May 26, 1942. W. H. ZEHNER 2,284,505

TRIPLE ACTING PUMP

Filed Aug. 11, 1939

Fig. 1

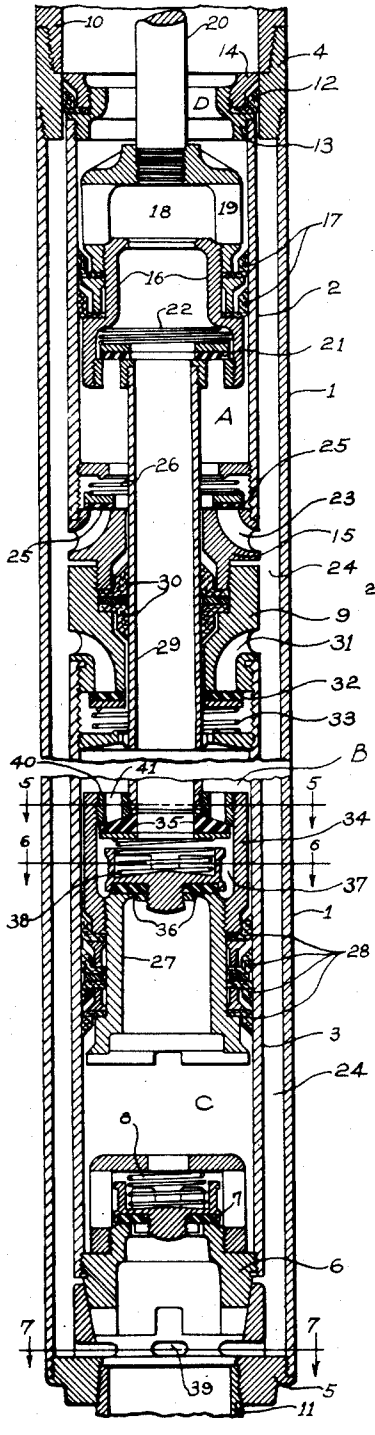


Fig. 2.

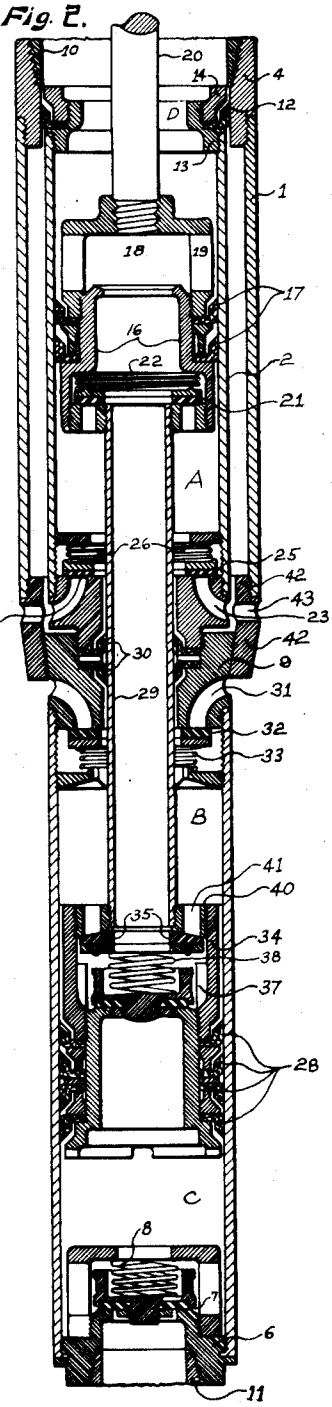
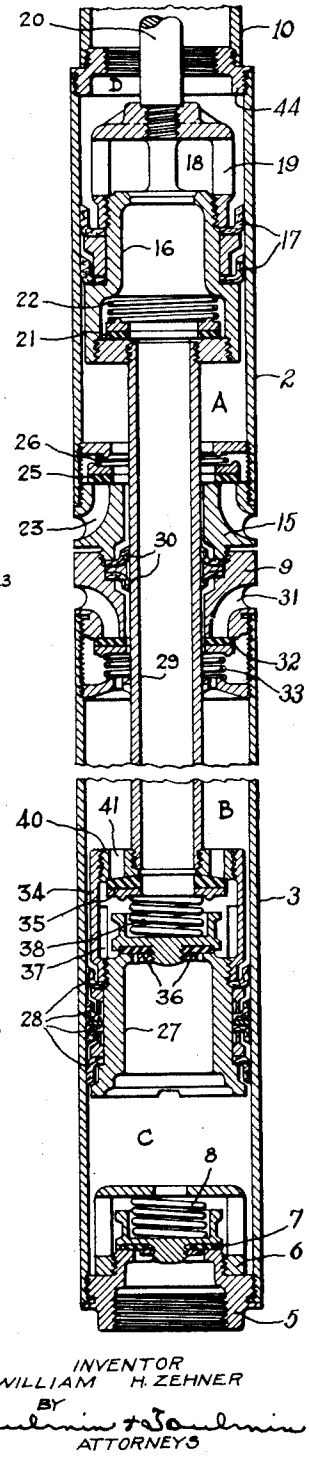


Fig. 3.



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TRIPLE ACTING PUMP

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Application August 11, 1939, Serial No. 289,650

7 Claims. (Cl. 103—4)

This invention relates to a triple acting pump which is adapted to deliver considerably more liquid per stroke than what is commonly known as a double acting pump of the same size.

The principal object of the invention is to provide a triple acting pump having two plungers, each of which is operative to deliver liquid into the delivery chamber, both in the upstroke and the down stroke, whereby the assembly is enabled to deliver more liquid per stroke than a double acting pump of the same size.

Another object is to provide a triple acting pump of the foregoing type which comprises an upper plunger and a lower plunger, each operating in co-axial cylinders, between which is disposed means for admitting liquid to the space above the lower plunger on its down stroke and means for admitting liquid to the space below the upper plunger on its upstroke. Means is also provided for admitting liquid below the lower plunger on its upstroke. Means is also provided for delivering the liquid thus admitted to these three spaces into the delivery chamber on the stroke opposite to that which filled each of the three spaces.

Consequently on the down-stroke of the upper and lower plunger unit, liquid is forced into the delivery chamber from the spaces directly below the upper and lower plungers, while on the upstroke the liquid is delivered from the space directly above the lower plunger. Apparatus of this character is therefore properly designated a "triple-acting" pump, which is clearly distinguishable from the so-called "double-acting" pump in which the fluid is delivered to the delivery chamber from only two of these three spaces during a complete reciprocation of the plunger unit.

It is a further object to provide a pump of the foregoing type wherein the working assembly is adapted to be pulled upwardly as a unit for inspection or repair by merely pulling upwardly on the pump rod and without pulling the well pipe.

Still another object is to provide an assembly of the type just described wherein the working unit is supported by an inwardly tapered casting disposed at the lowermost portion of the outer casing.

Still another object is to provide an assembly of the type just described wherein the supporting casting is at the foot of the working unit.

Another object is to provide a removable assembly wherein the supporting casting is located intermediate of the working unit.

Yet another object is to provide a modified form of triple acting pump in which the working unit cannot be removed to the surface by pulling on the pump rod but with which it is necessary to pull the well pipe in order to remove the working unit for repairs or the like; this modification provides a more economical construction than that of the removable types and one which gives proportionately a greater capacity per unit of over-all diameter.

Still other objects will more fully hereinafter appear.

Reference is made to my co-pending applications Serial Nos. 289,647, 289,648 and 289,649, filed of even date herewith, which have resulted, respectively, in Patents 2,262,128 of November 11, 1941, 2,255,305 of September 9, 1941, and 2,255,306 of September 9, 1941.

Referring to the accompanying drawing:

Figure 1 is a vertical sectional view showing the preferred form of pump assembly in operating position with the plungers and valves at rest.

Figure 2 is a similar view of a modified form of pump.

Figure 3 is a similar view of still another modification in which it is necessary to pull the drop pipe connected to the top of the working cylinder in order to withdraw the cylinder from the well.

Referring to the drawing in detail and, first, to the preferred form of the invention shown in Figure 1, reference numeral 1 designates an outer casing which extends throughout the length of the working cylinder and which is threaded at its top to a coupling 4 which receives the well pipe 10. Outer casing 1 is provided at its lower end with a supporting coupling 5, into which is threaded a pipe 11 which extends downwardly into the well. Disposed within casing 1 is an upper inner cylinder 2 and a lower inner cylinder 3. At the upper end of inner cylinder 2 there is mounted, between couplings 13 and 14, a sealing leather 12 which slidably seals the space between the top of inner cylinder 2 and coupling 4.

Supporting coupling 5 is tapered internally inwardly and downwardly and slidably receives an outwardly tapered check valve casting 6 which is threadably attached at the extreme lower end of lower cylinder 3. Mounted upon casting 6 is a check valve 7 which opens upwardly allowing liquid to pass upwardly into space C thereabove, but preventing liquid from returning downwardly from space C by reason of spring 8 which normally urges valve 7 into the closed position.

Disposed at the upper end of lower cylinder 3

and threadably engaged therewith is a lower inlet casting 9 into which is threadably engaged an upper inlet casting 15 which is threadably engaged on its exterior face with the extreme lower portion of upper cylinder 2.

Mounted within upper cylinder 2 is the reciprocating upper plunger designated generally as 16 which is provided with sealing leathers 17 slidably engaging the interior of cylinder 2. Upper plunger 16 is further provided with a cylindrical internal passageway designated generally as 18 which is in communication with delivery space D by means of ports 19 formed in the uppermost portion of upper plunger 16. Threadably engaged with upper plunger 16 is pump rod 20, through which reciprocating motion is applied to the plungers. Upper plunger 16 is provided with upwardly opening valve 21 which is normally held closed by spring 22 and which allows liquid to pass upwardly from space A into space 18 and thence into space D.

Upper inlet casting 15 is provided with outwardly opening ports 23 which are in communication with annular chamber 24 formed between outer casting 1 and the working cylinder. An upwardly opening valve 25 is provided at the upper end of these ports 23 and is adapted to allow liquid to pass upwardly from ports 23 into space A but to prevent its return by reason of spring 26 which normally urges valve 25 into the closed position.

Disposed within lower cylinder 3 is a lower plunger designated generally as 27 which is provided on its exterior face with sealing leathers 28 which slidably seal it with respect to cylinder 3. Plunger 27 is connected to plunger 16 by hollow tube 29, which causes plunger 27 to be reciprocated simultaneously with plunger 16 and which allows liquid to pass upwardly through it into the delivery space 18. Mounted between upper inlet casting 15 and lower inlet casting 9 are sealing leathers 30 which slidably seal and engage the exterior of tube 29.

Lower inlet casting 9 is provided with outwardly opening ports 31 which are likewise in communication with chamber 24. Lower inlet casting 9 is further provided with a downwardly opening valve 32 which is normally held closed by a spring 33 and which is adapted to allow liquid to pass downwardly into space B formed above lower plunger 27 but to prevent upward passage of liquid from space B.

Threadably mounted on upper portion of lower plunger 27 is a coupling 34 which connects tube 29 to plunger 27 and which carries within it valves 35 and 36, whose function will presently appear. Disposed within coupling 34 is a space 37 which is adapted to function as a passageway between space C and the interior of tube 29. Valves 35 and 36 are normally held closed by a spring 38 which is disposed between them. Upper valve 35 is adapted to allow liquid to pass from space B into the interior of tube 29 but to prevent its return. Lower valve 36 is adapted to allow liquid to pass upwardly from C into the space within tube 29 but to prevent its return.

Lower supporting coupling 5 is provided with radial passageways 39 which provide free fluid communication between annular chamber 24 and the interior of down pipe 11, and which allow water to be sucked inwardly through ports 23 and 31 as the occasion arises during the operation of the pump.

Upper valve 35 presses upwardly against an annular member 40 which is screw-threadedly interposed between pipe 29 and coupling 34 and which is provided with vertical passageways 41 which allow the liquid from space B to pass downwardly and thence inwardly and upwardly within the space of tube 29.

The operation of the device of Figure 1 is as follows: The upward movement of lower plunger 27 draws water through check valve 7 into space C while the simultaneous upward movement of upper plunger 16 draws water from chamber 24 through ports 23 and valve 25 into space A. At the same time, upper plunger 16, because of valves 36 and 21 being closed, lifts the water in space D upwardly into the well pipe while lower plunger 27, because of valve 32 being closed, forces liquid from space B through valve 35 and tube 29 into space D and thus into the well pipe. On the down stroke, check valve 7 is closed and lower plunger 27 forces water from space C through valve 36 and tube 29 into space D while upper plunger 16, because of valve 25 being closed, forces water from space A through valve 21 into space D and thus into the well pipe. At the same time, lower plunger 27, because of valve 35 being closed, draws water from chamber 24 through ports 31 and valve 32, filling space B.

Thus the device delivers water into the well pipe on both the up and down strokes and both plungers act to deliver water into the well pipe on both the up and the down stroke.

The working assembly of the device of Figure 1 is removable as a unit upwardly through well pipe 10 by merely pulling upwardly on pump rod 20 until the upper part of pump plunger 16 contacts coupling member 13, whereupon downwardly, inwardly tapered check valve housing 6 is unseated from internally correspondingly tapered supporting member 5. The entire working assembly is adapted to slide upwardly through upper coupling member 4 and thence upwardly into the well pipe.

In the modified form shown in Figure 2, the mode of operation is identical with that of the preferred embodiment of Figure 1, but the method of supporting the working assembly is different. In this modification, outer casing 1 extends only down to the intermedite inlet castings. Lower inlet casting 9 is tapered downwardly and inwardly on its outer surface, and is supported by a correspondingly tapered supporting coupling member 42 which is provided with ports 43 communicating with the exterior of the pump and adapted to allow ports 23 of upper inlet casting 15 to communicate with the water surrounding the assembly. In this construction, it is necessary that the water in the well stand at a point above ports 31 and 43.

In the modified form of Figure 3, the construction and mode of operation are similar to that of the devices described above except that the outer casing 1 is eliminated entirely and the working cylinder instead of being slidably and removably mounted is fixedly attached to a coupling member 44 which is threaded to the bottom of the well pipe 10. In order to remove the working cylinder upwardly, it is necessary to pull the well pipe.

When using this modification, it is likewise essential that the water in the well stand above the level of ports 23 in upper inlet casting 15.

Another difference between the construction of the modifications of Figures 2 and 3 and that of the preferred form of Figure 1 is that the check valve casting 6 of the modifications of Figures 2 and 3 is not tapered externally and does not sup-

port the working unit as is the case with the device of Figure 1.

I wish it to be understood that I intend to include within my invention such modifications as may be necessary to adapt it to varying conditions and uses and as fall within the terms or spirit of the appended claims.

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 cylinder, an upper plunger adapted to reciprocate therein, the space contained in the upper cylinder immediately above the upper plunger constituting a delivery space, a lower cylinder, a lower plunger adapted to reciprocate therein, hollow means connecting said plungers so that they reciprocate together, means for moving the plungers as a solid sucker rod movable within said delivery space, means intermediate of said cylinders provided with ports adapted to connect the space below said upper plunger with a source of liquid to be pumped, an outlet for liquid from the space below the upper piston, valve means allowing liquid to pass through said ports into said space below said upper plunger but preventing the reverse flow of liquid, said intermediate means being also provided with passageways adapted to connect the space above said lower plunger with a source of liquid to be pumped, valve means associated with said last-named passageways adapted to allow liquid to pass through said passageways into the space above said lower plunger but to prevent the reverse flow of liquid, and valve means carried by said lower plunger and adapted to allow liquid to pass from the space above said lower plunger into said hollow connecting means but to prevent the reverse flow of liquid, said plungers and valve means being so arranged that when the double plunger unit is moved downwardly the fluid in the space directly below the upper plunger and contained between the cylinder and said hollow means, also the fluid in the space directly below the lower plunger are both forced upwardly into the delivery space above the upper plunger from which fluid under pressure is discharged by the pump, and on the upward movement of the plunger unit the fluid directly above the lower plunger and contained between said cylinder and said hollow means is forced upwardly into said delivery space.

2. In a pump, an upper cylinder, an upper plunger adapted to reciprocate therein, the space contained in the upper cylinder immediately above the upper plunger constituting a delivery space, a lower cylinder, a lower plunger adapted to reciprocate therein, means for moving the plungers as a solid sucker rod movable within said delivery space, a check valve located in said upper plunger to allow liquid to pass upwardly from below said upper plunger to a point thereabove but to prevent a reverse flow of liquid, a check valve located below said lower plunger and adapted to allow liquid to pass upwardly therethrough into the space below said lower plunger, intermediate means connecting said upper and lower cylinders, hollow means connecting said upper and lower plungers so that they reciprocate together and in free communication with the space above said upper plunger, passageways in said intermediate means adapted to connect the space above said lower plunger with a source of liquid to be pumped, valve means associated with said passageways for allowing liquid to flow through said passageways, into said space above said lower plunger but to prevent the reverse flow of liquid, valve means carried by said lower plunger and adapted to allow liquid to flow from the space above said lower plunger into said hollow connecting means, and separate valve means carried by said lower plunger and adapted to allow liquid to flow from said space below said lower plunger into said hollow connecting means but to prevent the reverse flow of liquid, said plungers and valve means being so arranged that when the double plunger unit is moved downwardly the fluid in the space directly below the upper plunger and contained between the cylinder and said intermediate means, also the fluid in the space directly below the lower plunger are both forced upwardly into the delivery space above the upper plunger from which fluid under pressure is discharged by the pump, and on the upward movement of the plunger unit the fluid directly above the lower plunger and contained between said cylinder and said intermediate means is forced upwardly into said delivery space.

3. In a pump, containing only two plungers in line with one another, an upper and lower cylinder in which said plungers are adapted respectively to reciprocate, hollow means connecting said plungers so that they reciprocate together and in communication with the delivery space, said delivery space being immediately above the upper plunger and within the upper cylinder, intermediate means disposed between said upper and lower cylinders, means for moving the plungers as a solid sucker rod movable within said delivery space, ports in said intermediate means adapted to place the space below said upper plunger in communication with a source of liquid to be pumped, check valve means allowing liquid to pass through said ports into said space but preventing the reverse flow of liquid, valve means carried by said upper plunger adapted to allow liquid to pass therethrough from the space below said upper plunger and into said delivery space but to prevent the reverse flow of liquid, separate ports carried by said intermediate means adapted to place the space above said lower plunger in communication with a source of liquid to be pumped, check valve means associated with said last-named ports and adapted to allow liquid to flow therethrough into said space above said lower plunger but to prevent the reverse flow of liquid, check valve means below said lower plunger adapted to allow liquid to flow upwardly therethrough into the space below said lower plunger, valve means carried by said lower adapted to allow liquid to flow from the space below said lower plunger into said hollow means but to prevent the reverse flow of liquid, and separate valve means also carried by said lower plunger adapted to allow liquid to flow from the space below said lower plunger into said hollow means but to prevent the reverse flow of liquid, said plungers and valve means being so arranged that when the double plunger unit is moved downwardly the fluid in the space directly below the upper plunger and contained between the cylinder and said hollow means, also the fluid in the space directly below the lower plunger are both forced upwardly into the delivery space above the upper plunger from which fluid under pressure is discharged by the pump, and on the upward movement of the plunger unit the fluid directly above the lower plunger and contained between said cylinder and said hollow means is forced upwardly into said delivery space.

4. In a pump, containing only two plungers in line with one another, an upper and lower cylinder in which said plungers are adapted respectively to reciprocate, hollow means connecting said plungers so that they reciprocate together and in communication with the delivery space, said delivery space being immediately above the upper plunger and within the upper cylinder, intermediate means disposed between said upper and lower cylinders, means for moving the plungers as a solid sucker rod movable within said delivery space, ports in said intermediate means adapted to place the space below said upper plunger in communication with a source of liquid to be pumped, check valve means allowing liquid to pass through said ports into said space but preventing the reverse flow of liquid, valve means carried by said upper plunger adapted to allow liquid to pass therethrough from the space below said upper plunger and into said delivery space but to prevent the reverse flow of liquid, separate ports carried by said intermediate means adapted to place the space above said lower plunger in communication with a source of liquid to be pumped, check valve means associated with said last-named ports and adapted to allow liquid to flow therethrough into said space above said lower plunger but to prevent the reverse flow of liquid, check valve means below said lower plunger adapted to allow liquid to flow upwardly therethrough into the space below said lower plunger, valve means carried by said lower plunger adapted to allow liquid to flow from the space above said lower plunger into said hollow means but to prevent the reverse flow of liquid, and separate valve means also carried by said lower plunger adapted to allow liquid to flow from the space below said lower plunger into said hollow means but to prevent the reverse flow of liquid, and a common spring between said two last-named valve means tending to normally maintain said valve means closed, said plungers and valve means being so arranged that when the double plunger unit is moved downwardly the fluid in the space directly below the upper plunger and contained between the cylinder and said hollow means, also the fluid in the space directly below the lower plunger are both forced upwardly into the delivery space above the upper plunger from which fluid under pressure is discharged by the pump, and on the upward movement of the plunger unit the fluid directly above the lower plunger and contained between said cylinder and said hollow means is forced upwardly into said delivery space.

5. In a pump, an outer casing, a cylinder assembly disposed concentrically therewithin and forming an annular chamber therebetween, said cylinder assembly comprising an upper cylinder, an upper plunger adapted to reciprocate therein, the space within said cylinder and directly above said plunger constituting a delivery space, a lower cylinder, a lower plunger adapted to reciprocate therein, hollow means connecting said plungers so that they reciprocate together, and providing constant free fluid communication between the space below said lower plunger and said delivery space, intermediate means connecting said cylinders, ports in said intermediate means adapted to connect said annular chamber with the space below said upper plunger, separate ports in said intermediate means adapted to connect said annular chamber with the space above said lower plunger, means carried by said lower plunger adapted to alternatively connect said space above said lower plunger with said hollow means and to connect said space below said lower plunger with said hollow means, said annular chamber being in free communication with liquid below said cylinder assembly, upwardly opening check valve means carried by said upper plunger for allowing fluid to pass upwardly therethrough into said delivery space, and inwardly opening check valve means for allowing fluid to pass into said space below said plunger.

6. In a pump, an outer casing, an internally and downwardly inwardly tapered supporting member at the bottom thereof, a cylinder assembly having an externally and downwardly inwardly tapered member mounted at the bottom thereof and received in said supporting member, said cylinder assembly forming an annular chamber with said outer casing, said supporting member having passageways therethrough connecting said annular chamber with liquid below said cylinder assembly, said cylinder assembly comprising an upper cylinder, an upper plunger therein, the space within said cylinder and directly above said plunger constituting a delivery space, a lower cylinder, a lower plunger therein, hollow means rigidly connecting said plungers, means for moving the plungers as a solid sucker rod movable within said delivery space, and providing constant free fluid communication between the space below said lower plunger and said delivery space, check valved means allowing liquid to flow from said annular chamber into the space below said upper plunger, check valved means allowing liquid to flow from said annular chamber into the space above said lower plunger, said lower plunger having check valve means allowing liquid to flow from above said lower plunger into said hollow means and having separate check valve valve means allowing liquid to flow from the space below said lower plunger into said hollow means, upwardly opening check valve means carried by said upper plunger for allowing fluid to pass upwardly from the space below said upper plunger into said delivery space, and inwardly opening check valve means for allowing fluid to pass into said space below said lower plunger, said plungers and valve means being so arranged that when the double plunger unit is moved downwardly the fluid in the space directly below the upper plunger and contained between the cylinder and said hollow means, also the fluid in the space directly below the lower plunger are both forced upwardly into the delivery space above the upper plunger from which fluid under pressure is discharged by the pump, and on the upward movement of the plunger unit the fluid directly above the lower plunger and contained between said cylinder and said hollow means is forced upwardly into said delivery space.

7. In a triple-acting pump containing only two plungers in line with one another, means including a cylinder associated with the upper plunger for forming a chamber within which said plunger may reciprocate, means associated with the lower plunger for forming a chamber within which said lower plunger may reciprocate, hollow means connecting said plungers so that they reciprocate together and in free communication with the delivery space directly above said upper plunger and contained within said cylinder, means for moving the plungers as a solid sucker rod movable within said delivery space, means associated with said upper plunger for causing it to draw liquid to be pumped into the space

immediately below it on the upstroke and for causing it to deliver liquid from said space below it to a point immediately above it on the down stroke, and means associated with said lower plunger for causing it to draw liquid to be pumped into the space immediately above it on the down stroke, to force liquid from the space immediately below it into said hollow means on the down stroke, and to force liquid from the space immediately above it into said hollow means on the upstroke and to draw liquid to be pumped into the space immediately below it on the upstroke.

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