

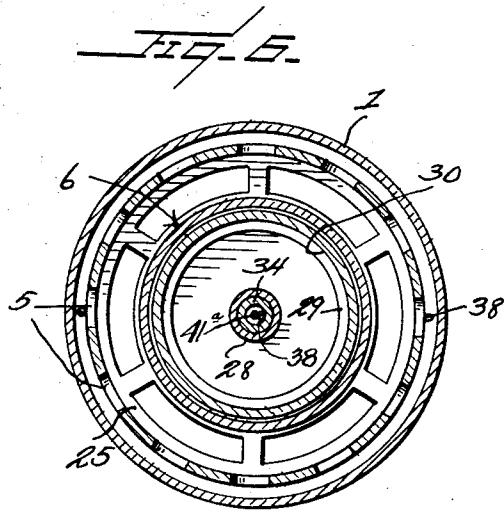
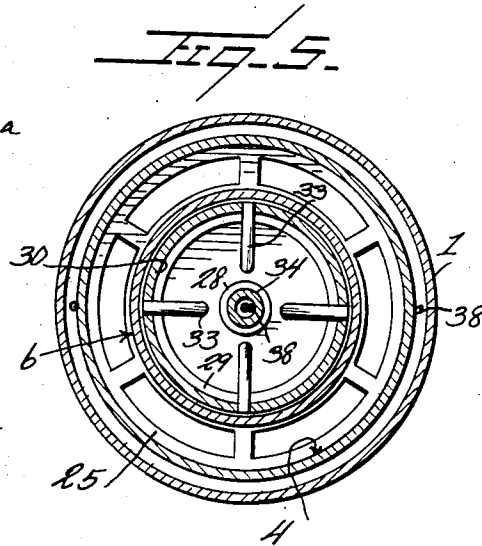
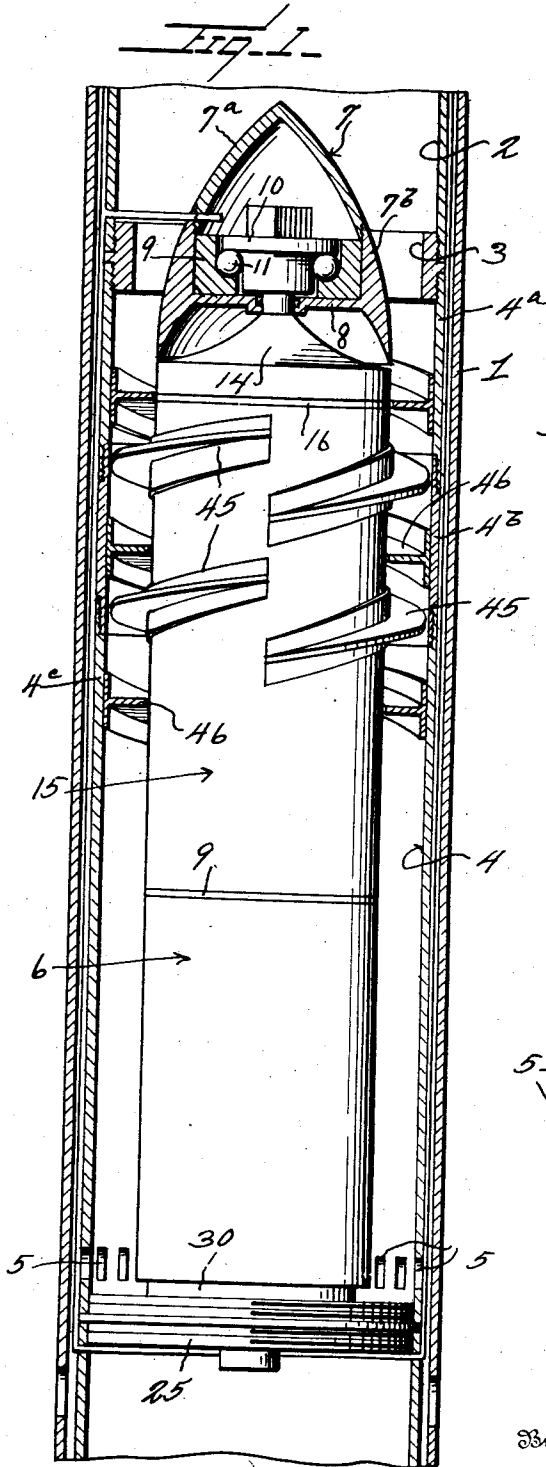
Sept. 23, 1941.

L. R. THRASHER
DEEP WELL PUMP MOTOR

2,256,659

Filed June 25, 1940

2 Sheets-Sheet 1



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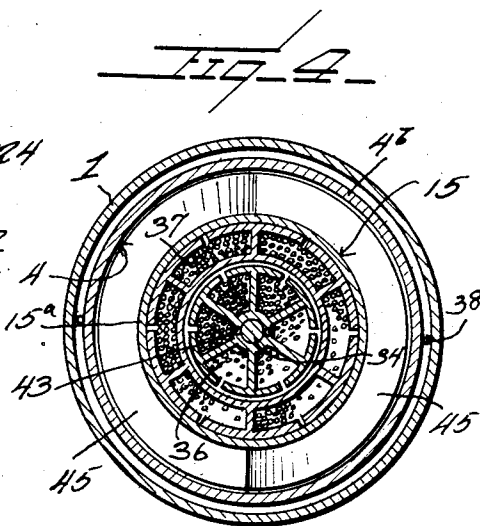
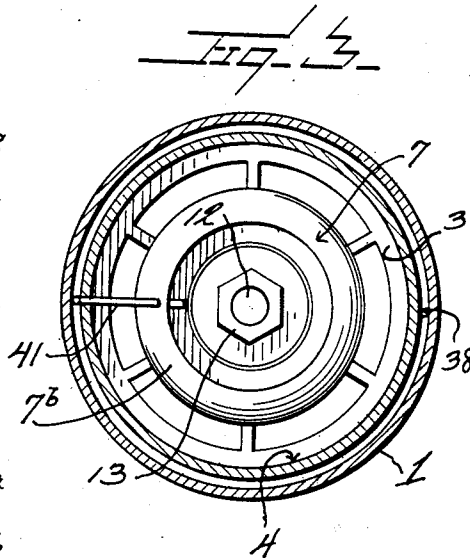
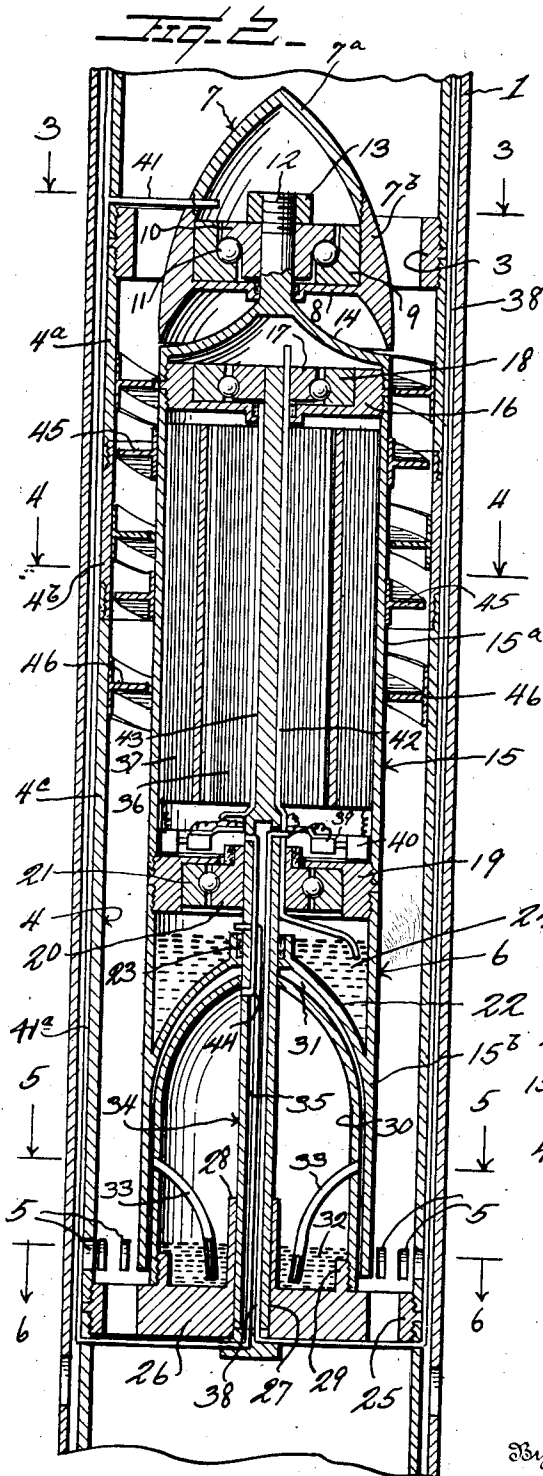
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UNITED STATES PATENT OFFICE

2,256,659

DEEP WELL PUMP MOTOR

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Application June 25, 1940, Serial No. 342,369

7 Claims. (Cl. 172—36)

This invention relates to improvements in pumping devices and pertains particularly to pumps of the rotary type designed for use in wells.

The primary object of the present invention is to provide a rotary type deep well pump in which a novel means is employed for supporting and centering within a tubular housing, the elongated cylindrical rotary unit forming a part of the impeller whereby such rotary unit is caused to revolve with a minimum of friction.

Another object of the invention is to provide an improved rotary deep well pump employing an electric driving motor in which the armature encircles and rotates about the field coils, with a novel means for suspending the rotating field coil unit which carries impeller blades for effecting the movement of fluid upwardly through the discharge pipe of the pumping mechanism.

A further object of the invention is to provide a deep well pumping structure in which the various parts of the driving electric motor are completely shielded against the entrance of moisture or other undesirable substances and in which a novel means is employed for equalizing the pressures inside and outside of the motor housing.

Still another object of the invention is to provide in a rotary deep well pump, a novel means for supplying lubricant to the moving parts of the enclosed and sealed driving motor structure.

The invention will be best understood from a consideration of the following detailed description taken in connection with the accompanying drawings forming part of this specification, with the understanding, however, that the invention is not to be confined to any strict conformity with the showing of the drawings but may be changed or modified so long as such changes or modifications mark no material departure from the salient features of the invention as expressed in the appended claims.

In the drawings:

Fig. 1 is a view in longitudinal section of a well casing and a fluid discharge column and pump housing therein, showing the motor unit embodying the present invention within the pump housing, partly in elevation and partly in section.

Fig. 2 is a longitudinal sectional view through the complete pumping unit and the enclosing housing and well casing.

Fig. 3 is a transverse section on the line 3—3 of Fig. 2, showing the tip of the pumping unit head removed.

Fig. 4 is a transverse sectional view on the line 4—4 of Fig. 2.

Fig. 5 is a transverse sectional view on the line 5—5 of Fig. 2.

Fig. 6 is a transverse sectional view on the line 6—6 of Fig. 2.

Referring now more particularly to the drawings, the numeral 1 generally designates the well casing within which the present pumping structure together with its enclosing housing and the fluid discharge pipe or column, is disposed.

The fluid discharge pipe or column which is let down into the casing and to which the pumping unit is connected, is indicated by the numeral 2 and to the lower end of this column is attached, by means of a spider ring 3, the tubular pump housing 4, which is divided into a number of units or sections which are indicated by the numerals 4^a, 4^b and 4^c. These sections are threadably coupled together as clearly shown in Fig. 1, so as to form the complete tubular housing and the lower end of the lower portion or portion 4^c is provided with an annular series of apertures 5 for the admission of fluid from the outer side of the housing.

The actual pumping unit is indicated as a whole by the numeral 6 and comprises an elongated body of circular cross-section, which is disposed within the housing 4 and coaxially therewith. Forming a part of this unit is a stationary head which is secured to the spider ring 3 and which is indicated generally by the numeral 7. This head is of bullet-shape and has a tip portion 7^a and a skirt portion 7^b. The skirt portion is integral with the spider ring 3 while the tip or point 7^a is removably attached thereto. The head 7 is hollow and has within the skirt portion the horizontal wall 8 which supports a thrust bearing unit comprising a fixed ball race or ring 9 and the central rotatable race 10 which is centrally supported by the fixed race 9 through the medium of balls 11. This bearing is mounted upon the bottom or wall 8 of the unit head.

The rotatable central portion or ball race portion 10 of the bearing has extended axially therethrough a rotary stub shaft 12 which is secured in position by means of the nut 13. The lower end of this shaft 12 is integral with a bell-like cap 14 which is suspended beneath the fixed head 7 for rotation with the shaft. This cap 14 forms the top of the hanging cylindrical motor casing, which is indicated generally by the numeral 15 and which comprises, in addition to the cap 14, the upper portion 15^a and the lower or skirt portion 15^b.

The upper portion 15^a of the motor casing is joined to the cap 14 by an exteriorly threaded cupped ring 16 which supports a bearing unit consisting of the inner and outer rings 17 and 18, respectively, the outer ring being secured to the cupped ring to turn therewith.

The portions 15^a and 15^b of the motor casing are coupled together by a lower cupped ring 19 which is exteriorly threaded, as shown, and which carries the inner and outer relatively rotatable portions or races 20 and 21, respectively, of a lower bearing unit.

The lower or skirt portion 15^b of the motor casing is open, as shown in Fig. 2, but inwardly of its open lower end, it is provided with the upwardly tapering dome-like partition wall 22 at the apex of which is an aperture encircled by a heavy duty oil retainer or packing 23 for the purpose hereinafter described. There is thus formed in the upper part of the skirt portion 15^b of the motor casing by the dome-like wall 22, an annular receptacle 24 in which oil is placed. The top of this oil receptacle is closed by the lower cupped ring 19 and the bearing unit which it carries.

Threadably secured in the lower end of the lower portion 4^c of the pump housing is a bottom spider ring 25 having a central body portion 26 provided with the axial passage 27. Upon the top of this body there extends upwardly in encircling relation with the aperture 27, the sleeve 28 and adjacent the periphery of the body is formed the upstanding exterior threaded flange 29. Engaging over and encircling the flange 29 is an upstanding shell 30 which is threadably joined with the flange, as shown, and which extends upwardly into the skirt portion 15^b of the motor casing and into the domed partition 22, the upper end of the shell being tapered to substantially conform to the form of the wall 22, as shown. Between the shell and the wall 22 is an air space 31 into which air enters from beneath the lower edge of the skirt portion 15^b for the purpose hereinafter to be described.

The shell 30 forms with the fixed portion 26 of the bottom spider, an oil receptacle in the lower part of which the body of oil 32 is placed.

Extending inwardly and downwardly from the wall of the shell 30 is a plurality of fluid admission tubes 33, the lower ends of which are submerged in the oil pool 32.

The numeral 34 designates a fixed shaft which extends upwardly from the lower spider ring 25, passing through the aperture 27 and the sleeve 28 and through the central part of the shell 30, through the heavy duty oil retainer 23 and the inner races 20 and 17, respectively, of the lower and upper bearing units which are enclosed within the motor housing. This fixed shaft is secured to the body 26 of the lower spider ring so that it will be held against rotation and it is likewise secured to the inner race members 20 and 17 through which it passes.

The fixed shaft 34 is tubular through substantially the lower half of its length, as indicated at 35, and the upper end of the tube is located within the area between the upper and lower cupped rings 16 and 19.

Within the area or space between the cupped rings 16 and 19 are enclosed the stator and rotor windings 36 and 37, respectively, of an electric motor.

The tubular portion 35 of the fixed shaft serves as a conduit for an electric current carry-

ing cable 38 which is run down the outside of the housing 4 and brought in through the lower end of the fixed shaft beneath the lower spider ring 25. Passing upwardly through the tube 35 the cable is carried beyond the lower cupped ring 19 and into the space beneath the stator and rotor windings of the motor where it is connected with the brushes 39 which have contact with current pick-up segments 40 carried by the motor casing, the brushes 39 and segments 40 constituting the commutator by which the current is conducted to the motor armature.

Lubricant is supplied to the upper bearing for the pump unit in a suitable manner as by the provision of a pipe line 41 which may be run down through the well casing and extended in through the housing and through the stationary part of the head 7, as shown in Fig. 2. For the lubrication of the upper and lower motor bearings which are carried by the rings 16 and 19 there are provided the oil conducting tubes 42 and 43. These tubes are run along the upper part of the fixed shaft 34 between the same and the motor stator 36 and the tube 42 extends upwardly into the cap 14 as shown in Fig. 2, while at its lower end it passes downwardly to the under side of the bearing supporting ring 19 and into the oil contained in the receptacle 24. The lower end of the tube 42 is curved to extend circumferentially within the oil receptacle and the end of the tube is directed oppositely to the direction of rotation of the motor casing. By this means as the motor casing rotates, it will carry with it the body of oil within the receptacle 24 and move the oil against the open end of the tube 42, thereby forcing the oil into and upwardly through the tube for discharge into the cap 14. The oil discharging into the cap will flow down between the elements 17 and 18 of the bearing and enter the upper end of the return tube 43 by which it will be conveyed downwardly to and discharged over the two elements of the lower motor bearing unit which are supported by the ring 19. After passing between the parts 20 and 21 of the lower motor bearing, the oil returns to the receptacle 24 for re-circulation.

Extending from the upper part of the interior of the shell 30 through the tube 35 and into the space above the ring 19 and below the motor is an air transfer tube 44, the purpose of which is about to be described.

Secured in spiral order around the outside of the motor casing upon the portion 15^a thereof, is a series of propeller blades or fins 45. These are arranged so that as the motor casing is rotated, fluid into which the motor casing is submerged, will be driven upwardly through the ring 3 and into the discharge pipe or column 2. To facilitate this action, there are provided upon the inner surface of the housing 4, the spirally directed stationary blades 46 between which the rotating or impeller blades 45 are located. It is preferred that each of the three sections of the pump housing carry one or more of these stationary fins. By providing the pump housing in sections as illustrated, its assembly around the motor casing is facilitated.

In the operation of the present deep well pump, it will be, of course, obvious that when electric current is supplied through the conductor cable 38, the casing with the attached blades 45 will be rotated from the suspension shaft 12 with which it is connected. The skirt portion 15^b

of the casing will turn around the fixed chamber 30. The pump unit is, of course, lowered into the fluid which is to be pumped, such as oil, water or the like, and as the pump unit is lowered together with the housing in which it is suspended, some of the fluid will pass upwardly between the skirt portion 15^b and the shell 30. This will trap air in the space 31 and thus provide a buoyant bearing and centering means for the lower part of the motor casing. Some of the fluid will also enter the tubes 33 and flow downwardly into the oil well, causing the oil to be raised in the shell and thereby forcing the air from the upper part of the shell through the pipe 44 into the chamber or space in which the motor is located. By this means, the air pressure within the motor space or chamber will be equalized with that outside of the motor casing as the casing is lowered in the water or other well fluid.

As previously stated, as the motor operates to turn the casing 6, the body of oil within the receptacle 24 will also turn and be forced against and into the open end of the tube 42. By this means, the oil will be forced to flow to the bearings for the motor.

In order that oil may be supplied to the receptacle 24, the pipe 41 may be continued down the outer side of the pump housing 4 as indicated at 41^a, and run into the tubular lower end portion 35 of the fixed shaft 34, passing upwardly through this tubular portion of the shaft and extending laterally through the wall of the same, as shown in Fig. 2, into the receptacle 24. Thus it will be seen that as oil is supplied to the upper bearing with which the vertical rotary shaft 12 is connected, it will also flow into the receptacle 24 to keep this filled, as required.

From the foregoing, it will be readily apparent that with the construction herein disclosed, the various bearings for the pumping unit are completely housed and protected against the entrance of grit or other material which would interfere with their proper operation and also it will be apparent that there has been provided a novel means for supporting the rotating portion of the pumping unit in such manner as to cooperate with the bearings to provide for smooth operation with a minimum of friction, this last-mentioned means being the air cushion which is provided by the trapping of air in the chamber 31.

What is claimed is:

1. A submersible motor of the character stated, comprising a tubular housing, a head secured in the upper end of said housing in spaced relation with the wall of the housing, said head being hollow, a bearing within the hollow head having a central rotatable element, an elongated cylindrical motor casing within the housing which is closed at its upper and lower ends, a shaft extending from the upper end of the casing axially thereof into and secured to the central element of said bearing, an electric motor within the casing including a fixed part and a movable part, said movable part being secured to the casing, a fixed shaft extending axially through the casing and secured at its lower end to said housing, the upper end of the shaft terminating within the casing and supporting the fixed part of the motor, means for conducting electric current to the motor, and means providing a buoyant support for said motor casing when the same is submerged in a fluid.

2. A submersible motor of the character stated,

comprising a tubular housing, a head secured in the upper end of said housing in spaced relation with the wall of the housing, said head being hollow, a bearing within the hollow head having a central rotatable element, an elongated cylindrical motor casing within the housing which is closed at its upper and lower ends, a shaft extending from the upper end of the casing axially thereof into and secured to the central element of said bearing, an electric motor within the casing including a fixed part and a movable part, said movable part being secured to the casing, a fixed shaft extending vertically through the casing and secured at its lower end to said housing, the upper end of the shaft terminating within the casing and supporting the fixed part of the motor, means for conducting electric current to the motor, said motor casing being formed at its lower end to provide a downwardly opening chamber in which air is trapped upon the lowering of the motor into a fluid, to provide a buoyant support around said fixed shaft for the motor casing.

3. A submersible motor of the character stated, comprising a motor unit housing, a motor unit within the housing, comprising an elongated cylindrical casing, means closing the upper end of said casing, a shaft forming an integral part of said means, means coupling said shaft with the upper end of the housing facilitating rotation of the motor casing in the housing, said motor casing being interiorly divided to form a motor chamber and an oil receptacle, a fixed shaft extending axially through the motor casing from the lower end thereof and terminating in the upper part of the upper chamber, means coupling the lower end of the fixed shaft with the motor housing, an electric motor in the motor chamber including a fixed part secured to the casing, bearings coupling the fixed shaft above and below the motor with the motor casing, said lower chamber forming an oil receptacle, and means for effecting a forced distribution of oil from the oil receptacle to said bearings upon rotation of the motor casing.

4. A submersible motor of the character stated, comprising a vertical housing, a spider ring secured in the lower end of the housing, a unit within the housing including a fixed head and a tubular casing, said head being secured to the upper end of the housing and the casing being disposed between the head and the spider unit, said casing having a partition wall transversely thereof inwardly of its lower end forming a downwardly opening air trapping chamber, the upper end of the casing being closed, means connecting the upper end of the casing with said head facilitating turning of the casing on its long axis, a shaft secured at one end to said spider and extending upwardly through said partition wall and into the casing and terminating in the upper part of the latter, an electric motor within the casing above said wall and having a stator secured to the shaft and a rotor secured to the casing, means for conducting electric current to said electric motor, the lower part of the casing between the motor and said partition wall forming an oil receptacle, bearing means between the shaft and the casing, and means for effecting a forced flow of oil from said receptacle to said bearing means.

5. A submersible motor of the character stated, comprising a vertical housing, a spider ring secured in the lower part of the housing, a spider

ring in the upper part of the housing, a unit within the housing, comprising a fixed head secured to the upper spider ring and an elongated casing, a cap closing the upper end of the elongated casing, a stub shaft rotatably coupling the cap with said head, a domed partition wall in the lower part of the casing inwardly of the lower end thereof forming a downwardly opening cup-like chamber, a fixed shaft secured at one end to the first spider and extending upwardly through the partition wall into and terminating within the upper part of the casing, bearings coupling the fixed shaft with the wall of the casing, an electric motor between said bearings and having a stator secured to the fixed shaft and a rotor secured to the casing, a hollow body supported upon the first spider and extending into said cup-like chamber and having spaced relation with the wall of the latter to form an air space, said shell forming an oil receptacle, fluid tubes leading from the wall of the shell into the bottom part thereof from said air space, a tube leading from within the shell into the casing, and means for conducting electric current to said motor.

6. A submersible motor of the character stated, comprising an elongated vertical housing, a spider ring secured in the upper end of the housing, a unit extending longitudinally within the housing and including a head, said head comprising a body of substantially bullet-shape having a lower skirt portion fixed in said ring and a removable tip portion, the interior of the head being hollow, a thrust bearing enclosed within the head and having a central rotatable portion, an elongated cylindrical casing constituting another portion of the unit, a cap forming a removable closure element for the upper end of the cylindrical casing and having an axially extending integral shaft, said shaft extending upwardly into the rotatable portion of said bearing, a ring member secured in the lower part of the housing and having a central apertured portion, the lower end of the casing terminating adjacent the lower ring, a fixed shaft secured at its lower end to the lower ring and extending axially through said casing and terminating within the same adjacent the cap, a pair of spaced bearing units coupling the fixed shaft with the casing, an electric motor within the casing between said

bearing units and including a stator secured to the first shaft and a rotor secured to the casing, means for conducting electric current to said motor, means forming an oil receptacle in the lower part of the casing, and an oil conducting tube secured to the fixed shaft and extending into the oil receptacle and constructed and arranged to pick up oil upon rotation of the casing and convey the same to said spaced bearings.

7. A submersible motor of the character stated, comprising an elongated vertical housing, a spider ring secured in the upper end of the housing, a unit extending longitudinally within the housing and including a head, said head comprising a body of substantially bullet-shape having a lower skirt portion fixed in said ring and a removable tip portion, the interior of the head being hollow, a thrust bearing enclosed within the head and having a central rotatable portion, an elongated cylindrical casing constituting another portion of the unit, a cap forming a removable closure element for the upper end of the cylindrical casing and having an axially extending integral shaft, said shaft extending upwardly into the rotatable portion of said bearing, a ring member secured in the lower part of the housing and having a central apertured portion, the lower end of the casing terminating adjacent the lower ring, a fixed shaft secured at its lower end to the lower ring and extending axially through said casing and terminating within the same adjacent the cap, a pair of spaced bearing units coupling the fixed shaft with the casing, an electric motor within the casing between said bearing units and including a stator secured to the first shaft and a rotor secured to the casing, means for conducting electric current to said motor, means forming an oil receptacle in the lower part of the casing, an oil conducting tube secured to the fixed shaft and extending into the oil receptacle and constructed and arranged to pick up oil upon rotation of the casing and convey the same to said spaced bearings, and said casing being formed below said oil receptacle forming means to provide a downwardly opening chamber in which air is trapped upon submerging the motor in a fluid to form a buoyant support for the casing.

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