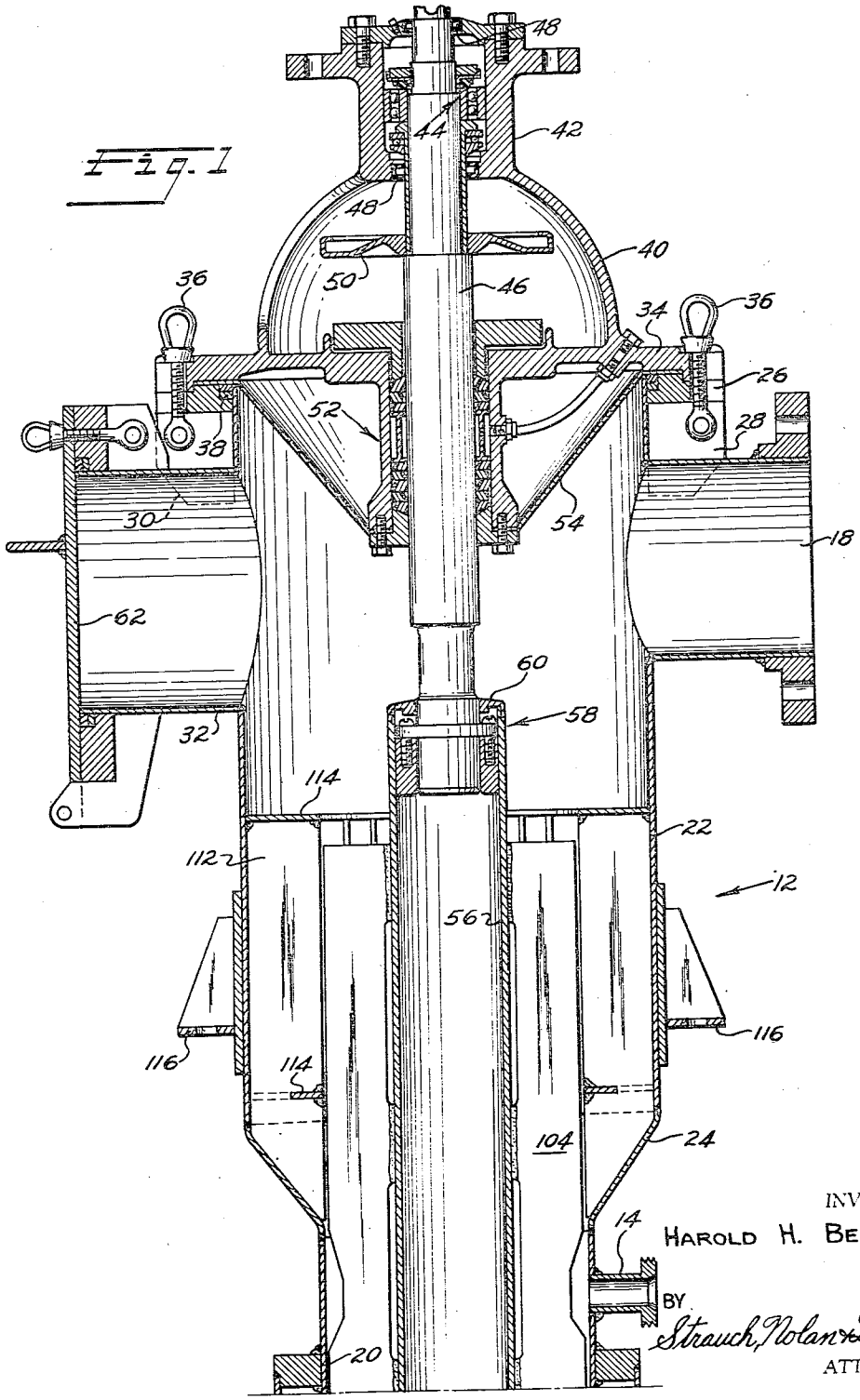
Dec. 18, 1956 H. H. BELCHER 2,774,415

EVAPORATOR

Filed Oct. 25, 1951 4 Sheets-Sheet 1

Fig. 1



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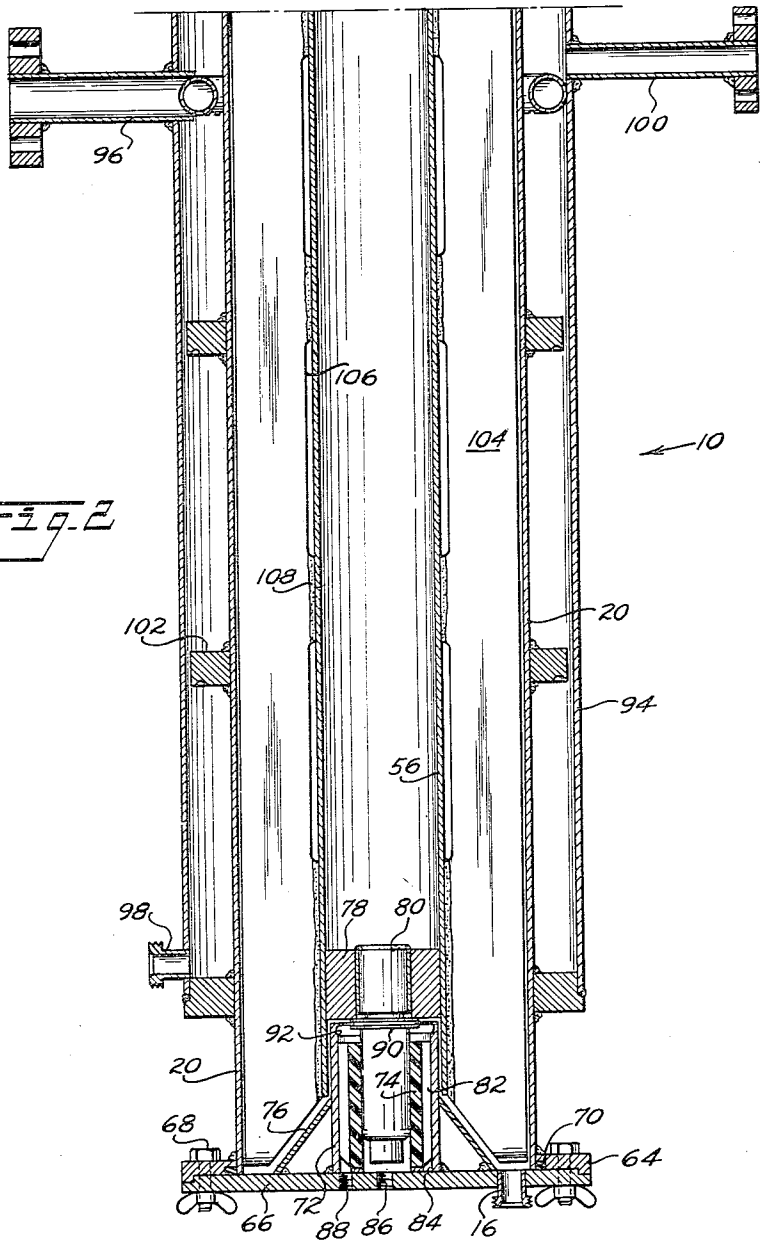


Fig. 2

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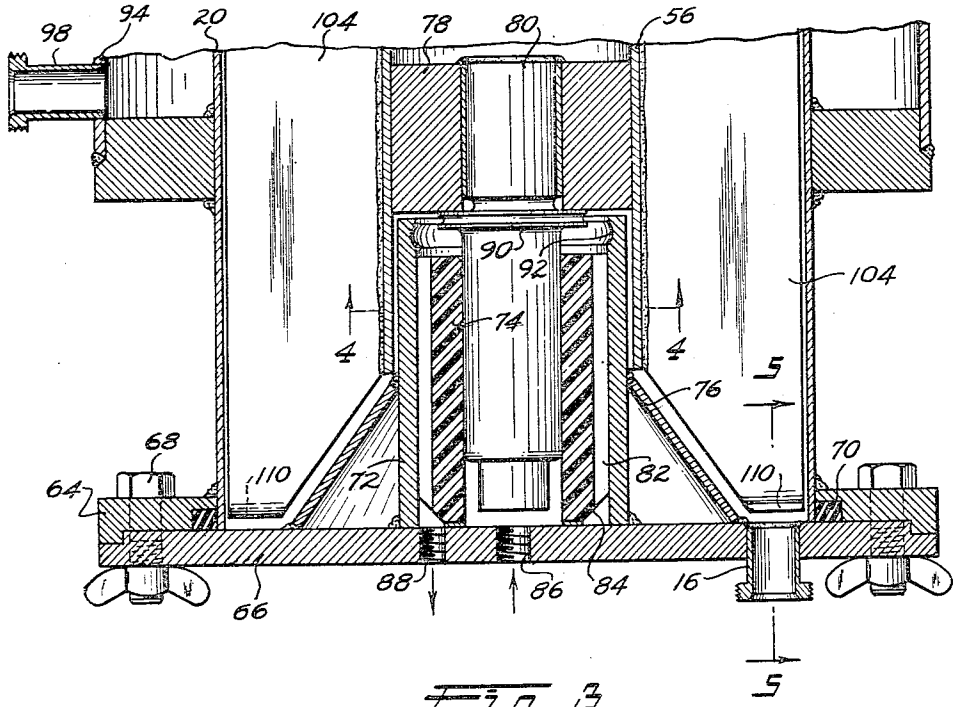


Fig. 3

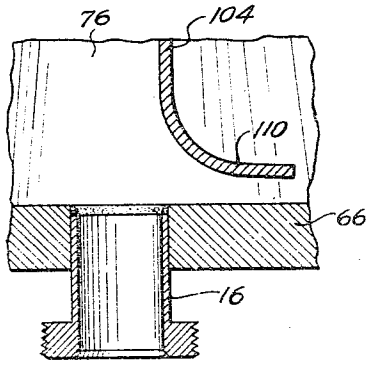
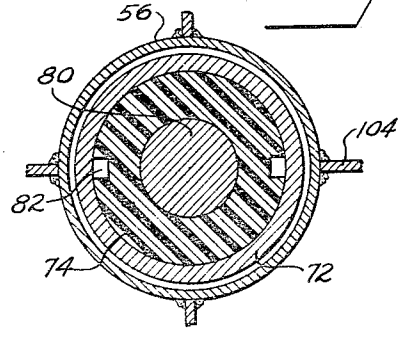


Fig. 5

Fig. 4



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Dec. 18, 1956 H. H. BELCHER 2,774,415

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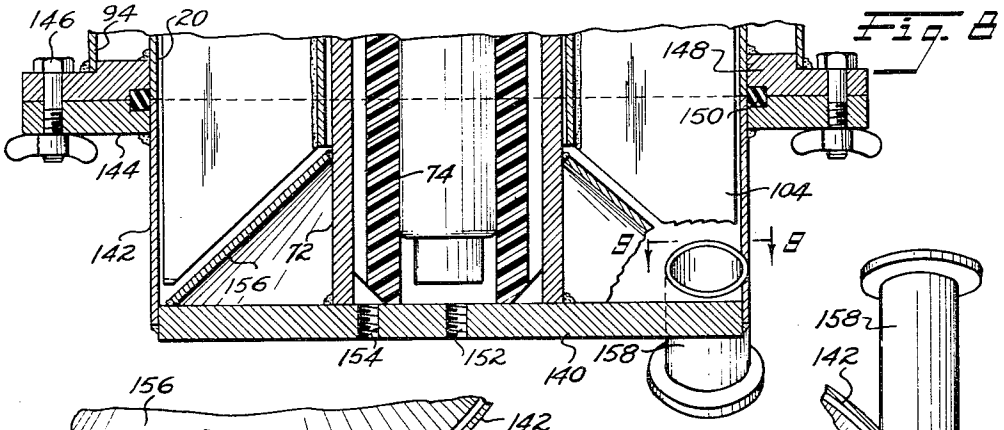


Fig. 8

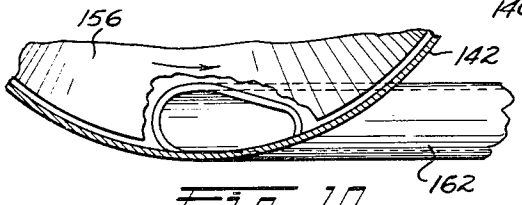


Fig. 10

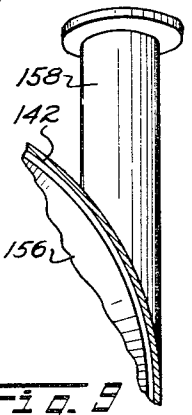


Fig. 9

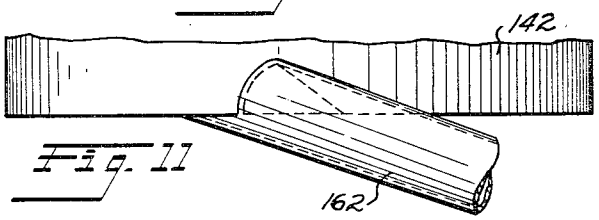


Fig. 11

Fig. 6

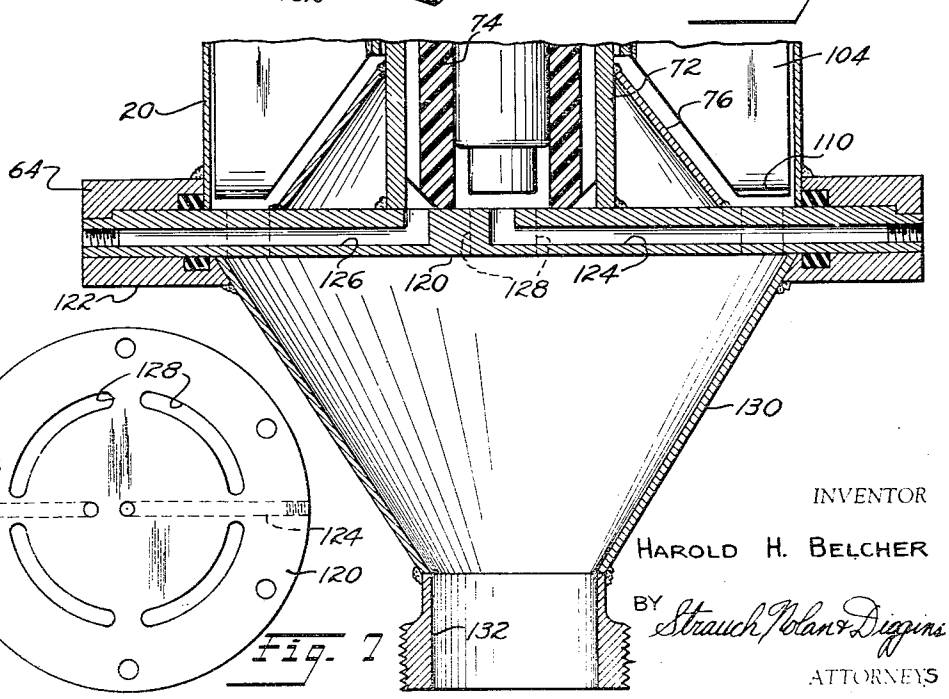


Fig. 7

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United States Patent Office 2,774,415 Patented Dec. 18, 1956

2,774,415

EVAPORATOR

Harold H. Belcher, Orange, Mass., assignor to Rodney Hunt Machine Company, Orange, Mass., a corporation of Massachusetts

Application October 25, 1951, Serial No. 253,126
15 Claims. (Cl. 159—6)

The present invention relates to apparatus for concentrating or evaporating liquids and separating entrapped liquid from the resulting vapor.

My invention is illustrated in connection with an evaporator or concentrator of the type shown in Patent No. 2,596,086 and application Serial No. 216,217, filed March 17, 1951, by Hans C. Bechtler for Evaporator.

In the concentrating or evaporating of liquids, especially sensitive liquids such as milk, fruit juices or the like, it is important that the liquid be protected from overheating which may injure the flavor, vitamin content, enzyme activity or the like. It has been found that such over-heating is most likely to occur at the bottom of the evaporator-concentrator where the liquid is most concentrated. The relatively thick viscous concentrate should be kept agitated and should be expelled from the apparatus quickly after evaporation.

Another problem in the construction of an evaporator-concentrator of this type is in providing a suitable lower bearing for the rotor since this lower bearing should fulfill a number of exacting conditions. The bearing should be such that the rotor may be easily removed and replaced for cleaning and sterilizing. Proper lubrication is important because the rotor rotates at fairly high speed and the lower bearing is subjected to fairly high temperatures. Where the bearing is lubricated by concentrate, lubrication may be inadequate. It is also essential that this lower bearing be lubricated in such a way that the lubricant does not contaminate the liquid being concentrated.

One of the objects of the present invention is to provide a thin film concentrator-evaporator in which overheating of the concentrate is substantially prevented.

Another object is to provide a thin film concentrator-evaporator in which the concentrate is quickly removed after concentration.

Another object is to provide a thin film concentrator-evaporator having an improved lower bearing.

Another object is to provide a thin film concentrator-evaporator in which the rotor may be readily inserted and removed.

Another object is to provide a thin film evaporator-concentrator in which the lower bearing may be readily removed and replaced.

Another object is to provide a thin film evaporator-concentrator which may be effectively lubricated without contaminating the liquid being concentrated or evaporated.

These and other objects and advantages reside in certain novel features of construction arrangement and combination of parts as will hereinafter be more fully set forth and pointed out in the appended claims.

Referring to the drawing:

Figure 1 is a vertical section of the upper part of a thin film evaporator-concentrator embodying my invention;

Figure 2 is a vertical section of the lower part thereof;

Figure 3 is an enlarged vertical section of the lower bearing and vane structure of a thin film evaporator embodying my invention;

Figure 4 is a fragmentary horizontal section taken on line 4—4 of Figure 3;

Figure 5 is a fragmentary vertical section taken on line 5—5 of Figure 3;

Figure 6 is an enlarged fragmentary vertical section

of a modified form of the lower bearing and outlet section of the apparatus;

Figure 7 is a plan view of the bottom plate of the apparatus of Figure 6 shown removed from the assembly;

Figure 8 is an enlarged fragmentary vertical section of a further modification of the discharge section of the apparatus;

Figure 9 is a fragmentary section taken along line 9—9 of Figure 8; and

Figures 10 and 11 are fragmentary views of a modified discharge pipe installation which may be incorporated in the apparatus in Figure 8.

The general construction of an efficient thin film evaporator-concentrator is described and claimed in the aforesaid Patent 2,596,086 and application Serial No. 216,217, filed March 17, 1951, by Hans C. Bechtler entitled "Evaporator."

Referring particularly to Figures 1 and 2, this apparatus is of tubular construction and is normally operated in vertical position. The lower portion, indicated generally at **10**, is the evaporator portion of the apparatus and the upper portion, indicated generally at **12**, is the separator portion. The liquid to be concentrated is introduced through a pipe or fitting **14** which is generally located between the evaporator **10** and separator **12** and flows down through the evaporator **10** by gravity. The concentrated liquid is withdrawn through a pipe or fitting **16** at the bottom of the evaporator **10** and vapor is discharged through a pipe or conduit **18** above the separator **12**.

The evaporator portion has a wall **20** which is normally cylindrical throughout substantially the entire length of the evaporating chamber. This wall **20** may be tapered to form a frusto-conical rather than a cylindrical chamber and, while a cylindrical chamber is ordinarily preferred, it is to be understood that the term "cylindrical" when applied to the evaporator includes also a chamber of tapered or conical form.

The separating chamber **12** may be a continuation of the evaporating chamber or may be larger or smaller than the evaporating chamber **10** but in the preferred form, the separating chamber **12** formed by a wall **22** is of larger diameter than the evaporating chamber and the walls **20** and **22** are connected by a conical wall **24**. A flange **26** is secured around the upper end of the wall **22**, above the pipe or conduit **18**, and is reinforced by braces **28** and **30** secured to pipe **18** and a second pipe **32** respectively. These braces **28** and **30** may be welded to the ring **26** and to the pipes **18** and **32**.

The top of the apparatus is closed by a cap **34** removably secured on the top of wall **22** and ring **26** by screws or bolts **36** and a suitable gasket **38** insures a pressure-tight seal.

An extension **40** on top of the cap **34** carries a bearing housing **42** at its upper end for receiving suitable bearings indicated generally at **44**. The specific construction of these bearings forms no part of the present invention but they are preferably of the anti-friction, self-aligning type. A shaft **46** is rotatably mounted in the bearings **44** and the housing **42** is provided with oil seals **48** at its upper and lower ends to prevent leakage of oil along the shaft. The shaft **46** may also be provided with an oil flinger cup **50** between the bearing housing **42** and the cap **34** to afford further protection against the leakage of oil or lubricant along the shaft.

A suitable pressure seal such as the water seal indicated generally at **52** is usually provided between the shaft **46** and cap **34** and various satisfactory forms of pressure seal are known. A conical wall **54** extends between the joint of wall **22** and cap **34** and the lower end of the pressure seal **52** and serves to reinforce the pressure seal and protect it from the hot vapors.

The shaft 46 is relatively short and is detachably secured at its lower end to the rotor 56 as indicated generally at 58.

This connection is preferably protected from the hot vapors by a cap 60. This cap also simplifies the cleaning and sterilizing of the rotor assembly. The rotor 56 of the apparatus is coaxial with the shaft 46 and could be a solid shaft but is preferably of tubular construction to save weight and cost.

The connection 58 between shaft 46 and rotor 56 is accessible through the large pipe or handhole 32 which is usually opposite the pipe or conduit 18 and is normally closed by a door 62. The pipe or handhole 32 is sufficiently large to permit a workman to reach into the chamber 12 for various operations such as adjusting or examining the seals 54, disconnecting the shaft 46 from the rotor 56 so that the cap 34 and shaft 46 may be removed as a unit for cleaning or repairing the apparatus or the like. Suitable means such as a gasket is provided to form a pressure seal between the door 62 and handhole 32.

In my preferred form of apparatus, an annular flange 64 is welded around the lower end of the wall 20 and a flat plate 66 is detachably secured to the flange 64 by bolts 68. A gasket 70 forms a pressure seal between the flange 64 and plate 66.

A sleeve 72 is welded to the plate 66 and extends into the chamber 10 substantially concentric with the wall 20. A bearing 74 which I prefer to be of the water-lubricated type, is secured within the sleeve 72. Many suitable bearing materials are known and various rubber-graphite compositions are entirely satisfactory. The sleeve 72 and bearing 74 are reinforced by a frusto-conical wall 76 which is welded to the sleeve 72 and plate 66.

The rotor 56 extends through the entire length of the separating chamber 12 and evaporating chamber 10 and a plug or ring 78 is threaded, welded or otherwise rigidly secured in the rotor. A stub shaft 80 in axial alinement with the shaft 46 is threaded, welded or otherwise firmly secured in the plug or ring 78 and projects downwardly therefrom into the bearing 74.

As shown in Figures 2 and 4, the rotor 56 extends downward beyond the plug or ring 78 outside the sleeve 72 into close proximity with the conical wall 76. The sleeve 72 extends upward beyond the bearing 74 into close proximity with the plug or ring 78 and protects the bearing from injury in the event that the rotor 56 is dropped.

The outer surface of the bearing 74 is provided with longitudinal grooves 82 and with an annular peripheral notch 84 at the bottom. The plate 66 has two openings 86 and 88 in alinement with the central bore and peripheral notch respectively of the bearing 74 so that the lubricant, preferably water, may be introduced through the opening 86 and withdrawn through the opening 88 by suitable means, not shown. The openings 86 and 88 are maintained under vacuum, substantially the same as the vacuum on outlet 16 as hereafter described. In order to keep the lubricant from flowing over the sleeve 72 where it might contaminate the concentrate, the stub shaft 80 is provided with a flinger ring 90 and the upper end of the sleeve 72 is recessed as indicated at 92, opposite the flinger ring 90 so that the lubricant is returned to the top of the bearing 74 and withdrawn through grooves 82, notch 84 and opening 88.

The evaporating chamber 10 is preferably heated by a steam jacket formed by the wall 94 and steam is introduced through a pipe 96 at the upper end of the jacket and is exhausted through a pipe 98 at the lower end of the jacket. If desired, an exhaust pipe 100 may be provided to exhaust the air from the steam jacket when operation is started and the wall 20 is preferably provided with means such as rings 102 at intervals to remove

condensation from the surface of wall 20 allowing maximum contact of the steam.

The rotor 56 is imperforate throughout its length and is sealed at both ends. The rotor 56 is smaller than the evaporating chamber 10 formed by the wall 20, and within the chamber 10, and is provided with a plurality of blades or vanes 104 which extend outward from the rotor into close proximity with the wall 20. In the embodiment shown in Figures 1 and 2, there are four equally spaced vanes or blades 104 which project radially outward toward the wall 20. Ordinarily the vanes or blades 104 are flat strips of metal or the like and may be rigidly secured along one entire edge to the rotor 56 by welding or the like, or the inner edges of the vanes may be recessed as indicated at 106 and the vanes welded to the rotor at spaced points as indicated at 108. This latter construction is less costly than the first form but the first form may be easier to clean or sterilize. It is not essential that the vanes 104 be flat radially nor that they extend longitudinally along the rotor but the flat longitudinal vanes are simpler to make and attach to the rotor and are also lighter in weight.

The vanes 104 are continuous longitudinally and from the rotor 56 to close proximity with the wall 20 so that every part of the space between the rotor 56 and wall 20 is acted upon by the vanes 104 when the rotor is rotated. Holes, notches or perforations in the vanes 104 will not prevent satisfactory operation so long as liquid cannot pass from the inlet 14 to the outlet 16 and liquid or foam cannot collect or remain in the steam jacket portion of the evaporator portion 10 without being acted upon by the vanes 104.

The clearance between the vanes 104 and the wall 20 is kept as small as possible within reasonable mechanical limitations. Any number of vanes 104 may be used but, because of the small clearances, it is important that the rotor 56 be balanced and the vanes are therefore preferably symmetrically disposed about the rotor.

As shown in Figure 2, the rotor 56 and vanes 104 extend a substantial distance below the bottom of the steam jacket into close proximity to the plate 66. The liquid at the lower part of the evaporator 10 is usually quite thick and susceptible to burning, especially if any foam or liquid is allowed to collect in this lower portion. The vane portions below the steam jacket keep the foam and liquid agitated and by stopping the steam jacket short of the bottom, the foam and liquid are protected from excessive heat. My improved construction further protects the concentrate from over-heating by forcing the concentrate out of the apparatus.

The outlet opening 16 is located adjacent the wall 20 and the frusto-conical wall 76 extends downward and outward from the sleeve 72 into close proximity to the inner edge of the outlet opening 16. This frusto-conical wall thus acts with the centrifugal force on the concentrate due to the action of the rotor 56, to force the concentrate downward and outward toward the outlet opening.

Further, the lower ends of the vanes 104 are bent rearwardly of the direction of rotation as indicated at 110 in Figure 5 and these curved lower ends serve to force the concentrate downward toward the plate 66 and outlet opening 16.

In each of the embodiments illustrated, the vanes 104 continue along the rotor up into the separating chamber 12 and a grid, consisting of a plurality of vertical, radially disposed, spaced baffles 112 and spaced horizontal, annular baffles 114, is positioned in the separating chamber 12 opposite the upper end of the rotor 56 and vanes 104. The lower ends of the baffles 112 are tapered to seat on the conical wall portion 24 and the horizontal and vertical baffles 112 and 114 are preferably welded together so that the entire grid may be inserted or removed from the separating chamber as a unit. There is preferably a clearance between the lower horizontal baffle

114 and the wall 22 so that liquid can run down the wall 22 without interference and the top horizontal baffle 114 is preferably higher than the upper ends of vanes 104 as shown in Figure 1. The baffles 112 and 114 extend inward into close proximity to the vanes 104 so that the vapor cannot pass through the separating chamber without being acted upon by the vanes.

As pointed out above, the evaporator-concentrator is operated in a vertical position and mounting brackets 116 may be secured to the apparatus for securing the apparatus to suitable supports.

The apparatus is usually operated under a vacuum and a condenser and pump, not shown, which may be of any suitable construction, are connected to the vapor outlet conduit 18. The concentrate is discharged through the pipe 16 and a suitable trap, or pump, not shown, which maintains the vacuum.

In operation, the shaft 46 may be provided with a pulley, not shown, above the bearing housing 42 and be driven by a suitable source of power such as an electric motor, not shown. The rotor is rotated rapidly but the exact speed of rotation is not critical. The operation is successful when the shaft 46 and rotor 56 carrying the vanes 104 are rotated at a speed such that the circumferential speed of the vanes 104 is in the general range of ten to fifteen meters per second.

The liquid to be concentrated is introduced through the pipe 14 which is ordinarily above the steam jacket to avoid burning of the incoming liquid and is preferably between the evaporating chamber 10 and separating chamber 12 although it may be located in the separating chamber 12. If desired, a plurality of inlet pipes 14 may be symmetrically disposed around the wall 20 to equalize the cooling effect of the liquid and notches 118 may be provided in the vanes 104 opposite the inlet 14 to facilitate introduction of the liquid to be concentrated.

The wall 20 is heated by introducing steam at the desired temperature and pressure and the vanes 104 force the liquid out against the heated wall 20 in a thin film. The liquid flows down the wall 20 by gravity to the bottom of the evaporator housing and is withdrawn through the pipe 16. As the liquid flows down the wall 20, vapor is driven off and this vapor passes upward between the rotor 56, wall 20 and the vanes 104. The moving vanes 104 drive entrapped droplets of foam or liquid outward against the wall 20.

The rotor 56 is usually of fairly large diameter relative to the diameter of the evaporating chamber 10 and the vanes 104 are relatively narrow since narrow vanes are stronger and more rigid than wide vanes. However, it is desirable that there be sufficient space between the rotor 56 and the wall 20 so as not to impede or unduly restrict the passage of the vapor upward through the evaporating chamber 10.

Because the rotor 56 is imperforate and the vanes 104 are substantially continuous longitudinally and radially, the entire contents of the evaporating chamber 10 is at all times subject to centrifugal force resulting from rotation of the rotor and vanes. This tends to suppress the formation of foam and to force any foam which may be formed outward against the heated wall 20. Likewise, the rising vapor must pass between the vanes which tend to drive entrapped liquid or foam particles outward against the heated wall 20. There is no place within the steam jacket portion of the evaporator portion 10 where liquid or foam can collect free from the action of the rotating vanes 104.

All of the vapor from the evaporating chamber 10 passes upward through the separating chamber 12 which is normally unheated except by the vapor. Ordinarily the temperature in the separating chamber 12 is insufficient to cause substantial further evaporation of the liquid. The purpose of this separating chamber is to remove any unevaporated foam or liquid carried by the vapor so that operating losses may be kept as low as possible. In some instances, it may be necessary or desirable to supply some outside heat to the wall 22 to prevent condensation in the separating chamber which may occur if the separating chamber is made very long to ensure extraction of liquids which are not easily separated from their vapors. Such heat should, however, be kept at a minimum to avoid burning the separated liquid flowing down the wall 22.

In the preferred form of separator shown, the length and speed of rotation of the rotor 56 and vanes 104 in the separating zone is such that the vanes will move through at least the angular distance between adjacent vanes while vapor is moving the length of the vanes in the separating zone so that every part of the vapor passing through the separating zone is acted upon by a vane 104 moving through the vapor and any entrapped foam or liquid will be driven outward by centrifugal force toward the wall 22. The vertical baffles 112 prevent rotation of the separated foam and liquid within the separating chamber and the horizontal baffles 114 prevent the separated foam and liquid from being carried upward by the vapor. The top horizontal baffle is located above the ends of the vanes 104 to prevent the vapor from carrying entrapped foam or liquid over the top of the grid. Any foam and liquid in the vapor in the separating chamber 12 is projected outward against the wall 22 by the vanes 104 and flows down the walls 22 and 24 back into the evaporating chamber.

As pointed out in application Serial No. 216,217 of Hans C. Bechtler referred to above, it is important that the apparatus be easy to take apart for cleaning and sterilizing.

In my apparatus, the connection 58 may be reached through handhole 32 and shaft 46 disconnected from the rotor 56. The cap 34 carrying the shaft 46 may then be removed and the rotor 56 left in place with the plug or ring 78 resting on the sleeve 72. The interior of the apparatus may then be cleaned with a brush or by flushing. If more complete cleaning or sterilizing is desired the cap 34, shaft 46 and rotor 56 may be removed as a unit and cleaned and sterilized outside the apparatus. The separator grid may be removed after removal of the cap 34 with or without removing the rotor 56.

If it is necessary or desirable to remove the lower bearing for cleaning or sterilizing or for replacement or repair, the plate 66 and entire bearing unit can be removed without disturbing the rest of the apparatus by removing the screws or bolts 68.

The apparatus described above has been found to be particularly effective in the production of concentrates having relatively low viscosity.

However, to facilitate efficient removal of the more viscous concentrates, such as eggs and gelatin, particularly when such substances are concentrated to 50% solids or greater, the modifications of the discharge section of the apparatus shown in Figures 6 through 11 of the drawings may be preferred.

Referring now more particularly to Figure 6, it will be seen that the bottom plate 66 has been replaced with a bottom plate 120, to which the bearing sleeve 72 and cone 76 are secured in the same manner as described in connection with Figure 3. The plate 120 is clamped between the flange 64 and a ring 122 by means of a plurality of bolts, not shown, which extend through the ring 122, plate 120 and flange 64. Cored passages 124 and 126 are formed in plate 120 for the purpose of supplying and withdrawing lubricant respectively in the manner previously described. The outer ends of the passages 124 and 126 may be connected to a suitable lubricant circuit, not shown. Four arcuate slots 128 are provided in the plate 120, directly beneath the rounded tips 110 of the rotor vanes, through which the concentrate may be discharged into a conical receiving section 130, which is preferably welded at its upper end to the ring 122. At its lower end the conical section 130 carries a threaded fitting for attachment to a suitable container or pipe.

Except for the modifications just described, the evaporator-concentrator apparatus of Figure 6, is identical to that illustrated in Figures 1 and 2. The concentrate is forced through the slots **128** by the action of the vanes and the vane tips **110**, as in the case of discharge pipe **16**, the principal difference being in the enlargement of cross-section of the discharge passages.

In the modification of Figure 8, the bottom plate **66** has been replaced with a detachable discharge section comprising a bottom plate **140**, welded to a tubular section **142**, in turn welded to an annular attaching flange **144**. The flange **144** is secured as by bolts **146** to an annular flange **148**, which is welded to tubular section **20** and forms the bottom of the heating jacket. In this modification, section **20** terminates at a point flush with the lower surface of the flange **148**, to permit the flush installation of the tubular section **142**. A seal **150** is provided at the juncture of tubular sections **20** and **142**, to effect a fluid-tight connection at this point. Lubricant passages **152** and **154** in plate **140** function in the same manner as passages **86** and **88** previously described. It will be noted that the conical reinforcing wall **156** which replaces the wall **76**, has been extended almost to the tubular section **142**. The contour of the bottom of the vanes **104** has been modified accordingly. The rounded construction of the lower tip of the vanes may be retained. However, the vanes will function properly if the vane tips are straight and coplanar with the vane body. The discharge pipe **158** is welded to the tubular section **142**, and extends tangentially therefrom as seen in Figure **9**, extending downwardly at an angle preferably in the neighborhood of 45° or less, with respect to the plane of the bottom plate **140**. By virtue of this construction, full advantage is taken of the centrifugal throw of the rotor blades, and the concentrate is taken off the wall **142** tangentially of the direction of flow of the concentrate thus insuring a satisfactory discharge even where highly viscous concentrates which tend to cling to tubular wall **142** are produced.

The discharge pipe **162**, illustrated in Figures 10 and 11 which is installed at the intersection of the bottom plate and the vertical tubular section is arranged to take full advantage of both the centrifugal and vertical flow components imposed on the concentrate by the rotor blades **104** which revolve in the direction indicated by the arrow. This installation of the discharge pipe would be most effectively utilized in a discharge section of the type illustrated in Figure 8, modified so as to bring the slope of the reinforcing cone into agreement with that shown in Figure 3.

It is believed that the tangential discharge pipe installations shown in Figures 8 through 11 will have particular utility in handling certain highly viscous concentrates which are apt to cling to the vertical wall of the apparatus, although the lighter and less viscous concentrates, which fall readily to the bottom plate, may be handled efficiently by the apparatus illustrated in Figures 1–7.

It will be understood that the apparatus of Figures 6 through 11 may be partially or wholly disassembled for cleaning, inspection or repairs in the same manner as the apparatus of Figures 1–5.

It is also to be noted that, where operating conditions require, additional discharge pipes or openings may be incorporated in all forms of the apparatus.

From the foregoing it will be apparent that I am able to attain the objects of my invention and provide a new and improved apparatus for concentrating liquids in which operational losses are minimized. The apparatus is simple in construction and the parts are so made that the apparatus may be readily disassembled for cleaning and sterilizing.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. In an evaporator, including a chamber having a substantially vertical cylindrical wall, a rotor rotatably mounted in said chamber substantially coaxial with said wall, a plurality of vanes radially spaced around said rotor and extending outward therefrom into close proximity with said wall, means for rotating said rotor, means at the upper end of said chamber for introducing liquid to be evaporated, and heating means on said wall below said inlet; a substantially flat plate detachably secured to said chamber and closing the lower end thereof; and said plate having a plurality of circumferentially spaced outlets for unevaporated concentrate, a downwardly and outwardly flared member secured at its base to said plate within said chamber substantially centrally of said chamber, the outer edge of said member being adjacent said outlets to deflect the concentrate outward toward said outlets and bearing structure for said rotor rigidly secured to said plate, said plate having a first passage for supplying lubricant to the center of said bearing structure and an additional passage for removing lubricant from said bearing structure at a point adjacent the periphery thereof.

2. An evaporator as defined in claim 1 in which the vanes extend downward into close proximity with said plate and said conical member.

3. An evaporator as defined in claim 2 including means on the lower ends of the vanes for urging the unevaporated concentrate downward and outward toward said outlets.

4. An evaporator comprising a wall forming a vertically elongated chamber, a rotor having a coaxial open cylindrical portion forming an open lower end thereof, said rotor being mounted for rotation in said chamber substantially coaxially with said wall, a plurality of vanes radially spaced around said rotor and extending outwardly therefrom into close proximity with said wall, means for rotating said rotor, means at the upper end of said chamber for introducing a fluid to be evaporated, a substantially flat plate detachably secured to said chamber and closing the bottom thereof, means forming an outlet for unevaporated concentrate in the lower end of said chamber, a stub shaft secured within said open cylindrical portion of said rotor and coaxial therewith, a bearing assembly secured to said plate within said chamber coaxial with said wall for rotatably and slidably receiving said stub shaft comprising an outer cylindrical sleeve, an inner cylindrical sleeve of anti-friction material, said inner sleeve being concentric with and shorter than said outer sleeve and the upper part of each of said sleeves extending into said open cylindrical portion of said rotor, means for introducing lubricant within said inner sleeve, means for preventing lubricant from passing over said outer sleeve, means for withdrawing lubricant from between said sleeves, a frusto-conical member encircling said bearing and secured at its upper end to said bearing and at its lower end to said plate, said member being secured to the plate at substantially the same distance from the center of the plate as the inner edge of said outlet, the vanes on said rotor extending into close proximity to said member and said plate, and means for heating the wall of said chamber from a point beneath said inlet to a point spaced above said plate.

5. An evaporator as defined in claim 4 including means for releasably securing said plate and bearing to said wall in fluid pressure tight relation thereto.

6. An evaporator as defined in claim 4 in which the heating means comprises a heating jacket surrounding

said wall from beneath said inlet to a point adjacent the top of said bearing.

7. In an evaporator including a chamber having a substantially vertical cylindrical wall, a rotor comprising a hollow tube rotatably mounted in said chamber substantially coaxial with said wall, a plurality of vanes radially spaced around said rotor and extending outward therefrom into close proximity with said wall, means for rotating said rotor and means at the upper end of said chamber for introducing liquid to be evaporated; a plate closing the bottom of said chamber, means forming an outlet for unevaporated concentrate in said plate adjacent said wall, a stub shaft secured within said tube adjacent the lower end thereof and coaxial therewith, a bearing secured to said plate within said chamber coaxial with said wall for rotatably and slidably receiving said stub shaft, and a frusto-conical member encircling said bearing and secured at its upper end to said bearing and extending downwardly and outwardly into engagement with said plate adjacent the inner edge of the outlet to direct unevaporated concentrate toward said outlet.

8. An evaporator as defined in claim 7 in which the hollow tube of said rotor extends downwardly over the upper part of said bearing into close proximity with the top of said frusto-conical member, and the vanes on said rotor extend downward from said tube into close proximity with said frusto-conical member and said plate.

9. In an evaporator, including a chamber having a substantially vertical cylindrical wall, a rotor rotatably mounted in said chamber substantially coaxial with said wall, a plurality of vanes radially spaced around said rotor and extending outwardly therefrom into close proximity with said wall, means for rotating said rotor and means at the upper end of said chamber for introducing a liquid to be evaporated; a substantially flat plate closing the lower end of said chamber, said plate having a plurality of circumferentially spaced openings to provide outlets for unevaporated concentrate, and a downwardly and outwardly flared member secured at its base to said plate within said chamber, the outer edge of said member being adjacent the inner edge of said circumferentially spaced openings to deflect concentrate toward said outlets.

10. An evaporator as defined in claim 9, together with a conical receiving member for the concentrate and means detachably securing said member to the lower side of said plate.

11. In an evaporator including a chamber having a substantially vertical cylindrical wall, a rotor rotatably mounted in said chamber substantially coaxial with said wall, a plurality of vanes radially spaced around said rotor and extending outward therefrom into close proximity with said wall, means for rotating said rotor, and means at the upper end of said chamber for introducing a liquid to be evaporated; a discharge section adapted to be detachably secured to the lower end of said evaporator, comprising a tubular member forming a continuation of said vertical cylindrical wall, a substantially flat plate rigidly secured to the lower end of said tubular member to close said chamber, an outlet for unevaporated concentrate in said tubular member adjacent said plate and a downwardly and outwardly tapered member secured at its base to said plate within said chamber, the outer edge of said member being adjacent said outlet to deflect the concentrate toward said outlet.

12. In an evaporator including a wall forming a vertically elongated chamber of substantially circular section, a rotor rotatably mounted in said chamber substantially coaxial with said wall, a plurality of vanes radially spaced around said rotor and extending outwardly therefrom in close proximity with said wall, means for rotating said rotor, and means at the upper end of said chamber for introducing a liquid to be evaporated; a plate detachably secured to the lower end of said chamber and forming a closure therefor, said plate having a plurality of circumferentially spaced openings to provide outlets for unevaporated concentrate, a bearing structure on said plate for rotatably and slidably supporting said rotor substantially centrally thereof, said plate having inlet and outlet passages for lubricant for said bearing formed in the portions of said plate intermediate said openings, and a downwardly and outwardly flared member secured at its base to said plate within said chamber, the outer edge of said member being adjacent the inner edge of said openings to deflect concentrate toward said outlets.

13. An evaporator as defined in claim 12 together with a conical receiving member for the concentrate, and means detachably securing said member to the lower side of said plate.

14. An evaporator comprising means forming a vertically elongated chamber of circular section, a rotor rotatably mounted in said chamber substantially coaxially thereof, said rotor having a stub shaft adjacent its lower end, means for rotating said rotor, means at the upper end of said chamber for introducing a liquid to be evaporated, a plate detachably secured to said chamber and closing the bottom thereof, said plate having a plurality of circumferentially spaced openings forming outlets for unevaporated concentrate, a bearing assembly mounted on said plate within said chamber coaxial with said wall for rotatably and slidably receiving said stub shaft, said bearing assembly comprising an outer cylindrical sleeve, an inner cylindrical sleeve of anti-friction material, said inner sleeve being concentric with and shorter than said outer sleeve, means forming radially extending inlet and outlet lubricant passages in said plate, said inlet passage communicating with the interior of said inner sleeve and said outlet passage communicating with the interior of said outer sleeve, a frusto-conical member encircling said bearing and secured at its upper end to said bearing and at its lower end to said plate at substantially the same distance from the center of the plate at the inner edge of the outlet, and means for preventing lubricant from passing over the said outer sleeve into the interior of said chamber.

15. An evaporator comprising means forming a vertically elongated chamber of circular section, a rotor rotatably mounted in said chamber substantially coaxially thereof, said rotor having a stub shaft adjacent its lower end, means for rotating said rotor, means at the upper end of said chamber for introducing a liquid to be evaporated, a plate detachably secured to said chamber and closing the bottom thereof, said plate having a plurality of circumferentially spaced openings forming outlets for unevaporated concentrate, a bearing assembly mounted on said plate within said chamber coaxial with said wall for rotatably and slidably receiving said stub shaft, said bearing assembly comprising an outer cylindrical sleeve, an inner cylindrical sleeve of antifriction material, said inner sleeve being concentric with and shorter than said outer sleeve, means forming radially extending inlet and outlet lubricant passages in said plate, said inlet passage communicating with the interior of said inner sleeve and said outlet passage communicating with the interior of said outer sleeve, a conical receiving member for the concentrate and means for detachably securing said member to the lower side of said plate, and means for preventing lubricant from passing over said outer sleeve into the interior of said chamber.

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