

Aug. 21, 1934.

C. J. COBERLY

1,970,596

LONG STROKE PUMPING MECHANISM

Filed Oct. 8, 1928

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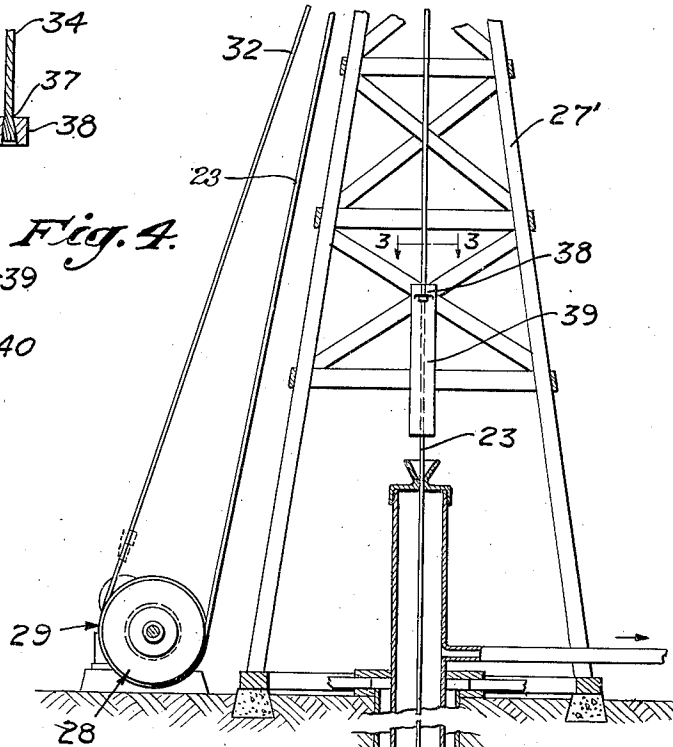
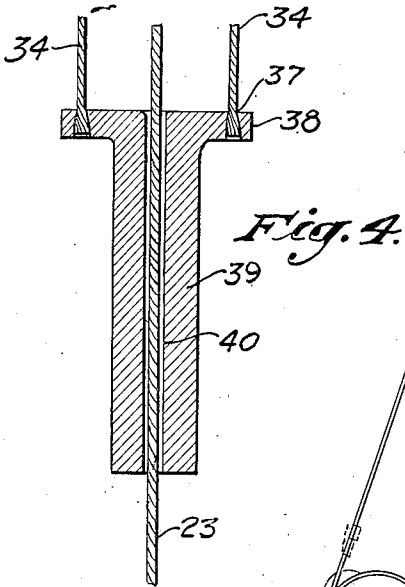
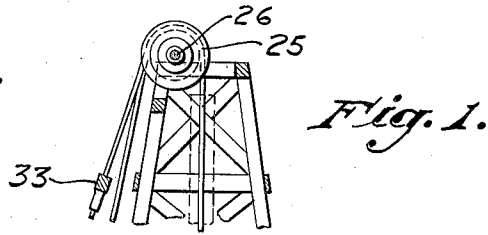
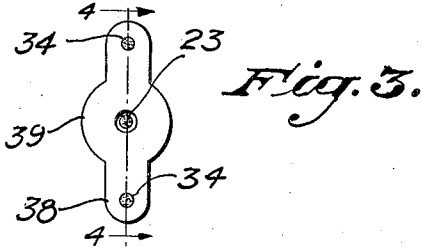
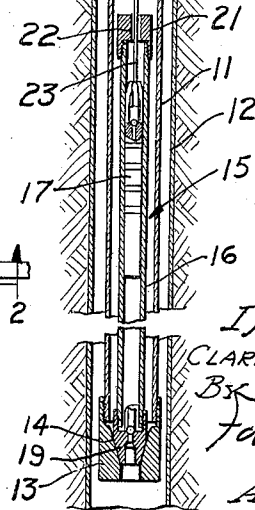
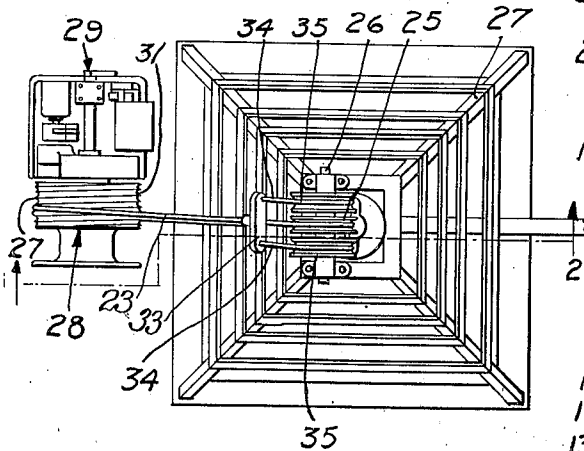


Fig. 2.



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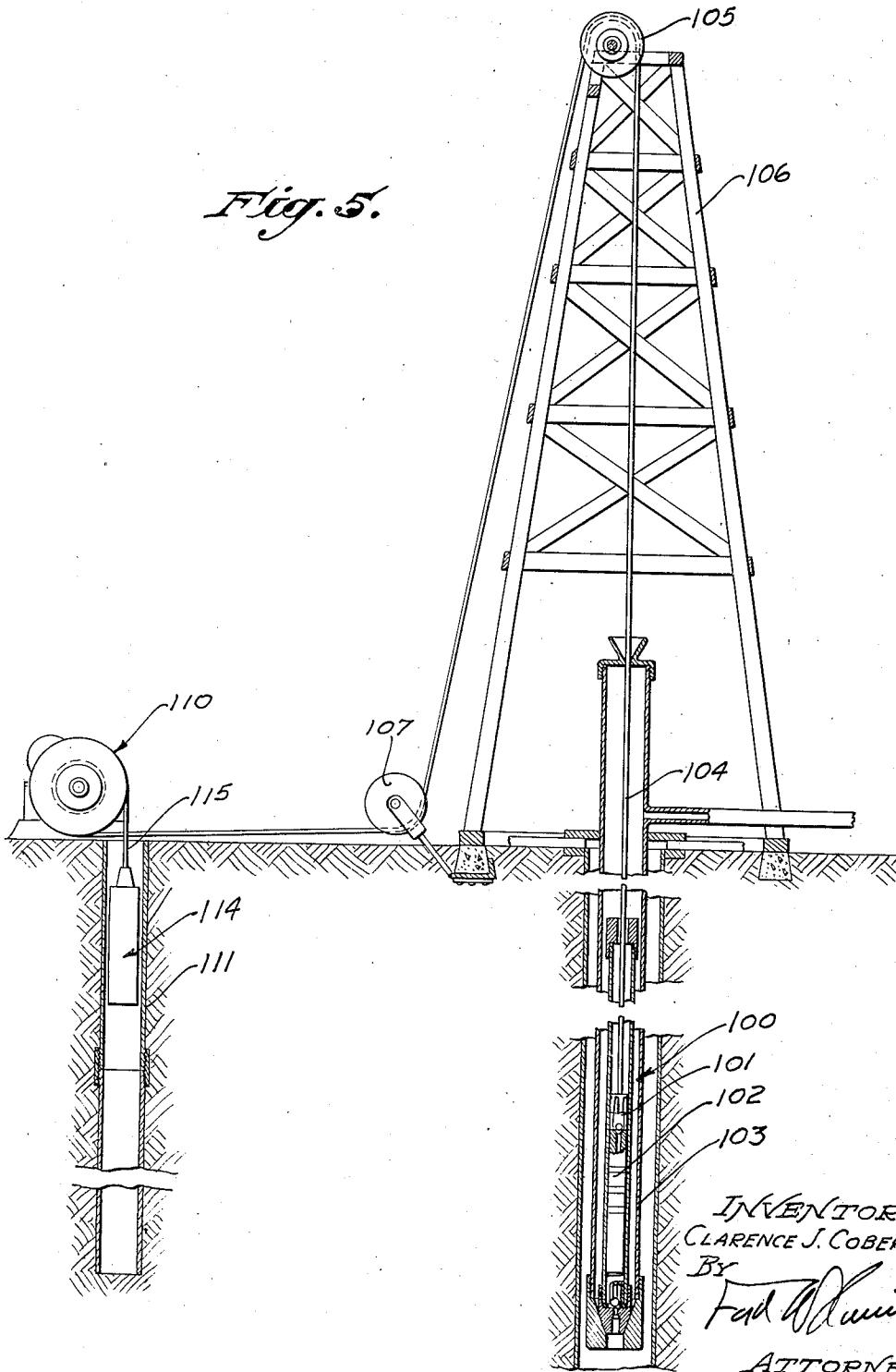
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Fig. 5.



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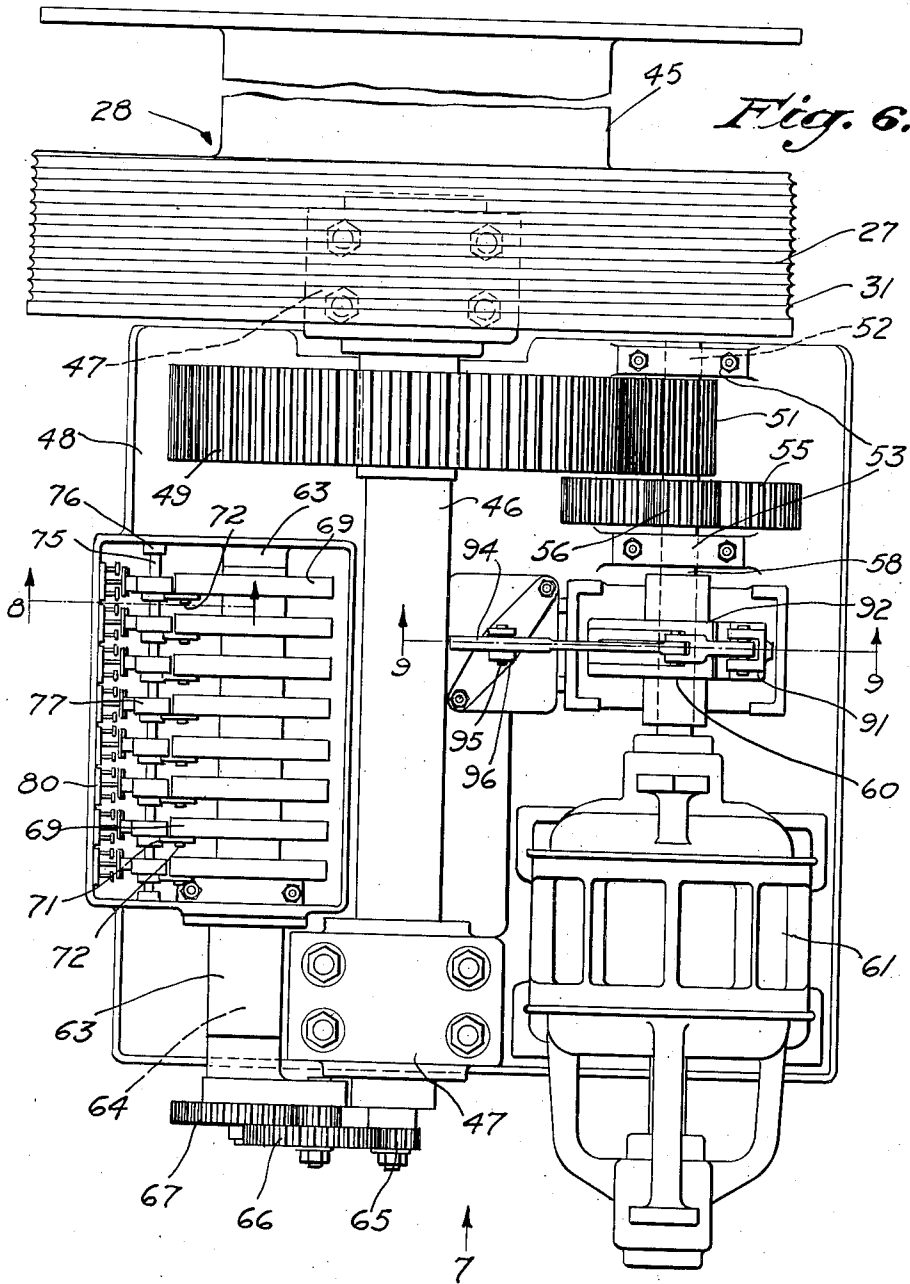
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LONG STROKE PUMPING MECHANISM

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LONG STROKE PUMPING MECHANISM

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Fig. 7.

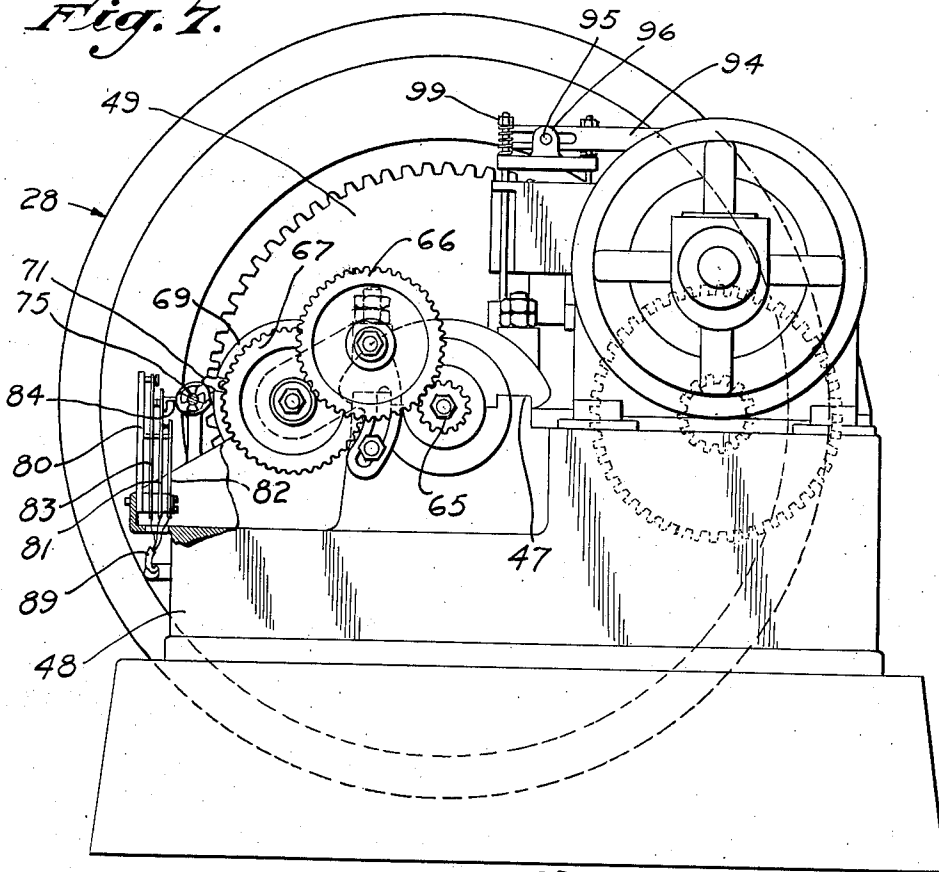


Fig. 8.

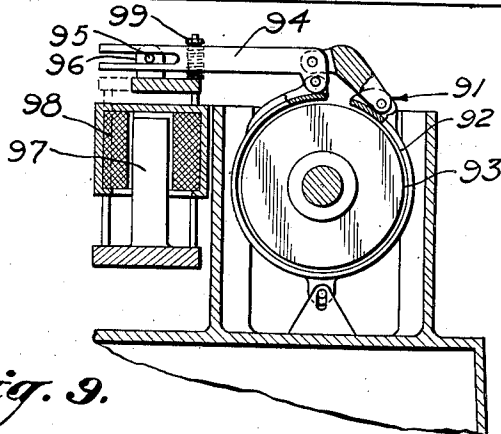
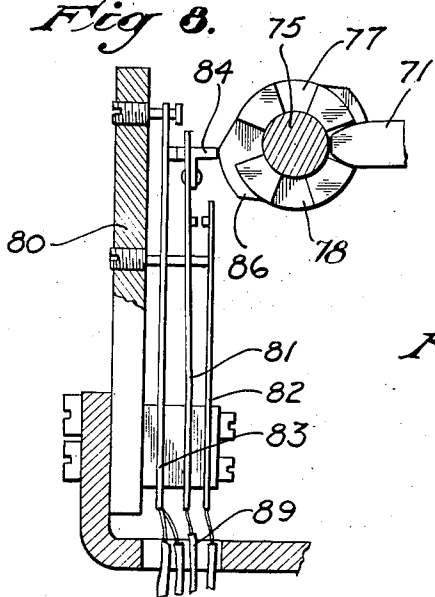


Fig. 9.

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UNITED STATES PATENT OFFICE

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LONG-STROKE PUMPING MECHANISM

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of California

Application October 8, 1928, Serial No. 311,007

1 Claim. (Cl. 254—178)

My invention relates to the oil pumping industry, and relates particularly to a novel long-stroke mechanism.

It is common practice in the oil pumping industry to extend a pump tubing into a well to the lower end of which pump tubing there is secured a pump barrel. Adapted to reciprocate in the pump barrel is a pump plunger to which the lower end of a string of sucker rods is connected. The string of sucker rods extends upwardly through the pump tubing and the upper end thereof is connected to a walking beam by means of which the pump plunger is reciprocated in the pump barrel in order to elevate oil to the surface of the ground. The stroke of the pump when using the walking beam as a reciprocating means is limited to about four feet.

The standard type of pump works well in wells of three thousand feet depth or less, but its operation in deeper wells is rather uncertain. This is due to the fact that the diameter of the sucker rods is limited by well conditions, and as the load is imposed thereon on the upstroke of the pump, the rods stretch due to their elasticity, this stretch being taken up at the beginning of the downstroke when the load is taken off the rods.

The amount of elongation of the rods is indefinite and uncertain, but in very deep wells may become so great that nearly the entire four foot stroke is taken up in stretching and releasing the rods, the pump plunger having a very short stroke. If, for example, in a deep well the rods are stretched three feet by the normal load thereon, it is obvious that with a four foot stroke the plunger will move only one foot and the capacity of the pump will be only one quarter the full capacity.

If, however, the same rods are used to operate a nine foot stroke pump, the pump will operate at two-thirds its full capacity. It is, therefore, obvious that considerable economies can be effected by increasing the stroke. Many attempts have been made to provide mechanism by which such longer strokes can be obtained.

It is an object of this invention to provide a long-stroke pumping mechanism capable of a very long stroke and susceptible of ready adjustment.

It is another object of this invention to provide a long-stroke pumping mechanism of this character in which the pump is operated through a flexible member which is connected directly to the pump plunger.

It is a further object of my invention to provide a long-stroke pumping mechanism in which the

weight placed on the driving unit thereof by the pump plunger is counterbalanced.

It is also an object of this invention to provide a long-stroke pumping mechanism of the character mentioned in which the pump may be quickly removed from the well for inspection or repair by winding up the flexible member.

It is another object of this invention to provide in a long-stroke pumping mechanism of the character mentioned a driving unit having an integral drum which is provided with individual sections for reciprocating a flexible member and for winding it up.

A further object of this invention is to provide a long-stroke pumping mechanism of the character mentioned in which the prime mover is operated in one direction and then in the other to obtain the desired stroke, with the speed and reversing operation automatically controlled.

Another object of the invention is to provide a long-stroke pumping mechanism of the character mentioned in which higher speed on the downstroke can be made than on the upstroke.

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

Referring to the drawings in which I illustrate this invention,

Fig. 1 is a vertical section through an oil well having the long-stroke pumping mechanism of my invention installed therein.

Fig. 2 is a plan view of Fig. 1.

Fig. 3 is a section taken on the line 3—3 of Fig. 1, this view showing the counterweight of the invention.

Fig. 4 is a section taken on the line 4—4 of Fig. 3.

Fig. 5 is a vertical section through an oil well employing an alternative form of this invention.

Fig. 6 is a plan view of a driving unit which forms a part of the invention.

Fig. 7 is an end view of Fig. 6 taken as indicated by the arrow 7 of Fig. 6.

Fig. 8 is a fragmentary section taken on the line 8—8 of Fig. 6, this view showing a portion of the current control mechanism of the driving unit.

Fig. 9 is a fragmentary section taken on the line 9—9 of Fig. 6, showing a solenoid brake of the driving unit.

Referring particularly to Fig. 1, my invention employs an oil tubing 11 which is adapted to be lowered into a well 12. The lower end of the oil tubing 11 is provided with a shoe 13 having a conical seat 14. Placed at the lower end of the oil

tubing 11 is an oil well pump 15 which consists of a pump barrel 16 and a pump plunger 17. The lower end of the pump barrel 16 is provided with a standing valve 19 which engages the conical seat 14 of the shoe 13 and thus seals the lower end of the oil tubing 11. The upper end of the pump barrel 16 is provided with a collar 21 which has an opening 22 provided therein.

The pump plunger 17 is reciprocated in the pump barrel 16 by means of a flexible cable 23. This cable 23 is secured directly to the upper end of the pump plunger 17, extending through an opening in the collar 21. The cable 23 extends upwardly through the oil tubing 11 and extends over a sheave 25 which is supported on a shaft 26, which shaft 26 is positioned at the upper end of a derrick 27'. The cable 23 extends downwardly from the sheave 25 and is wound on a portion 27 of the drum 28, this drum 28 being a part of a driving unit 29. The portion 27 of the drum 28 is provided with helical grooves 31 onto which the cable 23 is wound. The cable 23 is wrapped around the portion 27 of the drum 28 a sufficient number of times to obtain considerable friction so that the cable will be moved according to the rotation of the drum 28.

The cable 23 extends upwardly from the drum 28 and an end 32 thereof is secured to a yoke 33. Attached to the yoke 33 is a pair of cable members 34, these cables being positioned on opposite sides of the cable 23. The cable members 34 extend upwardly from the yoke 33 and pass over sheaves 35 which are also supported by the shaft 26. The cable members 34 extend downwardly from the sheaves 35 on opposite sides of the cable 23. The lower ends of the cable members 34 are secured, as indicated at 37, to ears 38 formed at the upper end of a counterweight 39. The counterweight 39 surrounds the cable 23, having a vertical opening 40 formed centrally therein through which the cable 23 may extend.

The construction of the driving unit 29 of my invention is shown clearly in Figs. 6 to 9 inclusive, reference to which will now be had. The drum 28 is provided with a cylindrical spooling portion 45 which is formed directly adjacent to the portion 27 thereof. The drum 28 is rigidly secured on a shaft 46 which is rotatably supported by bearings 47, these bearings 47 being supported by a base 48. A gear 49 is mounted on the shaft 46 next to the drum 28, which gear 49 is in mesh with a pinion 51. The pinion 51 is secured on a shaft 52 which is rotatably supported by bearings 53. Also secured on the shaft 52 is a gear 55 which meshes with a pinion gear 56. The pinion gear 56 is secured at one end of a motor shaft 58. The motor shaft 58 is connected by means of a joint 60 to a slip ring motor 61, by means of which the driving unit 29 is operated. The motor 61 rotates the motor shaft 58 which rotates the shaft 52 through the pinion gear 56 and the gear 55. The pinion 51 rotates with the shaft 52 and rotates the gear 49 which in turn rotates the shaft 46. The shaft 46 rotates the drum 28 therewith.

In order to reciprocate the pump plunger 17 in the pump barrel 16, it is necessary to move the cable 23 alternately in opposite directions. This is accomplished by first rotating the drum 28 in one direction and then rotating it in an opposite direction. To accomplish this rotating of the drum 28 alternately in opposite directions it is necessary to alternately reverse the current supplied to the motor 61 so that the armature thereof will first be rotated in one direction and then

in the opposite direction. Such means as this are well known in the art and it is not necessary to go into considerable detail as to the construction thereof. However, in Figs. 6 to 9 inclusive, I show diagrammatically a current control means for reversing and controlling the supply of current to the motor 61.

Rotatably supported in bearings 63 of the base 48 is a shaft 64. The shaft 64 is rotated by means of the drum shaft 46 by a chain of gears 65, 66, and 67 which are interchangeable so that various gear ratios between the shaft 46 and the shaft 64 may be obtained. Secured to the shaft 64 between the bearings 63 is a plurality of discs 69. The discs 69 carry teeth 71 which are secured thereto by cap screws 72, these teeth 71 being adjustable at various positions. Extending parallel to the shaft 64 and directly adjacent thereto is a cam shaft 75 which is supported in bearings 76. The cam shaft 75 carries a plurality of cams 77, there being one cam for each disc 69. The cams 77 are provided with pockets 78 into which the teeth 71 may extend as the discs revolve in order to revolve the cams 77 one-fourth of a revolution.

Associated with each of the cams 77 is a switch member 80. The switch member 80 includes a central spring contact 81 and front and back contacts 82 and 83, respectively. The upper end of the central contact 81 is provided with an engager 84. The engager 84 is adapted to be engaged by cam portions 86 of each of the cams 77. When the engagers 84 are engaged by the cam portions 86, the central spring contacts 81 are contacted with the rearward spring contacts 83. When the cams 77 are in such positions that the engagers 84 are not in engagement with the cam portions 86, the central spring contacts 81 are in engagement with the forward spring contacts 82. The spring contacts 81, 82, and 83 have wires indicated at 89 connecting the contacts as part of a standard control system. Such systems for reversing and controlling the speed of motors are well known in the art and need not be described herein. As the driving unit operates, the various cams 77 are moved so that the motor is harmonically accelerated from zero to maximum R. P. M. and is harmonically decelerated from maximum R. P. M. to zero. The current is then reversed and the motor is operated in an opposite direction.

When the drum 28 revolves in one direction, the cable 23 is moved in such a manner that the pump plunger 17 is moved through its upward stroke, and when the drum 28 is rotated in an opposite direction, the pump plunger 17 is moved through its downward stroke.

The weight of the plunger which carries the oil is counterbalanced by the counterweight 39; therefore the labor of the driving unit is reduced to a minimum. The length of stroke of the pump plunger 17 may be readily changed by changing the rotations of the slip ring motor 61 in a given direction, which is conveniently accomplished by adjusting the current control arrangement in the line, as required.

The driving unit 29 is provided with a solenoid brake 91 which is illustrated best in Fig. 9. The solenoid brake 91 consists of a brake band 92 which surrounds a drum face 93 provided by the joint 60. The brake band 92 is constricted on the drum face 93 by means of a lever 94. The lever 94 is engaged by a pin 95 which is carried by a yoke 96. The yoke 96 has a solenoid bar 97 which extends upwardly from the lower part

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thereof into a solenoid coil 98. When the current is supplied to the motor 61, the solenoid bar 97 is pulled upwardly into the solenoid coil 98 and the brake band 92 is in expanded position. However, when the current ceases, the solenoid bar 97 will drop due to its weight and due to the action of the springs 99, and the band 92 will be caused to engage the drum face 93. The brake arrangement 91 therefore prevents a movement of the drum 28 when there is no flow of current to the motor 61. In practice I prefer to use the solenoid brake merely as a safety device which is never applied unless the pump is shut down or the supply of current fails, the ordinary deceleration of the motor being taken care of by inserting resistance in the motor secondary.

When it is desired to remove the pump 15 from the well, the cable 23 is removed from the portion 27 of the drum 28 and is extended around the spooling portion 45 thereof. Also the counterbalance 39 is detached from the cable 23 preferably by detaching the cable 23 from the yoke 33. The motor 61 is then continuously operated in one direction and the cable 23 is wound on the spooling portion 45 of the drum 28. The entire pump 15 is lifted to the surface of the ground when the cable 23 is wound up.

Referring to Fig. 1 it will be seen that the collar 21 of the upper end of the pump barrel 16 provides a shoulder which is engaged by the upper end of the pump plunger 17 when the pump plunger 17 is moved upwardly beyond its normal stroke. The lower end of the oil tubing 11 is opened when the pump 15 is removed from the position at the lower end thereof, and the oil in the tubing may drain therefrom.

In Fig. 5 I show an alternative form of my invention which consists of an oil well pump 100 which is of the same construction as the oil well pump 15, consisting of a pump barrel 101 and a pump plunger 102, and being located at the lower end of an oil tubing 103. A flexible member in the form of a cable 104 extends upwardly through the oil tubing 103 and extends over a sheave 105 mounted at the upper end of a derrick 106. The cable 104 extends downwardly from the sheave 105 and passes around a pulley 107 which

is rotatably secured near the lower end of the derrick 106 and at one side thereof. The cable 104 extends horizontally from the pulley 107 to a driving unit 110 which is identical in construction with the driving unit 29.

A counterweight well 111 is drilled directly adjacent to the driving unit 110, and placed in the well 111 is a counterweight 114 which is connected to an extending end 115 of the cable 104. The operation of this form of my invention is substantially the same as the operation of the first form of my invention. The essential difference in construction is that the counterweight 114 is situated in a counterweight well 111 at one side of the derrick and is not placed inside the derrick as in the form of the invention shown in Fig. 1.

The important features of the invention have been clearly expressed in the foregoing description. It is finally pointed out, however, that this invention makes it possible to obtain an extremely long stroke of the pump, which stroke may be readily adjusted as previously described by merely changing the contacts on the limit switch or by changing the gearing ratio. In my invention all sucker rods are eliminated and the flexible member or cable is secured directly to the pump plunger. Another important feature of the invention is that the entire pump may be elevated to the surface of the ground simultaneously.

I claim as my invention:

In an apparatus for reciprocating a primary member in a well, the combination of: a drum capable of being rotated in opposite directions; a flexible member wound around said drum and having an end thereof connected to said primary member; a counter-weight connected to the other end of said flexible member for frictionally engaging said flexible member with said drum so that said flexible member is driven by said drum to reciprocate said primary member, said counter-weight being guided by the portion of said flexible member intermediate said drum and said primary member.

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