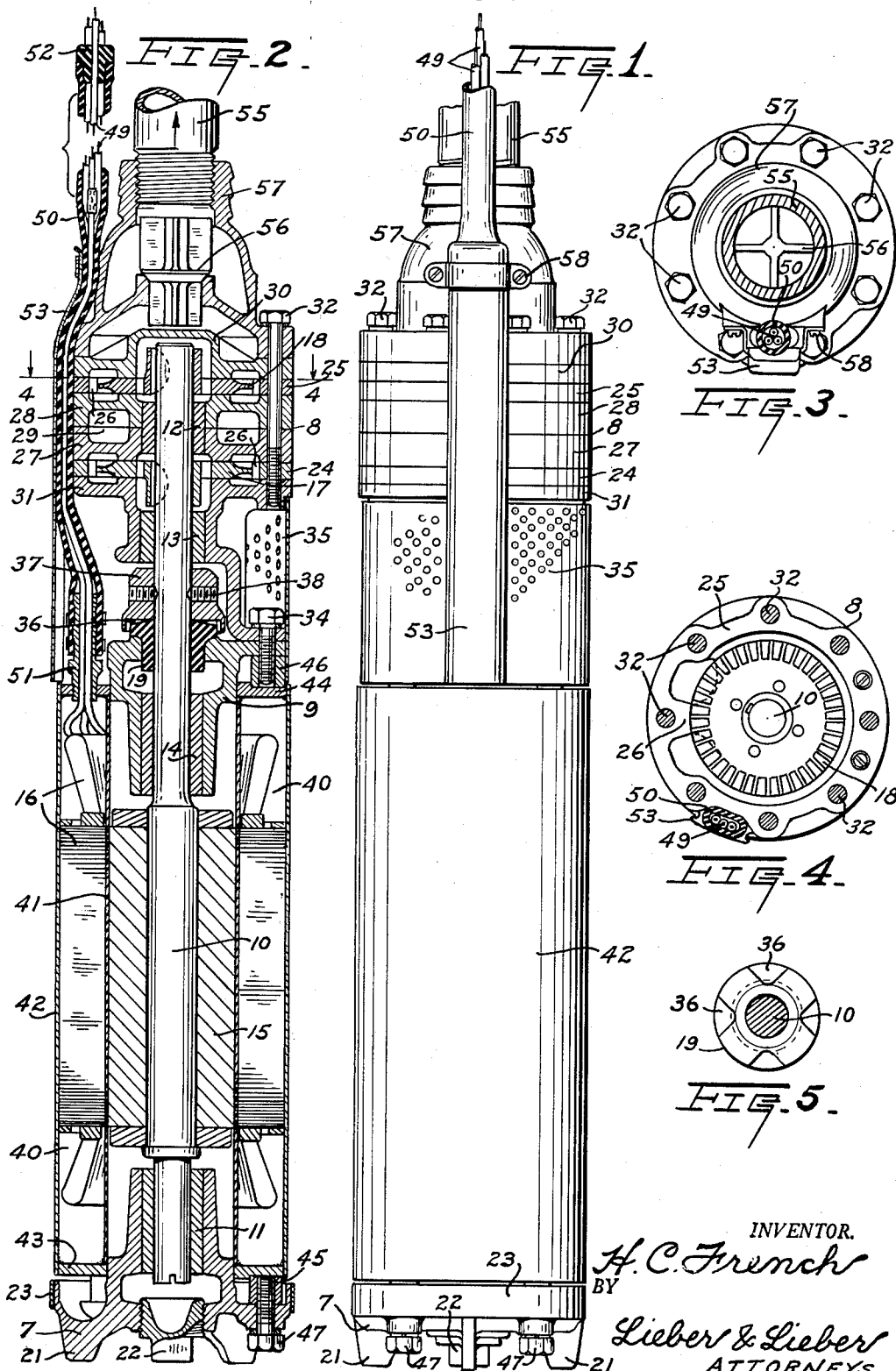


Nov. 8, 1955

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SUBMERGED LIQUID PUMP

2,722,892

Filed July 9, 1952



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2,722,892

SUBMERGED LIQUID PUMP

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Application July 9, 1952, Serial No. 297,854

2 Claims. (Cl. 103—87)

The present invention relates in general to improvements in the construction and operation of submersible rotary liquid pumps, and is a continuation in part of my copending application Serial No. 190,709, filed October 18, 1950, now abandoned.

The main object of my invention is to provide various improvements in submerged rotary liquid pumps, whereby the construction and installation thereof is facilitated, while the operating efficiency is enhanced to a maximum.

An important object of the invention is to provide a simple, durable and compact electric motor driven liquid pumping unit especially adapted to be submerged within the source of liquid supply.

Another important object of this invention is to provide an efficient motor driven pump assembly in which the various parts are well protected against excessive wear or other damage during normal operation; and wherein these parts may be readily manufactured, assembled, or dismantled.

A further important object of my present invention is to provide an improved rotary liquid pumping device comprising relatively few simple parts which can be easily machined and united to produce a well balanced structure.

Still another important object of the invention is to provide a high speed rotary motor driven pump of limited dimensions and free from external projections, thus adapting it for convenient insertion or removal with respect to wells of small diameter and of varying depths.

An additional important object of the present invention is to provide a self cooled motor driven pump unit having ample and well protected bearings, and which is operable for long periods of time with minimum attention and at moderate cost.

Another important object of this invention is to provide various improvements in pumps of the type shown and described in my copending application above referred to, whereby the motor parts and bearings of such units are more thoroughly protected and obstruction to flow of the liquid is minimized.

These and other more specific objects and advantages of the invention will be apparent from the following description.

A clear conception of the present improvements and of the construction and operation of a typical motor propelled pumping unit embodying the invention, may be had by referring to the drawing accompanying and forming a part of this specification in which like reference characters designate the same or similar parts in the various views.

Fig. 1 is an outside view of one of the improved electric motor driven two stage rotary pumps with the upper portion of the tube for confining the motor energizing wires omitted;

Fig. 2 is a central vertical longitudinal section through the same unit, taken at right angles relative to the view of Fig. 1;

Fig. 3 is a top view of the same assemblage, a trans-

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verse section having been taken through the upper liquid discharge pipe;

Fig. 4 is a transverse section through the pumping unit, taken along the line 4—4 of Fig. 2; and

Fig. 5 is a top view of the self-cleaning thrust bearing for the main shaft and which is located in the pump intake space.

While the invention has been illustrated and described herein as being advantageously applicable to a submersible two stage rotary electric motor driven water pump of a specific type, it is not my desire or intention to unnecessarily restrict the use of all of the improved features by virtue of this limited showing, and it is also contemplated that specific descriptive terms employed herein be given the broadest possible interpretation consistent with the disclosure.

Referring to the drawing, the improved submersible electric motor propelled liquid pump illustrated therein comprises in general, a main frame including a lower base section 7, an upper composite section 8, and an intermediate bearing section 9; a single continuous shaft 10 rotatable in axially aligned guide bearings 11, 12, 13, 14 mounted in the frame sections 7, 8, 9 respectively, and also being supported by a thrust bearing 19 carried by the intermediate section 9; an electric motor rotor 15 secured to the shaft 10 between the guide bearings 11, 14 and being located centrally within a stationary field 16; and a pair of rotary pump impellers 17, 18 also secured to the unitary shaft 10 within the upper frame section 8 on opposite sides of the uppermost bearing 12.

The lower or base section 7 of the frame within which the guide bearing 11 is confined, may be provided with supporting pads 21 and with a central removable plug 22 for permitting free access to the bearing 11 and to the lower end of the shaft 10, and the section 7 is preferably embraced by a protective guard ring 23, as shown in Figs. 1 and 2. The upper composite frame section 8 comprises a pair of pump impeller housing rings 24, 25 each having thereon an inwardly extending radial projection 26; an adjoining pair of casings 27, 28, located between the rings 24, 25 and coacting with each other to form an annular manifold chamber 29 communicable with the impellers 17, 18; an upper discharge head 30 for the high pressure pump impeller 18; and a lower inlet head 31 for the low pressure pump impeller 17. The guide bearing 12 is mounted in the manifold casings 27, 28, while the guide bearing 13 is likewise mounted in the pump inlet head 31, and all of these pump housing elements constituting the upper frame section 8 of the unit are normally firmly but detachably and adjustably united by cap screws 32 or the like.

The intermediate or thrust bearing section 9 of the main frame, and within which the guide bearing 14 and the thrust bearing 19 are mounted, is also normally firmly but detachably secured to the lower end head 31 of the pump by other cap screws 34, and both the end head 31 and the frame section 9 are surrounded by an annular liquid inlet screen 35 of approximately the same external diameter as that of the pump casing, see Figs. 1 and 2. The thrust bearing 19 which is exposed to the liquid centering the pump, is formed of special wear resisting material and with radial indentations 36 as illustrated in Fig. 5, and coacts with a thrust collar 37 secured to the shaft 10 by screws 38 as shown in Fig. 2. This special formation of the thrust bearing 19 acts as a spinner and tends to prevent sand and other gritty substances from lodging thereon. The peripheral skirt depending from collar 37 also serves to prevent deposit of silt and the like on the thrust bearing. Since no effort is made to seal the bearings leakage will take place and, as a result, all of the bearings 11, 12, 13, 14 and 19 are normally exposed to and are lubricated by the fresh liquid within

which the unit is submerged. The thrust bearing shown serves as a shaft seal also and prevents constant changing of the water around the rotor and therefore prevents silt from accumulating on the rotor.

While the rotor 15 of the propelling motor is also exposed to the submerging liquid, the motor stator or field 16 is not thus exposed and must be protected against exposure to water which may have objectionable particles therein. The stator field 16 is therefore sealed within an annular space 40 which may be filled with pure insulating material such as oil, and which is formed by inner and outer concentric thin-walled tubes 41, 42 welded or otherwise sealingly secured to lower and upper rings 43, 44 having threaded lugs 45, 46 respectively, firmly secured thereto, see Fig. 2. These tubes 41, 42 are preferably formed of thin non-magnetic and non-corrosive sheet metal such as stainless steel, and the inner tube 41 loosely embraces the motor rotor 15, while the outer tube 42 has approximately the same external diameter as that of the screen 35 and of the guard ring 23 of the lower frame section 7. The frame section 7 is normally rigidly attached to the lower lugs 45 by cap screws 47 while the cap screws 34 which fasten the pump casing to the intermediate frame section 9 also firmly secure this section 9 to the upper lugs 46, thus firmly uniting the successive parts of the unit all of which have substantially like external diameters.

Since the material within the space 40 is subject to some expansion and contraction, or breathing, and current conductors 49 for energizing the electric motor must also be connected to the field windings, it is necessary to provide means for permitting such breathing and for leading the conductors into the space 40 without permitting water to enter the latter. This important feature of the present invention is accomplished by providing an elongated flexible water-proof tube or conduit 50 the lower end of which is sealingly attached to the upper seal ring 44 by a water-tight fitting 51 and the upper end of which is sealed by a plug 52, and through which the conductors 49 extend. The lower portions of this tubular conduit 50 may be held close to the frame section 8 and protected by a U-shaped guard plate 53, and the conduit 50 should be of sufficient length to extend well above the level of the liquid within which the pump is submerged.

In order to complete the assemblage and to permit the assembled motor propelled pump unit to be readily installed and submerged within a source of liquid supply such as a well of limited diameter, the vertical pump outlet or discharge pipe 55 is secured to and is communicable past a non-return check valve 56, with a liquid outlet cap 57 which is also firmly secured to the pump housing frame section 8 by the clamping screws 32. This cap 57 is dome shaped as shown in Figs. 2 and 3, and also has an external diameter approximately equal to that of the pump housing; and the conductor conduit guard plate 53 may be attached to the cap 57 by screws 58. The rigid liquid discharge pipe 55 thus serves as an effective means for installing or removing the unit and for normally suspending it in a source of liquid supply, and this pipe may be of any suitable length and diameter.

The details of construction and the mode of assembling and of adjusting the improved two stage pump constitute the subject of my copending application Serial No. 190,709, filed October 18, 1950, now abandoned, and therefore will not be repeated herein. However, when the improved rotary electric motor driven pumping unit has been properly constructed and assembled as hereinabove described, and the upper suspension cap 57 has been attached to a discharge pipe 55, the latter may be readily utilized to lower and to submerge the motor and pump within a well or other source of liquid supply from which water is to be pumped. The electric motor may then be operated at will by actuating a control switch associated with the conductors 49 beyond the upper end of the con-

duit 50, thereby causing the motor rotor 15 to rotate the shaft 10 and the pump impellers 17, 18 at high speed. Liquid will then flow through the screen 35 and will pass through the impeller 17, manifold chamber 29, and impeller 18 in succession, and will be delivered past the check valve 56 and into the outlet pipe 55 at relatively high pressure and in the form of a constant stream.

Whenever the motor is stopped, the valve 56 will close automatically and the pipe 55 will thus be maintained filled with liquid. All of the bearings 11, 12, 13, 14, 19 being constantly submerged in the liquid, are effectively lubricated and cooled, and the improved construction of the thrust bearing 19 prevents solid matter from lodging thereon or on the rotor. The formation of the pump is also such that the pressures acting upon the impellers 17, 18 are balanced thus relieving the thrust bearing 19 from excess pressure other than the weight of the rotary elements. The insulating material confined within the chamber 40 in which the motor field 16 is housed, will be cooled by the liquid surrounding the casing tube 42, but the chamber 40 will always be sealed against possible entry of water, by the tubes 40, 41, end disks 43, 44, fitting 51, and by the riser conduit 50.

The several frame and casing sections of the unit, all having approximately the same relatively small external diameter and being substantially devoid of external projections, make it possible to easily lower the unit into a well of small diameter and to likewise remove the same, without obstruction. The several parts of the pump may also be assembled or dismantled by manipulating only a few screws, and access to the lower guide bearing 11 for inspection or removal of sediment may be gained by withdrawal of the plug 22. The formation of the stator casing with rigidly attached lugs 45, 46 with which the cap screws 47, 34 coact, provides simple means for uniting the lower and intermediate frame sections 7, 9 in perfect axial alinement, and the longer cap screws 32 also serve to effectively unite the pump housing section 8 with the intermediate frame section 8 and with the discharge cap 57.

From the foregoing description of the construction and operation of the improved motor driven unit, it will be apparent that the present invention provides a submersible high speed deep well pump assembly which besides being simple and compact in structure may also be quickly and conveniently installed in liquid supply sources of limited dimensions. The improved motor and pump housing is composed of parts which may be readily machined and assembled or dismantled, and which normally effectively conceal and protect the more delicate parts of the unit. The breathing seal for the motor stator including the riser conduit 50, is especially important and positively prevents objectionable foreign matter from entering the chamber 40, and all parts of the device are normally cooled by the liquid in the source of supply. The invention has proven highly satisfactory and successful in actual use, and the pumps while being especially adapted for deep well service may be used for other purposes as well.

It should be understood that it is not desired to limit this invention to the exact details of construction and operation of the motor driven two-stage submersible pumping unit herein specifically shown and described, for various modifications within the scope of the appended claims may occur to persons skilled in the art.

I claim:

1. A submersible pump comprising, an elongated assembly, an electric motor in the lower portion of the assembly, a pump in the upper portion of the assembly, a water intake between the pump and the motor, means sealing the motor stator against entrance of water, a shaft in said assembly, the motor rotor being mounted on the shaft, the pump impeller being mounted on the shaft, said rotor being submerged in water and lubricated by the water, a thrust bearing and seal unit be-

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tween said intake and said motor to support the shaft and to prevent interchange of water in the rotor, said unit including a bearing member fixed in said assembly and having a bearing surface surrounding the shaft and an annular bearing surface facing upwardly, a bearing collar fixed on the shaft and having an annular bearing surface overlying and in contact with said annular bearing surface on said bearing member, one of said annular bearing surfaces being radially grooved to provide an outwardly diverging space between the annular bearing surfaces.

2. A submersible pump comprising, an elongated assembly, an electric motor in the lower portion of the assembly, a pump in the upper portion of the assembly, a water intake between the pump and the motor, means sealing the motor stator against entrance of water, a shaft in said assembly, the motor rotor being mounted on the shaft, the pump impeller being mounted on the shaft, said rotor being submerged in water and lubricated by the water, a thrust bearing and seal unit between said intake and said motor to support the shaft and to prevent interchange of water in the rotor, said unit including a bearing member fixed in said assembly and hav-

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ing a bearing surface surrounding the shaft and an annular bearing surface facing upwardly, a bearing collar fixed on the shaft and having an annular bearing surface overlying and in contact with said annular bearing surface on said bearing member, said collar being provided with a depending peripheral skirt which projects downwardly past the level of said annular bearing surface of said bearing member, and one of said annular bearing surfaces being radially grooved to provide an outwardly diverging space between the annular bearing surfaces.

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