March 18, 1947. F. E. BRADY, JR 2,417,627

PUMP

Filed Sept. 18, 1943 2 Sheets-Sheet 1

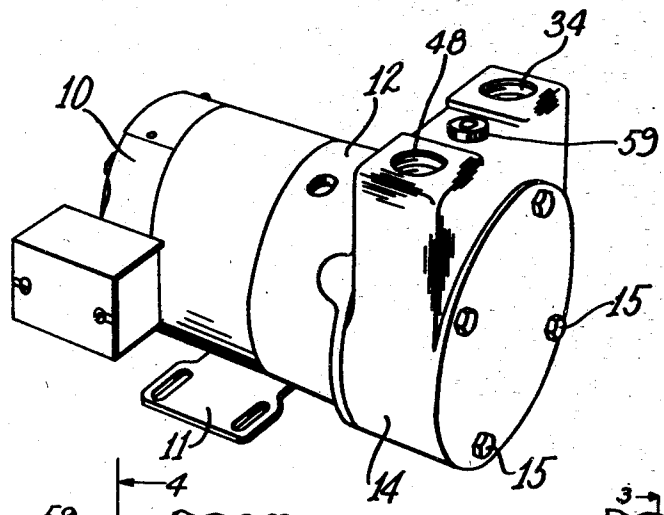


Fig.1

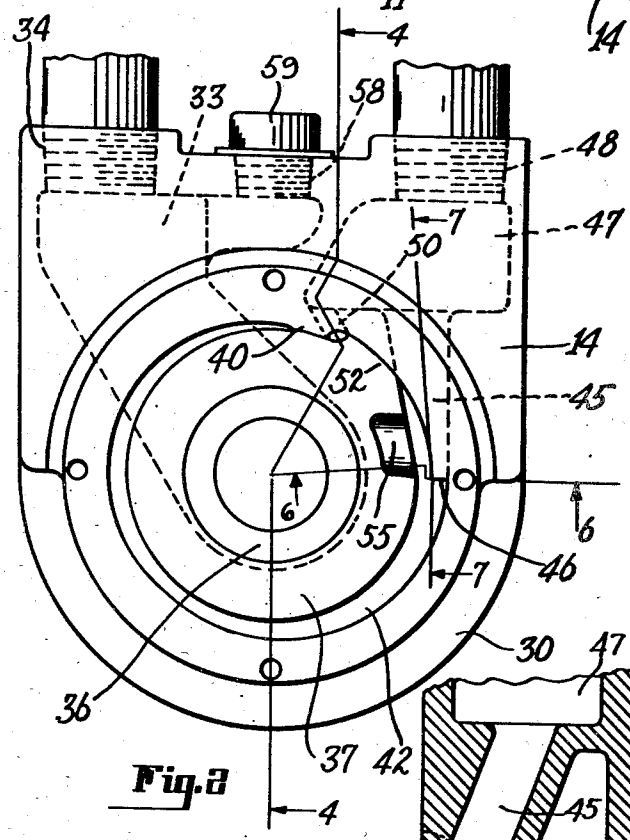


Fig.2

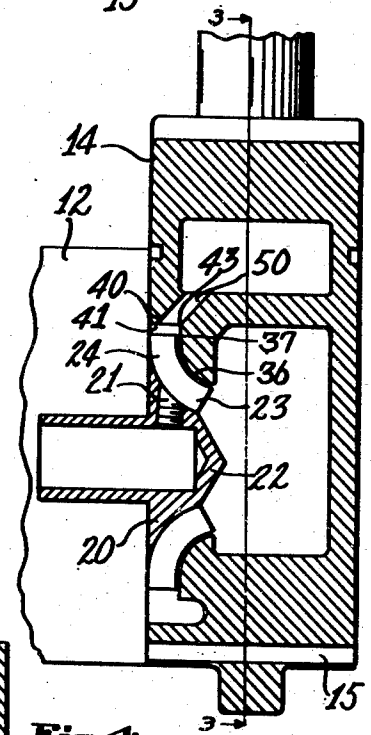


Fig.4

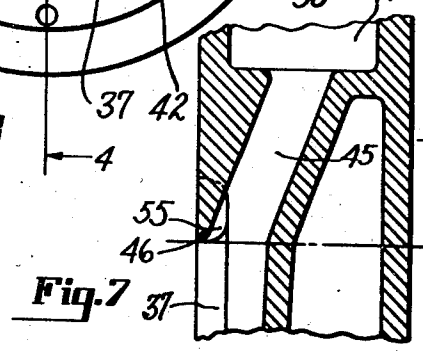


Fig.7

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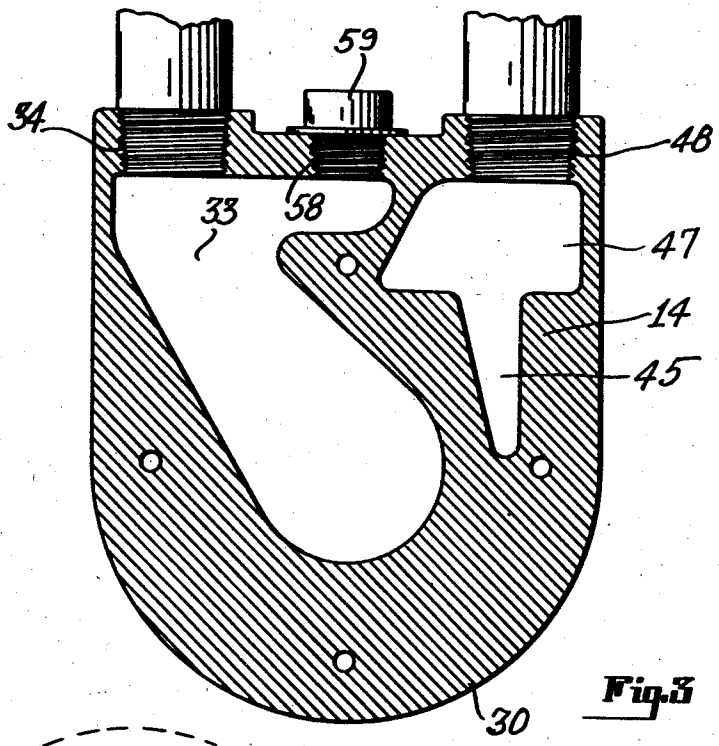


Fig. 5

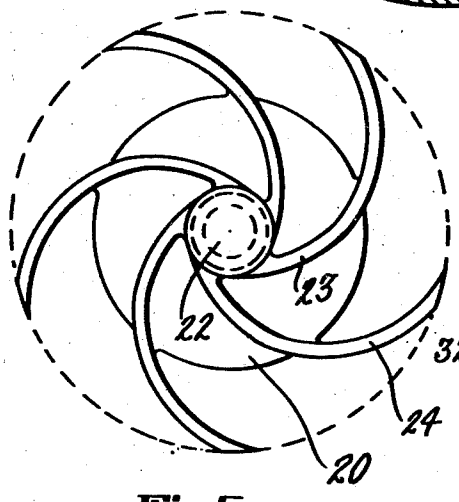


Fig. 6

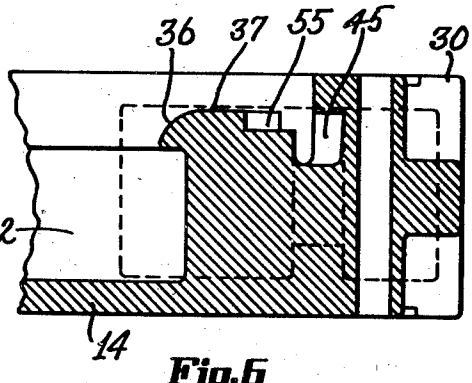


Fig. 6

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PUMP

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Application September 18, 1943, Serial No. 502,941

12 Claims. (Cl. 103—113)

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This invention relates to pumps and more particularly to self-priming liquid pumps.

It is the principal object of the invention to provide a liquid pump of the rotary impeller type which has the capacity for rapid self-priming as soon as it is placed in operation so that it will establish the flow with a minimum of delay, and which in operation is highly efficient and produces desirable operating results.

It is a further object to provide such a pump in which residual liquid in the pump casing is delivered laterally into the path of travel of the impeller blades from which the liquid is discharged at high velocity through the body of air trapped above the liquid, being discharged outwardly to effect rapid entrainment and discharge of the trapped air, to quickly prime the pump so that its normal suction will be rapidly established and the pump thereafter continue to operate in an efficient and satisfactory manner.

Other objects and advantages will be apparent from the following description, the accompanying drawing and the appended claims.

In the drawing,

Fig. 1 is a perspective view of a pump unit constructed in accordance with the present invention and assembled with a drive motor;

Fig. 2 is an end elevational view of the pump housing removed from the supporting motor casing.

Fig. 3 is a vertical sectional view through the pump housing on the line 3—3 of Fig. 4;

Fig. 4 is a vertical sectional view through the pump housing on the line 4—4 of Fig. 2;

Fig. 5 is an elevational view of the impeller used in conjunction with the invention;

Fig. 6 is a sectional view through the pump housing on the line 6—6 of Fig. 2; and

Fig. 7 is a broken sectional view on the line 7—7 of Fig. 2.

Pump construction have heretofore been provided which embody features of self priming, that is, in which the pump will begin operation without the necessity of filling the pump chambers with liquid and excluding air trapped within the pump casing or within the suction line. However the constructions as heretofore developed have not provided a rapid self-priming action, or have not accomplished such rapid action while at the same time providing for satisfactory and efficient operation of the pump in the normal pumping of the liquid. In cases where satisfactory pumping was obtained, the time required for the priming of the pump under its own action was excessive and in other constructions where lesser

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priming time was involved, this was accomplished by some sacrifice of efficiency during normal running.

In accordance with the present invention, not only is the normal operation of the pump efficient and highly satisfactory, but the time required for the pump to prime itself is materially reduced substantially below that attained heretofore. In accordance with the present invention, the pump will be fully primed and in full operation within a very brief period after starting, providing not only for the clearing of the air trapped in the pump chamber but also providing for the discharge of such air as may be present in the suction line. The priming is accomplished very rapidly, in most cases the full period required being measured in terms of a few seconds with the time under favorable conditions being of the order of one second or less. The pump therefore is highly satisfactory not only for general pump applications in which it gives good results because of its high operating efficiency, but also in applications where the pump is repeatedly started and stopped by reason of the freedom from any material delay in the priming of the pump.

Referring to the drawing, which discloses a perfected embodiment of the invention, the assembled pump unit as shown in Fig. 1 comprises a drive motor 10 suitably secured to a bracket 11 for mounting the pump on a convenient support. To the forward end of the motor casing is secured an adapter casting 12, the pump housing 14 being bolted to the end face of the adapter by means of a plurality of bolts 15.

The drive shaft of the motor extends through the adapter 12 and on the overhanging end thereof receives the impeller shown at 20, the impeller being suitably fastened to the motor shaft by means of a set screw 21. The impeller is formed with a central hub portion 22 which projects axially beyond the blades which are shown at 24, the blades having an inner curved part 23 and the outer part of the blades being of uniform width and the blades being inclined rearwardly in the direction of rotation as indicated.

As shown and described herein the invention is shown as applied to a pump in which the impeller rotates about a substantially horizontal axis. The invention is so described for illustrative purposes, as it may be similarly advantageously applied to a vertical axis pump, a pump of such arrangement being ordinarily somewhat less difficult to prime than a horizontal axis pump.

The pump housing 14 is provided with a face 30 which is adapted to be received against the

face of the adapter 12, a suitable gasket being used to form a liquid tight seal providing however for the ready separation and disassembly of the pump when desired. Radially inwardly of the face 30, the housing 14 is formed with a central recess 32 which has communication with a downwardly extending passage 33, such passage extending upwardly to a tapped opening 34 in the upper side of the case, to which a suitable supply pipe may be connected. This forms the suction side of the pump, the passage 32 thus providing for the supply of the liquid through the suction line and into the path of the impeller blades in a substantially axially direction. It will also be noted that such supply of liquid takes place to the inner part of the impeller where it is picked up by the parts 23 of the impeller blades, being delivered thereby laterally outwardly toward the outer portions 24 of the blades.

The housing 14 is formed with a curved surface 36 defining a pump casing, so that such fluid as delivered to the blades will be forced to travel over the path as just described, the contour of the surface of the casing 36 closely conforming with that of the outer edges of the impeller blades over the entire extent of those blades from the hub outwardly thereof.

Radially outwardly of the curved part 36 of the casing is a flat part 37 which forms a continuation of the casing and in the assembled position of the pump housing is spaced from the opposite plane face of the adapter 12 by a distance corresponding with the width of the outer parts 24 of the impeller blades with only enough clearance to give a free running fit, effectively sealing such blades within the pump chamber so formed.

A volute passage 40 is formed outwardly of the casing 37, such passage extending below the level of surface 37 as indicated at 41, to form a progressively enlarged discharge space through which the liquid is delivered being discharged outwardly from the ends of the impeller blades. The wall of the casing is formed as shown at 43 to provide a seal for separating the inlet and discharge sides of the volute, the wall 43 extending inwardly to a position closely adjacent the outer periphery of the impeller blades to thereby effectively seal the pump passage.

The housing is formed to provide a sealing wall 40 which is located on the upper part of the housing between the suction and discharge connections and in close radial relation with the outer peripheries of the impeller blades. A volute passage 42 extends from wall 43 around in the direction of rotation of the blades with progressively increasing cross section. On the discharge side of the pump it has direct communication with the main discharge outlet 45, the wall of the housing being formed with a lip 46 approximately at the level of the horizontal axis of the impeller beneath which the main discharge passage begins extending upwardly into a cored discharge chamber 47. Above this chamber is the tapped outlet 48 which is adapted to receive a discharge pipe providing for the discharge of the pumped liquid.

Immediately adjacent the sealing wall 40 and on the discharge side thereof there is provided an auxiliary discharge outlet 50, such outlet having its upper end in communication with the discharge chamber 47 providing for delivery thereto of discharged fluid, such fluid being thus discharged through the same outlet as that flowing through the main discharge outlet 45.

At its lower end auxiliary discharge outlet 50 has communication with a passage 52 which is

directly in line and in continuous communication with the volute passage 42. Passage 52 preferably extends from the sealing wall 40 to the lip 46 and as shown may be defined by a concentric wall of the housing 14 thus forming a communicating passage of substantially uniform cross section throughout. It may have lesser cross-sectional area than the adjacent part of the volute passage because it is not required to handle the entire volume of flow.

In order to provide for the rapid removal of air trapped within the pump casing, means are provided for assuring that liquid remaining within the pump casing will be delivered to the working surfaces of the blades, so that when placed in operation, those blades will quickly deliver liquid into and through the body of air above the liquid rather than merely cavitate through such liquid without establishing an effective delivery thereof. Such liquid being discharged from the blades through the body of air serves to entrain the air and, placing it in motion, to direct it to the discharge chamber so that the pump chamber is rapidly scavenged and the pump thus freed of air and quickly enabled to begin its normal operation.

For this purpose a passage is provided on the discharge side of the pump chamber which affords communication between the liquid in the chamber and a point on the outer periphery of the impeller blades providing for a flow of liquid into the path of the blades in a substantially axial direction. With such passage, and even under the very small or almost negligible pressure developed by the level of the liquid standing above the horizontal axis of the pump, a definite flow will nevertheless take place directly into the path of the blades, that liquid being picked up on blade surfaces and quickly discharged in the manner and with the results described above.

Such passage may be formed on either or both sides of the impeller. Preferably it is formed as a recess 55 in the flat wall 37 of the casing. As shown it is located substantially at the level of the horizontal axis of the impeller on the discharge side thereof opposite the lower end of the main discharge passage 45 and with its lower end extending downwardly substantially to the horizontal axis. It may if desired be located so as to extend below the horizontal axis.

As thus located recess 55 lies at least in part below the normal level of the liquid within the pump casing, it being understood that at the end of any pump operation there is always a residual quantity of liquid left within the pump. For initial operation, a separate priming opening 58 is provided which is closed by a plug 59, the opening being in communication with the suction inlet 33 to provide for filling the pump chamber and thereby submerging part or all of recess 55.

When the pump is placed in operation with the liquid level above recess 55, liquid is then supplied laterally of the blades in a generally axial direction and directly into the path of travel thereof. This overcomes the tendency of the blades, in the absence of the construction herein described, to merely channel through the liquid without picking up any substantial quantity thereof on the face of the blades. With this supply of liquid laterally into the path of the blades even under the small head provided by the level of the residual liquid above the recess 55, a positive flow of the liquid in appreciable quantities into the blades is assured. Such liquid as delivered into the blades is rapidly rotated and dis-

charged from the outer surface of the blades into passage 52, in such a direction as to be driven toward the auxiliary outlet 50. With a substantial mass of liquid being discharged in this manner, such liquid necessarily entrains air so that the air trapped in the casing above the liquid level is picked up and delivered along with the liquid into the discharge chamber 47. The action is analogous to the formation of an emulsion of liquid and air, the particles of liquid as they are broken up picking up the air and carrying the same along with the liquid, the liquid however retaining sufficient mass so that its travel outwardly through the outlet 50 and into chamber 47 continues and the air is thus discharged at the same time. In actual operation this condition takes place very rapidly, the flow of liquid quickly freeing the pump of trapped air, and likewise providing for rapid removal of such air as may be found in the suction line. It will also be clear that prior to the establishment of the main flow out through the discharge passage 45, the liquid delivered to chamber 47 is free to flow back through passage 45 into the pump casing again where it is reused in the manner already described, such action continuing until the air is cleared from the pump chamber and the main flow established. As stated, this occurs quite rapidly and the pump is rapidly primed and is thus brought into full operation with only a very brief period of delay, the delay in most cases being practically unnoticeable and in any event unobjectionable.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In a self-priming rotary pump, the combination of a casing forming a pump chamber, a suction chamber and a discharge chamber, a rotary impeller having a series of outwardly extending impeller blades having close running relation with the walls of said pump chamber, said casing being formed to provide a discharge passage in direct communication with said discharge chamber, an auxiliary discharge passage in communication with said discharge chamber, and means on the discharge side of said pump chamber communicating with said discharge passage in advance thereof for supplying liquid laterally into the path of the impeller blades to be discharged thereby outwardly through said auxiliary discharge passage with the entrainment and discharge of the air in said pump casing.

2. In a self-priming rotary pump, the combination of a casing forming a pump chamber, a suction chamber and a discharge chamber, a rotary impeller having a series of outwardly extending impeller blades having close running relation with the walls of said pump chamber, said casing being formed to provide a volute passage outwardly of said impeller blades in direct communication with said discharge chamber through a discharge outlet, an auxiliary discharge passage in communication with said discharge chamber, and means communicating directly with said discharge outlet and separated from said discharge chamber providing for supplying residual liquid within the pump chamber laterally into the path of the impeller blades to be discharged thereby outwardly through said auxiliary discharge passage with the entrainment and discharge of the air in said pump casing.

3. In a self-priming rotary pump, the combination of a rotating impeller having a series of outwardly extending impeller blades, a pump casing providing an inlet passage for supplying liquid centrally of said impeller blades, a main discharge outlet, an auxiliary discharge outlet on the discharge side of said casing and located beyond said main discharge outlet in the direction of rotation, said casing being formed on the discharge side thereof in advance of said auxiliary discharge passage with a laterally extending recess providing for the flow of liquid laterally into the path of said impeller blades to be discharged thereby in finely divided form outwardly through said auxiliary discharge passage to entrain and remove air within said casing.

4. In a self-priming rotary pump, the combination of a rotating impeller mounted for rotation about a substantially horizontal axis and having a series of outwardly extending rearwardly inclined impeller blades, a pump casing providing an inlet passage for supplying liquid in a substantially axial direction to the central part of said impeller blades, a main discharge outlet, an auxiliary discharge outlet on the discharge side of said casing and located beyond said main discharge outlet in the direction of rotation, said casing being formed on the discharge side thereof in advance of said auxiliary discharge passage with a recess opening into said main discharge outlet providing for the flow of liquid laterally into the path of said impeller blades to be discharged thereby in finely divided form outwardly through said auxiliary discharge passage to entrain and remove air within said casing.

5. In a self-priming liquid pump of the character described, the combination of a rotary impeller having plurality of impeller blades, a pump casing having an inlet passage for supplying fluid to said impeller substantially centrally thereof, said pump casing forming a volute passage located radially outwardly of said impeller, a main discharge outlet communicating with said volute passage on the discharge side thereof, means for sealing the discharge side of said passage from the inlet side thereof, an auxiliary discharge outlet, and means located in advance of said auxiliary outlet and opening into said volute passage providing for the flow of liquid laterally into the path of travel of said blades to supply liquid to said blades to be discharged thereby into the air above the liquid in said pump casing to cause entrainment of said air and discharge thereof with said liquid through said auxiliary discharge outlet.

6. In a self-priming liquid pump of the character described, the combination of a rotary impeller having plurality of impeller blades, a pump casing having an inlet passage for supplying fluid to said impeller substantially centrally thereof, said pump casing forming a volute passage located radially outwardly of said impeller, a main discharge outlet communicating with said volute passage on the discharge side thereof, means for sealing the discharge side of said passage from the inlet side thereof, an auxiliary discharge outlet located adjacent and in advance of said sealing means on the discharge side of said impeller, and means located in advance of said auxiliary outlet and opening into the radially inner side of said volute passage providing for the flow of liquid laterally into the path of travel of said blades to supply liquid to said blades to be dis-

charged thereby into the air above the liquid in said pump casing to cause entrainment of said air and discharge thereof with said liquid through said auxiliary discharge outlet.

7. In a self-priming liquid pump of the type described, the combination of a rotary impeller having a plurality of impeller blades, a pump casing having an inlet for supplying liquid to said impeller substantially centrally thereof, said casing being formed to define a volute passage located radially outwardly of said impeller, means for sealing the inlet side of said passage from the discharge side thereof, a main discharge outlet communicating with said volute passage on the discharge side thereof, an auxiliary discharge passage also communicating with the discharge side of said volute passage beyond the point of communication therewith of said main discharge outlet, and means forming a recess in the wall of said casing in advance of said auxiliary discharge outlet and substantially at the point of communication of said passage and said main discharge outlet providing for the lateral flow of liquid into the path of travel of said impeller blades to discharge a mass of liquid in finely divided form through said auxiliary discharge outlet with accompanying entrainment and discharge of the air within said casing.

8. In a self-priming liquid pump of the type described, the combination of a rotary impeller having a plurality of impeller blades, a pump casing having an inlet for supplying liquid to said impeller substantially centrally thereof, said casing being formed to define a volute passage located radially outwardly of said impeller, means for sealing the inlet side of said passage from the discharge side thereof, a main discharge outlet in communication with said volute passage on the discharge side thereof, means defining a lip on said casing for closing the wall of said main discharge passage, an auxiliary discharge outlet adjacent said sealing means, said casing being formed to define a communicating passage extending from said lip to the opening of said auxiliary discharge outlet, the side wall of said pump casing being recessed providing for supply of liquid laterally into the path of travel of said impeller blades to discharge a substantial mass of liquid through said communicating passage and into said auxiliary discharge outlet to entrain and remove the air from said pump casing.

9. In a self-priming liquid pump of the type described, the combination of a rotary impeller having a plurality of impeller blades, a pump casing having an inlet for supplying liquid to said impeller substantially centrally thereof, said casing being formed to define a volute passage located radially outwardly of said impeller, means for sealing the inlet side of said passage from the discharge side thereof, a main discharge outlet in communication with said volute passage on the discharge side thereof, means defining a lip on said casing for closing the wall of said main discharge passage, an auxiliary discharge outlet adjacent said sealing means said casing being formed to define a communicating passage extending from said lip to the opening of said auxiliary discharge outlet, the side wall of said pump casing being recessed substantially in the zone of said lip providing for supply of liquid laterally into the path of travel of said impeller blades to discharge a substantial mass of liquid through said communicating passage and into said auxiliary discharge outlet to entrain and remove the air from said pump casing.

10. In a self-priming liquid pump of the character described, the combination of a rotary impeller having a plurality of impeller blades, a pump casing having an inlet passage for supplying fluid to said impeller substantially axially thereof, means defining a volute passage located radially outwardly of said impeller, means adjacent the upper part of said volute passage for sealing the inlet from the discharge side of said passage, a main discharge outlet communicating with said volute passage on the discharge side of said impeller approximately at the horizontal axis thereof, an auxiliary discharge outlet also communicating with said passage above the point of communication of said main discharge outlet, the lateral wall of said pump casing substantially at the horizontal axis of said casing being recessed away from said impeller to provide for lateral flow of liquid into the path of said impeller blades to be discharged thereby toward and through said auxiliary discharge outlet with accompanying entrainment of air above said liquid level to provide rapid priming of said pump.

11. In a self-priming liquid pump of the character described, the combination of a rotary impeller having a plurality of impeller blades adapted for rotation about a substantially horizontal axis and rearwardly inclined in a direction of rotation, a pump casing having an inlet passage for supplying fluid to said impeller substantially axially thereof, means defining a volute passage located radially outwardly of said impeller, means for sealing the inlet from the discharge side of said passage, a main discharge outlet communicating with said volute passage on the discharge side of said impeller approximately at the horizontal axis thereof, an auxiliary discharge outlet also communicating with said passage above the point of communication of said main discharge outlet and substantially adjacent said sealing means, the lateral wall of said pump casing at approximately the level of the horizontal axis thereof and below the normal liquid level within said casing being recessed away from said impeller to provide for lateral flow of liquid into the path of said impeller blades to be discharged thereby toward and through said auxiliary discharge outlet with accompanying entrainment of air above said liquid level to provide rapid priming of said pump.

12. In a self-priming pump of the character described, the combination of a rotary impeller having a plurality of impeller blades adapted for rotation about a substantially horizontal axis, a pump casing having an inlet passage for supplying fluid to said impeller substantially axially thereof, means defining a volute passage located radially outwardly of said impeller, means for sealing the inlet from the discharge side of said passage, a main discharge outlet communicating with said volute passage on the discharge side of said impeller approximately at the horizontal axis thereof, an auxiliary discharge outlet also communicating with said passage, the lateral wall of said pump casing at approximately the level of the horizontal axis thereof and below the normal liquid level within said casing being recessed away from said impeller to provide for lateral flow of liquid into the path of said impeller blades to be discharged thereby toward and through said auxiliary discharge outlet with accompanying entrainment of

air above said liquid level to provide rapid priming of said pump.

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