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CENTRIFUGAL PUMP IMPELLER

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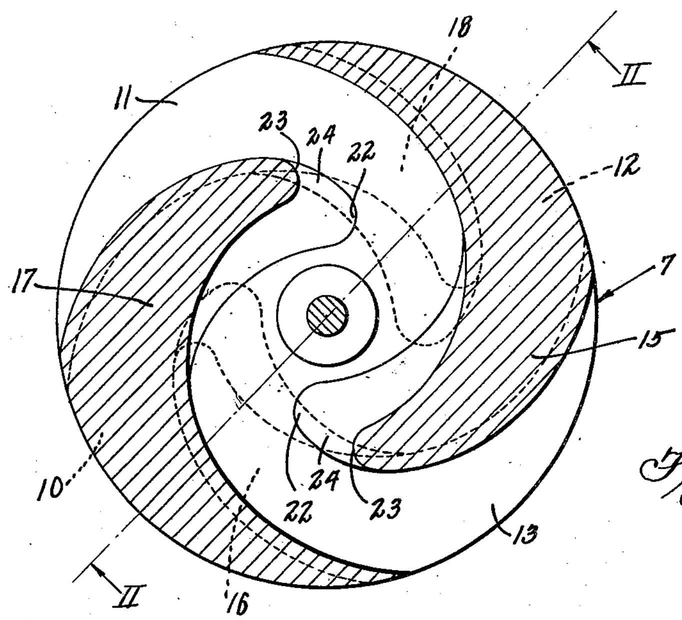

Fig. 1.

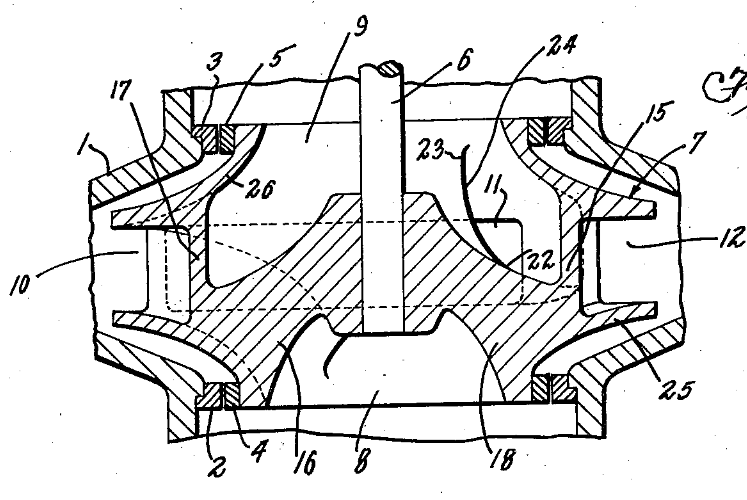

Fig. 2.

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CENTRIFUGAL PUMP IMPELLER

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8 Claims. (Cl. 103—115)

This invention relates to improvements in centrifugal pump impellers, and particularly for use on those pumps which are employed for pumping fluids of the nature of sewage, containing pulpy or stringy material and relatively large solids.

It has been the common practice in pumps for handling sewage and the like to employ single-suction impellers provided with vanes having well rounded forward ends and only one or two discharge ports which form substantially an L or a T, so that there are no sharp shoulders in the suction eye on which débris might collect. These pumps do not easily clog, but their use has been limited to pumps of relatively small size or large size and slow speed.

The disadvantages of the single-suction impeller having one and even two discharge ports results from the poor control of the water flowing through the impeller and to the unbalanced hydraulic forces which limit the maximum head to which these pumps can be satisfactorily applied. Furthermore, the necessity of full-width channels in a single-suction impeller makes it impossible to construct the fluid passages in proper proportions for best efficiency.

It is, therefore, an object of this invention to fully eliminate the above disadvantages by providing an impeller of the double-suction type with four ports.

As pumps of ordinary, single-suction type increase in size, the problem of the unbalanced hydraulic forces becomes one of great importance, especially when the pumps are to operate at relatively high speeds. It is, therefore, a further object of this invention to provide double-suction impellers having four ports or fluid channels which impellers will be in substantial hydraulic balance whether the impellers are large or small or whether they are to run at relatively high or low speeds.

The advantages of our design are emphasized to a greater degree as the size of the pump is increased where the restriction of the passages due to the presence of the pump shaft is not objectionable and where the elimination of any unbalanced hydraulic forces are of greater importance for successful operation.

It is a further object of the present invention to provide a pump having the non-clogging characteristics of the previous pumps but of greater capacity for a given size of impeller and of greater efficiency.

It is a further object of the present invention to provide a non-clogging pump which is substantially balanced against axial thrust.

It is a further object of this invention to provide a non-clogging pump having a discharge passage substantially around the entire periphery of the impeller so as to substantially eliminate the pulsating of the discharge.

It is a further object to provide a pump impeller with a pair of diametrically opposed ports having an inlet entrance communicating with one side of the impeller and a pair of diametrically opposed ports spaced 90° from the other pair of ports having an inlet entrance communicating with the other side of the impeller.

It is a further object to provide an impeller having two pairs of discharge ports and each pair of discharge ports arranged to discharge from substantially one-half of the periphery of the impeller, so that with the two pairs of ports disposed at right angles to each other they will discharge from substantially the entire periphery of the impeller.

Pump impellers which do not discharge from substantially the entire periphery thereof are subject to a pulsating discharge. It is, therefore, a further object of this invention to provide double-suction pump impellers with ports which do discharge from substantially the entire periphery thereof to eliminate the pulsating of the impeller discharge.

It is a further object to provide a pump construction which will be hydrostatically balanced, non-clogging, non-pulsating, and which may be built for relatively high speeds in large sizes and which will have a large capacity and high efficiency.

It is a further object to provide a double-suction impeller having intertwining ports whereby the discharge passage of the ports, from the periphery of the impeller, may be more than one-half of the width of the entrance end of the ports, whereby the solids which may pass through the ports in our impeller may be twice as large as those which may pass through an ordinary double-suction impeller of the clear-water type.

Other objects and advantages of the invention will become apparent as the nature of the same is more fully understood from the following description and accompanying drawing, wherein is set forth what is now considered to be a preferred embodiment. It should be understood, however, that this particular embodiment of the invention is chosen principally for the purpose of exemplification and that variations therefrom in details of construction or arrangement of parts may accordingly be effected and yet remain within the spirit and scope of the invention as the same is set forth in the appended claims.

In the drawing:

Figure 1 illustrates a cross-sectional view of the pump impeller taken in a plane at right angles to the impeller shaft;

Figure 2 illustrates a cross-sectional view of Figure 1, taken substantially in the plane of line II—II, and also illustrates a fragmental sectional view of the pump casing.

In the preferred form of the invention, the pump structure may include a conventional double-inlet pump casing or volute 1 provided with wearing rings 2 and 3. The pump impeller 7 is of the double-suction type and may be provided with the usual wearing rings 4 and 5 which cooperate with the rings 2 and 3 to act as running seals to reduce leakage from the pressure side or volute of the pump into the inlet eyes thereof. The impeller may be suitably mounted upon the usual pump shaft 6, and may be of the double-suction type having opposed suction eyes 8 and 9. Double-suction impellers are inherently balanced against axial thrust, as is well known.

Referring to Figure 2, it will be noted that each of the suction eyes 8 and 9 communicates with a pair of discharge ports 10, 11 and 12, 13, these ports being defined by the vanes 15, 16 and 17, 18, respectively. The inner ends of the vanes are well rounded to prevent solids from sticking. The inner edge 22 of each vane is in advance of the outer edge 23 (in the direction of rotation), so that there is a smooth and rounded shoulder 24 which slopes outwardly away from the axis of the impeller. This gives the suction eye a somewhat funnel-shaped entrance, with the small end thereof toward the inner part of the impeller. Each pair of discharge ports discharges on substantially one-half of the periphery of the impeller, so that with the two pairs of ports disposed at right angles to each other, the fluid is discharged from substantially the entire periphery of the impeller. This is important since impellers which do not discharge from substantially the entire periphery are subject to a pulsating discharge. By our construction we have provided a balanced non-clogging, non-pulsating impeller discharging from substantially the entire periphery and which can be built for high speed or in large sizes having both large capacity and high efficiency.

Non-clogging pumps have been built heretofore having single-suction (unbalanced) impellers and having only two discharge ports. In some cases these discharge ports have covered substantially the entire periphery of the impeller, to limit pulsation of the discharge, but this could only be poorly accomplished with a two-port impeller because the forces acting on the water in the way of ports are materially different than the ones acting in the way of the vane, which is relatively close to the periphery. The double-suction four-port impellers discharging symmetrically from substantially the entire periphery eliminates this pulsation and also eliminates the axial thrust.

Double-suction impellers of the clear-water type heretofore constructed are provided with fluid passages, which passages at their discharge ends may be only one-half the width of the periphery of the impeller, and are not intertwined. In the impeller of our invention, the fluid passages are intertwined, thus permitting the discharge ends of the fluid passages to be nearly equal to the full width of the periphery of the impeller. Consequently the solids which can pass through the passages in our impeller may be twice as large as those which can pass through an ordinary double-suction impeller of the clear-water type. This is most important in the handling of sewage.

It will be seen that in our double suction impeller the vanes form the separating walls between the ports developed from the opposed inlet eyes of the impeller. Furthermore, it will be seen that in the four-port impeller, (Figure 2), the vanes 15 and 16 are of substantially constant thickness for practically their entire length, serving on their convex sides as the higher-pressure faces or surfaces of the ports entering from one inlet eye, and serving on their concave sides as the lower-pressure faces or surfaces of the ports entering from the opposite inlet eye. Another way of expressing the same idea is to say that in the double-suction two-port impeller having four discharge ports at the periphery, there are four vanes, each having a high- and a low-pressure side—the two vanes which serve as higher pressure surfaces for water entering from one inlet eye of the impeller also serve as lower-pressure surfaces for water entering from the opposite inlet eye thereof.

While we have shown the impellers as being provided with shrouds 25 and 26 (Figure 2), it is to be understood that the impeller may be of the "open" type, in which event the shrouds would be stationary parts in the pump casing.

Having fully described the invention, it is to be understood that it is not to be limited to the details shown herein, but the invention is of the full scope of the appended claims.

We claim:—

1. In a centrifugal pump impeller, a pair of opposed suction inlet eyes, and four intertwining hollow arcuate vanes arranged to define four fluid channels for communicating the periphery of the impeller alternately with one and then the other of said inlet eyes, and each of said vanes having a well rounded terminal section adjacent its respective inlet eye from which section the convex surface of the vane develops radially traversing substantially a quarter turn of the impeller before arriving at the periphery thereof, while the concave surface of the vane develops radially from said terminal section traversing substantially a half turn of the impeller before arriving at the periphery thereof.

2. In a centrifugal pump impeller, a pair of opposed suction inlet eyes, and four intertwining hollow arcuate vanes arranged to define four fluid channels of substantially uniform cross sectional area throughout their entire length for communicating the periphery of the impeller alternately with one and then the other of said inlet eyes, and each of said vanes having a well rounded terminal section adjacent its respective inlet eye from which section the convex surface of the vane develops radially to the impeller periphery while the concave surface of said vane develops radially from said terminal section to arrive at the impeller periphery substantially a quarter turn in advance of the peripheral engaging point of the convex surface.

3. In a centrifugal pump impeller, a pair of opposed suction inlet eyes, and four intertwining hollow arcuate vanes arranged to define four fluid channels for communicating the periphery of the impeller alternately with one and then the other of said inlet eyes, and each of said vanes having

an outwardly tapering terminal section adjacent its respective inlet eye from which section the axially parallel surface of the vane develops radially traversing substantially a quarter turn of the impeller before arriving at the periphery thereof while the concave surface of the vane twists from an outwardly directed taper to an axially parallel surface as it develops radially from the outwardly tapered terminal section traversing substantially a half turn of the impeller before arriving at the periphery thereof.

4. In a centrifugal pump impeller, a pair of opposed suction inlet eyes, and four intertwining hollow arcuate vanes arranged to define four fluid channels for communicating the periphery of the impeller alternately with one and then the other of said inlet eyes, and each of said vanes having a well rounded terminal section adjacent its respective inlet eye from which section the convex surface of the vane develops radially to the impeller periphery while the concave surface of the vane develops radially from said terminal section to arrive at the impeller periphery substantially a quarter turn in advance of the peripheral engaging point of the convex surface.

5. In a centrifugal pump impeller, a pair of opposed suction inlet eyes, and four intertwining hollow arcuate vanes arranged to define four fluid channels for communicating the impeller periphery alternately with one and then the other of said inlet eyes, and each of said vanes having a well rounded terminal section adjacent its respective inlet eye from which section the convex surface of the vane develops radially to the impeller periphery while the concave surface of the vane develops radially from said terminal section to substantially overlap the terminal section of the diametrically opposite vane before arriving at the impeller periphery.

6. In a centrifugal pump impeller, a pair of opposed suction inlet eyes, and four intertwining hollow arcuate vanes arranged to define four fluid channels for communicating the impeller periphery alternately with one and then the other of said inlet eyes, and each of said vanes having a well rounded terminal section adjacent its respective inlet eye from which section the convex surface of the vane develops radially traversing substantially a quarter turn of the impeller before arriving at the periphery thereof while the concave surface of the vane develops radially from said terminal section traversing substantially a half turn of the impeller before arriving at the periphery thereof.

7. In a centrifugal pump impeller, a pair of opposed suction inlet eyes, and four intertwining hollow arcuate vanes arranged to define four fluid channels of substantially uniform depth throughout their entire length, for communicating the impeller periphery alternately with one and then the other of the said inlet eyes, and each of said vanes having a well rounded terminal section adjacent its respective inlet eye from which section the convex surface of the vane develops radially to the impeller periphery while the concave surface of the vane develops radially from said terminal section to arrive at the impeller periphery substantially a quarter turn in advance of the peripheral engaging point of the convex surface.

8. In a centrifugal pump impeller, a pair of opposed suction inlet eyes, and four intertwining hollow arcuate vanes arranged to define four fluid channels for communicating the impeller periphery alternately with one and then the other of said inlet eyes and each of said fluid channels communicating through substantially a quarter turn of the impeller periphery, and each of said vanes having a well rounded terminal section adjacent its respective inlet eye from which section the convex surface of the vane develops radially to the impeller periphery while the concave surface of the vane develops radially from said terminal to arrive at the impeller periphery substantially a quarter turn in advance of the periphery engaging point of the convex surface.

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