Sept. 17, 1946. E. SCHMIDT 2,407,748

ROTARY PUMP

Filed Dec. 28, 1943 3 Sheets-Sheet 1

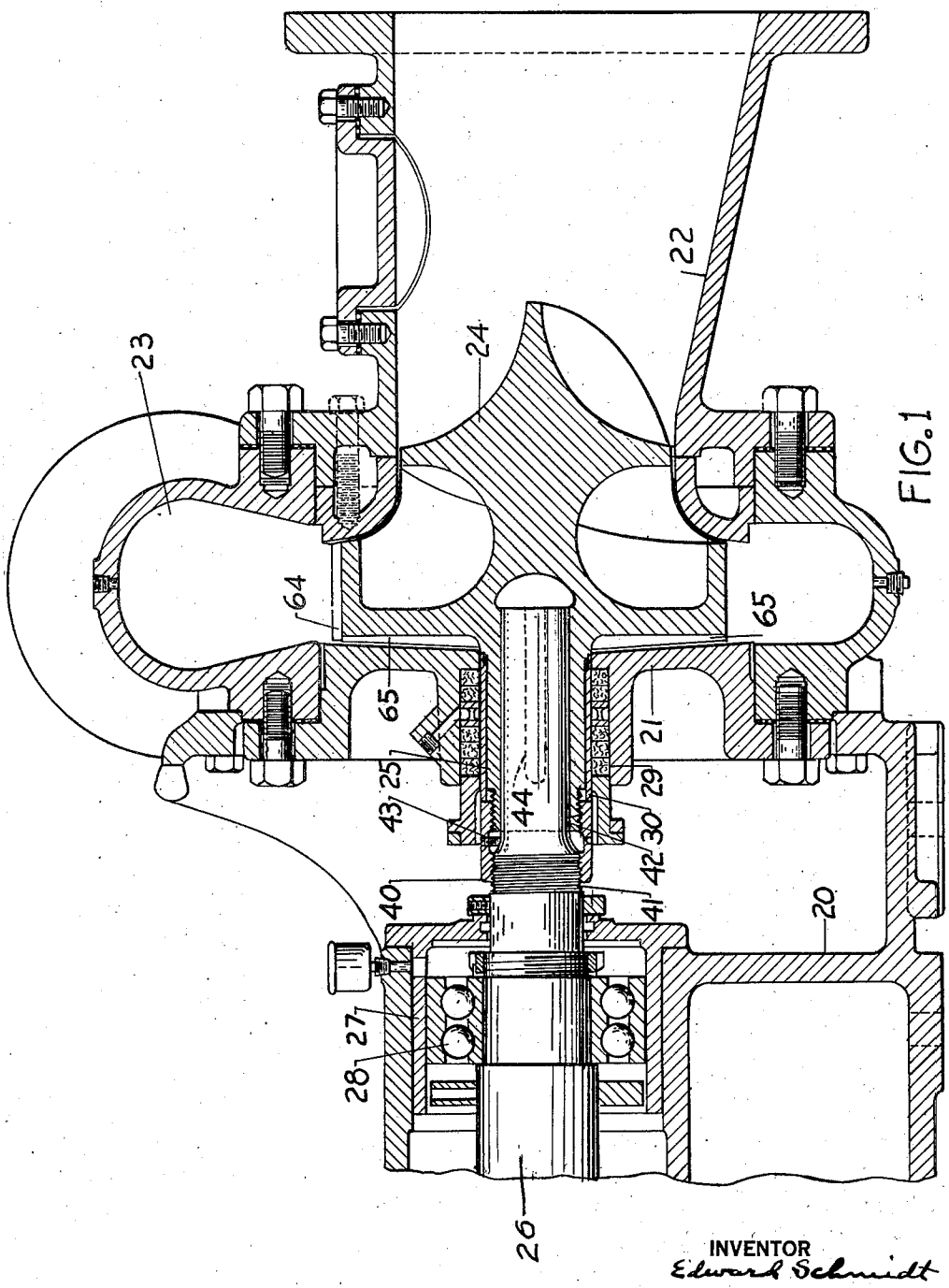


FIG. 1

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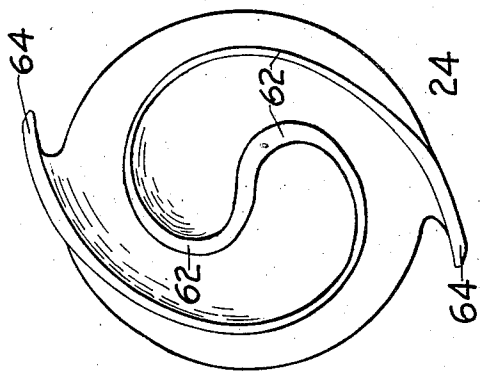


FIG. 4

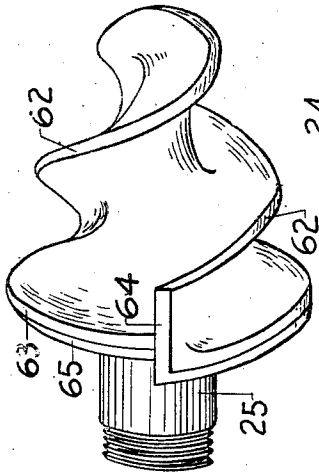


FIG. 3

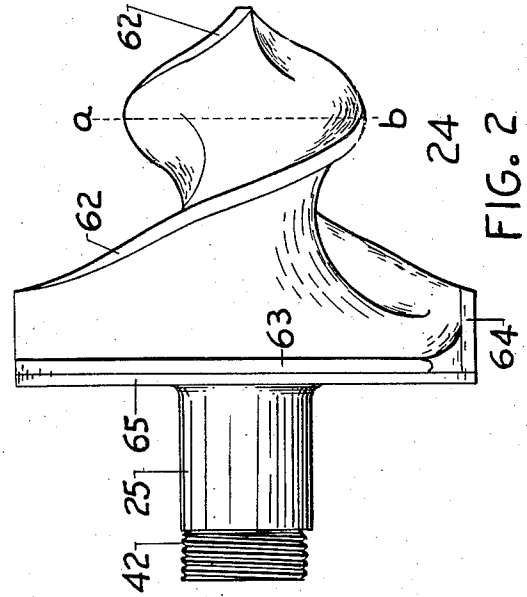


FIG. 2

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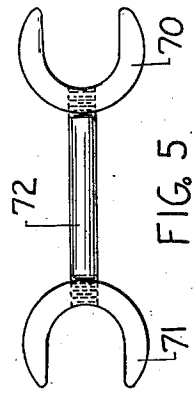


FIG. 5

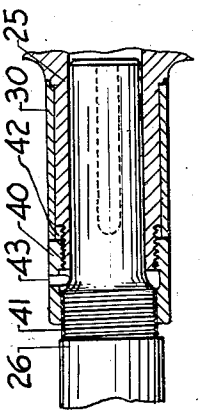


FIG. 8

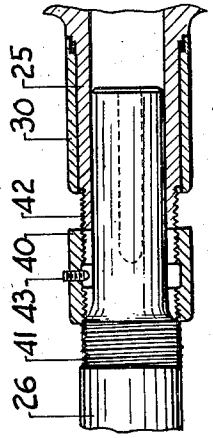


FIG. 7

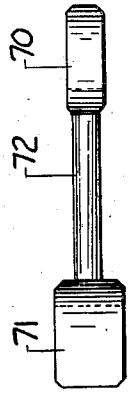


FIG. 6

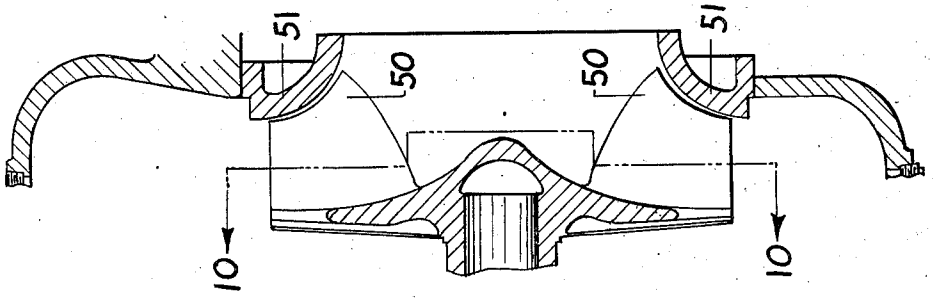


FIG. 9

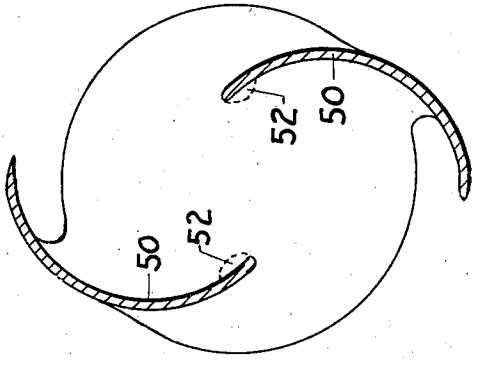


FIG. 10

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UNITED STATES PATENT OFFICE

2,407,748

ROTARY PUMP

Edward Schmidt, Andover, Mass., assignor to Lombard Governor Corporation, Ashland, Mass., a corporation of Massachusetts

Application December 28, 1943, Serial No. 515,909

3 Claims. (Cl. 103—88)

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The present invention relates to rotary pumps, and more particularly to pumps of that class used for pumping liquids containing solid matter in suspension, such as paper pulp, although the invention is not limited to such use.

The primary object of the invention is to provide a rotary or centrifugal pump whereby the clogging which occurs in the suction inlet in front of the impeller is eliminated. A subsidiary object is to provide improved means for locking the impeller to the drive shaft, such means when used with an auxiliary device being effective also to pull or force the impeller from the drive shaft when it becomes necessary to dismantle the pump for repairs or cleaning. A further object is to shorten the overhang of the impeller and its drive shaft and thereby increase the rigidity of the pump.

Other objects of the invention will appear from the detailed description of the particular embodiment thereof selected to illustrate its underlying principle. The invention consists of the various parts and combinations of parts hereinafter more fully described and defined by the appended claims.

In the drawings which accompany and form a part of this specification,

Figure 1 is a central longitudinal vertical section of a rotary pump involving my invention, the plane of the section being indicated by the line 1—1 on Fig. 4.

Fig. 2 is a side elevation of the impeller removed from the pump assembly.

Fig. 3 is a perspective view of said impeller.

Fig. 4 is an end elevation of the impeller removed from the pump assembly.

Fig. 5 is a front elevation of a co-operative adjunct known as a "horseshoe" for use when the locking nut is employed to force the impeller from its drive shaft.

Fig. 6 is a side elevation of said horseshoe.

Fig. 7 and Fig. 8 are fragmentary sectional views used in explaining the operation of the lock nut in securing the impeller hub to the drive shaft and in "pulling" or forcing it off said shaft.

Fig. 9 is a vertical elevation of a conventional impeller, and

Fig. 10 is a section taken on the line 10—10 of Fig. 9, these figures being used hereinafter in explaining the problem solved by the present invention.

In the particular drawings selected for more fully disclosing the principle underlying my invention, said drawings to be taken as illustrative, merely, and not restrictive, 20 is a portion of

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the base or bed to which is attached in any suitable manner the pump housing 21, provided with the usual suction inlet 22 and volute outlet 23. Within the housing is mounted for rotation an impeller the forward portion 24 of which extends well into said suction inlet and is spaced throughout its entire length from the walls thereof; the rearward end of the impeller is provided with a hub 25 mounted on the drive shaft 26 which rotates in a suitable journal box 27 carried by the bed and preferably provided with ball bearings 28. A suitable stuffing box 29 is carried by the housing and interposed between said stuffing box and the impeller hub is a sleeve 30.

By means of the nut 40, the end portions of which are threaded interiorly in opposite directions for engagement with the oppositely directed threads 41 and 42 cut into the juxtaposed end portions of the drive shaft 26 and impeller hub, respectively, said hub is locked to the drive shaft and held thereon axially immovable with respect thereto. A set screw 43 may be employed to lock said nut to the drive shaft. The hub preferably is keyed to the drive shaft, as indicated at 44.

Referring now to Figs. 9 and 10, wherein I have shown conventionally an impeller of the type now generally in use for the purpose of more fully explaining the problem solved by the present invention, the impeller vanes 50 are carried down into the eye of the suction, indicated at 51, 51, with the result that vacuum chambers, indicated at 52, 52, will be formed on the back of the vanes due to the high peripheral velocity of the end portions of the vanes, in consequence whereof the liquid which contains the solid matter in suspension, for example, the water in the pulp, if the pump be employed for pumping pulp, will more readily flow into the impeller than the pulp or other solid matter in suspension and will be pumped through the volute while the pulp and other solid matter will accumulate in front of the impeller eye and form a solid relatively dry mass, thereby requiring the stopping of the pumping operation and the clearing of the suction and sometimes the dismantling of the pump.

In order to prevent the clogging of the suction inlet and the attendant disadvantages, I have provided an impeller which might properly be described as having a screw shaped body tapering toward the forward end thereof, the forward portion of the impeller extending well into the suction inlet and throughout its entire length being spaced away from the walls of the suction inlet by a distance which progressively increases forwardly, and each vane 62 (of which two are

shown in the present instance, although it will be understood that one or more than two may be used) being of progressively increasing radius of curvature rearwardly throughout its entire length.

Each vane at its forward end is substantially coincident with the axis of the impeller and its forward end is disposed a substantial distance forwardly of the suction inlet, such distance being shown in the present instance as equal approximately to the maximum diameter of the mid portion of the impeller, as shown in Fig. 1. The forward portion of each vane is of spiral shape from its forward end to substantially the longitudinal center thereof (the line *a*—*b* Fig. 2) and is curvilinear, preferably of plane involute curvature, throughout the remainder of its length. The envelope of the portion of the impeller forward of the line *a*—*b*, is preferably paraboloidal or otherwise forwardly tapering. At its rearward end, the vane extends beyond the base portion **63** thereof, as indicated at **64**, and projects into the volute outlet. The base portion of the impeller is provided with an annular rib **65** at or near the circumference thereof.

By thus arranging matters, the peripheral speed of the impeller is practically nil at its forward end and progressively increases toward its rearward end, with the result that the vacuum pockets above described in connection with Figures 9 and 10 are completely eliminated and the pulp delivered to the vane proper **64** and thence to the pump outlet without clogging of any sort.

By means of my improved pump, pulp of a higher stock density than it is now feasible to handle economically can be pumped efficiently and economically without dehydration, and the resulting clogging. Furthermore, the forwardly tapering screw shape of the inlet vane of my impeller will permit a certain amount of slippage, so that while said impeller performs the functions of mixing and conveying the pulp to the outlet vanes whereby it is expelled into the pump outlet, such conveying is markedly different from that effected by the usual screw conveyor, the action of which is comparable to that of a pump of the piston type. As the result of such slippage, excessive power consumption when operating with throttled discharges is eliminated, and when the discharge valve is closed while the pump is operating there will be established a maximum head which cannot be exceeded, with the result that the pressure developed will not injure the piping, thereby eliminating the necessity for the relief valve heretofore employed.

It is to be understood that the impeller herein described is not limited to use with the particular type of pump shown in the drawings and that it can be used with good effect on almost every type of centrifugal pump.

It will be obvious that with the screw shaped impeller above described, the usual type of nut securing the impeller to the forward end of the shaft cannot be used, and for that reason and also because it performs the function of lock nut as well as impeller puller, I secure the impeller to the drive shaft by the nut **40** hereinbefore mentioned.

In Fig. 7, I have shown the position of the parts when the impeller has been driven by a lead hammer, or otherwise, on the drive shaft to such position that the nut **40** is substantially in engagement with the ends of the threaded

portions of the shaft and hub. The threads of the shaft being right-hand threads and those of the hub, left-hand threads, it will be apparent that clockwise rotation of the nut **40** will draw the hub to the position shown in Fig. 8, whereupon the screw **43** will be set to lock the nut in position. The nut **40** in co-operation with an auxiliary device forms an effective impeller puller. When the set screw **43** is loosened and the nut **40** turned counterclockwise sufficiently to disengage itself from the threads **42**, substantially the position shown in Fig. 7, said nut is then turned clockwise to the position shown in Fig. 8, the hub in such case not following, and an abutment, such as a horseshoe **70**, is placed over the shaft between the right-hand end of the nut **40** and the left-hand end of the collar **30**. The nut **40** is then turned counterclockwise, thereby forcing the hub further off the drive shaft and then turned clockwise to its original position shown in Fig. 8.

Another horseshoe **71**, wider than the horseshoe **70**, is now placed over the hub between the nut and collar and the nut turned counterclockwise, thereby forcing the hub still further off the drive shaft, and so on, until the impeller is clear of the shaft.

As indicated in Figs. 5 and 6, a plurality of horseshoes, herein shown as two, of varying widths may be attached to a single shank **72**, for convenience.

One advantage of having the impeller nut placed rearwardly of the impeller and not on the forward end thereof, as in the case of rotary pumps now in use, is that the overhang of the impeller and drive shaft, that is to say, the distance between the longitudinal center of the impeller and the longitudinal center of the inboard bearing is reduced and thereby the diameter of the drive shaft may also be reduced and the rigidity of the pump increased.

Having thus described an illustrative embodiment of my invention without, however, limiting the same thereto, what I claim and desire to secure by Letters Patent is:

1. A rotary pump, comprising a housing having a suction inlet and an impeller mounted for rotation therein, said impeller consisting of a body tapering toward the forward end thereof and having on its periphery a vane progressively increasing in radius of curvature from its forward to its rearward end, said vane at its forward end being substantially coincident with the axis of said body and extending a substantial distance into said suction inlet, the forward portion of said impeller throughout its entire length being spaced away from the walls of the suction inlet by a distance which is progressively increasing forwardly.

2. In a rotary pump comprising a housing having a suction inlet, an impeller, the vane of which is screw-shaped at its forward end and of involute curvature throughout the remainder of its length, the forward end portion of the impeller tapering forwardly and the forward end thereof extending a substantial distance into said suction inlet.

3. In a rotary pump comprising a housing having a suction inlet, an impeller having screw-shaped inlet vanes and outlet vanes of involute curvature, the forward end of said inlet vanes being disposed a substantial distance forwardly of the eye of said suction inlet.

EDWARD SCHMIDT.