Jan. 20, 1925. 1,523,709

C. B. PENDLETON

AUTOMATIC FLUID PRESSURE DISPLACEMENT PUMP

Filed Sept. 1, 1923 3 Sheets-Sheet 1

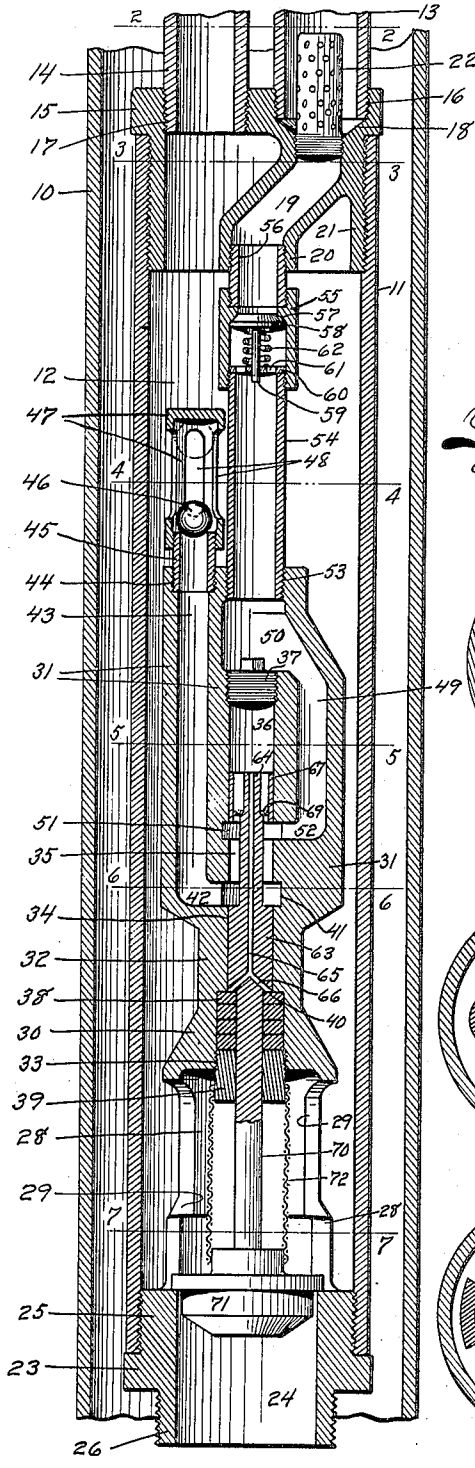


Fig. 1.

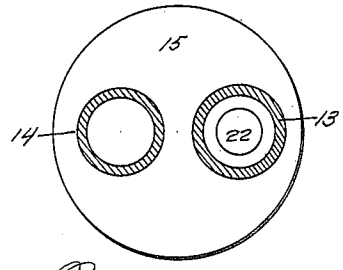


Fig. 2.

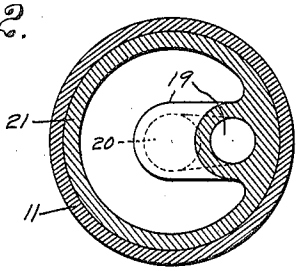


Fig. 3.

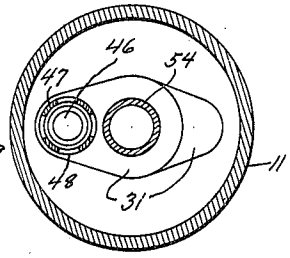


Fig. 4.

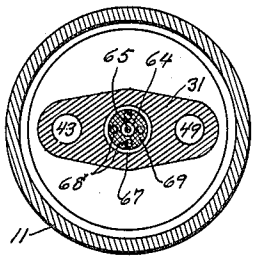


Fig. 5.

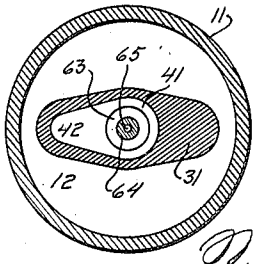


Fig. 6.

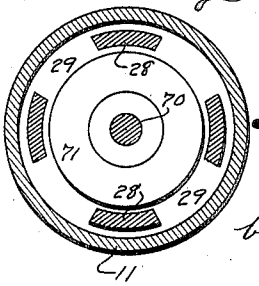


Fig. 7.

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C. B. PENDLETON

AUTOMATIC FLUID PRESSURE DISPLACEMENT PUMP

Filed Sept. 1, 1923 3 Sheets-Sheet 2

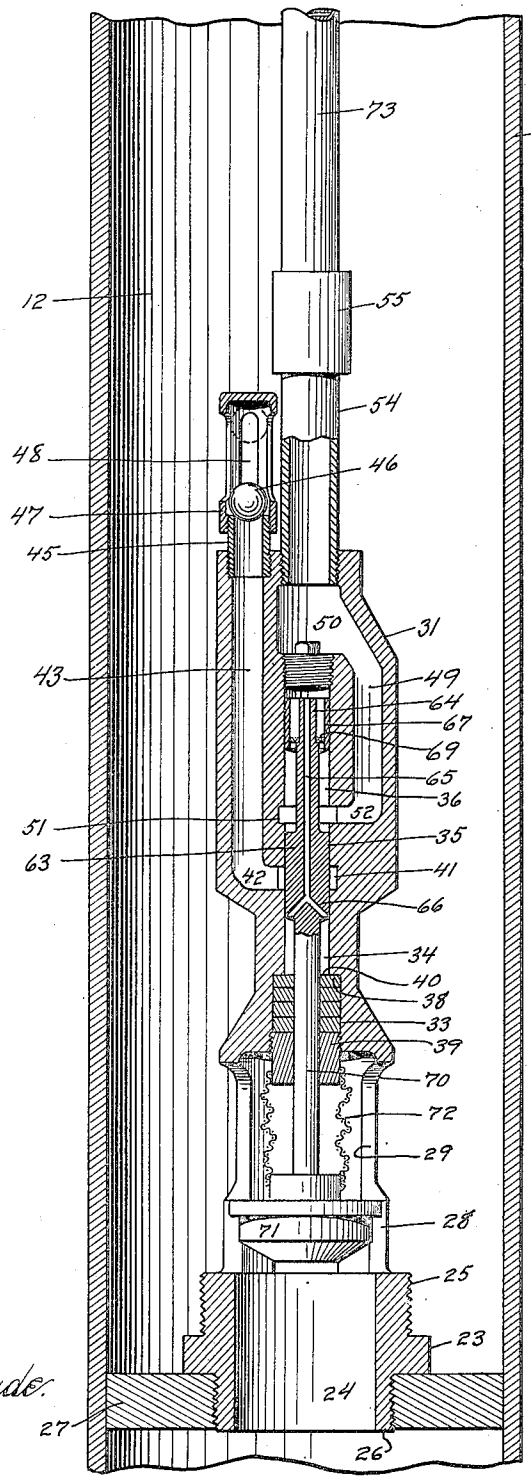


Fig. 8.

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AUTOMATIC FLUID PRESSURE DISPLACEMENT PUMP

Filed Sept. 1, 1923 3 Sheets-Sheet 3

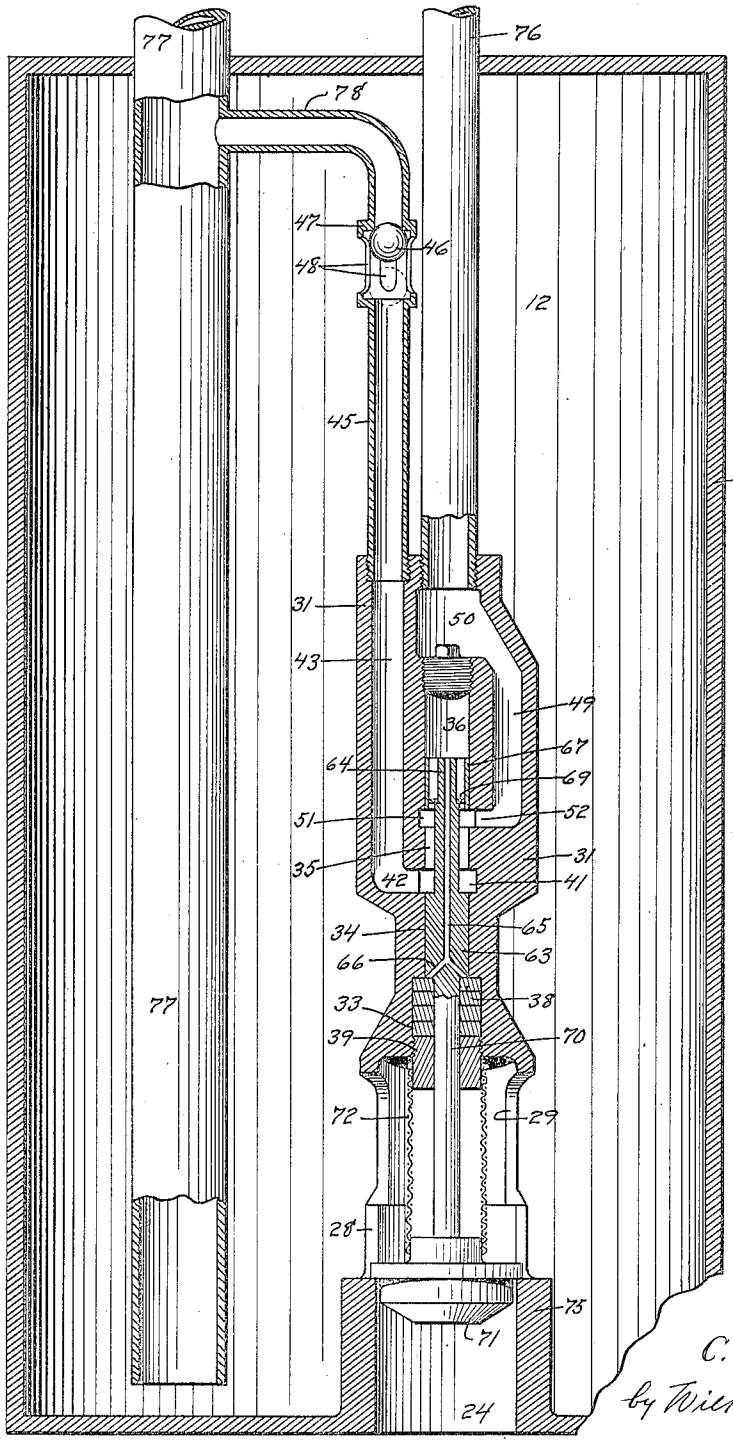


Fig. 9.

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UNITED STATES PATENT OFFICE.

CHARLES B. PENDLETON, OF DENVER, COLORADO.

AUTOMATIC FLUID-PRESSURE-DISPLACEMENT PUMP.

Application filed September 1, 1923. Serial No. 660,545.

To all whom it may concern:

Be it known that I, CHARLES B. PENDLETON, a citizen of the United States, and a resident of the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Automatic Fluid-Pressure-Displacement Pumps, of which the following is a specification.

This invention relates to automatic fluid pressure liquid displacement pumps of the type wherein an operating pressure fluid, such as a constantly supplied source of compressed air for example, is intermittently and alternately admitted into a displacement zone, relatively to the like admission thereto of charges or volumes of the incoming liquid to be pumped, the said operating pressure fluid functioning as a fluid piston to force said liquid through an outlet or discharge conduit suitably leading from said displacement zone, and the inflow of both said operating pressure fluid and said liquid being under such automatically coacting valvular control that the one is cut off while the other is being admitted into said displacement zone.

Although the improvements have been devised primarily for the individual pumping of oil wells, as distinguished from the more or less complex pumping riggings heretofore quite customarily employed, the many disadvantages of which are well understood, and while the same will accordingly be more particularly disclosed with reference to oil well pumping, still it is to be understood from the outset that the use of the invention is not necessarily restricted to this one special field of employment, as the improvements might well be adapted for installation in other analogous relations and for the pumping of liquids other than oil.

It has heretofore been proposed to employ displacement pumps, of the general character set forth, with which both the inflow of the liquid to be pumped and the operating pressure fluid are, broadly speaking, under the automatic control of valvular means located within the displacement zone of the pump, but no claim is made herein, in so far as the valve features by themselves are concerned, to arrangements embodying a coacting pair of disconnected and individually actuated valve parts, nor for that matter to a unitarily paired valve structure, from the broadest aspect, functioning to automatically control the inflow of the operating pressure fluid and the liquid to be pumped.

One of the primary objects or features of the present invention, however, has been to devise a simple, durable and economically efficient unitary or unitarily operating valve structure that embodies both the operating pressure fluid control valve part and the liquid inlet control valve part, the former of which is encased or enclosed, relatively to the displacement zone, whereby it may be constructed, and preferably is so constructed, as to provide for a valvular control of a balanced piston type, being in the nature of a plunger part, of different cross-sectional area at its opposite ends, longitudinally apertured or bored to furnish conduit means opening to the opposed faces thereof and in communication at all times with the operating pressure fluid line, and with one end of said plunger part provided with a reduced stem that mounts the liquid inlet control valve.

The foregoing as well as other features, objects and advantages will be so clearly apparent, however, as incidental to the following disclosure, that it would serve no useful purpose to further enlarge upon the same initially, and reference will therefore be immediately had to the accompanying drawings, illustrating certain practical embodiments of the improvements, which drawings form a part of this specification, and in which drawings—

Figure 1 is a central longitudinal sectional view through the pump proper and one form of its associated parts, as assembled and lowered within a well casing, wherein the displacement chamber thereof is provided for by a barrel containing the pump elements and suspended by both the pressure fluid and discharge pipe lines, all of the valve elements being shown seated in their positions when the pump is not operating, with the unitarily operating fluid and liquid controlling valve parts moved to their lowermost positions, and thus set for automatic actuation upon the cutting in of the constantly supplied operating pressure fluid;

Figures 2 to 7, inclusive, are cross-sectional views, omitting the well casing, taken respectively in the planes of the lines 2—2, 3—3, 4—4, 5—5, 6—6 and 7—7 of Figure 1;

Figure 8 is a central longitudinal sectional view, illustrating a modified applica-

tion of the invention, wherein the well casing itself also functions as the pumped liquid discharge pipe line, but the pump elements proper are the same as at Figure 1, and the unitarily operating fluid and liquid controlling valve parts are shown as moved to their uppermost positions, or the reverse to that of Figure 1, in the cycle of pumping operations, for shutting off the operating pressure fluid while admitting the incoming liquid to the displacement zone; and

Figure 9 is a central longitudinal sectional view, illustrating a further modified application of the invention, wherein the displacement zone is provided for by a closed tank, for immersion in a large body of liquid, the operating pressure fluid being introduced towards the top of the tank, and the discharge pipe extending to approximately the bottom thereof.

The use of the words "air" and "liquid," wherever appearing in the following, as well as other expressions in analogous conjunction therewith, unless the meaning is otherwise apparently qualified, are employed in the broader sense of any suitable operating pressure fluid and the liquid to be pumped, respectively, and likewise the expressions "air control valve" and "liquid control valve," or their equivalents, are respectively employed in the sense of the operating pressure fluid inlet control valve part and the liquid inlet control valve part.

Referring first to Figures 1 to 7, the numeral 10 indicates a well casing into which there is lowered a pump casing or barrel 11, for containing the pump parts proper and providing a liquid receiving chamber 12, the upper portion of which functions as the displacement zone thereof, the said barrel 11 with all of its contained parts being lowered as a unit into the well casing, and likewise being fixedly suspended therein, by the air inlet pipe conduit 13 and the liquid outlet discharge pipe conduit 14.

The upper end of the barrel 11 has a capping top or head 15, apertured as at 16 and 17 to receive the lower ends of the respective conduit pipes 13 and 14, which are preferably threaded therein, and the aperture 16 may be formed with a beveled recess 18 at its bottom, merging into an offsetting elbow pipe 19 that terminates in a downwardly disposed substantially central nipple 20, the capping head being further provided with a hollow extension 21 for fitting the upper end of the barrel 11. This hollow extension is preferably cylindrical and may be fitted to the upper end of the barrel in internal threaded relation, as shown, although obviously it may be otherwise fitted thereto. At 22, there is also shown a short length tube or thimble, threaded into the upper end of the elbow 19 and upstanding within the lower end of the air inlet pipe 13. The lower end of this thimble 22 is in open communication with the elbow pipe 19, but its top is preferably closed to the pipe 13, being provided around its peripheral wall with a number of small apertures for the admission of the pressure air to the elbow pipe 19 or equivalent conduit. Obviously, however, this element need not necessarily be employed, or it might be of other foraminate structure, but when used it functions both as an air strainer, for trapping any foreign matter, and as a moderating means for the admission of the pressure air, as distinguished from where the operating air would directly rush down through the elbow connection 19.

The lower end of the barrel 11 has an open-ended tubular bottom or capping head 23, providing the liquid inlet conduit or bore therethrough, indicated at 24, and the upper wall extension 25 of which functions as a seat for the liquid control valve. This element 23 is also shown as provided with a lower wall extension 26, both of which upper and lower extensions 25—26 are preferably screw-threaded externally, the said upper extension being also adapted for threaded attachment to the lower end of the barrel 11, when the latter is employed as in the structure of Figure 1, while the said lower extension is adapted for the threaded attachment of a packer ring or gasket 27, when the barrel 11 is not employed as in the structure of Figure 8.

Formed integrally with the valve seating extension 25, or otherwise rigidly supported thereby, is an upstanding spider or cage consisting of spaced wall sections, supporting arms or pedestal legs 28, forming vertically disposed slots or openings 29 therebetween, which in turn are surmounted by a substantially solid base 30 for the plurally chambered body portion of the air control valve casing 31, a neck portion 32 being shown therebetween and forming a part of the air valve casing proper.

The said base section 30 has a longitudinal bore 33 therethrough which merges into a continuing longitudinal bore of lesser diameter that extends through the neck section 32 and the main body portion 31 for a substantial distance up the latter, the said latter restricted bore being indicated at the three positions 34, 35 and 36 as providing a lower, an intermediate and an upper chamber, respectively, for housing the air control valve which is of elongated or piston plunger structure. The upper end of the upper chamber 36 is closed by a plug 37, and the lower end of the lower chamber 34 is partially closed by the upper one 38 of a series of washers or packing means located within the bore 33 and held up in place by a longitudinally bored plug 39, which forces the packing means at its upper face against an

annular shoulder, formed by the larger and smaller merging chambers 33—34, with the said upper face of the said packing means partially extending directly below the chamber 34 and forming therefor an internal annular ledge, as it were, indicated at 40, for reasons hereinafter referred to. Obviously, however, the said packing means could be other than a series of washers 38.

The air valve casing 31 is formed, at the bottom of the chamber 35, with a lower annularly encompassing portway 41 merging into a tapering lateral channel 42 which is in direct communication with a vertical bore 43 that opens through the top of the casing 31 as at 44. This opening 44 is provided with a fitting 45 which functions as the lower valve seat of a ball check valve 46 contained within its valve casing 47, which latter is connected with the tubular fitting 45 and is longitudinally slotted, as at 48, or otherwise apertured, to form discharge openings into the displacement zone of the barrel chamber 12, it being thus seen that the foregoing is the pressure air discharge line through the air control valve casing into the displacement zone.

The air valve casing 31 is also formed, at the top of the chamber 35, with an upper annularly encompassing portway 51 merging into a tapering lateral channel 52, oppositely disposed but otherwise analogous to the portway channel 41—42, which channel 52 is in direct communication with a vertical bore 49 terminating in an upper chamber 50, over the plugged valve chamber 36, which chamber 50 opens as at 53 through the top of the casing 31, it being thus seen that the foregoing is the pressure air inlet line through the air control valve casing.

This opening 53 is provided with a pipe connection 54 that mounts an open-ended check valve casing 55, which in turn is in communication with the elbow 19 by means of a short tubular fitting 56 coupling the nipple 20 with the check valve casing 55. This piston check valve casing 55 has an upper internal beveled seat 57 for a piston check valve 58 which has a depending guide stem 59 that passes through a central aperture of a disk 60, seated over the pipe 54 within the check valve casing 55, the said disk 60 being also provided with a plurality of orifices 61, and the said piston check valve 58 being mounted under the upwardly retractile tension of a coil spring 62 that is interposed between it and the disk 60.

The air control valve itself is of elongated and preferably cylindrical structure or piston-plunger type, embodying the larger base section 63, snugly operating in the chambers 34—35, the central upstanding stem 64, which is of substantially smaller cross-sectional area than its base section 63, and the upper cup portion 67, snugly operating in the chamber 36, the said cup portion preferably having a screen-lined bottom 69, which bottom is plurally apertured as at 68. The said upstanding stem 64 and its base section 63 are longitudinally apertured or bored to open to and through the larger and smaller opposite end faces thereof, to permit of the passage of a portion of the pressure air therethrough for balancing purposes. This is illustrated by the central longitudinal bore 65 which opens at its upper end through the upper restricted face of the stem 64 and which at its lower end merges into divergent short bores 66 opening through the larger lower end face of the base section 63, in air pressure delivering association with the annular ledge face or the inwardly protruding upper face of the upper packing washer 38 or its equivalent.

In line with the bore 65 and between the divergent bores 66, the base section 63 merges into a continuing reduced depending stem 70, operating through the packing means and the apertured plug 39 therefor, the lower end of which stem 70 mounts the liquid inlet control valve 71, of any suitable type, associated with its tubular seat 25 and operating in the lower portion of the pedestal spider or cage, and in order to protect the valve parts of the air valve arrangement from grit or other deleterious foreign matter in the liquid, this lower zone is preferably provided with a flexibly collapsible filter cloth or casing 72 enclosing the stem 70.

In the modified arrangement of Figure 8, the valve constructions and housings therefor are the same as in Figures 1 to 7 and the functioning of the apparatus as a whole is substantially the same, the only differences being that, in the modified arrangement, the barrel 11 with the head 15 and its parts are dispensed with, as the well casing 10 itself now functions as the liquid discharge line in lieu of the pipe conduit 14, a packer ring or gasket 27 being supplied as illustrated to divide the well casing off into two chambers, the upper one of which provides the displacement zone 12, in valved communication with the discharge air line through the valve casing 31, and also the air inlet conduit pipe 73 is shown in direct communication with the piston check valve casing 55, without the interposition of the elbow pipe 19.

Likewise, in the modified arrangement of Figure 9, the valve constructions and housings therefor are the same, and the functioning of the apparatus as a whole is substantially the same as in the constructions previously described, excepting that in this modified arrangement, at Figure 9, the displacement zone 12 is provided for within a closed tank 74, adapted to be immersed in a large body or volume of the liquid to be pumped, the inlet conduit 24 thereto being provided for by the internal upstanding tu-

bular projection 75, functioning as the seat for the liquid control valve 71, in lieu of the element 23—25—26. In this arrangement, as in Figure 8, the elbow section 19 is not required, but although not shown the air inlet pipe line 76 may be provided with a piston check valve and casing 55 therefor as in the other constructions. Also, in this modified arrangement, the liquid discharge pipe conduit 77 extends downwardly to approximately the bottom of the tank 74, and is connected upwardly thereof with the check valve casing 47 by means of an air relief conduit 78, in communication with the upper portion of the tank 74 through said check valve casing 47. The functioning of all of the foregoing will hereinafter appear.

In the constructions of either Figure 1 or 9, although not actually shown, it is obvious that a check valve may be provided for in the liquid discharge pipe line 14 or 77.

Operation.

In operation, and assuming that the head of liquid in the well casing 10 is sufficiently high to have filled up the barrel 11, the liquid control valve 71 having now been closed and with it the air control valve 63—64 correspondingly set in its open position, is illustrated at Figure 1, then it follows that, upon cutting in the source of pressure air supply with the air inlet pipe 13, the operating pressure air will flow downwardly through the elbow 19, valve casing 55, pipe 54, chamber 50, vertical inlet casing bore 49 and into and around the portways 52 and 51, when the main volume thereof will pass downwardly through the chamber 35 into and around the lower portways 41 and 42, and thence upwardly through the vertical outlet casing bore 43, raising the ball check valve 46 to its upper seat, as indicated in dotted lines, thereupon discharging the operating pressure air, through the openings 48 of the ball check valve casing 47, into the displacement zone of the barrel chamber 12, which is above the seating fitting 45 for the ball check valve. Thus the liquid in the displacement zone will be elevated by a fluid piston, formed by the increasing volume of incoming pressure air, and forced upwardly through the liquid discharge pipe conduit 14. During this pumping step, the air control valve is positively maintained open and the liquid control valve likewise maintained closed, against the pressure of liquid through the inlet 24, mainly by virtue of the internal liquid pressure on the liquid control valve 71 as augmented by the downward operating air pressure of the fluid piston on the volume of liquid below the displacement zone, but the foregoing is also partially accomplished by virtue of the weight of the unitary air and liquid control valve structure plus the air pressure upon the upper face of the air valve section 63, which upper face is exposed to the lower portway 41—42. However, it is to be particularly noted that a portion of the incoming pressure air passes from the upper portway 52—51 through the apertures 68 into the air valve cup section 67 and chamber 36, so that there is an additional downward air pressure upon the restricted upper face of the bored upstanding stem 64. All of this air pressure on the upper faces of the air control valve, however, is more or less counterbalanced or compensated for by the discharge of a portion of the pressure air downwardly through the bore 65 and its lower divergent branches 66, opening to the chamber 34 beneath the bottom face of the air valve section 63 and in pressure association with the annular ledge face 40 of the packing means 38. Thus the air control valve is enclosed by its casing, relatively to its encompassing barrel chamber, and is of a substantially balanced piston-plunger type, owing to the by-passageway formed by the apertures 68, cup member 67, chamber 36, longitudinal bore 65 and its divergent branches 66.

The aforesaid pumping or displacement operation, for forcing the liquid up through the discharge pipe 14 under the elevating pressure of a gradually expanding fluid piston, will continue until the internal pressure is so relieved that it becomes less than the external pressure, on the underneath face of the liquid control valve 71, of the liquid seeking to flow within the barrel 11 by way of the inlet 24. When this external pressure of the liquid slightly exceeds the internal pressure, and the air valve element being substantially pressure balanced as heretofore set forth, the said external pressure of the liquid will then elevate the liquid control valve 71 from its seat 25, allowing the liquid to flow into the barrel 11 through the inlet 24 and pedestal cage, which at the same time will cause the elevation of the air valve, the parts then assuming the positions disclosed at Figure 8, with the air casing discharge line closed by the section 63 of the air valve covering the portways 41—42, but with the portways 51—52 still maintained open and supplying pressure fluid to the chamber 34, by the same by-passageway before mentioned, in the same substantial pressure balancing relation for the air valve member as heretofore described.

The liquid then continues to flow into the chamber 12 and hence again filling the upper displacement zone thereof, until the internal liquid pressure substantially balances the external liquid pressure upon the liquid control valve 71, whereby the unitary air and liquid control valve structure falls by gravity, plus perhaps any excess air pressure on the upper faces of the air valve section, the amount of force applied to the

air valve being determined by the ratio of the pressure area faces of the air valve section to the air pressure.

Thus the parts again assume the positions disclosed at Figure 1, with the air valve becoming wholly opened practically simultaneously with the closing of the liquid control valve, so that the liquid pumping or displacement operation is again started, and obviously this cycle of alternating operations is automatically continuous, without any other controlling means and without requiring the care of an attendant, assuming that the operating air pressure is maintained on through the pipe conduit 13, with the well properly flowing and with the parts properly functioning, which latter is practically assured by the minor number of parts employed, the simplicity of their combination and arrangement, and the negligible liability, therefore, of their becoming impaired or getting out of order.

From the foregoing, the operation of the arrangement of Figure 8 will also be fully understood, the well casing being separated into two chambers by the packer 27, with its upper section functioning as the liquid discharge conduit, as heretofore set forth.

So also with the arrangement of Figure 9, where the tank 74 is employed for the purpose of submerging the same in a large volume of the liquid to be pumped, it will be obvious that the general operations are the same as before described, excepting that in this instance the pressure air, being discharged into the tank towards the top thereof through the valve casing 47, will first function as a downwardly displacing fluid piston on the liquid in the tank and thereby forcing the liquid up the pipe 77, but it subsequently becomes an elevating fluid piston with reference to the liquid in the pipe 77 and the pressure air following up therethrough when the tank is emptied. It may also be stated that, regardless of whether or not a check valve be employed in the outlet pipe 77, when the internal pressure upon the valve 71 becomes so relieved as to be slightly less than the external liquid pressure thereon, through the inlet 24, the unitarily operating valve arrangement is elevated as heretofore described, whereupon, and with the air pressure shut off through the passageway 41—42—43—45, the ball check valve 46 will have dropped to its lower seat, as indicated in dotted lines, permitting the air in the tank, above the incoming volume of liquid, to escape through the valve casing 47 and pipe 78, into the pipe 77 as a venting or relief conduit, and thereby preventing such air from being trapped in cushioning relation within the tank below the level of the check valve casing 47.

From the foregoing replete description, it is believed that the operations and various objects and advantages of the invention will have been made clearly apparent, but, while there has thus been disclosed certain preferred embodiments thereof, it may nevertheless be found later to be expedient or desirable to make some alterations in the structural arrangement and form of the parts, although without departing from the gist of the invention, and it is to be understood, therefore, that the invention is not to be restricted necessarily to all of the details exactly as disclosed, excepting as they may come within the terms of the claims, or evquivalent combinations and arrangements of the elements, or as when fairly interpreted in the light of the specification if necessary.

What I do claim, as new and patentable, is:—

1, In a pump adapted for association with a displacement zone having a liquid inlet and a liquid outlet, the combination with a casing which embodies an inlet duct for communication with an operating pressure fluid supply line, an outlet duct for communication with said displacement zone, a valve housing compartment providing for communicating upper, lower and intermediate chambers, an upper portway opening to said inlet duct and said upper and intermediate chambers, and a lower portway opening to said outlet duct and said intermediate chamber, of a pressure fluid control valve operating in said valve housing compartment and alternately opening and closing said lower portway, a liquid control valve associated with said liquid inlet and carried by said fluid control valve, and means for supplying a restricted flow of said operating pressure fluid to said lower chamber.

2. In a pump adapted for association with a displacement zone having a liquid inlet and a liquid outlet, the combination with a casing which embodies an inlet duct for communication with an operating pressure fluid supply line, an outlet duct for communication with said displacement zone, a valve housing compartment providing for communicating upper, lower and intermediate chambers, an upper portway opening to said inlet duct and said upper and intermediate chambers, and a lower portway opening to said outlet duct and said intermediate chamber, of a pressure fluid control valve operating in said valve housing compartment and alternately opening and closing said lower portway, a liquid control valve for said liquid inlet and carried by said fluid control valve, and means for supplying a restricted flow of said operating pressure fluid from said upper chamber to said lower chamber.

3. In a pump adapted for association

with a displacement zone having a liquid inlet and a liquid outlet, the combination with a casing which embodies an inlet duct for communication with an operating pressure fluid supply line, an outlet duct for communication with said displacement zone, a valve housing compartment providing for communicating upper, lower and intermediate chambers, an upper portway opening to said inlet duct and said upper and intermediate chambers, and a lower portway opening to said outlet duct and said intermediate chamber, of an elongated pressure fluid control valve operating in said valve housing compartment and alternately opening and closing said lower portway without affecting said upper portway, a liquid control valve for said liquid inlet and carried by said fluid control valve, and conduit means through said fluid control valve for supplying a restricted flow of said operating pressure fluid from said upper chamber to said lower chamber.

4. In a pump adapted for association with a displacement zone having a liquid inlet and a liquid outlet, the combination with a casing which embodies an inlet duct for communication with an operating pressure fluid supply line, an outlet duct for communication with said displacement zone, a valve housing compartment providing for communicating upper, lower and intermediate chambers, an upper portway opening to said inlet duct and said upper and intermediate chambers, and a lower portway opening to said outlet duct and said intermediate chamber, of axially apertured packing means at the bottom of said lower chamber, an elongated pressure fluid control valve operating in said valve housing compartment and alternately opening and closing said lower portway without affecting said upper portway, the said valve embodying a base section, a depending stem and an upstanding stem, with restricted pressure fluid conduit means extending through said base section and upstanding stem for opening to the upper portion of said upper chamber and the lower portion of said lower chamber, and a liquid control valve carried by said depending stem in association with said liquid inlet.

5. In a pump adapted for association with a displacement zone having a liquid inlet and a liquid outlet, the combination with a casing which embodies an inlet duct for communication with an operating pressure fluid supply line, an outlet duct for communication with said displacement zone through a suitably apertured check valve casing, a valve housing compartment providing for communicating upper, lower and intermediate chambers, an upper portway opening to said inlet duct and said upper and intermediate chambers, and a lower portway opening to said outlet duct and said intermediate chamber, of a pressure fluid control valve operating in said valve housing compartment and alternately opening and closing said lower portway, a check valve freely operating in said check valve casing, a liquid control valve for said liquid inlet and carried by said fluid control valve, and means for supplying a restricted flow of said operating pressure fluid from said upper chamber to said lower chamber.

6. In a pump adapted for association with a displacement zone having a liquid inlet and a liquid outlet, the combination with a casing which embodies an inlet duct for communication with an operating pressure fluid supply line, an outlet duct for communication with said displacement zone, a valve housing compartment providing for communicating upper, lower and intermediate chambers, an upper portway opening to said inlet duct and said upper and intermediate chambers, and a lower portway opening to said outlet duct and said intermediate chamber, of an elongated pressure fluid control valve, operating in said valve housing compartment, embodying a base section alternately opening and closing said lower portway, a depending extension of said base section, an upstanding stem and a guiding cup having an apertured bottom encompassing the upper end of said stem, a liquid control valve carried by said depending extension in association with said liquid inlet, and means for supplying a restricted flow of said operating pressure fluid from said upper chamber to said lower chamber.

7. In a pump adapted for association with a displacement zone having a liquid inlet and a liquid outlet, the combination with a casing which embodies an inlet duct for communication with an operating pressure fluid supply line, an outlet duct for communication with said displacement zone, a valve housing compartment providing for communicating upper, lower and intermediate chambers, an upper portway opening to said inlet duct and said upper and intermediate chambers, and a lower portway opening to said outlet duct and said intermediate chamber, of an elongated pressure fluid control valve, operating in said valve housing compartment, embodying a base section, for alternately opening and closing said lower portway, and a depending extension of said base section, means for supplying a restricted flow of said operating pressure fluid from said upper chamber to said lower chamber, a liquid control valve mounted on the lower end of said depending extension in association with said liquid inlet, and a collapsible strainer tube encompassing said depending extension in closed relation with the upper and lower mounting supporting means therefor.

8. In a pump adapted for association with a displacement zone having a liquid inlet and outlet, the combination with a casing which embodies an operating pressure fluid inlet duct, an outlet duct for communication with said displacement zone through a check valve casing, a valve compartment supplying upper, lower and intermediate chambers, an upper portway opening to said inlet duct and said upper and intermediate chambers, and a lower portway opening to said outlet duct and said intermediate chamber, of axially apertured packing means at the bottom of said lower chamber, an elongated valve for said valve compartment embodying a base section alternately opening and closing said lower portway, a depending stem, and an upstanding stem with a guiding cup having an apertured bottom encompassing its upper end, the said base and upstanding stem having restricted conduit means extending longitudinally therethrough, a check valve freely operating in said check valve casing, a liquid control valve mounted at the lower end of said depending stem in association with the liquid inlet, and a collapsible fabric tube freely encompassing said depending stem for keeping it free of grit.

In testimony whereof, I affix my signature.

CHARLES B. PENDLETON.