Aug. 4, 1942. H. E. RUPP 2,291,760

LIQUID SUCTION PUMP

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Fig. 1.

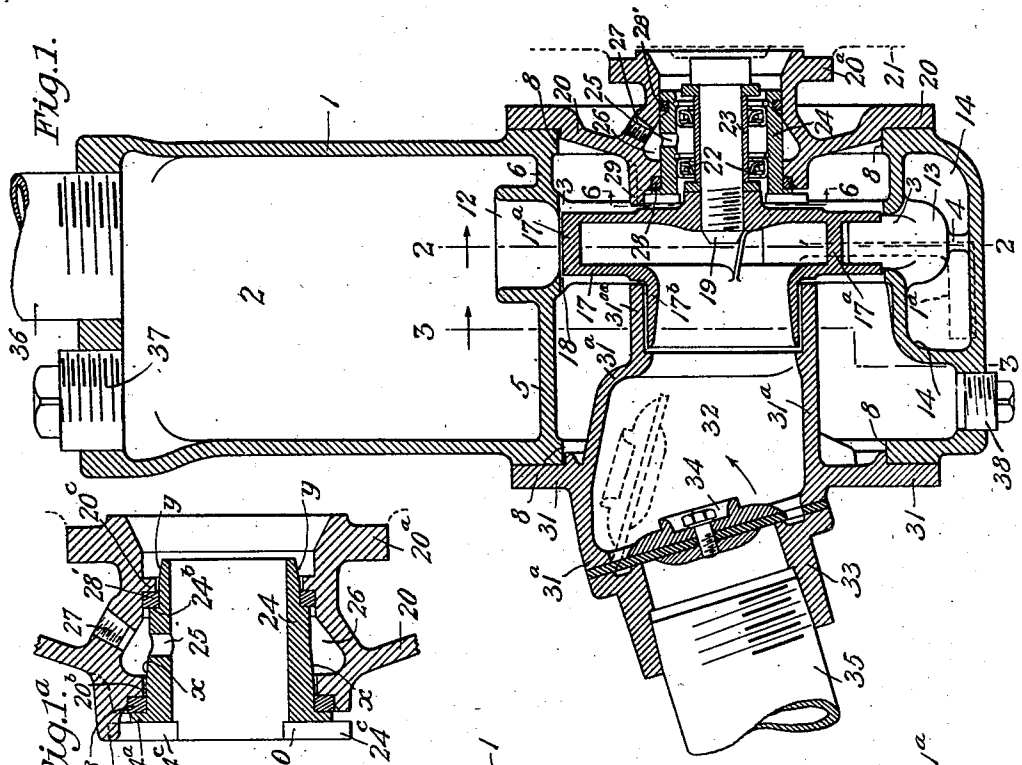
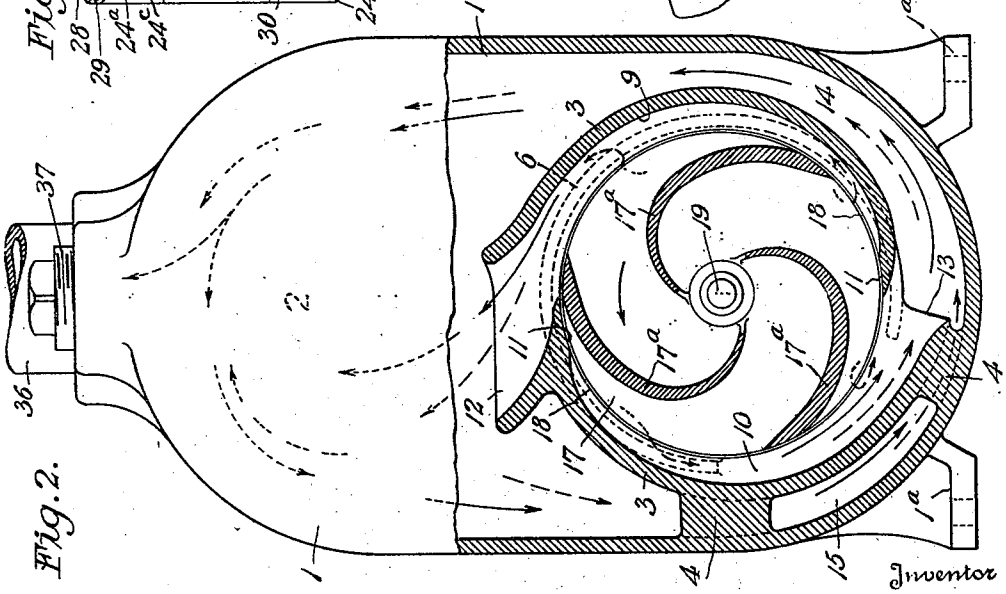


Fig. 1a.

Fig. 2.



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Fig. 4.

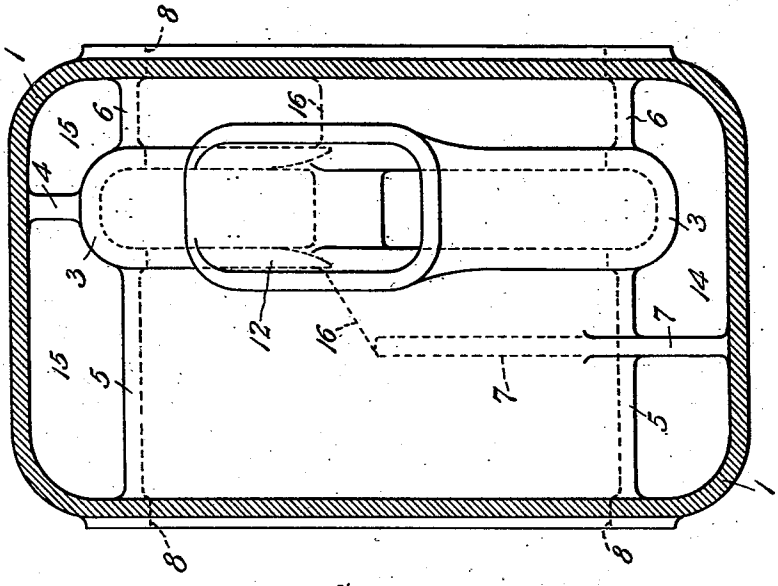
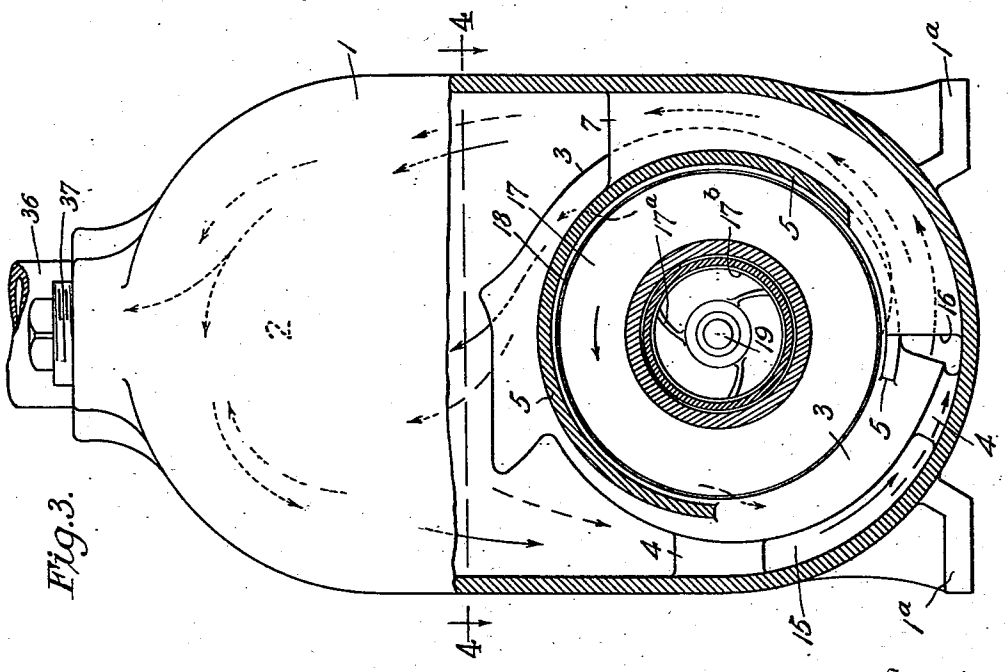


Fig. 3.



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Fig. 5.

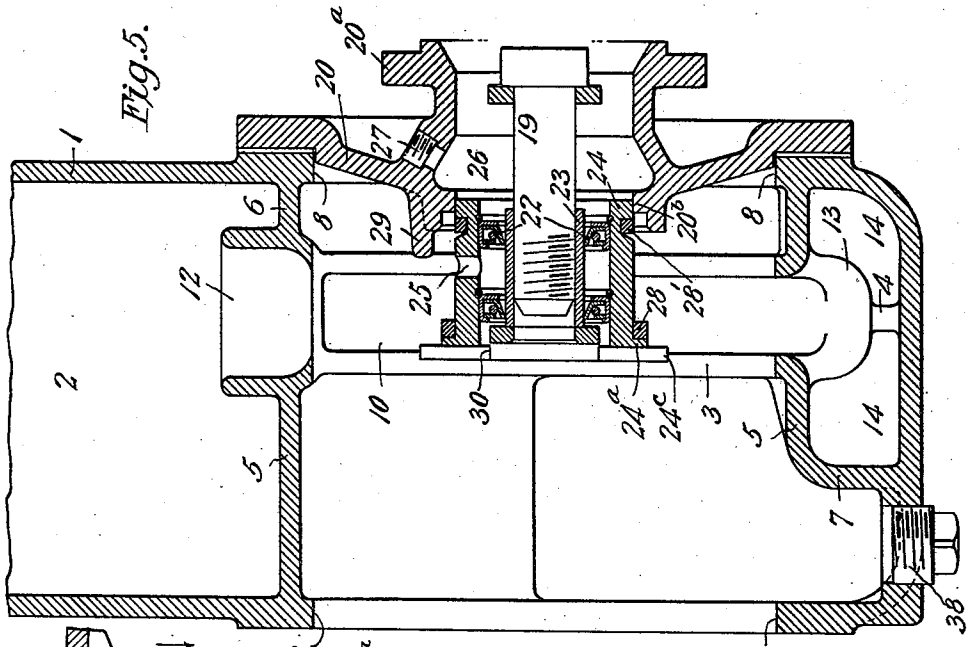


Fig. 7.

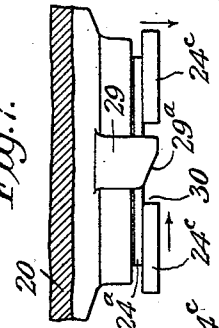


Fig. 5a.

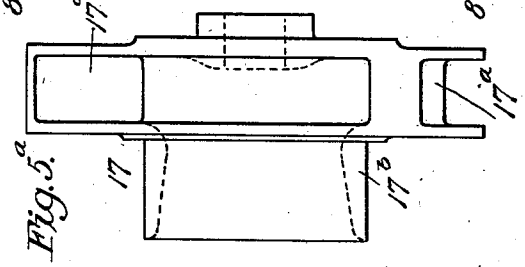


Fig. 6.

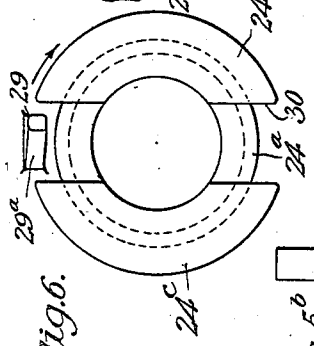
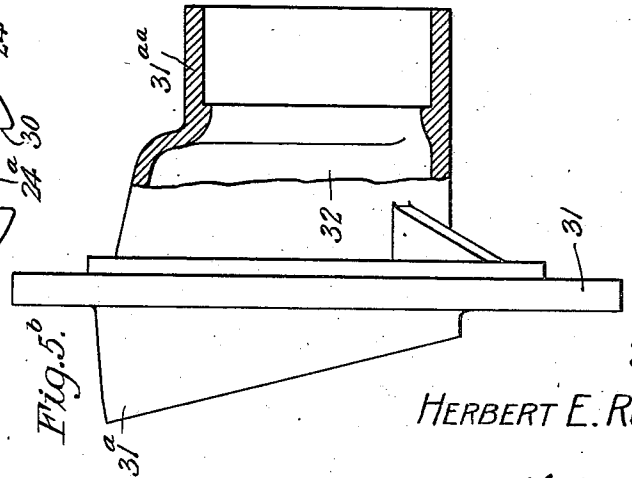


Fig. 5b.



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Fig. 8.

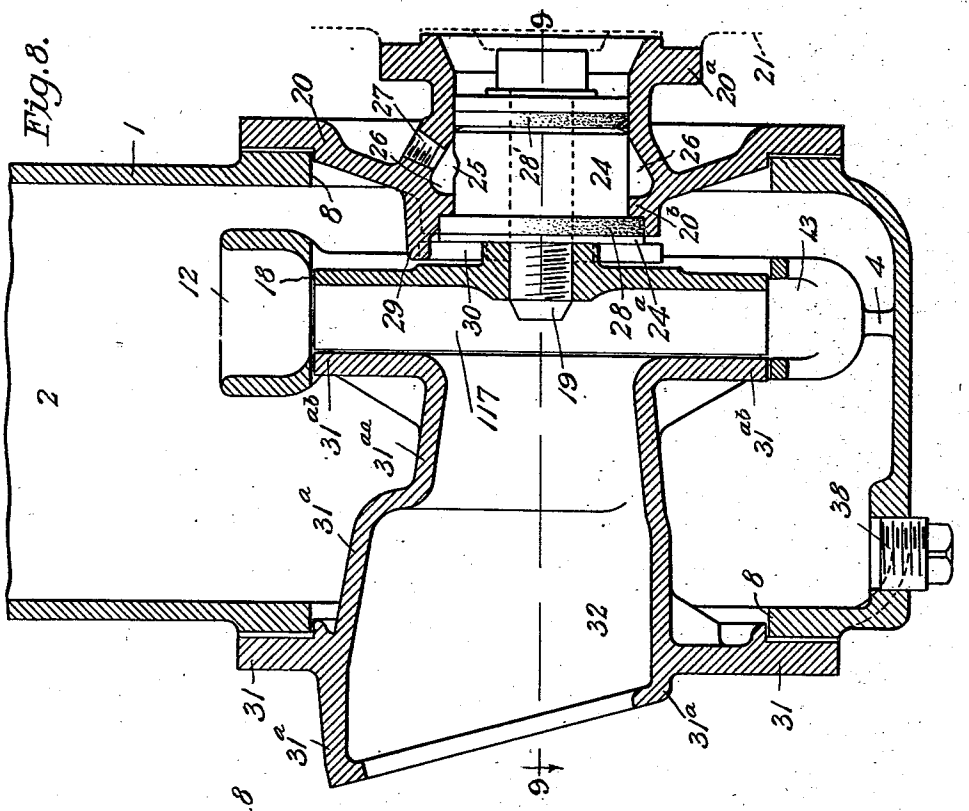
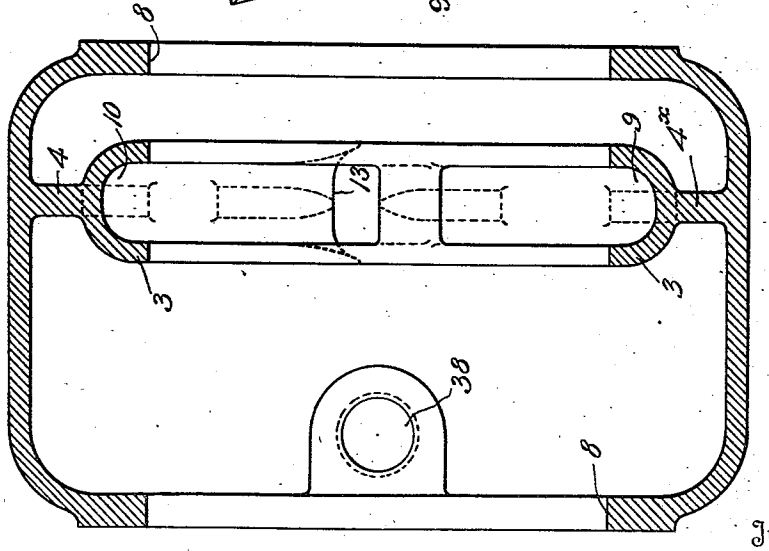


Fig. 9.



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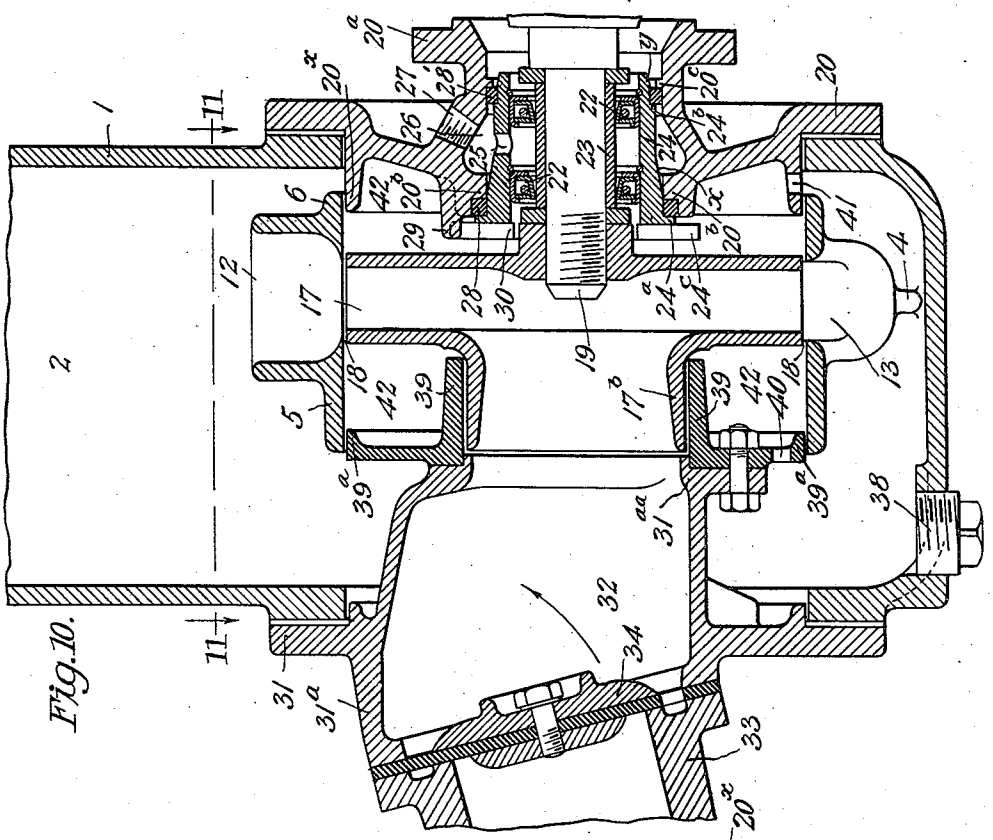


Fig. 10.

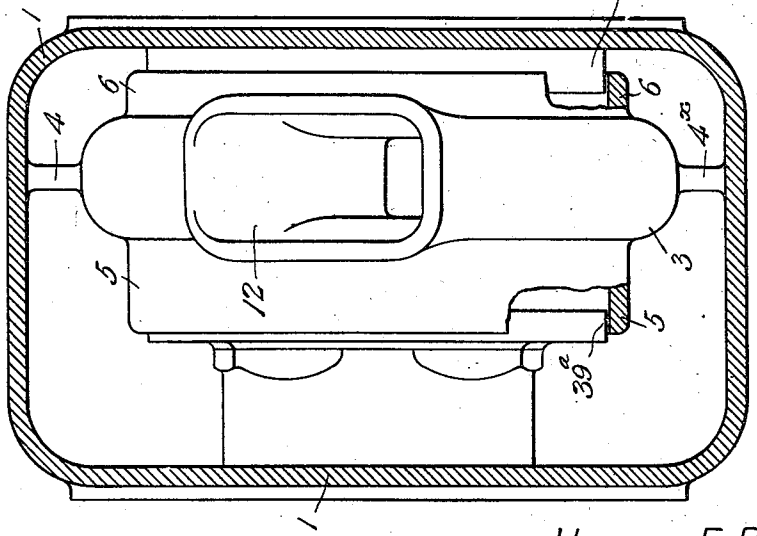


Fig. 11.

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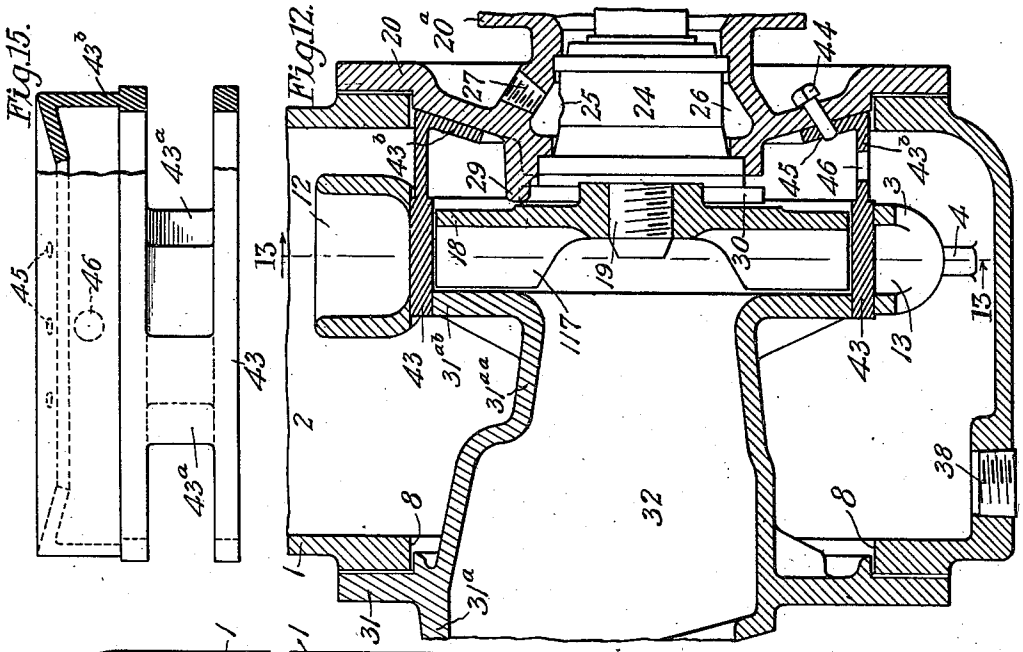


Fig. 15.

Fig. 12.

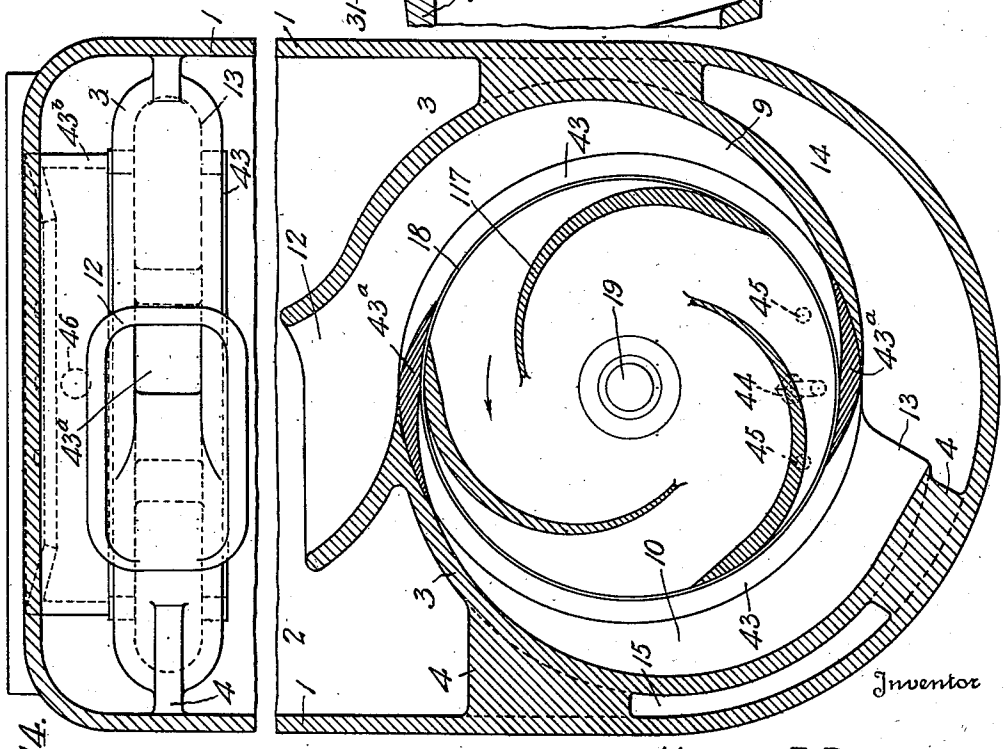


Fig. 14.

Fig. 13.

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Patented Aug. 4, 1942 2,291,760

UNITED STATES PATENT OFFICE

2,291,760

LIQUID SUCTION PUMP

Herbert E. Rupp, Springfield Township, Richland County, Ohio

Application March 29, 1940, Serial No. 326,743

23 Claims. (Cl. 103—113)

This invention relates to liquid pumps, or to improvements in liquid pumps, having reference more particularly to that type and class of such devices known as "centrifugal pumps" embodying a bladed impeller rotatable in a volute form of casing or surrounding chamber and designed to be "self-priming."

An object of the invention is to provide an improved self-priming pump in which the priming action of evacuating air and gas from its suction line or inlet is rapid and performed in very quick time; that is, a pump adapted to prime for regular pumping operation in a manner both speedy and highly efficient. At the same time it is aimed to avoid any impairment of efficiency in the primary function or regular pumping action of the pump, such as the employment of bi-passes and valve arrangements might produce, but on the contrary to actually increase the working efficiency and capabilities of the device.

Another object, incident to the first-stated priming purpose, is to provide a pump capable of handling considerably more air and gas than any ordinary pump of relative size and capacity, so that it will not only more quickly and effectually prime but will thereafter be less affected in ordinary pumping performance by any air or gas that may find its way into the suction line insufficient to actually break the established suction.

Still another object is to provide a pump capable of handling or pumping out rocks and other solid material that may be drawn thereinto through its suction line which would otherwise tend to clog the pump and render it ultimately inoperative.

A further object is to provide a pump wherein the working parts are easily accessible to reach and removal for repair or replacement—and which can be removed by hand rather than by the need of some tool. In this connection also it is aimed to provide a very simple construction in which the parts are relatively few and no special machining thereof or therefor is necessary.

In general it is sought to provide a substantially improved pump construction whereby material advantages of operation will be attained. This general purpose has reference to the pump capacity, economy and wearing qualities.

Additional objects will be stated or made to appear in the following specification, wherein the invention for better and more comprehensive understanding will now be described in fuller detail with reference to the attached drawings illustrating, by way of example, one practicable embodiment of the same, with modifications, in the form of a trench pump.

In said drawings:

Fig. 1 is a side vertical section view of the pump, showing certain connections broken away and omitting the motive unit;

Fig. 1[a] is a somewhat enlarged fragmentary view illustrating a modification of a part of Fig. 1;

Fig. 2 is a front end view of the pump with its lower portion shown in section taken on the line 2—2 of Fig. 1, looking rearwardly as indicated by the arrow;

Fig. 3 is another front end view with the lower portion shown in section taken a little more forwardly on the line 3—3 of Fig. 1, also looking rearwardly as indicated by the arrow;

Fig. 4 is a horizontal or plan view section across the pump taken on the line 4—4 of Fig. 3 upon a slightly enlarged scale;

Fig. 5 is an enlarged and partly broken-off view corresponding to Fig. 1, wherein certain of the connected parts have been withdrawn and another part of sleeve form, comprising a special retaining member, is shown partly removed from place, this and the next two successive views jointly illustrating the several parts in separated assembly relation;

Fig. 5[a] is a side elevation of the impeller part in applicative relation to the pump body of Fig. 5;

Fig. 5[b] is a side and partly sectional elevation of the front closure and coupling part, also in applicative relation to the pump body of Fig. 5;

Fig. 6 is a front end view of the special retaining member or sleeve part of Fig. 5 as seen from the front end of the pump or on the line 6—6 of Fig. 1 looking rearwardly;

Fig. 7 is a top plan view of said special retainer member as viewed through the top of the pump, indicating its manner of extraction or removal from place;

Fig. 8 is an enlarged view corresponding substantially to Fig. 1, illustrating a modification of the structure accommodated to a case in which an open or different form of impeller is used;

Fig. 9 is a horizontal or plan view section across this modified structure of the pump, taken on the line 9—9 of Fig. 8;

Fig. 10 is another enlarged view also corresponding substantially to Fig. 1, illustrating another modification of the structure of an alter-

native character, and in which the modification of Fig. 1ª is also included;

Fig. 11 is a horizontal or plan view section, similar to Fig. 9, taken on the line 11—11 of Fig. 10;

Fig. 12 is a further enlarged view similar to Fig. 1, illustrating still another modification;

Fig. 13 is a vertical section taken on the line 13—13 of Fig. 12;

Fig. 14 is a plan view looking downward upon the structure of Fig. 13; and

Fig. 15 is a plan view, partly in section, of the principal modificational part shown in Figs. 12 and 13.

In the illustrative embodiment, referring first to the construction of Figs. 1 to 7, the pump body is formed by the shell-like casing 1 having foundation rest portions or feet 1ª for securing in place. The upper part of this casing provides a chamber 2 serving as an air and liquid separating space during the priming action of the pump and constituting a mere liquid body space in the pumping operation of the same. The lower part of said casing contains an impeller housing or trough 3 supported by the web-sections or ribs 4 (see Fig. 2) and separated from the upper part in this instance by baffle portions 5 and 6 which also partially support the same (see Figs. 1, 3, 4 and 5). A partitioning wall 7 (see Fig. 4) that is later described serves to supplement the support of baffle portion 5. At opposite sides, forming the front and back in this example, the casing is formed with wall openings 8 in line with said impeller housing, the three, i. e. the center of said housing and the two said openings, being bored to the same size so as to afford easy assembly or dismantling and inspection through either side—permitting insertion or removal of the impeller member through either opening.

The said impeller housing 3 constitutes a channelway comprising a plurality of peripheral discharge passages or channels such as 9 and 10 of volute form in this instance surrounding the periphery of the impeller. It is shown formed in this instance with only two of said passages, due to the complication of illustrating a greater number, but in other constructions and certain instances of desirability therefor it is proposed to form it with a greater number of these passages. For example, the two shown might be duplicated with opposite corresponding passages on either side, as in the case of a width divided channelway, or a third, fourth or fifth passage might be added in circumferential relation, as when the channelway is of a larger diameter.

In the present embodiment composing only the two named passages, each extends substantially the full length of one side of the housing, or 180 degrees (see Fig. 2), one opening upwardly from the bottom along one side and the other opening downwardly from the top along the other side. These passages begin each with a cut-off point or edge 11, close to which the tips of the impeller blades sweep in their rotated movement, and enlarge or expand outward progressively from their said points. The upwardly opening passage 9 terminates in a wide discharge mouth 12 opening directly into the upper chamber 2, while the downwardly opening passage 10 terminates in a narrower discharge mouth 13 opening into the pump casing bottom, both in the direction of impeller rotation indicated by the arrow.

Opening from said bottom and receiving the discharge from said mouth 13 is another passage 14 (see Fig. 2) formed partly by the impeller housing and its supporting aforedescribed baffle-plates 5 and 6 partly by the aforedescribed partitioning wall 7, in conjunction with the wall of the pump casing (see Figs. 3, 4 and 5). This passage accordingly constitutes more essentially a divided-off casing space considerably wider than the mouth 13 discharging thereinto. It extends upwardly at one side around the outside of the impeller housing with full opening to the larger space above and so provides an indirect discharge of said mouth 13 into the upper chamber 2. At the opposite side a similar passage or space 15 extends downwardly around the outside of the impeller housing (see Figs. 3 and 4), except that it is divided vertically by the web-sections 4 and tapers to a restricted opening at the bottom under the bottom volute mouth 13. This latter passage discharges also into the former passage 14, through side openings 16 at the former's entrance, and provides for a liquid jet action to be later described.

The impeller mounted in said impeller housing or channelway comprises a rotor 17 of closed type in this instance, having a plurality of backwardly curved vanes 17ª partially overlapping one another (see Fig. 2). The front wall of this rotor is formed with a central projecting hub-like collar 17ᵇ (see Figs. 1 and 5ª) providing an axial opening in one side through which liquid is admitted between its vanes. The opposite wall or side however is entirely closed. Said rotor is mounted upon its shaft in close fit within the housing or channelway, leaving a peripheral (circumferential) clearance 18 therearound (see Figs. 1 and 2) great enough merely to ensure free rotation and to permit a certain amount of liquid to be drawn therethrough by suction.

The described impeller is operatively supported on a motive shaft 19 extending through the back wall opening 8 of the casing (see Fig. 1). Through this opening, which is the same size as the housing center or bore, the impeller accordingly may if desired be inserted, although it will generally be preferable to do all assembling and dismantling through the corresponding front opening. Said opening 8 around the shaft is closed by a plate 20 formed with a space for packing against leakage that is later described, said plate being of course marginally bolted, with intermediate gasketing (shown in Fig. 5), to the main casing. In this instance the said plate also carries a rearward flange 20ª boltable to the motive unit, indicated by the dotted line 21, which is coupled direct to the pump on the same foundation therewith and of which the shaft 19 forms a part. In other constructions however the arrangement might desirably or necessarily be different and it will be understood that said shaft may instead be an independent member separately supported and driven by some other or some remotely located power source.

The aforementioned packing around the shaft in its extension through the closure plate consists essentially of spring-pressed washer rings 22 encircling a sleeve 23 on the shaft body (see Fig. 1) adapted on the one hand to prevent leakage of liquid outwardly from behind the impeller or pump interior and on the other hand to prevent leakage of lubricant inwardly, or outwardly, from therebetween. Such a packing is disclosed for example in my joint patent with James C. Gorman No. 2,104,355 dated January 4, 1938 entitled "Shaft sealing means."

The described packing is contained within a retainer sleeve 24 fitting therearound in the shaft opening or bore of the closure plate 20. This retainer, carrying said packing members 22 and 23 as a unit therewith, is applicable to and removable from place around the shaft from the inside of the pump. A top hole 25 therein feeds lubricant between the packing rings 22 from a surrounding space 26 formed in the closure plate, which said space is filled through a plugged hole 27 in said plate. It is sealed against liquid passage or leakage therearound by front and back end sealing rings 28 and 28' of suitable material encircling the same. These sealing rings are advantageously carried on the retainer for expediency in applying or removing from place, the first or front ring 28 being seated between a head-flange or shoulder 24a of the retainer and an opposing flange or shoulder 20b of the closure plate and the second or back ring 28' being seated in a groove around the retainer against the bore of said plate. It may be preferable however to have both rings seated between opposing parts of the retainer and closure plate. Fig. 1a illustrates a modification in which the back ring 28', similarly to the front ring 28, is alternatively seated between a shoulder 24b of the retainer and an opposing flange or shoulder 20c of said closure plate. Also, in this modification, the retainer wall is exteriorly tapered slightly in rearward advance of both rings and their annular seating surfaces as indicated at x and y respectively. so as to better facilitate its application with said rings to place within the closure plate opening therefor.

Said retainer sleeve, pressed rearwardly in the shaft opening of the closure plate with its head flange 24a acting as a stop against the inner end thereof, is held in such position primarily by the impeller on the shaft in front of the same which prevents its movement forward, both by closeness to its forward end and by bearing against the packing sleeve 23. Other forces such as the action of liquid against said forward end tend also to press it rearwardly. Thus the effectiveness of the seal is increased by pressing its sealing rings the more tightly against their opposing surfaces and those forces which in the ordinary construction might tend to impair the effectiveness of the seal serve instead to enlarge it. The greater the inside pressure, the better and more positive the sealing will be. A further holding in the stated position is provided by a locking arrangement to hold the retainer against any rotational tendency. This includes a lug 29 formed immediately above the retainer on the inner end or side of the closure plate 20 (see Figs. 1, 6 and 7). Said lug extends into a notch formed in this instance by a diametrical slot 30 in the head portion or flanging 24c of the retainer, so as to be obstructively strikable by opposite edges of the latter (see Figs. 6 and 7) and thereby normally prevent turn movement in either direction. When the impeller is removed however, thereby exposing the retainer from the front as seen in Fig. 6, it may be turned in one direction against a beveled edge 29a of the lug so as to ride up on said edge and be simultaneously drawn slightly forward or outward, as indicated by the lateral and longitudinal arrows in Fig. 7, thus loosening to easy withdrawal or removal as illustrated in Fig. 5. The said lug accordingly serves both as a lock and as an extraction wedge for the retainer.

The front wall opening 8 of the casing is closed by a plate 31, which, similarly to the back plate 20, is marginally bolted to the main casing with suitable gasketing (not shown) therebetween. This front closure plate is formed with an opening neck or tubular portion 31a providing an inlet passage 32 extending inwardly to and in this instance around the central hub-like projection 17b of the impeller. That part 31aa which fits immediately around said central projection of the impeller is closely spaced thereto and preferably bored or recessed as shown for the purpose, in order to prevent or at least render practically zero the flow of liquid in either direction therebetween and at the same time permit the impeller to rotate freely. Said neck 31a of the closure plate extends also outwardly to a convenient projection extent, with an elbowing or canting of the outer edge in downward direction, and is fitted with a suction coupling 33 on its outer end. Between said outer end and the suction coupling a flap or flexible check-valve 34 is clamped in convenient and easily repairable provision of means for closing the inlet passage against return liquid flow, the said valve closing by weight upon its inclinative seat and opening by inward upward swing as indicated by the dotted line positioning thereof with liquid or air suction of the pump. To the suction coupling 33 of course is connected the suction pipe or hose 35 from the liquid source to be pumped.

Opposite to the suction inlet, the upper end of the pump casing is provided with a discharge pipe or hose connection 36 opening from the upper chamber 2, through which both air and liquid impelled by the impeller wheel is carried off. An opening closed by the plug 37 in the casing top provides for initially filling the pump with priming liquid. A similar opening closed by the plug 38 in the casing bottom provides a suitable drain.

The operation of this pump, in its priming and pumping cycles, is as follows:

Assuming that the pump space has been filled with priming liquid, the impeller is set into rotation by its driving means. In this connection it should be stated that the speed rate of drive is intended to be normally from 2000 to 3600 R. P. M., or in some cases as much as 5000 R. P. M., giving the impeller a high peripheral velocity; however, it will be understood that depending upon the particular design, capacity and purpose of the pump the speed rate may be varied either way—up or down—according to requirements or working conditions and that no limitation is imposed or intended to be imposed in said regard beyond what is necessary to the proper functioning of the pump Action of the impeller drives the liquid out of its rotational sphere into the surrounding liquid passages or channelway and upwardly therefrom into the chamber above, lifting said liquid level—possibly to a partial entry also into the discharge pipe 36—and substantially sustaining it bodily so lifted in gravity suspension tending constantly to surge back into the excluded space. At the same time it sets up liquid currents, induced by swirling movement, substantially as indicated by the broken-shafted arrows in Figs. 2 and 3, one passing upwardly through the discharge mouth 12, another passing upwardly through the passage 14 and a third moving downward in the passage 15.

Air in the impeller and mixed—by its centrifugal force—with the liquid surrounding it within said channelway or housing is carried in bubble form by said upward currents into the top of the chamber 2, where it is liberated and escapes off

through the discharge 36, aided by the opposing trends of said currents which tend to counteract each other and still the liquid in the upper part of said chamber. A certain amount of the air-freed liquid of course flows downward from said chamber to the bottom of the casing through the passage 15, where it unites with the current flow upward from the bottom discharge mouth 13 in the natural tendency to fill a forced void. The baffle plates 5 and 6 shield air from descent with such downward flow and tend to smooth out as well as to direct the movement of the liquid.

As the impeller continues to force air into the surrounding liquid, drawing it centrally from the suction inlet and driving it out with the dischargive liquid currents set up by its rotation, a certain amount of air-free liquid is drawn in from the casing space through the clearance 18 around its periphery as indicated by the shorter broken-shafted arrows in Fig. 2 to replace the liquid forced out of the discharge passages 9 and 10 at the orbit, this indrawn liquid being in turn whirled out in the current flow and mixing with or taking up air from between the impeller vanes so as to carry it off therewith. Actually this indrawn liquid serves for a compression and pushing or "batting" of the air by the vane tips into the discharging liquid within said discharge passages 9 and 10. Possibly a certain amount of the liquid in spray form will be drawn also through the clearance around the collar projection 17^b into the center of the impeller, in which event it would simply be thrown into the surrounding liquid, carrying some of the air with it, but such if any would be negligible and is not intended; rather is it sought to be avoided.

This priming action continues until all air from the casing, inlet passage and connected suction line has been exhausted or expelled out, the time required therefor being exceedingly short, whereupon the pump will begin pumping operation substantially like the ordinary centrifugal pump and the liquid flow or movement will undergo a slight change.

In the pumping operation, the liquid is of course drawn into the center of the impeller through its suction line and passage from the pumping source. This liquid is discharged out by the centrifugal force of the impeller through its surrounding discharge passages 9 and 10 and through the outlet connection from the top of the pump casing. The current trends of the liquid in thus expelling off are indicated by the full-shafted arrows in Figs. 2 and 3, being substantially the same as in the priming cycle except that the two upward flows are naturally predominately outward from the chamber 2, while the downward flow is more definite and regular. The liquid is forced or pumped out under the full force of the impeller which divides its discharge between the plurality of peripheral discharge passages, maintaining a continuous volume ejection as long as liquid is drawn into its center.

Due to the larger opening of the top discharge mouth 12 than the bottom discharge mouth 13, the force of discharge through the upward volute passage 9 is less than the force of discharge through the downward volute passage 10. This tends in a measure to permit the downward discharge back up the receiving passage 14 to overcome the shorter directly upward discharge into chamber 2. Thus the former in fact actually exerts the stronger force even at the top of said chamber and promotes a smooth evolution of the much less forceful downward flow at the opposite side into the passage 15. This downward flow is induced by the strong discharge up passage 14 into which said passage 15 as well as the bottom discharge mouth 13 delivers—both in the same direction. As the liquid is thus drawn down through passage 15, the converging form of the latter increasingly restricts its flow and causes a suctional pull at its bottom under the freely discharging mouth 13, thereby creating a strong jet or nozzling action sufficient to remove and expunge up the opposite receiving passage 14 any solid matter that may be drawn into the bottom of the pump casing. This is one of the important features of the present device and provides a pump which will be kept clear of the collection of debris that might clog and stop it.

The described pumping action gives a high lifting force and capacity to the pump which is wholly efficient in such operation as compared with other pumps of the same general type or class. Liquid that is mucky or laden with foreign matter is handled with the same effect as any clear liquid and there are no controlling valves or other movable parts to wear and impair the working efficiency. Once the pumping operation has started it continues until the pump is stopped or loses its prime and will be resumed again as soon as the drive is restored or the prime is reestablished. As to loss of prime during the pumping function, the ability to handle a large amount of air and gas and to prime very quickly renders the pump less affected by such air as may at times be drawn into its suction line not sufficient to actually break the prime.

Referring now to the modification of Figs. 8 and 9, an open type impeller 117 may if desired be substituted for the closed impeller 17 of the preceding disclosure. This substituted impeller is open at its front side but closed as formerly at the back. The central hub-like collar projection 17^b of the closed member being thus eliminated, the inlet opening neck 31^a in this instance is alternatively extended laterally from the former encircling portion 31^{aa} into a flanged plate portion 31^{ab}, providing a substitute for the omitted front wall of the impeller. An advantage of this modificational form is that the close fit between parts 17^b and 31^{aa} and the added possible liquid entry to the impeller through their clearance is eliminated. Another advantage is that when the front cover plate 31—with its neck extension 31^a—is removed, the interior of the impeller is revealed.

In all other respects the construction may be the same. However, additionally in this modification the pump casing and its contained impeller housing are shown formed with the baffle-plates 5 and 6 and the partitioning wall 7 omitted, in which case an extra web-section or rib 4^x—corresponding to the ribs 4—is necessary to properly support and rigidify said impeller housing. In certain instances it may be desired to construct the casing interiorly in this way, although the first described form is considered to be generally preferable.

The modification of Figs. 10 and 11 again employs the closed form of impeller 17, but in this instance the extended portion 31^{aa} surrounding its central hub-like collar projection 17^b is substituted or provided instead by a renewably removable collar-plate 39 attached to the shortened end of the inlet neck 31^a. A renewable element is thus incorporated for replacement when worn to avoid the necessity of supplying a whole new front plate.

If desired, said collar-plate may also serve to effect a control of liquid adjacent the sides of the impeller by a complete lateral enclosure provision. For such purpose it is formed with an annular flange portion 39ª fitting into the annular side opening of the baffle 5 continued all the way around in this instance in an abbreviated extension from the impeller housing. In said flange portion an orifice 40 is formed at its lower side. The front side of the impeller is thus effectually enclosed. At its back side similarly a corresponding annular flange 20ˣ formed on the back cover plate 20 is fitted into the annular side opening of the baffle 6 also continued all the way around in this instance in an abbreviated extension from the impeller housing. In said latter flange an orifice 41 is formed at its lower side. The back side of the impeller is thus correspondingly enclosed. This enclosure on both sides forms spaces 42 from which the liquid is excluded except as admitted through the bottom orifices 40 and 41. These can be made as large or small as desired to control the amount and rate of liquid admission therethrough. Thus, the amount of liquid present in said spaces to be drawn through the peripheral clearance 18 between the impeller and its housing or channelway may be controlled, or restricted to any lower segment of the impeller.

Figs. 12 to 15 illustrate a modification in which provision is made for changing the head capacity of the pump without necessity of rebuilding or remodeling it and which may at the same time be employed to effect a liquid control as described with reference to Figs. 10 and 11. This modification consists in a special insert ring-member 43 fitted peripherally between the impeller and its surrounding channelway, said insert consisting substantially of parallel rings registering with the edges of the channelway and connected by web-portions 43ª of substantially triangular cross-section (see Fig. 13) which fit registerably over or lappingly upon the cut-off surfaces 11 of said channelway passages in substitution or replacement of the same, the latter being cut back slightly for such purpose. In other words this insert constitutes a liner between the impeller and the channelway and its web-portions 43ª may if desired be formed to provide a longer or more extended cut-off surface. Thus, if it is desired to increase the head capacity, an insert member of larger inside diameter is fitted into place—the channelway being bored to larger size for the purpose—and a correspondingly larger impeller is mounted on its shaft; and if it is desired to decrease the head capacity an insert member of smaller inside diameter and a correspondingly smaller impeller are fitted into place.

Provision for changing the head capacity at will is accordingly made by very simple means. This is a very desirable feature, especially in pumps driven by electric motors which have a constant speed and are subject to overloading when the head conditions drop to a lower point. Another advantage of the insert is that the pump's air handling capacity depends upon the closeness of the cut-off surfaces 11 to the impeller vane tips. When the pump is working upon liquid containing abrasive material the cut-offs and the impeller vanes will both wear away from each other, but with this provisional feature it is merely necessary to fit the pump with an insert, or a new insert, and a new impeller, whereupon it will again be as good as new and will perform like a new unit.

The described insert of this modification will be held in place and against rotation by the closeness of its fit within the impeller channelway and requires no attachment or fastening. However, it may if desired be formed with a flange or with arms 43ᵇ and secured to the back cover plate 20 by one or more dowel pins or screws 44 as shown in Fig. 12. In this event it may be also rotatably adjustable or shiftable so as to laterally shift its web-portions 43ª to more or less lap-extensiveness over the cut-off surfaces, for which purpose extra positioning holes 45 therein are shown in Fig. 13. On the other hand, instead of comprising a separate element, it may be formed as a part of said cover plate by simply making the flange or arm portions 43ᵇ thereof integral with the latter as will be obvious without need of illustration. When formed with a flange 43ᵇ all the way around, either as a separate or as an integral element, it may additionally serve the purpose of the flange 20ˣ described in connection with Figs. 10 and 11 in effecting a liquid control enclosure at the back side of the impeller. In this latter event an orifice 46 corresponding to the orifice 41 in said other flange 20ˣ is formed in its lower or bottom side.

In addition to a rapid self-priming ability and efficient pumping operation, due to its structural formation with a plurality of impeller discharge passages, the described pump has the following particular advantages. There are no side walls adjacent the impeller to resist the liquid action and reduce or impair its effective centrifugal force. There is no vacuum or suction pull at any time upon the packing retainer sleeve, but only a constant pressure from its seating direction, so that even if a leak therethrough should develop it would not destroy or affect the pump's priming ability. The capacity and performance of the pump can be changed by altering the form of the impeller discharge passages and substituting a different cooperating impeller. The parts are all readily accessible and may be easily removed or replaced by reach of the hand. The pump can be easily and quickly dismantled. The entire assembly is simple and inexpensive in construction and there are few parts to become worn so as to require replacement.

Other modifications and various changes in the form and arrangement of the parts in their relation to each other, with different combinations or sub-combinations of the same, can plainly be made without exceeding the scope of this invention. It will therefore be understood that the appended claims are not intended to restrict the invention to the specific construction or arrangements shown, nor to otherwise impose limitations upon the same beyond what said claims themselves in specific terms define.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A self-priming centrifugal pump having in a housing around the periphery of its impeller a plurality of successively arranged circumferentially extending volute type passages opening lengthwise of said passages from extended segments of the impeller and gradually expanding toward and open at their forward ends, and a casing enclosing said parts provided a discharge chamber in which priming water can be retained at a level substantially higher than the other mentioned parts and from the upper part of

which air can escape during priming, the pump proper comprising the impeller and housing in which it rotates being laterally exposed in said chamber, the impeller being enclosed against reentry of water from said chamber laterally into the impeller pockets and there being a crevice or crevices allowing restricted intake of water from said chamber by the pump at and around the periphery of the impeller.

2. A centrifugal pump having passages successively arranged around an impeller housing and extending circumferentially of the impeller and opening therefrom lengthwise of said passages along successive extended segments of the periphery of the impeller, through which passages fluid discharges from said periphery, a discharge chamber containing said housing and into which said passages discharge, walls confining laterally the liquid in the impeller pockets, at least one of the walls being rotatable with the impeller relative to said housing, there being crevices between the housing and rotatable wall forming restricted passages arranged circumferentially of and along said segments of said periphery through which liquid may flow from said chamber laterally to said periphery for substantially their full arcuate lengths.

3. A centrifugal pump having an impeller and housing in which it rotates and a casing providing an enclosed liquid retaining space in which said housing is laterally exposed, said housing having a passage through which fluid discharges from the impeller into said space, a wall confining laterally the liquid in the impeller pockets and rotatable with the impeller relative to the housing, there being a crevice between said housing and wall forming a restricted passage for flow from said space laterally to the periphery of the impeller, said passage arranged and extending laterally and circumferentially of the impeller periphery and allowing restricted flow from said space laterally to said periphery substantially all around said periphery.

4. A centrifugal pump having an impeller, an annular housing in which it rotates having a passage through which fluid discharges from the periphery of the impeller, walls surrounded by said housing laterally confining fluid in the impeller pockets, and a casing providing an enclosed liquid retaining space containing said parts and into which said passage discharges, there being clearance between said housing and peripheries of said walls permitting restricted flow of liquid from said space laterally to the periphery of the impeller.

5. A centrifugal pump having an impeller, an annular housing in which it rotates having a passage through which fluid discharges from the periphery of the impeller, walls laterally confining fluid in the impeller pockets, and a casing providing an enclosed liquid retaining space containing said parts and into which said passage discharges, there being clearance between said housing and walls permitting restricted flow of liquid from said space to the periphery of the impeller, and chambers disposed between said clearance and space having apertured walls communicating with the space for controlling the flow to said periphery through the clearance.

6. A centrifugal pump having a closed type impeller, an annular housing in which it rotates having a passage through which fluid discharges from the periphery of the impeller, and a casing providing an enclosed liquid retaining space containing said parts and into which said passage discharges, there being clearance between said housing and impeller closure plates permitting restricted flow of liquid from said space laterally to the periphery of the impeller along substantially the entire length thereof, and chambers interposed between said clearance and space having apertured walls communicating with the space for controlling the flow to said periphery.

7. A centrifugal pump having passages successively arranged around and substantially or nearly surrounding the periphery of the impeller, through which passages fluid discharges from said periphery, and a chamber into which said passages lead and through which said pump discharges in its water pumping operation and in which priming water can be retained at a level higher than the other mentioned parts, and from the upper part of which air can escape during priming, all of said passages functioning as discharge passages both during priming and the ensuing water pumping operation there being restricted crevices arranged along and adjacent to the impeller periphery for flow of liquid from said chamber to the periphery of said impeller substantially all around its periphery.

8. In a centrifugal pump having an impeller housing provided with a volute type passage through which fluid discharges from the periphery of the impeller and having a chamber into which said passage discharges and in which priming water can be retained at a level higher than said other mentioned parts and from which air can escape during priming, a wall confining laterally the liquid in the impeller pockets and rotatable with the impeller, there being a crevice between said housing and wall permitting restricted intake of liquid from said chamber laterally into said passage at and along substantially the entire length of the segment of the impeller which defines the inner boundary of said passage.

9. A centrifugal pump comprising an impeller having a back closure plate, an annular housing surrounding the periphery of the impeller, said impeller being insertable into said housing through its front side, an annular wall between which and said back closure plate fluid in the impeller pockets is laterally confined, said wall having a tubular extension coaxial with the impeller, and a casing containing said parts and having a front closure and an opening closed thereby through which the impeller is insertable for insertion within said housing, said front closure having a tubular extension for connection with the pump suction line and interfitted with said first mentioned tubular extension.

10. A centrifugal pump comprising a closed type impeller, an annular housing surrounding the periphery of the impeller, the front closure plate of said impeller having a tubular extension coaxial with the impeller, said impeller being insertable into said housing through its front side, and a casing in which said housing is mounted having a front closure and an opening closed thereby through which the impeller is insertable for insertion within said housing, said front closure having a tubular extension for connection with the pump suction line and interfitted with said first mentioned tubular extension.

11. A centrifugal pump comprising an impeller having a back closure plate, an annular housing surrounding the periphery of the impeller, said impeller being insertable into said housing from either side thereof, an annular plate between which and said back closure plate

fluid in the impeller pockets is laterally confined, said wall having a tubular extension coaxial with the impeller, and a casing enclosing said parts and having front and back closures and openings closed thereby through either of which the impeller is insertable for insertion within said housing, said front casing closure having a tubular extension for connection with the pump suction line and interfitted with said first mentioned tubular extension, and said back casing closure having an impeller shaft housed and packed therein.

12. A centrifugal pump having a closed type impeller, an annular housing surrounding the periphery of the impeller and into which the impeller is insertable from either side of said housing, the front closure plate of said impeller having a tubular extension coaxial with the impeiler, and a casing containing said parts and having front and back closures and openings closed thereby through either of which the impeller is insertable in said housing, said front casing opening having a tubular extension for connection with the pump suction line and interfitted with said first mentioned tubular extension, and said back casing closure having the impeller shaft housed and packed therein.

13. A centrifugal pump comprising a casing, an impeller having a back closure plate, an annular housing surrounding the periphery of the impeller, said housing being mounted within said casing, said impeller being insertable into the housing through its front side, said casing having a front closure and an opening closed thereby through which opening the impeller is insertable for insertion within the housing, said opening being in line with the opening in said housing, said front closure having a suction passage in communication with the central part of the impeller, an annular wall between which and said back closure plate liquid in the impeller pockets is laterally confined, there being slight clearance between said annular housing and said wall and between said housing and back closure plate of the impeller, said housing having one or more discharge passages into said casing, the latter adapted to hold during priming a supply of priming water at a level substantially higher than the said parts contained therein, the back closure plate of the impeller and said annular wall being exposed in said casing and the crevices between said wall and housing and between said plate and housing allowing intake of liquid from said casing into said housing at and around the periphery of the impeller.

14. A centrifugal pump having a closed type impeller and an annular housing surrounding the periphery of the impeller, said housing having one or more passages for discharge of fluid expelled from the impeller, and a liquid containing casing in which said other parts are contained and in which said impeller and housing are laterally exposed, there being crevices between the side walls of said impeller and side walls of said housing permitting intake of liquid from said casing into said housing at and around the periphery of the impeller.

15. A centrifugal pump having an impeller with a back closure plate, an annular housing surrounding the periphery of the impeller, an annular wall through the central opening in which the impeller takes in fluid, said annular wall cooperating with said back closure plate to confine laterally the liquid in the impeller pockets, said housing having one or more passages for discharge of fluid expelled from the impeller, and a liquid containing casing enclosing said other mentioned parts and in which the sides of said housing are exposed, there being crevices between said housing and impeller closure plate and wall permitting intake of liquid from said casing into the housing at and around the periphery of the impeller.

16. A centrifugal pump having an impeller, a housing surrounding the periphery of the impeller, a suction passage in communication with the central part of the impeller, walls laterally confining liquid in the impeller pockets, there being slight clearance extending along and around substantially the entire periphery of the impeller between said housing and peripheries of said walls, a pump body having said housing in a lower part thereof and having an upper discharge chamber and lower passages in communication therewith in which said walls are exposed, said housing having a plurality of passages for discharging fluid expelled from the impeller including a passage discharging into said upper chamber and a passage discharging into one of the passages in communication with said chamber, the crevices between said housing and walls permitting restricted re-entry of liquid to the periphery of the impeller.

17. In a self-priming centrifugal pump, an impeller, an impeller chamber having successively arranged volute type passages through which fluid discharges from the periphery of the impeller, a surrounding air and liquid separating chamber into which said passages discharge, and other passages in the impeller chamber arranged along and adjacent to the periphery of the impeller substantially all around the periphery thereof through which priming liquid returns from said separating chamber to the respective volute type passages, all of said volute type passages functioning as discharge passages during both the priming operation and the ensuing operation of pumping water from its source of supply.

18. In a self-priming centrifugal pump, an impeller, an impeller chamber having successively arranged volute type passages through which fluid discharges from the periphery of the impeller, a surrounding air and liquid separating chamber into which said passages discharge, a chamber adjacent to the impeller chamber having apertured walls communicating with the separating chamber permitting restricted passage therethrough of liquid from the separating chamber, and return passages from said last mentioned chamber to said volute type passages extending substantially all around the periphery of the impeller.

19. In a self-priming centrifugal pump, an impeller, an impeller chamber having successively arranged volute type passages through which fluid discharges from the periphery of the impeller, a surrounding air and liquid separating chamber into which said passages discharge, and restricted passages in the impeller chamber arranged along and adjacent the periphery of the impeller and embracing at least the arcuate lengths of the volute type passages through which fluid returns from said separating chamber to the periphery of the impeller.

20. In a self-priming centrifugal pump, an impeller, an impeller chamber having successively arranged volute type passages through which fluid discharges from the periphery of the impeller, a surrounding air and liquid separating chamber into which said passages discharge, an-

nular chambers arranged laterally of and adjacent to the impeller chamber and having inlet for priming liquid from said separating chamber, and restricted passages establishing communication between said last mentioned chamber and the impeller chamber, said last mentioned passages being arranged along and adjacent to segments of the impeller periphery embracing at least the respective volute type passages.

21. A self-priming centrifugal pump comprising an impeller, a housing therearound having passage for fluid discharge from the periphery of the impeller, walls laterally confining fluid in the impeller pockets, annular members associated with said housing and walls providing lateral chambers, an air and liquid separating chamber surrounding said housing and associated members and into which said housing discharges, said lateral chambers having inlets for priming liquid from said separating chamber, and there being crevices arranged along and adjacent to the periphery of the impeller substantially around the entire periphery thereof between said housing and walls through which priming liquid returns from said lateral chambers to the impeller chamber.

22. In a self-priming centrifugal pump having a volute type impeller chamber and an air and liquid separating chamber into which the impeller chamber discharges and from which priming liquid recirculates to the impeller chamber during priming, the construction wherein said impeller chamber has auxiliary inlet for priming liquid comprising a crevice or crevices arranged along and adjacent to and laterally of the impeller periphery substantially therearound, allowing restricted intake of priming liquid into the impeller chamber at and around the periphery of the impeller.

23. A centrifugal pump having an impeller, an annular housing surrounding the periphery of the impeller and having one or more passages for discharge of fluid expelled from the impeller, walls confining laterally the liquid in the impeller pockets, at least one of said walls being rotatable with the impeller relative to said housing, there being a crevice between said housing and such rotatable wall, and a liquid containing chamber in which said crevice is exposed, said crevice permitting intake of liquid from said chamber into said housing at and along the periphery of the impeller, the rotation of said wall relative to said housing tending to dislodge from said crevice any debris or foreign matter in the liquid being pumped which may tend to close such crevice.

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