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CENTRIFUGAL PUMP WITH ADJUSTABLE IMPELLER

Filed Nov. 7, 1963

3 Sheets-Sheet 1

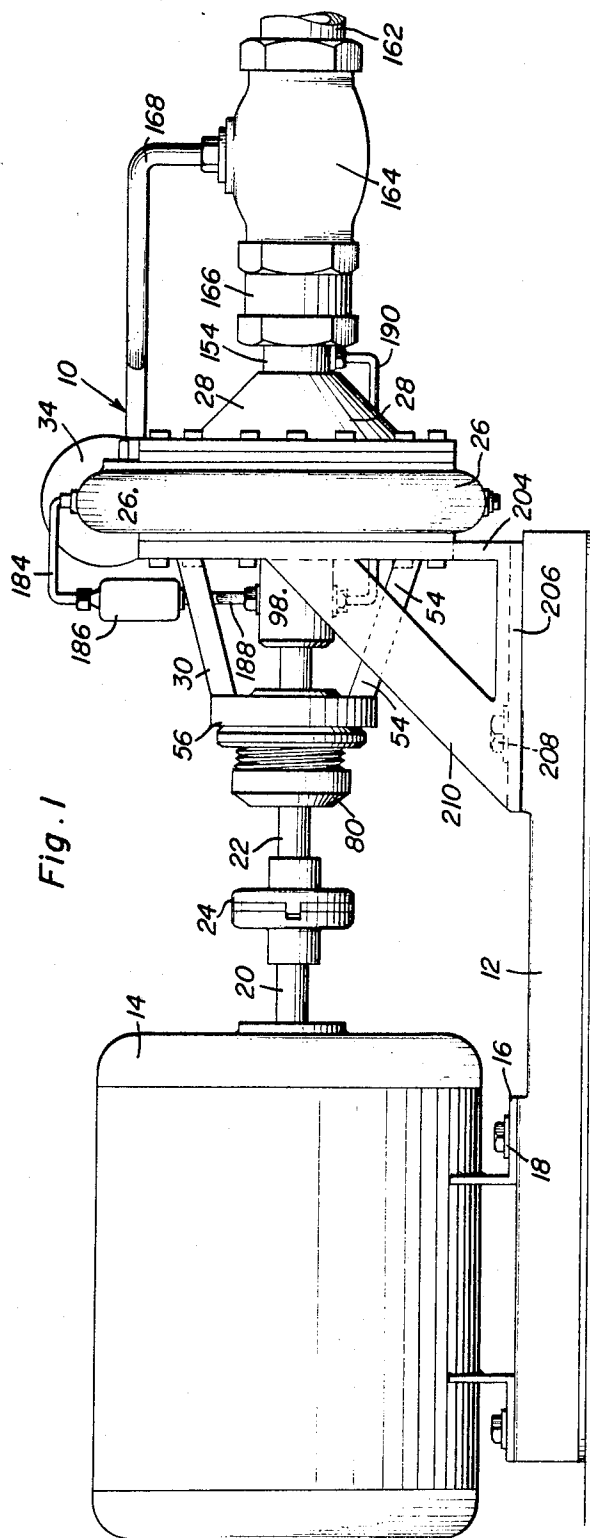


Fig. 1

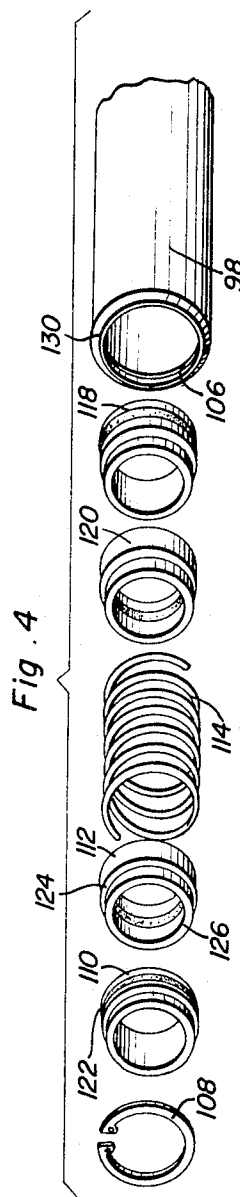


Fig. 4

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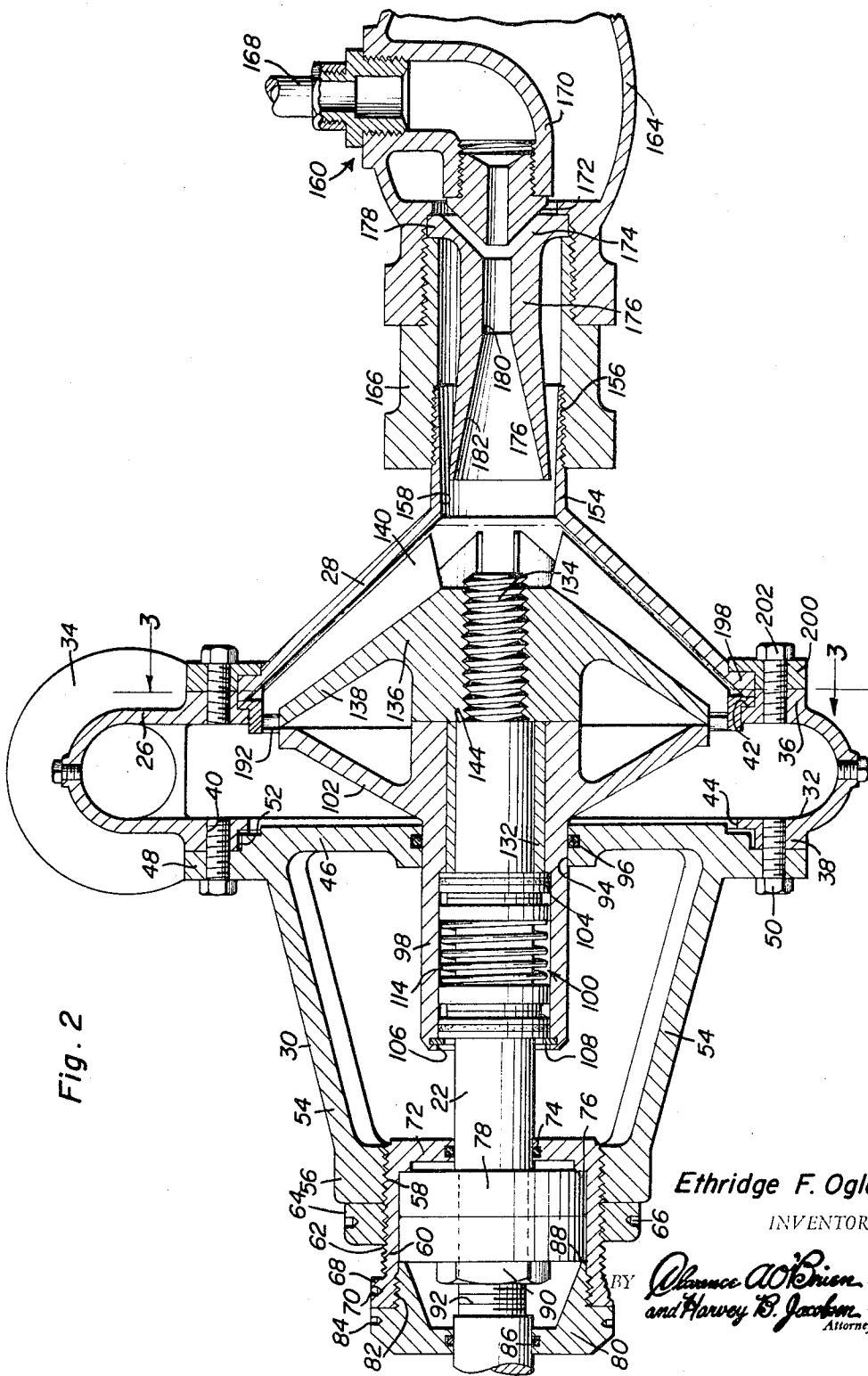
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Fig. 3

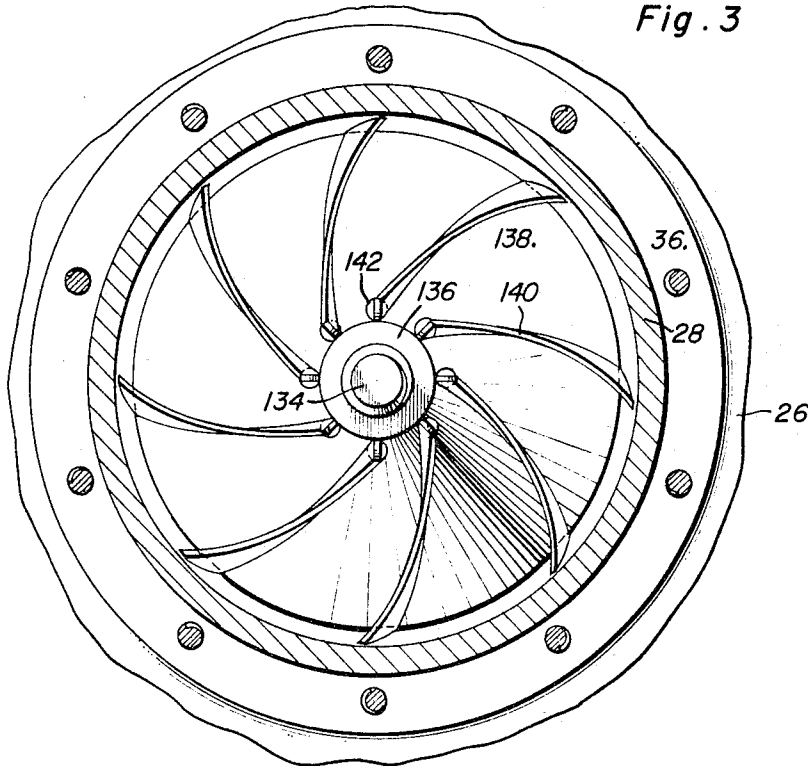
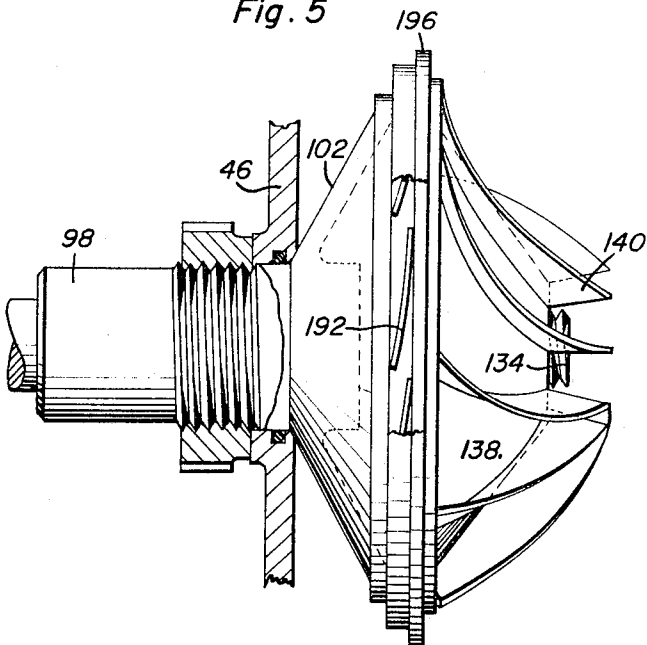


Fig. 5



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CENTRIFUGAL PUMP WITH ADJUSTABLE IMPELLER

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The present invention generally relates to a novel and improved pump construction and more particularly relates to a centrifugal type of pump having structural features incorporated therein which enables the pump to operate at an increased discharge pressure and also enables adjustment of the impeller in relation to the housing structure associated therewith.

An object of the present invention is to provide a centrifugal pump incorporating a suction jet system therein to increase the discharge pressure of the pump.

Another object of the present invention is to provide a centrifugal pump having components thereof which may be reversible or rotationally adjustable in relation to each other to enable the orientation of the components of the pump to be varied for adapting the pump to various installation orientations.

Still another object of the present invention is to provide a centrifugal pump having a novel supporting structure for the pump impeller in order to enable the impeller to be adjusted in relation to the pump housing for maintaining a desired clearance relationship.

Yet another important object of the present invention is to provide a centrifugal pump having a novel bearing structure as well as a novel seal structure for retaining the pressure developed by the pump in an effective manner.

Another salient feature of the invention resides in its simplicity of construction, adaptability in installation, ease of replacement or repair of parts and its relatively inexpensive manufacturing and operating cost.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a side elevational view of the centrifugal pump of the present invention illustrating the components thereof in assembled condition;

FIGURE 2 is a longitudinal, sectional view of the pump assembly, on an enlarged scale, illustrating the orientation of the components of the pump itself;

FIGURE 3 is a transverse sectional view taken generally upon a plane passing along section line 3—3 of FIGURE 2 but illustrating the impeller in elevation;

FIGURE 4 is an exploded group perspective view of the seal assembly illustrating the arrangement of components thereof; and

FIGURE 5 is a side elevational view of the pump impeller including the drive shaft and manifold which receives the seal arrangement.

Referring now specifically to the drawings, the pump 10 of the present invention is illustrated as being mounted on a base 12 and driven by a suitable electric motor 14 that is also mounted on the base 12. The electric motor 14 has the usual mounting flanges 16 thereon and is held on the base 12 by suitable bolts 18. While an electric motor has been illustrated, it is pointed out that the present invention is equally as well adapted for use with a small internal combustion engine or the source of power thereof may be any desired output shaft from any desired engine or vehicle such as the power take-off of a tractor or other vehicle. Regardless of how the power is supplied to the pump, it is supplied through a power shaft

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20 that is coupled to the drive shaft 22 of the pump 10 in any suitable manner such as an interlocked flanged coupling 24 by virtue of which the drive shaft 22 is drivingly connected to the power shaft 20.

The pump 10 includes basically three major components including a pump housing 26, an impeller housing 28 on one side thereof and a drive shaft and bearing housing 30 on the opposite side thereof.

The pump housing 26 is generally a hollow annular member having a generally U-shaped interior configuration 32 and provided with a tangential discharge conduit and flange assembly 34 that may be connected to a suitable discharge pipe. Each side of the pump housing 26 is provided with an attaching flange 36 and 38 which are identical in configuration, shape and size with each flange 36 and 38 having a plurality of circumferentially spaced threaded apertures 40 therein. This enables the pump housing to be reversed whereby the impeller housing 28 and the bearing housing 30 may be reversed in their orientation for rendering the pump more universal in installation. Also, each of the flanges 36 and 38 is provided with a peripheral recess 42 at the inner edge thereof thereby defining an enlarged opening 44 with the surfaces of the flanges 36 and 38 as well as the recesses 42 being machined to provide a sealing fit and in addition, gaskets may be employed between the pump housing 26 and the impeller housing 28 and the bearing housing 30. The bearing housing 30 includes a circular plate 46 including a peripheral flange 48 abutting against the surface of the flange 38 and being secured thereto by a plurality of bolts 50. The plate 46 is provided with a recessed portion defining an annular flange 52 received in the recess 42 on the flange 38 thus fixedly securing the bearing housing 30 to the pump housing 26. Extending outwardly from the plate 46 at a point adjacent the flange 48 is a pair of diametrically opposed supporting members or brace members 54 which converge inwardly towards and extend axially of the drive shaft 22. The ends of the support members 54 are formed integrally with an annular bearing supporting ring 56 which is internally threaded at 58 for adjustably receiving a bearing housing 60 which is externally threaded as at 62. A bearing housing lock nut 64 is screwthreaded onto the bearing housing 60 and abuttingly engages the annular ring 56 for locking the bearing housing 60 in adjusted relation in the annular ring 56. The lock nut 64 is provided with circumferentially spaced recesses 66 or other means for enabling a suitable spanner wrench or the like to be engaged therewith for loosening and tightening the lock nut 64. Also, the bearing housing 60 is provided with a peripheral flange 68 having recesses 70 or other means for receiving a suitable spanner wrench or the like for enabling rotation of the bearing housing 60 for adjusting its position in relation to the annular ring 56.

The inner end of the cylindrical bearing housing 60 is provided with an inwardly extending flange 72 having an O-ring seal 74 in the inner edge of an opening which rotatably receives the drive shaft 22. Also, the interior surface of the bearing housing 60 is provided with a shoulder 76 which faces the outer end thereof and abuttingly engages a pair of drive shaft bearing assemblies 78 that are retained against the shoulder 76 by a screw-threaded cap 80 that is externally threaded at 82 for engagement with internal threads formed on the bearing housing 60 at the outer end thereof. The cap 80 is provided with a plurality of recesses 84 or other suitable means for receiving a spanner wrench or the like and the cap is rotatably engaged with the drive shaft 22 and an O-ring seal 86 is provided for sealing the cap to the shaft 22. The inner end of the cap 80 abuttingly engages the outer surface of the bearings 78 at 88 and retains the bearings fixedly

within the bearing housing 60. However, the bearing housing 60 may be longitudinally adjusted for longitudinally adjusting the position of the shaft 22 inasmuch as the shaft 22 has a conductor abutting the bearing 78 and a retaining nut 90 screw threaded on a screw-threaded portion 92 of the shaft 22 for engaging the outer ends of the bearings thus fixing the inner races of the bearings 78 to the shaft 22 so that the bearing assemblies will prevent longitudinal movement of the shaft 22 during operation thus counteracting any longitudinal thrust exerted on the shaft 22 and also enabling the longitudinal position of the shaft 22 to be adjusted in relation to the bearing ring 56 by loosening the lock nut 64 and adjusting the housing 60 in the annular ring 56 and thereafter relocking the lock nut 64. By removing the cap 80 and also dismantling the drive shaft 22 from the remainder of the pump, the nut 90 may be removed for enabling replacement of the bearing assemblies 78.

The plate 46 is provided with a central opening 94 having an O-ring seal 96 in a groove therein for receiving a tubular extension or discharge manifold 98 for receiving a seal assembly 100 and having on its inner end an outwardly inclined plate 102 spaced slightly from the inner end thereof and disposed within the pump housing 26. The manifold 98 includes a peripheral shoulder 104 spaced inwardly from one end thereof and there is a groove 106 adjacent the end thereof for receiving a split lock ring 108 which is a retainer for the drive shaft seal assembly 100 which is illustrated in more detail in FIGURE 4.

Referring specifically to FIGURE 4, the seal assembly includes the split retainer ring 108 and symmetrically arranged outside seal ring 110 and inside seal ring 112 and a drive shaft seal spring 114. Inwardly of the seal ring there is another assembly of outside seal rings 118 and inside seal ring 120 with their being in each instance an outside O-ring seal 122 and an inside O-ring seal 124 and a carbon wear ring 126 interposed between the seal rings 110 and 112. This entire assembly is retained within the manifold 98 which has a beveled end edge 130 by means of the ring 108 in groove 106. Thus, by removing the lock ring 108, the seal assembly may be removed and the components thereof replaced as required for varying the sealing characteristics thereof. The seal is constructed to hold suction or pressure from the pump which develop from either suction or pressure and the inner end of the discharge manifold is provided with a bushing 132 which receives the end of the drive shaft 22 immediately inwardly of a threaded end portion 134 thereof which receives the hub 136 of an impeller 138 which has a configuration generally in the form of a cone with a plurality of radially extending vanes 140 on the conical surface of the impeller 138 and also having a twist incorporated therein from the inner end to the outer end as illustrated in FIGURE 3. The inner ends of the vanes 140 generally are inclined in the direction of rotation of the impeller 138 while the outer ends thereof are generally inclined away from the direction of rotation or, in effect, trail the leading ends thereof. The inner ends of the vanes are spaced from each other and the inner ends thereof overlie passageways 142 which extend through the hub 136 of the impeller 138 and communicate with the opposite end of the hub which is engaged with a shoulder 144 on the shaft aligned with the inner end of the discharge manifold 98.

The impeller housing 28 is generally frusto-conical in configuration and provided with a longitudinal tubular extension 154 which is externally threaded at 156 and forms an inlet passageway 158 in alignment with the space defined by the spaced inner ends of the vanes 140 on the impeller 138. A suction jet system 160 is attached to the extension 154 at one end and at the other end, it is attached to an inlet pipe 162. The suction jet system 160 generally includes a hollow body 164 screw-

threadedly engaged with an adapter 166 which in turn is threaded onto the extension 154. The body 164 is attached to a jet line 168 connected with the discharge assembly 34 of the pump housing by employing suitable connections. The body 164 also has a curved passage forming member 170 formed integrally therewith together with a jet orifice or nozzle 172 screwthreaded thereinto and having a passageway 174 extending there-through. The nozzle 172 discharges into the throat of a jet orifice tube 176 having a flange 178 secured between the body 164 and adapter 166 when assembled for retaining the orifice tube 176 in place. The orifice tube 176 has a restricted passageway area 180 and an outwardly flaring passageway area 182 in alignment with the passageway 174 and the nozzle 172 as illustrated in FIGURE 2.

In order to prevent trashy or sandy material from entering the seal assembly, a filter system is provided including an upper filter line 184 having suitable connection with the discharge side of the pump housing with the line 184 being connected into a filter 186 extending into a lower filter line 188 that has fittings connecting it to the discharge manifold 98 and the seal assembly disposed therein. A lower suction filter line 190 interconnects the discharge manifold 98 and the inlet extension 154 which lowers the pressure on the seal assembly with the centrally disposed orientation of the rings 112 and 120 in relation to the discharge 98 retaining the pressure equalized in both directions insofar as the seal is concerned thus serving to cool and lubricate the seal.

With the construction as described, the position of the impeller in relation to the impeller housing may be varied so that the spatial relationship between the vanes 140 and the impeller housing 28 may be varied for increasing the efficiency of the pump and compensating for any wear. The bearing assemblies 78 counteract any thrust developed from the impeller and also enables the adjustment mentioned above. The pump assembly is quite universal in its installation since the housing may be orientated so that the discharge thereof is in any position and the housing may even be reversed if desired by detaching the components therefrom and reassembling them in a desired orientation.

The discharge manifold 98 has a plurality of vanes or fins 192 therein which are designed to increase the pressure from the impeller with the vanes disposed between the periphery of the impeller 138 and the outer periphery of the pump housing. The inner ends of the vanes 192 are supported by the plate 102 and the outer ends thereof are supported by an annular ring 196 received in the annular recess 42 of the housing flanges 36 or 38 depending on the manner of installation. Also the impeller housing 28 is provided with a peripheral flange 198 received against the flange 196 with the flanges 196 and 198 being held in place by a retaining ring 200 and a plurality of bolts 202 which thread into apertures 40.

A supporting bracket is illustrated for supporting the pump from the base 12 and includes an upstanding annular member 204 attached to either the bearing housing 30 by virtue of the bolts 50 or to the annular ring 200 by the bolts 202 depending upon the manner of installation. Base plate 206 is provided and is attached to the base 12 by suitable bolts 208 and the like and an upstanding pair of braces 210 interconnect the base plate 206 and the annular member 204. The annular member 204 may be supported in any suitable manner in which the pump housing may be orientated in any desired angular position about its center and also, the annular member 204 may be attached to the pump by a pair of lugs diametrically opposed and fastened by bolts for clampingly engaging the annular member 204. The bracket structure for the pump may vary as desired depending upon the installation involved.

The impeller may be disposed at a convenient angle such as 45° and is adjacent the pump housing rather than being housed therein as in usual structures of centrifugal pumps. The angle of inclination of the impeller and, of course, the vanes thereon may vary within certain limits such as between 15° and 70° and the preferable range probably would fall within 30° to 60°. This angulation in the impeller has the advantage of changing the fluid flow direction in a gradual stage by stage arrangement rather than abruptly as is done in a conventional centrifugal pump impeller.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A pump comprising a housing including an outlet communicated therewith, a generally conical impeller housing attached to the pump housing and including an inlet, an impeller received in the impeller housing and including a generally conical surface conforming with the impeller housing, a discharge manifold including a plate received in the pump housing and having spaced vanes communicated with the periphery of the impeller for enabling discharge of liquid pumped from the impeller to the pump housing, drive means connected with the impeller and extending through the pump housing from the side thereof opposite to the impeller housing, said impeller including vanes thereon extending substantially throughout the length thereof and disposed adjacent the internal surface of the impeller housing whereby the liquid being pumped is changed from axial flow to radial flow in sequential stages, said impeller including a hub having a central opening therein, said drive means including a drive shaft received in the opening, a drive shaft housing and bearing assembly mounted on said pump housing in opposed relation to the intake impeller, bearing means rigidly fixed longitudinally on said shaft, said bearing means being mounted on said drive shaft housing in spaced relation to the pump housing and being adjustably attached thereto whereby the position of the drive shaft in relation to the pump housing and the position of the impeller in relation to the impeller housing may be adjusted for varying the position of the impeller in relation to the impeller housing, said discharge manifold including a tubular extension extending outwardly from the pump housing in opposed relation to the impeller housing and receiving a portion of said drive shaft, seal means within said extension on the manifold for sealing the drive shaft, and tube means interconnecting the seal means and the outlet of the pump housing for conveying lubricating liquid to the seal means, a mounting bracket, means detachably connecting the bracket to the pump housing, and a base supporting the

bracket thereon, said means connecting the bracket to the pump housing being symmetrical for connection of the bracket to the pump at a plurality of points for enabling the pump to be installed in different orientations.

2. The structure as defined in claim 1 wherein said pump housing is in the form of an annular member having a generally U-shaped transverse configuration, said annular member having symmetrical attaching flanges on each side thereof whereby the pump housing may be reversed for orientating the outlet in any desired position for enabling adaptability in installation.

3. A centrifugal pump including an annular housing in which the periphery thereof is substantially U-shaped in cross-sectional configuration and provided with generally parallel wall portions, said wall portions terminating in circular inner edges defining an enlarged central opening in each wall portion, a closure plate for one of said openings, a drive shaft extending through said closure plate, an impeller mounted on said drive shaft and having a periphery generally aligned with the periphery of the opening in the other wall portion, an impeller housing mounted on the other wall portion and forming a closure for the pump housing, said pump housing having a generally tangential discharge at the periphery thereof, said impeller housing having a generally centrally disposed axial inlet therein, said impeller having a conical portion extending axially beyond the pump housing and away from the closure plate, said impeller housing having a generally conical shape conforming with the shape of the impeller, said impeller including a plurality of laterally projecting vanes thereon which are closely received with the interior surface of the impeller housing and generally in parallel relation thereto, and means engaged with the drive shaft outwardly of said closure plate for axially shifting the drive shaft and the impeller mounted thereon in relation to the pump housing and impeller housing for varying the pumping characteristics of the impeller.

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