April 1, 1941. A. ARUTUNOFF 2,236,887

SUBMERGIBLE DEEP WELL PUMP

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Fig. 1.

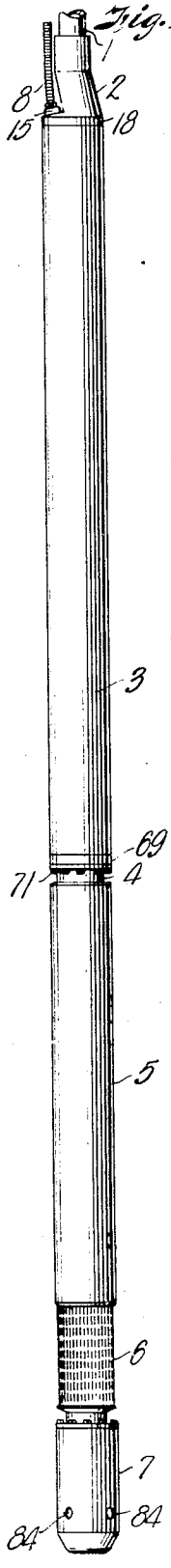


Fig. 2.

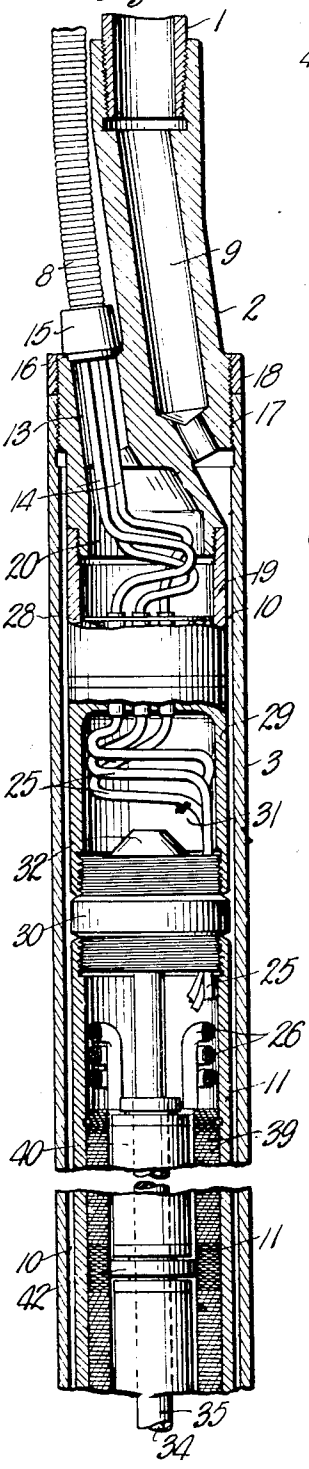


Fig. 3.

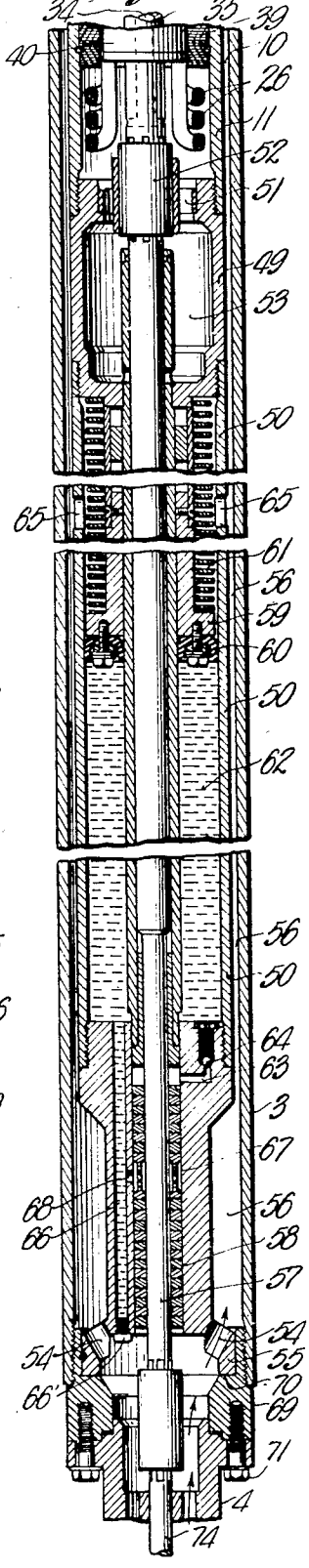
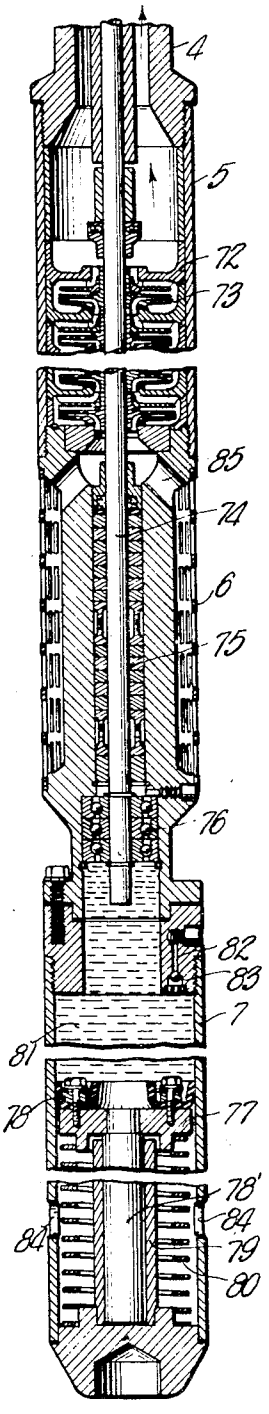


Fig. 4.



INVENTOR
Armais Arutunoff
BY Thos. E. Scofield
ATTORNEY

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Fig. 5.

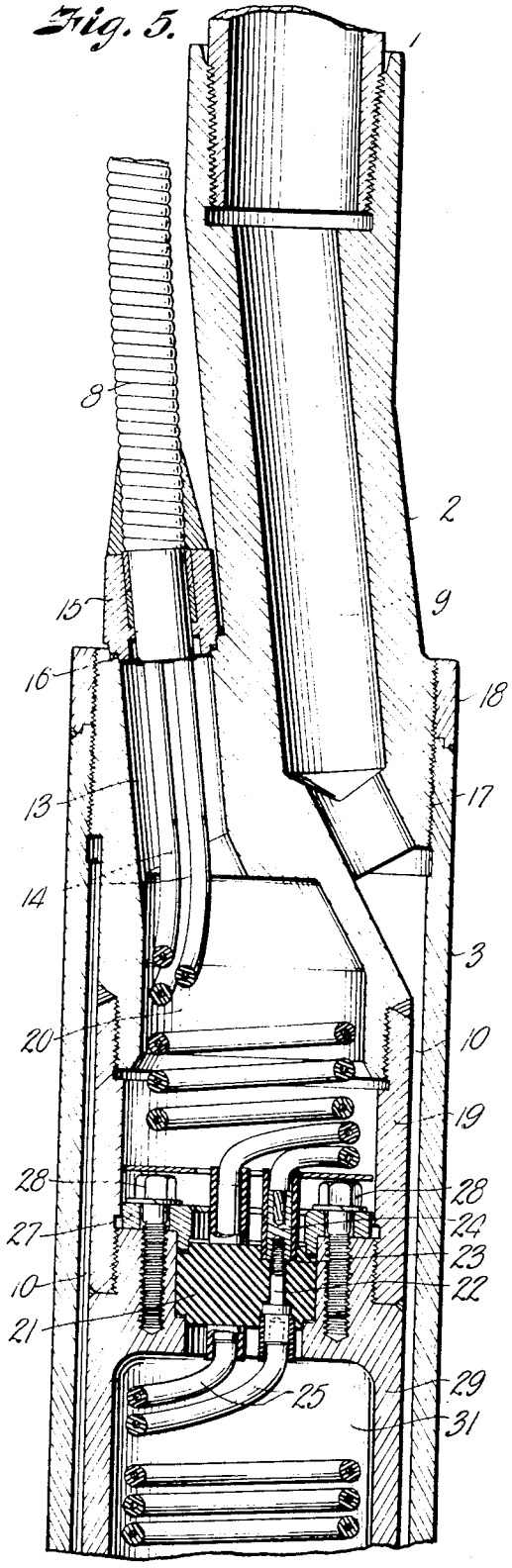


Fig. 6.

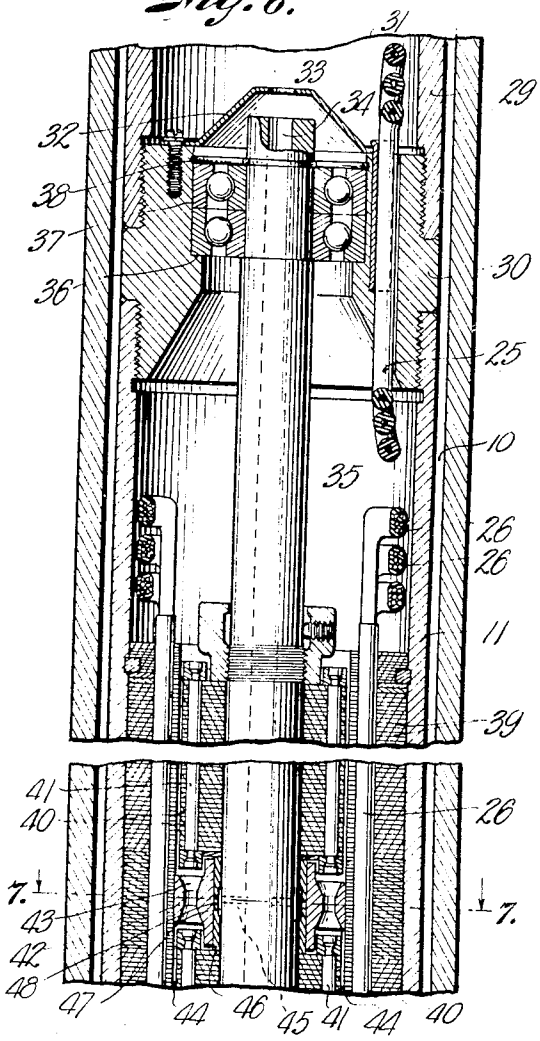
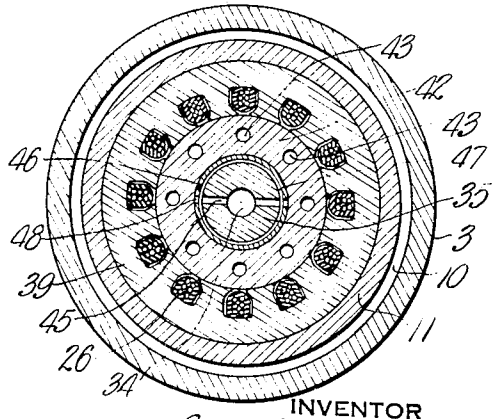


Fig. 7.



INVENTOR
Armais Arutunoff
BY Thos. E. Scofield
ATTORNEY

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UNITED STATES PATENT OFFICE

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SUBMERGIBLE DEEP WELL PUMP

Armais Arutunoff, Bartlesville, Okla., assignor to Reda Pump Company, Bartlesville, Okla., a corporation of Delaware

Application March 28, 1938, Serial No. 198,381

4 Claims. (Cl. 103—87)

My invention relates to submergible deep well pumps, and more particularly to an electrically driven submergible deep well pump adapted to be positioned at the bottom of a deep well.

A deep well, such as an oil well or a water well, must necessarily be of comparatively small diameter. Many oil wells, for example are equipped with a well casing, having a seven inch diameter. The wells may vary in depth over wide limits. Some are comparatively shallow, being about one thousand feet in depth. Others are extremely deep, being over seven thousand feet. The lifting of oil or water through such comparatively great distances necessitates a pump having a high discharge pressure. This may be obtained by having a multistage pump of a large number of stages.

Due to the limitations of the small diameter of the deep well, oil pumps comprising an elongated electrical motor and pump assembly have been constructed with the motor below the pump so that the motor will not obstruct the discharge of the fluid to the eduction tubing. The great length of the assembly results in the pump being a considerable distance above the bottom of the well. In some cases the motor, for example, may be over twenty feet in length. This will entail the pump suction being positioned twenty feet above the bottom of the well. When there is considerable fluid in the well, no particular disadvantage results from having the pump suction positioned such a distance from the bottom of the well. If the well has been flowing for some time, or if for other reasons the fluid in the well is reduced in height, the pumps of the prior art will lose suction.

One object of my invention is to provide a submergible pump and motor assembly for deep wells, in which the pump is positioned below the motor so that it may be used in wells where the level of liquid is comparatively low.

Another object of my invention is to provide a pump and motor assembly with the pump positioned below the motor, providing means for protecting the motor and pump bearings from the deleterious action of foreign matter, sand, grit and the like, present in the well fluid.

Other and further objects of my invention will appear from the following description.

In the accompanying drawings which form part of the instant specification and are to be read in conjunction therewith, and in which like reference numerals are used to indicate like parts in the various views,

Fig. 1 is a perspective view of a pump assembly in accordance with my invention.

Fig. 2 is a sectional view of the upper portion of the pump assembly according to my invention showing the manner of connecting the eduction tubing and the upper portion of the motor.

Fig. 3 is a sectional view of an intermediate portion of my pump assembly showing the lower portion of the motor, the motor protector and the manner in which it is connected to a coupling member coupling it with the pump housing.

Fig. 4 is a sectional view of the lower portion of my pump assembly showing the pump, the pump thrust bearing and the bearing protector.

Fig. 5 is a view on an enlarged scale of the eduction end of the assembly.

Fig. 6 is a sectional view on an enlarged scale of the upper portion of the motor.

Fig. 7 is a sectional view taken on the line 7—7, Fig. 6.

More particularly, referring now to the drawings, the eduction tubing 1 is connected by means of member 2 to a housing 3, in which is positioned in spaced relation to the walls thereof the motor housing. A connector section 4 secures the pump housing 5 in the assembly. A strainer 6 surrounds the suction of the pump. Pump thrust bearing oil reservoir 7 is secured at the bottom of the assembly. Power for the electric motor is furnished by a cable 8.

Referring now to Figs. 2 and 5, the housing 3 is closed by a member 2 provided with a bore 9 communicating with the eduction tubing 1. The bore 9 communicates with an annular space 10 formed by the housing 3 and the motor housing 11. The eduction fluid flows through the annular space 10. The closure member 2 is provided with another bore 13 through which the electric conductors 14 from the cable 8 pass. The end of cable 8 is provided with a connecting member 15 which seals bore 13 against fluid in the well, being seated upon a gasket 16. The upper portion of housing 3 is provided with internal threads adapted to co-act with the external threads formed on member 2 forming a threaded joint at 17. A locking ring 18 locks the member 2 in threaded position. A nipple 19 connects the lower portion of member 2 to the section 29, and forms a chamber 20 through which the conductors 14 pass. The upper end of section 29 is sealed by an insulating block 21 provided with three conducting members 22. The upper ends of conducting members 22 are threaded at 23 for engagement with conductor terminals 24 as will readily be seen by reference

to Fig. 5. The lower ends of respective members 22 are connected to conductors 25, which furnish energy to the motor winding 26. The insulating block 21 is held in place by a plate 27 and stud bolts 28. A connector 30 is adapted to connect section 29 to the motor housing 11. Section 29 forms an oil reservoir 31. The floor of reservoir 31 is closed by a shield plate 32, as shown in Fig. 6. The shield 32 is provided with a central opening 33 at its upper portion, permitting oil from the reservoir to pass through the duct 34 formed in the motor shaft 35. The shape of shield 32 is such that oil suction is always taken above the bottom of the reservoir 31 so that sediment, grit and foreign matter will settle in the annular space between the shield and the side walls of the section 29. The connector 30 is provided with an annular shoulder 36, upon which bearings 37 seat, the bearings being held in place by a snap ring 38. A plurality of laminations 39 form the stator iron through which motor winding 26 passes. A plurality of rotors are secured to the shaft 35. The rotors comprise laminations 40 through which copper bars 41 extend, forming squirrel-cage rotors. As shaft 35 will be of great length and it is important that the rotors do not touch the stator during operation, intermediate the rotors I provide bearing rings 42 provided with a plurality of passages 43 for oil circulation. The gap between the rotors and the stator is indicated by the reference numeral 44.

The free space within the motor housing is completely filled with oil. Transverse ducts 45 are formed in the motor shaft 35 so that oil may be thrown from the axial duct 34 through the motor shaft to lubricate the friction surface between the shaft 35 and the bushing 46. Each bushing 46 in turn floats in each bearing ring 42, the bushings being provided with an annular recess 47 through which oil may pass. Openings 48 in the bushing permit oil to pass from the annular recess 47 to the interface between the bushing and the bearing ring. The openings 43 in the bearing ring permit oil to flow vertically through the gap 44.

Referring now to Fig. 3, a connecting housing 49 connects the motor housing 11 to the protector housing 50. The upper end of housing 49 is formed with a spider 51 supporting a bearing 52. The chamber 53 in housing 49 below the spider 51 forms a sediment chamber into which grit, moisture and foreign matter from the oil may settle. The pump discharge is through a plurality of openings 54 formed in discharge ring 55. Fluid passing into the annular space 56 between the protector housing 50 and the housing 3 is under high pressure. The motor connecting shaft 57 operates in a packing 58. It will be observed that if the packing alone were all that sealed the pump discharge fluid from the motor housing, that there would be seepage of the eduction fluid between the packing and the shaft which would eventually find its way into the motor housing where moisture and the like would be apt to injure the motor winding and bearings. The function of the protector is to prevent eduction fluid from finding its way into the motor housing. Within the protector housing 50, I mount an annular piston 59 provided with sealing means 60. A spring 61 urges the piston downwardly. The space in front of the piston is filled with a lubricant 62 which may be grease or an oil of high viscosity. The lubricant is supplied before assembly through a duct 66 provided with a plug 66'. As the lubricant is introduced, the piston 59 is moved upwardly against the action of spring 61. The duct 63 in which is positioned check valve 64 serves to assist in equalizing the pressure of the oil in the motor with the pressure in the lubricant chamber 62.

Openings 65 are formed in the protector housing 50 and provided communication with the annular space 56. The spring plus the pressure of the eduction fluid forces the piston downwardly causing the lubricant 62 to pass into duct 66. The packing 58 is provided with a spacing ring 67. An opening 68 is formed in duct 66 adjacent the spacing ring 67. It will be observed that the pressure of the eduction fluid will tend to cause it to pass between the shaft 57 and the gland 58. Opposing this action is the pressure of the eduction fluid plus the pressure of the spring, which will cause the lubricant to ooze into the space between the shaft 57 and the packing 58, so that there will be a gradual leakage of lubricant through the gland outwardly instead of a gradual seepage of eduction fluid inwardly.

The lower end of housing 3 is closed by a fitting 69 provided with an internal shoulder 70 upon which discharge ring 55 seats. The fitting 69 is externally threaded for co-action with internal threads formed in the lower portion of housing 3. The connector 4 is sealingly bolted by bolts 71 to the fitting 69. The lower portion of connector 4 is threaded to the upper portion of the pump housing 5. The pump comprises a plurality of diffuser rings 72 and impellers 73 assembled upon the pump shaft 74. The lower end of the pump shaft 74 passes through a packing 75 and terminates in a thrust bearing 76. The thrust bearing takes the thrust of the eduction flow and it is extremely important that it be well lubricated. The pressure of the fluid within the well will tend to prevent lubricating of the bearing 76 by leakage between the shaft 74 and the packing 75. For lubricating the thrust bearing 76 I secure a housing 7 at the bottom of the assembly. Within the housing 7 is disposed a piston 77 provided with a sealing means 78. The piston is connected to a piston rod 78' housed within a cylinder 79. A spring 80 urges the piston upwardly. The space within the housing 7 above the piston is filled with a viscous lubricant 81, the filling taking place through duct 82 which is provided with a check valve 83. The housing 7 is provided with openings 84 adapted to communicate with the fluid within the well. It will be seen that the forces tending to force the lubricant 81 into the thrust bearing 76 are the thrust of the spring 80 plus the hydrostatic pressure of fluid within the well. This insures that the thrust bearing is always properly lubricated. Suction for the pump is taken through passages 85, a strainer 6 being disposed around the inlet passages.

It is believed that the operation of the assembly will be clear from the foregoing description. The motor drives the pump shaft 74 through shaft 57. The motor is protected against seepage of fluids being pumped by the protector. The pump thrust bearing is lubricated by the lubricating reservoir arrangement described. The motor shaft is constantly lubricated by the oil with which the free space within the motor housing is filled.

It will be observed that I have accomplished the objects of my invention. I have provided a pump and motor assembly of the character de-

scribed in which the motor is above the pump, and I have overcome the many difficulties entailed by this construction. The eduction fluid passes around the motor in an annular space formed by housing 3 and the motor housing 11.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of my claims. It is further obvious that various changes may be made in details within the scope of my claims without departing from the spirit of my invention. It is, therefore, to be understood that my invention is not to be limited to the specific details shown and described.

Having thus described my invention, what I claim is:

1. In a deep well centrifugal pump, an elongated housing, centrifugal pumping elements positioned in said housing, a shaft for rotating said pumping elements, a bearing for the lower end of said shaft, a lubricant reservoir containing a lubricant, means providing communication between said reservoir and said bearing, a piston in said reservoir, a spring behind said piston adapted to urge lubricant from said reservoir into said bearing, and means providing communication between fluid within said well and space behind said piston.

2. In a submergible deep well pump assembly adapted to pump fluid from the bottom of a well through eduction tubing, a motor having a housing and a motor shaft, a gland for said motor shaft, a lubricant reservoir, means providing communication between lubricant in said reservoir and said gland, a piston within said reservoir, a spring behind said piston adapted to urge lubricant from said reservoir into said gland, said motor housing and said reservoir being positioned within and spaced from a casing to form an annular passageway therewith, means in said lubricant reservoir providing communication between said passageway and the space behind said piston, a centrifugal pump below said lubricant reservoir, said centrifugal pump having a shaft, means connecting said shaft with said motor shaft, said pump having an intake port adjacent its lower end and a discharge port, said discharge port communicating with said annular passageway, and means providing communication between said annular passageway and said eduction tubing.

3. A submergible deep well pump assembly as in claim 2 in which said means providing communication between said annular passageway and said eduction tubing comprises a member having a pair of ducts formed therein, one of said ducts providing communication between said eduction tubing and said annular passageway, and the other of said ducts providing a passageway for electrical conductors.

4. A submergible deep well pump assembly as in claim 2 in which said means providing communication between said annular passageway and said eduction tubing comprises a member having a pair of ducts formed therein, one of said ducts providing communication between said eduction tubing and said annular passageway, the other of said ducts providing a passageway for electrical conductors, means for connecting said motor housing to said member, said motor housing being formed with an opening at its upper end, an insulating block seated in said opening and sealing the same, conducting members secured in said insulating block, means for connecting conductors passing through said duct to the upper ends of said conducting members in said insulating block, and means for connecting the motor winding to the lower end of said conducting members.

ARMAIS ARUTUNOFF.