May 9, 1933. H. E. LA BOUR 1,908,635

PUMP

Filed Nov. 21, 1924 2 Sheets-Sheet 1

Fig. 1.

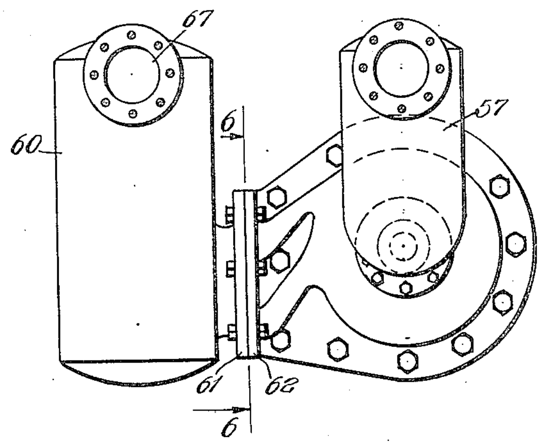

Fig. 2.

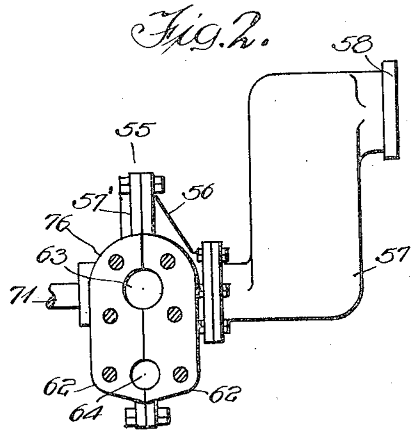

Fig. 3.

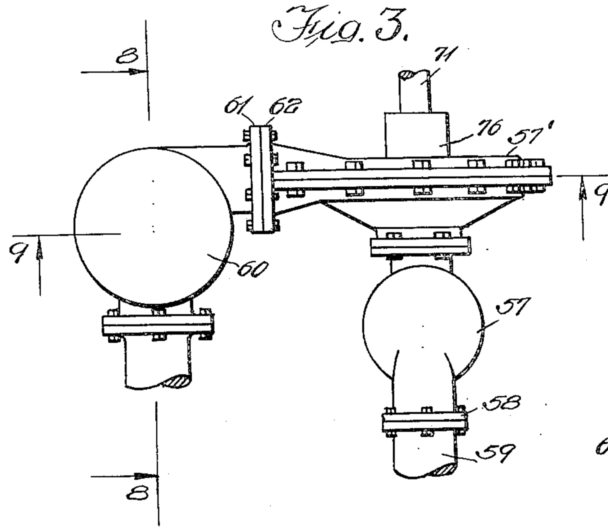

Fig. 4.

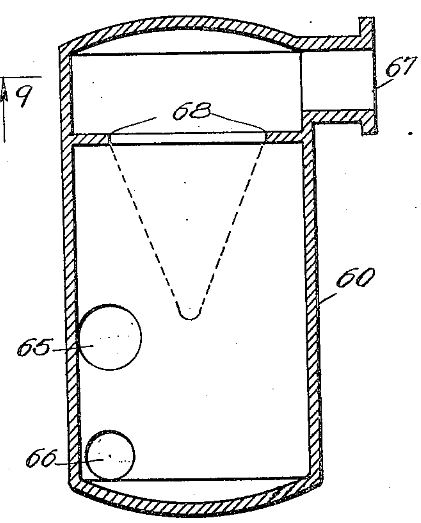

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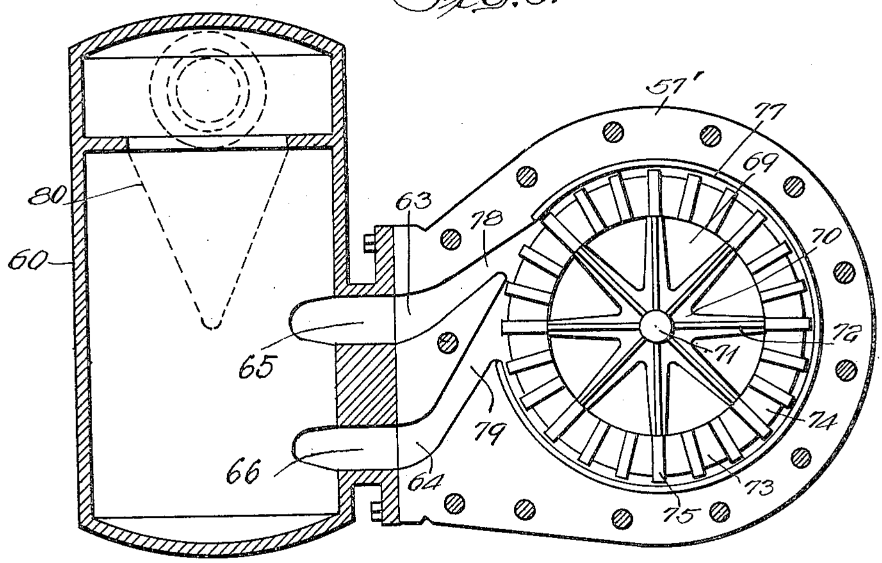
Fig. 5.



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UNITED STATES PATENT OFFICE

HARRY E. LA BOUR, OF HOMEWOOD, ILLINOIS

PUMP

Application filed November 21, 1924. Serial No. 751,210.

My present invention relates to pumps, particularly of the class designated as centrifugal self-priming pumps.

This type of self-priming pump was disclosed in my co-pending Patent No. 1,578,236, granted March 23, 1926. Therein I disclose the broad idea of a substantially tangent discharge opening, a liquid and gas separator and a liquid return passage from the separator opening into the runway of the impeller, so as to return liquid into the impeller peripherally for the priming function.

Now, according to the broad principles of the present invention, I find that it is desirable to stratify the discharge from the impeller because of the fact that the pump should operate in one manner, while it is working in the self priming phase, and should operate in a different manner when the pump is working on substantially solid liquid.

To this end I provide the pump of the present invention with a discharge outlet comprising a throat which is so proportioned to the capacity of the pump and the impeller that this throat will be substantially filled with the discharge of liquid and air mixed together, when the pump is operating on the self priming characteristic. An adjacent throat is adapted to take the excess of liquid which is discharged by the impeller, when the pump is operating exclusively or substantially exclusively on liquid. Now, this adjacent throat may operate to return liquid to the impeller for the self priming function, or an additional passageway may be provided if so desired.

In the early form of the pump first disclosed in my co-pending Patent No. 1,578,236, the tangential discharge throat is made sufficiently large to take not only the discharge of liquid on the self priming function, but also to handle the complete discharge of liquid when the pump is operating as a liquid pump. A separate return passageway for returning liquid for the self priming function is shown as opening substantially radially into the groove or runway in which the impeller operates.

Now, it was found in operating that pump, that when the pump was operating on the self priming phase, the liquid would not completely fill the discharge throat and there was a return circulation of liquid and air back into the impeller, which seriously cut down the efficiency of the pump. I, therefore, inserted a vane for stratifying the discharge to prevent the eddy current and return of gas and liquid into the impeller by compelling the same to take a longer path, which tends to avoid the eddying effect above referred to. Such vane is so placed as to define two throats, the first of which is the primary throat and which is adapted to be substantially filled with liquid when the pump is operating on the self priming phase. During this phase of operation, there is a return of liquid and gas back through the secondary throat, but it is relatively less than that occurring in the earlier form and the result is a better efficiency and a higher vacuum. The secondary throat takes the excess of liquid discharged from the impeller when the pump is operating on the liquid pumping phase. In this second form of pump, which was shown in my second application above referred to, I still retained a separate by-pass which emptied into a pocket formed in the casing and communicating with the impeller at a point a substantial distance posterior to the discharge outlet.

It was intended, and I found it to be a fact, that when the pump was operated on substantially solid liquid, this return conduit or passageway was substantially idle, depending upon the design of the pump. That is to say, it was possible to control the movement of liquid in this return pipe to have either a discharge out of it when the pump was pumping liquid, or to have the pressure substantially equalized so that no movement occurred, or to have an actual return from the separator back to the pump, if so desired.

In that form of pump, I found also that it was possible to close off the return conduit or passageway and rely simply upon the secondary throat of the discharge for a return of liquid during the self priming phase.

Now, in the final form herein shown, I have laid the pump over on its side and caused it to discharge substantially tangentially into the separator. I retain the feature of two discharge throats and have made them both subtantially tangential, the first discharge throat being so proportioned to the other parts of the pump that this primary discharge throat will be substantially filled with liquid during the self priming stage, and the secondary throat and its connected passageway will serve as a return passageway for liquid from the separator to the impeller. This particular arrangement of the separator gives superior results and a much better assembly and smaller dimensions. Also, I find that the efficiency of the pump as a whole has been very greatly increased.

There are a number of incidental features which I disclose herein, such as the improved stuffing box or gland, and the improved construction of the separator.

Now, in order to acquaint those skilled in the art with the manner of constructing and operating a device according to my invention, I shall describe a specific embodiment in which the invention appears.

In the drawings,

Fig. 1 is an end elevation of a pump embodying my invention;

Fig. 2 is a section taken on line 2—2 of Fig. 1;

Fig. 3 is a plan view of the pump shown in Fig. 1;

Fig. 4 is a vertical section taken on the line 4—4 of Fig. 3 and shown on an enlarged scale; and

Fig. 5 is a section taken on line 5—5 of Fig. 3, showing the pump runner or impeller and the separator.

This pump has the dual function of pumping air and of pumping liquid. That is to say, the pump is capable of filling its own suction pipe by evacuating the air therefrom and after the air has been pumped out, it proceeds to pump liquid. The pump may be used with a trap on the intake side, such as is indicated at 57 in Fig. 1, in order to insure a suitable charge of liquid in the pump and chamber 60 for performing the priming operation.

In Figs. 1 to 5, inclusive, I have indicated the preferred embodiment of my invention.

I have not shown the driving motor, nor mounting of the parts, since the latter may be as shown in my prior patent above referred to. In the form shown in Figs. 1 to 5, the pump comprises a casing 55 made up in two sections, namely, the front section 56 and a rear section 57′, the front section 56 having an inlet opening communicating with the inlet trap 57. This inlet trap 57 is bolted to the front half 56 and it has suitable clamping flanges for accomplishing this purpose and also a clamping flange as indicated at 58 for bolting to an inlet pipe 59. The pump 55 has, as a necessary part thereof, the separator 60, which is in this case mounted at one side of the housing of the pump 55, and it has a bolting flange 61, bolted to the flanges 62 formed on the casing halves 56 and 57′. The separator 60 provides for a circular chamber with a substantially vertical axis, so that the incoming liquid which leaves the impeller buckets substantially tangentially will enter the chamber 60 substantially tangentially and will whirl on the inside of the chamber 60 throwing the liquid outwardly and tending to separate the air by centrifugal stratification toward the center. There are two discharge openings from the pump 55, namely, a main discharge opening 63 and a secondary or auxiliary opening or passageway 64. These two passageways communicate through suitable ports and passageways 65 and 66 formed through the flange 61 and extending into the separator 60. It is to be observed that the passageway 63 is substantially tangential and straight for a short distance and then the passageway curves and enters the opening 65 in the separator in a substantially horizontal direction. It can be seen that the liquid which leaves the impeller 73 in a straight tangential line by its inertia of movement tends to continue in a straight line. As a result, the liquid is thrown across the full cross-section of the passageway at the curve in the passageway and impinges upon the concave wall on the lower side of passageway 63—65. This insures complete sealing of the passageway, even when the stream of liquid is not sufficient to fill the cross-section of the throat 78 during the priming stage. The separator 60 is a cylindrical shell or drum having the passageways and ports 65 and 66 formed in its lower part, and having a discharge opening 67 formed at it top. A baffle ring 68 is formed on the interior of the separator 60 for the purpose, as will be described later, of holding down the height of the swirling mass of water, while the pump is operating on the self priming characteristic. There is a tendency for the priming water, due to the tangential discharge of liquid into the separating chamber, to rise to such a point that a part of the priming liquid would go out of the discharge port 67. This internal ring or flange 68 holds down the water to a surface shown in the dotted lines 80 in Figs. 4 and 5 during the priming operation. The structure of the pump runner 69 comprises a central hub 70 mounted on a shaft 71 and having suitable spider arms 72 leading out to a ring 73 which ring or web has the pockets 74 formed in the sides thereof, these pockets being continuous along one side across the edge and along the opposite side to form U-shaped pockets. These pockets are separated by vanes 75 which fit closely within a channel formed between the casing halves. The pump may be mounted by a suitable mounting boss 76 formed upon the rear half 57'.

The discharge passageways 63 and 64, which extend from the casing into communication with co-operating passageways leading into the separator 60, extend into communication with the groove or channel in which the runner 69 rotates. The channel or groove is formed mainly in the back plate 57' and in order to form a seal between the parts, the ring or flange 77 is formed about said ring or channel, in which the impeller rotates. The passageway 63 terminates in a relatively narrow throat 78 and the passageway 64 likewise terminates in a throat 79, which, however, is not so narrow, but both of these throats are adapted to be substantially tangential to the impeller and opening into the channel so closely adjacent each other that during priming the return flow of liquid through channel 79 will at once fill that part of the impeller which has just discharged into the channel 78. Now, the proportion of the parts is such that the throat 78 will be substantially filled by the discharge of the impeller when the pump is operating on the self priming characteristics, that is, is pumping air. During this stage of operation, liquid returns through the passageway 64 and throat 79 into the periphery of the impeller 69, the opening of said passageway into said impeller space being sufficiently great to permit the return of liquid, such as will substantially fill the throat 78. In other words, there is a relation between the throat 78 and the return passageway 79 such that the mixture of air and liquid will substantially fill the throat 78 on the discharge from the impeller and the returning liquid at passageway 64 returning from the separator 60. will be sufficient to maintain such flow out of the throat 78. The discharge from the throat 78 is led through passageway 63 and 65 into the separator 60 substantially tangential to the interior of the separator. In like manner, the passageway 64 and its extension 66 into the separator 60, is disposed substantially tangential to the inside of the separator. Upon starting the pump, the liquid maintained in the intake trap 57 supplies sufficient liquid for priming the pump 55, this liquid being insufficient to act as a piston for filling the intake pipe. It is sufficient to furnish the circulation from the pump to the separator 60 and back again. The liquid in the separator tends to assume the shape of a ring about the interior of the drum or cylinder 60 and a cone of air will be formed substantially as indicated by the dotted lines 80 in Fig. 9. Due to the centrifugal or whirling action of the body of water in chamber 60, the centrifugal force tends to push the liquid outwardly and to raise the same, the surface of the liquid under the influence of centrifugal force and gravity assuming the shape roughly illustrated by the dotted line 80. As soon as the air is evacuated from the suction or intake pipe, the pump begins to discharge solid water and the discharge from the impeller 69 will be more than sufficient to fill the primary discharge throat 78, the remaining water being discharged through the throat 79, and the two passageways 65 and 66 then discharging water in parallel in the interior of the separator 60 which, however, at such time, no longer serves as a separator but serves merely as a place in which the whirl produced by the tangential discharge may subside without too great loss to secure a steady flow out of the discharge opening 67. When the intake pipe is filled with liquid and the pump begins to operate as a straight liquid pump, the chamber 60 is completely filled with liquid and has no free surface. Thus, it will be seen that the secondary passageway 64 and throat 79, serves a dual purpose of first, a return for liquid during the self priming phase of operation and, next, as an additional tangential outlet during the stage of pumping liquid. The inlet trap 57 permits the level to stand in the chamber 60 at such a height as to keep the pump casing substantially full of liquid during periods of non-use of the pump. It is not essential that the pump casing be filled with liquid but the pump casing and connected parts 60 and 57 should contain sufficient liquid to complete the circuit, i. e. the buckets and the whirlpool with connecting passageways. Upon starting the pump, assuming the intake pipe to be full of air, liquid will be thrown out of the impeller buckets by the rotation of the driving shaft and the impeller, whereupon air will enter the pump casing. The return of liquid from the chamber 60 into the impeller causes the returning liquid to entrain air and be carried by the impeller around to the upper discharge throat where liquid and air are driven out the passageway 65 substantially tangential to the walls of the chamber 60, producing a whirling or centrifugal stratification of liquid and air in the chamber 60. As the buckets empty themselves by discharge of air and liquid, there is a tendency to produce a vacuum within the pump casing, which vacuum is satisfied in part by the returning liquid from the whirling body of liquid in the chamber 60 and in part by air drawn from the intake pipe. It can be seen that the mass of liquid in the chamber 60 is set in rotation by the action of the impeller buckets driving out liquid and, at the same time, permitting some to return for entraining and discharging air.

While I have shown a separate passageway for discharge and another passageway for reentrance of liquid during the priming stage and this is the preferred form for the sake of efficiency, it will be understood that if these two passageways 63 and 64 were merged into one opening, the same general action would continue, that is, due to the tangential discharge of mixed air and liquid along the upper channel, which in the form shown is defined by a separate passageway 63, the liquid in the chamber 60 would be set into action to separate the air and liquid, and at a point posterior in the direction of rotation of the impeller, liquid would reenter the buckets from the said chamber 60.

The pump may be operated in the priming stage indefinitely, if desired. In this stage, it pumps or compresses air. Naturally, the device is of low efficiency operating as a compressor, but during the priming stage such low efficiency is of substantially no importance.

After the air is pumped out of the intake pipe, and liquid enters the pump by suction, the impeller takes its full capacity of liquid and discharges the same out through the two passageways 63 and 64, if the design is such as to require both passageways to carry liquid, or through the passageway 63 if the design is such as to carry substantially all of the liquid out the passageway 63. It is a matter of design as to what occurs in the passageway 64 during liquid pumping. In the preferred design, there is a reversal of liquid flow in the channel or passageway 64, at the stage where priming is completed and the liquid pumping begins.

I have compared a particular size of the form of pump shown herein with the form shown in my prior patent aforesaid and I have observed the following comparison between the two. Under a given set of conditions, the earlier form gave a pressure under the same conditions in a closed discharge pipe of 35 lbs. whereas the second form gave a pressure of 40 lbs. I found that the maximum air pressure, that is, the limiting pressure at which the pump of the first form would operate, was 10 lbs. per square inch, whereas the pressure which the second pump would maintain was 26 lbs.

The earlier pump gave on test a dry vacuum of 20 inches of mercury, whereas the later form gives a dry vacuum under the same conditions of 28 inches of mercury. I find that the pick-up, that is, the period within which the pump will start pumping liquid under a given set of conditions in the case of the first form, is about one minute and fifty seconds as compared with about forty-eight seconds for the second form of pump, under the same conditions.

The efficiency of the pump of the first form under the test was 31% as maximum efficiency, whereas the efficiency of the second form was a maximum of 34%. I have observed that the first form of pump is relatively noisy, whereas, the second form is quiet and steady, the noise being scarcely noticeable.

The pump of the second form may be used in the heating system disclosed in my prior patent since the reversal of flow in the throat 79 and the variations of pressure in the throat 78 may be employed for the purposes of controlling the introduction of liquid into the pump to raise its pumping efficiency or the discharge head may be lowered to increase the pumping capacity, all as explained in said co-pending patent.

I do not intend to be limited to the details shown or described.

I claim:

1. In combination a suction line, a pump casing having an inlet for air and liquid connected to the suction line, an annular channel, an impeller having vanes running in said channel, a pair of passageways in the pump casing leading into the channel, a separator having passageways substantially tangent to the inside periphery thereof, communicating with aforesaid passageways in the pump casing, said separator comprising a substantially cylindrical drum with its axis vertical.

2. In combination, a pump casing having an annular channel, a pair of tangential discharge passageways leading into said channel, an impeller having buckets running in said channel, one of said passageways having a throat which is adapted to be substantially filled by the air and liquid discharged from the impeller when the pump is pumping air, a separator adapted to cause the liquid to take a whirling motion in a generally horizontal plane, the other passageway being adapted to convey liquid from the separator back to the impeller during the self priming operation and to receive the discharge of liquid in excess of that discharged through the first passageway when the pump is pumping liquid.

3. In combination, a pump casing having an annular channel, an impeller having vanes running in said channel, a pair of substantially tangential discharge passageways, a separator comprising a drum, said passageways extending into the separator substantially tangent to the cylindrical surface of the same.

4. In combination, a pump casing having an annular channel, an impeller having vanes running in said channel, a pair of substantially tangential discharge passageways leading from said channel, a separator having a cylindrical surface and having substantially horizontal passageways communicating with said tangential discharge passageways.

5. In a pump, a casing having fluid inlet and discharge connections, a bucket bearing rotor disposed in said casing and lying in substantially a vertial plane and adapted to form a mixture of air and liquid in said casing during priming of said pump, a circular chamber having its axis substantially vertical communicating substantially tangentially with the rotor said chamber being adapted to retain a

body of priming liquid for priming the pump, the tangential discharge of liquid and its admixed air from the pump causing a whirling motion of liquid and its admixed air in the chamber, which sets up a centrifugal air separating action.

6. In a pump, a casing having fluid inlet and discharge connections, a bucket bearing rotor disposed in said casing and lying in substantially a vertically plane, a circular chamber having its axis substantially vertical communicating substantially tangentially with the rotor, said chamber being adapted to retain a body of priming liquid for priming the pump, the tangential discharge of liquid from the pump causing a whirling motion of liquid in the chamber, which sets up a centrifugal air separating action, there being a channel for returning liquid freed of air from the chamber back into the buckets after the discharge of liquid from such buckets.

7. In combination with a pump having a bucket bearing rotor, a drum shaped separator for air and liquid, said chamber being adapted to retain a body of liquid which is set in rotation by the pump rotor during the priming stage and there being a passageway for the return of liquid from the chamber into the buckets of the rotor.

8. In a pump, a casing having a fluid inlet and outlet, a rotor in said casing, having fluid impelling buckets thereon, and a chamber disposed adjacent the path of said buckets, said chamber being in communication with the rotor and being arranged to retain a body of liquid therein and to permit the same to receive from the buckets a whirling movement to separate air from the liquid in the chamber.

9. In a pump, a casing having a fluid inlet and a fluid outlet, a rotor in said casing having fluid impelling buckets thereon, and a chamber at said outlet opening communicating through the same with the buckets, the chamber serving to receive and retain liquid discharged through the opening and being arranged to have imparted to the liquid therein by said buckets a continuous movement.

10. In a pump, a casing having a fluid inlet and a fluid outlet, a rotor in said casing having fluid impelling buckets thereon, and a chamber at said outlet opening communicating through the same with the buckets, the chamber serving to receive and to have pass therethrough gaseous fluid discharged through the opening and serving to retain a body of liquid which has imparted thereto by said buckets a whirling movement.

11. In a pump, a casing having a fluid inlet and fluid outlet, a rotor in said casing having fluid impelling buckets thereon, and a chamber at said outlet opening communicating through the same with the buckets, the chamber serving to receive and to have passed therethrough gaseous fluids discharged through the opening and serving to retain a body of liquid which has imparted thereto by said buckets a whirling movement for stratifying the gaseous fluid by centrifugal action.

12. In a pump, a casing having a fluid inlet and a fluid outlet, a rotor in said casing having fluid impelling buckets thereon, and a chamber at said outlet opening communicating through the same with the buckets, the chamber serving to retain constantly a body of the liquid discharged through the opening and being arranged to have imparted to the liquid therein by said buckets a whirling movement.

13. In a pump, a casing having a fluid inlet and a fluid outlet, a rotor in said casing having fluid impelling buckets therein, a chamber at said outlet opening communicating through the same with the buckets, the chamber serving to receive and retain liquid discharged through the opening and being arranged to have imparted to the liquid therein by said buckets a continuous movement, and an outlet passage of reduced area leading from said chamber.

14. In a pump, a rotor having a plurality of buckets, a casing in association with the rotor having an inlet and having an outlet opening, and means for maintaining at said outlet opening a moving body of liquid which is given a whirling movement by said rotor as it is operated, and the liquid repeatedly passing said opening in said whirling movement.

15. In a pump, a casing having a fluid inlet and a fluid outlet, a rotor in said casing having fluid impelling buckets, and a chamber disposed adjacent the path of said buckets, said chamber being in communication with the rotor and being arranged to retain a body of liquid some of which flows into contact with the rotor buckets and is carried by the rotor buckets and discharged back into the chamber to give the body of liquid a whirling motion in the chamber thereby to separate air from the liquid in the chamber.

16. The method of priming a pump having a closed casing containing a bucket bearing runner which comprises rotating the runner, introducing a mixture of air and liquid into the buckets, throwing the mixture from the buckets into a horizontal whirlpool, separating the air from the liquid by the centrifugal force of the whirlpool, and conducting liquid from the whirlpool back into the buckets and mixing air with the liquid in the buckets.

17. In a pump, a casing having a fluid inlet and a fluid outlet, a rotor in said casing having fluid impelling buckets thereon, and a chamber disposed adjacent the path of said buckets, said chamber being in communication with the rotor through an opening and being arranged to retain a body of liquid

therein and to permit the same to receive from the buckets through said opening a movement in which it engages the buckets as the rotor is operated.

18. The method of pumping gas which comprises setting up two rotating rings of liquid, mixing gas with the liquid in the first ring, passing gas laden liquid from said first ring into the second ring, simultaneously passing liquid substantially free of gas from the second ring to the first ring, and freeing the gas from the liquid in the second ring.

19. The method of pumping gas which comprises setting up two rotating circular bodies of liquid, the first body having a substantially horizontal axis and the second body having a substantially vertical axis, entraining gas in the liquid of the first body, and discharging such gas laden liquid into the second body, separating the gas from the liquid in the second body by centrifugal force, and returning liquid substantially free of gas from the second body to the first body.

20. The process of pumping air which comprises mixing air and liquid, projecting a stream of the mixture into a whirling mass of liquid, and subjecting said mixture of air and liquid to centrifugal separation to discharge air.

21. The method of pumping air which comprises setting up a whirling pool of liquid, mixing air and liquid outside said whirling pool, projecting a stream of mixed liquid and air into said whirling pool to cause centrifugal separation of said air and liquid.

22. The method of pumping air which comprises setting up a horizontal whirlpool of liquid by injection of liquid thereinto substantially tangentially, then injecting liquid with air entrained therewith, and separating the air from the liquid by centrifugal action in said whirlpool.

23. A self priming liquid pump comprising a casing having an inlet adapted for connection to a suction line for air and liquid to be pumped and an air and liquid outlet, a rotor in said casing having fluid impelling buckets to drive liquid through said casing, means near the outlet adapted to maintain as the rotor operates a whirling body of liquid which separates air by centrifugal action, said means being in communication with the rotor buckets, whereby liquid from the whirling body may engage the rotor buckets.

24. A self priming liquid pump comprising a casing having an inlet adapted to be connected to a suction line for air and liquid to be pumped and an air and liquid outlet, a rotor in said casing having fluid impelling buckets to drive liquid through said casing, means near the outlet adapted to maintain as the rotor operates a whirling body of liquid which separates air by centrifugal action, said means being near the rotor and said outlet opening, whereby liquid from the whirling body may engage the rotor buckets at said outlet opening and cause to be passed into the whirling body air from the rotor.

25. In a self-priming liquid pump having a runner chamber, a runner rotatably mounted in said chamber, said runner chamber having an inlet connection through which air may be drawn during the priming stage for evacuating a connected suction pipe, said pump having means for retaining priming liquid within the runner chamber, said runner operating during priming to form a mixture of air and the priming liquid, a separator having a communication with the runner chamber permitting the discharge of a mixture of air and liquid by the movement of the runner during priming, and having additional communication with the runner chamber to permit return of liquid from the separator to said chamber at a point sufficiently remote from the inlet connection that when the pump is in the liquid pumping phase, the pressure built up by the runner at said point will substantially prevent re-entry of liquid at said point to the runner from the separator, said separator providing guiding walls for directing the stream of mixed air and liquid during priming in a curved circuitous path within the separator to secure separation of air from the liquid by centrifugal separation and to prevent direct return of air charged liquid to the runner.

In witness whereof, I hereunto subscribe my name this 18 day of November, 1924.

HARRY E. LA BOUR.

DISCLAIMER

1,908,635.—*Harry E. La Bour*, Homewood, Ill. PUMP. Patent dated May 9, 1933. Disclaimer filed November 30, 1934, by the patentee.

Hereby enters this disclaimer to that claim which is numbered 17 in said patent, and which is in the following words, to wit:

"17. In a pump, a casing having a fluid inlet and a fluid outlet, a rotor in said casing having fluid impelling buckets thereon, and a chamber disposed adjacent the path of said buckets, said chamber being in communication with the rotor through an opening and being arranged to retain a body of liquid therein and to permit the same to receive from the buckets through said opening a movement in which it engages the buckets as the rotor is operated."

[*Official Gazette January 1, 1935.*]