Dec. 17, 1929. C. J. COBERLY 1,740,003

ELECTRICALLY DRIVEN OIL WELL PUMP

Filed May 24, 1926

Fig. 1.

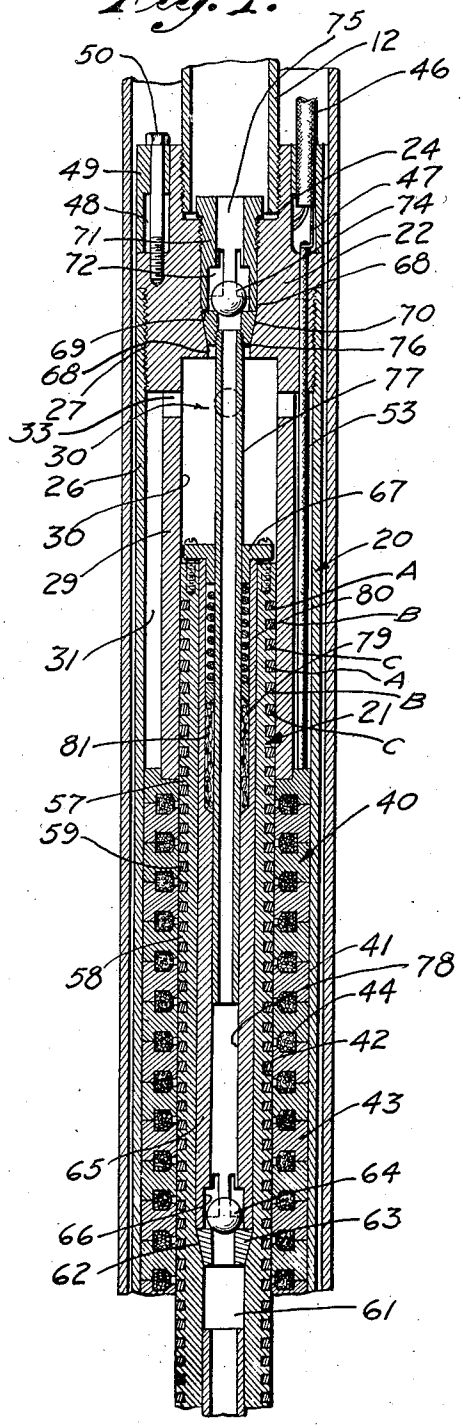
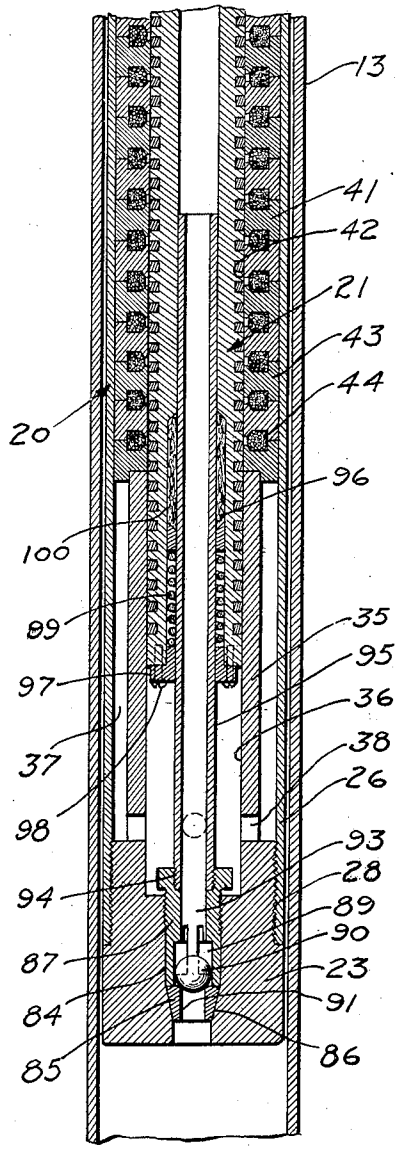


Fig. 2.



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ELECTRICALLY-DRIVEN OIL-WELL PUMP

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My invention relates to the oil industry and comprises a novel oil pumping apparatus. My invention is intended to take the place of the ordinary oil well pump which is placed in the well and actuated by sucker rods which extend downwardly to the pump from suitable reciprocating mechanism in the derrick, and differs from such a pump in that the pump and all the operating mechanism are placed in the well, thus entirely eliminating the sucker rods. To accomplish this new and useful result I provide a mechanism embodying a novel form of pump about which is built a novel form of motor, the pump and motor forming a self-contained, compact, and efficient mechanism.

It is an object of my invention to provide such a combined pump and motor in which the motor is electrically energized, preferably by a polyphase electric current, and in which the motor is of a reciprocating type.

It is a further object of my invention to provide as a part of such a combination a pump which moves oil upwardly through the tubing, through which it is delivered to the surface of the ground on both the down and up stroke.

It is a further object of my invention to provide a combined motor and pump in which the motor is built concentrically about the pump.

Other objects and advantages of the invention will be made evident hereinafter.

Referring to the drawings in which I illustrate a preferred embodiment of my invention,

Fig. 1 is a vertical cross section of the upper end of a pump embodying my invention.

Fig. 2 is a vertical cross section of the lower end of a pump embodying my invention.

My invention as shown in the drawings is embodied in a combined motor and pump 11 which is connected at the lower end of an oil tubing 12 which is extended into a well through a well casing 13. The oil tubing 12 extends above the surface of the ground and may be connected through a suitable flow line to deliver oil to a storage tank not shown.

The combined motor and pump 11 is shown in detail in Figs. 1 and 2. The motor portion consists of two main parts, viz, a casing 20 and a moving member 21. The casing 20 has an upper head 22 and a lower head 23. The head 22 has a threaded cavity 24 into which the lower end of the oil tubing 12 is screwed. A shell 26 is screwed on the head 22 at 27 and on the head 23 at 28, thus connecting them together in fluid-tight relationship. Extending downwardly from the head 22 is a projection 29 which is an integral part thereof and which has an opening 30 formed therein. The projection 29 is of smaller external diameter than the internal diameter of the shell 26, and there is a cooling space 31 provided therebetween, this cooling space being connected to the opening 30 of the projection 29 by apertures 33. Formed integral with the lower head 23 and extending upwardly therefrom is a lower projection 35 having an opening 36 formed therein which is of the same size as the opening 30 of the upper projection 29. The lower projection 35 is also of smaller external diameter than the internal diameter of the shell 26 and there is therefore a cooling space 37 provided therebetween which is connected to the opening 36 by means of apertures 38.

Clamped between the lower end of the upper projection 29 and the upper end of the lower projection 35 is a stator 40. This stator 40 consists of a primary magnetic body 41, the outer face of which fits closely inside the inner face of the shell 26. A central bore 42 in which the moving member 21 is free to slide extends through the primary magnetic body 41, which opening is of the same size as the openings 30 and 36 in the upper and lower projections 29 and 35, and serves to connect these openings together. In the drawings the primary magnetic body is shown as composed of sections 43. If desired, these sections 43 may be laminated to eliminate eddy currents according to standard motor practice. The stator 40 also includes primary windings 44 which are wound on the sections 43 of the primary magnetic body 41. These windings 44 as arranged for use with a standard three phase source of electric supply, consist of a plurality of sets of coils A, B and C which are

arranged in the order ABCABCABCABC etc. The coils A are connected in the first phase, the coils B are connected in the second phase, and the coils C are connected in the third phase. These coils set up magnetic fluxes which circulate therearound through the moving member 21, setting up a three phase field which moves axially along the stator. The three phase current is supplied to the stator 41 through a triple conductor cable 46 consisting of wires 47 (Fig. 1). The lower end of the cable 46 extends into a space 48 formed by a cap 49 which is secured to the upper end of the head 22 by bolts 50. The wires 47 are each connected to a connector 53 which extends downwardly through the upper barrel member 22 and through the upper cooling space 31 to one terminal of one of the coils A, B, or C.

When three-phase current is supplied to the stator 40 a traveling field is set up therein, which is very similar to a revolving field which is set up in the ordinary induction motor when polyphase current is supplied to the stator thereof. In my invention the field does not revolve as in the standard induction motor, but travels axially along the stator in a direction depending upon the relation of the separate phases. A current reversing means is included in the main conductor 46 at the surface of the ground whereby the current may be reversed, the direction of travel of the traveling field being thereby reversed, that is to say, the traveling field first moves upwardly and then moves downwardly according to the method of connection of the different phases as determined by the current reversing means. This reversal of phases can be readily accomplished by leaving the supply wire for one phase permanently connected to the coil A and reversing the connection of the other two phases to the coils B and C. The lower terminals of the lowest coils A, B and C are connected together to give a star connection of the phases.

Adapted to be reciprocated in the openings 30, 36 and 42 of the upper and lower head projections 29 and 35 and the stator 40 is the moving member 21. This member 21 includes an impeller 57. This impeller 57 corresponds to the rotor of an inductor motor, the essential difference being that it does not rotate but reciprocates. The impeller 57 consists of a secondary magnetic body 58 which may be laminated, if desired, and which carries secondary windings in the form of conductor rings 59. These conductor rings are shown clearly in Fig. 1 and correspond to the secondary windings or bars or the squirrel-cage of an ordinary induction motor.

When the polyphase current is supplied to the stator 40 a traveling field is set up, which traveling field sets up an induced field in the impeller and the impeller is therefore moved in the direction of travel of the traveling field. Therefore the impeller is first moved upwardly and then moved downwardly, being in this manner reciprocated in the barrel 20.

The above parts constitute a polyphase electric motor having a reciprocating impeller whose motion is utilized to operate the pump which will now be described.

A passage 61 is formed axially through the impeller 57, a conical seat 62 being formed near the central part of the pump plunger. The passage 61 is of larger diameter above this seat than it is below. Adapted to engage the seat 62 is a seat member 63 having an opening therethrough which is closed by a working valve 64. Extending into the upper or larger end of the passage 61 is a retaining sleeve 65, the lower end of which engages the seat member 63 and retains it in place. The lower end of the retaining sleeve 65 is provided with a chamber 66 in which the ball 64 is free to move for a short distance vertically. The retaining sleeve 65 is held in place by a gland 67 which is attached by bolts to the upper end of the member 21.

An opening 68 connects between the oil tubing 12 and the opening 30 of the barrel member 22. A seat member 69 is adapted to rest on a conical portion 70 of the opening 68. A valve cage 71 is screwed into the opening 68, the lower end of the cage 71 engaging and holding the seat member 69 in place. The lower end of the cage 71 forms a chamber 72 in which an upper traveling valve in the form of a ball 74 is free to move vertically, this ball being adapted to close an opening through the seat member 69. The cage 71 has an opening 75 formed therethrough.

Screwed to the seat member 69 at 76 is an upper quill 77 which extends downwardly therefrom and into an opening 78 formed in the retaining sleeve 65, this opening 78 being concentric with the passage 61. A stuffing box 79 is formed in the upper end of the moving member 21, surrounding the upper quill 77. The gland 67 is utilized for the purpose of compressing a spring 80 which places a resilient pressure on packing 81 so as to provide an efficient stuffing box at all times.

The lower head 23 has an opening 84 which connects between the lower end thereof and the opening 36. A seat member 85 engages a conical portion 86 of the opening 84, being held in contact therewith by means of a cage 87 which screws into the upper end of the opening 84. The lower end of the cage 87 provides a chamber 89 in which a standing valve in the form of a ball 90 is free to move vertically, this ball 90 being adapted to close an opening 91 formed through the seat member 85. The cage 87 has an opening 93 formed therethrough.

Screwed to the upper end of the cage 87 at 94 is a lower quill 95 which extends upwardly

into the lower end of the passage 61 of the moving member 21. A lower stuffing box 96 is provided at the lower end of the member 21, surrounding the lower quill 95. The lower stuffing box has a gland 97 secured to the lower end of the member 21 by bolts 98, this gland 97 compressing a spring 99 which places resilient pressure at all times on a packing 100 so as to provide an efficient stuffing box at all times.

The area of the lower quill 95 is preferably about twice that of the upper quill 77. The purpose of this will be explained shortly.

The operation of the pump of my invention is as follows:

The polyphase current is supplied to the stator 40 through the main conductor 46, as previously described, and a traveling field which first travels upwardly and then downwardly is established. The traveling field, as previously explained, reacts upon the impeller and causes the member 21 to reciprocate in the barrel 20. During the up stroke of the member 21 the working valve 64 is closed. The cubical contents of the space in the lower end of the passage 61 and the lower quill 95 between the working valve 64 and the standing valve 90 decreases when the member 21 moves upwardly and the lower standing valve 90 is unseated during this time so that oil is drawn into the lower quill 95 and the lower end of the passage 61, flowing through the opening in which the standing valve 90 seats. During the down stroke of the member 21 the lower standing valve 90 is closed and the working valve 64 is opened. The distance between the working valve 64 and the lower standing valve 90 is shortened; therefore oil will pass from the lower part of the passage 61 past the working valve 64 and into the opening 78 formed thereabove in the retaining sleeve 65. When the member 21 moves upwardly again, the space between the working valve 64 and the standing valve 90 is increased and oil is drawn through the standing valve 90 as previously explained.

The purpose of making the lower quill 95 of substantially twice the size of the upper quill 77 is so that it will displace substantially twice the volume of oil displaced by the upper quill 77. By this construction, during the down stroke of the pump the oil forced upwardly around the working valve 64 is double the amount required to fill the space between the working valve 64 and the upper standing valve 74. Therefore half the amount of oil will be forced upwardly around the upper standing valve 74 and into the oil tubing 12. By this construction, there will be a flow of oil from the pump into the oil tubing 12 during the down stroke of the member 21 as well as during the up stroke. This construction gives a double acting pump.

The openings 30 and 36 may be supplied with a cooling fluid for keeping the stator 40 and the impeller 57 cool. These fluids during the reciprocation of the member 21 will be alternately forced into the cooling spaces 31 and 37 through the openings 33 and 38.

The important feature of the invention is the manner in which the pump of the invention is operated. It will be seen that my invention wholly eliminates the use of sucker rods which are disadvantageous in certain respects, by providing a pumping apparatus having a self-contained driving mechanism. When it is desired to pull the pump of my invention to the surface of the ground it is necessary to elevate the oil tubing 12. In the ordinary pump construction employing sucker rods it is necessary to elevate and uncouple a pump tubing which corresponds to the oil tubing 12, and to also uncouple the sucker rods thereof. The valve 74 has no function during the operation of the pump providing the valves 64 and 90 function normally. The valve 74 closes, however, whenever the pump ceases to operate, thus preventing sand which may settle out of the oil in the tubing 12 from entering the pump.

I claim as my invention:

1. In a pump of the class described the combination of: a body; a stator stationarily supported in said body, said stator having a central bore; a moving member adapted to be reciprocated in said bore, said moving member having a passage; a traveling valve for said passage; an upper quill carried by said body, and extended downward into said passage of said moving member; a lower quill carried by said body, and extended upward into said passage of said moving member; and a standing valve at the lower end of said pump.

2. In a pump of the class described the combination of: a body; a stator stationarily supported in said body, said stator having a central bore; a moving member adapted to be reciprocated in said bore, said moving member having a passage, said passage having a seat formed near the central part thereof; a traveling valve engaging said seat; a retaining means for holding said traveling valve against its seat, said retaining means extending from one end of said moving member; an upper quill carried by said body, and extended downward into said passage of said moving member; a lower quill carried by said body, and extended upward into said passage of said moving member; and a standing valve at the lower end of said pump.

3. In a pump of the class described the combination of: a body, including a shell and heads at the opposite ends of said shell; a stator stationarily supported in said body, said stator having a central bore; projections extending inward from said heads for clamping said stator in said body; a moving mem-

ber adapted to be reciprocated in said bore, said moving member having a passage; a traveling valve for said passage; an upper quill carried by said body, and extended downward into said passage of said moving member; a lower quill carried by said body, and extended upward into said passage of said moving member; and a standing valve at the lower end of said pump.

4. In a pump of the class described, the combination of: a body, including a shell and heads at the opposite ends of said shell; a stator stationarily supported in said body, said stator having a central bore; projections extending inward from said heads for clamping said stator in said body; a moving member adapted to be reciprocated in said bore, said moving member having a passage, said passage having a seat formed near the central part thereof; a traveling valve engaging said seat; a retaining means for holding said traveling valve against its seat, said retaining means extending from one end of said moving member; an upper quill carried by said body, and extended downward into said passage of said moving member; a lower quill carried by said body, and extended upward into said passage of said moving member; and a standing valve at the lower end of said pump.

5. In a pump of the class described the combination of: a body, including a shell and heads at the opposite ends of said shell; a stator stationarily supported in said body, said stator having a central bore; projections extending inward from said heads for clamping said stator in said body, said projections being cylindrical and forming continuations of said bore of said stator; a moving member adapted to be reciprocated in said bore, said moving member having a passage; a traveling valve for said passage; an upper quill carried by said body, and extended downward into said passage of said moving member; a lower quill carried by said body, and extended upward into said passage of said moving member; and a standing valve at the lower end of said pump.

6. In a pump of the class described, the combination of: a body, including a shell and heads at the opposite ends of said shell; a stator stationarily supported in said body, said stator having a central bore; projections extending inward from said heads for clamping said stator in said body, said projections being cylindrical and forming continuations of said bore of said stator; a moving member adapted to be reciprocated in said bore, said moving member having a passage, said passage having a seat formed near the central part thereof; a traveling valve engaging said seat; a retaining means for holding said traveling valve against its seat, said retaining means extending from one end of said moving member; an upper quill carried by said body, and extended downward into said passage of said moving member; a lower quill carried by said body, and extended upward into said passage of said moving member; and a standing valve at the lower end of said pump.

7. In a pump of the class described the combination of: a body, including a shell and heads at the opposite ends of said shell; a stator stationarily supported in said body, said stator having a central bore; projections extending inward from said heads for clamping said stator in said body, said projections being smaller than said shell so as to form cooling spaces, and said projections having openings connecting said cooling spaces and the interior of said projections; a moving member adapted to be reciprocated in said bore, said moving member having a passage; a traveling valve for said passage; an upper quill carried by said body, and extended downward into said passage of said moving member; a lower quill carried by said body, and extended upward into said passage of said moving member; and a standing valve at the lower end of said pump.

8. In a pump of the class described, the combination of: a body, including a shell and heads at the opposite ends of said shell; a stator stationarily supported in said body, said stator having a central bore; projections extending inward from said heads for clamping said stator in said body, said projections being smaller than said shell so as to form cooling spaces, and said projections having openings connecting said cooling spaces and the interior of said projections; a moving member adapted to be reciprocated in said bore, said moving member having a passage, said passage having a seat formed near the central part thereof; a traveling valve engaging said seat; a retaining means for holding said traveling valve against its seat, said retaining means extending from one end of said moving member; an upper quill carried by said body, and extended downward into said passage of said moving member; a lower quill carried by said body, and extended upward into said passage of said moving member; and a standing valve at the lower end of said pump.

9. In a pump of the class described the combination of: a body, including a shell and heads at the opposite ends of said shell; a stator stationarily supported in said body, said stator having a central bore; projections extending inward from said heads for clamping said stator in said body, said projections being cylindrical and forming continuations of said bore of said stator, said projections being smaller than said shell so as to form cooling spaces, and said projections having openings connecting said cooling spaces and the interior of said projections; a moving member adapted to be reciprocated in said

bore, said moving member having a passage; a traveling valve for said passage; an upper quill carried by said body, and extended downward into said passage of said moving member; a lower quill carried by said body, and extended upward into said passage of said moving member; and a standing valve at the lower end of said pump.

10. In a pump of the class described, the combination of: a body, inculding a shell and heads at the opposite ends of said shell; a stator stationarily supported in said body; said stator having a central bore; projections extending inward from said heads for clamping said stator in said body, said projections being cylindrical and forming continuations of said bore of said stator, said projections being smaller than said shell so as to form cooling spaces, and said projections having openings connecting said cooling spaces and the interior of said projections; a moving member adapted to be reciprocated in said bore, said moving member having a passage, said passage having a seat formed near the central part thereof; a traveling valve engaging said seat; a retaining means for holding said traveling valve against its seat, said retaining means extending from one end of said moving member; an upper quill carried by said body, and extended downward into said passage of said moving member; a lower quill carried by said body, and extended upward into said passage of said moving member; and a standing valve at the lower end of said pump.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 18th day of May, 1926.

CLARENCE J. COBERLY.