July 16, 1929. L. C. BLACK 1,721,245

FLEXIBLE MULTISTAGE DEEP WELL PUMP PLUNGER

Filed Sept. 6, 1927

FIG. 1. FIG. 3. FIG. 5.

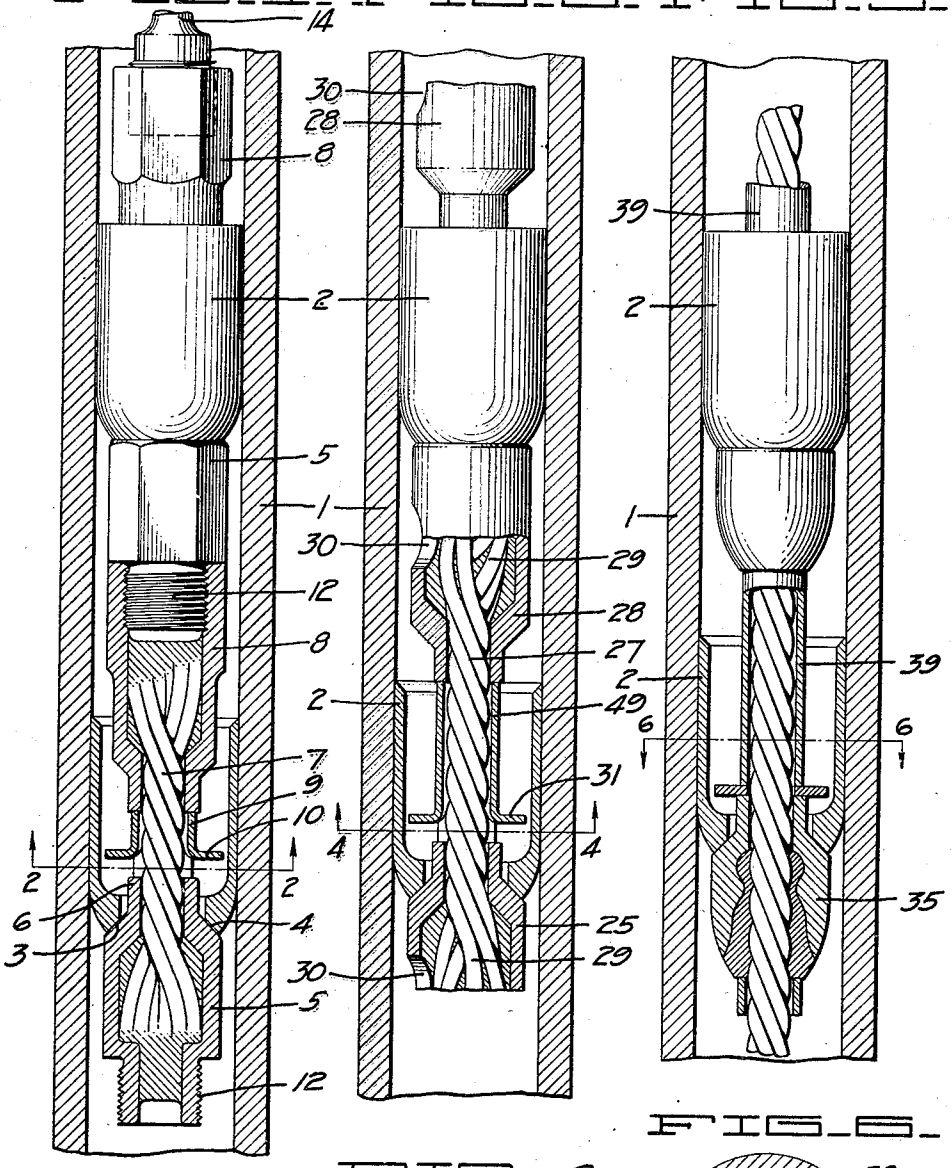


FIG. 6.

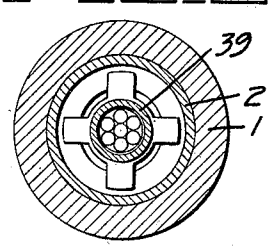


FIG. 4.

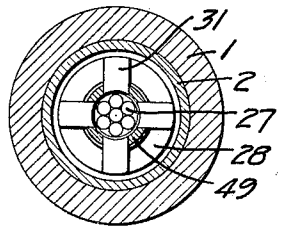
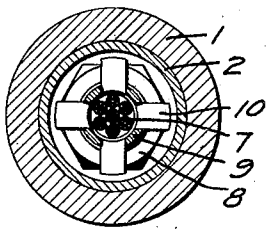


FIG. 2.



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UNITED STATES PATENT OFFICE.

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FLEXIBLE MULTISTAGE DEEP-WELL PUMP PLUNGER.

Application filed September 6, 1927. Serial No. 217,572.

This invention relates to pump plungers which are adapted to be used in multi-stage pumps or pumps in which the plungers are provided with a plurality of cups and a plurality of valves corresponding to the cups so that the pressure from the column of liquid above the plunger is distributed over a plurality of valves. The standard type of oil well includes a relatively long pump plunger located in an accurately machined pump barrel near the bottom of the well where it is subjected to the entire hydrostatic pressure of the oil column. To be efficiently operated the pump must be provided with plungers having a tight sliding fit within the pump or working barrel. The working barrel, due to its long length, is quite frequently out of alinement and therefore the free passage of the plungers through the working barrel is prevented and a great amount of power is absorbed in overcoming the friction between the working barrel and the plunger. I have found that this difficulty may be overcome by using a plurality of short plungers very accurately machined to closely fit the working barrel and connected together by flexible means which permits the plungers to aline themselves with the working barrel even though the working barrel may be out of alinement and it is one object of this invention to so construct a multi-stage plunger.

Another object of this invention is to provide a multi-stage plunger in which the upper and lower members of each stage are flexibly connected and in which each stage is detachably secured to the next preceding stage.

Another object of this invention is to provide a multi-stage plunger in which the various fixed elements of each stage may be readily and economically secured to the flexible element of each stage.

Another object of this invention is to provide a plunger sleeve which is not exposed to eccentric wear within the working barrel caused by the out of alinement of the working barrel.

Another object of this invention is to provide a plunger which has a closer fit within the working barrel than previously attained.

Another object of this invention is to provide pump plungers which will slide easier and faster in any barrel even though the barrel may be out of alinement.

Another object of this invention is to provide a plunger which will prevent any excessive wear on the working barrel and thus prolong the life of the working barrel.

It is a further object of the invention to construct a multi-stage plunger which is especially adapted for use in oil wells and which may be readily and cheaply manufactured, simple in construction and will give a high pumping efficiency.

Further objects will appear from the following specification in which I describe the preferred embodiment of my invention.

Referring to the drawings:

Figure 1 is an elevational cross sectional view of a working barrel in which are shown two of a series of pump plungers, one of which together with its flexible connections has been shown in section.

Figure 2 is a section taken on line 2—2 of Fig. 1 and looking in the direction as indicated by the arrows.

Figure 3 is a view similar to that shown by Fig. 1 but shows a different scheme of securing the flexible element to the socket members of the plunger.

Figure 4 is a section taken on the line 4—4 of Fig. 3 and looking in the direction as indicated by the arrow.

Figure 5 is a further modification of the apparatus shown in Fig. 1 wherein still another method of connection with the flexible cable has been shown.

Figure 6 is a section taken on the line 6—6 of Fig. 5 and taken in the direction as indicated by the arrows.

In Figs. 1, 3 and 5 there is shown in cross section a portion of a working barrel 1, within which, in tight sliding engagement are a series of short cup shaped plungers 2. The lower open end of each cup plunger 2 is provided with an outwardly flaring surface 3 adapted to cooperate with the complementary seating surface 4; these surfaces being provided at the upper end of a lower socket and valve seat 5. The upper end 6 of each socket 5 fits snugly about a flexible cable section 7 and extends well within the lower end of each cup shaped member 2 to insure the proper seating of the same on the upward stroke of the plunger. Each flexible cable section 7 is secured to a lower socket member 5 by means of zinc which is poured into each socket 5 and surrounds the lower unravelled strands of the cable. In the same manner an upper socket 8 is secured to the upper end of each flexible cable section 7. The lower end of each socket member 8 is of a reduced diameter

and extends well within the upper end of the cup shaped member 2. The socket members 5 and 8 of each cable section are held in spaced relation by means of a spacer 9 which is provided with radially projecting fingers 10, thus serving as a spider to limit longitudinal movement of the cup plunger 2 with respect to the sockets 5 and 8. Spacer 9 also operates to make the entire construction a little more rigid and prevents buckling of the cable sections in the event compressional rather than tensional forces are applied to the same. .

The lower ends of the socket members 5 are of reduced diameter and are externally threaded as at 12 and threadedly engage the upper internally threaded ends of the socket members 8. The uppermost socket 8 of the entire series is engaged by the lower end of the sucker rod 14 by which the entire series of plungers is reciprocated. It will be noted that in Fig. 1 the socket members 5 and 8 have been secured together by small lengths of a cable. This construction provides the necessary flexibility between the various cup shaped plungers of the series to enable them to be accurately machined to the diameter of the working barrel and still pass through a working barrel which is out of alinement without any undue friction.

The same flexibility between the cup plungers 2 can be obtained by the modified structure shown in Fig. 3. In this modification the cable sections are formed of a single length of cable 27. The upper and lower socket members 28 and 25 respectively have been secured to the flexible cable 27 by unravelling the portion 29 of cable which lies within the socket members and in then pouring zinc through the opening 30 into the socket members about these unravelled portions of the cable. The openings 30 also are convenient in separating the strands of the cable. In this modification a spacer 49 has been shown as a little longer than spacer 9 of Fig. 1 but just as in the spacer shown in Fig. 1, the spacer 49 is also provided with struck out fingers 31 which serve as a spider to limit the movement of the cup shaped plungers 2. It will be noted that in this modification neither the socket members 28 nor 25 are threaded except of course the uppermost socket member 28, of the entire series which is internally threaded to accommodate the lower end of the sucker rod 14 by which the multiple cup plungers are reciprocated.

Fig. 5 shows a still further modification. In this modification as well as the one shown in Fig. 3 a single cable is used. The construction of this modification is simpler than that of either of the other two modifications in that both of the socket members are identical and consist of an inverted funnel shaped member or socket 35 which I have secured to the cable by means of zinc which is poured into the open lower end of the socket members about the cable. It will be noted that the inner surface of the socket 35 is of corrugated form to prevent the zinc after solidifying from falling away from the socket. The spacer in this modification consists merely of a plain tubular member 39, and the spider consists of an apertured cross shaped member surrounding the cable. In this modification the upper end of the cable should be provided with an internally threaded socket member to accommodate the lower end of a sucker rod. The operation of the device is thought to be apparent to those skilled in the art from the above disclosure.

In all three modifications the zinc which is poured into the socket to secure the socket to the cable also serves to effectively seal the cable against any leakage.

From the above description it will be seen that flexible connections have been provided between the various stages of a multi-stage cup shaped plunger which allow sufficient play between the various parts to permit the entire structure to slide without undue friction through a working barrel even though that working barrel may be out of alinement and notwithstanding that the cup plungers have been accurately machined to fit the working barrel. The above described method of securing the socket members by means of zinc or other suitable material to the flexible cable is very effective, easily done and economical. In the modification shown in Fig. 1 the various stages have been shown as detachable. This construction permits of the ready replacement of any particular section or stage in the event of its injury.

I claim:

1. In a pump, the combination with a working barrel of a plunger comprising a series of sockets each one of which is secured to the next preceding socket by flexible means, means for limiting the flexibility of said flexible means, cup shaped members seated on and forming valves with said sockets and means for limiting the longitudinal movement of said cup shaped members with respect to said flexible means.

2. In a pump, the combination with a working barrel of a plunger comprising a series of sets of upper and lower sockets, flexible means for securing the upper and lower sockets of each set in spaced relation, means for detachably securing the lower socket of each set with the upper socket of the next preceding set, cup shaped members seated on each lower socket and forming a valve therewith and means for limiting the longitudinal movement of said cup shaped members with respect to the socket on which it is seated.

3. In a pump, the combination with a working barrel, of a plunger comprising a plurality of sets of upper and lower sockets, the upper and lower ends respectively of which

are internally and externally threaded, a flexible cable whose upper and lower unravelled ends are secured within the lower and upper ends respectively of said sockets by means of molded zinc surrounding said cable ends, cup shaped members seated on each of said lower sockets and forming a plurality of valves therewith, and a tubular spacer surrounding said cable and lying between said upper and lower sockets, said spacer being provided with radially projecting fingers for limiting the longitudinal movement of the cup shaped member with respect to their seats.

4. In combination with a working barrel, a pump plunger comprising a plurality of spaced socket members, a plurality of plunger members each being cooperably associated with a socket member, each plunger member having a valve associated with the same, and means for permitting lateral movement of each socket member relative to the other socket members, said means comprising flexible sections connecting said socket members.

5. In combination with a working barrel, a multi-stage plunger, each stage comprising upper and lower flexibly connected sockets whose upper and lower ends respectively are internally and externally threaded, longitudinally movable cup shaped members seated on the upper end of each of the lower sockets and a spider co-acting with said cup shaped members for limiting the longitudinal movement thereof with respect to their seats.

6. In a pump, a working barrel, a plurality of vertically spaced socket members disposed in said barrel, flexible means interconnecting said socket members, means for stiffening said flexible means, and a plurality of plunger members closely fitting said barrel and each cooperably associated with a socket member whereby said plunger members are reciprocated upon reciprocation of said connected socket members.

7. In a pump, a working barrel, a plurality of vertically spaced socket members disposed in said barrel, flexible cable sections interconnecting said socket members, spacer means imposed between the socket members and surrounding the cable sections, and a plurality of plunger members closely fitting said barrel and each cooperably associated with a socket member whereby said plunger members are reciprocated upon reciprocation of said connected socket members.

In testimony whereof, I have hereunto set my hand.

LESTER C. BLACK.