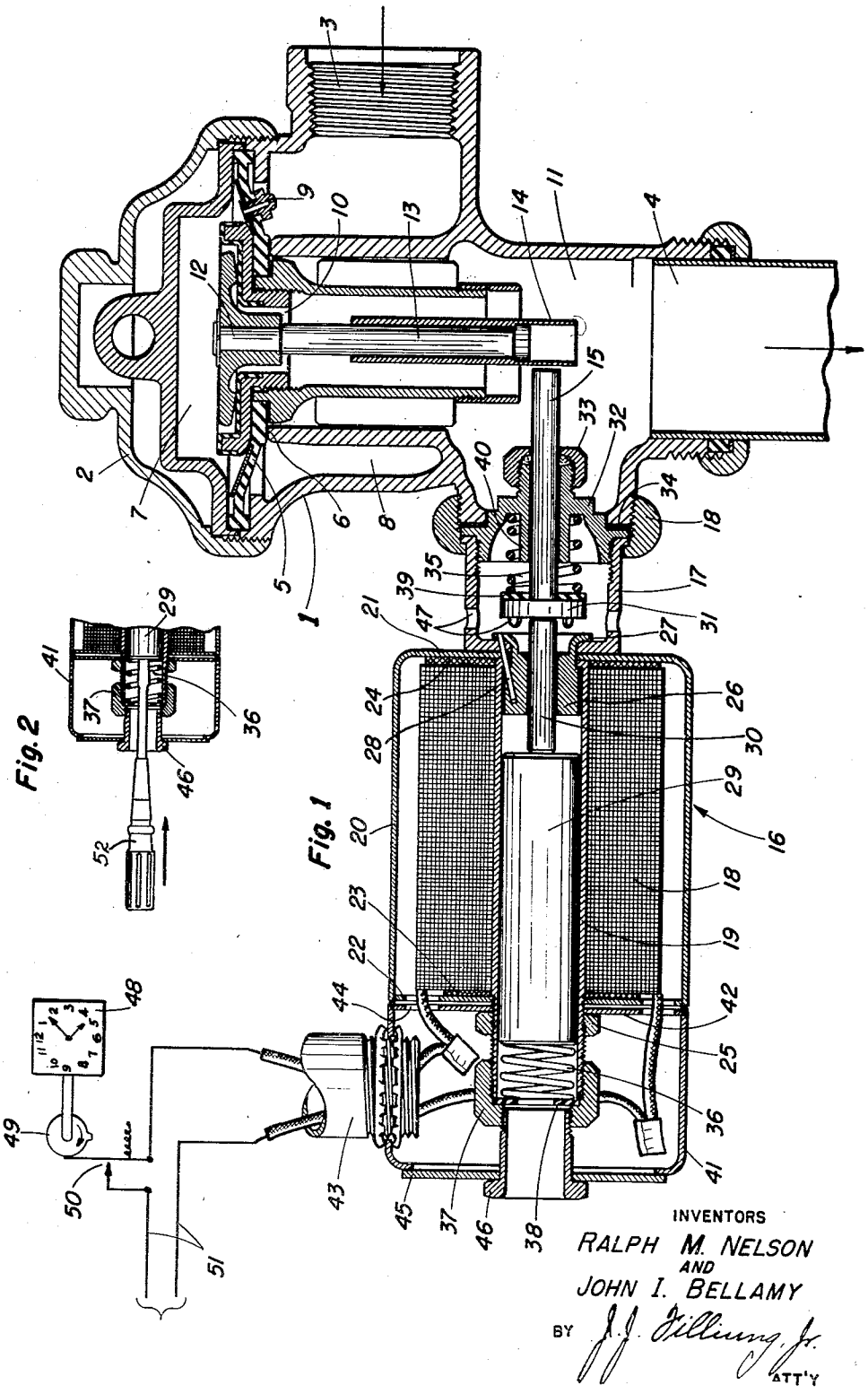
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ELECTRICALLY OPERATED FLUSH VALVE

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ELECTRICALLY OPERATED FLUSH VALVE

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This invention relates in general to the operation of flush valves, and has for its object the provision of new and improved electrical means for automatically operating flush valves.

In many plumbing installations, it is desirable for sanitary reasons that the flush valves be operated automatically rather than manually, particularly where they are utilized for the flushing of urinals. In installations where manually operated urinal flush valves have been used, it has been observed that the flush valve has not been operated after use of the urinal, due usually to the reluctance of the user touching the operating handle or to neglect to do so. In any event, the urinal became foul and created a health hazard. It is accordingly an object of the present invention to provide a new and novel means whereby flush valves are operated automatically at periodic intervals, thereby eliminating the disadvantages pointed out in connection with manual operation.

A further object of the invention resides in the novel combination of a flush valve and electrical operating means in which the electrical means is supported directly upon the flush valve as an integral unit therewith.

An additional object resides in the provision of novel means for preventing leakage of water from the flush valve to the electrical operating means to protect the same from damage or corrosion.

It is a further object of the invention to provide in combination a means for automatically operating a flush valve, together with means for manually operating the flush valve in the event the automatic means fails to function or when it is desired to test the flush valve as upon its installation.

Still another object is to reduce the impact shock and noise in a flush valve caused by the operation of the electrical operating means.

With the above and other objects and advantages in view, the invention comprises certain features of construction and operation of the parts which will hereinafter be described in detail in connection with the accompanying drawing, wherein

Fig. 1 is a vertical sectional view of a flush valve together with the electrical means for automatically operating the same.

Fig. 2 is a sectional view on a smaller scale of a portion of the electrical means showing how a manual actuation of the flush valve may be performed.

Referring to the drawing, Fig. 1, which illustrates a single embodiment of the invention, there is shown, for example, a flush valve of the diaphragm type, but the invention is equally applicable to other types of flush valves, such as piston valves. In the construction shown, the valve comprises a body or casing 1 and a cover portion 2, together with an inlet passage 3 and an outlet passage 4. Within the body 1 is the main diaphragm valve 5 seating upon the main valve seat 6. The main valve 5 divides the casing into an upper chamber 7 and an inlet chamber 8. A by-pass 9 of small cross-section provides limited communication between the two chambers. The main valve 5 is also provided with a passageway 10 which connects the upper chamber 7 with the discharge chamber 11 and which passageway is controlled by the auxiliary valve 12 carried by the main valve 5. This auxiliary valve 12 is provided with a stem consisting of telescoping members 13 and 14, and is adapted to be opened by moving or tilting the stem laterally. In the construction shown, this is accomplished by means of the plunger stem 15, which is operable laterally or inwardly to strike the stem member 14. The auxiliary valve 12 is accordingly tilted from its seat and water pressure is relieved in the upper chamber 7 so it passes through the passage 10 into the discharge chamber 11. The pressure of the water from inlet 3 and chamber 8 then causes the main valve 5 to be lifted from its seat 6 and the full flow of water passes from the inlet 3 over the main seat 6 to the outlet 4. When the main valve 5 is lifted so that the part 14 of the auxiliary valve stem rises above the plunger member 15, the stem 13—14 returns to its vertical position and the auxiliary valve 12 is closed. Water passing through the by-pass 9 then enters the chamber 7 and the water pressure will equalize so that the main valve 5 descends upon the main seat 6 and shuts off the water flow through the flush valve.

The foregoing describes the ordinary structure and operation of the flush valve, and it is customary to provide the plunger stem 15 with a handle whereby the plunger stem 15 may be manually actuated in the manner stated to flush the valve. According to the present invention, however, this handle is dispensed with and means are provided for automatically effecting the operation of the flush valve. This automatic means may take the form of an electrical operating means such as the electrical solenoid illustrated and indicated generally at 16.

The solenoid assembly 16 is mounted and supported as a unit directly upon the usual handle

opening in the flush valve by means of the hollow socket member 17 which is held rigidly and tightly against the opening by the coupling nut 18 threadedly engaging the outer surface of the opening. The solenoid assembly 16 includes an electrical coil winding 18 having an axial opening therein occupied by a brass tube 19 which protrudes slightly through one end of the coil. Completely enclosing the coil 18 is a metal casing or housing 20 which has the front end wall 21 formed integral therewith and the opposite or rear end open for insertion of the coil 18. The housing rear opening is closed by an iron disc 22 and insulating spacers 23 and 24 are placed at the coil ends to protect the windings from the housing 20. The coil 18 is securely clamped in the housing by the clamping nut 25 which threads upon the protruding rear end of the brass tube 19. At the front end of the tube 19, there is provided an iron plug 26 having an axial opening therein and also an annular portion 27 thereof which is peened over inside the hollow socket member 17 and thereby securely clamps the socket member 17, the end housing wall 21, and the front end of the tube 19, together as a unit. To prevent relative rotation between the solenoid assembly 16 and the socket member 17, a locking pin 28 is driven through holes in the plug 26, tube 19 and end housing wall 21.

Laterally movable within the brass tube 19 is an operating plunger or magnetic core member 29 shown in its retracted position, and which is positioned in operative relation to a brass pin 30, in turn axially projecting through the iron plug 26 into the socket member 17. The brass pin 30 is arranged in abutting relationship with the flanged head 31 of the plunger stem 15 as shown, and the plunger stem is in turn laterally movable and has bearing support through the brass bushing member 32 and the packing gland 33 arranged on the end thereof. The brass bushing 32 has threaded engagement with the interior of the socket member 17 and also a flanged portion clamped by coupling nut 18 between the socket member 17 and the opening in the valve body. The gasket 34 assists in making the connection water tight.

The plunger stem 15, the pin 30, and the operating plunger 29 are all held in their normal retracted position as shown by the restoring compression spring 35, which is arranged in the socket member 17 and exerts its restoring spring power against the flanged head 31 of the plunger stem 15. This spring 35 is strong enough to overcome the friction on the plunger stem 15 caused by the packing gland 33. In order to absorb the restoring impact shock of the operating plunger 29 after its operation, a recoil spring 36 is arranged in the rear end of the tube 19 between the end of plunger 29 and an inner shoulder formed on coupling nut 37 threaded onto the end of tube 19. The recoil spring 36 is weaker than the restoring spring 35 and as shown is at its expanded limit so that the operating plunger 29 always provides a full operating stroke and does not "float" in some intermediate position in the tube 19. By the provision of the restoring spring 35 at one end and the recoil spring 36 at the other end, the operating plunger assembly is at all times maintained under positive control and does not rattle or loosely slide longitudinally within the solenoid unit. This is necessary since the solenoid is usually mounted in a horizontal position on the flush valve and does not depend upon gravity to restore the operating plunger after its operation. In order to further reduce the impact shock and "clicks" due to the restoring action of the operating plunger 29, a rubber washer 38 is provided at one end of the recoil spring 36 where it rests against the coupling nut 37, and another washer 39 is provided under the flanged head 31 of plunger stem 15 where the restoring spring 35 exerts its force. This latter rubber washer 39 also takes up the full impact force of the operating plunger 29 and limits as well as cushions its longitudinal operating movement by engaging the projecting shoulder 40 formed in the bushing 32. The forward limit of the operating movement of the plunger elements are such that the rubber washer 39 engages the shoulder 40 to halt the operating movement before the end of operating plunger 29 comes in contact with the iron plug 26.

The electrical connections for the solenoid and part of the assembly thereof are made at the rear end of the solenoid where a second housing or casing 41 is arranged. This housing 41 is of the same diameter as the solenoid housing 20 and is clamped at its inner wall 42 directly against the housing plate 22 by the clamping nut 25 whereby the housing 41 is securely supported upon the tube 19. The opposite end of housing 41 is open to facilitate connection of the electrical wiring from the coil 18 and the wires in the conduit piping 43, and also enables the coupling nut 37 and clamping nut 25 to be screwed on the tube 19. The conduit 43 is held to the housing 41 in the usual manner by a pair of conduit clamping nuts as shown and the connecting wires from the coil 18 pass through holes 44 in the housing end plates 22 and 42 into the conduit. At the rear the opening in housing 41 is enclosed by a cover plate 45, held in place by the hollow clamping screw 46 threaded into the coupling nut 37. By this arrangement of providing a housing separate and independent of the solenoid itself, for the electrical connections and assembly of certain parts, a unitary, symmetrical structure is evolved presenting a smooth, pleasing appearance.

Direct external access to the operating plunger 29 may be had through the hollow clamping screw 46, washer 38 and recoil spring 36, for the purpose of manually pushing the operating plunger 29 inward to actuate the flush valve. This can be accomplished by means of the screw driver 52 as shown in Fig. 2 and may be utilized by the plumber when the installation is being made in order to test the operation or adjustment of the flush valve, or in the event the electrical operating equipment or the solenoid is disabled or fails to function, the flush valve may be manually operated to cleanse the plumbing fixture.

Since the solenoid is associated with a flush valve which operates to control the flow of water at relatively high pressures, it is necessary that the solenoid and associated wiring be properly protected from corrosion or any accidental leakage of water from the flush valve. Otherwise, the danger would exist of short circuiting and damaging the electrical equipment or of grounding the same and this could conceivably be dangerous to a user of the plumbing fixture. The solenoid and the wiring space being completely enclosed and made water tight by the housings 20 and 41, the danger of splashing from the exterior of the electric unit is clearly obviated from this viewpoint. The interior of the electrical unit is protected from the water in the flush

valve by the stuffing box or packing gland 33 through which the plunger stem 15 extends and is reciprocally arranged. Due to constant usage and wear upon the plunger stem 15 over a period of time or in the event the coupling nut 18 loosens up slightly, water may possibly leak into the interior of the socket member 17. This leakage, however, cannot pass to the solenoid because of the presence of a series of drain holes 47 in the socket member 17 through which the leakage can drain off to the outside of the unit. As a further precaution and to prevent leakage along the plunger stem 15 and pin 30 to the operating plunger 29, the flanged head 31 serves as drip ring to divert the water into the socket member 17 and out of the drain holes 47.

The control means for automatically and periodically energizing the solenoid may take the form of any well known timing arrangement, and may comprise a timer or clock work mechanism diagrammatically indicated at 48 which is operatively connected with a cam 49, adapted to rotate and thereby open and close the electrical contacts 50. The timer mechanism 48 is preferably arranged to periodically and at predetermined adjustable time periods close the contacts 50 which thereby establish an electrical circuit from a suitable source of commercial current passing over wires 51 to the connections extending to the solenoid windings 18, to energize the solenoid and thereby effect the operation of the flush valve in the manner now to be pointed out. It will be obvious that the features hereinbefore described and pointed out are equally applicable to any other electrical operating means such as alternating or direct current controlled solenoids or motors, and the invention is not limited by the precise electrical structure disclosed.

The use and operation of the present invention are as follows:

When the parts are in the position illustrated in Fig. 1, the flush valve is closed and upon the momentary closure of electrical contacts 50 by the timer mechanism 48 an impulse of current passes over wires 51 to the connections and to winding 18 of the solenoid 16 to energize the same. With the coil energized a magnetic circuit or flux flow is caused to be created which passes over a path including the operating plunger 29, the plug 26, housing end wall 21, the housing shell 20, the closure disc 22 and back to the plunger 29. The foregoing elements being all made of magnetic material such as iron, a free passage for the magnetic flux is provided causing the plunger 29 to be instantly projected forward longitudinally within the non-magnetic brass tube 19. As a result, the plunger pin 30 and the plunger stem 15 are likewise projected forward, the plunger pin 15 striking the auxiliary valve stem 14 and causing the valve 12 to be tilted off its seat. This action results in a full flushing operation of the flush valve in the manner previously pointed out and also compresses restoring spring 35. Upon the deenergization of the coil winding 18, the magnetic flux ceases to flow and the operating plunger 29 is then placed under control of the compressed restoring spring 35 which in expanding instantly forces the plunger elements back to their normal positions, as shown. The recoil spring 36 absorbs the restoring thrust of the operating plunger 29 and with rubber washer 38 renders the restoring action relatively quiet.

What is claimed is:

1. In a solenoid assembly for automatically operating a flush valve, said solenoid including a tube having an electrical coil wound thereon and an operating plunger movable in said tube, a casing enclosing said coil, a second casing having an open end and arranged axially upon one end of said coil casing, means engaging said tube for clamping said coil, said second casing and said coil casing together on said tube, said second casing having facilities through the open end thereof for the attachment of electrical wiring means to said coil, a cover enclosing the open end of said second casing, a hollow screw axially secured to said tube for clamping the cover to said second casing, said hollow screw enabling external manual access to be had to said operating plunger to manually actuate the same, a hollow socket member secured to the opposite end of said coil casing, coupling means on said socket member providing the sole means for supporting said solenoid assembly, and connecting means extending outwardly through said hollow socket member from said operating plunger and actuated by said operating plunger upon the electrical energization of said coil.

2. In an electrical solenoid for operating a flush valve, said solenoid comprising a tube having a coil winding thereon and an operating plunger movable in said tube responsive to the electrical energization of said coil, coupling means for supporting said solenoid, an operating stem in said coupling means extending from said operating plunger, a restoring spring in said coupling means for the operating stem, a recoil spring in said tube for the operating plunger, and cushioning means associated with each of said springs.

3. In an electrical solenoid for operating a flush valve, said solenoid comprising a tube having a coil wound thereon and an operating plunger movable in said tube responsive to the electrical energization of said coil, a hollow socket member serving to support said solenoid, an operating stem extending through said socket member from the operating member, a restoring spring on said operating stem normally holding said operating stem retracted and said operating plunger in normal retracted position in said tube, a recoil spring in said tube on the other end of said operating plunger for absorbing the impact shock of said operating plunger caused by the restoring action of said restoring spring, and cushioning means on each of said springs for eliminating "clicks" caused by the action of said springs.

4. In a solenoid assembly, a tube, an electrical coil wound thereon, an operating plunger movable in said tube, a casing enclosing said electrical coil, a second casing arranged on the end of said first casing and having an opening on the opposite end thereof, said tube extending through the ends of both of said casings and terminating inside said second casing, a nut threaded on said tube in said second casing for clamping the ends of said casings together to hold them in position on said tube, a second nut threaded on said tube and having a shoulder thereon to limit the retracted position of said operating plunger, a cover plate enclosing the open end of said second casing, and a third nut threaded into said second nut for clamping said cover plate to the opening in the second casing.

5. A supporting member for supporting an electrical operating means upon a flush valve, said supporting member comprising a hollow body portion having spaced drain openings ar-

ranged around the sides thereof, means on one end of said supporting member for supporting said electrical operating means in axial alignment with said supporting member, an operating member extending axially through said supporting member whereby the same is operated upon the energization of the electrical operating means, means on said operating member for diverting liquid leakage towards the drain openings in said supporting member and away from the end of said supporting member carrying said electrical operating means, and guiding means for said operating member associated with the other end of said supporting member.

6. In a flush valve operating solenoid, an operating coil and an enclosing casing therefor, both having axial passages extending therethrough, operating means projecting through one end of both passages and movable in response to actuation of said operating coil, said operating means being also movable independent of said operating coil by a manual thrust from the opposite end of said passages and a support for said enclosing casing arranged at the end through which the operating means projects, said support having drain openings therein spaced apart from said operating means for precluding the admission of fluid to said passages and operating coil.

7. A supporting means for mounting an electrical device upon a flush valve comprising a cup-shaped supporting member having a series of water drain openings arranged around the body sides and an axial opening in the bottom thereof, coupling means extending from the bottom axial opening of said supporting member for directly supporting said electrical device upon the end of said supporting member, said electrical device being arranged to extend axially from the end of said supporting member, a valve operating member operable by said electrical device passing axially through said coupling means and said supporting member, said valve operating member being arranged in spaced relationship to said drain openings whereby leakage will pass directly from said valve operating member and out of said drain openings, and a flanged head on said valve operating member for diverting leakage away from said axial opening in the bottom of said supporting member.

8. A supporting means for mounting an electrical device upon a flush valve comprising a cup-shaped supporting member having water drain openings in its side and an axial opening in its bottom, coupling means extending from the bottom axial opening of said supporting member for directly supporting said electrical device upon the end of said supporting member, said electrical device being arranged to extend axially from the end of said supporting member, a valve operating member operable by said electrical device passing axially through said coupling means and said supporting member, a casing for said electrical device, in which said electrical device is enclosed, extending generally axially outwardly from said supporting member and secured to said supporting member, and means on said valve operating member for diverting leakage away from said axial opening in the bottom of said supporting member.

9. A supporting member for supporting an electrical operating means upon a flush valve, said supporting member comprising a hollow body portion having a circumferential side wall vented to permit drainage, means on one end of said supporting member for supporting said electrical operating means in axial alignment with said supporting member, an operating member extending axially through said supporting member, whereby said flush valve is connected for operation, with said electrical operating means, means on said operating member for diverting liquid leakage from the flush valve toward the drain venting in said supporting member and away from the end of the supporting member carrying said electrical operating means, and guiding means for said operating member associated with the other end of said supporting member.

10. A supporting and operating assembly for flush valves including supporting means for mounting an electrical valve operating device upon a flush valve, comprising a cup shaped supporting member having a side vented for water drainage and an axial opening in its bottom, a housing extending generally axially outwardly from the bottom of said supporting member, an electrical device positioned in said housing, on the general axis of said supporting member, a valve operating member operable by said electrical device, passing axially through the aperture in the bottom of said supporting member, and means on said valve operating member for diverting water leakage away from said axial opening in the bottom of said supporting member.

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