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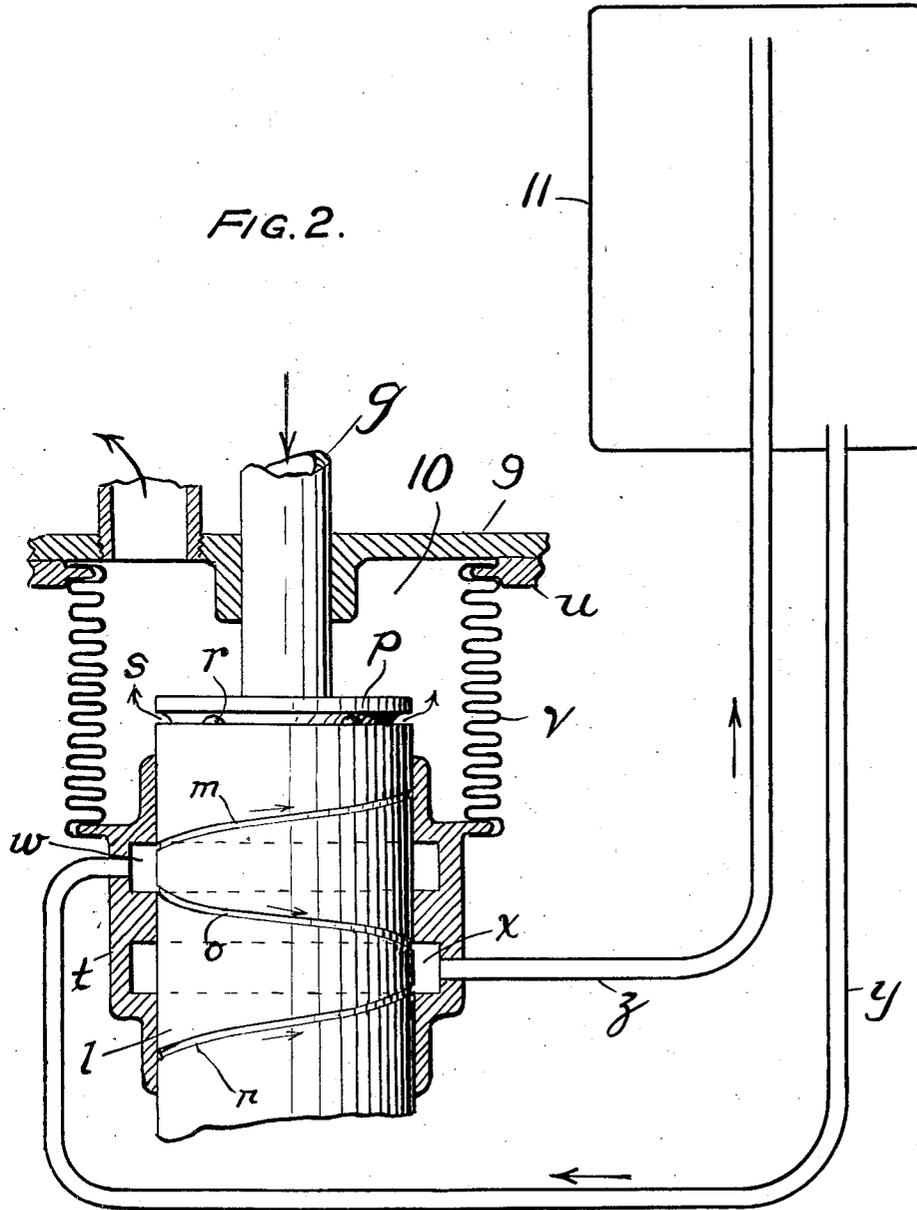
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NONAERATING APPARATUS FOR CENTRIFUGALLY PURIFYING LIQUIDS

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UNITED STATES PATENT OFFICE.

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NONAERATING APPARATUS FOR CENTRIFUGALLY PURIFYING LIQUIDS.

Application filed October 8, 1924. Serial No. 742,343.

To all whom it may concern:

Be it known that I, SELDEN H. HALL, a citizen of the United States, residing at Poughkeepsie, county of Dutchess, and State of New York, have invented a new and useful Improvement in Nonaerating Apparatus for Centrifugally Purifying Liquids, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form a part of this specification.

It is well known to centrifuge transformer, lubricating and other oils to remove from them water, dirt and sludge. When the purified oil escapes from the rapidly revolving bowl, it passes as a finely divided spray through a gas-filled space around the bowl discharge and inside the receiving covers. The gas in this space is ordinarily either air, or a mixture of air and oil vapor. In either case, the oil becomes saturated with air. Chemists who have carefully investigated the subject aver that centrifuged oil actually takes into solution as much as four per cent of oxygen and that this oxygen is an active agent in causing the formation of sludge in the oil.

The objectionableness of oil that has been contaminated with air is so well recognized that experts on the art of centrifuging have long sought to avoid this contamination. Perhaps the most nearly successful expedient has been to make provision for the maintenance of an atmosphere of CO₂ or other inert gas in the space adjacent the oil discharge from the centrifuge and in the receiving chamber; but this expedient, which has mitigated the evil somewhat, has not met with full success.

My own researches have convinced me that success depends on the substantial exclusion of air or any other gas from the oil during its passage from the transformer or other container for used oil, to and through the centrifuge and from the centrifuge back to the container.

The provision of apparatus adapted to effect this result involves something more than the mere arrangement of closed passages toward and from any centrifuge of known construction.

The solution of the problem in its most nearly perfect embodiment involves the provision of a special construction at the discharge neck of the centrifuge, the arrange-

ment of passages to and from the centrifuge specially designed to exclude the admission of air to the system, provisions for establishing a super-atmospheric pressure in the discharge passage with which the centrifuge outlet for purified oil communicates, and provisions for excluding the leakage of oil from said discharge passage of the system.

A preferred embodiment of the invention is shown in the drawings. Figure 1 represents a complete centrifuging apparatus partly in elevation and partly in section. Figure 2 is a detail view partly in section, of part of the apparatus adjacent the bowl outlet, including particularly the discharge chamber, the bowl neck and its bearing, and the air and oil separating chamber and connections thereto.

A feed pipe *a* leads from a container (not shown), such as a transformer, for used oil to be centrifuged. The pipe *a*, or an extension thereof, extends into a regulating cup *c*, and has at its lower end an exit port *b* opening into the cup. A tube *g* extends from the cup *c* to the bowl *h* of the centrifuge. The upper end of tube *g* communicates with an inlet port *f* opening into the cup. Within the cup is a float *d*. The float carries a valve *e*, by which the admission of oil from the feed pipe *a* into the cup and from the cup into the tube *g* is regulated, as hereinafter described.

The bowl proper *h* may be of ordinary construction and is not shown in its entirety, the drawing showing only the upper end portion of the tubular shaft *q* and the upper part of the bowl shell, and its frusto-conical cover.

The tube *i* for carrying water from the bowl discharges into a space surrounding the lower part of the neck *l* of the bowl. *j* is a water discharge regulating ring. *k* is a water receiving cover.

On the upper extremity of the tubular bowl shaft *q* is screwed a bowl nut *p*, which is held away from the bowl neck *l* by buttons *r*, so as to leave a discharge orifice *s* for discharge of purified oil.

Mounted on the inner edge of the upper shell of the water receiving cover is a cylindrical extension *u*, which is secured, by means of a threaded ring *8*, to an annular cover plate *9* threaded on the tube *g*. Depending from a flange on the extension *u* is a copper bellows *v* which flexibly supports

a bearing *t* having a working fit around the bowl neck *l*. A ring 23 supported from the cover *k* by two bolts (not shown) underlies the bearing *t*.

5 The bowl *h*, in its normal operation, will oscillate rapidly with small amplitude. The bearing *t*, by reason of its described flexible suspension, can follow the oscillations of the bowl.

10 The bellows *v* forms a surrounding fluid-tight wall of a chamber 10 into which the oil discharges from the bowl neck through the orifice *s*.

The bowl neck *l* has formed in its outer wall (see Fig. 2) two right-hand spiral grooves at *m* and *n* and an intermediate left-hand spiral groove *o*. In the bearing *t* are formed two annular chambers *w* and *x*. Spiral groove *m* communicates with chamber *w* and extends upward therefrom.

20 Spiral groove *o* connects chambers *w* and *x*. Spiral groove *n* extends downward from chamber *x*.

A glass jar 11 (forming an oil supply-chamber and oil and air separating chamber) is located alongside the regulating cup *c*. A flexible tube *y* extends from chamber *w* and opens into jar 11 just above its bottom. Another flexible tube *z* extends from chamber *x* into jar 11 and opens thereinto near the top thereof. A wire gauge cup 13 surrounds the upper end of tube *z*. Cup *c* and jar 11 communicate by means of a tube 12. 22 is an air vent from the top of the jar chamber.

A valved pipe 14 leads from the regulating cup *c* to the discharge chamber 10.

An oil discharge pipe 15 leads from the discharge chamber 10 to a pressure regulating valve 16, which comprises two ports 17 communicating with the oil discharge pipe 21 leading to the container from which supply pipe *a* leads. These ports are adapted to be closed by a plunger 18 on which is mounted a weight 19. The weight 19 fits so closely within a cup 20 that when the cup is filled with oil there is a strong dash pot action.

In operation, oil pumped from the container through pipe *a* enters the cup *c* through port *b* and flows from cup *c* through port *f* into tube *g*. During operation, the valve *e* is held up by the float *d* in position to open both ports. If oil tends to enter the cup *c* faster than the bowl can take and centrifuge it, the float *d* rises and the valve *e* closes, or throttles, port *b* and so stops, or reduces, the inflow of oil. The inflow of oil will be altogether stopped before the cup overflows. If, on the other hand, the bowl tends to take and centrifuge oil faster than it is supplied to the cup through port *b*, the float and the valve fall, throttling port *f* so as to prevent the in-
65 drawing of air.

At the narrow annulus between the float *d* and the wall of the cup, the surface of the oil is exposed to air, but the area of exposure is so limited and the oil at the exposed surface is so stagnant that the amount of air which it will dissolve is negligible.

70 From the tube *g* the oil flows into the bowl where it is subject to the usual centrifugal separating operation. The water and dirt form an outer surrounding zone and the purified oil an inner central zone. The heavy dirt collects in a layer against the inside of the bowl shell. The water flows out through the tube *i* and escapes around the discharge control ring *j* into the cover *k* from which it is carried off by a spout (not shown).

The purified oil displaced toward the center of the bowl flows up the inside of neck *l* out through the orifice *s* into the discharge chamber 10. From this chamber it passes through the pipe 15 and presses against the bottom of the plunger 18. When the predetermined pressure is reached, it lifts the plunger, opens port 17 and escapes through pipe 21 to the container for the oil.

The reason for maintaining a super-atmospheric pressure in the oil discharge chamber 10 is that, otherwise air will work in between the bearing *t* and the bowl neck. I have found that an excess pressure of about six pounds to a square inch is sufficient to prevent this inward flow of air. However, with this pressure there is a tendency for oil to leak outward between the bowl neck and its bearing. This tendency is counteracted by the right-hand spiral groove *m*. To be certain that it will fully counteract, the groove *m* is made large enough to pump some oil upward from the annular chamber *w* which, as hereinbefore stated, is connected, through pipe *y*, with the chamber 11.

The left-hand spiral *o* is made large enough to insure against entrance of air to chamber *w* and will pump some oil from chamber *w* to annular chamber *x* which, as hereinbefore stated, is connected through pipe *z* with the upper part of chamber 11.

110 There is thus a restricted, but constant, endless circulation of oil from chamber 11, through pipe *y*, to chamber *w*; from chamber *w*, through spiral groove *o*, to chamber *x*; and from chamber *x* back to chamber 11; and there is a slight diversion of oil from chamber *w* through spiral groove *m*, thereby absolutely preventing leakage of oil from the discharge chamber 10, as described.

The right-hand spiral groove *n* prevents escape of oil from the bottom of the chamber *x*, but being large enough to accomplish this with certainty, necessarily pumps some air into chamber *x*, which will mix with the oil in this chamber. The flow, however, being away from chamber *x* through pipe *z*, this mixture of air and oil passes into the
125 130

top of chamber 11, where they separate by gravity, the air escaping by the vent 22 and the oil settling to the bottom of the chamber and outflowing, as above described, through tube γ to the chamber, w .

Ring 23 supports bearing t so that pressure of liquid in the discharge chamber 10 cannot force the bearing downward.

By means of the apparatus described, a closed circuit is established from the container to the centrifuge and from the centrifuge back to the container. There is substantially no contact between the oil in the circuit and the atmosphere. There is no spray of oil from the centrifuge into a space which is open to atmosphere or within which it is necessary to maintain a body of neutral gas, as the oil is discharged from the bowl into a discharge chamber from which is excluded access of all fluids (liquid or gas) except the purified oil itself. Adequate provision is made to exclude the admission of air and the escape of oil at the point in the circuit where, without such provision, one or the other condition could necessarily occur.

While I have stated that the purpose of the invention is to prevent the contamination of centrifugally separated mineral oil with air, it is obvious that the machine is adapted to be used for separating any light liquid from any heavier liquids or solid material admixed therewith, where it is desired to prevent the absorption of air or any other foreign gas by such lighter liquid.

While I have described the liquid as circulating from the container for used liquid, or any other mixture to be separated, back to the same container, it will be understood that the purified or separated liquid may be discharged into a separate container, although in that case it will be desirable to prevent access of air or other foreign gas into the receiving container. Inasmuch, however, as the purified or separated liquid will flow into the receiving container in bulk and not in a fine spray, as when discharged from the ordinary centrifuge, it may be unnecessary, in some instances, to take any precautions against contact between such liquid and air in the receiving chamber.

Where in the claims I speak of "gas," I mean the word to be understood in its generic sense, and therefore to include atmospheric air, which, ordinarily, is the only contaminating gas whose absorption by oil or other liquid that is being purified or separated must be guarded against.

What I claim is:

1. In an apparatus for centrifugally purifying liquids, the combination of a container for the contaminated liquid, means providing a succession of passages from the container and back to the container, a centri-

fuge for purifying the liquid having an inlet communicating with one of said passages and an outlet communicating with another of said passages, and means substantially closing said passages against admission of gas, thereby providing an endless circuit including the container and the centrifuge within which the liquid may be maintained uncontaminated by exteriorly present gas.

2. In the combination specified in claim 1, a valve interposed in the passage between the centrifuge outlet and the container and tending to close such passage and adapted to be operable by the pressure of the liquid flowing through such passage to build up a superatmospheric pressure between it and the centrifuge outlet.

3. In an apparatus for purifying liquids, the combination with a centrifuge for separating a liquid from its impurities by centrifugal force, the centrifuge having an outlet for the purified liquid, and means adapted to convey the contaminated liquid to the centrifuge, of a discharge passage communicating with the outlet from the centrifuge, said passage comprising walls one of which is flexible to allow for the oscillation of the centrifuge.

4. In an apparatus for purifying liquids, the combination with a centrifuge for separating a liquid from its impurities by centrifugal force, the centrifuge having an outlet for the purified liquid, and means adapted to convey the contaminated liquid to the centrifuge, of a discharge passage communicating with the outlet from the centrifuge, and means allowing oscillation of the bowl while maintaining said discharge passage sealed against admission of gas.

5. In an apparatus for purifying liquids, the combination with a centrifuge for separating a liquid from its impurities by centrifugal force, the centrifuge having a neck through which the purified liquid is discharged from the centrifuge, of a discharge passage having walls closing said passage against leakage of gas thereinto, the passage walls including a bearing in which the bowl neck rotates and a flexible support for the bearing.

6. In an apparatus for centrifugally purifying liquids, the combination with a centrifuge bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, a discharge passage communicating with said outlet and closed against admission of gas except between the bowl neck and its bearing, and means preventing leakage of gas between the two last named elements into the discharge passage.

7. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided

with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid discharged from the bowl outlet, and means preventing leakage of gas between the bowl neck and its bearing into said passage.

8. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid discharged from the bowl outlet and means preventing the leakage of gas between the bowl neck and its bearing into said passage and escape of liquid from said passage between the bowl neck and its bearing.

9. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid discharged from the bowl outlet, and means to establish a super-atmospheric pressure in said passage to prevent leakage of gas thereinto through the bowl neck and its bearing.

10. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid discharge from the bowl outlet, and means to establish a super-atmospheric pressure in said passage to prevent leakage of gas thereinto through the bowl neck and its bearing, the bowl neck having a spiral groove so directed that, in the rotation of the bowl any fluid in the groove will be pumped toward said passage, thereby counteracting the tendency of the liquid in the passage, due to the super-atmospheric pressure therein, to escape between the bowl neck and its bearing.

11. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid discharged from the bowl outlet, the bowl neck having a spiral groove so directed that in the rotation of the bowl any fluid in the groove will be pumped toward said passage, an auxiliary source of liquid supply, and

means establishing communication between said source and said groove, thereby effecting a pumping of said liquid through said groove toward said passage and thus preventing leakage of gas to said passage and leakage of liquid from said passage.

12. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl and its bearing providing a closed passage for receiving and carrying away the purified liquid discharged from the bowl outlet, the bowl neck having a spiral groove so directed that in the rotation of the bowl, any fluid in the groove will be pumped toward said passage, and the bearing having a chamber adapted to supply said groove.

13. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid discharged from the bowl outlet, means to establish a super-atmospheric pressure in said passage to prevent leakage of gas thereinto through the bowl neck and its bearing, the bowl neck having a spiral groove so directed that, in the rotation of the bowl, any fluid in the groove will be pumped toward said passage, an auxiliary source of liquid supply, and means establishing communication between said source and said groove, thereby effecting a pumping of said liquid through said groove toward said passage.

14. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid discharged from the bowl outlet, and means to establish a super-atmospheric pressure in said passage to prevent leakage of gas thereinto through the bowl neck and its bearing, the bowl neck having a spiral groove so directed that, in the rotation of the bowl any fluid in the groove will be pumped towards said passage, the bearing having a chamber adapted to supply liquid to said groove.

15. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and

carrying away the purified liquid discharged from the bowl outlet, the bowl neck having a spiral groove so directed that, in the rotation of the bowl, any fluid in the groove will be pumped toward said passage, the bearing having a chamber adapted to supply liquid to said groove, the bowl neck having another spiral groove communicating with said chamber and so positioned and directed as to insure against the entrance of air to said chamber.

16. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid, discharged from the bowl outlet, the bowl neck having a spiral groove so directed that, in the rotation of the bowl, any fluid in the groove will be pumped toward said passage, the bearing having a chamber adapted to supply liquid to said groove, the bowl neck having another spiral groove extending in the opposite direction adapted to prevent entrance of air to, and to pump liquid from, said chamber.

17. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid discharged from the bowl outlet, the bowl neck having a spiral groove so directed that, in the rotation of the bowl, any fluid in the groove will be pumped toward said passage, the bearing having a chamber adapted to supply liquid to said groove, the bowl neck having a second spiral groove extending in the opposite direction and adapted to pump liquid from said chamber, the bearing having a second chamber into which the liquid is pumped from the second groove and means providing for circulation of liquid from the second chamber to the first chamber.

18. In an apparatus for centrifugally purifying liquid, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid discharged from the bowl outlet, the bowl neck having a spiral groove so directed that, in the rotation of the bowl, any fluid in the groove will be pumped toward said passage, the bearing having a chamber adapted to supply liquid to said groove, the bowl neck having a

second spiral groove extending in the opposite direction and adapted to pump liquid from said chamber, the bearing having a second chamber into which the liquid is pumped from the second groove, the bowl neck having a third spiral groove extending in the same direction as the first groove and communicating with the second chamber and preventing escape of oil therefrom between the bowl neck and the bearing.

19. In an apparatus for centrifugally purifying liquid, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid discharged from the bowl outlet, the bowl neck having a spiral groove so directed that, in the rotation of the bowl, any fluid in the groove will be pumped toward the said passage, the bearing having a chamber adapted to supply liquid to said groove, the bowl neck having a second spiral groove extending in the opposite direction and adapted to pump liquid from said chamber, the bearing having a second chamber into which the liquid is pumped from the second groove, the bowl neck having a third spiral groove extending in the same direction as the first groove and communicating with the second chamber and preventing escape of oil therefrom between the bowl neck and the bearing but adapted to pump air between the bowl neck and the bearing into the second chamber, means allowing circulation of liquid from the second chamber to the first chamber, and means operative during said circulation to release air mixed with the liquid flowing from the second chamber.

20. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid discharged from the bowl outlet, the bowl neck having a spiral groove so positioned and directed that, in the rotation of the groove, it will pump air from the atmosphere between the neck and its bearing, and means to divert such air away from between the neck and bearing toward the atmosphere.

21. In an apparatus for centrifugally purifying liquids, the combination of a discharge passage for purified liquid, a centrifugal bowl having an outlet adapted to force liquid into said discharge against pressure greater than atmospheric, the bowl neck having liquid pumping grooves, and a flexibly supported bearing having a chamber adapted to supply liquid to the grooves and

thus prevent access of air to the upper end of the neck.

22. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal separating bowl having an outlet adapted to force liquid into a discharge chamber against a pressure greater than atmospheric and having a neck with three spiral grooves, of a flexibly supported bearing surrounding the neck and having an annular liquid supply chamber and an annular liquid escape chamber; one of said grooves being adapted to pump liquid from the supply chamber to the discharge chamber and another adapted to pump liquid from the supply chamber to the escape chamber and the third adapted to pump air from the exterior to the escape chamber.

23. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid discharged from the bowl outlet, means operative in the bowl's rotation to pump from a point between said neck and bearing two streams of liquid, one toward said passage and the other in the opposite direction, and means providing passages for the return of the liquid in the second stream to said common point.

24. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid discharged from the bowl outlet, means operative in the bowl's rotation to pump from a point between said neck and bearing two streams of liquid, one toward said passage and the other in the opposite direction, an auxiliary oil supply chamber, a pipe providing a passage for the flow of liquid in the second stream to said chamber, and a pipe providing a passage for the flow of liquid from said chamber to said point.

25. In the combination specified in claim 24, means to feed liquid to the centrifuge, said means including a regulating cup, and a pipe connecting said cup and chamber and adapted to supply liquid to the chamber.

26. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid dis-

charged from the bowl outlet, means operative in the bowl's rotation to pump from a point between said neck and bearing two streams of liquid, one toward said passage and the other in the opposite direction and to pump air between the bearing and bowl to a point to which the second stream of liquid is pumped, means to circulate liquid from the second point to the first point, and means to release air from the liquid during its said circulation.

27. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid discharged from the bowl outlet, means operative in the bowl's rotation to pump liquid from a point between said neck and bearing toward said passage, an auxiliary liquid supply chamber, an outflow pipe therefrom to said point, a feed for supplying to the centrifuge liquid to be purified, and a by-pass from said feed to said auxiliary liquid supply chamber.

28. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, means adjacent the bowl neck and its bearing providing a closed passage for receiving and carrying away the purified liquid discharged from the bowl outlet, means operative in the bowl's rotation to pump from a point between said neck and bearing two streams of liquid, one toward said passage and the other in the opposite direction and to pump air between the bearing and bowl to a point to which the second stream of liquid is pumped, a liquid and air separating chamber, a pipe for mixed liquid and air leading from said second point into the upper part of said chamber, and a liquid outflow pipe from the lower point of said chamber to said first point.

29. In the combination specified in claim 28, means providing an air vent from said chamber for air entrained with the liquid flowing through the first named pipe.

30. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl and means to feed liquid thereto, of means to prevent admixture of air with the liquid fed thereto, a bearing in which the neck of the bowl is adapted to run, and a fluid-tight flexible wall supporting the bearing.

31. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a round neck, of a

bearing in which said neck is rotatable and a fluid-tight wall adapted to support flexibly the bearing to permit it to follow unavoidable oscillations of the bowl.

5 32. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal bowl having a round neck rigid therewith, a non-rotatable bearing adapted to fit around the neck, a stationary member, 10 and a metal bellows providing a flexible fluid-tight wall from said member to said bearing and permitting the bearing to follow the rapid oscillations of the bowl.

15 33. In an apparatus for centrifugally purifying liquids, the combination with a cylindrical bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, and means adjacent the bowl neck and the bearing providing a closed passage for receiving the purified liquid discharged from the centrifuge, said means including a fluid-tight flexible wall supporting the bearing.

20 34. In an apparatus for centrifugally purifying liquids, the combination with a cylindrical bowl having a neck and provided with an outlet for purified liquid, of a bearing in which said neck rotates, and means adjacent the bowl neck and its bearing providing a closed passage for receiving the purified liquid discharged from the centrifuge, said means including a metal bel-

lows providing a flexible support for the bearing.

35. In an apparatus for centrifugally purifying liquids, the combination with a centrifugal separating bowl having a neck through which the purified liquid is discharged, of means to feed liquid to said bowl and to control the feed to prevent overflow thereof and substantial contact of air therewith, a passage adapted to receive the purified liquid discharged from the bowl and having a liquid outlet but otherwise closed, means on said outlet to cause the pressure in said passage to be greater than atmospheric, a bearing around the neck of the bowl, means to supply liquid to said bearing relatively near the liquid discharge end of said neck, means for escape of liquid from said bearing relatively distant from the liquid discharge end of said neck, means on said neck tending to cause a flow from said supply means toward the liquid discharge end of said neck and toward the escape means and means tending to cause a flow of fluid from the end of the bearing most distant from the liquid discharge end of the neck toward the escape means.

In testimony of which invention, I have hereunto set my hand, at Poughkeepsie, New York, on this third day of October, 1924.

SELDEN H. HALL.