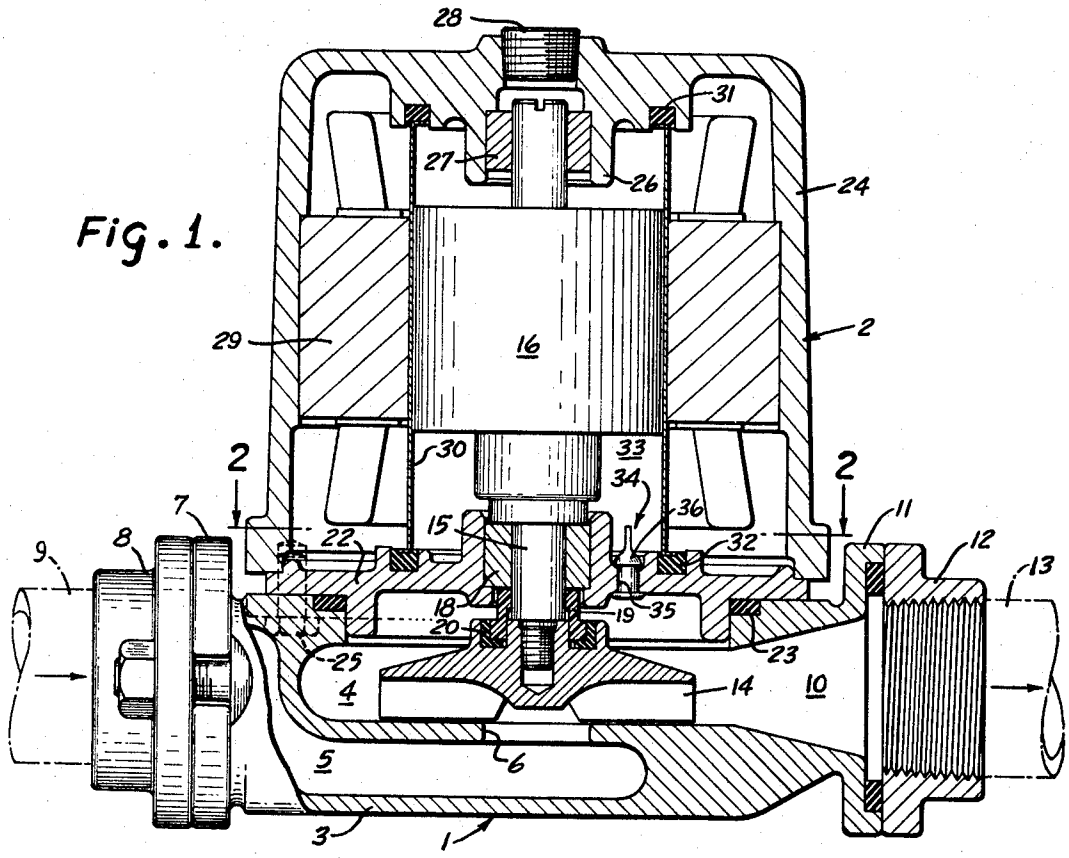
Aug. 6, 1968 G. GREBEL ET AL 3,395,644

MOTOR PUMP UNIT

Filed June 16, 1966

Fig. 1.



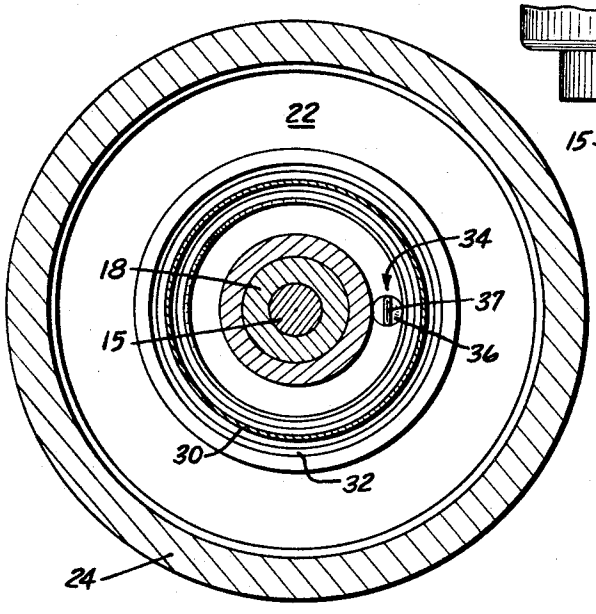


Fig. 2.

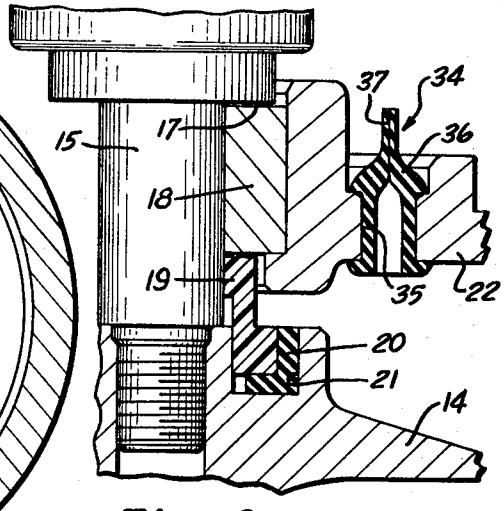


Fig. 3.

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MOTOR PUMP UNIT

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ABSTRACT OF THE DISCLOSURE

The invention relates to a motor-pump unit for use in a closed water pumping system which prevents the build-up of magnetite on the liner and other elements in the motor chamber. The unit includes a dynamic face-type seal for the rotor shaft in which the shaft is provided with a shoulder adapted to engage, and seal against, the inner end of the bearing during conditions of outward thrust. In addition, the impeller, which is carried by the shaft, is provided with a sealing ring and under conditions of inward thrust, the ring is adapted to bear against the outer end of the bearing to provide a seal.

Under non-operating, no-thrust conditions, the ends of the bearing are spaced from the respective sealing members so that small amounts of water can pass through the seal faces and along the shaft to make up for minute quantities of water lost from the rotor chamber due to leakage through static seals.

In addition, a check valve is provided between the rotor chamber and the pumping chamber and under conditions of continuous operation of the pump, the check valve permits the flow of small amounts of water from the pumping chamber to the rotor chamber to make up for leakage.

This invention relates to a motor-pump unit and more particularly to a motor-pump unit to be used in a hot water pumping system.

Two types of motor-pump units are commonly used in closed pumping systems. One type is generally referred to as a dry-motor type in which the motor is protected from the liquid being pumped by a mechanical seal or the like. The second type is a wet-motor type in which the stator and rotor of the motor are separated by a thin metal liner or shell and the liquid being pumped is circulated within the rotor chamber to lubricate the bearings as well as to cool the bearings and the motor itself.

In a hot water heating system, the water is normally circulated through a ferrous boiler and sometimes through ferrous pipes, hence the water contains iron oxide corrosion products. When the system is closed to the atmosphere, the amount of oxygen in the system is limited, and the iron oxide is primarily in the form of Fe_3O_4 or magnetite, which is attracted by magnetic fields. In the conventional wet-type, motor-pump unit, the magnetic particles of magnetite enter the rotor chamber and are attracted to the magnetic field of the motor, thereby depositing on the liner, rotor and bearings in the rotor chamber. The buildup of the magnetite particles on the liner and on other elements in the rotor chamber can eventually bind and stall the motor.

In the past, attempts have been made to prevent the buildup of magnetite on the elements within the rotor chamber, but these attempts have not met with great success. It has been proposed to employ a porous plug within an opening connecting the rotor chamber and the pumping chamber, with the purpose of the plug being to restrict the flow of magnetic particles into the rotor chamber. However, the porous plug permits the flow of liquid in both directions and due to temperature variations of the water within the rotor chamber, water flow will normally occur between the rotor chamber and the pumping chamber. The magnetite particles are very small in size and at least a portion of the magnetite particles will pass through a porous plug type of filter with the result that the magnetite will continue to build up on the liner. As an added problem, larger foreign particles will tend to accumulate on the surface of the porous plug and may eventually clog the plug.

The present invention is directed to a wet-type of motor for use in a closed water pumping system which prevents the buildup of magnetite on the liner and other elements in the rotor chamber.

According to the invention, the rotor chamber water is separated from the pumpage during the operation by a dynamic face-type fluid seal. Thus, the only magnetite in the rotor chamber is that contained in the water used for the initial filling of the rotor chamber and this amount of magnetite is very small. When the pump is operating, the rotor chamber is sealed. When the pump is not in operation, small amounts of water can pass through the seal faces to make up for minute quantities of water lost from the rotor chamber due to leakage through static seals. This amount of leakage is extremely small so that the buildup of magnetite in the liner or other elements of the rotor chamber is negligible. In systems where the pump is operated continuously, the characteristics of the invention are attained by use of a check valve. An opening is provided between the rotor chamber and pumping chamber and a check valve is located within the opening. The check valve permits the flow of water from the pumping chamber to the rotor chamber, but prevents the flow of water in the opposite direction. The rotor chamber is filled with water which is in a substantially static condition, and there is no appreciable flow of water through the check valve during ordinary operating conditions. As the only flow of water through the check valve into the rotor chamber will be the replacement of minute quantities of water lost from the rotor chamber due to leakage through the seals, there will be no appreciable buildup of magnetite on the liner or other elements in the rotor chamber. Moreover, the check valve will permit relatively large particles to pass therethrough and does not attempt to filter out foreign materials, with the result that there will be no clogging of the check valve after extended periods of use, as in the case of a porous plug or other filter element.

As the present invention reduces the buildup of magnetic particles within the rotor chamber, it substantially reduces the maintenance for a wet-type of motor unit which is to be employed in a hot water heating system.

Other objects and advantages will appear in the course of the following description.

The drawings illustrate the best mode presently contemplated of carrying out the invention.

In the drawings:

FIG. 1 is a longitudinal section of the motor-pump unit of the invention;

FIG. 2 is a view taken along line 2—2 of FIG. 1; and

FIG. 3 is an enlarged longitudinal section showing the motor shaft bearing, shaft seal and check valve in a non-operating condition of the pump.

The drawings illustrate a wet-type, motor-pump unit adapted to be used in a hot water heating system and the unit comprises a pump 1 which is driven by a motor 2.

The pump 1 includes an outer casing 3 which defines a pumping chamber 4. Water is introduced into the pumping chamber through an inlet passage 5 and opening 6 which connects passage 5 and the pumping chamber 4. Casing 3 is provided with a flange 7 bordering inlet passage 5, and flange 7 is bolted to a flanged fitting 8 having a threaded opening which receives an inlet pipe 9.

The casing 3 also defines a volute or discharge passage

10 which extends from the pumping chamber 4, and the casing is provided with a flange 11 bordering the outlet of passage 10. Flange 11 is connected to a flanged fitting 12 by a series of bolts and a discharge pipe 13 is threaded within the fitting 12.

Located within the pumping chamber 4 is a conventional impeller 14 which is driven by the motor shaft 15 attached to rotor 16. As best shown in FIG. 3, the rotor shaft 15 is provided with a shoulder 17 which bears against the upper end of bearing 18. The lower end of the bearing 18 rides against a ring 19 which is bonded to a rubber or resilient ring 20 fitted within a recess 21 in the upper end of the impeller 14. During operation of the motor, there is a downward thrust produced by the impeller which brings the shoulder 17 into bearing engagement with the upper end of bearing 18 to provide a mechanical shaft seal. If at any time the thrust is upward, the ring 19 bears against the lower end of the bearing 18 to similarly provide a shaft seal. If the pump is not operating, the bearing 18 will normally be spaced from both shoulder 17 and ring 19 and this spacing permits the liquid under line pressure to pass along shaft 15 to the rotor chamber, as will be described subsequently.

The bearing 18 is mounted within a recess formed in an adapter plate 22 which is sealed with respect to the pump casing 3 by an annular seal 23.

The motor 2 includes an outer casing 24 connected to the pump casing 3 by a series of bolts 25. The upper end of the motor casing 24 is formed with a downwardly extending annular ring 26 which serves as a mount or support for a bearing 27 that journals the upper end of the motor shaft 15.

Located centrally of the upper end of motor casing 24 is a vent hole which is enclosed by a threaded plug 28.

The stator 29 of motor 2 is separated from the rotor 16 by a thin metal liner or shell 30. The upper end of the liner 30 is sealed to the motor casing 24 by the annular seal 31, while the lower end of the liner 30 is sealed to the adapter plate 22 by seal 32.

With a wet-type of motor, the pumped liquid is circulated in the rotor chamber 33 and serves not only to lubricate the bearings but also to cool the bearings and the motor. In a hot water heating system where the supply of oxygen is limited the ferrous products of corrosion are not completely oxidized and exist primarily as Fe_3O_4 or magnetite which is magnetic in character. Thus, the magnetic particles of magnetite will be attracted to the magnetic field of the conventional wet-type motor and will be deposited on the liner as well as on other elements within the rotor chamber 33, and this accumulation of magnetite may bind and stall the motor. As the motor used in a conventional motor-pump unit for a hot water heating system generally has a low starting torque, the motor does not have the capability of spinning free from the binding accumulation of magnetite.

The present invention overcomes this problem which occurs in a conventional wet-type motor-pump unit, by separating the rotor chamber water from the pumpage by use of a dynamic seal. During operation of the pump, the thrust of the impeller closes the gap between the shaft shoulder 17 and the corresponding face of the bearing 18 to provide a seal and prevent the pumpage from entering the rotor chamber. When the pump is not operating, the ends of bearing 18 are spaced from the shoulder 17 and ring 19, respectively, to permit the pumpage under line pressure to pass along shaft 15 to rotor chamber 33.

In addition to the dynamic shaft seal, a check valve 34 is located in an opening 35 in the adapter plate 22. Check valve 34 permits the flow of liquid from the pumping chamber 4 into the rotor chamber 33 but prevents the flow of liquid in the opposite direction. The check valve 34, as shown in the drawings, is a flap-type formed of a resilient material, such as rubber, and having a tubular body 36 secured with opening 35. The upper end of the body 36 terminates in a crimped end or flap 37 which, under balanced pressure conditions, provides a closure. It is contemplated that other types of conventional check valves can be employed to control the flow of liquid through the opening 35.

While the drawings illustrate the use of a single check valve 34 to control the flow of liquid between the pumping chamber 4 and the rotor chamber 33, it is contemplated that a series of check valves can be employed if desired. Moreover, check valve 34 is shown as communicating with the discharge passage 10 of the pump. While this is a preferred construction, it is also possible to provide communication between the rotor chamber 33 and the inlet passage 5 or suction side of the pump, as there is sufficient pressure both on the inlet and discharge sides of the pump to force the water or other liquid through the check valve 34 to the rotor chamber 33.

At the start of operation, the rotor chamber 33 is filled with water by initially removing the vent plug 28 and starting the pump. Water will be forced from the discharge passage 10 through the check valve 34 into the rotor chamber 33 to fill the same and exhaust the air from the rotor chamber. When the rotor chamber has been filled with water, the vent plug 28 is replaced.

During operation of the pump, there will be no appreciable circulation of water between the pumping chamber 4 and the rotor chamber 33 due to the fact that a dynamic seal is formed between shaft face 17 and face of bearing 18 and the check valve 34 permits flow of water only in one direction. This prevents the water being pumped, which contains particles of magnetite, from entering the rotor chamber and therefore minimizes the accumulation of magnetite on the rotor elements. If a minute amount of water should leak from the rotor chamber through the vent plug 28 or shaft seal, this water is replaced by water being forced through the check valve into the rotor chamber. However, under normal conditions, the amount of water lost by leakage is of a minute quantity, so that only a very small amount of magnetite will be brought into the rotor chamber with the replacement water and will not cause an appreciable buildup of the liner 30 or other parts of the rotor.

The use of the valve 34 has distinct advantages over filters or porous plugs in that the check valve prevents the circulation of water between the rotor chamber and pumping chamber so that no appreciable quantities of magnetite will flow into the rotor chamber. However, the check valve 34 does permit the flow of small quantities of water into the rotor chamber to make up for water lost through leakage, so that the rotor chamber will be filled with water at all times. Moreover, as the check valve will permit particles of substantial size to pass therethrough, there is no danger of the check valve being clogged due to an accumulation of particles or foreign material. Thus, the invention enables the motor-pump unit to be operated for extended periods under trouble-free conditions with a minimum of maintenance.

As previously mentioned, during operation of the pump, shoulder 17 will be in bearing engagement with the upper end of the bearing 18 to provide a mechanical shaft seal, and if at any time the thrust is upward, the ring 19 will bear against the lower end of bearing 18 to similarly provide a mechanical shaft seal. When the pump is not operating, there is a sufficient space between the ends of bearing 18 and shoulder 17 and ring 19 to permit water under line pressure to pass along shaft 15 to rotor chamber 33. Thus, the bearing not only journals the shaft, but the ends of the bearing act to provide mechanical seals, and under non-operating conditions, the spacing is such that water can flow along the shaft, in cooperation with the flow through check valve 34, to rotor chamber 33.

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

We claim:

1. In a wet-type motor-pump assembly to be used in a closed pumping system, a motor unit having a housing defining a rotor chamber and a stator chamber and having means for sealing the rotor chamber from the stator chamber, said motor unit including a rotor and a rotatable shaft connected to the rotor and extending outwardly of said rotor chamber, a casing defining a pumping chamber and having an opening to receive said shaft, an impeller located within the pumping chamber and secured to the shaft and disposed to rotate with the shaft, a bearing mounted in the casing and disposed to journal said shaft for rotation, said bearing having a generally flat outer end facing said impeller and having a generally flat inner end facing said motor unit, a first abutment on the shaft and having a bearing surface facing the inner end of the bearing, and a second abutment on the shaft and having a bearing surface facing the outer end of said bearing, the bearing having an axial length such that the ends of said bearing are spaced from the corresponding bearing surfaces when the pump is not operating to permit the pumpage to flow under line pressure along the shaft to the rotor chamber, during operation of the pump one of said ends being in engagement with the corresponding bearing surface to provide a dynamic shaft seal and prevent the flow of pumpage to the rotor chamber.

2. The motor-pump assembly of claim 1, and including conduit means providing communication between the rotor chamber and the pumping chamber, and check valve means disposed within said conduit means for permitting the flow of pumpage from the pumping chamber to the rotor chamber but preventing flow in the opposite direction.

3. The motor-pump assembly of claim 2 in which said conduit means communicates with the discharge side of the pumping chamber.

4. The motor-pump assembly of claim 1, in which said check valve means is a resilient member having an end facing said rotor chamber which under balanced pressure conditions is normally biased closed.

5. In a motor-pump assembly, a casing defining a rotor chamber and a pumping chamber and having a wall separating said rotor chamber from said pumping chamber, a motor unit disposed within the casing and including a rotor disposed within the rotor chamber and a shaft member connected to the rotor and extending through an opening in said wall, a bearing disposed within said opening for journalling said shaft member for rotation, an impeller member secured to said shaft member and disposed within said pumping chamber, a first abutment on said shaft member and having a bearing surface facing the inner end of said bearing, a second abutment on one of said members and having a bearing surface facing the outer end of said bearing, said bearing having an axial length less than the distance between said first and second abutments so that the ends of said bearing are spaced from the corresponding bearing surfaces when the pump is not operating to permit liquid to flow under line pressure from said pumping chamber along the shaft member to the rotor chamber, one of said ends of the bearing being in engagement with the corresponding bearing surface when the pump is operating to provide a dynamic shaft seal and prevent the flow of liquid from the pumping chamber to the rotor chamber, conduit means disposed within the wall and providing communication between the rotor chamber and said pumping chamber, and check valve means located within said conduit means for permitting flow of liquid from the pumping chamber to the rotor chamber but preventing flow of said liquid in the opposite direction.

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