

May 29, 1934.

E. C. EKSTROMER

1,960,484

MULTIPLE MOTOR UNIT FOR OIL WELL PUMPS

Filed Feb. 16, 1931

2 Sheets-Sheet 1

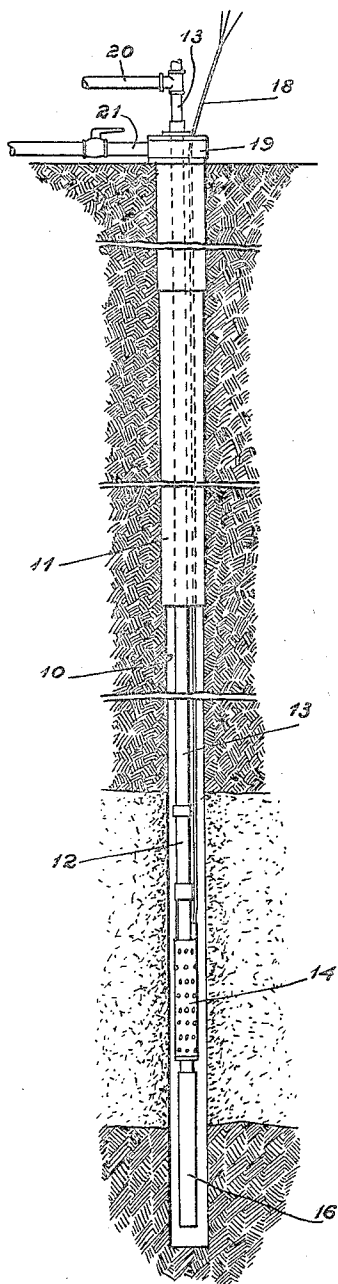


Fig. 1

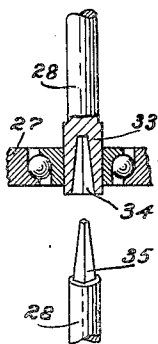


Fig. 3.

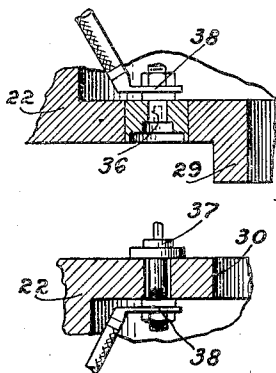


Fig. 4

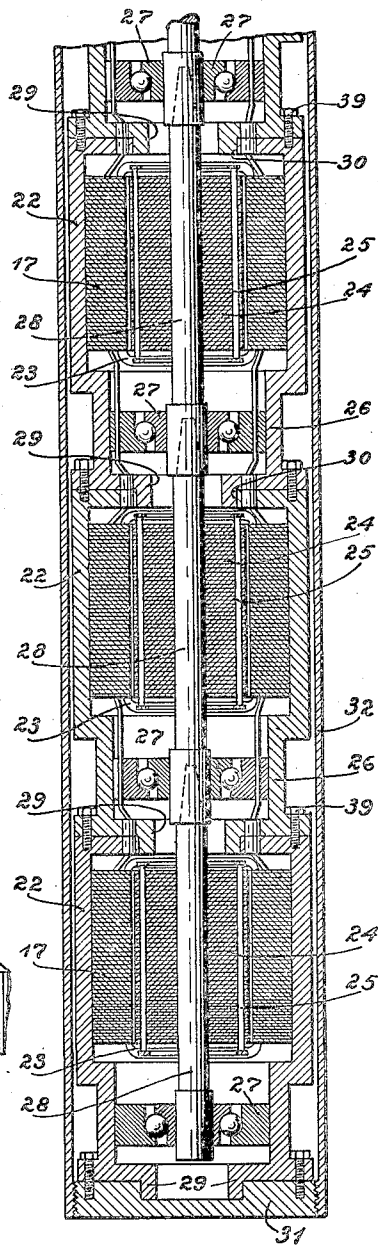


Fig. 2.

INVENTOR.

EDWARD C. EKSTROMER.

BY *Wm. H. Robinson*
ATTORNEY.

May 29, 1934.

E. C. EKSTROMER

1,960,484

MULTIPLE MOTOR UNIT FOR OIL WELL PUMPS

Filed Feb. 16, 1931

2.Sheets-Sheet 2

INVENTOR,

EDWARD C. EKSTROMER

BY J. H. Atkinson
ATTORNEY.

UNITED STATES PATENT OFFICE

1,960,484

MULTIPLE MOTOR UNIT FOR OIL WELL PUMPS

Edward C. Ekstromer, Redwood City, Calif., assignor of one-half to Blanche Nash Gallagher, Berkeley, Calif.

Application February 16, 1931, Serial No. 515,952

4 Claims. (Cl. 172—36)

My present invention relates to pumping apparatus and more particularly to an oil pumping unit in which a plurality of electric motors are disposed in a well below the pump.

5 An object of my invention is to provide an improved form of oil well pump wherein the electric motors and the pump can be lowered into the well as a unit.

10 Another object of my invention is to provide an improved arrangement of motors for oil well pumps and the like, whereby a power unit of any desired capacity can be obtained without necessitating an enlargement of the well casing.

15 A further object of my invention is to provide a drive for oil well pumps which can be located in the well beneath the pumps.

20 Another object of my invention is to provide a motor of special construction for deep wells which can be readily and conveniently assembled in any number to provide a power unit of a desired horsepower.

25 Other objects and advantageous features of my invention will be set forth at length in the following description wherein I have outlined in full that form of apparatus selected for illustration.

30 At the present time oil well pumps of the reciprocating type are operated by means of a motive power unit located on the surface at the top of the well. These units comprise a prime mover, a walking beam which is oscillated by means of a pitman connected to the prime mover and a sucker rod which is attached to the walking beam and caused to move with a reciprocating movement as the walking beam is oscillated. The sucker rod extends downwardly into the well where it connects to the moving parts of the pump. The use of such a sucker rod is attended with many undesirable features, some of which are stretching, whipping, and its weight. All of these undesirable features become more exaggerated as the depth of the well increases and it is therefore desirable that some means be provided whereby these difficulties can be overcome.

45 In order to overcome these difficulties, I propose to construct a prime mover element for operating a reciprocating oil well pump which can be lowered into the well and which will dispense with the use of the above referred to motive power unit and its cooperating sucker rod. The greatest obstacle in providing such a prime mover element is in constructing a unit small enough to be inserted into the well casing, which casing is of a relatively small diameter for such a purpose.

55 This restriction in the size of such a unit, how-

ever, applies only to its horizontal or diametrical dimensions and since it can be made of almost any desired length, I propose to build an electro-mechanical power element by employing a plurality of smaller units, each of which is small enough to be inserted in the well.

60 Many previous attempts have been made to provide a driving unit for oil well pumps which could be lowered in the well with a pump. In all these prior attempts, so far as I am aware, the driving motor has been located above the pump and as a result the motor has been found to constitute a serious problem in that it forms a constriction in the well casing which will interfere with the flow of oil from the pump. This means that the motor cannot be made as large in diameter as would be possible if provision did not have to be made for the oil flow from the pump. It is well known that the casings in deep wells are not of a very large diameter at the bottom of the well and consequently the diameters of the motors must be comparable with the casing. In my prior applications, Serial Number 244,208, filed January 3, 1928, and Serial Number 266,471, filed April 2, 1928, I show pump drives in which a plurality of motors are incased in a special housing through which there is provided suitable conduits for the flow of oil from the pump. In these arrangements the provision of the conduits adjacent the motors greatly limits the space for the motors and as a result the motors cannot be made as powerful as would be possible if they could occupy all the space available in the casing.

75 The last above objectionable features are overcome in my present invention by disposing the motors below the pump and providing a special driving connection between the pump and motors.

80 My invention also contemplates the provision of a plurality of specially designed motor units that can be assembled together in any desired number to produce the power required and in which the individual motor units are each provided with complementary parts and connecting devices so that they can be arranged end to end in a convenient and practical manner.

85 For a better understanding of my invention, reference should be had to the accompanying drawings, in which I have shown by way of illustration and not of limitation apparatus which represents the best embodiment of my device now known to me. I desire to have it understood, however, that many changes and modifications can be made therein without departing from the spirit of my invention.

In the drawings, wherein like numerals refer to like parts throughout the several views,

Figure 1 is a vertical sectional view showing my improved pumping unit disposed in a well,

Figure 2 is a partial sectional view showing the details of a preferred type of motor unit.

Figure 3 is a fragmentary detail view showing one form of shaft support and coupling,

Figure 4 is a fragmentary view in section showing one form of electric coupling device carried by my motor units,

Figure 5 is a vertical view partially in section showing the motor units arranged in a protective casing,

Figure 6 is a continuation of the unit partially illustrated in Figure 5 showing the motion changing device and method of connecting same to the motor units,

Figure 7 is a continuation of the showing of Figure 6 illustrating the manner of attaching the pump to the motion changing device,

Figure 8 is a sectional view of the upper part of Figure 7 taken along a plane 90° from that of Figure 7, and

Figures 9 and 10 are sectional views showing respectively the discharge and intake ends of a reciprocating pump.

In Figure 1 of the drawings 10 designates the bore of an oil well in which there is disposed the usual casing 11. This casing as is well known extends down into the well a sufficient distance to form a free passage for the pump and its discharge pipe. In this figure of the drawings the pump is designated by the numeral 12. Extending from the pump and out of the well I show a discharge pipe 13. Connected to and supported upon the lower end of the pump there is also shown an intake screen 14 that surrounds a rotary to reciprocating motion changing device 15 which will be described in greater detail hereinafter. Below the screen 14 and connected to the motion changing device 15, I show a motive power driving unit 16. The motive power unit 16, as will also hereinafter appear, comprises a plurality of fractional horsepower polyphase induction motors 17 of the squirrel cage type. The polyphase electric current power is supplied to the motors 17 through a special impervious three wire cable 18 which extends from the motors to the surface of the well where it passes through a well casing head or capping fixture 19. A branch pipe 20 is provided at the upper end of the oil discharge pipe for conducting the pumped oil to a suitable storage tank and a pipe 21 is connected to the casing head 19 for disposing of the gas.

As previously suggested, in order to provide a motive power unit which can be lowered into an oil well as contemplated, I construct my power unit by assembling a plurality of individual motor units end to end.

In Figure 2, I have shown three of the preferred type of motors arranged end to end. These motors as here illustrated each comprise a frame 22 that carries a suitable primary or stator winding 23 and a rotor 24 with a secondary winding 25. The winding 25 upon the rotors 24 is preferably of the squirrel cage induction type and has no brushes or sliding contacts which would cause sparking.

The frames 22 of the motors 17 are provided at one end with a projecting portion 26 which supports a suitable bearing 27 for one end of a rotor shaft 28. The portion 26 of the frame 22 also carries an annular flange 29 which engages

with an opening 30 in the end of an adjacent frame 22. At the lower end of the motor assembly the flange 29 engages a closure plug 31 which is inserted in the end of a suitable motor enclosing casing 32.

In order to simplify the construction of the motors 17 and also shorten their length I provide a special shaft coupling upon the ends of the shafts 28. The lower ends of these shafts are shown in Figure 3 as having an enlarged end 33 in which there is formed a suitable socket 34 for the upper end of the next adjacent shaft and the upper ends of the shafts 28 are each provided with a specially formed projecting end 35 that is adapted to firmly engage the socket 34 and connect the rotor elements 24 together in driving relation with each other.

The enlarged ends 33 of the shafts 28 are each supported centrally within the frames 22 by the bearings 27 and when two of the shafts are connected together as shown each of the bearings, except the top and bottom ones, will serve to support the coupled ends of two of the shafts 28. This arrangement greatly simplifies the operation of assembling and also permits a considerable shortening of the motor units.

The electrical connection between the different motors 17 is formed, as shown in Figure 4, by mounting a plurality of complementary connecting devices upon the meeting faces of the motor frames 22. This connection consists of a plurality of suitable plug receptacles 36 upon one of the ends of the frames 22 and a plurality of complementary plugs 37 upon the opposite ends of the frames. In a three phase motor system there may be three sets of these connecting devices or if desired a single three contact receptacle and plug may be used. As shown in the drawings suitable conductor connecting means 38 are provided on the receptacles 36 and plugs 37.

From the above it will be seen that any number of the motors 17 may be assembled in a line. In one experimental model which I have constructed I assembled fifty such fractional horsepower motors and successfully operated a pump at a depth of 2,000 feet. As illustrated in Figure 5 the motors 17 are secured together end to end by means of bolts 39 which pass through flanges on the portions 26 of the frames 22 and into the next adjacent frame. When the motors are thus assembled they are enclosed in the casing 32 which engages the lower end of the motion changing device 15, as shown in Figure 6.

The motion changing device illustrated in this latter figure of the drawings is the subject of my copending application Serial Number 435,141, filed March 12, 1930 and allowed July 12, 1930. For a detailed description of this motion changing device reference should be made to the above patent application. It should be sufficient for the purpose of this description to state that this feature of my invention comprises a shuttle member 40 which is adapted to move with a reciprocating motion along a double threaded screw shaft 41 as the latter is driven continuously in one direction.

The shuttle 40 carries suitable shaft engaging means which are caused to alternately grip the screw shaft 41 as the shuttle travels between stops 42 and 43 arranged respectively at the top and bottom ends of the screw shaft 41. The stop 43 is carried by a suitable supporting member 44 which has a projecting flange 45 that is complementary to the frame 22 of the uppermost motor 17 and the lower end of the screw shaft 41 is

journaled in and extends down through the member 44 to a point where it engages the shaft 28 of the driving motors. In order to prevent the shuttle 40 turning with the shaft 41 there is provided a cylindrical housing 46 to which the shuttle is keyed by means of oppositely disposed keyways 47.

Connected to the upper end of the shuttle 40, I provide two oppositely disposed driving rods 48 that terminate with a crosshead 49 to which is attached a sucker rod 50.

As shown in Figure 7 of the drawings the pump sucker rod 50 extends upwardly through suitable packings 51 in the end of the housing 46 and through a screen outlet member 52 to which the screen 14 is secured. The screen 14 is spaced from the walls of the shuttle housing 46 so that the latter will not interfere with the flow of oil through the screen buttons and the outlet member 52 is provided with two outlet ports 53, as shown in Figure 8, which connect with the intake end of the pump.

A junction box 54 is shown upon the member 52 through which the current conductors 18 may pass. The conductors extend down the inside of the screen 14 and pass through the member 44 to the motors, as shown in Figure 6. The upper end of the screen outlet member 52 is also provided with a threaded and ported end 55 which is adapted to engage the lower end of a reciprocating pump of the type illustrated in Figures 9 and 10 of the drawings.

As shown in these latter figures of the drawings the pump, designated by the numeral 56, is modified so that the intake is located on the sucker rod end. In Figure 9 the upper end of the pump 56 is shown as connected directly with the lower end of the oil discharge pipe 13. At this point the pump is provided with a ball check valve 57 which cooperates with a similar check valve 58 carried by a special pump piston 59. The piston 59 carries suitable packings 60 and is attached to the end of the sucker rod 50.

The operation of my improved pumping unit is as follows:

It will be assumed that the motors 17 have been assembled as suggested above and connected through the motion changing device 15 to the pump 56 and that this assembly has been lowered into a well at the end of the discharge pipe 13.

When electric current is supplied to the conductors 18 the motors 17 will rotate and drive the screw shaft 41. This will cause the shuttle 40 to move along the shaft 41 until it strikes one or the other end where its direction of travel will be reversed. As the shuttle 40 thus travels back and forth along the shaft 41 this movement will be transmitted to the sucker rod 50 of the pump 56 and cause the latter to pump oil into the discharge pipe 13.

As the pump 56 operates the oil will be sucked from the well through the screen 14 and out through the conduits 53 in the member 52 to the pump where it will then be discharged through the check valve 57 and into the discharge pipe 13 which will conduct the oil to the top of the well.

While I have, for the sake of clearness and in order to disclose my invention so that the same can be readily understood, described and illustrated specific devices and arrangements, I desire

to have it understood that this invention is not limited to the specific means disclosed but may be embodied in other ways that will suggest themselves, in view of this broad disclosure, to persons skilled in the art. It is believed that this invention is broadly new and it is desired to claim it as such so that all such changes as come within the scope of the appended claims are to be considered as part of this invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. In an electric motive power unit, the combination of a motor frame having a suitable field winding, a rotary element adapted to rotate within the field winding of said frame, a shaft for said rotary element, a single bearing at one end of said frame adapted to support one end of said shaft, a second frame secured to said first frame, a second shaft journaled in said second frame, and means carried by said second shaft cooperating with the adjacent end of said first shaft to form a support therefor, whereby said first shaft will be supported at one end upon the bearing carried by its associated frame and at its other end upon a bearing carried by said second frame.

2. In a multiple motor unit for driving oil well pumps and the like, the combination of a field frame having a winding therein, a bearing at one end of said frame, a rotor element disposed in said field frame having a shaft journaled at one end in said bearing, said shaft having a coupling means at its other end remote from said bearing, and a second field frame having a similarly journaled rotor and shaft, the shaft carried by said second field frame being provided at its inner end with a coupling means secured to the coupling means on said first shaft, whereby the first rotor and shaft will be supported at its ends by the bearings carried by said first and second field frames.

3. In a multiple motor unit for driving oil well pumps and the like, the combination of a field frame having a winding therein, a spacing collar extending from one end of said frame adapted to be secured to a second field frame, a bearing mounted within said collar, a rotor element disposed in said field frame having a shaft journaled at one end in said bearing, said shaft having a coupling socket extending through the plane of said bearing, and a second field frame having a similarly journaled rotor and shaft, the shaft carried by said second field frame being provided at its inner end with an extension which projects into said socket and through the plane of said first bearing, whereby the second rotor and shaft will be supported upon the bearings carried by said first and second field frames.

4. A multiple motor unit comprising a plurality of detachable field magnet frames rigidly secured together, rotor elements including separate shafts disposed within said field magnet frames, a coupling joining the shafts of adjacent motor units together, bearings at the ends of the end motor units supporting the outer ends of the shafts of the end rotors and at least one intermediate bearing providing a journaling support for adjacent coupled shafts at the coupling.

EDWARD C. EKSTROMER.