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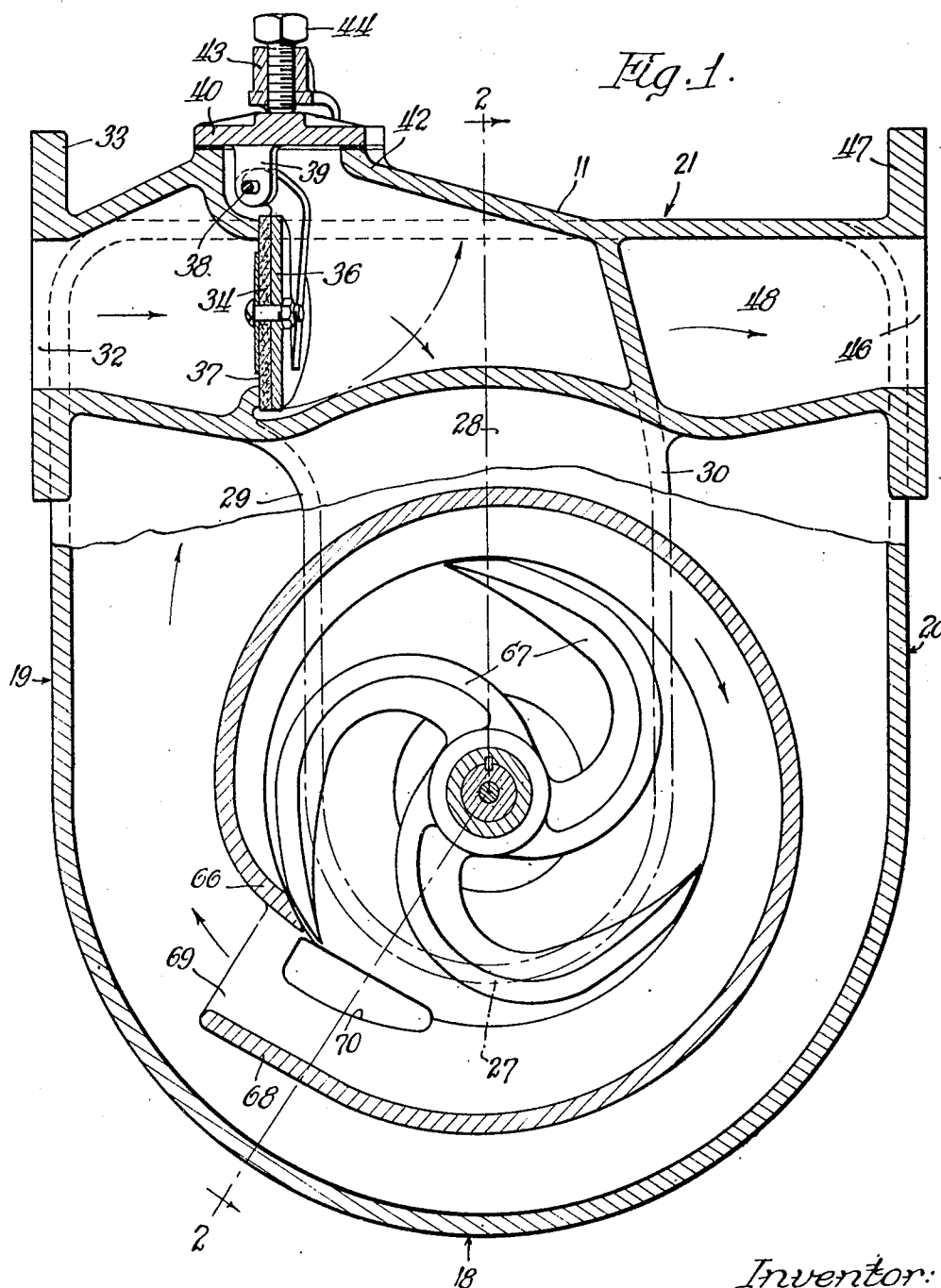
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2,244,397

SELF-PRIMING CENTRIFUGAL PUMP

Filed May 26, 1938

6 Sheets-Sheet 1



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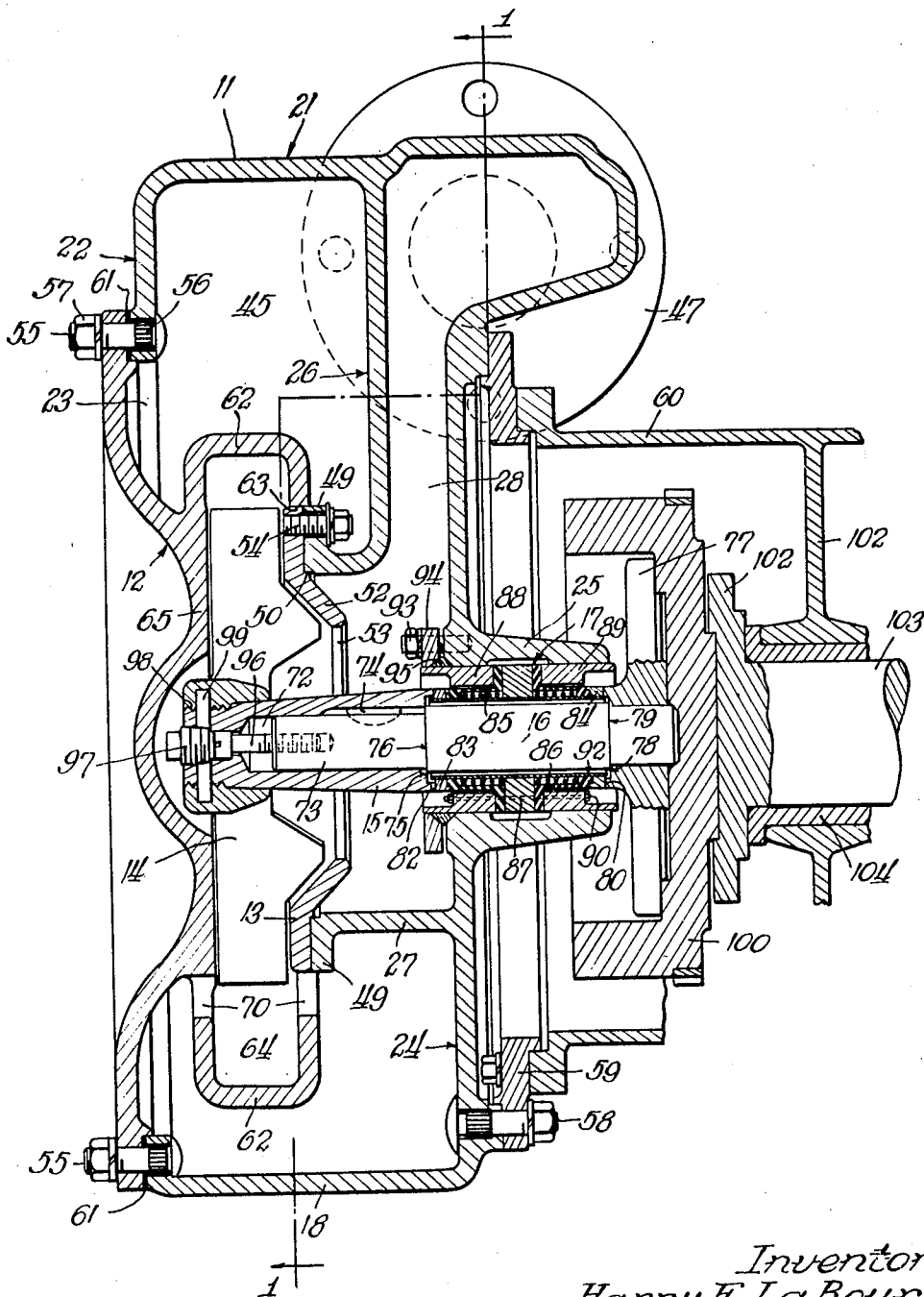
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SELF-PRIMING CENTRIFUGAL PUMP

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Fig. 2.



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SELF-PRIMING CENTRIFUGAL PUMP

Filed May 26, 1938

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Fig. 3.

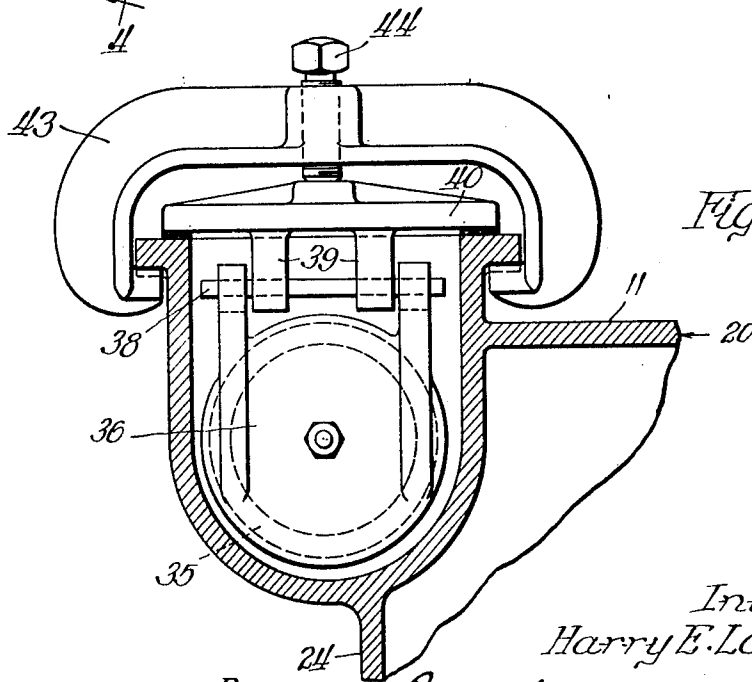
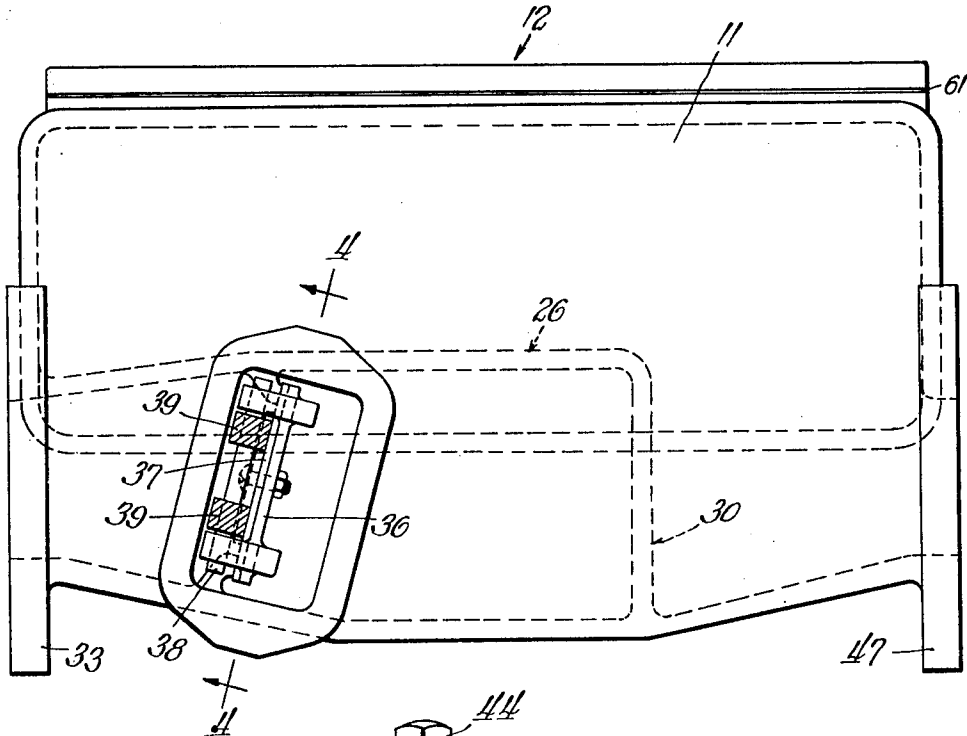


Fig. 4.

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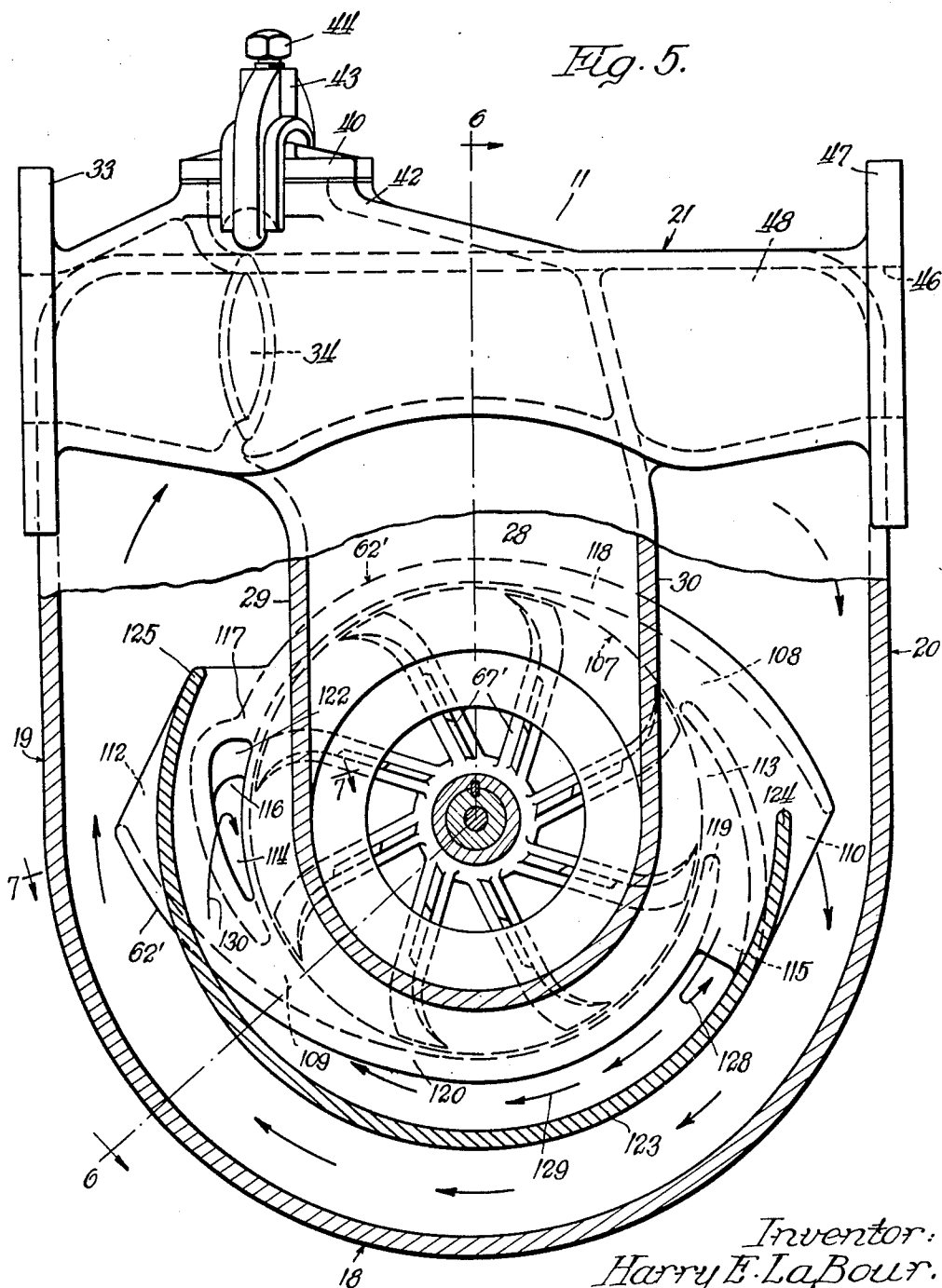
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2,244,397

SELF-PRIMING CENTRIFUGAL PUMP

Filed May 26, 1938

6 Sheets-Sheet 4



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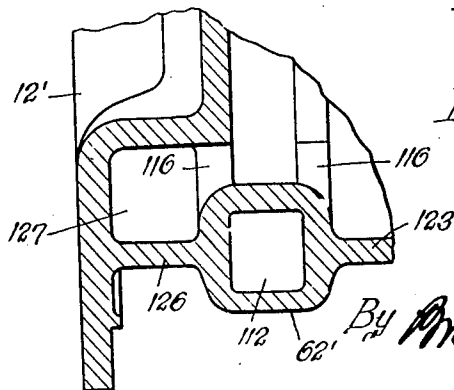
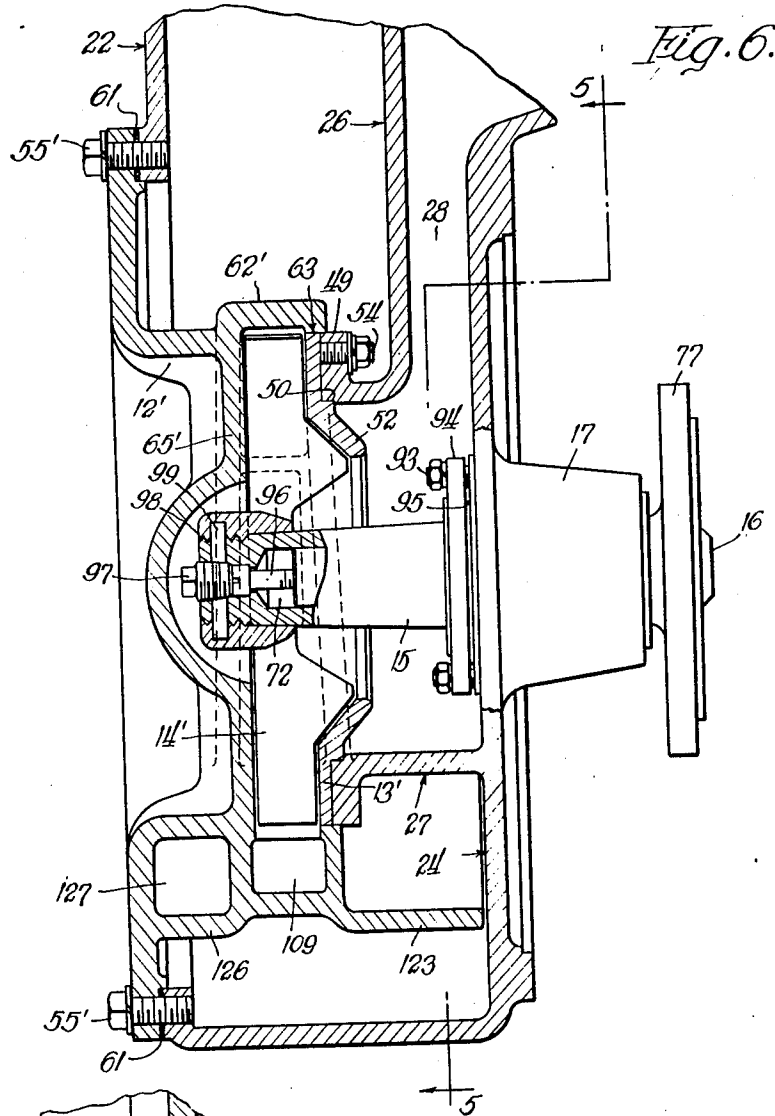
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SELF-PRIMING CENTRIFUGAL PUMP

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6 Sheets-Sheet 5



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2,244,397

SELF-PRIMING CENTRIFUGAL PUMP

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Application May 26, 1938, Serial No. 210,131

20 Claims. (Cl. 103—113)

The present invention relates to self-priming centrifugal pumps. While the specific embodiment herein shown is intended for general hydraulic service rather than the more exacting chemical service, it is to be understood that the specific form herein shown and the service for which it is intended are not limiting, but illustrative.

The pump herein disclosed embodies improvements which are capable of being employed in various forms and for various uses. Also, the pump herein disclosed contains two distinct improvements embodied in the same structure. The first is that of a self-priming centrifugal pump which may be used in either a horizontal or vertical position without change of the operating parts which make it self-priming and, second, the concept of building a pump of such construction that the wearing parts may be made of one metal, such as a durable, wear-resisting metal or alloy, whereas the main frame or body may be made of another metal or alloy, such as a light-weight metal to reduce the overall weight of the unit.

The pump herein illustrated and described embodies a number of desirable objectives in pump construction, among others the following:

1. A self-priming pump which may be used in either the horizontal or the vertical position without alteration of the pump structure.

2. A pump having the suction and discharge connection and operating parts so located that all the operating parts may be replaced without disturbance of the pump shell on its mounting and without disconnecting either the suction or the discharge.

3. A pump having a construction permitting interchangeable casings and impellers to suit different head and capacity requirements and the like, thus lowering manufacturing costs.

4. A pump having all the working parts so reduced in size and isolated from the large, expensive castings, that these working parts may be replaced at a minimum cost.

5. A pump of simple design, permitting low cost and compact construction reducing space requirements.

6. A pump wherein the parts subjected to severe wear may be made of materials most resistant to wear, and yet keeping these parts reduced in size and weight so that they will not be excessively expensive. At the same time, this pump permits the use of a light-weight material such as aluminum or aluminum alloys for the

larger parts which would normally have the greatest effect on the weight of the pump.

7. A pump which permits the use of the type of casing employing the so-called trash type impeller, and a large open throat of the type disclosed in my copending applications, Serial No. 118,032, of December 29, 1936, and 175,187, of November 18, 1937.

8. A pump permitting the use of a multiple throat construction of the type shown in Patent No. 2,110,883, of March 15, 1938.

9. A pump permitting the use of a mechanically sealed gland so arranged that it normally operates under suction only, thereby being protected when the pump is operating with dirty or gritty liquid.

10. A pump and gland construction so arranged that the gland may be removed or replaced from the front of the pump without disturbing any more parts than would be necessary for the replacement of an impeller as referred to in paragraph 2 above.

11. A pump consisting of a main body casting and an impeller housing insertible into and removable from the main body and wherein only a single gasket is required for these parts.

In attaining the above objectives a number of structural features of novelty are involved, among them being the following:

(a) Disposing the inlet trap upon the shaft side of the pump with the inlet opening uppermost in either position.

(b) Disposing the discharge trap or separator with its outlet on the shaft side of the pump so that the outlet is uppermost in either position of the pump.

(c) Providing a check valve for the intake trap or intake of a pump of the class herein described operable in either the horizontal or vertical position without change.

(d) Providing a complete hollow body with an opening adapted to receive the active pump parts and to be closed by insertion of the pump parts into the body.

(e) Providing a separate impeller casing or housing which is divided into two parts on the diameter of the impeller and mounting one part on one wall and the other part on another wall of the hollow pump body.

(f) Mounting one of the parts of the impeller casing or housing on or integral with the closure plate that closes the external opening into the body.

(g) Eliminating all gaskets except one, i. e., the one that closes the outside opening.

(h) Making the joint between the two parts of the impeller casing or housing a telescopic joint so that variation of the thickness of the external sealing gasket offers no difficulty in fitting the two parts together.

Now in order to acquaint those skilled in the art with the manner of constructing and operating a specific embodiment of my invention I shall now describe, in connection with the accompanying drawings, a specific embodiment of the invention and mode of operation thereof.

In the accompanying drawings which form a part of the present specification, and in which like reference numerals designate like parts—

Figure 1 is a section taken from the shaft side of the pump, that is, from the right of Figure 2 on the line 1—1 of Figure 2;

Figure 2 is a transverse, generally vertical section taken on the line 2—2 of Figure 1;

Figure 3 is a top plan view showing particularly the location of the check valve and the walls which separate the inlet from the discharge or separator;

Figure 4 is a fragmentary cross-sectional view taken on the line 4—4, showing the position of the gravity operated check valve in the intake connection;

Figure 5 is an elevational, partly sectional view similar to Figure 1, and taken on the line 5—5 of Figure 6, showing the same main frame with a different form of impeller and impeller housing, to form a multi-throat self-priming pump;

Figure 6 is a vertical sectional view taken on the line 6—6 of Figure 5;

Figure 7 is a section taken on the line 7—7 of Figure 5;

Figure 8 is a side elevation, partly in section, taken on the line 8—8 of Figure 9, showing a self-priming single throat pump usable in either horizontal or vertical position;

Figure 9 is a rear elevational view of the same;

Figure 10 is a view like Figure 8, showing a single throat self-priming pump usable in either horizontal or vertical position without an intake trap; and

Figure 11 is a similar view of a further modification in which the inlet is upon the shaft side of the pump casing.

The illustrations of Figures 8, 9, 10 and 11 are largely diagrammatic.

Now referring first to the form of pump shown in Figures 1 to 4, inclusive, it will be seen that the pump comprises, first, the main housing or frame unit 11 and second, the cover plate and impeller housing unit 12. A third main stationary part is the side plate and inlet member 13. The chief moving parts comprise primarily the impeller 14, its connected shaft 15, and the driving shaft section 16. A packing gland unit, generally designated by the reference numeral 17, of the mechanical seal type, seals the moving system to the stationary housing 11, as will be described more in detail, hereinafter.

Referring first to the main frame and housing unit 11, this unit comprises substantially, and in a preferred form, a hollow unitary casting of aluminum or aluminum alloy. Obviously, the material of which the unit 11 is made is optional within the invention, but by the use of aluminum or aluminum alloys a large amount of weight is avoided, since this comprises the most expensive structural feature of the pump. This main unit is hollow and is formed with a generally semi-cylindrical bottom wall 18, vertically extending

end walls 19 and 20 tangent to the cylindrical bottom wall 18, and a substantially flat top wall 21 which, preferably, is approximately at right angles to the walls 19 and 20. A flat front wall 22 which, in the position shown in Figures 1 and 2, is substantially vertical, has a large circular opening 23 disposed substantially concentric with the axis of the impeller 14 and its shaft 16. A substantially parallel back wall 24 has a central hub or boss 25 for receiving the packing gland unit 17. This hub or boss 25 is likewise substantially concentric with the axis of the impeller and its shaft. An intermediate wall 26 extends down from the top wall 21 and is joined to a curved cylindrical bottom wall 27 to define an intake passageway generally designated as 28. The lateral flanks or sides of this inlet passageway 28 are defined by vertical walls 29 and 30 (see Figure 1) and the intake passageway 28 then extends substantially horizontally, in the position shown in Figures 1 and 2, to a flanged inlet opening 32.

In the horizontal portion of the inlet passageway and trap 28 there is disposed a valve port 34 having a valve seat disposed obliquely with respect to both a vertical line and a horizontal line. This valve seat 35 is shown in dotted lines in Figure 4. It is adapted to be closed by a gravity operated flap valve 36 having a suitable facing 37 and being hinged upon a pin 38 the axis of which also is oblique to a horizontal plane when the pump is in either a vertical or a horizontal position. The pin 38, in the present case, is mounted in a pair of lugs 39 carried by the cover plate 40. This cover plate 40 is held over the flanged opening in domed wall 42 as by means of a hooked clamping bar 43 and a central set screw 44. Obviously, instead of a fixed pin hinge, a flexible or fabric hinge of known construction might be employed, and also it is to be observed that instead of a flap valve a gravity operated ball valve might be employed, it being understood that in that case the ball would fall by gravity to the seat of the valve port, whether the pump be in vertical or in horizontal position.

The space within the main casing unit not employed by the intake trap and passageway 28 and lying outside of the pump impeller casing, forms a separating space or chamber 45. This separator forms a trap when the pump is in either a horizontal or vertical position, by virtue of the placement of the discharge or outlet opening 46 at the top of the separator chamber 45 when the pump is in the horizontal position as shown in Figures 1 and 2, or in the vertical position, that is, when the shaft 16 is disposed in a vertical position. The discharge outlet 46 has a surrounding coupling flange 47 and this opening 46 leads to the inside of the separator 45 through a lateral passageway 48 which, in effect, forms a dome into which the air tends to gravitate when the pump is in either a horizontal or vertical position.

It will now be observed that the inlet opening 32 and the discharge or outlet opening 46 are disposed substantially in line and at the upper inner corner of the main frame unit, so that whether the pump be in the horizontal position shown in Figures 1 and 2 or in the vertical position (not shown), the inlet and outlet openings 32 and 46, respectively, are so disposed that they tend to trap liquid in the intake and in the separator chamber, whereby a charge of priming liquid is provided.

The intermediate wall 26 and the semi-cylindrical wall 27, with the side walls 29 and 30, merge into a short tubular neck having a large circular opening surrounded by the clamping flange 49. This opening is intermediate in size between the relatively large opening 23 which is closed by the cover plate and the relatively small opening for the shaft in the opposite wall. This clamping flange has a planar surface against which is clamped the corresponding planar surface of the inlet side plate member 13. The said side plate member 13 has a radial shoulder at 56 to pilot the side plate member 13 accurately in the opening in the flange 49. The member 13 has a flared conical wall 52 with a central opening 53 through which the shaft of the impeller member 14 extends and which also forms communication between the inside of the impeller casing and the intake trap 28.

In the form shown, the main frame or housing casting 11 is made of aluminum or aluminum alloy which is relatively soft, hence, to bolt to the relatively thin walls it is preferable not to cut threads in the main casing or body portion. In clamping the side plate 13 upon the flange 49 the studs 54 are set or threaded into the wall 52 of the side plate member 13, which is of a wear-resisting material and hence harder and stronger than the metal of the flange 49. Similarly, in bolting the unit 12 over the opening 23, the bolts 55 are inserted from the inside through openings formed in the wall 22, these bolts having knurled or fluted portions such as 56 to keep them from turning when the clamping nuts 57 are drawn tight. Similarly, the bolts 58 employed for clamping the main body portion to the mounting plate or member 59 secure the clamping of these parts in the aforesaid manner.

The adapter plate 59 may be varied with the mounting of the pump, but in the form shown in Figure 2 it couples the flanged bell housing 60 of an internal combustion engine to the main frame 11 of the pump.

The cover and impeller casing unit 12 consists of a circular disc-like member having a flange piloted into the opening 23 and clamped under the bolts 55 to the front wall 22, a suitable gasket 61 being interposed to make a tight joint. This unit 12 has cast integral therewith the peripheral impeller housing portion 62. This impeller housing 62 comprises the operating features of a pump casing in combination with the side plate 13. That is to say, there is a circular opening in the impeller housing portion of the unit 12 which fits fairly closely the periphery of the inlet side plate member 13. The joint at 63 is intended to be a fairly close fit. Packing might be employed at this point but it is not, particularly necessary, since the volute channel 64 defined by the periphery of the impeller casing is always under pressure when the pump is in operation, and leakage out into the separator does no particular harm. The joint is located at the tips of the impeller blades, where substantially maximum pressure prevails at all times that the impeller has sufficient liquid to operate upon.

Obviously, the impeller housing, as such, might be split on the left side of the volute wall as viewed in Figure 2, instead of on the right side. That is to say, the volute and side plate member 13 might be integral instead of having the volute 62 and the side plate member 65 integral. There are several advantages in the construction shown; first, that it is easier to get at the im-

PELLER and the fastening means, such as the bolts 54, when the volute housing 62 is made integral with the cover plate member 12, and, second, the weight and the forces of pumping are better supported on the large circle of bolts 55 than on the smaller circle of bolts 54.

The volute portion 62 of the housing comprises the cut-off portion 66 (see Figure 1), which has a machined surface just clearing the tips of the impeller blades 67, 67 of the impeller 14. The volute also comprises a spout portion 68 with the outlet opening 69 and lateral inlet openings 70, 70 through which openings 70, 70 priming water may return into the periphery of the impeller to be mixed up with air in the impeller casing during priming and ejected out of the spout 69. It is to be observed that the inlet trap and separator are so related to the pumping casing and impeller that re-entry of priming water will occur during the priming operation but will be prevented from re-entry during liquid pumping.

The method of operation of the pump shown in Figures 1 to 4 is broadly that of my basic Patent No. 1,578,236, of March 23, 1926, and specifically that of the pump disclosed in my copending application, Serial No. 175,137, above referred to.

The impeller 14 as shown herein is fastened as a unitary member upon the end of the shaft section 15. The shaft section 15 is bored out to provide a cylindrical socket 72 to receive the reduced portion 73 of the shaft section 16 in telescopic relation, these parts being keyed together as indicated by the key at 74. The shaft section 15 is counterbored to provide a shoulder 75, resting against the shoulder 76 of the shaft section 16. At the outer end of the shaft section 16 a mounting plate or spider 77 is likewise counterbored to provide a shoulder 78 cooperating with a shoulder 79 on the shaft section 16. The hub of the member 77 has an annular wear shoulder 80 which may be faced with a metal highly resistant to wear, and the shaft section 15 similarly has a wear shoulder 82, likewise faced with a material highly resistant to wear, for engagement with the stationary rings 83 and 84 of the packing gland. These rings 83 and 84 are connected to rubber diaphragm members 85 and 86, respectively, having radial flanges clamped to a central block 87 by means of aligned cylindrical cheek pieces 88 and 89 which are held together by longitudinally extending bolts 90, whereby the packing gland member is a unitary, axially expansible device mounted upon the impeller shaft but releasable by separating the sections 15 and 16. A guiding sleeve 92 which preferably but not necessarily is a unitary cylinder is keyed or pinned to the end rings 83 and 84 and to the central block 87 to prevent turning of the rings 83, 84 and to hold the rings 83, 84 and the diaphragms 85, 86 in alignment. The external cylindrical surface of the gland unit is fitted fairly closely in the bore of the hub member 25, in which it is axially adjustable to the desired position. Upon being adjusted to the desired position it may be fixed and sealed in place by means of the studs 93 and clamp ring 94 which compress a packing 95 upon the cylindrical surface of the cheek piece 88.

While I have herein shown and above described one form of a packing unit, I prefer to employ the particular form of packing unit shown in my copending application, Serial No. 206,425 filed May 6, 1938.

While in the specific form of packing unit herein shown, an adequate seal is produced if the shaft section 16 runs fairly true, the packing unit shown in my copending application above referred to, permits not only of axial play but of lateral or, in fact, universal movement, even though the shaft 16 be subject to appreciable eccentricity or wobble.

The two shaft sections are held together by a screw bolt 96 which seats in a bore in the outer end of the shaft section 15, this bore being closed by a pipe plug 97.

In casting the impeller upon the end of the shaft section 15, the shaft section is first threaded, as indicated at 98, and provided with a transverse pin or key 99. Then the shaft is put in the mold and the hub of the impeller cast around the same with the blades integral. Thereafter, the shaft section 15 and the impeller are suitably finished, as by grinding and machining.

The mounting plate or spider 77 is clamped, as by bolting, upon a suitable seat on the engine flywheel 100 which, in turn, is carried upon the flange 102 of the engine crank shaft 103, which crank shaft is supported in suitable bearings 104 rigid with the bell housing 60, so that the stationary parts and the movable parts are all held accurately in alignment.

When it is desired to remove the impeller the cover plate and housing unit 12 is released by releasing the bolts 55 so that the unit may be pulled off of the housing unit 11, revealing the impeller 14. Thereupon the pipe plug 97 is unscrewed, the screw 96 is released, and the shaft section 15, with the impeller 14 thereupon, may be pulled off of the stud or reduced shaft portion 73. The impeller may then be replaced, if desired, or, if desired, the packing gland unit 17 may be released and withdrawn, leaving the shaft section 16 in place. Also, at this time, the side plate member 13 may be replaced or interchanged, if desired. All of these operations may be performed without disturbing the pipe connections, the mounting of the pump, or any other fixed part.

Only one gasket is required and that is the gasket 61, which is external and easily accessible. Variations in the thickness of the gasket or the degree to which it is tightened have no adverse effects, within limits, upon the fit of the impeller casing nor upon the tightness of the inner joints.

The check valve is likewise accessible for inspection, renewal, cleaning and the like, without disturbing any of the pipe connections or any of the other fastenings.

It is to be understood that instead of the particular form of gland above disclosed, any other form of gland having a flange taking the place of the ring 94 and being capable of being clamped in place might be employed, such packing gland requiring no specific axial location on the shaft sections 15 and 16, which need to provide only a cylindrical surface.

While I have not shown the lubrication circulation feature disclosed in my copending application above referred to, it is to be understood that where the same is employed the reservoir will extend upward and to the right as indicated in Figure 2, so that the reservoir will be uppermost whether the pump is in the horizontal or in the vertical position.

In operation, the pump is mounted as, for example, by means of the bell housing 60 or any other suitable mounting, and it is to be under-

stood that the mounting may be widely varied. For example, the independent bracket or bearing construction shown in my prior Patent No. 1,993,999, of March 12, 1935, is intended as one method of mounting the pump in a horizontal position.

If the pump is to be mounted in a vertical position the shaft 15, 16 extends vertically upward and the pump may be mounted, for example, by legs integral with the cover and housing unit 12, or the pump may be suspended from a support such as a bell housing 60 connected to a motor either of the electric or internal combustion type, the various methods of supporting the same being, I believe, within the skill of the art.

The suction and discharge pipes or hoses may be connected to the flanges 33 and 47 as by mating flanges and, assuming the pump to be in the horizontal position as shown in Figures 1 to 4, inclusive, the pump may be filled with liquid by releasing the cover plate 40 and the check valve 36 and introducing water into the inlet trap 28. The valve and cover plate being replaced, the impeller is then rotated in a clockwise direction as viewed in Figure 1. The impeller 14 herein shown is simply one form of impeller which may be employed, it being understood that any suitable impeller desired for the particular operation for which the pump is adapted may be employed. Upon rotation of the impeller, liquid is driven out of the impeller housing, out of the spout 68, and into the separator space 45. As soon as this is accomplished, air enters the impeller and the resultant pressure developed by the impeller on air being insufficient to overcome any appreciable back pressure of the hydrostatic head of the liquid, liquid flows back into the impeller as soon as the drop in pressure permits, and liquid and air are churned up or mixed in the impeller housing and driven out of the spout 69. The mixture tends to follow the inner peripheral wall of the volute 62 and, following this wall, is lifted away from the impeller so that the impeller has a region of low pressure at about the openings 70, and liquid freed of air returns through these openings into the impeller, continuing this recirculation and evacuation of air until the desired degree of vacuum in the suction passages pulls liquid over, and then pumping proceeds with the discharge of liquid out of the spout 69 and some of it out through the openings 70. The flow reversing at the openings 70 provides additional outlets and tends to prevent any clogging of the said openings.

While I have shown the spout 68 as directed upwardly, in the lower left hand quarter of Figure 1, it is to be understood that since the mounting of this housing unit is on the cover plate member 12, any desired position of the spout 68 about the axis of the shaft may be secured if desired. I prefer the disposition of the spout 68 within the lower half of the casing in order to insure adequate travel of the mixture to the surface of the liquid in the separator and adequate sealing of the return opening 70 during the priming operation.

When the pump is in the position shown in Figures 1 to 4, that is, with the shaft horizontal, the level of water in the separator will be in a horizontal plane parallel to the shaft, but if the pump is placed in a vertical position the level of the water will be at right angles to the axis of the shaft, but no substantial difference in mode of operation results, since the level of

liquid in the separator will be maintained high enough, because of the location of the outlet 46, to seal adequately the openings 70 and also to provide a free surface for the separation of the air from liquid.

Obviously, the right hand opening 70 shown in Figure 2 might be closed or omitted if the pump were to be used only in vertical position. In that case a larger opening in the bottom side of the volute, corresponding in capacity to the two passageways 70—70 might be provided.

Upon the cessation of pumping, liquid tends to run back through the pump and down the suction pipe to the source. The check valve 36 is intended to stop this, chiefly for the purpose of saving the escape of too much liquid from the inlet pipe or trap 28. Without some means of retarding the back flow, there might be times when the backward rush of liquid through the pump down to the source would carry too much of the liquid out of the pump unit for satisfactory priming on the next operation. Hence, the check valve 36, even if it should leak, will prevent such back rush of water and will thereby insure the trapping of an adequate amount of priming liquid in the pump.

While the outlet and inlet openings are shown axially in line, it is to be understood that this is optional, the desirable feature being that they be at approximately the same level for the trapping of liquid, for trapping is the most reliable method of retaining the charge of priming liquid. For general operation this is the preferred manner, but it will be obvious that within my invention, reliance may be put upon a check valve, operating in either the horizontal or the vertical position of the pump, for retaining an adequate charge of priming liquid in the separator and pump casing.

In Figures 5, 6 and 7 I have shown the main frame or shell 11 as provided with a cover and impeller housing unit 12' having multiple outlets and embodying the structure and mode of operation disclosed and claimed in my prior Patent No. 2,110,883. The impeller unit 14' is of a type which substantially sweeps the periphery of the casing between multiple outlets and is of any preferred type, such, for example, as that shown in the aforesaid Patent No. 2,110,883. The tips of the impeller blades 67', 67', describe the circle 107 and with little more than mechanical clearance they sweep the inner cylindrical portions of the periphery of the impeller housing 62'. In the embodiment shown in Figures 5, 6 and 7 there are two sets of discharge throats or outlets from the impeller housing 62', namely, the main throats 108, 109 which terminate in divergent passageways 110 and 112, respectively, and the auxiliary throats 113 and 114 which likewise diverge into passages 115 and 116 (see Figure 5). The casing 62' is substantially concentric from the point 117 to substantially the point 118 in advance of the throats 108 and 113 and likewise, on the other side, the casing is concentric from the point 119 to substantially the point 120 in advance of the throats 109 and 114. These throats and their passageways are substantially tangential, outwardly flaring passageways for reducing the velocity of flow of the liquid discharged by them respectively during liquid pumping.

It will be observed that the throat 114, instead of discharging in the plane of the impeller, opens out sidewise as indicated at 116, on each side of the casing 62', there being a

wedge-shaped prow or wall 122 for dividing the stream discharged at this point during liquid pumping, half of it going to one side of the plane of the impeller and half to the other side.

In order to prevent air discharged with mixture from one of the main throats from reaching too quickly the auxiliary or priming throat during the priming operation, I have provided a baffle arrangement comprising the arcuate baffle 123 which extends from the point 124 above the outlet 110 of the main throat 108 on the right hand side of Figure 5 to a point 125 substantially beyond the outlet 112 of the main throat 109. An integral web 126 lies upon the opposite side of the impeller housing 62' and is formed preferably integral with the cover plate and housing unit 12', as may be seen from Figures 6 and 7. The baffle arrangement operates during priming as follows. Assume that the pump casing has been charged with a priming charge of water and the suction hose lowered into a source of water, the pump is started into rotation in a clockwise direction as viewed in Figure 5. The impeller promptly discharges the water from the impeller casing and empties the intake passageway 28, drawing air into the impeller and impeller casing. Liquid then tends to return through the auxiliary passageways 115 and 116 through the throats 113 and 114 into contact with the tips of the impeller blades. This priming liquid is mixed with air and carried by the impeller blades to the respective main discharge throats 108 and 109, where the mixture is discharged continuously so long as priming proceeds. It will now be observed that the mixture discharged from the main outlet 110 is directed inside the main separator chamber below the arcuate baffles 123 and 126 and is driven around in a clockwise direction to the left to where it is joined with the discharge from the other main outlet 112. Thereupon the mixture of air and liquid, some of which has tended to separate by gravity in the meanwhile, is driven upwardly, at the left of Figure 5, towards the surface of liquid in the separator with the result that air escapes at the said free surface of the liquid, and liquid from which air has been separated flows over towards the left in a generally clockwise direction and then drops down on the upper side of the baffle 123 and 126, some of the liquid flowing into the auxiliary passageway 115 as indicated by the arrow 128 on Figure 5. Other parts of the liquid not flowing into the priming throat 115 continues as indicated by the arrow 129 (Fig. 5) and flows upwardly to the auxiliary throat 116 and enters as indicated by the arrow 130 on Figure 5.

A like flow occurs on the opposite side of the impeller casing 62', where the side plate of the unit 12 and the arcuate baffle 126 forms a passageway 127 communicating, on the left-hand side, as viewed in Figure 6, with both of the auxiliary passageways 115 and 116. In this manner, priming proceeds in an orderly fashion without danger of short-circuiting mixture from a main discharge throat immediately to one or both of the auxiliary throats. Thereby the mixture discharged is given ample time to produce separation of the gas from the liquid.

The normal level of liquid in the separator will be at, or slightly below the bottom of the discharge opening 46, as viewed in Figure 5 and in Figure 1.

The structure of the packing gland and the general method of constructing the impeller and

the driving shaft thereof for the pump shown in Figures 5, 6 and 7 may be the same as that described in connection with Figures 1 to 4, inclusive, or any other preferred form of construction for these parts may be utilized.

Thus it will be apparent that within the aforesaid teaching in regard to the renewable or interchangeable impeller and casing, I have shown in Figure 1 a volute type of casing and trash type of impeller, while in Figures 5 and 6 I have shown the concentric type of impeller casing and a substantially straight bladed type of impeller.

The pump casing 62' may be of the volute type with a volute and corresponding outlet for each half or third of the circumference of the impeller. That is to say, each outlet becomes during priming a means for discharging mixture and for the reentry of liquid to be mixed with gas and ejected at the next succeeding outlet.

Within the teaching of my invention the construction of a pump for use in either horizontal or vertical position may be accomplished without the removable or interchangeable impeller housing, as illustrated diagrammatically, for example, in Figures 8 and 9.

As shown in Figures 8 and 9, an impeller casing 140 containing an impeller 141 is provided with a separator 142 having the lateral extension 143 at the upper shaft side, so that the outlet 144 will be uppermost whether the pump be in the horizontal or in the vertical position. Likewise, the impeller housing 140 has the intake trap 145 located on the shaft side, and it terminates in an outlet 146 which is substantially in line with and at the same level as the discharge outlet 144.

The shaft 147 for the impeller 141 extends through a stuffing box of any desired type 148, in a wall of the intake trap 145. The impeller casing 140 may be of the volute type, having a cut-off at 149, shown in dotted lines in Figure 9, a discharge spout 150, as shown in dotted lines in Figure 9, and the lateral inlets 152, 152 in accordance with the teachings of my copending application Serial No. 175,187 above referred to.

The operation of the pump shown in Figures 8 and 9 will be apparent from the above description, namely, that it will operate as a self-priming pump in either the horizontal or in the vertical position of the shaft 147. If desired, a suitable check valve such as the double position check valve 36 shown in Figure 1 may be employed in the intake trap 145 or in the passageway leading thereto, but it will be understood that this is optional.

Also within my invention, the intake trap as a means for retaining a charge of liquid may be dispensed with and reliance placed upon a two-positional check valve 153, as shown in Figures 10 and 11. In that case the intake passageway may be placed opposite the shaft side, as at 154 in Figure 10, or it may be placed on the shaft side, as at 155 in Figure 11 of the impeller casing. The impeller casing may be of the volute type above referred to in connection with Figures 8 and 9, having a spout 150 disposed above the bottom of the separator 142, with side inlet passageways such as 152 serving as auxiliary inlets and discharge passageways during priming and liquid pumping, respectively.

Where the pump is to be made up for vertical use only, the type of gland shown in my

copending application, Serial No. 206,424, filed May 6, 1938, may be employed.

It will be apparent to those skilled in the art that numerous modifications in detail may be made without departing from the spirit of my invention. I do not intend, therefore, to be limited to the details shown and described, except as they are significantly recited in the following claims.

I claim:

1. A self-priming centrifugal pump capable of operating in either a vertical or a horizontal position, comprising an impeller casing having a centrally disposed inlet opening and a peripheral discharge, an impeller in the casing having a driving shaft extending from one side of the casing, a separator chamber communicating with the discharge of the impeller casing and having a discharge outlet disposed at a sufficient radial distance from the axis of the shaft to provide a trap for a charge of priming liquid when the shaft is horizontal and at a sufficient axial distance from the plane of the impeller and on the shaft side of said impeller casing to provide a trap for a charge of priming liquid when the shaft is vertical, means submerged in the trapped liquid in either horizontal or vertical position of the trap for returning priming liquid into the impeller casing during priming and an intake connection having means for preventing the escape of a priming charge of liquid when the pump is disposed in either horizontal or vertical position.

2. The pump of claim 1 having an intake trap in the intake connection, said trap having an inlet opening lying at approximately the same radial distance from the axis of the shaft and at approximately the same axial distance from the plane of the impeller, respectively, as said discharge outlet.

3. The pump of claim 1 wherein the means in the intake connection comprises a swinging flap valve the axis of which is diagonal to the plane of the horizon and the valve tends to close by gravity when the pump is in either the horizontal or the vertical position.

4. A self-priming centrifugal pump operable in either vertical or in horizontal position, comprising an impeller casing having a central inlet and a discharge outlet, an impeller having a driving shaft extending out of said inlet, a separator communicating with the discharge outlet and having means for retaining a charge of priming water during priming when the pump is in either position, said means comprising an outlet opening disposed at substantially the junction of the top and side walls of the separator whereby said opening is uppermost in either position of the pump and an intake trap communicating with the inlet of the casing and having means to prevent the escape of priming water during the time the pump is not operating and when the pump is in either position.

5. The pump of claim 4 wherein the intake trap has an intake opening which lies above the inlet opening of the impeller casing in either of said positions of the pump.

6. In a pump, a combined integral impeller housing and cover plate unit comprising a circular imperforate disc-like member having sealing and piloting surfaces at its margin for mounting the unit in a circular opening, the impeller housing comprising a peripheral pumping channel with an integral side plate, said housing having a discharge throat leading from the inside

of the channel to the outside thereof, said housing having a circular opening in the side thereof opposite said integral side plate large enough for the introduction of an impeller into the housing.

7. The unit of claim 6 wherein the impeller housing comprises an integral volute having a cutoff and a discharge spout, said discharge spout constituting during priming as means for conducting a discharge of gas and liquid from the impeller housing and an inlet of liquid back into the impeller housing.

8. In a pump of the class described, a main hollow body casting having inlet and discharge chambers and a dividing wall between them, an impeller, a two part impeller housing for the impeller comprising first a side plate carried by the dividing wall and being apertured for entry of fluid from the inlet chamber and second a main impeller housing part open at one side to pass over the impeller and telescopically embrace the side plate, said second part comprising a closed side plate and a mounting flange, means for attaching the mounting flange to the wall of the discharge chamber, and an impeller shaft extending through an opening in the wall of the inlet chamber.

9. In a self-priming centrifugal pump, a main hollow body casting having inlet and discharge chambers, comprising respectively an inlet trap and a separator, and a dividing wall between them, an impeller, a two part impeller housing for the impeller comprising first a side plate carried by the dividing wall and being apertured for entry of fluid from the inlet chamber, and second a main impeller housing part open at one side to pass over the impeller and telescopically embrace the side plate, said second part comprising a closed side plate and a mounting flange, and a channel portion, said channel portion having peripheral throating leading to the discharge chamber inside the hollow body, said throating comprising means for returning priming liquid from the separator into the impeller during priming, means for attaching the mounting flange to the wall of the discharge chamber, and an impeller shaft extending through an opening in the wall of the inlet chamber.

10. A self-priming centrifugal pump adapted to operate in either horizontal or vertical position comprising an impeller chamber provided with an impeller and having an outlet, an inlet passageway leading into the central part of the impeller chamber, a gas and liquid separator communicating with the outlet of the impeller chamber and having a discharge outlet said outlet communicating with the inside of the separator at the junction of the two walls which are top and side walls when the pump is horizontal and side and top walls when the pump is vertical, whereby a charge of priming liquid is retained in the separator in either position, and means in the inlet passageway operable in either position of the pump to prevent the escape of said charge of priming liquid.

11. A pump of the class described comprising in combination a hollow integral main body casting with internal walls dividing the space into two chambers constituting a separator and an inlet trap respectively, there being an insert opening in a wall of the separator, and a shaft opening in a wall of the trap in alignment with the insert opening, said internal walls comprising an annular rim defining an opening aligned with said openings, an apertured inlet side plate de-

tachably secured to said rim, an integral imperforate cover and impeller casing member removably attached to said main body portion with the impeller casing disposed inside the separator with separating space surrounding the periphery of the impeller casing, one side of the impeller casing having an opening which permits insertion of the impeller, said last named opening being closed by a sliding fit with the periphery of the side plate, an impeller in said casing, and an impeller shaft extending through the shaft opening.

12. An integral cast hollow pump body for a self-priming centrifugal pump comprising a housing which has walls defining a separator chamber and an inlet trap, said body having integral tubular discharge and intake connections communicating with said separator and trap respectively, the walls of the separator having a relative large opening, the walls of the inlet trap having a relatively small opening for an impeller shaft, said walls comprising an intermediate wall between the separator chamber and the trap with an opening of intermediate size, said first and last named openings being each surrounded by an annular rim having an annular clamping face for the attachment thereto of impeller housing parts and said opening being substantially coaxial.

13. In a centrifugal self-priming pump, the combination of an integral cast hollow pump body comprising a housing which has walls defining a separator chamber and an inlet trap, said body having integral tubular discharge and intake connections communicating with said separator and trap respectively, the walls of the separator having a relatively large opening, the walls of the inlet trap having a relatively small opening for an impeller shaft, said walls comprising an intermediate wall between the separator chamber and the trap with an opening of intermediate size surrounded by an annular rim having an annular clamping face, an impeller housing side plate having a central opening, said side plate being clamped to said annular clamping face, an imperforate cover plate clamped to the main body over said first named opening, said cover plate forming an imperforate impeller housing side plate, said cover plate having an integral impeller housing channel portion with an opening embracing the first named side plate, said housing channel portion bearing an integral hollow projection defining a discharge passageway which opens into the separator and being insertible and removable through said first named opening when the cover plate is applied and removed, an impeller in said housing, and a shaft therefor extending out through said shaft opening.

14. A self-priming centrifugal pump adapted for operation with the shaft vertical, comprising a main hollow body casting having walls defining a separator and an inlet trap, discharge and inlet connections from the top of the separator and the trap, respectively, there being an opening in the bottom of the separator, an imperforate cover plate for closing said opening, the bottom of the inlet being defined by a tubular wall, an impeller housing side plate with a central inlet opening clamped to the tubular wall, the cover plate having a part forming a cooperating impeller housing side plate, there being a peripheral housing portion integral with one of said side plates and having a sliding joint with the other of said side plates to define an impeller housing, said peripheral housing portion defining an internal channel and having a discharge port and a re-

entry port opening into said separator, the separator providing free space around the periphery of the housing portion, and an impeller in said impeller housing cooperating with said channel.

15. In a pump of the class described, a hollow main body having chambers constituting a trap and a separator, said body having an internal wall between said trap and separator having a circular opening, an external wall for the separator having a circular opening in alignment with the first opening, an impeller housing disposed in and surrounded by the separator, an impeller in the housing, said housing being divided by a cylindrical telescopic joint of a diameter large enough to clear the periphery of the impeller into two parts comprising, first, an integral side plate and channel member, the channel member carrying one or more discharge spouts, and the side of the channel member having a circular bore forming the external part of said telescopic joint and, second, a side plate member having a circular periphery adapted to fit said bore and forming the internal part of said telescopic joint, one of said members having formed integral therewith an imperforate closure disc adapted to be clamped to the margins of the opening in the external wall and sealed by a compressible gasket, the other of said members being clamped over the opening in the internal wall and having a central inlet opening, and a shaft for the impeller extending through said latter opening and through the wall of the trap.

16. In a pump, a combined integral impeller housing and cover plate unit comprising a circular disc-like member having sealing and piloting surfaces at its margin for mounting the unit in a circular opening, the impeller housing comprising a peripheral pumping channel with an integral side plate, said housing having a circular opening in the side thereof opposite said integral side plate large enough for the introduction of an impeller into the housing, said housing having a peripheral main discharge opening and a peripheral auxiliary discharge opening which latter opening is adapted to serve as a priming liquid inlet during the operation of self-priming, and a wall for shielding the auxiliary inlet from undue interference by the main discharge opening when the pump is priming.

17. For use in a self-priming centrifugal pump, a combined integral impeller housing and cover unit comprising an imperforate closure member having circular sealing and piloting surfaces at its margin for mounting the unit upon a circular sealing seat, the impeller housing comprising an integral impeller channel member and side plates, said channel member having walls defining a pair of adjacent discharge passageways opening substantially tangentially out of the channel, said passageways constituting a main discharge passageway and an auxiliary or priming passageway, liquid directing means for directing the discharge of the main discharge passageway away from the auxiliary or priming passageway to prevent interference during priming, said impeller housing having a circular opening in the side thereof opposite said integral side plate large enough for the introduction of an impeller into the housing.

18. In a vertical centrifugal self-priming pump a pump body comprising a substantially circular impeller housing disposed in a substantially horizontal plane, said body comprising a casing defining a separator chamber surrounding the impeller housing and extending above and below the plane of the impeller housing and adapted

to provide an annular free surface of priming liquid during priming, a discharge outlet communicating with the space above said free surface, said housing having walls defining a pair of adjacent substantially tangential discharge passageways opening at their inner ends into the inside of the housing on substantially the same horizontal plane and communicating at their outer ends with the separator chamber at different levels to avoid interference during priming of a mixture discharged into the separator by the one passageway with the return of liquid through the other passageway, and an impeller mounted for rotation on a vertical axis disposed in said housing, and means to trap a charge of priming liquid in said pump body.

19. A centrifugal self-priming pump comprising a stationary part and a rotary part, the rotary part comprising an impeller and a shaft therefor, the stationary part having three functional chambers, namely an inlet chamber, an impeller chamber communicating centrally with the inlet chamber and peripherally with the discharge chamber, and a discharge chamber surrounding at least a part of the inlet chamber and a part of the impeller chamber, said stationary part comprising three separate members, namely a main frame member provided with fixed inlet and discharge connections and comprising a part of the walls of the inlet and discharge chambers and having an opening for the impeller shaft, an imperforate closure member provided with fastening means for securing it to the main frame member, said closure member forming a part of the walls of the discharge chamber and of the impeller chamber, and a third member having a telescopic joint with the said closure member, said joint being substantially at the periphery of the impeller and lying within the discharge chamber, said third member having means for securing it to the main frame member and forming a part of the walls of the impeller chamber and of the inlet chamber and having an inlet opening between the impeller chamber and the inlet chamber through which the impeller shaft extends out of the impeller chamber.

20. The combination of a pump body comprising a hollow casting having a closed top wall with a central opening for a shaft in said top wall, said casting comprising outer and inner walls concentric with the central opening, the inner wall terminating in an annular rim, the outer wall terminating in an annular gasket surface lying below the said rim, said inner wall defining interiorly thereof a trap and the space between the inner and outer walls defining a separator, tubular inlet and discharge connections providing external communication with the upper end of the trap and separator, respectively, an annular top impeller housing plate secured against the annular rim, said plate having a central opening forming an impeller housing eye, and a closure plate having a gasket surface cooperating with said first-named gasket surface and forming a closure for the lower end of the outer wall, said closure plate forming also a bottom impeller housing plate and having an annular wall cooperating with the top plate for closing the periphery of the impeller housing, said annular wall having throating communicating with the separator, and an impeller in the impeller housing, said throating comprising a pair of throats, and a directing flange separating the throats from each other.

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