March 23, 1937. W. H. ROOD 2,074,591

PUMP PLUNGER

Filed Feb. 18, 1935

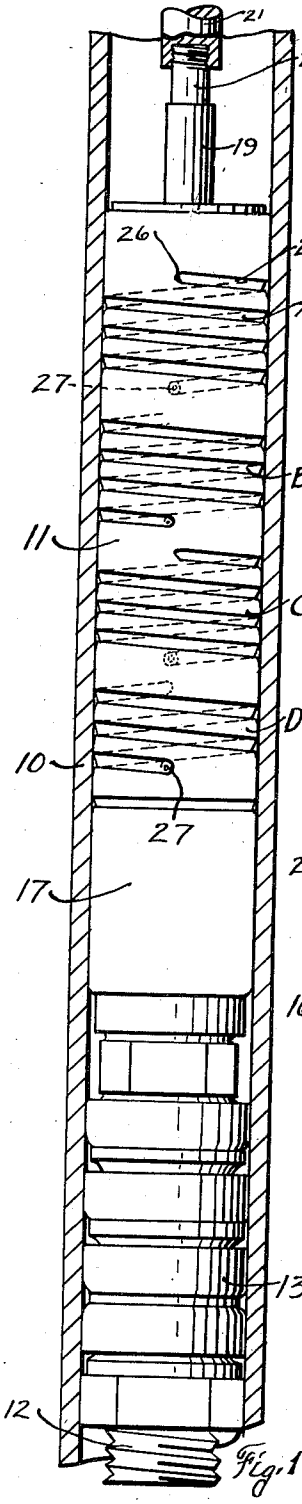

Fig. 1

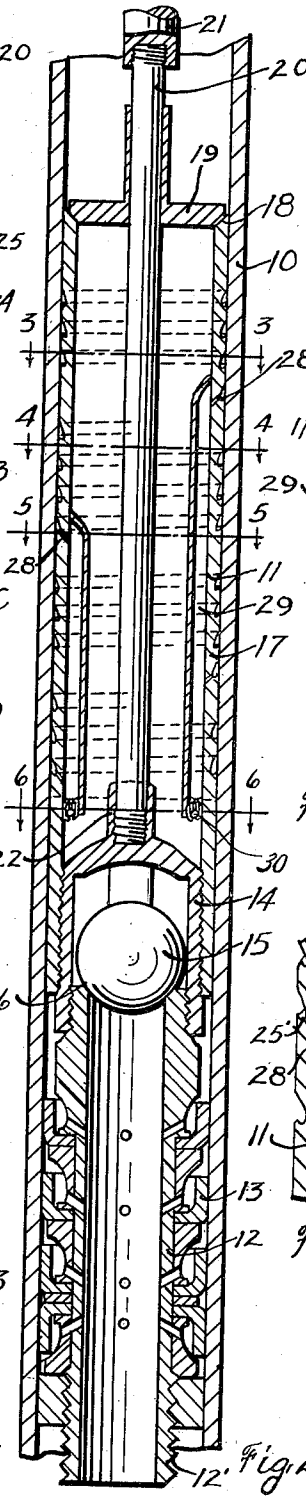

Fig. 2

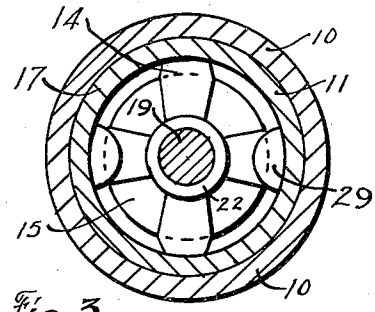

Fig. 3

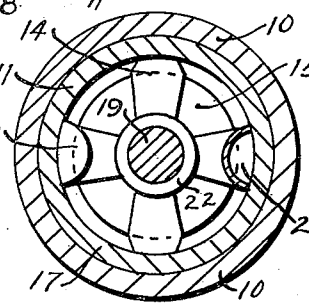

Fig. 4

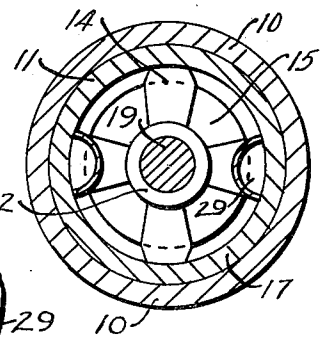

Fig. 5

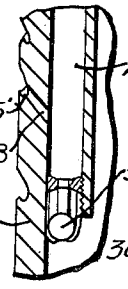

Fig. 7

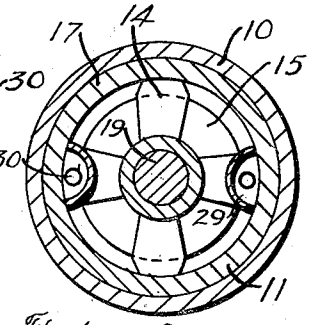

Fig 6

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UNITED STATES PATENT OFFICE

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PUMP PLUNGER

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Application February 18, 1935, Serial No. 7,022

3 Claims. (Cl. 103—225)

This invention relates to new and useful improvements in pump plungers.

One object of the invention is to provide an improved pump plunger arranged to reciprocate within the working barrel to pump the oil to the surface from any depth.

An important object of the invention is to provide an improved pump barrel and plunger having means for conducting into the interior of said plunger, upon one stroke, the sand and other gritty material which accumulates above the plunger and between the outer face of said plunger and the walls of barrel; whereby such sand and matter are carried from the well in suspension in the liquid, upon the next stroke of the plunger, thereby preventing scoring of the face of the plunger and the bore of the barrel, as well as stopping the accumulated sand and other materials from interfering with the operation of said plunger.

Another object of the invention is to provide spiral grooves in the wall of a reciprocating plunger, said grooves communicating with the interior of the plunger, whereby sand accumulating between the wall of said plunger and the working barrel is conducted to the interior of the plunger to be carried from the well with the oil being pumped by said plunger.

A further object of the invention is to provide means within a pump plunger for retaining on the downstroke sand which has accumulated above the plunger and between the wall of said plunger and the working barrel during the preceding upstroke, said means being arranged to release the sand into the interior of the plunger on the next following upstroke, whereby said sand is carried to the top of the well with the oil upon said upstroke.

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawing, in which an example of the invention is shown, and wherein:

Figure 1 is an elevation of a plunger, constructed in accordance with the invention, showing the barrel in section,

Figure 2 is a vertical sectional view of the same mounted within a working barrel,

Figure 3 is an enlarged horizontal cross-sectional view, taken on the line 3—3 of Figure 2,

Figure 4 is an enlarged horizontal cross-sectional view, taken on the line 4—4 of Figure 2,

Figure 5 is an enlarged horizontal, cross-sectional view, taken on the line 5—5 of Figure 2,

Figure 6 is an enlarged horizontal cross-sectional view taken on the line 6—6 of Figure 2, and

Figure 7 is a vertical sectional detail view of one of the check valves.

In the drawing, the numerals 10 designates the usual pump barrel in which the pump plunger assembly 11 reciprocates. The plunger comprises a mandrel 12 which has a plurality of packing cups 13 mounted thereon. As is clearly shown in Figure 2, the mandrel has its upper end screw-threaded to receive the cage 14 of a ball check valve 15. The ball engages a seat 16 and is arranged to unseat on the downstroke of the mandrel, as will be hereinafter explained.

The main body 17 of the plunger comprises an elongated section of casing which has its lower end internally screw-threaded. The outer face of the valve 14 is threaded to receive the lower end of the body 17, whereby the body and mandrel are connected together. The body is of substantially the same diameter as the barrel 10 and has a snug sliding fit therein. The upper end of said body is provided with a valve seat 18 which is arranged to be engaged by a vertically movable valve 19. The valve 19 is slidable on a stem 20 which has its upper end screwed into the lower end of the sucker rod 21 and its lower end depending through the body 17 and connected into an axial collar 22 on the upper end of the valve cage 14. It is obvious that the entire assembly 11, that is, the body 17, valve 15, and mandrel 12 are carried by the well tubing. The lower end of the mandrel 12 is screw-threaded at 12'.

By observing Figure 2, it will be seen that as the plunger assembly 11 moves downwardly in the barrel 10, the ball valve 15 and the valve 19 will be opened by the pressure of the fluid standing in the barrel. This causes the fluid to flow upwardly through the body 17 and outwardly through the upper end thereof into the well casing (not shown) above the barrel 10. After the plunger assembly completes its downstroke, it is obvious that a body of oil is standing thereabove and as said assembly moves upwardly, the pressure of the fluid thereabove closes the valve 19 at the upper end of the body 17, whereby on the upstroke of the assembly the fluid is lifted. At the completion of the downstroke, there is, of course, some fluid standing in the body 17 between the valves 19 and 15 and upon the upstroke, the weight of this fluid closes the ball valve 15. Thus, it is obvious that during the

downstroke of the assembly the valves 19 and 15 are unseated to permit fluid to flow through the assembly, while during the upstroke, said valves are closed and fluid thereabove is lifted. This action is the same as in the usual reciprocating pump plunger.

In pumping fluid where there is sand, or other abrasive material, present in said fluid, it has been found that small particles of the sand accumulate on top of the valve 19 and have a tendency to sift between the outer wall of the plunger body 17 and barrel 10. Due to the constant vertical reciprocation of the assembly, this abrasive material which has sifted between said plunger body 17 and the barrel, scores and mars the walls of the parts, which, in a short time, detracts from the efficiency of operation, and causes constant replacement of the assembly, as well as the barrel.

To overcome this disadvantage and to carry this accumulated sand upwardly from the well with the upwardly moving fluid, the body 17 is provided with spiral grooves 25 in its outer wall. As clearly shown in Figure 1, four continuous grooves A, B, C and D are formed one below the other along the vertical length of the body 17. Each groove commences at a point 26 on the body and spirals downwardly. The other end of the groove is at a point 27 below and diametrically opposite the point 26 where the groove begins. It is pointed out that it is preferable to stagger the points 26 and 27 of alternate grooves, that is, the commencement of the groove B at 26 is in alinement with the end of the groove A at 27, and the end 27 of the groove B is on the opposite side of the body in alinement with the point 26 of the groove A. Thus, each alternate groove has its lower end 27 diametrically opposite the lower end of the adjacent groove.

The lower end of each groove communicates through an inclined radial port 28 with the interior of vertically extending passages 29 which are formed on the inner wall of the body 17. The passages have their lower ends terminating above the cage 14 (Figure 2) and receive ball check valves 30 which are suitably mounted therein. The ball valves are arranged to close on the downstroke of the assembly and to be unseated upon the upstroke. It is desirable, although not essential, to undercut the grooves at 25' as shown in Figure 7. It is pointed out that although four grooves are shown, the plunger 17 may be lengthened or shortened to accommodate more or less of the grooves. The passages 29 are, of course, only long enough to cover all the radial ports 28 which connect the lower ends of the grooves with said passages.

In operation, upon the downstroke of the assembly 11, the valves 15 and 19 are unseated to permit fluid to flow upwardly through said assembly. The pressure of the fluid passing upwardly through the body, however, closes the check valves 30 to prevent said fluid entering the passages 29 and flowing into the barrel 10 through the ports 28.

After the assembly has completed its downstroke and commences its upstroke, the weight of the fluid closes the valves 19 and 15, as has been described. As the upstroke starts, the tendency of the fluid in the valve is to immediately flow downwardly through the body. This downward flow creates a suction in the body which not only opens the check valves 30, but pulls the accumulated sand, and other abrasives from the passages and spiral grooves. It is pointed out that this suction is only of a short duration, that is, only until the ball valve 15 closes. However, it does serve to draw accumulated sand from the grooves upon the start of each upstroke. The accumulation of any sand or other abrasive materials, as before referred to, occurs on the upstroke and thus, during the next downstroke this sand sifts between the walls of the plunger body 17 and barrel 10. This sand enters the grooves 25 and moves downwardly therein finally entering the passages 29. Since the check valves 30 are closed on the downstroke, the sand within the passages 29 is held therein while fluid is passing through the assembly 11. The closing of the valves 30 on the downstroke also prevents the pressure of the fluid from acting upon the sand trapped in the passages 29, whereby said sand can not be forced upwardly back into the spiral grooves through the inclined ports. However, at the start of the upstroke, with the valves 19 and 15 closed, the check valves 30 open due to the suction created and the sand within the passages is drawn into the interior of the plunger body 17 above the ball valve 15. After the suction ceases, gravity causes the remaining sand in the passages 29 to fall into the interior of the body. On the next succeeding downstroke, this sand is carried upwardly with the fluid passing through the assembly. Thus, it will be seen that the sand, or other material is conveyed from between the walls of the body 17 and barrel 10 into the interior of said body and carried to the surface with the pumping fluid, thereby preventing scoring and marring said walls by the abrasives, which not only increases the efficiency of the plunger assembly, but also prolongs the life thereof.

It is pointed out that although all the ports 28 of alternate grooves are shown diametrically opposite each other in the wall of the body 17, it would be possible to provide a single passage 29 and permit all the ports 28 to communicate therewith. By locating the ports as shown, a more equal distribution around the periphery of the body is had. The inclination of the ports 28 aids in conveying the abrasives from the grooves to the passages, but it would be possible to form them straight in a horizontal plane.

What I claim and desire to secure by Letters Patent, is:

1. A reciprocating pump plunger for an oil well pump arranged to move vertically in a working barrel and including, a tubular plunger body having a valve seat at its upper end and provided with separated groups of spiral grooves in its outer wall, said body having inclined openings extending through its wall from the bottom of each group of grooves, conductors on the inside of the body connecting the openings, check valves unseated by gravity in the lower ends of said conductors, a stem extending into the plunger body, a valve cage carried by said stem and fastened in the plunger body below the conductors, a valve mounted in said cage, and a valve slidable on said stem for engaging the seat at the upper end of said body.

2. A reciprocating pump plunger for an oil well pump arranged to move vertically in a working barrel and including, a tubular plunger body having spaced groups of spiral grooves in its outer surface and inclined openings in the lower ends of the grooves extending through the wall of the body, the wall of said body being otherwise imperforate, conductors within the body communicating with the openings thereof, and check valves unseated by gravity in said conductors for controlling the flow of fluid therethrough.

3. A reciprocating pump plunger for an oil well pump arranged to move vertically in a working barrel and including, a hollow cylindrical body having spaced groups of spiral grooves in its outer surface provided with inclined apertures in their lower ends extending through the wall of said body, vertical passages on the inner wall of the body communicating with the openings of the grooves, whereby abrasives travelling down said grooves are delivered to said passages, said passage ways having their lower ends open to the interior of the body and a gravity operated valve at the lower end of each passage way free from springs and arranged to be closed by the fluid upon the downstroke of the plunger to retain abrasives within said passage ways and free to drop to open said passage ways upon the upstroke of the plunger to release said abrasives into the interior of said plunger body.

WALTER H. ROOD.