Nov. 20, 1934. R. DEMING 1,980,985

WELL PUMP

Original Filed Jan. 10, 1930 2 Sheets-Sheet 1

Fig. 1.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 2.

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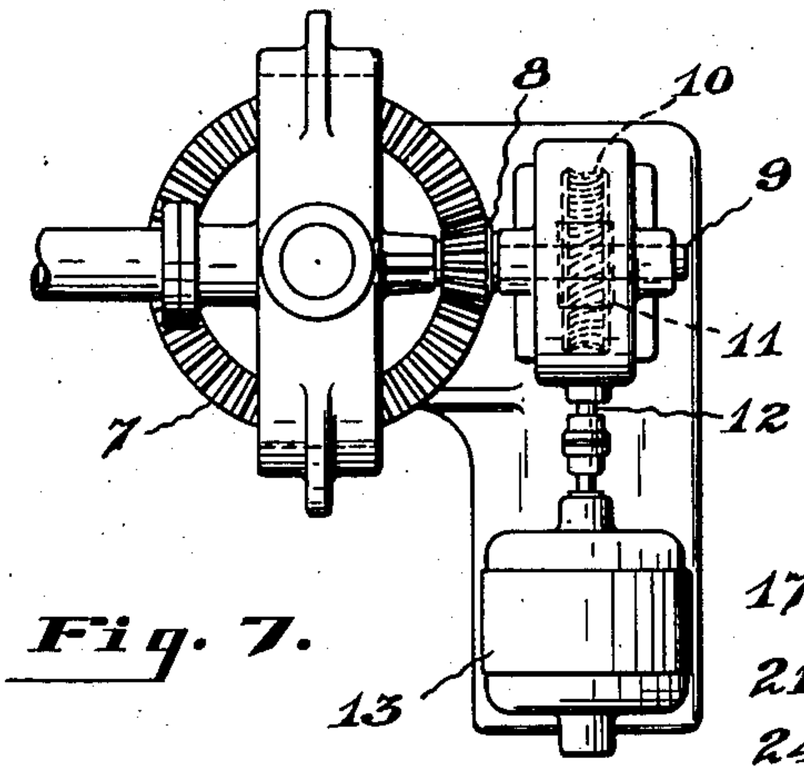

Fig. 7.

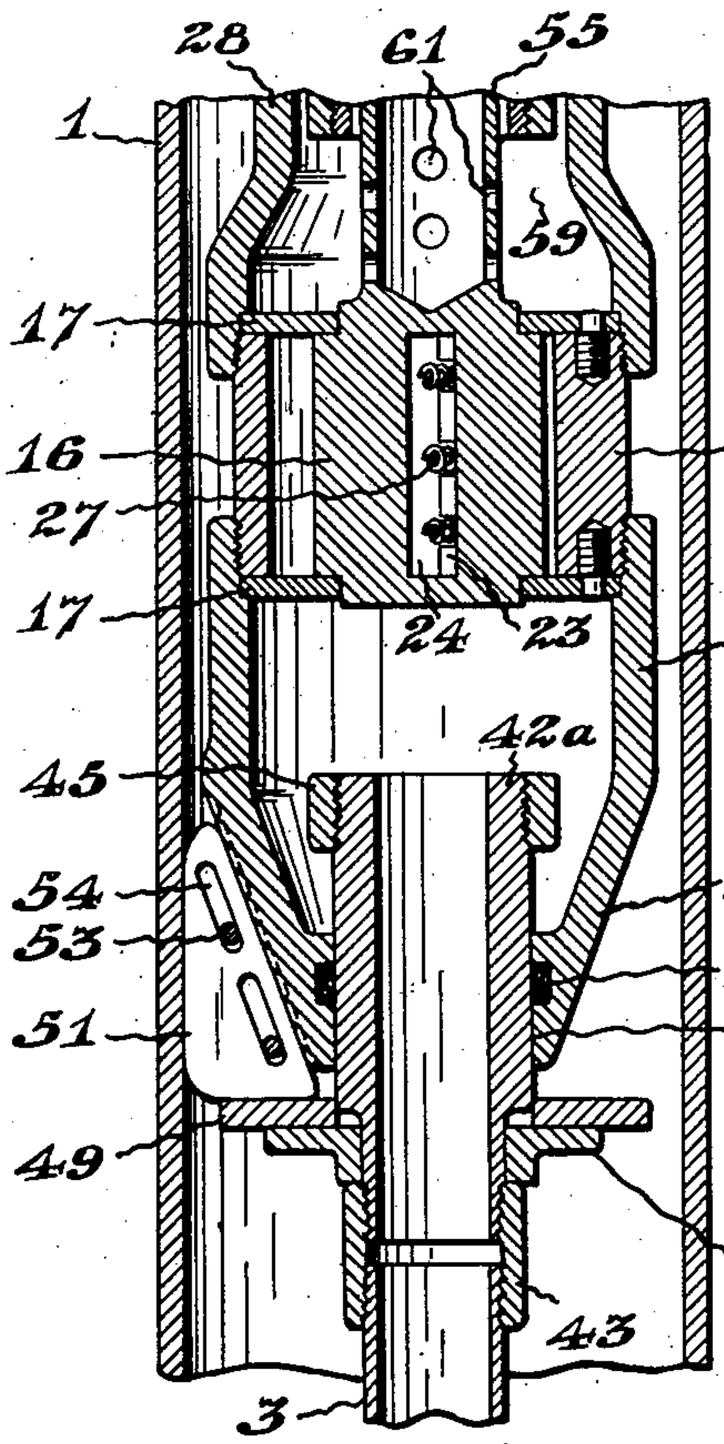

Fig. 8.

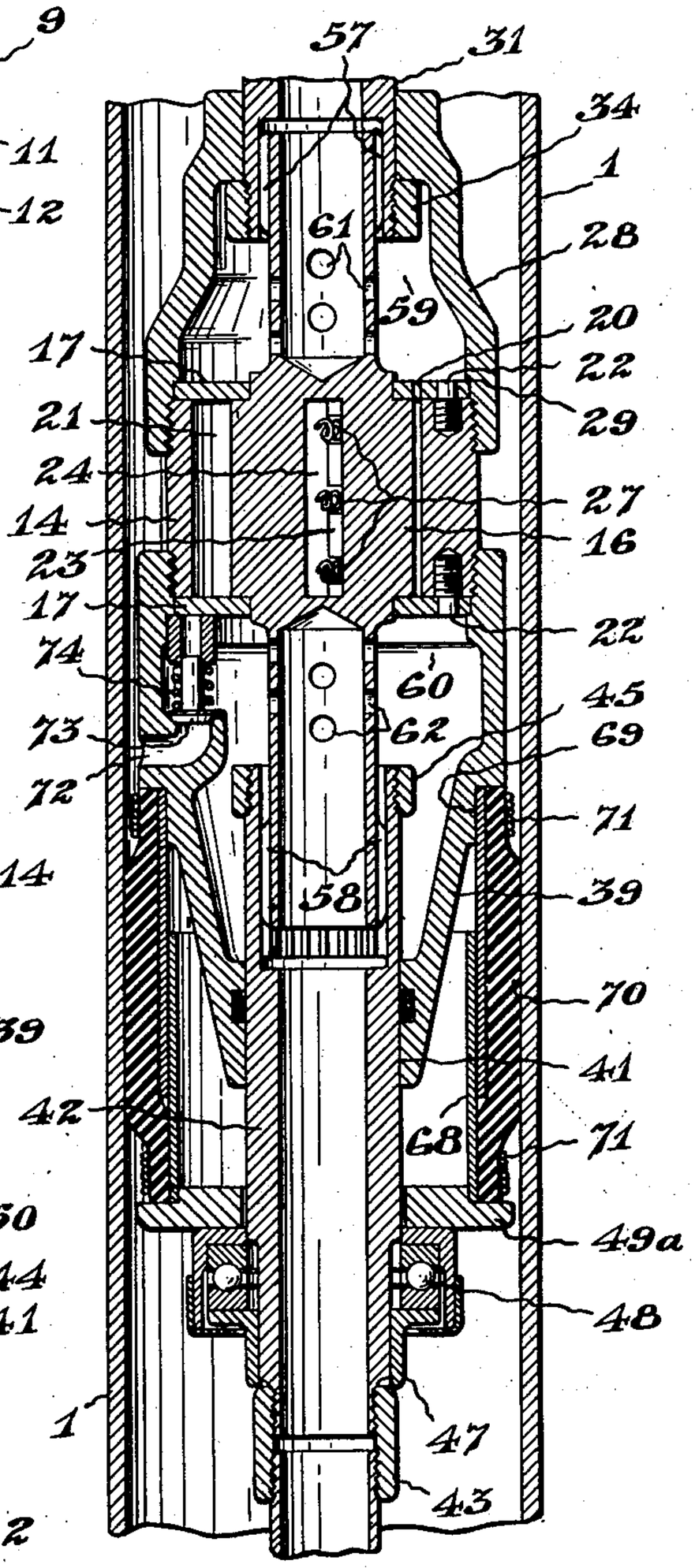

Fig. 9.

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UNITED STATES PATENT OFFICE

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WELL PUMP

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Renewed July 30, 1934

25 Claims. (Cl. 103—119)

This invention relates to pumping apparatus and more particularly to pumping apparatus suitable for elevating liquid and discharging the same from bored wells.

In oil wells in which the pressure in the well is insufficient to create automatic flow, it is common practice to pump the oil out by means of a pump of the reciprocating piston type lowered into the well casing to the level of the liquid therein, the piston of the pump being connected to operating mechanism at the top of the well by a connecting rod extending from the piston to the operating mechanism. In deep wells, the weight of the reciprocating element of the pump is so great as to make the pump relatively inefficient and costly to operate, due to the power expended in overcoming the inertia of the reciprocating element.

The present invention has for an important object to provide a positive pressure pumping apparatus in which the pump is operated by a rotating element extending to the top of the well instead of a reciprocating element, so that the loss of power due to inertia of moving parts of the pump is greatly reduced.

A further object is to provide a rotary piston pump so designed that it may be lowered into the casing of a bored well.

A further object is to provide means for automatically anchoring the housing of the pump in the well.

A further object is to provide anchoring means for the pump housing which will free the rotor operating shaft from the weight of the pump and shafting below the same.

A further object is to provide pumping apparatus extending to the bottom of the well in which the major portion of the weight of the apparatus is supported on the bottom and wall of the well.

A further object is to provide well pumping apparatus in which a shafting for operating the pump rotor or rotors is in the form of piping which serves as a conduit for the liquid forced upwardly by the pump or pumps.

A further object is to provide well pumping apparatus comprising a plurality of rotary piston pumps positioned at different depths in the well, so that the liquid may be elevated by stages from the bottom to the top of a well of any depth.

A further object is to provide pumps of the rotor type, and shafting composed of sections which may be joined one to another and to the pumps as the apparatus is being lowered into the well.

A further object is to provide means for automatically anchoring the pump housings in the well to hold the same against rotation when the apparatus has been lowered to the bottom of the well.

A further object is to economize power expenditure by providing means above the bottom of the well for collecting and retaining liquid leaking from the pumps and piping and for pumping such liquid from the level at which it is collected.

With the above and other objects in view, the invention may be said to comprise the pumping apparatus as illustrated in the accompanying drawings hereinafter described and particularly set forth in the appended claims, together with such variations and modifications thereof as will be apparent to one skilled in the art to which the invention appertains.

Reference should be had to the accompanying drawings forming a part of this specification in which:

Figure 1 is a sectional view showing the pumping apparatus of the present invention in operative position in a well.

Fig. 2 is an axial section through one of the rotary piston pumps.

Fig. 3 is a section taken on the line indicated at 3—3 in Fig. 2.

Fig. 4 is a section taken on the line indicated at 4—4 in Fig. 2.

Fig. 5 is a fragmentary vertical section showing one of the centering spiders carried by the piping.

Fig. 6 is a plan view of one of the centering spiders.

Fig. 7 is a plan view showing one of the various driving mechanisms which may be used for operating the pumps.

Fig. 8 is an axial section through the lowermost pump.

Fig. 9 is a sectional view through one of the pumps above the lowermost, showing a packer which may be used for sealing the space between the exterior of the pump housing and the well casing, together with the valve controlled inlet to the pump from the space around the liquid conduit above the packer.

Referring to the accompanying drawings, Fig. 1 shows the apparatus of the present invention positioned in a bored well which may be provided with a casing 1 extending to near the bottom of the well or to any desired depth in the well.

The pumping apparatus of the present invention has a pump 2 adjacent the bottom of the well which is supported by means of a perforated pipe 3, which extends downwardly from

the pump 2 and rests upon the bottom of the well, the pipe 3 providing an inlet for liquid to the pump 2.

The pumping apparatus of the present invention preferably includes one or more pumps 4 spaced at suitable distances apart above the lowermost pump 2, successive pumps from the lowermost to the uppermost being connected by pipes 5 which extend axially of the well casing from one pump to the other. Above the uppermost pump, there is a pipe 6 which extends axially of the well casing to the top of the well. The pipes 5 and 6 are rotatably mounted and serve as shafting which may be driven by any suitable mechanism to rotate the piston rotors of the pumps.

Fig. 7 of the drawings shows one form of driving mechanism in which the pipe 6 has a bevel gear 7 fixed thereto above the top of the well casing and meshing with the gear 7, there is a bevel pinion 8 fixed to a horizontal shaft 9 which has fixed thereto a worm gear 10 meshing with the worm 11 on the shaft 12 of a suitable electric motor 13.

By means of the driving mechanism above described, the pipe 6 may be rotated at a suitable speed to drive the rotor of the uppermost pump together with the connecting pipes 5 and the rotors of the other pumps, the rotors of all the pumps being keyed to the pipes. The pipes 3, 5 and 6, together with the pump housings form a conduit extending from the bottom to the top of the well through which the liquid is forced in successive stages by the piston rotors of the pumps.

The rotary piston pumps of the present invention are all of similar construction and, as shown in Figs. 2 and 3 of the drawings, each pump housing has a body portion in the form of a block 14 of an over all diameter less than the internal diameter of the well casing, this block being provided with an eccentric bore 15 which receives the cylindrical body portion of a rotor 16 which is suitably positioned in the block 14 by means of end plates 17 which are secured upon opposite ends of the block and which have bearing openings which receive shoulders 18 of the rotor 16.

The end plates 17 may be of identical construction and each bottom plate is provided with an opening 19 at one side of the bearing opening, the opening 19 of the lowermost plate providing an inlet opening to the piston chamber 21 and the opening 20 of the top plate providing an outlet opening therefrom. The plates 17 are positioned upon the upper and lower ends of the block 14 by means of dowel pins 22 which are secured in the block 14. The cylindrical body portion of the rotor 16 is of a diameter such that it bears at one side against the wall of the bore 15 of the block and the end plates 17 are so positioned by the dowel pins 22 that the inlet and outlet openings 19 and 20 are positioned adjacent to and on opposite sides of the line of contact between the rotor and housing.

Each pump is of the rotary piston type and, as herein shown, the rotor is provided with diametrically opposite radially movable piston vanes 23 which are mounted in a diametrical slot 24 and each vane bears at its ends upon the end plates 17 and at its outer edge against the wall of the bore 15.

In order to maintain full contact with the wall of the housing, the vanes are provided at their outer edges with bearing members 25 extending the full length of such edges, the members 25 being formed on their outer sides to fit against the cylindrical wall of the housing and on their inner sides to fit in grooves 26 formed in the body portions of the vanes. The vanes 23 are pressed outwardly against the wall of the casing by means of compression springs 27 interposed between the vanes in the slot 24, and the bearing members 25 turn in the grooves 26 of the vanes to maintain full contact with the wall of the housing during the entire rotation of the rotor. Rotation of the rotor causes liquid to be drawn upwardly into the piston chamber 21 through the inlet 19 and to be forced out of the piston chamber through the outlet 20.

Each pump housing has an upper end section 28 of tubular form which is internally threaded at its lower end to screw onto the cylinder block 14 which is externally threaded at its upper end, the casing section 28 being provided with an internal shoulder 29 which clamps the upper end plate 17 against the upper end of the cylinder block 14. The end section 28 of the pump housing has an axial bearing portion 30 at its upper end which receives a short tube 31 which is coupled to the pipe extending upwardly from the pump by means of a threaded coupling sleeve 32.

The end bearing 30 may be provided with a packing 33 to prevent leakage of liquid along the exterior of the pipe section 31. The lower end of the tube 31 has attached thereto a collar 34 which engages an internal shoulder 35 upon the interior of the casing section 28 so that the pump housing may be supported from the pipe extending upwardly therefrom.

Above the upper end of the end section 28, the tube 31 has attached thereto a flanged collar 36 which carries on the under side thereof a ball thrust bearing 37 which has a floating ring 38 at the bottom thereof which is supported by the upper end of the bearing 30 of the housing.

Each pump casing has a lower end section 39 which screws onto the lower end of the block 14 and which is provided with a clamping shoulder 40 which engages the bottom plate 17 and clamps the same against the lower end of the block 14. The lower end section 39 has an axial bearing portion 41 at its lower end which receives a short tube 42 which is rigidly attached by means of a threaded coupling sleeve 43 to the pipe extending downwardly from the pump. The bearing portion 41 of the housing may be provided with a packing 44 to prevent leakage along the exterior of the tube 42. The tube 42 has a collar 45 at its upper end which is engageable with a shoulder 46 upon the interior of the housing section 39, so that the pipe extending downwardly from the pump housing may be supported from the pump housing. Beneath the casing, the tube 42 has a flanged collar 47 which supports a ball thrust bearing 48, the upper race ring of which carries an annular floating flange 49 which may serve as a support for the pump housing. The lower end section 39 of the pump housing has a downwardly tapering lower end portion 50 which is engaged by circumferentially spaced slip plates 51, which are slidably supported in upright position between flanges 52 formed integrally with the housing and held in contact with the inclined wall of the housing by means of pins 53 extending across the space between the guide flanges 52 and passing through inclined slots 54 in the plates.

When the lowermost pipe 3 engages the bottom of the well, the lowermost pump 2 will slide down on the pipe 3, causing the slip plates 51 to engage with the floating flange 49, arresting their down-

ward movement and causing the inclined wall of the housing to slide down on the inclined inner edges of the plates, the slip plates being thus wedged between the wall of the well or well casing and the wall of the pump housing. Continued downward movement of the pumps and piping will cause the weight of the intermediate connecting pipe 5 to be imposed upon the housing of the lowermost pump 2 so that the pump next uppermost will be lowered on the pipe 5 and anchored to the wall of the well or well casing by means of its slip plates 51, the pumps from the bottom to the top of the well being thus successively anchored in place automatically. The weight of the piping and pump housing is thus transferred from the uppermost pipe 6 to the ball thrust bearings 37 and 48 and to the walls of the well or well casing, it being understood that if any of the pumps are located below the lower end of the well casing, such pumps will be anchored against the wall of the hole.

Each of the rotors 16 has tubular shafts 55 and 56 extending axially from the top and bottom thereof and telescoping into the tubes 31 and 42, the tubular shaft 55 of each pump being connected by splines 57 to the tube 31 extending into the upper end of the pump housing so that the rotor will be driven by rotation of the pipe extending upwardly from the pump. The tubular shaft 56 of the rotor of each pump above the lowermost is connected by splines 58 to the tubing 42 extending into the lower end of the pump housing so that the pipe extending downwardly from each of said pumps will turn with the rotor.

As shown in Fig. 8 of the drawings, the tubular shaft 56 is omitted so that the pipe 3 is not driven but opens into the pump casing through the short tube 42*a*. The upper and lower end sections 28 and 39 of the pump housing form outlet and inlet chambers 59 and 60 through which liquid passes from and to the piston chamber 21 through the openings 20 and 19, the tubular shafts 55 and 56 being provided with openings 61 and 62, establishing communication between the chambers 59 and 60 and the pipes extending upwardly from the pump housing.

It is desirable that the pipes be so supported in the well casing that they will be centered with respect to the well casing and rigidly held against lateral movements therein. To this end, the pipes are provided at intervals with centering spiders 63 which are rotatably mounted on sleeves 64 which are attached to the pipes adjacent the couplings between adjacent sections thereof, each spider consisting of a hub portion 65 and vanes 66 which extend radially from the hub portion and are of a length to bear upon the interior surface of the wall of the well or casing. The hub 65 is preferably provided with a circumferential outwardly projecting flange 67 and the vanes 66 extending outwardly from the flange 67 are twisted so that the outer ends of the vanes are positioned vertically. The twisting of the vanes disposes the bearing edges thereof vertically and these edges are preferably rounded to avoid binding in the well casing. The spiders 63 are preferably in the form of sheet metal stampings and the vanes, if subjected to excessive thrusts in an upward or downward direction will bend about their inner ends, so that the spiders will not seriously interfere with the pulling of the piping from the well.

Each of the pumps may be assembled as a unit prior to insertion in the well and may be connected to the pipes above and below the same by the couplings 32 and 43 joining the pipes to the tubes 31 and 42, the couplings 32 and 43 being identical with the couplings joining adjacent sections of the pipe. The threads of all the couplings are of the same hand and the pipes are rotated to drive the pumps in the direction in which the torsional thrust tends to tighten the couplings. In lowering the pumps and piping into the well, the lowermost pump is coupled to the bottom pipe 3 and as the pump is lowered into the well, a section of pipe is coupled to the tube 31 at the upper end thereof and additional sections of pipe are added as the pump and piping are lowered until the length of the pipe above the pump corresponds to the desired difference in elevation of the pumps, whereupon, a second pump is attached to the pipe and the operation continued until the lowermost pipe 3 strikes the bottom of the well, as many pumps being interposed in line as desirable. After all of the pump casings have been anchored in the well by transferring the weight thereof from the pipe above to the pipe below the same, the pumps may be simultaneously driven by any suitable driving means such as the motor and gearing above described. The pipes and the pump rotors are connected to rotate together and all of the pump housings are held against rotation by their anchoring means so that each piston rotor forces a predetermined volume of liquid into the pipe extending upwardly therefrom upon each revolution. Since all of the pumps are substantially identical, each will take a volume of liquid corresponding to that forced upwardly by the next lower pump and force this liquid into the pipe extending upwardly therefrom, elevating the liquid in stages from the bottom of the well to the top thereof where it is discharged in any suitable way. The diameter of the pumps is limited by the diameter of the well bore but the capacity thereof may be increased by lengthening the housing blocks 14 to increase the volumetric capacity of the piston chambers 21.

There may be some leakage of liquid from the pipe line and from successive pump housings, particularly after the apparatus has been in use for a considerable period of time, and this liquid may be permitted to drop to the bottom of the well. However, it may in some instances be desirable to collect and retain liquid leaking from the liquid conveying conduit at a point above the bottom of the well and to pump this leakage liquid from the elevated position rather than to pump it again from the bottom of the well. To accomplish this result, one or more of the pumps between the lowermost pump and the top of the well may be provided with means for sealing the space between the pump housing and well casing, so that any liquid above the seal will be retained in the space between the liquid conveying conduit and the well casing above the seal.

In Fig. 9 of the drawings, there is shown a packer which is adapted to replace the slip plate anchoring means of one or more of the pumps. As shown in Fig. 9, the floating flange 49*a* of the ball thrust bearing 48 has attached thereto a short section of steel tubing 68 which has a telescopic fit with a short section of steel tubing 69 attached to the lower end of the pump casing. Fitting upon the outside of the telescoping tubes 68 and 69, there is a rubber sleeve 70 which is secured at its ends to the tubes 68 and 69 by any suitable means such as wire bands 71.

When the weight of the pump casing is transferred to the floating flange 49*a*, the tubes 68 and

69 are caused to telescope and the rubber sleeve 70 is bulged outwardly against the wall of the well casing forming a seal to prevent leakage of liquid through the space between the pump housing and the well casing.

Any liquid leaking from the liquid conveying line above the packer will accumulate in the space surrounding the conduit above the packer and means is provided for introducing this liquid into the housing of the pump to which the packer is attached, so that this liquid may be pumped from the space above the packer to the top of the well. As shown in Fig. 9, the pump housing is provided with an inlet passage 72 which is normally held in closed position by means of a spring 74. The spring 74 preferably exerts a pressure on the valve sufficient to prevent opening of the valve by external air or gas pressure during the suction stroke of the piston, so that air or gas cannot be sucked into the pipe line through the opening. However, when the column of liquid has accumulated above the packer to a height such that the pressure of the liquid overbalances the spring 74, the liquid will be admitted to the pump inlet chamber during the portion of the cycle in which the pressure in the chamber is reduced and this liquid will be pumped with liquid from a lower level through the piping to the top of the well, thus saving the power that would be required to repump the leakage from the bottom of the well and permitting the pumping apparatus to be used for a longer period of time before it is necessary to remove the same for repairs.

It will be apparent that the present invention provides pumping apparatus which is of simple construction, inexpensive to manufacture, and easy to assemble and install in a well, all of the pumps being automatically rendered operable as they reach their final positions in the well.

It will further be apparent that the liquid may be elevated very efficiently by reason of the rotative mounting of the pump actuating elements and the elevation of the liquid by stages in the delivery conduit, and that, by reason of the continuous rotation in one direction, loss of power such as occurs in reversing the direction of movement of a heavy mass is eliminated.

Furthermore, it will be apparent that the pump housings are so supported as to relieve the rotors of all strain, the weight of the casings and shafting being supported wholly independently of the rotors.

Furthermore, it is to be understood that the particular form of apparatus shown and described, and the particular procedure set forth, are presented for purposes of explanation and illustration and that various modifications of said apparatus and procedure can be made without departing from my invention as defined in the appended claims.

What I claim is:

1. Pumping apparatus comprising a pair of axially alined pipes, a pump rotor between the ends of the pipes axially alined with the pipes and non-rotatably connected to both, a pump housing enclosing the rotor and rotatably mounted on said pipes, said housing having an inlet communicating with one pipe and an outlet communicating with the other, a second rotor non-rotatably connected to the opposite end of one of said pipes, a housing enclosing the second rotor having an outlet communicating with the latter pipe, means for holding the housings against rotation, and means for rotating the pipes and rotors.

2. Pumping apparatus for bored wells comprising a pump housing of a diameter to enter the well having inlet and outlet chambers at opposite ends thereof and an intermediate eccentrically disposed rotor chamber having an inlet to the first mentioned chamber and an outlet communicating with the other chamber, a rotor in said rotor chamber concentric with the housing and having tubular shafts projecting into said inlet and outlet chambers, said tubular shafts having openings in the walls thereof within said chambers, inlet and outlet pipes journaled in opposite ends of said pump housing and coupled to the projecting ends of said shafts, means for rotating one of said pipes to drive said rotor, and means for anchoring the pump housing in the well.

3. Pumping apparatus for bored wells comprising a pump housing of a diameter to enter the well having an inlet and outlet chamber at opposite ends thereof and an intermediate rotor chamber having an inlet to the first mentioned chamber and an outlet communicating with the other chamber, a rotor in said rotor chamber having tubular shafts projecting into said inlet and outlet chambers, said tubular shafts having openings in the walls thereof within said chambers, inlet and outlet pipes journaled in opposite ends of the pump housing and coupled to the projecting ends of said shafts, means for supporting said housing on the inlet pipe and for holding the housing against rotation, and means for rotating the outlet pipe to drive said rotor.

4. Pumping apparatus for bored wells comprising a pipe line within the well, a plurality of pump rotors interposed between sections of the pipe line, the lowermost rotor being nonrotatably connected to the lower end of the pipe above the same and the other of the rotors being nonrotatably connected to the pipes above and below the same, housings rotatably mounted on the pipes and enclosing the rotors, each housing above the lowermost having an inlet communicating with the pipe below it and an outlet communicating with the pipe above it and the lowermost housing having an inlet communicating with the well and an outlet communicating with the pipe extending upwardly therefrom, means for anchoring said housings in the well and means for rotating the pipes and rotors.

5. Pumping apparatus for bored wells comprising a plurality of rotary piston pumps at different depths in the well, each pump having a rotor and a housing, independent means for releasably anchoring each pump in the well and for holding the housing of each pump against rotation, pipes connecting the rotors for simultaneous rotation, means establishing communication between pipes above and below each pump through the housing of the pump, and driving means connected to the upper most pipe.

6. Pumping apparatus for bored wells comprising a line of shafting adapted to be lowered into the well to the bottom thereof, piston rotors splined to the shafting at intervals along the length thereof for limited endwise movement, a housing enclosing each rotor and rotatably mounted on the shafting, each housing having an inlet at its lower end and an outlet at its upper end, means on the shafting for supporting each housing and rotor and for limiting the endwise movement thereof with respect to the shafting, and means controlled by endwise movement of

the housings on the shafting for anchoring said housings in the well.

7. Pumping apparatus for bored wells comprising a line of shafting adapted to be lowered into the well to the bottom thereof, said shafting having sections at intervals along the length thereof telescopically connected to the shafting sections above and below the same, the lowermost of said telescopic sections being splined to the section above it and the other of said telescopic sections being splined to the sections joined to the upper and lower ends thereof, a pump rotor fixed to each telescopic section, a pump housing enclosing each rotor and rotatably mounted on the shafting, means on the shafting for supporting each housing and for limiting the endwise movement thereof, and means controlled by endwise movement of the housings on the shafting for anchoring said casings in the well.

8. Pumping apparatus for bored wells comprising a pump housing of a size to be lowered into the well, said pump housing having a shaft bearing at its upper end and a piston chamber eccentrically disposed with respect to said bearing and provided with an inlet at the bottom and an outlet at the top thereof, a piston rotor in said chamber, a shaft extending through said bearing of the housing and having a driving connection with said rotor, a member slidably connected with the pump housing and engageable with the bottom of the well, and means controlled by said member for anchoring the pump housing.

9. Pumping apparatus for bored wells comprising a pump housing of a size to be lowered into the well, said pump housing having a shaft bearing at its upper end and a piston chamber eccentrically disposed with respect to said bearing and provided with an outlet at the top thereof, a piston rotor in said chamber, a shaft extending through said bearing of the housing and having a driving connection with said rotor, anchoring means mounted on the pump housing for movement outwardly into engagement with the well wall to anchor the pump housing, and a member movably suspended from the pump housing and engageable with the bottom of the well, said member being engageable with said anchoring means to actuate the same.

10. Pumping apparatus for bored wells comprising a pump housing of a size to be lowered into the well, said pump housing having a shaft bearing at its upper end and a piston chamber eccentrically disposed with respect to said bearing and provided with an inlet at the bottom and an outlet at the top thereof, a piston rotor in said chamber, a shaft extending through said bearing of the housing and having a driving connection with said rotor, a second shaft suspended from the pump housing and slidable therein, said second shaft being engageable with the bottom of the well and having a shoulder below the housing, and outwardly movable anchoring members carried by the housing and engageable with said shoulder upon upward movement of said second shaft with respect to the pump housing.

11. Pumping apparatus for bored wells comprising a pump housing of a size to be lowered into the well, said pump housing having a shaft bearing at its upper end and a piston chamber eccentrically disposed with respect to said bearing and provided with an inlet at the bottom and an outlet at the top thereof, a piston rotor in said chamber, a shaft extending through said bearing of the housing and having a driving connection with said rotor, a second shaft suspended from the pump housing and slidable therein, said second shaft being engageable with the bottom of the well and having a shoulder below the housing, and an anchoring means including wedge shaped members slidably mounted on the pump housing and engageable with the well wall, said wedge shaped members being engageable with said shoulder when said second shaft is caused to move upwardly in the housing due to its engagement with the bottom of the well.

12. Pumping apparatus for bored wells comprising a pump housing of a size to be lowered into the well, said pump housing having shaft receiving openings at its upper and lower ends, and a piston chamber eccentrically disposed with respect to said openings, said chamber having an inlet at its bottom and an outlet at its top, an upper shaft extending into the upper end of the pump housing and having a supporting shoulder engaging said casing interiorly thereof, a lower shaft extending into the lower end of said housing and having a supporting shoulder engaging said housing interiorly thereof, said lower shaft being slidable and rotatable in said pump housing, means for limiting the upward movement of the lower shaft in said housing, a piston rotor in said piston chamber which is splined to the upper shaft, and means controlled by the endwise movement of the lower shaft in said pump housing for anchoring the pump housing in the well.

13. Pumping apparatus for bored wells comprising a shaft extending down into the well, a pump housing rotatably supported at its upper end on the lower end of said shaft, a shaft rotatably supported at its upper end in the lower end of said housing, the latter shaft being movable endwise in the housing, a second pump housing supported on said second shaft at its lower end, a third shaft suspended from the second housing and slidable in said housing, means controlled by a sliding movement of the housings with respect to the shafts beneath them for anchoring the said housings in the well, and rotors in said pump housings having driving connections with said shafts.

14. A well pump comprising a pump housing having a body portion composed of a block having an eccentric longitudinal bore, end plates having circumferentially offset inlet and outlet openings and bearing openings axially disposed with respect to the block, a rotor having end portions journaled in said openings and tubular shafts projecting from opposite ends thereof which have openings in the walls thereof, said rotor having a cylindrical body portion bearing at one side on the wall of said eccentric bore and radially movable piston vanes bearing on the wall of said bore, end members attached to opposite ends of said block and forming inlet and outlet chambers, pipes journaled in said end members and coupled to said tubular shafts, and means for rotating one of said pipes to turn said rotor.

15. A well pump comprising a pump housing having a body portion composed of a block having an eccentric longitudinal bore, end plates having circumferentially offset inlet and outlet openings and bearing openings axially disposed with respect to the block, a rotor having end portions journaled in said openings and tubular shafts projecting from opposite ends thereof which have openings in the walls thereof, said rotor having a cylindrical body portion bearing at one side on the wall of said eccentric bore

and radially movable piston vanes bearing on the wall of said bore, end members attached to opposite ends of said blocks and forming inlet and outlet chambers, pipes journaled in said end members and coupled to said tubular shafts, means carried by said pump housing for anchoring the same in a well, and means for rotating one of said pipes to turn the rotor.

16. Pumping apparatus for bored wells comprising a shaft extending down into said well, a pump housing rotatably suspended on the lower end of said shaft, a second shaft telescopically received in the lower end of the pump housing and having a shoulder engaging the housing interiorly thereof, the latter shaft having a shoulder below the housing, a flanged rotatable sleeve above said shoulder, a thrust bearing interposed between the sleeve and shoulder, outwardly movable anchoring means carried by the pump housing and engageable with said sleeve upon upward movement of said lower shaft in said pump housing, and a rotor in said housing keyed to the upper shaft.

17. Pumping apparatus for bored wells comprising a shaft extending down into said well, a pump housing rotatably suspended on the lower end of said shaft, said casing having a tapering lower end, a second shaft telescopically received in the lower end of the housing, the latter shaft having a shoulder below the housing, and anchoring means comprising wedge shaped members slidably mounted on the tapering lower end of the housing, said wedge shaped members being engageable with said shoulder and having inclined inner faces bearing against the tapering end of said housing.

18. Pumping apparatus for bored wells comprising a conduit extending down into the well, said conduit including pump housings spaced along the length thereof, a piston rotor in each pump housing, means for driving said rotors, a packer sealing the space between said conduit and well wall between successive pumps, and a valve controlled inlet to a pump housing above said packer whereby liquid may be pumped from the space surrounding the conduit above said packer.

19. Pumping apparatus for bored wells comprising a conduit extending down into the well, said conduit including pump housings spaced along the length thereof, a piston rotor in each pump housing, means for driving said rotors, a packer carried by one of said pump housings for sealing the space between the conduit and well wall, and a valve controlled inlet to the latter pump housing whereby liquid may be pumped from the space surrounding the conduit above said packer.

20. Pumping apparatus for bored wells comprising a plurality of rotary piston pumps at different heights in said well, each pump comprising a rotor and a pump housing enclosing the rotor, each pump housing having inlet and outlet chambers, shafting coupled to the rotors and rotatable in the pump housings, said shafting being in form of pipes disposed axially of the well casing, the pipe extending down from each pump housing being in communication with the inlet chamber of said housing and the pipe extending up from each pump housing being in communication with the outlet chamber thereof, and means for anchoring each pump housing in the well, certain of said anchoring means being in the form of a packer sealing the space between the pump housing and well wall.

21. Pumping apparatus for bored wells comprising a conduit extending down into the well, said conduit comprising a plurality of axially alined pump housings and pipes telescopically connected with the upper and lower ends of said housings, piston rotors in said housings splined to said pipes, means controlled by sliding movements of the pipes in said pump housings for anchoring said pump housings in the well, and means for turning said pipes to rotate said rotors.

22. Pumping apparatus for bored wells comprising a conduit composed of pipes and pump housings joined end to end, said housings being rotatably connected to the pipes, each housing having an outlet chamber communicating with the pipe joined to the upper end of the housing, an inlet chamber communicating with the pipe joined to its lower end, and an eccentrically disposed chamber intermediate the inlet and outlet chambers, a piston rotor in the eccentric chamber of each pump housing, each rotor being connected to the pipes for rotation therewith, means for anchoring said housings in the well and means for rotating the pipes and rotors.

23. Pumping apparatus for bored wells comprising a pump housing of a diameter slightly less than the bore of the well, said housing having an outlet chamber at its upper end, an inlet chamber at its lower end and an intermediate eccentrically disposed rotor chamber having inlet and outlet ports communicating with the inlet and outlet chambers, a piston rotor in the rotor chamber having tubular shafts projecting into the inlet and outlet chambers and having openings to said chambers, pipes journaled in the upper and lower ends of the housing and keyed to said tubular shafts, means carried by said housing for anchoring the same in the well, and means for driving the pipes and rotors.

24. Pumping apparatus comprising an upright conduit composed of sections joined end to end, a plurality of pump housings forming sections of the conduit and rotatably joined to adjacent sections, a piston rotor in each housing non-rotatably connected to conduit sections above and below the housing, and means for rotating the rotors and conduit sections connected thereto relatively to said housings.

25. Pumping apparatus comprising an upright conduit composed of sections joined end to end, a plurality of pump housings forming sections of the conduit and rotatably joined to adjacent sections, a piston rotor in each housing non-rotatably connected to conduit sections above and below the housing, means for holding the housings against rotation, and means for driving the rotors and conduit sections connected thereto.

ROBERT DEMING.

CERTIFICATE OF CORRECTION.

Patent No. 1,980,985. November 20, 1934.

ROBERT DEMING

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, line 16, after "normally" insert the words closed by an inwardly opening valve 73 which is normally; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 12th day of February, A. D. 1935.

(Seal)

Leslie Frazer
Acting Commissioner of Patents.