G. STADE.

VACUUM EVAPORATING APPARATUS.

APPLICATION FILED MAR. 29, 1913.

1,168,758.

Patented Jan. 18, 1916.

2 SHEETS—SHEET 1.

Fig. 1.

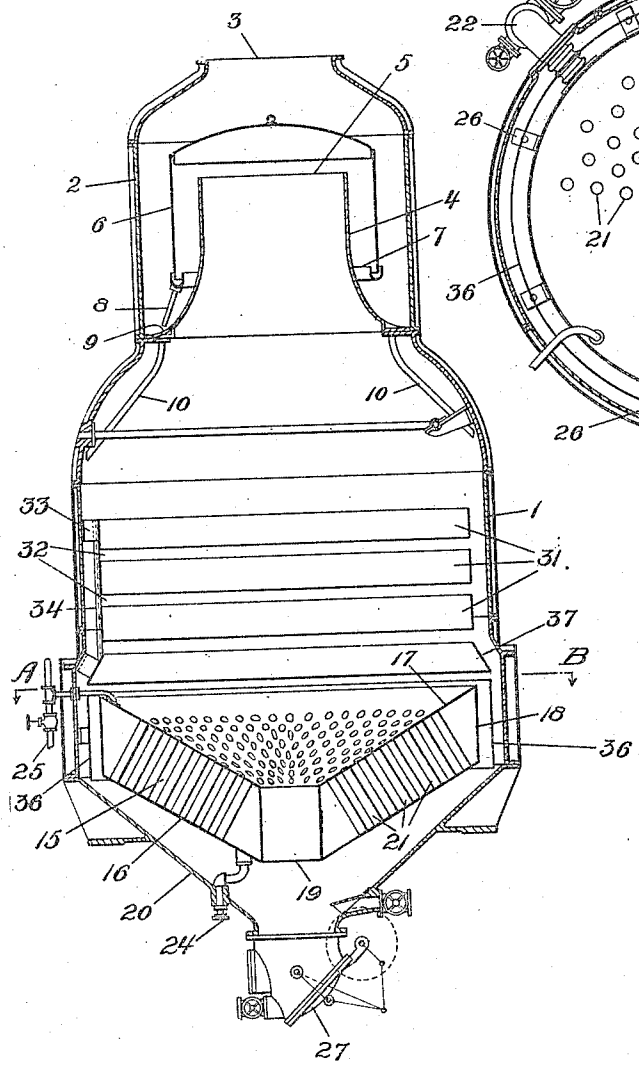
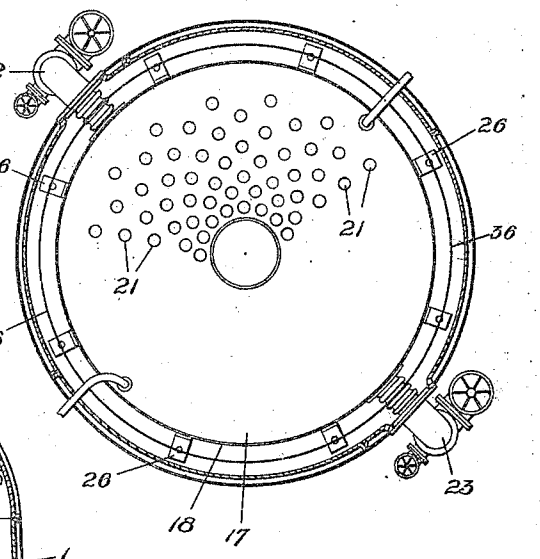


Fig. 2.



Witnesses:
John Darby
Rose Merk

George Stade Inventor
By his Attorney John D. Morgan

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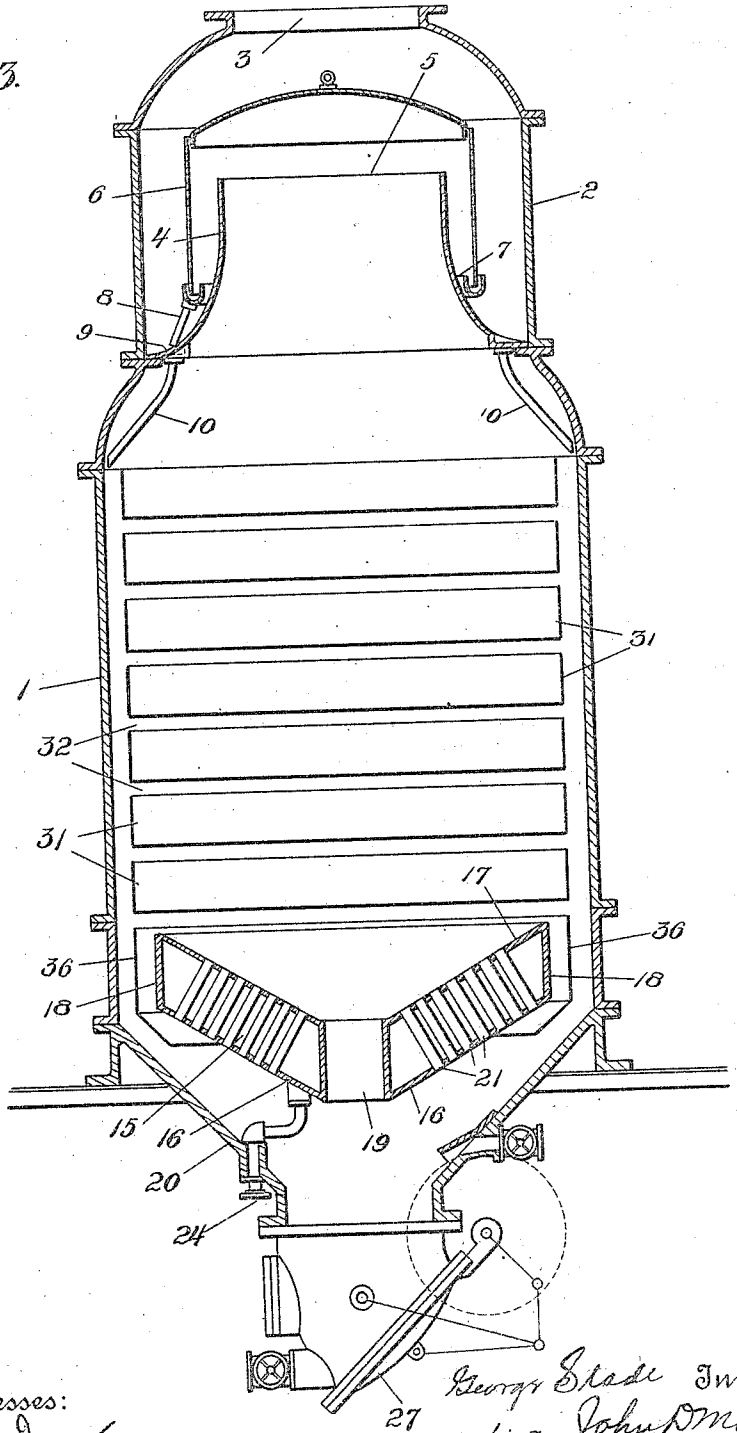
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2 SHEETS—SHEET 2.

Fig. 3.



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UNITED STATES PATENT OFFICE.

GEORGE STADE, OF SCHLOSS HUBERTUSBERG, GERMANY, ASSIGNOR TO HONOLULU IRON WORKS COMPANY, OF HONOLULU, TERRITORY OF HAWAII, A CORPORATION OF THE TERRITORY OF HAWAII.

VACUUM EVAPORATING APPARATUS.

1,168,758. Specification of Letters Patent. Patented Jan. 18, 1916.

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To all whom it may concern:

Be it known that I, GEORGE STADE, a subject of the Emperor of Germany, residing at Schloss Hubertusberg, Germany, have invented certain new and useful Improvements in Vacuum Evaporating Apparatus, of which the following is a specification.

The invention relates to vacuum evaporating apparatus such as is used in evaporating various fluids in a reduced atmospheric pressure such as for illustration milk, or vegetable juices, the evaporation of juice in the making of sugar being a well known example.

Objects of the invention are to provide a novel apparatus giving the highest results in efficiency of evaporation and providing for the most advantageous and effective circulation of the fluids within the vacuum chamber; to provide for the direction and separation of the hotter ascending fluids and cooler descending fluids to prevent their meeting and baffling one another; to provide for increasing the ratio or proportion of heating surface to the capacity or content of the device; and to provide for the conjoint realization of these and other objects and advantages. These and other objects of the invention will in part be obvious and will in part be set forth hereinafter.

The invention consists in the novel parts, constructions, arrangements, apparatuses, combinations and improvements herein shown and described.

The accompanying drawings, referred to herein and forming a part hereof, illustrate one embodiment of the invention, the same serving in connection with the description herein to explain the principles of the invention.

Of the drawings: Figure 1 is a central section of a vacuum device constructed in accordance with the principles of the invention; Fig. 2 is a transverse horizontal section substantially on the line A—B of Fig. 1 looking downwardly; and Fig. 3 is a central longitudinal section of a somewhat different form of the device on an enlarged scale.

Referring now to the accompanying drawings, illustrating by way of example one embodiment of the invention, a vacuum chamber is indicated generally by reference numeral 1 designed to receive and contain the fluid to be operated upon during the evaporating process and to conduct away the vapors therefrom. Communication from said chamber to a suitable vacuum creating means is provided to carry away the vapors resulting from the evaporation. As embodied, the upper portion 2 of said chamber 1 communicates by a suitable opening 3 with a condenser or a conduit leading to such condenser. Therewith is provided also a device for arresting any globules or particles of fluid or juice which may be carried away by the evaporative process from the body of liquid within the chamber 1 and for returning these particles to the liquid within the chamber. As shown herein, said means comprises a throat 4 into which the upper part of the chamber 1 opens or terminates, said throat being shown contracted upwardly and having the opening 5 at the top thereof. Over the opening 5 is arranged a bell 6 which is larger than the upper part of throat 4 and is spaced away therefrom thus leaving a passageway between the top of the throat 4 and the bell 6 and also between the side walls of the throat 4 and the side walls of the bell 6. About the lower open edge of the bell 6 is a gutter 7, communicating by a pipe 8 with a gutter 9. The gutter is formed about the base of the throat 4 where it joins and incloses the upper end of the chamber 1 and from the gutter 9 pipes 10 communicate into the chamber 1 and discharge near the side walls thereof. Thus the particles of juice carried along by the swiftly upwardly traveling vapors impinge against the bell 6 and fall backwardly through the throat 4 or are gathered either into the gutter 7 or 9 and thus return to the chamber 1.

Means are provided by the present invention for directing into the interior or relatively central portion of the chamber 1 all of the heated fluid ascending from the heating device and for returning the relatively cooled and downwardly traveling fluid along the outer or peripheral portions of the chamber back to the heating device. Thus the most advantageous circulation is obtained, that is, the heated ascending fluid

and intermixed vapor are directed to and travel upwardly in the central or relatively hottest parts of the chamber 1 and the cooler and heavier fluid, from which the vapor has separated and been conducted away to the condenser, is directed to and travel downwardly at and near the periphery or relatively cooler portions of the chamber 1. The ascending hot fluid and vapor are also gathered together substantially into a single stream or current and travel upwardly together, and the heavier downwardly descending fluid travels downwardly separately therefrom and outside thereof. The further great advantage is secured that the hot ascending currents and the cooler descending currents do not meet or impinge upon each other thus is avoided by interference with or baffling of each by the other, whereby the circulation would be impaired or stopped at important or necessary points, thereby impairing the evaporating efficiency of the device and nullifying a great part of the momentum energy derived from the heating apparatus.

Suitable heating devices are provided and in the embodied form said heating devices are provided near the bottom of the chamber 1 with a passage or passages between the side walls of the chamber 1 and the heating device 15 and also between the bottom of the chamber 1 and the bottom of said heating device. Said embodied form of heating device comprises an inverted conoidal device having a bottom plate 16 and a top plate 17 of substantially the same shape and form and having a peripheral side wall 18 shown substantially vertical, and with the apex at the central part with an opening 19 therethrough.

The heating device is provided with a series of tubes 21 extending between the bottom 16 and the top 17 providing passageways through the heating device for the liquid to be evaporated. Inlets 22 and 23 are shown for the supply of steam or other heating fluid to the heating device 15, and a drain 23, 24 serves to carry away the condensation therefrom. An outlet or conduit 25 may be provided for carrying away air and non-condensible vapors from the heating device. Suitable means are provided for supporting the heating device in position within the chamber 1 and are shown herein, as a series of brackets 26.

The bottom 20 of the chamber 1 as embodied is inclined from the sides or periphery toward the center or axis, a space or passageway being left therebetween and the bottom of the heating device 15. A gate 27, at the bottom of the chamber 1 serves to discharge the crystallized mass, in the case of sugar making, from the chamber 1 into the mixer and separator.

Within the body of the chamber 1 are provided a series of circulating rings 31, which serve to separate the interior or central portion of the chamber 1 from the outer or peripheral portion thereof, the hotter fluid and vapors rising from the heating device flowing upwardly within the circulation rings and as the fluid cools and becomes relatively heavier, it is carried outwardly and flows downwardly between the circulating rings 31 and the walls of the chamber 1 back to the heating device to be reheated. Said rings are arranged one above the other, and preferably a plurality thereof in vertical alinement, but with horizontal spaces or openings 32 therebetween. By this means the lateral or radial flow of the cooling juices toward the outer or peripheral portion of the chamber 1 is unimpeded at the various stages of the filling of the chamber 1, as crystallization proceeds and successive supplies of syrup or other liquid are added. Suitable supporting means are provided for the circulation rings such as brackets 33 and standards 34, shown supported on the walls of chamber 1.

It will be understood that by an arrangement such as supplied by this invention, the simplest and most natural and mechanically efficient circulation upwardly and downwardly of the fluid within the chamber 1 is provided and that non-interference of the oppositely flowing currents is effected. There is likewise provided by the invention means for directing into the central portion of the chamber 1 the fluid heated by the bottom portion 16 and the side walls 18 of the heating device 15, and also means for keeping separate this particular part of the ascending heated fluid and vapor from the cooler descending or returning fluid. The embodied form of such means comprises the ring or plate 36 arranged about but spaced away from the wall 18 of the heating device 15, thus leaving a space between ring 36 and the wall 18 and also leaving a space or passageway between said ring or plate 36 and the outer wall of the chamber 1. This ring or plate 36 is in such relation to the circulating rings 31 that the upwardly traveling hot fluid is directed inside the circulating rings. Referring to the form of such directive means illustrated in Fig. 1, a ring or annular plate 37 is provided flaring or opening downwardly to receive the upwardly directed or traveling fluid from between the wall 18 of the heating device and said ring or plate 36 and directing said fluid inwardly within the circulating ring or rings. At the same time the downwardly descending cooler fluid is deflected or directed outwardly between said ring or plate 36 and the walls of the chamber 1 and the two currents are kept separate from each other and are prevented from baffling or neutralizing each at this point and thus largely

diminishing or negativing the circulation and efficiency of the apparatus. Said cooler downwardly traveling currents of the fluid are thus permitted to flow unimpeded to the underside of the heating device 15, where a large portion thereof is drawn through the tubes 21 by reason of the strong upward flow of mixed fluids and vapor through and from the top of the heating device. A portion of said cooler fluid, however, is highly heated by the inclined bottom plate or floor 16 of the heating device and travels upwardly and outwardly along the upwardly inclined parts thereof and up through the passageway between the wall 18 and the ring 36 as already described into the interior of the circulating rings 31.

Referring to the form of device shown in Fig. 3, it will be noted that the ring or plate 36 is in vertical alinement, or substantially so, with the circulating rings 31, and that the heated fluid from between the ring 36 and the walls 18 of the heating device may pass vertically up inside the circulating ring.

In Fig. 1 the chamber 1 is shown of greater diameter at the bottom portion where the heating device is located and of lesser diameter in the upper portion where are the circulating rings. By this means the proportion or ratio of heating surface to the cubical capacity or content for the fluid to be evaporated is greatly increased, which also adds very much to the efficiency and satisfactory operation of the device. The various other parts and coöperating instrumentalities of the apparatus as already described, and especially as shown in Fig. 1, are designed to coöperate with this relation or proportion of the heating surface with the cubical or fluid content of the apparatus and there are embodied therewith the various features of construction and arrangement to secure the advantages pointed out together with other advantages. Thus not only is the greater efficiency secured as just described but in connection therewith the most advantageous flow or circulation of the fluids, that is, the hotter ascending fluids within and the cooler descending fluids without, and also the oppositely traveling currents are separated one from the other and each directed along the path or in the direction conducing most to the highest efficiency of the device.

It will be understood that a device has been provided which embodies the various features of invention and which realizes the objects and advantages pointed out, together with other objects and advantages. It will be understood also that the variations in structure herein shown are illustrative and explanatory in character and not restrictive upon the invention, and that changes in the construction and arrangement may be made from what is herein shown and described within the scope of the accompanying claims without departing from the principles of the invention.

What I do claim as my invention and desire to secure by Letters Patent, is:

1. A vacuum evaporating apparatus including in combination a closed vacuum chamber, heating means arranged at the bottom part of said chamber, a circulating ring within said chamber and of less diameter than the chamber, and means for directing the heated liquid from all parts of said heating means, including the sides and bottom thereof, within said cylindrical member.

2. A vacuum evaporating apparatus including in combination a closed vacuum chamber, heating means arranged at the bottom part of said chamber, a circulating ring within said chamber and of less diameter than the chamber, and means for directing the heated liquid from all parts of said heating means, including the sides and bottom thereof, within said cylindrical member, and for separating said heated liquid from the cooler liquid returning to said heating means.

3. A vacuum evaporating apparatus including in combination a closed vacuum chamber, heating means arranged at the bottom part of said chamber, a circulating ring above said heating means within said chamber and of less diameter than the chamber and a partition open at the bottom and encircling said heating means for keeping the heated liquid flowing from said heating means from the returning cooler liquid flowing toward said heating means.

4. A vacuum evaporating apparatus including in combination a closed vacuum chamber, a heating device within and near the bottom of said chamber with a passage way for the fluid therebetween, a hollow cylindrical member within and of less diameter than said chamber and located above said heating device, and means in said passageway for separating the heated liquid flowing upwardly outside said heating device and the cooler liquid returning thereto and for directing said heated liquid within said hollow cylindrical member.

5. A vacuum evaporating apparatus including in combination a closed chamber, a heating device having upwardly directed fluid passages within and near the bottom of said chamber with a passage way for the fluid between the heating device and the side walls and bottom of the chamber, a circulating ring within said chamber above said heating device, and means for directing the heated liquid flowing upwardly outside said heating device from beneath and around said heating device, within said circulating ring and for keeping said heated liquid and the cooler liquid returning from the heating means separate from each other.

6. A vacuum evaporating apparatus including in combination a heating device within and near the bottom of said chamber, a circulating ring within said chamber above said heating device, means for directing substantially all the heated fluid flowing from said heating means, including that from the bottom and outside, within said circulating ring and for returning substantially all the cooler fluid to said heating device exteriorly to said circulating ring.

7. A vacuum evaporating apparatus including in combination a heating device within and near the bottom of said chamber with a passage way around and beneath said heating device, a circulating ring within said chamber above said heating device and means for directing heated fluid from around the outside and from beneath said heating device within said circulating ring and for directing the cooler fluid returning exteriorly to said circulating ring beneath said heating device.

8. A vacuum evaporating apparatus including in combination a chamber, a heating device of generally conical exterior conformation and having upwardly directed passageways therethrough, said device being in inverted position within said chamber near the bottom thereof, a circulating ring within said chamber above said heating device, and means arranged about said heating device and open at the bottom for directing the heated liquid from the underneath conical exterior of said device within said circulating ring and for keeping said heated fluid separate from the cooler fluid returning exteriorly to said ring to said heating device.

9. A vacuum evaporating apparatus including in combination a chamber, a heating device of a generally conical exterior conformation and having upwardly directed passageways therethrough, said device being in inverted position within said chamber near the bottom thereof, a circulating ring within said chamber above said heating device and means arranged around and separate from said heating device, and being open at the bottom, for directing the heated liquid from the underneath conical exterior of said device within said circulating ring and for keeping said heated fluid separate from the cooler fluid returning exteriorly to said ring to said conical underneath exterior of said heating device.

10. A vacuum evaporating apparatus including in combination a chamber, a heating device of a generally conical exterior conformation and having upwardly directed passageways therethrough, said device being in inverted position within said chamber near the bottom thereof with a passage around and beneath the heating device, a circulating ring within said chamber above said heating device, and means for directing the heated liquid from the underneath conical exterior of said device within said circulating ring and for keeping said heated fluid separate from the cooler fluid returning exteriorly to said ring and around said heating device to the underneath part thereof.

11. A vacuum evaporating apparatus including in combination a chamber of varying diameter having a part of lesser diameter above and a part of greater diameter beneath, a circulating ring in said part of lesser diameter, a heating device in said portion of larger diameter and means for directing the heated liquid from about said heating device into the interior of said circulating ring.

12. A vacuum evaporating apparatus including in combination a closed chamber, a heating device located within and near the bottom of said chamber but with a fluid circulating space within said chamber walls beneath and horizontally around said heating device, a circulating ring arranged within said chamber above said heating device to divide the interiorly hot ascending currents from the exteriorly downwardly descending cooler currents, and a ring around and horizontally in alinement with said heating device for receiving at its bottom the upwardly traveling hot liquid from the bottom and sides of said heating device and directing said liquid upwardly and within said circulating ring, while the cooler liquid travels downwardly exteriorly to said ring about said heating device and the upwardly and downwardly traveling currents are kept from intermingling and interfering with one another.

13. A vacuum evaporating apparatus including in combination a closed chamber, a heating device located within and near the bottom of said chamber, said heating device having an upwardly and outwardly inclined bottom, spaced apart from the chamber walls, a circulating ring arranged within said chamber above said heating device to divide the interiorly hot ascending currents from the exteriorly downwardly descending cooler currents, and a ring arranged around and horizontally in alinement with, but spaced apart from, said heating device for receiving at its bottom the hot fluid traveling upwardly from said bottom of the heating device and directing said fluid within said circulating ring while the cooler downwardly descending currents travel exteriorly to said ring around said heating device, and the upwardly and downwardly traveling currents are kept from intermingling with one another.

14. A vacuum evaporating apparatus including in combination a closed chamber, a

heating device located within said chamber near the bottom thereof but spaced apart from said chamber, means for causing an upward circulation of hot fluid within the central part of said chamber and a cooler downward circulation near the walls of said chamber, and a partition about said heating device and spaced away both from said heating device and the chamber walls, for dividing the hot current ascending from the sides and bottom of said heating device from the cooler currents descending along the walls of said chamber.

15. A vacuum evaporating apparatus including in combination a closed chamber, a heating device within said chamber near the bottom thereof but spaced apart from said chamber, said heating device having an upwardly and outwardly inclined bottom and substantially vertical sides, and a partition arranged about said heating device and in substantial horizontal alinement therewith, but spaced apart therefrom and from said chamber wall and being open at the bottom for receiving within itself the hot upward currents rising from the bottom and sides of said heating device and keeping the downwardly descending cooler currents separate therefrom and directing them to the bottom of said heating device.

16. A vacuum evaporating apparatus including in combination a chamber having its upper part of lesser diameter and its lower part of greater diameter, circulating rings located within said upper part, a heating device located in said lower part, and means for directing the heated fluid from both the interior and exterior of said heating device upwardly into the interior of said circulating rings, the cooler downward currents passing exteriorly to said circulating ring and heating device.

17. A vacuum evaporating apparatus including in combination a chamber having its upper part of lesser diameter and its lower part of greater diameter, circulating rings located within said upper part, a heating device located in said lower part, and means for directing the heated fluid from both the interior and exterior of said heating device upwardly into the interior of said circulating rings, and a partition around the exterior of said heating device, spaced apart therefrom and from the walls of said chamber, being open at the bottom and arranged to direct the hot fluid from about the exterior of said heating device within said circulating ring, the cooler downward currents passing exteriorly to said circulating ring and heating device.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

GEORGE STADE.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.