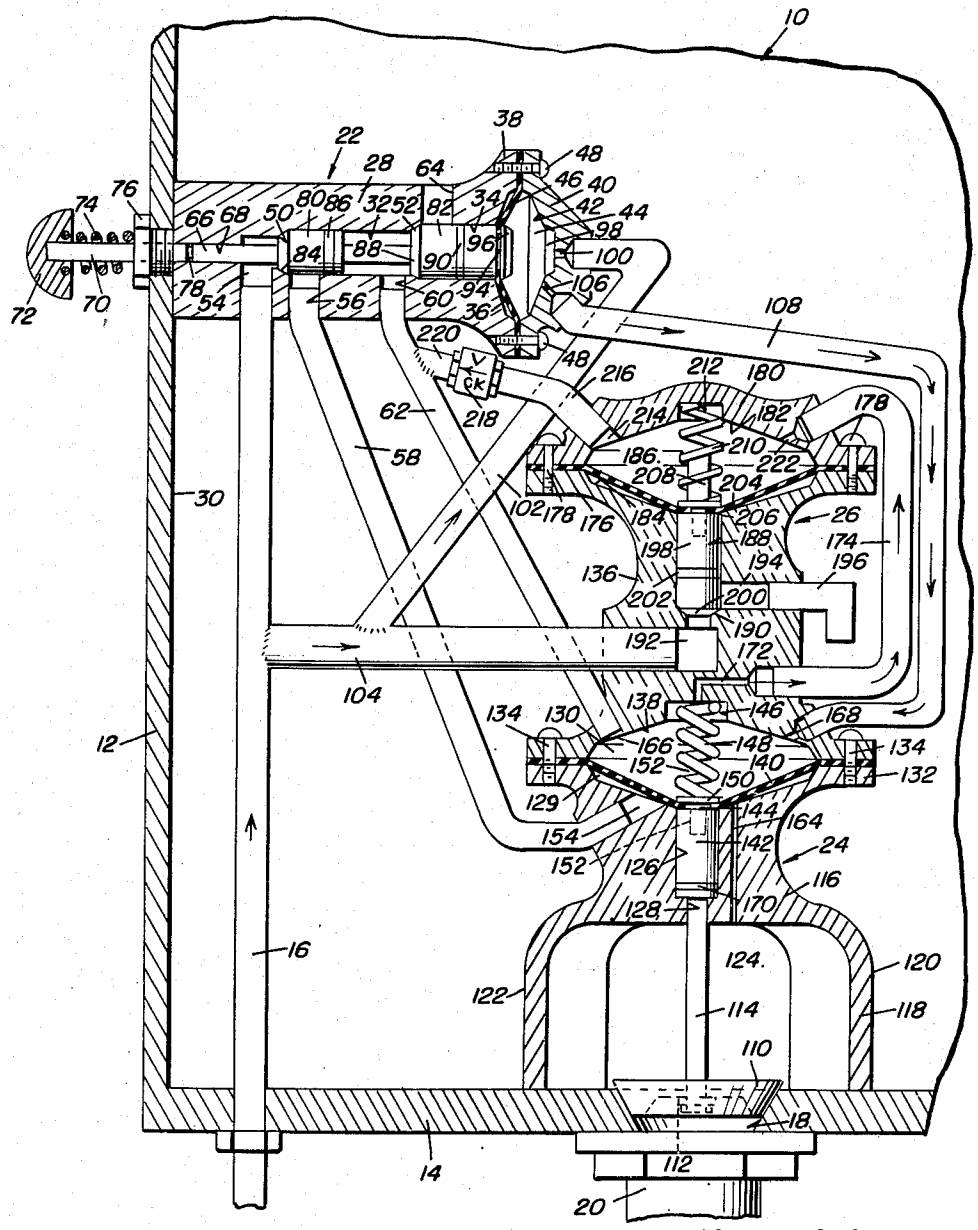
Aug. 28, 1956 M. A. JOANIS 2,760,204

FLUSH TANK CONTROL SYSTEM

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Fig. 1



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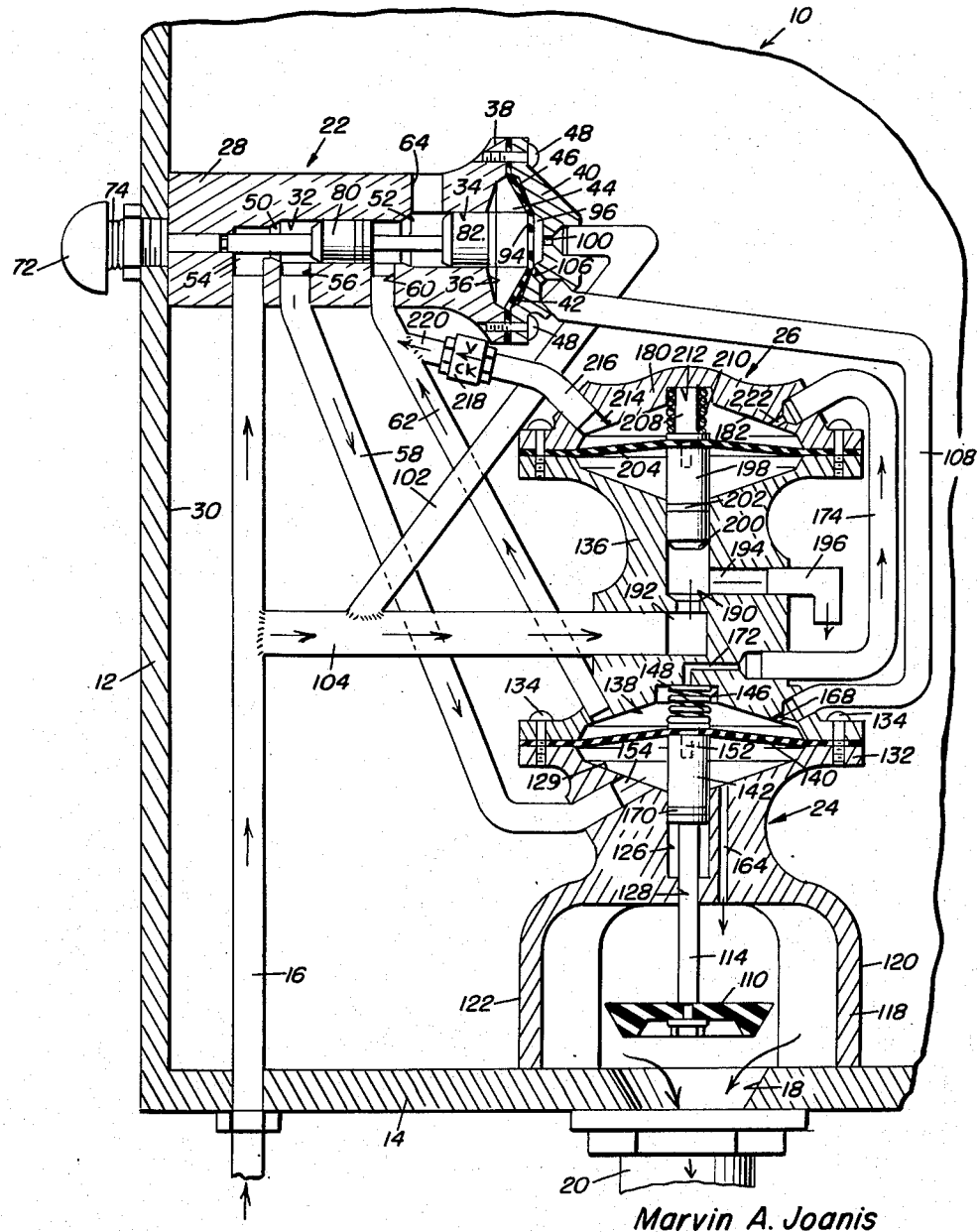
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Fig. 2



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FLUSH TANK CONTROL SYSTEM

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5 Claims. (Cl. 4—41)

This invention relates generally to flush tank systems and is more particularly concerned with an improved flush tank system incorporating a novel flush tank actuating portion, flush tank emptying portion and flush tank re-fill portion.

A further object of invention in conformance with that set forth above is to provide in a flush tank system of the character set forth wherein said flush tank actuating, emptying and re-fill portions include pressure responsive movable walls and metered apertures operatively connected whereby emptying of fluid in the flush tank and re-filling of the same is controlled by a fluid pressure supply in communication with said tank and the flush tank actuating portion.

A still further object of invention in conformance with that set forth above is to provide in a flush tank control system of the character set forth whereby the release of fluid in the flush tank and re-filling of the same is controlled by a fluid pressure supply source in communication with said tank whereby said flush tank control system provides a certain and positive control obviating the annoyance, inconvenience and an uncertainty of operation of present type flush tank systems.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

Figure 1 is a fragmentary portion of a flush tank showing portions in section and illustrating diagrammatically the novel flush tank actuating, emptying and re-fill portions prior to actuation of the flush tank actuating portion; and

Figure 2 is a view similar to Figure 1 showing the relative portion of the parts when the flush tank actuating portion has been actuated.

Indicated generally at **10** is a fragmentary portion of a conventional flush tank which includes the usual side wall **12** and bottom wall **14**, the bottom wall **14** having extending therethrough a fluid pressure supply conduit **16** which is suitably seated in the bottom portion **14**, the bottom portion **14** also including therein a valve seat flush outlet portion **18** which is in communication with a suitable conduit **20** operatively connected to a conventional toilet stool (not shown), the conduit **20** being suitably and sealingly secured on the lower portion **14** of the flush tank. In addition to the flush tank **10**, fluid pressure supply **16**, and flush tank outlet **20**, the novel flush tank control system includes a flush tank actuating portion indicated generally at **22**, a flush tank emptying portion **24**, and a flush tank re-fill portion **26**.

The flush tank actuating portion **22** includes an elongated body portion **28** suitably secured on the inner portion **30** of the vertical wall **12** of the flush tank in any suitable manner, the body portion **28** including an elongated bore portion **32** which includes an enlarged diameter portion **34** in which terminates an enlarged recess

portion **36**. The recess portion **36** is formed in an enlarged end portion **38** of the body member **28** and secured thereto is a cap element **40** which has a recess portion **42** therein cooperating with the recess **36** forming an enlarged end chamber **44**, the portions **38** and **40** having interposed therebetween a flexible diaphragm or pressure responsive movable wall element **46**, the element **40** being secured to the portion **38** by means of suitable fastening elements such as screws **48**. Thus the pressure responsive movable wall **46** defines oppositely disposed compartments which may be identified by means of reference characters **36** and **42**, which will be defined as variable volume compartments as will subsequently become apparent.

The body member **28** includes a pair of axially spaced annular valve seat portions **50** and **52** which may be defined as the inlet and outlet valve seat portions, respectively, for the purpose of controlling fluid flow through the flush tank actuating portion. The variable diameter portions **32** and **34** of the longitudinal bore of the body member **28** define the valve seat portions **50** and **52**, respectively, and the body member **28** includes on opposite sides of the valve seat **50** a fluid passage **54** in communication with the fluid supply source conduit **16**, and a second fluid passage **56** suitably connected to a conduit **58**. The other annular valve seat portion **52** has disposed on opposite sides thereof in the body portion **28**, a fluid passage portion **60** suitably connected to a conduit element **62**, the body portion **28** having disposed on the opposite sides of the valve seat portion **52**, the passage portion **64** in communication with the interior of the flush tank **10**.

A reciprocable control rod **66** is suitably supported in a bore portion **68** of the body member **28** having an end portion **70** extending on the outside of the flush tank, the end portion **70** having a suitable enlarged end portion **72** for actuating the rod **66**, the portion **70** having concentrically disposed thereon a compression spring element **74** which extends between the element **72** and a securing nut element or guide element **76** which helps to support the rod **66** in the vertical wall **12** of the flush tank. The rod **66** has suitably disposed thereon in a suitable groove portion a sealing element **78** concentrically disposed on the rod **66** for preventing leakage thereby from the supply source **16** to the outside of the tank. The control rod **66** includes suitably secured thereon a pair of spaced valve seal elements **80** and **82**, the valve seal element **80** including a suitable sealing portion **84** cooperating with the valve seat **50** and having concentrically disposed thereon a suitable O-ring seal element **86** for preventing leakage past the valve seal element **80**, the valve seal element **82** includes a valve seat portion **88** thereon cooperating with the annular valve seat **52**, said valve seal element **82** having concentrically disposed on an intermediate portion thereof a suitable O-ring seal element **90** for preventing leakage along the outer periphery of the valve seal element **82**, the end of the valve seal element **82** opposite the seat portion **88** being sealingly secured in the flexible diaphragm **46** as seen at **94** and including on the opposite end portion the second valve seat portion **96**.

The cap member **40** includes in axial alignment with the annular valve seat portions **50** and **52**, and the valve seal elements **80** and **82**, annular valve seat portion **98** including centrally disposed therein a metering port portion **100** in communication with a conduit **102** which is in communication with a branch conduit **104** communicating with the fluid pressure supply line **16**. It will be noted that the valve seal portion **96** of the valve seal element **82** is engageable with the annular valve seat portion **98** in the cap element **40** for closing off communication with a metering port portion **100** in the variable

volume chamber 42. A second metering port portion 106 is included in the cap element 40 communicating with the aforementioned variable volume chamber 42, said second metering aperture portion being in communication with a conduit element 108. Compression spring member 74 and the water pressure from the conduit 102 through the metering aperture 104 into the chamber 42, said water pressure acting against the pressure responsive movable wall 46 tends to retain the valve seal elements 80 and 82 and their respective seating portions in sealing engagement with the annular valve seat portions 50 and 52, see Figure 1. It will be further noted that movement of the control rod 66 toward the right by applying pressure on the end elements 72 for overcoming the pressure of the compression spring 74 and the fluid pressure on the pressure responsive movable wall results in sealing engagement of seat portion 96 with the annular valve seat 98 wherein pressure through conduit 102 is no longer available against the pressure responsive movable wall, and further permits the supply pressure from the line 16 to pass through the fluid passage portion 56 and to the conduit 58. This movement also permits communication between the fluid conduit 62 into the fluid passage portion 60, past the valve seat 52 and out of the fluid passage portion 64 into the flush chamber for a purpose to become subsequently apparent.

The previously mentioned metering ports or apertures 100 and 106, and those to be subsequently described, although being indicated as fixed aperture portions could readily incorporate a plurality of interchangeable variable apertured jet elements (not shown) in order to provide a predetermined amount of metering to a given portion of the device depending upon the amount of time desired to fill a given compartment or portion thereof.

The flush tank emptying portion 24 includes a conical disk sealing element 110 which is sealing engageable with the outlet portion 18 for permitting communication between the flush tank and the conduit 20, said sealing nut 112 to one end of an actuating rod 114. The emptying portion 24 further includes an emptying housing portion 116 which includes a lower support portion 118 comprising a pair of spaced leg elements 120 and 122 which define a pair of oppositely disposed aperture portions 124 (only one being shown) in communication with the interior of the flush tank, the housing portion 116 further including a vertically disposed bore portion 126 which terminates at the lower end thereof in a reduced diameter portion 128, and at the upper end thereof in a variable volume compartment 129 of an enlarged end chamber indicated at 130. The housing 116 includes an upper enlarged flange portion 132 upon which is suitably secured by means of securing screws 134, for example, a body portion 136 which has a lower recess portion 138 cooperating with the variable volume compartment portion 129 for defining the end compartment 130, and a second pressure responsive movable wall 140 is suitably secured between the portion 132 of the housing portion 116 and the body portion 136 by means of the previously mentioned fastening elements 134.

The actuating rod 114 extends through the reduced diameter bore portion 128 of the housing 116 and terminates in an enlarged diameter rod portion 142 which is sealingly secured at 144 to the pressure responsive movable wall or flexible diaphragm 140. The recess portion 138 of the body portion 136 includes a centrally located reduced diameter recess portion 146 which receives one end of a compression spring element 148 disposed in the recess or variable volume compartment 138 of the end chamber 130, the other end of the compression spring 148 being in engagement with the upper end portion 150 of the enlarged diameter rod portion 142, and being retained thereon by means of a guide pin element 152 suitably secured in the top of enlarged rod portion 142. The compression spring 148 acts upon portion 150 of the actuating rod 114 tending to urge the sealing element 110 into engagement with the conical valve seat 18. The body portion 116 includes a fluid passage portion 154 which is suitably connected to the previously mentioned conduit 58 through which the fluid pressure supply line 16 is communicated upon rightward movement of the valve seal element 80. Also in communication with the variable volume chamber 129 is a suitable reduced diameter bore portion 164 which communicates said compartments to the inferior of the flush tank to the apertures 124 between the leg elements 120 and 122 of the housing portion 116.

The recess portion 138 or upper variable volume compartment includes a passage portion 166 therein in communication and suitably connected to the conduit 62 which will communicate with the interior of the tank when the valve seal element 82 is moved toward the right from the valve seat 52. Also in communication with the recess portion 138 is a metered aperture portion 168 which is in communication with the conduit 108 which communicates with the metered aperture portion 106 communicating with the variable volume recess or compartment 42 of the end chamber in the body portion of the flush tank actuating portion.

It will be noted that a suitable "O-ring" seal element 170 is provided about the enlarged diameter portion 142 of the actuating rod 114 to prevent leakage between the variable volume compartment 128 and the interior of the flush tank.

It will be noted that the conduit 102 by virtue of its communication to the metered aperture portion 100 and thence the further communication to the metered aperture portion 106 being in communication with the conduit 108 and finally to the metered aperture portion 168 results in supply pressure being available in the variable volume or recess portion 138 thus presenting applied pressure on the top of the pressure responsive movable wall 140 in addition to the force of the compression spring 148 which further aids in urging the previously mentioned sealing engagement between the element 110 and the conical valve seat 18.

A suitable passage portion 172 is provided in the body portion 136, said passage portion 172 communicating with the interior of the variable volume recess 138 and constituting a metered apertured portion which communicates with a fluid conduit 174 for a purpose to be subsequently apparent.

The body portion 136 constitutes a lower portion of the flush tank re-fill housing portion 26, and includes an upper annular portion 176 which has suitably secured thereto by means of the fastening screws 178, for example, a recessed cap element 180 which includes a lower recess portion 182 which may define an upper variable volume compartment cooperating with a recess portion 184 of the body portion 136, the recess portion 182 and 184 cooperating to define an enlarged end chamber portion 186 of the re-fill housing portion. The body portion 136 includes a vertically disposed bore portion 188 which includes a lower annular valve seat portion 190 in communication with a passage portion 192 communicating with the conduit 104 which is connected to the fluid pressure supply line 16. A fluid passage portion 194 communicates with the bore portion 188 on the other side of the annular valve seat 190 and is suitably connected to an outlet or re-fill element 196 communicating with the interior of the flush tank. Reciprocably supported within the bore portion 188 is a fluid pressure responsive piston element 198 which includes a lower valve seat portion 200 engageable with the annular valve seat 190 for closing off communication between the conduit 104 and the re-fill outlet 196. The pressure responsive valve element 200 includes a suitable "O-ring" seal element 202 concentrically disposed thereon for preventing leakage by the pressure responsive piston element. Secured between the portions 180 and the body portion 106 by means of the fastening elements 178 is a third pressure

responsive movable wall or flexible diaphragm element **204** which defines the variable volume compartments **180** and **184**, the pressure responsive piston element **198** being suitably secured at **206** to the pressure responsive movable wall. The pressure responsive piston element **198** having suitably secured therein in an upper end portion a guide pin **208** supporting one end of a compression spring element **210**, the other end of which being received within a recess portion **212** of the cap element **180**.

The recess or variable volume compartment portion **182** communicates by means of a passage portion **214** to a conduit **216** which includes a one-way check valve element **218** in communication therewith, said check valve only permitting the passage of fluid away from the recess portion **182**, and being in communication with a conduit portion **220** which is suitably connected to the previously mentioned conduit **62** which communicates with the flush tank when the valve seal element **82** is moved toward the right upon actuation of the same. The recess portion **182** is also in communication by means of a metered aperture portion **222** to the previously mentioned conduit **174** which communicates with the metering aperture **172** communicating with the upper recess or variable volume compartment **138** of the flush tank emptying portion.

Considering first Figure 1, it will be noted that the previously mentioned compression spring **74** and pressure responsive movable wall **46** urge the valve seal elements **80** and **82** into engagement with the respective annular valve seats **50** and **52**. The relative position of the valve seal elements prevent the communication between conduits **16** and **58**, and **62** and fluid passage **64**. The fluid pressure supply conduit **16** communicating with the branch conduit **104** and conduit **102** provides the previously mentioned fluid pressure against the pressure responsive movable wall or flexible diaphragm **46** and the fluid is also in communication with the conduit **108** to the top of the pressure responsive movable wall **140** of the emptying portion **24** which aids the compression spring **148** in urging the previously mentioned sealing engagement between element **110** and valve seat **18**. The fluid pressure is also in communication with the metering aperture or passage portion **172** and thence through the conduit **174** through the metering aperture **222** to the upper portion of the flexible responsive movable wall or diaphragm **204** which in conjunction with the force of the compression spring **210** aids in urging the pressure responsive piston element **198** and its sealing portion **200** into sealing engagement with the valve seat **190** thus preventing communication between the branch conduit **104** and accordingly fluid pressure of the supply source to the outlet **196** and into the flush tank. The previously mentioned movement of the fluid pressure supply is indicated by the arrows appearing in the conduits and metering passage portions of the system shown in Figure 1.

As seen in Figure 2, rightward movement of the element **72** which overcomes the compression spring **74** results in urging the valve seal elements **80** and **82** off their respective cooperating valve seats and overcomes the water supply pressure on the flexible diaphragm or pressure responsive movable wall portion **46** results in the sealing engagement of the valve seat portion **96** with the annular valve seat **98** thus cutting off communication of the metering aperture portion **100** with the metering aperture portion **106**. As indicated by the direction arrows rightward movement of the flush tank actuating portion results in pressure fluid flowing from the conduit **16** to the conduit **58** and into the recess portion or variable volume compartment portion **128**, this is permitted inasmuch as the recess or variable volume compartment portion **138** is in communication through conduit **62** and fluid passage **64** to the interior of the flush tank. This is permitted inasmuch as the recess portion or variable volume compartment portion **138** is in communication with the flush tank to the conduit **62** and the fluid passage portion **64**. This also results in upward movement of the pressure responsive movable wall **140** and accordingly the upward movement of the sealing element **110** away from the flush outlet **18** resulting in the emptying of the flush tank. The aforementioned actuating movement also results in communication of the conduit **104** with the bottom of the pressure responsive piston element **198**, and inasmuch as the conduit **216** is in communication with the conduit **62** which is now open to the interior of the flush tank pressure is relieved on the upper portion of the pressure responsive movable wall **204** and accordingly upward movement of the valve seat portion **200** away from its cooperating valve seat **190** permits the supply line **104** to communicate directly with the re-fill outlet **196** which communicates with the flush tank.

Release of pressure on the element **72** results in the compression spring **74** and the pressure responsive movable wall **46** urging the valve seal elements **80** and **82** back into engagement with their respective valve seats as seen in Figure 1. This resulting movement cuts off the communication between the conduits **16** and **58** and **62** and fluid passage **64**. When this occurs fluid is metered through the conduit **102** to the conduit **108** and thence upon the upper portion of the pressure responsive movable wall or flexible diaphragm **140**. This pressure begins to fill up the recess or variable volume compartment **138** and the compartment **128** is emptied through the aperture **164** into the flush tank. After the compartment **138** is filled fluid passes through the passage portion **172** in through the conduit **174** into the recess portion **182** exerting a downward pressure on the pressure responsive movable wall or flexible diaphragm **204** resulting in the subsequent sealing engagement of the portion **200** with the valve seat **190**. When this final sealing engagement occurs the flush tank will have been filled to the desirable level which is sufficient for flushing the toilet stool which is operatively connected to the conduit **20**.

Thus there has been disclosed highly efficient, and positively operating flush tank control system which fully conforms with the objects of invention heretofore set forth.

Various positional directional terms such as "front," "top," "bottom," etc., are utilized herein to have only a relative connotation to aid in describing the device and are not intended to require any particular orientation with respect to any external elements.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A flush tank control system comprising a flush tank having a fluid pressure supply and flush outlet from said tank, a flush tank actuating portion, flush tank emptying portion, and flush tank re-fill portion; said actuating portion comprising an elongated body portion having an elongated bore portion terminating in an end chamber, said bore portion including fluid inlet and outlet valve seat portions, fluid passages in communication with the bore portion of the body portion on opposite sides of said valve seat portions, a control rod element reciprocably supported in a bore portion, spaced valve seal elements secured on said rod element and including portions engageable on the valve seat portion of said bore for controlling fluid flow between the fluid passages on opposite sides of the valve seat portions, the end chamber including a first pressure responsive movable wall dividing said end chamber into two variable volume compartments, one of said valve elements extending in sealing relation through the pressure responsive movable wall and including a valve

seat portion on an end thereof contained in one of said compartments, said one compartment including a first metered aperture portion surrounded by a valve seat and communicating with the fluid pressure supply, the valve seal portion of said valve seat element in said one compartment being operable to prevent fluid flow through said first metered aperture portion when the valve seal element is out of engagement with its cooperating valve seat portion in the bore of said body portion, and a second metered aperture portion in communication with said one compartment, said flush tank emptying portion comprising a sealing element controlling communication between a flush tank and flush outlet, an actuating rod having one end secured to said sealing element, the flush tank emptying housing portion including a chamber portion divided into two variable volume compartments by a second pressure responsive movable wall, the other end of the actuating rod being sealingly secured and movable with said second pressure responsive movable wall, one of the compartments of the tank emptying housing portion communicating with one of the fluid passages on one side of one of the valve seats in the bore of the body member, the other fluid passage on the other side of said valve seat communicating with the fluid pressure supply, said one compartment of the tank emptying housing portion including a metering aperature portion in communication with the flush tank, the other of said compartments of said tank emptying housing portion communicating with one of the fluid passages on one side of the other valve seat of the bore of the body portion, the fluid passage on the other side thereof communicating with the flush tank, a first compression spring element in the other compartment of said tank emptying housing portion engageable with the actuating rod for urging the sealing element into a sealing relationship with the flush tank outlet, a pair of metering aperture portions in communication with the other compartment of said tank emptying housing portion, one of the pair of metering aperture portions communicating with the second metering aperture portion in said one compartment with the end chamber of the body portion; said flush tank re-fill portion comprising a re-fill housing portion having a chamber divided into variable volume compartments by a third pressure responsive movable wall, a bore portion in said re-fill housing portion having an annular valve seat portion, a pair of fluid passages communicating on opposite sides of said valve seat portion, one of said fluid passages communicating with the fluid pressure supply, the other of which communicating with said flush tank, a reciprocable pressure responsive piston element contained in the bore portion of said re-fill housing portion engageable with the valve seat portion for controlling fluid pressure flow past said valve seat portion and into the flush tank, said piston element including a portion sealingly and movably engaged with the third pressure responsive movable wall, a second compression spring contained in one of the compartments in said re-fill housing portion and engageable with the pressure responsive movable wall for urging the piston element in the bore of said second re-fill housing portion into sealing engagement with the valve seat in said bore portion, said one compartment in the re-fill portion communicating with the one of the fluid passages on one side of the other valve seat of the bore of the body portion, the one compartment of said re-fill housing portion including a metered aperture portion in communication with the other of the pair of metered aperture portions in the other compartment of the tank emptying housing portion.

2. A flush tank control system as set forth in claim 1 wherein the control rod is operatively connected to a compression spring element urging the spaced valve seal elements into engagement with annular valve seat portions in the bore of the elongated body portion of the actuating portion.

3. A flush tank control system as set forth in claim 2 wherein the bore portion of the elongated body portion includes variable diametered co-axial portions defining said spaced valve seat portions, the valve seat surrounding the first metered aperture portion in the enlarged chamber of the actuating portion communicating with the fluid pressure supply being in axial alignment with the bore portion of said elongated body portion.

4. A flush tank control system as set forth in claim 3 wherein the one compartment in the re-fill housing portion communicating with said one fluid passage on the one side of the other valve seat of the bore of the body portion includes a one-way valve operatively connected thereby permitting flow from said one compartment toward said fluid passage.

5. A flush tank control system comprising a flush tank having a fluid pressure supply and flush outlet from said tank, a flush tank actuating portion operatively connected to cooperating flush tank emptying and re-fill portions; said actuating portion including first valve means controlling fluid pressure flow between the actuating portion and the fluid supply, emptying and re-fill portions for emptying the flush tank in response to movement of actuating control means operatively connected in the actuating portion, said actuating, emptying and re-fill portions each including pressure responsive movable wall portions defining variable volume compartments, means operatively connecting said compartments together for providing an automatically operating emptying and re-filling cycle of the flush tank upon actuation of the actuation control means, the last mentioned means including a flush tank valve connected to the movable wall in the compartment of said emptying portion, a liquid conductor extending from the other compartment to said actuating portion so that fluid under pressure enters said other compartment, an outlet valve connected to the movable wall of said other compartment, and a fluid line interconnecting said compartments.

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