the connection between the evaporating chamber of the one effect and the heating chamber of the other effect.

3. A multiple effect evaporator in combination with a condenser, each effect comprising an evaporating chamber, a heating chamber, a pipe leading from the evaporating chamber to the condenser and to the heating chamber of the adjoining effect, and, means for alternately closing the connection between the evaporating chamber of one effect and the heating chamber of the adjoining effect, and between said evaporating chamber and said condenser.

4. A multiple effect evaporator, comprising a series of effects disposed in a symmetrical group, in combination with a condenser, in concentric relation with said group, each effect comprising an evaporating chamber, a heating chamber, a vapor pipe leading from the evaporating chamber to the condenser and to the heating chamber of the adjoining effect, and, means for closing the connection between the evaporating chamber of one effect and the heating chamber of the adjoining effect.

5. A multiple effect evaporator in combination with a condenser, each effect comprising an evaporating chamber, a heating chamber, a vapor pipe leading from the evaporating chamber to the condenser and to the heating chamber of the adjoining effect, means for alternately closing the connection between the evaporating chamber of one effect and the heating chamber of the adjoining effect; and, connections arranged to transmit the concentrate from one evaporating chamber to another throughout the series.

6. A multiple effect evaporator in combination with a condenser, each effect comprising an evaporating chamber, a heating chamber, a vapor pipe leading from the evaporating chamber to the condenser and to the heating chamber of the adjoining effect, means for alternately closing the connection between the evaporating chamber of one effect and the heating chamber of the adjoining effect; and, connections arranged to supply steam to any one of said heating chambers; whereby each evaporating chamber in the series may be connected in succession as the initial chamber to which the raw liquid is introduced and steam may be supplied to heat said initial chamber.

7. In an evaporating apparatus, the combination with a condenser, of a plurality of pans grouped around the condenser; each pan comprising an evaporating chamber, a heating chamber, a vapor pipe leading from

the evaporating chamber to the condenser and to the heating chamber of the adjoining pan, means for alternately closing the connection between the evaporating chamber of one effect and the heating chamber of the other effect and between said evaporating chamber and the condenser, a liquid supply pipe common to all of said pans, a liquid discharge pipe common to all of said pans, and valves controlling the connections between said pipes and pans; whereby each pan in the series may be connected in succession as the initial pan to which the raw liquid is introduced.

In testimony whereof, I have hereunto signed my name, at Philadelphia, Pennsylvania, this ninth day of December, 1903.

GEORGE WESLEY CHILDS.

Witnesses:

GEO. P. MCARTHUR,
ARTHUR E. PAIGE.

Corrections in Letters Patent No. 1,005,600.

It is hereby certified that in Letters Patent No. 1,005,600, granted October 10, 1911, upon the application of George Wesley Childs, of Ridgway, Pennsylvania, for an improvement in "Evaporating Apparatus," errors appear in the printed specification requiring correction as follows: Page 2, line 26, for the word "flanges" read *branches*, and line 122, for the words "an dvaporize" read *and evaporize*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of November, A. D., 1911.

[SEAL.]

E. B. MOORE,
Commissioner of Patents.

6. A multiple effect evaporator in combination with a condenser, each effect comprising an evaporating chamber, a heating chamber, a vapor pipe leading from the evaporating chamber to the condenser and to the heating chamber of the adjoining effect, means for alternately closing the connection between the evaporating chamber of one effect and the heating chamber of the adjoining effect; and, connections arranged to supply steam to any one of said heating chambers; whereby each evaporating chamber in the series may be connected in succession as the initial chamber to which the raw liquid is introduced and steam may be supplied to heat said initial chamber.

7. In an evaporating apparatus, the combination with a condenser, of a plurality of pans grouped around the condenser; each pan comprising an evaporating chamber, a heating chamber, a vapor pipe leading from

the evaporating chamber to the condenser and to the heating chamber of the adjoining pan, means for alternately closing the connection between the evaporating chamber of one effect and the heating chamber of the other effect and between said evaporating chamber and the condenser, a liquid supply pipe common to all of said pans, a liquid discharge pipe common to all of said pans, and valves controlling the connections between said pipes and pans; whereby each pan in the series may be connected in succession as the initial pan to which the raw liquid is introduced.

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