Feb. 17, 1942. R. D. SCHOTT 2,273,420

CENTRIFUGAL PUMP

Filed Feb. 17, 1941 2 Sheets-Sheet 1

Fig. 1.

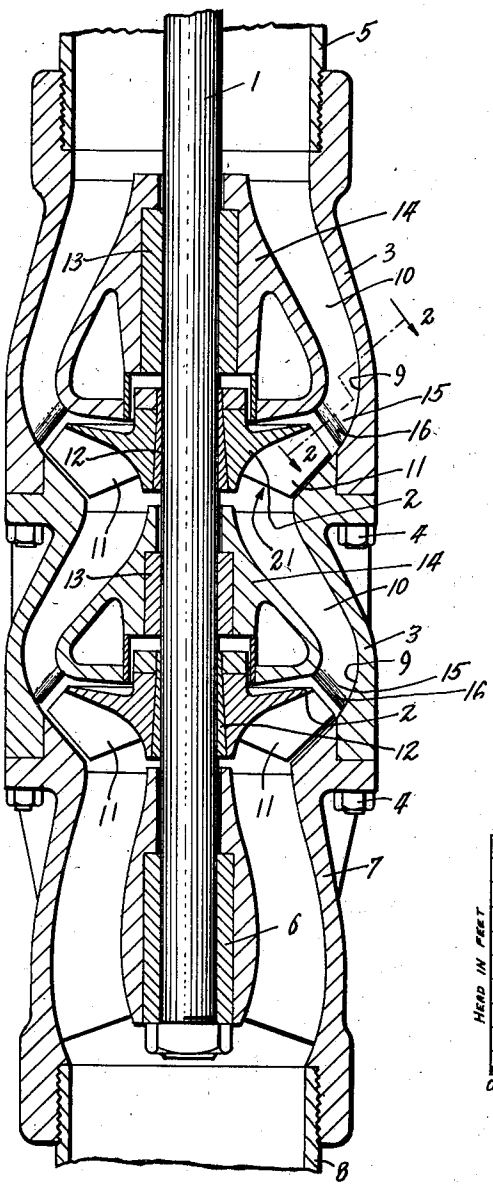
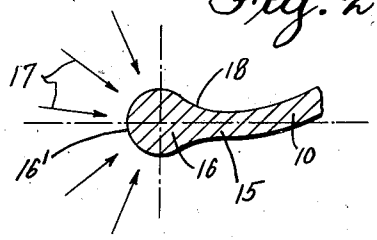


Fig. 2.



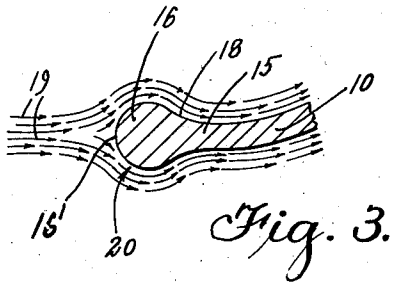
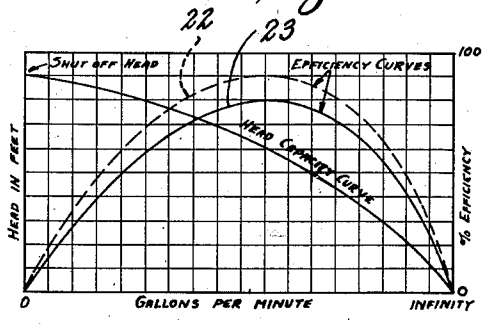


Fig. 3.

Fig. 4.



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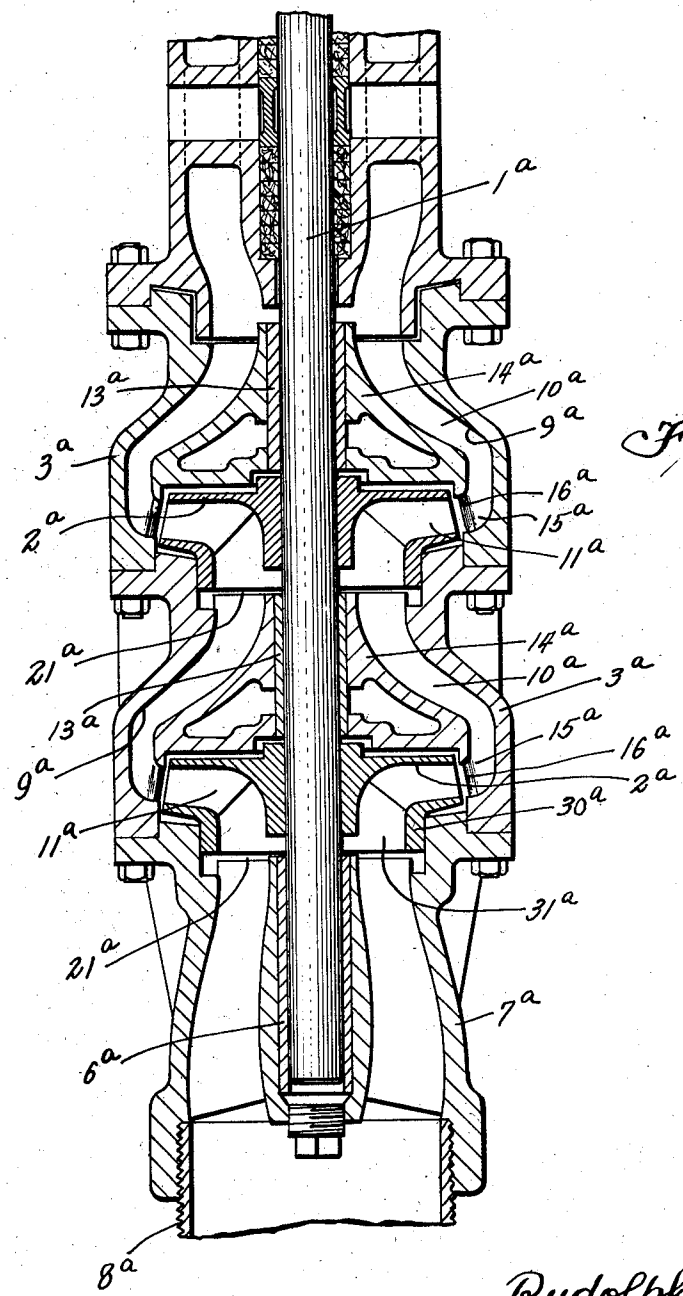


Fig. 5.

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CENTRIFUGAL PUMP

Rudolph D. Schott, Pomona, Calif., assignor to Pomona Pump Co., Pomona, Calif., a corporation of Delaware

Application February 17, 1941, Serial No. 379,182

6 Claims. (Cl. 103—103)

This invention relates to centrifugal pumps, and more particularly to a pump of the type employing centrifugally actuating impellers for lifting fluid, particularly water.

In the construction of centrifugally operated pumps, extended efforts have for a great many years been directed toward the improvement of the efficiency of operation of such pumps over a wide range of operation as to the amount of fluid or water elevated, and to increase the efficiency of lift.

It has heretofore been common practice in the construction of such pumps to employ body or bowl members which included directional vanes for translating substantially lateral or horizontal movement of the fluid or water into vertical lift thereof, and wherein the lateral motion is imparted to the water by rotating impeller members positioned within the body of water.

It is common in such pump constructions to use one or more stages, including a bowl and impeller member for each such stage in order to effect the desired lift and to obtain the desired efficiency of lift.

I have discovered that the efficiency of operation of a pump of the above set forth type may be increased materially by so forming the ends of the vanes provided for directing the up-flow of the fluid or water as to reduce the power consumption heretofore required in order to direct the fluid upward.

I have discovered that by forming the ends of the vanes in a manner which I prefer to define as of bulbous shape, that the power consumption required for the raising of the water or fluid is materially decreased over substantially the entire operating range of such a pump structure.

It is therefore the primary object of this invention and toward which this invention is directed, to provide a centrifugal pump having greater operating efficiency than pumps of similar construction heretofore widely manufactured and used.

Another object of this invention is to provide a pump of the centrifugal fluid lifting type particularly adapted for raising water in wells which includes a bowl member having directional vanes operable in conjunction with rotary impellers for changing the direction of flow of water as set in motion by said impellers and which vanes have a bulbous end in the path of the water as set in motion by the said impellers.

Other objects and advantages of this invention it is believed will be apparent from the hereinafter set forth description of a preferred embodiment of my invention as illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a sectional elevation of a centrifugal pump embodying my invention.

Figure 2 is a sectional view taken substantially on the line 2—2 of Figure 1 illustrating the vane end of the said pump on an enlarged scale, illustrating diagrammatically the direction of impact of the fluid or water against the bulbous end of the vane.

Figure 3 is a view similar to Figure 2 illustrating theoretically the direction of fluid travel over the vane end.

Figure 4 is a comparative plotting of the percent efficiency against volume of lift illustrating in dotted lines the curve of the pump embodying my invention as compared with the curve shown in full lines of the same pump minus, or not embodying, my invention.

Figure 5 is a side elevation mainly in vertical section of a modified form of impeller centrifugal pump embodying my invention.

In the embodiment of my invention as illustrated in Figure 1, there is shown an impeller bowl type of centrifugal pump including a pump rod 1 which carries one or more impellers 2 operating within bowl members 3. The bowl and impellers may be of any desirable type of structure which is well known in the art, and any desired number of such bowl and impeller assemblies may be connected together, depending upon the conditions of the installation. The bowls are generally connected together as indicated at 4 and are connected to the discharge pipe 5. The shaft 1 is supported at the lower end of the assembly in a bearing member 6 formed in a supporting member 7 secured to the lower bowl 3.

The well pipe 8 which may be a screen member, extends below the supporting member 7. As is well understood in this art, each of the bowl members 3 is formed to provide a plurality of directional passages 9 defined by vane members 10 which change the direction of flow of the fluid or water set in motion by means of the impellers 2. The impellers 2 are of the multiple type, including a plurality of blades 11. The impellers are secured to the shaft 1 by any suitable or desirable means such as through the medium of the tapered bushing 12. The bowls 3 each preferably provide a bearing support 13 for the shaft 1 formed in the central hub portion 14 joined to the outer structure of the bowl 3 through the medium of the multiple vanes 10.

In accordance with my invention, the vane end

15 which lies in the path of the fluid or water set in motion by the impeller 2 and is the advanced end of the vanes, is formed bulbous, as indicated at 16.

In the operation of pumps of this kind, the volume of water lifted may be changed in accordance with the condition at the surface of the well as to the volume of water desired. Such changes of volume of water may be accomplished as is common in this art by throttling the discharge, varying the pressures in the same or different applications, changing the directional component of flow, so that friction losses under these varying conditions are encountered. These losses may be attributed due to changes in conditions of flow pattern developing increased turbulence, eddying, and changes of pressure differences flowing over the advanced ends 15 of the vanes 10.

By forming the advanced bulbous sections 16 of the vane end 15, I am enabled to meet changes of flow as indicated in Figure 2 so that should the direction of impact of the fluid or water against the bulbous end 16 change, as indicated by the different arrows 17, the direction of impact against the bulbous ends will be at all times substantially tangent to the surface. This insures greater uniformity of flow pattern over the said bulbous ends and will produce a greater constance of efficiency of lift of water as compared with power input over the varying conditions of operation.

A much more important characteristic of the bulbous end 16, however, is found in the fact that it enables me to attain a greater efficiency of operation under the same conditions of operation and over substantially the entire range of operating conditions of such a pump. The reason for this totally unexpected increase in efficiency due to the use of this type of structure is difficult of explanation. The loss of efficiency in a pump of this character is due to hydraulic losses. These hydraulic losses are variable, depending upon conditions of flow.

There of course is a constant loss of efficiency attributable to friction losses in the mechanically operating elements as, for example, the losses occasioned by the rotation of the shaft through its bearing elements; these latter losses, however, being constant, are not the losses here considered or included within the term "hydraulic losses."

As will be observed particularly from Figures 2 and 3, the bulbous end 16 has its advanced surface, or the one first in the line of flow, curved so as to maintain substantially tangential impact with the flow and at the rear is recessive, as indicated at 18, as compared with the body of the vane 10. The particular proportions indicated are not essential to the attaining of the high degree of efficiency, but the particular shape contributes thereto because the bulb end 16 is by this means formed in such manner that its periphery substantially follows the unobstructed line of flow of the fluid as the same is indicated in Figure 3 by the lines 19. The bulbous end as thus formed acts to fill the void 20 which forms on the impact of the water or fluid against the advanced edge 16' and by being recessive at 18, prevents pressure application by the fluid against the vane 10 at the rear of the advanced edge 16'. The bulbous end is thus made in form to compensate for the tendency of a void 20 to form as a result of flow of fluid over the obstruction provided by a vane end, so that increase of turbulent flow and eddy currents are not developed at the start of the changing direction of flow of the fluid as it is directed through the passages 9 which divert the flow upwardly and in directions to properly enter the areas 21 of the next impeller 2.

In Figure 4 I have illustrated the efficiency curves of my pump as hereinabove described and the curve of the same pump operating under the same conditions but not including the bulbous ends 16. The efficiency curve of the pump embodying my invention is illustrated by the dotted line 22. The efficiency curve of the pump of the same construction operating under the same conditions but not having the bulbous end 16 is illustrated by the curve 23. The pump operating to produce the efficiency curve 23 is the same as has been manufactured and sold and used for many years, and in this structure the advanced ends of the vanes were, as has been common in this art for many years, formed to a substantial knife edge. From Figure 4 it will be noted that the increase in efficiency of operation of the pump embodying my invention is in the neighborhood of 6% to 10% throughout the normal entire range of operation, and the curves are of efficiency over differing and increasing volume discharges from the pumps.

In the modified form of my invention as illustrated in Figure 5, I have shown what is commonly known in this art as the enclosed impeller type of centrifugal lift pump as compared with that known in the art as the open end impeller type of construction shown in Figure 1.

In the modified form of Figure 5, the same numerals have been utilized to indicate the same parts, with the addition of an exponent "a" thereto, and the same conditions of operation and construction prevail throughout this modified form of construction in so far as this invention is concerned, the principal difference of construction being that in this form the impeller 2^a has at its lower end an enclosing flange 30^a defining enclosed impeller passages 31^a entirely within the structure of the impellers 2^a. In the modification of Figure 1 the impeller passages are defined between the impeller and the bowl and not within the structure of the impeller.

In applicant's copending application, Serial No. 394,517, filed May 21, 1941, for Bulbous steam turbine blade, applicant is claiming his invention as particularly adapted to use in structures other than centrifugal pumps and particularly as related to turbine construction.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claims.

I claim:

1. In a pump of the class described, including an impeller, and a bowl member having a plurality of vanes defining flow passages operative to change the direction of flow of the fluid induced in the fluid by the impeller wherein the advanced ends of the vanes have a bulbous form

2. In a pump of the class described, including an impeller, and a bowl member having a plurality of vanes defining flow passages operative to change the direction of flow of the fluid induced in the fluid by the impeller wherein the advanced ends of the vanes are bulbous in form, including a curved advanced end which is recessive at its rear to substantially fill the void otherwise produced by the flow of fluid over the advanced edge.

3. In a pump of the class described, including an impeller and a bowl member having a plurality of vanes defining flow passages operative to change the direction of flow of fluid induced in the fluid by the impeller wherein the advanced edges of the vanes are of curved form providing a protuberance in the line of flow of the fluid, the curve being of greater diameter than the normal thickness of the vane and wherein the thickness of the vane edge decreases from its greatest diameter to the normal vane thickness.

4. In a pump of the class described, including an impeller, a bowl member having a plurality of vanes defining flow passages operative to change the direction of flow of the fluid induced in the fluid by the impeller wherein the advanced end of the vanes are rounded in a direction transverse of the flow and substantially tangential to the impact of the fluid therewith, the rounded edge having a radius of curvature greater than one-half the vane thickness, and where the curve of the rounded edge merges into the vane behind the rounded end.

5. In a pump of the class described, including an impeller, a bowl member having a plurality of vanes defining flow passages operative to change the direction of flow of the fluid induced in the fluid by the impeller wherein the advanced edge of each vane is of curved form providing a protuberance in the line of flow of the fluid, the said protuberance being of greater thickness than the normal thickness of its vane.

6. In a pump of the class described, including an impeller, a bowl member having a plurality of vanes defining flow passages operative to change the direction of the flow of the fluid induced in the fluid by the impeller wherein the advanced edge of each vane provides a rounded protuberance in the line of fluid flow of greater thickness than the normal vane thickness, each side of the vane adjoining the protuberance at the rear thereof providing a curved surface merging to normal vane thickness whereby the line of fluid flow conforms smoothly to the vane surfaces.

RUDOLPH D. SCHOTT.