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MULTI STAGE CENTRIFUGAL PUMP

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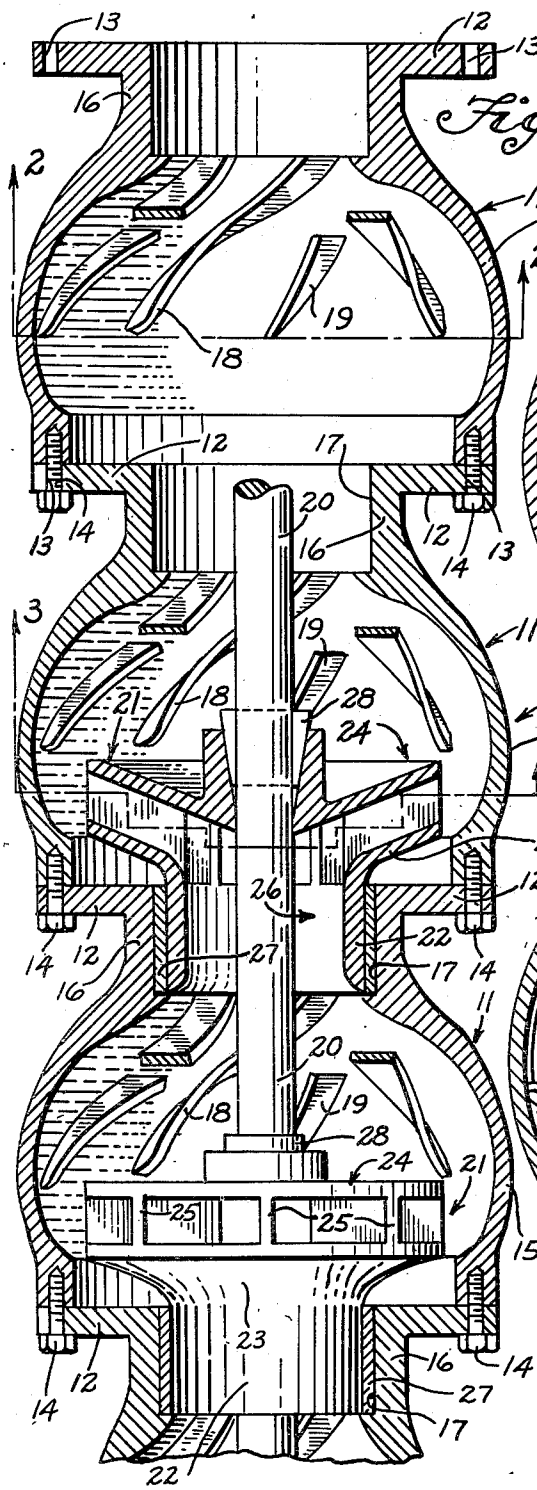


Fig. 1.

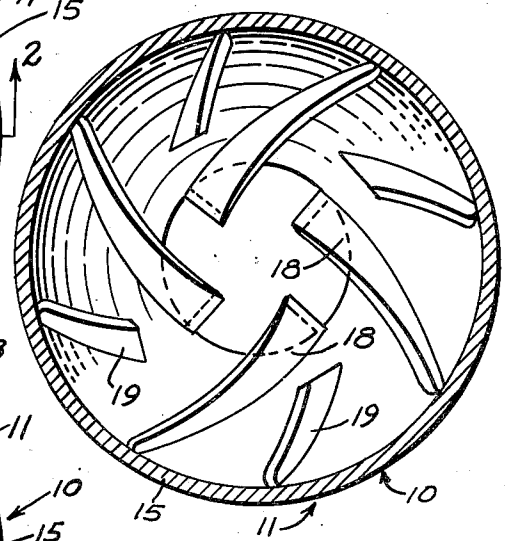


Fig. 2.



Fig. 3.

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MULTI STAGE CENTRIFUGAL PUMP

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This invention relates to a pump, and more particularly to a multistage centrifugal pump.

The object of the invention is to provide a multistage centrifugal pump which includes pump bowl elements and impellers together with a driving shaft and wherein the pump impellers form their own operational bearings by means of elongated necks which ride within suitable cavities within the pump bowl.

Another object of the invention is to provide a multistage centrifugal pump which will have high operational efficiency and high abrasion resistance, and wherein skin friction effects will be reduced by virtue of minimized exposed area.

A further object of the invention is to provide a multistage centrifugal pump which is extremely simple and inexpensive to manufacture.

Other objects and advantages will be apparent during the course of the following description.

In the accompanying drawings, forming a part of this application, and in which like numerals are used to designate like parts throughout the same;

FIGURE 1 is a longitudinal sectional view taken through the multistage centrifugal pump of the present invention;

FIGURE 2 is a sectional view taken on the line 2—2 of FIGURE 1; and

FIGURE 3 is a sectional view taken on the line 3—3 of FIGURE 1.

Referring in detail to the drawings, the numeral 10 indicates the multistage centrifugal pump of the present invention which comprises a plurality of alined bowl sections or bowl elements 11 which are of similar construction. The bowl elements 11 are each provided with a flanged end 12 that has openings 13 therein, whereby suitable securing elements such as bolts or studs 14 can be extended through these openings 13 and into threaded engagement with suitable openings in the adjacent end of the contiguous bowl element 11.

The bowl elements 11 all have the same construction except for slight variance in the first and last elements of an assembly as required to facilitate mechanical attachment and each comprises a generally rounded enlarged chamber portion 15, as well as a reduced diameter end portion 16, and there is provided in each portion 16 a circular cavity or opening 17.

The numerals 18 and 19 indicate vanes which are secured to or formed integral with the inner surface of the portion 15, and as shown in FIGURE 1 for example, these vanes 18 and 19 are spaced from each other and have different lengths. For example the vanes 18 are longer than the vanes 19.

Extending longitudinally through the multistage centrifugal pump 10 is a drive shaft 20 which may be connected to a suitable power source such as a motor, engine or the like. The numeral 21 designates each of a plurality of impellers which are affixed to the shaft 20, and each impeller 21 includes a cylindrical neck 22 which is arranged in the corresponding cavity 17. Each impeller 21 further includes a flaring section 23 which terminates in a circular body portion 24. The interior of each impeller is hollow as at 26, and spaced apart ribs or vanes 25 are mounted in each impeller 21.

If desired bearings 27 may be provided for the neck portions 22 to rotate in, and the bearings 27 may be seated in the cavities 17.

The impellers 21 may be affixed to the shaft 20 in any

suitable manner, as for example by means of key members or wedge members 28.

From the foregoing, it is apparent that there has been provided a multistage centrifugal pump, and in use, by actuating or rotating the shaft 20 by any suitable mechanism, as for example by means of a conventional motor, it will be seen that the shaft 20 will cause rotation of the plurality of impellers 21, while the bowl elements 11 will remain stationary. As these impellers 21 rotate, fluid which is being pumped will pass upwardly from the bottom or lower end of the pump 10 as shown in FIGURE 1, and this fluid will then pass up through the hollow space 26 in the lowermost impeller and then enter the chamber 15, and this fluid will then pass through the space 26 in the next impeller and then into the corresponding chamber 15, and this process will be repeated until the fluid passes out of the upper end of the pump.

The bowl units 11 are fastened together by means of the securing elements 14, and the various parts can be made of any suitable material and in different shapes or sizes.

It will be seen that the multistage centrifugal pump of the present invention consists of the pump bowl elements 11 together with the pump impellers 21 which are suitably mounted on the shaft 20 by means of locking devices 28. This arrangement is unique in that the pump impellers 21 form their own operational bearings by means of an elongated neck 22 which rides within a suitabel cavity 17 within the pump bowl. For special services, temperatures or fluids, it has been found desirable to insert or use a bushing such as the bushing 27 of suitable resilient or wear resistant material between the impeller 21 and the bowl as shown in FIGURE 1 for example. This design allows maximum water way passages for high operational efficiency and high abrasion resistance.

The fluid guide vanes 18 are kept to an absolute minimum, and the guide vanes 19 are not full length and are approximately fifty percent of the length of the guide vanes extending completely into the bowl throat. By this means, skin friction effects are reduced by virtue of minimized exposed area. A semi-open guide vane pattern of this type has been found entirely satisfactory as centrifugal force between the impeller and bowl, as well as the converging nature of the bowl itself tends to keep the fluids firmly conformed to the bowl surface without the necessity of an inner diffusing member presently considered essential in comparable pump designs.

The impeller neck 22 serves as an inter-stage bearing and seal. The bushing 27 is not required at all times, and this bushing may be fixed, by any required means, such as, a press fit, to prevent relative movement between the bushing and the bowl, or the bushing may be permitted to float, depending upon the fluid characteristic.

It is to be noted that according to the present invention, the pump uses impellers which have the vanes 25, and the impellers have the elongated neck or skirt 22 which functions both as an inter-stage seal and as an inter-stage bearing. The usual end thrust of this type pump is in operation transferred from impellers 21 to shaft 20 and thence carried by thrust bearings within the conventional drive head or motor. It has been found that by an alteration of bushing 27 a thrust bearing may be formed between impeller 21 and bowl flange 12, in order that end thrust may be carried on a per stage basis if so required.

In conventional multistage design considerable effort is expended, by means of complex vaning and diffusers, to redirect the flow from one stage periphery to the next stage eye. The bowl of the present invention is designed so that inter-stage flow takes the form of a directed vortex with a minimum of mechanical constraint. No com-

plicated guide vanes and inter-stage bearing sockets are involved or needed.

Previously, there has been much theory to emphasize the need in pumps for true axial inlet flow to a centrifugal impeller, but the present invention, when so required, makes use of controlled pre-rotation to afford smooth transition and velocity pressure conversion. The present invention can be used as a vertical deep well type pump or it can also be used as a horizontal unit. While all discussion has pertained to a pump of multistage configuration, it should be recognized that a monostage unit will operate as a complete and highly practical pump. It should also be noted that proper selection of impeller vane **25** with corresponding guide vane **18** and **19** will enable the complete coverage of design "specific speed," as developed in current theory.

The pump is easy to manufacture, and is economical to make and has a light weight, as well as many other advantages.

Minor changes in shape, size and rearrangement of details coming within the field of invention claimed may be resorted to in actual practice, if desired.

I claim:

1. In a multistage centrifugal pump, a plurality of bowl elements arranged in end-to-end alined relation with respect to each other and connected together, a shaft extending longitudinally through said bowl elements, impellers rotatably arranged in said bowl elements and affixed to said shaft, each of said impellers including an elongated neck, and cavities in said bowl elements for receiving said necks, the impeller forming a bearing and seal between the neck and cavity, spaced apart vanes of different lengths affixed to the inner surfaces of said bowl elements, the different lengths of said vanes reducing skin friction effects in said pump by reason of minimized exposed area, the impellers on said shaft being of similar configuration to each other and each having a flaring section terminating in a circular body portion, each of said impellers being hollow and having a plurality of spaced apart ribs therein.

2. In a multistage centrifugal pump, a plurality of alined bowl elements arranged in end-to-end relation with respect to each other and connected together, each of said bowl elements including an enlarged generally rounded chamber portion and a reduced diameter end portion having a central circular cavity, spaced apart vanes of different lengths affixed to the inner surface of said chamber portion, a shaft extending longitudinally through said bowl elements, a plurality of similar impellers mounted on said shaft and connected thereto, each of said impellers including a cylindrical neck arranged in a corresponding cavity in the reduced diameter end portion, each impeller further including a circular body portion, the interior of each impeller being hollow, and a plurality of spaced apart ribs in each impeller.

3. In a hydraulic pump, a bowl element having a reduced diameter end portion provided with a circular cavity therein, guide vanes on the interior surface of said bowl element, an impeller rotatably arranged within the bowl element, and means forming an operational bearing and interstage seal, said last named means comprising an elongated neck that is on said impeller that is fitted within said cavity, said neck being in communication with said impeller whereby an efficient open flow channel is provided, and wherein the guide vanes are of different lengths so that reduced surface friction is provided by reducing the contact surface of said vanes, said vanes being positioned in said bowl so that a greater number of vanes are located where the bowl area is also greater, and whereby as the bowl converges, alternate guide vanes are gradually shortened to avoid a superfluous vaning and actual choking of the converged section near the cavity and wherein the major portion of each of said vanes is positioned in the bowl cavity, the fluid being forced to follow the bowl convergence by the centrifugal component imparted to it by the impeller.

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