

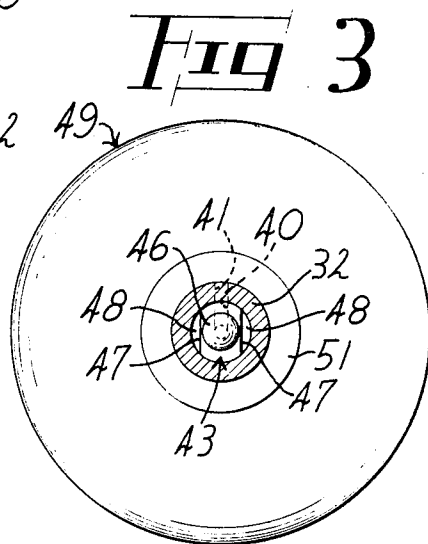
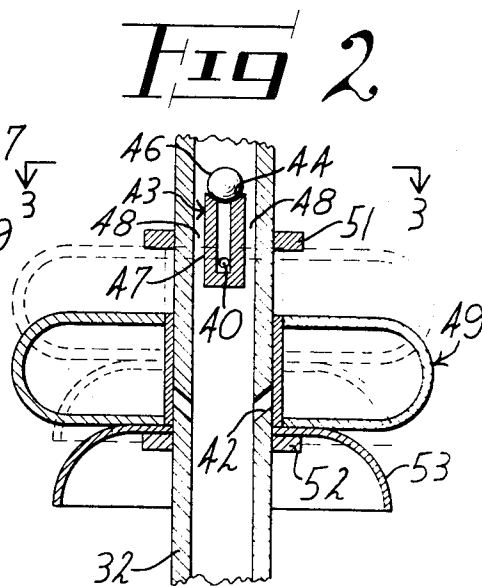
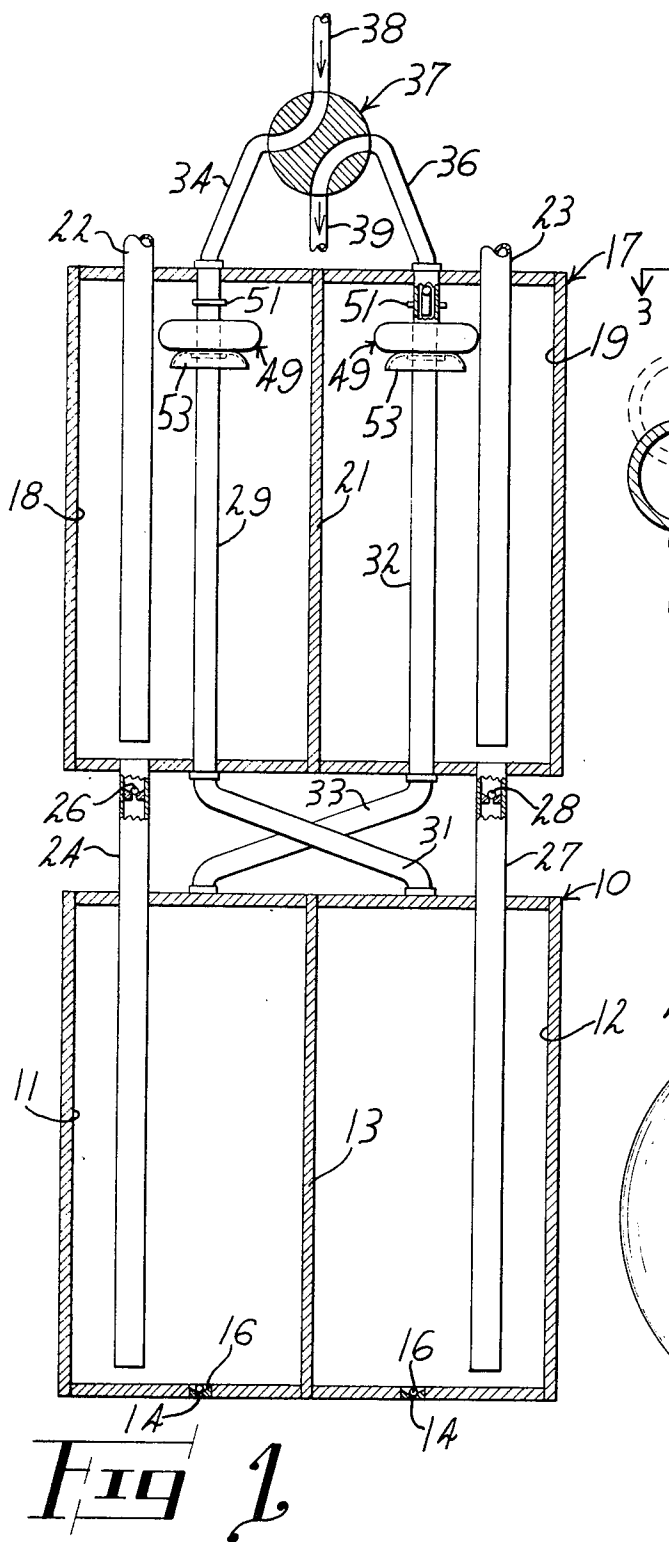
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FLUID PUMP

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FLUID PUMP

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ABSTRACT OF THE DISCLOSURE

Fluid pump having upper and lower pairs of laterally disposed chambers with liquid receiving openings in lower chambers. Liquid discharge conduits extend above upper chambers and communicate with lower portion of upper chambers. Lower portion of one chamber of upper chambers communicates with lower portion of one chamber of lower chambers while lower portion of other chamber of upper chambers communicates with lower portion of other chamber of lower chambers with check valves preventing flow of liquid from upper chamber to lower chamber. A first conduit communicates with upper portion of said one chamber of upper chambers and upper portion of said other chamber of lower chambers while a second conduit communicates with upper portion of said other chamber of upper chambers and upper portion of said one chamber of lower chambers. Gas introduced alternately into first conduit as exhausted through second conduit and alternately into second conduit as exhausted through first conduit.

BACKGROUND OF THE INVENTION

This invention relates to a fluid pump and more particularly to a pump which is operated by gas under pressure whereby liquid is forced upwardly from one stage to another.

As is well known in the art to which my invention relates, difficulties have been encountered in lifting liquids a substantial distance from wells due to the fact that the column of liquid being removed extends substantially the depth of the well. In accordance with my invention, I provide a plurality of pairs of chambers and introduce air downwardly through the pairs of chambers whereby the liquid is lifted from one stage to the next until it is discharged from the uppermost pair of chambers.

BRIEF SUMMARY OF INVENTION

My invention comprises a fluid pump having upper and lower pairs of laterally disposed chambers with means for introducing liquid into the lowermost pair of chambers. The lower portion of one chamber of each upper pair of chambers communicates with the lower portion of one chamber of the subjacent lower pair of chambers while the lower portion of the other chamber of the upper pair of chambers communicates with the lower portion of the other chamber of the subjacent lower pair of chambers. Check valves prevent flow of liquid from the upper chambers to the lower chambers. A gas conduit communicates with the upper portion of one chamber of the upper pair of chambers and the upper portion of the other chamber of the lower pair of chambers while a second gas conduit communicates with the upper portion of said other chamber of the upper pair of chambers and the upper portion of said one chamber of said lower pair of chambers. Gas is introduced alternately into one gas conduit and then the other while the gas is exhausted alternately from the conduit not receiving gas.

Apparatus embodying features of my invention is illustrated in the accompanying drawing, forming a part of this application, in which:

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FIG. 1 is a vertical sectional view showing a lower pair of chambers and an upper pair of chambers, together with means for introducing gas alternately into each of the uppermost pair of chambers;

FIG. 2 is an enlarged, fragmental view showing the float member which surrounds the gas conduits whereby the flow of gas therethrough is controlled; and,

FIG. 3 is a sectional view taken generally along the line 3—3 of FIG. 2.

Referring now to the drawing for a better understanding of my invention, I show a lower pair of laterally disposed chambers generally at 10 which comprises separate chambers 11 and 12 separated by a common partition wall 13. An inlet opening 14 is provided in each chamber 11 and 12 and the flow of liquid therethrough is controlled by a check valve 16. That is, the check valves 16 restrain the flow of liquid from the chambers 11 and 12.

Mounted above the lower pair of chambers 10 is an upper pair of laterally disposed chambers indicated generally at 17 which comprise separate chambers 18 and 19 separated by a common partition wall 21. While I have shown the chambers 11 and 12 as being separated by a common partition wall 13 and have shown the chambers 18 and 19 as being separated by a common partition wall 21, it will be apparent that each chamber may be formed separate from its associated chamber.

Extending downwardly within the upper chambers 18 and 19 are liquid discharge conduits 22 and 23, respectively. The lower end of each conduit 22 and 23 terminates adjacent the bottom of its associated chamber while the upper end thereof extends outwardly of and above the upper chambers, as shown in FIG. 1.

Communicating with the lower end of the chamber 18 is the upper end of a conduit 24 having a check valve 26 therein which restrains flow of fluid outwardly of chamber 18. The conduit 24 extends through the upper wall of chamber 11 with the lower end of conduit 24 terminating adjacent the bottom of chamber 11. Accordingly, fluid is free to flow upwardly through conduit 24 into chamber 18. Communicating with the lower portion of chamber 19 is a conduit 27 having a check valve 28 therein which restrains flow of liquid from chamber 19. The conduit 27 extends through the upper wall of chamber 12 with the lower end of conduit 27 terminating adjacent the bottom of chamber 12 whereby fluid is free to move upwardly through conduit 27 to chamber 19.

Extending downwardly through suitable openings in the top and bottom of chamber 18 is a conduit 29. The lower end of conduit 29 communicates with a conduit 31 which in turn, communicates with the upper end of chamber 12. In like manner, extending downwardly through suitable openings in the top and bottom of chamber 19 is a conduit 32. The lower end of conduit 32 communicates with a conduit 33 which in turn communicates with the top of chamber 11, as shown in FIG. 1. The upper ends of the conduits 29 and 32 are connected to conduits 34 and 36, respectively for supplying a gas, such as air, to and exhausting gas from conduits 29 and 32.

The conduits 34 and 36 communicate with a conventional type 4-way valve unit 37 which in turn communicates with a gas supply conduit 38 and an exhaust conduit 39. Accordingly, with the four-way valve 37 in the position shown in FIG. 1, gas will be introduced through conduit 34 into conduit 29 while gas is discharged from conduit 36 through exhaust conduit 39. Upon rotation of the four-way valve, the direction of flow through conduits 34 and 36 is reversed whereby gas would then be supplied from conduit 38 through conduit 36 to conduit 32 and would then be discharged through conduits 29, 34 and 39.

Each conduit 29 and 32 is provided with an upper opening 41 and a lower opening 42 therethrough which are spaced vertically from each other, as shown in FIG. 2. The opening 41 communicates with a lateral passageway 40 provided in a sleeve-like member 43 having a closed bottom, as shown in FIG. 2. The upper end of sleeve 43 is provided with a conical seat 44 for receiving a ball 46 which defines a check valve that restrains flow of fluid from conduit 32 to valve openings 41 and 40. As shown in FIGS. 2 and 3, the sides of the sleeve member are cut away as at 47 to provide vertical passageways 48 at opposite sides of the sleeve member 43 whereby gas is free to flow around the sleeve member 43.

Surrounding and mounting for sliding movement relative to each conduit 29 and 32 is a float indicated generally at 49 which is adapted to move from the solid line position shown in FIG. 2 to the dotted line position. While I have shown in FIGS. 2 and 3 the float arrangement for conduit 32, it will be apparent that the identical structure is employed on conduit 29. While in the lower, solid line position shown in FIG. 2, the opening 42 is closed whereby there is no flow of gas therethrough. On the other hand, upon movement of the float 49 to the dotted line position shown in FIG. 2, the opening 41 is closed whereby there is no flow of gas therethrough. Upward movement of the float 49 is limited by a stop member 51 while lower movement of float 49 is limited by a stop member 52. Secured to the lower end of the float 49 and surrounding each conduit 29 and 32 is a downwardly and outwardly extending baffle 53 which is in position to be engaged by gas discharged through opening 42 whereby the upwardly and outwardly moving gas retains the baffle 53 and its associated float 49 in the raised position until the flow of gas through opening 42 ceases.

From the foregoing description, the operation of my improved pump will be readily understood. The four-way valve 37 is moved selectively whereby gas is introduced alternately into the conduits 34 and 36 and is then discharged alternatively through the conduit which does not receive the gas under pressure. With the four-way valve 37 in the position shown in FIG. 1, gas under pressure is introduced through conduit 34 through conduit 29 whereby gas flows through opening 42 in conduit 29 to thus force liquid from chamber 18 through outlet 22. That is, the chamber 18 is filled with liquid at the time gas is introduced through conduit 34. Since the air discharged through conduit 42 is directed upwardly and outwardly against the baffle 53, the float 49 is retained in the uppermost position until the four-way valve 37 is rotated to reverse the flow of air through conduits 34 and 36. At this time, the float 49 moves downwardly to the solid line position shown in FIG. 2. As air is introduced through conduit 29, it also passes downwardly through conduit 31 to the upper end of chamber 12 whereby the column of fluid in chamber 12 is forced downwardly and is then forced upwardly through conduit 27 through check valve 28 to chamber 19. As the column of liquid rises in chamber 19, air is discharged through passageways 41 and 40 into sleeve 43 whereupon it then passes outwardly past ball check valve 46 and then outwardly through conduit 36 to exhaust port 39. Air continues to be discharged through exhaust port 39 until the liquid in chamber 19 rises to a point to elevate float 49 from the solid line position to the dotted line position shown in FIG. 2.

Upon movement of the float 49 to the dotted line position shown in FIG. 2, the four-way valve 37 is rotated to reverse the flow of air to conduits 34 and 36, whereupon air under pressure is then introduced through conduit 36 and is exhausted through conduit 34. Since the float 49 is in the raised position at the commencement of gas flow downwardly through conduit 32, air passes outwardly and upwardly through opening 42 to thus retain the float 49 in the raised position until the flow of gas is interrupted by rotation of four-way valve 37. The air introduced through passageway 42 thus forces the column of fluid

in chamber 19 downwardly whereupon it is discharged through outlet conduit 23. As fluid is forced from chamber 19, gas introduced through conduit 32 also passes downwardly through conduit 33 to chamber 11 whereupon the column of liquid in chamber 11 is forced upwardly through conduit 24 to chamber 18. As the column of liquid rises in chamber 18, gas is exhausted through passageways 41 and 40 to conduit 29 whereupon it is then exhausted through conduit 34 until the float 49 moves to the uppermost position, as shown in dotted lines in FIG. 2.

As air under pressure is introduced through conduit 33 into the upper end of chamber 11, the chamber 12 is in communication with the exhaust side of four-way valve 37 by conduits 31, 29 and 34 whereby liquid is free to move upwardly into chamber 12 as liquid is forced from chamber 11. In like manner, while gas under pressure is introduced through conduit 31 into the upper end of chamber 12, the chamber 11 is in communication with the exhaust side of four-way valve 37 whereby air in chamber 11 is exhausted through conduits 33, 32, and 36 thus permitting liquid to move upwardly into chamber 11 as liquid is forced from chamber 12. The lowermost chambers 11 and 12 may be submerged in the liquid being pumped or the chambers 11 and 12 may be connected to other means of supply, such as the upper ends of other chambers 18 and 19 whereby liquid is forced upwardly through check valves 16 into the chambers 11 and 12 alternately as the four-way valve 37 is rotated to selected positions to reverse the flow of gas to the conduits 29 and 32.

From the foregoing, it will be seen that I have devised an improved fluid pump whereby liquid is forced upwardly by gas under pressure from a lower stage to an upper stage. Also, by providing a fluid pump which comprises separate stages, a plurality of stages may be connected in series whereby liquid may be forced upwardly a predetermined distance by each stage so that a deep well pump would comprise a plurality of stages. Furthermore, by providing a fluid pump which operates by gas under pressure, I eliminate the necessity of providing mechanical parts beneath the surface, thus greatly reducing the maintenance and operating cost of the apparatus.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof.

What I claim is:

1. A fluid pump comprising:

- (a) a lower pair of laterally disposed chambers having inlet openings therein for introducing liquid into said lower pair of chambers,
- (b) means restraining flow of liquid through said inlet openings outwardly of said lower pair of chambers,
- (c) an upper pair of laterally disposed chambers at an elevation above said lower pair of chambers,
- (d) a liquid discharge conduit communicating at one end with the lower portion of each chamber of said upper pair of chambers with the other ends thereof extending above said upper pair of chambers,
- (e) means communicating the lower portion of one chamber of said upper pair of chambers with the lower portion of one chamber of said lower pair of chambers with means restraining flow of liquid from said one chamber of said upper pair of chambers to said one chamber of said lower pair of chambers,
- (f) means communicating the lower portion of the other chamber of said upper pair of chambers with the lower portion of the other of said lower pair of chambers with means restraining flow of liquid from said other chamber of said upper pair of chambers to said other chamber of said lower pair of chambers,
- (g) a first conduit in flow communication with the upper portion of said one chamber of said upper pair of chambers and the upper portion of said other chamber of said lower pair of chambers,
- (h) a second conduit in flow communication with the

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upper portion of said other chamber of said upper pair of chambers and the upper portion of said one chamber of said lower pair of chambers, and

- (i) means introducing a gas alternately into said first conduit while gas is exhausted from said second conduit forcing liquid from said one chamber of said upper pair of chambers and forcing liquid from said other chamber of said lower pair of chambers into said other chamber of said upper pair of chambers until the liquid level reaches a predetermined level in said other chamber of said upper pair of chambers and alternately into said second conduit while gas is exhausted from said first conduit forcing liquid from said other chamber of said upper pair of chambers and forcing liquid from said one chamber of said lower pair of chambers into said one chamber of said upper pair of chambers until the liquid level reaches a predetermined level in said one chamber of said upper pair of chambers.

2. A fluid pump as defined in claim 1 in which the means introducing a gas alternately into said first conduit and said second conduit comprises a four-way valve communicating with a source of gas under pressure, an exhaust port, said first conduit and said second conduit.

3. A fluid pump as defined in claim 1 in which each of said means restraining flow of liquid comprises a check valve.

4. A fluid pump as defined in claim 1 in which said liquid discharge conduits comprise upstanding tube-like members extending downwardly into said one chamber and said other chamber of said upper pair of chambers with the lower ends of said tube-like members terminating adjacent the bottoms of said one chamber and said other chamber of said upper pair of chambers.

5. A fluid pump as defined in claim 1 in which said first conduit and said second conduit comprise:

- (a) a first tube-like member extending downwardly through said one chamber of said upper pair of chambers and a second tube-like member extending downwardly through said other chamber of said upper pair of chambers with the lower end of said first tube-like member communicating with the upper end of said other chamber of said lower pair of chambers and the lower end of said second tube-like

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member communicating with the upper end of said one chamber of said lower pair of chambers.

6. A fluid pump as defined in claim 5 in which at least one passageway is provided in each of said tube-like members extending through said one chamber and said other chamber of said upper pair of chambers adjacent the upper portions of said one chamber and said other chamber of said upper pair of chambers.

7. A fluid pump as defined in claim 6 in which vertically spaced openings are provided in each of said tube-like members extending through said one chamber and said other chamber of said upper pair of chambers and a float is movable along each said tube-like member and disposed to close the uppermost opening and open the lowermost opening upon raising said float to a predetermined point and disposed to close said lowermost opening and open said uppermost opening upon lowering said float to a predetermined point.

8. A fluid pump as defined in claim 7 in which said lowermost opening discharges gas in an outwardly and upwardly extending direction and a downwardly and outwardly extending baffle is carried by said float in position to be engaged by gas discharged from said lowermost opening so that said float is retained in said uppermost position while gas is discharged from said lowermost opening.

9. A fluid pump as defined in claim 7 in which the flow of gas through said uppermost opening is controlled by a check valve which restrains flow of gas outwardly of said uppermost opening.

10. A fluid pump as defined in claim 7 in which stop members limit vertical movement of said float.

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