July 14, 1925. 1,545,475

E. T. ADAMS

CONSTANT DISCHARGE PUMP

Filed Aug. 27, 1924

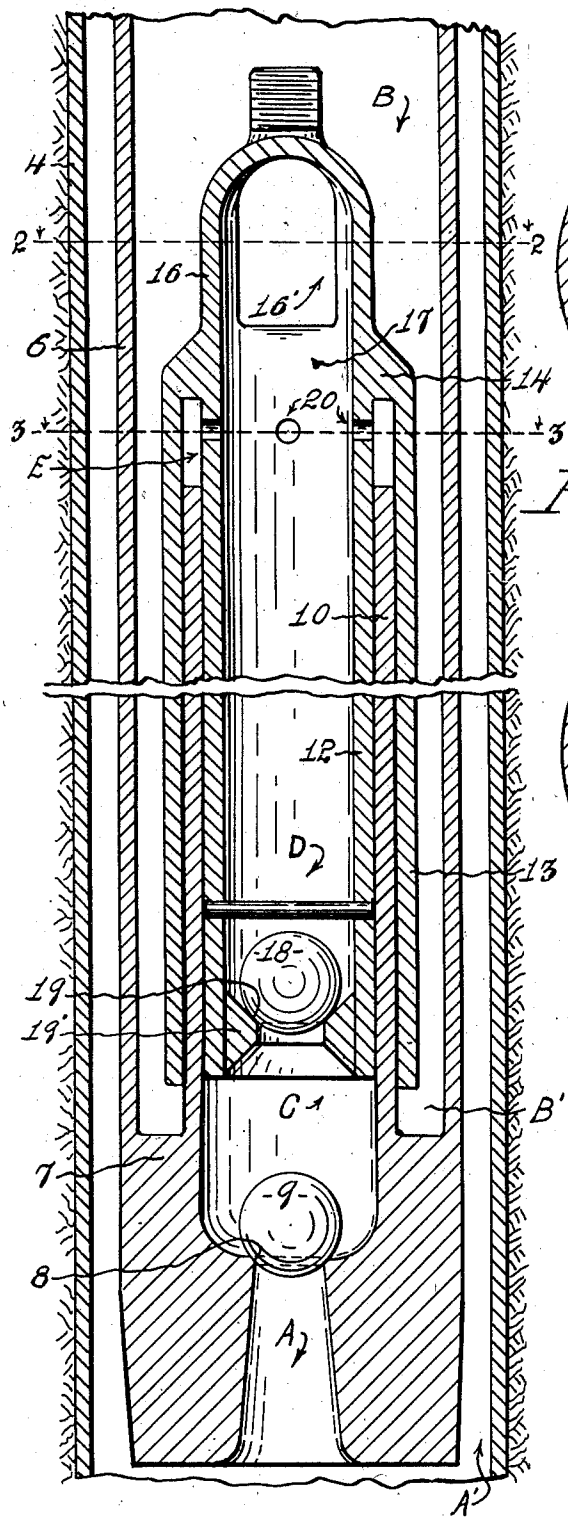
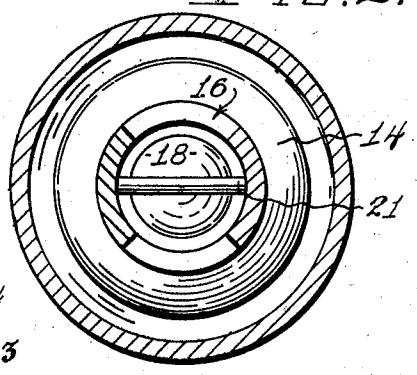



Fig. 1.

Fig. 2.



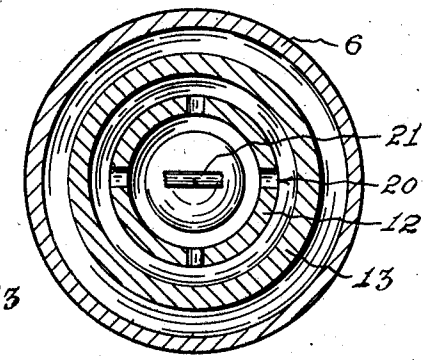




Fig. 3.

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# UNITED STATES PATENT OFFICE.

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## CONSTANT-DISCHARGE PUMP.

Application filed August 27, 1924. Serial No. 734,407.

*To all whom it may concern:*

Be it known that I, EDWARD T. ADAMS, a citizen of the United States, and a resident of Los Angeles, in the county of Los Angeles and State of California, have invented new and useful Improvements in Constant-Discharge Pumps, of which the following is a specification.

The present invention relates to deep well pumps of the single acting bucket valve type and has for its principal object to provide a pump in which there is the tendency to discharge constantly.

It will be understood in the consideration of this invention that in pumps of this character the actual work of lifting the oil is accomplished only by the up stroke. The discharge is therefore intermittent and the pump reciprocating means must overcome considerable inertia at the beginning of each stroke. In many instances oil wells are of considerable depth, some extending into the earth almost a mile, and for various practical reasons the fluid course leading from the lower parts of the well to the surface is of limited area of flow. Obviously, if it is possible to distribute the discharge evenly between the up stroke and the down stroke of the plunger the strain on the reciprocating parts will be reduced and the frictional resistance through the long fluid course will be greatly reduced.

It is therefore another object of this invention to adhere quite closely to common practice, to provide a pump construction of the utmost simplicity, and to still attain the above mentioned objects and result.

One of the greatest practical difficulties encountered in pumping oil wells is that known as "sanding up." In other words, sand and silt carried by the oil tends to separate from the upflowing stream of oil and to settle back in the pump, eventually finding its way to the suction valve, or standing valve as it is generally referred to.

It is another object of this invention to reduce the tendency for sand to so accumulate by causing all matter which settles adjacent the pump to be picked up and to be positively injected into the heart of the moving oil stream, so that it may be carried directly to the surface and out of the well.

Obviously, by so taking care of the settling and by providing a substantially constant flow through the discharge tubing, rather than the usual intermittent flow, all sand lifted from below the pump should eventually find its way to the surface.

In view of the immediately foregoing it is still another object of this invention to provide a simple construction of pump which will jointly provide for so disposing of the sand, while maintaining a substantially constant upward discharge.

Still other objects and advantages of my invention will appear hereinafter and will be better understood by virtue of the order in which they appear.

I have illustrated by the accompanying drawings a preferred practical embodiment of my invention.

In the said drawings:

Figure 1 is a view in vertical section of the said embodiment;

Figure 2 is a view in section seen on a line 2—2 of Figure 1;

Figure 3 is a view in section seen on a line 3—3 of Figure 1.

In carrying out my invention in the embodiment illustrated there is provided an annular wall or tube 6 which forms the usual pump casing and incloses a pump chamber or space B. Integral with the casing and at the lower end, there is provided a closure wall 7. The closure wall is provided with a suction aperture A, encompassed by an annular valve seat 8. Upon this valve seat there rests a ball 9. The valve seat and ball are hereinafter referred to jointly as the standing valve. Within the pump chamber there is provided an inner annular coaxial wall 10 which is termed the standing tube. This tube encompasses a central fluid course C which is a one-way communication with the space A′ through the standing valve. The standing tube is well spaced inwardly from the pump casing wall and provides a comparatively large annular space B′ which serves as a sand settling space.

As the equivalent of a plunger I provide inner and outer coaxial annular walls 12 and 13 which each connect with the plunger head 14; the plunger head providing the integral ball cage 16. In conformance with a salient feature of this invention the ball cage merely provides a convenient means for attaching the plunger to the usual sucker rods (not shown). The inner wall 12 is a working fit within the standing tube while the outer

wall 13 is fitted around the outside of the standing tube with a minimum working clearance therebetween.

It will be apparent now that the telescopic relation of the wall 13 to the standing tube is similar to the relation of the ordinary plunger to its pump casing. In this embodiment, however, it will be apparent that any sand or silt gravitating downwardly from above the pump will be deflected by the plunger head and by wall 13, so that it will settle in space B' without finding its way directly to the fluid course C. It will be apparent hereinafter that the throat 17 of the plunger head will discharge a constant stream of fluid upwardly and as a consequence there will be little or no possibility of solid matter gravitating from the space B to the internal space D encompassed by wall 12.

The plunger head is provided with the usual working valve-ball 18 and a valve seat 19. This ball and seat, is of necessity, within the inner wall 12. In conformance with a salient feature of this invention this working valve should be located well downward in the plunger, or at least an appreciable distance below the throat 17.

The arrangement of walls 12 and 13 with the standing tube provides an annular space E which will increase in volume during the up stroke of the plunger and subsequently decrease in volume with the succeeding down stroke of the plunger. Annular space E serves as a means for trapping sand as well as an auxiliary pumping chamber, as will appear hereinafter.

Now in order to carry out the objects of this invention the inner wall 12 is provided with a plurality of unobstructed ports, of suitable area, leading from the fluid course D directly into the anuular space E. Said ports are located above the working valve, or in other words the working valve is located below the ports in conformance with the results desired to be obtained.

The operation of this pump will be understood from the following: As the plunger is reciprocated constantly space C will alternately increase and decrease in volume. During the upward stroke of the plunger the working valve will be closed and the decrease in pressure created will cause the standing valve to open and oil will flow into space C as the plunger ascends. During this up stroke of the plunger, however, chamber E will be increasing in volume and it will draw a certain amount of oil from the fluid course D. During the up stroke all fluid which is above the working valve will, of course, be raised upwardly. It is to be understood, although not shown in the drawings, that the pump casing continues upwardly and connects with a string of tubing which leads to the surface to provide a continuous fluid course into and through which the pump discharges.

The fluid induced into E during the up stroke of the plunger is a portion of that which is being raised by the up stroke of the plunger. Therefore it may be said of this pump that while it is fundamentally a single acting, single discharge pump, a portion of the oil which it pumps during its up stroke is not delivered but is merely drawn into E and there reserved. It will be apparent therefore that the energy consumed by the pump reciprocating means (not shown) is not as great as it would be if all the oil had to be raised during the up stroke of the plunger.

During the next down stroke space E will be decreased in volume and the fluid which has been drawn therein will be again displaced into the fluid course D. Now at the same time that the space E is decreasing in volume the working valve is moving downwardly through the oil now contained in space C, which oil of course cannot escape downwardly because of the closed standing valve. Therefore there exists from the standing valve, and from the space C, a column of fluid reaching to the surface and filling the space E as well. Now it will be apparent that with the standing valve closed and the space E decreasing in volume a certain displacement must take place, and that displacement is equal to the reduction in effective volume of the space E.

This pump might well be termed a simple single acting bucket valve pump which has the peculiarity of retaining a portion of the fluid which passes through its valves, and redelivering that oil to the fluid course at the time when a simple pump is ordinarily ineffective in raising fluid. It is probably advisable in practice to arrange the space E so that its effective maximum volume is about one-half of the normal displacement, so that one-half of the oil is raised during the up stroke and the other one-half raised during the down stroke. It will be understood that the sucker rods have a very considerable weight and this weight may be relied upon to force the plunger downward. Obviously I have provided a pump in which the energy consumed is quite well distributed between the up stroke and the down stroke, and in which pump the discharge is quite constant.

Up to this point the self-cleaning features of this pump have not been considered. At all times the pressure in space B, and D as well as E is always the maximum hydrostatic pressure caused by the column of oil which reaches from the pump to the surface. The pressure in A and A' is only that due to the normal fluid level in the well. The pressure at C of the fluid, in this form of pump, changes. During the up stroke of

the plunger it will be approximately that of A, while during the down stroke it will of course be that of D, B and E.

I have stated heretofore that the ports should be of "suitable" area, while to be specific, it is best to have the ports slightly restricted so that during the up stroke of the plunger there will be a slight decrease in pressure in E due to throttling through the ports so that there is a slight induction from B′ to E. This induction will cause a slight flow upward through the clearance from B′ to E and sand or silt which has found its way to B′ will be drawn with the oil into the annular space E. This sand, during the down stroke of the pump will be ejected through the ports into the stream of oil which is then moving upward through the throat 17.

It will be apparent that I have provided a pump in which settlings are diverted into a suitable space and subsequently picked up and ejected again into the uprising oil stream, before the settlings can find their way to the standing valve, and,

Whereas I have shown and described a specific embodiment of my invention I do not limit myself to any specific embodiment and may alter the construction and arrangement of parts, as I desire, or as occasion requires, without enlarging the scope of my invention and without departing from the spirit thereof, within the appended claims.

I claim as my invention:

1. In a pump, a plunger embodying two co-axially arranged tubular members; one member of smaller diameter than the other, a casing embodying two co-axially arranged tubular members; one member of smaller diameter than the other; the plunger members coacting with the casing members to provide a main pump chamber and an auxiliary pump chamber; the auxiliary pump chamber being separated from the main pump chamber by one of the aforesaid tubular members, a standing valve, a port leading from said auxiliary pumping chamber to said main pumping chamber through that member which separates said chambers; said port being devoid of non-return means and providing constant communication between said pumping chambers; the said member being open at the upper end and devoid of non-return means, and a working valve carried by the smaller tubular plunger member at a point below said ports; whereby some of the fluid raised by said working valve during the up stroke of the plunger will be drawn into said auxiliary pumping chamber to be subsequently discharged therefrom on the following downstroke of the said plunger.

2. In a pump, a plunger embodying two coaxially arranged tubular members; one member of smaller diameter than the other, a casing embodying two co-axially arranged tubular members; one member of smaller diameter than the other; the plunger members coacting with the casing members to provide a main pump chamber and an auxiliary pump chamber; the auxiliary pump chamber being separated from the main pump chamber by one of the aforesaid tubular members, a standing valve, a port leading from said auxiliary pumping chamber to said main pumping chamber through that member which separates said chambers; said port being devoid of non-return means and providing constant communication between said pumping chambers, and a working valve carried by the smaller tubular plunger member at a point below said ports; whereby some of the fluid raised by said working valve during the up stroke of the plunger will be drawn into said auxiliary pumping chamber to be subsequently discharged therefrom on the following down stroke of said plunger.

3. In a pump, a pump casing having an inlet opening at its lower end provided with a standing valve, a standing tube extending upwardly from said standing valve and spaced from said casing, a plunger provided with inner and outer walls sliding respectively on the inside and outside of the standing tube so as to form a main pump chamber within said inner plunger wall and an auxiliary pump chamber between said inner and outer plunger walls; said inner plunger wall being provided with a port establishing permanent communication between said main pump chamber and said auxiliary pump chamber in both directions, and a working valve carried by said inner plunger wall at a point below said port; said inner plunger wall being open at the upper end and devoid of non-return means above said port for the purpose set forth.

EDWARD T. ADAMS.