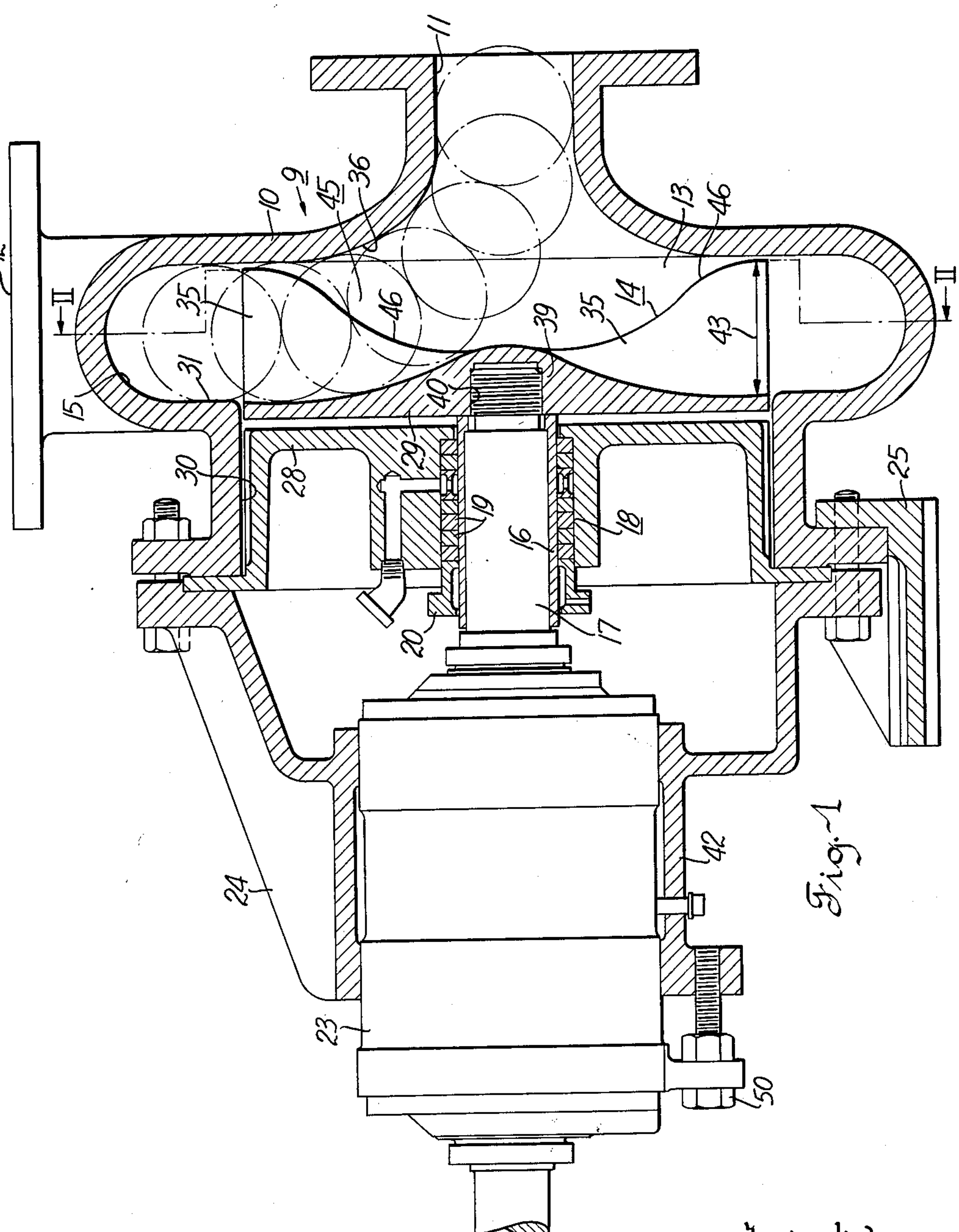

Fig. 1

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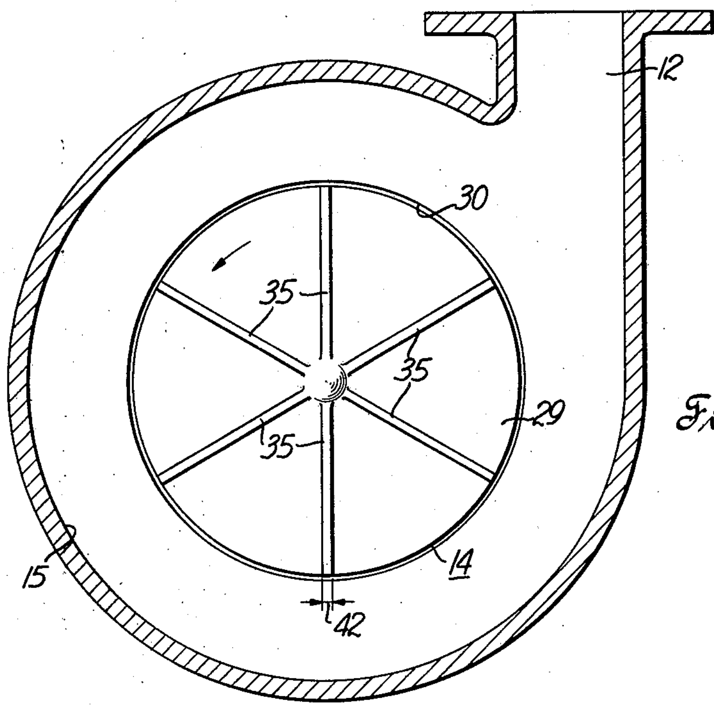

Fig. 2

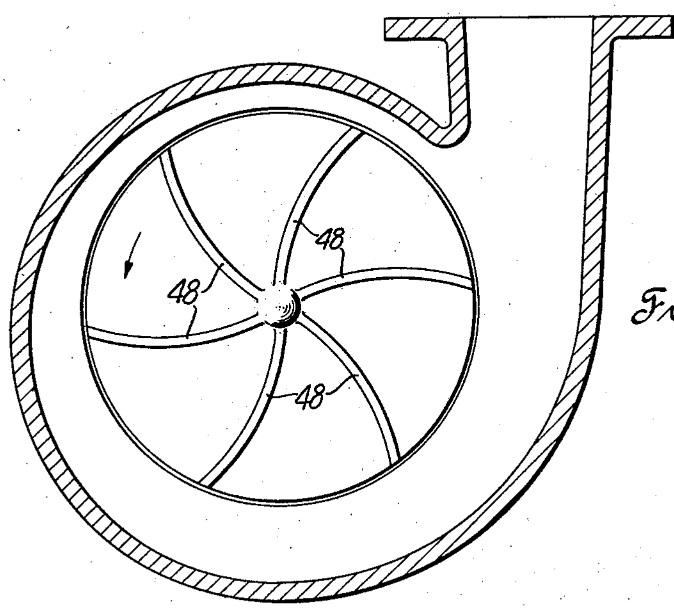

Fig. 3

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NONCLOGGING CENTRIFUGAL PUMP

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This invention relates generally to centrifugal pumps. More specifically this invention relates to non-clogging, solids handling centrifugal pumps.

There has long been a problem in the hydraulic industry in connection with pumping solid material or fibrous material. These materials tend to clog the impeller of a centrifugal pump. However, there is a trend toward pumping more and larger solid material suspended in liquids. One way of solving this problem is to take a conventional centrifugal pump impeller and position it in a recessed area alongside a swirl or pumping chamber. The impeller is spaced from the opposing wall of the pump casing a distance equal to the diameter of the inlet of the pump so that any material entering the pumping chamber can be pumped outward through the discharge without engaging the impeller vanes. Although pumps of this type have been successful to a certain degree, they can only develop a very limited head and their efficiency is extremely low. As a result, such a pump is used only where it is absolutely necessary to pump solids of such a size that they frequently clog the impeller of a conventional centrifugal pump.

Applicant overcomes the problems mentioned above by providing a unique impeller which permits the use of the vanes in the pumping chamber and is still capable of pumping any solid which enters the inlet of the pump. The impeller vanes are formed so that they are very narrow near the center of the impeller and gradually widened to extend substantially across the impeller chamber near the periphery of the impeller. The vanes are arranged so that they combine with the backplate of the impeller and the casing to define a passageway extending from the eye of the impeller to its periphery which has a minimum size equal to a sphere of the same diameter as the inlet of the pump. Such a pump is truly nonclogging in that there is a continuous path through the pumping chamber which is the equivalent size of a sphere equal to the diameter of the inlet. Furthermore, since the vanes of the impeller are positioned in the pumping chamber, it utilizes the characteristics of a true centrifugal pump and hence can develop heads and efficiencies comparable to a conventional centrifugal pump.

Therefore, it is the object of this invention to provide a new and improved centrifugal pump.

Another object of this invention is to provide a nonclogging solids handling pump with improved head and efficiency.

Other objects and advantages will be apparent from the following description when read in connection with the accompanying drawings in which:

FIG. 1 is a cross sectional view of a centrifugal pump embodying the impeller of this invention;

FIG. 2 is an end view taken along the line II—II of FIG. 1 of the impeller of this invention; and

FIG. 3 shows an alternate embodiment of this invention in which the impeller vanes are curved.

The pump assembly 9 illustrated in FIG. 1 comprises generally a pump casing 10 having an inlet 11 and a discharge 12. The casing 10 defines an impeller or pumping chamber 13 in which an impeller 14 of this invention is positioned. The chamber 13 has a peripheral volute 15 to gather the discharge from the impeller and direct it into the discharge nozzle or opening 12.

The impeller 14 is connected to a shaft 17 which extends rearwardly from the pump casing 10 to a source of power. The shaft 17 is surrounded by a conventional shaft sleeve 16 and a suitable seal illustrated as a stuffing box 18 having the usual packing 19 and a gland 20 held in place by suitable bolts. The shaft 17 is also surrounded by a bearing and bearing cartridge 23 which is in turn mounted in a bearing bracket 24. The bearing bracket is in turn connected to the pump casing 10 and a base member 25.

The pump 9 is also equipped with a rear cover plate 28 which in this particular embodiment surrounds the stuffing box 18 and is positioned adjacent the rear plate or shroud 29 of the impeller 14. The rear cover plate 28 is recessed into a cylindrical neck portion 30 of the pump casing 10 so as to be slightly spaced from the impeller chamber 13. The rear shroud 29 of the impeller is also partially recessed into the cylindrical neck 30 so that the front edge of the shroud 29 is aligned with the rear surface 31 of the impeller chamber 13. This is to avoid the formation of any sharp corners or surfaces which would tend to impede the progress of solids or fibers as they go through the impeller chamber.

The hub 39 of the impeller is provided with an axial bore 40 which is threaded for connection to the end of the shaft 17. As shown in FIGS. 1 and 2, the vanes 35 are arcuately spaced around the shroud 29 and extend from near the center of the shroud plate 29 radially outward to its periphery. The thickness 42 of the vanes is substantially the same throughout their length although it could be varied if desired. However, the depth or width 43 of the vanes 35 varies from a very narrow width near the hub 39 of the impeller to a maximum width near the periphery of the impeller at which point the vanes extend almost entirely across the impeller chamber 13. However, in many applications it is preferred that the edge of the vane be spaced from the wall of the impeller chamber a sufficient distance to form a fluid passageway and thereby avoid any kind of a constriction about which stringy material such as found in paper pulp can get caught and clog the pump.

The vanes 35, the shroud plate 29 and the wall 36 of the impeller chamber 13 combine to define a plurality of fluid impelling passages 45 that extend from the inlet end of the pump to the discharge. The minimum size of these passageways 45 is equivalent to a sphere of the same diameter as the inlet 11 of the pump. Thence, any solid material entering the inlet of the pump can pass through one of these passages through the impeller chamber into the discharge. The minimum size of these passages is made possible by forming the leading edge 46 of the vanes so that it curves away from the wall of the impeller chamber near the hub of the impeller where the arcuate space between adjacent vanes is very small. In this area the distance between the edge 46 of the vane and the wall 36 of the casing is substantially equal to the diameter of the inlet.

As the vane extends radially outward, the edge 46 of the vane curves toward the opposing wall surface 36 of the impeller chamber. In areas radially outward from the hub, the sphere can move between adjacent vanes 35 and a portion of the sphere extends inwardly from the edge of the vanes toward the shroud plate 29 of the impeller. In this position it does not require as much space between the edge 46 of the impeller vane and the casing wall 36 to pass a sphere the size of the inlet. For this reason the edge of the vane can extend closer to the opposing wall surface as the vane extends radially outward. The curve on the edge of the vanes continues until a point is reached where the distance between adjacent vanes is equal to the diameter of the inlet or the diameter of the theoretical sphere which is to be passed through the pump. At this point, the blades or vanes 35 could extend all the way to the opposing wall surface 36. However, as mentioned above, it is preferable to keep a sufficient clearance between the wall surface and the tip of the vanes to avoid any restrictions to the flow through the pump of any solids or fibers suspended in the liquids.

In an alternate embodiment illustrated in FIG. 3, the entire impeller vanes 48 are curved backwardly as the vane extends outwardly to the periphery or rim of the impeller. This is in accord with conventional practices in the manufacture of centrifugal pumps and is done to further improve the hydraulic efficiency of the pump. However, the same configuration of the leading edge of the vanes that is shown in FIG. 1 is carried out in this embodiment on the vanes 48. Hence, the width of the impeller vanes 48 near the hub is very small and gradually gets larger as the vane extends radially outward until it reaches its full width near the outer periphery of the impeller.

In the preferred embodiment we have illustrated a pump having a circular volute 15 for collecting the fluid discharged from the impeller. However, it is obvious that this impeller could be used with a pump having a conventional or true volute type casing such as shown in FIG. 3 as well as the circular casing. The circular or uniform clearance type of casing has better nonclogging action.

In operation, as the impeller 14 begins to rotate, liquid with solids entrained therein are drawn in through the inlet 11. This liquid is then acted upon by the impeller and thrown radially outward. Any solids in the liquid move through the impelling passages 45 defined between the vanes 35, the internal wall surface 36 of the impeller chamber and the rear shroud 29. In this way, any solid which can enter the inlet of the pump can be impelled through the impeller into the discharge without clogging the pump.

The position of the impeller 14 relative to casing wall 36 can be varied by changing the position of the bearing cartridge 23 in housing 42 relative to the pump casing 10. This can be done by rotating adjusting bolt 50 or other means well known in the art. As is apparent from FIG. 1, there is sufficient space between the rear cover 28 of the pump and rear shroud 29 of impeller 14 to allow for some adjustment of the spacing between the impeller and its opposing wall surface.

Although but one embodiment has been illustrated and described, it will be apparent to those skilled in the art that various modifications and changes can be made therein without departing from the spirit of the invention or the scope of the appended claims.

Having now particularly described and ascertained the nature of my said invention and the manner in which it is to be performed, I declare that what I claim is:

1. A centrifugal pump comprising: a casing having walls defining an impeller chamber, said chamber having an axial inlet and a radially spaced discharge opening, an impeller mounted for rotation in said chamber, said impeller having a rear shroud plate and a plurality of arcuately spaced substantially radially extending vanes mounted thereon, said vanes extending inward to near the center of said impeller, the depth of said vanes being smaller near the center of said impeller than near its outer periphery, the radially outer portion of said vanes extending across substantially the entire width of said chamber, said vanes being arranged on said impeller so as to define with said shroud plate and the opposing said wall of said impeller chamber a plurality of passages continuous from the inlet of said chamber to said outlet, the minimum size of said passages being at least equal to a sphere of the same diameter as the width of said inlet, whereby any solid body entering said chamber through said inlet can be passed through said impeller to said discharge.

2. A centrifugal pump comprising: a casing having walls defining an impeller chamber, said chamber having an axial inlet and a radially spaced discharge opening, an impeller mounted for rotation in said chamber, said impeller having a rear shroud plate and a plurality of arcuately spaced vanes mounted thereon, said vanes extending from the periphery of said plate radially inward to near the center of said impeller, the width of said vanes being smaller near the center of said impeller than near its outer periphery, the radially outer portion of said vanes extending across substantially the entire width of said chamber, said vanes being arranged on said impeller so as to define with said shroud plate and the opposing said wall of said impeller chamber a plurality of passages continuous from the inlet of said chamber to said outlet, the minimum size of said passages being at least equal to a sphere of the same diameter as the width of said inlet, whereby any solid body entering said chamber through said inlet can be passed through said impeller to said discharge.

3. A centrifugal pump comprising: a casing having walls defining an impeller chamber having an axial inlet, said chamber having a peripheral uniform clearance volute connected to a discharge nozzle, an impeller mounted for rotation in said chamber, said impeller having a rear shroud plate and a plurality of arcuately spaced substantially radially extending vanes mounted thereon, said vanes extending inward to near the center of said impeller, the depth of said vanes being smaller near the center of said impeller than near its outer periphery, the radially outer portion of said vanes extending across substantially the entire width of said chamber, said vanes being arranged on said impeller so as to define with said shroud plate and the opposing said wall of said impeller chamber a plurality of passages continuous from the inlet of said chamber to said outlet, the minimum size of said passages being at least equal to a sphere of the same diameter as the width of said inlet, whereby any solid particle entering said chamber can be passed through said impeller to said discharge.

4. A centrifugal pump comprising: a casing having walls defining an impeller chamber having an axial inlet, said chamber having peripheral gradually increasing clearance volute terminating in a discharge nozzle, an impeller mounted for rotation in said chamber, said impeller having a rear shroud plate and a plurality of arcuately spaced substantially radially extending vanes mounted thereon, said vanes extending inward to near the center of said impeller, the depth of said vanes being smaller near the center of said impeller than near its outer periphery, the radially outer portion of said vanes extending across substantially the entire width of said chamber, said vanes being arranged on said impeller so as to define with said shroud plate and the opposing said wall of said impeller chamber a plurality of passages continuous from the inlet of said chamber to said outlet, the minimum size of said passages being at least equal to a sphere of the same diameter as the width of said inlet, whereby any solid particle entering said chamber can be passed through said impeller to said discharge.

5. A centrifugal pump comprising: a casing having walls defining an impeller chamber, said chamber having an axial inlet and a radially spaced discharge opening, an impeller mounted for rotation in said chamber, said impeller having a rear shroud plate and a plurality of arcuately spaced substantially radially extending vanes mounted thereon, said vanes extending inward to near the center of said impeller, the depth of said vanes being smaller near the center of said impeller than near its outer periphery, the radially outer portion of said vanes extending partially across said chamber, said vanes being arranged on said impeller so as to define with said shroud plate and said opposing wall of said chamber a plurality of separate passages continuous from the inlet of said chamber to said outlet, the minimum size of said passages being at least equal to a sphere of the same diameter as the width of said inlet, whereby any solid particle entering said chamber can be passed through said impeller to said discharge.

6. A centrifugal pump comprising: a casing having walls defining an impeller chamber, said chamber having an axial inlet and a radially spaced discharge opening, an impeller mounted for rotation in said chamber, said impeller having a rear shroud plate and a plurality of arcuately spaced vanes mounted thereon, said vanes extending inward along a curved line from the periphery of said plate to near the center of said impeller, the width of said vanes being smaller near the center of said impeller than near its outer periphery, the radially outer portion of said vanes extending across substantially the entire width of said chamber and being arranged on said impeller so as to define with said shroud plate and said walls a plurality of independent passages continuous from the inlet of said chamber to said outlet, the minimum size of said passages being at least equal to a sphere of the same diameter as the width of said inlet, whereby any solid body entering said chamber through said inlet can be passed through said impeller to said discharge.

7. The centrifugal pump of claim 1 in which the tips of the vanes combined with the hub of the impeller to define a continuous smooth surface.

8. The centrifugal pump of claim 1 in which the walls defining the impeller chamber are substantially parallel.

9. The centrifugal pump of claim 1 in which the maximum depth of the vanes is at the outer periphery of the impeller.

References Cited in the file of this patent

UNITED STATES PATENTS

2,635,548	Brawley	Apr. 21, 1953
2,655,868	Lindau et al.	Oct. 20, 1953
2,785,930	Burnside	Mar. 19, 1957
2,853,019	Thornton	Sept. 23, 1958
2,958,293	Pray	Nov. 1, 1960

FOREIGN PATENTS

542,597	France	May 19, 1922
413,573	Great Britain	of 1934
574,079	Great Britain	Dec. 19, 1945
82,497	Switzerland	Oct. 1, 1919