

June 16, 1959

E. UMBRIGHT

2,890,660

NON-CLOGGING CENTRIFUGAL PUMP

Filed May 26, 1953

3 Sheets-Sheet 1

FIG. 2.

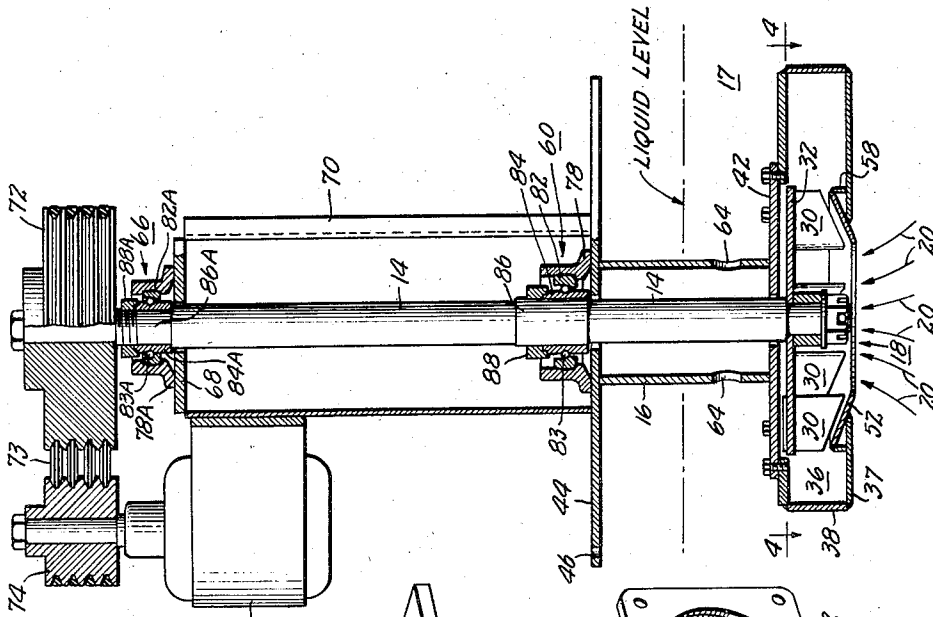
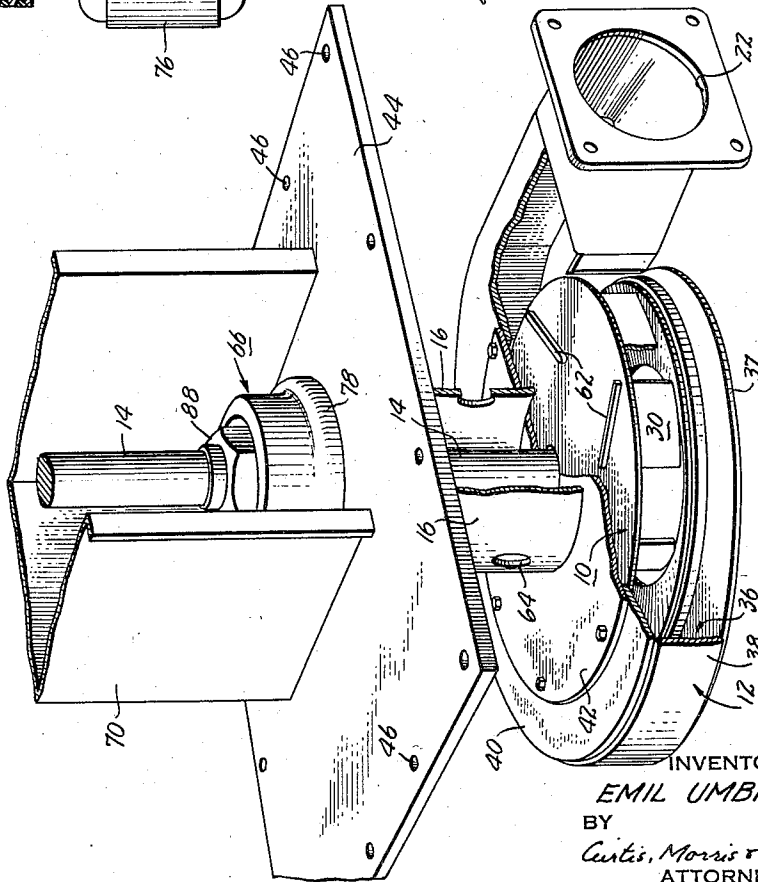


FIG. 1.



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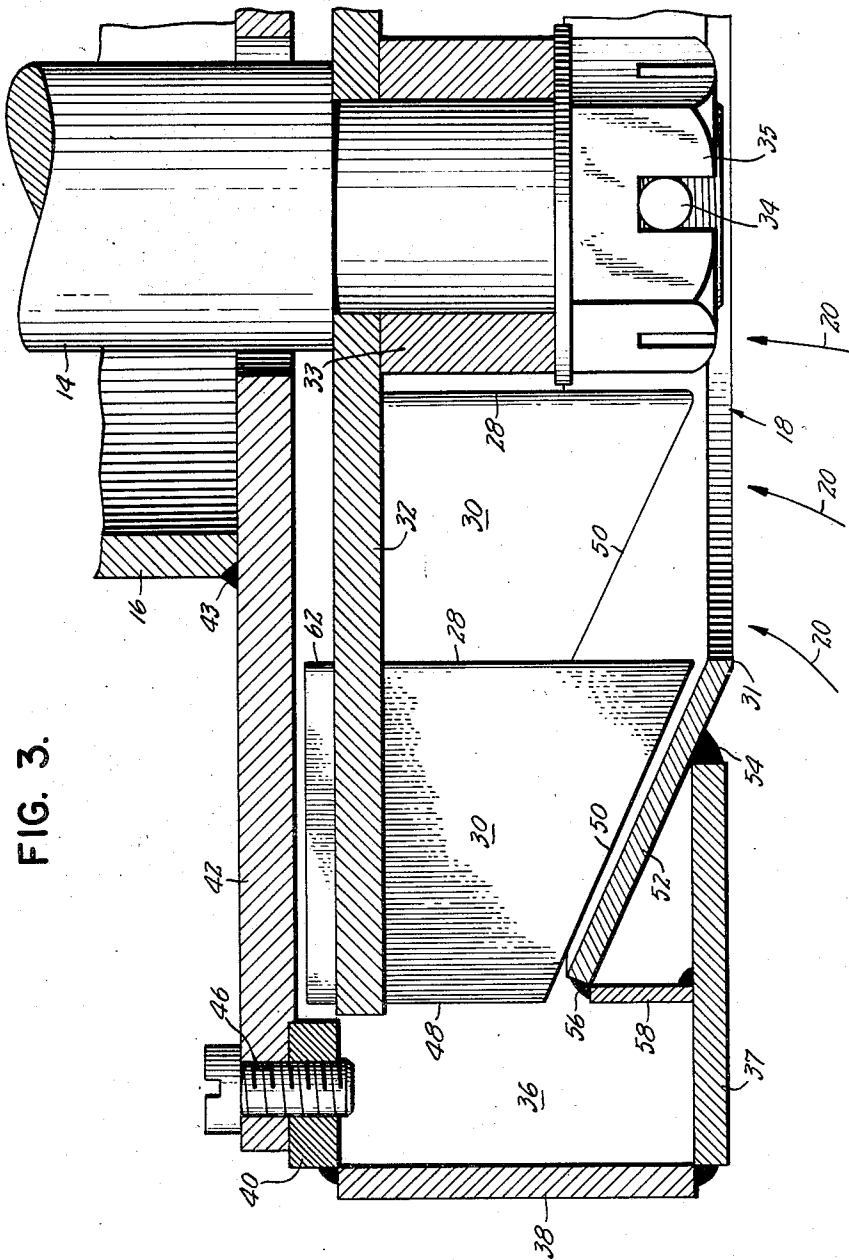
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NON-CLOGGING CENTRIFUGAL PUMP

3 Sheets-Sheet 3

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NON-CLOGGING CENTRIFUGAL PUMP

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Application May 26, 1953, Serial No. 357,450

6 Claims. (Cl. 103-103)

This invention is in the field of centrifugal pumps for pumping liquids, and in particular relates to an improved non-clogging pump. The invention has particular utility for pumping and circulating large volumes of contaminated liquids and for maintaining high pressures over long periods of time regardless of the degree of contamination of the liquid pumped.

The invention is described as embodied in a pumping assembly for use in power washing equipment and spray washing booths wherein the pump-shaft bearing assemblies are readily accessible and require little servicing.

In pumping the large quantities of liquid which are continuously recirculated in power washing applications, one of the most troublesome difficulties encountered with existing pumps is that they become clogged in a relatively short period of time. Many existing pumps have a high initial capacity and can deliver a satisfactorily high pressure when they are first placed in operation, but due to the large amount of recirculation and the increasing contamination of the washing solution these pumps soon become clogged. Their capacity and delivery pressure drop off until efficient operation ceases. With these existing pumps a considerable portion of the working time is lost because of the required frequency of dismantling and cleaning.

Another difficulty of existing pumps is that their bearing assemblies are immersed in or exposed to the contaminated washing solution which often has a corrosive effect on the bearing surfaces. In this way the bearings are rapidly worn and require an early replacement. Moreover, in many such washing solutions there are high concentrations of detergents or other solvent agents which make it difficult to maintain adequate bearing lubrication wherever the solution strikes the bearing surfaces. The bearing packing deteriorates from excessive friction and in many cases troublesome leaks have developed.

The described embodiment of the invention successfully operates under the most severe working conditions. For example, in many power washing installations an object to be painted is first washed under a high pressure jet of detergent laden water. The combined washing and solvent action serve to remove scale, dirt, and grease, which go into the washing solution and are recirculated through the pump. Occasionally even wiping cloths fall into the washing solution. The pump described herein operates at high efficiency in spite of the heavy quantities of sticky and dense dispersions formed in such power washing installations and successfully handles solids in the washing solution such as rust scales, dirt particles, pieces of cloth, and the like.

It is an object of the present invention to provide an improved, simplified non-clogging pump for handling contaminated solutions and requiring a minimum of maintenance.

Various other objects, aspects, and advantages of the present invention will be in part pointed out and in part apparent from the following description considered in conjunction with the accompanying drawings, in which:

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Figure 1 is a perspective view, on enlarged scale, of the impeller and casing of a simplified heavy duty pump embodying the present invention, shown partially broken away;

5 Figure 2 is a vertical axial cross-sectional view of the whole pump unit;

Figure 3 is a vertical, fragmentary sectional view through the impeller assembly and casing;

10 Figure 4 is a horizontal cross-sectional view taken along the line 4-4 in Figure 2, looking down on the impeller and pump scroll;

Figure 5 is an enlarged elevational view of one of the impeller blades; and

15 Figure 6 is a bottom view of the blade shown in Figure 5.

In operation the impeller 10, pump casing 12, and a bottom portion of the pump shaft 14, and of the lower shaft housing and casing support 16 project below the level of the washing solution 17. The centrifugal impeller 10 is rotated in a clockwise direction as seen in Figure 4, and the washing solution is sucked up from the bottom into the intake port 18, as shown by the arrows 20, and driven out through the discharge port 22 (Figure 4) in the direction of arrow 24 at a relatively high pressure.

In order to provide a large capacity and to enable the pump to handle the various solid matter discussed above, which is likely to occur in the washing solution, the intake port 18 (see Figure 3) has a large diameter equal to the full diameter (see Figure 4) of the central impeller space, indicated at 26, inside of the inner or leading edges 28 of the eight impeller blades 30. The intake port 18 is immediately adjacent the impeller space 26 and has a sharp projecting edge 31. Thus, this pump has a wide intake orifice and a very short intake path through which the washing solution travels while being sucked into the central impeller space. The result is that in spite of any stickiness of the solution, the pump is not required to overcome any significant intake pressure drop. Moreover, the relatively long sharp edge 31 co-operates with the impeller blades 30 to chew up rapidly any lumps of dirt or pieces of cloth in the solution 17.

The eight impeller blades 30 are vertically mounted from the underside of an impeller disk 32, which is welded to a collar 33, held onto the bottom end of the vertical pump shaft 14 by a pin 34 and nut 35. As the impeller blades revolve, they drive the washing solution out from the central space 26 into an exit channel 36. This channel 36 is formed by the space within a bottom wall or casing plate 37, an outer casing wall or pump scroll 38 of approximately involute shape, and a top wall or casing plate 40. To provide access to the impeller, the top casing plate 40 is detachably supported at its inner edge from an impeller cover 42, welded along a seam 43 to the bottom of the lower shaft housing 16, which in turn is supported from a mounting plate 44 for the whole pump assembly. For ease in mounting, the mounting plate 44 may be square in form and may have a number of bolt holes 46 spaced around its edge to co-operate with bolt holes formed around the inner edge of an opening in the top of the tank for the solution 17.

To provide a relatively high exit velocity and pressure, the impeller blades 30 are tapered to decrease their size in going from their inner edges 28 to their outer edges 48. The bottom or clearance edges 50 of the blades 30 are inclined upwardly and outwardly and are spaced with uniform clearance from the upper inclined surface of a casing ring 52. This ring 52 has the form of a truncated cone, shown in section in Figures 2 and 3, and in these figures the bottom edges 50 of blades 30 are shown as straight to emphasize that a uniform clearance exists be-

tween them and the ring 52. Actually, the clearance edges 50 of the blades are curved, as shown in Figure 5. These blades are vertical and (see Figure 4) are set at an angle with respect to radii from the axis of the impeller so that their bottom edges must approximate portions of a parabolic curve.

As seen in Figure 3, the sharp inner lower edge 31 of the casing ring 52 forms the edge of the intake port discussed above. This edge 31 projects slightly below the bottom casing plate 37 and is welded along a seam 54 to the inner edge of the bottom plate 37. The outer edge of the casing ring 52 is supported by welding along seam 56 to a cylindrical brace 58 welded at points to the bottom casing plate 37.

The uniform clearance along the edges 50 and the relatively large size of the exit channel 36 feeding into the discharge port 22 give even further protection against any clogging of the pump.

Further protection against clogging is obtained by using a relatively large clearance between the upper or reverse surface of the substantially imperforate impeller member 32 and the cover 42.

Because of the high pressure existing in the outlet channel 36, there is a tendency for the liquid to flow or leak back up past the edge of the impeller disk 32 into the large clearance between the cover 42 and the disk 32 and inwardly toward the shaft 14 and then up between the inner edge of the cover 32 and the shaft 14 into the interior of the lower shaft housing 16. To prevent this leakage or reverse flow from building up within the lower shaft housing 16 and reaching the lower bearing assembly 60, which rests on top of the mounting plate 44, four auxiliary impeller blades 62 are attached to the upper surface of the impeller disk 32. As seen in Figure 4, these four auxiliary impellers are the same horizontal length as the main blades 30, but are of little vertical height, and are at the same inclination as the blades 30, being located directly above alternate blades 30. These auxiliary impellers create an outward thrust and act to prevent any substantial reverse flow into the housing 16. Moreover, leakage holes 64 are formed in the housing 16 below the level of the washing solution 17 so that any slight residual reverse flow is readily discharged from the housing 16. Another advantage of the auxiliary blades 62 is that they act to chew up any solid material which may find its way into the clearance between the top of the impeller disk 32 and the cover 42. The large clearance therebetween allows the freeing of any such material.

Among the advantages of this pump are those which flow from the fact that the impeller 10 is free from the close presence of any bearings. The intake opening 18 is entirely free, nothing obstructs access to the impeller space 26 so that the impeller blades 30 can rapidly chew up any solid matter therein to free the pump. Also, the top surface of the impeller is free; any solid matter in the clearance space under the cover 42 is quickly ground up, and there is no bearing assembly nearby to become clogged.

Neither the lower or upper bearing assemblies 60 or 66, respectively, are submerged or subjected to attack by the washing solution. There is no requirement for any special sealing glands or any other sealing arrangement and no bearing leakage can occur. Thus, the lower bearing assembly 60 is accessibly located on top of the mounting plate 44 and is entirely protected by the auxiliary blades 62 and the leakage holes 64. The upper bearing assembly 66 is supported upon the cover 68 resting on an upper shaft housing 70, which is welded on top of the mounting plate 44 and may have a door, not shown. Both bearing assemblies are of the self-aligning type, and the shaft 14 is of fairly large diameter in order to support the impeller 10 which is on its free lower end at a considerable distance below the lower bearing assembly 60. On the upper end of the shaft 14 is mounted

a multiple V driving sheave 72 around which run several V-belts 73 driven by a sheave 74 of smaller diameter connected to an electric motor 76. With this belt drive the necessary reduction in speed and increase in torque is obtained; the motor 76 is substantially isolated from any shocks from the impeller 10. However, in many installations a reduction gear transmission or a direct drive, with a special low speed electric motor, may be used.

The lower bearing assembly 60 includes a bearing support 78 with an inner alignment socket opening upwardly, in which rests the outer bearing race 82. The ball bearings 83 run between this outer race 80 and an inner race 84 which is held down around the journal portion 86 of the shaft 14 by a locknut 88. Since the lower bearing 60 absorbs most of the vertical thrust and shocks, it may be somewhat larger than the upper bearing which includes the same elements, indicated by corresponding reference numerals followed by an appropriate suffix. The journal portions 86 and 86A of the shaft 14 may have a slight taper so that the locknuts 88 and 88A hold the inner race firmly seated down on the taper.

The motor 76 preferably may be supported upon the mounting plate 44, whereby the whole pump assembly is a self-contained unit, or the motor 76 may be separately mounted, and the V-belts 73 will be of an appropriate length to accommodate the motor installation.

Another advantage of this pump is that the length of the lower housing 16 and shaft 14 may be varied to accommodate the pump to different types of installations, wherein the casing and impeller are required to be located at various depths below the liquid surface.

I have found that it is preferable to have the distance between the mounting plate 44 and the liquid level no less than 2 inches in order to prevent the liquid from approaching unnecessarily close to the lower bearing. However, where it is required to have the mounting plate 44 closer to the liquid than this, seals may be placed below the lower bearing to exclude the liquid therefrom. In any event, the leakage holes 64 are provided, preferably always located beneath the liquid level.

Following is a description of certain aspects, dimensions, and features of a pump assembly which has proven highly successful for continuous use in power washing installations in connection with paint spray booths. This pump is fabricated from flat stock material and eliminates the need for complicated expensive castings, all joints are welded or bolted, as shown in the drawings.

The impeller disk 32 is $\frac{3}{8}$ inch thick and has a diameter of $12\frac{1}{32}$ inches. The main impeller blades 30 are $\frac{1}{4}$ inch thick and are $2\frac{7}{16}$ inches high along their inner edges 28 (Please see Figure 6.) which are rounded along their length to a $\frac{1}{8}$ inch radius for streamlining effect. The outer edges of the blades are $1\frac{1}{4}$ inches high. These blades are $3\frac{17}{32}$ inches in length from inner to outer edge as seen in Figure 5 and their bottom edges have a curvature or bulge of about $\frac{3}{32}$ inch in the center. These eight blades are arranged vertically and welded to the impeller disk 32 at an angle of 70° to radii passing near their leading edges, so that they are equally spaced 45° apart as measured around the impeller disk. The effective impeller diameter measured across the outside edges 48 of the blades is $12\frac{1}{4}$ inches, and the diameter of the central space 26 within the edges 28 is 7 inches. The impeller collar 33 is $1\frac{3}{8}$ inches long with an O.D. of $2\frac{1}{2}$ inches and an I.D. of 1.625 inches, with a $\frac{1}{4}$ inch x $\frac{1}{8}$ inch vertical keyway, and a $\frac{1}{4}$ inch pin 34.

The casing ring 52 has a slope of 25° ; the diameter of its inner edge 31 is 7 inches and this edge projects about $\frac{1}{16}$ of an inch below the bottom 37. A vertical clearance of $\frac{1}{8}$ of an inch exists between the sloping ring 52 and the blade edges 50, and a large clearance

of $\frac{1}{32}$ of an inch exists between the cover 42 and the disk 32. The four auxiliary blades are about $\frac{1}{32}$ of an inch high, thus with a clearance of about $\frac{1}{8}$ of an inch from the cover 42. The height of the scroll 38 is equal to the spacing between the bottom 37 and the top 40 and is $2\frac{3}{4}$ inches.

From this description it will be understood that the present invention provides a simple, low cost, practical, heavy duty centrifugal pump with improved non-clogging properties, and ease of maintenance, well adapted for continuous use with contaminated liquids. Although a power washing installation has been described, it is to be understood that aspects of the invention make it well suited for adaptation to a wide variety of severe operating conditions. For example, the invention has been used in other installations, such as in curtain spray systems, which require a high capacity pump which will handle solids such as lumps of dirt. The dimensions given above are merely illustrative, being those used in a successful pumping assembly embodying my invention.

I claim:

1. A centrifugal pump for handling contaminated liquids without clogging, comprising an impeller including an imperforate member having blades projecting from its front face, said blades being in an annular area with their inner edges spaced out from the axis of rotation defining a central impeller space having a diameter larger than one-half of the diameter of the circle defined by their outer edges, the height of said blades at their inner edges being greater than at their outer edges, said blades being inclined backwardly from their inner to outer edges with respect to the direction of rotation, a casing surrounding said impeller and having a first wall with a relatively large axial intake port, said wall providing a conical annular face in juxtaposition to said blades, the outstanding edges of said blades being curved so as to provide a uniform clearance with said conical annular surface, a generally spiral-shaped scroll forming the periphery of said casing, a second wall for said casing in spaced relationship with said first wall and having an axial shaft opening therein, outer portions of said walls and said scroll defining a curved peripheral discharge channel of gradually expanding cross section within said scroll, a shaft end extending into said casing through said opening and having a clearance space therearound, said impeller being secured to said shaft end with said member spaced from said second wall, the inner edges of said blades substantially in alignment with the edge of said intake port, and a plurality of auxiliary impeller blade portions projecting from the rear face of said member toward said second wall to permit controlled flow of liquid back from said discharge channel past said disk and through said shaft opening, the auxiliary blades having a uniform clearance from the cover plate equal to the clearance of the other blades from said conical annular surface.

2. A centrifugal pump for handling contaminated liquids without clogging comprising mounting means, an upper support extending up from said mounting, upper and lower vertically aligned bearings, said upper bearing being secured to said support above said mounting means, said lower bearing being above said mounting, a vertical rotatable shaft carried by said bearings, driving means connected to the upper end of said shaft, the lower end of said shaft projecting down a substantial distance below said lower bearing and below said mounting means, a lower support extending down from said mounting means, a horizontal cover plate secured to the lower end of said lower support, said horizontal cover plate having a central opening down through which projects the lower end of said shaft and providing a clearance spacing around the portion of the shaft passing therethrough, said lower support providing access to the outside of the pump from the clear-

ance spacing in said opening, said cover plate defining the top surface of an impeller chamber, a horizontal circular impeller disc secured to the lower end of said shaft beneath said cover plate and providing a substantial clearance above said disc, said impeller disc having a plurality of impeller blades projecting down from its lower face and arranged in an annular pattern with their outer edges adjacent to the edge of the impeller disc and with their inner edges each being spaced out from the center of the impeller disc by equal substantial distances defining a large central impeller space inside of said inner edges, said blades inclining backwardly from their inner edges with respect to the direction of rotation of the impeller disc, and the spaces between the outer edges of said blades being unobstructed, the lower edges of said blades tapering upwardly from their inner edges to their outer edges, a casing ring defining the bottom of said impeller chamber and having a downwardly projecting inner lip defining a large open intake port which is directly beneath said central impeller space and is adjacent to the inner edges of said blades, said casing ring having a truncated conical inner surface sloping upwardly and outwardly from the intake port and uniformly closely spaced to the lower edges of said blades, whereby any contaminating agents in said fluid entering said intake port are directly exposed to the chewing action of said blades, a pump scroll secured to said casing ring and detachably secured to said cover plate and defining a discharge channel surrounding the unobstructed outer edges of said blades, and auxiliary blades on the upper surface of said impeller disc adjacent to the cover plate for limiting the reverse flow of liquid from said discharge channel past the upper surface of said impeller disc and up through the clearance spacing around the portion of the shaft which passes through said cover.

3. A centrifugal pump for handling contaminated liquids without clogging comprising mounting means, upper and lower vertically aligned bearings supported by said mounting means, a vertical rotatable shaft carried by said bearings, driving means connected to the upper end of said shaft, the lower end of said shaft projecting down a substantial distance below said lower bearing, a lower support extending down from said mounting means, a horizontal cover plate secured to the lower end of said lower support, said horizontal cover plate having a central opening down through which projects the lower end of said shaft with a spacing therearound, said cover plate defining the top surface of an impeller chamber, an outwardly extending impeller disc secured to the lower end of said shaft beneath said cover plate with a substantial clearance between said impeller disc and cover plate, said lower support providing an opening to the outside of the pump from said spacing around the shaft, said impeller disc having a plurality of impeller blades projecting down from its lower face and arranged in an annular pattern with their outer edges adjacent to the edge of the impeller disc and with their inner edges being spaced out a substantial distance from the center of said impeller disc so as to define a central impeller space among the inner edges of the blades, the diameter of said central impeller space being more than one-half of the diameter of said impeller disc, said blades being inclined backwardly at an angle with respect to the direction of rotation, the lower edges of said blades inclining upwardly from their inner edges to their outer edges, a casing ring forming the bottom of said impeller chamber and having a downwardly projecting inner lip defining a large open intake port which is adjacent to the inner edges of said blades and has a diameter more than one-half of the diameter of said impeller disc, said casing ring having a truncated conical inner surface which is uniformly spaced from the lower edges of said blades, a pump scroll secured to said casing ring and remov-

ably secured to said cover plate and defining a discharge channel surrounding the outer edges of said blades, and auxiliary blades on the upper surface of said impeller disc adjacent to the cover plate for limiting the reverse flow of liquid from said discharge channel past the upper surface of said impeller disc and out through said spacing around the shaft.

4. A centrifugal pump for handling contaminated liquids without clogging comprising mounting means, upper and lower vertically aligned bearings supported by said mounting means, a vertical rotatable shaft carried by said bearings, driving means on the upper end of said shaft, the lower end of said shaft projecting down a substantial distance below said lower bearing, a lower support extending down from said mounting means, a cover plate extending outwardly from the lower end of said lower support, said cover plate having a central opening down through which extends the lower end of said shaft having a spacing therearound, said cover plate defining the top surface of an impeller chamber, an outwardly extending impeller disc secured to the lower end of said shaft beneath said cover plate with a substantial clearance between the top of said impeller disc and the cover plate, said lower support providing communication to the outside of the pump from said spacing around the shaft, said impeller disc having a plurality of planar impeller blades projecting down from its lower face and arranged in an annular pattern with their outer edges adjacent to the edge of the impeller disc and with their inner edges being spaced out a substantial distance from the center of said impeller disc so as to define a central impeller space among the inner edges of the blades, the diameter of said central impeller space being more than one-half of the diameter of said impeller disc, said blades being inclined backwardly at an angle of 70° with respect to radii from the axis of rotation passing through their inner edges, the lower edges of said blades inclining upwardly from their inner edges to their outer edges, a casing ring forming the bottom of said impeller chamber and having a downwardly projecting inner lip defining a large open intake port which is adjacent to the inner edges of said blades and has a diameter more than one-half of the diameter of said impeller disc, said casing ring having a truncated conical inner surface which is uniformly spaced from the lower edges of said blades, a pump scroll secured to said casing ring and removably secured to said cover plate and defining a discharge channel surrounding the outer edges of said blades, and auxiliary blades on the upper surface of said impeller disc adjacent to the cover plate for limiting the reverse flow of liquid from said discharge channel past the upper surface of said impeller disc and out through said spacing around the shaft.

5. A non-clogging centrifugal pump for handling contaminated liquids comprising a rotatable shaft, an impeller connected to the end of the shaft and having a disc-like member with the shaft extending out from the rear surface of the member and a plurality of blades projecting from its front face, said blades being in an annular pattern around the axis of the shaft, the inner edges of said blades being spaced a substantial distance from the axis defining a central impeller space, the outer edges of said blades being adjacent to the periphery of said member, said blades decreasing in height from their inner to their outer edges and inclining backwardly from the central impeller space with respect to the direction of rotation, a support around said shaft, a pump casing carried by said support, said casing comprising a cover plate secured to the lower end of said support and having a central opening through which the shaft extends with a substantial clearance therearound, a generally spiral pump scroll removably secured to the edge of said cover plate and defining a curved

peripheral discharge channel of expanding cross section surrounding the outer edges of said blades, a truncated conical casing portion secured to said pump scroll and having an inside surface adjacent to said blades, said truncated conical casing portion having a downwardly projecting central lip defining a large unobstructed intake port adjacent to the central impeller space, the inner surface of the truncated conical portion adjacent to the blades sloping upwardly away from the intake port at an angle of 25° with respect to the horizontal.

6. A non-clogging centrifugal pump for handling contaminated liquids comprising mounting means for said pump, upper and lower vertically aligned bearings for said pump, a vertical rotatable shaft carried by said bearings, driving means near the upper end of said shaft, the lower end of said shaft projecting down a substantial distance below said lower bearing, a lower support connected to said mounting means and extending down therefrom, an outwardly extending cover plate secured to the lower end of said lower support, said cover plate having a central opening down through which projects the lower end of said shaft with a significant clearance around said shaft, said lower support permitting liquid passing through the clearance to pass out of the pump, said cover plate defining the top surface of an impeller chamber, a disc-like impeller member secured to the lower end of said shaft beneath said cover plate, said impeller member having a plurality of impeller blades projecting down from its lower face, said impeller blades being arranged in an annular pattern with their outer edges adjacent to the outer limits of the impeller member and with their inner edges being spaced out a substantial distance from the axis of the shaft defining a central impeller space, said blades being inclined backwardly with respect to the direction of rotation, the lower edges of said blades inclining upwardly from their inner edges to their outer edges, a casing ring defining the bottom of said impeller chamber and having a downwardly projecting inner lip defining a large intake port which is adjacent to the inner edges of said blades, said casing ring having a truncated conical inner surface which is uniformly spaced 1/8 of an inch from the lower edges of said blades, a pump scroll secured to said casing ring and detachably connected to said cover plate and defining a discharge channel surrounding the outer edges of said blades, and auxiliary blades on the upper surface of said impeller disc adjacent to the cover plate for restricting the reverse flow from said discharge chamber through said clearance space around the portion of the shaft passing through the cover plate, the upper edges of said auxiliary blades being uniformly spaced 1/8 of an inch from the cover plate.

References Cited in the file of this patent

UNITED STATES PATENTS

998,300	Parsons	July 18, 1911
1,791,547	Yoder	Feb. 10, 1931
1,821,772	Ruthman	Sept. 1, 1931
2,050,104	Lauchenaue	Aug. 4, 1936
2,265,758	Klosson	Dec. 9, 1941
2,273,214	McConaghy	Feb. 17, 1942
2,283,263	Kates	May 19, 1942
2,515,398	Derocher	July 18, 1950
2,542,896	Brady	Feb. 20, 1951
2,622,537	Wortendyke	Dec. 23, 1952
2,659,312	Wahle	Nov. 17, 1953

FOREIGN PATENTS

108,376	Sweden	Aug. 31, 1943
212,879	Great Britain	1925
341,305	Great Britain	Jan. 15, 1931
566,336	Great Britain	Dec. 22, 1944
691,148	Germany	May 17, 1940