April 24, 1934. A. O. FABRIN 1,955,955

SUBMERSIBLE PRIME MOVER

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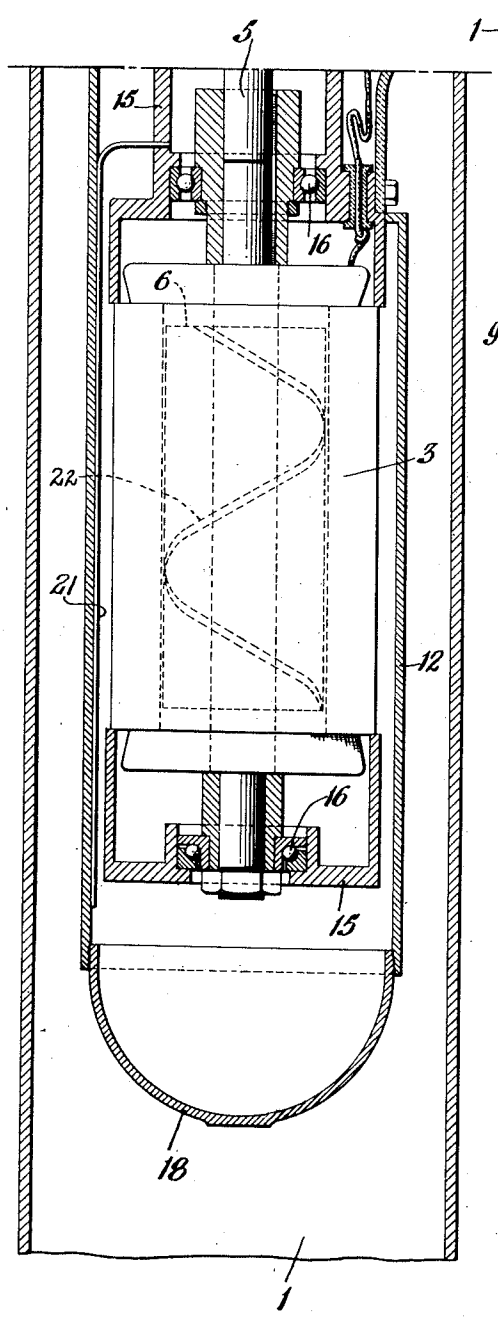


Fig. 1.

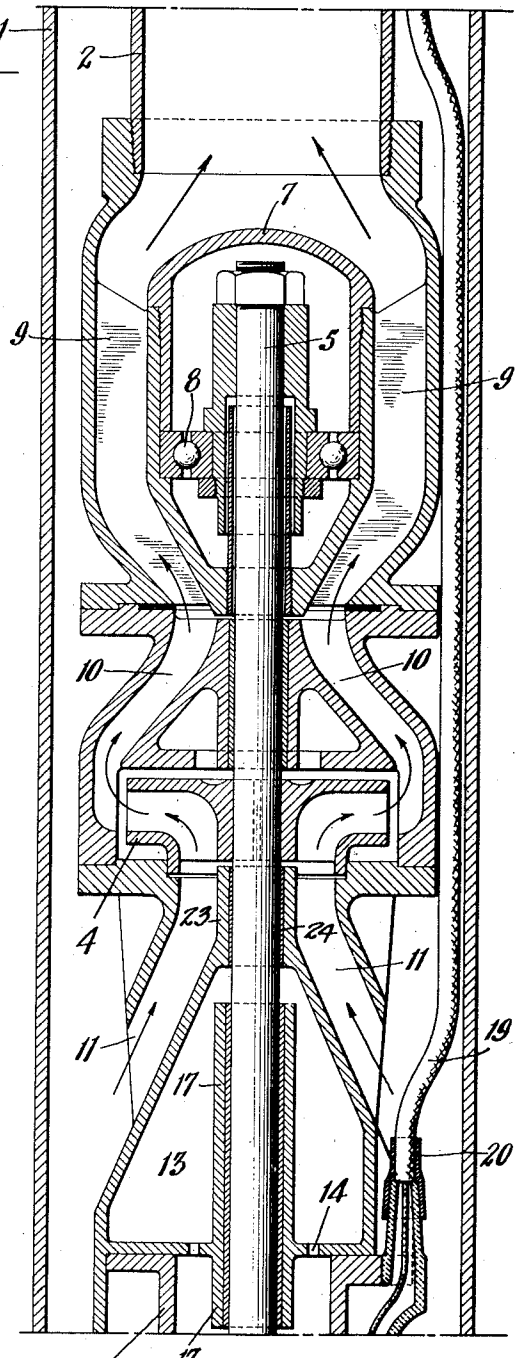


Fig. 2.

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SUBMERSIBLE PRIME MOVER

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8 Claims. (Cl. 172—36)

This invention relates to improvements in motors or prime movers such as are adapted to operate while submerged in a fluid.

I have developed my improved device in connection with deep-well pumps such as are used, by way of example, for irrigation purposes in some of the more arid sections of the country. The present disclosure, therefore, will be of a device which is suitable for this purpose, although it is to be understood that the invention is not necessarily to be limited to this field of service.

Nevertheless the invention is particularly useful in deep-well pumps for the reason that it overcomes many of the disadvantages inherent or incident to previous pumping equipment for this class of service.

It should be understood that deep-well pumps may go down anywhere from a hundred or two hundred feet to seven, eight or nine hundred feet or even deeper, and once the equipment is installed it is, of course, an extremely difficult and expensive job to remove it for the purpose of making any repairs.

In general deep-well-pumps have heretofore been operated by a long driving shaft which extends from the pump at the bottom of the well up to the surface of the ground where it is connected with suitable motor equipment. These shafts must be provided with suitable bearings and must be protected from the water or other fluid being pumped. Furthermore, the bearings must be properly lubricated throughout the entire length of the shaft. All of this construction is complicated, heavy and expensive and must be very accurately installed in order to be satisfactory. Furthermore the difficulties of installation are greatly aggravated where the well is in any way crooked, as is often the case in wells of this character.

All of the foregoing factors involve difficulties with which every engineer skilled in this art is thoroughly familiar, but with my invention these problems are entirely overcome.

It can be stated, therefore, that, broadly speaking, the principal object of my invention is to greatly simplify and cheapen the installation of a submersible motor or prime mover, and I accomplish this by the use of an electric motor which is provided with a suitable housing filled with an insulating fluid which is heavier than the fluid in which it operates. A specific example of how this is accomplished will be seen by reference to the accompanying drawing wherein—

Figures 1 and 2 represent a vertical section through the lower end of a well at the point where the motor and pump assembly is installed which, as stated, may be many hundred feet under the surface of the ground. It should be understood that the portion of the structure shown in Figure 2 is intended to be superimposed upon the portion shown in Figure 1.

Referring to the drawing, the casing is shown at 1. This is of usual character and may be provided at its lower end with any suitable type of screening device, not shown, as it forms no part of the present invention. Within this casing I prefer to use a discharge pipe or casing 2 by means of which the fluid is carried to the surface of the ground. However, if desired, the casing 1 can be used as a discharge pipe if a suitable packer be provided between such casing and the pumping unit to be described below.

At the lower end of the discharge pipe 2 is attached my improved pump and motor assembly, the motor 3 being located below the pump 4 shown as of the centrifugal-impeller type. A shaft 5, which is in reality an extension of the motor shaft, connects the rotor 6 of the motor with the pump 4. The shaft 5 is extended above the pump 4 to a dead-end housing 7 within which the shaft may be provided with any suitable combination radial and thrust bearing 8.

Surrounding the dead-end housing 7 are passages 9 which carry the water from the impeller discharge passages 10 up to the discharge casing 2.

Below the impeller 4 are the inlet openings 11 through which the water is drawn from the surrounding stratum, the water, of course, having entered through any suitable screening device at the bottom of the outside casing 1.

The motor is completely enclosed in a housing or metal shell 12 which is provided at its upper portion with an expansion chamber 13 having communication with the housing proper through an opening or openings 14.

Within the housing 12 suitable structure 15 is provided for carrying the bearings 16 of the motor shaft, as clearly shown in the drawing.

I prefer to form the inner wall of the expansion chamber as an annular sleeve or standpipe 17 which extends well up into the chamber and also downwardly a short distance within the housing proper as shown at the bottom portion of the right-hand half of the figure.

Below the motor I prefer to provide rather a good-sized enlargement in the shape of a rounded end 18, which end acts as a bottom cover for the housing and serves as an oil reservoir as will appear more fully below.

The motor housing or chamber 12 is completely filled with an insulating fluid having a specific gravity which is heavier than the fluid to be pumped. Preferably, this fluid should have a dielectric value to properly insulate the motor as well as a good lubricating quality so it will act as a lubricant for the ball bearings. Furthermore, it should have a relatively low viscosity as measured by the Saybolt scale. At the time of assembly and installation the supply of this heavy insulating fluid or lubricant is sufficient to fill the expansion chamber as well as the housing proper. A circulation pipe 21 is preferably provided for circulating the fluid in the housing. This will help in preventing the possibility of developing hot spots in the motor. If desired, the natural circulation due to difference in temperature between the top and the bottom portion of the fluid, may be made a positive circulation by the use of any suitable pumping device such as a spiral groove or grooves 22 on the pump rotor or a small directly driven pump. One type of fluid which is especially suitable for the purpose described is produced by the General Electric Company under the trade name of "Pyranol #1477".

A cable 19 is provided for carrying the necessary supply of current for operating the motor, and this cable extends from the motor casing 12 all the way to the surface of the ground and is located between the outside casing 1 and the inner or discharge casing 2. At its lower end the cable is provided with a fluid-tight connection 20 at the top of the housing 12.

The operation of the apparatus is as follows: After installation has been completed, current is supplied to the windings of the motor through the cable 19 by any suitable switching mechanism, not shown, at the surface of the ground. This will start the motor and also the impeller. As the motor becomes warm, the insulating fluid will, of course, expand to a certain extent and flow out of the upper end of the housing into the expansion chamber 13 and from the expansion chamber 13 it will pass outwardly through the opening at the top which surrounds the shaft 5. After a certain period of operation the motor will not become any hotter and the expansion of the fluid will cease so that only a given quantity will be forced out.

After the motor is shut down the insulating fluid, of course, will cool, and as it cools it will contract and the volume of it which has been lost will be replaced by fluid or water from the well, which fluid, of course, will enter around the shaft 5 through the sleeve like portion 23 at the top of the expansion chamber, the bushing 24 in the sleeve not being intended to function as a tight packing. However, the expansion chamber 13 is designed to have a capacity sufficient to accommodate whatever water will enter in this way so that no water will ever enter the motor housing, or at most water will never enter in sufficient quantity to extend down to the motor itself. In this way all injury to the motor is permanently avoided. Since the insulating fluid is heavier than the fluid to be pumped it will always remain at the bottom of the housing. The flow of the fluid being pumped upwardly around the housing 12 will serve to cool the fluid therein and prevent excessive heating of the motor even after long periods of pump operation.

The sleeve or standpipe 17 acts as a baffle between the rotating shaft 5 and the fluid in the expansion chamber 13 and thus serves to prevent the shaft from rotating or agitating the fluid. In addition, the fact that the expansion chamber and the motor chamber are separated by a baffle or partition member through which communication between the two chambers is effected by means of the comparatively small capacity passages 14, prevents the turbulence which necessarily exists in the motor chamber during operation from being imparted to the fluid in the expansion chamber.

By these means I am enabled to prevent mixing of the lubricant and the water which, of course, meet in the expansion chamber and by preventing such mixing I avoid the possibility of drawing water into the motor chamber when cooling and contraction take place after a period of motor operation. In other words, I maintain the lubricant and the water in distinct layers or relationship with the oil below the water and avoid drawing even a mixture of oil and water into the motor chamber proper as might be possible were a mixture actually formed as a result of the turbulence around the motor or by the whipping action of the shaft in the expansion chamber.

As will be seen the device is extremely simple and inexpensive. It saves a great deal of trouble in installation and weighs very much less than the old type of equipment. It will run for years without attention or repair of any kind.

What I claim is:—

1. A submersible motor device including in combination with the operating shaft, a housing surrounding the motor, an expansion chamber surrounding the shaft above said housing, the lower portion of said chamber being in communication with the motor housing and the upper portion thereof being open to the fluid in which the motor is submerged, and an insulating fluid in the housing which fluid is of greater specific gravity than the fluid in which the device is submerged.

2. An under-water motor with upwardly extending operating shaft, a housing for the motor through which the shaft projects, a chamber surrounding the shaft communicating below with the motor housing and open above to the water, and an insulating fluid in the housing which fluid is of greater specific gravity than the water.

3. An under-water motor with upwardly extending operating shaft, a housing for the motor through which the shaft projects, a chamber surrounding the shaft communicating below with the motor housing and open above to the water, a sleeve in the chamber closely surrounding the shaft, and an insulating fluid of greater specific gravity than the water, said fluid filling said housing and at least partially filling said chamber to surround said sleeve.

4. An under-water motor with upwardly extending operating shaft, a housing for the motor through which the shaft projects, a chamber surrounding the shaft having restricted communication with the motor housing below and open above to the water, and an insulating fluid of greater specific gravity than the water, said fluid filling said housing and at least partially filling said chamber.

5. An under-water motor with upwardly extending operating shaft, a housing for the motor through which the shaft projects, a chamber surrounding the shaft having restricted communication with the motor housing below and open above the water, a sleeve in the chamber closely surrounding the shaft, and an insulatng fluid of

greater specific gravity than the water, said fluid filling said housing and at least partially filling said chamber to surround said sleeve.

6. A submersible motor device including in combination with the operating shaft, a housing surrounding the motor through which housing the shaft projects upwardly, an expansion chamber surrounding the shaft above said housing, the lower portion of said chamber being in communication with the motor housing and the upper portion thereof being open to the fluid in which the device is submerged, a sleeve in the expansion chamber closely surrounding the shaft, the upper end of said sleeve being well above the point of communication between the chamber and the housing, and an insulating fluid in the housing which fluid is of greater specific gravity than the fluid in which the motor is submerged.

7. A submersible motor device including a combination with the operating shaft, a housing surrounding the motor through which housing the shaft projects upwardly, the upper portion of said housing around said shaft constituting an expansion chamber which is open above to the fluid in which the device is submerged, a sleeve in the expansion chamber closely surrounding the shaft, and an insulating fluid in the housing which fluid is of greater specific gravity than the fluid in which the motor is submerged, the expansion chamber portion of said housing being of capacity sufficient to accommodate whatever fluid will enter from the outside after the motor has been stopped and cooling and contraction of the insulating fluid have taken place.

8. A submersible device including in combination with the operating shaft, a housing surrounding the motor through which housing the shaft projects upwardly, the upper portion of said housing around said shaft constituting an expansion chamber which is open above to the fluid in which the device is submerged, a partition dividing the expansion chamber from the rest of the housing, relatively small capacity passage means providing restricted communication between the interior of the housing and the expansion chamber, a sleeve closely surrounding the shaft and projecting upwardly from the partition, the upper end of said sleeve being well above the point at which said passage means communicates with the expansion chamber, and an insulating fluid in the housing which fluid is of greater specific gravity than the fluid in which the motor is submerged, the expansion chamber where it surrounds said sleeve being of capacity sufficient to accommodate whatever fluid will enter from the outside through its upper opening after the motor has been stopped and cooling and contraction of the insulating fluid have taken place.

AXEL OSCAR FABRIN.

CERTIFICATE OF CORRECTION.

Patent No. 1,955,955. April 24, 1934.

AXEL OSCAR FABRIN.

It is hereby certified that the name of the assignee in the above numbered patent was erroneously described and specified as "Layne & Bowler" whereas said name should have been described and specified as Layne & Bowler, Incorporated, as shown by the records of assignments in this office; page 2, line 149, claim 5, after "above" insert to; page 3, line 20, claim 7, for "a" second occurrence read in; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 19th day of June, A. D. 1934.

Bryan M. Battey

(Seal) Acting Commissioner of Patents.