United States Patent [19]

Young

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[45] **Jan. 15, 1974**

[54] **WATER CONTROL VALVE STRUCTURE**

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[73] Assignee: **American Standard Inc.,** New York, N.Y.

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[52] **U.S. Cl.** **137/434,** 137/436, 137/444, 137/451

[51] **Int. Cl.** **F16k 31/26**

[58] **Field of Search** 137/217, 218, 315, 137/414, 426, 429, 430, 432, 434, 436, 441, 442, 444; 251/118, 367, 368; 285/81, 91, 99, 376, 402; 215/44; 220/40

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Primary Examiner—Martin P. Schwadron
Assistant Examiner—David R. Matthews
Attorney—Jefferson Ehrlich et al.

[57] **ABSTRACT**

This application covers a water control valve for the water tank of a toilet bowl. The housing encloses a vertically movable plunger and an open-ended chamber into which water is admitted for filling the tank, together with mechanism for controlling the vertical or axial movement of the plunger. The housing includes two unitary molded sections — a body section and a cap section which can be joined together in assembling the valve structure, or they may be separated from each other. The body section has a plurality of peripherally arranged inverted L-shaped sections which are equally spaced from each other, while the cap section embodies a corresponding plurality of bayonet members. When the body and cap sections are to be interconnected to form the composite housing, the bayonet members are positioned between the corresponding L-shaped members and one of the sections is physically given a rotary twist or shift to complete the interconnection.

13 Claims, 11 Drawing Figures

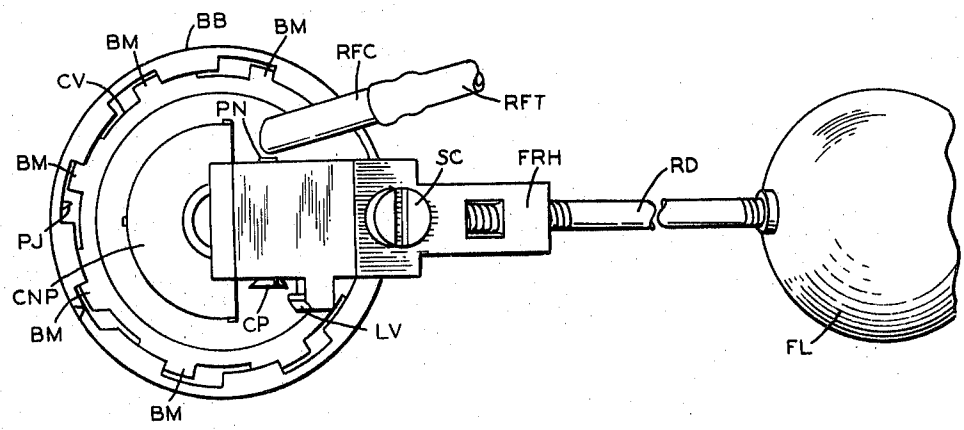


FIG. 2

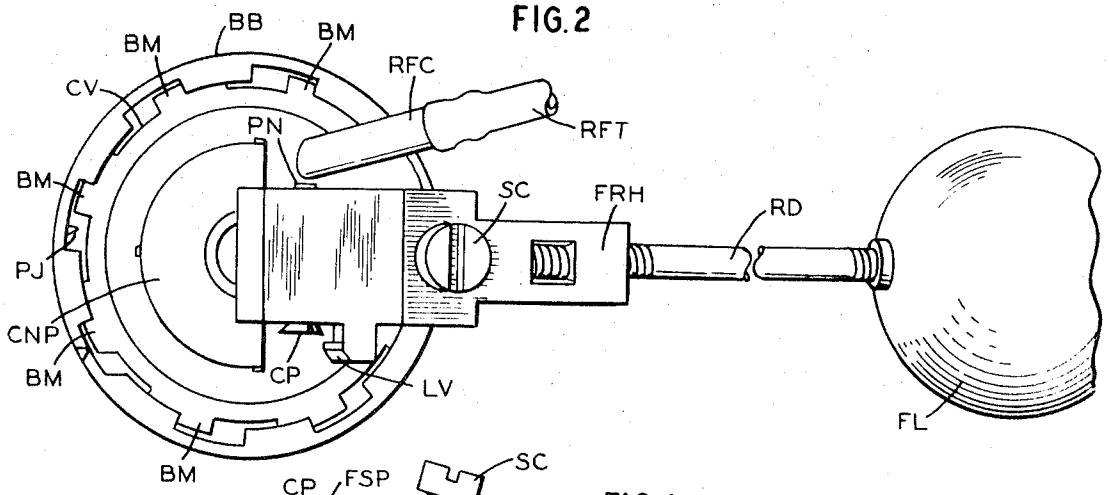

BM
BB
BM
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RD
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CP
LV
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BM

FIG. 1

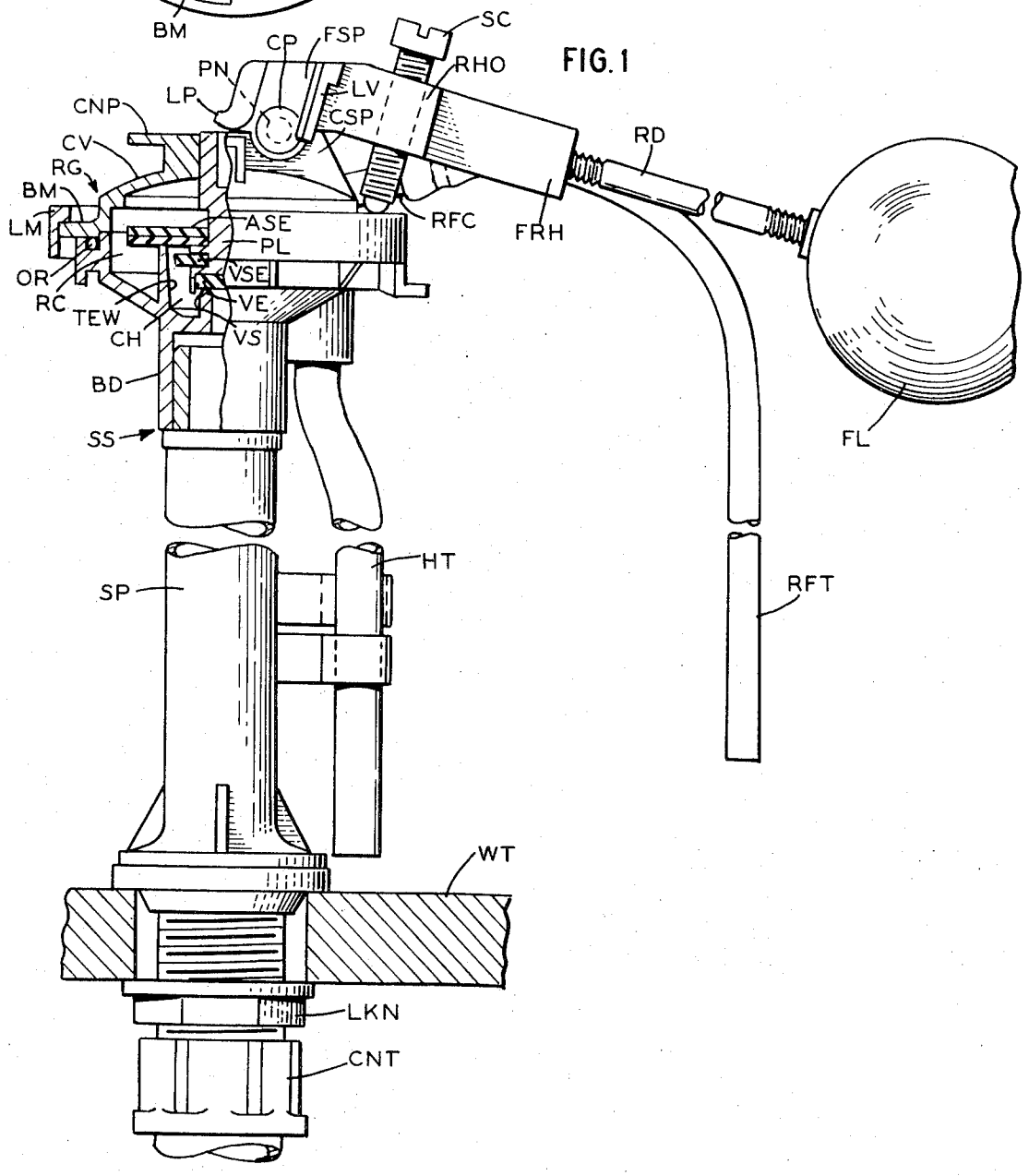

SC
CP
FSP
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LV
CSP
CNP
RD
CV
RG
BM
LM
ASE
RFC
FRH
PL
VSE
OR
RC
TEW
VE
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VS
BD
SS
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HT
SP
RFT
WT
LKN
CNT

FIG. 4

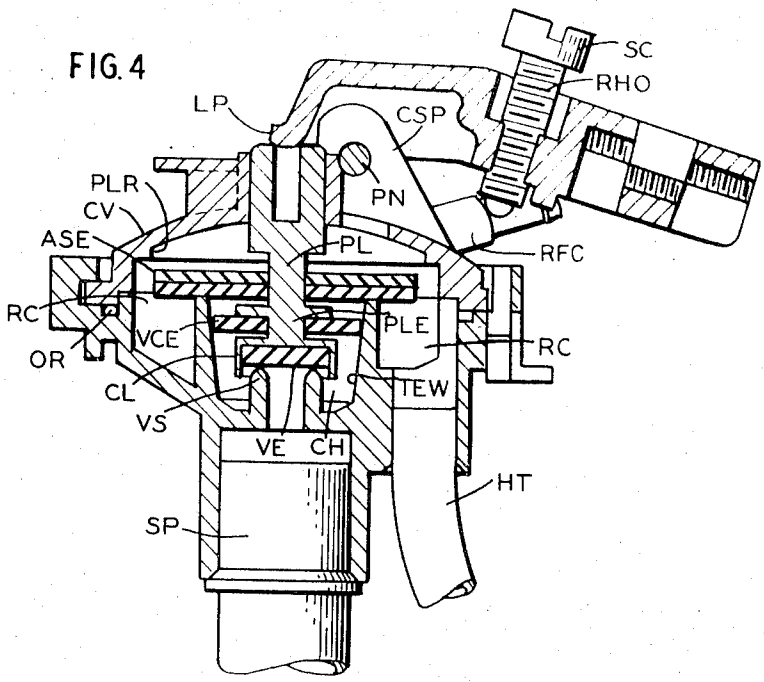

SC
RHO
LP
CSP
PLR
CV
ASE
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RFC
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VCE
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RC
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VS
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CH
HT
SP

FIG. 3

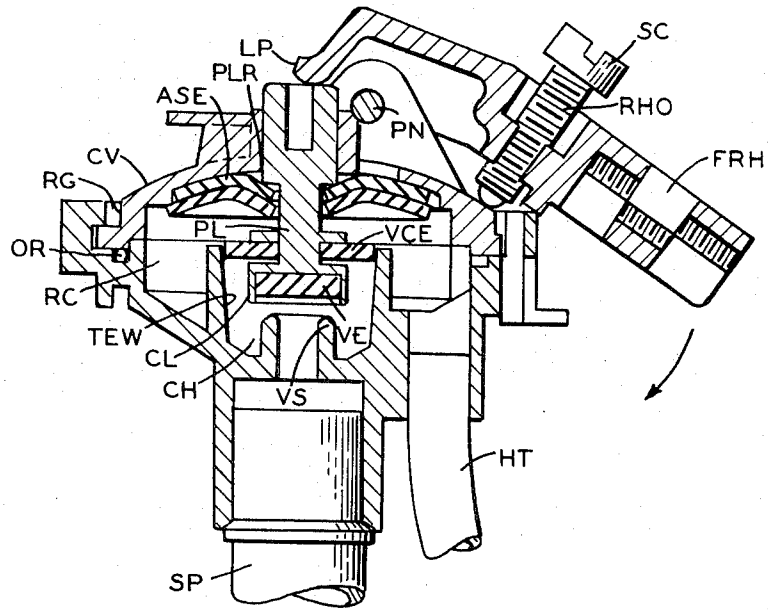

LP
SC
PLR
ASE
RHO
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FIG. 5

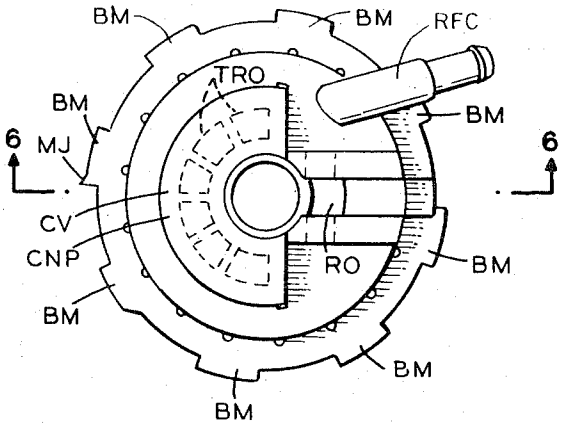


FIG. 6

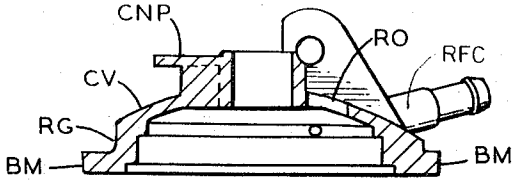


FIG. 7

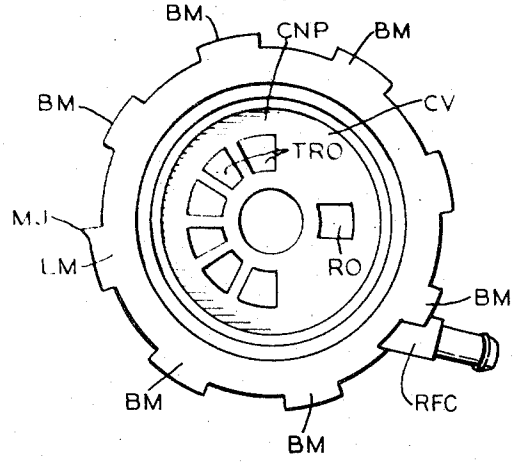


FIG. 8

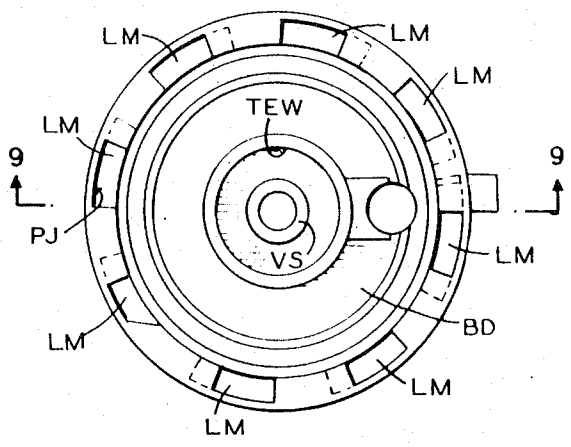


FIG. 9

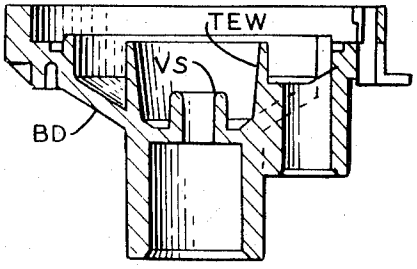


FIG. 10

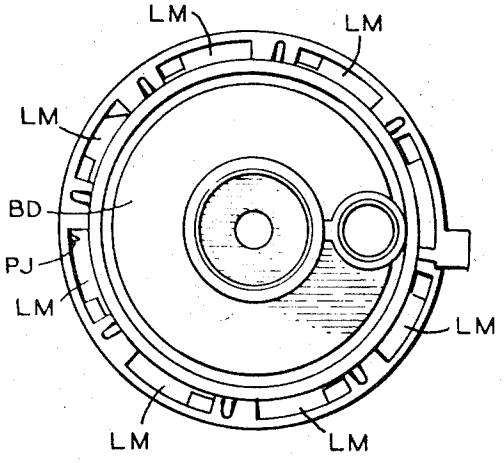
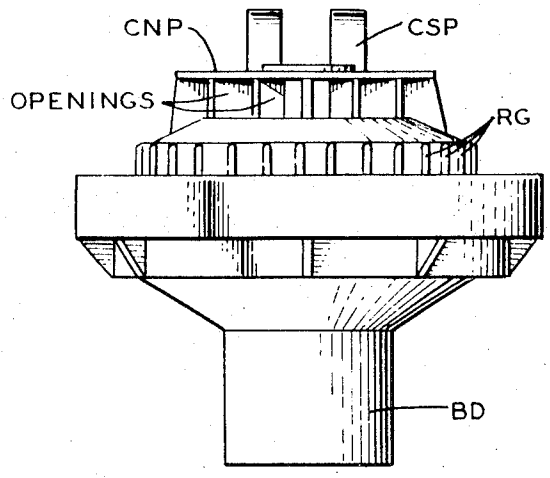


FIG. 11



WATER CONTROL VALVE STRUCTURE

This invention relates to water control valves for the control of the flow of water into water tanks for toilet bowls and is especially related to simplified mechanism for assembling and disassembling such control valves.

One of the principal objects of this invention is to achieve a water control valve which will be simple and of good construction, efficient in its operation, low in cost, easy of assembly and installation, and easy for the average unskilled person, even the housewife, to make whatever repairs may be required to maintain the mechanism and keep it in good operating condition for years.

The usual or conventional water control mechanism presently manufactured and used for the control of the flushing operation of the conventional toilet bowl is little different from its predecessor of many years ago. The mechanism includes numerous parts, many of which are made of metal. The housing of the valve, as is shown by the Antunez U.S. Pat. No. 3,070,118, issued Dec. 2, 1962, which is an improvement over the owens U.S. Pat. No. 2,635,622, issued Apr. 21, 1953, is composed of sections which are connected to each other by screws and screw-threaded members. Such parts often loosen in due course. Metal parts, moreover, suffer from corrosion and other chemical action. The mechanisms are difficult to repair and hence require the services of a plumber. Sometimes a repair is of limited life and replacement of the entire mechanism must be made.

Another of the principal objects of this invention is in the provision of a plastic housing formed of two segments, a body segment and a cap segment. Each segment is molded into a unitary structure in which several parts are unified and coordinated. The body and cap segments may be easily and quickly joined together whenever the mechanism is to be assembled for operation. These same segments may be just as easily disassembled whenever desired. To accomplish this easy assembly and dis-assembly, the two segments are provided with a plurality of peripherally arranged interconnectable members which become interlocked by a slight twist or turn about the common axis of the two members. The same members may be disengaged by a corresponding twist or turn in the opposite direction about the common axis.

To achieve this objective, the body section of the housing has, about its periphery, a plurality of inverted L-shaped members equally spaced from each other and the cap segment is provided with a corresponding plurality of bayonet members which are equally spaced from each other. The two segments may be assembled into the common housing by positioning the periphery of the cap segment along the periphery of the body segment so that the respective bayonet elements are adjacent to, but spaced between, the L-shaped elements and then the angular twisting is performed to join the two segments firmly into a steady housing combination. The housing may be separated into its two segments by a reverse twist of the two segments with respect to each other.

A further feature involves the provision of additional projections on the body and cap segments to render it difficult to separate the two segments except by the application of sufficient additional initial tangential twisting force and, similarly, to render it difficult to join the two segments together except by the application of a similar sufficient additional initial tangential twisting force.

This invention and its further objects and features will be better and more clearly understood from the more detailed description and explanation hereinafter following when read in connection with the accompanying drawing in which:

FIG. 1 illustrates an elevational view, partly in cross-section, of the water control valve employing structure conforming to this invention;

FIG. 2 shows a top plan view of the apparatus of FIG. 1;

FIG. 3 shows a cross-sectional view of the valve structure in its open position;

FIG. 4 shows a corresponding cross-sectional view of the same valve structure in its closed position;

FIG. 5 shows a plan view of one form of cap segment for the housing of the chamber of the valve structure shown in this application;

FIG. 6 illustrates a cross-sectional view of the cap segment taken along the lines 6—6 of FIG. 5;

FIG. 7 illustrates a bottom plan view of the cover taken from the underside thereof;

FIGS. 8, 9 and 10 illustrate views of the body segment of the housing for the valve structure, these figures corresponding to the three respective views of the cap segment in FIGS. 5, 6 and 7; and

FIG. 11 shows certain features of the combination of the body section and the cap section of the structure of this invention.

Like parts will be designated by like reference characters wherever they may occur throughout the drawing.

Referring to FIGS. 1, 2, 3 and 4 of the drawing and especially to FIG. 1 of the drawing, there is shown a standpipe structure SS embodying a water inlet standpipe SP which is threaded at its lower end so that it may be connected through the base of water tank WT to the city or local water supply by means of a lock nut LKN and a coupling nut CNT. The standpipe SP is to be coupled to a float FL which may be any conventional ball-type float adaptable for resting on the surface of the water within the tank WT and which is expected generally to follow, and respond to, the change in the water level within the tank WT. As is well understood, when the conventional hand lever (not shown), positioned on the outside of tank WT, is depressed to discharge the water previously accumulated within the tank WT, the flush valve (not shown) located at the base of the tank WT, which may be, for example, of the type shown and described in Hurko et al U.S. Pat. No. 2,772,268, issued Dec. 11, 1956, to which reference is herein made as a part of this disclosure, is opened and the water within the tank WT is released through the flush valve to discharge the water within tank WT to the toilet bowl (not shown) to eliminate its contents. The float FL will then be promptly lowered to about its lowermost position and a new supply of water will then be allowed to enter the tank WT through standpipe SP to refill the tank. The incoming water supplied through standpipe SP will thereafter be shut off, as will be explained.

As is better shown by FIGS. 3 and 4, a vertically movable plunger PL of special construction has permanently affixed to its base a flat circular rubber element VE or other elastomer element. The vertical movement of the plunger PL will be controlled to regulate the in-

flow of water to the tank WT. The elastomer element VE will normally rest on a valve seat VS of cylindrical shape. The elastomer valve element VE may be glued or otherwise permanently retained within a collar CL of plunger PL. The valve seat VS is tapered and somewhat rounded at its upper end, as shown in FIG. **1, 3** and **4,** to adequately receive the valve element VE so as to seal the valve seat VS (see FIG. **4**) when the valve is to be closed. No water may then enter the tank WT from standpipe SP whenever the valve element VE is seated against the valve seat VS, as shown in FIGS. **1** and **4.**

The standpipe SP has, or may be considered to have, a superimposed chamber CH as an integral part of the body segment BD, the chamber CH having an upwardly and outwardly tapered valve extension wall TEW which is coaxial with the valve seat VS and within which a larger circular elastomer valve element VCE is positioned. The element VCE is mounted on a necked portion PLE of the plunger PL in a predetermined location immediately above the collar CL of plunger PL so that the element VCE will be loosely carried by plunger PL and moved by plunger PL upwardly or downwardly. The elastic element VCE serves to improve the closure characteristic of the valve element VE against its valve seat VS at about the point in time when the water level within the tank WT returns to its assigned upper level, as will be further explained hereinafter.

Two additional elastomer elements, together designated anti-siphon elements ASE, are positioned about and loosely mounted on another necked portion PLE of plunger PL. These two elastomer elements ASE serve to seal the upper rim of the tapered extension wall TEW in the event that anti-siphon action is experienced, as will be later explained, to prevent the backflow of water from tank WT into the standpipe SP and thereby prevent the contamination of the city or local water supply.

Coaxial with the tapered extension wall TEW, there is a circular raceway and water channel RC which receives water upon the upward movement of plunger PL to raise the valve element VE above the valve seat VS, as may be seen more clearly in FIG. **3.** The entering water passes over the rim of the valve seat VS, rises within chamber CH and then passes also over the rim of the tapered wall extension TEW and flows into and along the raceway RC. Most of the entering water then travels through the hush tube HT into tank WT(see FIG. **1**) for filling the tank to prepare it for subsequent usage.

As shown in FIGS. **1** and **2,** the ball float FL is attached to the float rod holder FRH by means of a long slender cylindrical rod RD which is threaded at both ends, as shown in FIGS. **1** and **2,** for easy attachment to the correspondingly threaded segments of float FL and of the rod holder FRH. The float rod holder FRH just referred to has two parallel apertured supports FSP which are alignable with two corresponding parallel apertured supports CSP on the cap segment CV. Along slender cylindrical pin PN is insertable through all of the apertures of both pairs of supports FSP and CSP to couple these supports to each other to render holder FRH rotatable about pin PN as an axis. The pin PN has a head CP which is positioned under and retained by lever LV when the pin PN is inserted through the several apertures of the supports FSP and CSP and holds the pin PN in place to interconnect and couple the cap segment CV and rod holder structure FRH. By manually deflecting the lever LV (which is part of the rod holder FRH), the pin PN may be released whenever desired and then removed from the several apertures to uncouple the rod holder FRH from the cap segment CV.

The rod holder FRH has a threaded opening RHO through which a set screw SC may be inserted to limit the downward angular rotation of the rod holder FRH about the axis formed by pin PN. This set screw SC fixes and limits the downward or clockwise angular rotation of the rod RD and the float FL in response to the opening of the flush valve at the base of water tank WT after the water within tank WT has been discharged.

The cap segment CV also embodies as an integral part thereof a protruding conduit RFC as part of cap segment CV (see FIG. **2,** for example) to which a rubber or plastic refill tube RFT may be affixed. The free end of the refill tube RFT is insertable into the usual overflow pipe (not shown) within the tank WT to feed water to the bowl to replenish the water in the conventional bowl trap after the flushing cycle has been completed and water has been supplied to the tank WT.

The cap segment CP is shown, in one form, in FIGS. **5, 6, 7** and **11.** The plan and bottom views (FIGS. **5** and **7,** respectively) show a plurality of peripherally arranged protruding bayonet members, eight in number for illustration, each designated BM and all peripherally spaced from each other about the center of the cap segment CV. The valve body BD, one form of which is shown in FIGS. **8, 9** and **10,** contains a corresponding plurality of inverted L-shaped members LM for receiving and latching the protruding or bayonet members BM of cap segment CV so as to firmly connect the body segment BD to the cap segment CV. The peripheral spaces between the latching members LM of the body segment BD are sufficient to receive the corresponding bayonet members BM of the cap segment CV. By joining the two segments CV and BD, the housing for the valve chamber and its components will be completed.

The several members LM of the body segment BD are intended to receive and hold the corresponding number of protruding bayonet members BM positioned on the internal wall of the cap segment CV whenever the cap segment CV is to be attached to the standpipe structure SP. The cap segment CV may be attached to the body segment and to the standpipe structure SP merely by inserting the bayonet members BM "within" and against the several latching members LM and then manually twisting the cap member CV about its axis through a very small arc of perhaps 7½° to establish a good firm physical connection between the two structures. The cap segment CV will remain attached to the body segment BD until the cap segment is physically twisted through a corresponding angle in the opposite direction. The cap member CV and the body member BD have an O-ring OR interposed between them (see FIGS. **1, 3** and **4**) to seal these members against leakage.

When the flush valve of the water tank WT is opened by manipulating the hand-controlled lever on the outer wall of the tank to initiate the discharge of the water previously accumulated within the tank WT, the discharged water will necessarily lower the water level within tank WT, whereupon the float FL and the rod RD will both be correspondingly lowered by their clockwise rotation about the axial pin PN. As shown by

FIG. 3, the holding force provided by the lip LP on the rod holder FRH will then be released, thereby allowing plunger PL to rise above the valve seat VS in response to the upward pressure of water then flowing upwardly through the standpipe SP and through valve seat VS and against valve element VE. The incoming water flowing in the space then opened up between the valve element VE at the bottom of plunger PL and the valve seat VS will travel upward through tapered chamber CH and over its upper rim into the raceway RC and then through hush tube HT into the water tank WT. The volume flow rate will increase rather rapidly as the plunger PL ascends.

Upon the closure of the flush valve at the base of tank WT after the tank WT has been substantially emptied, water will continue to flow at a rather rapid rate over the path previously described in connection with FIG. 3 to refill the tank WT. Hence, the level of the water will rise at a good rate within tank WT, thereby correspondingly elevating the float FL and its rod RD which together act as a lever controlling the vertical movement of plunger PL. Consequently, the plunger PL will descend to correspond generally with the upward movement of float FL.

The general operation of the valve mechanism is described in some detail in a copending application of Barry S. Fichter, Ser. No. 270,896 filed of even date herewith and assigned to the same assignee and hence the description of the operation need not be repeated here.

The standpipe structure SS as well as the cap structure CV, the plunger PL, the pin PN, the rod holder FRH and the set screw SC, are each separately formed as a single or unitary component and each is molded into a uniform solid plastic component of "ABS" material. Each of these components is strong at all normally anticipated forces and pressures. Because of the nature and quality of the plastic material, each component resists the adhesion of foreign matter and corrosion due to chemical activity. The standpipe structure SS and the body member BD and the cap member CV can be joined together or disconnected at any time merely by partially rotating the cap member CV over a small angle. Such a small number of components indeed diminishes the number of steps required in the manufacture and assembly of the water control apparatus. Consequently, the cost of manufacture, assembly and installation of the apparatus is quite low.

Substantially foolproof anti-siphonic structure is embodied in the valve mechanism. As will be observed from the underside of the exemplary cap member CV (see FIG. 7), there are six trapezoidal openings TRO and a substantially rectangular opening RO, all of which are employed for the easy admission of air to the upper side of the anti-siphonic elements ASE which, as already noted, may comprise two rubber-like or elastic elements loosely mounted on a neck of plunger PL (see FIG. 1). Furthermore, the cap member CV embodies an overhanging canopy CNP (see FIG. 11) which is surmounted above all of the tapezoidal openings TRO. The canopy CNP prevents foreign matter from being dropped into the trapezoidal openings TRO. Hence the openings TRO will remain free and clear at all times. When freed of foreign matter, the multiple openings TRO in canopy CNP definitely prevent the establishment of suction in the region above the anti-siphon elements ASE.

The float rod holder FRH has, in cross-section, an inverted U shape, and two apertured supports FSP project downward from the legs of the U-shaped holder. The supports FSP are positioned outside the parallel apertured supports CS on the cap segment CV. The rectangular opening RO is situated in the cap segment CV between supports CSP and hence the opening RO is also covered and protected from foreign matter by the holder FRH. Thus, by preventing foreign matter from entering the valve chamber CH, the operation of the mechanism is maintained at a high level and the life of the equipment is extended.

The anti-siphonic arrangement is intended to prevent contamination of the city or local water supply, as already noted, by blocking the flow of water, which was previously collected within tank WT and which may be nonpalatable or contaminated water then flowing into and mixing with the city or local water supply. The contamination of the water would occur in response to an abnormal pressure demand developed by a fire hydrant or by a pump drawing water from the city or the local supply. The anti-siphonic protective action will take place whether the plunger PL is in its closed position or in its open position or in any intermediate position. Whenever an abnormal demand for water should be developed, as may occur suddenly and in an emergency situation, the suction pressure developed in the standpipe SP will immediately attract the anti-siphon elements ASE and deflect these elements so as to seal the upper rim of the tapered wall TEW. The closure of the upper rim of the tapered wall TEW by the flexible anti-siphonic element ASE will occur promptly and unfailingly if the opening TRO and the opening RO are all held unimpeded. By sealing the upper rim of the wall TEW, it will be impossible for any of the water accumulated in the tank WT to be siphoned back into the standpipe SP and then into the city or local water supply.

When water is flowing through the valve mechanism, the anti-siphonic elements ASE are pushed by the oncoming water against the upper inner surface of cap segment CV (see FIG. 3) so that their outer edges will seal against the underside of the cap CV. Water pressure supplied through standpipe SP also firmly presses the flexible members ASE against the shoulder PLR of plunger PL, thus sealing the inner edge of members ASE. The anti-siphon members ASE thus form a coating for the upper part of the body cavity and prevent water from leaking out through apertures RO and TRO. This prevents leakage around plunger PL as an added feature.

The cap segment CV is formed so as to have a plurality or exterior radially extending ridges RG. (see FIG. 11). These ridges may be gripped by hand whenever it is desired to join the cap segment CV to the body segment BD and to the standpipe structure SS or whenever it is desired to break the union between the cap segment CV and these structures. The connection or disconnection requires only a small angular rotation, as already noted. No tools or instruments are required for these purposes.

The pin PN and the lever LV for connecting or disconnecting the float rod holder FRH and the cover CV are described and claimed in a co-pending application of S. L. Young, Ser. No. 223,271, filed Feb. 3, 1972.

The cap member CV, shown in FIGS. 5, 6 and 7, and the body member BD, shown in FIGS. 8, 9 and 10 are

to be joined together as a housing to enclose the chamber CH, the valve seat VS and the plunger PL and other components as already explained. The bayonet members BM of the cap member CV and the latching members LM of the body member BD will be firmly interlocked whenever the two units are to be joined together. This is accomplished by interspersing the bayonet members BM with the corresponding latching members LM and twisting the cap member CV about the common axis of the body member BD and cap member through a relatively small angle. To insure that these members remain interlocked, a projection PJ (see FIG. 8) is employed on the body member and a matching projection MJ (see FIGS. 5 and 7) is employed on the cap member CV to resist any initial movement of the cap member CV and the body member BD. These projections PJ and MJ interpose additional resistance which must be overcome to prevent the decoupling of the cap member CV from the body BD except upon the application of sufficient initial twisting force on cap member CV and, likewise, when the two units are to be joined together, the latching members PJ and MJ will interpose a corresponding additional resistance which must be overcome before the bayonet members BM become interlocked with the latching members LM.

The body member BD constitutes a unitary component which integrally includes the upper portion of the standpipe SS, the chamber CH, the valve seat VS, the water channel RC, part of the channel for supporting the O-ring OR, and the inverted L-shaped latching members LM. The cap member CV constitutes a unitary component which integrally includes the peripheral bayonet segment BM, the gripping elements RG, the canopy CNP and its numerous openings, the parallel supports CSP, the openings for the pin PN, the channel for guiding the plunger PL, the refill segment RFC and part of the channel for supporting the O-ring OR. The members CV and BD provide a rather comprehensive housing structure of many integrated components which have long life at low cost. The achievement of including the numerous parts in the body member BD and the numerous parts in the cap member CV stems from the organization of the several parts included in each of these two members and from the use of moldable plastic material which functions to unify the various components. The bayonet structure facilitates the assembly of the housing by a mere twist of one of the segments about the axis which is common with the other segment.

What is claimed is:

1. A water control valve for the water tank of a toilet bowl, comprising a cap member having a circular base, a body member also of circular shape, one of the members having a plurality of peripherally arranged, substantially equal bayonet members and a projection element and the other member having a like plurality of peripherally arranged, substantially equal inverted L-shaped members and a corresponding projection element, said bayonet members and said L-shaped members being of such peripheral lengths that they may be interspersed with each other to enable the body member and the cap member to be firmly interlocked, the cap member and the body member, when interlocked, forming a housing for the valve, the body member having integrally molded therein an open-ended chamber having an axis which substantially coincides with the axes of the cap member and the body member, the cap member having a vertically positioned channel, a vertically movable plunger to be guided within the vertically positioned channel, and means responsive to the level of water within the water tank for moving the plunger so as to control the volume of water entering the tank through said chamber.

2. A water control valve according to claim **1** in which the projection elements substantially continuously coact to bias the bayonet members and the L-shaped members so as to increase the resistance required to initiate the locking of the cap member with the body member and for increasing the resistance required to unock the body member from the cap member.

3. A water control valve according to claim **2** in which the cap member, the body member, and the plunger are unitary structures made of ABS plastic material.

4. A water control valve for the water tank of a toilet bowl comprising a body segment of circular cross-section having integrated therein an open-ended chamber through which water may be admitted and a plurality of peripherally arranged substantially equal locking members, a cap segment of similar circular cross-section having integrated therein a plurality of peripherally arranged substantially equal locking members to be interlocked with the locking members of the body segment, means for biasing the locking members of the body segment with respect to the locking members of the cap segment to increase the pressure required to interlock said members and to release said members, said biasing means including a projection element on the body segment and a projection element on the cap segment, the cap segment having a channel having an axis which substantially coincides with the axes of the cap segment and the body segment, a plunger which is guided within the channel of the cap segment, and means responsive to the level of the water within the tank for controlling the movement of said plunger.

5. A water control valve according to claim **4** in which the locking members of one of the segments are bayonet-shaped and the locking members of the other segment are L-shaped.

6. A water control valve according to claim **5** in which the means for controlling the movement of the plunger includes resilient disk structure mounted on the plunger for guiding the plunger's movement through the open-ended chamber.

7. A water control valve according to claim **6** in which the cap segment, the body segment and the plunger are each molded into a unitary structure of ABS plastic material.

8. A water control valve for the water tank of a toilet bowl comprising a molded unitary body segment and a molded unitary cap segment, the body segment having integrally formed therein a plurality of locking members and a pressure biasing device, the cap segment having integrally formed therein a plurality of peripherally arranged locking members and a second co-acting pressure biasing device, each of the pressure biasing devices having a projection element for increasing the pressure required to interlock the locking members or to release the locking members, the peripheral lengths of the locking members of the cap segment and the locking members of the body segment being so organized that they may be interspersed between each other

and, in response to axial manual pressure overcoming the biasing pressure of said devices, caused to join the body segment to the cap segment to form a composite housing, the cap segment having integrally formed therein a guiding channel, a plunger mounted within the interior of the housing formed by the cap segment and the body segment so that the movement of the plunger may be guided within the channel in the cap segment to control the flow of water through the valve.

9. A water control valve according to claim **8** including means responsive to the level of water within the water tank for moving the plunger within the cavity of the housing.

10. A water control valve according to claim **9** in which the locking members of one segment are bayonet-shaped while the locking members of the other segment are L-shaped.

11. A water control valve for the water tank of a toilet bowl comprising a body member of circular cross-sectional shape, a cap member of similar cross-sectional shape, the cap member having a guiding channel integrally formed therein, the body member having an open-ended chamber integrally formed therein for receiving water under pressure, a plunger which is movable within the open-ended chamber and guided by the channel in the cap member, and means for interlocking the cap member with the body member, said interlocking means including a plurality of peripherally spaced elements on the cap member and a plurality of peripherally spaced elements on the body member and separate biasing pressure means on said cap member and on said body member so that said elements will be joined and held in contact with each other under the influence of said biasing pressure means upon the application of a manual tangential force overcoming the resistance of the pressure biasing means.

12. A water control valve according to claim **11** including flexible disk means loosely mounted on the plunger for controlling the operation of the plunger in response to the level of water within the water tank.

13. A water control valve according to claim **12** in which the separate biasing pressure means separately biases the spaced elements on the cap member and on the body member so as to increase the resistance that would otherwise be required to initiate the locking of the cap member with the body member and to increase the resistance required to unlock the body member from the cap member.

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