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P. I. NAGLE

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AUTOMATIC PRIMING PUMP AND THE LIKE

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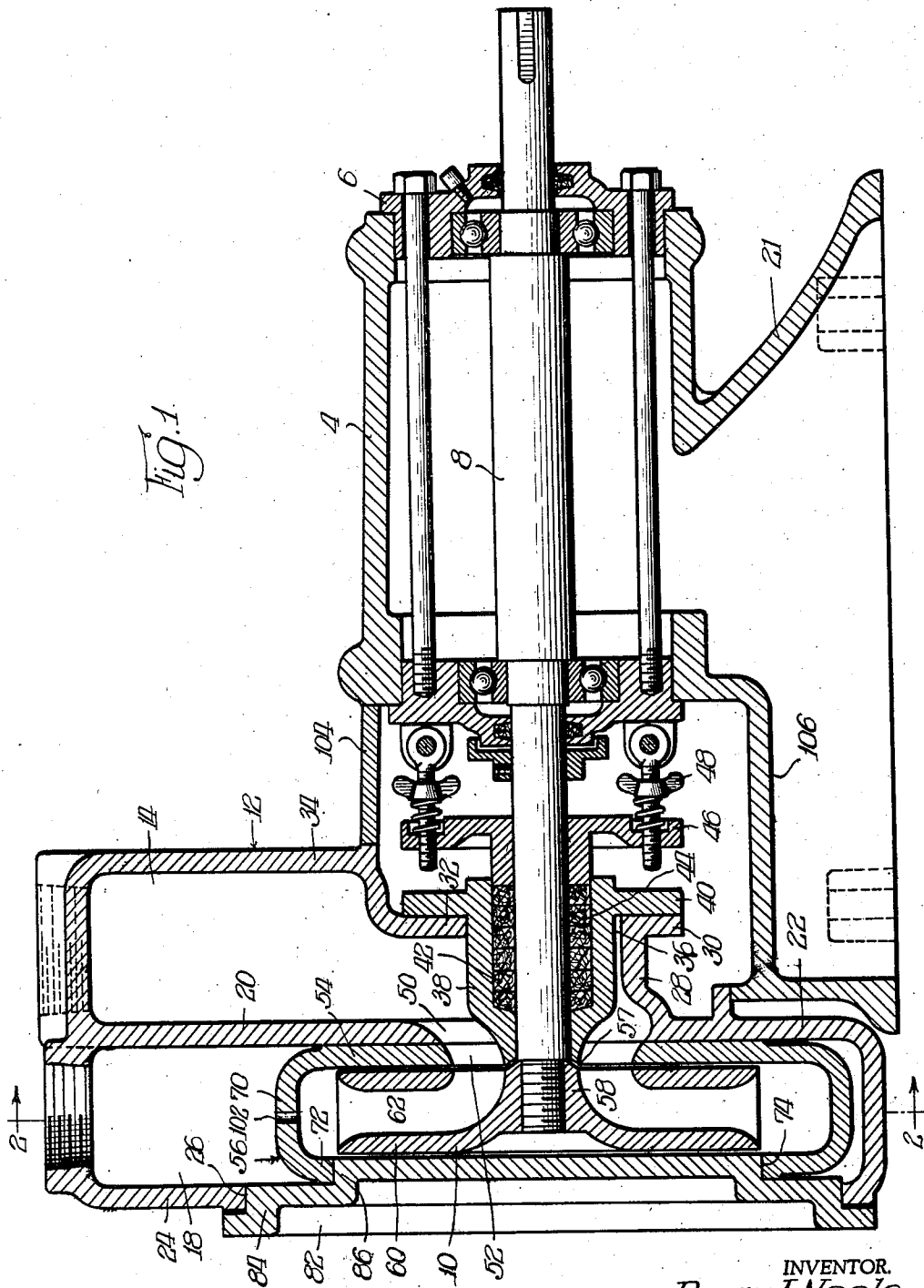


Fig. 1

INVENTOR.
Perry I. Nagle,
BY
Wilkinson Hays & Brown & Knight
Attys.

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AUTOMATIC PRIMING PUMP AND THE
LIKE

Perry I. Nagle, Chicago Heights, Ill., assignor to
The American Brake Shoe and Foundry Com-
pany, New York, N. Y., a corporation of Dela-
ware

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14 Claims. (Cl. 103—113)

The present invention relates to fluid impelling devices, and more in particular to automatic priming pumps.

Among the objects of the present invention is to provide an automatic priming pump embodying in its structure novel means and an arrangement of parts to assure a fluid-tight assembly at the stuffing box for the impeller shaft.

More particularly, the present invention embraces within its scope a novel arrangement in an automatic priming pump for the entrance chamber to deliver water, or other similar fluid, to the impeller on the stuffing box side of the device whereby a negative or reduced pressure obtains in the environment of said stuffing box preventing leakage of fluid through the said stuffing box.

Another object of the present invention is to provide a novel housing construction for an automatic priming pump whereby access can be gained to the impeller housing or shell without disturbing the entrance and discharge pipes leading into the housing for the said pump.

As a still further object of the present invention, the pump housing is formed to include discharge means having a compartment constituted in part by a separator chamber and in which is disposed a shell or housing for the impeller chamber detachably and adjustably secured in position with respect to the housing for the pump whereby the same can be removed for repair and replacement or adjusted with respect to the impeller because of wear and the like.

Still a further object of the present invention is to provide a novel housing assembly for an automatic priming pump wherein the impeller shell or housing is disposed within the chamber for the discharge means and which is provided with a side opening for access to the impeller closed by a common closure member for the said opening and the opening for the said compartment.

Another object within the purview of the present invention is to provide novel means for priming an automatic priming pump, the said novel means being constituted in the arrangement of the impeller and its housing, as well as the provision of suitable openings in the blades or vanes for the impeller, serving to induce, in conjunction with the fluid seal therefor, an ejection of the air or gas on the entrance side of the pump to the discharge side thereof, whereby the said air or gas is exhausted gradually to bring the fluid to be pumped into the environment of the impeller for normal pumping operations.

More particularly, the present invention contemplates the use of one or more openings provided in one or more of the vanes of the impeller, the said openings terminating in the trailing edge of the said vane or vanes on one side thereof and communicating with the passage or passages on the aft side of the impeller and being inclined toward the periphery of the vane or vanes in a direction opposite to the direction of rotation of the impeller whereby efficient ejection of the air on the entrance side of the impeller is produced in order to start normal operation of the pump without causing re-circulation of the water or fluid within the pump, which operation would materially decrease the normal efficiency of the said pump.

While the invention in respect of its priming performance comprehends the use of one or more openings on one or more of the vanes of an impeller, nevertheless the invention also comprehends the use of a groove in association with said one or more openings disposed generally in a transverse direction with respect to the said vane or vanes, which groove is of open-faced construction on the trailing edge of the blade or blades and which is in communication with said opening or openings to provide for somewhat more efficient discharge of the air from the entrance to the discharge end of the automatic priming pump.

As a still further object of the present invention, the said groove for the opening or openings may be of a width corresponding to the width or diameter of the opening or openings, or, if desired, may be of a different width. As an illustration, the said groove may be of a width greater than the width or diameter of the opening or openings.

The present invention, insofar as it relates to the efficiency of operation of the automatic priming pump embodying the openings on the vane or vanes of the impeller, comprehends an impeller shell or housing so constructed and arranged in respect to the said impeller as to efficiently effect a discharge of air from the suction side of the pump and to provide a proper water seal at the discharge end of the pump whereby, during normal operation of the impeller, the water on the discharge side of the pump is not permitted to re-circulate within the confines of the impeller, which operation would materially decrease the efficiency of the said pump.

Other objects, features, capabilities and advantages are comprehended by the invention, as will later appear and as are inherently possessed thereby.

Referring to the drawings:

Figure 1 is a longitudinal view in cross section of an automatic priming pump embodying the novel features of the present invention;

Figure 2 is a transverse sectional view taken in the plane represented by line 2—2 of Figure 1 of the drawings;

Figure 3 is a fragmentary plan view of a leading edge of a vane taken in the plane represented by line 3—3 of Figure 2 of the drawings;

Figure 4 is an enlarged fragmentary view in section taken in the plane represented by line 4—4 of Figure 3 of the drawings; and

Figure 5 is an enlarged fragmentary view in section of an impeller vane similar to the view of Figure 4 but showing a slight modification of one of the features of construction, all in accordance with the present invention.

Referring now more in detail to the drawings, an embodiment selected to illustrate the invention is constituted by an automatic priming pump for pumping water or other fluid, which comprises a base 2 adapted to be mounted upon any suitable foundation and which is formed with the bearing housing 4 in which is mounted a bearing assembly, generally referred to as 6, for an impeller shaft 8 which extends laterally of the bearing housing 4 and has an impeller 10 mounted adjacent its end.

The impeller 10 operates within a housing, generally referred to as 12, which is formed in part by an entrance chamber 14 having one or more fittings, such as 16, to which may be connected a conduit or pipe communicating with the chamber 14 and with a source of water or other similar fluid to be pumped by the impeller 10. The housing 12 is further constituted by a discharge compartment 18 defined in part by the partition wall 20 and inner side wall 22, and in part by the outer side wall 24 formed with the opening 26. The inner side wall 22 has a lateral offset 28 forming the lower part of the entrance chamber 14 and which is flanged as at 30, the said flange being in substantial alignment with the downwardly depending wall section 32 formed as an inward offset to the wall 34 which defines in part the entrance chamber 14. Between the offset wall 28 and the downwardly depending wall section 32 is an axial opening 36 into the side of the pump, through which the impeller shaft 8 extends into the housing 12 and in which is disposed a stuffing box housing 38 of the general shape as shown and which is laterally flanged as at 40 to provide means whereby the same is connected to the flange 30 and the downwardly depending wall section 32 to provide a tight joint for the housing 12 at that point.

Stuffing box housing 38 has an inner annular bore 42 of a diameter substantially greater than the diameter of the impeller shaft 8 to receive gland packing material 44 embracing the shaft 8 to prevent leakage through the stuffing box. The gland material 44 is compressed and maintained in its operative relation with the shaft 8 by way of the gland follower 46 adjustable axially of the impeller shaft by means of the gland adjusting mechanism 48. While other details of construction for the gland adjusting mechanism, as well as the bearing 6, are shown in the drawings, more detailed reference thereto is not made inasmuch as the same do not form any part of the present contributions in the art.

The housing 12 at the walls 20 and 22 is apertured as at 50, which aperture is aligned with an aperture or opening 52 formed in the back

plate 54 of impeller housing 56 to provide an inlet eye of substantially annular formation embracing the stuffing box housing 38 and communicating on one side with the entrance chamber 14. It will be noted that the marginal edges defining the inlet eye have a flow line contour to provide for efficient flow of fluid from the entrance chamber 14, and that the said stuffing box housing 38 has its inner end of similar contour conforming to the opposed flow line contour to eliminate abrupt and rapid changes in the direction of flow of water from the entrance chamber to the impeller 10.

From the above description it will be observed that the entrance of the pump is on the stuffing box side thereof, one of the purposes of such design being to create a pressure differential between the discharge and intake sides of the pump to cause directional flow of fluid at the juncture of the stuffing box and shaft toward the discharge end of the pump, thus tending to prevent leakage at the stuffing box. The fluid pressure adjacent the impeller end of the stuffing box may be much less than on the discharge side of the pump, and for more efficient operation of the device may be a negative pressure, thus assuring substantially absolute prevention of flow of fluid outwardly through the said stuffing box. This directional flow of fluid is facilitated by the inclined contiguous surfaces of the impeller and stuffing box housing to provide the annular restricted clearance space 57 angularly disposed in the direction of fluid flow from the entrance to the discharge end of said pump. The provision of the entrance for the pump on the stuffing box side thereof further leads to improved structural characteristics in that the said pump is much more compact, more readily fabricated with fewer parts, and further provides for simplicity in the construction and arrangement of the gland adjusting mechanism and provision for its inspection, as well as a novel arrangement for the control of any fluid which may leak through the stuffing box to prevent damage to any of the parts of the pump in the event said fluid has corrosive or other deteriorating properties.

The impeller 10 may be of open vane construction or of the shrouded type and of any number of vanes, but in the present illustration the said impeller is of the shrouded type provided with the hub 58 screw-threaded upon the end of the impeller shaft 8, and further including the opposed walls 60 and 62 between which are disposed the arcuate-shaped blades 64 having their roots adjacent hub 58 to provide substantially axially disposed passages at that point communicating with the annular inlet eye adjacent thereto. These vanes or blades, four being shown in the present illustration, provide a plurality of passages, such as 66, extending from the inlet eye to the periphery of the impeller or runner, and which blades or vanes terminate to provide peripheral surfaces such as 68 at the trailing edge of the vanes disposed between the side walls 60 and 62.

The impeller housing or shell 56 is further constituted by a circular wall 70 extending laterally from the side wall 54 and which has a radially and inwardly extending marginal wall 72 defining an opening 74 slightly greater in diameter than the diameter of the impeller 10, whereby the said impeller 10 can be removed through said opening 74.

The present invention is also directed to the provision of novel means for gaining access to

the impeller 10 for its proper adjustment, together with proper adjustment for the impeller shell or housing 56, without in any way disturbing the entrance and discharge pipes for the device, the latter said discharge pipe being connected, for example, to the discharge fitting 76 formed in the top wall defining the discharge chamber 18 and leading to any point desired for discharging the water or other similar fluid propelled by the pump.

Accordingly, the said impeller shell 56 is formed with lugs, such as 78 and 80, adapted to be secured in any desired manner as by bolts, brackets or the like, to the walls 20 and 22 whereby adjustment of said shell can be effected. In furtherance of this inventive thought, the openings 26 and 74 are closed by a closure 82 stepped as at 84 and 86 to provide a shouldered fitting for the openings 26 and 74, respectively. This closure member 82 may be secured to the housing in any desired manner, but preferably in accordance with the connections shown in application Serial No. 384,807, for Fluid impeller housing assemblies, filed March 24, 1941. It will therefore be clearly apparent that the closure member 82 provides a common fitting for the discharge compartment 18, as well as the impeller shell or housing 56, and that whenever necessary, access can be readily and easily gained into the impeller housing or shell without disturbing in any way the entrance and discharge pipes for the device.

The laterally disposed wall 70 of the impeller shell or housing hereinbefore referred to as substantially circular for convenience, is in fact substantially in the shape of a volute formed with a discharge opening or throat as at 88 defined in part by a tongue 90 disposed in contiguous relation to the periphery of the runner or impeller 10 for a purpose to be hereinafter more fully described. The impeller shell or housing is mounted in the pump with respect to the impeller whereby the wall 70 is disposed in respect to the periphery of the runner or impeller to provide a fluid passage 92 gradually increasing in width in a counter-clockwise direction from tongue 90, and which passage communicates with the discharge throat or opening 88 substantially beneath the impeller 10 adjacent the bottom of the discharge compartment 18. In accordance with the arrangement of the various elements hereinbefore described, the upper part of the discharge compartment 18 serves as a separator chamber, about which reference will be made hereinafter.

As clearly shown in Figures 2, 3 and 4 of the drawings, each of the blades or vanes 64 at its trailing edge is provided with a transversely disposed groove 94 communicating with a centrally disposed opening 96 which is angularly disposed and inclined toward the periphery of the runner or impeller in a direction opposite to the direction of rotation of said impeller which, in the illustration, is in a counter-clockwise direction.

While a single groove and a single opening are shown for the purposes of illustration, the invention comprehends a plurality of arrangements for such elements; that is to say, a plurality of grooves, together with a plurality of openings, may be provided for one or more of the vanes or blades for the runner or, if desired, one or more of the blades or vanes may be provided with one or more openings without the grooves and without the inclination or angularity disclosed, all in accordance with the present invention, and for

effecting the results to be hereinafter more fully disclosed.

While the groove of Figure 4 is shown as being of a width greater than the dimension of the opening 96 in the direction of rotation of the impeller, nevertheless the width of the groove may conform to the width of the opening, all as shown in Figure 5 of the drawings, wherein the transverse groove 98 is of the same width as the opening 100, or if desired, said groove may be of less width than said opening.

As is well understood in the pump art, self-priming pumps operate to progressively and by degrees exhaust the air or other similar gas from the entrance side of the pump in order to render the pump operative to draw fluid being pumped from the suction side thereof and to discharge the same on the discharge side of the pump. According to the present invention, this operation is effected through the medium of the openings 96 on the trailing edge of the vanes 64 and which communicate on the aft side of the impeller with passages 66 and in turn through the inlet eye with the entrance chamber 14 and the duct or ducts leading therein and extending to the source of water or other fluid to be pumped.

As is conventional in this art, priming of a pump is effected in the presence of water or other similar fluid initially retained within the pump housing and which, upon operation of the impeller thereof, is discharged into the discharge compartment from the entrance chamber 14. This general scheme of operation is characteristic of the present device in that said water or other fluid within the housing 12, upon operation of the impeller 10, is drawn through the inlet eye to the impeller and, under the rotational action of said impeller, is discharged through the throat 88 into the discharge compartment 18. Since this impeller is operating at high R. P. M., the water maintained within the impeller housing 56 and within passageway 92 takes the form of a resilient body seeking to flow or gravitate toward the center of the impeller, but which is prevented from doing so by the rapid progressive passage of the trailing edge of the impeller vanes or blades over the inner annular surface thereof. This rapid rotational movement of the impeller, according to the present theory of operation of the device disclosed herein, creates a positive pressure in the fluid body within passageway 92 and a negative pressure on the aft side of the vanes or blades, thus providing, through the medium of the openings 96, an ejector action for discharge of air or other gas from the suction or intake side of the impeller to the discharge side of the pump, thus gradually and progressively removing the air or gaseous body from the suction side of the pump to permit fluid drawn into the entrance chamber 14 to be acted upon by the impeller for the proper operation of the pump. The air or other gaseous body is ejected from the aft side of the pump into the environment of the trailing edge of the vanes or blades in rather small and minute quantities and is discharged in the form of bubbles not only into the body of fluid within passageway 92, but through the discharge throat 88 where the same is discharged into the separator chamber and the discharge duct connected thereto. In order to facilitate the latter operation, it is desirable to locate tongue 90 in contiguous relation to the trailing edges of the vanes or blades as the same rapidly rotate past the same in their normal orbital movement, whereby the tongue acts to discharge these accumulated

bubbles from the trailing edges of the blades, or in other words, serves to create a wiping action for their proper discharge to the separator chamber. While satisfactory results have been obtained without the use of the grooves, nevertheless greater priming efficiency is secured when the same are provided in conjunction with the grooves, the said grooves apparently facilitating a more efficient ejecting of the air or other gas because of their disposition throughout the entire width of the blade or vanes.

According to the present theory of operation, a wall of water or other fluid to be pumped is maintained in the passage 92 because of the rapid rotation of the impeller blades, which action of the impeller prevents any re-circulation of the water or other fluid into the passages between the blades or into the suction end of the pump, thus greatly increasing the efficiency of the pump.

Furthermore, any air or other gas ejected through openings 96 from the suction side of the pump which may be discharged in the form of bubbles due to the somewhat turbulent state of the fluid or liquid in the passageway 92 at the interface of the trailing edge of the blades or vanes, is discharged, through opening 102 formed in the impeller shell or housing 56 on the upper side thereof, into the separator chamber, thus preventing the formation of an air interlock which might be formed and which, if formed, would prevent effective operation of the device.

As in application Serial No. 384,808, for Fluid impelling devices, filed March 24, 1941, the gland adjusting mechanism 48 may be inspected by way of the removable housing 104 and, as in said application, the base 2 is formed with the offset 106 disposed below the stuffing box assembly and its adjusting mechanism for proper inspection thereof, and to provide a support for a receptacle for receiving fluid which might leak from the stuffing box and its environment, and to accordingly prevent damage to other parts of the device.

While I have herein described and upon the drawings shown an illustrative embodiment of the invention, it is to be understood that the invention is not limited thereto but may comprehend other constructions, arrangements of parts, details and features without departing from the spirit of the invention.

I claim:

1. In an automatic priming pump, the combination of a housing having entrance and discharge means, an impeller disposed in said housing and having its passages formed by the vanes thereof in operative communication with said means, said passages being defined circumferentially by openings formed between the edges of adjacent vanes, said housing having a tongue interposed between said entrance and discharge means, one or more of said vanes being provided with a trailing edge having a peripheral surface with one or more openings therethrough to the aft side of the vane and communicating with said passages and adapted to cooperate with said tongue for priming the pump.

2. In an automatic priming pump, the combination of a housing having entrance and discharge means, an impeller disposed in said housing and having its passages formed by the vanes thereof in operative communication with said means, said housing having a tongue interposed between said entrance and discharge means, one or more of said vanes being provided with a trailing edge having a peripheral surface with at least

one transversely disposed groove formed therein and one or more openings communicating with said groove and extending therethrough to the aft side of the vane adapted to cooperate with said tongue for priming said pump.

3. In an automatic priming pump, the combination of a housing having entrance and discharge means, an impeller disposed in said housing and having its passages formed by the vanes thereof in operative communication with said means, said housing having a tongue interposed between said entrance and discharge means, one or more of said vanes being provided with a trailing edge having a peripheral surface with at least one transversely disposed groove formed therein and one or more openings communicating with said groove, said one or more openings being inclined toward the peripheral surface in a direction opposite to the direction of rotation of said impeller and extending through to the aft side of the vane and being adapted to cooperate with said tongue for priming the pump.

4. In an automatic priming pump, the combination of a housing having entrance and discharge means, said discharge means having a compartment constituted in part by a separator chamber, an impeller shell disposed in said compartment and having an opening communicating with said separator chamber, said opening being defined in part by a tongue, and an impeller disposed in said shell and having its passages formed by the vanes thereof in operative communication with said entrance means and said separator chamber through the opening in said shell, one or more of said vanes being provided with a trailing edge having a peripheral surface with one or more openings therethrough to the aft side of the vane adapted to cooperate with said tongue for priming the pumps.

5. In an automatic priming pump, the combination of a housing having entrance and discharge means, said discharge means having a compartment constituted in part by a separator chamber, an impeller shell disposed in said compartment and having an opening communicating with said separator chamber, and an impeller disposed in said shell and having its passages formed by the vanes thereof in operative communication with said entrance means and said separator chamber through the opening in said shell, the discharge opening for said shell being disposed at the lower portion of said compartment and being defined in part by a tongue, one or more of said vanes being provided with a trailing edge having a peripheral surface with one or more openings extending therethrough and to the aft side of the vane adapted to cooperate with said tongue for priming the pump.

6. In an automatic priming pump, the combination of a housing having entrance and discharge means, said discharge means having a compartment constituted in part by a separator chamber, an impeller shell disposed in said compartment and having communication with said separator chamber, and an impeller disposed in said shell and having its passages formed by the vanes thereof in operative communication with said entrance means and said separator chamber through the opening in said shell, the discharge opening for said shell being disposed at the lower portion of said compartment and being defined in part by a tongue disposed in juxtaposed relation to the trailing edge of said vanes, one or more of said vanes being provided adjacent the periphery thereof with one or more

openings extending from the trailing edge there-through and communicating with a passage on the aft side of the impeller, said one or more openings extending toward said periphery in a direction opposite to the direction of rotation of said impeller.

7. In an automatic priming pump, the combination of a housing having entrance and discharge means, said discharge means having a compartment constituted in part by a separator chamber, an impeller shell disposed in said compartment and having communication with said separator chamber, and an impeller disposed in said shell and having its passages formed by the vanes thereof in operative communication with said entrance means and said separator chamber through the opening in said shell, the discharge opening for said shell being disposed at the lower portion of said compartment and being defined in part by a tongue disposed in juxtaposed relation to the trailing edge of said vanes, one or more of said vanes being provided with at least one transversely disposed groove formed in the trailing edge and adjacent the periphery thereof, and one or more openings extending from said trailing edge therethrough and communicating with a groove and a passage on the aft side of the impeller.

8. In an automatic priming pump, the combination of a housing having entrance and discharge means, said discharge means having a compartment constituted in part by a separator chamber, an impeller shell disposed in said compartment and having communication with said separator chamber, and an impeller disposed in said shell and having its passages formed by the vanes thereof in operative communication with said entrance means and said separator chamber through the opening in said shell, the discharge opening for said shell being disposed at the lower portion of said compartment and being defined in part by a tongue disposed in juxtaposed relation to the trailing edge of said vanes, one or more of said vanes being provided with at least one transversely disposed groove formed in the trailing edge and adjacent the periphery thereof, and one or more openings extending from said trailing edge therethrough and communicating with a groove and a passage on the aft side of the impeller, said one or more openings extending toward said periphery in a direction opposite to the direction of rotation of said impeller.

9. A fluid impeller comprising a plurality of vanes spaced to provide passages therebetween and having said passages defined circumferentially by openings formed between the edges of adjacent vanes, one or more of said vanes being provided with a trailing edge having a peripheral surface with one or more openings therethrough communicating with one or more of said passages.

10. A fluid impeller comprising a plurality of vanes spaced to provide passages therebetween and having said passages defined circumferen-

tially by openings formed between the edges of adjacent vanes, one or more of said vanes having one or more openings therethrough adjacent the periphery in communication with one or more of said passages and inclined toward said periphery in a direction opposite to the direction of rotation of said impeller.

11. A fluid impeller comprising a plurality of vanes providing passages therebetween, a transversely disposed groove formed in the trailing edge of one or more of said vanes, and said one or more of said vanes having one or more openings therethrough communicating with a groove on one side of said one or more of said vanes and with a passage on the other side of said one or more of said vanes.

12. A fluid impeller comprising a plurality of vanes providing passages therebetween, a transversely disposed groove formed in the trailing edge of one or more of said vanes, and said one or more of said vanes having one or more openings therethrough communicating with a groove on one side of said one or more of said vanes and with a passage on the other side of said one or more of said vanes, said one or more openings being inclined toward said trailing edge in a direction opposite to the direction of rotation of said impeller.

13. A fluid impeller comprising a plurality of vanes providing passages therebetween, a transversely disposed groove formed in the trailing edge of one or more of said vanes, and said one or more of said vanes having one or more openings therethrough communicating with a groove on one side of said one or more of said vanes and with a passage on the other side of said one or more of said vanes, said one or more grooves having a width different than the maximum width of said one or more openings in the same direction.

14. In an automatic priming pump, the combination of an impeller housing having intake and discharge chambers, an impeller shaft extending into said housing, an impeller removably mounted on the end of said shaft within said discharge chamber, an impeller shell disposed within said discharge chamber and embracing said impeller, said housing and shell having entrance means axially and centrally disposed with respect to said impeller and having openings on the side opposite said shaft for introduction of said impeller into said shell and for removal of the same therefrom, said impeller and shell having means cooperating to prime said pump, a stuffing box assembly for said shaft on the same side of the impeller as said entrance means, said entrance means comprising an annular passage surrounding the shaft at the junction of the impeller and stuffing box whereby the suction effect of the pump tends to eliminate leakage along said shaft and a closure for the openings of said housing and shell at the end of said shaft removably secured to said housing.

PERRY I. NAGLE.