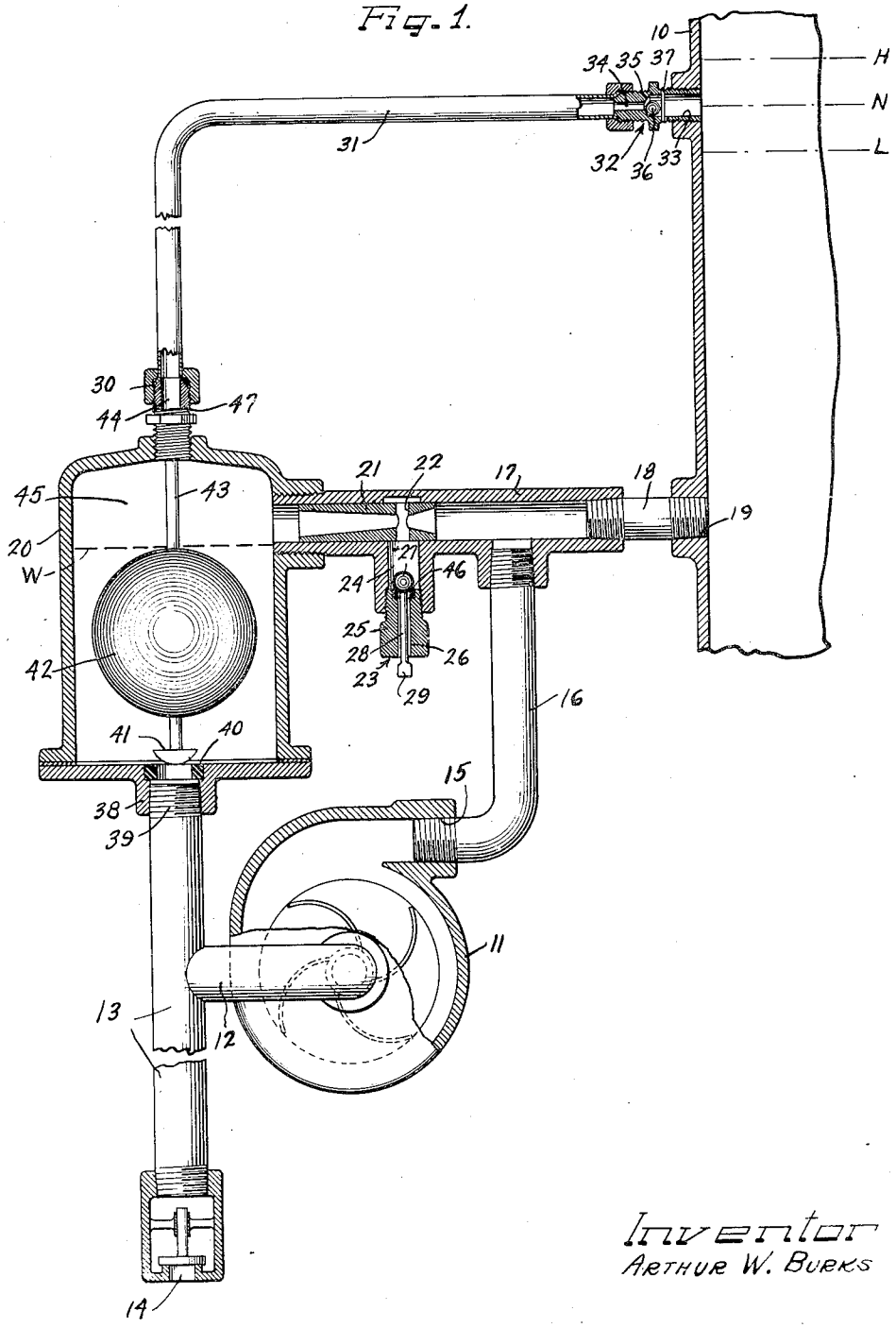
May 23, 1950 A. W. BURKS 2,509,130

AIR CHARGER FOR HYDROPNEUMATIC SYSTEMS

Filed March 9, 1945 2 Sheets-Sheet 1

Fig. 1.



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AIR CHARGER FOR HYDROPNEUMATIC SYSTEMS

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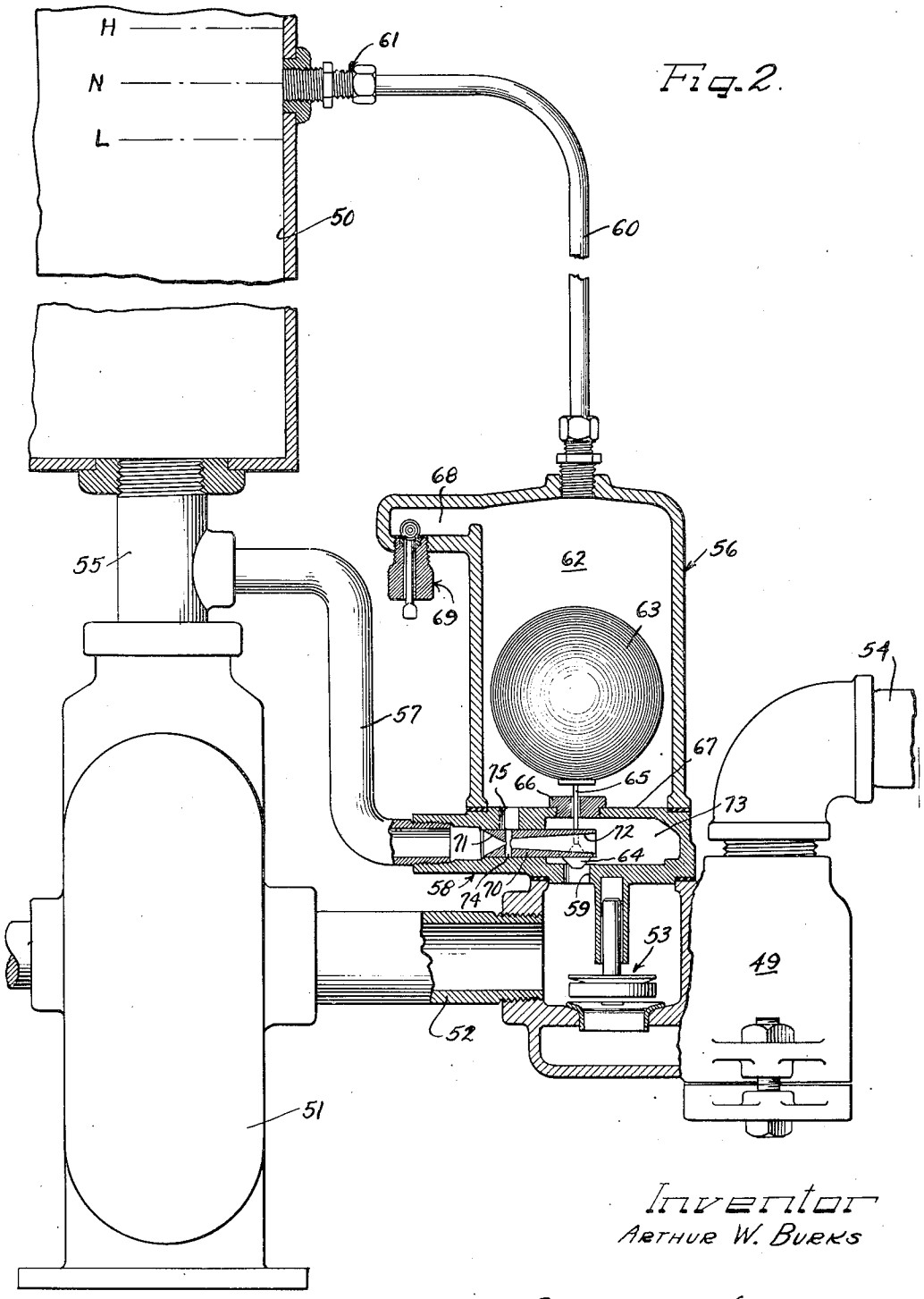

Fig. 2.

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AIR CHARGER FOR HYDROPNEUMATIC SYSTEMS

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10 Claims. (Cl. 103—6)

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This invention relates to an air charger for hydro-pneumatic systems, and more particularly to an air charger for supplying air to a hydro-pneumatic tank in response to the pneumatic pressure requirements of the system.

The present invention relates to a novel and improved air charger mechanism for maintaining the pneumatic pressures in a hydro-pneumatic supply tank within the desired limits. The air charger of my invention operates to supply air to the hydro-pneumatic tank if required whenever the pump that supplies the hydro-pneumatic tank with water is operated.

An important feature of my invention is the provision of an eductor, or aspirator, operated by a flow of water under pressure from the pump, when the air cushion in the tank requires replenishing, to draw atmospheric air into the air charger casing for subsequent displacement into the hydro-pneumatic tank to replace losses of air from the tank and to build up the air pressure therein to within the desired limits. A float valve cooperates with the eductor, or aspirator, to eliminate, or at least reduce, the possibility of air drawn in by the eductor finding its way into the pump and causing the pump to become air bound. This has been one of the objections to previous hydro-pneumatic systems employing means, such as an eductor, aspirator, or Venturi nozzle, for drawing air into the system under the action of the pump.

The air charger of my invention acts each time that the pump is started up, if the water level in the hydro-pneumatic tank is below its normal level, to introduce a charge of air into the tank. If no air is required in the hydro-pneumatic tank, no new charge of air is delivered into the tank, but air is merely withdrawn from the tank and expelled back thereinto. The device is thus fully automatic and requires little, if any, attention.

It is therefore an important object of this invention to provide an automatically operating air charger for maintaining the desired pneumatic pressure within a hydro-pneumatic tank of a water supply system, the air charger being responsive to the pumping operation when the level of the water in the tank is above normal to introduce a charge of air into the hydro-pneumatic tank. The air charger includes an eductor, or aspirator, for aspirating air into the system and a float controlled valve on the suction side of the pump for eliminating or reducing the possibility of such air being drawn into the pump to thereby lessen its efficiency.

It is a further important object of this invention to provide an air charger the operation of which

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depends upon the action of an eductor, or aspirator, actuated by the pressure discharge of water from the pump, in combination with a float controlled valve on the suction side of the pump to reduce the possibility of air getting back into the suction line and destroying the prime of the pump.

It is a still further important object of this invention to provide an air charger which, in addition to its function of maintaining the desired pneumatic pressure in a hydro-pneumatic tank, is so arranged and positioned as to serve as a primer for the pump supplying the hydro-pneumatic tank.

Other and further important objects of this invention will be apparent from the disclosures in the specification and the accompanying drawings.

On the drawings:

Figure 1 is a fragmentary vertical sectional view, partly in elevation, of an air charger embodying the principles of my invention.

Figure 2 is a fragmentary, broken sectional view, partly in elevation, of a modified form of my air charger.

As shown on the drawings:

In Figure 1, the reference numeral 10 indicates generally a hydro-pneumatic tank, which, as is customary, is partially filled with water maintained under the pressure of an air cushion above the water level. Water is supplied to the hydro-pneumatic tank 10 by a pump 11, preferably of the centrifugal type, which is connected through a suction intake 12 to a water supply pipe 13. Said supply pipe 13 has a foot valve 14 at its lower end, which, when installed, extends into the source of water that supplies the pump 11. The pump 11 is connected at its discharge end 15 with a pipe 16 that connects through a fitting 17 and a nipple 18 with the lower portion of the tank 10, as at 19.

The fitting 17 is either formed integrally with or for attachment to an air charger 20 that serves as an air trap. As illustrated, the discharge from pump 11 is free to pass through the fitting 17 either in the direction of the tank 10 through the nipple 18, or in the opposite direction into the chamber 45 of the air charger 20. Within the fitting 17 there is positioned an eductor, or aspirator, 21, through which water from the pump 11 must pass on its way into the chamber 45. Said eductor 21 is provided with a vented throat 22 so arranged with respect to an air valve 23 that air can be drawn into the flow of water passing through the eductor.

For this purpose, the fitting 17 is provided with

an apertured side connection 24 that is threaded at its outer end for receiving the air valve 23. Said air valve 23 includes a plug 25 having a small diameter bore 26 extending therethrough, terminating at its inner end in a counterbore for receiving a resilient seat 46. A ball valve 27 normally seats upon said seat 46. Said valve has a stem 28 passing through said bore 26 and terminating in an enlarged head 29 that projects beyond the plug 25. Thus, when there is a pressure flow of water through the eductor 21, the reduction in pressure that takes place at the throat 22 causes the ball valve 27 to rise off its seat 46 and open the bore 26 to admit air into the throat 22 for admixture there with the water passing therethrough. The mixture of water and air is discharged from the eductor into the chamber 45.

Said air charger 20 is connected at its upper end through a nipple 47 and a coupling 30 to a conduit 31. The upper end of said conduit 31 is connected through a check valve fitting 32 to the tank 10 at about its normal water level, as indicated by the dot-dash line N. Said fitting 32 is provided with an enlarged bore 33 opening at its inner end into the tank 10 and at its outer end merging into a reduced bore 34. A conical ball seat 35 is formed between said enlarged and reduced bores 33 and 34, respectively, and a ball 36 is positioned in said enlarged bore 33 for the purpose of seating against said conical seat 35 and closing off the reduced bore 34 under certain conditions. A stop pin 37 prevents the ball 36 from becoming displaced entirely from the bore 33.

This arrangement of the ball valve fitting 32 is such as to permit the flow of air through the fitting in either direction but prevent the flow of water from the tank through the fitting into the conduit 31. The latter is prevented by reason of the fact that the ball 36 in response to a flow of water from the tank into the fitting 32 rises against and seats upon the seat 35, thus closing off the reduced bore 34.

The air charger 20 is provided with a lower passaged cylindrical boss 39 which is in alignment with the upper nipple 47, and which is internally threaded to receive the threaded end 39 of a continuation of the vertical intake pipe 13. An annular valve seat 40 is positioned in a counterbore formed at the inner end of the passage through the boss 38. A float controlled valve 41 having a float 42 mounted on its upwardly extending stem 43 serves to control the port defined by the annular seat 40. The upper end of said stem 43 extends freely into the passage through the nipple 47, the walls of which serve as a guide therefore.

The operation of the air charger will now be described. When the pump is not running, the pressure equalizes itself throughout the system. Since the air charger is below the level of the water in the tank 10, the chamber 45 fills completely with water. The float 42, accordingly, holds the valve 41 off its seat 40. The foot valve 14, prior to starting up the pump 11, is closed.

When the pump 11 is started, the water already in it and in the chamber 45 serves to prime the pump. The suction created by the pump causes the foot valve 14 to open and let water be drawn up through the intake pipe 13. The pump discharges this water under pressure through the pipe 16 into the fitting 17. At the fitting 17 the flow of water from the pump divides, part of the water passing into the tank and the other part

of the water passing through the eductor 21. The passage of water under pressure through the eductor 21 causes a reduction of pressure at the throat 22, resulting in the air valve 27 being lifted off its seat and air being drawn into the eductor for discharge in admixture with water into the chamber 45. There, the water and air separate by gravity and the air accumulates above the water level, which may be indicated at this point by the dotted line W.

This action continues until the accumulation of air in the float chamber 45 of the air charger 20 causes a drop in the water level to the point at which the float is depressed sufficiently to seat the valve 41 upon its seat 40. The difference in pressure within the float chamber and the suction line 13 holds the float valve 41 seated. Water, however, continues to pass through the eductor 21 until the pressure within the float chamber 45 becomes equal to the pressure within the tank 10, at which point the flow of water through the jet ceases and the air contained in the float chamber 45, being below the water level in the tank, is displaced therefrom because of its difference in density and is caused to pass through the conduit 31 and the check valve fitting 32 into the tank 10.

During this period and so long thereafter as the pump continues to operate, the float valve 41 remains seated due to the difference in pressure between the suction line and the float chamber. As soon as the pump ceases to operate, however, the pressure on the system becomes equalized and the buoyancy of the float 42 operates to open the valve 41 and establish communication to the suction line 13.

The foregoing description of the operation applies whenever the level of the water in the tank 10 is at or above the normal water level indicated by the dot-dash line N, as for instance at the level indicated by the dot-dash line H.

If, however, the water in the tank 10 is below the normal water level, as, for instance at the level indicated by the dot-dash line L, the ball check 36 remains unseated and permits air to be drawn into the conduit 31 and thence into the float chamber 45. Under these conditions, there will be no difference in pressure between that in the float chamber and that within the tank 10, with the result that the eductor 21 will not operate to draw in air through the air intake 23, but, instead, will draw air in from the tank 10 through the check valve fitting 32 and the conduit 31. Such air displaces water from the chamber 45 into the suction line 13 until the level within the float chamber is sufficiently lowered that the float 42 operates to seat the valve 41.

Since the mixture of air and water coming from the eductor 21 when atmospheric air is being drawn in through the air intake 23 is of an intimate nature, the float chamber 45 should be sufficiently large to allow the air to be released from the water before any water is drawn from said float chamber into the suction line 13 to the pump. Otherwise, the pump 11 might draw in sufficient air to cause it to lose its prime.

In the modified form of my air charger illustrated in Figure 2, a hydro-pneumatic tank, indicated by the reference numeral 50, is supplied with water, as previously described, by a centrifugal pump 51 having an intake pipe 52 leading through a foot valve 53 and a strainer 49 to a water supply pipe 54. Said pump 51 may be directly connected to the bottom of the tank 50 through a discharge pipe 55.

An air charger, indicated generally by the reference numeral 56, is connected by piping 57 to the pump discharge pipe 55 through a fittting 58, which is in controlled communication through a port 59 with the intake side of the pump above the foot valve 53. Said air charger 56 is also connected at its top by means of a pipe 60 through a check valve fitting 61 to the tank 50 at or about its normal water level, as indicated by the dot-dash line N. The check valve fitting 61 is similar in all respects to the fitting 32 of Figure 1 and performs the same function as described for that fitting.

The air charger 56 provides a float chamber 62 in which is positioned a float 63 having a valve 64 attached thereto by a stem 65 for controlling the port 59. Said stem 65 passes freely through an apertured plug 66 in the upper wall 67 of said fitting 58. The apertured plug 66 provides a guide for the valve 65.

The air charger 56 is further provided with an offset upper chamber 68, in the lower wall of which is positioned an air intake valve 69, similar in all respects to the air intake valve 23 previously described.

The fitting 58 houses an eductor 70 having an intake nozzle 71 for receiving water under pressure through the piping 57 and a discharge nozzle 72 opening into the interior 73 of said fitting. The eductor 70 is provided with an apertured throat 74 which is in communication with the float chamber 62 through a passage 75 in the upper wall of said fitting.

The operation of the air charger illustrated in Figure 2 will now be explained.

When the pump 51 is started, assuming the water level in the tank 50 to be at or above the normal water lever N, for instance at the level indicated by the reference character H, the ball check fitting 61 prevents the flow of water through the piping 60 into the air charger 56. The float chamber 62 is, however, filled with water from the end of the previous cycle. Accordingly, the float 63 holds the valve 64 off of its seat 59 to permit the water in the float chamber 62 to serve as a prime for the pump 51.

As soon as the pump starts pumping, it creates a sufficient suction in the intake 52 to open the foot valve 53 and draw in water through the intake supply pipe 54. The water discharged from the pump 51 through the discharge pipe 55 flows partly into the tank 50 and partly through the piping 57 into the eductor 70. The reduced pressure at the throat 74 of said eductor causes water to be drawn from the float chamber 62 through the opening 75, thus lowering the water level within the float chamber 62 and effecting a reduction in the pressure above the water. Such reduction in pressure causes the air intake valve 69 to open and air to be drawn into the offset chamber 68.

When the water level in the float chamber 62 has dropped sufficiently to allow the float control valve 64 to close the port 59, the continued flow of water through the eductor 70 now flows out through the throat aperture 74, through the opening 75 and into the float chamber 62. The continued flow of water into the float chamber 62 effects the displacement of the air therefrom into the tank 50 through the piping 60 and ball check valve fitting 61. The float valve 54 remains seated because of the difference in pressure between that in the flow chamber 62 and that in the pump intake piping 52. Water continues to flow from the throat of the eductor into the chamber 62 until pressures are balanced within the float chamber 62 and the tank 50, after which flow through the eductor ceases.

As soon as the pump stops, the foot valve 53 closes and pressure is equalized between the tank and suction side of the pump through the pump itself, thereby permitting the float 63 again to rise and open the port 59. The charger is then ready to repeat the cycle when the pump again starts up.

If, however, the water level in the tank 50 is below the normal water level, as for instance at the level indicated by the dot-dash line L, air is preferentially drawn in through the check valve fitting 61 and the piping 60 into the float valve 62, and no atmospheric air is taken in through the air intake valve 69. The air so taken into the float chamber 62 is displaced back into the tank 50, as previously described, when the pump stops.

Thus, only when the pressure demand of the hydro-pneumatic tank 50 requires it is atmospheric air introduced into the tank through the air intake valve assembly 69.

In both of the forms of construction illustrated in Figures 1 and 2 the broad principle is the same, namely, the use of an eductor for drawing in atmospheric air when the level of the water is at or above the normal level in the hydro-pneumatic tank, and the use of the float valve for controlling the flow of water from the air charger to the intake side of the pump so that the eductor can operate when the pump is operating to draw a full charge of air into the charger and subsequently effect the displacement of such air into the hydro-pneumatic tank. Also, in both modifications of my invention, the air charger serves the dual function of a primer for the pump because of its being positioned above the intake of the pump and because of the arrangement whereby pressures equalize themselves within the air charger and within the hydro-pneumatic tank and the air charger fills up with water upon the pump being stopped.

It will, of course, be understood that various details of construction may be varied through a wide range without departing from the principles of this invention and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

I claim as my invention:

1. In a hydro-pneumatic system including a hydro-pneumatic tank and a pump for supplying water to the tank through a discharge line, an air charger for supplying air to the tank in accordance with the level of water therein as maintained by the pump, said charger comprising a casing having an opening for valve-controlled connection to the tank at about the normal water level therein to permit air flow through the opening in either direction and water flow therethrough only in the direction of the tank, said casing having a fluid flow opening for connection to the suction side of the pump, a valve-controlled air intake for admitting atmospheric air into said casing, an aspirator for connection to the pump discharge line and having a constricted throat portion vented to cooperate with said air intake to cause atmospheric air to be taken into said casing in admixture with water flowing through said aspirator and a float-controlled valve in said opening for connection to the suction side of the pump controlled by a float in said casing, whereby provided the water level

in the tank is above said normal water level, when the pump is started up, said float-controlled valve being at that time open, a flow of water under pressure through said aspirator draws atmospheric air through said intake for introduction into the casing for subsequent displacement therefrom into the tank through the valve-controlled connection to the tank.

2. In a hydro-pneumatic system including a hydro-pneumatic tank and pump for supplying water to the tank, an air charger for supplying air to the tank in accordance with the level of water therein as maintained by the pump, said charger comprising a casing for valve-controlled connection to the tank at about the normal water level therein, the connection permitting air flow therethrough in either direction and water flow only in the direction of the tank, said casing having a fluid flow opening for connection to the suction side of the pump, a valve-controlled air intake for admitting atmospheric air into said casing, an aspirator for connection to water under pressure from said pump and having a constricted throat portion vented directly to said valve for cooperation therewith to cause atmospheric air to be drawn into said aspirator upon water flow through said aspirator for introduction into the casing, and a float-controlled valve in that opening for connection to the suction side of the pump controlled by a float in said casing.

3. In a hydro-pneumatic system including a hydro-pneumatic tank and a pump for supplying water to the tank through a discharge line, an air charger for supplying air to the tank in accordance with the level of water therein as maintained by the pump, said charger comprising a casing having a first opening for valve-controlled connection to the tank at about the normal water level therein, the valve-controlled connection permitting air flow therethrough in either direction and water flow only in the direction of the tank, said casing having a second fluid flow opening for connectioon to the pump intake, a valve-controlled air intake for admitting atmospheric air into the casing, an aspirator for connection to the discharge line of the pump and having a constricted throat portion vented to cooperate with said air intake to cause atmospheric air to be admixed with water flowing through the aspirator for subsequent introduction into the casing, a float-controlled valve in said second fluid flow opening and a float in said casing controlling said float-controlled valve, said casing being above the pump intake to provide a source of priming water for the pump.

4. In a hydro-pneumatic system including a hydro-pneumatic tank and a pump for supplying water to the tank through a discharge line, an air charger for supplying air to the tank in accordance with the water level therein as maintained by the pump, said charger comprising a casing having a first fluid flow opening for valve-controlled connection to the tank at about the normal water level therein permitting air flow therethrough in either direction and water flow only in the direction of the tank, said casing having a second fluid flow opening for connection to the intake side of the pump, a valve-controlled air intake, an aspirator for connection to the discharge line of the pump and discharging into said casing, said aspirator having its low pressure throat zone vented in direct fluid flow communication with said air intake, and a float-controlled valve in said second fluid flow opening with its float in said casing, whereby fluid flow through said aspirator will draw air through said air intake for admixture with fluid flowing through the aspirator for separation within said casing and subsequent introduction into said tank through said first flow opening.

5. In a hydro-pneumatic system including a hydro-pneumatic tank, a pump for supplying water thereto, and a water supply pipe to said pump having a foot valve therein, an air charger having a first fluid flow opening for connection to the tank at about the normal water level therein and a second fluid flow opening for connection to the intake side of the pump, a check valve controlling the connection from said first fluid flow opening to permit air flow in either direction but preventing water flow from said tank to said charger, a float controlled valve in said second fluid flow opening, said charger having a third fluid flow opening for connection to the discharge line of the pump, an air intake communicating with said third fluid flow opening, and an aspirator also communicating with said third fluid flow opening and vented at its throat in direct communication with said air intake to draw air into said aspirator from said air intake and to discharge air in admixture with water into said air charger upon the flow of water under pressure therethrough.

6. In a hydro-pneumatic system including a hydro-pneumatic tank, a centrifugal pump for supplying water thereto through a discharge line, and a water supply pipe in said pump having a foot valve therein, an air charger providing a float chamber having a first fluid flow opening for connection to the tank at about the normal level of water therein, a second fluid flow opening for connection to the intake side of the pump for connection to the water supply pipe, and a third fluid flow opening for connection to the discharge line of the pump, means controlling fluid flow through said first flow opening to allow air flow in either direction and water flow only from said float chamber to the tank, a float controlled valve in said chamber for controlling said second fluid flow opening, an aspirator in said third fluid flow opening for receiving water from the pump discharge line and having a vented constricted throat, an air intake in direct communication at said vented aspirator throat so that water flow through the aspirator draws air into said aspirator from said air intake for introduction into said float chamber in admixture with water from said aspirator and a float in said chamber for controlling said float-controlled valve to close said valve when said float chamber is substantially filled with air and thus preventing air from being drawn into the pump.

7. In a hydro-pneumatic system as described, the combination with a water pump having an intake and discharge of a float chamber mounted above said pump intake and in float valve-controlled communication therewith, a float in said chamber actuating said float valve, an aspirator having a vented constricted throat, said aspirator being connected to the discharge of said pump and to said float chamber and an air intake connected to said aspirator through said vented throat adapted to open when said pump is forcing water under pressure through said aspirator to permit air to be drawn into said water for discharge in admixture therewith into said float chamber.

8. In a hydro-pneumatic system including a hydro-pneumatic tank and a pump for supply-

ing water to the tank, an air charger comprising a float chamber having a flow opening for connection to the inlet of the pump, a float valve in said chamber for controlling said flow opening, a float in said chamber for actuating said float valve, said chamber having a second fluid flow opening for connection to said tank, an aspirator having a vented constricted throat, said aspirator being adapted for the pressure flow of water therethrough from said pump and in flow communication with said float chamber, and an air intake connected to the vented throat of said aspirator and adapted to open when water flow through said aspirator is established to introduce a mixture of air and water into said chamber, said air and water mixture being separated in said chamber with the air being later introduced into said tank through said second flow opening when the pressure of the air within the chamber is sufficient to overcome pressure within said tank.

9. In a hydro-pneumatic system including a hydro-pneumatic tank and a pump for supplying water thereto, an air charger comprising a float chamber having a first fluid flow opening for connection to the intake side of said pump and a second fluid flow opening for connection to the tank at about the normal water level therein, a float valve in said chamber for controlling said first fluid flow opening, a float in said chamber actuating said float valve, an aspirator having an intake side for fluid flow connection with said tank and a discharge side for fluid flow connection with said chamber, said aspirator having a vented constricted throat, and an air intake connected to the vented throat of said aspirator and adapted to open upon water flow through the

aspirator to admit air for admixture with water flowing therethrough, whereby a mixture of air and water is introduced into said chamber for gravity separation therein and subsequent introduction of the separated air into said tank through said second fluid flow opening.

10. In a hydro-pneumatic system including a hydro-pneumatic tank and a pump for supplying water thereto, an air charger comprising a casing having a first fluid flow opening for connection to the intake side of a pump and a second fluid flow opening for connection to the tank at about the normal water level therein, a float in said casing, a valve actuated by said float for controlling the flow of water through said first fluid flow opening, an aspirator having an intake for connection to the tank and an outlet for connection to the casing, said aspirator having a vented constricted throat, and an air intake connected to the vented throat of the aspirator and adapted to open when water flow through the aspirator is established to introduce a mixture of air and water to said casing, said air and water mixture being gravity separated in said casing for subsequent introduction of the separated air into said tank through said second fluid flow opening.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,172,057	Burks	Sept. 5, 1939
2,172,097	Burks	Sept. 5, 1939
2,457,863	Burks	Jan. 4, 1949