July 12, 1938. E. C. EKSTROMER 2,123,183

PUMPING MECHANISM

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Fig. 1.

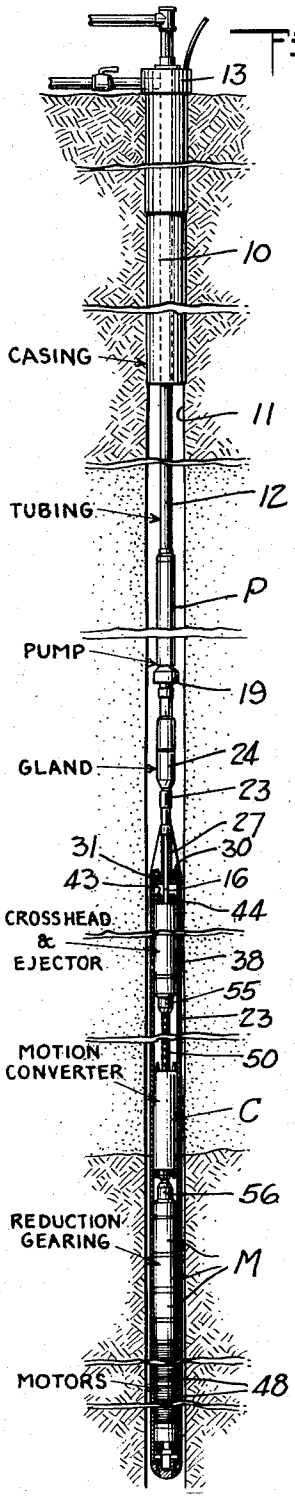


Fig. 12.

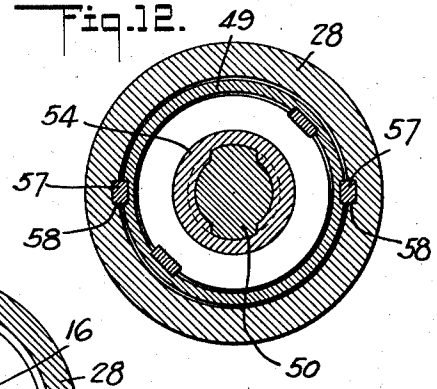


Fig. 10.

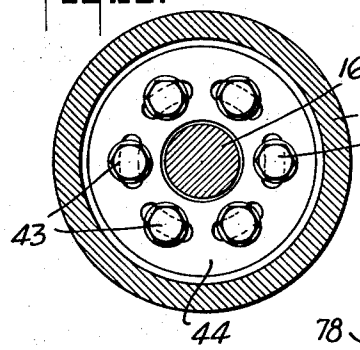


Fig. 13.

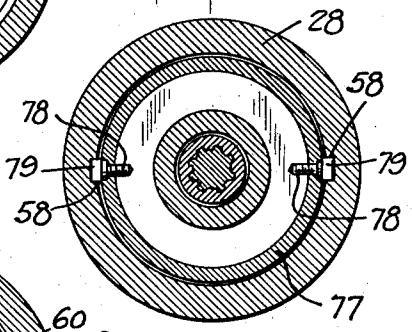


Fig. 11.

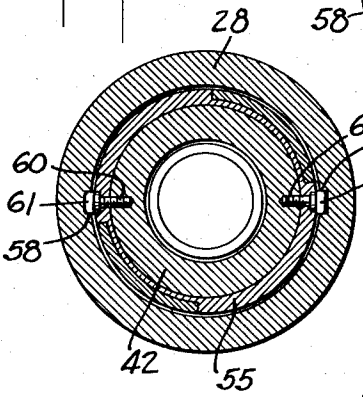
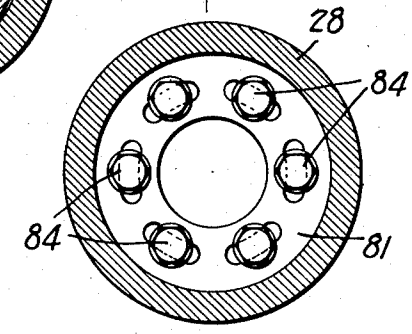


Fig. 14.



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PUMPING MECHANISM

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Fig. 9.

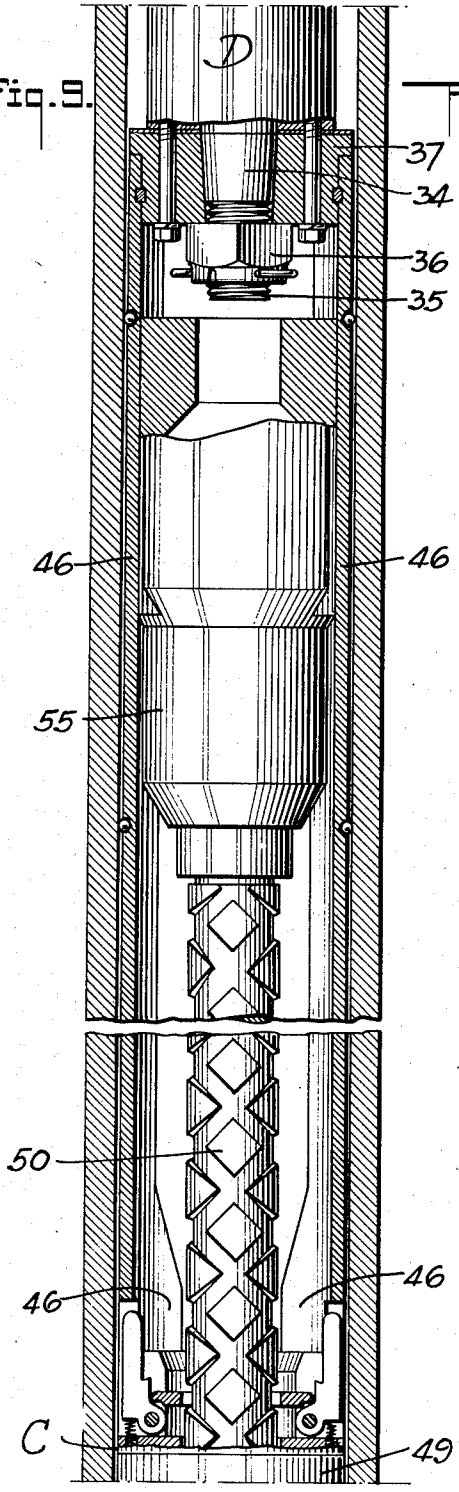
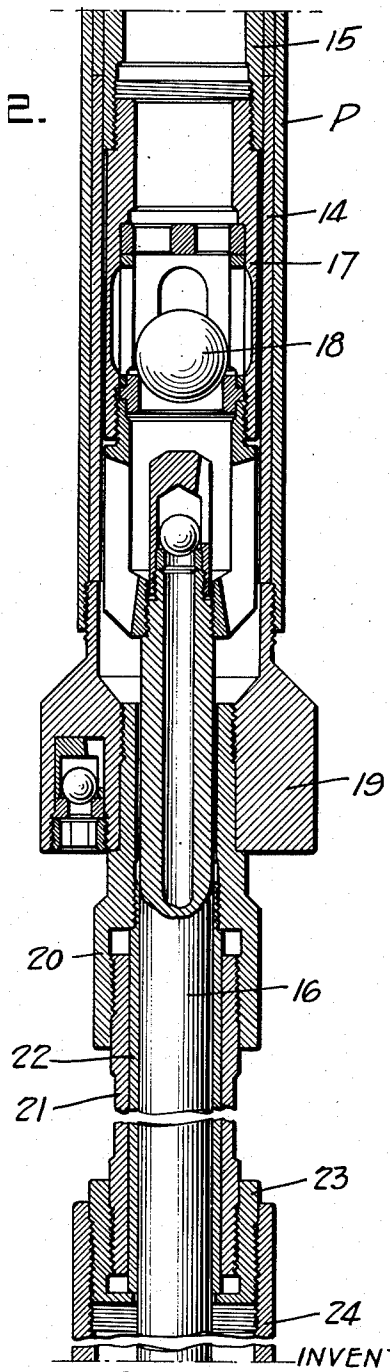


Fig. 2.



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PUMPING MECHANISM

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Fig. 3.

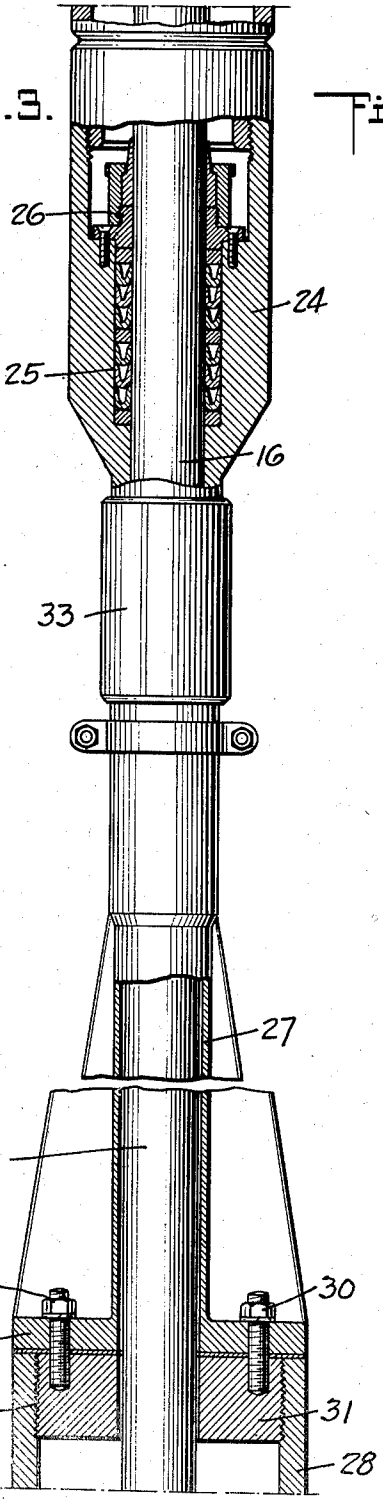
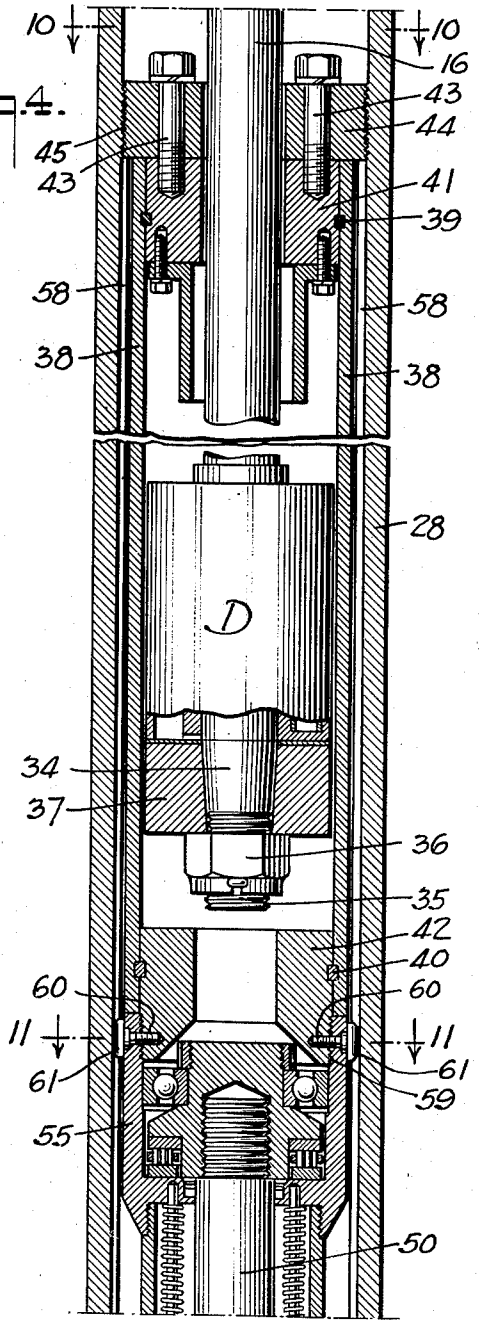


Fig. 4.



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PUMPING MECHANISM

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Fig. 5.

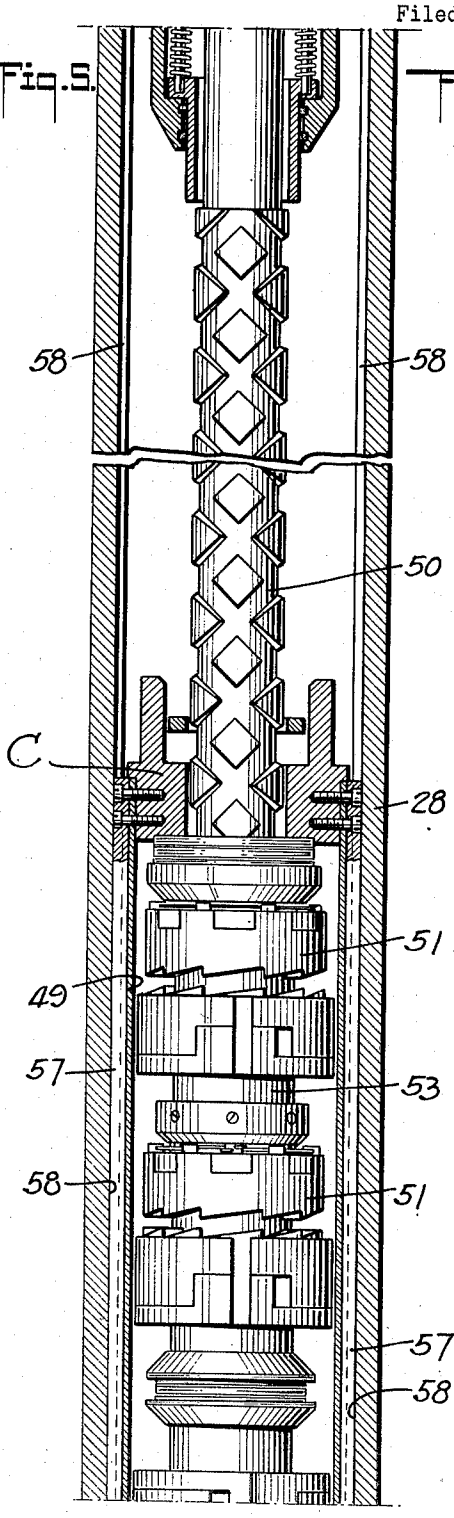

Fig. 6.

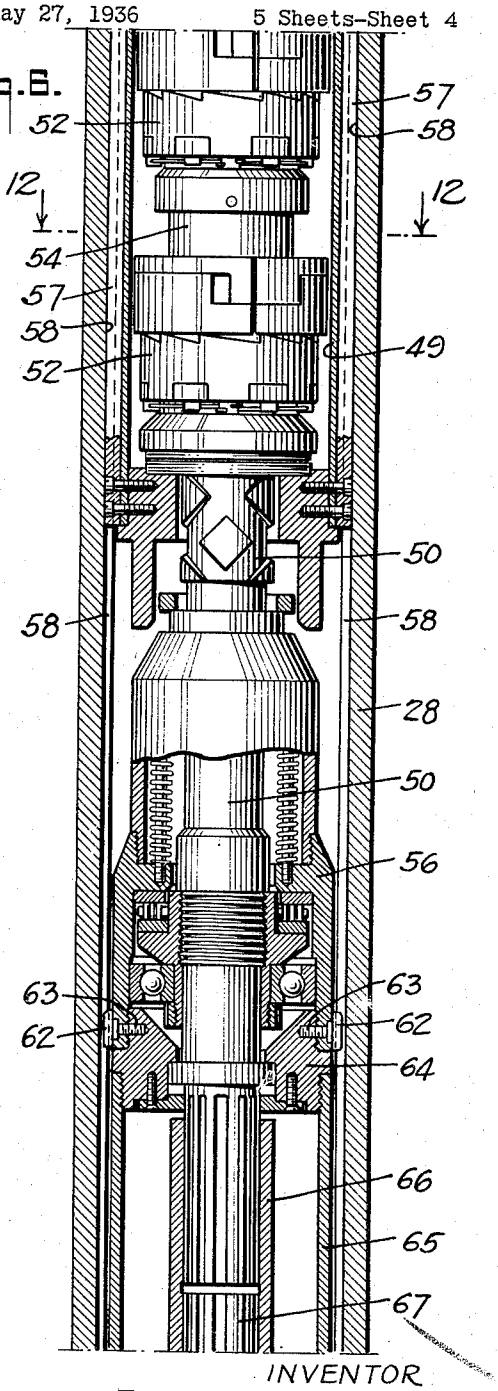

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Fig. 7.

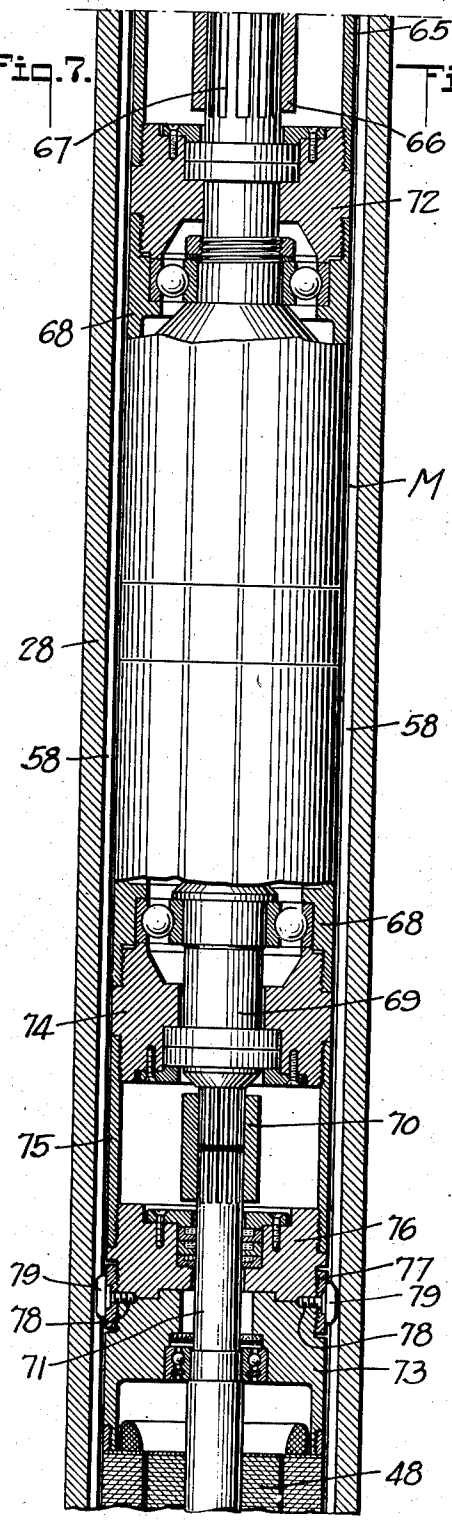
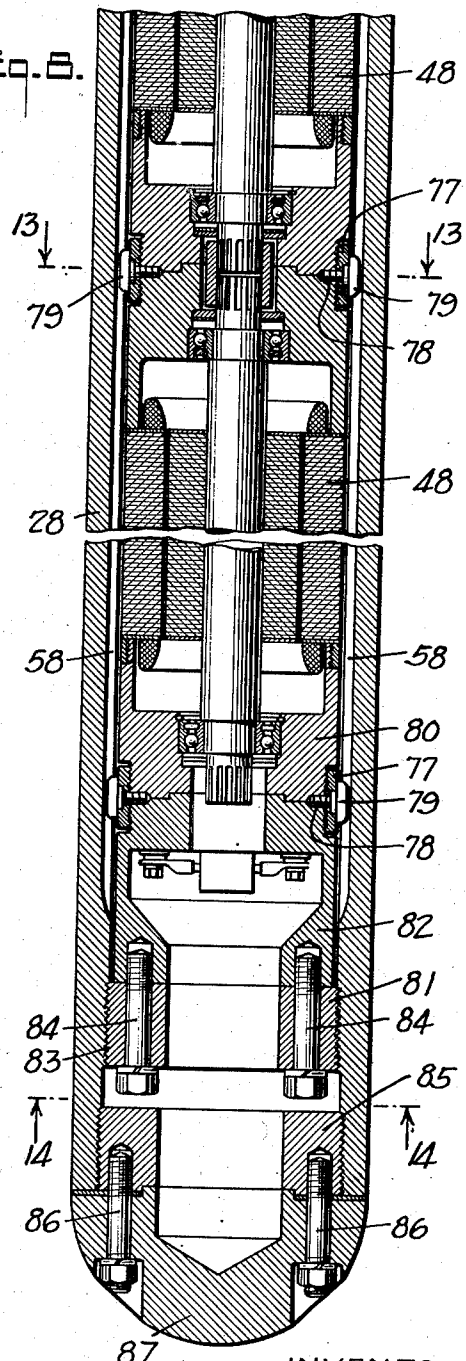


Fig. 8.



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Patented July 12, 1938

2,123,183

UNITED STATES PATENT OFFICE

2,123,183

PUMPING MECHANISM

Edward C. Ekstromer, Los Gatos, Calif., assignor to Electrolift Corporation, Reno, Nev., a corporation of Nevada

Application May 27, 1936, Serial No. 82,025

12 Claims. (Cl. 103—46)

The invention relates to pumping apparatus for wells, in which electric motors are arranged in a well to drive a pump for elevating fluid from the well.

An object of the invention is to provide a pumping mechanism wherein a plurality of electric motors are arranged in co-axial relationship to each other and to various other units, including a reciprocating pump, with means for positively maintaining such co-operating relationship of all parts as will prevent any relative displacement thereof both rotatively and axially, so as to insure a properly alined and balanced condition of the mechanism essential for the latter to function with maximum efficiency.

Another object of the invention is to provide a pumping mechanism as above structurally and functionally characterized, wherein said means greatly facilitates the operations of assembling and disassembling the motors and various units of the mechanism with respect to an enclosing housing within which all parts are received and sealed against the ingress of fluid from the well.

A further object of the invention is to provide a pumping mechanism wherein the motors and pumps can be lowered into the well as a unit; wherein a power plant of any desired capacity can be obtained without necessitating enlargement of the casing, and wherein the power plant can be located below the pump.

With these and other objects in view, the invention consists in the following combinations and arrangements of elements as set forth in the following specification and particularly pointed out in the appended claims.

In the accompanying drawings,

Figure 1 is a view showing the pumping mechanism embodying this invention installed in a well hole for pumping;

Figures 2, 3, 4, 5, 6, 7, and 8 are enlarged vertical longitudinal sectional views of the mechanism, which views are end-to-end continuations of each other in the numerical order of the figures, starting with the lower portion of the reciprocating pump in Figure 2 down to the bottom end of the housing in Figure 8;

Figure 9 is a longitudinal sectional view of portions of the mechanism shown in Figures 4 and 5, and taken at a right angle to the latter figures;

Figures 10 and 11 are transverse sectional views taken, respectively, on the lines 10—10 and 11—11 of Figure 4;

Figure 12 is a transverse sectional view taken on the line 12—12 of Figure 6;

Figures 13 and 14 are transverse sectional views taken, respectively, on the lines 13—13 and 14—14 of Figure 8.

Referring specifically to the drawings, and particularly to Figure 1, the invention is shown associated with a well casing 10 driven into the bore 11 of an oil well, and through which extends the usual tubing 12 constituting an oil discharge pipe and being suspended from the casing head 13 or other suitable support. At its lower end the tubing is connected to the barrel 14 of a reciprocating pump P.

In Figure 2, the lower end of this pump is illustrated in detail, to disclose a plunger 15 reciprocable in the barrel and connected to a depending and co-axially arranged hollow plunger rod 16 through the medium of the cage 17 of the traveling valve 18 of the plunger.

The plunger rod 16 passes freely through the lower and valved head 19 of the barrel 14, and through a collar 20 to which is secured a sleeve 21 containing a liner 22 within which the plunger works to provide a sealed joint between the two. The lower end of the sleeve 21 is secured by a collar 23 to a stuffing box 24 containing a packing 25 surrounding the plunger rod, and a packing gland 26 associated with the packing as shown in Figure 3.

From the stuffing box 24 the plunger rod extends through the top head 27 of a housing 28 in the form of an open ended and elongated tubular body of a uniform external diameter. The top head 27 is provided with a base flange 29 secured by bolts 30 to a plug 31 threaded tightly at 32 into the upper end of the housing 28 so as to secure the top head 27 rigidly thereto. The top head is rigidly connected at its upper end to the lower end of the stuffing box 24 by a coupling 33.

At its lower end the plunger rod is tapered and threaded as shown at 34 and 35, respectively for coaction with a nut 36 in securing the plunger rod to a crosshead 37 within connecting rod guides 38 of arcuate cross-section receiving and keyed at their upper and lower ends as indicated at 39 and 40, respectively, to collars 41 and 42. Supported on the crosshead 37 and surrounding the plunger rod is a protecting device D of the general characters embodied in my U. S. Patent Nos. 2,031,826, 2,034,753, and 2,034,754. Such a device functions during reciprocation of the plunger rod to collect and eject from the housing 28 through the plunger rod all fluids which might leak thereinto around the plunger rod.

The upper collar 41 is secured by a circular

series of bolts 43 to a suspension collar 44 threaded externally at 45 into the housing. Secured at their upper ends to the cross head 37 at diametrically opposed points and between the guides 38 are connecting rods 46 (Figure 9). These connecting rods provide an operative connection between the crosshead and a mechanism C for converting the rotary motion of electric motors 48 into reciprocating motion in order to reciprocate the plunger 15 of the pump P.

The mechanism C which is of the general character disclosed in my U. S. Patent No. 1,799,458, issued April 7, 1931, is specifically the same as that disclosed and claimed in my copending application Serial No. 95,556, filed August 12, 1936. For the purpose of this description, it will suffice to state that this mechanism comprises a shuttle member 49 to the upper end of which the connecting rods 46 are secured. The shuttle member is adapted to be reciprocated along a double threaded screw shaft 50, as the latter is driven continuously in one direction from the electric motor 48 through a suitable epicyclic reduction gearing mechanism M interposed between the motors and shaft within the housing as shown in Figure 7. Suitable clutches 51—51 and 52—52 are caused to be alternately engaged and disengaged to render right and left hand nuts 53 and 54, respectively, alternately operable to feed the shuttle member between the upper and lower bearings 55 and 56 in which the upper and lower ends of the shaft are journaled as shown, respectively, in Figures 4 and 6.

The shuttle member 49 has fixed thereto at diametrically opposed locations longitudinal keys 57—57 which slide in longitudinal grooves 58—58 formed in the housing 28 to extend from its upper end to a point adjacent its lower end, as shown in Figures 4, 5, 6, 7 and 8. The keys and grooves co-act to confine the shuttle member to movement axially in the housing.

The upper bearing 55 which is secured to the collar 42 by a threaded connection 59, and is locked to the collar by threaded fastening members 60, is confined against rotation relative to the housing by heads 61 on the members which are of rectangular form and are slidably received in the grooves 58. Likewise, the lower bearing 56 is confined against rotation relative to the housing 28 by the rectangular heads 62 of fastening members 63 which are slidably received in the grooves 58 and serve to lock this bearing member to a collar 64. The collar 64 is rigidly connected to a tube 65 enclosing the splined connection 66 between the lower end of the screw shaft 50 and the upper end of the driven shaft 67 of the epicyclic gearing mechanism M enclosed within a suitable cylindrical casing 68. At the lower end of the casing 68 the drive shaft 69 of the mechanism M has a splined connection 70 with the rotor shaft 71 of the uppermost electric motor 48.

The upper end of the casing 68 is rigidly connected to the tube 65 through an interposed collar 72, and the lower end of the casing is connected to the upper end bell 73 of the uppermost motor 48 through the medium of a collar 74, a tube 75, a second collar 76 abutting the bell 73, and a ring 77 threaded internally to have oppositely threaded connection with the latter collar and the bell. Fastening members 78 lock the ring to the collar 76 and to the bell 73 at the abutting faces thereof, and these members are provided with rectangular heads 79 slidably received in the grooves 58.

As will be readily apparent from Figures 7 and 8, the motors 48, of which there may be any desired number to provide a predetermined total horsepower, are arranged end to end in coaxial relationship. The specific form of fastening means including the ring 77 and fastening members 78 having heads 79 projecting into the grooves 58, is provided at the confronting ends of the motors and also at the lower end bell 80 of the lowermost motor, as shown in Figure 8. This fastening means except for the functioning of the heads 79 of the members 78 in providing keys which co-act with the grooves 58 to confine the stators of the several motors against rotation relative to the housing, form no part of the present invention, but are described and claimed in my co-pending application for patent on Multiple motor unit, Serial No. 95,557, filed August 12, 1936. A multiple motor unit of the same general character is disclosed in my U. S. Patent No. 1,960,484 in conjunction with reduction gearing and a motion converting mechanism, all in a submerged pumping assembly.

The ring 77 at the lower end bell 80 of the lowermost motor 48 connects the latter to a sustaining collar 81 through an interposed flange 82, the collar 81 having a threaded connection 83 interiorly of the housing 28, and receiving a circular series of bolts 84 threaded into the flange, all as clearly shown in Figure 8.

Threaded into the lower end of the housing 28 is a plug 85 to which is secured by a circular series of bolts 86, a cap 87 providing a sealing closure for the lower end of the housing.

In assembling the mechanism, the several units which are intended to be enclosed by the housing 28 are rigidly connected together, as above described. With the bottom cap 87 removed from the housing, and the plug 85 in place, the rigid assembly of the several units, i. e., electric motors 48, gearing mechanism M, motion converting mechanism 47, crosshead 37, plunger rod 16, with the suspension collar 44 applied to the rod, are inserted motors foremost, into the upper end of the housing. The heads 79 and 62, the keys 57, and the heads 61, are received in the grooves 58 as the associated parts are inserted in the housing. When the flange 82 abuts the sustaining collar 81, the bolts 84 are screwed home. The suspension collar 44 can now be screwed tightly into the housing 28 and the bolts 43 then screwed home. Following this the top head 27 and bottom cap 87 can be applied to the housing as shown in Figures 3 and 8, respectively.

With the aforestated rigid assembly of units thus supported in the housing 28, the heads 79, 62, and 61 co-act to positively prevent the assembly from rotating relative to the housing, as likewise do the keys 57, which latter in addition are free to slide in the grooves 58 so as to co-act therewith in confining the shuttle member 49 to motion axially in the housing.

The collars 44 and 81 co-act with the housing 28 to confine the aforestated rigid assembly of units against any and all axial displacement relative to the housing, so that the units will be maintained in proper co-operative relationship to insure the alined and balanced condition of the mechanism necessary for maximum efficiency in operation. Furthermore, the manner in which the assembly of units is structurally and functionally associated with the housing enables the latter to be effectively sealed against the ingress of well fluid, while providing for the application

of the assembly to, and its removal from, the housing with ease and dispatch.

From the foregoing description, it will be manifest that the entire mechanism, including the pump P, can be readily lowered into and removed from a well as a unit, and that when operating it is wholly suspended in the bore hole by the tubing through which the oil is raised from the well.

What is claimed is:

1. In pumping mechanism of the class described, a tubular housing adapted to be suspended from its upper end in a well hole; a rigid assembly of operatively connected units insertable into an end of the housing and including a co-axial series of motors and power transferring mechanism having a member to which reciprocating movement is transmitted; co-acting means on the housing and units of said assembly for confining the latter against rotation relative to the housing; and means in the housing co-acting with the uppermost and lowermost units of the assembly to secure the assembly against axial displacement in the housing.

2. In pumping mechanism of the class described, a tubular housing adapted to be suspended from its upper end in a well hole, and internally grooved longitudinally; a rigid assembly of operatively connected units insertable into an end of the housing and including a co-axial series of motors and power transferring mechanism having a member to which reciprocating movement is transmitted; keying means projecting from units of said assembly at intervals along the length thereof, into the groove of the housing to confine the assembly against rotation relative to the housing; and means in the housing co-acting with the uppermost and lowermost units of the assembly to secure the latter against axial displacement in the housing.

3. In pumping mechanism of the class described, a tubular housing adapted to be suspended from its upper end in a well hole, and internally grooved longitudinally; a rigid assembly of operatively connected units insertable into an end of the housing and including a coaxial series of motors and a power transferring mechanism having a member to which reciprocating movement is transmitted; keying means projecting from units of said assembly at intervals along the length thereof, into the groove of the housing to confine the assembly against rotation relative to the housing; collars secured in the housing above and below the uppermost and lowermost units of said assembly; and means co-acting with the collars and said uppermost and lowermost units to confine said assembly against axial displacement relative to the housing.

4. In pumping mechanism of the class described, a tubular housing adapted to be suspended from its upper end in a well hole, and internally grooved longitudinally; a rigid assembly of operatively connected units insertable into an end of the housing and including a coaxial series of motors and power transferring mechanism having a member to which reciprocating movement is transmitted; keying means projecting from units of said assembly at intervals along the length thereof, into the groove of the housing to confine the assembly against rotation relative to the housing; collars secured in the housing above and below the uppermost and lowermost units of said assembly; and bolts in said collars threadedly connecting the said uppermost and lowermost units to the collars for coaction therewith in confining the assembly against axial displacement relative to the housing.

5. In pumping mechanism of the class described, an open-ended tubular housing adapted to be suspended in a well hole, and being internally grooved longitudinally; an assembly of operatively connected units including a rotary prime mover and a reciprocating power transferring mechanism; keying means projecting from units of said assembly into the groove of the housing to confine the latter against rotation relative to the housing; collars secured in the housing above and below the uppermost and lowermost units of said assembly; fastening members accessible from the upper and lower ends of the housing and respectively co-acting with the collars and said uppermost and lowermost units to confine said assembly against axial displacement relative to the housing; a removable closure sealing the lower end of the housing; and a removable top head adapted to receive a plunger rod and closing the upper end of the housing.

6. In pumping mechanism of the class described, a tubular housing adapted to be suspended from its upper end in a well hole, and internally grooved longitudinally; a rigid assembly of operatively connected units insertable into an end of the housing and including a co-axial series of motors and mechanism having a shuttle driven thereby and provided with a key reciprocable in said groove of the housing to confine the shuttle to movement axially in the housing; keying means projecting from units of said assembly into the groove of the housing to confine such units against rotation relative to the housing; and means co-acting with the housing and with the uppermost and lowermost units of said assembly to confine the latter against axial displacement relative to the housing.

7. In pumping mechanism of the class described, a tubular housing adapted to be suspended from its upper end in a well hole; and internally grooved longitudinally; a rigid assembly of operatively connected units insertable into an end of the housing and including a co-axial series of motors and mechanism having a shuttle driven thereby and provided with a key reciprocable in said groove of the housing to confine the shuttle to movement axially in the housing; keying means projecting from units of said assembly into the grooves of the housing to confine such units against rotation relative to the housing; collars secured in the housing above and below the uppermost and lowermost units of said assembly and bolts in the said collar threadedly connecting said uppermost and lowermost units to the collars for co-action therewith in confining the assembly against axial displacement relative to the housing.

8. In pumping mechanism of the class described, a tubular housing adapted to be supported in a well hole; a rigid assembly of operatively connected power and power-transferring units insertable into an end of the housing; means on the housing and units of the assembly for confining the assembly against rotation relative to the housing while rendering the assembly free to be inserted into and removed from the housing in a longitudinal direction relative to the latter; and means co-acting with the housing and assembly to removably secure the assembly in the housing against relative displacement axially thereof.

9. In pumping mechanism of the class de-

scribed, a tubular housing adapted to be supported in a well hole and being longitudinally grooved internally; a rigid assembly of operatively connected power and power-transferring units insertable into an end of the housing; keying means on units of said assembly projecting into the housing groove for co-action therewith in confining the assembly against rotation relative to the housing while rendering the assembly free to be inserted into and removed from the housing in a longitudinal direction relative to the latter; and means co-acting with the uppermost and lowermost units of said assembly to removably secure the assembly in the housing against relative displacement axially thereof.

10. In pumping mechanism of the class described, a tubular housing adapted to be supported in a well hole and being longitudinally grooved internally; a rigid assembly of operatively connected power and power-transferring units insertable into an end of the housing; keying means on units of said assembly projecting into the housing groove for co-action therewith in confining the assembly against rotation relative to the housing while rendering the assembly free to be inserted into and removed from the housing in a longitudinal direction relative to the latter; collars fixed in the housing above and below the uppermost and lowermost units of said assembly; and bolts in the collars co-acting with said uppermost and lowermost units to confine the assembly in the housing against axial displacement relatively thereto.

11. In pumping mechanism of the class described, a tubular housing adapted to be suspended in a well hole, and being internally grooved longitudinally; an assembly of operatively connected units including a rotary prime mover unit and a power transferring unit having a reciprocating member portions of which work in said groove of the housing to confine said member to reciprocating motion therein; keying means projecting from the prime mover unit into the housing groove for coaction therewith in confining such unit against rotation relative to the housing; and means co-acting with the housing and the assembly to secure the latter against axial displacement in the housing.

12. In pumping mechanism of the class described, a tubular housing adapted to be suspended in a well hole, and being internally grooved longitudinally; an assembly of operatively connected units including a rotary prime mover unit and a power transferring unit having a reciprocating shuttle member; elongated keying means projecting from the shuttle member and working in the housing groove to confine the shuttle member to reciprocating motion in the housing; keys projecting from the prime mover unit of the assembly into the housing groove for co-action therewith in confining such unit against rotation relative to the housing; and means co-acting with the housing and assembly to confine the latter against axial displacement in the housing.

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