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B. S. AIKMAN

PNEUMATIC PUMP

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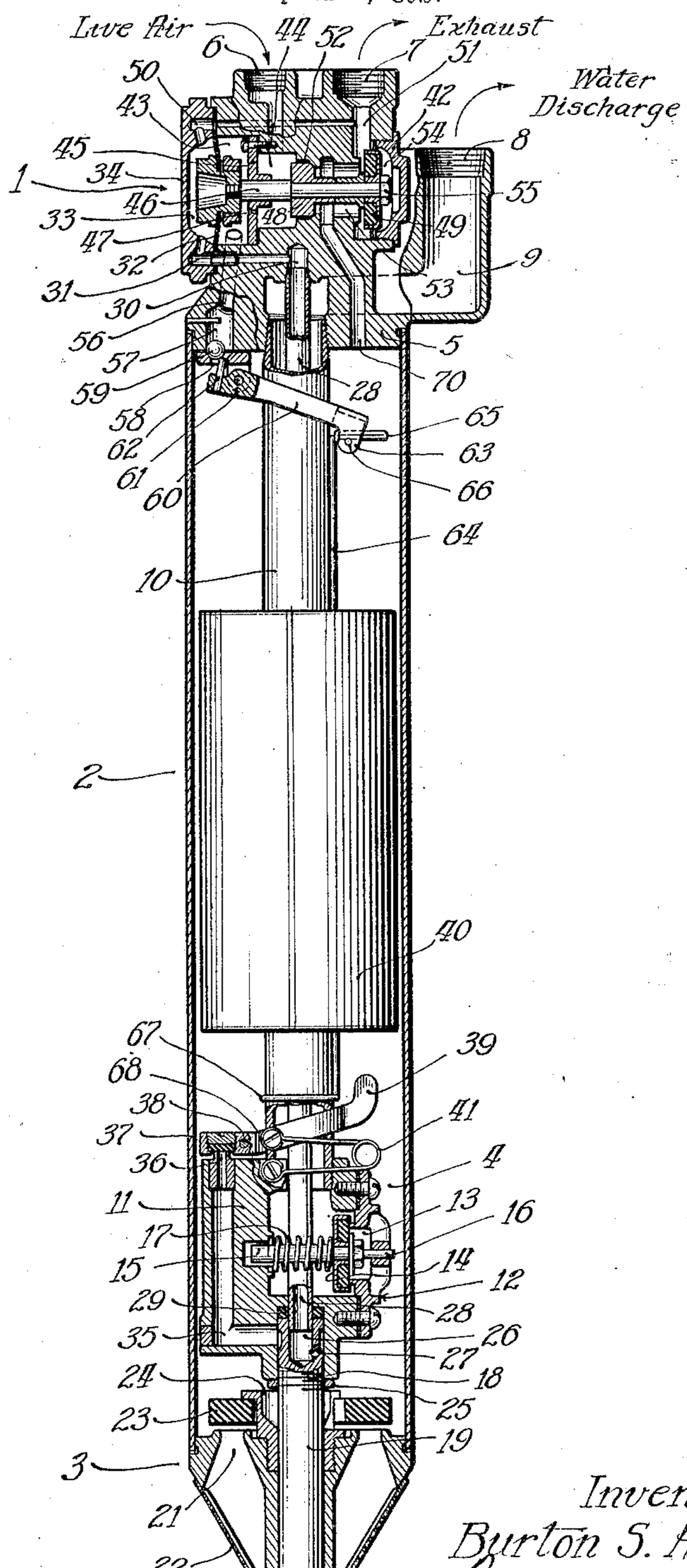

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UNITED STATES PATENT OFFICE.

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PNEUMATIC PUMP.

Application filed April 1, 1927. Serial No. 180,088.

My invention relates to pneumatic pumps adapted for faucet control.

The present invention comprises an improvement upon the pump disclosed in my co-pending application Serial No. 683,538, filed December 31st, 1923.

An object of the present invention is to provide a novel form of valve structure, particularly adapting the exhaust valve to have a greater lift for quicker exhaust and more rapid filling to increase the capacity of the pump. A further object is to improve the admission valve to provide greater effectiveness in shifting the valve structure to exhaust position and holding it there.

This change in the admission valve structure accentuates a condition previously existing in the original structure described in the aforesaid application, namely, that under certain specific circumstances occurring in installing the pump, and which will be detailed later, the valve structure failed to reverse from admission to exhaust position, and thereupon the pump stalled and would not exhaust until live air pressure was temporarily released and the operation repeated in order to start the pump.

A further object of this invention is the correction of this condition so that the pump invariably proceeds in an orderly fashion.

The invention comprehends certain other detailed improvements which will be pointed out and claimed in the following specification.

Now in order to acquaint those skilled in the art with the manner of constructing and operating a device embodying my invention, I shall describe in connection with the accompanying drawing a specific embodiment of the same.

The single figure of the drawing represents diagrammatically a longitudinal vertical section of a pump embodying the present invention.

The pump shown in the drawing comprises a head member 1 containing the valve structure hereinafter referred to and connections for live air, exhaust, and water discharge, the barrel 2 and the foot portion 3. Within the barrel 2 and above the foot portion 3 there is disposed a low level control mechanism and discharge check valve mechanism indicated by the reference numeral 4. The head member 1 comprises a head casting 5 in which there are formed certain passageways, to be described later, and threaded pipe sockets 6, 7 and 8. The pipe socket 6 is connected to the live air supply, the socket 7 is connected to exhaust, that is, preferably a pipe running from the socket 7 to a point above the level of water in which the pump is submerged and communicating with atmosphere. The water discharge connection extends from the socket 8 to the normally closed distributing system, such as the water pipe system in a residence, or the like.

This pump is adapted for faucet control, that is, it is adapted to stand under pressure when the faucets are closed.

The water discharge connection communicates through a passageway 9 in the head casting 5 to a central discharge pipe 10, this pipe being threaded into the bottom of the head casting 5 and extending down to a point adjacent the foot and there being connected to the structure 4. The lower end of the discharge pipe 10 is threaded into a socket in the casting 11, said casting having a lateral opening covered by a plate 12, which plate provides the valve passageway 13 controlled by the automatic check valve 14 for preventing flow of water out of the water system or the discharge pipe 10 when the pump barrel is connected to exhaust. The discharge check valve 14 is disposed eccentrically of the axis of the pump. It has a stem 15 guided in the casting 11 at its rear end and a forwardly projecting extension 16 guided in a spider formed on the plate 12. The valve is provided with a yielding face and urged to closed position by spring 17 to perform its function as a check valve. The lower end of the casting 11 has a recess formed therein axially, which recess is partly threaded to receive the threaded portion 18 of a stud 19, which extends down to the foot casting 3 and is connected thereto by a cap nut 20, which places the stud 19, the casting 11, and pipe 10 under tension to hold the head casting 5 against the upper end of the barrel member 2 and the foot casting 3 against the bottom of the barrel member 2. The foot casting 3 has an annular water inlet passageway 21 guarded by a conical screen 22 and controlled by the automatic inlet check valve 23, which comprises a block of relatively hard rubber composition, or the like, seating over the inlet port and holding

the same closed against the escape of liquid within the pumping chamber in the barrel 2.

A suitable guiding and restraining member for the check valve 23 is provided in the guide 24, which is threaded down into the upper face of the foot casting 3 and which has a flange overhanging the inner edge of the check valve 23 to limit the upward movement of the same when the valve is opened. This guide is recessed so as to avoid binding the lock nut 25 on the threaded portion 18 of the stud 19. The conical screen 22 is held in place on the foot casting 3 by means of the edge of the cap nut 20.

The upper end of the stud 19 above the threaded portion 18, and where the same extends into the recess in the casting 11, is drilled axially and radially, as indicated at 26 and 27. The upper end of said stud embraces the lower end of a small tube 28 which extends axially from the head casting 1 down through the water discharge pipe 10, through the lower wall of the water discharge check valve chamber, and into the axial recess 26 formed in the upper end of the stud 19. A seal is formed about the lower end of the pipe 12 by a compressible packing 29 which is compressed by threading of the stud 19 into the recess in the lower end of the casting 11.

The upper end of the tube 28 is threaded into a recess 30 formed in the head casting 1, which recess communicates through a passageway 31 through the motor diaphragm 32 with the chamber 33 formed in the cap 34.

The radial drilling 27 in the upper end of the stud 19 communicates with a passageway 35 which extends up to a valve port 36 controlled by the low level control valve 37, this valve comprising a lever pivoted at 38 to the top of the casting 11, and on the short arm bearing the valve 37. The long arm is shaped in the form of a ring embracing loosely the water discharge pipe 10. At its outer extremity the longer arm has an upwardly extending finger 39 adapted to be engaged by the lower end of the float 40 when the same is in low level position. This float 40 embraces loosely the water discharge pipe 10. The valve 37 is held to its seat by the hairpin type spring 41, the ends of which are secured to the longer arm of the valve lever and to the casting 11, respectively. When the pumping chamber in the barrel 2 is under pressure the valve 37, which has a yielding face, is held to its seat by internal pressure in the pump chamber.

The stroke control mechanism comprises a compound valve structure connected to the diaphragm 32. The head casting 1 is provided with a transverse bore which is divided off into sections to perform various functions and closed at the left by the cap 34 over the diaphragm 32, and at the right by a screw plug 42. The relatively large counterbore formed at the left end of the transverse passageway forms a motor chamber 43. The motor chamber 43 is divided off from the admission valve chamber 44 by a plate 45 which is perforated to form a guide for the valve stem 46, which bears the admission valve 48 and the exhaust valve 49.

The motor chamber 43 communicates through a small, constantly open passageway 47 with the live air in the admission valve chamber 44. The chamber formed in the cap 34 on the back of the diaphragm 32 communicates by way of a passageway 50 to the exhaust passageway 51. This passageway 50 is restricted relative to the passageway 31 which admits fluid under pressure at certain times to the pressure chamber 33. As a result, when the low level valve 37 is opened water under pressure is forced to the port 36, passageway 35, up through the tube 28 and through passageway 31 into the chamber 33 more rapidly than the same can escape through the passageway 50 to the main exhaust passageway 51. Under those circumstances a pressure is built up in said chamber 33.

The valve 48 comprises a relatively thick body forming, in reality, a loose piston in the bore 52 in which it moves, the conical face of the valve 48 cooperating with a valve seat formed in said axial passageway. The chamber 53 between the admission valve 48 and exhaust valve 49 communicates by way of a passageway 70 with the interior of the pump barrel 2, that is, the pumping chamber.

The pocket 54 formed in the cap 42, and in which the exhaust valve 49 is adapted to play, communicates by way of the main exhaust passageway 51 to the exhaust pipe which is threaded into socket 7.

The exhaust valve 49 is clamped in place on the stem 46 by means of the nut 55, a short collar lying between the exhaust valve and the admission valve 48, so that these parts are rigidly connected together at a predetermined spacing.

In the pump disclosed in my prior application above referred to, the lift of the exhaust valve corresponding to valve 49 was made relatively small so that the exhaust would assist in shifting the valve structure to the exhaust position, and in holding the same there during the exhaust period. I have found that there is some disadvantage in this structure in that it delays the rapidity of stroke which I desire for maximum capacity of the pump, and by the construction of the admission valve as above described the exhaust valve may be provided with a relatively large lift.

This greater lift of the exhaust valve materially increases the capacity of the pump to deliver water. In other words, it

shortens the filling stroke and thereby increases the maximum capacity of the pump. It also tends to increase the life of the exhaust valve 49, which for best results must be made with sufficient yield to insure a tight joint at all times. It will be observed that the length of the bore 52, in which the admission valve 48 plays, is longer than the distance which the exhaust valve lifts when it is opened. This, as will be pointed out later in detail, secures the desirable results of permitting a large exhaust valve lift with certaintity of closure of the admission valve.

The motor chamber 43, which communicates through the opening 47 with live air in chamber 44, has an exhaust passageway 56 extending down through the head and communicating with valve chamber 57 terminating in a valve port 58 controlled by the ball check valve 59 which tends to drop over said port and close the same, preventing the escape of pressure from the motor chamber 43. The port 58 is formed in a bracket member which is clamped to the bottom of the head casting 5 for convenience in manufacture. The high level valve control lever 60 is pivoted at 61 on a bracket formed in said plate member, and at its shorter arm it has a pin 62 extending up into the valve port 58 to unseat the check valve 59. The longer arm of the high level valve control lever 60 is formed in the shape of a ring which loosely embraces the water discharge pipe 10. A downwardly extending projection 63 is adapted to engage the upper end of the float 40 when water has substantially filled the pumping chamber.

A small wire constructed preferably of Monel metal, or the like, shown at 64, lies at the side of the water discharge pipe 10 and is embraced by the float 40. This wire 64 has a hook 65 formed at its upper end extending over a pin 66 in the projection 63, this projection being forked to receive said wire hook 65. At its lower end the wire 64 is provided with a loop 67 which extends at right angles to the length of the wire 64 and embraces the water pipe 10 and lies in such position that it will be engaged by the float 40 after the float has contacted with the finger 39 on the low level valve control lever 68.

The operation of the device shown in the drawing is as follows. The parts are shown in the position in which they would be during the filling stroke of the pump, the float 40 rising with the water level, the exhaust valve being open, the admission valve being shut, and the water inlet valve 23 being open. As the float 40 rises it comes into contact with projection 63 on the high level valve control lever 60, removing the pin 62 from contact with the check valve 69 and said check valve then seating over the port 58 to close the same. As the admission valve 48 is closed, live air does not enter the pumping chamber in sufficient volume to be effective, and after the valve 59 is seated, pressure which leaks through the small opening 47 into the motor chamber 43 builds up a pressure in said chamber acting on the diaphragm 32 until the total pressure overcomes the pressure on the back of the admission valve 49, whereupon the valve structure is shifted to the left with a relatively sharp snap action, closing the exhaust valve and opening the admission valve. Air then passes between the cylindrical peripheral portion of the admission valve 48 and the cylindrical bore in which it loosely fits through the open port of the admission valve, down the passageway 54, and into the upper end of the pumping chamber. This pressure very rapidly builds up to the point where it overcomes the head of the liquid and begins to drive the liquid level downwardly, the liquid opening the check valve 14 and forcing its way past said check valve and up through the central water discharge pipe 10, through passageway 9, and out to the distributing system, which is assumed to be open to permit such flow of the liquid.

As soon as the float 40 has descended with the descending liquid to a point where it no longer supports the end of the lever 60, the pin 62 pressing against the ball valve 59 forces the same from its seat. The lever 60 is weighted or unbalanced to a degree sufficient to secure this result. Very little force is required to lift the ball valve 59 from its seat when the pressures upon opposite sides of the same are subtantially equal, and that is the case in normal operation.

As the discharge of water from the pump chamber continues, the float 40 is lowered until it rests upon the projection 39 on the low level valve operating lever 68, and the weight of the float 40 overcomes the tension of the spring 41 and the pressure on the valve 37, opening said valve 37. Thereupon, water under pressure is discharged through the port 36, passageway 35, to the radial opening 27 and thence up through the tube 28, passageway 31, into the balancing chamber 33 formed in the cap 34, a part of the same escaping out through the bleeding port 50 to the main exhaust passageway 51. This entry of fluid under pressure into the balancing chamber 33 counterbalances the pressure on the opposite side in the motor chamber 43 to a sufficient extent to permit the pressure of air within the pumping chamber to force the exhaust valve 49 off its seat. At the same time there is sufficient pressure against the back of the admission valve 48 to assist in this operation, so that after the exhaust valve 49 once starts to open the valve system, together with the motor diaphragm, is snapped over to the right vigorously to shift the valve mechanism to

exhaust position, whereupon the pressure in the pumping chamber is permitted to escape to atmosphere and water again enters the pump through the water inlet passageway 21, past the valve 23 which opens to permit the same, and the float 40 is raised permitting the valve 37 to be closed by the spring 41. The float 40 is floated upward by the rising level of water in the pumping chamber until it engages the projection 63 on the high level valve operating lever 60 to raise the long arm of said lever 60 to permit the ball check valve 59 again to seat.

Thereupon, the operations above described are repeated.

It will be observed that the live air admitted to the pumping chamber from the admission valve chamber 44 finds considerable restriction to flow through the clearance between the valve 48 and the bore 52 in which it moves, a wire drawing effect being produced thereby. As a result, there are certain conditions when the pump is first installed which tend to raise the pressure in the motor chamber 43 to a valve substantially greater than the pressure in the pumping chamber, with the result that considerable force is required to unseat the ball check valve 59. This occurrs when the pump is first submerged in the well and connections are made to the live air. Assuming that the float 40 is in high level position due to filling of the pumping chamber, the valve 59 being in closed position, the lever 60 being in raised position, the admission of live air into the admission valve chamber 44 tends at first to snap the admission valve 48 shut until pressure builds up in the motor chamber 43, said air entering through the small port 47, whereupon the diaphragm 32 is snapped over to the left, opening the admission valve 48 and closing the exhaust valve 49. Since the water discharge pipe is empty, no substantial back pressure exists on the pump, and the entry of live air into the pumping chamber quickly depresses the level and forces the liquid out of the pump without building up any appreciable pressure in the pumping chamber. As a result, the pressure differential between the air in the motor chamber 43 and above the check valve 59, and that in the pumping chamber below the valve 59, is so great that the weight of the lever 60 is insufficient to force the check valve 59 off of its seat. As a result, the float 40 dropping down with the level, opens the valve 37 and water is driven through the pipe 28 into the balancing chamber 33, but not at sufficient pressure to overcome the pressure of the live air trapped in the motor chamber 43. As a result, the valve mechanism will not be shifted, or shifting will be delayed so long that the pump will not start satisfactorily without release and reapplication of the pressure by hand control. The conditions which foster this difficulty in starting are not often encountered, but the present pump is immune to the same.

To prevent the occurrence of this stoppage or delay, the lever 60 has been put under control of the low level position of the float 40 through the medium of the wire 64, its hook 65, and the loop 67. If the initial opening of the valve 37 does not secure reversal of the valve mechanism, the water level continues to be lowered until the float engages the loop 67 of the wire 64, thereby imposing the weight of the float 40 upon said lever 60 in addition to its own weight. This additional weight is great enough to force the check valve 59 off its seat to equalize the pressures in the motor chamber 43 and the pumping chamber, so that the balancing pressures in the chamber 33 is great enough to permit the exhaust valve to be snapped off its seat and the admission valve to be snapped onto its seat.

Obviously other means than the particular wire 64 and its connections could be employed within the spirit and scope of my invention.

I do not intend to be limited to the details shown and described.

I claim:—

1. In a pneumatic pump, the combination with a pumping chamber having air inlet and exhaust ports, of a compound reversible air control valve comprising an exhaust valve member of the lift type for closing said exhaust port against internal pressure in the pumping chamber, and an inlet valve member, said valve members being connected together for common movement, said inlet port having an annular seat and a cylindrical bore adjacent the same, said inlet valve member having a cylindrical body loosely fitting said bore and having a face adapted to cover said annular seat, said cylindrical body restricting the flow of compressed air through said air inlet port into the pumping chamber and forming a piston operating through a substantial distance for lifting the exhaust valve off its seat a substantial distance.

2. In a pneumatic pump, the combination of a pumping chamber having water inlet and discharge valves, compressed air and exhaust connections, a compressed air admission passageway including a port opening into the pumping chamber, a piston valve loosely fitting said passageway and adapted to obstruct said port to cut off the admission of compressed air to the pumping chamber, an exhaust passageway including a port opening from said pumping chamber, a left valve for closing said port against internal pressure in said pumping chamber, a connection between said piston valve and said lift valve, said piston valve forming a restriction to the flow of compressed air in

the pumping chamber and providing a force tending to close itself and lift the exhaust valve clear of its seat.

3. In a pneumatic pump, a pumping chamber, a head member having an air admission passageway, an air exhaust passageway, and a bore joining both said passageways and having communication with the pumping chamber, an exhaust valve seat at one end of the bore defining an exhaust port, an exhaust lift valve for said port, an admission valve seat adjacent the other end of the bore defining an admission port, said bore having a cylindrical portion in advance of said admission valve seat, a piston valve having a piston portion fitting loosely in said cylindrical portion of the bore to form a restricted annular passage for compressed air and having a valve portion adapted to engage said valve seat to close the admission port, a stem connecting said exhaust valve and said piston and being long enough to secure a substantial opening of said valves.

4. In a pneumatic pump, a pumping chamber, a head member having an air admission passageway, an air exhaust passageway, and a bore joining both said passageways and having communication with the pumping chamber, an exhaust valve seat at one end of the bore defining an exhaust port, an exhaust lift valve for said port, an admission valve seat adjacent the other end of the bore defining an admission port, said bore having a cylindrical portion in advance of said admission valve seat, a piston valve having a piston portion fitting loosely in said cylindrical portion of the bore to form a restricted annular passage for compressed air and having a valve portion adapted to engage said valve seat to close the admission port, a stem connecting said exhaust valve and said piston, and being long enough to secure a substantial opening of said valve, a fluid pressure motor member connected to said stem, said motor member having a working chamber having a constantly open inlet port and an outlet port, said outlet port being obstructed by a valve, a valve for said port, and level controlled means operative at high level in the pumping chamber to close the latter valve and operative at low level to open the said latter valve.

5. In a pneumatic pump, a pumping chamber, a head member having an air admission passageway, an air exhaust passageway, and a bore joining both said passageways and having communication with the pumping chamber, an exhaust valve seat at one end of the bore defining an exhaust port, an exhaust lift valve for said port, an admission valve seat adjacent the other end of the bore defining an admission port, said bore having a cylindrical portion in advance of said admission valve seat, a piston valve having a piston portion fitting loosely in said cylindrical portion of the bore to form a restricted annular passage for compressed air and having a valve portion adapted to engage said valve seat to close the admission port, a stem connecting said exhaust valve and said piston and being long enough to secure a substantial opening of said valve, a fluid pressure motor member connected to said stem, said motor member having a working chamber having a constantly open inlet port and an outlet port, said outlet port being obstructed by a valve, a valve for said port, and level controlled means operative at high level in the pumping chamber to close the latter valve and operative at low level to open the said latter valve, a balancing chamber for said motor member, and a pressure control valve therefor governed by said level control means.

6. In combination, a pumping chamber having water inlet and discharge check valves, an air admission port, an air exhaust port, a compound reversible valve having lift members for alternately obstructing said ports, a fluid pressure motor member having a working chamber and a balancing chamber, said working chamber having an air admission port and an air exhaust port leading into the interior of the pumping chamber, a check valve controlling said latter port, said check valve being held to seat by the internal pressure in the working chamber, means controlled by high level of water in said pumping chamber for closing said valve, and means controlled by low level of water in said pumping chamber for opening said valve against the internal pressure.

7. In a pneumatic pump, the combination of a pumping chamber having water inlet and exhaust valves, and having an air admission passageway including a port, and an air exhaust passageway including a port, an exhaust lift valve adapted to seat over said air exhaust port against internal pressure in the pumping chamber, said air admission passageway including a cylindrical portion terminating in a valve seat surrounding said port, a piston valve fitting said cylindrical portion with a small clearance and adapted when open to form a restriction to the flow of live air to said pumping chamber, said piston valve and exhaust valves being connected, and a pressure motor having a constant restricted connection with live air for holding said exhaust valve closed and for opposing the pressure on said piston valve.

8. In a pump, a pumping chamber having water inlet and discharge check valves, an air admission pasageway comprising a port, air admission passageway comprising a port, valves for said ports, said valves comprising lift valves, said admission valve obstructing its passageway to form a loose piston restricting the flow of air to the pumping

chamber, a motor member having a first chamber at one side which has a restricted open passageway leading to the air admission passageway and having a second chamber on its other side which has a restricted open passageway leading to exhaust, an air exhaust passage leading from said first chamber to the pumping chamber, a pilot valve controlling said latter passageway, and level control means in the pumping chamber for operating said pilot valve, said second chamber having an admission passageway, a pilot valve controlling said latter passageway, level controlled means in the pumping chamber for operating said latter pilot valve, and means connecting the motor member, the admission valve, and the exhaust valve together.

9. In a pump, a pumping chamber having water inlet and discharge check valves, an air admission passageway comprising a port, an air exhaust passageway comprising a port, valves for said ports, said valves comprising lift valves, a motor member having a first chamber at one side which has a restricted open passageway leading to the air admission pasageway and having a second chamber on its other side which has a restricted open passageway leading to exhaust, an air exhaust passage leading from said first chamber to the pumping chamber, a pilot valve controlling said latter passageway, level controlled means in the pumping chamber for operating said pilot valve to close at high level of liquid in the pumping chamber and to open at low level of liquid in the pumping chamber, said second chamber having an admission passageway, a pilot valve controlling said latter passageway, level controlled means for operating said latter pilot valve, and means connecting the motor member, the admission valve, and the exhaust valve together.

10. In a pump of the class described, a barrel member having a head member at one end closing the barrel member, a foot member at the other end closing the barrel member, a water discharge pipe connected at its upper end to the bottom of the head member, a discharge check valve box connected to the bottom of the water discharge pipe, a tension member connecting the water discharge valve box to the foot member, valve mechanism in the head for controlling the admission and exhaust of compressed air to and from the pumping chamber, a pressure motor in the head for controlling said valve mechanism, a pilot valve mounted on the discharge valve box, a pilot valve for said motor mounted on the bottom of the head, an annular float embracing said water discharge pipe and moving with the level of water in the pumping chamber, said pilot valve having members projecting into the path of movement of the float, and a member connected at its upper end to the operating member for the second pilot valve having a projection lying in the path of the float at low level to insure the operation of said second pilot valve upon low level of water in the pumping chamber.

11. In combination, a pumping barrel, a head closing the upper end, a foot member closing the lower end, a discharge valve box connected to the foot member, a water discharge pipe connecting the discharge valve box and the head member, a control valve operating lever pivoted at the upper end of the water discharge valve box and extending into the path of the float, an annular float embracing the water discharge pipe. a control valve operating lever pivoted on the under side of the head and extending into the path of said float, a rod connected to said latter lever and lying along the side of the water discharge pipe, said rod having a lateral extension projecting into the path of the float at low level, main valves for the pump and control valves actuated by said levers governing the operation of the main valves.

12. In a pneumatic pump having a pumping chamber provided with an air inlet and an air outlet and water inlet and outlet connections, an exhaust valve for the air outlet, a fluid pressure motor, said motor being connected to the exhaust valve and having a high level controlled valve and a low level controlled valve for controlling said motor, a float for operating the low level controlled valve to cause the motor to open the exhaust valve on low level conditions in the chamber, said float operating the high level controlled valve when water has substantially filled the pumping chamber to cause the motor to close the exhaust valve, and a lost motion connection between the high level controlled valve and the float to insure that the high level controlled valve is returned to its initial position before the water is completely expelled from the pump chamber.

In witness whereof, I hereunto subscribe my name this 28th day of March, 1927.

BURTON S. AIKMAN.

CERTIFICATE OF CORRECTION.

Patent No. 1,658,032. Granted February 7, 1928, to

BURTON S. AIKMAN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, line 126, claim 8, for the words "air admission" read "an air exhaust"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 13th day of March, A. D. 1928.

Seal.

M. J. Moore,
Acting Commissioner of Patents.