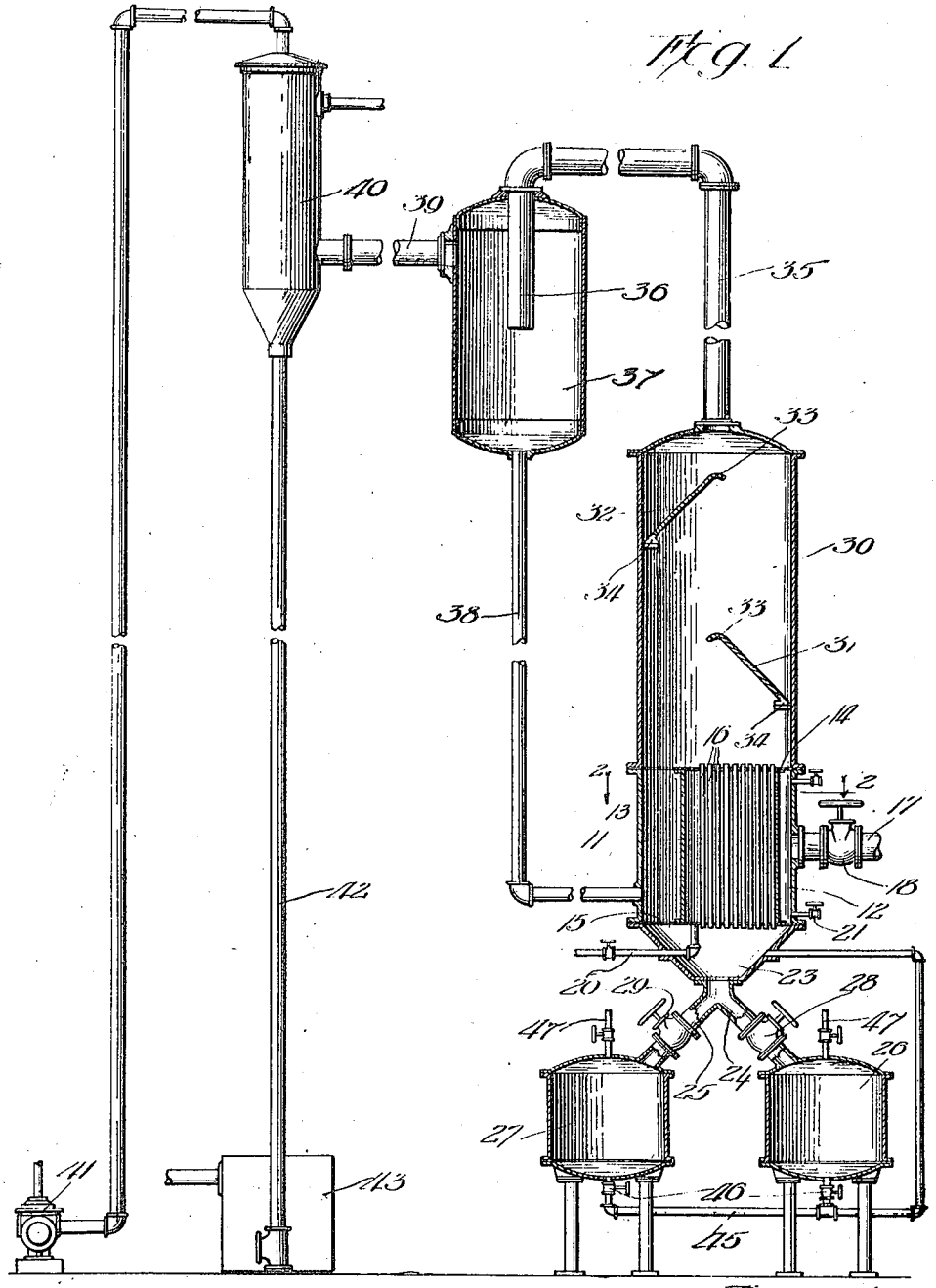
Sept. 9, 1924. 1,508,130

W. E. SANGER

EVAPORATOR

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Fig. 1.




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Fig. 2

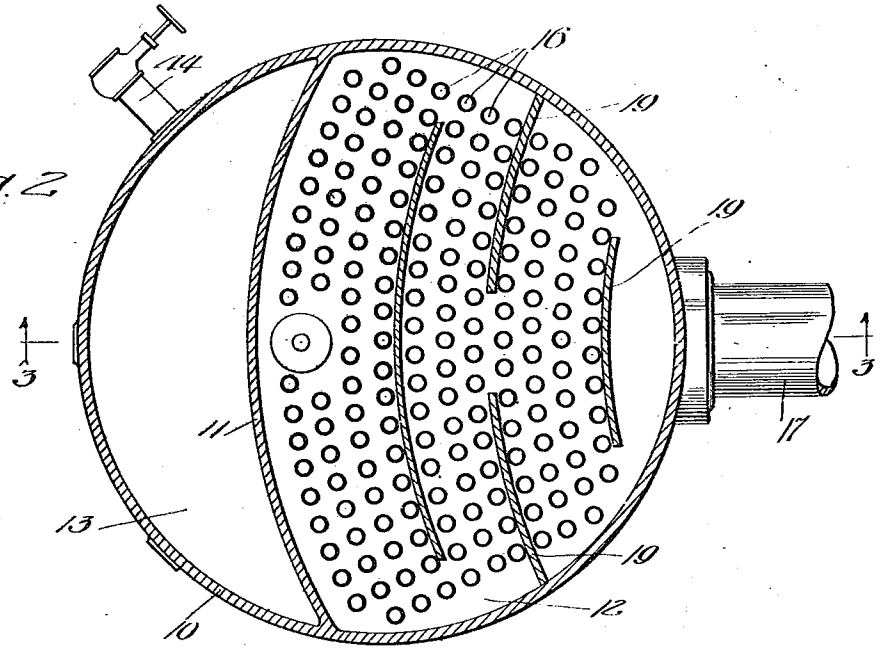
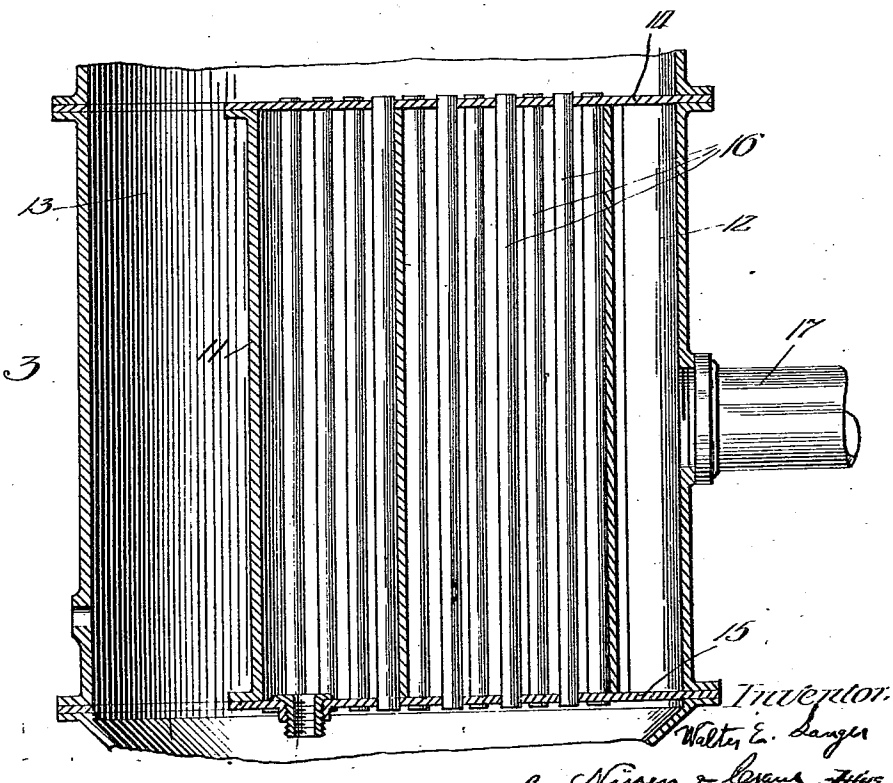



Fig. 3




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Patented Sept. 9, 1924. 1,508,130

# UNITED STATES PATENT OFFICE.

WALTER E. SANGER, OF CHICAGO, ILLINOIS, ASSIGNOR TO WURSTER & SANGER, OF CHICAGO, ILLINOIS, A PARTNERSHIP FIRM.

## EVAPORATOR.

Application filed February 3, 1922. Serial No. 533,780.

*To all whom it may concern:*

Be it known that I, WALTER E. SANGER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Evaporators, of which the following is a specification.

This invention relates to apparatus for evaporating liquids in which crystalline matter precipitates during the process and may be utilized, for example, in the evaporation of crude glycerine, but is applicable to a large variety of materials as will be readily apparent to those skilled in the art.

The object of the invention is to provide apparatus of the class named which shall be of improved construction and economical, convenient and efficient in operation.

The invention is exemplified in the combination and arrangement of parts shown in the accompanying drawings and described in the following specification, and is more particularly pointed out in the appended claims.

In the drawings—

Fig. 1 is a somewhat diagrammatical view with parts in section showing one embodiment of the present invention;

Fig. 2 is a horizontal section on line 2—2 of Fig. 1; and

Fig. 3 is a vertical section on line 3—3 of Fig. 2.

In the embodiment of the invention shown in the drawings, a heating chamber or calandria 10 is provided having an upright partition 11 which separates the chamber into two compartments 12 and 13, as shown best in Figs. 2 and 3. The outer casing of the calandria 10 is preferably cylindrical and the partition 11 separating the chambers 12 and 13 is arcuate in section so that the walls of the two chambers are formed by intersecting arc-shaped plates. It is apparent that the arcuate shape of the walls will give greater resistance to pressures, thus increasing the strength of the apparatus for a given amount of material, and the curvature of the wall 11 also gives a better distribution of the space within the calandria than would be the case if the wall were of a different shape, as will later appear.

The chamber 13 is open at its top and bottom, but the chamber 12 is closed by upper and lower heads 14 and 15. Pipes or tubes 16 extend through the heads 14 and 15 making tight connections where they penetrate the heads. The ends of the tubes open outside of the plates forming the heads 14 and 15 so that each tube forms a conduit passing through the chamber 12 and opening into the spaces above and below the chamber. The chamber 13 is entirely open and communicates directly with the space above and below the heads 14 and 15, respectively. A conduit 17 communicates through the wall of the calandria with the interior of the chamber 12 for the purpose of admitting a heating medium, such as superheated steam. A valve 18 is provided for controlling the flow of the heating medium to the chamber 12.

Deflector plates 19 arcuate in shape are interposed between the pipes 16 to cause the steam entering through the conduit 17 to pass back and forth around the pipes. It will be noted from Fig. 2 that the baffle plates 19 and the tubes 16 are all arranged on arcs of circles parallel with the wall 11. Steam entering the chamber 12 will first heat the pipes adjacent the entrance opening and will progressively heat the pipes spaced greater distances from the opening so that when liquid is present in the interior of the pipes boiling will begin near the entrance opening of the steam and the liquid will continue to boil more rapidly in the tubes closest the entrance opening and less rapidly in the tubes farther removed. A drain pipe 20 is provided for permitting the escape of condensed liquid in the chamber 12 and vent cocks 21 and 22 may also be provided for permitting escape of air or other non-condensable gas.

Beneath the lower head 15 there is located a hopper-shaped chamber 23 which communicates through pipes 24 and 25 with the receptacles 26 and 27, respectively. Valves 28 and 29 are interposed in the pipes 24 and 25. Above the head 14 is a chamber 30 in which there are located baffle plates 31 and 32, the upper edges of the baffle plates being curved outwardly and downwardly, as shown at 33. The baffle plates are each provided with openings 34 through which any liquid may drain which might otherwise be entrapped in the pockets above the baffle plates. The chamber 30 communicates through pipes 35 and 36 with a separator 37 so that vapor rising from

the chamber 30 will discharge any liquid held in suspension therein into the chamber 37, from the bottom of which it will drain through pipe 38 to the compartment 13 in the calandria 10. The separator 37 is connected by a pipe 39 with a condenser 40 having an exhaust pump 41 connected therewith to maintain a vacuum in the evaporating system. The lower portion of the condenser 40 is connected by a pipe 42 to the usual hot well 43 in which the liquid resulting from the condensation is collected.

In operation, the liquid to be treated is introduced through a pipe connection 44 into the chamber 13 filling the receptacles 26 and 27, the cone-shaped hopper 23, the chamber 13, the tubes 16. When the parts are thus filled, one of the valves 28 and 29 may be closed and the heating medium admitted through the pipe connection 17. Boiling will begin in the tubes 16 and will occur most vigorously in the tubes nearest the inlet opening for the steam. This will cause vapor to rise from the tubes farthest from the chamber 13 and strike the baffle plate 31. Any liquid carried upwardly with the rising vapor will be projected by the baffle plate 31 and its curved edge 33 downwardly into the open compartment 13. This will give rise to a circulation of the liquid upwardly in the tubes and downwardly in the open compartment and any crystals formed during the process will be carried downwardly in the cone-shaped hopper 23 and will pass through the connections 24 or 25 into one or the other of the compartments 26 and 27, depending upon which of the valves 28 and 29 is open. When one of the receptacles is filled with crystals its valve may be closed and the valve opened into the companion receptacle so that one or the other of the receptacles will at all times be in condition for receiving the deposited crystals.

A pipe 45 is connected by valves 46 with the bottoms of the receptacles 26 and 27, the pipe communicating with the hopper 23. Each of the receptacles is provided at its upper portion with pipes 47 through which steam may be admitted to force any liquid in the receptacle out of the crystals and return the liquid to the hopper 23. It will be noted that the arcuate shape of the wall 11 permits the chamber 13 to extend for a greater distance around the inner periphery of the calandria 10 than would be the case if a flat wall were used. At the same time the bulge in the central portion of the wall 11 provides a larger amount of space for the evaporating chamber. Any desired number of deflectors may be used in the vapor chamber 30, the deflectors being oppositely located, as shown in Fig. 1, so that upwardly rising liquid which passes one of the deflectors will strike the one next above. It is not essential that the inlet pipe 17 be located at any particular point in the wall of the calandria, but it is desirable that the arrangement be such that the heating of the pipes will gradually decrease from the inlet opening toward the open chamber 13. This effect may be augmented where desired by providing smaller pipes adjacent the inlet opening than those farther removed therefrom. In large installations it may sometimes be desirable to provide a plurality of inlet openings for the heating medium. The conical shape of the chamber 23 assists the circulating liquid in sweeping any crystals that are formed toward the center of the hopper where they enter the pipes leading to the receptacles 26 and 27.

While I have shown and described one specific embodiment of the invention, it will be apparent that the invention is not confined to the details represented in the drawings, but that various modifications may be made by those skilled in the art which will fall within the spirit and scope of the invention as defined by the appended claims. It will also be apparent that the device may be used singly, as shown, or may be connected with similar apparatus for a multiple effect operation, if desired.

I claim:—

1. A calandria comprising a cylindrical casing having an arcuate partition therein for separating said calandria into two compartments, upper and lower heads closing the compartment adjacent the concave side of said partition and forming a heating chamber, tubes extending through said heating chamber and opening outside of said heads, said tubes having their axes arranged in parallel arcs, and arcuate baffle plates interposed between said tubes for directing a heating medium about the various tubes in said heating chamber, some of said baffle plates extending inwardly from the walls of said heating chamber and spaced to form a central passage while others are spaced inwardly from said walls to provide outer passages.

2. In an evaporator, the combination of a calandria section having two chambers the walls of which, in transverse section, form arcs of intersecting circles of different radii, the first chamber being open and the second of which has upper and lower tube heads, a bottom sloping downwardly and inwardly toward the center, below the two chambers, a plurality of tubes extending between and through said heads, the centers of these tubes being located on the arcs of circles, these arcs being parallel to the arc forming one wall of the second chamber, means for introducing a heating medium into the space between said tubes on the outer wall of the second chamber,

and means for causing a circulation of liquid downwardly in the first chamber toward the center from the first chamber in the space below the first and second chambers.

3. In an evaporator, the combination of a calandria section having two chambers the outer walls of which comprising a continuous cylindrical shell, there being an inner partition wall between said chambers formed by an arc intersecting said outer shell at spaced positions thereon, the first chamber being open and the second of which has upper and lower tube heads, a bottom sloping downwardly and inwardly toward the center, below the two chambers, a plurality of tubes extending between and through said heads, the centers of these tubes being located on the arcs of circles, these arcs being parallel to the arc forming one wall of the second chamber, means above the upper head of the second chamber to deflect toward the first chamber liquid rising from the tubes, means for introducing a heating medium into the space between said tubes, between said heads, means for causing the circulation of the heating medium around the tubes, from the inlet toward the outlet, and means for introducing liquid to be evaporated into the first chamber as well as into the space into which the tubes open.

4. In an evaporator, the combination of a calandria section having two chambers, the second chamber having upper and lower heads and a bottom arranged to provide a space below the two chambers, means for introducing a heating medium between said heads at a point on the outer wall of the second chamber, a plurality of tubes extending between and through said heads, the centers of these tubes being located on the arcs of circles, these arcs being parallel to the arc forming one wall of the second chamber into which the heating medium is directly introduced, said bottom having means for the removal of precipitated matter at a point below that at which the heating medium is introduced, and means for causing circulation of liquid downwardly in the first chamber, upwardly in the tubes and inwardly from the first chamber in the space below the two chambers, to sweep precipitated matter toward said means for the removal of precipitated matter.

5. In an evaporator, the combination of a calandria section having two chambers, the second chamber having upper and lower heads and a bottom arranged to provide a space below the two chambers, means for introducing a heating medium between said heads at a point on the outer wall of the second chamber, a plurality of tubes extending between and through said heads, the centers of these tubes being located on the arcs of circles, these arcs being parallel to the arc forming one wall of the second chamber into which the heating medium is directly introduced, said bottom having an opening for the removal of precipitated matter at a point below that at which the heating medium is introduced, and baffle means arranged between said tubes, and between said upper and lower heads with alternating central and laterally spaced passages, to cause the heating medium to circulate around the tubes, beginning with those adjacent the point of introduction of the heating medium so that the heating effect will progressively diminish from the point of first application of the heating medium to the tubes most distant therefrom, and circulation of liquid will be caused downwardly in said first chamber, upwardly in the tubes, the opening in said bottom being disposed in the path of downcoming liquid from said first chamber so that precipitated matter will be swept by said liquid toward said opening.

6. In an evaporator, a hollow cylinder having spaced transverse partition walls therein, an arcuate partition wall connecting said transverse partition walls and joining the walls of said cylinder thus dividing the cylinder between the planes of said transverse partition walls into two portions, the one of said portions at the convex side of said arcuate wall being open through its upper and lower ends while the upper and lower ends of the other of said portions are closed by said transverse partition walls, tubes arranged in arcuate rows parallel to said arcuate partition wall and extending through said closed portion, means for introducing a heating medium at the side of said closed portion away from said arcuate partition wall, and baffle plates interposed between said tubes to cause said heating medium to engage said tubes in succession from the point of entry of said medium toward said arcuate partition wall.

7. In an evaporator, a calandria comprising a cylindrical casing having upper and lower walls extending transversely of said casing, and a longitudinally extending wall arranged to divide the space between the planes of said transverse walls into two portions each having its outer wall formed by the outer wall of said casing, one of said portions having its upper and lower ends open while the other of said portions is closed by said transverse partitions, circulation tubes extending through said closed portion, baffle walls interposed between said tubes, and means for introducing a heating medium into said closed portion at a point removed from said longitudinally extending partition so that said circulation tubes will be progressively heated from the point of entry of said medium toward said longitudinally ex-

tending partition, said baffle and partition walls having concave faces disposed toward the point of introduction of the heating medium.

8. An evaporator comprising a cylindrical shell having a heating chamber therein formed by an arcuate plate intersecting said shell and by upper and lower transverse partition walls, said chamber having circulation tubes extending vertically therethrough, means for introducing a heating medium into said chamber at a point opposite said partition wall, and means for directing said heating medium about said tubes successively, said means comprising an arcuate plate adjacent the inlet for said heating medium and having symmetrical passages around the edges thereof, a pair of plates spaced from said first plate opposite said heating medium each having its outer edge connected with the wall of said heating chamber, the inner edges of said plates being centrally spaced from one another to provide a central steam passage, and an additional baffle plate still further removed from the heating medium and having its lateral edges spaced from the walls of said heating chamber to provide symmetrical steam passages around said edges, the plates thus providing a tortuous passage for the heating medium about said tubes beginning adjacent the inlet for said medium and continuing toward said partition walls.

In testimony whereof I have signed my name to this specification on this 30th day of January, A. D. 1922.

WALTER E. SANGER.