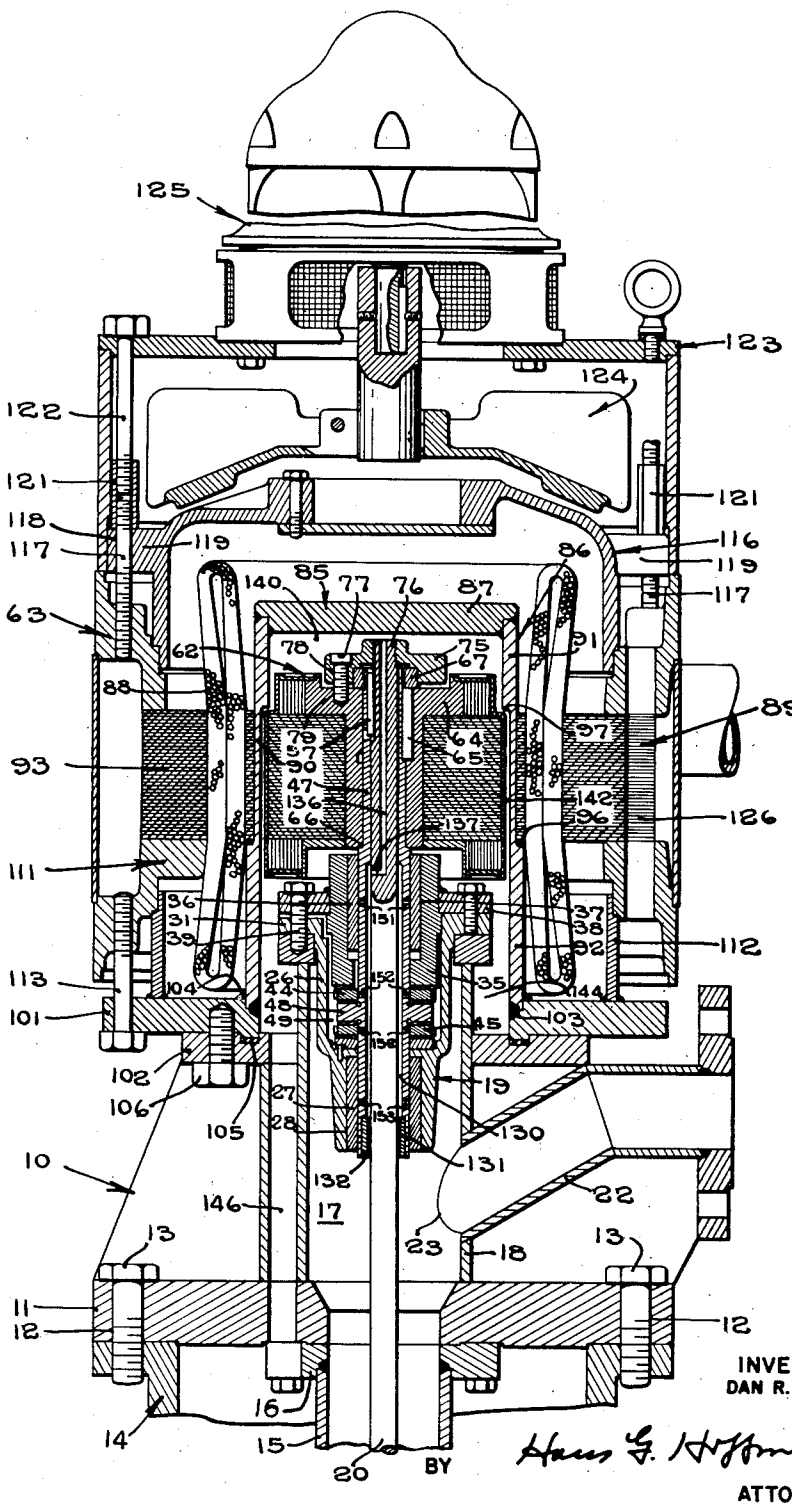
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PUMP DRIVE MECHANISM

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PUMP DRIVE MECHANISM

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This invention pertains to improvements in pumps and more particularly relates to an improved drive mechanism for an electrically driven pump.

To avoid the liquid sealing problems arising from the use in a pump of a rotating drive shaft that passes through the casing to drive the impellers, pumps which are driven by induction motors disposed inside the pump casing have been developed. In such pumps, the disposition of the motor inside the casing of the pump makes it necessary to break the liquid-tight seal of the casing each time an adjustment to the pump shaft or the motor is made.

It is an object of the present invention to provide an induction motor pump drive wherein portions of the motor can be removed for servicing or adjusting without breaking the liquid-tight casing seal.

Another object is to provide an improved apparatus for supporting and journalling the drive shaft of a vertically mounted pump motor and for permitting adjustment of the shaft to attain optimum arrangement of the pump impeller without disturbing the location of the motor armature with respect to the stator winding.

Another object is to provide novel means for lubricating the drive mechanism of an electrically driven pump, and for cooling certain parts of the motor which might otherwise tend to become overheated.

Other and further objects and advantages of the present invention will become apparent from the following description taken in connection with the accompanying drawing which illustrates a vertical section taken centrally through a preferred embodiment of the pump drive mechanism of the present invention.

The pump drive assembly of the present invention comprises a base 10 having a base plate 11 provided with a plurality of holes 12 adapted to receive bolts 13 for securing the base 10 to the top of a tank 14 containing liquid to be pumped. A column pipe 15, which extends down into the tank 14, is provided with a conventional pipe flange 16 at its upper end by which it is secured to the under side of the base plate 11. The column pipe 15 communicates, through an opening in the base plate 11, with a discharge chamber 17 formed in the base 10 by an upstanding tubular column 18 which carries at its upper end a bearing housing 19. A pump shaft 20 extends through the bearing housing 19 and downwardly through the opening in the plate 11 into the column pipe 15. The pump shaft 20 carries at its lower end one or more impellers (not shown) of well-known construction, which are operably disposed within a suitable pump bowl (not shown) carried at the lower end of the pipe 15. A discharge connection 22 is preferably welded into an opening 23 in the wall of the tubular column 18 and is arranged to receive liquid forced into the discharge chamber 17 by the impellers and deliver it to a suitable discharge pipe (not shown).

The bearing housing 19 comprises a lower bearing retainer 26 having a sleeve-type bearing 27 seated within a recess or counterbore 28 in the lower end thereof and

has a supporting flange 31 on its upper end which rests upon the upper end of the column 18 to support the retainer 26 thereon. An upper bearing retainer 35 similarly carries a sleeve type bearing 36 seated within a recess 37, and is provided with a supporting flange 38 which rests upon the flange 31. A plurality of bolts 39 extend through aligned holes in both flanges 31 and 38 and are threaded into the top of the column 18 to anchor both bearing retainers 26 and 35 rigidly in position.

A sleeve or quill shaft 47 is journalled by the bearings 27 and 36 and is supported against axial movement by a flange 48 on the sleeve 47 which extends into an annular space 49 between the lower end of the upper bearing retainer 35 and the upper end of the lower retainer 26 to be received between bearings 44 and 45 which are seated within the space 49.

The pump shaft 20 is axially adjustable within the sleeve 47, but is keyed thereto for rotation therewith by a key 57. A hermetically sealed rotor assembly 62 of an induction motor 63 is securely mounted on the upper end of the sleeve 47, its frame 64 being secured thereto as by a key 65. The frame 64 rests on a shoulder 66 on the sleeve 47 against which it is pressed by a lock nut 67 threaded on the upper end of the sleeve 47. An adjusting nut 75, threaded upon a stub 76 integral with and projecting from the upper end of the shaft 20, rests upon the lock nut 67 of the sleeve 47 so that by rotation of the adjusting nut 75 axial adjustment of the pump shaft 20 can be attained without disturbing the relative position of the rotor 62 with respect to the other portions of the motor 63. This makes possible the facile adjustment of the pump impellers with respect to the pump bowl within which they operate, the former being carried at the lower end of the shaft 20 and the latter by the lower end of the column 15. After such axial adjustment of the shaft 20 within the sleeve 47, the parts are locked in their selected position of adjustment by means of a cap screw 77 extending through a clearance hole 78 in the lock nut 75 and threaded into a tapped hole 79 in the frame 64 of the rotor 62.

A shell 85 encloses the rotor 62 and the upper ends of the motor shaft 20 and sleeve 47, this shell being composed of suitable non-corrosive rust-proof material through which magnetic forces can pass without material interference, stainless steel being well suited for this purpose. This shell 85 comprises a cylindrical side wall 86 and an upper end wall 87. This shell, furthermore, closes the upper end of the chamber 17 into which fluids pumped from the reservoir 14 are discharged when the pump mechanism is operated and consequently the interior of the shell 85 is subjected to fluid pressures of considerable magnitude. For this reason the walls 86 and 87 of the shell are preferably of substantial thickness, the end wall 87 being even thicker than the side wall 86 because of its being flat and therefore more subject to being flexed by bending stresses than is the side wall 86, the cylindrical form of which better adapts it for resisting such stresses. However, inasmuch as operation of the motor 63 with optimum efficiency requires minimum spacing between the rotor 62 and the windings 88 of the stator 89, that portion 90 of the cylindrical wall 86 which is disposed between the windings of the rotor 62 and those of the stator 89 is preferably considerably thinner than the upper portion 91 and the lower portion 92 of the cylindrical wall 86. Such relatively thin section for the intermediate portion 90 of the cylindrical wall 86 is compensated for by the fact that the core 93 of the stator 89 fits relatively tightly upon the outer circumferential surface of the intermediate portion 90 of the cylindrical wall 86, thereby providing ample

protection for the shell 85 against being expanded by even relatively high internal fluid pressures.

Inasmuch as assembly of the apparatus requires entry of the rotor 62 into the shell 85 through the open lower end thereof, the inside diameter of the lower portion 92 of the cylindrical wall 86 is at least as great as that of the intermediate portion 90. Therefore, in order to provide the desired wall thickness for the lowermost portion 92, the additional metal required for the desired thickness at this portion of the shell 85 is provided by an increase in the outside diameter, thus leaving a shoulder 96 on the outside of the cylindrical wall 86 between the intermediate portion 90 and the lowermost portion 92. Moreover, assembly also requires that the stator 89 be slid down from the upper end of the shell 85 until it seats upon the shoulder 96 of the shell. Consequently, the outside diameter of the uppermost portion 91 of the cylindrical wall 86 should have an outside diameter no greater than that of the intermediate portion 90 with the result that the added thickness of metal for the uppermost portion 91, as compared with the intermediate portion 90, should be obtained by decreasing the inside diameter of the uppermost portion 91 as compared with the inside diameter of the intermediate portion 90, thus leaving a shoulder 97 on the inside circumference of the cylinder wall 86 between the intermediate and uppermost portions 90 and 91, respectively.

A frame member 101, preferably of flat annular form and resting upon a flange 102 extending outwardly from the tubular column 18, provides support for the shell 85 the lower end of which is preferably welded to the frame member 101 as indicated at 103 and 104. Suitable packing material such as a gasket 105 is preferably interposed between the support member 101 and the flange 102 so as to provide a fluid-tight seal for the connection between the shell 85 and the tubular column 18. However, the shell 85 is subject to ready removal for the purpose of inspection, repair or replacement of any of the parts thereinside or for manipulation of the adjusting nut 75 as hereinabove described, this being made possible by removing the bolts 106 whereby the frame member 101 is secured to the flange 102.

The core 93 which carries the stator windings 88 is in turn supported upon and within a conventional, generally cylindrical motor frame 111; and this entire assembly is supported upon the annular frame member 101 preferably by means of an upstanding cylinder 112 welded to the support member 101, a plurality of bolts 113 bing employed to releasably secure the motor frame 111 in position thereupon. An end or cap 116 for the motor housing rests upon the upper end of the frame 111 and is securely fastened in position thereupon by means of a plurality of studs 117, the lower ends of which are threaded into the frame 111 with their upper ends extending through clearance holes 118 in lugs 119 carried by the cap 116. The upper end of each of these studs 117 is threaded into the lower end of a nut 121 which is sufficiently elongated to leave the upper end of the nut free for the reception of a cap screw 122 of which a plurality are employed to secure a housing 123 in position upon and extending over the cap 116. This housing 123 carries a ventilating fan 124 and its actuating motor 125, suitable vent holes 126 being provided to permit the fan 124 to circulate air about the motor 63.

The rotor assembly 62, the sleeve bearings 27 and 36, and the thrust bearings 44 and 45 are lubricated and cooled by liquid by-passed from that being pumped from the reservoir 14 and caused to flow through a series of passages extending through the bearing housing 19 and around the rotor assembly 62. These passages include an annular, longitudinally extending passage 130, the lower end of which communicates with the chamber 17 by means of preferably a plurality of small passageways 131 formed through a spacing collar 132 encircling the shaft 20 and fitted within the lower end of the sleeve 47.

The passage 130 extends between the pump shaft 20 and the sleeve 47 and communicates with a central bore 136 in the upper end of the pump shaft 20 through radially extending passages 137. A sufficient quantity of the liquid entering the discharge chamber 17 will pass upwardly through the passageways 131, the annular passage 130, the radial passages 137, and the central bore 136 of the drive shaft and be discharged into the space 140 between the upper end of the rotor assembly 62 and the upper end 87 of the shell 85. From this space 140 the liquid will flow downwardly through the clearance space 142 between the rotor assembly 62 and the shell 85, whence it drains into an annular chamber 144 between the tubular column 18 and the inner wall of the shell 85; and from this chamber 144 the liquid drains back into the reservoir 14 through a passageway 146 in the base 10. The sleeve bearings 27 and 36 and the thrust bearings 44 and 45 receive a sufficient quantity of this same fluid for their efficient lubrication through suitably arranged radial openings 151, 152 and 153, respectively.

Since the stator assembly 89 is secured only to the frame 111 of the motor housing, it will be evident that, when the bolts 113 are removed, the stator 89 and all the other apparatus mounted thereon can be lifted upwardly off the support member 101. It is to be noted particularly that removal of the stator in this manner does not disturb the casing seal. Thus, the ventilating motor 125, the fan 124 and the stator 89 can be serviced without breaking the liquid-tight casing seal.

The drive arrangement of the present invention does not require a bearing to support or guide the upper end of the pump shaft 20 above the rotor 62. The necessity of providing such a bearing at a point above the rotor is eliminated by the cantilever type of bearing support for the shaft 20 and the rotor 62 thereon which results from the comparatively great length of the motor shaft 20 which is engaged by the relatively elongated and widely separated sleeve bearings 27 and 36.

While I have illustrated and described a preferred embodiment of the present invention, it will be understood that various changes and modifications may be made in the details thereof without departing from the spirit and scope of the invention as set forth in the appended claims.

Having thus described my invention, what I claim as new and desire to protect by Letters Patent is:

1. In pumping apparatus, a housing comprising a hollow base portion, a fluid tight shell seated on said base portion and cooperating therewith to define a pump chamber, and releasable means removably securing said shell to said base portion in fluid tight engagement therewith, a motor comprising a stator carried by said base portion and arranged adjacent said shell exteriorly thereof and a rotor disposed within said shell in operative relation to said stator, a sleeve connected to said rotor in supporting relation thereto and to be rotated thereby, bearing means rotatably supporting said sleeve from said base portion and securing said sleeve against axial movement relative to said base portion, a pump shaft axially adjustable within said sleeve, means connecting said shaft to said sleeve to be rotated thereby, means independent of said rotor supporting means and accessible upon removal of said shell for adjusting said shaft axially with respect to said sleeve, and means for locking said adjusting means in selected position.

2. In pumping apparatus, a housing comprising a hollow base portion, a fluid tight shell seated on said base portion and cooperating therewith to define a pump chamber, and releasable means removably securing said shell to said base portion in fluid tight engagement therewith, a motor comprising a stator carried by said base portion and arranged adjacent said shell exteriorly thereof and a rotor disposed within said shell in operative relation to said stator, a sleeve connected to said rotor in supporting relation thereto and to be rotated thereby and having an

annular flange on a lower portion thereof a lower support member carried by said base and disposed in supporting relation under said annular flange, an upper clamping member carried by said base and disposed over said annular flange to prevent axially upward displacement of said sleeve, a pump shaft extending through said sleeve and secured thereto to be rotated thereby, an adjusting nut threaded upon said shaft above the upper end of said sleeve and supported from said sleeve, said nut being adjustable on said shaft to adjust said shaft relative to said sleeve, and releasable means for locking said nut in selected position of rotational adjustment to hold said shaft in selected position of axial adjustment.

3. A drive mechanism for a pump shaft comprising a casing providing an upright cylindrical support column, a generally cylindrical bearing housing having an outer flange disposed in supported relation on said column and an inner annular flange defining a central opening arranged to permit the pump drive shaft to extend freely therethrough, a motor mounted on said casing, said motor having a rotor disposed above said bearing housing and having a central opening receiving the pump drive shaft, a quill shaft having an upper portion disposed between said pump shaft and said rotor and a lower portion between said bearing housing and said pump drive shaft, means for keying said quill shaft to said rotor, means for keying said quill shaft to said pump drive shaft, an annular flange on the lower portion of said quill shaft supported on the inner annular flange of said bearing housing, and a retaining member carried by said column and disposed over said flange on said quill shaft to prevent axially upward displacement of said quill shaft.

4. A drive mechanism for a pump drive shaft which has an upper threaded end portion, said mechanism comprising a casing providing an upright cylindrical support column, a generally cylindrical bearing housing having an outer flange supported on said column and an inner annular flange defining an opening adapted to permit the pump drive shaft to extend freely therethrough, a quill shaft disposed between said inner annular flange and the pump drive shaft, an annular flange on said quill shaft supported on said inner annular flange of said bearing housing, a retaining member carried by said column and disposed over said flange on said quill shaft to prevent axially upward displacement of said quill shaft,

means providing a support shoulder on said quill shaft above said bearing housing, a motor having a stator supported on said casing and a rotor keyed to said quill shaft and supported on the support shoulder of said quill shaft, means for keying the pump drive shaft to said quill shaft, a nut threaded on the upper end of the pump drive shaft, and means for transmitting the weight of the pump drive shaft from said nut through said quill shaft and said bearing housing to said casing column.

5. A drive mechanism for a pump drive shaft which has an upper threaded end portion, said mechanism comprising a casing providing an upright cylindrical support column, a generally cylindrical bearing housing having an outer flange supported on said column and an inner annular flange defining an opening adapted to permit the pump drive shaft to extend freely therethrough, a quill shaft disposed between said inner annular flange and the pump drive shaft, an annular flange on said quill shaft supported on said inner annular flange of said bearing housing, a retaining member carried by said column and disposed over said flange on said quill shaft to prevent axially upward displacement of said quill shaft, means providing a support shoulder on said quill shaft above said bearing housing, a motor having a stator supported on said casing and a rotor keyed to said quill shaft and supported on the support shoulder of said quill shaft, means for keying the pump drive shaft to said quill shaft, and a nut supported on the upper end of said quill shaft and threaded on the upper end of said pump drive shaft, rotation of said nut being effective to adjust said pump drive shaft relative to said quill shaft.

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