

Aug. 4, 1942.

R. M. NELSON ET AL

2,291,746

AIR CHARGING CONTROL AND SYSTEM

Filed March 16, 1940

3 Sheets-Sheet 1

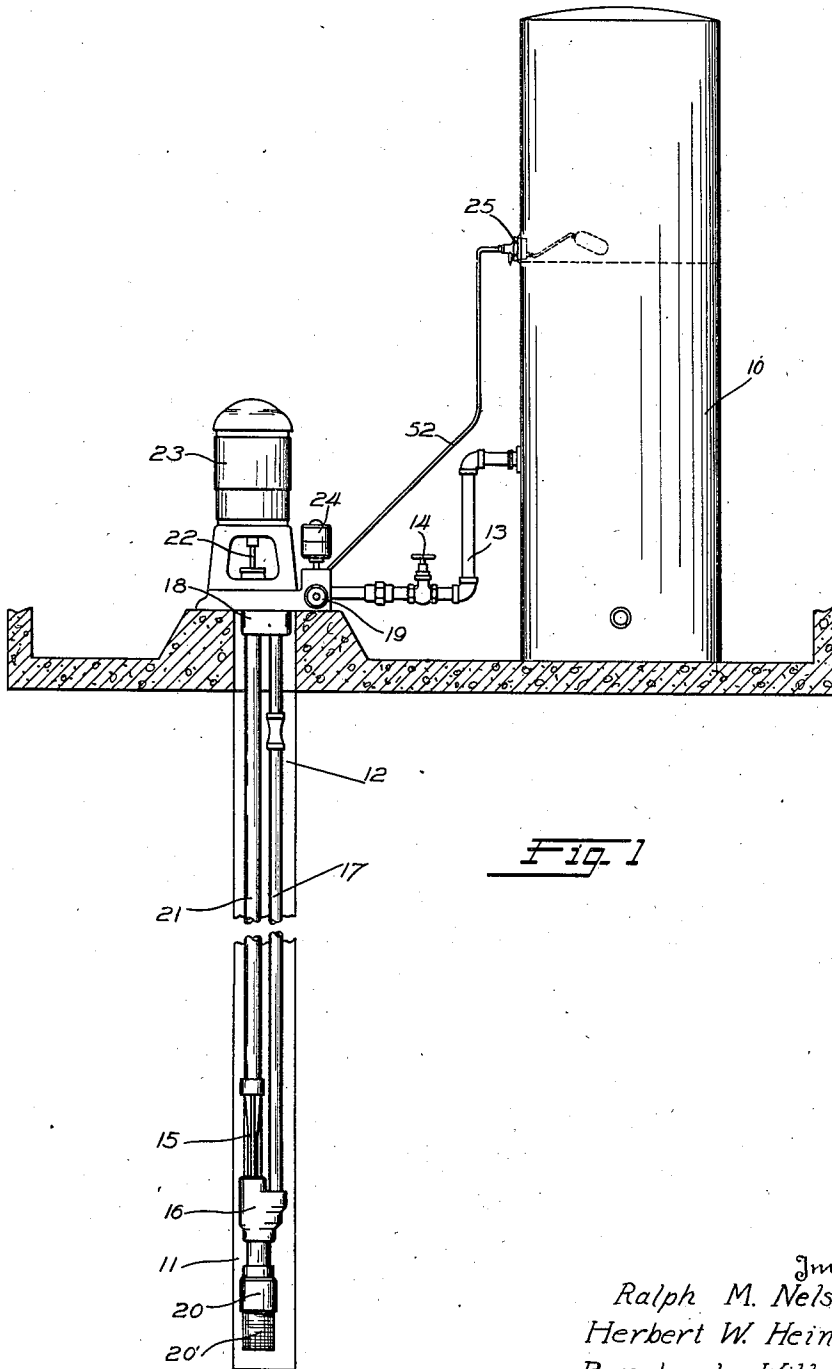


Fig. 1

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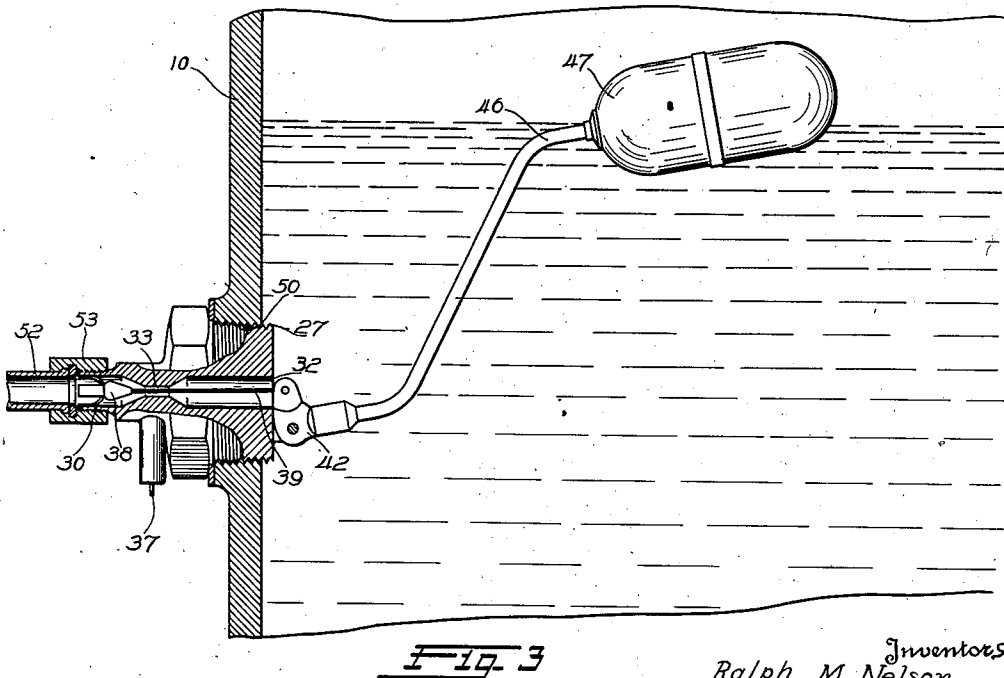
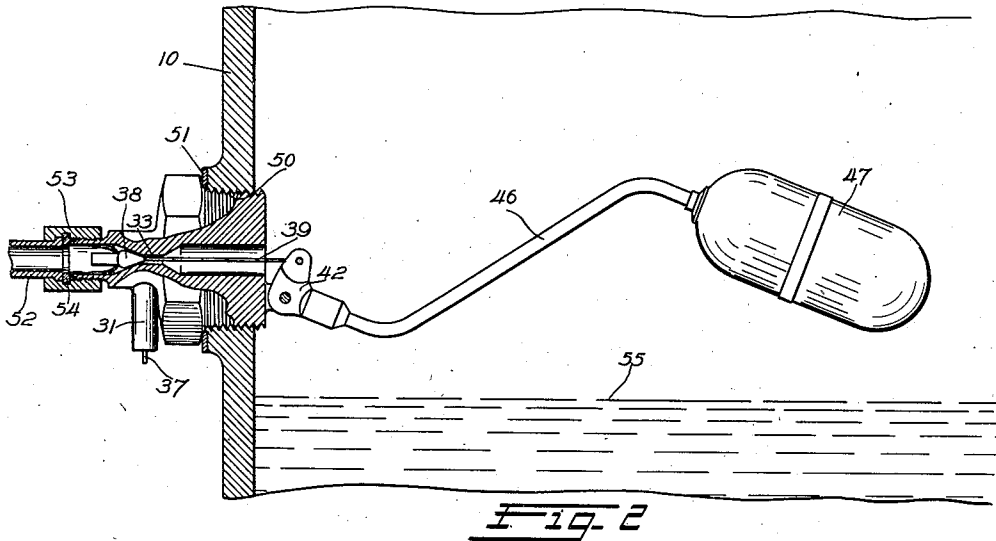
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3 Sheets-Sheet 2



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Fig. 4

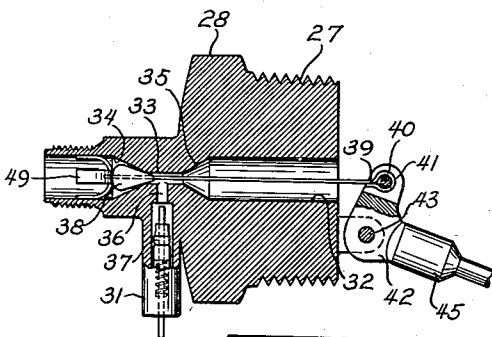
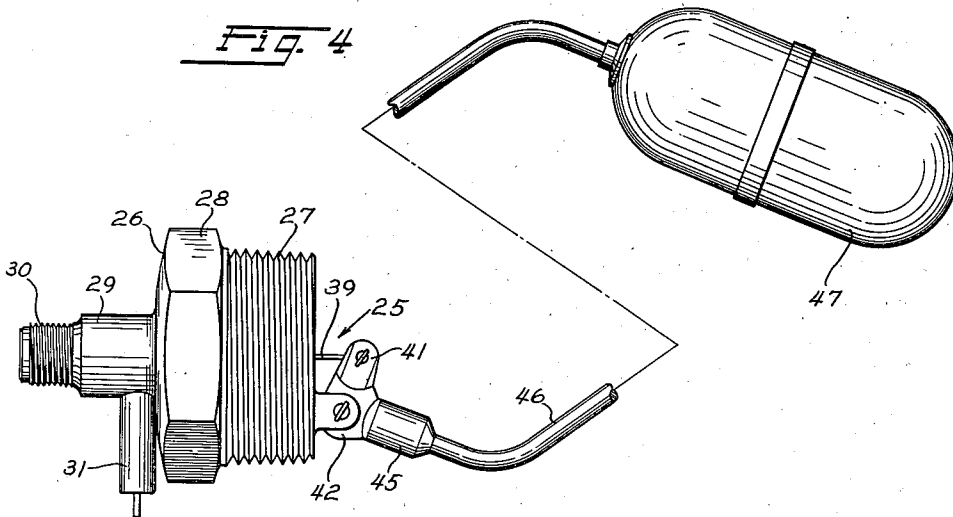


Fig. 5

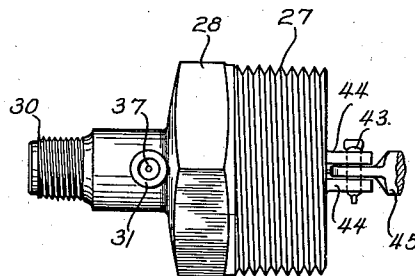


Fig. 6

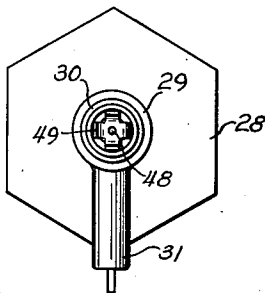


Fig. 7

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AIR CHARGING CONTROL AND SYSTEM

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14 Claims. (Cl. 103—6)

The present invention is concerned with automatically providing water supply systems with air so as to maintain a proper volume above the water in the tank at all times.

Water supply systems of the type now in wide use on farms and in other districts that do not have a community water supply system, require for their proper operation a certain volume of air above the water in the tank. The automatic maintenance of the required volume of air above the water in the tank of water supply systems, of the type just referred to, is not difficult, in the present state of development of the art, when the pump forming a part of the system is of such character that its operation is unaffected when air is introduced in the pumping system at the suction side of the pump.

However, when the pump is of such a character that air cannot be freely introduced into the water supply system by introducing it at the suction side of the pump in the manner now well understood in the art, great difficulties have been encountered in automatically supplying the air which is lost during the normal operation of the water supply system by absorption in the water. The difficulties just referred to have arisen in connection with pumping systems employing pumps of the ejector type. Such pumps are now being widely employed in water supply systems of the character above referred to, because of their ability to pump the water from the well regardless of its depth. It has been found to be impractical to introduce the needed air, to insure a proper volume of air in the tank at all times, by introducing the air to such pumps in the manner in which air has heretofore been freely introduced in pumping systems of other types with entire success.

It has accordingly been heretofore proposed to introduce the air into the tank, when pumps of the ejector type are employed, independently of the pump, that is, without passing the air through the pump. Air chargers of this type have been found to be generally unsatisfactory in practice because the air that can be introduced by such chargers is insufficient in quantity to replace the air which is absorbed by the water in the normal operation of the water supply systems. Such air chargers are furthermore not satisfactory because, generally they are designed to operate whenever the pump operates, so that systems employing them are not certain to at all times have substantially the same volume of air in the tank.

The primary purpose of the present invention is to provide an air charging system capable of successful use to maintain a predetermined vol-

ume of air above the water in the tank of the water supply system, regardless of the nature of the pump employed in lifting the water from the well to the tank.

5 A further object of the invention is to provide an air charger designed to introduce air into the system only when it is needed, and then in the form of minute air bubbles entrained in a stream of water returned from the tank to the suction side of the pump, it having been found
10 that when air is introduced in the form of minute bubbles distributed throughout a mass of water that enters the pump that neither the operating characteristics nor the efficiency of the pump
15 is effected thereby.

A still further object of the invention is to provide an air charger that at the same time constitutes a control automatically insuring that the proper volume of air is maintained in the
20 tank above the water therein at all times.

A still further object of the invention is to provide an air charging control so designed that the control may be applied to the water supply system by simply screwing a single entity in an
25 opening in the tank, necessitating only the addition of tubing extending from said entity to the suction side of the pump in order to provide a complete air charging and air controlling system.

This invention also aims to provide an air
30 charging control that will successfully function to maintain a predetermined volume of air in the tank of a water supply system including a pump of the widely used ejector type.

Still further objects of the invention will appear as the description thereof proceeds with reference to the accompanying drawings in which:

Figure 1 is an elevational view of a typical water supply system including a pump of the ejector type and showing the air charging and control system of the present invention applied thereto;

Figure 2 is a fragmental sectional view on an enlarged scale through the air charging control, the parts thereof being in the position they occupy when there is sufficient air in the tank to insure proper operation of the water supply system and when the water level is low;

Figure 3 is a view similar to Figure 2 but showing the position of the parts of the control when additional air is being supplied to the system;

Figure 4 is a side elevational view on a further enlarged scale of the air charging control device forming a part of the present invention in its present preferred form; and

Figures 5, 6 and 7 are, respectively, transverse sectional fragmentary top plan and end elevational views of the air charging control of Figure 4.

Like reference characters indicate like parts throughout the several figures.

Referring to Figure 1, a typical water supply system of the kind widely used on farms and in outlying districts is illustrated with the present invention applied thereto in its preferred form. The water supply system, illustrated in Figure 1, includes a pump of the ejector type because the maintenance of the proper volume of air in the tank of a water supply system having such a pump has heretofore been very difficult of accomplishment, though, with the present invention, the proper volume of air may be maintained in the tank automatically at all times. It should be understood, however, that, while the present invention has been illustrated as applied to a water supply system having a pump of the ejector type, said invention is capable of use in systems including pumps of other types, one of the advantages of the invention being its adaptability to pumping systems of all known kinds.

In Figure 1, 10 designates the tank of the water supply system. Water is drawn from a well 11 by a pump designated as a whole by 12. Water enters the tank through a pipe 13 extending from the pump to the tank, the flow through said pipe being controlled by a valve 14.

The ejector pump 12 includes a jet tube 15 having a nozzle therein of customary form. Water is projected into said tube from a jet nozzle within the jet body 16. Water under pressure is supplied to the nozzle of the jet through a pipe 17 extending from the outlet side of the impeller, disposed within the casing 18 and the jet body. Automatic regulator 19 diverts some of the water delivered by the pump to the pipe 17, and maintains sufficient pressure on the supply line to the ejector to operate the jet in the jet body 16. When the jet is in operation, water is drawn from the well through the foot valve 20 and strainer 20' by the action of the ejector and passes through the jet tube 15 into the pipe 21 extending from the jet tube to the impeller within the casing 18. The action of the ejector raises the water from the well to a point sufficiently close to the impeller within the casing 18, in order that the water will be drawn into the impeller by the suction created by the operation thereof. The impeller is connected to a shaft 22 driven by a motor within the casing 23. A pressure switch 24 starts and stops the pump automatically at predetermined minimum and maximum pressures by controlling the motor in the casing 23. The pumping system so far described constitutes, in itself, no part of the present invention, systems of this kind being in wide use.

In order to automatically insure that the proper volume of air is maintained in the tank 10, an air charging control designated as a whole by 25 is screwed into an opening in the wall of the tank at a proper height. The air charging control 25 is illustrated in detail on Figures 4-7, inclusive, and comprises a fitting or body 26 having an externally threaded portion 27, permitting the fitting to be screwed in the wall of the tank by means of a wrench applied to the hexagonal or like portion 28.

An extension 29 externally threaded at 30 for connection to a tube hereinafter referred to is provided. A hollow boss 31 extends laterally of the extension 29. A bore or passage 32 having

a restriction 33 therein extends completely through the fitting. The restriction in the passage is preferably provided by shaping the walls of the bore so as to provide a Venturi portion, that is, a portion having two truncated, conical surfaces 34 and 35 extending from the restriction 33 to the wider portions of the bore 32.

An air passage 36 intercepts the bore passing through the fitting at the restriction 33. The flow of air through the passage 36 into the restriction is controlled by a spring-controlled snifter valve 37 of conventional form, said valve being mounted in a bore in the extension 31 in conventional manner.

The flow of water through the bore 32 and the restriction 33 therein is controlled by a valve 38 of conical form rigidly secured to a stem 39 extending through the restriction 33 and bore 32, and connected by a pin 40 to an arm 41 of a bell-crank lever 42. Said lever is pivotally connected to the fitting by a pin 43 passing through said lever and a pair of perforated lugs 44 projecting into the tank from the fitting. The other arm 45 of the bell-crank lever 42 is rigidly secured to a float arm 46 on the end of which is rigidly secured a preferably hollow float 47 constructed in any desired manner. The valve 38 is guided in its movements toward and from its seat on the truncated conical surface 34 by a guide member 48, said guide member having a multiplicity of fingers 49 (four being shown) yieldingly bearing against the wall of the bore 32 beyond the Venturi formation therein.

In order to install the air charging control just described, it is only necessary to provide an opening in the wall of the tank 10 close to the point at which it is desired to substantially maintain the water level when the pump is not in operation. The opening in the wall of the tank 10 is internally threaded as shown by 50 (Figures 2 and 3). It will be noted that the maximum diameter of the float is less than the diameter of the opening in the tank, permitting the air charging control to be applied to the tank by first passing said float through the opening in the tank and then turning the threaded portion 27 of the fitting into engagement with the threads 50 of said opening. A gasket 51 may be disposed between a shoulder on the fitting and the outside of the tank to insure an air tight joint between the fitting and the tank wall. After the fitting has been screwed in the opening in the tank until the float arm occupies the position illustrated in Figure 2, a tube 52 extending from the suction side of the pump to the threaded extension 30 is connected to said extension by an internally threaded coupling sleeve 53. If desired, a suitable gasket 54 is arranged between the end of the tube 52 and the end of said extension, in order to insure a tight joint at this point. The connection of the other end of the tube 52 may be to the suction side of the pump itself, or to the upper portion of the line 21 leading to the pump where said line is subject to the suction of the pump and thus produces a differential pressure between the end of the tube 52 connected to the suction side of the pump, and that to which water flowing from the tank through the fitting into the tube from the other end thereof is subjected. Accordingly, when the valve 38 is opened, water is caused to flow from the tank through the tube 52. Said tube is of restricted capacity compared to the capacity of the pipe 21. A limited quantity of water will thus flow from the tank back to the suction side

of the pump, whenever valve 38 is unseated by the float.

The operation of the system, method and control constituting the present invention is as follows:

When water is drawn from the tank 10 by opening one or more of the faucets of the water supply system, there being sufficient volume of air in the tank above the water level, the level of the water drops below the point in the tank to which the air charging control device is applied. Such a point is indicated by 55 in Figure 2, which shows the position of the parts of the air charging control device when there is sufficient air in the tank. At such times the float 47 is spaced above the water level and the float 47 acts as a weight on the end of the float arm 46 holding the valve 48 against its seat 33 at one side of the Venturi formation. Accordingly, no flow occurs through the tube 52 and when the pump is automatically put in operation by virtue of a reduction of the pressure in the tank, due to the use of the water stored therein, the pump supplies water alone to the tank through the pipe 13, until the desired pressure is again built up on the tank.

As the water level rises to undesired levels, which occurs when there is an insufficient volume of air in the tank, the float 47 is lifted by the water to such a position as that indicated in Figure 3, which illustrates the position of the parts of the air charging control when additional air is needed in the tank to maintain the proper air cushion upon the water in the tank. As illustrated in said figure, when the float is lifted by an undesired rise of the level of the water in the tank, the float and arm acting through the bell-crank lever 42 shifts the valve to the left, viewing said figure, permitting a flow of water from the tank through the bore 32 the restriction 33, tube 52 to the suction side of the pump. The flow of water through the restriction 33 creates a suction at said restriction which serves to draw air through the snifter valve 37, said air mingling with the water passing through the restriction and passing to the suction side of the pump from which it is pumped into the tank with the water, replenishing air lost from the system by absorption of the cushioning air in the water normally used.

It will be observed that, inasmuch as the valve stem 39 passes through the restriction and that since the conical valve 38, when it is open, is disposed adjacent the outlet side of the venturi, the stream of water passing through the restriction is subdivided adjacent the point where air is introduced into said stream through the snifter valve. Such subdivision of the stream results in a breaking up of the air into minute bubbles, dispersed throughout the stream of water passing through the tube 52. The water passing from the tube 52, to the suction side of the pump, having minute air bubbles dispersed therethrough as stated, enters the larger stream of water lifted from the well by the action of the ejector and is mixed with said water as it enters the impeller of the pump. It has been found that when air is introduced in this manner to the suction side of the pump, neither the operating efficiency nor characteristics of the pumping system are adversely affected, though experience has shown that in a pumping system of the ejector type it is not practical to introduce substantial quantities of free air into said system without lowering

the efficiency of the pump and substantially altering its operating characteristics.

The pumping system continues to supply air to the tank 10 until the tank contains a sufficient volume of air to again cause the water level in the tank to drop to a point at which the float 47 acts as a weight and serves to prevent the further flow of water through the tube 52 back to the suction side of the pump. Whenever air is again lost from the system, due to absorption, or any other reason, the cycle of operations just described is repeated.

While the invention has been illustrated as applied to a pumping system including a pump of the ejector type, it will be understood that the air charging control is adaptable for use in connection with other pumping systems. When used with such systems, it is only necessary to connect the tube 52 to the suction side of the pump, whatever its nature, when the air charging control will function in a manner already described.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. A water pumping system, comprising a pump, a tank, a supply line leading to said pump and a delivery line extending from said pump to said tank, an air supply line connecting said tank and the suction side of said pump, a restriction in said air line, an air passage opening into said air supply line at said restriction, valve means to control the flow of air through said air passage, and further valve means arranged to control the flow of water through said air supply line, and mechanism to automatically govern said last named valve means to permit flow when the water in the tank reaches an undesired level and to prevent said flow when the water in the tank is at desired levels.

2. A water pumping system, comprising a pump, a tank, and connections between said pump discharge and tank, an air supply line extending from said tank to the suction side of said pump, a valve to control the flow through said air supply line, a float operatively connected to said valve and arranged to maintain said valve in closed position until the water in said tank reaches an undesired level and to then open said valve, a venturi in said air supply line, an air passage opening into said last named line at said venturi, and a spring controlled snifter valve in said passage.

3. In a water pumping system, comprising a pump, a tank and connections between said pump discharge and tank, an air supply arrangement for said system consisting of an air supply line extending from the tank at a point adjacent the desired water level to the suction side of the pump, a float-controlled valve arranged to prevent flow of water from said tank to said pump through said line unless the water rises to undesired levels and to then permit flow through said line, a restriction in said line, an air passage opening into said line at said restriction, and an air valve arranged to permit flow of air into

said line when water flows therethrough and to prevent air flow at other times.

4. In a water pumping system, comprising a pump, a tank and connections between said pump discharge and tank, an air supply arrangement for said system consisting of an air supply line extending from the tank at a point adjacent the desired water level to the suction side of the pump, a float-controlled valve arranged to prevent flow of water from said tank to said pump through said line unless the water rises to undesired levels and to then permit flow through said line, a venturi in said line, an air passage opening into said line at said venturi, and a spring-controlled air valve arranged to permit air to flow into said line when water flows through said venturi and to prevent air flow at other times.

5. A system of charging the tank of a water pumping system with air, comprising a tank, a pump, a conventional connection between said tank and pump discharge, a further connection from the tank to the suction side of the pump, means for automatically controlling the flow of water from the tank through said last named connection to the pump, said means permitting flow when the water in the tank reaches an undesired high level, a restriction in said last-named connection, an air passage adjacent said restriction, and a spring seated valve in said air passage, the flow of water through said restriction causing air to be drawn through said air passage into the stream of water in the form of minute bubbles when said means permits flow from said tank back to the pump.

6. A water supply system, comprising a pump, a tank, and conventional connections between said pump discharge and said tank, and an air charger consisting in a conduit extending from said tank back to the pump, an air passage opening into said conduit, a snifter valve in said air passage, a further valve to permit the flow of water through said conduit back to said pump, and mechanism to automatically maintain said last named valve closed when the water level is below a predetermined point in said tank and to automatically maintain said valve open when said level is above said point.

7. A water supply system, comprising a pump, a tank, and conventional connections between said pump discharge and said tank, and an air charger consisting in a conduit extending from said tank back to the pump, a restriction in said conduit, means in said conduit at said restriction to subdivide the water adjacent the restriction, an air passage opening in said conduit at said restriction, a snifter valve in said air passage, a further valve to permit the flow of water through said conduit back to said pump, and mechanism to automatically maintain said last named valve closed when the water level is below a predetermined point in said tank and to automatically maintain said valve open when said level is above said point.

8. A water supply system, comprising a pump, a tank and conventional connections between said pump discharge and tank, and an air charger comprising a conduit of restricted capacity extending from said tank back to the suction side of said pump, a venturi in said conduit, a conical element in said conduit adjacent said restriction to subdivide the stream of water as it passes through said conduit, and means to entrain air in said subdivided stream whereby the air enters the stream in the form of minute bubbles.

9. A water supply system comprising a tank, a

pump, and conventional connections between said tank and pump discharge, and an air charger comprising a conduit arranged to permit a small flow of water from the tank back to the pump, means to entrain air in the form of minute bubbles when water flows through said conduit, and a float-controlled valve to prevent the flow through said conduit when the tank has a sufficient volume of air above the water therein and to permit flow when the volume of air in said tank is insufficient.

10. An air charging control comprising a fitting having an externally threaded portion, a passage extending completely through said fitting and portion and having a restriction therein, a spring controlled air snifter valve in a further passage in said fitting intersecting said first named passage adjacent said restriction, a float movably attached to said fitting, a valve to control flow through said first named passage, mechanism operatively connecting said float and said last named valve, and attaching means having a passage in communication with said first named passage.

11. An air charging control comprising a fitting having a portion threaded externally, a bore extending completely through said fitting and portion and having a Venturi throat formation intermediate the length, a passage intersecting said bore at said formation, a spring controlled air snifter valve in said passage, a float movably attached to said fitting, a valve to control flow through said formation, mechanism operatively connecting said float and said last named valve, and attaching means having a passage in communication with said bore.

12. An air charging control comprising a fitting having a threaded attaching portion, a bore extending through said fitting and having a Venturi throat formation intermediate the length thereof, a passage intersecting said bore adjacent said formation, a spring controlled air snifter valve in said passage, a float movably attached to said fitting, a valve to control flow through said portion of said bore, said valve being seated on the Venturi throat portion of said bore at the side of said passage remote from said float, mechanism operatively connecting said float and said last named valve, and attaching means having a passage in communication with said bore.

13. An air charging control, comprising a threaded fitting having a bore extending completely therethrough, a restriction in said bore, a passage open to atmosphere intersecting said bore adjacent said restriction, a snifter valve controlling the flow of air through said passage, a valve controlling the flow through said restriction, mechanism including a float to operate said last named valve, and attaching means having a passage in communication with said bore.

14. An air charging control comprising a fitting having means for attachment and a bore provided with a Venturi throat formation, an air passage intersecting said bore at said formation, a valve controlling flow through said formation, a seat formed at one side of said formation, a valve stem extending through said formation adjacent an end of said bore, a float connected to said fitting, mechanism operatively uniting said float and stem, and attaching means having a passage in communication with said bore.

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