May 9, 1950

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2,506,827

CENTRIFUGAL TURBINE PUMP

Filed March 15, 1948

2 Sheets-Sheet 1

Fig. 1.

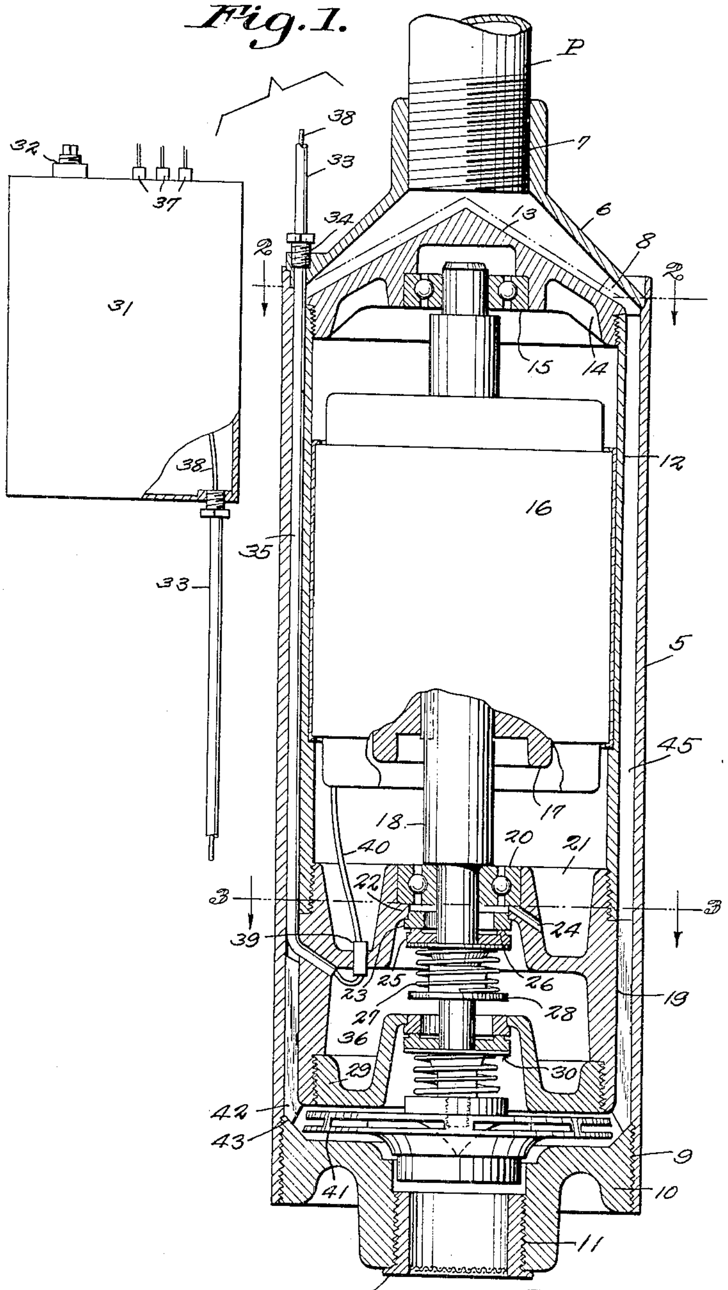

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Fig. 2.

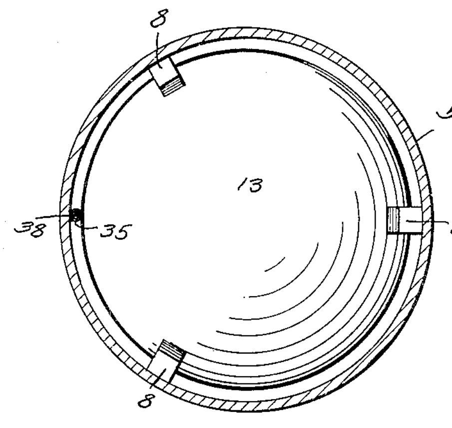
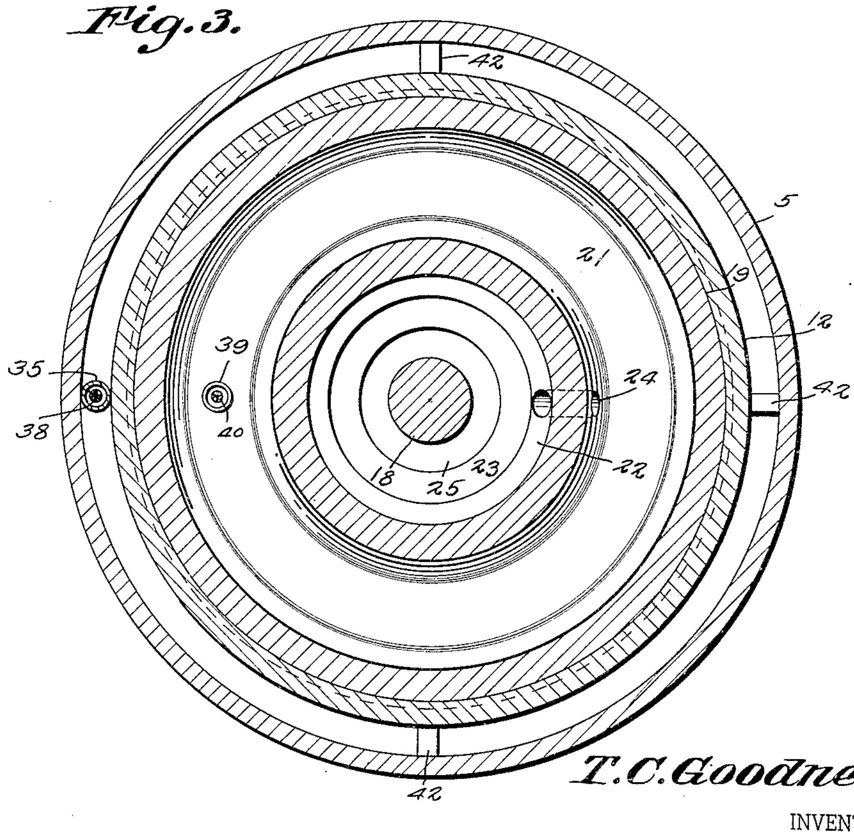


Fig. 3.



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UNITED STATES PATENT OFFICE

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CENTRIFUGAL TURBINE PUMP

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Application March 15, 1948, Serial No. 14,881

4 Claims. (Cl. 103—87)

1

This invention relates to a pump unit which can in general be described as a close-coupled motor pump designed particularly, though not necessarily, for submersible use.

The general object of the present invention is to provide a pump of the type described which, by reason of the novel assembly and arrangement of its component parts, will improve generally upon the construction and operation of similar pumps previously devised.

Some specific objects of the invention are to provide a pump that will be of simple design, with few parts; which will be of minimum outside diameter so as to be easily installed in small diameter well casings; will be capable of easy assembly at time of manufacture; will be deliverable to a purchaser as a packaged unit readily capable of installation without need of skilled help; will be operable cheaply and with minimum maintenance; and will be very durable despite its relatively low cost.

Briefly, the invention comprises a cylindrical outer casing; an inner assembly which as a single unit is insertable in the outer casing or shell, the inner assembly comprising a sealed motor casing in which runs a motor within an air or gas-filled space, a pump chamber, and a lubricating chamber between the motor casing and pump chamber equipped with a double seal and remotely controlled; and remote means for controlling pressure of a lubricating medium in the lubricating chamber and for supplying power to the motor.

With the foregoing and other objects in view which will appear as the description proceeds, the invention consists of certain novel details of construction and combinations of parts, hereinafter more fully described and pointed out in the claims, it being understood that changes may be made in the construction and arrangement of parts without departing from the spirit of the invention as claimed.

Referring to the drawings

Figure 1 is a longitudinal section through the device, parts remaining in elevation, and other parts being broken away.

Figure 2 is a section taken substantially on line 2—2 of Figure 1.

Figure 3 is an enlarged section taken substantially on line 3—3 of Figure 1.

Referring to the drawings in detail, 5 is a cylindrical outer casing substantially smooth-walled both inside and out. To the upper end of the outer casing is secured the generally conical head 6 centrally formed with an internally threaded discharge port 7 receiving the discharge

2

pipe P, that is not part of the present invention. Discharge pipe P would normally, though not necessarily, serve as support for the pump assembly.

Aligning bosses 8 (Figures 1 and 2) are rigidly secured to the inner surface of head 6 and serve as abutments and aligning means for the upper end of an inner assembly insertable in the outer casing, and which will be described in detail hereinafter.

The lower end of the outer casing 5 is threaded as at 9 to receive an inlet cover 10 having a central opening 11.

The parts so far described constitute an outer casing or shell assembly, in which is insertable the unitary inner assembly, which will now be described.

This includes a cylindrical motor casing 12 threaded at both ends, and of a diameter sufficiently smaller as compared to that of the outer casing as to define an annular passage for pumped liquid. Threaded into the upper end of the motor casing is a conical head that constitutes a motor cover and a bearing support. The aligning bosses 8 could, as readily seen, be cast integral with motor cover 13, as a construction alternative to that described above. The motor cover is designated 13, and the marginal portion of its inner surface is preferably formed with a plurality of radial cooling fins 14. A life-time lubricated bearing 15 is mounted centrally in the head, and constitutes a journal for one end of the motor shaft.

Seated in the motor chamber defined by the motor casing 12 is an electric motor that includes a stator 16 and a rotor 17 to which is keyed the motor shaft 18.

Closing the lower end of the motor chamber is a lower bearing support 19 which is threaded into the lower end of the motor casing, and which supports centrally a bearing 20 similar to the upper bearing 15. Shaft 18 extends downwardly through the bearing 20. The bearing support 19 is cast with an annular catch basin 21.

The inner wall of the central opening of the bearing support 19 has cast on it an annular seat 22 on the top of which is seated the lower bearing 20. Fitted into this seat and slightly spaced from the bearing 20 is a seal member 23. A seep oil passage 24 provided in the wall of the central opening and extending away from the space between bearing 20 and seal member 23, extends into the catch basin 21.

The seal member 23 comprises one part of a mechanical seal that also includes another seal member 25 which is normally pressed against the seal member 23 so that the seal faces of the two members are in tight engagement as at 26. This sealing engagement is maintained by spring 27 that is also part of the seal assembly and which is held under compression between the seal member 25 and a seal assembly collar 28 secured, as by threading, to the shaft 18.

As readily seen from Figure 1, the support 19 additionally defines the side wall of a lubricating chamber the lower end of which is closed by a seal plate 29 threadedly connected to the support 19. This also has a central opening through which shaft 18 extends, and in which opening is fitted a seal generally designated at 30 and of identical formation with the seal already described. It may be noted at this point that both the upper and lower seal are similarly positioned, that is the spring in each case presses one seal member upwardly against the other seal member.

However, the distinction is to be noted, as to the upper and lower seal, that the upper seal is disposed within the lubricating chamber previously mentioned, while the lower seal is disposed within the pump or impeller chamber.

It is understood that a device of this character will most generally be mounted within a well casing, and will be submerged. In this connection, I provide an oil reservoir 31 which would most usually be disposed remote from the rest of the device, as on the ground surface. This has a filler plug 32, and extending from the reservoir is an oil supply tube 33 which is coupled at the upper end of the outer casing, as at 34 so as to communicate with a tube 35 downwardly extended between the outer casing and motor casing, and feeding into the lubricating compartment or chamber 36. Coupling 34 should be packed to prevent leakage.

Power terminals 37 may be mounted on the reservoir 31, and from these extend leads 38 which can be extended directly through the oil tube 33 if desired. Leads 38 extend through an insulated bushing 39 mounted in the support 19, and supply power to the motor through motor leads 40. These leads might be of suitable type supplied externally of the oil tube and connecting into the motor through conical head 6 of outer shell and motor cover 13 by sealed means.

The lower end of the shaft 18 extends downwardly into the pump chamber, and has secured to it the impeller 41.

Diffusion vanes 42 are secured to the outer surface of the support 19, in a radial arrangement, as best seen from Figure 3. It may be noted in this regard that the tube 35 is aligned longitudinally with one of these vanes, so that the tube assists in proper channeling of pumped fluid, and in any event, does not interfere with the desired path which the fluid takes in being led to the discharge pipe P.

The diffusion vanes are so formed at their lower ends as to engage the marginal portion of the inlet cover 10 as shown at 43, and additionally, the vanes have a snug fit against the inner wall of the outer casing 5 when the inner assembly of the device is mounted in the outer casing.

If desired a strainer 44 can be secured within the opening 11 of the inlet cover. Also, a suction pipe, not shown, might be attached to the inlet cover.

When the parts are assembled as in Figure 1, it will be seen that a fluid passage 45 is defined between the outer casing 5 and the inner assembly. This passage is free of obstructions which might otherwise tend to deflect the fluid as it passes through the structure.

In assembling the pump, the inner assembly comprising the motor casing and parts contained therein, support 19 and parts contained therein, the impeller, and the tube 35, and additionally, the diffusion vanes 42, is assembled during manufacture remote from the outer casing and associated parts. Then, to complete assembly of the pump, it is necessary only to insert the remotely assembled inner portions as a unit inside the outer shell. In doing so, the aligning bosses 8 constitute an abutment and aligning means for one end of the inner assembly. Additionally, as the unit is inserted, the diffusion vanes 42 also constitute an aligning means for the other end. Then, it is necessary only to thread inlet cover 10 into the outer casing 5, and this will engage the lower ends of the diffusion vanes, and will support the entire inner assembly within the outer shell.

To mount the complete structure within a well, it is necessary only to thread the discharge pipe P into the head 6, and couple tube 33 to the tube 35. Then, the entire device may be submerged, and controlled remotely in a manner which will now be described.

In describing the control and operation of my device, there should first be noted the fact that the motor chamber is designed to be sealed. In assembling the inner parts of the structure, I enclose the motor in a space, the motor chamber, that is filled with a compressible medium such as air, gas, or vapor. No attempt is made, during the assembly, to compress this medium prior to sealing the motor chamber, and it is important only to note that the medium is one which is compressible. In this way, turbulence and frictional losses are at a minimum, and this contributes to efficiency and lower maintenance, and permits use of a motor rotor and stator of standard design carried on standard life-time lubricated ball bearings.

The lubricating compartment 36, however, is filled with a lubricating medium such as oil, that is contained in the reservoir 31. This compartment is not for the purpose of lubricating the impeller, or the upper or lower shaft bearings. It is, rather, for the purpose of lubricating and keeping free from abrasive substances the upper and lower seals. The lower seal 30, which is positioned externally of the lubricating compartment is so arranged that any pressure in the pump chamber is additive to the pressure of the spring of this seal, and thus the pressure in the pump compartment forces the seal faces of the lower seal all the more tightly together, thus reducing seepage through these faces.

However, if there is a build-up of pressure within the lubricating compartment 36, this would be subtractive of the spring pressure of the lower seal. In this way, I spread the seal faces of the lower or external seal to a slight degree, thereby forcing passage through the seal faces of any water or abrasives contained within the compartment 36. Such water or abrasives will tend, in devices of this type, to seep into the compartment 36 over a period of time, and naturally, these abrasives tend to destroy the effectiveness of the seal. By building up the pressure within the lubricating compartment 36, it becomes possible not only to flush the water and abrasives out and into the pump chamber, thereby flushing the seal faces free of any abrasive or foreign matter, but also, such increase in pressure will additionally force lubricant between the seal faces of the lower seal **30**.

As to the upper seal that is disposed within the lubricating compartment, it will be seen that this internal seal is so positioned that an increase in pressure in the lubricating compartment is additive to the pressure of its spring, thereby forcing the seal faces of the internal seal more tightly together and further tending to prohibit seepage through this seal. Any oil which might seep through this seal will move through passage **24** to the catch basin **21** which is of a size consistent with requirements.

The building up of pressure within the lubricating compartment **36** is readily accomplished by such means as a small pump, not shown, which can be manually or automatically operated and applied to reservoir **31**.

I believe it is further worthy of note that since the motor chamber is filled with a compressible medium, any seepage of oil into the catch basin **21** tends to compress this medium, so that a counteracting pressure is built up within the motor chamber, which pressure would tend as time goes on to retard such seepage.

Additionally, for a fuller understanding of the operation of the device, I believe it should be pointed out that the upper and lower seals are both in like positions, and thus seal against flow or bypass from the pump compartment into the motor compartment any fluid being pumped, regardless of the pressure exerted by said fluid in passing through the structure.

To be noted also is the fact that while I have described the compressible medium within the motor chamber as not being compressed at the time of assembly of the parts, yet I believe it is within the spirit of the invention to compress this medium during assembly in desired degree before sealing the motor chamber. It is not critical to the invention that the medium be so compressed, and yet, if this is done, this initially applied air or gas pressure could tend to counteract a portion of the pressure of the lubricating compartment **36**, so as to further retard seepage of oil through the internal seal.

In any event, it is a part of the invention that the motor operates in a dry gas atmosphere so as to reduce turbulence and frictional losses to a minimum.

In operation, the structure, by reason of its design, cools the motor by means of the passage of the fluid being pumped and passing between the spaced apart walls of the motor casing and outer casing. Additionally, and accompanying the dissipation of heat from the motor through the casing and into the pump liquid, there is a further dissipation of heat through the medium of air within the motor circulating through the cooling fin area.

A singular feature of the pump is the fact that by pressure lubrication of the seals, the pump is particularly adapted for the pumping of water or other liquids that are very dirty or contain a high percentage of abrasives without cause for concern about seal wear and the rapid failure of these parts, permitting entry of damaging liquids into the motor area.

What is claimed is:

1. In a motor pump, an outer shell, an inner assembly including a motor casing spaced from the outer shell to define a passage for pumped liquid, a motor cover on one end of the motor casing, a support on the other end of the motor casing, said cover, support, and motor casing defining a motor chamber, a motor within said chamber, a shaft on the motor and journaled in the cover and support respectively, a seal plate secured to and spaced from the support, said support and seal plate being adapted to define a fluid chamber below the motor chamber, the seal plate and one end of the outer shell being adapted to define a pump chamber in communication with the passage for pumped fluid, one end of the shaft being extended into the pump chamber, seals at the upper and lower ends of the fluid chamber, and means for controlled variation of fluid pressure within the fluid chamber to control the engagement of the seal faces of the respective seals, said means including a fluid tank remote from and supplying the fluid chamber and adapted for the controlled application of pressure to the tank contents.

2. In a pump, an outer shell, aligning bosses at one end thereof, and an inner assembly adapted for assembly remote from the outer shell prior to insertion therein as a unit, said inner assembly including a motor casing, a cover on one end thereof adapted for engagement with the aligning bosses, a support secured to the other end of the casing, radial diffusion vanes on the support, said diffusion vanes constituting a means for spacing the inner assembly from the outer shell and for aligning the inner assembly within the outer shell, and means at the other end of the outer shell adapted to engage the diffusion vanes to support the inner assembly within the outer shell.

3. In a motor pump, a cylindrical outer casing, a ported discharge head at one end of the outer casing, a ported inlet cover removably connected to the other end of the casing, a motor casing within and spaced from the outer casing and defining in cooperation therewith an annular passage for pump liquid, a motor cover on one end of the motor casing, a support connected to the other end of the motor casing, a motor within the motor casing, a shaft on the motor and journaled in the motor cover and support respectively, a seal plate connected to the support and defining in cooperation therewith a compartment for lubricating fluid, said seal plate being spaced from the inlet cover to define in cooperation therewith a pump chamber, the shaft extending into the pump chamber, seals at the ends of the compartment for fluid and surrounding the shaft, an impeller on the shaft and within the pump chamber, means cooperating between the outer shell and the motor cover and support respectively for aligning inner portions of the pump within the outer shell and for permitting assembly of said inner portions as a unit prior to insertion in the outer shell, means remote from the pump adapted to retain the fluid compartment filled and to direct pressure against fluid contained in said compartment, whereby to control the sealing action of the seals.

4. In a submersible pump a hollow casing, spaced transverse partitions therein defining a motor chamber and a pump chamber at opposite ends of the casing and a liquid chamber between said motor and pump chambers, said partitions each having an opening, a seal normally closing the opening in the partition separating the motor and liquid chambers and positioned to open only when the pressure within the motor chamber exceeds the pressure within the liquid chamber, a second seal normally closing the opening in the partition separating the liquid

chamber from the pump chamber and positioned to open only when pressure within the liquid chamber exceeds pressure within the pump chamber, a liquid filling the liquid chamber, a tank remote from said casing and holding a reserve supply of liquid, a conduit communicating between said tank and liquid chamber, and said tank adapted for the controlled application of pressure to its contents, to keep the liquid chamber filled and to apply hydraulic force to the contents of the liquid chamber for controlled change of the pressure within said liquid chamber.

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