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3,475,634

SUBMERGIBLE OIL-FILLED ELECTRIC MOTOR WITH A PROTECTING
UNIT FOR THE DRIVE OF A SUBMERGIBLE WELL PUMP

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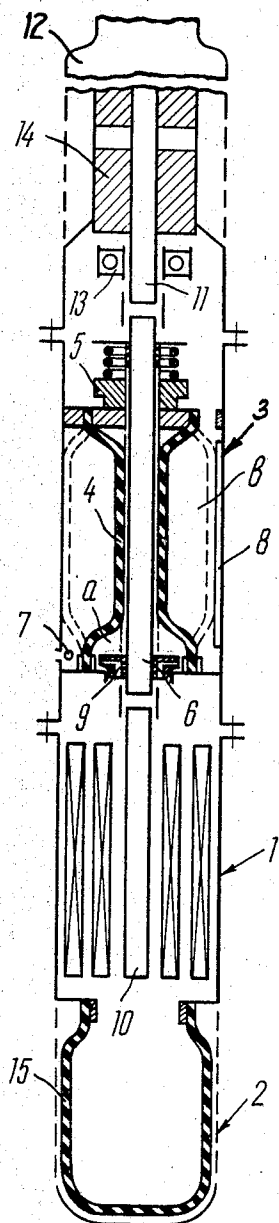


FIG. 1

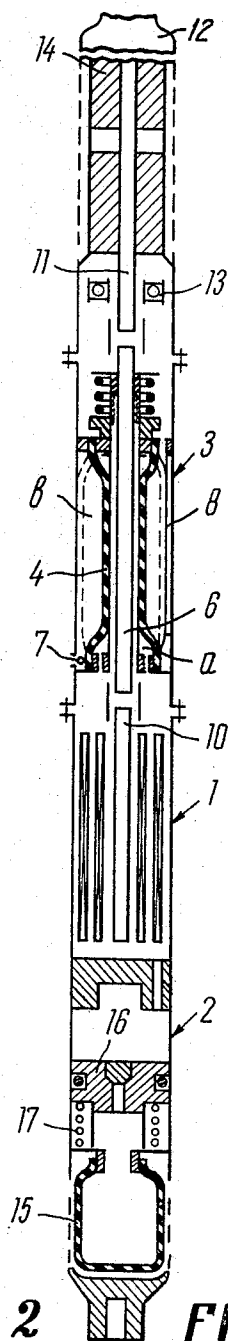


FIG. 2

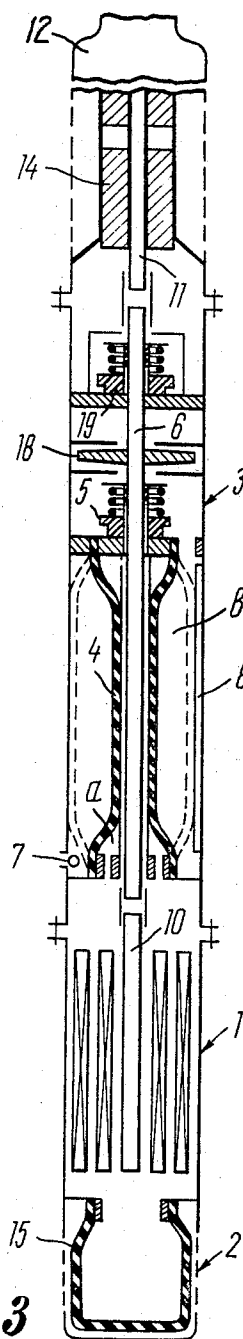


FIG. 3

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SUBMERGIBLE OIL-FILLED ELECTRIC MOTOR WITH A PROTECTING UNIT FOR THE DRIVE OF A SUBMERGIBLE WELL PUMP

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6 Claims

ABSTRACT OF THE DISCLOSURE

A submergible oil-filled electric motor for driving submergible well pumps is provided with a protecting unit which comprises a surge chamber connectable to the lower portion of the electric motor, and a protector including a casing, an intermediate shaft and a diaphragm dividing the casing, together with packing means, into two chambers, one of which communicates with the space of the electric motor while both chambers are filled with protective fluid. In two embodiments a blade wheel or a spring biased piston is provided to overpressure the outer chamber when consistent grease is used therein.

The present invention relates to submergible pumps, and more specifically it relates to the drives for said pumps.

Known in the art are drives for submergible electric pumps comprising an electric motor, a surge chamber, and a protector. The protector in the known drives consists of two chambers intercommunicating with each other, and with the electric motor and the oil well. The volume of the lubricating fluid is compensated by discharging it into the oil well and admitting water into the protector (see U.S. Patent No. 2,783,400, 1957).

Among the disadvantages of the above-mentioned protector is the fact that the fluid lubricating and protecting the electric motor and protector is in contact with the fluid in the oil well. As the protective fluid cools during motor shut-downs, the volume of the protective fluid which is warmed up and discharged into the oil well during operation, is replaced in the protector by the water. This results in a loss of approximately 20 to 25% of the total quantity of the protective fluid, which determines the duration of the drive operation. Besides, since the protective fluid contacts the water this fluid must be of a special nonhygroscopic type.

Other known protectors are filled with two fluids differing from each other in viscosity and physico-chemical properties; these fluids are also in contact with each other which results in their mixing and mutual dissolution (see U.S. Patent No. 1,970,484).

An object of this invention consists in increasing the operating time of the submergible pump drive between repairs.

Another object of the invention consists in providing a drive excluding the contact between the water and the lubricating and protective fluid filling the electric motor.

Still another object of this invention consists in providing a drive not requiring the use of special nonhygroscopic fluids.

Yet another object of this invention consists in providing a drive in which the protector can be filled with different fluids not contacting with each other.

In accordance with the above and other objects there is provided a drive for submergible electric pumps com-

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prising: an electric motor, a surge chamber and a protector filled with at least one fluid wherein, according to the invention, the protector is equipped with an elastic diaphragm separating the protector into two fluid-tight chambers so that there is no contact between the fluids contained in the protector.

It is practicable to provide a valve in the lower part of the chamber not communicating with the motor space.

It is also practicable to provide said chamber with a pipe extending along said chamber.

If said chamber is filled with consistent grease, it is practicable, for building up overpressure in the protector, to mount a blade wheel on the protector shaft.

The employment of the present invention will increase the time of motor operation between repairs and render unnecessary the use of special fluids for lubricating and protecting the electric motor.

Now the invention will be described in connection with examples of submergible electric pump drives with reference to the appended drawing, wherein:

FIG. 1 illustrates in longitudinal section a drive for the submergible electric pumps with a wheel on the protector shaft according to the invention;

FIG. 2 shows, in longitudinal section, a second embodiment of a drive for submergible electric pumps, according to the invention, using a piston with a spring; and

FIG. 3 shows, in longitudinal section, a third embodiment of a drive for submergible electric pumps in which the protector and electric motor are filled with the same lubricating and protective fluid.

The drive for the submergible electric pumps comprises an electric motor 1 (FIG. 1), a surge chamber 2 and a protector 3.

The body of the protector 3 accommodates a flexible diaphragm 4 which, together with a mechanical seal 5, mounted on a shaft 6 of the protector 3, divides the latter into two chambers, *a* and *b*.

Chamber *a* communicates with the chamber of the electric motor 1.

Chamber *b* does not communicate directly with the space of the electric motor 1 being separated from it by said flexible diaphragm 4 and seal 5. Chamber *b* houses a valve 7 through which water is admitted to replace the spent protective fluid filling this chamber. Extending along chamber *b* is a pipe 8 which serves as a connecting passage between the chambers above and under the diaphragm 4 when the latter bears against the walls of the body of the protector 3.

If chamber *b* of the protector 3 is filled with consistent grease, said protector shaft 6 supports a blade wheel 9 intended to build up overpressure in the protector.

Said shaft 6 of the protector 3 is connected to the shaft 10 of the electric motor 1 and the shaft 11 of the pump 12. Installed on the shaft 11 of the pump 12 is a thrust bearing 13 resisting the axial load of the pump, and a stuffing box 14.

Connected to the lower part of the electric motor 1 is the surge chamber 2 with a flexible container 15.

This surge chamber 2 may accommodate a piston 16 and a spring 17 (FIG. 2). In this case the surge chamber makes up for the changes in the volumes of the protective fluid during starting and stopping of the drive and creates overpressure in the drive by means of the piston 16 and spring 17; the blade wheel 9 is not mounted on the shaft 6 of the protector 3 in FIG. 2.

If an axial sliding support 18 (FIG. 3) is installed on the shaft 6 of the protector 3, said shaft additionally supports one more mechanical seal 19 while chamber *b* is filled with the same fluid as chamber *a* and the electric motor 1. In this case there is no need in creating overpressure in the system. Chambers *a* and *b* of the pro-

lector 3 are formed by the flexible diaphragm 4 and two mechanical seals 5 and 19 on the shaft.

The drive for the submergible electric pumps functions as follows.

After switching on the electric motor 1 (FIG. 1), rotation is transmitted from the shaft 10 to the shaft 6 of the protector 3 and then to the shaft 11 of the pump 12. The protective and lubricating fluid filling the electric motor and protector 3 becomes heated and expands. The increase in the volume of this fluid is made up for by the deformation of the flexible container 15 of the surge chamber 2.

The blade wheel 9 rotating together with the shaft 6 of the protector builds up overpressure in chamber *a*, this overpressure being transmitted into chamber *b* through the flexible diaphragm 4. Consistent grease filling this chamber is delivered to the bearing 13 and stuffing box 14. The consumption of the consistent grease through the seal 5 exceeds the consumption of the protective fluid filling the electric motor. This, and the pressure of the column of fluid contained in the oil well upon the flexible container 15 of the surge chamber 2, as well as the flow of the protective fluid from this container into chamber *a* of the protector 3, results in gradual movement of the flexible diaphragm 4 to the walls of the body of the protector 3. As soon as all the grease is consumed from chamber *a*, water starts flowing in through the non-return valve 7.

The pipe 8 serves as a connecting valve when the diaphragm 4 bears against the walls of the body of the protector 3.

As the water enters chamber *b*, the latter serves as a settler separating the water from the oil, the oil moving upward to the bearing 13.

As the protective fluid flows gradually out of chamber *a* through the seal 5, the flexible diaphragm begins moving to its initial position owing to the inflow of the water through the valve 7 into chamber *b*. The changes in the volume of the protective fluid during starting and stopping of the drive are made up for by the flexible container 15 and the diaphragm 4.

If the surge chamber 2 has a piston 16 and spring 17 (FIG. 2) then, after the protective fluid becomes heated in operation, the piston moves to its downmost position. The pressure of the spring 17 on the piston 16 builds up an overpressure in the surge chamber-motor-protector system; this overpressure is transmitted via the flexible diaphragm 4 to the consistent grease, feeding it to the bearing 13. During this period, the changes in the volume of the protective fluid during stopping and starting of the drive are made up for by the movement of the piston 16 in the surge chamber 2.

As soon as the consistent grease is used up in chamber *b* of the protector 3, the diaphragm 4 will bear tightly against the walls of the body while the protective fluid will move from the space above the piston into chamber *a* of the protector. As it gradually seeps through the seal 5 into chamber *b*, the water flows in through the valve 7, forcing the diaphragm 4 from the walls of the body 3 to the initial position. During this period there is no overpressure in the drive and the changes in the volume of the protective fluid during starting and stopping of the drive are made up for by the diaphragm 4 and the piston 16 with the spring 17.

If the shaft 6 of the protector 3 (FIG. 3) supports the axial sliding support 18, the drive operates without any overpressure in the system since in this case chamber *b* is filled with the protective fluid with which the electric motor is also filled. As the protective fluid becomes gradually used up from chamber *b*, the fluid enters cham-

ber *a* from the flexible container of the surge chamber as described above. After the protective fluid leaves chamber *b*, the latter becomes filled with the water which settles there.

In describing the present embodiment of the invention specific narrow terminology has been used for the sake of clarity. However, the invention is not confined to the narrow sense of the terms used and it will be understood that each of said terms embraces all the equivalent elements functioning similarly and employed for the same purposes.

While a specific embodiment of the invention has been disclosed in the description, it will be understood that various modifications and changes within the spirit and scope of the invention may occur to those skilled in the art.

These changes and modifications can be resorted to without departing from the true idea or scope of the invention.

What is claimed is:

1. A drive for a submergible well pump, comprising a vertical, oil-filled electric motor; a surge chamber connected to the lower portion of the electric motor to compensate for variations in the volume of the protective oil in the electric motor; protector means coupled to said motor to prevent water from entering the same, said protector means being installed between said electric motor and pump and including: a casing, and an intermediate shaft concentrically disposed in said casing for driving connection with said electric motor and pump; means for packing the intermediate shaft; an elastic diaphragm disposed in said casing and dividing the latter, together with the packing means, into inner and outer chambers to be filled with protecting fluid; the inner chamber being connected with the interior of the electric motor, while the outer chamber does not communicate with the space of said electric motor.

2. A submergible oil-filled electric motor as claimed in claim 1, wherein the inner and outer chambers of the protector are filled with protective fluids of different viscosity, the inner chamber being filled with the same fluid as the electric motor.

3. A submergible oil-filled electric motor as claimed in claim 1, wherein the outer chamber of the protector is provided with an inlet valve adapted to provide communication between said chamber and the ambient environment, to admit water after the protective fluid from this chamber has been consumed.

4. A submergible oil-filled electric motor as claimed in claim 2, wherein said outer chamber of the protector is provided with an inlet valve adapted to provide communication between said chamber and the ambient environment to admit water after the protective fluid of greater viscosity has been consumed.

5. A submergible oil-filled electric motor as claimed in claim 2 comprising a wheel with blades mounted on said intermediate shaft to build up excessive pressure in the protector.

6. A submergible oil-filled electric motor as claimed in claim 4 comprising a wheel with blades mounted on said intermediate shaft to build up excessive pressure in the protector.

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