Jan. 22, 1935. C. I. LONGENECKER 1,989,061

SELF PRIMING ROTARY PUMP

Filed May 23, 1932 2 Sheets-Sheet 1

Fig. 5.

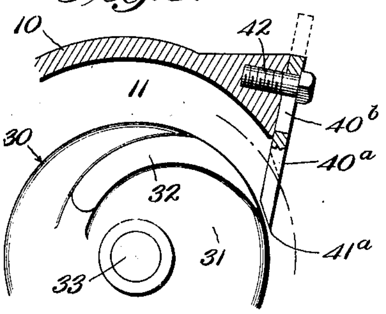
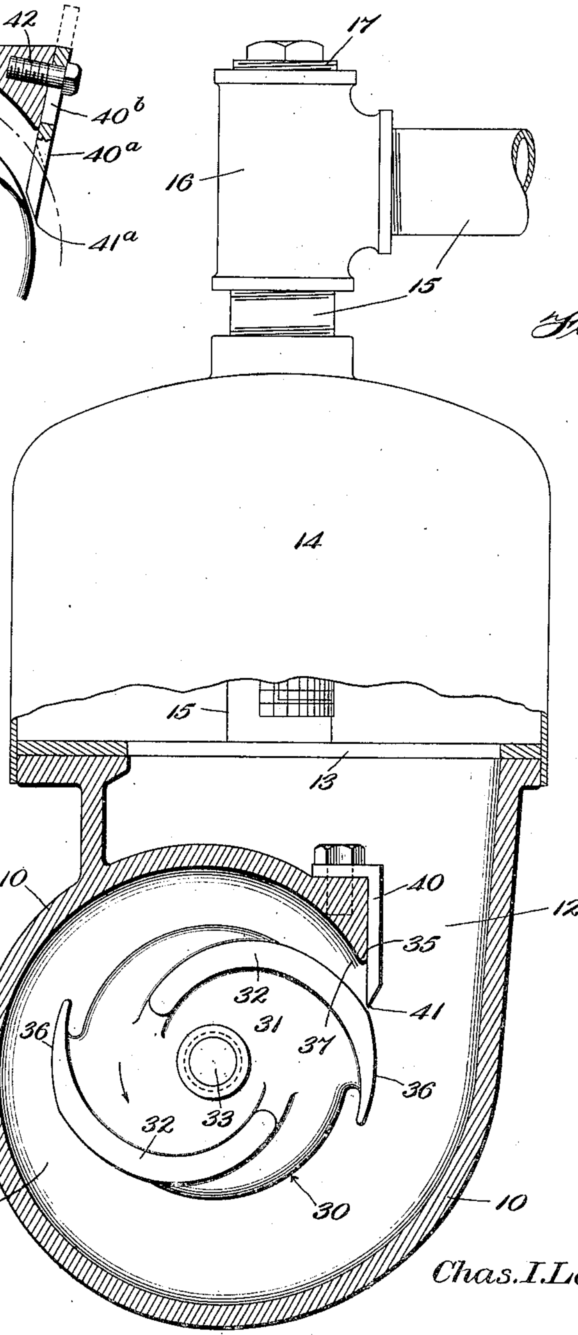


Fig. 1.



Inventor

Chas. I. Longenecker,

By Barker & Collings

Attorneys

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C. I. LONGENECKER

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2 Sheets-Sheet 2

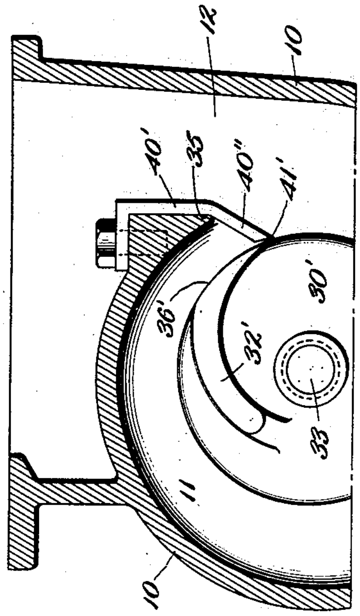

Fig. 3.

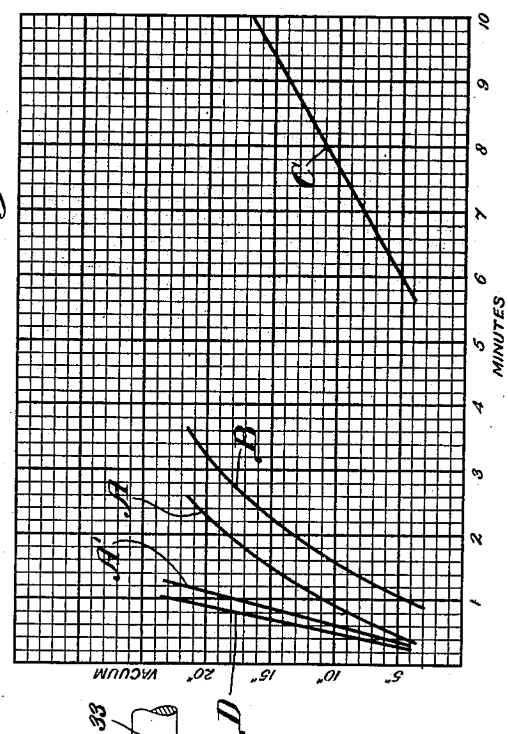

Fig. 4.

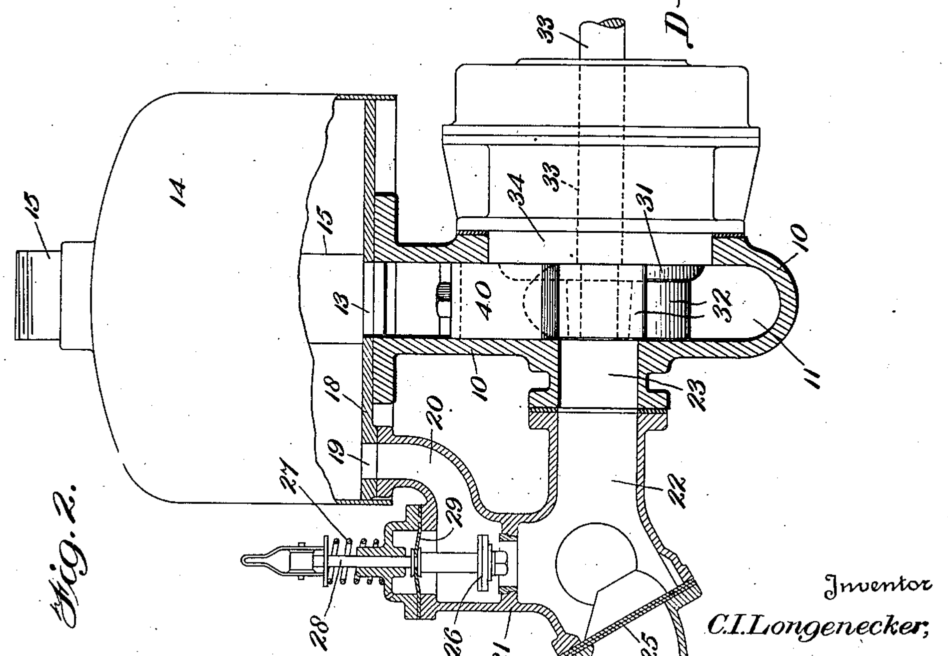

Fig. 2.

Inventor

C. I. Longenecker,

By Barker & Collings

Attorneys

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UNITED STATES PATENT OFFICE

1,989,061

SELF-PRIMING ROTARY PUMP

Charles I. Longenecker, Wauwatosa, Wis., assignor to Chain Belt Company, Milwaukee, Wis., a corporation of Wisconsin

Application May 23, 1932, Serial No. 613,049

3 Claims. (Cl. 103—113)

This invention relates to self-priming rotary pumps, and more especially those in which a small quantity of liquid is recirculated through the pump passages to effect priming, and has for one of its objects to provide a construction which will materially reduce the time required to withdraw the air from the suction pipe, thereby appreciably increasing the priming efficiency of such pumps.

It is the usual trade practice to designate centrifugal pumps as to size in accordance with the diameter or size of the outlet; e. g., the trade designates a pump having a four inch discharge orifice, pipe or outlet as a four inch pump. It is also general commercial practice to provide only one definite size of pump casing for each size of pump, with the volute thereof being designed to accommodate an impeller of a certain maximum diameter. For instance, a three inch pump casing may take an impeller of a ten inch maximum diameter; a four inch pump casing may be designed for a twelve inch impeller; a six inch pump casing may be designed for a fifteen inch impeller; and so on.

While the pump casings may thus be designed for receiving impellers of certain maximum diameters, it is frequently desirable to use a pump having a large size outlet, but provided with an impeller of a diameter smaller than the maximum for which that particular casing is designed, as there will be a considerable saving in the power required to move any given quantity of liquid at low velocity in a relatively large pipe over that which would be required to move the same quantity of liquid in a smaller pipe at a higher velocity, due to reduction of frictional losses which occur at higher velocities.

The volume of water delivered by a centrifugal pump is directly proportional to the peripheral speed of the impeller, and for this reason a four inch pump, for example, designed for a twelve inch impeller, when equipped with an eleven inch impeller, will discharge approximately the same volume of water at a head of say, below 50 feet, as it will when equipped with a 12 inch impeller, if the peripheral speed of the two impellers be the same. For this reason, 4 inch pumps designed for 12 inch impellers are frequently sold equipped with 11 inch or 10 inch impellers, since a 4 inch pump with a 10 inch impeller will handle a given volume of water more economically than a 3 inch pump with a 10 inch impeller.

While there is no appreciable loss in the liquid-pumping efficiency of a centrifugal pump when thus operated with an impeller of smaller diameter than the maximum for which the volute is designed, provided the smaller impeller be speeded up to make its peripheral speed equal to that at which the larger impeller would be operated, the use of such smaller impellers ordinarily results in a decided loss in the priming efficiency of such pumps. So much so, in fact, that heretofore it has not been practical to operate recirculating self-priming centrifugal pumps with impellers of greatly reduced diameters, and although the desirability of self-priming for such pumps has been appreciated, it has been necessary up to the present to prime such pumps by other means.

It is therefore a further important object of the present invention to provide means in a recirculating rotary pump which will permit of the use of an impeller of materially smaller diameter than the maximum for which the pump is designed without sacrificing the self-priming feature, or impairing the efficiency thereof.

With the above and other objects in view which will appear as the description proceeds, the invention consists in the novel details of construction and combinations of parts more fully hereinafter described and particularly pointed out in the appended claims.

Referring to the accompanying drawings forming a part of this specification in which like reference characters designate like parts in all the views:—

Figure 1 is a vertical sectional view of a self-priming centrifugal pump constructed in accordance with the present invention, the impeller shown being of the maximum diameter, say 12 inches, for which the volute was designed in accordance with standard practice;

Figure 2 is a transverse sectional view, on a somewhat smaller scale, at right angles to Figure 1, and taken approximately on the plane indicated by the line 2—2 thereof, looking in the direction of the arrows;

Figure 3 is a fragmentary view similar to and on the same scale as Figure 1, and showing the pump equipped with an impeller of smaller diameter, say 10 inches;

Figure 4 is a graphic representation of the priming results accomplished by a 4 inch centrifugal pump constructed in accordance with previous practice when equipped with 10 inch, 11 inch, and 12 inch impellers, as compared with an identical pump constructed according to the present invention and operated with the same impellers; and

Figure 5 is a fragmentary view similar to Figures 1 and 3, showing a slight modification of the invention.

For the purposes of illustration only the pump has been shown in the accompanying drawings as associated with recirculating priming apparatus of the type described and claimed in my co-pending application filed January 28, 1931, Serial No. 511,908 entitled Self-priming rotary pumps, although it will be readily understood that any other suitable form of recirculating mechanism may be employed if desired.

In the said drawings the pump is shown as being provided with a casing 10 which usually takes the form of an iron or other casting having the interior spiral or volute working chamber 11 which discharges into a tangential discharge passage 12 communicating through a port 13 with the interior of a recirculating tank or chamber 14 which in this instance is illustrated as being mounted directly upon the pump casing 10. As fully described in my said prior co-pending application the said recirculating liquid chamber 14 is provided with an outlet or discharge pipe or conduit 15 which may include a T-connection 16 having a removable plug closure 17 through which the chamber 14 may be initially filled. The bottom 18 of the said tank 14 may be provided with a port 19 which communicates with a passage 20 of a valve housing 21, another passage 22 of which leads to the intake port 23 of the pump casing 10. The suction or intake pipe 24 is connected to the valve housing 21 as shown and the said housing contains a gravity or other suitable check valve 25 for controlling the flow of fluid from said suction pipe. The valve housing 21 also contains the recirculating control valve 26, normally urged to open position by a helical spring 27 associated with the valve stem 28. The said stem 28 engages with a diaphragm 29 which is subject to pressure conditions within the housing 21; and as is fully disclosed in my said co-pending application, during the priming operation the valve 26 is maintained in open position by the spring 27 but as soon as the pump is completely primed the increase in the vacuum within the housing 21 acts upon the diaphragm 29 to close the valve 26 against the action of spring 27 and thereby cut off the flow of recirculating liquid from the tank 14 through the passages 20, 22 and 23 to the pump. Thereafter the pump operates as an ordinary centrifugal pump until the failure of the liquid supply to the pipe 24, whereupon the vacuum within the valve housing 21 falls and the spring 27 opens the valve 26 to again permit recirculation of the priming liquid.

Within the volute working chamber 11 of the pump there is mounted the usual runner or impeller 30 which may comprise a base or disk 31 having two or more integral curved blades 32 arranged eccentrically of the rotative axis of the said base. The impeller is rigidly carried by a shaft 33 which extends through a removable cover member 34 carried by one side of the pump casing, and said shaft may be driven from any suitable source of power not shown.

Under the ordinary commercial methods of manufacture of centrifugal pumps it is not practical to bring the point 35 of the wall of the pump housing where the volute 11 joins the discharge passage 12 extremely close to the outer periphery 36 of the impeller blades 32 and for this reason there is ordinarily considerable space 37 between the said outer periphery 36 and the closest point of approach of the volute wall thereto. Furthermore, these pump casings are ordinarily constructed of cast iron which does not readily lend itself to sharpening to a thin straight edge at the point 35, and the casing wall at this point is ordinarily left blunt, since so far as the pumping capacity of the impeller is concerned, this makes little difference. I have found, however, as a result of my experiments that if means be provided, preferably in the form of a detachable blade or vane 40 of steel or other material which can be provided with a straight sharp edge capable of arrangement in close proximity to the outer periphery 36 of the impeller blades 32, the priming efficiency of the pump can be increased to quite an appreciable extent so that the time required for priming may be considerably reduced.

This is shown graphically in Figure 4 which shows curves plotted as a result of experiments carried on with a four inch centrifugal pump equipped with an impeller of twelve inches, which is the maximum for which this particular pump was designed, as well as with impellers of eleven and ten inch diameter. The impellers in each instance were rotated at a peripheral speed of 5,000 feet per minute, and the vacuum produced upon the suction side, expressed in inches of mercury, is plotted vertically, while the time in minutes required to obtain such vacuum is plotted horizontally. The curve A shown in Figure 4 represents the results attained when employing a twelve inch impeller within the pump housing and without employing the additional vane or blade 40 above referred to. The curve A′ represents the results attained when the same casing and impeller but with the blade 40 secured to the wall of the casing at its juncture between the volute and discharge passage in such a manner that its lower sharp edge 41 cleared the periphery 36 of the impeller blades by from 1/32 to 3/64 of an inch. The curve A indicates that with the twelve inch impeller running at a peripheral speed of 5,000 feet per minute without the vane 40 it required approximately two minutes and eighteen seconds to attain a vacuum equivalent to twenty inches of mercury upon the suction side of the pump, whereas under precisely the same operating conditions with the vane 40 in place the same vacuum was attained in approximately 65 seconds. It will thus be seen that the use of the vane 40 reduces the time necessary to attain the desired vacuum to less than half, which of course means quite a saving in priming time, even where impellers of the maximum diameter for which the pump is designed are employed.

The results are even more pronounced if impellers of less than the maximum diameter for which the pump is designed be used, as is frequently the case. Curve B upon the chart of Figure 4 is a graphic reproduction of the results attained with the same pump above described when an eleven inch impeller was substituted and the vane 40 omitted and curve C shows the results of the use of a ten inch impeller with the vane 40 omitted, while curve D represents the results attained with both the eleven and ten inch impeller when a vane such as 40 is employed. These curves indicate that with an eleven inch impeller running at a peripheral speed of 5,000 feet per minute without the vane it required three minutes and fifteen seconds to attain a twenty inch vacuum, whereas with a vane the same vacuum was attained in approximately 54 seconds. This same vacuum of twenty inches was also attained in 54 seconds when operating with a ten inch impeller in conjunction with the vane 40, whereas when such vane was omitted it was impossible to secure twenty inches of vacuum, even though the pump were operated for a period of ten minutes. It will thus be seen that while the provision of the sharp edged steel vane 40 effects material improvement in the priming efficiency of centrifugal pumps when they are equipped with impellers of the maximum diameter for which they are designed, the use of such vanes when operating these pumps with impellers smaller than the maximum diameter effects even greater increases in efficiency and so much so that in the case of a four inch pump designed for a twelve inch impeller but supplied with a ten inch impeller, and which without the vane could not be operated as a self-priming pump, it can if supplied with such vane be operated as a self-primer just as efficiently as with eleven or twelve inch impellers.

As above stated the vane 40 preferably takes the form of a block or piece of steel or other similar metal which lends itself to being provided with a sharp straight edge which may be brought in close proximity to the outer periphery of the impeller blades. When the vane is being employed with an impeller of maximum diameter it may take the form shown in Figure 1 whereas if it is being employed with an impeller smaller than maximum diameter the vane such as 40′ of Figure 3 may be provided, with an angularly disposed extension 40″ to bring its sharpened edge 41′ into proper relationship with the periphery 36′ of the impeller 30′.

If desired the vane may take the form of a flat plate such as 40^a shown in Figure 5 which may be mounted in a slightly inclined position, and provided with a slot 40^b through which passes a securing bolt 42 whereby the said vane may be adjusted longitudinally to accommodate itself to impellers of different diameters.

As will be clear from Figure 2 the vane such as 40 extends completely across the working chamber 11 from one side wall of the housing to the other and completely closes off communication between the discharge passage 12 and the beginning of the volute 11.

It is obvious that those skilled in the art may vary the details of construction as well as the precise arrangement of parts without departing from the spirit of the invention, and therefore it is not wished to be limited to the above disclosure except as may be required by the claims.

What is claimed is:

1. In a self-priming rotary pump, a casing provided with a volute working chamber and a discharge passage leading therefrom, said working chamber being designed to accommodate an impeller of a predetermined maximum diameter; an impeller of a diameter less than said maximum rotatable in said working chamber; a recirculating-fluid chamber in communication with said discharge passage; recirculating-fluid connections between said chambers; and a fixed vane in said casing disposed in angular juxtaposition to the periphery of said impeller, for rendering said recirculating elements effective.

2. In a self-priming rotary pump, a casing provided with a volute working chamber and a discharge passage leading therefrom, said working chamber being designed to accommodate an impeller of a predetermined maximum diameter; an impeller of a diameter less than said maximum rotatable in said working chamber; a recirculating-fluid chamber in communication with said discharge passage; recirculating-fluid connections between said chambers; and a fixed vane in said casing disposed substantially tangential to said impeller, and having a sharpened edge in close proximity to the periphery thereof, for rendering said recirculating elements effective.

3. In a self-priming rotary pump, a casing provided with a volute working chamber and a discharge passage leading therefrom, said working chamber being designed to accommodate an impeller of a predetermined maximum diameter; an impeller of a diameter less than said maximum rotatable in said working chamber; a recirculating-fluid chamber in communication with said discharge passage; recirculating-fluid connections between said chambers; and a vane in said casing disposed in angular relation to the periphery of said impeller and having a sharpened edge in close proximity thereto, for rendering said recirculating elements effective, said vane being longitudinally movable to accommodate it to impellers of various diameters.

CHARLES I. LONGENECKER.