FLUIDIC CONTROLLED REFILL SYSTEM

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ABSTRACT

A fluidically controlled refill system which automatically maintains the flow of the refill fluid until a predetermined liquid level or fluid pressure is achieved in the container to be filled. The system includes a diaphragm which interacts with the main valve to hold the valve in the open position during the filling operation, and a fluid switching device which causes the pressure on the diaphragm to decrease in response to predetermined conditions and thus close the main valve.

11 Claims, 9 Drawing Figures
FLUIDIC CONTROLLED REFILL SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention
   This invention relates to a fluid refill system, and, more particularly, to such a system which is controlled by a fluidic switching mechanism.

2. Description of the Prior Art
   The need for an efficient, reliable refill system for a variety of applications has long existed. For example, the various types of refill devices normally used in water closets are characteristically noisy, and are subjected to excessive wear. Also they do not normally stay in the full open position during the entire filling operation, but rather have to begin a slow close procedure well before the tank is completely full. Furthermore, these valves require the use of a large float and a lever arm mechanism, etc., which are relatively bulky in size and expensive to manufacture and assemble.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a refill system which is inexpensive, efficient and reliable, as well as being relatively quiet and durable.

It is a further object of the present invention to provide a refill system that may be maintained completely in the open position during the entire refill cycle, and then closed in a relatively short time to stop the refill cycle.

Briefly summarized, the system of the present invention comprises a first conduit connecting an inlet and outlet for the tank to be filled, valve means disposed in said first conduit and normally closed to prevent fluid from therethrough, a fluid chamber, means in said fluid chamber responsive to a predetermined fluid pressure in said fluid chamber for moving said valve means to an open position, a second conduit adapted to directly connect said inlet to said fluid chamber to establish said predetermined pressure in said fluid chamber, a flow switching chamber connected between said first conduit and said fluid chamber and normally permitting fluid flow therethrough to maintain said predetermined pressure in said fluid chamber, and switching means in said flow switching chamber responsive to a predetermined fluid flow from said outlet for switching fluid flow to and from said fluid chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

Reference is now made to the accompanying drawings for a better understanding of the nature and objects of the refill system of the present invention, which drawings illustrate the best mode presently contemplated for carrying out the objects of the invention and its principles, and are not to be construed as restrictions or limitations on its scope. In the drawings:

FIG. 1 is a schematic illustration of the refill system of the present invention;
FIGS. 2-5 are schematic illustrations of modifications of the refill mechanism according to the present invention; and
FIGS. 6-9 are partial schematic illustrations depicting various arrangements of the main valve and its associated structure.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The refill system of the present invention will be described in connection with the refilling of the main tank of a water closet by means of example, it being understood that it can be applied to any other related device. As shown in FIG. 1, a water inlet 10 is adapted to supply water to an outlet 12 by means of a conduit 14 and its branches 14a and 14b, it being understood that the inlet 10 is connected to the main water source and that the outlet 12 empties into the main tank of the closet. A secondary outlet 12a extends from the main outlet 12 and may be used in this embodiment to supply some water flow directly to the water closet bowl to wash down the latter during the tank refill operation.
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The embodiment of FIG. 5 is designed so that it provides a single outlet for the fluid flow. Particularly, an inlet 80 registers with a conduit 84, with the head portion 86c of a valve 86a adapted to cooperate with a seat formed adjacent the conduit 84 to control the flow of fluid therethrough. A diaphragm 90 is disposed in a fluid chamber 92 and is attached to a shoulder portion 86d of the valve 86. A plunger 86c is formed on the valve and is adapted to be pulled upwardly as viewed in FIG. 5 to move the head portion 86a to an open position as shown by the dotted lines.

A nozzle 100 of a fluid switching device is in communication with the conduit 84 and with two outlet conduits 102 and 104, both of which register with a single outlet 106. A vent tube 108 is provided which operates as in the previous embodiments to switch flow between the outlet conduits 102 and 104. During the refill operation, water flows from the nozzle 100 into the conduit 102 by virtue of the air supplied by the vent tube 108. A large portion of the flow from conduit 102 is directed into the main outlet 106, and a small portion of the flow passes, via a conduit 110, into the bottom portion of the fluid chamber 90 to exert an upwardly extending pressure on the diaphragm 90 and provide the necessary force to maintain the valve member 86 in its open position despite a later release of the plunger 86c. When the fluid level in the tank reaches the height of the free end of the vent tube 108 and thereby blocks the flow of air, the flow of water from the nozzle 100 is diverted into the conduit 104 and flows directly into the outlet 106. The pressure exerted upwardly on the diaphragm 90 is thus relieved and the force of the water flowing from the inlet 80 downwardly onto the head portion 86c of the valve 86 will cause the latter to move into its closed position and thus terminate the refill operation.

It can be appreciated that several modifications of the exact structure and particular arrangement of the valve members 86a is possible while their associated structure can be made within the scope of the above invention. For example, the embodiment of FIG. 6 is identical to the embodiment of FIG. 5, with the exception that the valve 86 has an enlarged portion 86d forming a shoulder which is engaged by a spring 120 which applies a force in addition to the force applied by the water pressure from the inlet 80, to urge the valve 86 into its downward closed position. This, of course, will cause the valve to seat firmly and will eliminate any flow therethrough after the fluid level in the tank has reached its predetermined level.

The embodiment of FIG. 7 a spring 122 is provided between the shoulder 86d and the upper wall of the chamber 92 to urge the valve head (not shown) against its seat, as in the previous embodiment.

The embodiment of FIG. 8 is similar to that of FIG. 5, but is designed to permit a slower closing of the valve 86. Specifically, the upper portion of the chamber 92 contains fluid and is in communication with a dash pot 124 via a restricted conduit 126. The arrangement is such that fluid in the upper chamber portion must flow through the conduit 126 into the dash pot 124 when the valve 86 moves upwardly to its open position as viewed in FIG. 8. Conversely, the fluid must flow from the dash pot through the conduit 126, and into the upper portion of the chamber 92 when the valve 86 moves downwardly into a closed position. In this manner, a slower closing of the valve is achieved by virtue of the dash pot 124 and the conduit 126, thus eliminating the water hammer problem described above which is normally associated with rapid closing valves.

A still further variation of the arrangement of FIG. 5 is shown in the embodiment of FIG. 9 in which the conduit 110 has an enlarged portion 110a containing a ball valve 130. Two other portions 110b and 110c of the conduit 110 connect the portion 110a to the chamber 92 and to the conduit 102, respectively. A plurality of flutes or grooves (not shown) are formed in the portion 110b of the conduit 110. In this manner, when water flows through the conduit 110 into the fluid chamber 92, the ball valve 130 moves towards a seat defined by the conduit portion 110b, whereby water will flow rapidly through the flutes formed in the latter portion and into the
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When fluid is switched from the conduit 102 and therefore from the conduit 110, the fluid in the lower portion of the chamber 92 will begin to flow through the conduit 110 into the conduit 102. The ball valve 130 will thus be forced against a seat formed by the conduit portion 110c. The diameter of the ball valve 110 can be designed so that a small fluid flow will be permitted in the latter position of the ball valve so that the valve 86 will close gradually and thus prevent a water hammer.

It can be appreciated that several other variations of the above system may be made within the scope of the present invention. For example, other types of valve heads can be used other than those shown in the embodiments of FIGS. 1-5, such as ball valves connected to the stem portions. Also, the vent tubes disclosed above may be made adjustable to vary the desired water level in the tank and can be in the form of a vacuum line, or the like. Also, the variations of FIGS. 6-9 can be applied to the embodiments of FIGS. 1-4 as well as to the embodiment of FIG. 5.

Of course, other variations of the specific construction and arrangement of the refill system disclosed above can be made by those skilled in the art without departing from the invention as defined in the appended claims.

1 claim:

1. Apparatus for controlling fluid flow between an inlet and at least one outlet, said apparatus comprising a first conduit connecting said inlet and outlet, valve means disposed in said first conduit and normally closed to prevent flow therethrough, a fluid chamber, means in said fluid chamber responsive to a predetermined fluid pressure in said fluid chamber for moving said valve means to an open position, a second conduit adapted to directly connect said inlet to said fluid chamber to establish said predetermined pressure in said fluid chamber, a fluidic flow switching chamber having at least one stable state and connected between said first conduit and said fluid chamber and normally permitting fluid flow therebetween to maintain said predetermined pressure in said fluid chamber, and switching means in said fluidic flow switching chamber responsive to a predetermined fluid flow from said outlet for switching fluid flow to and from said fluid chamber.

2. The apparatus of claim 1 further comprising a third conduit registering with said fluidic flow switching chamber, said switching means adapted to switch fluid flow from between said fluid chamber and said third conduit.

3. The apparatus of claim 1 further comprising an additional valve means disposed in said second conduit, said additional valve means being manually actuated to connect said inlet to said fluid chamber.

4. The apparatus of claim 1 wherein said fluid switching chamber comprises, a power nozzle, a first switching chamber conduit, a second switching chamber conduit and a control port connection said first switching chamber conduit being connected between said flow switching chamber and said fluid chamber to permit fluid flow between said flow switching chamber and said fluid chamber to maintain said predetermined pressure in said fluid chamber, said flow switching chamber power nozzle being arranged to receive flow from said first conduit.

5. The apparatus of claim 1 wherein said switching means comprises vent means registering with said flow switching chamber, and adapted to supply air to said chamber to permit fluid flow between said first conduit and said fluid chamber.

6. Apparatus of claim 5 further comprising a tank for said fluid, said vent means extending into said tank and adapted to be submerged upon the fluid reaching a predetermined level in said tank to restrict the supply of air to said chamber to effect said switching.

7. Apparatus for controlling fluid flow between an inlet and at least one outlet, said apparatus comprising a conduit connecting said inlet and outlet, valve means disposed in said conduit and normally closed to prevent flow therethrough, actuating means directly connected to said valve means for moving said valve means to an open position, a fluid chamber, means in said fluid chamber responsive to a predetermined fluid pressure in said chamber for maintaining said valve means in said open position, a fluidic flow switching chamber having at least one stable state and connected between said conduit and said fluid chamber, and switching means in said fluidic flow switching chamber responsive to a predetermined fluid flow from said outlet for switching fluid flow to and from said fluid chamber, and an additional conduit registering with said fluidic flow switching chamber, said switching means adapted to switch fluid flow from between said fluid chamber and said additional conduit.

8. Apparatus for controlling fluid flow between an inlet and at least one outlet, said apparatus comprising a conduit connecting said inlet and outlet, valve means disposed in said conduit and normally closed to prevent flow therethrough, actuating means directly connected to said valve means for moving said valve means to an open position, a fluid chamber, means in said fluid chamber responsive to a predetermined fluid pressure in said chamber for maintaining said valve means in said open position, a fluidic flow switching chamber having at least one stable state and connected between said conduit and said fluid chamber and normally permitting fluid flow therebetween to maintain said predetermined pressure in said fluid chamber, and switching means in said fluidic flow switching chamber responsive to a predetermined fluid flow from said outlet for switching fluid flow to and from said fluid chamber, and said apparatus comprising: a conduit connecting said fluid chamber to said outlet for switching fluid flow to and from said fluid chamber, and a tank for said fluid, said actuating means comprising a plunger extending outwardly from said tank and adapted to be actuated manually.

9. Apparatus for controlling fluid flow between an inlet and at least one outlet, said apparatus comprising a conduit connecting said inlet and outlet, valve means disposed in said conduit and normally closed to prevent flow therethrough, actuating means directly connected to said valve means for moving said valve means to an open position, a fluid chamber, means in said fluid chamber responsive to a predetermined fluid pressure in said chamber for maintaining said valve means in said open position, a fluidic flow switching chamber having at least one stable state and connected between said conduit and said fluid chamber and normally permitting fluid flow therebetween to maintain said predetermined pressure in said fluid chamber, and switching means in said fluidic flow switching chamber responsive to a predetermined fluid flow from said outlet for switching fluid flow to and from said fluid chamber, each of said fluid chambers being provided with a conduit connecting said fluid chamber to said outlet for switching fluid flow to and from said fluid chamber, and a tank for said fluid, said actuating means comprising a plunger extending outwardly from said tank and adapted to be actuated manually.

10. Apparatus for controlling fluid flow between an inlet and at least one outlet, said apparatus comprising a conduit connecting said inlet and outlet, valve means disposed in said conduit and normally closed to prevent flow therethrough, ac-
tuating means directly connected to said valve means for moving said valve means to an open position, a fluid chamber, means in said fluid chamber responsive to a predetermined fluid pressure in said chamber for maintaining said valve means in said open position, a fluidic flow switching chamber having at least one stable state and connected between said conduit and said fluid chamber and normally permitting fluid flow therebetween to maintain said predetermined pressure in said fluid chamber, and switching means in said fluidic flow switching chamber responsive to a predetermined fluid flow from said outlet for switching fluid flow to and from said fluid chamber, and said means for maintaining said valve means in said open position comprising a diaphragm disposed in said fluid chamber and connected to said valve means, said diaphragm being movable in response to changes in fluid pressure in said chamber, and a dash pot connected to said fluid chamber for controlling the rate of fluid flow from said chamber.

11. Apparatus for controlling fluid flow between an inlet and at least one outlet, said apparatus comprising a conduit connecting said inlet and outlet, valve means disposed in said conduit and normally closed to prevent flow therethrough, actuating means directly connected to said valve means for moving said valve means to an open position, a fluid chamber, means in said fluid chamber responsive to a predetermined fluid pressure in said chamber for maintaining said valve means in said open position, a fluidic flow switching chamber having at least one stable state and connected between said conduit and said fluid chamber and normally permitting fluid flow therebetween to maintain said predetermined pressure in said fluid chamber, and switching means in said fluidic flow switching chamber responsive to a predetermined fluid flow from said outlet for switching fluid flow to and from said fluid chamber, and said means for maintaining said valve means in said open position comprising a diaphragm disposed in said fluid chamber and connected to said valve means, said diaphragm being movable in response to changes in fluid pressure in said chamber, and an additional conduit connecting said fluidic flow switching chamber and said fluid chamber, and a ball valve disposed in said additional conduit for controlling the rate of fluid flow from said chamber.