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SUBMERSIBLE MOTOR-PUMP ASSEMBLY

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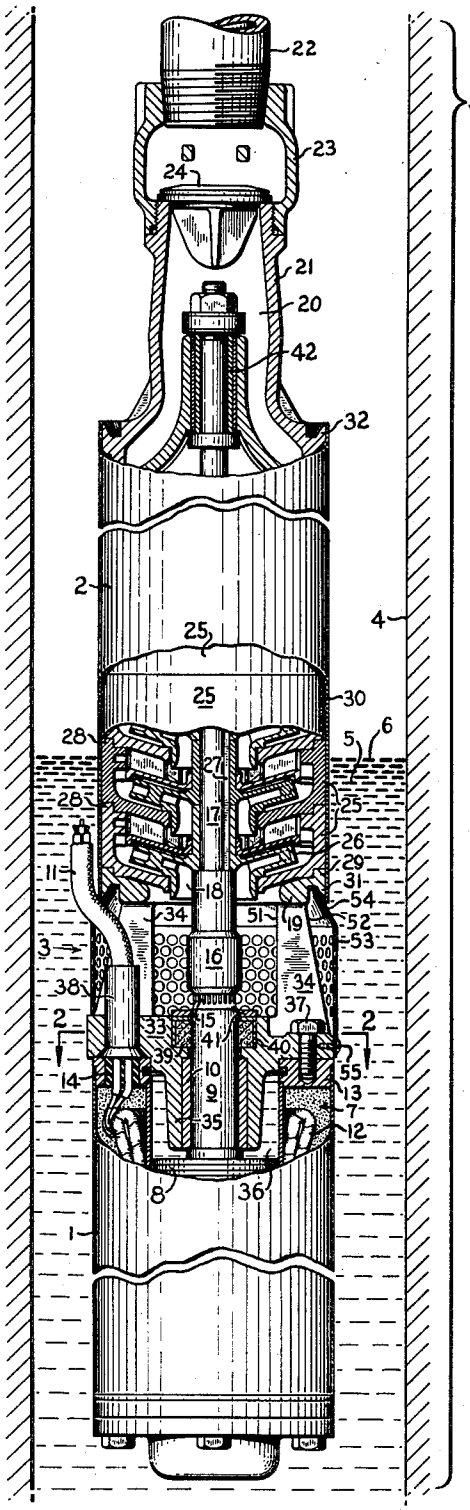


Fig. 1

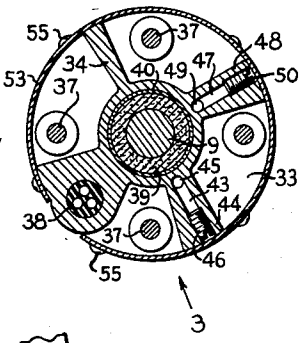


Fig. 2

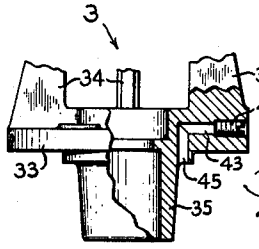
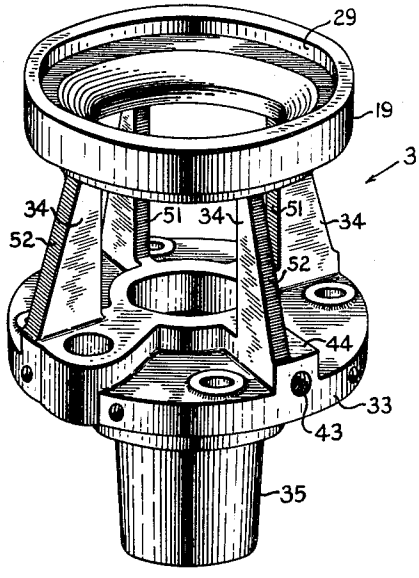


Fig. 3

Fig. 4



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SUBMERSIBLE MOTOR-PUMP ASSEMBLY

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1 Claim. (Cl. 103—87)

This invention relates to a submersible motor-pump assembly and in particular to a motor-pump assembly having a multi-stage pump.

The general construction of a submersible motor-pump assembly comprises a separate motor and pump unit having the respective shafts coupled together and adapted to be lowered into a well with the motor and the pump submersed into the well liquid. A spacer structure secures the pump and the motor in spaced relation to allow the water to enter the lower end of the pump which forces the water upwardly through a stringer pipe leading to the top of the well. The motor is provided with a thrust bearing at its lower end to take up the thrust forces during operation. The motor and pump are each provided with their own upper and lower radial bearing to radially support and align the respective shafts.

In accordance with the present invention, the spacer member is preferably integrally cast with the upper motor bearing housing and the base for the pump assembly. When integrally cast, the conventional pump suction casting is eliminated with the upper motor housing serving the dual purpose of a bearing support and also supporting the pump. The construction of the present invention eliminates the lower pump bearing. The cast spacer is smaller than the conventional spacer structure and the upper radial bearing of the motor also radially supports the lower end of the pump shaft and consequently serves as the lower pump bearing.

The present invention provides a simplified, compact motor-pump assembly with reduced cost of material and assembly.

The drawing furnished herewith illustrates the best mode presently contemplated for carrying out the invention.

In the drawing:

Figure 1 is an elevational view of a submersible motor-pump unit embodying the invention with parts broken away and sectioned;

Fig. 2 is a view taken on the line 2—2 of Figure 1;

Figure 3 is a fragmentary elevational view with a portion broken away and sectioned of a spacer member shown in Figure 1; and

Figure 4 is a perspective view of an integrally formed bearing housing-spacer-pump base member.

Referring to the drawing and particularly Figure 1, a submersible motor 1 is coupled in driving relation to the lower end of a multi-stage pump 2 and is connected in spaced relation thereto by a spacing member 3. The unit is lowered into a well 4 from which water 5 is to be pumped with the motor 1 and at least the lower end of the pump 2 below the upper level of the water 6.

The submersible motor 1 is an induction motor having an annular stator assembly 7 with a rotor 8 rotatably mounted within the bore of the stator. The rotor is secured to a motor shaft 9 and is supported at the lower end by a thrust bearing and a radial bearing, neither of

which is shown in the drawing. At its upper end the rotor is supported by a radial bearing 10, more fully described hereinafter. The power lines 11 which are connected to a field winding 12 within the stator extend from the stator assembly through an opening in the upper stator end member 13. The opening is sealed by potting with any suitable resin 14 to prevent fluid leakage into the stator assembly. The shaft 9 of motor 1 extends upwardly through a portion of the spacing member 3, and is splined on its exterior periphery as at 15 to mate with an internally splined recess in an enlarged end portion 16 of the pump shaft 17.

The splined coupling rotatably binds and axially aligns the motor shaft 9 and the pump shaft 17. As the upper motor radial bearing is to radially support the lower end of the pump shaft, a coupling or other relatively rigid coupling is preferable. The shafts may also be integrally formed. When the motor is energized via lines 11, the pump raises the water or the like from the well.

The pump 2 is a multi-stage pump shown as having its inlet passage 18 at the bottom through a generally ring-shaped base 19 and its outlet passage 20 at the top through a discharge nozzle 21 which is connected to a stringer tube 22. A conventional coupling 23 threads onto the outer end of the discharge nozzle 21 and the stringer tube 22 to connect them together. A float valve 24 in the coupling 23 prevents the water once pumped into the tube 22 from returning to the well.

Each stage of the pump 2 comprises a housing 25 within which an impeller 26 rotates and centrifugally forces the water to the succeeding stage. Each impeller 26 is locked to the pump shaft 17 by a key 27. The housings 25 are stacked one upon another with the first stage resting on the base 19. The lower periphery of each housing 25 is recessed to accommodate an upstanding flange portion 28 of the immediately lower housing except for the first stage which receives an upstanding flange portion 29 of the base 19. The plurality of pump stages are secured in stacked relation by a sleeve casing 30 which is crimped at each end upon projections 31 and 32 formed respectively on the lower surface of the base portion 19 and the discharge nozzle 21 of the pump 2.

The spacing member 3, a perspective view being shown in Fig. 4, comprises an upper motor bearing housing 33 and the pump base 19 which are connected by a plurality of spacer struts 34 formed integrally at their ends with the housing and base. The spacing member 3 is preferably made as a single casting to obtain maximum economy in construction and assembly.

The upper bearing housing 33 is a generally thick, circular member with a downwardly depending hub 35 having a central bore through which the motor shaft 9 extends. The radial bearing 10, previously described, is secured within the hub 35.

The spacing member 3 is secured to the stator end plate 13, with the hub 35 extending into the rotor chamber 36, by a plurality of bolts 37 which pass through suitable openings in the housing 33 and thread into suitably tapped openings in the end plate. A lead-in plug 38 extends through the circular member of housing 33 for passage of the power lines 11.

The radial bearing 10 secured within the bore of the hub 35 maintains the radial alignment of motor shaft 9 and pump shaft 17. A shaft seal 39 is disposed within a recess in the housing through which shaft 9 passes to restrict entry of water and foreign matter into the rotor chamber 36 and a seal cover 40 overlies seal 39 to frictionally hold it in place. A sand slinger 41 is secured to the shaft immediately adjacent the shaft seal 39 to centrifugally throw larger foreign particles from about the seal.

A radial bearing **42** is provided at the upper end of the pump shaft **17** and a radial bearing, not shown, is provided at the lower end of the motor shaft **9** to complete the radial support for the shafts **17** and **9**.

The motor **1** is adapted to run with the rotor chamber **36** filled with water. As more clearly illusrtated in Figs. 2 and 3, to initially fill the rotor chamber with water, a water inlet is formed by a tapped opening **43** extending laterally inwardly within an enlarged portion **44** on the top of the circular member of housing **33** and into communication with a longitudinal opening **45** in the housing adjacent the hub **35**. The opening **45** is in communication with the rotor chamber **36** which may be filled with water and a plug **46** then threaded into the lateral opening **43** to seal the passage.

A similar passage is also formed in circumferential spaced relation to the first passage by a lateral opening **47** formed in an enlarged portion **48** and longitudinal opening **49** in the housing **33**. The latter passage allows the air in the rotor chamber **36** to escape while filling with water. The lateral opening **47** is also tapped to receive a correspondingly threaded plug **50** which seals the passage after the rotor chamber **36** is filled. This prevents formation of air pockets and allows rapid filling of the rotor chamber.

The four circumferentially spaced struts **34** are integrally formed with the housing portion of the spacing member **3** and hold the integrally formed pump base **19** in vertically spaced relation to the motor **1** to thereby allow entry of water to the inlet **18** of the pump **2**. Each strut **34** extends radially from the structure of seal **40** to the outer edge of the housing. The inner vertical surface **51** of each strut **34** is generally vertical with the outer vertical surface **52** tapering inwardly and upwardly to the base portion **19** with the circumferential lip **31**, about which the pump casing **30** is crimped, encircling the upper ends of the struts.

The length of the struts **34** is maintained at a minimum consistent with allowance for suitable flow to the pump opening **18** and coupling of the motor shaft **9** and the pump shaft **17**. In this manner, the pump shaft **17** is maintained and radially supported in alignment without the necessity of a lower radial bearing for the pump.

The base portion **19** is generally ring-shaped and has the lip **31** and flange **29** integrally formed with the struts **34**.

A screen **53** encircles the struts **34** and the circular portion of housing **33** and tapers inwardly as at **54** to dispose the top edge within the depending base lip **31**. Setscrews **55** thread into housing **33** and secure the screen in position.

In operation, the submersible motor-pump unit is lowered into the well **4** with the motor **1** and water inlet

18 disposed below the upper level of the water. The unit is started and stopped by remotely controlling the energization of the stator winding **12** via the power lines **11**.

When energized, the motor **1** drives the pump **2** which draws water in through the lower end of the pump and raises it through the various pump stages, discharging it through the discharge nozzle into the stringer tubing which carries the water from the well.

The combined bearing-spacer **3** permits the entry of water into the lower end of the pump assembly. As previously noted, the spacing struts are shortened to a minimum consistent with a satisfactory water flow.

The present invention eliminates the radial bearing for the lower end of the pump and permits a substantial reduction in the size of the spacing structure. By forming the bearing housing, strut spacers and pump base as an intgeral cast unit substantial economy of materials and assembly is obtained.

Various modes of carrying out the invention are contemplated as being within the scope of the following claim particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

A submersible motor pump assembly comprising an electric motor, a spacing member mounted on said motor and having a plurality of openings therein for passage of fluid to be pumped and a hub integral therewith and extending within said motor, a shaft disposed within the motor and driven thereby and extending within said hub, a pump unit mounted on the spacer member and having a plurality of vertically stacked impellers located therein and a shaft extending through the impellers to which the impellers are secured and depending into said spacer member into engagement with the motor shaft to be driven by said motor shaft, a bearing confined within said hub in engagement with the motor shaft to support the motor shaft and pump shaft against radial thrust and thereby eliminate a separate bearing support for the lower end of the pump shaft, and a shaft sealing means disposed around the motor shaft within the spacing member and at the end of the bearing exposed to the fluid being pumped to restrict entry of fluid and foreign matter to the bearing and motor.

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