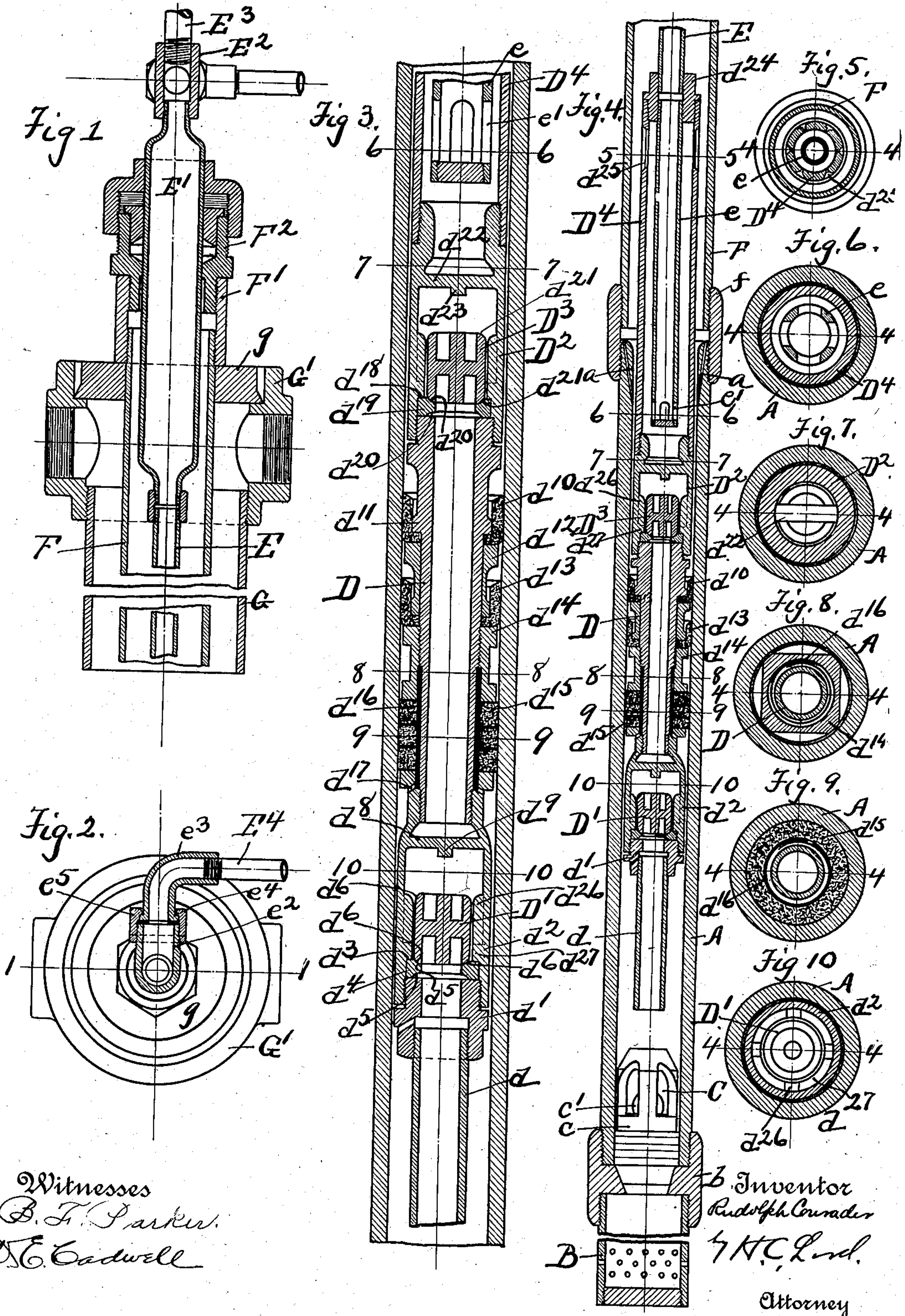


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PUMP.

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Patented Oct. 12, 1909.



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To all whom it may concern:

Be it known that I, RUDOLPH CONRADER, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented new and useful Improvements in Pumps, of which the following is a specification.

This invention relates to pumps and consists in certain improvements in the construction thereof as will be hereinafter fully described and pointed out in the claims.

The invention more particularly relates to that class of pumps which are used in Artesian wells, and is peculiarly adapted for such wells, and as shown, is especially designed for oil wells.

Some features of the invention are in the nature of improvements on the construction shown and described in an application filed by me April 24, 1905, No. 257,184. In that application I utilize a column of liquid on the plunger to balance the pressure of liquid under the plunger. In that application however the liquid for supplying this weight was introduced at the top of the tubing, so that, with the initial pumping action there was no weight unless supplied from some other source than the pumped fluid from the well. In this construction the liquid is furnished as liquid rises in the lift.

Other features of the construction are applicable not only to the general construction shown in my former application, but also to other constructions as well.

The invention is illustrated in the accompanying drawings as follows.

Figure 1 is a section on the line 1—1 in Fig. 2, this showing the portions usually at the surface of the ground. Fig. 2, a plan view of the same parts. Fig. 3, an enlarged view of the working barrel and plunger, the line of section being on the lines 4—4 in Figs. 6 to 10. Fig. 4 is a similar view on a smaller scale, taking in parts above and below those shown in Fig. 3, and being a section on the line 4—4 in Figs. 5 to 10. Fig. 5, a section on the line 5—5 in Fig. 4. Fig. 6, a section on the line 6—6 in Figs. 3 and 4. Fig. 7, a section on the line 7—7 in Figs. 3 and 4. Fig. 8, a section on the line 8—8 in Figs. 3 and 4. Fig. 9 shows a section on the lines 9—9 in Figs. 3 and 4. Fig. 10, a section on the lines 10—10 in Figs. 3 and 4.

A marks the working barrel. This has extending from it the usual strainer intake B, the strainer being connected with the

working barrel by the coupling *b*. The standing valve C is of the usual construction, comprising the cage *c* and a valve ball *c'*. The plunger D is hollow and in the operation of the pump, the liquid is forced on the downward stroke of the plunger through the plunger and lifted through a hollow sucker rod. The plunger has the extension *d* and this extension operates in the manner described in my former application; that is it maintains a column of liquid in the space between it and the walls of the working barrel, and this column of liquid reciprocates with the extension and thus prevents the liquid being pumped from coming in contact with the working surfaces of the working barrel. The extension is screwed into a valve cage *d*². This valve cage is provided with a shoulder *d*³. A seat ring *d*⁴ is secured between this shoulder and the end of the extension. The seating ring has the seating surfaces *d*⁵, one surface on each side of the ring so that the ring may be reversed to renew the seating surface. The ring may be removed for this purpose by unscrewing the extension. A valve D' operates upon this seat. This is arranged in the cage *d*² and is provided with a seating surface *d*⁶ at each end so that the valve may be reversed to renew the seating surface. A spider *d*⁸ is arranged at the upper part of the cage and this has the projection *d*⁹ arranged near the center, the purpose of which is to limit the upward movement of the valve D' and to prevent the seating surfaces of the valve from becoming injured through contact with the spider *d*⁸.

The plunger D has arranged upon it the flexible cup *d*¹⁰. This cup is arranged against a shoulder *d*¹¹ in the upper portion of the plunger, and a follower *d*¹² is forced against the lower portion of the cup, clamping. This is provided with the shoulder *d*¹³ at the follower. A second cup *d*¹⁴ is arranged at the lower end of said follower and is clamped in position by the nut *d*¹⁵, this nut *d*¹⁵, acting through the follower, clamping both cups. Packing rings *d*¹⁶ are arranged below the nut *d*¹⁵ and are secured in position by the end of the cage *d*², the cage being secured on the end of the plunger proper. Arranged within these packing rings *d*¹⁶ is a spring *d*¹⁷. The spring is tensioned to normally hold the packing rings out against the walls of the working barrel. An opening *d*¹⁸ extends through the cage to the space

within the packing rings. The purpose of this opening is to allow the entrance of liquid to this space when liquid below the plunger is put under pressure in the lifting action of the pump, and this liquid, acting on the inner surfaces of the packing rings, spreads them and holds them in intimate contact with the walls of the working barrel. The valve cage D^2 is secured to the end of the plunger and extends upwardly therefrom. This is provided with the shoulder d^{18} at its lower end and the valve ring d^{19} is secured between this shoulder and the end of the plunger. This ring has the two seats d^{20} one above and one below so that the seats may be renewed by reversing of the ring. The valve D^3 operates upon a seat d^{20} and is provided with the two seats d^{21} so that the seat on the valve may be renewed by reversing the valve. The valve in its upward movement contacts the lug d^{23} on a spider d^{22} . The construction of the valve D^3 and valve seat is similar to the valve D' and its valve seat, the parts operating in substantially the same manner.

A separating tube D^4 extends upwardly from the valve cage D^2 . A sucker rod E is secured to this separate tube by a coupling d^{24} . An extension e is secured to the coupling d^{24} and extends downwardly into the separating tube D^4 to near the bottom thereof, the tube being open through radial passages e' at its bottom. The separating tube D^4 has vertically arranged slits d^{25} near its upper end. These slits are preferably V shaped in cross section as shown in Fig. 5 forming a strainer which is effective, but will not readily clog.

In the operation of the pump, the sucker rod and plunger are reciprocated. On the upward stroke of the plunger, the valve D' seats, and liquid enters through the standing valve. On the downward stroke of the plunger, liquid is forced upward through the plunger, past the valves D' and D^3 and enters the separating tube D^4 . As the pumping continues, the liquid rises both in the sucker rod and in the separating tube. The liquid upon reaching the slits d^{25} passes out into the tubing F , and as the pumping continues, the level of the liquid in the tubing rises with the level of the liquid in the sucker rod. Inasmuch as the lifting action is accomplished during the downward stroke of the plunger, the column of liquid in the tubing acts as a weight on the plunger, and its height being approximately that of the lift balances the weight of the liquid in the lift, the excess of weight incident to the metal in the parts giving the preponderance of weight to the plunger so as to effect its movement. This is an important feature in deep wells in that it is difficult to communicate movement to the plunger through pressure delivered to the sucker rod at the

top of the well. The liquid column in the tubing also replenishes the liquid in the space between the extension d and the walls of the working barrel, so that this space is filled at all times with a clear liquid. The leakage, however, past the plunger shown in the construction herein disclosed, is very small. As soon as the level of the liquid in the tubing reaches the top of the tubing, practically all the liquid then actuated by the plunger is forced through the sucker rod. If, therefore, in the initial pumping action, water has been forced through the inlets d^{25} , it will be gradually replaced by oil, the water settling back by the action of gravity, and being carried up through the sucker rod. This construction, so far as replenishing the column of liquid in the tubing is concerned, is in some respects more desirable than that shown in my earlier application, by reason of the fact that the column is immediately supplied as the pump is started so that the column in the lift is balanced as it rises initially in the sucker rod. With the former construction, it was desirable, if not necessary, to fill the tubing with liquid before starting the pumping, while in the present device, this is automatically accomplished.

The tubing F extends through the casing cap g in the casing head G' . The casing head is secured as ordinarily to the casing G . The tubing extends through the casing cap into a coupling F' . A stuffing box F^2 is arranged in the top of this coupling. The polished rod E' forms a part of the sucker rod system and is secured to the sucker rod proper, and a fitting E^2 above the stuffing box F^2 . A rod E^3 extends upwardly from the fitting and is reciprocated by any convenient source of power for operating the pump. The fitting has a lateral extension e^2 , and the elbow e^3 having the shoulder e^4 is secured to the lateral extension e^2 by means of the flange nut e^5 . The liquid is conveyed away from the pump by the pipe E^4 , the joint formed on the lateral extension being such as to permit the elbow e^3 to swing or oscillate on said extension to permit of the reciprocating movement of the sucker rod.

The polished rod E' is of a size to compensate for the displacement of the liquid in the column in the tubing by the plunger as it is reciprocated. As the plunger is lifted the column in the tubing outside of the sucker rod is of course lifted with it. The polished rod, however, is of such size that as the column is lifted, the shoulder at the bottom of the polished rod recedes so as to compensate exactly for the column being lifted, and on the downward stroke, the inward movement of this polished rod takes up the space as the column recedes from the top of the tubing. By this con-

struction, the tubing may be completely filled and the column in the tubing reciprocated without any excessive movement backward and forward through the strainer formed by the slits d^{25} .

Where cups such as the cup d^{10} is used, either in a plunger or as a packing, it is usually ruined when the parts are lifted with the column or weight of the liquid upon it. This would happen in the construction shown if the plunger were lifted so as to move the cup out of the top of the working barrel. The cup, on reaching the top of the working barrel, would open up under the pressure of liquid so that its edges would engage the bottom of the tubing and the result would be that the cup would be entirely turned over and in practice, the parts of the cup are usually torn off. This is objectionable not only by reason of the loss of the cup itself, but by reason of the fact that the parts torn off are deposited in the well and are apt, in the after operation of the well, to get into the valves and otherwise clog the pump. I avoid this objection by arranging the passages a in the walls of the working barrel. These passages extend longitudinally of the working barrel and are in communication with the interior of the working barrel at the top and bottom. They are of such length relatively to the length of the cups, that when the bottom of the cup is above the bottom of the passage a , the upper end of the passage is still exposed so that liquid may pass through the passage along the cup and thus balance the pressure above and below the cup so as to prevent the outturning of the cup as it moves past the end of the working barrel.

As shown the passage a is formed by drilling from the end of the working barrel, the passage terminating in the interior of the working barrel a sufficient distance from the top to form a by pass around the cup. The form of the passage is not material, providing it forms the by pass for permitting the movement of the liquid from above to below the cup as the plunger is lifted.

I prefer to provide the cages d^2 and D^2 with the guiding shoulders d^{26} . These are usually provided, the space between the shoulders forming the passage for the liquid. I prefer, however, to provide the shoulder d^{27} which so contracts the passage immediately adjacent to the valve seat, that the movement of the liquid at this point is more rapid so as to clear the valve seat of any sand that might otherwise lodge thereon. It will be noted that the separator formed by the tube D^4 and extension e , not only tends to separate the oil from the water, but also permits any sand or dirt that may enter the tube to settle and be carried up through the sucker rod, rather than be expelled through the tubing F .

I prefer to close the direct entrance at the bottom of the extension e to facilitate the entrance of any matter that may have settled back into the separating tube to the sucker rod.

What I claim as new is:

1. In a pump the combination of a working barrel; a plunger forcing liquid on the downward stroke thereof; a liquid weight on the plunger; and means for maintaining the pressure exerted by said weight at approximately that of the liquid in the lift.

2. In a pump the combination of a working barrel; a hollow plunger operating in said barrel; a hollow sucker rod conveying the liquid pumped; a liquid weight on the plunger arranged to exert its pressure upon the plunger during the downward stroke; and means for maintaining the pressure exerted by said weight at approximately that of the liquid in the sucker rod with all levels of liquid in the rod.

3. In a pump the combination of a working barrel; a plunger arranged to force liquid on its downward stroke; means for holding a liquid above the plunger to weight the plunger on the downward stroke; and devices for supplying the liquid to said means, arranged to vary the level of the liquid in the means as the level of the lift varies.

4. In a pump the combination of a working barrel; a hollow plunger operating in said barrel; a hollow sucker rod conveying the liquid pumped; means for holding the liquid above the plunger to weight the plunger on the downward stroke; and devices for supplying the liquid to said means arranged to vary the level of the liquid in said means as the level in the lift varies.

5. In a pump the combination of a working barrel, a hollow plunger through which the actuated liquid is carried; a hollow sucker rod for conveying the actuated liquid; means for holding a liquid weight above the plunger; and devices adjacent to the plunger for conveying liquid from the lift to said means.

6. In a pump the combination of a working barrel; a hollow plunger through which the actuated liquid is carried; a hollow sucker rod for conveying the actuated liquid; means for holding a liquid weight above the plunger; devices adjacent to the plunger for conveying liquid from the lift to said means; and a strainer arranged in said devices.

7. In a pump the combination of a working barrel; a hollow plunger through which the actuated liquid is carried; a hollow sucker rod for conveying the actuated liquid; means for holding a liquid weight above the plunger; devices adjacent to the plunger for conveying liquid from the lift to said means; and a strainer formed with vertical slits arranged in said devices.

8. In a pump the combination of a working barrel; a hollow plunger through which the actuated fluid is carried; a hollow sucker rod for conveying the actuated fluid; means above the plunger for holding the liquid weight upon the plunger; a tube surrounding the sucker rod and carried thereby and arranged adjacent to the plunger, said device having a passage for conveying liquid from the lift to said means.

9. In a pump the combination of a working barrel; a hollow plunger through which the actuated fluid is carried; a hollow sucker rod for conveying the actuated fluid; means above the plunger for holding the liquid weight upon the plunger; and a tube communicating with the plunger and into which the sucker rod extends, the sucker rod having an opening for conveying liquid therefrom, said tube having passage to said means arranged above the openings to the sucker rod.

10. In a pump the combination of a working barrel; a hollow plunger through which the actuated fluid is carried; a hollow sucker rod for conveying the actuated fluid; means above the plunger for holding the liquid weight upon the plunger; and a tube communicating with the plunger and into which the sucker rod extends, the sucker rod having an opening for conveying liquid therefrom, said tube having a passage to said means arranged above the openings to the sucker rod, said passage being provided with strainers.

11. In a pump the combination of a working barrel; a hollow plunger through which the actuated fluid is carried; a hollow sucker rod for conveying the actuated fluid; means above the plunger for holding the liquid weight upon the plunger; and a tube communicating with the plunger and into which the sucker rod extends, the sucker rod having an opening for conveying liquid therefrom, said tube having a passage to said means arranged above the openings to the sucker rod, said passage being provided with strainers formed by vertical slits in the tube.

12. In a pump the combination of a working barrel; a hollow plunger through which the actuated fluid is carried; a hollow sucker rod for conveying the actuated fluid; means above the plunger for holding the liquid weight upon the plunger; and a tube communicating with the plunger and into which the sucker rod extends, the sucker rod having an opening for conveying liquid therefrom, said tube having a passage to said means arranged above the openings to the sucker rod, said passage being provided with strainers formed by vertical slits in the tube, V shaped in cross section.

13. In a pump the combination of a working barrel; a hollow plunger through which the actuated fluid is carried; a hollow sucker

rod for conveying the actuated fluid; means above the plunger for holding the liquid weight upon the plunger; a tube surrounding the sucker rod and carried thereby and arranged adjacent to the plunger, said tube having a passage for conveying liquid from the lift to said means, said passage being arranged in the form of vertical slits in the walls of the tube forming a strainer.

14. In a pump the combination of a working barrel; a hollow plunger therein; the tube D^4 extending above the plunger and having the vertical slits d^{25} near its upper end; a coupling d^{24} secured to the tube; a sucker rod E secured to the coupling; and the extension e secured to the sucker rod and extending into the tube for the purpose described.

15. In a pump the combination of a working barrel; a plunger operating in said barrel; means for maintaining a liquid weight above the plunger; and devices adjacent to the plunger for conveying liquid from the lift to said means, said devices comprising a separator for separating different materials pumped and arranged to maintain one of said materials on the plunger.

16. In a pump the combination of a working barrel; a hollow plunger operating in said barrel; a hollow sucker rod conveying the liquid pumped; a liquid weight on the plunger arranged to exert its pressure on the downward stroke of the plunger; devices for maintaining the pressure exerted by said weight approximating that of said liquid in the sucker rod; and an extension on the plunger of less diameter than the plunger.

17. In a pump the combination of a working barrel; a hollow plunger operating in said barrel; a hollow sucker rod conveying the liquid pumped; means for holding the liquid above the plunger to weight the plunger on the downward stroke; devices for supplying the liquid to said means arranged to vary the level of the liquid in said means as the level in the lift varies; and an extension on the plunger of less diameter than the plunger.

18. In a pump the combination of a working barrel; a hollow plunger arranged in the barrel; a hollow sucker rod for conveying the liquid from the plunger; means for maintaining a liquid weight above the plunger; devices adjacent to the plunger for conveying liquid from the lift to said means; and an extension on the plunger of less diameter than the plunger.

19. In a pump the combination of a working barrel; a plunger therein; means for maintaining a liquid weight on the plunger comprising a closed tubing; and appliances reciprocating with the plunger arranged in the tubing for compensating for the displacement of the plunger.

20. In a pump the combination of a work-

ing barrel; a plunger therein; a sucker rod of smaller diameter than the plunger for operating the same; a closed tubing for maintaining a liquid weight on the plunger; and an enlarged polished rod passing into and out of the tubing to compensate for the displacement of the plunger.

21. In a pump the combination of a working barrel; a plunger therein; a hollow sucker rod for operating the plunger and conveying the liquid pumped; a closed tubing for maintaining the liquid weight on the plunger; and an enlarged polished rod connected with the sucker rod passing into and out of the tubing to compensate for the displacement of the plunger.

22. In a pump the combination of a working barrel; a plunger therein; means for maintaining a liquid weight on the plunger comprising a closed tubing; means for supplying the weight arranged to fill the tubing; and appliances reciprocating with the plunger arranged in the tubing for compensating for the displacement of the plunger.

23. In a pump the combination of a working barrel; a plunger therein; means for maintaining a liquid weight on the plunger comprising a closed tubing; appliances reciprocating with the plunger arranged in the tubing for compensating for the displacement of the plunger; and means for supplying the liquid weight from the lift.

24. In a pump the combination of a working barrel; a plunger therein; means for maintain a liquid weight on the plunger comprising a closed tubing; appliances reciprocating with the plunger arranged in the tubing for compensating for the displacement of the plunger; and means for supplying the liquid weight from the lift and subjecting the same to the pressure of the lift.

25. In a pump the combination of a working barrel; a plunger therein; means for maintaining a liquid weight on the plunger comprising a closed tubing, said tubing approximating the height of the liquid; and appliances reciprocating with the plunger arranged in the tubing for compensating for the displacement of the plunger.

26. In a pump the combination of a working barrel; a plunger therein; a sucker rod of smaller diameter than the plunger for operating the same; a closed tubing for maintaining a liquid weight on the plunger, said tubing approximating the height of the lift; and an enlarged polished rod passing into and out of the tubing at the top to compensate for the displacement of the plunger.

27. In a pump the combination of a working barrel; a hollow plunger therein; a hollow sucker rod for conveying the liquid therefrom; a closed tubing for maintaining a liquid weight on the plunger, said tubing approximating the height of the lift; and an enlarged polished rod connected with the sucker rod and passing into and out of the tubing at the top for compensating for the displacement of the plunger.

28. In a pump the combination of a working barrel; a plunger therein; means for maintaining a liquid weight on the plunger comprising a closed tubing said tubing approximating the height of the liquid; appliances reciprocating with the plunger arranged in the tubing for compensating for the displacement of the plunger; and means for filling said tubing in supplying the liquid weight.

29. In a pump the combination of a working barrel; a plunger therein; means for maintaining a liquid weight on the plunger comprising a closed tubing; appliances reciprocating with the plunger arranged in the tubing for compensating for the displacement of the plunger; and means for supplying the liquid weight from the lift at a point adjacent to the plunger.

30. In a pump the combination of a working barrel; a plunger therein; means for maintaining a liquid weight upon the plunger comprising a closed tubing; a hollow sucker rod for operating the plunger; appliances reciprocating with said plunger and sucker rod, arranged on the tubing for compensating for the displacement of the plunger; and devices for conveying liquid from the lift at a point near the plunger to said means.

31. In a pump the combination of a working barrel; a hollow plunger therein; a hollow sucker rod E of less diameter than the plunger for operating the same; a tube surrounding the sucker rod and having the passages therefrom above the bottom of the sucker rod; a tube F closed at the top, secured to the working barrel; and the polished rod E' secured to the sucker rod and being of a size to compensate for the displacement of the plunger.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

RUDOLPH CONRADER.

Witnesses:

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W. E. CADWELL.