C. R. MABEE.

DEVICE FOR THE EVAPORATION OF LIQUIDS AND IN THE DRYING OF SUBSTANCES.

APPLICATION FILED DEC. 15, 1913. RENEWED FEB. 13, 1920.

1,402,238. Patented Jan. 3, 1922.

FIG. 1.

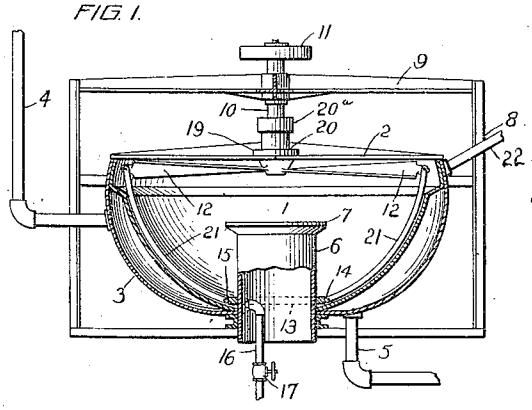


FIG. 4.

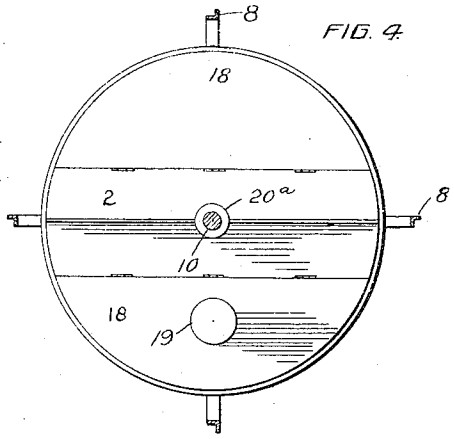


FIG. 2.

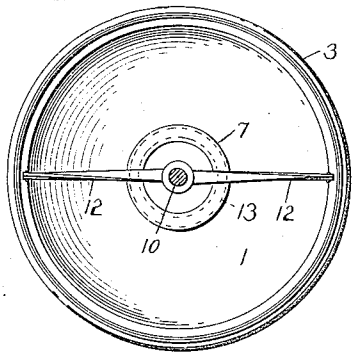


FIG. 3.

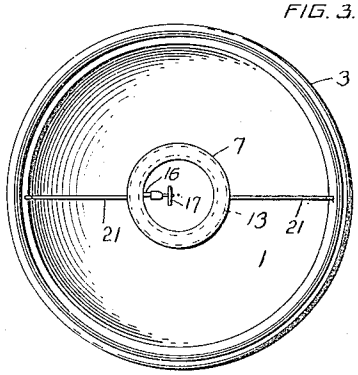
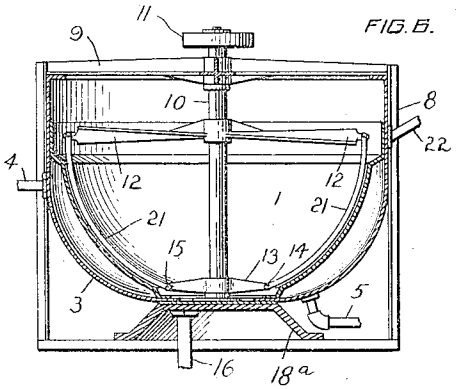


FIG. 5.



FIG. 6.



Inventor

Charles R. Mabee

Witnesses

W. F. Doyle

K. L. Martin

UNITED STATES PATENT OFFICE.

CHARLES R. MABEE, OF TOLEDO, OHIO.

DEVICE FOR THE EVAPORATION OF LIQUIDS AND IN THE DRYING OF SUBSTANCES.

1,402,238. Specification of Letters Patent. Patented Jan. 3, 1922.

Application filed December 15, 1913, Serial No. 806,888. Renewed February 13, 1920. Serial No. 358,433.

To all whom it may concern:

Be it known that I, CHARLES R. MABEE, of the city of Toledo, county of Lucas, and State of Ohio, have invented certain new and useful Improvements in Devices for the Evaporation of Liquids and in the Drying of Substances, and I do hereby declare that the following is a full, clear, and exact description of the same.

This invention relates to the evaporation of water from solutions and mixtures and to the drying of substances by the combined action of heat and outward pressure upon the solutions, mixtures or substances operated upon against heated surfaces as a result of rotary motion applied thereto, the means for effecting said rotary motion being rigid in character and conformed to the heated surface adjacent to which it may travel as a result of said rotary motion.

To enable others skilled in the art to which it appertains to make and use the same, I will proceed to describe it with reference to the drawing, in which similar reference characters refer to similar parts in all the figures.

Figure 1 is a vertical section of my improved device, Figure 2 is a top plan view of the same showing the revolving arm, Figure 3 is a similar view with the arm removed showing the segmental arm attached to the ring, Figure 4 is a plan view of the cover, Figure 5 is a detail view partly broken away, of one of the segmental arms and Figure 6 is an alternative form of the device.

Referring more particularly to the drawings, 1 is the container of general hollow hemispherical form, surmounted by a flat cover 2 and surrounded by a steam jacket 3 of crescent shaped cross-section provided with a steam inlet 4 and an outlet 5 for water of condensation. Centrally of the base of the receiver, a vertical tube 6 inserted in an aperture in the base thereof and rigidly secured thereto, is provided open to the atmosphere and having at its upper extremity, an outwardly flanged extension 7. A suitable frame 8 supports an horizontal support 9 provided with a bearing for a vertical shaft 10 in the longitudinal axis of the receiver 1 and driven by a pulley 11 connected to suitable motive power. Upon the free lower extremity of the shaft 10, an arm 12 extending diametrically of the upper rim of the receiver is rigidly secured. The shaft 10 passes centrally through the cover 2, through an aperture 20^a where a steam tight stuffing box permits rotation of the shaft but prevents the escape of vapors from the container. Upon the outer extremities of the arm 12 segmental arms 21 are hingedly attached, their lower extremities being similarly attached to a ring 14 revoluble about the lower extremity of the tube 6 where said tube unites with the body of the container. An outlet pipe 16 opens through the walls of the tube 6 and is provided with a valve 17 for the withdrawal of the finished product from the container.

In the alternative form of my device as shown in Figure 6, the vertical tube 6 is removed and the container is shown without opening from the bottom thereof, the segmental arms 21 in this instance, being attached to a collar bearing arms 13, sleeved upon the shaft 10, here shown as journaled in the base of the receiver.

The operation of my device is as follows: The substance to be treated is introduced within the container 1 through inlet 22 or through the cover segment 18, hingedly attached to said cover, proper motion having first been imparted to the arm 12 and said substance has imparted to it through and by means of the segmental arm 21, a rotary motion, in the direction of the rotation of the arm 12. An outlet for the gas and vapor of evaporation is afforded through the vertical tube, and it will be noted that the arms 12 constitute fan blades whereby to drive off through the vertical tube the vapor and gases. When water has been sufficiently extracted from the contents of the receiver, said contents may be removed through the outlet 16, controlled by the valve 17 or through the cover segment 18. In the alternative form, the receiver is maintained in upright position by supports 18^a, the tube 16 passing through the walls thereof at any convenient point within said supports. In this embodiment of the invention, wherein the tube 6 is dispensed with, the vapor and gases may be driven out of the top of the receptacle by the fan blades 12.

Among the advantages accruing from the use of the rigid arms employed in this device, particularly where the device is used for the evaporation of milk and similar substances, it may be mentioned that they prevent casein and other substances from

adhering to the heating surface and thereby render the device more easily cleaned and permit a larger amount of liquid to be removed from the substances operated upon, owing to the fact that any thing adhering to a heated surface, in an evaporating device retards the transmission of heat from the surface of the liquid.

While the construction set out is excellently adapted for the employment of my invention in practice I do not limit myself to the details, as they may be modified without departing from the spirit of the invention.

While I have herein shown and described some features of structure and operation more or less similar to those presented in other copending applications, it is to be understood that the claims herein presented are intended to be limited to the matters specifically described in them, respectively. They relate, respectively, either to a mechanism having a container which is approximately hemispherically shaped, or to a mechanism having a container which has its axis vertically disposed together with a vapor duct through the lower end or base of the container for the escape of vapors downward through said duct, or a mechanism having scraper cleaning devices connected to fan blades designed for moving air and vapor.

I do not claim herein any patentable and novel features of construction or operation incident to the automatically movable or yielding scraper arms adapted to brush, polish or cleanse the active surface of the container, or the forming of a film upon said surface either with or without continuous supply of material or continuous discharge of it from the container, or the withdrawal of vapor or the positive forcing of it out from the container, or the reduction of the atmospheric pressure, or the forming of a partial vacuum in the interior of the container, except as specifically described in the claims herein; these subjects-matter being presented in the said copending applications.

In said other applications, respectively, are presented claims for subjects-matter common to one or more thereof and also to the present case, together with claims in each, respectively, for matters characteristic thereof, and I reserve the right to secure therein the claims last referred to.

The copending applications to which cross reference is thus made are Serial No. 718,114, filed August 31, 1912; Serial No. 738,178, filed December 23, 1912; Serial No. 108,956, renewal of Serial No. 797,087, filed October 24, 1913, Serial No. 805,598, filed December 9, 1913; Serial No. 366,962, renewal of 806,889, filed December 15, 1913; Serial No. 280,143, renewal of 806,890, filed December 15, 1913; Serial No. 280,144, renewal of 806,891, filed December 15, 1913; Serial No. 40,757, filed July 19, 1915; Serial No. 77,996, filed February 12, 1916; Serial No. 57,472, filed October 23, 1915; and Serial No. 277,904, filed February 18, 1919.

Having thus fully described my invention, what I claim is—

1. In an evaporating and drying device, in combination, a hemispherical container, rigid means adapted to revolve about the interior surface of the said container in close proximity to and in apposition with the heated surface, means for applying rotary motion to said rigid means, and a substantially centrally arranged open ended tube projecting upwardly from the bottom of the container for the exit of vapors and gases.

2. In an evaporating and drying device, in combination, an externally heated hemispherical container a cover provided with a central aperture, a stuffing box mounted in said aperture, a shaft axially of the container passing through said cover and stuffing box, a transverse horizontal arm mounted on the extremity of the shaft approximately equal in length to the interior diameter of the upper portion of said container, a tube centrally introduced in the lower portion of said container and extending upwardly therefrom, a loose ring surrounding said tube, a plurality of segmental arms attached to the outer extremity of the horizontal arm adapted to conform to the contour of the curved interior surface of said container and attached at their lower extremities to said loose ring and means for applying rotary motion to said arms.

3. In an evaporating and drying device, in combination, an externally heated hemispherical container, a tube axially of the bottom thereof, extending upwardly therefrom, an axial shaft, a horizontal arm mounted on the lower extremity of said shaft, segmental arms hingedly attached at their upper extremities to the ends of the horizontal arm and adapted to move in close proximity to the inner surface of said container and at their lower extremities attached to a loose ring sleeved upon said tube, a pipe within the tube at its lowest point adapted to withdraw the contents of said container and means for applying rotary motion to said shaft, said horizontal arm and said segmental arms.

4. In an evaporating and drying device, in combination, an externally heated hemispherical container provided with an aperture centrally of the lower portion thereof, an axially disposed tube mounted in said aperture and extending upwardly, an axial shaft terminating slightly below the rim of said container, a horizontal arm mounted on the lower end of said shaft, flat rigid arms loosely attached to the extremity of the

horizontal arms and adapted to move in close proximity to the contour of the internal surface of said container and means for applying rotary motion to said shaft and said arms.

5. In an evaporating and drying device, in combination, an externally heated hemispherical container open at the top, means for maintaining said container in an upright position, a stub shaft externally of the upper portion of said container in the line of the axis thereof and terminating within the upper margin thereof, a horizontal arm mounted on the extremity of said shaft extending diametrically of the container, segmental arms loosely attached to the extremities of the horizontal arm and to a revoluble ring in the lower portion of said container and means for applying rotary motion to said shaft and said arms.

6. In an evaporating and drying device, in combination, an externally heated hemispherical container, flat arcuate arms in the axial plane of the container, the convex edges of said arms disposed adjacent to the concave surface of the container, an upwardly extending member on the base, round in cross section, a loose sleeved connection between said upwardly extending member and the lower ends of said arms, and means having a loose connection with the upper ends of said arms for applying motion to said arms circumferentially of the container.

7. In an evaporating and drying apparatus, the combination of an externally heated hemispherical container having a cover for the top thereof and a relatively large opening in the base thereof for the free and unrestricted escape of vapors, flat quadrantal arms in the axial plane thereof, the convex edges of said arms disposed adjacent the concave surface of the container, and a hinge connection for the upper end of said arms, and means for rotating said arms.

8. In an evaporating and drying device, in combination, an externally heated hemispherical container, means adapted to give the contents thereof motion circumferentially thereof, an off-take pipe axially of the bottom thereof and means for driving the vapor and gas of evaporation downwardly through said pipe independently of the discharge for the material treated, and means for controlling at will the discharge of said treated material.

9. In an evaporating and drying device, in combination, an externally heated hemispherical container, means adapted to give the contents thereof motion circumferentially thereof, means for the downward removal of the vapor and gas of evaporation, means for permitting the discharge of the treated material, and means for regulating such discharge independently of the vapor discharge.

10. In an evaporating and drying device, in combination, an externally heated hemispherical container having in its base a relatively large opening for the free escape of vapors and gases, means adapted to give the contents of the container motion circumferentially thereof and a fan for the downward removal of the vapor and gases through said opening.

11. In an evaporating and drying device, in combination, a hemispherical container having a relatively large free vapor escape opening, a heated jacket externally thereof, oppositely disposed quadrantal arms internally thereof disposed adjacent to the internal surface thereof and means for applying rotary motion to said arms circumferentially of said container, said means including rotatable fan blades which form a support for one end of said arms, and said fan blades acting to quickly expel the vapor through said opening.

12. In an evaporating and drying device, in combination, an externally heated upright, hemispherical container having an opening in the base thereof for the escape of gases and vapors, and an inwardly projecting flange or collar surrounding said opening, flat quadrantal arms in the axial plane thereof and adjacent to the interior surface thereof and means for applying rotary motion to said arms circumferentially of said container.

13. In an evaporating and drying device, in combination, an upright hemispherical container, a plurality of oppositely disposed quadrantal arms adjacent to the interior surface thereof, means for supporting said arms and means for imparting rotary motion thereto, circumferentially of said container, a vertically disposed open-ended tubular part projecting inwardly from the base of the container, of appropriate proportions for the free escape of the vapors, and an outlet independent of said vapor escape opening projecting through said tubular part, for the treated material.

14. In an evaporating and drying device, in combination, an externally heated hemispherical container, a tube axially of the bottom thereof, extending upwardly therefrom, an axial shaft, a horizontal arm mounted on the lower extremity of said shaft, segmental arms hingedly attached at their upper extremities to the ends of the horizontal arms and adapted to move in close proximity to the inner surface of said container and at their lower extremities attached to a loose ring revoluble about said tube, and means for applying rotary motion to said shaft, said horizontal arm and said segmental arms.

15. In an evaporating and drying device, in combination, an externally heated hemispherical container, a tube axially of the bottom thereof, extending upwardly there-

from, an axial shaft, a horizontal arm mounted on the lower extremity of said shaft, segmental arms hingedly attached at their upper extremities to the ends of the horizontal arms and adapted to move in close proximity to the inner surface of said container, and at their lower extremities attached to a loose ring revoluble about said tube, said tube having an opening in its side wall constituting an outlet for the treated material, and means for imparting rotatable movement to said shaft and connected parts.

16. In an evaporating and drying device, in combination, an externally heated hemispherical container provided with an aperture centrally of the lower portion thereof, an axially disposed tube mounted in said aperture and extending upwardly, an axial shaft supported on the top of the container, a horizontal arm adjacent the lower end of said shaft, relatively flat arms of rigid construction loosely suspended from the extremity of said horizontal arm, with the edges thereof adapted to move in close proximity to the contour of the internal surface of said container, and means for applying rotatable movement to the shaft and connected parts.

17. In an evaporating apparatus of the character described, the combination of a vertically disposed hemispherical container having a treating surface of a temperature different from that of the material to be treated, and means adapted to give the material within the container, motion circumferentially of said surface, said means including arms extending longitudinally of the surface, means connected to one end of the arms for imparting rotatable movement thereto, a rotatable support for the opposite ends of said arms, and means projecting from the base of the container constituting an axial bearing for said support, said last-mentioned means being hollow whereby to constitute an opening for the discharge of vapors or gases.

18. In an evaporating and drying device in combination, an externally heated hemispherical container, means adapted to give the contents thereof motion circumferentially thereof, and an off-take pipe axially of the base of the container for the vapors, and an auxiliary off-take pipe projecting through the first-mentioned pipe for the escape of the treated material.

19. In an evaporating apparatus of the character described, the combination of a vertically disposed hemispherical container, means for applying to the surface of the container, a temperature different from that of the material to be treated, means adapted to give the contents of the container motion circumferentially of said surface, an off-take pipe axially of the bottom of the container, said off-take pipe being relatively large for the unrestricted discharge of vapors, and an auxiliary off-take pipe leading from the interior of the container and projecting through the vapor off-take pipe for the independent discharge of the treated material.

20. In an evaporating apparatus of the character described, the combination of a hemispherical container, means for applying to the wall thereof a temperature different from the material to be treated, said container having an inlet and an oppositely disposed outlet for the material, and means adapted to give to the contents of the container motion circumferentially over the interior wall of the container, said means including a rotatable fan blade support, and arms movably connected to said support and shaped to correspond with the treating surface of the container, the said container having a relatively large substantially unobstructed opening for the rapid and free discharge of the vapors of evaporation, and said fan blades operating to force the said vapors through said last-named opening.

21. In an evaporating apparatus of the character described, the combination of a vertically disposed container, the inner surface of which is curved toward the base thereof, a rotatable fan blade adjacent the top of the container, arms loosely depending from the outer edges of said blades and shaped to conform to the interior surface of the container, and a vapor outlet at the base of the container, the wall of said outlet constituting a loose bearing for the lower ends of said arms.

22. In an evaporating apparatus of the character described, the combination of a vertically disposed container, the inner surface of which is curved toward the base thereof, a rotatable fan blade adjacent the top of the container, arms depending from the outer edge of said blade and shaped to conform to the interior surface of the container, a projection on the base of the container, and a rotatable connection between the lower ends of said arms and said projection, the said container having a free vapor escape opening, and the said fan blade acting to quickly expel the vapors of evaporation through said opening.

23. In an evaporating apparatus of the character described, the combination of a vertically disposed hemispherical container, means for applying to the wall of the container a temperature different from that of the material being treated, an inlet for the material at the top of the container, an outlet for the material adjacent the base of the container, means for imparting to the material circumferential movement over the interior surface of the container, and means for maintaining a free unobstructed outlet in the base of the container for the vapors and gases.

24. In a device of the character described, in combination, an externally heated substantially hemispherical container, having a cover, a shaft axially of the container projecting downwardly from said cover, a transverse supporting arm on said shaft in the upper portion of said container, an open-ended tube centrally introduced in the lower portion of said container and extending upwardly therefrom, a loose ring surrounding said tube, a plurality of segmental arms attached to the outer extremity of the transverse supporting arm and adapted to conform to the contour of the curved interior surface of said container and attached at their lower extremities to said loose ring, and means for applying rotary motion to said segmental arms.

25. In a device of the character described, the combination of a vertically disposed externally heated container, a cover member for the top of the container, a centrally-disposed open-ended tube projecting upwardly from the base of the container and constituting a relatively large vapor escape opening, the side wall of the container being curved inwardly towards the base thereof, a transverse rotatable support within the container adjacent the top thereof, a ring-shaped device sleeved upon the tube, and conveyor arms curvd to conform to the curvature of the side wall of the container pivotally connected at their upper ends to said supporting member and at their lower ends to said ring-shaped member.

In testimony whereof I have hereunto signed my name this 28th day of November, 1913, in the presence of two subscribing witnesses.

CHARLES R. MABEE.

Witnesses:
H. O. MARTIN,
W. S. SHERLOCK.