July 19, 1932. A. W. BURKS 1,867,651

HYDROAIR COMPRESSOR AND VACUUM PUMP

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Fig. 1.

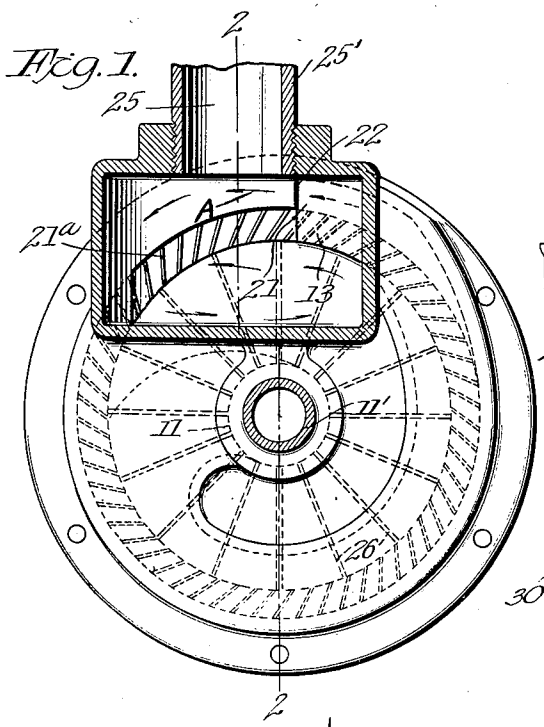


Fig. 2.

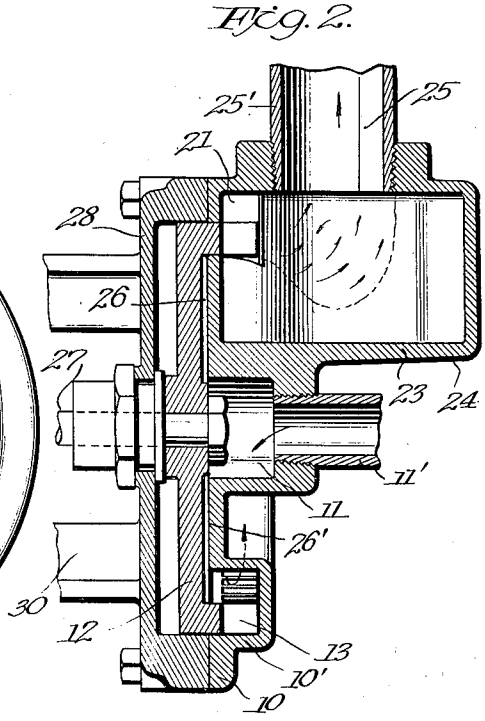


Fig 4.

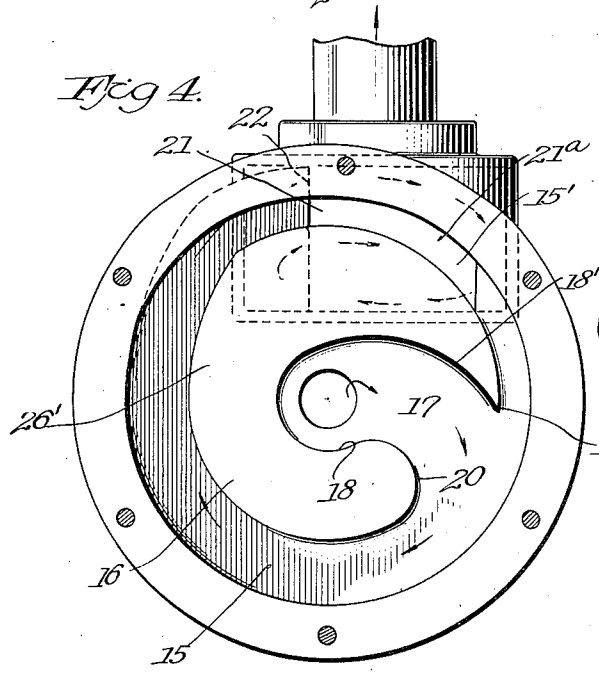
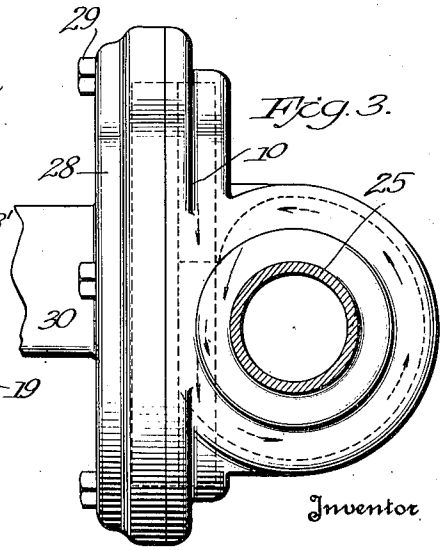


Fig. 3.



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HYDROAIR COMPRESSOR AND VACUUM PUMP

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Fig. 5.

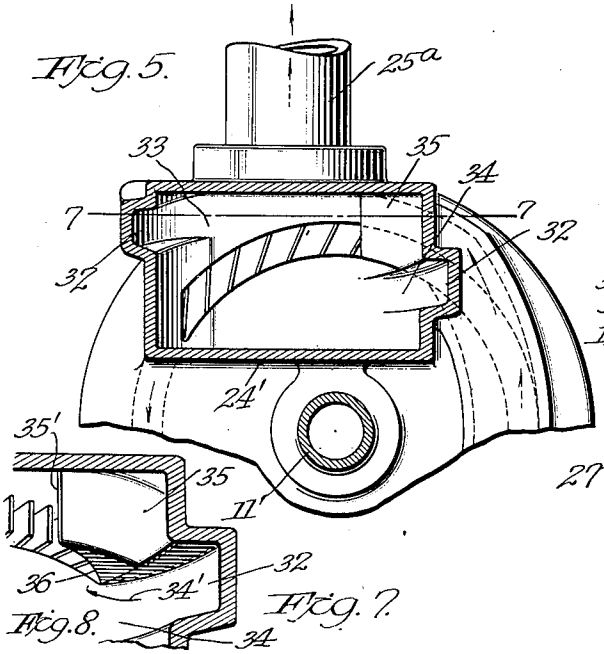


Fig. 6.

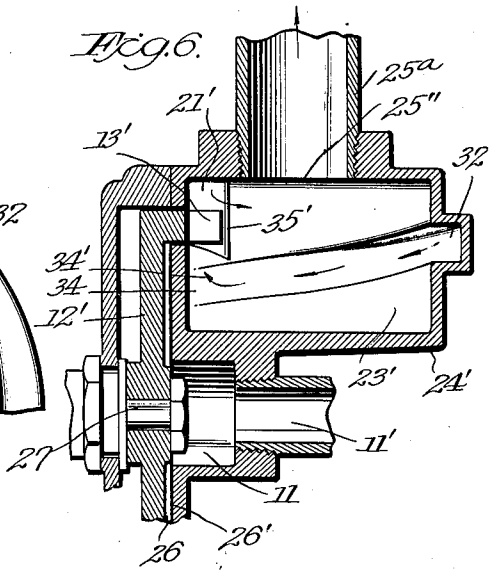


Fig. 8.

Fig. 7.

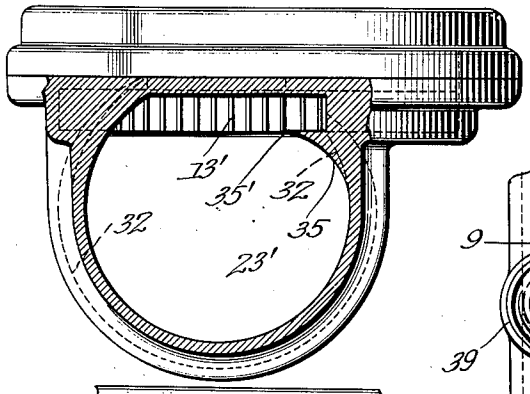


Fig. 9.

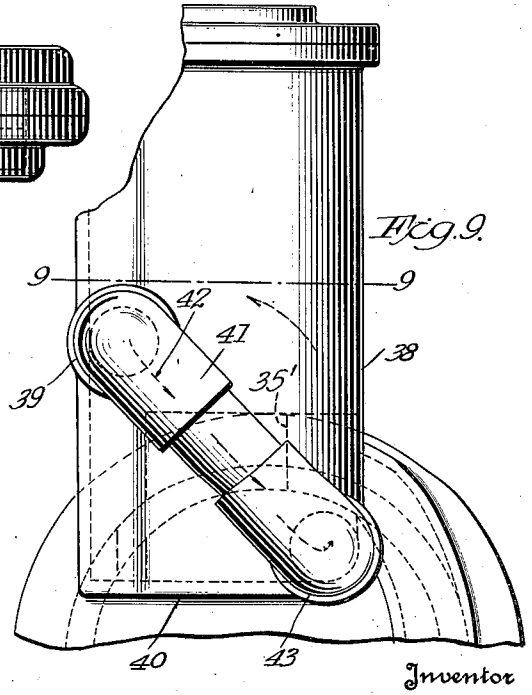
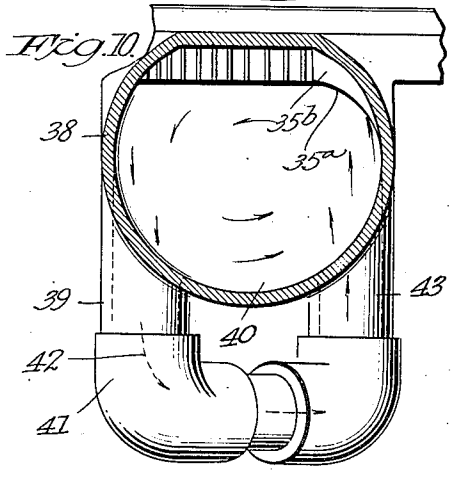


Fig. 10.



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Patented July 19, 1932

1,867,651

UNITED STATES PATENT OFFICE

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HYDROAIR COMPRESSOR AND VACUUM PUMP

Application filed February 4, 1930. Serial No. 425,868.

The present invention relates to pumps, and more particularly to pumps of the rotary type.

An object of the invention is to provide a rotary pump which is adapted to operate efficiently upon either gases or liquids.

The invention seeks to provide a structure which will pump either air or liquid or a mixture of the two, and which is self-priming.

In my Patent 1,686,549, granted October 9, 1928, there is disclosed a rotary self-priming pump having adjacent the outlet a chamber adapted to maintain a whirling body of fluid which separates air by centrifugal force, the chamber being so disposed that the whirling body engages the rotor buckets and displaces air therefrom into the whirling body.

The present invention has to do with improvements which relate to the rotor construction; to the disposition of the rotor buckets with respect to the whirling body of fluid; to the means for maintaining the whirling body of fluid and to the general pump construction.

It has been found that the operation of the pump may be materially improved, at least when the rotor buckets are of the type which project into the rotor, if the chamber has associated therewith means for directing the fluid of the whirling body from one part of the whirlpool to another after air has been separated therefrom, thereby insuring engagement of the buckets by liquid which has been freed from air and obtaining the desired angle of engagement between the whirling fluid and the buckets.

The invention also has to do with other features of the pump, and the same will be clearer as the description proceeds in connection with certain preferred embodiments shown in the accompanying drawings, wherein

Figure 1 is a side view partly in section.

Figure 2 is a vertical section on substantially the line 2—2 of Figure 1.

Figure 3 is a top plan view.

Figure 4 is an elevational view of one of the casing sections.

Figure 5 is a fragmentary elevational view of a modified form.

Figure 6 is a vertical sectional view of the construction shown in Figure 5.

Figure 7 is a horizontal section on substantially the line 7—7 of Figure 5.

Figure 8 is a fragmentary perspective view.

Figure 9 is an elevational view of another modification, and

Figure 10 is a sectional view of the construction shown in Figure 9 illustrating more clearly the relation of the passage openings to the interior of the chamber.

Referring to the drawings for a more detailed description, and more particularly to Figures 1 and 4 inclusive, the pump casing comprises a section 10 having an inlet 11 for gas and liquid, which will be referred to, for example, throughout the specification and claims as "air" and "water". The inlet, in the present instance, is disposed substantially axially with respect to a rotor 12 having adjacent its periphery or at its margin a circular series of buckets formed by blades 13. These blades project laterally from the face of the rotor as distinguished from the rotor blades of my patent above mentioned which are set into the rotor so as not to project for any considerable distance outwardly from the plane of its lateral face, on which the buckets are disposed. The end edges of the blades 13 do not extend in an exactly radial direction, but are disposed on lines which are substantially chords of the circumference of the rotor, as shown most clearly in Figure 1, and they project into a raceway 15 formed between the outer rim 10′ of the casing section 10 and a shoulder 16 spaced radially inwardly from the rim 10′. The inlet 11 communicates with the raceway by means of a passage 17 which is formed between a wall 18 and an arcuate wall 18′ extending to a point which merges with a shoulder 16 at a point or lip 19. As will be understood, the water is adapted to enter the buckets at a point between the lip 19 and the opposite side 20 of the entrance of the passage 17 into a raceway, the raceway extending therefrom to an outlet 21. Between the point 20 and

the outlet 21, the raceway is of considerably greater width, radially of the rotor, than the blades, as illustrated clearly in Figure 4. This radial widening forms a raceway outlet 21 disposed radially outside the buckets and the periphery of the rotor, whereby the liquid from the raceway passes through the outlet in a plane radially beyond the rotor periphery. But the raceway is reduced in radial width at a shoulder 22 formed on the outer rim 10′, so that between the outlet opening 21 and the point 19, there is provided a relatively narrow portion 15′ through which the buckets pass. This reduced portion, forming substantially a cut-off between the outlet 21 and the inlet, the cut-off overlying at all times, as will be observed, a substantial number of buckets.

A portion of the narrowed passage is formed with a continuation 21ª of the outlet opening 21. The continuation is of considerable size in a direction around the rotor, as will be apparent from Figures 1 and 2, so that at all times a substantial number of blades project therethrough, as shown most clearly in Figure 2.

At the outlet is disposed a chamber 23 into which the blades 13 project, so as to pass through a portion of the chamber as the rotor revolves. The chamber is disposed substantially tangentially with respect to the face of the rotor, from which the blades project, and is provided with a bottom 24 and an outlet 25 considerably smaller in diameter than the chamber which is substantially circular in horizontal cross-section. As will be observed (Figures 1 and 4), the raceway outlet 21 discharges into the chamber in planes radially outside the rotor periphery and the buckets, and permits the liquid to discharge into the chamber substantially tangentially, as indicated by the arrows A in Figure 1. The face of the rotor radially inwardly from the blades is provided with a series of relatively shallow radial blades 26 which fit substantially flush against the face 26′ of the casing section 10 and by their centrifugal action prevent radial inward flow of the water from the raceway 15.

The rotor may be actuated as by means of a shaft 27 extending through a rear casing section 28 which at its circumference is secured to the casing section 10 as by screws 29. The section 28 may have laterally extending and integral bars or webs 30 which are broken away in Figure 2, this construction corresponding to that shown more clearly in my patent above mentioned; the bars are adapted to support a rotor shaft bearing, as best shown in Figure 2 of said patent.

As will be observed, the inlet 11 may have a connection 11′ leading to any suitable source of air or water and the discharge 25 may have a similar connection 25′.

To operate the pump, it is simply necessary to introduce into the chamber 24 a quantity of liquid, and as the rotor is actuated, this liquid will have imparted thereto a whirling motion, thereby setting up a liquid whirlpool. This whirling motion is caused by the tangential discharge into the raceway through the outlet 21, which discharge enters the chamber radially outside the path of the blades or buckets. The whirling motion is also caused by the direct engagement with the buckets by the liquid in the whirlpool. As will be understood, however, the liquid is entering the chamber tangentially through the outlet 21 in planes radially outside the path of the buckets, although, of course, some liquid in the buckets also enters the raceway. At the same time, the buckets are directly engaged by the whirling body, and thus air in the buckets is wiped therefrom while the moving buckets tend to maintain the whirling movement. The water of the whirlpool tends to seek the circular inner wall of the chamber, and as the buckets formed by the blades 13 pass through the chamber, they are repeatedly engaged by the liquid which serves to displace air therefrom into the whirlpool. This air seeks the center of the whirlpool and is discharged through the outlet 25. As will be understood, some water is necessarily carried away from the chamber by the buckets, since the water of the whirlpool enters the buckets to displace the air, but this water is returned to the whirlpool, and its tangential introduction into the chamber assists the mechanical action of the blades in maintaining the whirling motion. It will be understood, therefore, that the whirling motion is set up both by the repeated tangential introduction of liquid into the chamber and by the engagement of the buckets with the whirling body.

The air or liquid is thus drawn into the pump through the inlet 11 and carried through the raceway 15 to the outlet, where in the chamber 23 the air is separated from the water, where the whirling action is maintained.

When the pump is drawing only air, a sufficient amount of water will be maintained in the chamber 23 to displace constantly the air from the buckets as the latter pass the chamber. Of course, some water will be carried away from the chamber in the buckets since the liquid whirlpool is constantly engaging the buckets. But this water will be simply carried through the casing and raceway and again discharged into the chamber. However, the amount of water carried off in this manner is maintained at a minimum by the reduced portion 15′ of the raceway. It is not essential in the operation of the pump upon air that the water thus carried off from the chamber be carried past the inlet or through the raceway, but it has been found that the most convenient way of maintain-

ing an adequate amount of water in the whirlpool chamber is simply to return the water carried away by the buckets to the chamber. Of course, it will be understood, therefore, that the water in the chamber might be replaced from an extraneous source, thus permitting the water carried off by the buckets to be discharged therefrom before the buckets again reach the discharge chamber.

When the pump is operating upon liquid alone, the whirlpool will be maintained, and any air which may be in the water may be separated by the centrifugal action described.

By reference to Figure 1, it will be observed that although the whirlpool is maintained on an axis substantially radial with respect to the rotor axis, the buckets travel therethrough on an arc which causes the liquid as it whirls to pass through the buckets between the blades. The water does not whirl with relation to the blades or buckets on a line paralleling the opposed faces of the blades, but instead in a path which causes the whirling water to engage the faces of the buckets. It has been found, however, that the whirling water tends to travel upwardly as it whirls toward the outlet 25, and thus the water of the whirlpool tends to seek the radially outer edges of the blades and displace the air into the whirlpool.

Referring to Figures 5, 6 and 7, there is shown an improved construction which is applicable not only to a pump of the type shown in the other views, but also to other types of pumps including that shown in my patent above mentioned. In these figures, the chamber 23′ has a bottom 24′ and a discharge outlet 25″ provided with a connection 25*a*. With the chamber is associated a rotor 12′ of the precise construction shown in Figures 1 to 4 inclusive, and, therefore, no further description is thought to be necessary. The blades 13′ project into the chamber as they pass the same through the outlet opening 21′, which is preferably of the form shown in Figure 4. As will be understood, the operation or action of the rotor maintains in the chamber a liquid whirlpool, provided at the start of the pump operation a certain amount of liquid is introduced into the chamber, for instance, through the outlet connection 25*a*. As in the pump previously described, the liquid whirlpool is set up not only by the mechanical action of the rotor, as in its operation the blades pass through the chamber, but also by the tangential discharge of liquid into the chamber when both air and liquid are being pumped. Moreover, the buckets necessarily carry out from the chamber some liquid, as a portion of the liquid in the whirlpool enters the buckets to displace air from the latter into the whirlpool.

For the purpose of insuring proper engagement of the liquid from the whirlpool with the buckets, the chamber 23′ has associated therewith means for guiding the liquid in the whirlpool from one part of the whirlpool to another. Preferably, this means is of a character which will direct the air freed-liquid from a point adjacent the discharge 25″ to another part of the whirlpool nearer the bottom 24′ of the chamber. This means, in its preferred form, is a passage 32 extending from a point 33 on the chamber wall adjacent the rear edge of the outlet 21*a* (Figure 4) in a substantially spiral and downward direction to a point 34 below and radially inwardly from the series of buckets. The passage 32 is formed between upper and lower exposed walls joined by a substantially vertical wall, the three walls together producing an open-sided passage communicating with the interior of the chamber.

As will be observed (Figure 7) the passage terminates immediately below a shield or web 35, which overlies the ends of the blades and has a forward edge 35′ forming the entrance to the chamber from the raceway. The lower face of this shield is cut away at 36 (Figure 8) so as to expose the bottoms of the buckets to the whirling fluid which follows the arrow 34′ (Figure 8), and enters the buckets to displace air therefrom. As shown in Figure 7, this web or shield 35 is formed on an arc which is a continuation of the circle of the chamber above the passage, and thus does not obstruct in any way the whirl set up within the chamber.

The passage 32 guides the water from the upper part of the chamber in a spiral direction downwardly to the lower part, and since the upper part of the chamber is substantially above the circle of blades, the water is, therefore, guided by the passage from a portion of the whirlpool above or radially outwardly of the blades to a point on the opposite side of the blades or radially inwardly therefrom. Furthermore, as the passage is located on the outer wall, it guides the water which is most completely freed of air, toward the bottom of the whirlpool and within the circle of the blades. This water will then tend to engage the blades and pass upwardly mixed with air to the upper portion of the whirlpool, and when again freed from air, will be directed downwardly to the bottom of the whirlpool. It will be understood, of course, that in the meantime a portion of the water will engage the buckets and be carried around by the same through the raceway to be returned to the chamber. The passage 32, therefore, performs a function of directing air freed water under or within the circle of the impeller blades, this water being guided from the upper part of the whirlpool to the lower part along the outer edge or rim of the whirlpool.

Obviously, the passage may take other forms; for example, the form shown in Fig-

ures 9 and 10. In these views, the chamber 38 corresponds to the chamber 23 and 23′ of the other figures and communicates with the buckets which project thereinto, as shown in Figure 10, through an outlet opening (not shown). The chamber includes a shield 35ª corresponding to the shield 35 in Figures 7 and 8, except that instead of being extended to the top of the chamber, it has a top wall 35ᵇ overlying the tops of the blades where they enter the chamber. The chamber has communicating with the interior thereof at an opening 39 spaced above its bottom 40, a by-pass 41 which leads water in the direction indicated by the arrows 42 from the upper portion of the whirlpool downwardly into the bottom of the whirlpool at an inlet opening 43. It will be observed that the opening 39 at which the by-pass receives liquid from the chamber communicates with the chamber off the center of the latter or in a substantially tangential direction, as best illustrated in Figure 10, so that as the water whirls at the upper part of the whirlpool, it tends to enter the by-pass through which it is gravitationally directed downwardly to the inlet 43 which also communicates with the whirlpool in a tangential direction and re-enters the whirlpool in the direction of travel of the latter. As will be understood, the water enters the upper end of the by-pass as it whirls and the opening 39 facing the whirl is disposed so that the centrifugal action tends to throw the water into the by-pass. The by-pass 41 performs the same function as the passage 32 of the forms shown in Figures 5 and 6.

Obviously, the invention is not limited to the details of construction above described. The various forms are shown and described in detail simply for purposes of illustration, and not to limit the invention to the structural details which may be modified considerably without departing from the essential features of the invention set forth in the following claims.

I claim:

1. In a rotary pump, a rotor having a series of buckets, a casing having a main inlet and an outlet, and a chamber in communication with the rotor buckets through said outlet for maintaining a body of liquid which has imparted thereto by the rotor action a whirling movement in which it separates air, said chamber having means for guiding the water from one plane of the whirlpool to another to engage the rotor buckets after it has been freed from air.

2. In a rotary pump, a rotor having a series of buckets, a casing having an inlet and an outlet and a liquid raceway extending therebetween, and a chamber at said outlet in communication with the rotor buckets for maintaining a body of liquid which has imparted thereto by the rotor action a whirling movement in which it engages the rotor and separates air, said raceway opening into the chamber radially outside the rotor buckets and the chamber having means for guiding the water from one plane of the whirlpool to another to engage the rotor buckets after it has been freed from air.

3. In a rotary pump, a rotor having a series of buckets, a casing having an inlet and an outlet and a raceway extending therebetween, and a chamber at said outlet in communication with the rotor buckets for maintaining a body of liquid which has imparted thereto by the rotor action a whirling movement in which it separates air, said raceway opening into the chamber radially outside the rotor buckets and the chamber having means for guiding the water from planes of the whirlpool radially outside the rotor buckets to other planes and into a position to engage the rotor buckets after it has been freed from air.

4. In a rotary pump, a rotor having a series of buckets, a casing having an inlet and an outlet and a fluid raceway extending therebetween, and a circular chamber at said outlet in communication with the rotor buckets for maintaining a body of liquid which has imparted thereto by the rotor action a whirling movement in which it engages the rotor and separates air, said buckets being disposed to project into the chamber as they pass the latter, said raceway opening into said chamber in planes radially outside the rotor buckets and the chamber having means for guiding the water from planes of the whirlpool outside the rotor buckets into a position to engage the rotor buckets after it has been freed from air.

5. In a rotary pump, a rotor having a series of laterally opening buckets, a casing having an inlet and an outlet, and a circular chamber at said outlet laterally disposed relative to the buckets and in communication therewith for maintaining a body of liquid which has imparted thereto by the rotor action a whirling movement in which it engages the rotor and separates air, said buckets being disposed to project into the chamber as they pass the latter, and said chamber having means including substantially facing walls forming an open-sided passages for guiding the water from one plane of the whirlpool to another into a position to engage the rotor buckets at said outlet after it has been freed from air.

6. In a pump, a rotor having a marginal series of buckets, a casing having a main inlet and an outlet, a chamber into which the buckets project as they pass said outlet, the latter being adapted to maintain a liquid air-separating whirlpool which engages the buckets as they pass the chamber, means including an open-sided passage in association with said chamber for guiding the air freed liquid from one plane of the whirlpool into another to engage the buckets, and means for taking off separated air from said chamber.

7. In a pump, a rotor having a marginal series of buckets, a casing, a chamber adjacent the periphery of said rotor and into which said buckets open and project, said chamber being adapted to maintain under the rotor action a liquid air-separating whirlpool having a path of movement in which the liquid engages the buckets, a passage for taking off air from said chamber, and means in association with said chamber for guiding liquid from one cross sectional plane of the whirlpool into another so as to cause the same to re-engage the buckets.

8. In a pump, a rotor having a marginal series of buckets, a casing having an opening, a chamber adjacent the rotor periphery of said rotor and with which said buckets communicate through said opening, said chamber being adapted to maintain under the rotor action a liquid air-separating whirlpool having a path of movement in which the liquid engages the buckets, means for taking off air from said chamber, and means in association with said chamber for guiding liquid from one cross sectional plane of the whirlpool into another so as to cause the same to re-engage the buckets, said last mentioned means being disposed to direct liquid away from said air take-off portion of the chamber.

9. In a pump, a rotor having a marginal series of buckets, a casing having an inlet and an outlet, a chamber at said outlet, said chamber being adapted to maintain a liquid air-separating whirlpool set up by the rotor action, and means adapted to direct fluid in said chamber adjacent the outer edge of the whilpool and near the chamber wall from one part of the whirlpool to another.

10. In a pump, a rotor having a marginal series of buckets, a casing having an inlet and an outlet, a chamber at said outlet, said chamber being adapted to maintain a liquid air-separating whirlpool set up by the rotor atcion, and a passage for guiding liquid from adjacent one end of the whirlpool toward the other, whereby to cause the same to re-engage the buckets.

11. In a pump, a rotor having a series of buckets, a casing having an inlet and an outlet, a chamber at said outlet of substantially circular cross section and arranged substantially tangential with respect to the path of said buckets, said chamber being adapted to maintain an air-separating liquid whirlpool set up by the action of the rotor and being disposed so that the liquid of the whirlpool engages the buckets as they pass said opening, means disposed radially outwardly from said outlet opening for taking off air from said chamber, and a guide passage associated with said chamber for directing liquid of the whirlpool away from said last mentioned means to another portion of the whirlpool.

12. The method of operating a pump comprising a rotor having a series of buckets, which consists in forming by the movement of the buckets, a liquid whirlpool immediately adjacent the path of the buckets, and maintaining said whirlpool so that the whirling motion stratifies air and causes the liquid to engage the rotor buckets as the latter pass the whirlpool, discharging liquid from the rotor into the whirlpool in planes radially outside the buckets while permitting the liquid of the whirlpool to engage the buckets and leading whirlpool liquid from said planes to planes of the whirlpool radially inward therefrom.

13. The method of operating a pump comprising a rotor having a series of buckets which consists in forming by the movement of the buckets, a liquid whirlpool immediately adjacent the path of the buckets, and maintaining said whirlpool so that the whirling motion stratifies air and causes the liquid to engage the rotor buckets as the latter pass the whirlpool, discharging liquid from the rotor into the whirlpool in planes radially outside the buckets while permitting the liquid of the whirlpool to engage the buckets and at the outer circumference of the whirlpool leading whirlpool liquid from said planes to planes of the whirlpool radially inward therefrom.

In testimony whereof I have hereunto set my hand.

ARTHUR W. BURKS.