Dec. 10, 1946. L. B. GREEN 2,412,452

FLUSH TANK CONTROL

Filed Feb. 28, 1944 2 Sheets-Sheet 1

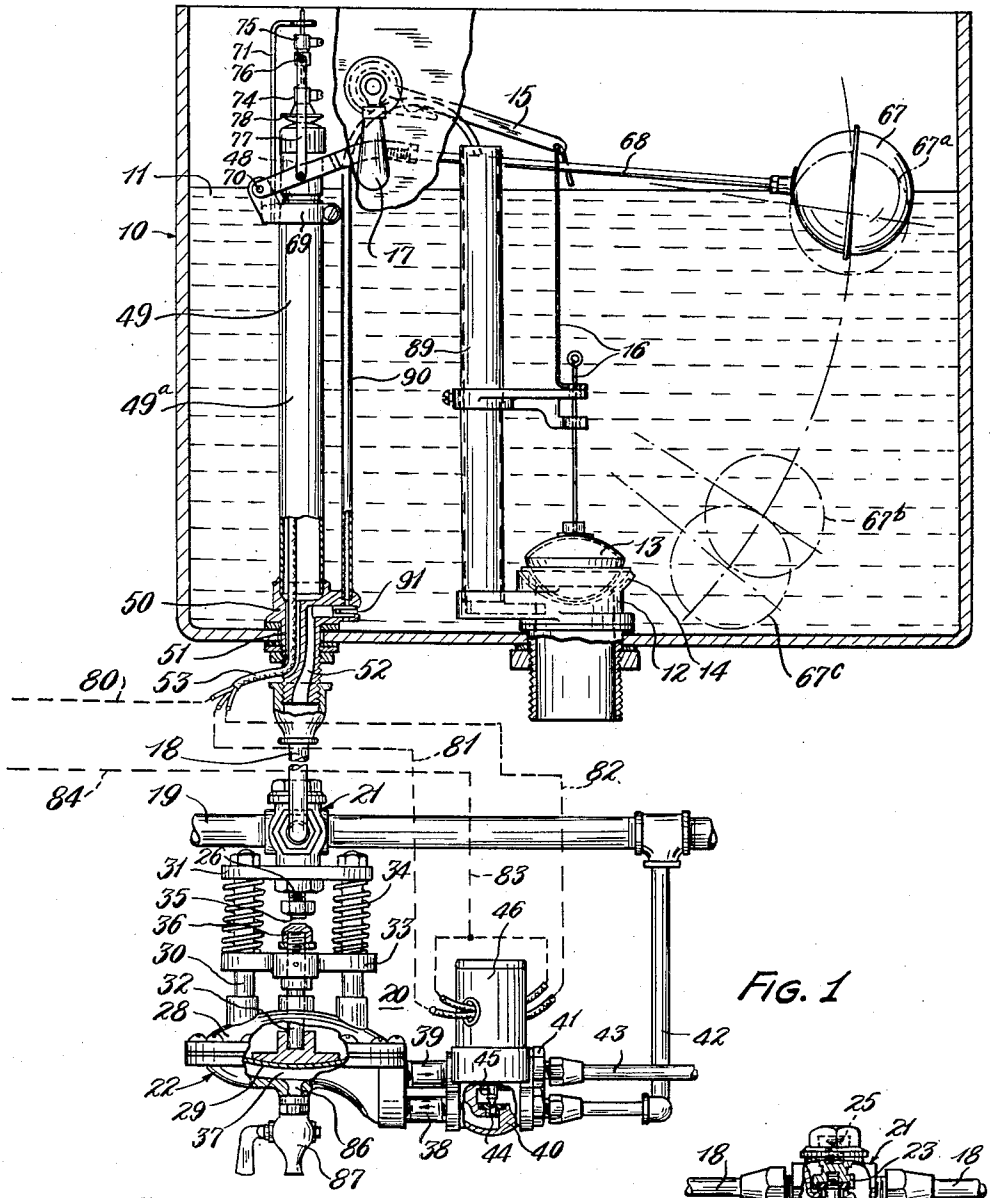

FIG. 1

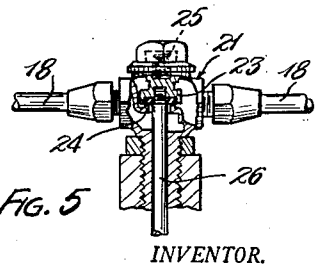

FIG. 5

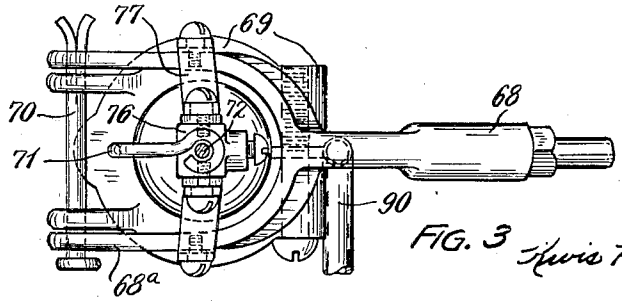

FIG. 3

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FLUSH TANK CONTROL

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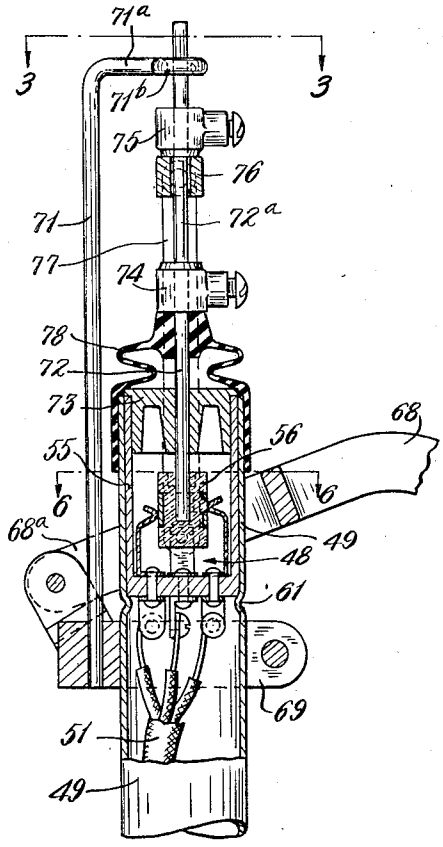

FIG. 2

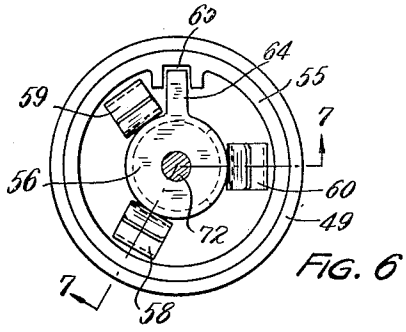

FIG. 6

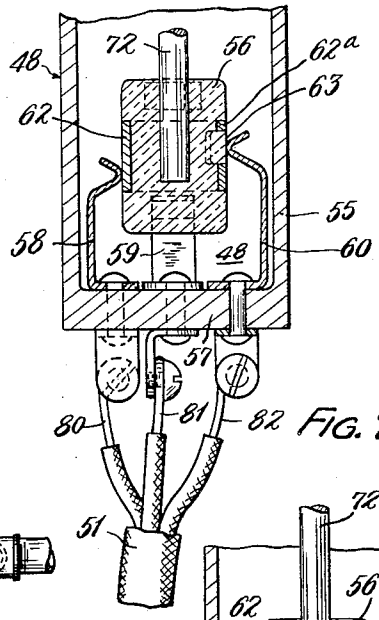

FIG. 7

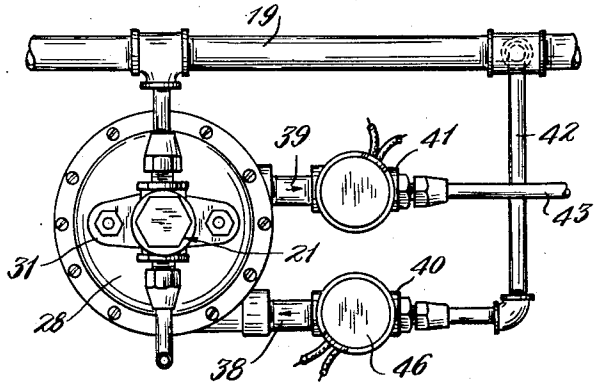

FIG. 4

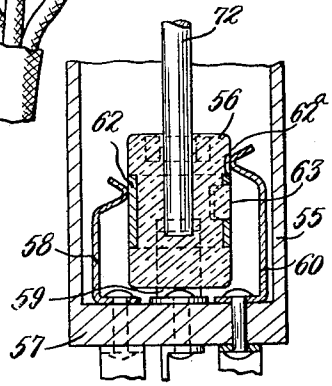

FIG. 8

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FLUSH TANK CONTROL

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Application February 28, 1944, Serial No. 524,226

1 Claim. (Cl. 137—68)

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This invention relates to water distributing systems and more particularly to a control for the filling of flush tanks or the like.

An object of this invention is to provide novel means for controlling the filling of flush tanks, or the like, and by which the filling can be carried out in a quiet, efficient and reliable manner.

Another object of the invention is to provide novel control means, of this kind, permitting the use of a remotely located valve for controlling the supply of water to the tank.

Still another object of this invention is to provide novel means by which the filling of a flush tank, or the like, can be electrically controlled.

Yet another object of the present invention is to provide novel control means, of the character mentioned, in which a float-actuated switch located at the tank controls the remotely located water supply valve.

It is also an object of this invention to provide tank control means of this character, wherein novel safety means prevents overfilling of the tank in the event of current failure during the filling operation.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings, in which

Fig. 1 is an elevational view, partly in section and somewhat diagrammatic in form, showing tank filling means embodying this invention;

Fig. 2 is a partial side elevation showing the float-actuated switch with portions thereof broken away;

Fig. 3 is a partial plan view of the float-actuated switch, viewed as indicated by line 3—3 of Fig. 2;

Fig. 4 is a plan view of the remotely-located filling valve and the actuating means therefor;

Fig. 5 is a detailed elevational view, partly in section, further illustrating the remotely located filling valve;

Fig. 6 is a transverse sectional view taken through the float-actuated switch substantially on line 6—6 of Fig. 2;

Fig. 7 is a partial vertical sectional view taken through the float-actuated switch as indicated by line 7—7 of Fig. 6 and showing the switch on a larger scale; and

Fig. 8 is a sectional view similar to Fig. 7 but showing the movable switch member in another position.

The tank filling and control means of my invention is especially suitable for flush tanks of the kind used with toilets and other plumbing fixtures and is hereinafter described as being used

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in this connection, but it should be understood, however, that the invention can be applied to various other kinds of tanks and can be used with liquids other than water.

In Fig. 1 I show a flush tank 10 adapted to contain a quantity of water 11 and having a bottom outlet 12 for connection with a toilet or other plumbing fixture (not shown). The outlet 12 is controlled by a conventional ball valve 13 which normally engages a seat 14 but is adapted to be unseated by the lever 15 and linkage 16 to permit the discharge of the water 11 through the outlet. The lever 15 is adapted to be swung by means of the usual actuating handle 17 connected with such lever and located exteriorly of the tank 10.

Water is supplied to the tank 10 through a conduit 18 which is connected with a suitable source of water under pressure, such as the water supply pipe 19. The flow of water through the conduit 18 is controlled by means of a valve unit 20 which is preferably located at a point relatively remote from the tank 10, such as in the basement or in a plumbing shaft.

The valve unit 20 comprises a control valve 21 located in the conduit 18 and an actuating device 22 for actuating the valve 21. The control valve 21 is provided with a movable valve element 23 which is normally urged toward a closed position in engagement with the seat 24 by means of a spring 25 and is adapted to be opened by upward movement of the valve stem 26.

The valve actuating device 22 is here shown in the form of an expansible chamber device having a sectional housing 28 containing a transversely extending flexible diaphragm 29. The housing 28 may be connected with the control valve 21 by means of the spaced guide posts 30 and the transverse yoke 31. An actuating stem 32 slidable in the housing 28 and projecting therefrom is adapted to be lifted by the diaphragm 29, for imparting valve-opening movement to the stem 26. A movable yoke 33 carried by the stem 32 is guided on the posts 30 and is engaged by the compression springs 34 which normally tend to produce a downward or return movement of the actuating stem 32. The adjacent ends of the stems 26 and 32 preferably have an intervening gap 35 therebetween which can be varied in width by adjustment of the nut 36 for varying the timing, or the extent of opening, of the control valve 21.

The lower portion or section of the housing 28 contains a pressure chamber 37 adapted to be supplied with pressure fluid such as water from the supply pipe 19. Inlet and outlet pipes 38 and

39 connected with the housing 28 provide passages for the flow of pressure fluid into and out of the chamber 37. The flow of water through these passages is controlled by a pair of solenoid actuated valves 40 and 41, the valve 40 being located in the inlet passage 38 and the valve 41 being located in the outlet passage 39. The inlet valve 40 is connected with the water supply pipe 19 by a conduit 42. The conduit 43 leading from the outlet valve 41 is a drain or waste connection.

The solenoid valves 40 and 41 each comprise a valve body having a passage 44 therein which is controlled by a movable valve element or pin 45. The valve element 45 is urged towards a closed position by a compression spring contained in a housing 46 and is adapted to be opened by energization of a magnet or solenoid contained in such housing. For a purpose which will be explained hereinafter, the passage 44 of the outlet valve 41 is somewhat smaller in size than the corresponding passage 44 of the inlet valve 40.

For controlling the actuation of the solenoid valves 40 and 41 I provide an electric switch 48 which is located at the flush tank 10 and controls the energization of these valves in response to variation in the water level in the tank. The electric switch 48 is preferably, though not necessarily, located in the tank 10 and, to this end, I provide a water-tight housing 49 in the tank in which the switch 48 is located. The housing 49 comprises an elongated tubular member 49a mounted in the tank 10 in upright relation by means of a fitting 50 which extends through the bottom wall of the tank. The fitting 50 is provided with passages 51 and 52 therein, the former of which communicates with the interior of the housing 49 and accommodates an electric conductor cord 53. The passage 52 is a water passage connecting the conduit 18 with the interior of the tank 10.

The electric switch 48 comprises a pair of cooperating stationary and movable switch members 55 and 56 located in the housing 49 adjacent the upper end thereof. The switch member 55 is preferably a cup-shaped member formed of molded insulation, or other suitable material, and having a transverse end or bottom wall 57 on which a group of annularly spaced contact elements 58, 59 and 60 in the form of resilient fingers are mounted. The switch member 55 is retained in the housing 49 and is located therein by engagement with the annular rib or seat 61.

The movable switch member 56 comprises a cylindrical body of molded insulation, or other suitable material, carrying a ring-shaped contact element 62 with which the annularly spaced contact fingers 58, 59 and 60 cooperate. The portion of the ring 62 which cooperates with the contact finger 60 is notched or recessed to provide a blank area or section 63 with a narrow ring portion 62a thereabove. The movable switch member 56 is also provided with a radial projection 64 which is movable in a groove 65 of the stationary switch member 55 and holds the movable switch member against arcuate shifting so that the contact finger 60 will always operate on the portion of the ring 62 in which the blank area 63 is located.

The electric switch 48 is operated in response to variation in the level of water in the tank 10 and for this purpose I provide a float 67 in the tank which is operably connected with the movable switch member 56. The float 67 can be in the form of a hollow ball mounted on the outer end of a lever or arm 68. The inner end of the lever 68 has a forked portion 68a which is pivotally connected with a collar 69 by means of the pivot pin 70. The collar 69 is clamped on, or otherwise attached to, the housing 49 at a point adjacent the annular rib 61 and carries an upwardly extending guide rod 71. The guide rod 71 has an arm portion 71a which extends laterally above the upper end of the housing 49 and is provided with a guide opening 71b.

An actuating rod 72 connected with the movable switch member 56 extends out of the housing 49 through a cover member 73 and is of a length to extend through the guide opening 71b of the guide member 71. The switch actuating rod 72 carries a pair of clamps 74 and 75 which form axially spaced stops thereon. A thrust member 76 which is slidable on the exposed rod portion 72a located between the stops 74 and 75, is connected with the forked portion 68a of the float arm 68 by means of a pair of push rods or links 77. A flexible sleeve 78 formed of rubber, or other resilient material, surrounds the upper end of the housing 49 and is connected with the switch actuating rod 72. The sleeve 78 forms a shield or seal by which water is prevented from entering the upper end of the housing 49.

In Fig. 1 I show the float 67 in full lines in its upper position corresponding with a filled condition of the tank 10. I also show a broken-line float position 67a adjacent the upper position and two broken-line positions 67b and 67c adjacent the bottom of the tank. The position 67c represents the lowest position to which the float is movable and which corresponds with an empty condition of the tank. During the major portion of its movement between the positions 67 and 67c, the float has a substantially free travel during which the water level is rising or filling in the tank, and which travel is accompanied by an idle movement of the sleeve 76 along the rod portion 72a between the stops 74 and 75. The significance of these different float positions will be further explained presently.

To enable the switch 48 to control the solenoid valves 40 and 41, I provide circuit connections extending between such valves and switch. The switch element 58, which can be conveniently referred to as the energizing or current supply contact, is connected with one side of a current supply line by the conductor 80 and is at all times in engagement with the ring contact 62. The contacts 59 and 60 can be conveniently designated the valve opening and closing contacts. The valve opening contact 59 controls the energization of the solenoid valve 40 and is connected with the latter by the conductor 81. The valve closing contact 60 controls energization of the solenoid valve 41 and is connected with the latter by the conductor 82. A common conductor 83 provides a return connection by which the solenoid valves 40 and 41 are connected with the other line conductor 84.

To explain the operation of my flush tank control means, let it be assumed that the handle 17 is actuated to lift the valve 13 and permit the tank 10 to be emptied through the outlet 12. The emptying of the tank 10 permits the float 67 to drop and to pass through the position 67b to its lowermost position 67c. The downward movement of the float between the positions 67 and 67b is a free travel which produces an idle movement of the sleeve 76 on the rod portion 72a but when the float drops to approximately the position 67b the sleeve 76 engages the stop 74. The subsequent downward movement of the float to the position 67c shifts the movable switch

member 56 from the position shown in Fig. 7 to that shown in Fig. 3 thereby bringing the ring 62 into engagement with the valve opening contact 59 and causing the solenoid valve 40 to be energized.

The energization of the solenoid of the inlet valve 40 will open the valve element 45 thereof to supply pressure fluid to the diaphragm chamber 37. The water pressure in this chamber will lift the diaphragm 29 against the action of the springs 34 and 25 and will open the control valve 21 causing water to be supplied to the tank 10 through the conduit 18 and the passage 52 of the fitting 50. This same downward movement of the switch member 56 which energizes the inlet valve 40 also causes the valve closing contact 60 to be temporarily engaged by the narrow ring portion 62a and this engagement temporarily energizes the solenoid valve 41. However, this does not prevent the opening of the control valve 21 because, as explained above, the opening 44 of the solenoid valve 41 is more restricted than the corresponding opening of the solenoid valve 40 and also because the ring portion 62a quickly moves out of engagement with the contact finger 60.

As water flows into the tank 10 the level will rise therein and the float 67 will be moved upwardly through the position 67a to the position 67. This upward movement of the float from its lowermost position 67c to a point adjacent the position 67a is a substantially free movement accompanied by an idle travel of the sleeve 76 on the rod portion 72a but when the float nears the position 67a the sleeve 76 engages the upper stop 75. The subsequent upward movement of the float to the position 67 shifts the switch member 56 from the position shown in Fig. 3 back to the position of Fig. 7. As the float moves through the position 67a the narrow ring portion 62a engages and traverses the valve closing contact 60.

The movement of the contact portion 62a over the contact 60 causes temporary energization of the valve closing solenoid 41. This energization of the solenoid valve 41 permits water to flow out of the diaphragm chamber 27 but inasmuch as the opening 44 of the outlet valve 41 is more restricted than the corresponding opening of the inlet valve 40, the diaphragm chamber will not be fully emptied and the control valve 21 will remain open or partially open to continue the filling of the tank 10. The continued movement of the switch member 56 toward its extreme position shown in Fig. 7 causes the ring portion 62a to leave the contact 60 while the contact 59 is still in engagement with the ring 62. Immediately after the ring portion 62a leaves the valve closing contact 60 the valve opening contact 59 is also disengaged by the ring 62 thus deenergizing the solenoid valve 40. The closing of the solenoid valves 40 and 41 upon movement of the switch member 56 to its Fig. 7 position as just explained, causes some water to be trapped in the chamber 37 but this water is forced out through the normally open drain passage 86 by the action of the springs 34 thus permitting the control valve 21 to close. The closing of the valve 21 leaves the float 67 substantially in its full line position and leaves the switch 48 with the contact 60 resting on the blank area 63 so that the valve closing solenoid 41 will be left in a deenergized condition.

To prevent overfilling of the tank 10 in the event that current failure should occur during the filling operation, I provide a safety means in the valve unit 20. This safety means comprises the above mentioned normally open drain or outlet connection 86 for the diaphragm chamber 37 through which the pressure in this chamber can be relieved to permit closing of the control valve 21. Such current failure would, of course, result in deenergization of both of the solenoid valves 40 and 41 which would permit these valves to close and such closing of these valves would result in pressure fluid being trapped in the diaphragm chamber 37 if the outlet connection 86 were not provided. The outlet 86 is a relatively restricted passage of smaller size than the passage 44 of the inlet valve 40 so that it will not prevent filling of the chamber 37 and actuation of the diaphragm 29 when opening of the control valve 21 is called for or signaled by the float-actuated switch 48. If desired, the outlet passage 86 can be provided with a pet cock 87 by which the size of this passage can be varied in accordance with the desired functioning of the valve unit 20.

As shown in Fig. 1, the outlet 12 of the tank 10 can be provided with a conventional upright overflow tube 89 whose upper end extends above the normal upper level of the water 11. The tank also contains a bypass tube 90 which discharges water from the inlet passage 52 into the overflow tube 89 during the filling of the tank for the purpose of filling the syphon or trap in the toilet or other plumbing fixture connected with the outlet 12. The orifice or opening 91 by which the inlet passage 52 is connected with the tank 10, is preferably of a shape such that a flow of water will be produced through the bypass tube 90 into the overflow tube 80 during the tank filling operation.

From the foregoing description and the accompanying drawings it will now be readily understood that I have provided novel means for controlling the filling of flush tanks or the like in a quiet, efficient and satisfactory manner. It will be seen also that my control means involves the use of a float-actuated switch located at the tank, by which a remotely located valve in the water supply line to the tank, can be controlled.

While I have illustrated and described my flush tank control in more or less detail, it will be understood, of course, that I do not wish to be correspondingly limited but regard my invention as including all changes and modifications coming within the spirit of the invention and the scope of the appended claim.

Having thus described my invention, I claim:

In combination, a flush tank, a conduit connected with said tank for supplying water thereto, a valve in said conduit, electrically controlled means for actuating said valve, a water-tight housing in said tank, a fitting extending through the wall of said tank and mounting said housing therein, said fitting having a passage connecting said conduit with the tank and a second passage leading into said housing, an electric switch in said housing and connected with said electrically controlled means by conductors extending through said second passage, and a float in the tank responsive to the water level therein and operatively connected with said switch.

LEE B. GREEN.