Sept. 9, 1941. W. H. ZEHNER 2,255,305

TRIPLE ACTING PUMP

Filed Aug. 11, 1939

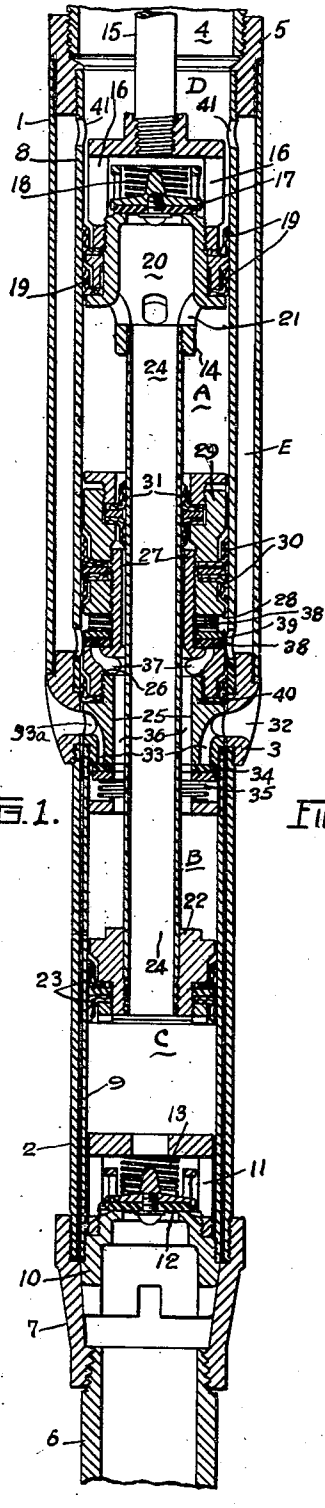


FIG. 1.

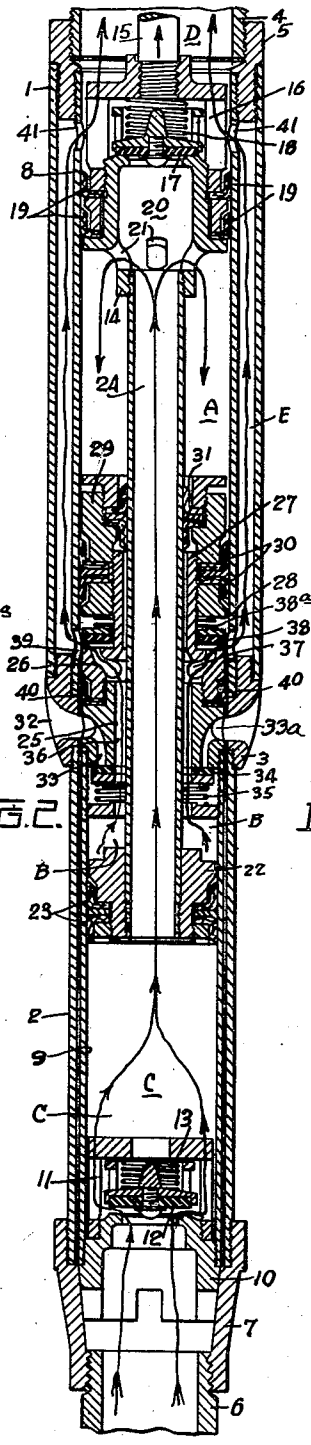


FIG. 2.

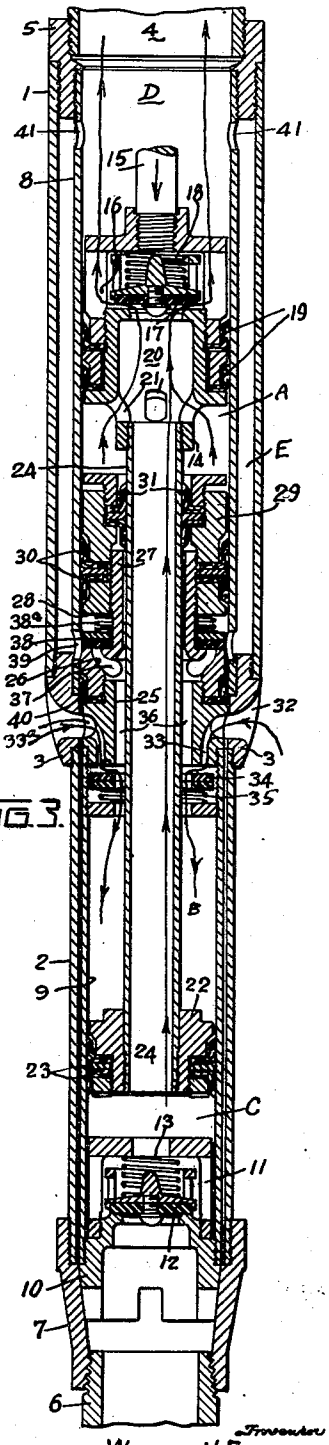


FIG. 3.

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TRIPLE ACTING PUMP

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Application August 11, 1939, Serial No. 289,648

12 Claims. (Cl. 103—4)

This invention relates to a triple acting pump and more particularly to such a pump which is especially adapted to be used in deep wells. While the invention will be described as applied to a pump for pumping water, it is to be understood that the principles of this invention may be embodied in a pump for any liquid.

The principal object of this invention is to provide a triple acting pump and to thereby greatly increase the amount of liquid delivered by a given size of pumping equipment over that obtained from what is known as a double acting pump.

It is an object to so arrange all the working parts that they move in a straight line and that they can be removed as a unit to the surface by merely pulling the sucker rod upwardly.

It is another object to provide venting means for eliminating all unvented vacuum space from the pump and thereby avoiding the strain and loss of power attendant upon operating the lower plunger in a sealed space.

It is another object to provide means associated with the venting means aforesaid to provide an additional pumping stage in the pump; in this way, a triple acting pump is provided, the liquid which is employed to vent the lower plunger in its downward movement being delivered under pressure to the delivery side of the pump cylinder, thus increasing the capacity of the pump without interfering with the venting action referred to above.

Still other objects will appear from the following description of a preferred embodiment of the invention.

Reference is made under Rule 43 to my copending application, Serial No. 289,647, filed August 11, 1939, in which there is disclosed related subject-matter.

Referring to the accompanying drawing:

Figure 1 is a vertical section of a triple acting pump cylinder embodying the principles of the present invention.

Figures 2 and 3 are vertical sections showing the position of the working parts in the upstroke and down stroke, respectively.

Referring to the drawing in detail, reference numeral 1 designates the upper outer casing of the cylinder, and reference numeral 2 designates the lower outer casing. Casings 1 and 2 are joined by the ported coupling member 3, which will be hereinafter more fully described. Casing 1 is connected to the well pipe 4 by a coupling 5 and casing 2 is connected to a pipe 6 which extends downwardly into the well by means of an internally tapered coupling member 7. Disposed within casing 1 is an upper inner casing 8 which is screw-threadedly engaged with coupling 5 and rests in a seat in coupling 3. Disposed within the lower outer casing 2 is a lower inner casing 9, the external diameter of which is slightly smaller than the internal diameter of casing 2, casings 2 and 8 being of substantially the same internal diameter.

Casing 9 is supported in the cylinder by means of tapered collar 10 which is screw-threadedly connected to its lower portion and which is externally tapered to correspond to the internal taper of coupling 7. Thus, collar 10 is seated within coupling 7 during the normal operation of the pump. Collar 10 is provided with the upstanding cage 11 which encloses check valve 12 which is normally held closed by a spring 13 but which is adapted to allow water to pass upwardly into the space C formed immediately thereabove.

Disposed so as to reciprocate in the upper inner casing 8 is an upper plunger designated generally as 14 to which is attached the sucker rod 15. Above plunger 14 is a space D which constitutes the lower portion of the delivery chamber. Plunger 14 is provided with an upwardly extending cage 16 which encloses a valve 17 which is adapted to allow liquid to pass upwardly through valve 17 into space D but to prevent the return of liquid downwardly through valve 7. A spring 18 is provided which normally holds valve 17 closed. Upper plunger 14 is provided with sealing means 19 which seals the space between plunger 14 and inner upper casing 8. Plunger 14 is also provided with an internally formed cylindrical passageway 20 which is in communication with space A below plunger 14 by means of ports 21.

There is provided in the lower inner casing 9 a reciprocating plunger designated generally as 22 which has sealing means 23 to seal it with respect to casing 9. Plungers 14 and 22 are connected by a hollow tube 24 extending downwardly through plunger 22, so that they reciprocate together and so that fluid communication is provided between passageway 20 and space C below plunger 22.

Disposed intermediate of plungers 14 and 22 is a stationary assembly which is fixedly held above casing 9. This stationary assembly comprises a stationary collar 25 which is screw-threadedly engaged into the top of casing 9 and which is of substantially the same external diameter as casing 9 and plunger 14. Screw-thread-

edly engaged with member 25 and located thereabove is a collar 26 having an upstanding integral sleeve portion 27 which is screw-threadedly engaged with collars 28 and 29, between which is provided sealing means 30 which seals off the space between the stationary assembly and upper inner casing 8 and prevents liquid from passing upwardly or downwardly along the inside surface of casing 8.

Collar 29 is provided with sealing means 31 which bears against hollow tube 24 and prevents liquid from passing to or from space A along the outside of tube 24.

Circular coupling member 3 is provided with ports 32 which are adapted to communicate with ports 33 provided within member 25. An annular depression 33a is provided on the periphery of member 25 so that passageways 33 will be in fluid communication with ports 32 regardless of the angular disposition of the assembly in the casings 8 and 2. Check valve 34 is provided at the lower portion of member 25 and this valve allows water or other liquid entering ports 33 from the exterior of the cylinder to pass into space B when plunger 22 is pushed downwardly. This check valve 34 is normally held closed by a spring 35 so that fluid within space B above plunger 22 cannot pass outwardly through ports 33. Provided between member 25 and tube 24 is a passageway 36 which is in communication with space B and which communicates with passageways 37 in member 26. A valve 38 is provided just above these passageways 37 to allow fluid to pass from space B upwardly into annular chamber E formed between casings 1 and 8 but to prevent the liquid in space E from returning through this valve. A spring 38a holds valve 38 normally closed. Ports 39 are provided in the lower portion of inner upper casing 8 to allow the liquid to pass through check valve 38 into space E. A sealing means 40, located between members 25 and 26, prevents liquid from passing downwardly from chamber E between the stationary assembly and the inner casing 8, coupling 3, or lower outer casing 2.

Liquid accumulating in chamber E is adapted to pass upwardly into delivery space D through ports 41 provided in the upper portion of inner upper casing 8. These ports 41 are located above the operating position of upper plunger 14, so that plunger 14 never interferes with the passage of liquid from chamber E into space D.

The operation of the mechanism is as follows: On the upstroke, the upward movement of plunger 22 will draw liquid through check valve 12 into space C while plunger 14 draws liquid through tube 24 and ports 21 into space A. At the same time, plunger 14, because of its valve 17 being closed, lifts the liquid in space D upward into the well pipe 4, while plunger 22, because of check valve 34 being closed, forces liquid from space B through passage 36, open valve 38, ports 39, chamber E, and ports 41 into space D and thus into the well pipe 4. On the downstroke, check valve 12 is closed and plunger 22 forces liquid from space C through tube 24 and upper plunger valve 17 into space D, while plunger 14 forces liquid from space A through ports 21 and plunger valve 17 into space D. At the same time, plunger 22, because of valve 38 being closed, draws liquid through ports 32, passageways 33, and valve 34, into space B.

When it is desired to remove the working assembly from the cylinder, this is accomplished by merely pulling sucker rod 15 upwardly until plunger 22 strikes the bottom of the stationary intermediate assembly disposed in the top of inner casing 9. Thereupon, upper plunger 14, lower plunger 22, and the intermediate stationary assembly together with lower inner casing 9 and the check valve assembly including cage 11, spring 13, valve 12, and collar 10 will move upwardly into the well pipe 4. In order to reassemble the apparatus into operative position, this unit working assembly will be simply lowered until tapered collar 10 is firmly seated in internally tapered coupling 7, whereupon the device will be ready for operation.

As will be understood, the cylinder is operated with ports 32 submerged below the level of liquid in the well, so that the pumping stage provided by plunger 22 and space B may be operative to deliver water into the well pipe 4.

From the foregoing description, it will be seen that I have provided a mechanism which gives rise to numerous advantages over prior pumping devices, and which makes possible the attainment of the objects set out above. While the invention has been described with particular reference to the embodiment shown in the drawing, it is to be understood that numerous changes may be made without departing from the spirit of the invention and that I intend to comprehend as within the invention such modifications as may be necessary to adapt the same to varying conditions and uses.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a pump, an upper casing, a reciprocating upper plunger therein, stationary sealing means below said plunger for sealing the space in said casing below said plunger, a lower casing, a lower plunger adapted to reciprocate therein, an upwardly opening check valve below said lower plunger, a downwardly opening check valve above said lower plunger, a hollow tube interconnecting said plungers passing through said stationary sealing means, means including said tube connecting the space below said lower plunger with the space below said upper plunger, upwardly opening check valve means allowing fluid to pass upwardly from said tube and said spaces below said plunger through said upper plunger to a point thereabove, and upwardly opening valve means communicating with means forming a fluid passage which interconnects the spaces above said plungers for allowing fluid to pass upwardly from the space above said lower plunger to a point above said upper plunger.

2. In a pump, a cylinder comprising an upper casing, a plunger reciprocatable therein, stationary means below said plunger for sealing the space in said casing below said plunger, a lower inner casing, a lower plunger reciprocatable therein, means connecting said plungers so that they move together, means including said connecting means providing open fluid communication between the spaces below said plungers, inwardly opening check valve means for allowing fluid to pass from exterior of said pump to the space below said lower plunger, upwardly opening check valve means for allowing fluid to pass from said spaces below said plungers to a delivery point above said upper plunger, a lower outer casing surrounding said inner casing, a coupler connecting said upper casing and said lower outer casing and having ports therein, check valve controlled means connecting said ports to the space above said lower plunger,

means providing fluid communication between the spaces above said plungers, and valved means for controlling the movement of the fluid from the space above said lower plunger to said point above said upper plunger.

3. In a pump, a well pipe, an upper outer casing, an upper inner casing therewithin forming a chamber between said inner and outer casings in fluid communication with said well pipe, a reciprocatable plunger in said inner casing, a lower casing, a reciprocatable plunger therein, means intermediate said plungers supported at the upper end of said lower casing and comprising (*a*) stationary means below said upper plunger for sealing the space in said inner upper casing below said upper plunger, (*b*) means connecting the space above said lower plunger to a point outside of said pump, (*c*) an inwardly opening check valve in said connecting means, (*d*) means connecting the space above said lower plunger to said chamber between said upper inner and outer casings, and (*e*) upwardly opening check valve means in said last-named connecting means allowing fluid to pass from said space above said lower plunger to said chamber, an upwardly opening check valve mounted in said lower casing below said lower plunger, a hollow tube connecting said plungers so that they reciprocate together, means including said tube providing fluid communication between the space below said lower plunger and the space below said upper plunger, and upwardly opening check valve means connecting said tube and thereby said spaces below said plungers to said well pipe.

4. In a pump, a well pipe, a cylinder connected thereto and comprising an outer upper casing, an inner upper casing, a chamber formed between said outer and inner casings and in communication with said well pipe, an outer lower casing, an inner lower casing slightly less in external diameter than the internal diameter of said inner upper casing, means connecting said outer lower casing to said upper casings and provided with ports communicating with fluid exterior of said pump, a reciprocatable upper plunger in said inner upper casing, a reciprocatable lower plunger in said inner lower casing, means rigidly connecting said plungers for causing them to reciprocate together and means including said tube for providing a fluid connection between the spaces below said plungers, means mounted on the upper portion of said inner lower casing comprising (*a*) means for sealing the space in said inner upper casing below said upper plunger, (*b*) inwardly opening check valve controlled passageways connecting said ports with the space above said lower plunger, and (*c*) upwardly opening check valve controlled passageways connecting said space above said lower plunger with said chamber formed between said inner and outer upper casings, inwardly opening check valve means for allowing fluid to pass from exterior of said pump to the spaces below said plungers, and upwardly opening check valve means carried by said upper plunger for allowing fluid to pass through said upper plunger from said spaces below said plungers to said well pipe, said upper plunger, inner lower casing, means mounted thereon and lower plunger being removable upwardly through said well pipe as a unit.

5. In a pump, a reciprocatable upper plunger, a reciprocatable lower plunger, means for connecting said plungers so as to reciprocate together, a cylinder casing surrounding said plungers, means below each of said plungers for sealing the spaces therebelow, means including said connecting means for admitting fluid to said spaces below said plungers, means for allowing fluid to pass from each of said spaces below said plungers to a point above said upper plunger, inwardly opening check valve means above said lower plunger for allowing fluid to pass into the space above said lower plunger, a chamber surrounding that portion of said casing which is traversed by said upper plunger for providing fluid communication between the spaces above said plungers, and valved means allowing fluid to pass from above said lower plunger to said chamber.

6. In a pump, in combination, a well pipe, a stationary assembly attached thereto which comprises an upper cylinder, a lower casing, intermediate means connecting said cylinder and said casing, and internally downwardly tapered means mounted on the lower end of said lower casing, a pump rod, and a slidable working assembly comprising an upper plunger attached to said pump rod and adapted to reciprocate in said upper cylinder, a lower cylinder adapted to normally rest within said lower casing, a lower plunger adapted to reciprocate in said lower cylinder, a hollow tube connecting said plungers, means including said tube providing fluid communication between the spaces below said plungers, stationary means at the upper end of said lower cylinder adapted to be normally disposed opposite said intermediate means and to separate said upper and lower cylinders, and externally downwardly tapered means attached to the lower end of said lower cylinder adapted to normally seat in said internally tapered means and to thereby support said working assembly, said working assembly being removable as a unit upwardly out of said stationary assembly by pulling upwardly on said pump rod.

7. In a pump, in combination, a well pipe, a stationary assembly attached thereto which comprises an upper cylinder, a lower casing, intermediate means connecting said cylinder and said casing, a pump rod and a slidable working assembly disposed within said stationary assembly comprising an upper plunger attached to said pump rod and adapted to reciprocate in said upper cylinder, a lower cylinder adapted to normally rest within said lower casing, a lower plunger adapted to reciprocate in said lower cylinder, a hollow tube connecting said plungers so that they reciprocate together, means including said tube providing fluid communication between the space below said upper plunger and the space below said lower plunger, and stationary means at the upper end of said lower cylinder adapted to be normally disposed opposite said intermediate means and to separate said upper and lower cylinders, said working assembly being removable as a unit upwardly out of said stationary assembly by pulling upwardly on said pump rod.

8. In a pump, a reciprocating upper plunger, means forming a chamber within which said plunger reciprocates, a lower plunger, means forming a chamber within which said lower plunger reciprocates, means connecting said plungers so as to reciprocate together, means affording constant fluid communication between the space below said upper plunger and the space below said lower plunger, upwardly opening check valve means below said lower plunger, upwardly opening check valve means carried by said upper plunger allowing liquid to pass upwardly through

said upper plunger from said spaces below said plungers to a point above said upper plunger, check valve means above said lower plunger and opening inwardly to the space above said lower plunger, a fluid passage interconnecting the spaces above said plungers, and upwardly opening check valve means associated with said passage allowing liquid to pass upwardly from said space aboye said lower plunger to a point above said upper plunger.

9. In a pump, an upper plunger, an upper chamber within which it reciprocates, a lower plunger, a lower chamber within which said lower plunger reciprocates, a hollow tube connecting said plungers, means including said tube providing constant fluid communication between the portions of said chambers below said plungers, venting means connecting the space above said lower plunger with fluid exterior of said pump, means allowing fluid to freely pass through said venting means into said space above said lower plunger but preventing it from passing outwardly therefrom, a fluid passage interconnecting the spaces above said plungers, check valve means allowing fluid to pass upwardly from the space above said lower plunger to a point above said upper plunger, and upwardly opening check valve means carried by said upper plunger and disposed above said tube for allowing fluid to pass upwardly from the spaces below both said plungers to a point above said upper plunger.

10. In a pump, a reciprocatable upper plunger, a reciprocatable lower plunger, means for connecting said plungers so that they reciprocate together, casing means within which said plungers reciprocate, stationary means extending across said casing means intermediate said plungers and sealing the space below said upper plunger and above said lower plunger, communicating means providing constant free fluid communication between the spaces in said casing means below said upper and said lower plungers, upwardly opening check valve means for allowing fluid to flow from exterior of said pump into the space below said lower plunger and thence through said communicating means to the space below said upper plunger, inwardly opening check valve means for allowing fluid to flow from a point exterior of said pump into the space above said lower plunger, upwardly opening check valve means in communication with a fluid passage for allowing fluid to pass from said space above said lower plunger to a point above said upper plunger, and upwardly opening check valve means carried by said upper plunger for allowing fluid to pass from said spaces below said plungers to said point above said upper plunger.

11. In a pump, a double-walled upper cylinder, coupling means for retaining said walls in spaced relation, a lower casing secured to the lower coupling, a foot-valve supported by the lower casing, a pair of plungers in cooperative working relation with the upper cylinder and the lower casing respectively, means for separating the working areas of the plungers, port means in the lower coupling for ingress of fluid to the space above the lower plunger, port means in the extremities of the double-walled cylinder for the egress of fluid from the space above the lower plunger to the space above the upper plunger, said separating means including valve means for controlling ingress and egress of fluid in the space above the lower plunger through the aforesaid port means, means interconnecting said plungers to reciprocate the same in unison, means including said interconnecting means for providing fluid communication between the spaces below said plungers, a head valve in the upper plunger in communication with a flow passage to permit fluid to be discharged from spaces below said plunger to a space above the upper plunger.

12. A pump comprising a stationary assembly consisting of an upper cylinder, means forming a fluid passage interconnecting the extremities of the cylinder, a lower casing, coupling means connecting said casing and cylinder, said coupling means having ports, support means connected to said lower casing, and a working assembly consisting of a lower inner cylinder normally arranged to rest upon said support means, an upper and a lower plunger in operative working relation with the upper and lower cylinders, means separating said plungers supported by said inner cylinder adjacent the coupling means, said separating means having valve means for controlling the ingress and egress of fluid in the space above the lower plunger through the coupling port and the aforesaid fluid passage, means rigidly connecting said plungers, means including said connecting means providing fluid passage between the spaces below said plungers, a foot-valve supported by said lower inner cylinder, and a head valve in said upper plunger, said working assembly being removable as a unit from the stationary assembly and being arranged in a manner that the lower inner cylinder aligns the plunger separation means adjacent the coupling when in assembled relation.

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