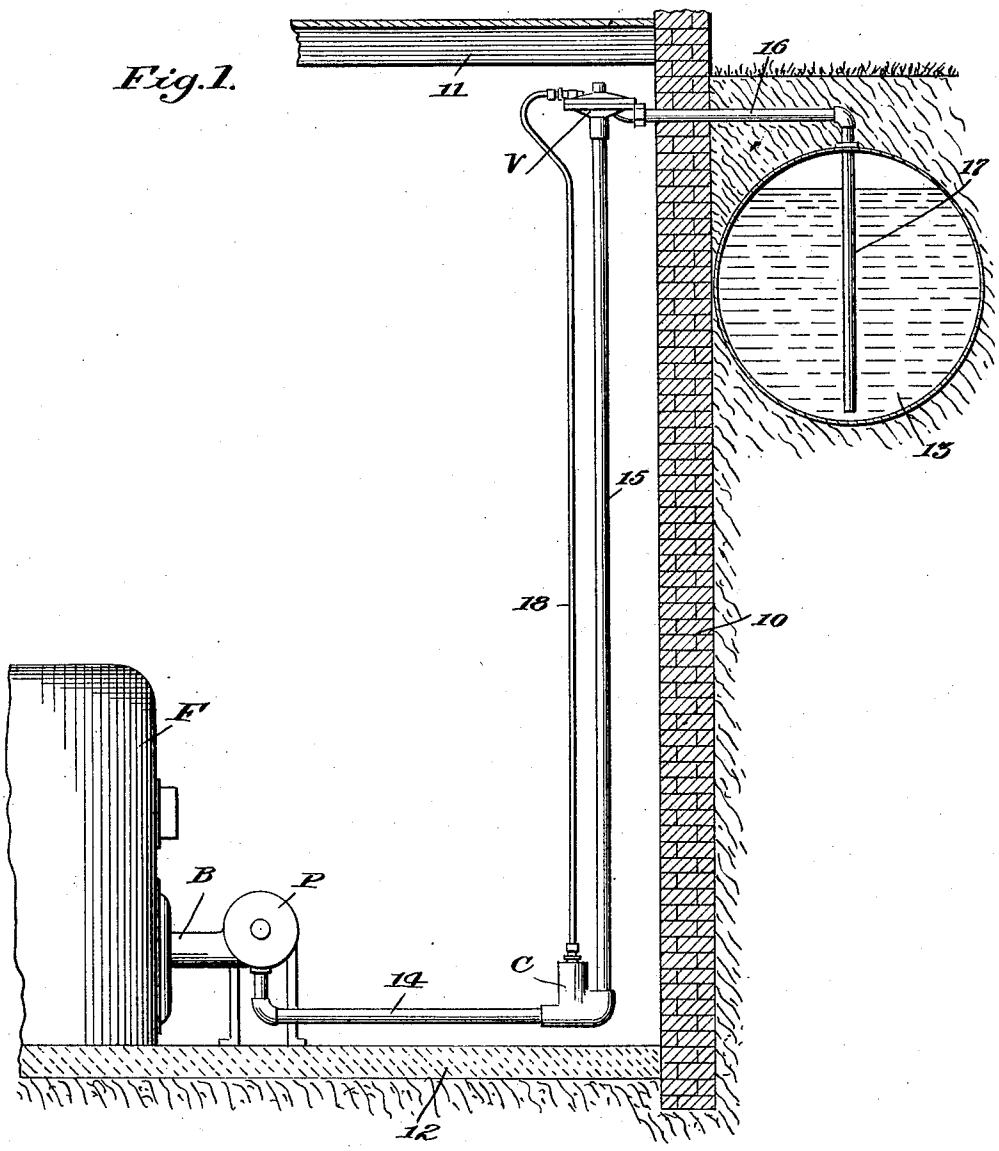
Dec. 16, 1930. A. U. WALTER 1,784,918

ANTISIPHONING SYSTEM

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Fig. 1.



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Fig. 2.

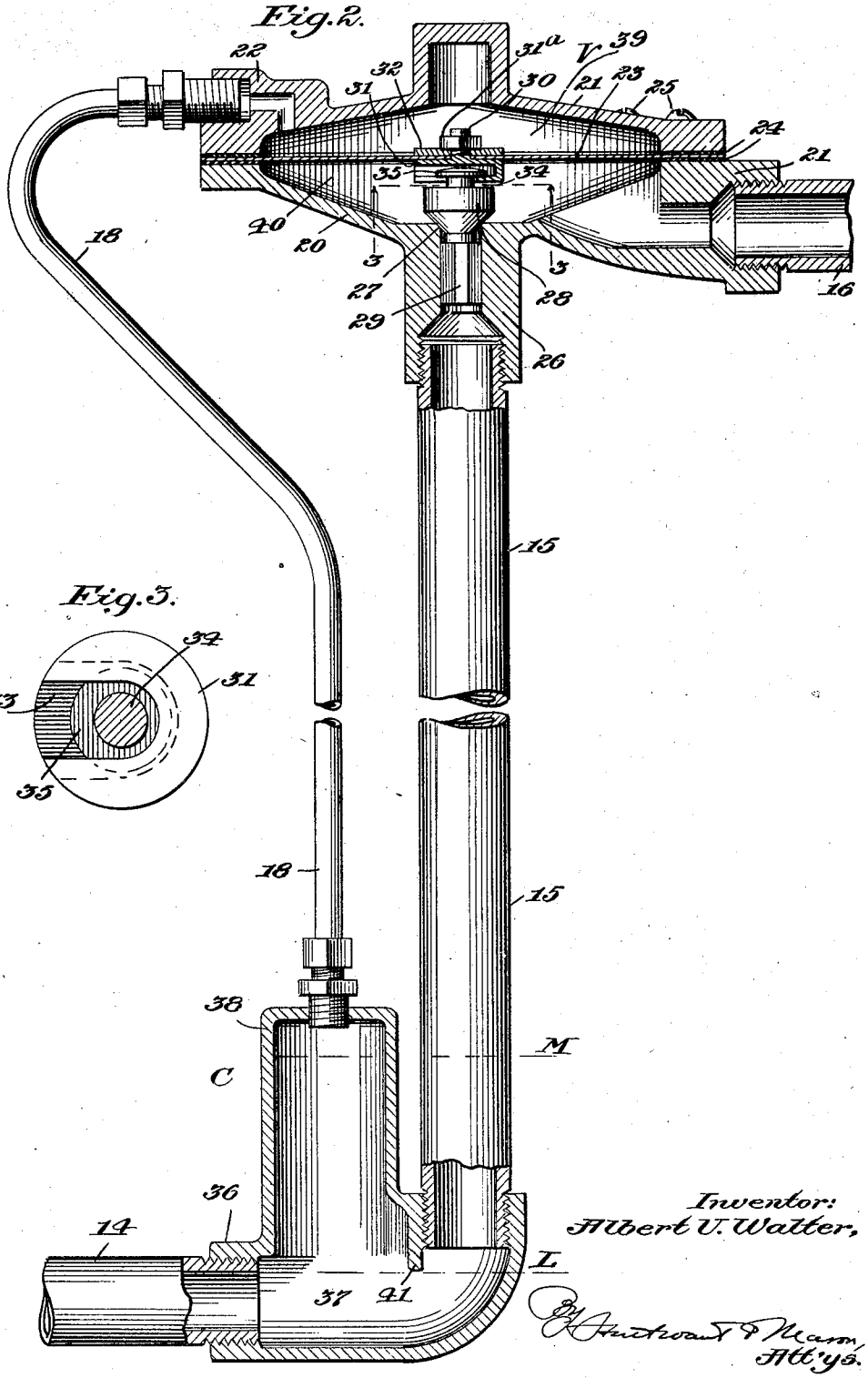


Fig. 3.

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UNITED STATES PATENT OFFICE

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ANTISIPHONING SYSTEM

Application filed November 22, 1927. Serial No. 234,975.

The invention relates to new and useful improvements in a liquid feeding system, and more particularly to a system which includes an elevated supply, a low level discharge, a siphon conduit connecting the supply with the discharge, and an anti-siphoning valve mechanism for stopping the flow of the liquid when the suction ceases. In a liquid feeding system of the above type, the anti-siphoning valve has heretofore been held open by the combined action of the head of the liquid in the discharge leg of the siphon, and by the suction of the pump, and is closed by a weight or spring which overcomes such head. Such systems require adjustments of the weight or spring to accord with the head on the liquid in the system to which it is applied, and are also limited as to the extent of head in which they can be used.

An object of the present invention is to provide an anti-siphoning valve and controlling means therefor in a system of the above type, wherein the valve is normally closed and is opened by means controlled by the operation of the pump, and which is entirely independent of the head of the liquid in the discharge siphon leg.

A further object of the invention is to provide a system of the above type, wherein the head of the liquid in the leg of the siphon leading to the supply aids in maintaining the valve closed.

A further object of the invention is to provide a liquid feeding system of the above type, wherein the controlling mechanism is of such a character that no priming of the system is required at initial starting.

With these and other objects in view as will appear in the course of the following specification and claims, I have shown an illustrative form of execution of the invention, in which:

Figure 1 is a diagrammatic sectional view through a building showing a fuel oil supply system according to this invention.

Fig. 2 is a sectional view through the valve and its controlling means, on a larger scale than Fig. 1.

Fig. 3 is a detail section of the valve structure substantially on line 3—3 of Fig. 2.

According to this invention, a fuel tank may be located so that its liquid level will at all times be above the furnace discharge. A fuel conduit system is provided between the tank and the motor driven pump. A control valve is located at a high point in this conduit to close the same against the passage of fuel oil when the motor ceases to operate. This valve is controlled by the suction upon the oil by the motor driven pump in the illustrative form.

In the accompanying drawings, a building is represented as having an external wall 10, a floor 11 and a basement having a floor 12. Outside of the building a fuel oil supply tank 13 is buried in the ground and is provided with the usual filling pipe (not shown) whereby the tank may be filled from the exterior in the usual way.

Within the cellar is located a furnace F having a burner B which is supplied by a blower fan P having an oil pump associated therewith for drawing oil from the supply tank 13 and delivering it to the burner B. Such pump, fan and burner constructions are old and well known in the art and no specific design is intended in the accompanying drawing, which merely illustrates this portion of the system in a conventional manner. Suffice it to say that the oil pump portion of the assembly P exerts a suction upon the conduit 14 which draws the oil through the vertical downcomer pipe 15 and the feed line pipe 16, 17. It will be seen that the length of the downcomer pipe 15 is greater than the length of the feed line pipe 17, so that in effect a siphon is produced whose longer leg 15 tends to constantly withdraw liquid from the tank

13 so long as the passage through pipes 17, 16, 15 is open.

Mounted at the end of the feed line pipe 16, 17 from the supply tank 13 and hence at the highest point of the system in this particular illustration, is a diaphragm valve V of the type to be described hereinafter. At the bottom of the downcomer pipe 15 is located an air trapping chamber C, the upper portion of which is connected by a vacuum pipe 18 with the diaphragm valve V.

As shown in Fig. 2, the diaphragm valve V comprises a lower casing 20 enclosing a lower chamber 40 having a lateral branch 21 therein to which is connected the supply pipe 16. The valve V likewise has an upper casing 21 enclosing an upper chamber 39 provided with a lateral branch 22 which has a passage therethrough in communication with the vacuum pipe 18. The diaphragm 23 is located between the peripheral flanges of the casing 20, 21 and is sealed therein by appropriate gaskets 24. Cap screws 25 are employed to hold the casings 20, 21 together and in sealing relationship with the diaphragm 23.

The lower casing 20 is likewise provided with a downwardly extending boss 26 into which the downcomer pipe 15 is threaded; and a fuel oil passage establishes communication between the interior of the downcomer pipe 15 and the lower chamber 40. The mouth of the passage through the boss 26 is formed as a valve seat 27 to receive the conical valve member 28 which is provided with the guide section 29 extending into the passage through the boss 26 and being guided by the wall thereof. The diaphragm 23 may be located at such a distance from the valve seat 27 in proportion to the size of the valve that there is a normal bias by the diaphragm to hold the valve closed against its seat: so that when pressures above and below the diaphragm are balanced the valve 28 closes its seat 27.

The diaphragm 23 has a central aperture to receive a threaded stub 30 of a valve supporting plate 31*a*. The washer 32 is placed above the diaphragm about the stub 30 and a clamping nut 31 holds the assembly rigidly together and seals the orifice through the diaphragm 23. The valve supporting member (Fig. 3) has a T-shaped slot 33 extending radially into it to receive the reduced neck 34 of the valve 28: while the end flange or head 35 of the valve is seated in the extension of the T-shaped slot so that the valve body is free to move in any direction parallel to the plane of the diaphragm (Fig. 3) and is therefore self-alining by reason of the guide section 29, while the play permitted between the several parts as shown in Fig. 3 compensates for any eccentricity or irregularity of shape relatively between the diaphragm and the lower casing 20.

The chamber C comprises the connection 36 to receive the end of the oil supply pipe 14 and is provided with a direct and open passage 37 to establish communication between the lower end of the downcomer pipe 15 and this oil pipe 14. Upwardly extending from and in communication with the chamber having the passage 37 is the dome or air trap 38, which as indicated above communicates with the vacuum pipe 18.

In a specific embodiment which has been mentioned, the diameter of the diaphragm 23 was about 3½ inches, which with the particular structure represented an effective pressure area of about four square inches. The vacuum pipe 18 was about 3/64 of an inch in internal diameter: while the air chamber 38 had a volume substantially greater than the volume of the vacuum pipe 18 and the upper chamber 39.

In operation, when the supply tank 13 contains fuel oil and the motor driven fan and pump P is driven, a suction is created in the pipe 14 which is communicated on the one hand through the downcomer pipe 15 and on the other hand through the vacuum pipe 18. At the moment, the lower chamber 40 is at or slightly above atmospheric pressure, by reason of the filling of tank 13. If the pressure in this middle chamber has been much above atmospheric, the pressure upwardly against the diaphragm more than compensates the downward pressure upon the valve 28 and the valve 28 has been raised slightly to permit the air to escape downward through the downcomer pipe 15.

As soon as suction occurs in the pipe 18, the difference of pressure between the atmospheric beneath the diaphragm 23 and the partial vacuum above this diaphragm will raise the diaphragm and therewith the valve body 28 so that the suction existing in downcomer pipe 15 is transmitted to the supply pipe 16, 17 and fuel oil is sucked up through these pipes into the chamber beneath the diaphragm 23 and drops downward in the downcomer pipe 15 and passes to the oil pump in the assembly P and is then delivered to the furnace. It will particularly be noted that substantially the same degree of vacuum is exerted upon the top of the large diaphragm 23 and beneath the valve body 28: thus making the diaphragm and valve structure in effect a differential piston which, by reason of the greater area above the diaphragm, causes the valve to open. The valve therefore is held open by a difference of pressure created by the suction of the motor-driven pump in its effect in the air chamber 38.

If the pump stops, fuel oil may momentarily run out of the lower chamber 40, downwardly in downcomer pipe 15, and thus create a higher liquid level in the air chamber 38: also oil in the pump P may contribute to the same increase of oil level, since it

will be noted that the delivery of oil in the pump P is above the top of the chamber C in Fig. 1.

During the operation of the pump, the liquid level in the chamber 38 will be substantially at the line "L" (Fig. 2) determined by the upper wall of pipe 14 and the bottom of flange 41 in chamber 37, for if there is a surplus of air in the chamber 38, in the vacuum pipe 18 and in the chamber 39 before the pump starts, it is sucked from the bottom of the chamber C and then through the pipe 14.

When the motor stops the vacuum which existed in 38, 18 and 39 is practically relieved due to the oil passing through the valve 28 and thence into pipe 15. Due to the decrease in this vacuum, the oil rises into the chamber 38 to a level such as that represented at M. However, as soon as this vacuum is relieved, there is approximately atmospheric pressure in the chamber 39 and a vacuum in chamber 40 which is substantially equal to the head of oil from the chamber 40 to the level of the oil in the tank 13. This difference in pressure moves the diaphragm 23 downward thereby forcibly closing the valve 28. The flow of oil from the tank 13 to the pump P is now shut off and no siphoning or flooding can occur.

It will be noted that, by reason of the area of the diaphragm 23 multiplied by the difference in pressure per square inch in chambers 39 and 40, the valve is very firmly seated. In addition the valve 28 is also held firmly seated since it is drawn down by the liquid head of oil in the downcomer line 15.

As soon as the motor pump is started again, the fuel oil is sucked out of chamber 38, again producing a reduced pressure in the vacuum pipe 18 and causing a lift of the diaphragm 23 and therewith of the valve 28, so that fuel oil is again drawn through pipes 17, 16, 15 and may again pass into the burner.

The system is especially free from danger by reason of leakage or breakage of the parts. Breakage or leakage in the pipes 16 and 17 will merely permit air to enter the system and this condition will be revealed by the improper operation of the burner: or if a severe leak occurs, no fuel oil can be pumped from the tank 13. If a leak occurs in the vacuum pipe 18, atmospheric pressure will be brought upon the upper side of the diaphragm 23, causing it to seat the valve 28 immediately. If a break occurs in the suction line 18, the valve 28 is not only seated but if a break occurs in the pipe 15, only the liquid therein will be discharged at most. If a break occurs in the diaphragm 23, the valve will then become inoperative, since its operation is dependent on difference of pressure.

In the particular assembly of construction stated above, it was found that a very slight suction by the pump in the assembly P would open the valve 28; and in particular that a pump pressure resulting in a pressure of three pounds per square inch below atmospheric immediately below the valve seat 27 effectively operated the valve 28 when the suction head from the liquid level in tank 13 to the valve V was two pounds per square inch below atmospheric. It will readily be seen that the actual pressure required to open the valve is the difference between the above pressures or one pound.

When the pump stopped, the rise of liquid level in the chamber C reduced the vacuum in the chamber 39. Since the effective area of the diaphragm used was four square inches and since approximately atmospheric pressure existed above the diaphragm, it will be readily seen that the suction head from the valve V to the tank 13 of two pounds per square inch gave a total closing pressure on the valve 28 of eight pounds. This, of course, is far more than is required to positively close the valve and thereby gives a large factor of safety.

The design of the system with the valve 28 seated upon the valve seat 27 of the discharge pipe causes the flowing oil to constantly wash this valve seat and prevent the accumulation of grit or dust upon the seat itself.

Owing to the design of the system, it is unnecessary to make adjustment either for the drop of the suction pipe 17 leading to the supply tank 13: or for the drop of the downcomer pipe 15 below the liquid levels in the supply tank 13.

It is obvious that the invention is not limited to the specific illustration: but that it may be modified in many ways within the scope of the appended claims.

What is claimed as new is:

1. In a liquid feeding system having an elevated supply and a low level dicharge, with a siphon conduit connecting the supply and discharge, a suction pump to draw the liquid through the conduit, a valve for closing said conduit located therein at a point above the liquid level in the elevated supply, means for normally holding said valve closed when there is no suction on the line, and means operating independently of the head of liquid between the valve and the pump for opening the valve and holding said valve open during the operation of the pump and for permitting said valve to close when the pump suction ceases.

2. In a liquid feeding system having a supply tank located above the discharge and connected thereto by a conduit having a suction pump therein, a valve located in said conduit at a high point thereof, means providing a chamber on said conduit between said valve and pump and adapted to be drained by said pump when operating and to

be filled by the liquid when said pump is not operating, and means connecting said chamber and valve whereby to close the latter when said chamber fills with liquid.

3. In a liquid feeding system having an elevated supply and a low level discharge with a conduit connecting the supply and discharge, a suction pump to draw the liquid through the conduit, a valve for closing said conduit located therein at a point above the liquid level in the elevated supply, said valve normally tending to close said conduit during suction therein, and a control device for said valve including means operated by the pump while operating to open the valve and permit the flow of liquid from said supply to said discharge, said means including means providing a chamber, a movable member associated with said chamber and responsive to variations in pressure in said chamber, said movable member being connected to said valve, and a member having a passage independent of said conduit and connecting said chamber to said conduit between the valve and the pump to produce pressure variations in said chamber.

4. In a liquid feeding system having an elevated supply and a low level discharge with a conduit connecting the supply and discharge, a suction pump to draw the liquid through the conduit, a valve for closing said conduit located therein at a point above the liquid level in the elevated supply and operated to be closed by suction in said conduit, and a control means for said valve including means providing a chamber, a movable member associated with said chamber and responsive to variations in pressure in said chamber, said movable member being connected to said valve, and a member having a passage independent of said conduit and connecting said chamber to said conduit between the valve and the pump, said passage having an enlarged portion adapted to receive and retain any liquid forced from the conduit into the passage by the head on the liquid between the valve and the connection when the suction on the conduit ceases, whereby to limit the rise of liquid level in said passage.

5. In a liquid feeding system having an elevated supply and a low level discharge with a conduit connecting the supply and discharge, a suction pump to draw the liquid through the conduit, a valve for closing said conduit located therein at a point above the liquid level in the elevated supply and operated to be closed by suction in said conduit, and a control means for said valve including means providing a chamber, a movable member associated with said chamber and responsive to variations in pressure in said chamber, said movable member being connected to said valve, and a pipe independent of said conduit and connecting said chamber to said conduit at a point thereof below said valve so that liquid from said conduit may rise in said pipe when the pump stops.

6. In a liquid feeding system having an elevated supply and a low-level discharge with a conduit connecting the supply and discharge, a suction pump to draw the liquid through the conduit, a valve for closing said conduit located therein at a point above the liquid level in the elevated supply, a control means for said valve including means providing a chamber, a movable member associated with said chamber and responsive to variations in pneumatic pressure in said chamber, said movable member being connected to said valve, and a pipe connecting said chamber to said conduit at a point thereof below said valve so that liquid from said conduit may rise in said pipe when the pump stops and thereby increase the pressure, said pipe having an enlarged portion which is adapted to receive and retain any liquid forced from the conduit into said enlarged portion of the pipe by the head on the liquid between the connection and the valve when the suction on the conduit ceases.

7. In a liquid feeding system having an elevated supply and a low level discharge with a siphon conduit connecting the supply and discharge, a suction pump to draw the liquid through the siphon conduit, a housing located at a high point of said siphon conduit, a diaphragm dividing said housing into two chambers, one chamber of said housing communicating with said conduit, a valve element connected to said diaphragm and adapted to close said conduit, and a pipe connecting the other chamber with said conduit at a low point thereof intermediate said valve and pump.

8. In a liquid feeding system having an elevated supply and a low level discharge with a conduit connecting the supply and discharge, a suction pump to draw the liquid through the conduit, a valve located in said conduit at a high point thereof, means providing an air chamber on said conduit, a housing having a diaphragm therein operatively connected to the valve, and a pipe establishing communication between said chamber and said housing.

9. In a liquid feeding system having a supply tank located above a discharge and connected to said discharge by a conduit having a suction pump therein, a valve located in said conduit at a high point thereof and operated to be closed by suction in said conduit, means providing a chamber on said conduit between said valve and pump to receive liquid from the conduit when the pump is at a standstill, such liquid being evacuated from the chamber when the pump is running, a tube of lesser cross-sectional area than said chamber in communication with said chamber and independent of said conduit, and means ac-

tuated by the differences in pressure in said tube and said conduit to operate said valve to open the same when the pump is operating and to close the same when the pump is not operating.

10. In a liquid feeding system having an elevated supply and a low level discharge with a conduit connecting the supply and discharge, said conduit having a portion lower than the discharge, a suction pump to draw liquid through the conduit and deliver it to the discharge, a valve located in said conduit, means providing an air chamber located at a low point of said conduit below the level of the discharge whereby said chamber accumulates liquid when the pump is at a standstill, and means operated by the draining of liquid from said chamber by the operation of said pump to open the valve and operated by the filling of liquid into said chamber to close said valve when the pump stops.

11. In a liquid feeding system having an elevated supply and a low level discharge with a conduit connecting the supply and discharge and extending above the maximum liquid level in the said supply, a suction pump to draw liquid through the conduit, a valve located in said conduit at the high point thereof, said valve being constructed and arranged to be closed by a suction from said pump through said conduit, and means operated during the actuation of the pump to open said valve against the suction in said conduit.

12. In a liquid feeding system having an elevated supply and a low level discharge with a siphon conduit connecting the supply and discharge, a suction pump to draw the liquid through the conduit, a valve and a valve operating device for closing said conduit and located therein at a point above the liquid level in the elevated supply, said valve and device being actuated by liquid in the portion of the conduit between the valve and the discharge to close the valve, and means energized by the pump while operating to actuate said valve device to open the valve against the actuation by such liquid.

13. In a liquid feeding system as in claim 12, said conduit having means providing a chamber and located at a low point of the conduit, means associated with said chamber to actuate the valve, whereby the pump suction will remove liquid from the chamber and operate through said chamber means for opening the valve, while the stoppage of the pump will permit the rise of the liquid level in said chamber and open through the chamber means for closing the valve.

14. In a liquid feeding system as in claim 12, said conduit having means providing an enlarged chamber at a low point thereof, and said valve operating device comprises a diaphragm and housing divided into two, valve chambers by said diaphragm, the conduit including one valve chamber, said valve operating to close the outlet from said chamber and being of lesser area than said diaphragm, and a suction pipe from said enlarged chamber communicating with the other valve chamber whereby said diaphragm will respond to differences of pressure in said enlarged chamber.

In testimony whereof, I affix my signature.

ALBERT U. WALTER.