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B. F. SCHMIDT

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MOTOR DRIVEN OIL WELL PUMP

Filed Dec. 9, 1924

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Fig. 1.

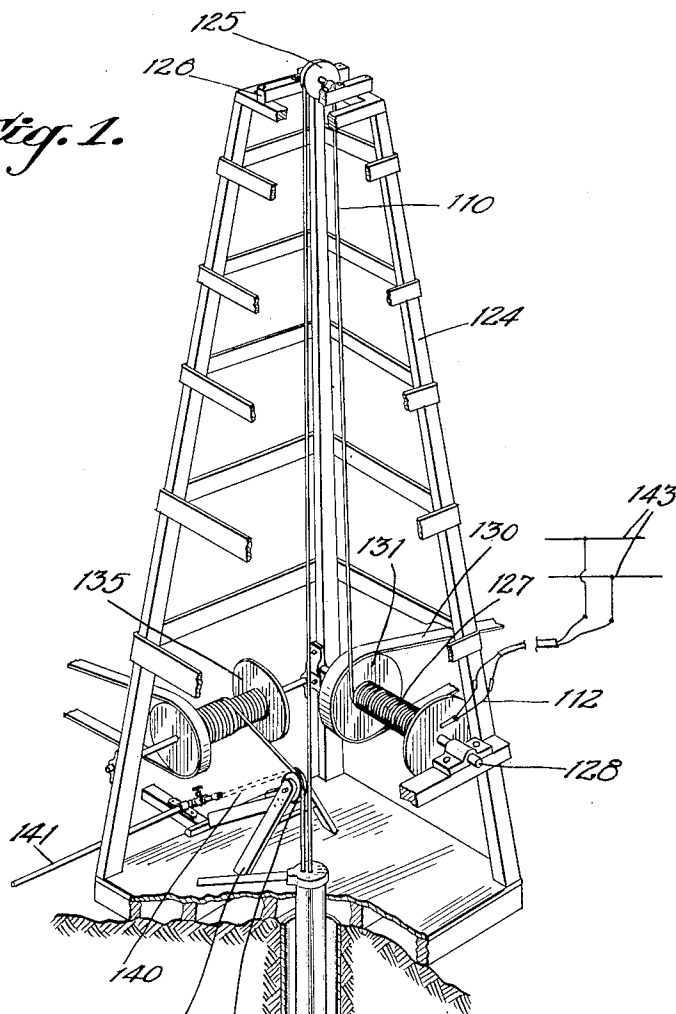
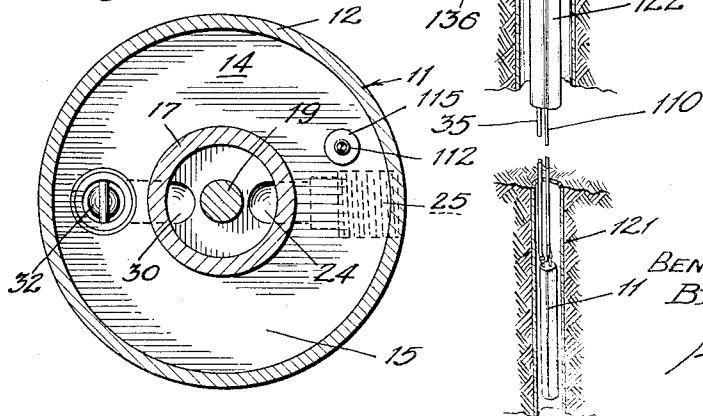


Fig. 6.



INVENTOR
BENJAMIN F. SCHMIDT

BY

For M. Smith

ATTORNEY

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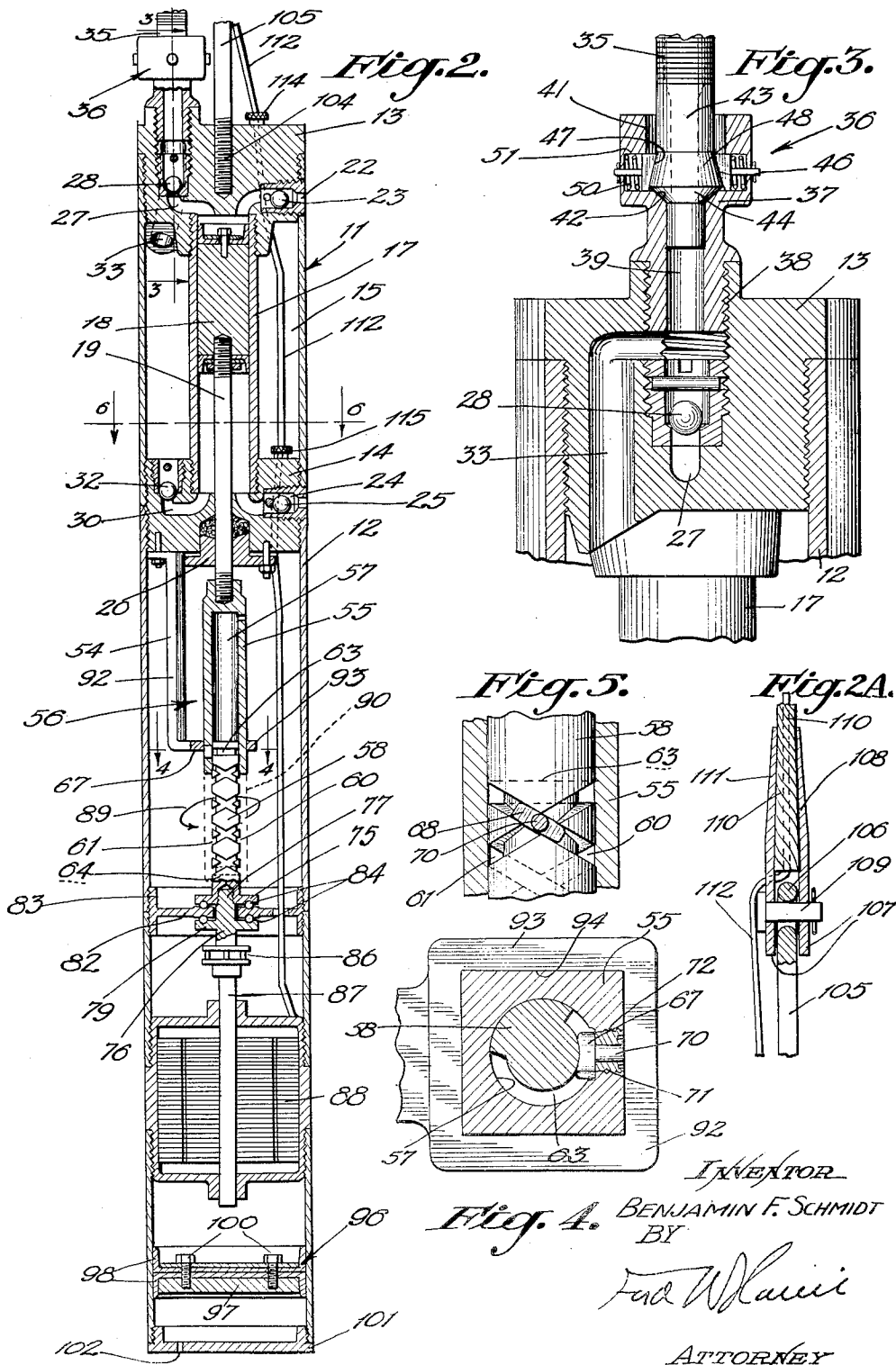
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UNITED STATES PATENT OFFICE

BENJAMIN F. SCHMIDT, OF LOS ANGELES, CALIFORNIA, ASSIGNOR OF ONE-FOURTH TO KING C. GILLETTE AND ONE-FOURTH TO KING G. GILLETTE, BOTH OF LOS ANGELES, CALIFORNIA

MOTOR-DRIVEN OIL-WELL PUMP

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My invention relates particularly to pumping equipment employed in the oil producing industry.

In the oil producing industry, oil is pumped from wells by means of equipment which generally includes a pump barrel situated at the lower end of the well and secured to the lower end of a pump tubing. A pump plunger is reciprocally disposed in this barrel, which pump plunger is ordinarily connected to a string of sucker rods which extend upward to the surface of the ground. The pump plunger is reciprocated by means of the sucker rod string by a walking beam which is situated in the derrick, this walking beam being attached to the upper end of the string of sucker rods. This pumping arrangement has some very pronounced disadvantages which I eliminate by my invention as will be described hereinafter. One noticeable disadvantage of the present pumping equipment is that much labor, time and expense are incurred in the installation because of the many joints which must be made, both in the pump tubing and in the sucker rods, and because of the labor and time consumed in the handling of these parts. If damage occurs to the pump, it is ordinarily necessary to withdraw the plunger and sometimes the barrel to the surface of the ground. To withdraw the barrel, one must withdraw the pump tubing as well as the sucker rod string. It is evident that this makes a repair job on a pump of this character very expensive.

It is an object of my invention to provide pumping equipment in which the pumping apparatus and the pump actuating mechanism are made in a unit, this unit being lowered into the well. This eliminates the sucker rods which ordinarily extend between the pump and the pump actuating mechanism.

It is another object of my invention to provide a pump and actuating mechanism unit, which may be readily installed and removed from a well with a minimum of expense and in a minimum of time as compared with the installing and removing of the present type of pump. The unit may be suspended from a flexible member such as a cable which may be conveniently wound on a drum at the sur-

face of the ground, and which may be very quickly unwound or wound in a manner to rapidly lower or raise the unit in the well.

It is a further object of my invention to provide a construction of this character having a pump actuating mechanism which is electrically operated.

It is a further object of my invention to provide in a pumping unit of this character a pressure equalizing means for causing a pressure to exist inside the unit which is substantially equal to the external pressure on the unit. When the unit is installed in a well, the hydrostatic pressure thereon is very great. By providing an arrangement for equalizing this external pressure by creating an internal pressure, I reduce the strains on the unit to a minimum.

It is another object of the invention to provide a pumping unit of this character having a novel means for conveying oil pumped by this unit to the surface of the ground. I accomplish this means in the form of a flexible tubing which is connected with the exhaust port of the pump. The flexible tubing may be carried by a drum at the surface of the ground, the tubing being readily wound thereon or unwound therefrom during the raising or lowering of the unit in the well.

It is another object of the invention to provide a means which will permit the removing of the flexible tubing from the well previous to the removing of the pumping unit. I provide a separable joint for connecting the flexible tubing to the pump unit. This joint is sufficiently strong to prevent a leakage thereat under ordinary conditions, but is separable when an appreciable pull is exerted on the flexible tubing.

It is another object of this invention to provide a pumping equipment in which settling of particles of sand in the pump will be minimized. My invention employs a discharge passage of a comparatively small diameter so that the velocity of the oil will be greater than the gravitation of the sand. Therefore, the sand will be carried out with the oil.

It is another object of the invention to provide a pump member of this character

which is simple in construction, low in first and repair cost, and which is very durable.

It is also an object of this invention to provide a novel form of reciprocating mechanism for reciprocating the plunger of the pump construction of my arrangement.

It is a further object of the invention to provide in a pumping unit of this character a thrust receiving means which is employed in conjunction with the reciprocating mechanism of the unit.

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

Referring to the drawings which are for illustrative purposes only,

Fig. 1 is a diagrammatic perspective view partially sectioned, delineating the utility of my invention.

Fig. 2 is a vertical sectional view taken through a pump unit embodying the features of my invention.

Fig. 2A is a partially sectioned view of the extreme upper part of the unit shown in Fig. 2.

Fig. 3 is an enlarged section taken on the line 3—3 of Fig. 2.

Fig. 4 is an enlarged section taken on the line 4—4 of Fig. 2, this view showing a portion of the pump plunger reciprocating mechanism.

Fig. 5 is an enlarged fragmentary partially sectioned view showing a portion of the pump reciprocating mechanism of my invention.

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

The form of my invention shown in the drawings comprises a pumping unit 11 which is clearly shown in Figs. 2 to 6. With particular reference to Fig. 2, the unit 11 has a cylindrical shell 12 having an upper pump head 13 secured in the upper end thereof. Inside the tubular body 12 and below the upper head 13 is a lower head 14, said shell and said upper and lower heads defining an oil chamber 15. Extending between the heads 13 and 14 and extending through the oil chamber 15 is a pump barrel 17 in which a pump plunger 18 is arranged. Extending downward from the plunger 18 is a pump plunger rod 19 which extends through a stuffing box 20 carried by the lower head 14. Connecting between the upper end of the barrel 17 and the side of the unit 11 is an upper intake port 22 having a valve 23 for preventing an outward flow of oil therethrough. A lower inlet port 24 connects between the lower end of the barrel 17 and a side of the unit 11, this port 24 having a valve 25 and preventing an outward flow of oil. An upper exhaust port 27 is connected to the upper end of the pump barrel 17 and extends to the upper face of the upper head 13 as shown, this exhaust 27 having a valve 28 for preventing an inward flow of oil. A lower exhaust port 30 is connected with the lower end of the barrel 17

and communicates with the oil chamber 15 as shown. Said lower exhaust port 30 is provided with a valve 32 for preventing a reverse flow therethrough. A passage 33 is provided in the upper body 13 for communicating between the oil chamber 15 and the upper exhaust port 27, this passage connecting with the port 27 above the valve 28 as shown. The pump plunger 18 is reciprocated in the barrel 17 by means of the plunger rod 19 to pump oil from the well. During the downward stroke of the plunger 18, oil is drawn into the upper end of the barrel 17 through the upper inlet port 22. During the upward stroke of the plunger 18, the oil previously drawn into the upper end of the barrel 17 is exhausted through the upper exhaust port 27, the valve 23 in the intake port 22 being closed at this time. Also during the upward stroke of the plunger 18 oil is drawn into the lower end of the barrel 17 through the lower intake port 24. When the plunger 18 again moves downward, oil is forced from the lower portion of the barrel 17 through the lower exhaust port 30 into the oil chamber 15. Oil in the chamber 15 at this time is forced through the passage 33 into the upper end of the exhaust port 27. A flexible tubing 35 is connected with the exhaust port 27 by means of a break joint 36. The oil as it is pumped passes from the exhaust port 27 through the flexible tubing 35 to the surface of the ground as will be explained later.

The break joint 36 comprises a member 37 which is threadably secured as at 38 into the upper end of the exhaust port 27. The member 37 has a passage 39 which extends therethrough. The upper end of the passage 39 is enlarged at 41 having a beveled face 42 provided at the point at which the passage 39 is enlarged. At the lower ends of the flexible tubing 35 I provide a male member 43 which is adapted to be inserted into the enlargement 41, this male member 43 having a head which provides a conical face 44 adapted for engagement with the beveled face 42 of the member 37. The lower end of the male member 43 is reduced in size and extends into the passage 39 serving as a centralizer. Dogs 46 are carried by the member 37, engagement faces 47 of these dogs 46 being forced into contact with a tapered face 48 of the male member 43. The dogs 46 are forced into engagement with the tapered face 48 by springs 50 which are arranged in recesses 51 in the member 37. The pressurable engagement between the dogs 46 and the tapered face 48 tends to retain the conical face 44 of the male member tightly against the beveled face 42 of the member 37 so that there will be no leakage of oil therebetween. The pressurable engagement between the dogs and the male member 43 is sufficient to retain the male member seated under ordinary conditions. However, the joint may be broken by exert-

ing an appreciable pull upon the male member 43, thus forcing the dogs outward into the recesses 51 and allowing the head of the male member 43 to pass upwardly thereby. The utility of this particular form of joint will be explained hereinafter.

Secured to the lower end of the pump plunger rod 19 is a square reciprocable member 55 of a plunger reciprocating mechanism 56, this plunger reciprocating mechanism 56 being situated in a lubricating chamber 54 provided by the shell 12 below the pump mechanism of the unit. This member 55 provides an internal opening 57 which is open at the lower end thereof. This opening 57 is adapted to receive a rotatable member 58 of the pump reciprocating mechanism 56. The diameter of the internal opening 57 and the diameter of the rotatable member 58 are approximately the same size so as to prevent radial vibration therebetween. Thread grooves 60 and 61 are provided in the rotatable member 58 as clearly shown in Figs 2 and 5. The thread grooves 60 and 61 are helical and extend from the lower part of the rotatable member 58 to the upper part and are connected together at the upper and lower ends by plane grooves 63 and 64. Extending into the helical grooves of the member 55 is a follower pin 67, this pin 67 having a rectangular portion 68 which is arranged to extend into the grooves of the member 55. A cylindrical portion 70 of the pin 67 extends through a bushing 71. The bushing 71 is threaded at 72 into an opening in the wall of the reciprocable member 55. In assembling these parts, the upper end of the rotatable member 58 is extended into the lower end of the opening 57 in the reciprocable member 55 whereafter the follower pin 67 is extended into the grooves 63, the bushing 71 being threaded into the opening in the reciprocable member for retaining the pin 67 in place.

The rotatable member 58 has a radial flange 75 formed at the lower end thereof. A connector member 76 is secured to the lower end of the member 58 by means of a threaded extension 77. The connector 76 is provided with a radial flange 79 which is spaced away from the flange 75. Extending between these flanges 75 and 79 is a web 82 which is formed integral with a cylindrical portion 83 secured inside the shell 12 as shown. Between the adjacent faces of the flanges 75 and 79 and the web 82, ball bearings 84 are placed. This construction supplies a double thrust bearing arranged to eliminate axial movement in the rotating member 57. A flexible connection 86 joins the connector 76 with a shaft 87 of a motor 88. This motor 88 is secured in the shell 12 as shown in Fig. 2, the shaft 87 thereof being in axial alignment with the rotating member 58 and the connector 76.

When the rotating member 58 is rotated by means of the motor 88 in a direction in-

dicated by the arrow 89, the follower pin 68 is caused to move downward in the helical groove 60 of the member 58, thus lowering the plunger 17 by means of the reciprocable member 55 and the plunger rod 19. When the follower pin 68 reaches the lower end of the helical groove 60, it will ride into the lower plane groove 64. The plane groove 64 connects with the lower end of the helical groove 61. As the member 58 rotates, the follower pin will enter the lower end of the groove 61 and ride upward therein until it reaches the upper plane groove 63. This reciprocates the plunger 17 upwardly, the reciprocable member 55 moving from the dotted line position 90 into the full line position shown in the drawings. Rotation of the reciprocable member 55 is prohibited by a bracket member 92 which is secured to the lower face of the lower head 14, said bracket having a foot 93 in which a square opening 94 is formed. The reciprocable member 55 extends through this opening 94 and is restricted from rotation thereby. From the drawings it will be seen that the helical grooves 60 and 61 intersect, but owing to the fact that the portion 68 of the follower pin 67 is elongated as clearly shown in Fig. 5, this portion 68 will ride by the intersections without interference.

In the lower portion of the inner shell 12, below the motor 88, is placed an equalizing plug 96 which comprises a disc 97 and cup leathers 98 which are secured to the disc 97 by means of suitable bolts 100. A closure member 101 is secured to the extreme lower end of the shell 12, this closure member having orifices 102 extending therethrough which communicate between the exterior of the shell 12 and the interior of the shell 12 below the plug 96. Hydrostatic pressure on the exterior of the shell 12 enters the portion of the shell below the plug 96 exerting a pressure thereagainst. The plug 96 in turn exerts a pressure on the interior of the shell 12 thereabove, causing the pressure inside the shell below the head 14 to equalize the external pressure this equalization of pressure above the motor being possible by reason of the fact that the external pressure is transmitted through the motor and past its shaft bearings which are loose enough to permit the motor to run freely. This pressure equalizing arrangement reduces considerable strain on the pumping unit by counteracting the external pressure. The lubricating chamber 54 and the space around the motor 88 above the plug 96 are filled with lubricating oil for lubricating the various moving parts.

Threaded at 104 into the upper head 13 is a connector rod 105 having an eye 106 formed at the upper end thereof as shown in Fig. 2A of the drawing. Legs 107 of a cable clamp 108 extend to either side of the eye 106 and a pin 109 is extended therethrough for con-

necting these parts together. A cable 110 is extended into an opening 111 in the connector 108, this cable being permanently secured in place. It is necessary to employ
 5 a connector rod of the length shown because of the situation of the break joint 36. Wires 112 for supplying current to the motor 88 are extended through the cable 110 as shown in Fig. 2A. The wires extend from the lower
 10 end of the cable 110 and pass through an opening in the body 13, through the oil chamber 15, through an opening in the lower head 14, through the lubricating chamber 54, through an opening in the web 82 and are
 15 connected to the motor 88 as shown. Suitable stuffing boxes 114 and 115 are provided in the heads 13 and 14 to prevent a leakage around the wires 112.

The operation of the device is substantially
 20 as follows: As shown particularly in Fig. 1, the pump unit 11 is lowered to the bottom of a well 121 by means of the cable 110. The cable 110 extends upward through a well tubing 122 from the pump unit 11 to the
 25 top of a derrick 124 and over a sheave 125 of a crown block 126, situated at the top of the derrick 124. The cable 110 extends downward from the sheave 125 to a cable drum 127 which rotates on a shaft 128, the shaft
 30 128 being rotated by a belt 130 which extends over a drive pulley 131. To lower the unit 11 into the well 121, the cable drum 127 is rotated in a manner to unwind the cable 110. Flexible tubing 35 which is connected to the
 35 pump unit 11 by the break joint 36 is wound on a tubing drum 135 which may be situated adjacent to the drum 127 as diagrammatically shown in Fig. 1. During the lowering of the unit 11, the tubing 35 is unwound
 40 from the drum 125, the flexible tubing extending over a sheave 136 rotatably secured to a jack 137, the flexible tubing passing from the sheave 136 through the well casing 122 to the unit 11. When the unit 11 has reached
 45 its proper position at the bottom of the well, the flexible tubing 35 is detached from the drum 135, and the end thereof is extended as indicated by the dotted lines 140 to a pipe 141 which connects with a suitable oil stor-
 50 age, not shown. When the unit 11 has reached the bottom of the well, there is no further rotation necessary of the drum 127. Therefore, the wires 112 may be connected with wires 143 which connect to a source of
 55 energy, this supplying a source of electricity for operating the motor 88 in a manner to actuate the pump reciprocating mechanism 54 and to elevate and depress the pump plunger 17. The oil being pumped by the
 60 pump construction as described, passes from the upper exhaust port 27 through the break joint 36 and is carried upward to the top of the well through a flexible tubing 35. The flexible tubing 35 delivers the oil to the pip-
 65 ing 141 which carries it to a suitable storage

facility, not shown. To elevate the pump unit 11 to the surface of the ground, I first exert a pull upon the flexible tubing 35 so as to separate the members 43 and 37 of the break joint 36, as previously described. The
 70 upper end of the tubing 35 is detached from the piping 141 and is secured to the drum 135. The drum 135 is then rotated in a manner to wind the flexible tubing 35 thereupon. The wires 112 are then detached from
 75 the circuit wires 143 and the cable drum 127 is rotated in a manner to wind the cable 110 thereupon, and to elevate the unit 11 to the surface of the ground. By the provision of the break joint 36, it is possible to separately
 80 wind the flexible tubing 35 and the cable 110. This greatly simplifies the elevating of the unit 11. It may be desirable to substitute a rigid tubing in place of the flexible tubing 35. This substitution may be readily made
 85 by removing the break joint 36 and screwing the lower end of the rigid tubing into the mouth of the upper exhaust port 27. By providing all of the joints of the rigid tubing left-handed, except at the connection of the
 90 rigid tubing to the unit 11 which will be right-handed, it will likewise be possible to rotate the rigid tubing, detaching it at the unit 11, thus permitting the rigid tubing to be removed from the well previous to the
 95 removing of the unit 11.

From the foregoing description, it is evident that the arrangement just described overcomes the disadvantages of the present type of pumping equipment. The pumping
 100 member may be very quickly lowered or elevated in the well owing to the rapidity with which the cable 110 may be wound or unwound on the drum 127. The reciprocating mechanism is extremely simple in construction, and is of such a design as to efficiently reciprocate the plunger 17 of the pump.

I claim as my invention:

1. In a pump, the combination of: a shell
 110 arranged to be lowered into a well; a motor situated within said shell; a pump situated within said shell above said motor; reciprocating means connected between said motor and said pump for reciprocating the
 115 plunger of said pump; and means for placing a pressure inside said shell equal to the pressure outside said shell.

2. In a pump, the combination of: a shell
 120 arranged to be lowered into a well; a motor situated within said shell; a pump situated within said shell above said motor; reciprocating means connected between said motor and said pump for reciprocating the plunger
 125 of said pump; and a plunger situated in said shell below said motor, said plunger being acted upon by the exterior pressure through an opening in said shell in such a manner as to make the pressure in said shell equal to the exterior pressure.

3. In a pump, the combination of: a shell arranged to be lowered into a well and providing a lubricant containing chamber; a motor situated in said chamber; pump operating connections in said chamber, driven by said motor; a pump connected with and operated by said connections; and means for placing said lubricant in said chamber under a pressure substantially equal to the pressure outside said shell.

4. In a pump, the combination of: a shell arranged to be lowered into a well and providing a lubricant containing chamber; a motor situated in said chamber; pump operating connections in said chamber, driven by said motor; a pump connected with and operated by said connections; and a plunger situated in one end of said chamber and acted upon by the exterior pressure through an opening in shell in such a manner as to make the pressure in said lubricant chamber substantially equal to the pressure outside said shell.

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

BENJAMIN F. SCHMIDT.

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