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ELECTRICALLY OPERATED OIL WELL PUMP

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Fig. 1.

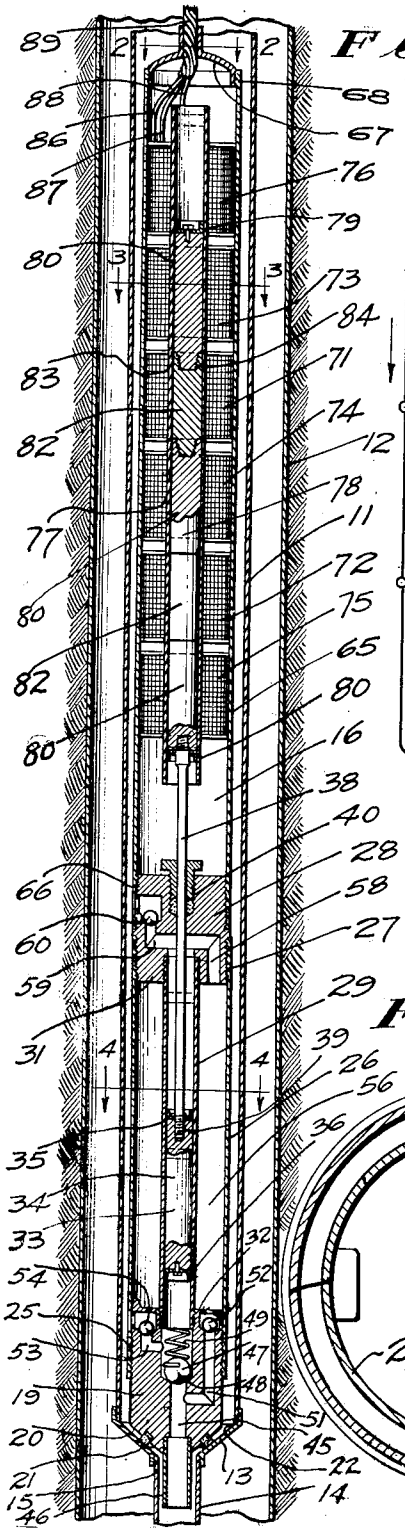


Fig. 5.

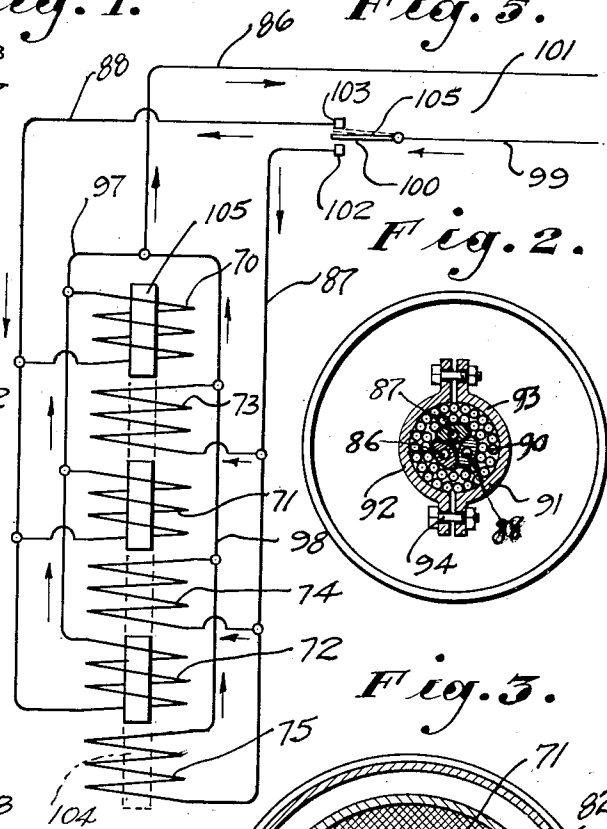


Fig. 2.

Fig. 3.

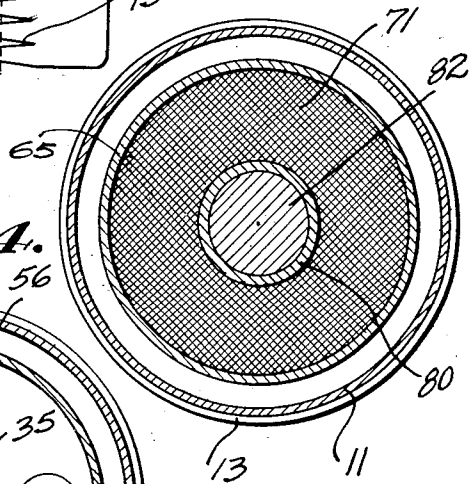
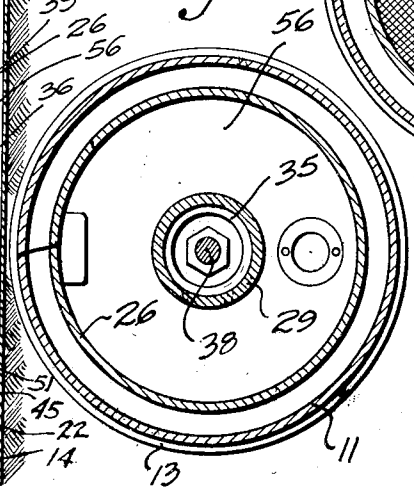


Fig. 4.



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UNITED STATES PATENT OFFICE.

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ELECTRICALLY-OPERATED OIL-WELL PUMP.

Application filed December 9, 1924. Serial No. 754,871.

This invention relates to the oil producing industry, and it relates particularly to pumping equipment employed in this industry.

Oil wells may be divided into two classes, first, flowing wells, which wells have a subterranean pressure sufficient to cause oil to flow therefrom without the employment of external forces. Secondly, pumped wells in which the oil must be removed therefrom by means of pumping equipment because of lacking this subterranean pressure. Pumping equipment commonly employed in wells is in the form of a pump tubing which is extended from the surface to a point adjacent to the bottom of the well. On the lower end of this pump tubing, there is attached a pump barrel which has a standing valve secured to the lower end thereof. Reciprocally situated in the pump barrel is a pump plunger, this pump plunger having sucker rods secured to the upper end thereof which extend to the surface of the well. The sucker rods at their upper end attach to a walking beam, a reciprocation of the walking beam causing a reciprocation of the pump plunger through the sucker rod string.

The prominent disadvantages of this type of pumping equipment which I intend to overcome in my invention are as follows: In the first place, considerable labor and time are expended in installing this equipment; first, because of the handling of the multiplicity of sections and the making of joints thereof as they are installed in the well. Another disadvantage is the labor necessary in removing the rods and tubing when repairs are necessary. It will be seen that should any damage occur in the pump of the well, it would be necessary to elevate it to the surface, this meaning that the sucker rod string and the pump tubing would have to be disassembled. Also, in this type of equipment there is a great possibility of the sucker rods uncoupling during the operation of the pump. This may be caused due to a rotation of the pump plunger within the pump barrel. When an uncoupling of this rod occurs, it is obvious that a fishing job is demanded. In a pump of this character, where no garbutt rod is used, it will be necessary to remove the standing valve thereof by an extra fishing operation which is expensive.

It is an object of this invention to provide pumping equipment having a pump actuating mechanism which is situated adjacent to the pump. A construction of this character eliminates the sucker rods necessary in the present type of pumping equipment and logically obviates the disadvantages associated with these sucker rods.

It is a still further object of the invention to provide a pump and actuating mechanism which may be installed and removed simultaneously without an expenditure of labor now necessary. This may be accomplished by providing a construction embodying a pump and actuating mechanism which may be lowered into the well by a continuous member such as a cable.

It is also an object of the invention to provide a pumping equipment of this character having a pump and actuating member which when lowered into pumping position cooperates with a tubing in the well in a manner to accomplish a result analogous to that of a standing valve. When the pump is elevated. the joint between the pump and tubing is immediately broken, and the oil held therein is allowed to flow from the tubing, the pump being readily removed from the well.

It is a still further object of this invention to provide a pump construction of this character which is electrically operated.

Other objects and the special advantages of this invention will appear in the following description.

Referring to the drawings which are for illustrative purposes only,

Fig. 1 is a vertical sectional view showing a pumping construction embodying the features of my invention, this construction being shown situated in a well and in pumping position.

Fig. 2 is a horizontal section taken substantially as indicated by the line 2—2 of Fig. 1, this view illustrating the manner in

which the flexible lowering and elevating member is secured to the upper end of the pumping construction.

Fig. 3 is a section taken substantially as indicated by the line 3—3 of Fig. 1.

Fig. 4 is a section taken substantially as indicated by the line 4—4 of Fig. 1.

Fig. 5 is an electrical diagram for the purpose of clearly illustrating the operation of the actuating mechanism employed in the present device.

As shown clearly in Fig. 1, the modification shown assumes the form of a tubing or eduction column 11 which is extended from the surface of the well 12 so that the lower end thereof extends to a point adjacent to the bottom of the well, this tubing 11 being installed previous to the other pumping equipment. Secured on the lower end of the tubing as shown, is a supporting member 13, this supporting member having a nipple 14 which screws into the lower opening 15 thereof.

The pumping and actuating member 16, which is lowered into the well subsequent to the installing of the tubing 11, provides a lower pump body 19 having a bottom conical face 20 on which there is mounted an annular closing member or gasket 21. When the pump is in operating position, the gasket 21 engages with a conical upper face 22 of the supporting member 13 in a manner to close the lower end of the tubing 11. Secured to the upper end of the lower pump body 19 as by the threads 25, is a tubular pump member 26 which extends upward therefrom. The tubular pump member 26 is secured at its upper end as at 27 to an upper pump body 28. A pump barrel 29 extends within the tubular pump member 26 between the upper and lower pump bodies 28 and 19, being threadably attached thereto as at 31 and 32, respectively. Reciprocally situated within the pump barrel 29 is a pump plunger 33, this pump plunger 33 comprising a body 34 and upper and lower cup leathers 35 and 36. For reciprocating the plunger 34, there is a pump rod 38 which secures to the upper end of the plunger 33 at 39 and which extends axially through the upper body 28, this body being provided with a suitable stuffing box or gland 40 which surrounds the rod 38.

The lower body 19 is provided with a central and axial oil inlet port 45, this port communicating between the pump barrel 29 and the portion below the tubing 11 through a nipple 46 which is screwed into the lower end of the port 45. A valve comprising a ball 47 which rests against a seat 48 being forced thereagainst by means of a spring 49, is provided to prevent a reverse or downward flow of oil through the port 45. Extending from the inlet port 45 at a point below the valve to the upper face of the lower pump body 19, there is a branch oil inlet 51 having a check valve 52 for preventing a reverse or downward flow of oil through the branch oil inlet 51. A branch oil outlet 55 is provided in the body 19, this outlet extending from the port 45 at a point above the valve to the exterior of the body in a manner to communicate with the tubing 11, there being a check valve 54 for preventing a flow of oil from the exterior of the body into the inlet port 45. The interior of the tubular pump member 26 provides an oil chamber 56 with which the upper end of the oil inlet branch 51 communicates. In the upper body 28 there is provided an oil passage 58 which communicates between the chamber 56 and the upper end of the pump barrel 29. Also in the body 28 there is provided an oil outlet passage 59 which communicates between the upper end of the barrel 29 and the exterior of the body 28, this oil outlet passage having a check valve 60 for preventing a reverse flow from the exterior of the body 28 to the upper end of the pump barrel 29.

During an upward stroke of the pump plunger 34 a space is created therebelow in the lower portion of the barrel 29, this creation allowing the oil to flow upward through the oil inlet 45 removing the valve ball 48 from its seat and filling the space created, due to the upward movement of the plunger 33. It will be seen that by the provision of the valves 52 and 54, there will at this time be no flow through the oil inlet branch 51 and the outlet branch 53, respectively. When the plunger 33 travels downward, the valve 47 will again seat and the oil will be forced by the plunger 33 through the oil outlet branch 53 to the exterior of the member 16, and to the interior of the eduction tubing 11, the valve 54 being opened at this time by the flow of oil therethrough. During the downward travel of the plunger 33 a space is created in the upper end of the barrel 29. This allows oil to flow through the lower portion of the port 45, through the oil inlet branch 51, forcing open the valve 52, through the chamber 56, the oil passage 58, and into the upper end of the barrel 29. When the pump plunger is moved upwardly again, the valve 52 closes and the oil situated in the upper portion of the barrel 29 is forced through the oil outlet passage 59 to the exterior of the pump 60 and to the interior of the tubing 11, the valve 60 at this time being opened by the flow of oil. It will be seen that the pump is double acting, and that the oil being forced through the outlets 53 and 59 flows into the tubing 11 and flows through this tubing 11 to the surface of the well.

A tubular actuator casing 65 is secured to the upper portion of the upper pump body 28 at 66. The extreme upper end of the

casing 65 is closed by means of a cable member 67 which is screwed thereinto as at 68. Situated within the casing 65 is the actuating mechanism of the pumping equipment. This actuating mechanism is provided in the form of elevating solenoids 70, 71 and 72 and depression solenoils 73, 74 and 75, these solenoids being alternately arranged as shown in the drawing. Extending through the central opening of each of the solenoids is a common and continuous tubular member 77. Arranged for reciprocation in the tubular member 77 is a reciprocating core 78 which has cup leathers 79 and 80 secured to the upper and lower ends thereof, respectively, these leathers being for the purpose of excluding foreign matter from between the surfaces of the tubular member 77 and the solenoid core 78. The upper end of the pump rod 38 attaches to the lower end of the solenoid core 78 as shown in Fig. 1. The core 78 comprises magnetizable members 80 which may be made of any suitable permeable substance, such as soft iron. For securing together and spacing the magnetizable members 80 are non-magnetic members or connectors 82 which may be provided from any suitable non-magnetic material such as brass. The lower ends of the members 80 and 82 are provided with portions 83 which screw into box portions 84 provided at the upper ends of these members.

Electricity is supplied to the solenoids 70 to 75, inclusive, through wires 86, 87 and 88, these wires extending to the surface of the well to a suitable power source through the supporting cable 89. As clearly shown in Fig. 2, this cable 89 comprises strands of wire 90 which are as shown, woven around the wires 86, 87 and 88, these strands serving a double purpose; first, to protect the wires, and secondly, to support the construction 16 during the lowering and the raising thereof. In Fig. 2 the cable 89 is secured to the member 16 by means of the clamp 91 provided by the upper cable 67, this clamp 91 comprising portions 92 and 93 which are securely clamped against the periphery of the cable 90 by suitable bolts 94.

In Fig. 5 I diagrammatically show the electrical system employed for the actuation of the actuating mechanism or the solenoid of the construction shown. The wire 86 having connection with the solenoid coils 70, 71 and 72 through wires 97 and with the solenoid coils 73, 74 and 75 through wires 98 may extend from a suitable source (not shown). The other circuit wire 99 connects with a movable finger 100 of a current alternator switch 101. From the contact 102 of the switch 101, the wire 87 extends, this wire 87 connecting to the lower ends of the solenoids 73, 74 and 75, as shown. Extending from a contact 103 of the switch 101, the wire 88 extends, this wire 88 connecting to the lower ends of the solenoid coils 70, 71 and 72, as shown.

The actuation of the solenoid member shown is substantially as follows: The magnetizable members 80, being in the position shown in full lines of Fig. 1 and the dotted lines 104 of Fig. 2, move into the upper position as indicated by full lines 105 of Fig. 5, when the finger 100 is moved upward into engagement with the contact 103 of the switch 101, as indicated by the dotted lines 105. A contact of the finger 100 with the contact 103 causes a current to flow through the wire 99, the finger 100, through the wire 88 from which the current travels through the elevating solenoid coils 70, 71 and 72. The current is carried from these elevating solenoids through a conductor 97 and back to the wire 86. When the finger 100 is caused to contact with the lower contact 102, a current is caused to flow through the wire 87 which supplies current to the depression solenoids 73, 74, and 75, energizing them and causing them to attract the magnetic members 80 in a manner to move the core member 79 into the lower position, as shown by full lines of Fig. 1 and the dotted lines 104 of Fig. 5, the current being carried from these depression solenoids by a conductor 98 and to the wire 86.

The installlation and operation of the pumping mechanism shown are substantially as follows: The eduction tube 11 having a supporting member 13 first secured to the lower end thereof is lowered into the well and may be considered as a permanent fixture thereof. After this installation, the pump and actuating mechanism in the form of the member 16 are lowered into the well by means of a cable 89. It will be seen that this may be rapidly accomplished due to the fact that the cable 89 may be wound on a suitable drum, this arrangement allowing it to be quickly unwound and the member 16 to be very quickly and readily lowered to the bottom of the well. When the member 16 reaches the bottom of the well, the seat or annular closing member 21 is brought into engagement with the upper face 22 of the supporting member 13, thereby causing a tight seal therebetween and closing the lower end of the tube 11. When this closure is effected, the weight on the cable 89 is reduced to a minimum. When the member 16 is in this position, it is considered as being in pumping position and the construction may be operated as previously described. When it is desired to elevate the pump and actuating mechanism 16 to the surface of the well for any purpose, repairs or otherwise, the cable 89 is drawn upward as by winding it on the drum, not shown. It will be seen that upon the initial movement of the member 16, contact between the annular closure member 21 and the face 22 of the

supporting member 33 is broken, thus allowing any oil in the tube 11 to flow therefrom, and the resistance, which might be caused thereby upon the pump as it is being elevated, is eliminated. It will be seen that by the use of the cable 89, the pump may be very quickly elevated to the surface of the well.

From the foregoing description it will readily be seen that there is no extra fishing job necessary as in some of the old types of pumps for removing the standing valve of the pump, owing to the fact that a closure is effected due to the novel arrangement and cooperation between the closure member 21 and the supporting member 13. The expense and labor of uncoupling sucker rods are eliminated by the use of my invention owing to the fact that the actuating mechanism and the pump are located adjacently thereto and connection therebetween may be made by a very short and unitary member such as the pump rod shown. The lowering and raising of the pumping construction 16 is readily accomplished. It will be seen that it is very much cheaper to install and remove a pump of my character than it is to remove one of the old type, owing to the fact that uncoupling of the pump tubing and the uncoupling of the sucker rods is entirely obviated in my invention.

Although I illustrate a solenoid type of motor for operating the pump, it should be understood that other types of motors may be employed without deviating from the spirit and scope of my invention.

I claim as my invention:

1. A pump unit adapted to be lowered into a well comprising: a pump barrel having an inlet and an outlet; a pump plunger reciprocable in said barrel; a solenoid core drivably associated with said plunger, said solenoid core comprising magnetizable members having non-magnetizable members situated therebetween; a plurality of elevating solenoid coils for elevating said core; a plurality of independent depression solenoid coils for depressing said core; and means for energizing only one set of coils to effect each plunger stroke.

2. In combination in a pumping organization, a pump comprising: a lower valve body having a single oil inlet port, an oil inlet branch connected with said oil inlet port, and an oil outlet branch connecting with said inlet port and leading directly to the exterior of the pump, said inlet port and said branches each having valves situated therein; an upper valve body having an upper oil outlet passage leading to an oil outlet port, said oil outlet passage having a valve situated therein; a tubular member extending between said upper and lower valve bodies in a manner to provide a single annular oil chamber, said chamber having communication only with said lower oil inlet branch and said upper oil outlet passage; a pump barrel extending within said oil chamber and between said upper and lower valve bodies, said barrel having a communication at its upper end with said upper oil outlet passage, and having communication at its lower end only with said single lower oil inlet port; a plunger reciprocable in said barrel; and a rod secured to said plunger and extending through said upper pump body.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 4th day of December, 1924.

BENJAMIN F. SCHMIDT.