No. 868,275. PATENTED OCT. 15, 1907.

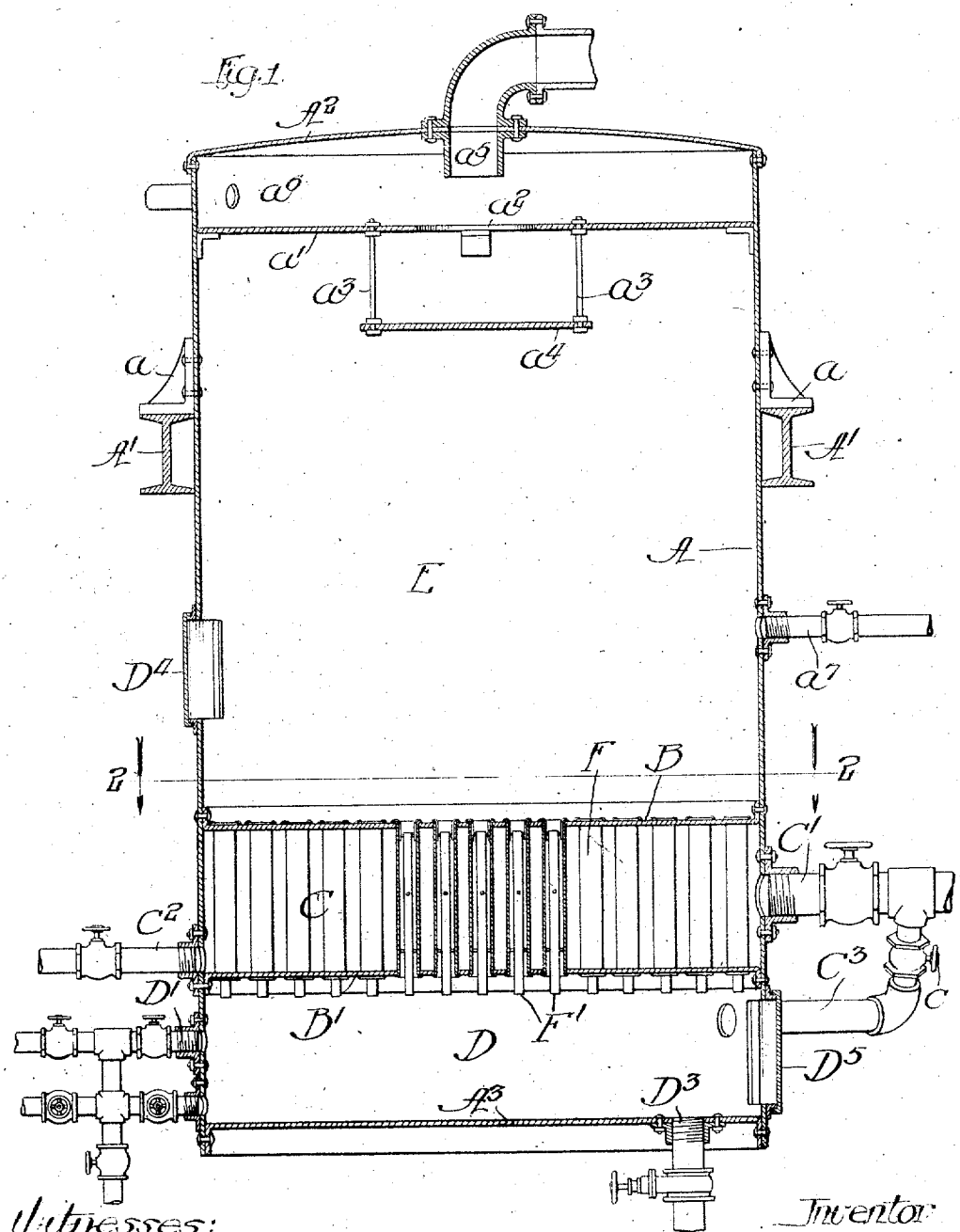
P. G. KAISER.

VACUUM PAN.

APPLICATION FILED JAN. 31, 1907.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2.

Fig. 2.

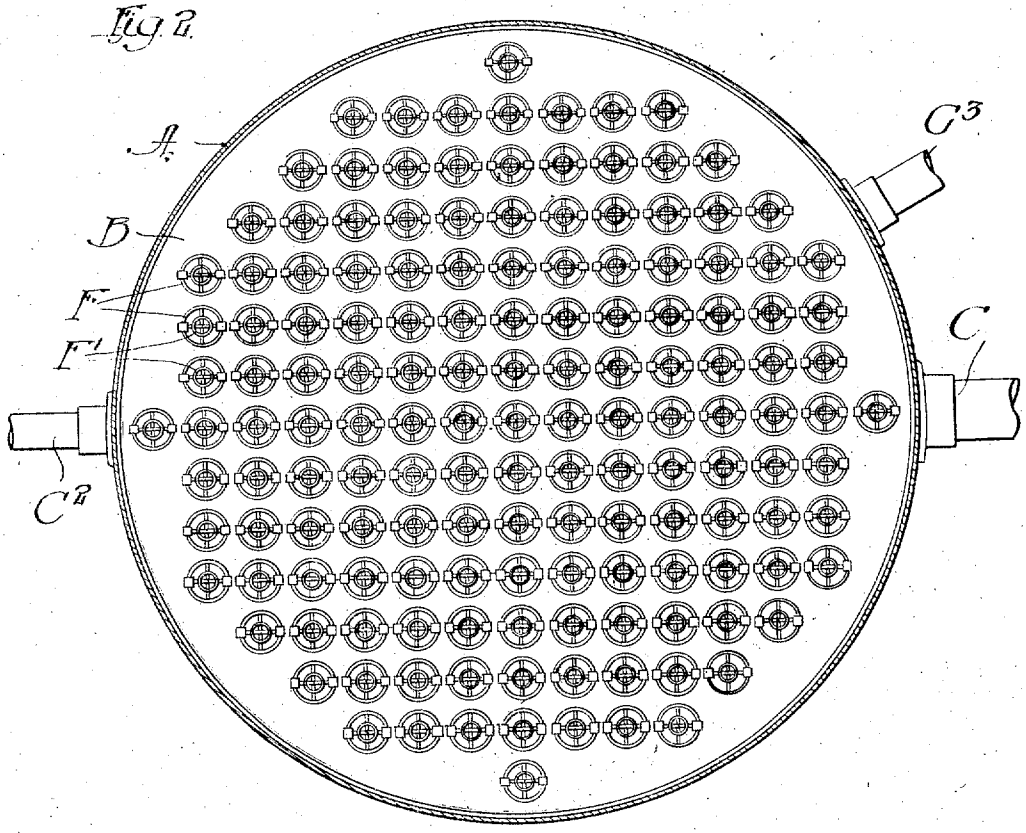


Fig. 3.

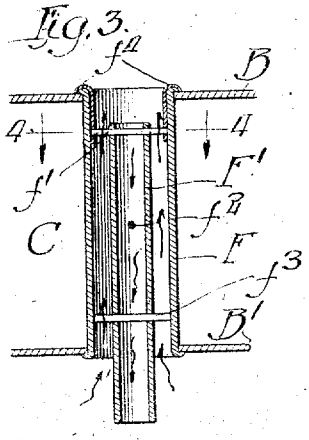
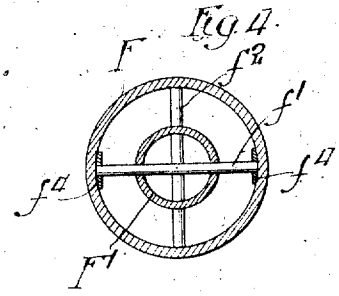


Fig. 4.



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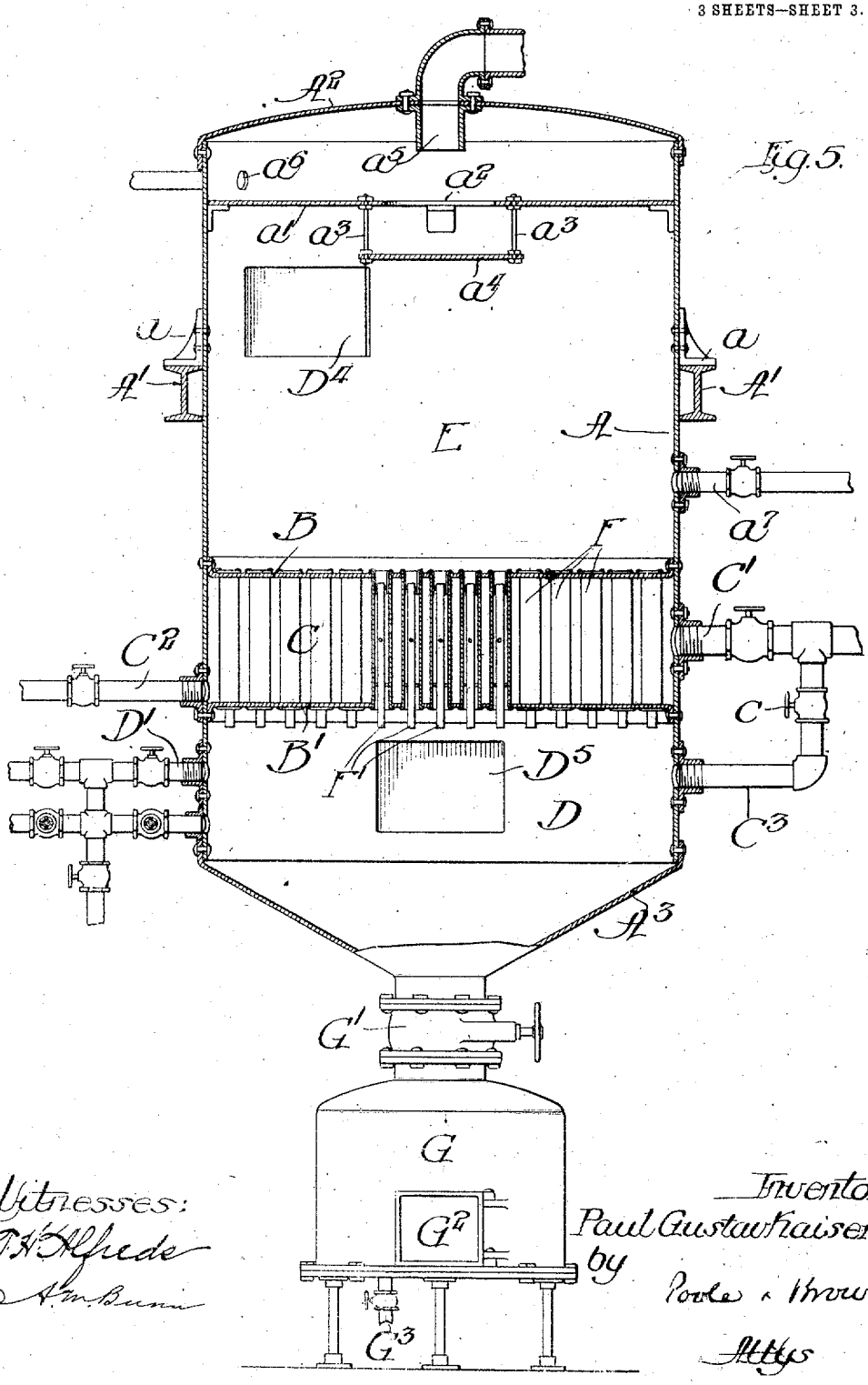
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VACUUM PAN.

APPLICATION FILED JAN. 31, 1907.

3 SHEETS—SHEET 3.

Fig. 5.



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UNITED STATES PATENT OFFICE.

PAUL GUSTAV KAISER, OF CHICAGO, ILLINOIS.

VACUUM-PAN.

No. 868,275. Specification of Letters Patent. Patented Oct. 15, 1907.

Application filed January 31, 1907. Serial No. 355,104.

To all whom it may concern:

Be it known that I, PAUL GUSTAV KAISER, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Vacuum-Pans; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to an improved evaporator or vacuum pan and more particularly to the circulating tubes therein, the object being to promote circulation of the fluid in such vacuum pan or evaporator and thus increase the efficiency of the device.

The embodiment of my invention herein illustrated is of a type of vacuum pan or evaporator peculiarly adapted for use in soap factories for the treating of spent lye; but it will be manifest that my invention is adapted and applicable to many other uses.

In devices of this general type heretofore in use, in which the liquid to be treated passes into a lower compartment thence upwardly through an intermediate heating compartment denominated a steam-chest, and thence into an upper compartment, it has been found desirable to employ, for the passage for the liquid through the steam-chest, or intermediate compartment, a plurality of small upright circulating tubes, thus dividing the liquid in its upward passage into a plurality of relatively small columns each of which is subjected to the heat during its upward passage through the steam-chest and thereby the more readily heated to the boiling point. Spent lye for example contains in solution glycerin and salt, and the purpose of thus treating the lye is to separate these ingredients and to first effect precipitation of the salt and subsequently the recovery of the glycerin. In vacuum pans made as described, it is found that the circulation becomes very imperfect, that abnormal or undesirable currents are formed by the circulating tubes of the steam-chest, through some of which the liquid is passing upwardly, while through others of which the liquid is passing downwardly to the chamber below. It is also found that the salt precipitated by the boiling action of the liquid accumulates unevenly in the evaporator, clogging the circulating tubes and ultimately stopping some of them, generally on one side or over a considerable area of the steam-chest, thereby reducing the number of effective passages through the steam-chest very considerably and diminishing the efficiency of the evaporator or vacuum pan. To remedy these and other defects in previously existing structures I provide an auxiliary or return tube in each circulating tube, as well as other devices hereinafter referred to, whereby each separate passage through the steam-chest will afford a complete circulation of the liquid, such circulation being effected by the use of the auxiliary tubes located within the several circulatory tubes whereby is provided upward passages separate and distinct from the downward or return passages for the liquid. These and other features of my invention will be more fully understood by reference to the accompanying drawings in which,—

Figure 1 represents in vertical sectional elevation, a vacuum pan embodying my invention, the same being taken upon the line 1—1 of Fig. 2. Fig. 2 is a horizontal or transverse section of the vacuum pan, taken upon the line 2—2 of Fig. 1, looking in the direction indicated by the arrows. Fig. 3 is an enlarged vertical section of a portion of the upper and lower plates of the steam-chest showing a single circulating tube and the auxiliary tube therein. Fig. 4 is a horizontal sectional detail view of the device shown in Fig. 3, taken upon the line 4—4 of Fig. 3, but made on a larger scale. Fig. 5 is a view similar to that of Fig. 1 showing a modification at the lower end of the vacuum pan to receive the salt or other precipitate extracted from the liquid under treatment.

As shown in said drawings, A indicates, as a whole, the cylindric body or shell of the evaporator or vacuum pan which is provided with supporting brackets a which rest upon fixed I-beams A^1. The body or shell A is closed at its top by a top wall or head A^2 and at its bottom by a bottom wall or head A^3, each secured to the shell A by rivets or otherwise.

The interior of the cylindric shell A is divided into three compartments by two transverse plates or partitions B B^1, secured by rivets or otherwise to the shell A and which form respectively the upper and the lower walls of an intermediate compartment constituting a steam-chest C. D indicates the lower compartment of the evaporator and E the upper compartment thereof. Each of the partitions B B^1 is provided with a plurality of openings arranged in vertical alinement and adapted to receive the upper and lower ends respectively of upright, circulating tubes F F, as clearly indicated in Figs. 1, 3 and 5. These circulating tubes form open conduits or passages from the lower compartment D to the upper compartment E through the intermediate steam-chest C. Said tubes may be secured in the partitions B B^1 by expanding the ends of the tubes or in any other desirable manner. In each of the tubes F is located a smaller tube F^1, arranged concentrically in said tubes F.

C' indicates an inlet pipe leading from a source of steam supply and communicating with the interior of the steam-chest C whereby steam will be delivered to said steam-chest and circulate therein around the outside of the tubes F in such manner that any liquid passing through said tubes will absorb the heat therethrough from said steam and thus the temperature of

said liquid will be raised and the proper boiling action of said liquid will ensue. Leading from the opposite side of the steam-chest C is a valved drain pipe C^2.

At the upper end of the vacuum pan is a horizontal baffle-plate a^1 provided with a central opening a^2 and suspended from said baffle-plate a^1 by bolts or rods a^3 is a smaller central baffle-plate a^4. Connected with said top plate A^2 is a passage or conduit a^5 through which the fumes, vapors and gases are permitted to escape. Said passage leads to a condenser, by the operation of which the gases escaping from the apparatus are condensed and removed and a partial vacuum maintained in the vacuum pan. Near the top of the vacuum pan, and preferably between the baffle-plate a^1 and the plate A^2 is an inlet a^6 through which water may be admitted to the interior of the pan A whenever it becomes necessary to wash out and clean the interior of said pan.

D^1 indicates a valved inlet pipe communicating with the lower compartment D through which pipe the spent lye, or other material to be treated, is delivered to said compartment D. In practice, it has been found that this inlet pipe D^1 may be conveniently used as an outlet, inasmuch as during the treatment of the spent lye or other material, salt or other solids are precipitated in the lower compartment D. It is desirable to drain off such liquid as remains on the top of the precipitated salt and the pipe D^1 affords a convenient outlet for said liquid. Furthermore, said pipe D^1 is shown as branched, each branch being provided with a valve, and the said branches entering the compartment D at different levels. The purpose of this construction is to permit the liquid to be drawn from different levels according to the amount of salt which may be present. The precipitated salt is taken from said compartment D through a manhole provided with a removable cover D^5. The compartment E is likewise provided with a manhole through which an operator may enter the pan for the purpose of cleaning the interior thereof, said manhole having a removable cover D^4.

D^3 indicates a valved pipe or conduit connected with the bottom wall A^3 of the vacuum pan, communicating with the compartment D and suitably connected with a sewer or drain, whereby the washout water brought into the pan A through the conduit a^6 may be drained off and pass to a sewer.

C^3 designates a steam pipe connected with the main steam supply pipe C^1 and opening into the compartment D. Said steam-pipe C^3 is provided with a valve c. The purpose of this pipe connection is as follows: In evaporating pans it is always necessary to create a substantial vacuum in said pan in order to lower the boiling point of the material to be treated. After the pan has been washed out by allowing water to enter through the conduit a^6, as hereinbefore referred to, this vacuum must be again created. For this purpose the valve c is opened and steam allowed to enter and fill the pan, displacing the air therein and forcing it out through the passage a^5. The valve c is then closed and condensation of the steam escaping through the passage a^5 creates a substantial vacuum in the apparatus. During the continued operation of the pan, the gases produced by the evaporation of the contents thereof are condensed and removed and a substantial vacuum thereby maintained in the pan. At the end of the evaporating operation, air is admitted to the apparatus and the vacuum therein destroyed by means of a valve a^7. This is necessary in order to permit the manhole cover D^5 to be opened, for when a partial vacuum exists in the apparatus, said cover is held tightly upon its seat by the atmospheric pressure upon the outer surface of said cover.

Referring more particularly to the construction of the tubes F F^1, hereinbefore referred to, the inner tubes F^1 are somewhat longer than the tubes F and are arranged with their upper and lower ends below the upper and lower ends of said tubes F. Said tubes F^1 are held centrally in the tubes F by means of three transversely disposed centering pins f^1 f^2 f^3 which extend radially through the tubes F^1 and project from the sides thereof and are of a length equal to the interior diameter of the tubes F. The top and bottom pins f^1 and f^3 are arranged in such a manner that the ends thereof contact with the inner walls of the tube F near the top and bottom of said tube F, while the pin f^2 is placed transversely to the pins f^1 and f^3, and its ends contact with the inner faces of the tube F near the center thereof. By this construction, the inner tube F^1 is prevented from moving laterally within the tube F and said tubes are held in concentric relation to each other. The tubes F^1 are supported within the tubes F by hangers f^4 f^4, the upper ends of which are outwardly curved and adapted to engage and rest upon the upper edges of the tubes F. In the lower parts of said hangers, which depend from the upper edges of the outer tubes, within the latter, are apertures for the reception of the ends of the upper centering pins f^1.

The hangers arranged as described sustain the inner within the outer tubes in the position described, namely, with the top of each tube F^1 at a considerable distance below the top of the tube F. Inasmuch as the inner tubes F^1 are longer than the outer tubes F, the lower ends of said inner tubes will project downwardly into the compartment D considerably below the lower ends of the tubes F. This arrangement of the tubes is an essential feature of my invention and, while I have shown a simple and preferred form of construction in means for sustaining the inner within the outer tubes, I do not desire to be limited to the details of construction shown and described, as it is manifest that other means may be employed for the purpose stated, without departing from the spirit of my invention.

Another form of vacuum pan embodying my invention is illustrated in Fig. 5 of the drawings. In the form of my invention hereinbefore described, the removal of the man-hole cover D^5, for the removal of the precipitated salt, admits air into the interior of the vacuum pan and destroys the existing vacuum, so that the process of restoring said vacuum must be effected as many times as it becomes necessary to remove the accumulated salt. The apparatus is, therefore, intermittent in its operation and the modification of my invention is designed to make this operation continuous. To effect this result, the bottom wall A^3 of the shell A is downwardly and inwardly extended so as to form a funnel, with an opening in the bottom thereof, which is connected with a comparatively large valved conduit

G^1 which latter opens into a receptacle or bin G situated just below said conduit and having a capacity considerably less than the capacity of the vacuum pan. When a quantity of salt has accumulated in the compartment D, the valve in the conduit G^1 may be opened, the salt allowed to descend and the valve then closed, it being evident that the small amount of air entering the vacuum pan from the receptacle G to equalize the pressures therein will not substantially impair the partial vacuum in said pan. The salt is removed from the compartment G through a door G^2. A suitable valved drain-pipe G^3 may conveniently be located at the bottom of the compartment G for draining off the liquid which passes into said compartment with the salt.

In order to completely describe the operation of the apparatus, let it be assumed that the pan has been washed out by the inflow of water at the conduit a^6 (Fig. 1). This water is allowed to pass out through the outlet pipe D^3, as before stated. The valves controlling the pipes a^6, D^1 and D^3 and the air tight doors D^4 D^5 are then closed. The valve c is opened and steam allowed to enter the pan and by its condensation effect a partial vacuum in the pan as above described. The spent lye, or material to be treated is then allowed to enter the compartment D, under pressure if necessary, filling said compartment and rising through the tubes F and F^1, until the level of the liquid or material reaches about six inches above the top of the tubes F, or higher if desired. Steam then being admitted to the steam compartment, the liquid in contact with the inner walls of the tubes F is brought to the boiling point by the transmission therethrough of heat derived from the steam, and said liquid being of less density than the liquid within the tubes F^1, rises while the liquid within the tubes F^1 descends. In this manner a continuous circulation of the liquid takes place through all the tubes, the heated liquid rising through the passages between the tubes and the cooler liquid descending through the inner tubes F^1. The liquid in passing out of the lower ends of the tubes F^1 mingles with the liquid in the compartment D and serves to heat the contents of said compartment. Such mingling of the circulating liquid with the liquid in the compartment D is facilitated by the extension of the lower ends of the tubes F^1 below the lower ends of tubes F. It is to be noted also that, as the liquid will descend through the tubes F^1 with considerable force, it will serve to agitate the liquid below and bring the liquid near the bottom of the compartment D in contact with the circulating liquid.

I regard this construction and arrangement of the tubes as a great improvement in the art, as continuous circulation of the liquid through every tube absolutely prevents the clogging of the tubes by the precipitated salt, as is common in the operation of vacuum pans now in use. This constant uniform circulation through all the tubes also insures a comparatively level deposit or accumulation of the precipitated salt and prevents the banking on one side which ordinarily results when part of the tubes become stopped or clogged or which results from irregular circulation. Moreover, the regular and uniform circulation through all the tubes prevents the liquid from foaming and boiling over, as in other constructions which require numerous catch-alls and baffle-plates to prevent the liquid from passing out, and pipes to lead it back to the evaporating pan. In my improved apparatus, the liquid rising in the space between tubes F^1 and F, on reaching the top of tube F^1, descends through tube F^1 into compartment D, thereby maintaining a perfect circulation without disturbing the liquid above the tubes. As a result, violent ebullition and loss by boiling over are prevented, and the capacity of the evaporator increased. As an additional means of preventing any liquid from passing into the outlet pipe a^5 during the boiling operation, I have provided the baffle-plates a^1 and a^4. Any liquid or solid matter which may strike said baffle-plates falls back, while the gases and vapors pass into the space between the baffle-plates a^1 and a^4, and through the opening a^2 to the outlet passage a^5. The liquid is subjected to this treatment for a period of time necessary to properly precipitate the contained salt and allow the gases, vapors, etc. to pass off into the condenser and until the liquid is of the required density. The valve a^7 is then opened allowing air to enter the apparatus and destroy the vacuum therein, after which the manhole cover D^6 is opened and the salt removed, and if necessary the pan flushed out.

It will be understood from the foregoing that while my improved device is adapted for the evaporation of liquids containing salts or other solids in solution, and the recovery of said solids, it is equally well adapted for the partial or complete evaporation of liquids not containing solids in solution and my invention covers an apparatus for partially or completely evaporating liquids of all kinds, whether they contain solids in solution or not.

I claim as my invention:—

1. A vacuum pad having an upper and a lower compartment and an intermediate steam-chest, a plurality of circulating tubes passing through said steam-chest, said tubes affording communication between said upper and lower compartments, and smaller auxiliary tubes located concentrically within each of said circulating tubes and communicating at their lower ends with said lower compartment, said tubes having their upper ends not higher than the level of the upper ends of said circulating tubes.

2. A vacuum pan having an upper and a lower compartment, and an intermediate steam-chest, a plurality of circulating tubes passing through the said steam-chest, said tubes affording communication between said upper and lower compartments, and auxiliary tubes located concentrically within said circulating tubes, said auxiliary tubes having their upper ends below the upper ends of said circulating tubes and communicating at their lower ends with said lower compartment.

3. A vacuum pan having an upper and a lower compartment and an intermediate steam-chest, a plurality of circulating tubes passing through said steam-chest, said tubes affording communication between said upper and lower compartments, and auxiliary tubes located within said circulating tubes, the upper ends of said auxiliary tubes being below the upper ends of the large circulating tubes, and the lower ends of said auxiliary tubes depending below the lower ends of said circulating tubes and opening into said lower compartment.

4. A vacuum pan having an upper and a lower compartment and an intermediate steam-chest, a plurality of circulating tubes passing through the said steam-chest, said tubes affording communication between said upper and lower compartments, auxiliary tubes located within each of said circulating tubes, and means for supporting

the auxiliary tubes in said circulating tubes embracing hangers having hooked upper ends engaging the upper margins of said circulating tubes.

5. A vacuum pan having an upper and a lower compartment and an intermediate steam-chest, a plurality of circulating tubes passing through the said steam-chest, said tubes affording communication between said upper and lower compartments, and auxiliary tubes located centrally within each of said circulating tubes, said auxiliary tubes being each provided with a plurality of radially extending centering pins projecting beyond the periphery thereof and contacting with the inner face of the circulating tube surrounding it.

In testimony, that I claim the foregoing as my invention I affix my signature in the presence of two witnesses, this 24th day of January A. D. 1907.

PAUL GUSTAV KAISER.

Witnesses:

C. CLARENCE POOLE,

D. EVELYN MARMON.