Dec. 2, 1930. R. W. GUNN ET AL 1,783,615

PUMP

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Fig. 2.

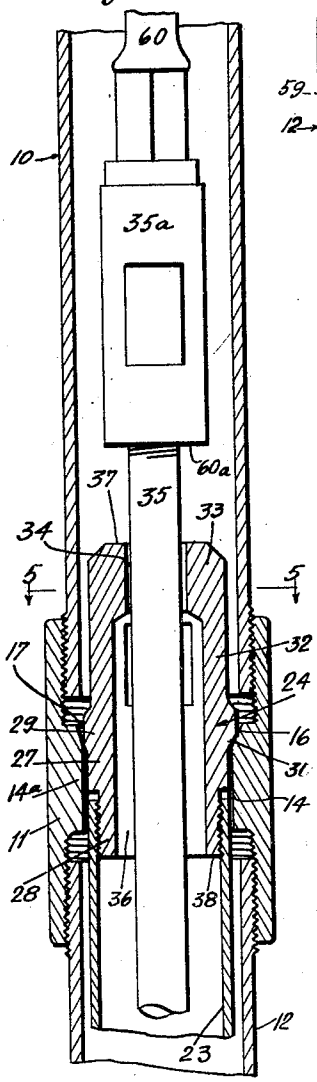


Fig. 3.

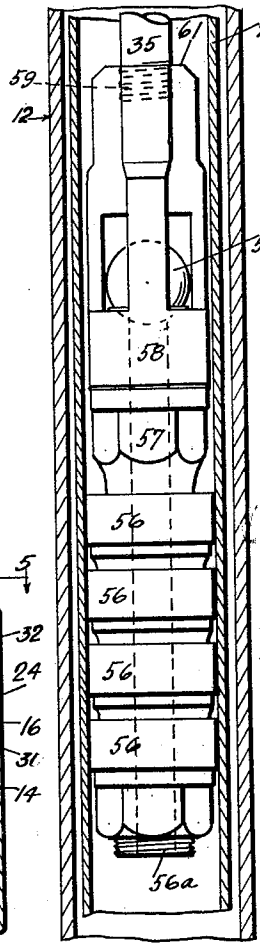


Fig. 4.

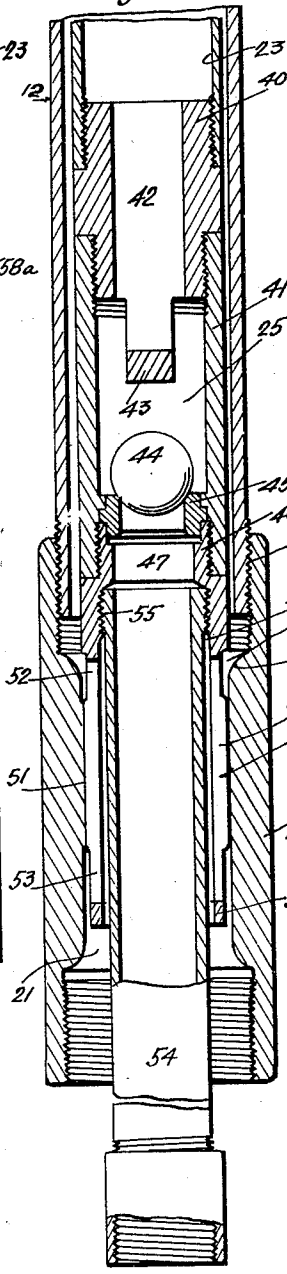


Fig. 1.

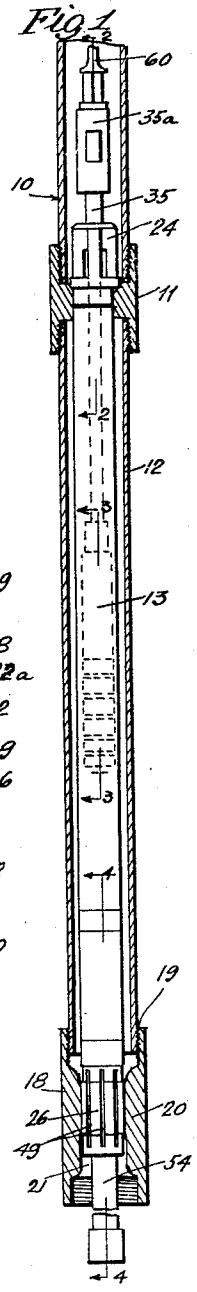
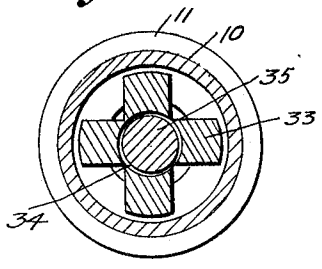


Fig. 5.



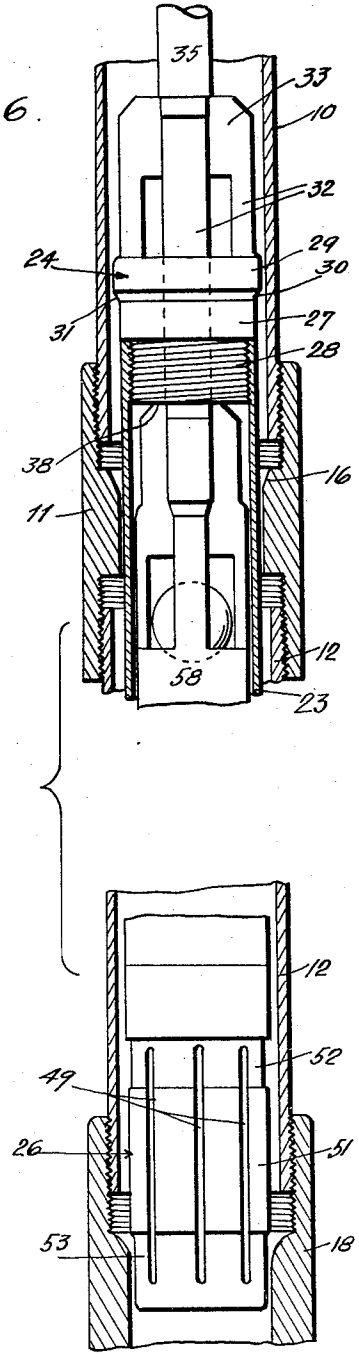
Inventors
Robert W. Gunn.
Willsie A. S. Thompson.
By
Attorney.

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Fig. 6.



Inventors
Robert W. Gunn.
Willsie A. S. Thompson.
James J. Bradley
Attorney.

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UNITED STATES PATENT OFFICE

ROBERT W. GUNN AND WILLSIE A. S. THOMPSON, OF LOS ANGELES, CALIFORNIA, ASSIGNORS, BY MESNE ASSIGNMENTS, TO EMSCO DERRICK & EQUIPMENT COMPANY, OF LOS ANGELES, CALIFORNIA, A CORPORATION OF CALIFORNIA

PUMP

Application filed April 26, 1927. Serial No. 186,681.

This invention relates generally to deep well pumps, and is more particularly concerned with pumps of the "lock-bottom" type.

Deep well pumps may be generally classified as of two types, the first type being characterized as one in which the working barrel is fixed to the lowermost joint of tubing and therefore set at the same time as the tubing, the plunger either being lowered to position after the tubing is set or being sent down with the tubing and subsequently attached to the sucker rod line through the medium of automatic catches, and the second type being characterized as a full pump assembly, including barrel and plunger, adapted to be lowered bodily into the tubing after the latter has been set. It is with the last type of pump that the present invention is concerned, the general features of advantage of this type over the other being well known to those skilled in the art.

One of the problems in connection with the installation of a lock-bottom pump, is to accomplish a releasable holding connection between the working barrel and the well tubing after the pump has been lowered to position, for it will be readily understood that the barrel must be held against longitudinal movement during the stroking of the plunger. This holding connection must be a sure one, yet must be of a nature both to be entered into easily and to be releasable when occasion arises for lifting the pump for inspection, replacement or repair.

There have been devised numerous types of releasable connections but, so far as we are aware, they have all been of a more or less complicated nature involving the use of grapple fingers, expanding mandrels and the like. In contradistinction to this, we have devised a connection which is of utmost simplicity and yet has all the features necessary to render it fully efficient in all phases of operation. It will readily be understood to those skilled in the art that the reduction of working parts to a minimum without in any way reducing efficient operation, contributes in large measure to the efficiency of the pumping operation, taken as a whole.

Another problem met with in connection with the operation of this type of pump is the tendency of sand, from above, working downwardly between the barrel and tubing in such a manner that it tends to "sand in" the barrel. That is, the sand works in between these members to such an extent that when occasion arises for lifting the barrel the packed sand resists such lifting, the resistance sometimes being such that all efforts to remove the barrel are without avail, and always greatly hampering the lifting operation. We have overcome this problem by making it possible to secure a sand-tight joint between the tubing and upper end of the barrel, this joint being secured in a very simple though fully efficient manner.

It may also be considered as a general object of the invention to provide a pump of the character described, which is of both simple and sturdy construction throughout, these features being well recognized as of great importance.

A further object of the invention is to provide a means for frictionally holding an inner tubular member against accidental movement, this means consisting of a bore and a gripping member secured to the inner tubular member, this gripping member having one or more longitudinally extending radially resilient arms adapted to have a friction-tight fit with said bore.

Another object of the invention is to provide this design of holding means in combination with a pump.

A still further object of the invention is to provide a means for holding an inner tubular member in an outer member, this means including a supporting-means for supporting the inner member and a separate friction-providing means for preventing the inner tubular member from accidental movement.

Other objects and novel features of the invention will be made apparent in the following detailed description, reference being had to the accompanying drawings in which:

Fig. 1 shows an embodiment of my invention in connection with the tubing at the bottom of the well;

Fig. 2 is an enlarged section, partly in elevation, on line 2—2 of Fig. 1;

Fig. 3 is an enlarged section, partly in elevation, on line 3—3 of Fig. 1;

Fig. 4 is an enlarged section, partly in elevation, on line 4—4 of Fig. 1;

Fig. 5 is a section on line 5—5 of Fig. 2; and

Fig. 6 is a contracted, sectional view, partly in elevation, showing the relative position of parts just before connection is made between the tubing and pump.

In Fig. 1 we have designated generally at 10 usual tubing adapted to be lowered into a well preparatory to pumping oil therefrom. Secured to the lowermost end of the tube through coupling 11, is the tubular shell 12. Broadly, it will be understood that shell 12 may be considered a part or extension of the well tubing, particularly since it may be made up of standard tubing stock and needs no special preparation except cutting to proper length. Hereinafter we will refer to section 12 as a shell in order more clearly to locate various elements, but we refer to this section as a part of the tubing in the appended claims.

As a matter of convenience and economy, coupling 11 is also adapted to cooperate with a member carried by the pump, generally indicated at 13, in a manner to seal off or form a fluid tight closure between the tubing and pump, though it will be understood this is not limitative on the invention since the sealing member may be carried by the tubing other than through coupling 11. Coupling 11 is shown in the form of a sleeve having a central internal annular flange 14*a* which defines a bore 14 of a diameter sufficient to pass, with clearance, the major extent of pump 13. The upper end of flange 14*a* is counterbored to provide a conical seating face 16, or face 16 may be considered as defining an inwardly and downwardly tapering counter-bore 17.

The lower end of shell 12 carries a gripping member or tubular shoe 18, the connection between shell and shoe preferably being made through screw threads 19. Shoe 18 has an internal annular flange 20 which is of considerable longitudinal extent and defines the relatively restricted bore 21. The upper end of flange 20 is relieved at 22 to provide a flaring mouth 22ª for bore 21, the curved or inclined walls defining this flaring mouth providing means for guiding the end of the pump into bore 21.

Pump 13 includes working barrel 23 having at its upper end a cap member 24, and at its lower end standing valve 25 and gripping member 26.

We have here shown member 24 as being made up in such a manner that it has several functions, though it will be understood our invention, considered broadly, is not limited to a structure wherein this single member has all these functions. Member 24 is made up of the tubular, cylindrical body portion 27 having at its lower end a threaded portion 28 whereby connection is made to barrel 23, an enlarged collar portion 29, and a downwardly and inwardly tapering portion 30 between portions 27 and 29, the portion 30 providing a conical, annular seating face 31 which is complementary to seating face 16 with which it is adapted to engage when the pump is fully assembled with the tubing.

This means just described constitutes the supporting-means of the invention whereby the pump barrel is supported in the well tubing.

Extending upwardly from portion 29 are posts 32 which support head 33, the latter having an axial bore 34 adapted to take pump rod 35, said rod being of such diameter that there is left ample annular clearance 36 between it and portion 27 to allow the free passage of oil from the barrel 23 upwardly about the rod and outwardly between posts 32 to the interior of tube 10 at a point above the pump. The top of head 33 presents an upwardly facing shoulder 37, while the lower end of member 24 presents a downwardly facing shoulder 38, shoulders 37 and 38 thus providing longitudinally spaced and oppositely facing abutments, the purpose of which will be made apparent hereinafter. It will be seen that head 33 provides a guide member for centering the pump rod in the barrel, also serving as an "out-board" bearing to reduce the chance of the rod being bent or sprung.

Connection between standing valve 25 and barrel 23 is made through a usual double-ended coupling 40, the tubular housing 41 of the standing valve comprising, in effect, a downward continuation of the barrel. Coupling 40 has the usual axial bore 42 to allow the free passage of fluid therethrough, and carries a usual bridge 43 spaced from the lower end thereof to provide a stop for limiting the upward movement of the valve ball or stopper 44. The seat 45, upon which ball 44 normally rests, is held in position within sleeve 41 by the externally threaded extension 46 of gripping member 26, this extension having a bore 47 which is in communication with the larger, threaded bore 48 which extends through the body of member 26.

Gripping member 26 may be considered as a tube which is so fashioned that it is capable of slight radial contraction and expansion. This characteristic is given to it by providing radially spaced slits 49 which extend through the wall of the member and longitudinally thereof. Preferably, though not necessarily, the slits stop short of the lower as well as the upper end of the member, leaving the complete annulus 50 at the lower end. The member then being made of suitable metal, it will be seen that the central portion thereof is capable of slight radial contraction, but

the inherent resiliency of the metal tends normally to hold the member in its relatively radially expanded condition. It will be seen that the member may be considered broadly as having a degree of radial resilience, it tending to spring to expanded position after it has been radially compressed or contracted. It is also preferable that the central portion 51 of the member, through and beyond which slits 49 preferably extend, be of slightly greater diameter than are the adjoining portions 52 and 53, and the lower portion 53 may be considered as a guide extremity or pilot for the gripping member. When in normal condition of radial expansion the outside diameter of portion 51 is slightly greater than the inside diameter of the shoe bore 21.

Preferably, though not necessarily, a gas anchor 54 in the form of a tube is threaded into member 26 at the upper end of its bore, as at 55, and extends downwardly below end 50, and, when the pump is fully within the tubing, below the end of the tubing. It will be evident that tubular member 26 has near its upper end an externally threaded portion 46 and internal screw threads 55, slits 49 extending downwardly from the point below the joint between the standing valve and the gas anchor.

While the plunger of the pump may be made up in any suitable form, we have here shown it as including a plurality of usual cups 56 provided on tubular stem 56*a* which is secured through coupling 57 to the lower end of usual working valve 58 having a ball stopper 58*a*. The cups have peripheral bearing with barrel 23 while the working valve 58 is connected at 59 to the end of pump rod 35. The pump barrel and the gas anchor constitute the inner tubing of our invention.

The upper end of rod 35, where it extends above member 24, is connected through coupling 35ª to sucker rod 60; and it will be noted that coupling 35ª presents a downwardly facing shoulder 60ª. The longitudinal spacing of shoulder 60ª from the upwardly facing shoulder 61 presented by working valve 58 determines the extent of relative longitudinal movement allowed between the barrel and plunger 56, this extent of movement being sufficiently greater than the length of working stroke of the plunger to permit full, unintercepted reciprocation of the plunger during normal pump actuation.

The tubing with its shoe 18 in place, is first set within the well. The fully assembled pump is then attached to the line of sucker rods and lowered in the usual manner, the pump during its descension being held from dropping from the rods due to the fact that shoulder 38 of member 24 rests upon shoulder 61 of valve 58. As soon as the enlarged portion 51 of member 26 engages shoe 18, the pump comes to rest, while the sucker rods and elements carried thereby continue downwardly until shoulder 60ª of coupling 35ª strikes portion 37 of member 24. The weight of the sucker rod line is then imposed upon the pump and forces the latter downwardly. The converging walls of bore 21 serve gradually to compress radially the portion 51 of the gripping member until said portion is of sufficiently small diameter to enter the restricted bore 21 of the shoe. The downwardly directed pressure then serves to enter portion 51 within said restricted bore, the inherent tendency of said portion to expand providing a friction tight fit between the shoe and gripping member. If the gripping member does not immediately enter the restricted bore, the sucker rod line may be lifted and dropped several times (the lift being less than enough to unseat the gripping member from the shoe) the gripping member thus being hammered or driven home.

It has been found that a force of about 1000 pounds is sufficient to drive the gripping member home, and since it takes a corresponding amount of upward pull to unseat the gripping member, it will be seen that the hold of the shoe on said member is sufficient to prevent accidental longitudinal displacement of the barrel, it thus being assured that there will be no movement of the barrel with respect to the tubing during the normal stroking of the plunger.

The engagement of conical face 31 with conical face 16 limits the downward movement of the plunger, the spacing of face 16 from the shoe being such that when faces 16 and 31 are in engagement the gripping member 26 has been driven fully home. The complementary faces 16 and 31 provide a fluid-tight fit between the tubing and the top of the pump, preventing leakage of fluid downwardly from above the pump. This conical end engagement also is such that it prevents the entrance of sand between the tubing and barrel from above, and therefore prevents the pump from becoming "sanded in." This conical end engagement also gives a type of joint which is readily releasable when occasion arises for pulling the pump.

When the plunger is raised through the sucker and pump rods, oil flows through anchor 54, lifts ball 44 and passes into the bore of the barrel, while the column of oil above the closed working valve 58 is lifted and passes out the upper end of the barrel through bore 36 and between posts 32 to the tubing bore above the pump. On the subsequent down-stroke of the plunger, ball 44 is seated, and the oil thereabove is forced through the bore of the plunger stem 56*a* into the barrel-bore thereabove, lifting stopper 58*a* of valve 58 in its passage.

It will be understood that when it becomes necessary or desirable to pull the pump, the sucker rods are moved upwardly until valve 58 again engages shoulder 38, whereupon con-

tinued upward pull on the sucker rods pulls the member 26 longitudinally free from the restricted bore of shoe 18, whereupon the gripping member radially expands to normal position.

It has been found by actual practice that the hold between the tubing and pump is ample for the purpose and it will be readily appreciated that the securement of this gripping faculty without the use of grab fingers or the like which call for comparative complication of mechanism, is a feature of very considerable merit. It is also notable that there is presented no mechanism which might become sanded in or otherwise effected in a manner tending effectually to resist wilful withdrawal of the pump.

Anchor 54, since it extends below the shell, may be utilized as a drive-out pin to free member 26 from the shoe after the shell and pump have been fitted together in the factory for test or packing purposes.

It will be understood the drawings and description are to be considered merely as illustrative of and not restrictive on the broader claims appended hereto, for various changes in design, structure and arrangements may be made without departing from the spirit and scope of said claims.

We claim:

1. In combination: a well tubing; a tubular shoe on said well tubing having a bore of lesser diameter than said tubing, said bore having plain uninterrupted side walls defining its portion of minimum diameter; a pump barrel; a gripping member on said barrel adapted to be forced with friction-tight fit into said bore, said member having a radially resilient portion engaging the plain side walls of said bore, said member having a longitudinal passage therethrough and adapted to receive in said passage a gas anchor, said gas anchor being connected with said member at its upper end so as to form a recess between said member and said gas anchor; and supporting means provided above said shoe to support said barrel within said well tubing.

2. In combination: a well tubing; a tubular shoe on said well tubing having a bore of lesser diameter than said tubing, said bore having plain uninterrupted side walls defining its portion of minimum diameter; a pump barrel; a gripping member on said pump barrel adapted to be forced with friction-tight fit into said bore, said member having a plurality of radially resilient arms adapted to engage the plain side walls of said bore and restrain said barrel from upward movement by frictional engagement with said walls, said member having internal threads at its upper end provided to receive a gas anchor so as to form a recess between said arms and said gas anchor; and supporting means provided above said shoe to support said barrel within said tubing, comprising an annular face formed on said barrel adapted to engage an annular seat formed on said tubing, the engagement between said face and said seat forming a fluid-tight joint between said barrel and said tubing above said shoe.

In witness that we claim the foregoing we have hereunto subscribed our names this 11th day of April, 1927.

ROBERT W. GUNN.
WILLSIE A. S. THOMPSON.