Aug. 14, 1934. J. B. WADE 1,970,154

SUBMERSIBLE MOTOR CONSTRUCTION FOR DEEP WELL PUMPS

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Fig. 1.

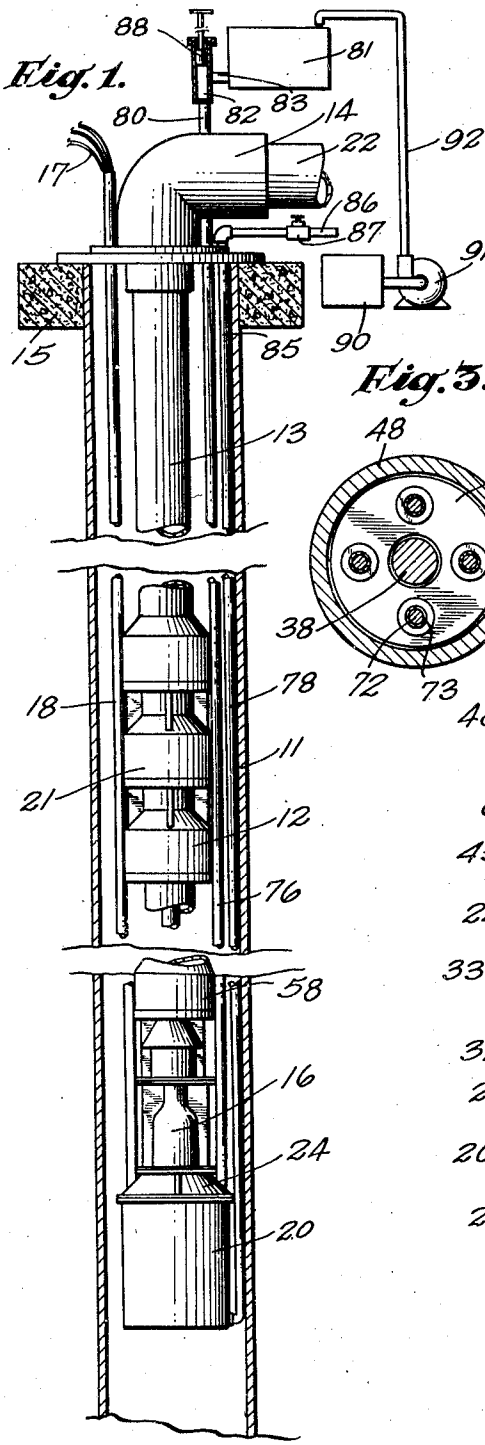
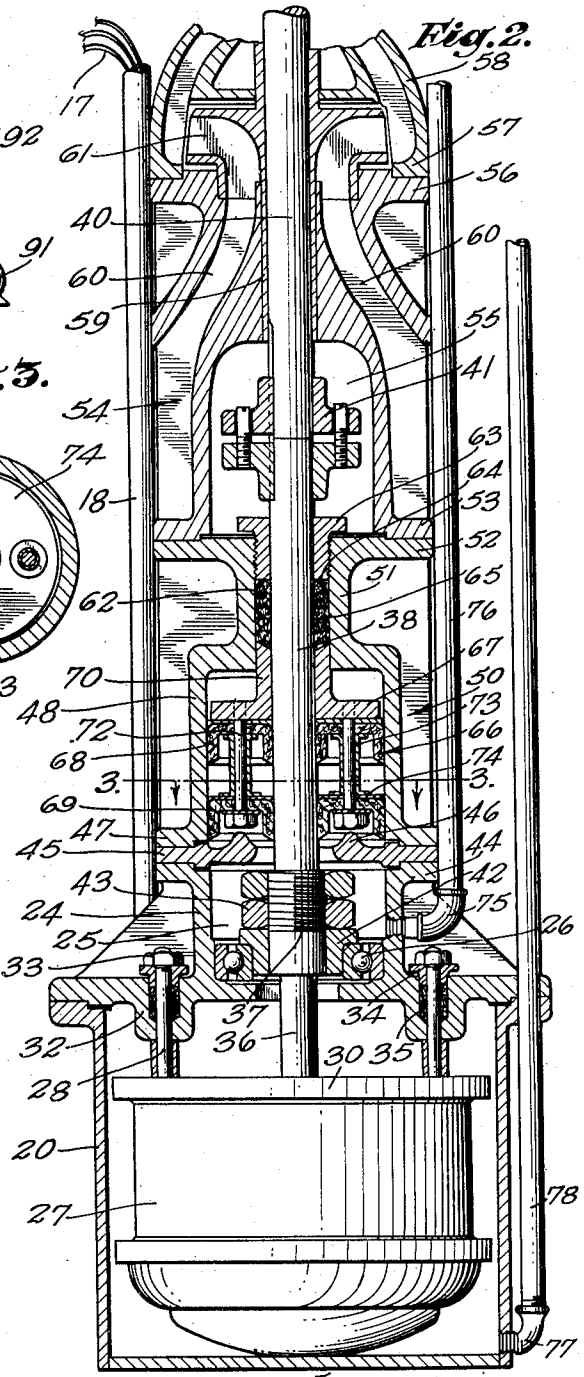


Fig. 3.

Fig. 2.



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SUBMERSIBLE MOTOR CONSTRUCTION FOR DEEP WELL PUMPS

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17 Claims. (Cl. 172—36)

My invention relates to means for driving rotary or centrifugal pumps of the character used to pump water from wells, and relates to a submersible motor construction which may be operated below the surface of a liquid and may be used to operate submerged mechanism through a driven shaft which projects from the submersible motor structure.

As my invention has its present principal utility in connection with deep well pumps I shall hereinafter disclose an embodiment thereof particularly adapted for the operation of such pumps. Deep well pumps for pumping water from deep wells are generally of the rotary or centrifugal type having a series of impellers operated in pump housings or bowls by means of a shaft which is extended down into the well from a driving means situated at the ground surface, to the pump mechanism which is submerged below the surface of the water in the well. The cost of the shaft and bearings therefor is an item of considerable expense, and the friction losses due to the operation of the shaft in its bearings and in liquid add to the operating expense of the pump.

It is an object of my invention to provide a pump for deep well use, in which the motor for driving the pump impellers is situated within the well at a point near the pump mechanism, thereby eliminating a greater portion of the shafting now used in deep well pump construction and reducing friction.

It is an object of the invention to provide for a pump of the above character, an electrically driven motor having a housing adapted to enclose the motor parts in a body of oil so as to keep from the motor parts water and other foreign substances injurious to the same. This motor, with its housing, is preferably situated below the pump mechanism and has a projecting shaft adapted for connection to the impeller mechanism of the pump.

It is an important object of the invention to provide in a submersible motor construction of the above character an improved and simplified means for sealing around the projecting shaft so that oil will not readily escape from the motor housing and so that water and foreign substances will not enter the motor housing.

A feature of the above sealing means is that it is actuated to compensate for wear by hydraulic pressure produced by a static head of fluid associated with the motor housing, this fluid being preferably a body of oil contained in an oil feed pipe which extends from the surface of the ground to the motor housing.

A further object of the invention is to provide an auxiliary actuating means for the sealing means, whereby to forcibly compress or set up the sealing element thereof, and to overcome any tendency for the movable parts of the sealing means to stick.

A further object of the invention is to provide a device of the above character having a simple means for removing the small amounts of water which may leak into the motor housing or condense therein, and to further provide a means whereby a continuous circulation of oil through the motor housing may be maintained.

Further objects and advantages of the invention will be brought out in the following part of the specification.

Referring to the drawing which is for illustrative purposes only,

Fig. 1 is an illustration showing a manner in which a preferred embodiment of the invention may be used in conjunction with a deep well pump.

Fig. 2 is an enlarged vertical section through the submersible motor structure shown in Fig. 1.

Fig. 3 is a cross-section on a plane represented by the line 3—3 of Fig. 2.

In Fig. 1 is shown a well casing 11 having a pump mechanism 12 supported therein by means of a discharge column 13 which projects downwardly from a discharge head 14 supported at the top of the well by a foundation member 15. Secured to the lower end of the pump mechanism is a submersible motor structure 16 to which electric current is carried by means of wires 17 extending through a pipe 18 connected in fluid tight relationship with the motor housing 20 of the structure 16. The pump mechanism 12 is shown as including a plurality of pump bowls 21 in which pump impellers are operated in a manner to force water from the well up through the discharge column 13 to be finally discharged through a pipe 22 projecting laterally from the head 14.

As shown in Fig. 2, the submersible motor structure 16 includes a casting 24 forming the upper wall of the motor housing 20 and having a chamber or recess 25 formed therein to receive a combined radial-thrust ball bearing 26, or its equivalent. An electric motor 27 is supported in the housing 20 by means of studs 28 which project upwardly from the case 30 through packing devices formed in and carried by the casting 24, there being nuts 33 on the uper ends of the studs 28 adapted to force packing glands 34 against bodies

35 of packing surrounding the upper portions of the studs 28. The motor 27 has an upwardly projecting shaft 36 provided with an enlarged threaded portion followed by a reduced portion or shaft stem 38 which is connected to a pump shaft 40 by means of a coupling 41. On the lower part of the enlarged portion 37 is a flanged sleeve 42 which fits into the bearing 26 and is adjusted vertically relative to the shaft 36 by means of locknuts 43, thereby adjustably supporting the shaft 36 and the motor rotor attached thereto.

On the flange 44 formed at the upper end of the casting 24 is an annular plate 45 which surrounds the shaft stem 38 and has a relatively short upwardly projecting flange 46. On the member 45 is secured a flange 47 forming the lower end of a cylinder 48, which in turn forms part of a sealing means casing 50 around the shaft stem 38. Projecting upwardly from the cylinder 48 is a tubular part or sleeve 51 surmounted by a flange 52 which receives a flange 53 forming the lower end of a water inlet fitting 54 having a space 55 in the lower portion thereof to receive the coupling 41. The upper end of the inlet fitting 54 has a flange 56 which is adapted to be secured to the bottom 57 of the lowermost pump bowl 58 of the pump mechanism 12. The upper part of the inlet fitting 54 has a bearing 59 for supporting the power portion of the shaft 40 and also has upwardly converging water inlet passages 60 through which water may enter the impeller 61 in the bottom pump bowl 58.

The upper end of the bore 62 of the sleeve 51 is threaded to receive a threaded closure sleeve 63 which surrounds the shaft stem 38 and forms an abutment 64 against which the upper part of a body of packing material 65 rests. In the cylinder 48 is an annular piston 66 consisting of an upper flange 67, to the lower face of which annular cup washers 68 and 69 are secured, and having an upwardly projecting sleeve or gland 70 which surrounds the shaft stem 38 and enters the lower end of the bore 62 in position to compress the packing material 65. The annular sealing means in the form of cup washers 68 and 69 are secured to the flange 67 by studs 72 and are held in spaced relation by sleeves 73 and annular washers 74. Downward movement of the piston 66 is limited by engagement of the lower ends of the studs 72 with the flange 46 of the annular plate 45.

A fitting 75 connects an oil feed pipe 76 with the recess 25, and a fitting 77 connects an oil discharge pipe 78 with the interior lower part of the housing 20. The upper end 80 of the oil delivery pipe 76 is preferably connected to an oil reservoir 81. In Fig. 1, I show such connection through the lower end of a small hand pump 82 and a nipple 83 which connects the pump 82 with the power part of the reservoir 81. Extending from the upper end 85 of the pipe 78 at a level below the reservoir 81 is an overflow pipe 86 which may be equipped with a valve 87 having a use which will be later explained.

The interior of the housing 20 the recess 25, the lower port of the cylinder 48 and the pipes 76 and 78 are filled with a selected oil of minimum moisture content. On the piston 66 is exerted an upward hydraulic pressure determined by the static head of oil in pipes 76 and 68 this pressure being transmitted to the packing 65 by the gland 70, compressing it around the shaft stem 38 and preventing movement of fluid through the sleeve 51. The diameter of the piston 66 is calculated, in accordance with the character of the packing 65 and the static head of oil due to the length of the pipes 76 and 78, to keep sufficient pressure on the packing 65 to at all times preserve a tight seal. By closing the valve 87 in the overflow pipe 86 and exerting downward pressure on the piston 88 of the hand pump 82, the upward force exerted against the piston 66 may be very greatly increased and the packing 65 may be in this manner forcibly set at desired intervals.

Water which may in any manner enter the submersible motor unit will collect in the lower end of the housing 20 and may be discharged at intervals, or continuously, through the pipe 78 by outward movement of oil therethrough. Oil may be periodically circulated down through the pipe 76, through the housing 20, and up through the discharge pipe 78, or such circulation may be continuous during the operation of the pump.

In Fig. 1 I have shown a receiver 90 in position to receive overflow oil from the overflow pipe 86, and connected to the receiver 90 is a pump 91 which delivers oil from the receiver to the reservoir 81 through the piping 92. By apparatus of this character a continuous circulation of oil may be maintained through the interior parts of the submersible motor unit without diminishing the oil pressure against the piston 66 for the purpose of maintaining the packing 65 properly compressed.

Although I have herein shown a practical and operative form of my invention, it is to be understood that the respective parts and elements thereof are representative of other equivalent parts and elements which may be used in the place of the parts shown without departing from the spirit of the invention; therefore, it is intended that the invention shall not be limited by the specific details shown herein, but shall have the scope defined by the following claims.

I claim as my invention:

1. A submersible motor structure of the character described, including: an electric motor; a housing enclosing said motor; a shaft driven by said motor, said shaft projecting out through said housing so as to drive a mechanism; hydraulically actuated packing means surrounding said shaft where it passes through said housing, said packing means having a hydraulic chamber connected to the interior of said housing; and means for delivering a dielectric fluid to said chamber and the interior of said housing.

2. A device as defined in claim 1, in which said delivery means comprises a stand-pipe connected with said housing for containing a fluid the static pressure of which provides the hydraulic pressure for actuating said packing means.

3. A device as defined in claim 1, in which said delivery means comprises a stand-pipe connected with said packing means and said housing for containing said fluid, the static pressure of which provides hydraulic pressure for actuating said packing means, and auxiliary means for applying additional pressure to said fluid to forcibly actuate said packing means.

4. A device as defined in claim 1, in which said means for delivering a fluid to the interior of said housing to fill said housing and engage said packing means comprises a pipe extending upwardly from said housing and being of such height that the static pressure in said housing will be at least as great as the pressure of the fluid to which the exterior of said packing is subjected.

5. A submersible motor structure of the character described, including: an electric motor; a housing enclosing said motor, there being an

opening therein through which a shaft may project; a shaft driven by said motor and projecting through said opening; packing material around said shaft at said opening; a member for compressing said packing material; a piston operating in a cylinder, said piston being connected to said member so as to actuate the same, and said cylinder being connected to the interior of said housing; and means for applying fluid pressure to said cylinder to actuate said piston and to fill said housing with such fluid.

6. A device as defined in claim 5, in which said means for applying fluid pressure comprises a pipe extending upwardly from said housing, and including an overflow pipe extending upwardly from the lower part of said housing, said pipes being adapted to be filled with fluid whereby to produce static pressure for actuating said piston and maintaining a fluid pressure in said housing.

7. A submersible motor structure of the character described, including: a motor; a housing enclosing said motor; a cylinder having a central opening at the upper end thereof mounted on said housing; a shaft extending from said motor through said cylinder and said opening; packing around said shaft at said opening; a gland around said shaft for compressing said packing; a piston in said cylinder for actuating said gland; and a pipe extending upwardly from said housing for delivering oil to fill said housing and apply pressure to said piston, the length of said pipe being such as to produce a predetermined pressure of oil against said piston.

8. A device as defined in claim 7, including auxiliary means for creating added pressure in said oil to actuate said piston.

9. A device as defined in claim 7, including an overflow pipe leading upwardly from a lower part of said housing to a point near the upper end of said first-named pipe.

10. A device as defined in claim 7, including an overflow pipe leading upwardly from a lower part of said housing and means for circulating oil through said pipes and said housing.

11. A device as defined in claim 7, including an overflow pipe leading upwardly from a lower part of said housing, means for circulating oil through said pipes and said housing, and a pump for increasing the pressure of said oil in said housing.

12. A submersible motor construction of the character described, including: a motor; a housing enclosing said motor; a cylinder having a central opening at the upper end thereof mounted on said housing; a shaft extending from said motor and through said cylinder and said opening; packing around said shaft at said opening and at the outer end of said cylinder; and means within said cylinder for applying a continuous pressure on said packing to take up the wear thereof due to rotation of said shaft.

13. A submersible motor structure of the character described, including: an electric motor; a housing enclosing said motor; a shaft driven by said motor, said shaft projecting out through said housing so as to drive a mechanism; a fluid actuated sealing means for said shaft where it passes out through said housing, said sealing means being exposed to and actuated by the pressure of fluid in said housing; and means for delivering a dielectric fluid to said housing under pressure sufficient to actuate said sealing means.

14. A device as defined in claim 13 in which said fluid delivering means comprises a stand-pipe extending upwardly from and connected to said housing.

15. A device as defined in claim 13 in which said fluid delivering means comprises a stand-pipe extending upwardly from said housing so as to contain a static head of fluid in communication with the interior of said housing, and has an auxiliary means for applying an excess pressure to said fluid to re-enforce the actuation of said sealing means by pressure of said fluid.

16. A submersible motor structure of the character described for use with a pump in a well, including: a housing having an opening; a member forming a fluid chamber mounted on said housing and connected to said housing at said opening; a motor in said housing; a shaft driven by said motor and extending out through said opening and through said chamber; fluid actuated sealing means for said shaft in said chamber; and a fluid stand-pipe extending upwardly from said housing to the top of said well, the lower end of said stand-pipe being connected with said chamber and said stand-pipe being adapted to contain a quantity of fluid to produce a static pressure in said fluid chamber.

17. A submersible motor structure of the character described, including: a water-tight motor housing; a motor in said housing, said housing having a shaft opening and said motor having a shaft extending out through said opening; a chamber member secured to said housing at said opening and surrounding a portion of said shaft; sealing means in said chamber member for sealing around said shaft, said sealing means being adapted to be actuated by fluid pressure; and fluid pressure supply means operatively connected so as to exert a fluid pressure in said chamber member to actuate said sealing means.

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