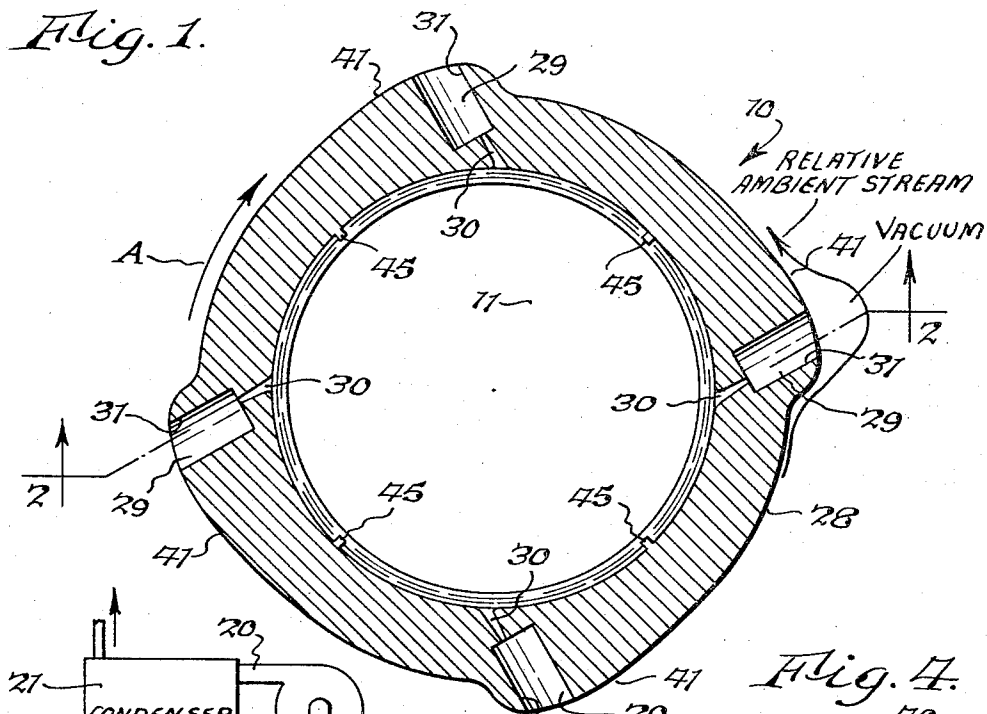
Oct. 3, 1967 J. F. KOPCZYNSKI 3,344,836

REVOLVING DISC SPRAY TYPE EVAPORATOR

Filed Dec. 3, 1965

Fig. 1.



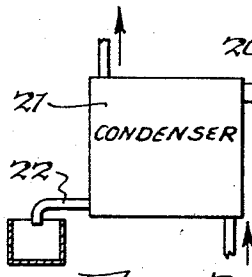
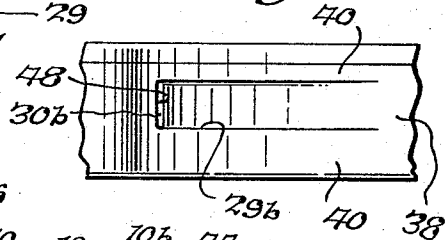


Fig. 2.

Fig. 4.



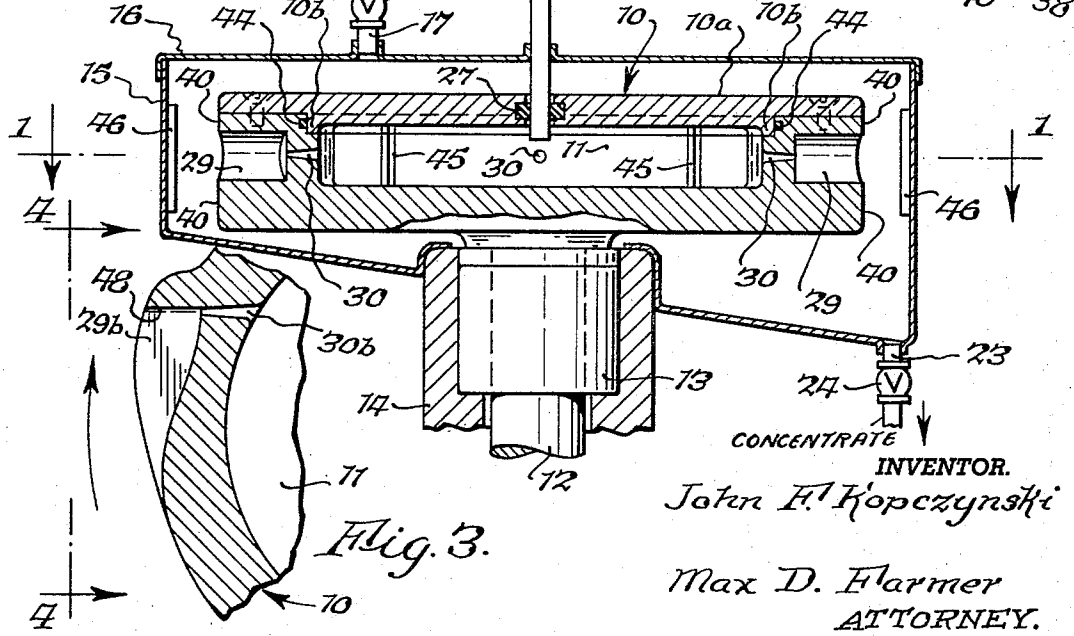


Fig. 3.

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REVOLVING DISC SPRAY TYPE EVAPORATOR

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This invention relates to vaporizers in which a component of a liquid may be vaporized and removed from the balance of the liquid, or all of a liquid may be vaporized, and which is also useful in studying the effect on various liquids of vaporizing conditions that do not utilize heat in the vaporization.

An object of the invention is to provide an improved centrifugal device in which a liquid may be introduced into a high speed rotor and vaporized by discharge therefrom into a partial vacuum, in which the partial vacuum is a maximum and vaporization of the liquid is a maximum, with which a vaporizable component of the introduced liquid is easily, rapidly, effectively and inexpensively separated from the balance of the liquid, and the component and the said balance separated from one another as a continuous operation, which will not damage the liquid or any component thereof by heat, and which is relatively simple, practical, effective and inexpensive.

Other objects and advantages will appear from the following description of two examples of the invention and the novel features will be particularly pointed out in connection with the appended claims.

In the accompanying drawing:

FIG. 1 is a sectional plan of the rotor of a device embodying this invention, the section being taken approximately along the line 1—1 of FIG. 2;

FIG. 2 is a schematic view, with some parts in sectional elevation, of a device made in accordance with this invention, and using the rotor shown in FIG. 1, the section being taken approximately along the line 2—2 of FIG. 1;

FIG. 3 is a sectional plan of a portion of a rotor embodying the invention, but illustrating a modification of the rotor; and

FIG. 4 is a side elevation of the modification shown in FIG. 3, as viewed from the line 4—4 of FIG. 3.

In the embodiment of the invention shown in FIGS. 1 and 2, the device includes a body or rotor **10** with a chamber **11** therein that is concentric with the outer periphery of the rotor **10**. The body or rotor **10** is fixed on the upper end of an upright shaft **12** supported for rotation at its upper end and below the rotor **10** by a bearing **13** of a support **14**. A closed housing **15** encircles and encloses the rotor **10** and rests upon the upper end of the bearing **14**. The housing has a removable cover **16**, and an exhaust pipe **17** is carried by the cover and opens through it. A control valve **18** is provided in pipe **17** and this pipe leads to the intake side of an exhaust pump **19**, the outlet of which is connected by pipe **20** to the upper part of a condenser **21**, and a drian pipe **22** leads from the bottom of the condenser for removing condensed vapors. The pump **19**, when running while valve **18** is open, creates a partial vacuum in the closed housing **15**.

The bottom wall of the housing is inclined to a drain opening leading to outlet pipe **23** controlled by a valve **24**, so that any non-vaporized components of the treated liquid may be collected and removed separately from the vapors through pipe **23**. An inlet pipe **25** having therein a control valve **26** extends through a seal in the cover **16** and through a seal ring **27**, such as an O-ring, in the top of the rotor **10** for continuously introducing into chamber **11** of the rotor, while the rotor is rotating, a liquid having at least a component which it is desired to remove therefrom. The pipe **25** enters rotor **10** concentrically with the axis of rotation of the rotor, and the peripheral wall

of chamber **11** of the rotor is also concentric with the axis of rotation of the rotor.

The outer peripheral wall **28** of the rotor is generally cylindrical, except as will be explained, and a plurality of recesses **29** are provided in the rotor at intervals along the outer peripheral wall and opening outwardly through the peripheral wall. The rotor also has outwardly converging passages **30** connecting the chamber **11** with the inner ends of recesses **29**. Each passage **30** opens at its larger end into chamber **11** in the peripheral wall thereof, and its smaller end opens through the inner end wall of a recess closely to that side wall **31** of the recess which is the leading side when the rotor turns in the direction of arrow A in FIG. 1. The longitudinal axes of the passages **30** and recesses **29** are inclined to radii of chamber **11**, so that the passages and recesses trail rearwardly and outwardly with respect to the direction of rotation A of the rotor. The smaller, outer or nozzle end of each passage **30** discharges abruptly into its recess **29** with its orifice opening through the inner end wall of the recess. The area of each such orifice opening is considerably smaller than the area of the inner end wall of the recess through which the passage **30** discharges. For example, in the illustrated embodiment, the area of said orifice or opening at the discharge end of each passage **30** is less than one-third of the end face area of the recess **29** and preferably it is less than one-eighth of such end face area.

The width of each recess at its outer open face, transverse to the wall **28**, is considerably less than the width of the wall **28** so as to leave peripheral strip areas **40** of the wall **38** of substantial width on each side of the recess as shown in FIGS. 2 and 4. The peripheral wall **38** of the rotor has air foil surfaces **41** designed to obtain reaction upon the peripheral wall surfaces from air or fluid that lies along the peripheral wall as the wall has its travel. One example of such an air foil surface is shown in FIG. 1 in which wall, beginning just before the open face of each recess is made outwardly convex and arcuate so that the peripheral wall increases, in its distance from the axis of rotation, from just in front of the recess open face to a position somewhat to the rear of such open face and then decreases slowly after passing the open face of a recess before a new open face of a recess is found. This curved, arcuate, radially outwardly progressing peripheral wall, which is for the full width of the rotor, cams air or fluid outwardly in passing and this creates a partial vacuum over such curved arcuate surface and since the recess has its open face disposed in such area where the suction occurs, this aids in creating a suction in the recess. The passages **30** and recesses **29** are open solely at their ends and are closed between their ends.

The rotor **10** is conveniently made in two parts to facilitate the creation of the chamber **11** and for providing access to form the passages **30**. For this purpose the rotor in FIGS. 1 and 2 has a removable cover **10*a*** with a flange **10*b*** that telescopes into the open face of chamber **11** to center the cover, with a seating ring such as an O-ring **44** (FIG. 2) disposed between the flange **10*b*** and the side wall of chamber **11**. The open face of chamber **11** is enlarged enough to receive the flange **10*b*** with the inner periphery of the flange forming a smooth continuation of the peripheral wall of chamber **11**. This peripheral wall of the chamber has arranged along it several ribs **45** of short radial height to resist or retard swirling of any liquid in the chamber while the rotor is rotative. The inner peripheral wall **15** of the housing is also provided with a plurality of ribs **46** of short radial height to retard swirling of any fluid in that part of the housing around the rotor's periphery.

The modification shown in FIGS. 3 and 4 is the same as in FIGS. 1 and 2, except that the recesses **29*b***, instead of being cylindrical in cross section as in FIGS. 1

and 2, vary progressively and decreasingly in depth from the leading end wall **48**, along and close to which the passages **30***b* discharge, in a trailing direction with respect to the direction of rotation of the rotor, so that the maximum depth of the recess will be greatest at wall **48** and decrease in a trailing direction. The widths of these recesses however are less than the width of the outer peripheral wall of the rotor so that the recess will open outwardly solely through the air foil peripheral wall surface and be closed on its sides. It should be noted that in this modification the passages **30***b* are elongated to be equal to the width of the recesses **29***b* to take advantage of the vacuum along their full width.

In use, the shaft is rotated at a high speed in the direction of arrow A and while it is so rotating, a liquid with a component to be vaporized is continuously introduced through pipe **25** into chamber **11**. At the same time the pump **19** will be operated, and a cooling medium such as water passed through the condenser **21**. Valves **26** and **18** will be open and valve **24** closed. The introduced liquid will form a layer along the outer peripheral wall of the chamber **11** where the layer rotates with the rotor. The centrifugal forces created on this liquid layer will force some of the liquid through the passages **30** at high pressure and discharge it from the small tapered end of the passage into a recess **29** or **29***b*. Air or fluid along the outer periphery of the rotor in its relative movement peripherally along the rotor will tend to create a suction or partial vacuum in the recesses so that the liquid discharged from the passages **30** will be into a partial vacuum. This sudden fall in pressure results in maximum vaporization of some of the discharged liquid. The air foil surface of the rotor along the open faces of the apertures causes further suction or partial vacuum in the recesses so as to further increase the sudden fall of pressure on the discharged liquid with still greater tendency to vaporization of some of the discharged liquid. When a wall is rotating in a direction generally normal to its face area, a partial vacuum or suction will be created on its trailing or leeward face and hence the passages **30** are arranged to discharge near the trailing wall of each recess, so as to utilize this added suction on the discharged liquid. The component of the liquid which is vaporized in this manner is removed and passed through the condenser and recovered for use, and the balance of the discharged liquid collects on the bottom wall of the housing and is withdrawn from time to time by opening valve **24**. The tapering of the passages **30** acts to speed up the rate of flow and energy in the liquid passing, in the same manner that a nozzle is used in a garden hose. The sudden fall in pressure on a fast moving stream aids in the breaking up of the discharged liquid under partial vacuum conditions so that maximum vaporization occurs without the use of heat that might damage some component of the introduced liquid. The vaporization is rapid and continuous, and accomplished in relatively simple and compact apparatus.

It will be understood that various changes in the details, proportions, materials and arrangements of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

I claim:

1. A device for converting a component of a liquid into a vapor, which comprises:

(a) an annular body mounted for rotation and having therein a closed chamber substantially concentric with the axis of rotation of the body,

(b) said body having therein a plurality of recesses opening outwardly through the outer peripheral wall of the body and arranged in succession and circular spaced apart along that wall and also a corresponding number of passages each respectively opening at one end into said chamber through the inner peripheral wall of the chamber and at its other end into the inner end of a said recess,

(c) the width of each recess at its open face in a direction parallel to the axis of rotation of the body being less than the width of said wall at the recess in a direction parallel to said axis of rotation,

(d) the peripheral wall of said body having an air foil cambered surface with regard to the direction of rotation, just preceding and at each recess for increasing the tendency of the ambient fluid along the periphery of the body, during rotation of the body, to create a partial vacuum radial lift action at the open face of each recess, and

(e) means for delivering a liquid for vaporization to said chamber during rotation of said body.

2. The device according to claim **1**, and a housing enclosing said body and having one outlet connected to suction means and a condenser to remove vapors and create a partial vacuum in said chamber, and a drainage outlet in its bottom portion for removong any component of the introduced liquid which is unvaporized the inside peripheral wall of said housing having means to retard swirling of any fluid in said housing around said body.

3. The device according to claim **1**, wherein each of said passages opens into its related recess close to the leading side wall of the recess with respect to the direction of rotation of the body.

4. The device according to claim **1**, wherein the longitudinal axis of each recess is inclined outwardly and rearwardly in a trailing direction with respect to the direction of rotation of the body.

5. The device according to claim **1**, wherein the longitudinal axes of the passages and recesses are inclined outwardly and rearwardly in a direction trailing with respect to the direction of rotation of the body.

6. A device for converting a component of a liquid into a vapor, which comprises:

(a) a body mounted for rotation and having therein a closed chamber substantially concentric with the axis of rotation of the body,

(b) said body having therein a plurality of recesses opening outwardly through the outer peripheral wall of the body and arranged in succession and spaced apart along that wall and also closed passages each opening at one end into said chamber through the outer peripheral wall of the chamber and at its other end into the inner end of a recess,

(c) the width of each recess at its open face in a direction parallel to the axis of rotation of the body being less than the width of said wall at the recess in a direction parallel to said axis of rotation,

(d) the peripheral wall of said body having an air foil surface, with regard to the direction of rotation just preceding and at each recess for increasing the tendency of fluid along the periphery of the body, during rotation of the body, to create a partial vacuum at the open face of each recess,

(e) means for delivering a liquid for vaporization to said chamber during rotation of said body, and

(f) the recesses at their open faces progressively decreasing in depth in a trailing direction with respect to the direction of rotation of the body and having their sides closed.

7. The device according to claim **1**, wherein each passage opens into its related recess close to the leading side wall of the recess with respect to the direction of rotation of the body, and the recesses at their open faces progressively decrease in depth in a trailing direction with respect to the direction of rotation of the body and have their sides closed.

8. A device for converting a component of a liquid into a vapor, which comprises:

(a) an annular body mounted for rotation and having therein a closed chamber substantially concentric with the axis of rotation of the body,

(b) said body having therein a plurality of recesses opening outwardly through the outer peripheral wall of the body and arranged in succession and circular spaced apart along that wall, and also a corresponding number of passages each respectively opening at one end into said chamber through the inner peripheral wall of the chamber and at its other end into the inner end of a said recess,

(c) the width of each recess at its open face in a direction parallel to the said axis of rotation of the body being less than the width of said wall at the recess in a direction parallel to said axis of rotation,

(d) the peripheral wall of said body having an air foil cambered surface with regard to the direction of rotation just preceding and at each recess for increasing the tendency of the ambient fluid along the periphery of the body, during rotation of the body, to create a partial vacuum radial lift action at the open face of each recess,

(e) means for delivering to said chamber, during rotation of said body, a liquid at least a component of which is to be vaporized, and

(f) a housing enclosing said body and having an outlet connected to a source of suction, for removing vapor and creating a partial vacuum in the chamber, and a drain for removing any of the introduced liquid which is unvaporized.

9. The device according to claim **8**, wherein said passage are convergingly tapered outwardly and discharge into said recesses close to the wall of the recess which is leading, with respect to the direction of rotation of the body.

10. A device for converting a component of a liquid into a vapor, which comprises:

(a) a body mounted for rotation and having therein a closed chamber substantially concentric with the axis of rotation of the body,

(b) said body having therein a plurality of recesses opening outwardly through the outer peripheral wall of the body and arranged in sucession and spaced apart along that wall, and also closed passages each opening at one end into said chamber through the outer peripheral wall of the chamber and at its other end into the inner end of a recess,

(c) the width of each recess at its open face in a direction parallel to the axis of rotation of the body being less than the width of said wall at the recess, in a direction parallel to said axis of rotation,

(d) the peripheral wall of said body having an air foil surface with regard to the direction of rotation just preceding and at each recess for increasing the tendency of fluid along the periphery of the body, during rotation of the body, to create a partial vacuum at the open face of each recess,

(e) means for delivering to said chamber, during rotation of said body, a liquid at least a component of which is to be vaporized, and

(f) a housing enclosing said body and having an outlet connected to a source of suction, for removing vapor and creating a partial vacuum in the chamber, and a drain for removing any of the introduced liquid which is unvaporized,

(g) said passages being convergingly tapered outwardly and discharging into said recesses close to the wall of the recess which is leading, with respect to the direction of rotation of the body and the recesses at their open faces progressively decreasing in depth in a direction traling with respect to the direction of rotation of the body and have their sides closed.

11. A device for converting a component of a liquid into a vapor, which comprises:

(a) a body mounted for rotation and having therein a closed chamber substantially concentric with the axis of rotation of the body,

(b) said body having therein a plurality of recesses opening outwardly through the outer peripheral wall of the body and arranged in succession and spaced apart along that wall and also closed passages each opening at one end into said chamber through the outer peripheral wall of the chamber and at its other end into the inner end of a recess,

(c) the width of each recess at its open face in a direction parallel to the axis of rotation of the body being less than the width of said wall at the recess in a direction parallel to said axis of rotation,

(d) the peripheral wall of said body having an air foil surface, with regard to the direction of rotation just preceding and at each recess for increasing the tendency of fluid along the periphery of the body, during rotation of the body, to create a partial vacuum at the open face of each recess,

(e) means for delivering a liquid for vaporization to said chamber during rotation of said body, and

(f) said air foil surface being a convex, arcuate, rising surface in a radial direction beginning immediately in front of and ledaing to the open face of each recess and after the recess decreasing in its distance from the axis of rotation of the body, toward the next recess along the outer peripheral wall of the body.

12. A device for converting a component of a liquid into a vapor, which comprises:

(a) a body mounted for rotation and having therein a closed chamber substantially concentric with the axis of rotation of the body,

(b) said body having therein a plurality of recesses opening outwardly through the outer peripheral wall of the body and arranged in sucession and spaced apart along that wall and also closed passages each opening at one end into said chamber through the outer peripheral wall of the chamber and at its other end into the inner end of a recess,

(c) the width of each recess at its open face in a direction parallel to the axis of rotation of the body being less than the width of said wall at the recess in a direction parallel to said axis of rotation,

(d) the peripheral wall of said body having an air foil surface, with regard to the direction of rotation just preceding and at each recess for increasing the tendency of fluid along the periphery of the body, during rotation of the body, to create a partial vacuum at the open face of each recess,

(e) means for delivering a liquid for vaporization to said chamber during rotation of said body, and

(f) said air foil surface being an individual convex, arcuate radial rise in the surface on the outer peripheral wall of the body, each beginning immediately in front of and leading to the open face of a recess and after the recesses decreasing in its distance from the axis of rotation of the body toward the next recess along the outer peripheral wall of the body.

References Cited

UNITED STATES PATENTS

2,319,230	5/1943	Harrington	103—262
2,780,175	2/1957	Thoren et al.	103—97
2,990,011	6/1961	Stratford	159—4
3,102,062	8/1963	Graham et al.	159—3

FOREIGN PATENTS

7,768	1910	Great Britain.
257,532	3/1928	Italy.

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