March 22, 1938. O. M. DAVIS 2,111,758

PUMP

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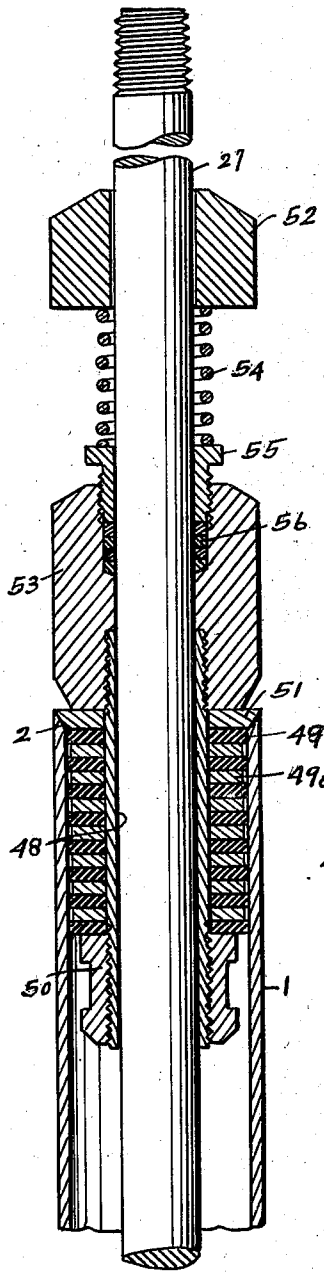


Fig. 5.

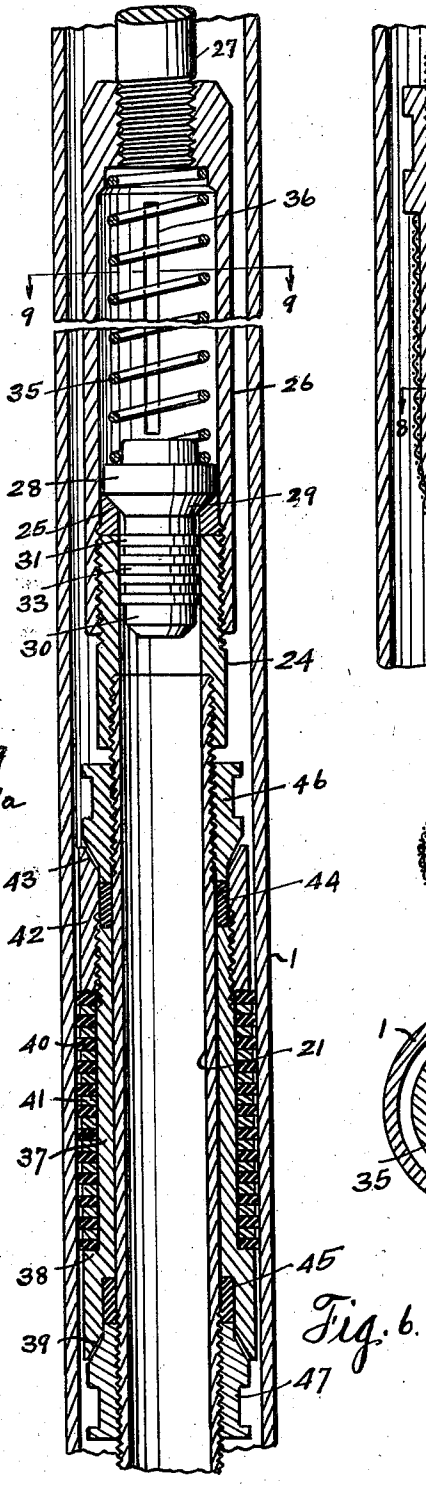


Fig. 6.

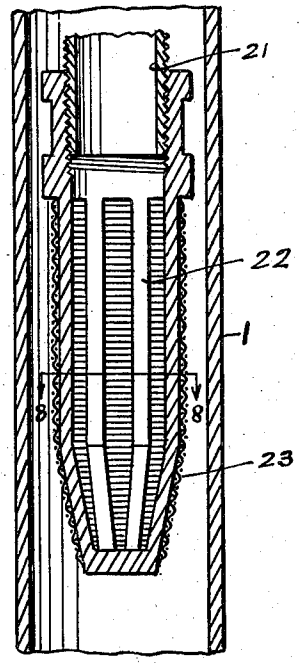


Fig. 7.

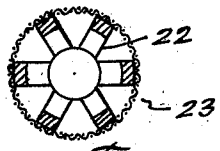


Fig. 8.

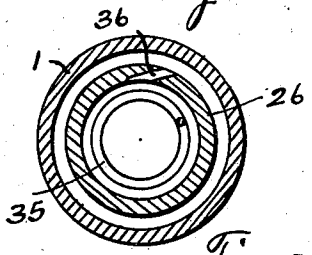


Fig. 9.

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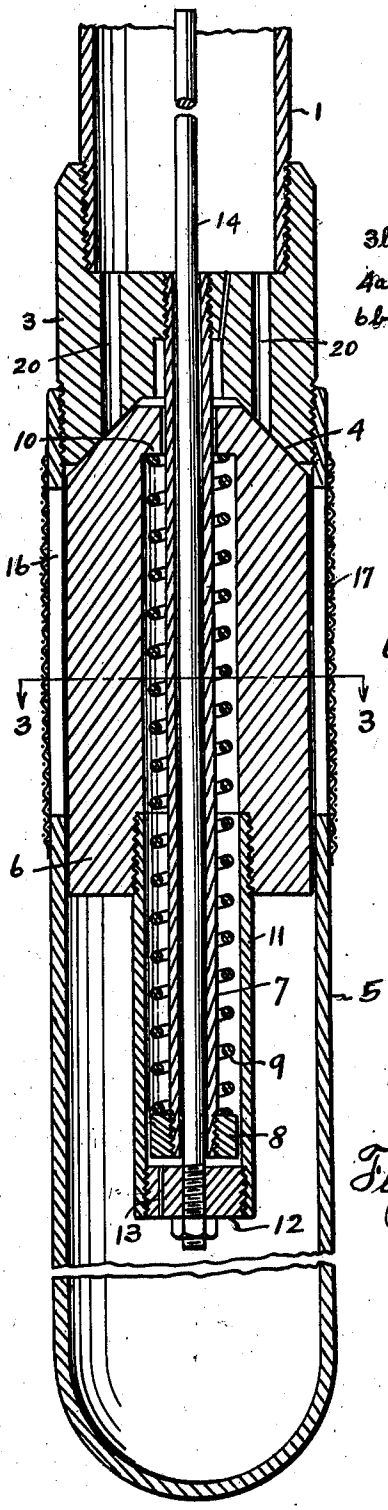


Fig. 1

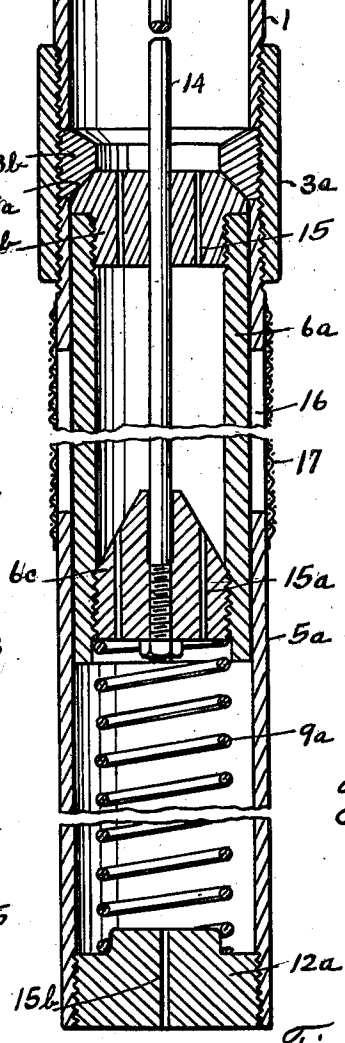


Fig. 2.

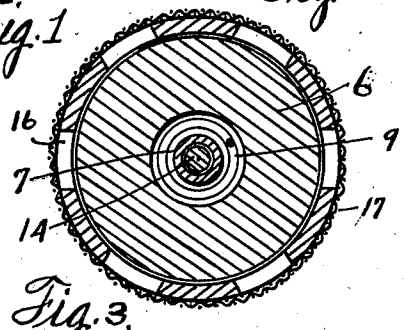


Fig. 3.

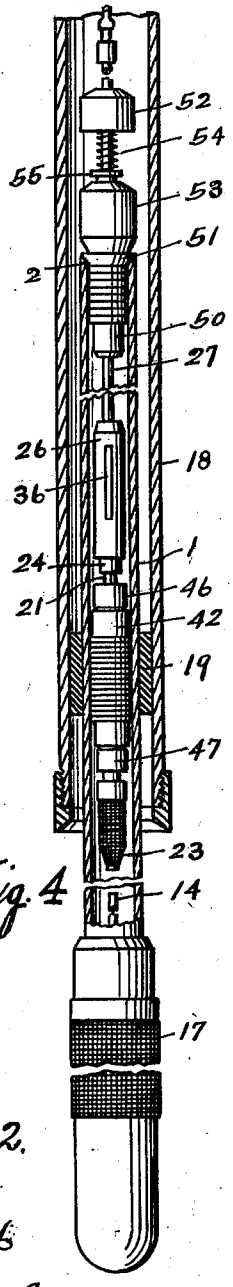


Fig. 4

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UNITED STATES PATENT OFFICE

2,111,758

PUMP

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Application April 17, 1935, Serial No. 16,858

6 Claims. (Cl. 103—179)

This invention relates to a pump.

An object of the invention is to provide a pump of the character described especially designed for use in wells, particularly deep oil wells.

Another object of the invention is to provide a pump of such novel construction as to utilize the gas pressure, which may accumulate in the well, to assist in expelling the liquid from the well.

A further object is to provide a pump having a novel type of standing valve for admitting the fluid from the surrounding reservoir and a novel type of traveling valve for elevating the fluid; the invention also comprehends a novel type of back-pressure valve for controlling the flow of fluid upwardly through the working barrel.

A still further object is to provide, in a pump, a novel type of traveling valve with packing means there around forming a fluid-tight joint with the working barrel, said traveling valve being capable of rotation with respect to the packing means.

With the above and other objects in view, the invention has particular relation to certain novel features of construction, operation, and arrangement of parts, an example of which is given in this specification and illustrated in the accompanying drawings, wherein:—

Figure 1 shows a vertical sectional view of the lower-end of the pump, showing the standing valve.

Figure 2 shows a vertical sectional view of a modified form of said lower end and valve.

Figure 3 shows a cross-sectional view taken on the line 3—3 of Figure 1.

Figure 4 shows a side view of the complete pump, partly in section.

Figure 5 shows a vertical sectional view, showing the upper end of the pump.

Figure 6 shows a vertical sectional view of an intermediate portion thereof.

Figure 7 shows a fragmentary vertical sectional view showing the working barrel and the lower end of the traveling valve therein.

Figure 8 shows a transverse sectional view taken on the line 8—8 of Figure 7, and

Figure 9 shows a transverse sectional view taken on the line 9—9 of Figure 6.

Referring now more particularly to the drawings wherein like numerals designate similar parts in each of the figures, the numeral 1 designates the tubular working barrel of the pump whose upper end is preferably outwardly flared forming the seat 2, and whose lower end is connected to a coupling, such as 3 in Figure 1, or 3a, as in Figure 2. The lower end of the coupling 3 is downwardly flared forming a valve seat 4, as illustrated in Figure 1, and in the form shown in Figure 2, a ring 3b is screwed into the coupling 3a and is provided with a downwardly flared valve seat 4a.

Attached to the lower end of the coupling 3, there is a tubular guide 5 forming a housing, and whose lower end is closed. Slidably mounted in this housing there is a valve 6 which is fitted snugly in the housing, and whose upper end is upwardly and inwardly tapered to conform to the shape of and to fit closely against the seat 4, when the valve is closed.

Anchored to the coupling 3 and extending axially through said coupling and through the valve. there is a sleeve 7 threaded on to the lower end of which is the nut 8, forming a support for the coil spring 9 which surrounds said sleeve.

Adjacent its upper end, the valve 6 has an inside annular shoulder 10 against which the upper end of the spring 9 abuts. Attached to the lower end of the valve 6 and depending therefrom there is a spring housing 11 which surrounds the lower end of the spring 9 and whose lower end is closed by the plug 12 which is provided with a duct 13. The spring 9 and its supporting nut 8 are thus enclosed within the valve 6 and housing 11.

A valve actuating rod 14 is attached at its lower end to the plug 12 and extends up through the sleeve 7 and terminates in the working barrel 1, as more accurately shown in Figures 1, 2, and 4.

As shown in Figure 2, the tubular housing 5a is attached to the lower end of the coupling 3a and slidably fitted in said housing 5a is the valve body 6a. The upper and lower ends of the valve body are substantially closed by the upper and lower plugs 6b and 6c. The upper end of the plug 6b is upwardly and inwardly tapered to form a valve which is shaped to fit closely against the seat 4a, when closed. The valve body 6a is seated on a coil spring 9a which is enclosed within the housing 5a and is seated on the plug 12a, which closes, the lower end of said housing. In this form the lower end of the actuating rod 14 is connected to the plug 6c. The plugs 6b, 6c, and 12a are provided with ducts 15, 15a, and 15b. The ducts 13, 15, 15a, and 15b are provided to prevent formation of a vacuum during the operation of the pump. The springs 9 and 9a serve to normally maintain the corresponding valves closed. The housings 5, 5a, have the lateral openings, such as 16, through the walls thereof adjacent their upper ends, and around said openings, a suitable screen-

ing material, as 17, preferably of wire mesh, is secured to the corresponding housing.

The numeral 18 refers to the pump tubing which is let down the required distance into the well. The pump is usually submerged in the liquid to be pumped and it should be submerged at least a sufficient distance so that the traveling valve will be beneath the normal level of the liquid standing in the well. Often times the pump will be several hundred feet beneath such level. A suitable packing, as 19, surrounds the working barrel 1 and forms a fluid-tight seal between said working barrel and the tubing 18. Upon downstroke of the valve 6, as hereinafter explained, the corresponding openings 16 will be uncovered and the fluid will flow in through said openings, and thence upwardly through the channels 20 which lead upwardly through the coupling 3. Upon lowering the valve 6*b*, as hereinafter described, the corresponding openings 16 will be uncovered and the liquid will flow inwardly through them and will pass thence upwardly through the ring 3*b*. It will be noted that the internal pressure in the well, when the valves 6, 6*b*, are closed, will be exerted laterally against the valve 6 and the valve body 6*a*, and will on that account offer only a minimum resistance to the opening movement of the valve but said pressure will be immediately released and will assist the traveling valve, hereinafter referred to, in expelling the liquid from the well, when the valve 6, or 6*b*, is opened.

There is a reciprocable traveling valve in the working barrel above the standing valve above described. This traveling valve has a long tubular body 21, screwed onto the lower end of which there is a tubular cagework 22 forming a skeleton support for the surrounding screen 23. The upper end of the tubular body 21 has a tubular nipple 24 connected thereto which supports an upwardly flared ring-like valve seat 25. This valve seat is enclosed and clamped in place by means of the cage 26 which is connected to the upper end of the nipple 24, and the sucker rod 27 is connected to this cage and extends to the top of the ground and may be reciprocated through the usual apparatus for that purpose. Within the cage 26, there is a valve 28 having the downwardly and inwardly tapering face 29 shaped to fit closely on the seat 25, when said valve is closed. The valve 28 has a depending extension 30 which is surrounded by the alternating packing rings 32 and metal spacer-rings 33, said packing rings forming a close fit within the nipple 24 when the valve is seated. A coil spring 35 is confined within the cage 26 and is interposed between the upper end of said cage and the valve 28 and normally holds said valve closed.

The cage 26 has a vertically elongated slot 36 cut through one side thereof which is approximately tangential to the inside curvature of the cage and which is directed to the left so that upon downstroke of the traveling valve, the fluid will be forced through said slot and will be given a whirling direction so as to agitate the liquid being pumped and to prevent the settling of sand and sediment about the traveling valve. The resistance of the liquid being pumped will also exert a tortional strain on the cage 26, and on the sucker rod 27 above which will tend to keep the threaded couplings of the sucker rod screwed tightly together.

Around the body 21, beneath the nipple 24, there is a packing cage 37 whose lower end is enlarged forming an outside annular shoulder 38, said enlarged portion terminating in a downwardly flared face 39. Around the cage 37, and seated on said shoulder, there is a packing assembly comprising the packing rings 40 formed of resilient material and metal spacer rings 41, said rings 40 and 41 being arranged in alternate relation, as shown in Figure 6, and a clamp collar 42 is screwed onto the upper end of the cage 37 and abuts said packing assembly. The upper end of the collar 42 is formed with the upwardly flared face 43. Closely surrounding the body 21 are the upper and lower packing sleeves 44, 45, which are located within the ends of the cage and are retained in place by the upper and lower glands 46, 47, respectively. These glands are screwed onto the tubular body 21 and are tapered to conform to the shape of the respective faces 43 and 39 respectively, and abut the packing sleeve 44, 45, to retain the same in place, and under the desired compression. The body 21 is thus rotatable relative to the packing cage 37, and the packing thereon so as to render the traveling valve more flexible and to prevent turning of the packing assembly with the turning movements of the body 21 due to the turning or twisting of the sucker rod 27.

The upper end of the working barrel 1 is controlled by a suitable upwardly opening valve shown in detail in Figure 5. This valve comprises a tubular nipple 48 which surrounds and is slidable on the sucker rod 27, and on which nipple is the packing assembly comprising the alternately arranged packing rings 49 and spacer-rings 49*a*. This assembly is clamped in place by the nut 50 which is screwed on to the lower end of the nipple 48, and the valve plate 51 which is fitted over the upper end of the nipple. The margin of the plate 51 is upwardly and outwardly beveled to conform to the shape of and to closely fit the seat 2 when the valve is seated, and the packing assembly on the nipple is of a diameter to fit closely within the upper end of the working valve 1. Slidably mounted on the sucker rod are the upper and lower weights 52 and 53, the latter of which is screwed on to the upper end of the nipple 48 and abuts the valve plate 51, and the latter of which is yieldingly mounted on the coil spring 54 which surrounds the sucker rod and which is seated on the gland 55. This gland is screwed into the upper end of the lower weight 53 and retains the packing 56, located within the lower weight 53, around the sucker rod in place. The sucker rod works loosely through the said gland and packing.

Upon downstroke of the traveling valve, when the lower end of the cage 23 strikes the upper end of the actuating rod 14, said rod and the valve 6, or 6*b*, as the case may be, connected thereto, will be forced downwardly and the opening 16 uncovered, placing the spring 9, or 9*a*, under compression. The liquid will then flow in through the opening 16, and in case gas has accumulated under pressure, this gas will also flow in and accelerate the inflow of the liquid, as well as the upward movement of the liquid in the pump barrel above. During the operation of the pump, the liquid will move on upwardly through the traveling valve, lifting the valve 28 and passing out through the slot 36 into the working barrel above. The vacuum created above the valve 28 by its preceding down-stroke will assist in lifting said valve 28. Upon upstroke of the traveling valve, the compressed spring 9, or 9*a*, will close the valve seated thereon, and the liquid above the valve 28 will be forced on upwardly through the working barrel 1 lifting the

valve 51 at the upper end of the barrel and passing on out into the tubing, 1, and upon the beginning of the next downstroke the valve 51 will be closed by the weight of the fluid column above and will be guided onto its seat by the sucker rod 27 and during the continued reciprocation of the traveling valve the liquid will be pumped upwardly to the ground surface. During the operation of the pump the passageways 13, 15, 15a and 15b will prevent the formation of a vacuum beneath the traveling valve. Ordinarily there is considerable gas pressure in the well and when the valve 6 is open a sufficient charge of oil will be immediately forced into the lower portion of the working barrel 1, passing on up through the body 21 above the valve 28, and even if there were no gas pressure, the pump being submerged in the liquid, the liquid will flow in by gravity completely filling the lower portion of the pump to a point well above the traveling valve. Upon the next upstroke of the traveling valve only that portion of the oil above the traveling valve will be discharged and the working barrel beneath the traveling valve will still be partly filled with the oil. On downstroke of the traveling valve it is true a partial vacuum will be created above the traveling valve but this will assist in opening the valve 28, as above stated and will cause the oil to flow on up above said valve 28. The pressure of the oil formation is ordinarily insufficient to lift the valve 51 and said valve will be lifted by the oil above the valve 28 upon upstroke of the traveling valve. Upon downstroke of the traveling valve mechanism, when it contacts and depresses the rod 14 the valve 6 will be opened. This valve will remain open a length of time depending on the rate of the stroke. If there is considerable gas pressure in the well this pressure will force the oil in through the openings 16 very quickly when the valve is open and in such a case the pump operation is speeded up. If there is substantially no gas pressure the pump will be operated slower so that the valve 6 will remain open longer. The valve 6 remains closed on upstroke of the traveling valve to conserve gas pressure while the mechanical lift is being made. If it were permitted to open upon upstroke of the traveling valve in the presence of strong gas pressure, gas would rush in upon upstroke of the traveling valve and force its way on up through the valves 28, 51 and be wasted. With the present construction the gas under pressure can escape only when the valve 6 is open and the pressure is thus conserved and not unnecessarily wasted. Upon upstroke of the valve 51 controlling the upper end of the working barrel, the inertia of the weight 52 will place the spring 54 under compression, and upon reverse stroke, this compression will accelerate the downward movement of the weight 53 and the valve beneath. When the valve plate 51 lands on its seat 2, the spring 54 will act as a shock absorber, thus relieving the seat 2 of the combined simultaneous impact of both weights 52 and 53.

During the operation of the pump the liquid will be forced back and forth through the screens 17, 23, so that the same will not become clogged with sand or other detritus.

The drawings and descriptions disclose what is now considered to be a preferred form of the invention by way of illustration only, while the broad principle of the invention will be defined by the appended claims.

What I claim is:

1. A pump comprising a working barrel, an upwardly opening valve at the upper end of the working barrel and controlling the flow of liquid upwardly therethrough, a traveling valve mechanism reciprocable in the working barrel and having an upwardly opening valve for controlling the flow of said liquid, a downwardly opening valve beneath the traveling valve for controlling the inflow of liquid into the working barrel and a rod upstanding from the downwardly opening valve arranged to be actuated by the traveling valve, upon its downward movement to open the downwardly opening valve.

2. A pump comprising a working barrel having an inlet opening, an upwardly opening valve controlling the flow of liquid through the barrel, a downwardly opening standing valve normally closing the opening and having an upstanding rod, a traveling valve reciprocable in the barrel above said standing valve, yieldable means normally maintaining the standing valve in closed position, said rod being effective to open the standing valve upon downward movement of the traveling valve.

3. A pump comprising a working barrel, having an inlet opening, a downwardly opening standing valve normally closing the opening, a traveling valve reciprocable in the barrel above said standing valve, a sucker rod for actuating the traveling valve, yieldable means normally maintaining the standing valve in closed position, means for opening the standing valve upon downward movement of the traveling valve, and an upwardly opening valve above the traveling valve and slidable on the sucker rod for controlling the flow of liquid through the working barrel.

4. In a pump, a working barrel having a valve seat at its lower end, a valve housing attached to the lower end of the barrel and having a side opening, a valve slidable in the housing and movable into one position to rest against said seat and also to close the opening and movable into another position away from the seat and clear of the opening, a rod upstanding from the valve, a traveling valve reciprocable in the housing to advance the liquid, being pumped, upwardly through the barrel said rod being effective, upon downward movement of the traveling valve, to open the other valve, and an upwardly opening valve controlling the flow of liquid through the barrel.

5. In a pump, a working barrel having a valve seat at its lower end, a valve housing beneath the seat and connected to the working barrel and having side openings, a downwardly opening valve in the housing whose upper end is shaped to fit said seat, a rod upstanding from the valve, a yieldable member normally holding said valve seated against the seat, said valve being movable downwardly into open position to clear said openings to permit the inflow of liquid through the openings, a reciprocable traveling valve in the working barrel, means for reciprocating the traveling valve, said rod being effective upon downward movement of the traveling valve to move the other valve into said open position and an upwardly opening valve on the barrel.

6. In a pump a working barrel having an upwardly opening valve to permit the advance of liquid upwardly therethrough, a seat adjacent the lower end of the barrel, a valve housing beneath the seat and connected to the barrel and having a side opening, a downwardly opening valve in the housing arranged to cooperate with

and close said seat, a rod upstanding from the downwardly opening valve, a yieldable member normally holding said last mentioned valve seated, said downwardly opening valve being movable into open position to clear said opening to permit the inflow of liquid through the opening, a reciprocable traveling valve in the working barrel, means for reciprocating the traveling valve, said rod being effective upon downward movement of the traveling valve to move the downwardly opening valve into said open position.

OSCAR M. DAVIS.