Sept. 5, 1939. A. W. BURKS 2,172,097

AIR-VOLUME CONTROL MECHANISM

Filed May 14, 1937 2 Sheets-Sheet 1

Fig. 1

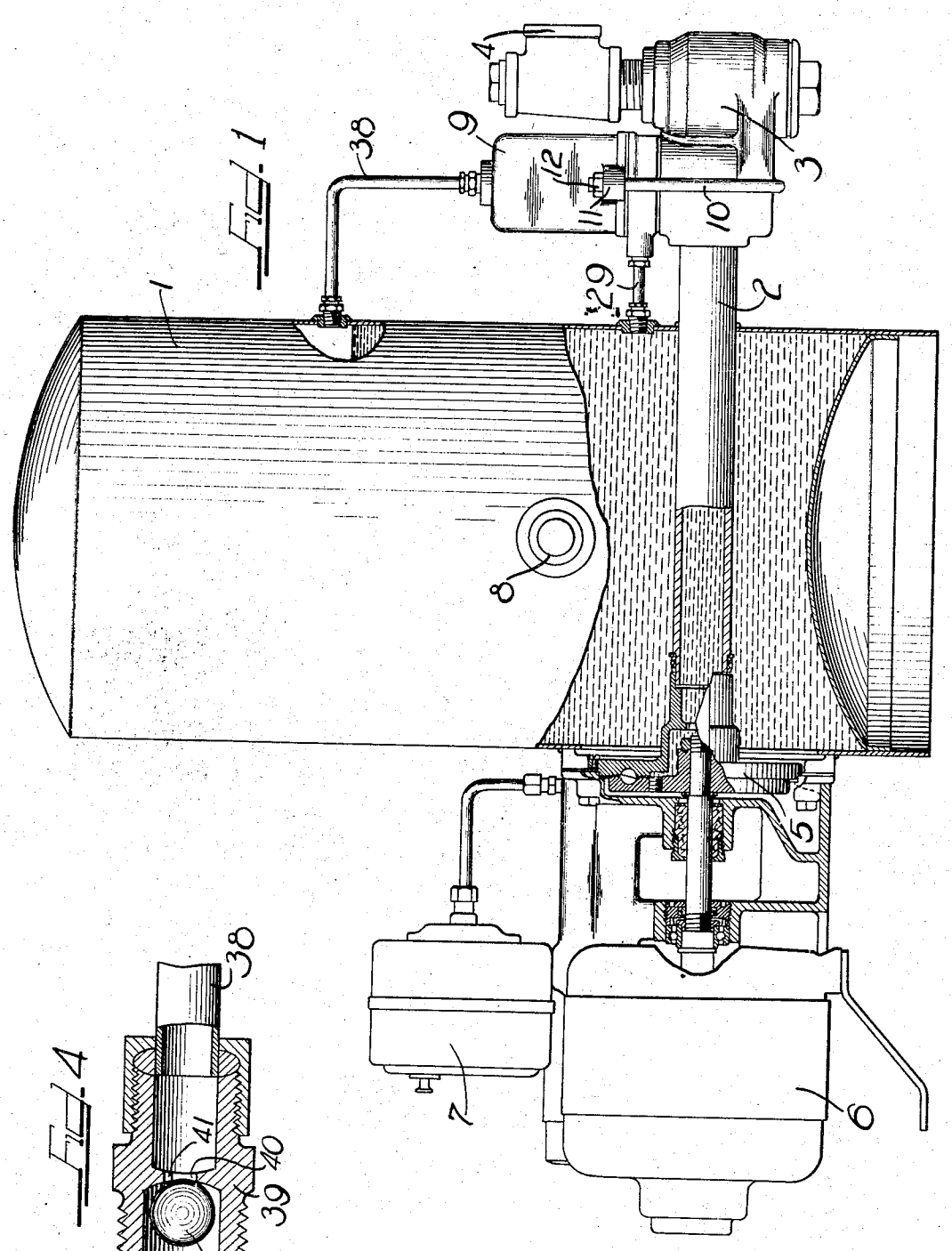


Fig. 4

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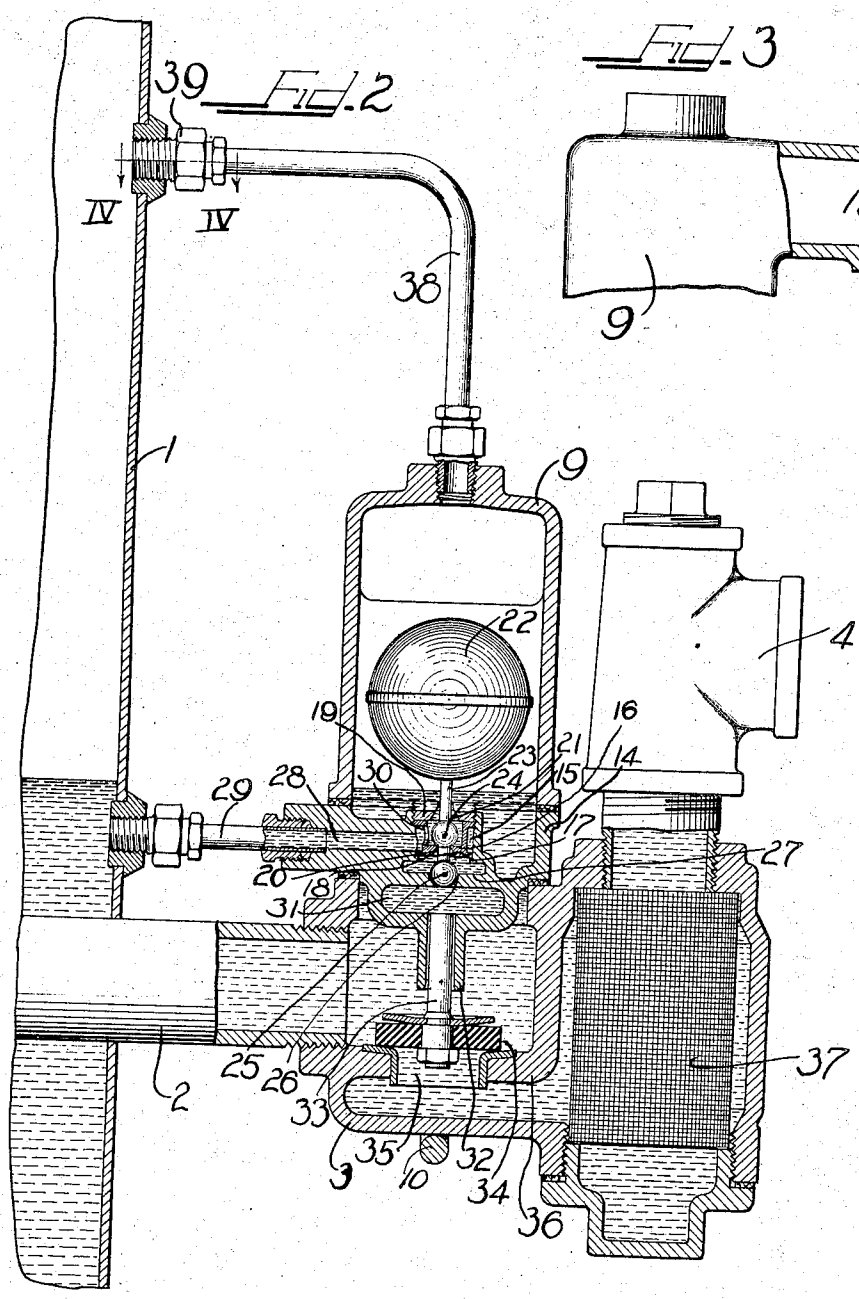


Fig. 2

Fig. 3

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AIR-VOLUME CONTROL MECHANISM

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Application May 14, 1937, Serial No. 142,563

23 Claims. (Cl. 103—7)

This invention relates to an air volume control mechanism that is primarily adapted for incorporation in a hydro-pneumatic water supply system and constitutes an improvement upon the apparatus disclosed in my pending application Serial No. 93,557, filed July 31, 1936.

This improvement consists mainly in the float controlled valve mechanism between the air inlet chamber and the suction line that provides a more successful operation of the water system thru higher pressure ranges than the apparatus disclosed in the aforementioned application.

It is among the objects of this invention to provide such a float controlled valve mechanism which is controlled by the differential in pressures between the water tank and the float chamber for maintaining the float valve in elevated position during the pumping of the water and air from the float and air chamber.

The invention comprises the novel structure and combination of parts hereinafter described and more particularly pointed out and defined in the appended claims.

In the accompanying drawings which illustrate a preferred form of this invention and in which similar reference numerals refer to similar features in the different views:

Figure 1 is an elevational view of an apparatus for a water system involving this invention.

Figure 2 is an enlarged sectional view thru the air controller.

Figure 3 is an enlarged fragmentary sectional view of the air controller.

Figure 4 is an enlarged fragmentary sectional view taken upon the line IV—IV of Fig. 2.

In order to illustrate this invention, there is shown in the drawings a water storage tank 1 through which a suction or water supply pipe 2 extends that is connected by a valve housing 3 with a water supply connection 4. The suction pipe 2 is connected to a centrifugal pump 5 driven by a motor 6 which is controlled by the mechanism in a switch box 7 supported upon the motor and controlled by the pressure in the tank as is well known. The tank 1 has an outlet 8 for the water supply pipe.

An air inlet housing or chamber 9 is secured to the top of the valve housing 3 by means of a stirrup 10 the ends of which extend thru ears 11 on the housing 9 for the reception of nuts 12 for clamping the housing 9 in position. This air housing 9 has an offset portion 9a (Fig. 3) that has an air inlet valve 13 which automatically admits air when a suitable vacuum occurs in the housing.

A novel valve structure is interposed between the housing 9 and the valve casing 3 and comprises a suitable casting 14 that forms the bottom of the housing 9. This casting 14 has a central cylindrical cavity 15 in which is supported a cylindrical cup-shaped member 16. It will be noted that the wall of the cavity 15 has an annular shoulder 17 and the cup-shaped member has a lower flange 18 resting upon such shoulder. A cap disk 19 is threaded in the upper end of the cavity 15 against the top of the cup-shaped member 16.

The bottom of the cup-shaped member 16 is provided with an exterior conical valve seat or port 20 and the cap disk 19 has an interior conical valve seat or port 21 similar to the valve seat 20. A float 22 in the housing 9 is provided with a valve stem 23 that extends thru the cap disk 19, and the bottom of the cup-shaped member 16. This valve stem 23 has spaced enlarged spherical valves 24 and 25 adapted to simultaneously close the ports 21 and 20 for closing the housing 9. The upper valve 24 has a slightly larger effective pressure area than the valve 25 with respect to the tank pressure since such pressure will be directed upwardly against the larger contacting ring of valve 24 and downwardly against the smaller contacting ring of valve 25.

The aforementioned cavity 15 has a conical valve seat or port 26 in its bottom which is a suitable distance below the bottom of the cup-shaped member 16 so that it can be engaged and closed by the spherical valve 25. Just above the valve seat or port 26 there is a relatively wide passage 27 thru the casting 14 that merges with the cavity 15 and communicates therewith thru port 20. This passage 27 communicates with the interior of the housing 9 for allowing the pump to withdraw the water from the air chamber 9 when the valve 25 is elevated.

In a plane between the valve seats 20 and 21, there is a passage 28 extending from the cavity 15. The passage 28 communicates with a pipe 29 connected to the tank 1. It will be noted that the wall of the cup-shaped member 16 which is spaced from the wall of the cavity is provided with an aperture 30 for establishing communication between the tank and housing 9 through the valve port 21 when the same is open.

The valve port 26 communicates with the water in the valve housing 3 thru a passage 31 in the lower part of the casting 14 which has a pendant bearing 32 for slidably receiving the stem 33 of a check valve 34 which normally closes a water inlet passage 35 in an angular portion 36 in the

valve housing 3. The water from the source of supply will enter thru the connection 4 and descend into a strainer 37 in a cylindrical part of the valve housing from which it will pass to the check port 35 of the suction line.

The upper end of the air chamber 9 is connected by a pipe 38 with a valve sleeve 39 (Fig. 4) threaded in the wall of the tank 1. This valve sleeve has an intermediate restricted passage 40 with a bleeder slot or groove 41. The passage 40 is adapted to be closed by a ball check valve 42 located in the passage thru the sleeve 39 upon the inner side of the restricted passage 40. This ball check valve 42 is under the influence of the pressure within the tank.

When the apparatus herein described has been installed and it is desired to put the same into service, it will be necessary to first prime the same by passing water into the tank 1 until it reaches the level shown in Fig. 2 which will be below the float 22. Consequently, the float will be in its lowered position with the ports 20 and 21 open and the port 26 closed as shown in Fig. 2. If the pump is now started, it will draw water from the suction line and fill the tank 1. As the water rises in the storage tank 1, it will also rise in the housing or chamber 9 due to the inflowing of pipes 29 and 38. As the water rises in the chamber 9, there will be a tendency for the float 22 to rise and open the lower valve and close the upper double valve. This tendency of the float to rise is however overcome by the differential in pressures between that in the chamber 9 above the valve 25 at 26 and that in the suction line below the valve 25 with the result that the valve 25 at 26 will remain closed as long as the pump is operating to initially fill the tank. For it will be evident that as the pressure increases in both the tank 1 and chamber 9, the pressure in the suction line will remain below atmospheric pressure as long as the pump operates. This difference in pressure will be sufficient to maintain the float down with the double valve open and the lower valve port 26 closed against the buoyancy of the float.

When the storage tank is initially filled, there is no excess of air therein with the result that the water will rise in the storage tank above the pipe 38 before the pump is stopped. As soon as the pump is stopped, the pressure will automatically equalize on both sides of the valve 25 when it is closing the port 26, thus allowing the buoyancy to lift float 22 and open the port 26 and close the ports 20 and 21.

It will be understood that when the water in the storage tank is above the sleeve 39, the entire mechanism is full of water and the lower port 26 will be open. If the pump is now set in operation the second time, the vacuum created in the suction line will draw the water from chamber 9 thru the port 26. As the water flowing from the storage tank thru pipe 38 into chamber 9 is restricted and incapable of replacing all the water withdrawn from chamber 9, a vacuum will be formed in chamber 9 which will draw in air thru air valve 13. This indrawn air will follow the water drawn from chamber 9 into the pump and into the storage tank.

As the water is withdrawn from the chamber 9 and the water level therein recedes, the float 22 will not drop for the reason that the upper valve 24 has a little larger effective area than the lower valve 25 and the pressure in the tank which is effective against valve 24 thru pipe 29 is greater than the pressure in the chamber 9. Thus the valve will be held in closed position in ports 21 and 20 while the valve port at seat 26 will remain open and allow all of the water to be withdrawn from chamber 9 into the pump. The air drawn into chamber 9 thru the decreased pressure therein will follow the withdrawn water into the suction pipe and into the pump and be discharged into the tank 1.

As long as the water in the tank 1 remains above the connection 39, the pump will continue to deliver air to the tank 1, but if water is drawn from the storage tank during the air pumping period in sufficient quantities to lower the water level in tank 1 below the connection 39, thus allowing air to pass from the tank through tube 38 into chamber 9, pressure will immediately be built up in chamber 9 to a point equal to the pressure in the tank. Thus the difference in pressure upon the opposite sides of valve 24 will be destroyed and the float will drop and open the valve ports 20 and 21 and close the valve port 26 causing the pump to immediately withdraw water from the source of supply.

If because of previous operations of the pump, sufficient air has accumulated in the tank to bring the water level below the connection 39, at any subsequent operation of the pump, air will pass from the tank thru pipe 38 into chamber 9 and prevent a drop of pressure therein so that, as the water level in chamber 9 lowers, there will be no differential pressure to hold the float in up position. Therefore it will drop with the water level, opening the valve ports 21 and 20 and closing the valve port 26 and preventing the mechanism from pumping air.

During the air pumping cycle, a small quantity of water passes thru the pipe 38 which finds its way through the valve port 26 and down on check valve 34 for providing a water seal therefor.

During the water pumping period, water escaping thru valve ports 20, 21 which are open at such time, supplies a water seal for valve 25 which at that time is closing the valve port 26. This is an important feature, for sometimes during the water pumping period, the water level in the tank is below the connection 39 and if there were a leakage at valve 25 when closing port 26, air would pass from the tank thru pipe 38, chamber 9 and thru leaky valve port 26 and kill the operation of the pump.

It will of course be understood that in such a water system, the pump is automatically controlled by the tank pressure so that it is automatically set in operation at a predetermined low pressure and automatically stopped at a predetermined higher pressure.

In this improved structure, the pipe 29 is not restricted and is capable of transmitting the full tank pressure at all times thus insuring a sufficient differential in pressure between that in the tank and that in chamber 9 for maintaining the valve 24 in its seat 21 for closing the port to chamber 9. Further, when port 21 is closed, port 20 will also be closed, thus preventing water from pipe 29 coming within the influence of the pump.

It will be appreciated from the foregoing that the air volume control mechanism will successfully operate between any desired ranges of pressure since the float valves are always water sealed in their closed position and there is no possibility of any air issuing from the tank to interfere with the operation of the pump due to the improved valve construction.

I am aware that many changes may be mad

and numerous details of construction may be varied through a wide range without departing from the principles of this invention, and I, therefore, do not purpose limiting the patent granted hereon otherwise than necessitated by the prior art.

I claim as my invention:

1. In a water supply system, a storage tank, a pump for supplying water to said tank including a suction pipe, a casing defining an air and water chamber connected to said suction pipe, said chamber having an air inlet valve, a pipe having a restricted orifice connecting said tank with the top of said chamber, a valve structure between said chamber and suction pipe, a pipe extending from said tank to said valve structure, said valve structure having a passage connecting said chamber with said suction line, a passage connecting said chamber with said last mentioned pipe and a passage connecting the first two passages and a float having a stem with spaced valves for controlling said passages.

2. In a water supply system, a storage tank, a pump for supplying air and water to said tank, a suction line connected to said pump, a casing having an air inlet valve connected to said suction line and defining an air and water chamber, a valve structure between said chamber and suction pipe, including a float controlled valve for establishing communication between said chamber and suction line, a flow connection between the top of said chamber and tank and means for establishing communication between said tank and valve structure beneath said float controlled valve for the purpose set forth.

3. In a water supply system, a storage tank, a pump for supplying water to said tank, a housing defining an air and water chamber having spaced connections with said tank and having an air inlet valve, said chamber communicating with said pump a float controlled valve controlling the communication between said chamber and pump, and means for subjecting said valve to the pressure of said tank in opposed relation to the pressure in said chamber.

4. In a water supply system, a storage tank, means including a suction pipe for supplying water to said tank, a casing defining an air and water chamber connected to said tank and having a flow connection with said suction pipe, a valve structure between said chamber and suction pipe for controlling said flow connection and including a float valve maintained in up position by the pressure in the tank during the withdrawal of water and air from said chamber by said means, and a flow connection between the top portion of said casing and tank.

5. In a water supply system, a water storage tank, a pump for supplying water to said tank, a suction pipe connected to said pump, a casing defining an air and water chamber having a connection with said suction pipe, a valve for controlling said connection, a pressure line from said tank to said valve for maintaining said valve in a predetermined position when said pump is withdrawing water and air from said chamber, and a flow connection between the upper portion of said chamber and tank.

6. In a water supply system, a water storage tank, a pump for supplying water and air to said tank, a source of air supply having separate flow connections with said tank and pump and means controlled by the differential of pressure between said tank and source of air supply for controlling the flow of air to said pump.

7. In a water supply system, a water storage tank, means including a pump and suction pipe for supplying water to said tank, a casing defining an air and water chamber having an air inlet valve, a valve structure between said chamber and suction pipe, a pipe extending from said tank to said valve structure, said valve structure having a valve port establishing communication between said chamber and last mentioned pipe, a valve port establishing communication between said chamber and suction pipe and a valve seat between and in alinement with said two valve ports, a float in said chamber having a stem with spaced valves for simultaneously engaging in the first mentioned valve port and said intermediate valve seat and shiftable for opening the first valve port and closing the other valve port, said valves presenting different pressure areas to the pressure in said tank when the same are in the first mentioned position and a fluid flow connection between the top of said chamber and tank.

8. In a water supply system, a storage tank, means including a pump and suction pipe for supplying water to said tank, means defining a water and air chamber adjacent said tank and having an air inlet, a flow connection between said tank and the bottom of said chamber, a flow connection between said chamber and suction line, valves for controlling said flow connections, a float in said chamber connected to said valves and a flow connection from the upper part of said chamber to said tank.

9. In a water supply system, a water storage tank, means including a pump for supplying water to said tank, means defining an air and water chamber adjacent said tank and having an air inlet, a flow connected between said tank and the bottom of said chamber, a flow connection between said chamber and suction pipe, valves for controlling said flow connections, a float in said chamber connected to said valves, and a flow connection between the upper portion of said chamber and tank.

10. In a water supply system, a water storage tank, means including a pump for supplying water to said tank, means defining an air and water chamber adjacent said tank, said chamber having an air inlet valve, a flow connection between said tank and the bottom of said chamber, a flow connection between said chamber and suction pipe, a pair of connected valves for controlling said flow connections, said valves being controlled by the differential in pressure between said tank and chamber under predetermined conditions, and a flow connection between the upper portion of said chamber and tank.

11. In a water supply system, a water storage tank, means including a pump and suction line for supplying water to said tank, means defining an air and water chamber adjacent said tank, said chamber having an air inlet valve, a flow connection between said tank and the bottom of said chamber, a flow connection between said chamber and suction line, valves for controlling said flow connections, means for controlling said valves for simultaneously opening one and closing the other, the valve in said second flow connection being sealed by water issuing from said chamber when said valve is in closed position, and a flow connection between said chamber and the upper part of said tank.

12. In a water supply system, a water storage tank, means including a pump and suction pipe for supplying water to said tank, means defining an air and water chamber adjacent said tank,

said chamber having an air inlet valve, a flow connection between said tank and chamber, a flow connection between said chamber and suction pipe, valves in said flow connections responsive to the fluid pressure of said system, a flow connection from said chamber to said valve in said second mentioned flow connection for allowing water to issue from said chamber for sealing said valve when it is in its closed position, and a flow connection between the upper part of said chamber and tank.

13. In a water supply system, a water storage tank, means including a pump for supplying water or air to said tank, means defining an air and water chamber having an air inlet adjacent said tank and having a valve structure at its bottom, a flow connection between said chamber and tank, a flow connection from said chamber to said pump, said flow connections including passages through said valve structure, a valve in each flow connection, means for connecting said valves for simultaneously opening one flow connection and closing the other through the fluid pressure in said system, and a flow connection between the upper portions of said chamber and tank.

14. In a water supply system, a water storage tank containing water and air under pressure, a source of water supply, an air and water chamber having a valved connection with the atmosphere, a pump having cyclic flow connections with said source of water supply and said air chamber for supplying water or air to said storage tank, in combination with means for preventing the withdrawal of air from said air chamber by said pump under predetermined water level conditions in the tank, said means including a flow connection from said tank to said air chamber for the passage of air from said tank to said chamber under said predetermined conditions.

15. In a water supply system, a water storage tank containing water and air under pressure, a source of water supply, an air and water chamber having a valved connection with the atmosphere, a pump having flow connections with said source of water supply and said air and water chamber for supplying water or air to said tank, and an air flow connection from said tank to said chamber effective for conveying air from said tank to said chamber when the water level in said tank recedes below said air flow connection for preventing the inflow of air to said chamber through said valved connection and means for closing the flow connection between said air chamber and pump when said chamber is under the pressure of the air in said tank.

16. In a water supply system, a water storage tank containing water and air under pressure, a source of water supply, an air and water chamber having an air inlet valve, a pump having flow connections with said source of water supply and chamber for cyclically supplying water or air to said tank, an air flow connection between said tank and chamber, adapted for the passage of air to said chamber under predetermined water level conditions within the tank, and means responsive to the pressure of said system for closing the flow connection between said pump and chamber during the operation of the pump under such predetermined conditions.

17. In a water supply system, a water storage tank, a pump having an air pumping cycle and a water pumping cycle for supplying air and water to said tank, a source of water supply having a flow connection with said pump, a source of air supply having a flow connection with said pump, and means responsive to the fluid pressure of said system for controlling said flow connections for supplying either air or water to said tank through said pump.

18. In a water supply system, a water storage tank containing air under pressure, a pump having an air pumping cycle and a water pumping cycle for supplying air and water to said tank, a source of water supply, a suction pipe connecting said source of water supply and said pump, a check valve between said source of water supply and suction pipe, a source of air supply having a flow connection with said suction pipe, a valve in said flow connection, said valves being responsive to differential fluid pressure between that in the source of air supply and that in the suction pipe for maintaining said check valve closed and the other valve open during the air pumping cycle, said check valve being sealed by water issuing from said tank, and a flow connection between the upper portion of said chamber and tank.

19. In a water supply system, a water storage tank, a pump having an air pumping cycle, and a water pumping cycle for supplying air and water to said tank, a source of water supply, a suction pipe, onnecting said pump with said source of water supply, a check valve between said source of water supply and said suction pipe, an air and water chamber adjacent said tank having an air inlet valve and a flow connection with said suction pipe and a connection with said tank and a valve in said flow connection, said valves being responsive to the differential fluid pressure of said system for maintaining said check valve closed and the other open during the air pumping cycle.

20. In a water supply system including a storage tank for water and air, a pump, a suction line from a source of water supply to said pump, a check valve between said source of water supply and said suction pipe, the combination therewith of a casing defining an air and water chamber, said casing having flow connections to said tank and suction pipe and having an air intake valve from the atmosphere, and a valve structure associated with said chamber for controlling fluid flow through said flow connections and air intake valve, said valve structure being operative under a predetermined reduction of pressure in said tank to establish air flow communication through said chamber from said air intake valve to said pump during the air pumping cycle of said pump, and to establish sufficient water flow through said chamber to provide a water seal for said check valve.

21. In a water supply system including an air and water storage tank, a pump, a source of water supply, a suction pipe connecting said source of water supply to said pump, the combination therewith of a chamber connected to said tank, said suction line and the atmosphere, valve means associated with said chamber for controlling flow through said connections responsive when the pressure in said tank is below a predetermined minimum to establish connection through said chamber between said suction line and atmosphere to cause air to be drawn from the atmosphere into said pump for delivery to said tank during the operation of the pump, and a flow connection between the upper portion of said chamber and tank.

22. In a water supply system, a water storage tank containing water and air under pressure, a source of water supply, an air and water chamber having a valved connection with the atmosphere, a pump having flow connections with said

source of water supply and said air chamber, valves in said connections, means for maintaining the valve in the flow line to said chamber in open position under a predetermined pressure in said tank during the operation of the pump for causing said pump to supply air from said chamber to said tank and causing said valve to close under a different predetermined pressure in said tank for causing said pump to supply water to said tank.

23. In a water supply system, a storage tank containing water and air under pressure, a source of air supply, a source of water supply, a pump having connections with said source of water supply and said air supply, means responsive to a predeterr ined fluid pressure in said tank for causing said pump to supply only air to said tank and responsive to a different predetermined pressure in said tank for causing air pressure in said tank to shut off the source of air supply to said pump for causing said pump to supply water to said tank.

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